Health Insurance and Tax Policy

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1 Introduction

The aim of this paper is to study the effects of tax policy on the health insurance decision of households in a general equilibrium framework with heterogenous agents. Motivating the economic importance of health care and health insurance is straightforward. Both in absolute and relative terms Americans spend a sizeable amount of resources on health care. According to BEA, health care expenditures account for 11.9% of GDP in 2004, more than housing services (10.6%), food (9.8%) or durable goods consumption (8.5%).[1] In absolute terms, an average American spends about the $4,887 on health care. At the same time a record number of 45 Million people or 15% of the population lack health insurance.

Not surprisingly, fiscal policy in general and tax policy in particular are heavily targeted at health care. In 2003 Medicare and Medicaid combined spent $420 billion annually, almost 4% of GDP. A lesser-known health policy is an estimated $140 billion a year[2] government subsidy in the form of de facto tax-deductibility of employer-provided health insurance. If an employer provides a health insurance plan then both the employer and employee portions are exempt from taxation. The origin of this policy lies in the World War II price and wage controls in the U.S. when companies used the employer-provided health benefits to compete for workers that were in short supply, thereby circumventing the price controls. Even after the price controls were lifted employers kept providing health plans because they could be financed with pre-tax income. The tax deductibility was extended to health insurance premiums of self-employed individuals.

Our paper attempts to set up a general equilibrium model to evaluate the merits of the tax-deductibility of health insurance. This policy is regressive if income taxes are progressive. To see this imagine that person A has low productivity, worth $20,000 of annual labor services putting him in the 15% tax bracket, while person B has high productivity, worth $1,000,000 of labor

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[1]OECD reports health care expenditures are 13.9% (in 2001), which also include pharmaceutical spending.

[2]Figures taken from Gruber (2004).

services putting him in the 35% tax bracket. Moreover, a health insurance plan costs \$5,000. Assume that initially employees pay for the health insurance plan with after-tax money. If we then introduce tax-deductibility of the insurance premium person A will save \$750 and person B will save \$1,750, that is, the already well-off person gains more from the tax subsidy. From a risk-sharing point of view this regressive policy is detrimental to welfare and our paper attempts to set up a general equilibrium model to assess the welfare costs of this policy. Preliminary results indicate that keeping the subsidy in place but making it less regressive indeed increases welfare. However, removing the tax subsidy completely would decrease welfare substantially.

Apart from looking at welfare the model will hopefully also shed some light on what is the source of the large number of uninsured in the U.S. since our model has an endogenous health insurance decision. If health insurance incurs high marginal costs for individuals with low income it may account for the large number of uninsured low-income households, though other factors such as the welfare system certainly discourage private insurance as well.

While there exists a large literature on health, to our knowledge we are the first to set up a model in the tradition of Aiyagari (1994) with endogenous health insurance decision. Health expenditure shocks have been found to be very helpful in adding realism to Aiyagari-type models. For example according to Livshits, MacGee and Tertilt (2003), health expenditure shocks are an important source of consumer bankruptcies. Hubbard, Skinner, and Zeldes (1995) add a health expenditure shock to Aiyagari's model and argue that the social safety net discourages savings by low income households. Only high income households accumulate precautionary savings to shield themselves from catastrophic health expenditures. What is common to papers in the existing macro-literature is that health insurance is not modelled at all and consequently a household's out-of-pocket expenditure process is exogenous.

Kotlikoff (1989) builds an overlapping generations model where households face idiosyncratic health shocks (but have no earnings uncertainty) and studies the accumulation of precautionary savings under different insurance schemes, such as self-payment, insurance, or Medicaid. Our model is an improvement in the sense that we don't need separate models for different insurance schemes but instead combine all three of them into one model and let households decide how they want to deal with health expenditure shocks.

Gruber (2004) measures the effects of different tax policies on the fraction of uninsured by employing a micro-simulation model that relies on reduced-form decision rules for households. Our approach has the advantage that we can compare welfare between policy experiments rather than the measure of insured which is clearly an imprecise measure of welfare. Moreover, we can take into account general equilibrium effects. For example changing the tax treatment of health insurance premiums will change savings behavior (and thus the aggregate capital stock and factor prices) directly through marginal taxes as well as indirectly because the attractiveness of health insurance drives precautionary savings motives. All this can not be performed with reduced form decision rules.

The paper proceeds as follows. Section 2 introduces the model. Section 3 details the parameterization of the model. Some parameters will estimated with the model by matching moments from the data. Others will be calibrated. Section 4 shows the numerical results of the computed model both from the benchmark and from policy experiments. Section 5 explains some robustness checks and extensions we will consider in the future and section 6 concludes the paper.

2 Model

2.1 Demographics

We employ an overlapping generations model with stochastic aging and dying. The economy is populated by two generations of agents, young and old. Young people supply labor and earn the market wage. Old agents are retired from market work and receive social security benefits. The young become old with probability ρ_o every period and the old die with probability ρ_d. We assume the population remains constant. The old agents who die and leave the model are replaced by the entry of the same number of young agents. The initial assets of the entrants are assumed to be zero. This demographic transition pattern generates a fraction of $\frac{\rho_d}{\rho_d+\rho_o}$ of young people and a fraction of $\frac{\rho_o}{\rho_d+\rho_o}$ of old people. All bequests are accidental and transferred in a lump-sum manner.

2.2 Endowment

Agents are endowed with a fixed amount of time and the young agents supply labor inelastically. Their labor income depends on an idiosyncratic stochastic component z and the market wage w, and it is given as wz. z is drawn from a set $\mathbb{Z} = \{z_1, z_2, ..., z_{N_z}\}$ and follows a Markov process that evolves jointly with the probability of being offered employer-based health insurance, which we discuss in the next subsection. Newly born young agents make a draw from the unconditional distribution of this process. Agents start with zero assets in the initial period.

2.3 Health and health insurance

In each period, agents face an idiosyncratic health expenditure shock x. It represents the required cost to restore the health status back to h, which depends on the age (young or old).

Young agents have access to an insurance market, where they can purchase a contract that would cover a fraction $q(x)$ of the medical cost x. Therefore, with the health insurance contract, the net cost of restoring the health will be $(1 - q(x))x$, while it will cost the entire x without insurance. Notice that we allow the insurance coverage rate q to depend on the size of the medical bill x. As we will see later in the calibration, q increases in x most likely due to deductibles. Obviously agents must decide whether to be covered by insurance before they find out what their expenditure shock is.

If a young agent purchases health insurance through his employer, which we also call group health insurance, a constant premium p must be paid to an insurance company in the year of the coverage. We also allow for the employer to subsidize the premium. More precisely, if an agent works for a firm that offers employer-based health insurance benefits, a fraction $\psi \in [0, 1]$ of the premium is paid by the employer, so the marginal cost of the contract faced by the agent is only $(1 - \psi)\, p$.

Agents that are not offered health benefits through their employer can purchase insurance, too. We call this private health insurance as a opposed to group health insurance through an employer. There are a number of important features in the private insurance market, such as adverse selection, exclusion of preexisting conditions or less generous benefits in private health insurance that are not included in our model. Instead, we assume that the premium paid outside of an employer-paid plan is $p_m(x)$.

The probability of being offered health insurance at work and labor productivity z evolve jointly with a finite-state Markov process. As we discuss more in the calibration section, we do this because the firms' offer rates differ significantly across income groups. Moreover, for workers, the availability of such benefits is highly persistent and the degree of persistence varies conditional upon the income shocks. The transition matrix is defined as $\Pi_{Z,E}$ of dimension $(N_z \times 2) \times (N_z \times 2)$, with an element $p_{Z,E}(z, i_E; z', i'_E) = prob(z_{t+1} = z', i_{E,t+1} = i'_E | z_t = z, i_{E,t} = i_E)$. i_E is an indicator function, which takes a value 1 if the agent is offered an employer-based health insurance and 0 otherwise.

