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HEALTH INSURANCE REFORM:
THE IMPACT OF A MEDICARE BUY-IN

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ABSTRACT

The steady state general equilibrium and welfare consequences of health insurance reform are evaluated in a calibrated life-cycle economy with incomplete markets and endogenous labor supply. Individuals face uncertainty each period about their future health status, medical expenditures, labor productivity, access to employer provided group health insurance, and the length of their life. In this environment, incomplete markets and adverse selection, which restricts the type of insurance contracts available in equilibrium, creates a potential role for health insurance reform. In particular, we consider a policy reform that would allow older workers (aged 55-64) to purchase insurance similar to Medicare coverage. We find that adverse selection eliminates any market for a Medicare buy-in if it is offered as an unsubsidized option to individual private health insurance. Hence, we compare the equilibrium properties of the current insurance system with those that obtain with an optional buy-in subsidized by the government, as well as with several types of health insurance mandates.

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1 Introduction

In the debate that led to enacting the "Patient Protection and Affordable Care Act," signed by President Obama in March 2010, much of the attention was focused on the desirability of a "public option," that the government should offer a health insurance alternative that would compete with those offered by private insurance companies. Current U.S. policy does provide public health insurance in the form of Medicare to individuals aged 65 and over. This paper evaluates the general equilibrium and welfare consequences of a policy reform that has been discussed in the U.S. at least since the Clinton administration that would allow younger workers (aged 55-64) to purchase Medicare coverage from the government.

This policy analysis is carried out using a calibrated life-cycle economy with incomplete markets and endogenous labor supply. In our model, working age individuals face idiosyncratic productivity shocks, choose whether or not to work (labor is indivisible), accumulate claims to capital, and can purchase private health insurance if they do not receive group health insurance through their employer. They face uncertainty each period about their future health status, medical expenditures and the length of their life. Retired individuals receive social security and Medicare which, along with accumulated savings, is used to finance consumption and medical expenditures. Individuals who retire early, between age 55 and 64, might be offered group retiree health insurance.

We focus on the Medicare buy-in proposal because, unlike many compulsory programs that have been debated, the idea is to make a popular government program available as an option to individuals who currently do not qualify due to age and do not have another form of group insurance. In addition, this program targets the ten year age group with the highest percentage of uninsured adults in fair or poor health in the United States according to the Kaiser Foundation. That is, individuals younger than 55 are more likely to be uninsured, but they don't need it as badly on average.

In this environment, incomplete markets and adverse selection, which restricts the type of insurance contracts available in equilibrium, creates a potential role for health insurance reform. However, the price of such a program, if it is to be self-financing, depends crucially on who chooses to enroll. Relatively healthy individuals may prefer individual health insurance or self-insurance and their exit from the pool would raise the cost of the buy-in program for those who remain. In fact, in our calibrated economy, this adverse selection problem eliminates any market for a self-financing Medicare buy-in program.

Hence, if this type of program is to have any impact on the number of uninsured, it must either be mandatory for those without another form of insurance or partially subsidized by the government to make it more attractive to healthy individuals. We therefore compare our benchmark economy, in which there is only individual health insurance or employer provided group insurance for those under age 65, with economies with a Medicare buy-in program that is subsidized at various rates by the government. We also consider an insurance mandate requiring everyone to purchase some form of health insurance. In this setting, the market for an unsubsidized Medicare buy-in is eliminated for the same reason that it doesn't exist without

the mandate – healthy individuals would prefer to purchase individual insurance coverage.

We find that by subsidizing the buy-in program, it is possible to bring the number of individuals aged 55-64 without insurance to below 5 percent without incurring large tax increases to finance the program. In particular, a 30 percent subsidy brings the fraction uninsured down from 30 percent in the benchmark to 4.5 percent. Due to the general equilibrium effects of introducing this policy, total labor taxes only need to be increased by 0.18 percentage points above the tax rate for the benchmark economy. In addition, while lifetime utility is somewhat lower for an individual born in this economy compared with that of an individual born in the benchmark economy, those of age 36 or higher enjoy greater lifetime utility on average from their current age forward. An insurance mandate, on the other hand, would imply lower welfare for individuals of all ages. In addition we find that if the Medicare buy-in is priced differently depending on the age of the individual, a lower subsidy (17 percent) is required to bring the fraction uninsured below 5 percent and the tax increase needed to fund the subsidy is even smaller (a 0.1 percentage point increase relative to the benchmark).

In addition to the basic mandate, we also compare the Medicare buy-in with mandates that come with a requirement that insurance providers use community rating–all working age individuals without employer provided coverage must purchase insurance and one price is charged to all participants. This turns out to be quite expensive (the tax rate is 1.17 percent above the benchmark) due to the fact that many younger individuals qualify for social welfare under this system. If adjusted community rating is permitted that allows insurance premiums to depend on age, this problem largely disappears. It is worth noting that the mandate required by the Affordable Care Act requires adjusted community rating that is somewhere between pure community rating and our adjusted community rating. We find that steady state welfare is higher under the subsidized Medicare buy-in policy than with these mandates. However, if the mandate is restricted to only those of age 55-64, the mandate economy provides higher steady state welfare than an economy with a Medicare buy-in.

We also consider an economy with a subsidized Medicare buy-in where those who qualify for this program do not have access to group insurance provided by employers. The lower equilibrium tax rate associated with eliminating some tax deductable insurance coverage implies that this economy is associated with higher steady state welfare than the benchmark economy.

Our paper contributes to the literature pioneered by Auerbach and Kotlikoff (1987) using calibrated general equilibrium life cycle models to study dynamic fiscal policy and social programs such as social security. It also builds on the the quantitative literature using dynamic general equilibrium models with incomplete markets pioneered by Aiyagari (1994), Huggett (1993) and Imrohoroglu (1989). While this literature has grown to be quite large, there are relatively few papers that have applied this approach to the study of health insurance programs.

Three exceptions are Attanasio, Kitao and Violante (2010), Jeske and Kitao (2009) and Pashchenko and Porapakkarm (2012). The first of these uses a model similar to ours to evaluate alternative funding

schemes for Medicare given demographic projections for the next 75 years. Jeske and Kitao (2009) study the role of adverse selection in a model where individuals choose whether to or not to purchase health insurance, which is either group insurance, provided through employers, or individual insurance. The paper argues that a regressive tax policy that subsidizes insurance for those receiving it through their employers by making premiums tax deductible is welfare improving since it encourages healthy individuals to stay in the program rather than seek private insurance. That is, the tax policy serves a role similar to the subsidizing the Medicare buy-in in our model. Pashchenko and Porapakkarm (2012) use a model similar to ours to evaluate the positive and normative consequences of the 2010 Affordable Care Act.

The remainder of the paper is organized as follows. We describe the theoretical model in section 2 and the model calibration in section 3. Results are presented in section 4, and concluding comments are given in section 5.

2 Model

We use a general equilibrium life-cycle model with endogenous demand for private health insurance, endogenous labor supply and incomplete markets for our analysis of health insurance reform. There is uncertainty resulting from idiosyncratic productivity shocks, whether one has access to employer provided group insurance, health status, medical expenditure shocks, and the length of life.

2.1 Demographics

The economy is populated by overlapping generations of individuals of age $j = 1, 2, ..., J$. An individual of age j survives until next period with probability $\rho_{j,h'}$ which depends on age j and health status $h' \in \{h_g, h_b\}$. If an individual reaches the maximum age J, $\rho_{J,h'} = 0$ for any h'. The size of new cohorts grows at a rate η.

2.2 Financial Market Structure

Individuals can hold non-state contingent assets which are claims to capital used in production. In particular, beginning of period asset holdings of a given individual of age j are denoted by a_j. We assume that $a_0 = 0$. In addition, all individuals receive a lump sum transfer, b, which is unintended bequests from individuals that did not survive from the previous period. The rate of return on asset holdings is denoted by r, which is equal to the marginal product of capital minus the rate of depreciation in equilibrium. These assets can be used by households to partially insure themselves against any combination of idiosyncratic labor productivity shocks and medical expenditure shocks.

The choice of next period asset holdings is subject to a borrowing constraint, $a' \geq 0$. This, along with an assumption of no annuity markets, is the source of market incompleteness in our model. The borrowing

limit especially impacts the asset holding decision of low-wealth households since they cannot smooth their consumption over time when they are hit by negative shocks to their disposable income.

2.3 Preferences and the Labor Decision

Each period, individuals are endowed with one unit of time that can be allocated to market work and leisure. If they choose to spend n hours on the market work, their earnings are given by (wzn), where w is the market wage per effective unit of labor, and z is an idiosyncratic labor productivity shock that is revealed at the beginning of the period.

The labor decision is indivisible. That is, the choice of n is restricted as follows: $n \in \{0, \bar{n}\}$ if $j < J^r$; $n = 0$ if $j \geq J^r$, where J^r is the age of mandatory retirement. Individuals choose consumption and hours worked to maximize utility, which is given by

$$E \left[\sum_{j=1}^{J} \beta^{j-1} \left(\prod_{t=1}^{j-1} \rho_{t,h} \right) u(c_j, n_j) \right],\tag{1}$$

Here, $0 < \beta < 1$ is the subjective discount factor and $u(c,n)$ is the period utility function, the functional form for which was chosen to be compatible with balance growth:

$$u(c, 1-n) = \frac{\left[c^{\phi} (1-n)^{1-\phi} \right]^{1-\mu} - 1}{1-\mu};\tag{2}$$

where ϕ determines the relative preference for consumption versus leisure, and μ governs the both the intertemporal elasticity of substitution for consumption and the labor supply elasticity. The coefficient of relative risk aversion is given by $\gamma = 1 - \phi + \phi\mu$.[1]

2.4 Health, Medical Expenditure and Health Insurance

2.4.1 Heath status and medical expenditure uncertainty

Given their beginning of period health status h determined in the previous period, individuals face exogenous uncertainty about their current health status h' and resulting medical expenditure x.[2] Health status evolves

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[1] See Heathcote, Storesletten and Violante (2008) for details. A separable utility between consumption and leisure is often used in the related literature, but this form is consistent with balanced growth only when μ is one:

$$u(c, 1-n) = \frac{c^{1-\mu} - 1}{1-\mu} - \psi \frac{n^{1+1/\varepsilon}}{1+1/\varepsilon},$$

where ψ is a disutility parameter and ε is Frisch elasticity of labor supply.

