

Welfare Cost of Medicare

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Abstract

This paper studies the welfare cost of Medicare system. A general equilibrium overlapping generations model with endogenous health accumulation is developed and calibrated to mimic the US economy. The quantitative results show that by eliminating Medicare, we actually obtain a welfare gain which is equivalent to a lump-sum increase in consumption to the agents at a magnitude of 5.1% of GDP. The welfare gain mainly comes from three sources: remove the labor market distortion through the working age, reduce the in-

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centive to overspend in medical expenditure among retirees and smooth health investment over the life cycle.

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1 Introduction

In 2008, national health expenditure accounted for 16.2% of GDP in the US. Yet, life expectancy in the US is the lowest among OECD countries. Health care reform triggered a huge debate in the 2008 presidential campaign. It attracts tremendous interests from public and academic.

Federal-supported Medicare system is an important source for funding health expenditure in the US. In 2008, Medicare accounted for about 3.25% of GDP. Medicare is a social insurance program administered by the US government, providing health insurance coverage to people who are aged 65 and over. It is partially financed by payroll taxes imposed by the Federal Insurance Contributions Act (FICA) and the Self-Employment Contributions Act of 1954. The current rate of Medicare payroll tax is 2.9%, shared equally by employees and employers. As the US population is aging, fiscal burden of Medicare is increasing. The future of Medicare system is

unclear.

This paper aims to understand the welfare cost of Medicare system. Specifically, this paper asks a quantitative question: *if we completely eliminate Medicare system, is it a welfare loss or gain?* In order to answer this question, this paper develops a overlapping generations general equilibrium model with endogenous health accumulation. Individuals are born as adults with zero physical assets and a full health stock. Health stock is subject to a natural depreciation and a random shock over the life cycle. Health is important in the model for two reasons. First, it enters into the utility function. Better health implies higher utility. Second, better health enables individuals to supply more labor to the labor market or at home. Therefore, the model incorporates so-called “consumption motive” and “investment motive” for the health investment (Grossman 1972). Over the life cycle, individuals make the decisions to choose consumption, saving and medical expenditure. Medical expenditure is used to improve the health stock. During the work age, individuals choose working hours and pay social security payroll tax and Medicare payroll tax. After a mandatory retirement age, individuals receive social security benefits as well as subsidized health care through Medicare. Individuals die at a certain age.

This model is calibrated to mimic the actual US economy. In the benchmark case, the Medicare payroll tax is set to the current level 2.9%. We then set the tax

rate to zero and compare the results with the ones in the benchmark case.

Our quantitative results show that by eliminating Medicare, we actually obtain welfare gain. The expected discounted life-time utility of a newly born individual increases about 0.9%. This is equivalent to a lump-sum increase in consumption to the agents at a magnitude of 5.1% of GDP in the benchmark economy.

Our analysis shows that the welfare gain mainly comes from two sources. First, by eliminating Medicare payroll tax, we remove the distortion created by this tax in labor market. Working hours increase during the working age. overall, the average working hours increase 1.1%. With higher labor supply, the output increases by 2.1%. Workers thus have higher consumption. Second, eliminating Medicare payroll tax removes subsidy to the medical expenditure of retirees. They now have to pay 100% of their medical bill. Therefore, this policy change discourages the incentive to overspend in health care. Our results show that medical expenditure decreases by 2.2%. And it is mainly driven by the decrease of medical expenditure among retirees. The resource thus is shifted from medical bill to consumption, which dramatically raises the utility for retirees.

Imrohoroglu, Imrohoroglu and Joines (1995) study the optimal social security replacement rate and the welfare benefits associated with it. Their results show that the optimal social security replacement rate is 30%. The welfare benefit produced by

this optimal rate over an arrangement of no social security is 2.08% of GDP. They claim that the benefits arise from eliminating dynamic inefficiency caused by the overaccumulation of physical capital and substituting the missing private annuities in providing a vehicle to smooth old-age consumption. In the current model, it is worth mentioning that the Medicare system still provides welfare benefits through these two channels similar to the social security. Medicare helps to reduce the precautionary savings aiming to insure against idiosyncratic health shock, thus further overcomes the dynamic inefficiency. In addition, as a social insurance, Medicare improves the risk-sharing among retirees on medical expenditure. However, the labor distortion and overspending caused by “moral hazard” are missing in Imrohoroglu (1995) due to their model structure. This paper shows these distortions cannot be ignored.¹ And they quantitatively dominate the welfare benefits of Medicare.

This paper sheds light on the impact of Medicare on health spending. Finkelstein (2007) finds empirically a significant impact on health spending by the introduction of Medicare in 1965 and argues the overall spread of health insurance between 1950 and 1990 may be able to explain about half of the increase in real per capita health spending over this time period. This paper shows that eliminating Medicare will

¹Imrohoroglu and Kitao (2009) find that social security reform leads to a large reallocation of hours worked over the life-cycle if one relaxs the fixed labor supply assumption as in Imrohoroglu (1995).

lower health expenditure-GDP ratio from 21.2% in the benchmark case to 20.3%. The impact of Medicare on medical expenditure is not negligible.

Attanasio, Kitao and Violante (2008) use a general equilibrium overlapping generations model to study the macroeconomic and welfare implications of alternative funding schemes for Medicare. Their model, however, treats health status as exogenous. Our analysis here shows that endogenous health accumulation is crucial in driving the welfare gain from eliminating Medicare.

The balance of this paper is organized as follows. Section 2 describes the model. Section 3 outlines the parameterization of the model. Section 4 presents the simulations of the benchmark model. Section 5 reports the results for the experiment of eliminating Medicare. Section 6 conducts the sensitivity analysis for some key parameters in the model. Section 7 concludes.

2 Model

In this section, we describe a overlapping generations model with endogenous health accumulation. This model is a general equilibrium extension of Halliday, He and Zhang (2009).

2.1 Economic Environment

2.1.1 Demographic

The economy is populated by overlapping generations of finite-lived individuals with measure one. Each individual lives at most J periods. For each age $j \leq J$, the conditional probability of surviving from age $j - 1$ to j is denoted by $\varphi_j \in (0, 1)$. Notice that we have $\varphi_0 = 1$ and $\varphi_{J+1} = 0$. The survival probability $\{\varphi_j\}_{j=1}^J$ is treated as exogenously given. We assume that annuity market is absent in this economy and accidental bequests are collected by the government and uniformly distributed back to all agents currently alive.

Each period the number of newborns grows at a constant rate n . The share of age- j individuals in the population μ_j is given by

$$\mu_j = \frac{\mu_{j-1}\varphi_j}{1+n}$$

with $\sum_{j=1}^J \mu_j = 1$. We will use the age share as weights to calculate aggregate quantities in the economy.

