Macroeconomic Effects of Medicare*

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Abstract

Medicare is one of the largest health insurance programs in the world, currently providing health insurance to about 50 million Americans and comprising 14.4 percent of federal outlays, or 2.9 percent of GDP. Despite its prevalent role, little is known about its implications for welfare and macroeconomic aggregates. This paper aims to improve our understanding of the role of Medicare in the macroeconomy. To do this, we first develop a general equilibrium overlapping generations model with incomplete markets and heterogeneous agents where households differ in age, education, health status, labor productivity, assets, and health insurance status. We use the model to quantify the effects of an unexpected transition to an economy without Medicare. The paper first shows that a simple comparison of steady states is insufficient to study the welfare effects of reforms since it abstracts from potentially large transitioning costs. In particular, we find significantly lower welfare gains to an unborn agent under the veil of ignorance from eliminating Medicare when the costs of transition is taken into account. We then turn attention to the effects on the current cohorts, and find that eliminating Medicare reduces overall welfare. Eliminating Medicare leads to a slight increase in welfare for all agents less than 40 years of age. However, this effect is negligible compared to the negative welfare effects on the currently older households. Next, we find that eliminating Medicare leads to an increase in the share of agents on Medicaid as retired households respond by substituting Medicare for Medicaid. Our results show that about 35 percent of the reduction in government spending from eliminating Medicare is offset by higher Medicaid expenses. Lastly, we find that eliminating Medicare leads to higher capital, which in turn generates higher wages, output, and consumption.

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1 Introduction

Medicare is one of the largest health insurance programs in the world, currently providing health insurance to about 50 million Americans and comprising 14.4 percent of federal outlays, or 2.9 percent of GDP (CBO, 2014). Despite its prevalent role, little is known about its implications for welfare and macroeconomic aggregates. This paper aims to improve our understanding of the role of Medicare in the macroeconomy. To do this, we first develop a general equilibrium overlapping generations model with incomplete markets and heterogeneous agents. In the model, households differ along the dimensions of age, education, health status, labor productivity, assets, and health insurance status. The agents are subject to idiosyncratic uncertainty to their labor productivity and health. Adverse health shocks require medical expenses. While shocks to labor productivity are uninsurable, medical expenses are insurable in the form of Medicare, Medicaid, private, and employer-provided health insurance. We then consider the effects of an unexpected transition to an economy without Medicare. This counterfactual policy reform enables us to capture the effects of Medicare on welfare and macroeconomic aggregates. Attention is not only given to comparative statics but to the full transition path between the economies, which has been shown to be crucial for policy evaluation (see e.g. Conesa and Krueger (1999, RED)).

Quantitative measures of welfare effects such as consumption equivalent measures are usually computed for unborn agents under the veil of ignorance. These measures are informative about what economy agents would prefer to live in. We use an analogous measure to quantify the effects of eliminating Medicare in our economy. Our attention is given to both the effect of the policy reform on unborn agents that are about to enter the economy and on its effect on current cohorts.

First, we show that a simple comparison of steady states is insufficient to study the welfare effects of reforms since it abstracts from potentially large transitioning costs. In particular, we find significantly lower welfare gains to an unborn agent under the veil of ignorance from eliminating Medicare when the costs of transition is taken into account. This follows because agents internalize the costs of accumulating assets to finance future medical expenses, which in the long run will have a positive effect on wages, but in the short run will require higher saving and lower consumption. We then turn attention to the effects on the current cohorts, and find that eliminating Medicare reduces welfare. To better understand what is driving this result, we compute the percentage change in welfare by age. Eliminating Medicare leads to a slight increase in welfare for all agents less than 40 years of age. However, this effect is negligible compared to the negative welfare effects on the currently older households. As an example, while lifetime income of a 20 year old has to increase by about 0.30 percent to make her indifferent between the initial steady state with Medicare and the transition, lifetime income has to decrease by more than 7.50 percent to make a 66 year old as well off without Medicare.

We find that eliminating Medicare leads to an increase in the share of households with Medicaid as their primary health insurance provider from 6.1 to 13.7 percent. Most of the increase in the Medicaid take-up rate is driven by retirees, who respond to the policy reform by substituting Medicare for Medicaid. Our results show that about 35 percent of the reduction in government spending from eliminating Medicare is offset by higher Medicaid expenses. Assuming a balanced budget, this cut in government spending translates into a reduction of payroll taxes of about 1.2 percentage points.