[2] We say that the uncertainty is exogenous because there is no sense in which actions taken by individuals can affect their health status. This assumption eliminates moral hazard from our model economy.

according to a two-state Markov chain where $h \in \{h_g, h_b\}$, denoting good and bad health. The transition matrix, $\pi_j^h(h', h)$, depends on age.

The probability distribution of the idiosyncratic medical expenditure shock x depends on age and current health status, h'. We assume that h' and x are revealed after the health insurance decision has been made. In particular, x is drawn from the conditional distribution $\pi_j^x(x|h')$, where $x \in X_{j,h'} = \{x_{j,h'}^1, x_{j,h'}^2, ..., x_{j,h'}^m\}$. Hence, the probability of an individual of age j with beginning of period health status h having expenditure equal to x (and beginning of next period health status h') is given by $\pi_j^x(x|h')\pi_j^h(h', h)$.

2.4.2 Group health insurance for employees and retirees (EHI and RHI) and individual health insurance (IHI)

Individuals can partially insure medical expenditure uncertainty with health insurance that covers a fraction ω of realized medical expenditures x.

To characterize the current US health insurance market, three types of insurance are incorporated in the model – employment-based group health insurance (EHI), group health insurance for early retirees (RHI), and individual (private) health insurance (IHI). The group insurance options, which are offered by employers, are required by law not to discriminate based on health status. In the latter, insurance companies are permitted to price-discriminate based on individual characteristics.

We assume that everyone has access to IHI, but EHI and RHI are available only if offered by the employer, and RHI is only available to early retirees, individuals aged J^g to $J^r - 1$, which will correspond to ages 55-64 in our quantitative analysis. That is, J^g is the age at which an individual qualifies for RHI (if offered) and J^r is the age at which an individual must retire. At this point, an individual qualifies for Medicare, which is described in the next subsection. If an individual chooses not to work prior to age J^g, there is no possibility of having coverage through group insurance. The premium charged for EHI, q^e, does not depend on an individual's age or health status. If EHI is offered, the premium is paid by the employer but the amount will be subtracted from an employee's pre-tax wage income to ensure that total compensation is consistent with labor market equilibrium. An offer of EHI comes with the job offer (the revelation of the idiosyncratic productivity shock) at the beginning of a period when agents make their labor supply decisions. We denote whether or not an individual has an EHI offer by the state variable e, where $e \in \{0, 1\}$. Whether or not the individual actually accepts the EHI offer is denoted by an indicator ι_{EHI}, where $\iota_{EHI} = 1$ if $e = 1$ and $n = \bar{n}$; $\iota_{EHI} = 0$ otherwise.

Once an individual reaches age J^g, he/she will be offered RHI if $e = 1$ and $n = 0$. That is, to have retiree health insurance, one must have been offered a job with EHI, but then choose not to work. In this case, if the insurance is accepted, we set $\iota_{RHI} = 1$ and the individual gets charged an insurance premium equal to q^g. This form of insurance is particularly desirable for individuals in the model because it is subsidized; a fraction σ_g of the total cost of the insurance is paid by the firm and $1 - \sigma_g$ by the individual. Once the

individual reaches age J^r, he/she is eligible for Medicare, which is the only health insurance offered in our model to those of age J^r and over.

If an agent decides to buy IHI to insure medical expenditures, a premium $q^i(j,h)$, which depends on the individual's current age and health status, needs to be paid at the beginning of the period before the medical expenditure shock is realized. This reflects standard risk rating in the IHI market. In addition, we denote whether or not the individual has an IHI insurance contract by ι_{IHI}, where $\iota_{IHI} = 1$ if the individual has IHI and $\iota_{IHI} = 0$ otherwise. Finally, because IHI requires that individuals be screened to determine how much they should be charged for insurance, there are additional underwriting costs that are not incurred by an insurance provider that employs some form of community rating. Our way of modeling this follows Jeske and Kitao (2009) by assuming that an IHI provider charges a markup of $\psi > 1$ on the premium that would be charged in equilibrium if there were no underwriting costs.

2.4.3 Stochastic process for z and e

We assume that z, which is idiosyncratic productivity, can take on one of N possible values. In addition, we assume that the probability that EHI is offered ($e = 1$) is a function of the realized value of z. We also assume that the probability of a particular (z,e) draw depends on health status and age. Therefore, we assume that the vector (z,e) follows a Markov chain with a $(2N)X(2N)$ transition matrix $P^{g,j}$ for individuals of age j with good beginning of period health status ($h = h_g$) and a transition matrix $P^{b,j}$ for individuals with $h = h_b$.

2.5 Government and Social Programs

2.5.1 Medicare

Medicare is a public program sponsored by the government that provides health insurance for the elderly. Once individuals reach the eligibility age of J^r (which corresponds to age 65), they are covered by Medicare automatically. Medicare covers a fraction ω_m of realized medical expenditure x. In addition, the government pays a fraction σ_m of the total premium required to offer Medicare in equilibrium, leaving participants to pay a fraction $1 - \sigma_m$ of the premium.

The program is financed by a combination of contributions from the general government budget and the Medicare premium charged to benefit recipients, q^m.

2.5.2 Social security

The social security program provides the elderly with a benefit S when they reach the eligibility age of J^r and retire. This program is also financed by the general government budget.

2.5.3 Minimum consumption guarantee

In addition to Medicare and social security, the government provides means-tested social insurance in this economy. The government guarantees a minimum level of consumption $\underline{c}$ by supplementing income by an amount T in case the household's disposable income plus assets (net after medical expenditures) falls below $\underline{c}$. That is, we employ the simple transfer rule proposed by Hubbard et al. (1995). This plays the same role in our model economy as transfer programs such as Medicaid, food stamps, and Supplemental Security Income do in the U.S.

2.5.4 Government budget

Government revenue consists of revenue from a labor income tax τ_l, capital income tax τ_k, and a consumption tax τ_c. Additional funds are obtained from the Medicare premium, q^m. The government uses its revenue to finance all public programs and its own consumption G, which is determined as the residual in our benchmark economy, but is held constant across our policy experiments. The government's budget constraint is given by:

$$\int \left\{ \tau_l \left[(wzn - q^e \cdot e) + S \right] + \tau_k r (a + b) + \tau_c c + q^m \right\} d\Phi = \int \left[T + S + \omega_m \cdot x \right] d\Phi + G, \tag{3}$$

where Φ is the cross sectional distribution of population over state variables.

2.6 Production Technology

On the production side, we assume competitive firms operate a standard constant returns to scale technology. Aggregate output Y is given by

$$Y = F(K, L) = K^\theta L^{1-\theta}, \tag{4}$$

where K and L are aggregate capital and effective labor. Capital is assumed to depreciate at the rate δ each period.

2.7 Competitive Equilibrium

2.7.1 Timeline

At the beginning of each period, individuals observe their asset holdings a determined in the previous period, a job offer that consists of a productivity draw z and an indicator e (0 or 1) as to whether the job comes with EHI, and their health status h. That is, their beginning of period state is given by $s = (j, a, h, z, e)$. They then make a decision to accept or reject the job offer and whether or not to purchase a private individual insurance contract (ι_{IHI}) or early retiree health insurance (ι_{RHI}) before this period's medical shock x is realized. After

the insurance purchase and labor decisions are made, health status h' and medical expenditure x are realized and then households make decisions on consumption c and end of period asset holdings a'.

2.7.2 Individual's dynamic program

Given prices and tax rates, the problem solved by an individual of age $j = 1, ..., J^r - 1$ can be written as follows:

$$V(s) = \max_{n \in \{0, \bar{n}\}, \; \iota_{IHI}, \; \iota_{RHI}} \sum_{(h', x)} \pi_j^x(x|h') \pi_j^h(h', h) \left\{ \max_{c, \; a'} u(c, n) + \beta \rho_{j,h'} \sum_{(z', e')} P_{(z', e')|(z, e)}^{h', j} V(s') \right\} \tag{5}$$

subject to

$$(1 + \tau_c)c + a' + q^i(j, h) \iota_{IHI} + q^g \iota_{RHI} = W + T \tag{6}$$

$$W \equiv (1 - \tau_l)(wzn - q^e * \iota_{EHI}) + (1 + (1 - \tau_k)r)(a + b) - (1 - \hat{\omega})x \tag{7}$$

$$T = \max\{0, \; (1 + \tau_c)\underline{c} - W\} \tag{8}$$

$$\hat{\omega} = \begin{cases} \omega & \text{if } \iota_{EHI} = 1, \; \iota_{RHI} = 1, \text{ or } \iota_{IHI} = 1 \\ 0 & \text{otherwise} \end{cases} \tag{9}$$

$$\iota_{EHI} = \begin{cases} 1 & \text{if } e = 1 \text{ and } n = \bar{n} \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

$$\iota_{RHI} \in \begin{cases} \{0, 1\} & \text{if } e = 1, \; n = 0 \text{ and } J^g \leq j \leq J^r - 1 \\ \{0\} & \text{otherwise} \end{cases} \tag{11}$$

$$a' \geq 0; \; c \geq 0. \tag{12}$$

Similarly, the problem of a retiree aged $j = J^r, ..., J$ is the following, where h' and x are revealed before any decisions need to be made:

$$V(j, a, h) = \max_{c, \; a'} \{u(c, 0) + \beta \rho_{j,h'} V(j + 1, a', h') \, |h', x\} \tag{13}$$

subject to

$$(1 + \tau_c)c + a' = W + T \tag{14}$$

$$W \equiv S + (1 + (1 - \tau_k)r)(a + b) - (1 - \omega_m)x - q^m \tag{15}$$

$$T = \max\{0, \; (1 + \tau_c)\underline{c} - W\} \tag{16}$$

$$a' \geq 0; \; c \geq 0. \tag{17}$$

2.7.3 Equilibrium definition

A competitive equilibrium consists of a set of individual decision rules $[n(s), \iota_{IHI}(s), \iota_{RHI}(s),$ and $a'(s,x,h')]$, a set of factor demands $[K$ and $L]$, and a set of prices $[w, r, q^i(j,h), q^e, q^g,$ and $q^m]$ such that

1. Given prices, the individual decision rules solve the households dynamic program.

2. Factor demands must satisfy

$$w = (1-\theta)\left(K/L\right)^{\theta} \tag{18}$$

$$r = \theta\left(L/K\right)^{(1-\theta)} - \delta \tag{19}$$

3. Markets clear

$$L = \int n(s)zd\Phi \tag{20}$$

$$K = \int (a+b)d\Phi \tag{21}$$

where

$$b = \int \frac{(1-\rho_{j-1,h})a}{1+\eta}d\Phi \tag{22}$$

$$q^i(j,h) = \psi \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega\, x \tag{23}$$

$$q^e = \int \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega\,(\iota_{EHI} + \sigma_g\,\iota_{RHI})\, x\, d\Phi \tag{24}$$

$$q^g = \int \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega\,(1-\sigma_g)\,\iota_{RHI})\, x\, d\Phi \tag{25}$$

$$q^m = (1-\sigma_m)\int \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega_m\,(\iota_{j\geq J^r})\, x\, d\Phi \tag{26}$$

where $\iota_{j\geq J^r}$ is an indicator that is equal to one if the individual is of Medicare eligible and zero otherwise.