2.1.2 Preferences

An individual derives utility from consumption, leisure and health. She maximizes expected discounted lifetime utility

$$E_0 \sum_{j=1}^J \beta^{j-1} \left[\prod_{k=1}^j \varphi_k \right] U(c_j, l_j, h_j) \quad (1)$$

where β denotes the subjective discount factor, c non-medical consumption, l leisure, and h health status. The period utility function takes the form

$$U(c_j, l_j, h_j) = \frac{[\lambda(c_j^\rho l_j^{1-\rho})^\psi + (1-\lambda)h_j^\psi]^{\frac{1-\sigma}{\psi}}}{1-\sigma} \quad (2)$$

Motivated by the real business cycle literature such as Cooley and Prescott (1995), we assume that the elasticity of substitution between consumption and leisure is one. The parameter ρ measures the weight of consumption. The elasticity of substitution between consumption and health is $\frac{1}{1-\psi}$. The parameter λ measures the relative importance of the consumption-leisure combination in the utility function. The parameter σ is the coefficient of relative risk aversion.

2.1.3 Budget Constraints

Each period this individual is endowed with one unit of non-sleeping time. She splits the time among working (n), enjoying leisure (l), and being sick(s). Therefore, we have the following time allocation equation

$$n_j + l_j + s_j = 1, \text{ for } 1 \leq j \leq J \quad (3)$$

Following Grossman (1972), we assume sick time s_j is a decreasing function of health status

$$s_j = Qh_j^{-\gamma} \quad (4)$$

where Q is the scale factor and γ measures the sensitivity of sick time to health. Notice that in contrast to recent structural work that incorporates endogenous health accumulation (*e.g.*, Suen 2006), in our model health does not directly affect labor productivity and/or survival probability. Allowing health to impact the allocation of time but not labor productivity is consistent with Grossman (1972), who says, “Health capital differs from other forms of human capital...a person’s stock of knowledge affects his market and non-market productivity, while his stock of health determines the total amount of time he can spend producing money earnings and commodities.”

This individual works until an exogenously given mandatory retirement age j_R .

She differs in her labor productivity due to differences in age. We use ε_j to denote her efficiency unit at age j . Let w be the wage rate and r be the rate of return on asset holdings. Accordingly, $w\varepsilon_j n_j$ is age- j labor income. At age j she faces the following budget constraint

$$c_j + m_j + a_j \leq (1 - \tau_{ss} - \tau_m)w\varepsilon_j n_j + (1 + r)a_{j-1}, \text{ for } j < j_R \quad (5)$$

where m_j is health investment in goods, a_j is asset holding, τ_{ss} is the Social Security tax rate, and τ_m is the Medicare payroll tax rate.

Once the individual is retired, she receives Social Security benefits denoted by b . Following Imrohoroglu, Imrohoroglu, and Joines (1995), we model the Social Security system in a simple way. The Social Security benefits are calculated to be a fraction κ of some base income, which we take as the average lifetime labor income

$$b = \kappa \frac{\sum_{i=1}^{j_R-1} w\varepsilon_i n_i}{j_R - 1}.$$

κ is referred to as the replacement ratio.

Retirees are also covered by Medicare in the sense that government will pay a constant fraction of retirees' medical bill. We denote this co-insurance rate by p . An

age- j retiree faces the following budget constraint

$$c_j + (1 - p)m_j + a_j \leq b + (1 + r)a_{j-1} + T, \forall j \geq j_R \quad (6)$$

We assume that agents are not allowed to borrow so that

$$a_j \geq 0 \text{ for } 1 \leq j \leq J.$$

Finally, there is no annuity market.

2.1.4 Health Investment

Following Grossman (1972), we assume that the individual has to invest in goods to produce health. The accumulation of health across ages is given by

$$h_{j+1} = (1 - \delta_{h_j})h_j + Bm_j^\xi + \varepsilon_j \quad (7)$$

where δ_{h_j} is the age-dependent depreciation rate of health stock, B measures the productivity of medical care technology, and ξ represents the return to scale for health investment. In each period, an age- j individual faces an idiosyncratic health shock which is denoted by ε_j . The shock is drawn from a finite set $\mathcal{S} = \{s_1, s_2, \dots, s_N\}$.

We assume that it follows a first-order Markov process. We denote the transition matrix for this shock $\Pi(\varepsilon', \varepsilon) = [\pi_{ij}]$, $i, j = 1, \dots, N$, where transition probability $\pi_{ij} = \Pr ob\{\varepsilon_{j+1} = j \mid \varepsilon_j = i\}$. Notice that this probability is age-independent.

We assume that the age-dependent depreciation rate of health stock δ_{h_j} takes the form

$$\delta_{h_j} = \frac{\exp(a_0 + a_1j + a_2j^2)}{1 + \exp(a_0 + a_1j + a_2j^2)}. \quad (8)$$

This functional form guarantees that $\delta_{h_j} \in (0, 1)$ and (given suitable values for a_1 and a_2) increases as the individual ages to capture the natural depreciation of health stock.

2.1.5 Technology

This economy has a constant returns to scale production function²

$$Y_t = K_t^\alpha N_t^{1-\alpha} \quad (9)$$

in which K and N are aggregate capital and labor inputs, respectively. The final good can be either consumed or invested into physical capital or health stock. The

²Our utility function does not allow the existence of a balanced growth path. Therefore, we do not include the labor-augmenting technological change in the production function.

aggregate resource constraint is given by

$$C_t + M_t + I_t = Y_t \tag{10}$$

C_t is aggregate consumption, M_t is aggregate goods expenditure in health, and I_t is aggregate investment in physical capital. Law of motion of aggregate capital thus follows

$$K_{t+1} = (1 - \delta_k)K_t + I_t \tag{11}$$

where δ is the depreciation rate on physical capital.

The representative firm maximizes its profits and ends up with following optimization conditions that determine wage rate and net real return to capital

$$w = (1 - a) \left(\frac{K}{N} \right)^\alpha \tag{12}$$

$$r = a \left(\frac{K}{N} \right)^{\alpha-1} - \delta_k. \tag{13}$$

2.2 Individual's Problem

At age j , an individual solves a dynamic programming problem. The state space at the beginning of age j is described by a vector $(a_{j-1}, h_j, \varepsilon_j)$, where a_{j-1} is the asset holding at the beginning of age j , h_j is health status at age j , and ε_j is the health

shock she faces at age j . Let $V_j(a_{j-1}, h_j, \varepsilon_j)$ denote the value function at age j given the state vector $(a_{j-1}, h_j, \varepsilon_j)$. The Bellman equation is then given by

$$V_j(a_{j-1}, h_j, \varepsilon_j) = \max_{c_j, m_j, a_j, l_j, n_j} \{U(c_j, l_j, h_j) + \beta \varphi_{j+1} E_j V_{j+1}(a_j, h_{j+1}, \varepsilon_{j+1})\} \quad (14)$$

subject to

$$\begin{aligned} c_j + m_j + a_j &\leq (1 - \tau_{ss} - \tau_m) w \varepsilon_j n_j + (1 + r) a_{j-1}, \forall j < j_R \\ c_j + (1 - p) m_j + a_j &\leq b + (1 + r) a_{j-1}, \forall j_R \leq j \leq J \\ h_{j+1} &= (1 - \delta_{h_j}) h_j + B m_j^\xi + \varepsilon_j, \forall j \\ n_j + l_j + s_j &= 1, \forall j \\ a_j &\geq 0, \forall j \end{aligned}$$

and the usual non-negativity constraints.