We assume that all retired agents are enrolled in a Medicare program. Each old agent pays a fixed premium p_{med} every period for Medicare and the program will cover the fraction $q_{med}(x)$ of the total medical expenditures.

For young agents, health expenditures x follow a finite-state Markov process drawn from a set $\mathbb{X}_y = \{x_{y,1}, x_{y,2}, ..., x_{y,N_y}\}$, with probability $p_{x_y}(x_y, x'_y) = prob(x_{y,t+1} = x'_y | x_{y,t} = x_y)$. The process for old agents are similarly defined with a different subscript. Newly born young agents draw an expenditures shock x from the stationary distribution over the set $\mathbb{X}_y$. When the young become old, they make a draw from the set $\mathbb{X}_o$ according to the transition matrix of the old agents conditional upon the state in the previous period as young.[3]

2.4 Preferences

Following earlier research by Kotlikoff (1989), we assume that health enters the utility function in a multiplicative way.

$$u_j(c) = h_j \frac{c^{1-\sigma} - 1}{1 - \sigma}, \ \ j = y \text{ (young) or } o \text{ (old)},$$

where c is consumption and h_j is the health status for the young or the old, that determines the marginal utility from consumption. Grossman (1972) treats health as an endogenous variable much like a durable good that can depreciate, but can also be restored to any desired level. Currently the h_y, h_o are given exogenously, so one could interpret our model as a Grossman model where health depreciates but it has to be restored back to the level h_j which will incur a health expenditure x. Therefore, the h_j have only one function in the current version of the paper, namely to create more realistic life-cycle consumption patterns. We might endogenize the h decision in future versions of our paper.

Agents discount future utility by a constant subjective discount factor β.

[3] This assumption requires the sets $\mathbb{X}_y$ and $\mathbb{X}_o$ to have the same number of grids, as we do in calibration.

2.5 Firms and production technology

A representative competitive firm operates the CRS technology. The aggregate output is given as

$$F(K, L) = AK^{\alpha}L^{1-\alpha}, \tag{1}$$

where K and L are the aggregate capital and labor efficiency units employed by the firm's sector and A is the total factor productivity, which we assume is constant. Capital depreciates at rate δ every period.

As discussed above, if a firm offers employer-based health insurance benefits to its employees, a fraction $\psi \in [0, 1]$ of the insurance premium is paid at the firm level. The firm needs to adjust the wage to ensure the zero profit condition. The cost c_E is subtracted from the marginal product of labor, which is just enough to cover the total premium cost that the firm has to pay.[4] The adjusted wage is given as

$$w_E = w - c_E, \tag{2}$$

where $w = F_L(K, L)$ and c_E, the employer's cost of health insurance per efficiency unit, is defined as

$$c_E = \mu_E^{ins} p\psi \frac{1}{\sum_j z_j \bar{p}_{Z,E}(j|i_E = 1)}, \tag{3}$$

where μ_E^{ins} is the fraction of workers that purchase health insurance, conditional on being offered employer-based health insurance benefits, i.e. $i_E = 1$.[5] $\bar{p}_{Z,E}(j|i_E = 1)$ is the stationary probability of drawing productivity z_j conditional on $i_E = 1$.[6]

2.6 The government

We impose balanced budget every period. The social security and Medicare systems are self-financed. Both Medicare and Social Security charge proportional taxes τ_{med} and τ_{ss} on labor income and therefore, total payroll taxes as a function of labor income wz are given as $(\tau_{med} + \tau_{ss})wz$.

The government levies tax on income and consumption to finance expenditures G and social insurance program. Labor and capital income are taxed according to a progressive tax function following Gouveia and Strauss (1994) and consumption is taxed at a proportional rate τ_c. More details on the tax system are provided in the calibration section.

[4] The assumption behind this wage setting rule is that a firm does not observe states of a worker (a, z, x and i) and does not adjust salary according to them. A firm simply employs efficiency units that consist of a mix of workers of different states according to their distribution.

The employer-based insurance system with a competitive firm in essence implies a transfer of a subsidy from uninsured to insured workers. Our particular wage setting rule assumes the subsidy for each worker per efficiency unit is the same across agents in the firm.

[5] It is computed as $\mu_E^{ins} = \sum_s \mu(s|j = y, i_{HI} = 1, i_E = 1) / \sum_s \mu(s|j = y, i_E = 1)$.

[6] It is easy to verify this wage setting rule satisfies the zero profit condition of a firm that employs labor N: wN = (total salary) + (total insurance costs paid by the firm).

Social insurance There is a "safety net" provided by the government, which we call social insurance. The government guarantees a minimum level of consumption $\bar{c}$ for every agent by supplementing the income in case the household's disposable assets fall below $\bar{c}$. This social insurance program stands in for Medicare, Food Stamp Program and all other social assistance programs. We will discuss the mechanism more in detail in the households' problem.

2.7 Households

The state for a young agent is summarized as a vector $s_y = (a, z, x, i_{HI}, i_E)$, where a is assets brought into the period, z is the idiosyncratic shock to productivity, x is the idiosyncratic health expenditure shock from last period that has to be paid in the current period, i_{HI} is an indicator function that takes a value 1 if the agent held health insurance in the last period and 0 otherwise. i_E is another indicator function for availability of employer-based health insurance benefits in the current period.

The timing of events is as follows. The agent observes the state (a, z, x, i_{HI}, i_E) at the beginning of the period, then pays last period's health care bill x, makes the consumption and savings decision, pays taxes and receives transfers and also decides on whether to be covered by health insurance. After the agent made all decisions this period's health expenditure shock x' and next period's productivity and offer status are revealed. Together with the policies a' and i'_{HI} they form next period's state $s'_y = (a', z', x', i'_{HI}, i'_E)$. Notice that our setup makes sure that the agent makes the health insurance decision i'_{HI} after he or she finds out whether the employer offers group insurance but before the health expenditure shock for the current period x' is known. Also notice that agents pay an insurance premium the year before payment occurs. We therefore assume that the insurance company earns interest on the premium for one period.

Since the health insurance contracts for young workers and retirees differ and agents pay their health care bills with a one period lag we have to distinguish between new and existing old people. A recent retiree which we call 'recently aged' has to pay the health care bill of his last year as a young agent, potentially covered by an insurance contract for young agents, while an existing old person was covered by Medicare and potentially supplemental health insurance last period. As a result, the state for recently aged agents is given as $s_r = (a, x, i_{HI})$ and for old agents $s_o = (a, x)$.