2.8 Policy Experiment – Medicare buy-in

Let J^b be the age at which an individual becomes eligible to participate in the Medicare buy-in program by paying a premium equal to q^b. We consider cases where this premium is and is not dependent on age. We also consider the possibility of introducing a government subsidy to overcome the adverse selection problem. In our quantitative experiments, we set J^b and J^g equal to each other.

If this program is available, the problem of an individual eligible for the buy-in, those of age J^b to $J^r - 1$, becomes:

$$V(s) = \max_{n \in \{0,\bar{n}\},\ \iota_{IHI},\ \iota_{RHI},\ \iota_{MB}} \sum_{(h',x)} \pi_j^x(x|h') \pi_j^h(h',h) \left\{ \max_{c,\ a'} u(c,n) + \beta \rho_{j,h'} \sum_{(z',e')} P_{(z',e')|(z,e)}^{h',j} V(s') \right\} \quad (27)$$

subject to

$$(1 + \tau_c)c + a' + q^i(j,h)\iota_{IHI} + q^g \iota_{RHI} + q^b(j)\iota_{MB} = W + T \quad (28)$$

$$W \equiv (1 - \tau_l)(wzn - q^e * \iota_{EHI}) + (1 + (1 - \tau_k)r)(a + b) - (1 - \hat{\omega})x \quad (29)$$

$$T = \max\{0,\ (1 + \tau_c)\underline{c} - W\} \quad (30)$$

$$\hat{\omega} = \begin{cases} \omega & \text{if } \iota_{EHI} = 1,\ \iota_{RHI} = 1,\ \iota_{MB} = 1,\ \text{or } \iota_{IHI} = 1 \\ 0 & \text{otherwise} \end{cases} \quad (31)$$

$$\iota_{EHI} = \begin{cases} 1 & \text{if } e = 1 \text{ and } n = \bar{n} \\ 0 & \text{otherwise} \end{cases} \quad (32)$$

$$\iota_{RHI} \in \begin{cases} \{0,1\} & \text{if } e = 1,\ n = 0 \text{ and } J^g \leq j \leq J^r - 1 \\ \{0\} & \text{otherwise} \end{cases} \quad (33)$$

$$a' \geq 0;\ c \geq 0, \quad (34)$$

where ι_{MB} is an indicator that takes a value of one if the agent qualifies for the Medicare buy-in and indeed buys it, and takes a value of zero otherwise.

In competitive equilibrium, if the Medicare buy-in program is subsidized at the rate σ_b, the equilibrium premium will be as follows:

$$q^b(j) = (1 - \sigma_b) \int \sum_{(h',x)} \pi_j^x(x|h') \pi_j^h(h',h) \omega_b\ \iota_{MB}\ \iota_j\ x\ d\Phi \quad (35)$$

where ι_j is an indicator equal to one if the individual is age j and zero otherwise. If the Medicare buy-in is not priced by age, the premium becomes

$$q^b = (1 - \sigma_b) \int \sum_{(h',x)} \pi_j^x(x|h') \pi_j^h(h',h) \omega_b \iota_{MB}\ x\ d\Phi \quad (36)$$

3   Calibration

To calibrate the earning processes, health expenditure shocks and to obtain empirical estimates of health insurance coverage rates, we use income, health status, health expenditures and insurance status from the Medical Expenditure Panel Survey (MEPS). We use eight two-year panels from 1999/2000 up to 2006/2007. We focus only on heads of households, which we define to be the individual (male or female) with the highest

income in a particular residential unit. Attached to each of these household heads is a weight that can be used to make adjustments for the possibility that the MEPS sample of individuals may not reflect the distribution of individuals in the population as a whole.

3.1 Health Insurance

The coverage rates for the various forms of insurance are constructed from MEPS data as follows. To be considered as having EHI in a given year, the respondent in the MEPS survey must have been employed and covered by some form of group insurance during the year. In particular, to be classified as "employed," the respondent must have answered that they were employed in at least two of the three interviews conducted in a given year. In order to be considered as covered by insurance, the respondent must declare that they are covered at least eight months of a given year. To be counted as having RHI, the respondent needs to be covered by some form of group insurance and not be employed. To be counted as being covered by IHI, the respondent would have been covered by private insurance (source unknown), nongroup insurance, or self-employment insurance.

We follow Attanasio, Kitao and Violante (2009) and set the reimbursement rate for private health insurance, ω, equal to 0.7, and the reimbursement rate for Medicare, ω_m, equal to 0.5. We set the markup for IHI, ψ, so that the IHI coverage rates predicted by our model match observed rates in MEPS data for individuals (household heads) aged 55 to 64. The fraction of the total cost of Medicare paid by the government, σ_m, is set equal to 0.88. The remaining cost is financed by the Medicare premium, q^m. Finally, we set the subsidy rate for early retirement insurance, σ_g, equal to 0.6 based on findings from the 2006 Kaiser/Hewitt Retiree Health Benefits Survey.

The ages of eligibility for RHI and the Medicare buy-in, which are denoted by J^g and J^b, are both set equal to 35. This corresponds to age 55 in the data.

3.2 Earnings and Employment Health Insurance

We jointly calibrate earnings and access to EHI or RHI, which we take as being attached to an employment opportunity. We set the number of earnings states to $N = 5$. In order to obtain values for these five grid points for z, we compute the average wage earnings from the whole sample in 2007 dollars, which turns out to be \$34,958. Next, we compute average earnings for the top 15% of earners, the next 20%, 30%, 20%, and the bottom 15%. Our earnings states are then computed as the ratio of these averages to the average of the whole sample:

$$Z = \{0.0029,\ 0.2667,\ 0.6811,\ 1.2011,\ 2.4235\}$$

Transition matrices are computed for five year age groups from 21 to 65. Each individual in the MEPS database is interviewed in two adjacent years, so we can compute the probability of moving from one

Table 1: Joint transition matrices of earnings and EHI offer by age group 51-55

Age 51-55 ($h' = h_g$)	$e'=1$ $z'=z_1$	$e'=1$ $z'=z_2$	$e'=1$ $z'=z_3$	$e'=1$ $z'=z_4$	$e'=1$ $z'=z_5$	$e'=0$ $z'=z_1$	$e'=0$ $z'=z_2$	$e'=0$ $z'=z_3$	$e'=0$ $z'=z_4$	$e'=0$ $z'=z_5$
$e=1\ z=z_1$	0.446	0.028	0.103	0.147	0.052	0.091	0.008	0.107	0.019	0.000
$e=1\ z=z_2$	0.000	0.243	0.356	0.086	0.081	0.022	0.076	0.115	0.021	0.000
$e=1\ z=z_3$	0.006	0.057	0.569	0.221	0.068	0.004	0.026	0.035	0.009	0.005
$e=1\ z=z_4$	0.006	0.016	0.147	0.575	0.222	0.001	0.007	0.012	0.013	0.002
$e=1\ z=z_5$	0.003	0.008	0.037	0.143	0.779	0.002	0.002	0.001	0.012	0.015
$e=0\ z=z_1$	0.000	0.019	0.005	0.000	0.015	0.712	0.188	0.046	0.015	0.000
$e=0\ z=z_2$	0.000	0.039	0.067	0.008	0.008	0.091	0.465	0.256	0.025	0.043
$e=0\ z=z_3$	0.002	0.017	0.081	0.045	0.005	0.039	0.157	0.469	0.130	0.054
$e=0\ z=z_4$	0.000	0.018	0.044	0.110	0.037	0.020	0.056	0.252	0.242	0.220
$e=0\ z=z_5$	0.000	0.000	0.012	0.037	0.087	0.010	0.076	0.074	0.216	0.488
Age 51-55 ($h' = h_b$)	$e'=1$ $z'=z_1$	$e'=1$ $z'=z_2$	$e'=1$ $z'=z_3$	$e'=1$ $z'=z_4$	$e'=1$ $z'=z_5$	$e'=0$ $z'=z_1$	$e'=0$ $z'=z_2$	$e'=0$ $z'=z_3$	$e'=0$ $z'=z_4$	$e'=0$ $z'=z_5$
$e=1\ z=z_1$	0.614	0.087	0.038	0.069	0.070	0.123	0.000	0.000	0.000	0.000
$e=1\ z=z_2$	0.056	0.372	0.313	0.010	0.020	0.109	0.061	0.059	0.000	0.000
$e=1\ z=z_3$	0.046	0.067	0.528	0.188	0.038	0.024	0.034	0.076	0.000	0.000
$e=1\ z=z_4$	0.023	0.002	0.230	0.537	0.172	0.006	0.000	0.000	0.010	0.020
$e=1\ z=z_5$	0.000	0.012	0.060	0.199	0.720	0.004	0.005	0.000	0.000	0.000
$e=0\ z=z_1$	0.007	0.001	0.008	0.000	0.008	0.871	0.095	0.005	0.006	0.000
$e=0\ z=z_2$	0.000	0.043	0.050	0.004	0.000	0.194	0.535	0.131	0.031	0.012
$e=0\ z=z_3$	0.000	0.055	0.116	0.037	0.000	0.072	0.194	0.451	0.076	0.000
$e=0\ z=z_4$	0.000	0.092	0.028	0.192	0.202	0.000	0.144	0.157	0.186	0.000
$e=0\ z=z_5$	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.500	0.272	0.176

earnings/EHI bin to another in one year, conditional on age and reported health status, by simply computing the weighted fraction of individuals who made that transition. In this way we construct the joint transition probabilities $P^{h',j}(z',e'|z,e)$ of going from income bin z with insurance status e to income bin z' with e'.[3] Hence, the joint Markov process is defined over 5×2 states with a transition matrix $P^{h',j}(z',e'|z,e)$ of size 10×10. For each age group, we compute two transition matrices corresponding to good and bad health status.