In terms of other macroeconomic aggregates, we find that eliminating Medicare strengthens the role of precautionary saving as agents accumulate assets to finance future medical expenses. The 2.1 percent higher capital stock per capita leads to a reduction in interest rates of 0.2 percentage points, and an increase in output per capita, wages, and average hourly labor supply of 0.8, 0.7, and 0.1 percent, respectively. Lastly, the combination of lower tax rates and higher wages raises labor income and leads to a 0.5 percent increase in consumption per capita.

2 Relation to the literature

To be included. Below is a partial list of related papers that we might want to cite.

Standard life-cycle models predict dissaving behavior by the elderly. This is inconsistent with empirical research, which shows that retired households continue to accumulate wealth as they grow older. Palumbo (1999, RES) argue that this behavior might be driven by uncertain future medical expenses. Using data from the National Medical Care Expenditure Survey, he finds that about 10 percent of elderly households spend

at least one-fifth of their incomes on out-of-pocket medical expenditures. He then develops a life-cycle model augmented with out-of-pocket medical shocks to test this theory. Using a version of the model calibrated to match consumption profiles in the PSID, he concludes that uncertain future medical expenses is an important driver of precautionary saving among the elderly. A similar conclusion is drawn by De Nardi, French, and Jones (2010, JPE). Their estimates also predict that out-of-pocket medical expenses increases rapidly with age, with average expenditures rising from $1,100 to $9,200 between the ages of 75 and 95.

Finkelstein (2007, QJE) estimates the impact of Medicare on hospital spending in a general equilibrium framework. She finds that the introduction of Medicare may have played a much larger role in the growth in the health care sector over the last half century than research using partial equilibrium models suggest. Her estimates suggest that half of the rise in health spending between 1950 and 1990 can be attributed to the spread of health insurance. Related to this is the paper by Attanasio, Kitao and Violante (2010, NBER), who study the implications of an aging population for the financing of Medicare and Social Security. To do this, they develop a heterogeneous agent general equilibrium overlapping generations model where households are subject to medical expenditure shocks. They find that labor taxes must increase from 23 to 36 percent to balance the budget in the long run, and that the majority of this increase is due to Medicare.

Dey and Flinn (2005, ECMA) examine whether presence of employer-provided health insurance has adverse implications for job mobility and welfare. They test this so-called "job-lock" phenomenon, whereby workers choose to remain in inefficient matches to keep their health insurance, using a search model where employee compensation vary along wages and health insurance coverage. They find that what may appear to be job lock in the data is consistent with an equilibrium model where all turnovers are efficient. Partly related to that research is the paper by Jeske and Kitao (2009, JME), who quantify the welfare effects of eliminating tax deductions for employer-provided health insurance premia. These subsidies discourage healthy agents to opt out of group insurance in favor of private insurance, and hence help alleviate adverse selection problems associated with group insurances. They find that a removal of tax deductions has adverse implications for welfare since it reduces risk sharing, lowers insurance coverage, and raises premia.

Cole, Kim, and Krueger (2014, WP) study the effects of the Health Insurance Portability and Accountability Act (HIPAA) of 1996 and the Patient Protection and Affordable Care Act (PPACA) of 2010 on the distributions of health status, earnings, and health insurance costs. To do this, they develop a dynamic model of health insurance with heterogeneous households where health affects productivity and the probability of future health-related productivity shocks. The agent's health is affected by how much effort she exerts to maintain it. This generates a moral hazard problem as health-related social insurance policies reduce households' incentives to maintain their health. Based on a quantitative exercise, they find that the incentive effects of HIPAA and PPACA will result in a deteriorated population health distribution in the long run.

Having low income is a requirement for Medicaid eligibility. However, this does not exclude unemployed agents with high potential income from enrolling. Pashchenko and Porapakkarm (2013, WP) examine whether this unobservability of earnings ability distorts work incentives. They test this in a general equilibrium model where agents are heterogeneous in health, productivity, and medical expenditure shocks. Using a version of their model calibrated to match key life-cycle profiles in the Medical Expenditure Panel Survey, they conclude that the Medicaid eligibility rule distorts labor decisions. Their results show that about one-fifth of current Medicaid enrollees would lose eligibility if they worked due to too high earnings ability, and that most of these agents would choose to work if they were able to keep their access to public health insurance.