We are now ready to define the maximization problems of all three types of agents in recursive form. In the value functions the subscript denotes the type of agent, where y stands for young agents, r stands for recently aged and o refers to existing old agents:

Young's problem

$$V_y(s_y) = \max_{c, a', i'_{HI}} \left\{ u_y(c) + \beta (1 - \rho_o) E \left[V_y \left(s'_y \right) \right] + \beta \rho_o E \left[V_r \left(s'_r \right) \right] \right\} \tag{4}$$

subject to

$$
\begin{aligned}
(1+\tau_c)c + a' + (1 - i_{HI}\cdot q(x))\,x &= \tilde{w}z - \tilde{p} + (1+r)(a+T_B) - Tax + T_{SI} && (5)\\
i'_{HI} &\in \{0,1\}\\
a' &\geq 0
\end{aligned}
$$

where

$$
\begin{aligned}
Tax &= T(y) + 0.5(\tau_{med}+\tau_{ss})(\tilde{w}z - i_E\cdot\tilde{p}) && (6)\\
y &= \max\{\tilde{w}z + r(a+T_B) - i_E\cdot\tilde{p}, 0\} && (7)\\
T_{SI} &= \max\{0, (1+\tau_c)\bar{c} + (1 - i_{HI}\cdot q(x))\,x + T(\tilde{y}) - \tilde{w}z - (1+r)(a+T_B)\} && (8)\\
\tilde{y} &= \tilde{w}z + r(a+T_B)\\
\tilde{w} &= \begin{cases} (1-0.5(\tau_{med}+\tau_{ss}))\,w & \text{if } i_E = 0\\ (1-0.5(\tau_{med}+\tau_{ss}))\,(w - c_E) & \text{if } i_E = 1 \end{cases} && (9)\\
\tilde{p} &= \begin{cases} p\cdot(1-\psi) & \text{if } i'_{HI}=1 \text{ and } i_E = 1\\ p_m(x) & \text{if } i'_{HI}=1 \text{ and } i_E=0\\ 0 & \text{if } i'_{HI}=0 \end{cases} && (10)
\end{aligned}
$$

The young agents' choice variables are (c, a', i'_{HI}), where c is consumption, a' is savings and i'_{HI} is the indicator variable for the this period's health insurance which covers expenditures that show up in next period's budget constraint. Remember that the current state x is last period's expenditure shock while the current period's expenditure x' is not known when the agents makes the insurance coverage decision.

With probability $(1-\rho_o)$ the agent remains young in the next period and with probability ρ_o becomes old and retired. In the latter case, the agent's value function will be that of a recently aged old, $V_r(s'_o) = V_r(a', x', i'_{HI})$, which we define below.

Equation (5) is the flow budget constraint of a young agent. Consumption, saving, medical expenditures and payment for the insurance contract must be financed by labor income, saving from previous period and a lump sum bequest transfer plus accrued interest, $(1+r)(a+T_B)$, net of income and payroll taxes, Tax plus social insurance transfer T_{SI} if applicable. $\tilde{w}$ is the wage per efficiency unit already adjusted by the employer's portion of payroll taxes and benefits cost as specified in (9). If the agent's employer does not offer health insurance benefits, it equals $(1-0.5(\tau_{med}+\tau_{ss}))\,w$, that is, marginal product of labor net of employer payroll taxes. If the employer does offer insurance, the wage is reduced by both c_E, which is the health insurance cost paid by a firm as defined in equations (2) and (3), and the the payroll tax. Consequently, one could interpret the $\tilde{w}z$ as the gross salary.

Payroll taxes are imposed on the wage income net of paid insurance premium if it is provided through an employer, as shown in the RHS of equation 6.[7] Equation (7) represents the income

[7] To be precise, the payroll tax base at each of firm and individual levels is bounded below by zero, and we have

$$Tax = T(y) + 0.5(\tau_{med}+\tau_{ss})\cdot\max\{\tilde{w}z - i_E\cdot\tilde{p}, 0\}.$$

For simplicity we present it as in equation (6), which is applicable when the zero boundary condition does not bind. The zero lower bound condition also aplies for the employer portion of payroll taxes.

tax base; labor income paid to a worker plus accrued interest on savings and bequests less the insurance premium, again provided that the purchase is through the employer. The taxes are bounded below by zero.

The term T_{SI} in (8) is a government transfer making sure that after receiving income, paying taxes and health care costs, an individual is guaranteed a minimum level $\bar{c}$ of consumption. Also notice that the health insurance premium is not covered under the government's transfer program.

The marginal cost of the insurance premium $\tilde{p}$ depends on the state i_E as given in equation 10.[8]

Recently aged agent's problem

$$V_r(s_o) = \max_{c,a',i'_{HI}} \{u_o(c) + \beta(1-\rho_d) E[V_o(s'_o)]\}$$

subject to

$$\begin{aligned}
(1+\tau_c)c + a' + (1 - i_{HI}q(x))\,x &= ss - p_{med} + (1+r)(a+T_B) - T(y) + T_{SI} \\
y &= r(a+T_B) \\
T_{SI} &= \max\{0, (1+\tau_c)\bar{c} + (1 - i_{HI}q(x))\,x \\
&\quad + p_{med} - ss - (1+r)(a+T_B) + T(y)\} \\
a' &\geq 0
\end{aligned}$$

ss is the social security benefit payment.

Existing old's problem

$$V_o(s_o) = \max_{c,a',i'_{HI}} \{u_o(c) + \beta(1-\rho_d) E[V_o(s'_o)]\}$$

subject to

$$\begin{aligned}
(1+\tau_c)c + a' + (1 - q_{med}(x))\,x &= ss - p_{med} + (1+r)(a+T_B) - T(y) + T_{SI} \\
y &= r(a+T_B) \\
T_{SI} &= \max\{0, (1+\tau_c)\bar{c} + (1 - q_{med}(x))\,x \\
&\quad + p_{med} - ss - (1+r)(a+T_B) + T(y)\} \\
a' &\geq 0
\end{aligned}$$

[8] Theoretically, agents who are offered insurance by employers also have an access to the individual insurance market and can purchase a contract at the market price, which depends on the individual health status. Given the same coverage ratios offered by each contract, agents choose one at a lower cost, also taking into account the tax break which can be applied only when they choose to purchase an employer-based contract. In our calibrated model, however, no one chooses to buy an individual contract in such a case since the fraction ψ paid by employers makes an employer-based contract more attractive, even for the agents with the best health condition, who could buy a contract in the market at the lowest price. Hence we present the premium $\tilde{p} = p_y(1-\psi)$, when $i_E = 1$ and $i'_{HI} = 1$.

2.8 Health insurance company

The health insurance company is competitive, that is, it charges premia p and $\{p_m(x)\}_{x \in \mathbb{X}_y}$ that precisely cover all expenditures on the insured.

2.9 Stationary competitive equilibrium

We define a stationary competitive equilibrium of the economy. At the beginning of the period, each young agent is characterized by a state vector $s_y = (a, z, x, i_{HI}, i_E)$, i.e. asset holdings a, labor productivity z, health care expenditure x, and indicator functions for insurance holding i_{HI}, and employer-based insurance benefits i_E. Old agent have state vectors $s_{yo} = (a, x, i_{HI})$ and $s_o = (a, x)$, depending on whether they are recently retired or existing old. Let $a \in \mathbb{A} = \mathbb{R}_+$, $z \in \mathbb{Z}$, $x \in \mathbb{X}_j$, $i_{HI}, i_E \in \mathbb{I} = \{0, 1\}$ and $j \in \mathbb{J} = \{y, r, o\}$ and denote by $\mathbb{S} = \{\mathbb{J}\} \times \{\mathbb{S}_y, \mathbb{S}_r, \mathbb{S}_o\}$ the entire state space of the agents, where $\mathbb{S}_y = \mathbb{A} \times \mathbb{Z} \times \mathbb{X}_y \times \mathbb{I}^2$ and $\mathbb{S}_r, \mathbb{S}_o = \mathbb{A} \times \mathbb{X}_o \times \mathbb{I}$. Let $s \in \mathbb{S}$ denote a general state vector of an agent: $s \in \{y\} \times \mathbb{S}_y$ if young, $s \in \{r\} \times \mathbb{S}_r$ if recently retired and $s \in \{o\} \times \mathbb{S}_o$ if old. The equilibrium is given by

- interest rates r, wage rate w and adjusted wage w_E,
- allocation functions $\{c, a', i'_{HI}\}$ and for young $\{c, a'\}$ for type r, o agents
- government tax system given by income tax function $T(I)$ consumption tax τ_c, Medicare system $\{p_{med}, q_{med}\}$ and social insurance program,
- accidental bequests transfer T_B,
- the private health insurance contracts given as pairs of premium and coverage ratios $\{p, q\}$, $\{p_m, q\}$.
- a set of value functions $\{V_y(s_y)\}_{s_y \in \mathbb{S}_y}, \{V_r(s_r)\}_{s_r \in \mathbb{S}_r}$ and $\{V_o(s_o)\}_{s_o \in \mathbb{S}_o}$, and
- distribution of people over the state space $\mathbb{S}$ given by $\mu(s)$,

such that

1. Given the interest rates, the wage, the government tax system, Medicare and the social insurance program, and the private health insurance contract, the allocations solve the above described maximization problem for each agent.
2. The riskless rate r and wage rate w satisfy marginal productivity conditions, i.e. $r = F_K(K, L) - \delta$ and $w = F_L(K, L)$, where K and L are total capital and labor employed in the firm's sector.