Table 1 displays the joint transition matrices of age-group 51-55 for both $h' = h_g$ and $h' = h_b$ as an example. The other matrices can be obtained from the authors.

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[3]Let the X be the set of all 10 possible earnings/EHI states and let $G^{h',j}(x,x')$ be the group of households who move from state $x \in X$ to state $x' \in X$. The gross flow from state x to x' is given by $F^{h',j}(x,x') = \sum_{i \in G^{h',j}(x,x')} w_i$, where w_i is the weight associated with individual i in the MEPS sample. The transition probabilities can then be calculated from these flows, $P^{h',j}(x'|x) = \frac{F^{h',j}(x,x')}{\sum_{y \in X} F^{h',j}(x,y)}$.

We found that a high earners are more likely to be offered EHI ($e = 1$), and that this state is persistent over time.

Table 2: Transition probabilities of health status by age group

Age		$h' = h_g$	$h' = h_b$
21-30	$h = h_g$	0.96	0.04
	$h = h_b$	0.48	0.52
31-40	$h = h_g$	0.96	0.04
	$h = h_b$	0.38	0.62
41-50	$h = h_g$	0.94	0.06
	$h = h_b$	0.32	0.68
51-60	$h = h_g$	0.93	0.07
	$h = h_b$	0.28	0.72
61-70	$h = h_g$	0.90	0.10
	$h = h_b$	0.30	0.70
71-80	$h = h_g$	0.88	0.12
	$h = h_b$	0.31	0.69
81-	$h = h_g$	0.87	0.13
	$h = h_b$	0.34	0.66

3.3 Health Status and Health Expenditures

The MEPS database is also used to calculate age dependent transition matrices for health status and the probability distribution of health expenditures conditional on health status. Each individual is interviewed three times in a given a year and we compute the average of the health status indicator (1 - 5) that is provided by the individual's response to the question, "In general, compared to other people of your age, would you say that your health is excellent (1), very good (2), good (3), fair (4), or poor (5)?" If the average is greater than 3, we say $h = h_b$ and set $h = h_g$ otherwise. We can then construct age dependent transition matrices as described above for the earnings state. The transition matrices of the health status for different age groups, which are calculated using the same method as in the previous subsection, are reported in Table 2.

In order to capture the long-tail in the distribution of the health expenditures and a small probability of incurring very large and catastrophic expenditures, we use three expenditure states with uneven measures (average of top 5%, next 35% and bottom 60%) for each age and health status. The distribution of health expenditures by age and health status is displayed in Table 3.

Table 3: Health expenditures from MEPS (2007 dollars)

		Medical expenditure		
Age	Health	Bottom 60%	Next 35%	Top 5%
20-29	h_g	76.19	1520.49	12163.42
	h_b	389.14	5027.02	33470.09
30-39	h_g	136.80	1898.03	13644.96
	h_b	621.60	7055.62	60358.85
40-49	h_g	275.13	2769.24	19939.88
	h_b	1055.28	9410.88	55337.89
50-64	h_g	639.93	4630.72	29758.45
	h_b	1947.97	13234.47	66826.10
65-	h_g	1560.28	9703.30	49647.48
	h_b	3402.35	19590.86	74479.44

3.4 Demographics, Preference and Technology

Following studies similar to ours, the utility discount factor β is set so that the capital output ratio is equal to 3.0, the utility parameter μ is set equal to 3, and ϕ is selected so that aggregate labor hours is equal to 0.3. The above setting implies that the relative risk aversion coefficient is 2.4, which is in the range of the estimates (between one and three) suggested in the empirical consumption literature (see Attanasio (1999), for a survey). The health dependent survival probabilities over the life cycle are taken from Attanasio, Kitao and Violante (2009) and Imrohoroglu and Kitao (2009).

The capital income share parameter (θ) in the production function is set equal to 0.36 and the depreciation rate of capital (δ) is set equal to 0.08.

3.5 Social Security, Consumption Guarantee and Government taxation

The social security payment is set equal to 45% of the average labor income of working age adults. The minimum consumption floor is calibrated so that the proportion of individuals with asset levels lower than $1,000 is equal to 13%. This percentage is the average across the individual years reported in Table 4 of Kennickell (2003).

The consumption tax rate (τ_c) is set equal to 5%, the capital income tax rate (τ_k) is 40%, and the labor income lax rate (τ_l) is 35%. These are based on measurements from Mendoza et.al. (1994). The labor tax rate is higher than the one reported in that paper since ours incorporates both the labor income tax and the

Table 4: Summary of parameters

Parameters	Notations	Values	Target/Note
Discount Factor	β	0.967	K/Y ratio $= 3$
Utility Parameter	μ	3	Relative risk aversion 2.4
Depreciation Rate	δ	0.08	
Labor Parameter	ϕ	0.72	Employment rate of those age 55-64 $= 71\%$ (MEPS)
Capital Income Share	θ	0.36	
IHI Premium Markup	ψ	1.092	IHI coverage rate for age 55-64 $= 5.9\%$ (MEPS)
RHI subsidy rate	σ_g	60%	Kaiser/Hewitt retiree health benefits survey
Social Welfare	$\underline{c}$	14% of avg earnings	Fraction with asset holdings $< \$1000 = 13\%$ (Kennickell, 2003)
Social security benefit	S	45% of avg earnings	
PHI reimbursement rate	ω	0.70	Attanasio et.al. (2008)
Medicare reimbursement rate	ω_m	0.50	Attanasio et.al. (2008)
Cons. tax rate	τ_c	0.05	Mendoza et.al. (1994)
Capital tax rate	τ_k	0.40	Mendoza et.al. (1994)
Labor tax rate	τ_l	0.35	

Table 5: Benchmark properties

PHI coverage 21-64	PHI coverage 55-64	Labor hours	Employment Rate (age < 65)	Capital-output ratio	r
73%	70%	0.32	87%	3.0	4%

Note: PHI=EHI+RHI+IHI.

Figure 1: EHI+RHI and IHI coverage rates (Benchmark)
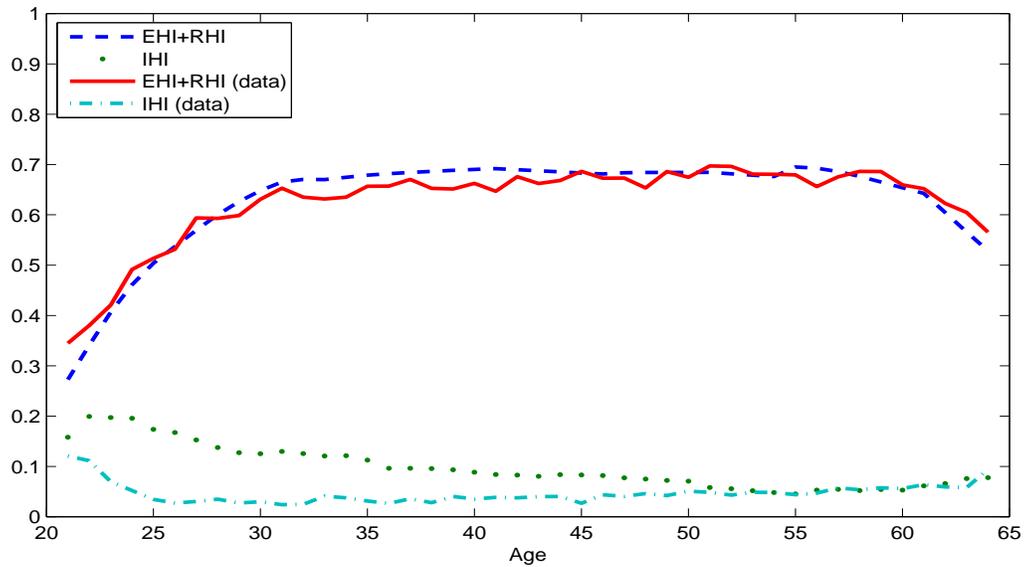
payroll taxes that finance social security and Medicare.

Our calibration is summarized in Table 4.

4   Quantitative Analysis

We first describe the properties of the benchmark economy that characterizes some features of the current US insurance market. We will then compare this economy to one with an insurance mandate and/or a Medicare buy-in program as policy alternatives.