Jung and Tran (2014, WP) examine the macroeconomic implications of the Affordable Care Act (ACA), with an emphasis on its effects on insurance take-up rates, macroeconomic aggregates, medical spending, and welfare. They measure these effects using a heterogeneous agent life-cycle model where households are subject to idiosyncratic shocks to labor productivity and health. The model incorporates key institutional details regarding the U.S. health insurance system such as Medicare, Medicaid, private, and employer-provided health insurance. They find that the ACA reform will increase the insurance take-up rate to about 99.6 percent, reduce labor supply and capital accumulation, and trigger a reduction in the level of health expenditures.

3 Data

To be included.

4 Model

The following sections present the benchmark model used in the analysis. The model is a discrete time, general equilibrium overlapping generations model with ex-ante heterogeneous households, where households differ in age, educational level, health status, labor productivity, assets, and health insurance status.

4.1 Environment

This section describes the environment of our economy.

4.1.1 Households

The economy is populated by a continuum of ex-ante heterogeneous households. Agents are indexed by type $s = (j, e, h, \eta_e, a, i)$, where j denotes age, e is educational level, h denotes health status, η_e is labor productivity conditional on education, a denotes assets, and i is the household's health insurance status. Throughout we let $\Phi_t(s)$ denote the measure of agents of type s at time t.

The agent's educational level can take on one of two values: college or non-college. For simplicity, we assume that the agent's educational level is permanent over her life time. Health status is stochastic and depends on the agent's current age, education, and health. It follows a finite-state Markov process with stationary transitions over time:

$$Q_{j,e}(h, H) = Prob(h' \in H : (h, j, e))$$

Labor productivity is governed by both a stochastic and a deterministic process. The stochastic process depends on the agent's education and is given by a stationary finite-state Markov process:

$$Q_e(\eta, E) = Prob(\eta' \in E : (\eta, e))$$

The deterministic process, ϵ_{jeh}, depends on the agent's current age, health, and education. Finally, the household's health insurance status can take on one of three values: the agent is either self-insured, has private health insurance or has health insurance provided by her employer. Health insurance is used to cover medical expenses, $m_{j,h}$, which depend on the agent's current age and health status.

Households are endowed with one unit of time in every period that can be allocated to work and leisure. Labor supply, ℓ, is indivisible and can take on one of four values: $\ell \in \{0, \ell_p, l_f, l_e\}$, where p, f, and e refer to part time, full time and extra time, respectively. In addition to leisure, households also derive utility from consumption, c. The period-by-period return function is given by:

$$u(c, \ell) = \frac{\left[c^{\gamma}(1-\ell)^{1-\gamma}\right]^{1-\sigma}}{1-\sigma}$$

Here, σ is the intertemporal elasticity of substitution and γ is the share of consumption in intratemporal utility.

All agents retire exogenously at age jr, after which they receive social security benefits $SS_{e,t}$ that depend on their education. Finally, households face a positive probability of death ψ_{jeh} in every period that depends on their age, education, and health. All agents that survive until age J die with probability one. In the event of death, the agent's assets are uniformly distributed across the population by means of lump-sum transfers, B.

4.1.2 Firms

Firms hire labor at wage w_t and rent capital at rate r_t from the households to maximize profits. We assume that the aggregate technology can be represented by a constant returns to scale Cobb-Douglas production function:

$$Y_t = \theta K_t^{\alpha} N_t^{1-\alpha}$$

where K_t is the aggregate capital stock, N_t denotes aggregate labor (measured in efficiency units), α is capital's share of income, and θ denotes total factor productivity. Output is used for consumption, C_t, investment, $I_t = K_{t+1} - (1-\delta)K_t$, and to cover medical expenses, M_t:

$$C_t + M_t + K_{t+1} = \theta K_t^{\alpha} N_t^{1-\alpha} + (1-\delta)K_t$$

where δ is the rate of depreciation.