2.3 Stationary Competitive Equilibrium

Given the model environment, the definition of a stationary competitive equilibrium for this economy is standard. Let $\mathcal{A} = \{a_1, a_2, \dots, a_m\}$ denote the admissible set of asset holdings, $\mathcal{H} = \{h_1, h_2, \dots, h_n\}$ denote the admissible set of health

status, $\mathcal{M} = \{m_1, m_2, \dots, m_p\}$ denote the admissible set of medical expenditure, $\mathcal{N} = \{n_1, n_2, \dots, n_k\}$ denote the set of the discrete grids for possible working hours or time investment in health, and $\mathcal{S} = \{s_1, s_2, \dots, s_N\}$ denote the set of idiosyncratic health shock. Therefore, we have state vector $(a, h, \varepsilon) \in \mathcal{A} \times \mathcal{H} \times \mathcal{S}$.

Definition 1 *A stationary competitive equilibrium is a policy combination $\{\kappa, p, \tau_{ss}, \tau_m\}$, a collection of value functions $V_j(a, h, \varepsilon) : \mathcal{A} \times \mathcal{H} \times \mathcal{S} \rightarrow R$; individual decision rules for consumption $C_j : \mathcal{A} \times \mathcal{H} \times \mathcal{S} \rightarrow R_+$, medical expenditure $M_j : \mathcal{A} \times \mathcal{H} \times \mathcal{S} \rightarrow \mathcal{M}$, asset holding $A_j : \mathcal{A} \times \mathcal{H} \times \mathcal{S} \rightarrow \mathcal{A}$, and labor supply $N_j : \mathcal{A} \times \mathcal{H} \times \mathcal{S} \rightarrow \mathcal{N}$; age-dependent distributions of agents over state space $\Phi_j(a, h, \varepsilon)$ for each age $j = 1, 2, \dots, J$; a price vector $\{w, r\}$; and a lump-sum transfer T such that*

(i) *Given prices, policy combination and a lump-sum transfer T , decision rules C_j, M_j, A_j, N_j and value function V_j solve the individuals' problem (14).*

(ii) *Price vector $\{w, r\}$ is determined by the firm's first-order maximization conditions (12) and (13).*

(iii) *The law of motion for the distribution of agents over the state space follows*

$$\Phi_j(a', h', \varepsilon') = \sum_{a:A_j(a,h,\varepsilon)} \sum_{h:H_j(a,h,\varepsilon)} \Pi(\varepsilon', \varepsilon) \Phi_{j-1}(a, h, \varepsilon)$$

(iv) Social security system is self-financing (pay-as-you-go):

$$\tau_{ss} = \frac{\sum_{jR}^J \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) b}{\sum_{j=1}^{jR-1} \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h) w \varepsilon_j n_j}.$$

(v) Medicare system is self-financing:

$$\tau_m = \frac{p \sum_{jR}^J \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) m_j}{\sum_{j=1}^{jR-1} \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h) w \varepsilon_j n_j}$$

(v) Lump-sum transfer of accidental bequest is determined by

$$T = \sum_j \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) (1 - \varphi_{j+1}) A_j(a, h, \varepsilon).$$

(vi) Individual and aggregate behavior are consistent:

$$\begin{aligned} K &= \sum_j \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) A_{j-1}(a, h, \varepsilon) \\ N &= \sum_{j=1}^{jR} \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) N_j(a, h, \varepsilon) \\ M &= \sum_j \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) M_j(a, h, \varepsilon) \end{aligned}$$

(vii) Goods market clears:

$$\sum_j \sum_a \sum_h \sum_\varepsilon \mu_j \Phi_j(a, h, \varepsilon) C_j(a, h, \varepsilon) + M + (n + \delta_k)K = Y.$$

(viii) Time constraint is satisfied as in (3).

3 Calibration

We now outline the calibration of the model's parameters. For the parameters that are commonly used, we borrow from the literature. For those that are model-specific, the parameter values are chosen so that the model economy matches some key moments in the US economy in 2002.

3.1 Demographics

The model period is one year. An individual is assumed to be born at the real-time age of 21. Therefore, the model period $j = 1$ corresponds to age 21. Death is certain after age $J = 65$, which corresponds to age 85. The conditional survival probabilities $\{\varphi_j\}_{j=1}^J$ are taken from the US Life Tables 2002. Retirement is mandatory and occurs at age $j_R = 45$, which corresponds to age 65. We take the age-efficiency profile $\{\varepsilon_j\}_{j=1}^{j_R-1}$ from Conesa, Kitao and Krueger (2009), who construct it following

Hansen (1993). The population growth rate n is equal to the average US population growth rate in the data, which is 1.2%.

3.2 Preferences

We set the annual subjective time discount factor to be 0.97, which is in the range of widely used values in the literature. We choose a coefficient of relative risk aversion $\sigma = 2$, which is also a value widely used in the literature (e.g., Imrohorglu, Imrohorglu, and Joines (1995); Fernandez-Villaverde and Krueger (2002)). Following Yogo (2008), we set the elasticity of substitution between consumption and health to be $\frac{1}{1-\psi} = 0.11$; this implies $\psi = -8$. Since the elasticity of substitution between consumption and leisure is one, health and consumption are more complements compared to leisure. Since this is a key parameter, we will conduct a sensitivity analysis later.

Following Cooley and Prescott (1995), we choose the weight of consumption in this consumption-leisure combination $\rho = 0.36$. Usually this parameter is calibrated to match the working hours ratio. It is close to the value used in Conesa, Kitao and Krueger (2009), which is 0.377. The share of consumption-leisure composition in utility function λ is set to be 0.80.

3.3 Social Security and Medicare

We set the Social Security tax rate to be 10.6%, which is the current rate for U.S. Old-Age and Survivors Insurance (OASI). Medicare payroll tax rate τ_m is set to its current level 2.9%.

3.4 Health Accumulation

There are five model-specific parameters regarding health accumulation: the productivity of health accumulation technology (B), the return to scale for health investment (ξ), and three parameters that determine the age-dependent depreciation rate of health stock (a_0, a_1, a_2). We set $B = 0.10$ and pick others from Halliday, He and Zhang (2009).