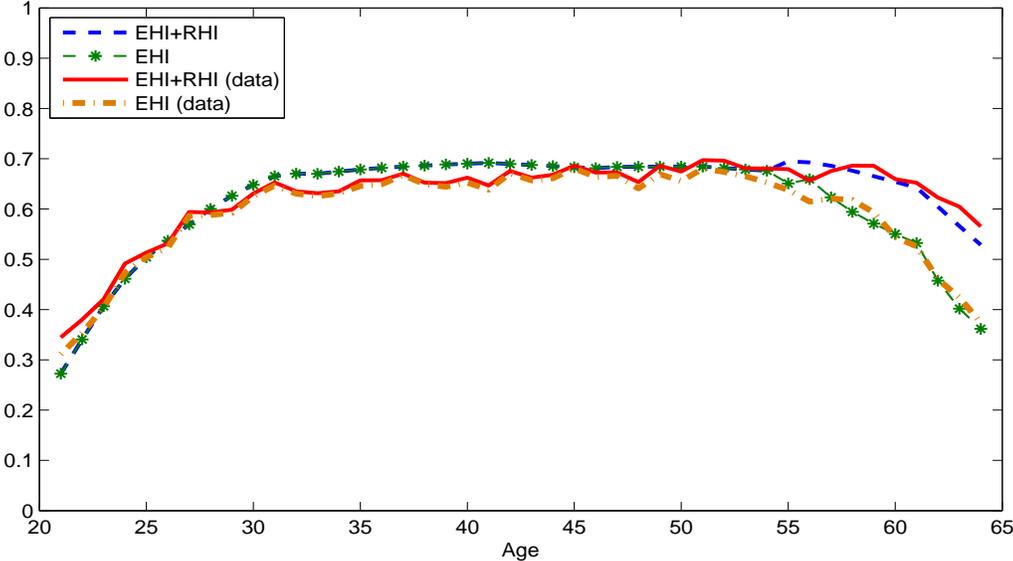Figure 2: EHI and RHI coverage rates (Benchmark)

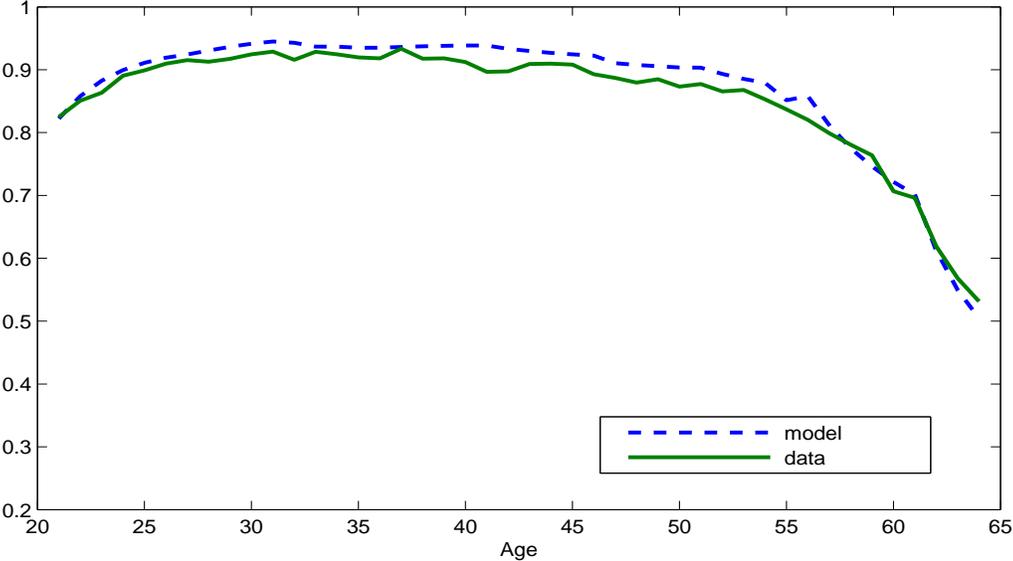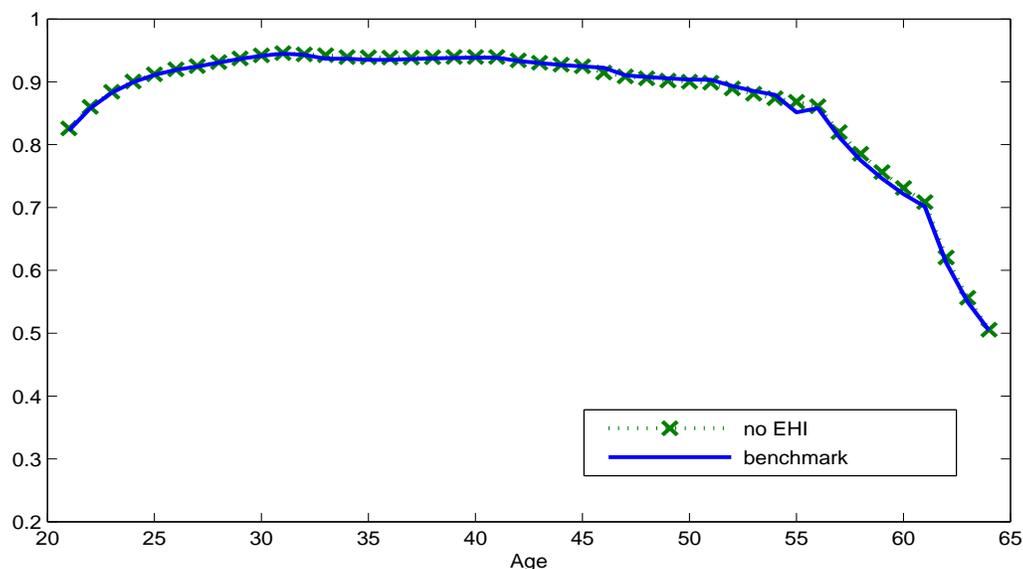Figure 3: Employment Rate by Age (Benchmark)

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Figure 4: Counterfactual: Employment Rate by Age with no EHI

4.1 Benchmark economy

Table 5 presents some summary statistics from our benchmark economy, including health insurance coverage rates, aggregate labor supply, capital-output ratio and the equilibrium interest rate.

Figure 1 shows health insurance coverage rates by age for the model economy and from MEPS data. In particular, we show EHI (employer provided health insurance) plus RHI (retirement health insurance) coverage rates as well as IHI (individual private health insurance). Recall that we calibrated the parameter ψ in order to match IHI coverage rates for those aged 55-64, and our success on this dimension can be seen in the figure. Our model, however, predicts that more people aged 21-50 should purchase IHI than observed in the data. The EHI+RHI coverage rates in the model are similar to those in the data for all ages, and this is due to our estimation of the joint transition matrices of earnings and EHI offers from MEPS data. Figure 2 shows EHI+RHI and EHI separately.

Next, Figure 3 shows that employment rates by age predicted by our model are very similar to those computed from MEPS data.

We also performed a counterfactual experiment where EHI and RHI are removed as options in the benchmark economy. The purpose is to determine whether the age profile of employment is affected by this change. As can be seen in Figure 4, employment rates are essentially identical in this counterfactual case as in the benchmark. Hence, there appears to be no sense in which people are "locked in" to employment

in order to maintain their EHI coverage.[4] This experiment is meant to illuminate why, once we add the Medicare Buy-in option, we find little or no effect on employment rates at any age.

The first block of lines in Table 6 reports the percentage of individuals aged 55-64 without health insurance and the equilibrium labor income tax rate for the benchmark economy. In addition, we report the same statistics for the benchmark economy without EHI or RHI. If employer provided group insurance options are removed, the percentage of uninsured increases from about 30 percent to 71 percent. Individuals still could choose to purchase IHI, which is not tax deductable in our economy, but most do not. The tax rate, on the other hand, is reduced from 35% to 34% due to the broadening of the tax base that would result from eliminating EHI and the tax free income that EHI represents.

4.2 Policy Reform – Medicare Buy-in

In this section we consider how insurance coverage is affected by introducing a Medicare Buy-in optional for individuals aged 55-64. As shown in the first line of Table 6, under the benchmark calibration, 30 percent of individuals aged 55-64 have no health insurance and the tax rate on labor income, τ_n, is 35 percent.

When a Medicare Buy-in program is introduced, with one price for all and fully funded by program participants, adverse selection eliminates the market for this form of insurance. That is, healthy individuals would rather purchase IHI or self-insure, and their refusal to participate drives up the equilibrium price for others. In the end, there doesn't exist a price at which this program would have participants and at the same time be fully funded. This result turns out to hold even if there a insurance mandate as long as IHI is available as an alternative to the Medicare Buy-in.

This finding led us to consider the implications of offering the Medicare buy-in at a discounted price funded by a government subsidy. In Table 6 we show results for various subsidy levels in the second block of rows in the table. As the subsidy percentage is increased, the fraction of those aged 55-64 without health insurance falls. No matter how large the subsidy, some individuals will still not purchase health insurance because they are effectively being insured through the means tested social insurance program. In fact, the reduction in uninsured is relatively small for any subsidy level above 30 percent. At this level, the total tax on labor income needed to fund all government spending ($\tau_n + \tau_{MB}$) is 35.18 percent. In addition, this tax rate can be decomposed into the tax rate needed to fund the Medicare buy-in subsidy ($\tau_{MB} = 0.16\%$) and the tax rate needed to fund the rest of the government budget, which is $\tau_n = 35.02\%$.

Next, we consider the implications of price discriminating by age, as is done with many Medicare supplemental insurance programs offered in the U.S. We find that the adverse selection problem continues

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[4]This is consistent with empirical findings in Dey and Flinn (2005) and Gilleskie and Lutz (2002), although the data studied in these papers include only relatively young workers and does not include our target demographic of individuals aged 55-64. On the other hand, French and Jones (2011) find that if the Medicare eligibility age was raised from 65 to 67, individuals would delay retirement on average by 27 days. Hence, their findings indicate that group health insurance availability does impact the labor participation decision to a small extent.

Table 6: Insurance coverage (age 55–64) and tax burden

Policy Reform	Percent without Insurance	MB coverage w/ no EHI offer	MB tax rate (τ_{MB})	Labor tax rate (τ_n)	$\tau_{MB} + \tau_n$
Benchmark	29.89%	–	–	35.00%	35.00%
Benchmark w/ no EHI/RHI	70.89%	–	–	34.01%	34.01%
MB (20% Subsidy)	26.29%	15.10%	0.03%	35.01%	35.04%
MB (29% Subsidy)	5.63%	85.83%	0.15%	35.01%	35.16%
MB (30% Subsidy)	4.50%	89.05%	0.16%	35.02%	35.18%
MB (50% Subsidy)	4.27%	89.70%	0.26%	35.03%	35.29%
MB PA (15% Subsidy)	17.96%	44.09%	0.04%	35.01%	35.05%
MB PA (17% Subsidy)	4.98%	87.68%	0.09%	35.01%	35.10%
MB PA (20% Subsidy)	4.83%	88.10%	0.10%	35.01%	35.11%
MB PA (30% Subsidy)	4.47%	89.13%	0.16%	35.02%	35.18%
MB PA (50% Subsidy)	4.20%	89.86%	0.26%	35.03%	35.29%
MB w/ no RHI (30% Subsidy)	4.54%	89.01%	0.20%	34.87%	35.07%
MB w/ no EHI/RHI for 55-64 (30% Subsidy)	4.50%	95.50%	0.45%	34.58%	35.03%

MB – Medicare Buy-in with one price for all participants.
MB PA – Medicare Buy-in with pricing by age.