3. A firm that offers employer-health insurance benefits pays the wage adjusted for the cost, given as

$$w_E = w - c_E,$$

where c_E is the cost of health insurance premium per efficiency unit paid by a firm, as defined in (3).

4. The accidental bequests transfer matches the left assets (net of health care expenditures) of the deceased:

$$T_B = \rho_d \int \left[a'(s) - \sum_{x'} \pi_o (x'|x) \left\{ (1 - q_{med}(x')) \, x' \right\} \right] \mu(s|j = r, o) ds$$

5. The health insurance company is competitive:

$$\begin{aligned} (1+r)\,p &= \frac{\int \sum_{x'} \pi_y (x'|x) \, x' q(x') \, i'_{HI}(s) \, \mu(s|j = y) ds}{\int i_E i'_{HI}(s) \, \mu(s|j = y) ds} \\ (1+r)\,p_m(\bar{x}) &= \frac{\int \sum_{x'} \pi_y (x'|\bar{x}) \, x' q(x') \, i'_{HI}(s) \, \mu(s|x = \bar{x}; j = y) ds}{\int (1 - i_E) \, i'_{HI}(s) \, \mu(s|x = \bar{x}; j = y) ds} \quad \forall \bar{x} \end{aligned}$$

6. Government's general budget is balanced.

$$G + \int T_{SI}(s) \, \mu(s) ds = \int [\tau_c c(s) + T(y(s))] \, \mu(s) ds$$

where $y(s)$ is the taxable income for an agent with a state vector s.

7. Social Security system is self-financed.

$$ss \int \mu(s|j = r, o) ds = \tau_{ss} \int (\tilde{w} z - 0.5 i'_{HI} \cdot i_E \cdot p \, (1 - \psi)) \, \mu(s|j = y) ds$$

8. Medicare program is self-financed.

$$\begin{aligned} \int q_{med}(x) \, x \mu(s|j &= o) ds = \tau_{med} \int (\tilde{w} z - 0.5 i'_{HI} \cdot i_E \cdot p \, (1 - \psi)) \, \mu(s|j = y) ds \\ + p_{med} \int \mu(s|j &= r, o) ds \end{aligned}$$

9. Capital and labor markets clear.

$$\begin{aligned} K &= \int [a(s) + T_B] \, \mu(s) ds + \int i'_{HI} \, (i_E p + (1 - i_E) \, p_m(x)) \, \mu(s|j = y) ds \\ L &= \int z \mu(s|j = y) ds \end{aligned}$$

10. An aggregate resource constraint:

$$G + C + X = F(K, L) - \delta K$$

where

$$\begin{aligned} C &= \int c(s)\mu(s)ds \\ X &= \int x(s)\mu(s)ds \end{aligned}$$

11. Law of motion for the distribution of agents over the state space $\mathbb{S}$ satisfies

$$\mu_{t+1} = R_\mu(\mu_t).$$

where R_μ is a one-period transition operator on the distribution.

More details on computation algorithm is provided in the Appendix [TBA].

3 Calibration

In this section, we specify the parameters used in the simulations. Table 1 summarizes the values and description of the parameters.

3.1 Demographics

A model period corresponds to one year. We define the two generations as follows. Young agents are between the ages of 20 and 64, while old agents are 65 and over. The probability of becoming old ρ_o is set at 1/45 to make sure that agents stay young for an average of 45 years. The death probability ρ_d is calibrated so that the old agents above age 65 constitute 20% of the population, based on data from the panel data set below. This is a slight deviation from the 17.4% in the Census because we restrict our attention to head of households. We abstract from population growth and the demographic structure remains the same across periods. Every period a measure $\frac{\rho_o \rho_d}{\rho_o + \rho_d}$ of young agents enter the economy to replace the deceased old agents.

3.2 Endowment, health insurance and health expenditures

3.2.1 Data Source

For endowment, health expenditure shocks and health insurance, we use income and health data from the Medical Expenditure Panel Survey (MEPS). The MEPS consists of six two-year panels 1996/1997 up to 2001/2002 with the usual data on demographics, income and most importantly data on health expenditures and insurance, though we drop the first panel because one crucial variable that we need in determining the joint endowment and insurance offer process is missing.

We can then calibrate the processes for income and health expenditures and insurance from the same source.

We include all heads of households (both male and female) with non-negative income defined as the sum of labor, business and sales income, unlike many existing studies in the vast literature on stochastic income process (for example, Storesletten, et al (2004), who use households to study earnings process, and Heathcote, et al (2004), who use white male heads of households to estimate wage process). The main reason for not relying on those studies is that we want to capture the individual characteristics associated with health insurance and health expenditures across the dimension of the income shocks. It is possible only by using comprehensive database like MEPS. In terms of sample units, we choose heads rather than households to better capture the process for individual health expenditures. Treating health expenditures of a family unit would require adjusting them for different family sizes to fit in our model and will inevitably bias the estimates of persistence. We include both male and female heads in order to have a larger number of samples, and more importantly, not to drop samples with zero or low assets.

Our model captures those with zero or very low level of assets, who would be eligible for public welfare assistance. Many households that fall in this category are headed by females and restricting samples to males does not provide us with a good approximation. In addition, most of the studies are focused on samples with strictly positive income, often with income above some threshold level and such treatment does not fit in our model, either.

Since for young agents we estimate a joint process of income and the insurance offer status we restrict our attention to those young agents that can be uniquely identified as either being offered or not being offered insurance. Agents that are offered insurance can be easily identified in MEPS by the corresponding dummy variable. Notice that in the data by definition only those agents that are employed can have an insurance offer status. Since we want to generate an income process for both employed and unemployed agents, we consider agents not offered insurance being those that according to MEPS are employed and not offered insurance plus those not currently employed who will have an "inapplicable" offer status.[9] For consistency purposes we also restrict our attention to the same set of agents when we calibrate the health expenditure process for young agents.

3.2.2 Endowment

We calibrate the endowment process jointly with the stochastic probability of being offered employer-based health insurance, for the reasons we discussed in the model section. For the income process, we avoid the detour of first estimating an AR(1) process and then discretizing it with the methods put forth by Tauchen (1986). Instead we specify the income distribution over the 5 income states so that in each year, equal number of agents belong to each of the five bins of equal size. Then we determine for each individual in which bin he or she resides in

[9] This implies that we disregard about 10% of the people in the MEPS, namely those that are employed but have unknown/inapplicable insurance offer status and those with unknown employment status. This restriction will not change the shape of the Markov processes in any systematic way. For example comparing the transition probabilities between income groups (unconditional on insurance offer status) between the full and the restricted sample does not generate substantial differences.

the two consecutive years and thus construct the joint transition probabilities $\pi_{Z,E}(z, i_E | z', i'_E)$ of going from income bin z with insurance status i_E to income bin z' with i'_E. Recall i_E is an indicator function that takes a value 1 if employer-based health insurance is offered and 0 otherwise. The joint Markov process is defined over $N_z \times 2$ states with a transition matrix $\Pi_{Z,E}$ of size $(N_z \times 2) \times (N_z \times 2)$. We average the transition probabilities over the five panels weighted by the number of people in each panel.