3.5 Health Shock

From PSID 1968-2005, we obtain self-reported health status (SRHS) measure in which the respondent reports that her health is in one of five states: excellent, very good, good, fair, or poor. Following the standard way of partitioning this health variable in the literature, we map the health variable into a binary variable in which a person is either healthy (self-rated health is either excellent, very good or good) or a person is unhealthy (self-rated health is either fair or poor). In consistent to this

exercise, we narrow down the set of health shock to a 2-state space. s_1 corresponds to the healthy state. Therefore, $s_1 = 0$. We set $s_2 = -0.04$ corresponding to the state of unhealthy, i.e., an individual is caught sick. We then run a regression over ages to determine the transition matrix

$$\Pi = \begin{bmatrix} 0.8467 & 0.1533 \\ 0.2932 & 0.7068 \end{bmatrix}.$$

3.6 Sick Time

Since there is no data source for two parameters governing the sick time. We set the scale factor of sick time $Q = 0.05$ and choose the elasticity of sick time to health $\gamma = 1.5$ from Halliday, He and Zhang (2009).

3.7 Technology

Following Prescott (1986), we set the capital share in production function $\alpha = 0.36$. The depreciation rate of physical capital $\delta = 0.069$ is taken from Imrohoroglu, Imrohoroglu, and Joines (1999).

Table 1 summarize the calibrated parameters for the benchmark model.

Parameter	Description	Value	Source
Demographics			
J	maximum life span	65	age 85
j_R	mandatory retirement age	45	age 65
$\{\varphi_j\}_{j=1}^J$	conditional survival probabilities	Data	US Life Table 2002
n	population growth	1.2%	Data
Preferences			
β	subjective discount factor	0.97	common value
σ	CRRA coefficient	2	IES=0.5
ψ	elasticity b/w cons. and health	-8	Yogo (2008)
ρ	share of c in c -leisure combination	0.36	Cooley and Prescott (1995)
λ	share of cons-leisure com. in utility	0.80	Halliday, He and Zhang (2009)
Health Accumulation			
a_0	dep. rate of health	-5.00	Halliday, He and Zhang (2009)
a_1	dep. rate of health	0.05	Halliday, He and Zhang (2009)
a_2	dep. rate of health	0.00032	Halliday, He and Zhang (2009)
B	productivity of health technology	0.1	
ξ	return to scale for health investment	0.8	Halliday, He and Zhang (2009)
ε	health shock	see text	
Sick Time			
Q	scale factor of sick time	0.07	
γ	elasticity of sick time to health	1.5	Halliday, He and Zhang (2009)
Labor Productivity			
$\{\varepsilon_j\}_{j=1}^{j_R-1}$	age-efficiency profile		Conesa et al. (2009)
Social Security and Medicare			
τ_{ss}	Social Security tax rate	10.6%	Data
ε_m	Medicare tax rate	2.9%	Data
Technology			
α	capital share	0.36	Conesa et al. (2009)
δ_k	depreciation rate of capital	6.9%	Imrohoroglu et al. (1999)

Table 1: Parameters of the model

Moments	Data	Model
Capital-GDP ratio	2.73	3.00
Consumption-GDP ratio	75%	73%
Med. expenditure-GDP ratio	15.1%	21.2%
Investment-GDP ratio	25%	24.3%
Working hours ratio	33%	30%
Dependency ratio ⁴	20.6%	21.7%
Social Security Payment-GDP ratio	5%	6.8%
Medicare-GDP ratio	2.5%	1.9%
Medicare co-insurance rate	18%	
Interest rate	4-5%	5.1%

Table 2: Moments in the benchmark economy

4 Results

Using the parameter values from Table 1, we compute the model using standard numerical methods.³ It is worth mentioning that we pick most of parameter values from the literature and do not intentionally target on some specific macro aggregate ratios. As a first step, we would like to see how the model performs in matching the moments in the US data in 2002. Table 2 reports the findings.

Table 2 shows the benchmark model mimics the US economy fairly well. Except the medical expenditure-GDP ratio, all the macro ratios are in line with the US data.

The overlapping generations structure of the model also allows us to generate life cycle profiles of decision variables such as consumption, asset holding and medical expenditure. We report these life-cycle profiles in Figure 1 to Figure 4.

³See Imrohoroglu et al. (1995) for a detailed description of the solution method for this type of overlapping generations model.

Figure 1 shows the life-cycle profile of health investment (m). Health investment increases steadily until the retirement age, at which point it increases dramatically. At age 65, the medical expenditure increases from 0.32 to 0.69. A possible explanation is that individuals expect they will start to receive subsidized health service through Medicare. That makes the relative price of medical service to consumption decrease sharply. Substitution effect thus induces retirees to overspend in health care. However, the model predicts a sharp decline in medical spending since age 79. This is a consequence of the assumption of certain death after age 85 in the model. A forward-looking individual knows that she will not need any health investment after age 85; therefore, she begins to disinvest in health as the death date approaches.

Figure 2 shows the life-cycle pattern of health expenditure-labor income ratio. In the data, this ratio is very low and stable until age 50, then it increases dramatically after age 55. The model captures the increasing pattern but overshoots the data.

Health investment (in conjunction with depreciation) determines the evolution of the health stock. Figure 3 displays the life-cycle profile of health. The model can produce decreasing health status over the life-cycle. However, health stock in the model decreases much faster than in the data. This indicates either the depreciation rate of health is higher than it should be or the negative shock is too strong. Notice that huge increase in medical expenditure at age 65 significantly improves the health