Table 7: Characteristics of Individuals Age 55-64
(all numbers are percentages)

	Benchmark	MB (30% subsidy)	MB PA (17% subsidy)
Percent with no health insurance	29.89	4.50	4.98
Percent qualifying for social insurance	3.67	3.55	3.57
% of uninsured qualifying for social insurance	12.22	74.99	69.47
% of uninsured in poor health	19.89	22.57	20.54
Employment rate of uninsured	43.32	3.95	6.90
Earnings of uninsured/earnings of insured	32.47	1.03	3.04
Assets of uninsured/assets of insured	50.16	0.86	1.29

MB – Medicare Buy-in with one price for all participants.
MB PA – Medicare Buy-in with pricing by age.

to eliminate a market for this form of insurance if the program is not subsidized. However, while a 30 percent subsidy was required to achieve 95 percent health insurance coverage among those aged 55-64,the same can be achieved with a 17 percent subsidy when there price discrimination by age. This can be seen in the third block of rows in Table 6. The total tax on labor income needed to fund all government programs is 35.1 percent, which is only tiny increase above the benchmark tax rate and is slightly less than the tax rate for the 30 percent subsidy case when price doesn't differ by age.

It seems reasonable to anticipate that if a subsidized Medicare buy-in were available, employer provided health insurance might disappear as an option for those who qualify for the buy-in program. This possibility motivated us to consider two additional experiments assuming a subsidized (30%) Medicare buy-in program with one price for all; one in which RHI (employer subsidized retiree insurance) is eliminated as an option and a second where both EHI and RHI are eliminated as options for individuals aged 55-64. As can be seen in the last block of rows in Table 6, the percentage of individuals of age 55-64 without insurance is not much affected by eliminating these employer sponsored insurance programs if the buy-in option is available.[5] Since more people would now take the buy-in option, the MB tax rate would be higher than in the MB (30% subsidy) case. However, given that a hundred percent of labor income would now be taxable since the tax deductability of EHI is no longer relevant, the total tax on labor income actually goes down relative to the MB (30% subsidy) case. Even in the case where only RHI is eliminated, in which case the impact on tax deductability is less important, the total tax rate falls. This is because, as reported in Table 8, individuals are more likely to continue working if they do not have the RHI option available. This has the implication that fewer people end up qualifying for social insurance.

In Table 7 we highlight some characteristics of those aged 55-64, particularly those without any health insurance. The main takeaway from this table is that, if a Medicare buy-in is available, the uninsured tend to be extremely poor relative to those with insurance and are very likely to qualify for social insurance. This is not the case in the benchmark economy. For example, the third row of this table shows that 75% of those without insurance when a subsidized Medicare buy-in is offered (the one price for all case) qualify for welfare. In the benchmark, only 12.22% of the uninsured qualify for social insurance.

Figures 5 and 6 show health insurance coverage rates by age for the subsidized Medicare buy-in cases compared with those for the benchmark economy. The introduction of the Medicare buy-in has essentially no effect on the coverage rates for individuals below age 55 and no effect on EHI coverage rates at any age. The Medicare buy-in completely eliminates demand for IHI among those aged 55-64. In addition, we find that availability of a subsidized Medicare buy-in has very little effect on employment rates at any age. That is, the employment rate by age looks the same as shown in Figure 3.

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[5]On the other hand, as shown in the second line of Table 6, if these options were eliminated and IHI was the only insurance available, the percentage of uninsured would be much larger.

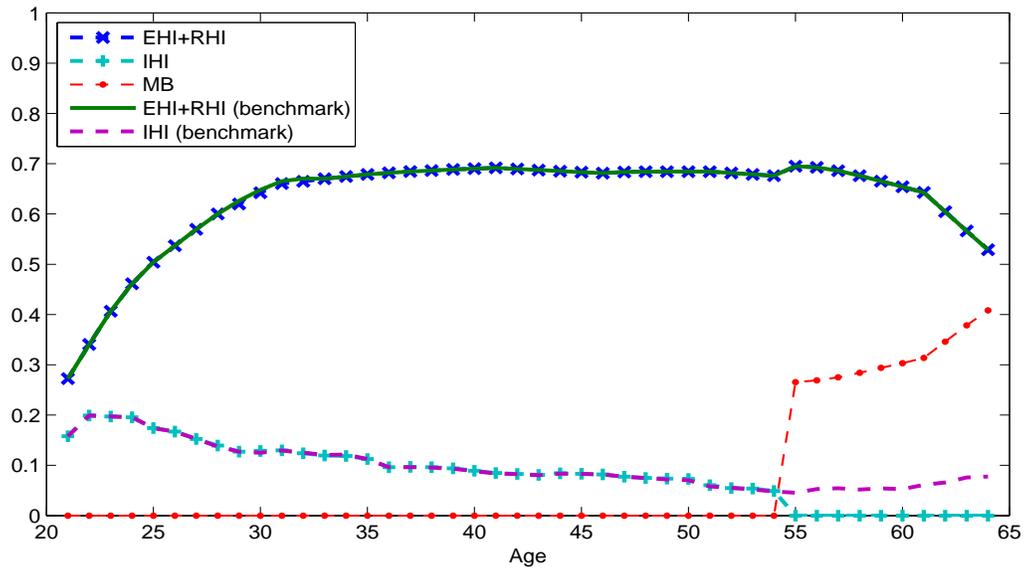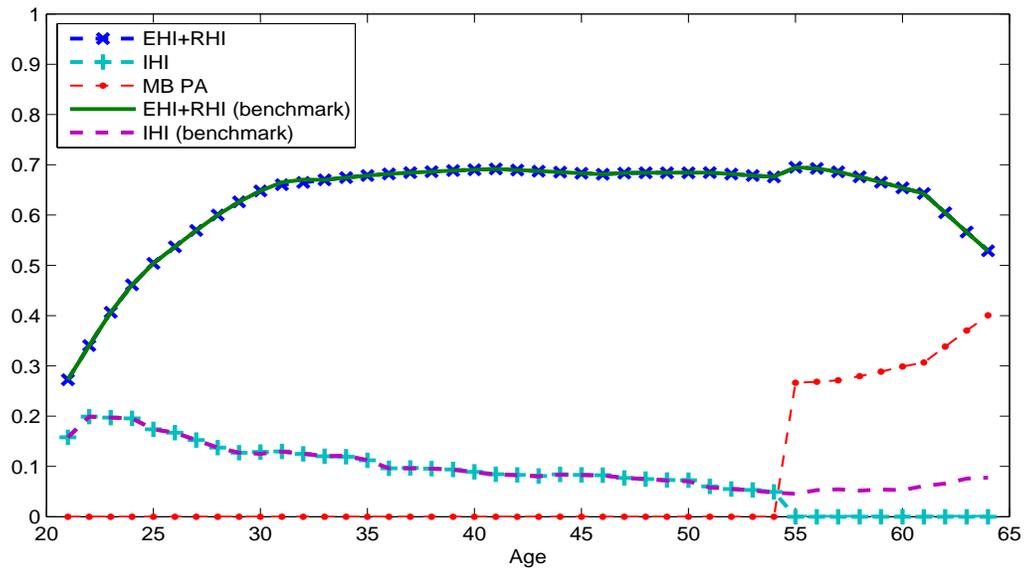Figure 5: Health insurance coverage rates (MB 30% Subsidy vs. Benchmark)

Figure 6: Health insurance coverage rates (MB PA 17% Subsidy vs. Benchmark)

4.3 Insurance Mandate

We now proceed to compare the properties of an economy with a Medicare Buy-in with those of an economy with a mandate that forces everyone to purchase some form of health insurance. There are many types of mandates that have been proposed or are relevant in our context so we consider several.[6] First, we consider a requirement that everyone purchase some form of health insurance, which could either be EHI/RHI or IHI. Next, in order to make a more direct comparison with the Medicare Buy-in program, we impose the mandate only on those age 55-64. Those below age 55 are free to choose not to purchase insurance. In these cases, an un-subsidized Medicare Buy-in can not exist in equilibrium due to adverse selection.

Next, we consider mandates with some form of community rating. For example, countries such as Netherlands or Switzerland require that IHI insurers charge all policy holders the same premium without regard to individual characteristics such as health status or age. Hence, we consider this type of mandate as well as one where price discrimination by age is allowed. The Affordable Care Act includes a mandate that is between these two–it allows partial, but not full, rating by age. In both these cases, we assume that the mandate applies to the entire working-age population.

Introducing a mandate requires us to modify our model slightly. In particular, we need to modify the income/wealth test for qualifying for the minimum consumption guarantee since in our formulation (see equations 6 through 8) optional insurance purchases are not subtracted from wealth when checking if an individual qualifies for social insurance.[7] But, once such purchases are required, it is possible that someone would suffer negative consumption if we do not change the nature of the qualification test. In particular, we replace equations 6 through 8 with the following:

$$(1+\tau_c)c + a' = W + T \tag{37}$$

$$W \equiv (1-\tau_l)(wzn - q^e * \iota_{EHI}) + (1+(1-\tau_k)r)(a+b) - (1-\hat{\omega})x - q^i(j,h)\iota_{IHI} - q^g\iota_{RHI} \tag{38}$$

$$T = \max\{0, (1+\tau_c)\underline{c} - W\} \tag{39}$$

In the first two mandates studied, equilibrium prices are determined just as in the benchmark economy. However, if some form of community rating is introduced, the pricing of IHI (see equation (20)) will be different. For the pure community rating case,

$$q^i = \int \psi \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega \, \iota_{IHI} \, x \, d\Phi, \tag{40}$$

where ι_{IHI} is an indicator that is equal to one if the individual holds an IHI plan and zero otherwise.