The transition probabilities averaged over the five panels are

$$\Pi_{Z,E} = \left[\begin{array}{ccccc|ccccc} 0.158 & 0.237 & 0.117 & 0.130 & 0.096 & 0.149 & 0.102 & 0.011 & 0.000 & 0.000 \\ 0.059 & 0.479 & 0.209 & 0.073 & 0.042 & 0.041 & 0.066 & 0.020 & 0.008 & 0.002 \\ 0.022 & 0.176 & 0.496 & 0.179 & 0.070 & 0.009 & 0.018 & 0.019 & 0.007 & 0.005 \\ 0.011 & 0.058 & 0.187 & 0.540 & 0.176 & 0.005 & 0.005 & 0.004 & 0.009 & 0.005 \\ 0.012 & 0.026 & 0.057 & 0.169 & 0.710 & 0.005 & 0.004 & 0.003 & 0.003 & 0.010 \\ \hline 0.007 & 0.013 & 0.005 & 0.003 & 0.001 & 0.811 & 0.107 & 0.028 & 0.017 & 0.008 \\ 0.014 & 0.055 & 0.041 & 0.017 & 0.006 & 0.178 & 0.466 & 0.141 & 0.051 & 0.031 \\ 0.003 & 0.019 & 0.055 & 0.042 & 0.013 & 0.095 & 0.254 & 0.328 & 0.123 & 0.067 \\ 0.001 & 0.012 & 0.039 & 0.043 & 0.017 & 0.052 & 0.132 & 0.195 & 0.332 & 0.178 \\ 0.000 & 0.001 & 0.007 & 0.019 & 0.048 & 0.065 & 0.118 & 0.132 & 0.180 & 0.428 \end{array}\right]$$

Entries 1 to 5 from the top are the income bins 1 to 5 with employer-based insurance and entries 6 to 10 are the five income groups without insurance offered. For example, for the probability of moving to income bin 2 without insurance next period, conditional upon being in income bin 3 with insurance this today is 1.8%, given by the entry $(3, 7)$.

Finally, in order to get the grids for z, we compute the average income in each of the five bins in 2001 dollars and normalize so that the average income is one:[10]

$$\mathbb{Z} = \{0.042, 0.493, 0.856, 1.295, 2.533\}$$

Notice that the income shocks look quite different from the ones normally used in the literature in that we include all heads of households, even those with zero income. This generates an extremely low income shock of near zero (only 4.5% of average income) for a sizeable measure of the population.

3.2.3 Health expenditure shocks

In the same way as for the endowment process, we estimate the process of health expenditure shocks and the transition probabilities directly from MEPS data. Again we use five states. For both young and old we specify the bins of size $(0.40, 0.40, 0.15, 0.04, 0.01)$. For young agents we get the following transition probabilities

$$\Pi_{x_y} = \begin{bmatrix} 0.667 & 0.268 & 0.052 & 0.011 & 0.002 \\ 0.268 & 0.541 & 0.154 & 0.030 & 0.007 \\ 0.143 & 0.414 & 0.343 & 0.087 & 0.014 \\ 0.095 & 0.320 & 0.335 & 0.191 & 0.059 \\ 0.058 & 0.163 & 0.292 & 0.253 & 0.235 \end{bmatrix}$$

[10] Average income per person in 2001 was $33,205.

with

$$\mathbb{X}_y = \{0.0050, 0.0463, 0.1827, 0.4857, 1.6075\}$$

which are the mean expenditures in the five bins in the first year of the last panel, that is, in the year 2001. The expenditures are normalized in terms of their ratios to the average income in 2001. This parametrization generates average expenditures of 8.37% of mean labor income in the young generation or \$2,552 in year 2001 dollars.

Notice that the big advantage of our procedure is that we can specify the bins ourselves. Average expenditures in the first bin are just 0.5% of average income which implies that there is very little action in the bottom 40 percent of the expenditure distribution. In contrast, expenditures vary wildly at the top. For example the top 1% have average expenditures of more than 1.5 times the average income (almost \$50,000 in 2001). The next 4% have average expenditures of slightly less than 50% of average income (\$14,700 in 2001) while the following 15% spend less than 20% of average income (\$5,500 in 2001).

Likewise, using the strategy for the old generation we compute

$$\Pi_{x_o} = \begin{bmatrix} 0.668 & 0.251 & 0.065 & 0.014 & 0.002 \\ 0.265 & 0.547 & 0.148 & 0.033 & 0.007 \\ 0.147 & 0.436 & 0.324 & 0.071 & 0.021 \\ 0.075 & 0.312 & 0.336 & 0.205 & 0.072 \\ 0.141 & 0.299 & 0.266 & 0.188 & 0.106 \end{bmatrix}$$

and

$$\mathbb{X}_o = \{0.0270, 0.1330, 0.4505, 1.0920, 2.9227\}$$

which generates unconditional expectation of x_o of 20.64% of mean income or \$6,297 in year 2001 dollars.

3.3 Health Insurance

The coverage ratios are calibrated using the same five MEPS panels as before. We average over the five panels and determine the share of expenditures covered by private insurance (conditional on holding insurance) in each of young generation's five expenditure bins:

$$\begin{aligned} q(x_1) &= 0.590 \\ q(x_2) &= 0.649 \\ q(x_3) &= 0.720 \\ q(x_4) &= 0.847 \\ q(x_5) &= 0.880 \end{aligned}$$

The premium p is determined in equilibrium to ensure zero profits for the insurance company. We know that the average annual premium of an employer-based health insurance was \$2,051 in 1997[11] or about 7% of annual average income. Model simulations get very close to 6.755% or average annual income.

A firm offering employer-based health insurance pays a fraction ψ of the premium. According to the Medical Expenditure Panel Survey (MEPS), the average percent of total premium paid by employee is 15.6% in 1997.[12] Other studies estimate similar figures and we set it to 15%.[13]

With regards to private health insurance, we assume that the insurance company sets $p_m(x)$ equal to its expected value, that is,

$$p_m(x) = E\{q(x')x'|x\}$$

Given the transition matrix Π_{x_y} we compute the premium as a function of last period's expenditures as

bin	premium
1	0.0242
2	0.0591
3	0.1129
4	0.2156
5	0.4801

One could interpret this as the agents who apply for private health insurance revealing their past medical history and the insurance company charging a premium that ensures zero expected profits for each medical expenditure bin.

3.4 Preferences

To determine the health parameters (h_y, h_o) we use data from Domeij and Johannesson (2004) on average health measures for different age groups and then compute the mean health over the two age groups in our model. Normalizing health of the young to one we then find that $h_o = 0.7738$. We calibrate the annual discount factor β to achieve an aggregate capital output ratio $K/Y = 3.0$ and choose a risk aversion parameter of $\sigma = 2$.

3.5 Technology

Total factor productivity A is normalized so that marginal product of labor equals one in the benchmark. As is standard in the literature the capital share is $\alpha = 0.36$. For the depreciation rate we pick $\delta = 0.06$ following Stokey and Rebelo (1995).

[11] Source: MEPS Methodology Report 14, "Estimation of Expenditures and Enrollments for Employer Sponsored Heath Insurance, by John Paul Sommers.