4.1.3 Health insurance and government welfare programs

This section presents the different types of health insurance that are present in the economy. As noted earlier, the household is either self-insured, has private health insurance or has health insurance provided by her employer. Health insurance is also provided by the government in the form of Medicaid, Medicare and a combined food stamps and medical relief program (for brevity, referred to as food stamps below). The agent's insurance status determines what fraction of her medical expenses must be paid out of pocket, m_{op}. Throughout, let χ_P, χ_E, and $\chi_{CARE,t}$ denote the copayment parameter for private health insurance, employer-provided health insurance, and Medicare, respectively. $\chi_{CARE,t}$ is time-dependent since the copayment parameter on Medicare changes as the economy transitions from a benchmark framework with Medicare to a setting without Medicare.

Private health insurance Agents can purchase health insurance for next period from private insurance companies. Following the laws that were present in the United States prior to the introduction of the ACA, we let private insurance companies price-discriminate based on age, education, and health. We assume the price is actuarially fair for each insurance pool (j, e, h), i.e., the firm breaks even on each insurance pool. This gives the following expression for the insurance premium:

$$\pi_{jeh} = \frac{\psi_{jeh}\chi_P(1 - \mathbb{I}_{j\geq jr}(\chi_{CARE,t}))\int m_{j',h'}Q_{j,e}\left(h, dh'\right)}{(1+r_{t+1})}$$

where the indicator function $\mathbb{I}_{j\geq jr}$ in the numerator equals one for all retired households.

Employer-provided health insurance We assume that a fraction of workers have health insurance provided by their employer. The employer pools the medical expenses of all their employees that do not choose to go on food stamps. These costs are then split evenly between all employees that currently work positive hours. That is, we model employer-provided health insurance as a pay-as-you-go system where current contributors pay for the health expenditures of current receivers. The premium is thus given by:

$$\bar{\pi}_E = \frac{\chi_E \int \mathbb{I}_{F=0} m_{j,h}\Phi_t\left(\{1,\ldots,j_r-1\}\times de\times dh\times d\eta_e\times da\times\left\{i^E\right\}\right)}{\int \mathbb{I}_{\ell>0}\Phi_t\left(\{1,\ldots,j_r-1\}\times de\times dh\times d\eta_e\times da\times\{i^E\}\right)}$$

where the indicator function $\mathbb{I}_{F=0}$ in the numerator takes on the value one for all agents that do not choose to go on food stamps. In order to remain eligible for employer-provided health insurance, healthy agents have to supply a minimum of $l_P > 0$ hours. Sick households, on the other hand, are free to choose zero hours. We further assume that agents cannot have both employer-provided and private health insurance. Note, however, that because retired agents are not eligible for employer-provided health insurance, we let agents on employer-provided insurance buy private insurance in their last period before retirement.

Medicaid In addition to the insurance policies specified above, agents also have access to government provided health insurance. Medicaid is a means-tested programs that provides health insurance to low income households. There are two ways to qualify for Medicaid. First, an agent is eligible for Medicaid if the sum of her gross labor income and interest earnings is below a threshold y^{cat} and her assets are less than a^{cat}. Second, agents also qualify for Medicaid if the sum of their gross labor income and interest earnings minus out-of-pocket medical expenses is below a threshold y^{mn} and their assets are less than a^{mn}. Following Pashchenko and Porapakkarm (2013), we call the two eligibility criteria "categorical eligibility" and "eligibility based on medical need," respectively. In the model, Medicaid covers all out-of-pocket medical expenses for eligible households that do not choose to go on food stamps.

Medicare The government also provides health insurance in the form of Medicare. Unlike Medicaid, Medicare is not a means-tested program, but provides equal health insurance to all retired households. As Medicare does not cover all out-of-pocket medical expenses, retired households are free to purchase private insurance in order to lower their medical expenditure copayment.

Food stamps and medical relief program Finally, the government provides health insurance in the form of a combined food stamps and medical relief program. The program combines institutional features of food stamps, disability insurance, and medical relief programs for the poor. In order to qualify for this program in the model, agents have to forfeit all their assets and work zero hours. In return, the government covers all out-of-pocket medical expenses and provides a consumption floor of $\underline{c}$ by means of lump-sum transfers.