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[6]The mandates we study, however, are not consistent with all the institutional details specified by the Affordable Care Act. See Pashchenko and Porapakkarm (2012) for a quantitative analysis of a mandate that incorporates these details.

[7]Allowing optional insurance expenditures to be part of the test qualifying someone for a social insurance transfer introduces a distortion that induces people to purchase insurance that they otherwise would not in order to qualify for welfare. Medicaid programs, which we have not explicitly modeled, presumably eliminate this incentive in the U.S. economy.

If pricing by age is permitted, this equation becomes,

$$q^i(j) = \int \psi \sum_{(h',x)} \pi_j^x(x|h')\pi_j^h(h',h)\omega \; \iota_{IHI} \; \iota_j \; x \; d\Phi, \tag{41}$$

where ι_j is an age indicator equal to one if the individual is of age j and zero otherwise.

Table 8 compares the benchmark with all of the policy reforms that we have considered in terms of the rate of employment of working-age individuals, the percent of the population qualifying for social welfare, and the total tax on labor required to balance the budget. Mandates as we have modeled them are not free. Relative to the benchmark they add to the number of people who qualify for social insurance and these increased payments must be financed with higher taxes. While the subsidized Medicare Buy-in programs explicitly add to the government budget, the most expensive program considered here is a mandate covering everyone with a pure community rating. The reason is that this program would increase the percentage of the population qualifying for social welfare from 2.9 percent in the benchmark to 6.43 percent due to the burden placed on young people to pay the insurance costs of the old.

Figure 7 shows the percentage qualifying for social welfare by age for the benchmark and each type of universal mandate (no community rating, pure community rating, and community rating by age). Three of the four cases are very similar with one significant outlier–the mandate with a pure community rating.

The employment rate associated with each policy in Table 7 are all similar to the benchmark with, again, one outlier. In the mandate with a pure community rating, poorer individuals that now qualify for social insurance if they were to work have no incentive to do so. This can be seen in Figure 8. We do not see the same effect on employment rates if there is community rating by age (see Figure 9).

Requiring only those aged 55-64 to purchase insurance places relatively little burden on young individuals and, as can be seen from Table 8, has similar properties to the benchmark. In fact, the employment rate by age is almost identical to that seen in the benchmark, although the percentage of 55-64 aged individuals qualifying for social welfare increases from 2.26 percent to 2.53 percent (this is not shown in the table). This accounts for the slightly higher labor income tax rate in this experiment.

4.4 Steady State Welfare

The welfare benefit or cost of living in an economy with an alternative policy relative to living in the benchmark economy is measured by the consumption-equivalent variation (CEV). That is, we calculate the percentage change in consumption each period in the benchmark economy required to make an individual of age $i = 1$ as well off in terms of expected lifetime utility as someone of the same age in the alternative

Table 8: Policy Reforms
(all numbers are percentages)

Policy Reform	Employment Rate (21-64)	% qualifying for social insurance	$\tau_{MB} + \tau_n$
Benchmark	87.4	2.90	35.00
MB (30% subsidy)	87.3	2.93	35.18
MB PA (17% subsidy)	87.3	2.90	35.10
Mandate for all	86.7	3.17	35.07
Mandate CR	81.6	6.43	36.17
Mandate CR PA	86.8	3.13	35.06
Mandate for 55-64 only	87.3	2.96	35.02
MB w/ no RHI (30% subsidy)	87.8	2.84	35.07
MB w/ no EHI/RHI for 55-64 (30% subsidy)	87.7	2.81	35.03

Mandate CR – Mandate with requirement that providers employ community rating (one price for all).
Mandate CR PA – Mandate with requirement that providers employ adjusted community rating (pricing by age).

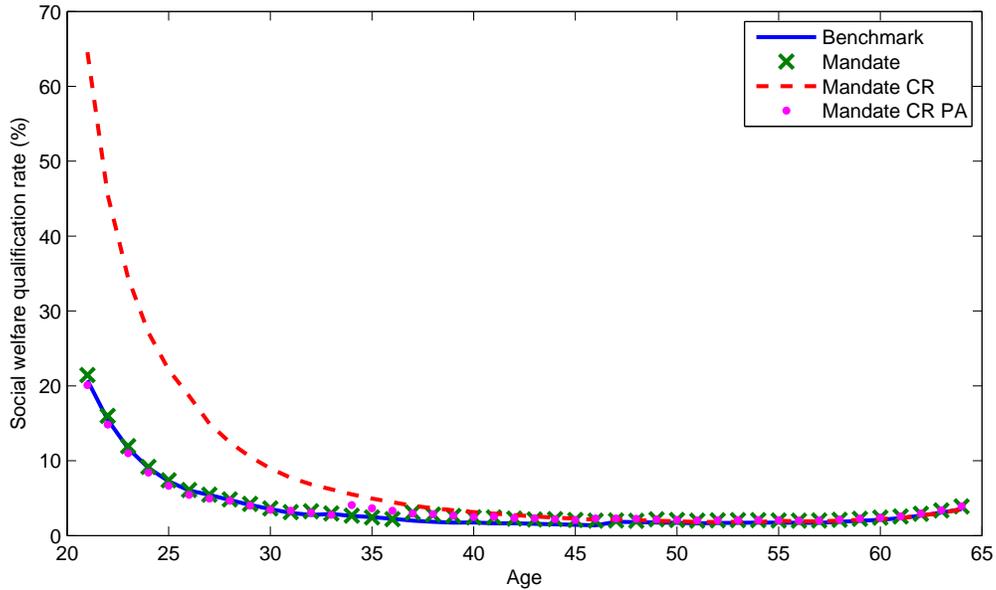Figure 7: Qualification rate for social welfare

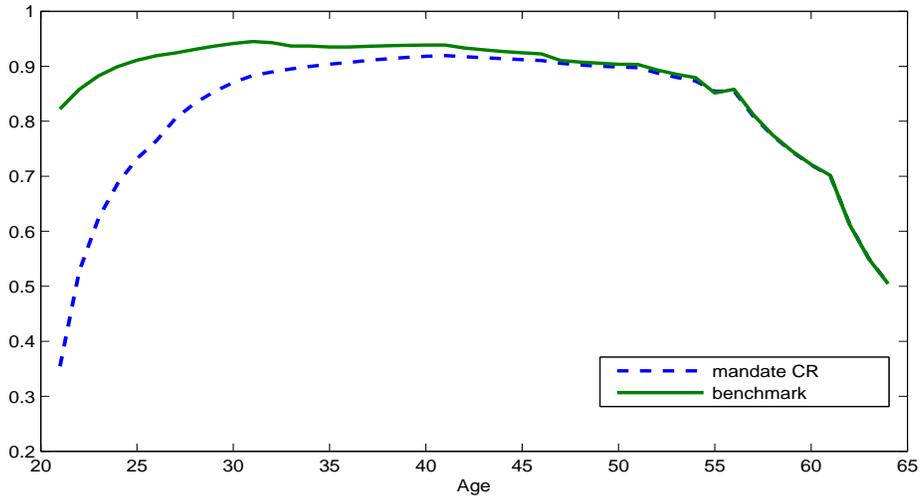Figure 8: Employment Rate (Mandate community rating vs. Benchmark)

Figure 9: Employment Rate (Mandate community rating by age vs. Benchmark)
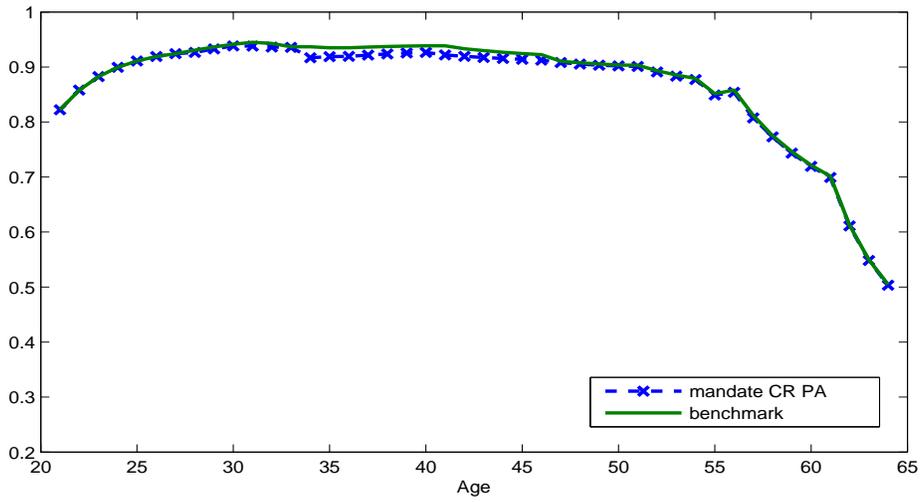
Table 9: Welfare comparison (CEV from Benchmark[*])

	Mandate without new option				Voluntary MB		
All	55-64 only	All with pure community rating	All with modified community rating by age		MB (30% subsidy)	MB PA (17% subsidy)	MB w/ no E/RHI for age 55-64 (30% subsidy)
-1.15%	-0.08%	-3.80%	-1.22%		-0.19%	-0.11%	0.53%[**]
		(-3.51% if $\psi = 1$)	(-0.78% if $\psi = 1$)				

[*] CEV based on expected welfare of individual at the beginning of life.

[**] If RHI is eliminated but EHI is still available for those 55-64, the CEV is still positive and equals 0.18%.

economy being considered.[8]

Table 9 compares welfare across the different cases studied. With a mandate to purchase insurance, new-born individuals are worse off than in the benchmark and the welfare cost is equal to a -1.15 % change in per period consumption relative to the benchmark. The subsidized Medicare buy-in policies also reduce welfare compared with the benchmark, but the costs are much smaller than for the insurance mandate. On the other hand, if the introduction of a subsidized Medicare buy-in is accompanied with the elimination of EHI and RHI for those aged 55-64, or if only RHI is eliminated, welfare is increased relative to the benchmark.

If the mandate comes with a requirement that providers use community rating, the welfare cost is significantly higher (-3.8%). If community rating by age is used, the welfare cost is comparable to, but still larger than, a mandate where standard risk rating is used to set IHI premiums.