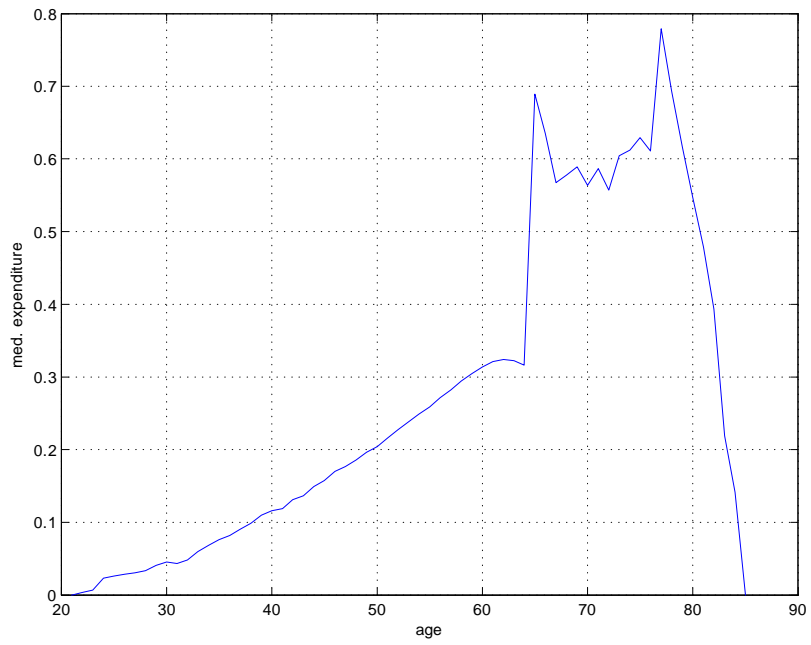


Figure 1: Life-cycle profile of medical expenditure: model

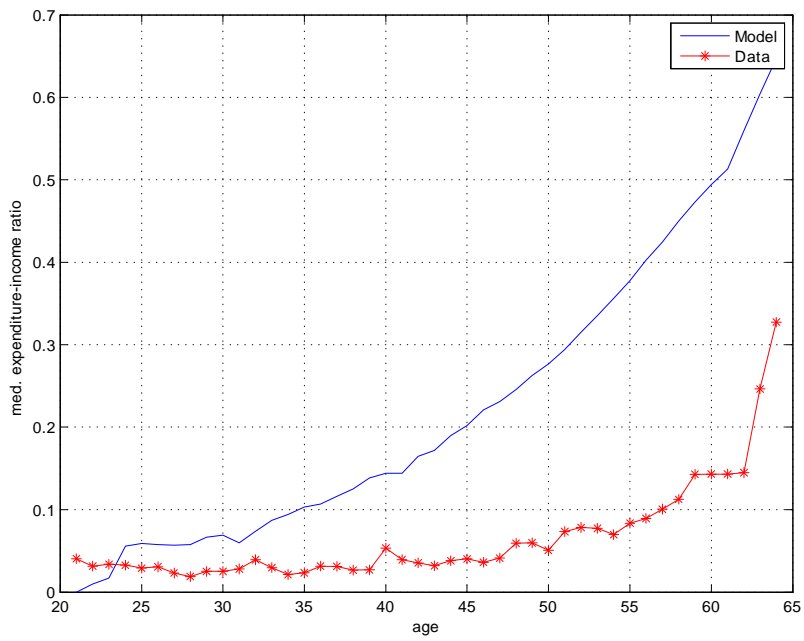


Figure 2: Life-cycle profile of medical expenditure-income ratio: model vs. data

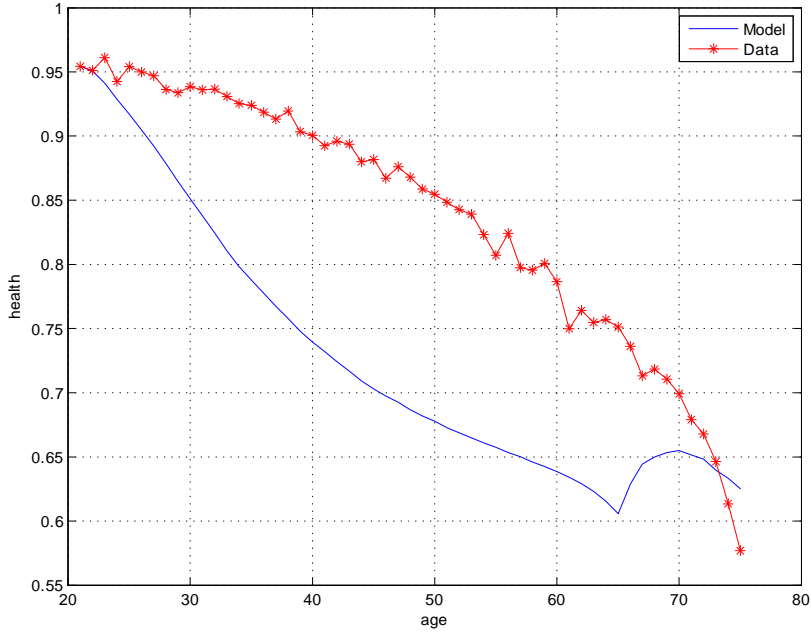


Figure 3: Life-cycle profile of health status: model

status of retirees.

The model also does well in replicating other economic decisions over the life-cycle. Figure 6 shows the life-cycle profile of working hours. The model captures the hump-shape of working hours. In the data, individuals devote about 34% of their non-sleeping time to working at age 20-24. The fraction of working time increases to its peak at ages 35-39, and it is quite stable until ages 45-59. It then decreases sharply from about 38% at ages 45-49 to 22% at ages 60-64. In the model, the fraction of working hours reaches the peak (about 38%) at ages 40-45. It then decreases by

11% to about 27% at ages 60-64. The health stock plays an important role in the declining portion of the working hours profile; as health status declines, sick time increases over the life-cycle, which, in turn, encroaches upon a person's ability to work. Our model predicts that from ages 45-49 to 60-64, the fraction of sick time in the non-sleeping time increases from 7.85% to 10.80%, which accounts for about 28% of the decline in working hours in the model.

Figure 4 shows the life-cycle profile of consumption (excluding medical expenditure) in the model. It matches some key properties of life cycle consumption profile in the data. First, it exhibits a hump-shape. The peak is around age 60. And after retirement, the consumption level is lower than the starting point at age 21. (Fernandez-Villaverde and Krueger 2006). Second, as a measure of the hump, the ratio of peak consumption to consumption at age 22 is 1.65. It is very close to the ratio that Fernandez-Villaverde and Krueger find in the CEX data. However, what is interesting is the non-medical consumption declines dramatically after the retirement age which is exactly when medical expenditure increases precipitously. From ages 64 to ages 65, it decreases from 0.61 to 0.30, while meantime medical expenditure increases from 0.32 to 0.69. Change in the relative price of health care around age 65 due to Medicare causes health investment to "crowd out" consumption.