[12] Source: "Estimation of Expenditures and Enrollments for Employer Sponsored Health Insurance," by John Paul Sommers, MEPS Methodology Report 14

[13] 15.1% by National Employer Health Insurance Survey in 1993 and 16% by Employer Health Benefits Survey in 1999.

3.6 Government

3.6.1 Expenditures and taxation

The value for G, that is, the part of government spending not dedicated to social insurance transfers, is exogenously given and it is fixed across all policy experiments. We calibrate it to 18% of GDP in the benchmark economy in order to match the share of government consumption and gross investment excluding transfers, at the federal, state and local levels (The Economic Report of the President (2004)). We set the consumption tax rate τ_c at 5.67%, based on the study by Mendoza, Razin and Tesar (1994).[14]

The income tax function consists of two parts, a progressive income tax and proportional tax on income. The progressive part mimics the actual income tax in the real world following the functional form of Gouveia and Strauss (1994), while the proportional part stands in for all other taxes, that is, non-income and non-consumption taxes that - for simplicity - we lump together into one single tax τ_y levied on income. In summary, we choose the functional form:

$$T(y) = a_0 \left\{ y - (y^{-a_1} + a_2)^{-1/a_1} \right\} + \tau_y y. \tag{11}$$

Parameter a_0 is the limit of marginal taxes in the progressive part as income goes to infinity, a_1 determines the curvature of marginal taxes and a_2 is a scaling parameter. To preserve the shape of the Gouveia and Strauss tax function we use their estimates

$$\begin{aligned} a_0 &= 0.258 \\ a_1 &= 0.768 \end{aligned}$$

and choose the scaling parameter a_2 such that the share of government expenditures raised by the progressive part of the tax function $a_0 \left\{ y - (y^{-a_1} + a_2)^{-1/a_1} \right\}$ equals 0.6472. This matches the fraction of total revenues financed by income tax according to the OECD Revenue Statistics. Obviously the parameter a_2 is calibrated within the model because it depends on other endogenous variables. The parameter τ_y in the proportional term is chosen to balance the overall government budget and it, too, will be determined within the computational part.

3.6.2 Social insurance program

The threshold level $\bar{c}$ of minimum consumption to be eligible for social insurance is calibrated so that the model achieves the target share of households with a low level of assets. Households with net worth of less than $5,000 constitute 20.0% (taken from Kennickell (2003), averaged over 1989, 1992, 1995, 1998 and 2001 SCF data, in 2001 dollars) and we use this figure as a target to match in the benchmark equilibrium.

[14] The consumption tax rate is the average over the years 1965-1996. The original paper contains data for the period 1965-1988 and we use an unpublished extension for 1989-1996 for recent data available on Mendoza's webpage.

3.6.3 Social security system

We set the replacement ratio at 45% based on the study by Whitehouse (2003). Consequently, τ_{ss} is pinned down once we set the replacement ratio. In the equilibrium condition,

$$ss \int \mu(s|j=o)ds = \tau_{ss} \int \tilde{w} z \mu(s|j=y)ds,$$

ss is replacement ratio times the average wage. Therefore, we have the relationship $\tau_{ss} = RepRatio \times$ (% of old) / (% of young) yielding a tax rate $\tau_{ss} = 10.57\%$, which is close to the current social security tax rate of 12.4%.

3.6.4 Medicare

Just as in the case of private insurance we calculate the coverage ratio of Medicare in the five expenditure bins $x_o \in \mathbb{X}_o$.

bin	$q_{med}(x)$
1	0.299
2	0.381
3	0.605
4	0.713
5	0.639

The Medicare premium was $799.20 annually in the year 2004 or about 2.11% of annual GDP ($37,800 per person in 2004) which is the ratio that we use in the simulations. The Medicare tax rate τ_{med} is determined within the model so that the Medicare system is self-financed. In 2003 the Medicare tax rate was 2.9% and its expenditures were about 2.3% of GDP. The model generates expenditures and revenues equal to 2.03% of labor income. This figure is slightly lower than in reality for two reasons. First, in our model Medicare is reserved exclusively for the old generation while the actual Medicare system pays certain expenditures even for young agents. Second, payroll taxes apply to all of labor income while in reality there is a threshold level of currently $87900 after which the marginal payroll tax is zero.

4 Numerical results

[THIS SECTION IS INCOMPLETE]

4.1 Benchmark model

We display most results of the numerical experiments in figures attached at the end of the paper. Figures 1 and 2 plot the takeup ratios, that is the share of insured agents within each expenditure and income bin. We happily report that our model matches insurance patterns observed in the MEPS data quite well not only qualitatively but in most cases even quantitatively.

In figure 1 we compute takeup ratios in the same expenditure bins used for constructing the expenditure Markov process. We observe that for the population as a whole as well as for the subgroups of agents with and without insurance offered through their employer the takeup ratios are hump-shaped in expenditures. The model simulations generate similar general patterns.

Agents that are offered insurance display takeup ratios at around 94-96%, very close to their empirical counterparts in the region of 94-99%. The hump-shape is not as pronounced as in the data, though. Notice that in bin 5 the model simulation generates takeup ratios that are lower than in MEPS for the two subgroups of agents with and without employer benefits. Yet the aggregate figure in the simulation is higher than in MEPS. To account for this anomaly, notice that in the model we assume that health expenditures are independent from the (Z, E) process, though in the data they clearly aren't. More precisely, in the data expenditures are negatively correlated with income which in turn is positively correlated with employer-provided health benefits, which means the model generates too many high expenditure agents with $i_E = 1$. The reverse is true for agents with low expenditures which explains why the plot for takeup ratios for the whole population are somewhat off their empirical targets. In future versions of the paper we might generate one large joint process for expenditures, income as well as insurance offer status to eliminate this problem.

In figure 2 we compute takeup ratios for the five income bins that correspond to the ones in the (Z, E) Markov process. For the model simulations we categorize the i_{HI} ratios by z, that is health insurance in the previous year by the current year income because last year's expenditures (affected by the insurance state variable i_{HI}) have to be paid in the current budget constraint and hence out of current year income. For the corresponding empirical part we display takeup ratios categorized by both current and leading income as a robustness check. Specifically we categorize current year takeup ratios by both current year income and income in the following year, though quantitatively there seems to be no significant difference between the two. Again the model simulations replicate the data well both qualitatively and quantitatively. Just as in the data takeup ratios increase with income. For each of the three groups (all agents, those with employer benefits and those without) model takeup ratios are within a couple of percentage points of their empirical counterparts.

4.2 Policy experiments

We now conduct experiments to determine the effect of changes in the tax treatment of health insurance. In the experiments we treat changes in government revenue as follows: Expenditures G, consumption tax rate τ_c as well as the Gouveia and Strauss part of the income tax function stay constant. The government alters τ_y to balance its budget. One could interpret that as the government adjusting marginal tax rates by $\tau_y^{experiment} - \tau_y^{benchmark}$ across the board. The finances of Medicare will also be affected because labor income changes. We assume that the Medicare premium p_{med} and replacement ratio for social security stay constant. Hence, ss adjusts to account for the change in average labor income and τ_{med} adjusts to make sure that Medicare stays self-financed..

In each case we compare steady state outcomes, though in future versions of this paper we may attempt to study transitions. To compare welfare across experiments, we employ an ex-ante criterion. Ex-ante social welfare or Rawlsian welfare of a new-born is defined as

$$SWF_R = \sum_{z,E,x_y} V_y(s|a=0, x=x_1, i_{HI}=0) \cdot \bar{p}_{z,E}$$

It is the average of value function for new born agents. $\bar{p}_{z,E}$ is the stationary distribution of z and E. In order to compare social welfare from two economies we compute the consumption equivalent, that is the proportional change in consumption in all dates and states of the benchmark economy that makes agents indifferent between the benchmark and the experiment:

$$CE = \left(\frac{SWF_R^{Experiment}}{SWF_R^{Benchmark}} \right)^{\frac{1}{1-\sigma}} - 1$$

Experiment 1: Abolishing tax deductibility of premium costs In the first experiment, we study the effect of abolishing the income tax deduction of the insurance premium. We alter equation (7) for taxable income:

$$y = \tilde{w}z + r(a + T_B) + i_E i'_{HI} \psi p$$

that is, not only is the employee portion $i_E i'_{HI}(1-\psi)p$ no longer tax-deductible, but even the portion paid by the employer is now considered taxable income.