As a robustness check, we also computed welfare costs for the community rating cases where the markup reflecting underwriting costs of IHI is set to zero ($\psi = 1$). This seems natural if ψ greater than one simply

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[8]We calculate the CEV for new-born agents who all have zero initial assets by assumption. This is defined by ζ in the following equation:

$$\int E \left[\sum_{i=1}^{J} \beta^{i-1} \left(\prod_{t=1}^{i-1} \rho_{t,h} \right) u \left(c_i^{alt}, n_i^{alt} \right) \right] d\Phi^{alt}(s|j=1)$$

$$= \int E \left[\sum_{i=1}^{J} \beta^{i-1} \left(\prod_{t=1}^{i-1} \rho_{t,h} \right) u((1+\zeta) c_i^{bench}, n_i^{bench}) \right] d\Phi^{bench}(s|j=1),$$

where c_j^{alt}, c_j^{bench}, n_j^{alt} and n_j^{bench} are the optimal consumption and labor allocations for an age j individual under the alternative and benchmark policies. In addition, $\Phi^{alt}(s|j=1)$ and $\Phi^{bench}(s|j=1)$ are the corresponding cross-sectional distribution of the population conditioned on being in the first period of life (recall that members of this cohort differ according to their draw of h, z, and e). Given the functional form of the utility function, the CEV, ζ, is given by

$$\zeta = \left(\frac{\int V^{alt}(s) d\Phi^{alt}(s|j=1)}{\int V^{bench}(s) d\Phi^{bench}(s|j=1)} \right)^{1/[\phi(1-\mu)]} - 1,$$

where V^{alt} and V^{bench} are the value functions for alternative and benchmark economies.
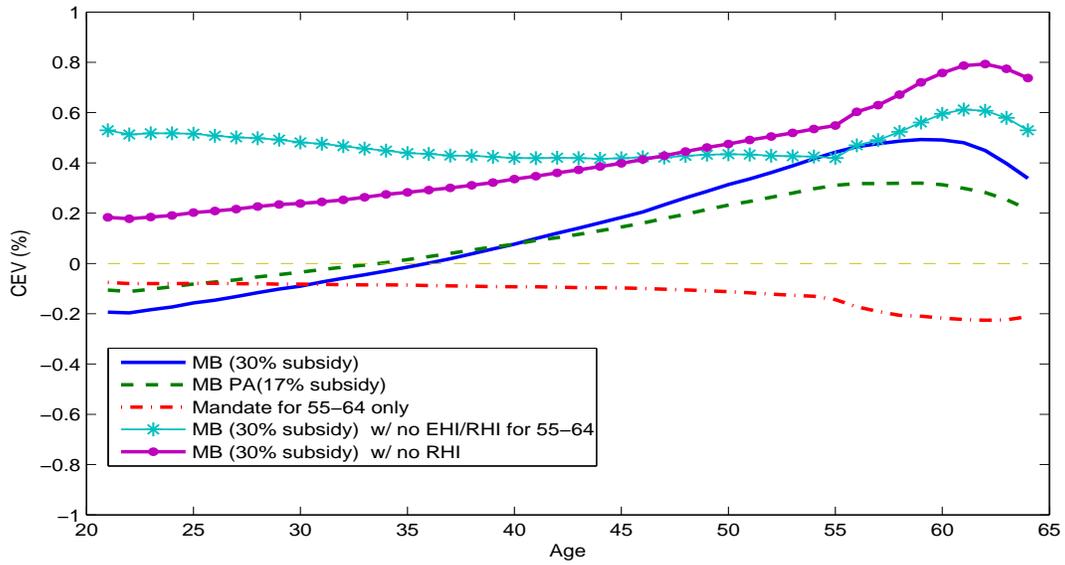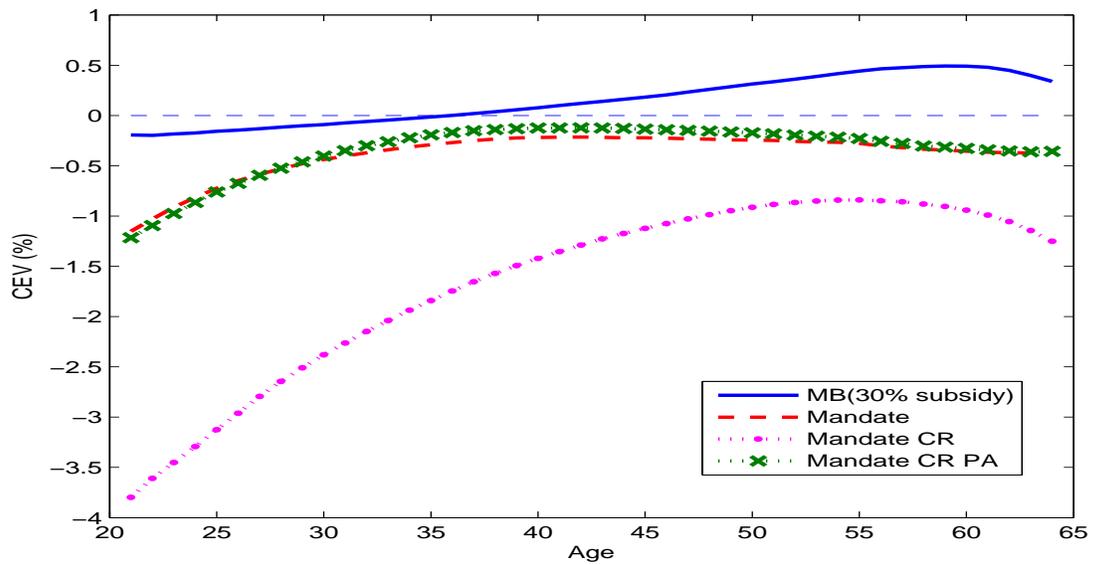
Figure 10: CEV by age (Medicare buy-in)

Legend:
- MB (30% subsidy)
- MB PA(17% subsidy)
- Mandate for 55–64 only
- MB (30% subsidy) w/ no EHI/RHI for 55–64
- MB (30% subsidy) w/ no RHI

Figure 11: CEV by age (Medicare buy-in v.s. Mandate)

Legend:
- MB(30% subsidy)
- Mandate
- Mandate CR
- Mandate CR PA

reflects additional costs associated with risk rating since these would be eliminated by a community rating requirement. As expected, this reduces the welfare costs relative to when the calibrated value of ψ is used. The cost associated with pure community rating are still quite large, but if the modified community rating is used, the costs are lower than for a mandate with standard risk rating.

If we restrict the mandate with risk rating to apply only to individuals aged 55-64, it turns out that, from the perspective of an individual at the beginning of life, this is preferable to a subsidized Medicare Buy-in program. This, however, turns out not to be the case if we calculate our welfare measure for someone of age 30 or higher (see Figure 10).

Figures 10 and 11 show the same welfare measure computed for individuals by age. That is, the welfare benefit to an individual of a particular age is the percentage increase in consumption each period from that age forward in the benchmark economy needed to make average expected lifetime utility equal to that in the alternative economy.[9] Figure 10 shows that all working age individuals 36 and above would prefer living in the subsidized Medicare buy-in economy rather than the benchmark economy when everyone pays the same price to participate in the program. The same is true for individuals 34 and above if the subsidized buy-in program is priced by age.

As we saw from Table 9, new born individuals would prefer a mandate that applied to only those aged 55-64 over the Medicare Buy-in program. From Figure 10 one can see that an individual of age 26 or higher would prefer the buy-in program with pricing by age and those aged 31 or higher would prefer either of the Medicare Buy-in programs to this type of mandate. On the other hand, all working age individuals prefer the benchmark relative to any form of mandate. Figure 10 shows this finding for a mandate applied to only those aged 55-64 and Figure 11 illustrates this for the universal mandates.

Finally, Figure 10 also shows the CEV by age for the subsidized Medicare buy-in program if EHI and RHI, or only RHI, are eliminated for those of age 55-64 when the buy-in program is available. In these cases, the CEV is positive at all ages, which implies that all individuals prefer living in these economies relative to the benchmark. The shape of the CEV plot when only RHI is eliminated looks similar to the MB (30% subsidy) case only shifted up due to the lower tax rate in that case. It is worth noting that younger individuals prefer the case when both EHI and RHI are eliminated as compared with the case when only RHI is eliminated due to the lower steady state tax rate that results from eliminating EHI. On the other hand, older individuals prefer the second case since they value having EHI as an option.

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[9]The CEV for age $j = m$ is computed as follows:

$$CEV = \left(\frac{\int V^{alt}(s)d\Phi^{alt}(s|j=m)}{\int V^{bench}(s)d\Phi^{bench}(s|j=m)} \right)^{1/[\phi(1-\mu)]} - 1.$$

5 Conclusion

In this paper we have studied the impact of introducing an optional Medicare buy-in program for individuals aged 55-64 to an overlapping generations economy calibrated to features of the U.S. economy. We find that unless this program is subsidized by the government, an equilibrium with an active market for the Medicare buy-in will not exist due to adverse selection. This result continues to hold even if there is a mandate requiring everyone to purchase some form of health insurance. Healthy individuals will prefer to purchase individual health insurance policies, or to self-insure, instead of being pooled with less healthy individuals.

If the Medicare buy-in is subsidized, we find that it is possible to bring the number of individuals aged 55-64 without insurance to below 5 percent without incurring large tax increases to finance the program. In particular, a 30 percent subsidy brings the fraction uninsured down from 30 percent in the benchmark to 4.5 percent. In addition, due to the general equilibrium effects of introducing this policy, labor taxes only need to be raised a small amount relative to our benchmark economy. If the the Medicare buy-in is priced differently depending on an individual's age, a 17 percent subsidy is sufficient to bring the fraction uninsured below 5 percent. In addition, those of age 36 or higher (34 if there is pricing by age) would prefer to live in a world with a subsidized Medicare buy-in program than in the benchmark economy without this program. All individuals prefer living in the steady state of the benchmark economy rather than in one with an insurance mandate. However, among all the cases we have considered, the highest steady state welfare is enjoyed in an economy in which employer provided health insurance is eliminated when the subsidized Medicare buy-in program is available.

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