Figure 5 reports the asset holding over the life cycle in the model. An individ-

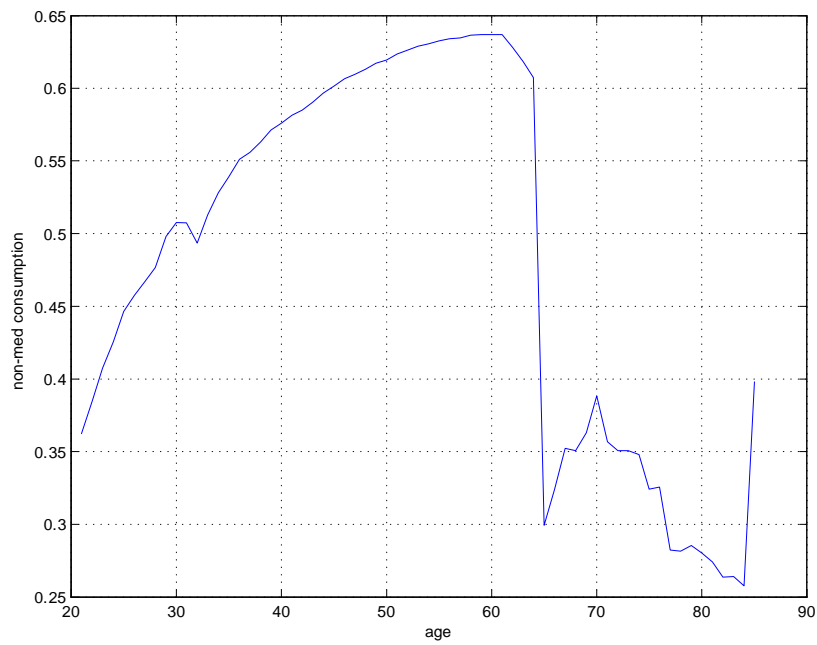


Figure 4: Life-cycle profile of consumption: model

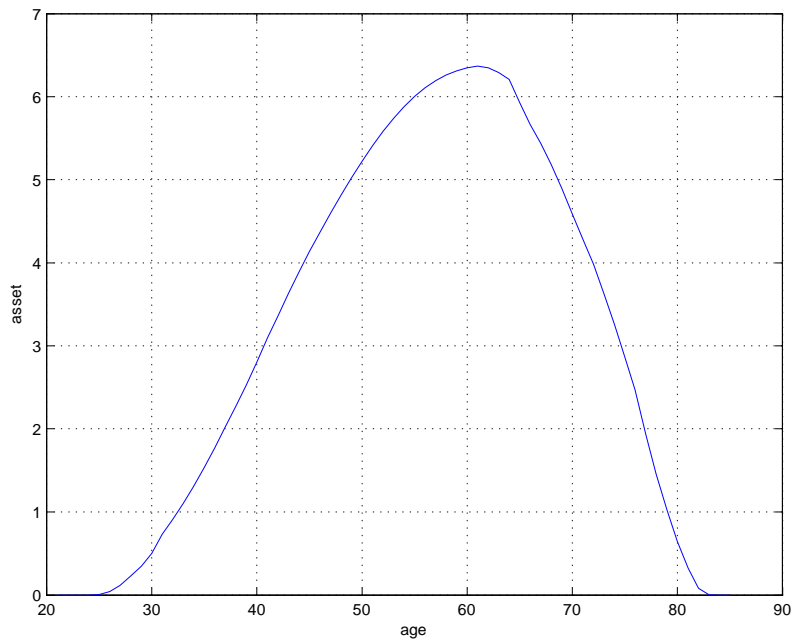


Figure 5: Life cycle profile of asset holding: model

ual faces a binding borrowing constraint at the early stage of her life cycle. She saves through working age, partly for smoothing consumption and partly for insuring against idiosyncratic health shock. After retirement, she starts to dissave until the end of life cycle.

Since the model includes leisure into the utility function, we can also see how it goes to match life cycle profile of working hours. Figure 6 shows that the model captures the hump-shape of working hours in the data quite well.

To summarize, the benchmark model is able to replicate both cross-sectional

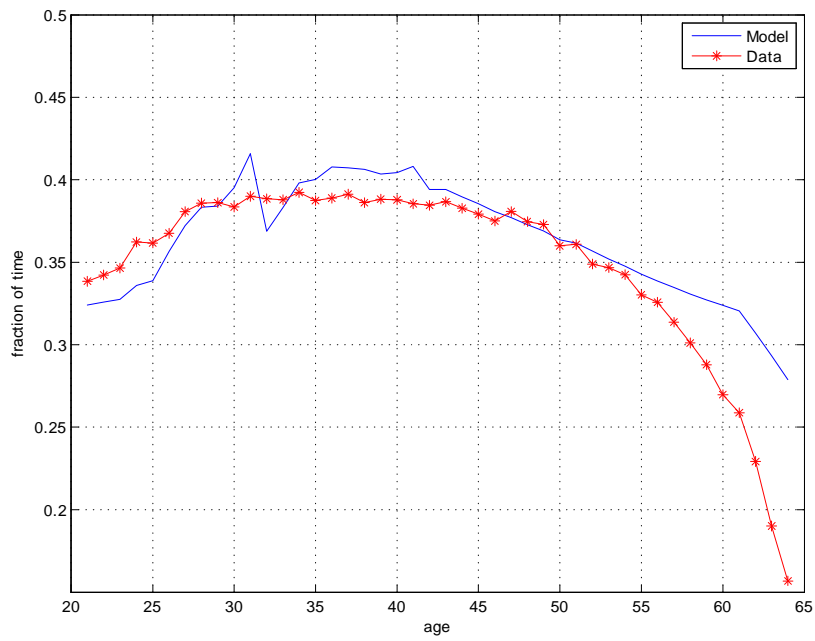


Figure 6: Life-cycle profile of working hours: model vs. data

aggregate ratio and life-cycle profiles of key macroeconomic variables in the US data quite well.

5 Eliminating Medicare

In this section, we show the effects and welfare implications if we completely remove Medicare from the current system. By doing so, we set the Medicare tax rate to be zero and keep all the other parameter values as used in the benchmark case. Now individuals have to rely on their own money for medical expenditure at old age.

In order to investigate the welfare change of this policy experiment compared to the benchmark economy, we employ two measurements of welfare used in Imrohoroglu et al. (1995). The first one measures an “average utility” of agents in the model economy. Given a policy arrangement $\Omega = \{\kappa, p, \tau_{ss}, \tau_m\}$, the average utility under this policy arrangement is defined by

$$W(\Omega) = \sum_j \sum_a \sum_h \sum_\varepsilon \beta^{j-1} \left[\prod_{k=1}^j \varphi_k \right] \Phi_j(a, h, \varepsilon) U(C_j(a, h, \varepsilon), l_j(a, h, \varepsilon), h_j(a, h, \varepsilon)).$$

In words, the average utility is the expected discounted utility a newly born individual derives from the lifetime consumption, leisure and health status under a given policy arrangement Ω .

Variables	Benchmark	No Medicare	Change (%)
Output	0.9691	0.9891	+2.1%
Capital	2.91	3.02	+3.8%
Med. expenditure	0.2053	0.2008	-2.2%
Consumption	0.5019	0.5351	+3.3%
Average working hours	0.3009	0.3041	+1.1%
Wage	1.19	1.20	+0.8%
Interest rate	5.09%	4.89%	-3.9%
K/Y	3.00	3.04	+1.3%
C/Y	0.518	0.541	+4.4%
M/Y	0.212	0.203	-4.2%
I/Y	0.243	0.247	+1.6%
Average utility	-56.0102	-55.4984	+0.9%
CEV	+5.08%		

Table 3: Comparison of steady states: Benchmark vs. No Medicare

The second measurement is the standard consumption equivalence (CEV). It is a lump-sum compensation (relative to output in the benchmark economy) to consumption in order to make new born in the benchmark economy is indifferent between policy arrangement $\Omega_0 = \{\kappa = \text{benchmark value}, p = \text{benchmark value}, \tau_{ss} = 10.6\%, \tau_m = 2.9\%\}$ and $\Omega_1 = \{\kappa = \text{benchmark value}, p = 0, \tau_{ss} = 10.6\%, \tau_m = 0\}$.

Table 3 reports the comparison between the benchmark economy and the case without Medicare.