Experiment 2: Abolishing the regressiveness An alternative experiment is to distribute the tax-deductibility more evenly. More precisely, assume that as in Experiment 1 the whole premium is taxable under the progressive part of the income tax function but in exchange the government gives back a subsidy for employer-based insurance:

$$T(y) = T(\tilde{w}z + r(a + T_B) + i_E i'_{HI} \psi p) - \varphi i_E i'_{HI} p$$

Now every agent gets the same tax subsidy independent of income. We assume that the subsidy is equal to the average tax on young agents from the progressive part of the income tax function in the benchmark economy:

$$\varphi = \frac{\int a_0 \left\{ y - (y^{-a_1} + a_2)^{-1/a_1} \right\} \mu(s_y) ds_y}{\int y \mu(s_y) ds_y}$$

Other ways to set the subsidy would have been the marginal tax rate of the median tax payer or the average marginal tax rate.

Results The following table details some of the computational results:

	B	X1		X2	
	value	value	B->X1	value	B->X2
p	0.06143	0.08819	43.5618%	0.06131	-0.1953%
μ^{ins}	0.77392	0.54582	-29.4733%	0.77641	0.3217%
$TUR^G(x_y = x_1)$	0.9203	0.3173	-65.5221%	0.9245	0.4564%
$TUR^G(x_y = x_2)$	0.9732	0.7067	-27.3839%	0.9764	0.3288%
$TUR^G(x_y = x_3)$	0.9749	0.8335	-14.5041%	0.9770	0.2154%
$TUR^G(x_y = x_4)$	0.9756	0.8566	-12.1976%	0.9772	0.1640%
$TUR^G(x_y = x_5)$	0.9758	0.8931	-8.4751%	0.9771	0.1332%
CE			-0.2050%		0.0564%
Y	1.24787	1.24906	0.0954%	1.24737	-0.0401%
K/L	4.66532	4.67772	0.2658%	4.66017	-0.1104%
r	0.06036	0.06016	-0.3313%	0.06045	0.1491%
w	0.99829	0.99925	0.0962%	0.99790	-0.0391%
τ_y	0.04538	0.03874	-0.00664	0.04433	-0.00105
τ_{med}	0.020312	0.02019	-0.00012	0.02032	0.00001

Removing the tax subsidy all together in experiment 1 causes a sharp drop in the share of young agents that sign up for insurance and an even sharper rise in the insurance premium. This makes perfect sense if we look at the takeup ratios by expenditure bin. The largest drop in insurance rates occurs in the lowest expenditure group. Since relatively more bad risk agents remain in the employer-based insurance program the premium has to increase. The opposite happens in experiment 2. Here more agents sign up for insurance and the largest increases occur for agents with low expenses which drives down the average cost per employee and thus the premium.

Social welfare is lower in experiment 1 despite the fact that steady state output and capital are higher. Agents accumulate precautionary savings to substitute for health insurance that has become more expensive. This is particularly taxing on young agents that start with no assets and now have to build up an even larger buffer stock of savings. The opposite happens in experiment 2. The increase in risk sharing more than makes up for the lower capital stock and output and therefore increases welfare.

Also notice that in order to balance the government's budget the tax rate τ_y has to adjust. In experiment 1 the whole excess tax revenue is rebated by lowering marginal income taxes by about two thirds of a percentage point while in experiment 1 the left-over after handing out the proportional subsidy amounts to about a one tenth of a percentage point reduction in marginal taxes. This explains the adverse welfare consequences of experiment 1: There is no redistribution of income that could offset the negative effect on health expenditure risk-sharing. The regressive tax subsidy on health insurance is merely replaced by a regressive tax rebate.

Even though the experiments did not affect the payroll treatment of the health insurance premium, Medicare taxes adjust due to general equilibrium effects. τ_{med} is slightly lower in experiment 1 because output is higher and the reverse is true in experiment 2. Social security taxes stay constant because they are only affected by the replacement ratio which is unchanged.

Notice that the comparisons refer to steady state outcomes. Fortunately we can be confident that transitions are not going to reverse the welfare results. For example in experiment 1 the negative welfare consequences will be exacerbated along a transition path when higher capital accumulation cuts into agents's consumption. Likewise, we can strengthen the positive welfare result in experiment 2 by noting that along the transition path agents can consume part of the excess capital stock.

5 Robustness check to consider in future

5.1 Wage setting rule

We'll check the sensitivity of the results to the wage setting rule.

5.1.1 Wage setting based on productivity

The gross wage for each productivity category z_i is adjusted:

$$gross\ income_i = z_i w - \frac{\mu_i^{ins}}{\mu_i^{ins} + \mu_i^{nins}} p^{HI} \psi$$

that is, an employer lowers the gross income in productivity category i by the expected benefits cost of that category.

5.1.2 Wage setting with equal subsidy per employee

Gross salary to each employee is given as

$$gs = zw - c_{HI},$$

where c_{HI}, the employer's cost of health insurance that falls on each employee, is defined as

$$c_{HI} = \sum_{s|j=y} p\psi\mu^{ins}(s) \frac{\mu(s)}{\sum_{s|j=y} \mu(s)}.$$

$\mu^{ins}(s)$ is the fraction of workers in state s that purchase insurance. This pricing rule ensures no profit condition of a firm.

5.2 Health in preference

We check what is the role of parameters h_j in our preference specification. Does it generate anything other than a more realistic pattern of life-cycle consumptions?

5.3 Private health insurance of the old

We check if there's any change in the results when we add private health insurance of the old.

6 Conclusion

We set up a model of endogenous health insurance decision in a general equilibrium model rich enough to generate insurance demand closely resembling that observed in the data. We then examine the effects of two possible tax reforms. The experiments indicate that the tax subsidy on employer-provided health insurance is desirable though not in the current form. Employer provided group insurance in our model has the special feature that the premium does not depend on any characteristics, most importantly it is independent of current health status. However, the vast risk-sharing potential of this sort of insurance contract is hampered by the one-sided commitment. Relatively healthy young agents want to opt out of this contract and either self-insure or find a cheaper insurance contract in the private market. A subsidy on group insurance can therefore encourage even healthy agents to sign up and alleviate the adverse selection problem that plagues this insurance contract. The first experiment confirms this intuition by showing that removal of the subsidy reduces welfare. Even though a subsidy is desirable, there is room for improving welfare. The second experiment demonstrates that making the subsidy less regressive allows for more sharing of income risk while leaving insurance demand and therefore risk sharing of health expenditure shocks unchanged or even increasing it slightly.

Our work highlights the importance of studying health policy in a general equilibrium framework. Equilibrium prices will necessarily be affected by changes in policy. For example altering the tax treatment of health insurance premia changes the composition of those agents signing up and therefore the equilibrium insurance premium. Altering the attractiveness of health insurance also drives precautionary savings motives and thus the capital labor ratio which in turn determines factor prices such as wages and interest rates.

References

[1] Aiyagari, S. R. (1994). Uninsured idiosyncratic risk and aggregate saving. *Quarterly Journal of Economics 109*(3), 659-684.