It is not surprising that eliminating Medicare will increase capital formation since now individuals have to save more for health uncertainty. Figure 7 shows that eliminating Medicare induces higher savings from age mid 40s to mid 70s when individuals begins to face higher pressure from deteriorating health status. With higher capital

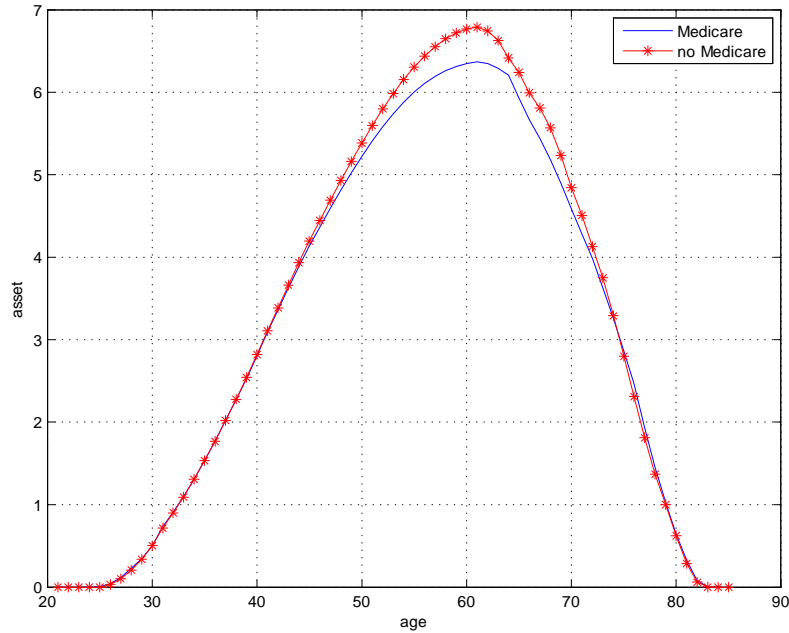


Figure 7: Life cycle of asset holding: benchmark vs. no Medicare

formation, interest rate is lower. It decreases from 5.09% to 4.89%.

However, what is interesting is by eliminating Medicare, aggregate medical expenditure is actually lower by 2.2%. Figure 8 shows the decrease mostly comes from less spending among retirees. Notice that without Medicare, medical expenditure only increases slightly from 0.6453 at age 64 to 0.6482 at age 65. Removing the subsidy to health care for retirees significantly reduces the inefficiency caused by the “moral hazard” linked to Medicare. It turns out to be an important source of welfare gain. Individuals in their working age, however, responses to this policy change

differently. Anticipating that they will not be covered by Medicare when they retire, forward-looking workers actually increase their health expenditure to accumulate more health stock. The increase is more significant after age mid 50s when health status depreciates faster than earlier ages. A change in relative price of health care at old age not only affects the health spending of retirees, but also changes the intertemporal allocation of health expenditure over the life cycle because now medical service becomes relatively more expensive at old age than young age. This change in intertemporal allocation of health investment also brings a smoother life cycle profile of health stock as shown in Figure 9. Since health directly enters into utility function and individuals are risk averse to the health shock, a smoother health stock over life cycle also contributes to welfare gain of eliminating Medicare.

Another source of welfare gain from eliminating Medicare comes from the labor market. Average working hours increase by 1.1%. As shown in Figure 10, zero Medicare tax raises labor supply through working age. Higher labor supply arises partly from removing distortion imposed by the tax. In addition, better health stock during working age reduces sick time, hence also increases the labor supply. With higher capital and labor input, output increases by 2.1%. Higher working hours also bring higher labor income over the life cycle shown in Figure 11.

Finally, because of higher labor income for working age individuals and lower

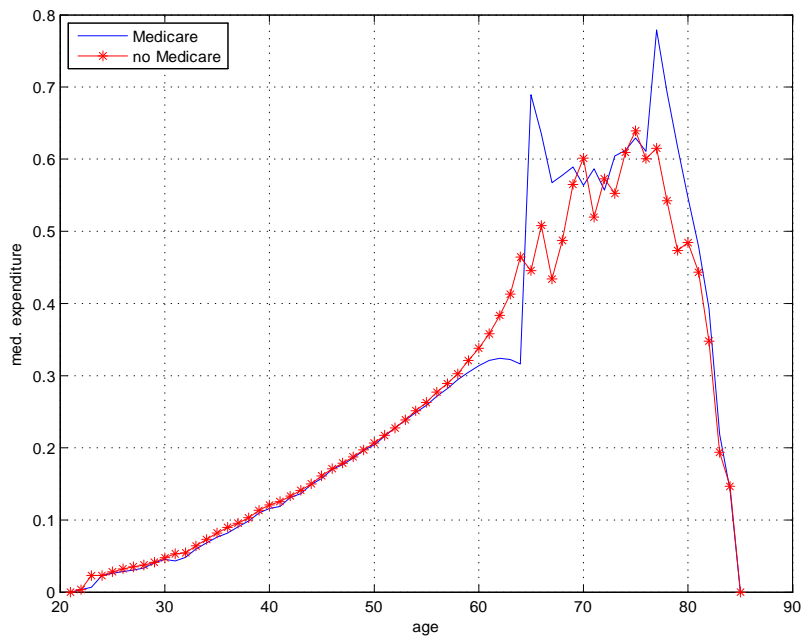


Figure 8: Life cycle profile of medical expenditure: benchmark vs. no Medicare

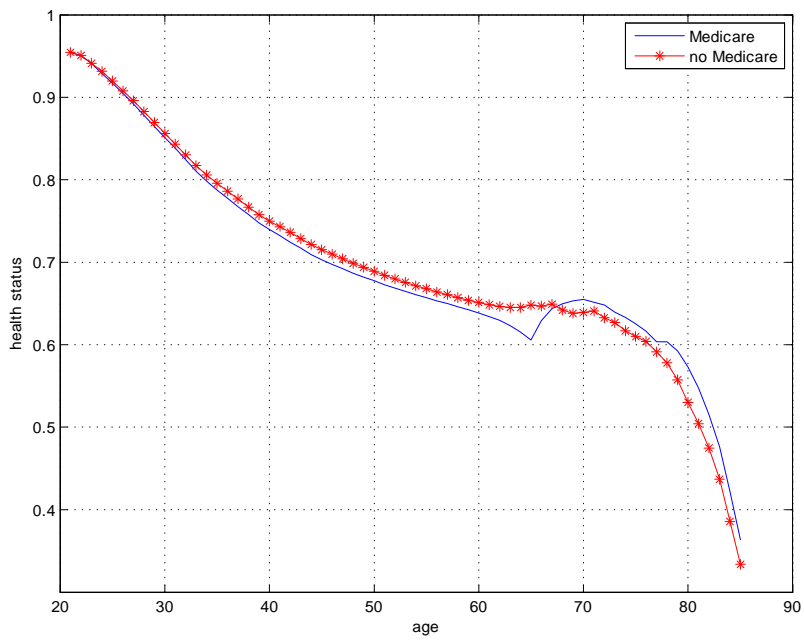


Figure 9: Life cycle profile of health status: benchmark vs. no Medicare

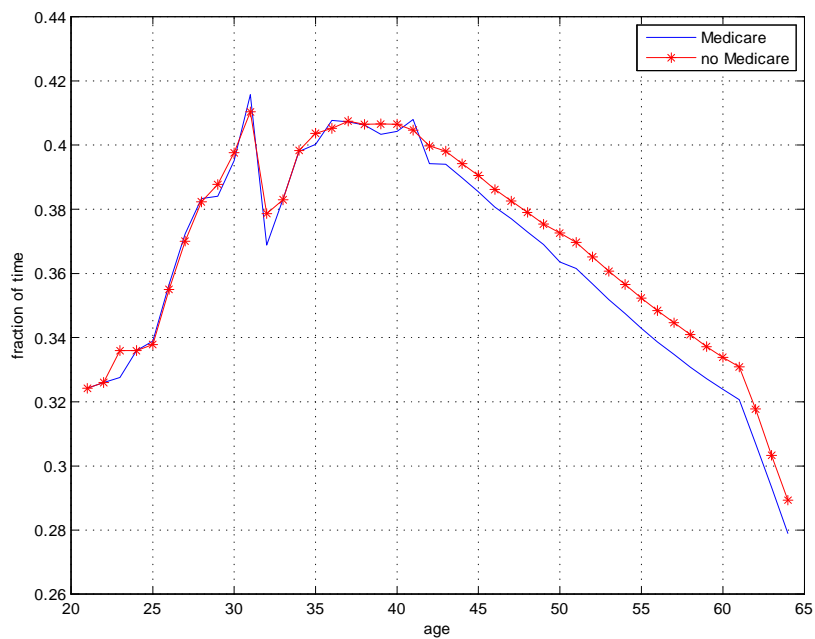


Figure 10: Life cycle profile of working hours: benchmark vs. no Medicare

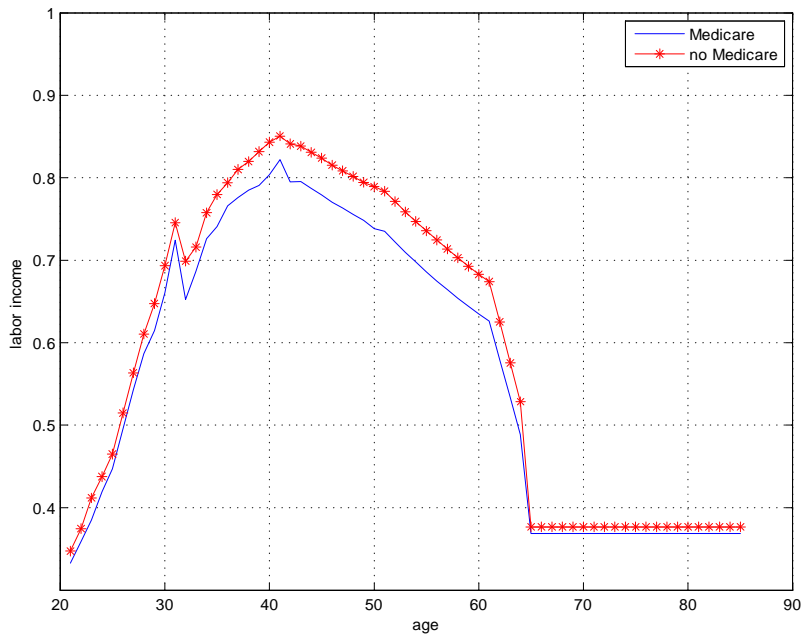


Figure 11: Life cycle profile of labor income: benchmark vs. no Medicare

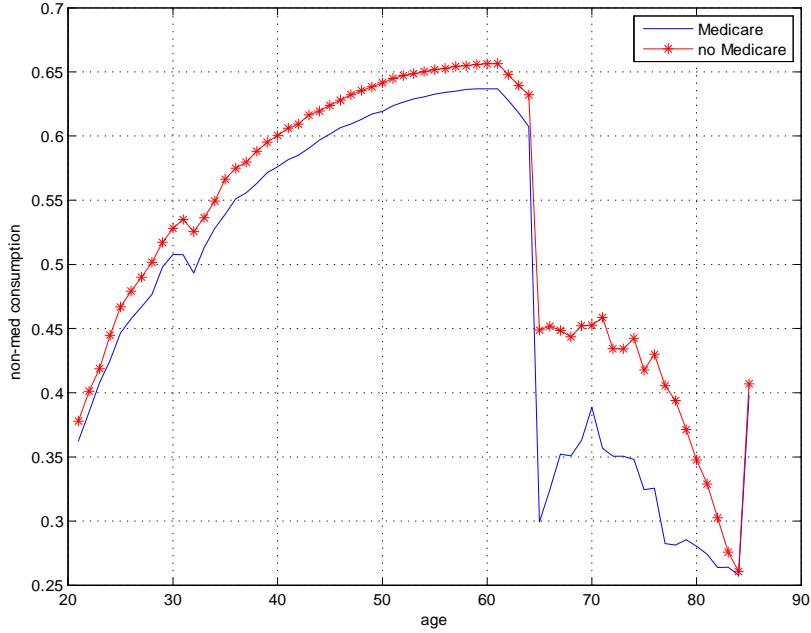


Figure 12: Life cycle profile of consumption: benchmark vs. no Medicare

medical expenditure for retirees, non-medical consumption is higher over the whole life cycle under zero Medicare tax. Aggregate consumption increases by 3.3%, pushing consumption-GDP ratio from 51.8% to 54.1%. It also brings higher average utility. In order to make new born indifferent between the benchmark economy and the one without Medicare, we have to compensate new born in the benchmark economy a lump-sum transfer to consumption in each period which is equivalent to 5.08% of GDP in the benchmark economy. By eliminating Medicare, a new born in the economy is significantly better off.

6 Sensitivity Analysis

To be added.

7 Conclusions

This paper asks an important question: does Medicare system bring a welfare gain or loss to the economy? In order to address this question, a general equilibrium overlapping generations model is developed and calibrated to mimic the US economy. An important feature of the model is health status is endogenous. It is subject to a natural depreciation and a random shock in each period. Individuals, however, can invest in health care to accumulate their health stock.

Our quantitative results show that by eliminating Medicare, we actually obtain welfare gain. The expected discounted life-time utility of a newly born individual increases about 0.9%. This is equivalent to a lump-sum increase in consumption to the agents at a magnitude of 5.1% of GDP in the benchmark economy.

Our analysis shows that the welfare gain mainly comes from two sources. First, by eliminating Medicare payroll tax, we remove the distortion created by this tax in labor market. Working hours increase during the working age. overall, the average working hours increase 1.1%. With higher labor supply, the output increases by

2.1%. Workers thus have higher consumption. Second, eliminating Medicare payroll tax removes subsidy to the medical expenditure of retirees. Therefore, this policy change discourages the incentive to overspend in health care. Our results show that medical expenditure decreases by 2.2%. And it is mainly driven by the decrease of medical expenditure among retirees. The resource thus is shifted from medical bill to consumption, which dramatically raises the utility for retirees.

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