[2] Cooley, T.F. and E. C. Prescott (1995). Economic Growth and Business Cycles. In: Cooley, T.F. and E.C. Prescott (Eds.). Frontiers of business cycle research, pp. 1-38, Princeton: Princeton University Press.

[3] Domeij, D and M. Johannesson (2004). Consumption and Health. *mimeo.*

[4] Gouveia, M. and R. P. Strauss (1994). Effective federal individual income tax functions: an exploratory empirical analysis. *National Tax Journal 47*(2), 317-339.

[5] Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *The Journal of Political Economy*, Vol. 80, No. 2, pp. 223-255.

[6] Gruber, J. (2004) Tax Policy for Health Insurance. NBER working paper 10977

[7] Heathcote, J., Storesletten K. and Violante G. L. (2004). The Cross-Sectional Implications of Rising Wage Inequality in the United States. *mimeo.*

[8] Hubbard, R. G., J. Skinner and S.P. Zeldes (1995). Precautionary Saving and Social Insurance. *The Journal of Political Economy*, v. 103, iss. 2, pp. 360-399.

[9] Kennickell, A. B. (2003). A Rolling Tide: Changes in the Distribution of Wealth in the U.S., 1989-2001. *working paper, Survey of Consumer Finances.*

[10] Livshits, I., J. MacGee and M. Tertilt (2003). Consumer Bankruptcy: A Fresh Start. *mimeo.*

[11] Storesletten, K., C. Telmer and A. Yaron (2004). Cyclical Dynamics in Idiosyncratic Labor-Market Risk. *The Journal of Political Economy*, v. 112, iss. 3, pp. 695-717

[12] Tauchen, G. (1995). Finite State Markov-chain Approximations to Univariate and Vector Autoregressions. *Economic Letters*, v. 20, pp. 177-181

[13] Whitehouse, E. (2003). The Value of Pension Entitlements: A Model of Nine OECD Countries. *OECD Social, Employment and Migration Working Papers No.9*

Table 1: Parameters of the model

Parameter	Description	Values
Preferences		
β	discount factor	0.9442
σ	relative risk aversion	2.0
$\{h_y, h_o\}$	health measures	{1.0000,0.7738}
Technology and production		
α	capital share	0.36
δ	depreciation rate of capital	0.06
Government		
$\{a_0, a_1, a_2\}$	income tax parameters (progressive part)	{0.258,0.768,0.739}
τ_y	income tax parameter (proportional part)	4.538%
$\bar{c}$	Social Insurance threshold assets level	12.500% of average income
τ_{ss}	Social Security tax rate	10.569%
	Social Security replacement ratio	45%
$q_{med}(x)$	Medicare coverage ratio	{0.299,0.381,0.605,0.713,0.639}
τ_{med}	Medicare tax rate	2.031%
p_{med}	Medicare premium	2.11% of per capita output
Demographics		
ρ_o	retirement probability	2.22%
ρ_d	death probability after retirement	10.85%
Endowment and health		
$\mathbb{Z}$	labor productivity shocks (Z)	{0.045,0.455,0.804,1.241,2.439}
$\Pi_{Z,E}$	– transition probabilities of Z and E	see text
$\mathbb{X}_y$	health expenditures shocks (young)	{0.005,0.045,0.176,0.467,1.522}
Π_{x_y}	– transition probabilities	see text
$\mathbb{X}_o$	health expenditures shocks (old)	{0.026,0.129,0.437,1.059,2.835}
Π_{x_o}	– transition probabilities	see text
Private health insurance		
$q(x)$	coverage ratio	{0.592,0.646,0.719,0.845,0.891}
p	insurance premium	6.755% of average income
ψ	premium covered by a firm (%)	85.0%

Figure 1: Takeup ratio by expenditure bin: Model vs data

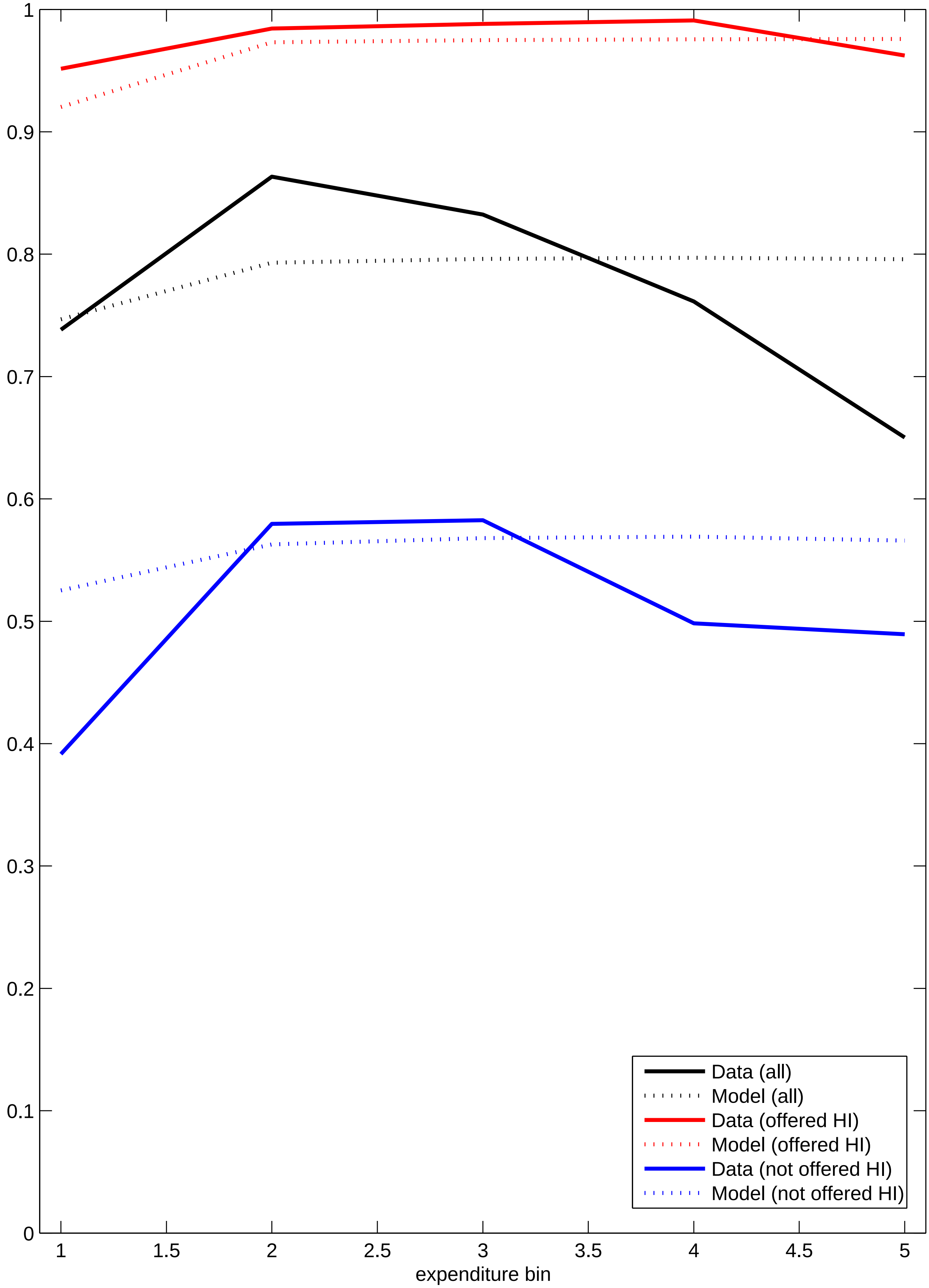

Figure 2: Takeup ratio by income bin: Model vs data