4.1.4 Government

The government finances its consumption and costs of providing health insurance, food stamps, and social security by means of payroll taxes. Let b_e denote the social security replacement rate conditional on the agent's educational level. Social security benefits $SS_{e,t}$ then satisfy:

$$SS_{e,t} = \frac{b_e w_t N_t}{\int \Phi_t \left(\{1, \ldots, j_r - 1\} \times de \times dh \times d\eta_e \times da \times di\right)}$$

For simplicity, we assume that the government balances its budget period-by-period. Let gov_t denote total government expenditure at time t on consumption, health insurance, and food stamps. Taxes on labor income, τ_t, then have to satisfy:

$$\tau_t w_t N_t = SS_{e,t} \int \Phi_t \left(\{j_r, \ldots, J\} \times de \times dh \times d\eta_e \times da \times di\right) + gov_t$$

We refer the reader to the appendix for details about gov_t.

4.2 Household problem

Before we present the household problem, let us describe the timing of events. At the beginning of the period, agents observe the realization of their idiosyncratic labor productivity shock, η_e, and their health status, h, the latter of which also determines the value of the medical expenditure shock, $m_{j,h}$. They also receive transfers from accidental bequests, B. Then, households supply labor and capital to the firm, after which production takes place, households receive factor income, workers pay taxes, and retired agents receive social security payments. Next, households receive health transfers from the government if they are on Medicare or Medicaid, from their employer if they have employer-provided insurance, or from private insurance companies if they purchased insurance in the preceding period. Then, agents pay out-of-pocket medical expenses and make their intertemporal decisions, i.e., they make their consumption-savings choice and decide whether or not to purchase private health insurance for the following period. The present discounted value of these choices are compared to the value of going on food stamps. If the value is higher under food stamps, the government seizes the agent's assets, covers all of her out-of-pocket medical expenses, and provides her with a consumption level $\underline{c}$. Finally, the uncertainty about early death is revealed.

The agent's choice set depends on her current age and insurance status. We start by presenting the problem of a working-age agent with employer-provided health insurance. This subsection also defines the value of going on food stamps. Next, we set up the problem faced by working-age households without employer-provided health insurance. Finally, we discuss the problem of retired agents.

4.2.1 Working-age households with employer-provided health insurance and the value of food stamps

Recall that an agent's type is given by $s = (j, e, h, \eta_e, a, i)$, where j denotes age, e is educational level, h denotes health status, η_e is labor productivity conditional on education, a denotes assets, and i is the household's health insurance status. Let $V^E(s)$ denote the value of being on employer-provided health

insurance. Similarly, let $V^F(s)$ denote the value of food stamps. Then the problem of a working-age household with employer-provided insurance is given by:

$$V(s) = \max \left\{ V^E(s), V^F(s) \right\}$$

where $V^E(s)$ is given by:

$$\begin{aligned} V^E(s) \quad &= \quad \max_{c,a',\ell} \; u(c,\ell) + \beta \psi_{jeh} \int \int V(s') Q_e(\eta, d\eta') \, Q_{j,e}(h, dh') \\ s.t. \quad & c + a' + m_{op} + \mathbb{I}_{\ell>0}(\bar{\pi}_E) = w_t (1-\tau_t) \epsilon_{je} \eta \ell + (1+r_t)(a + B_t) + \mathbb{I}_{Med}(s,\ell) m_{op} \\ & \ell \in \begin{cases} 0, \ell_p, \ell_f, \ell_e & \text{if sick} \\ \ell_p, \ell_f, \ell_e & \text{if healthy} \end{cases} \\ & c, a' \geq 0 \\ & i = i_E \\ & m_{op} = \chi_E m_{j,h} \end{aligned}$$

where the indicator function on the right-hand side of the budget constraint takes on the value one if the agent qualifies for Medicaid. Medicaid covers all out-of-pocket medical expenses, which are given by $\chi_E m_{j,h}$ for agents on employer-provided insurance. Finally, because retired agents are not eligible for employer-provided health insurance, we give households on employer-provided insurance the option to purchase private insurance in their last period before retirement.

In order to qualify for food stamps in the model, agents have to forfeit their assets and work zero hours. In return, the government covers all out-of-pocket medical expenses and provides the agent with consumption level $\underline{c}$. The value of food stamps is thus given by:

$$\begin{aligned} V^F(s) \quad &= \quad u(\underline{c}, 0) + \beta \psi_{jeh} \iint V_{t+1}(s') Q_\eta(\eta, d\eta') \, Q_{j,e}(h, dh') \\ & \quad s.t. \quad a' = 0 \\ & \qquad\quad i' = i_E \end{aligned}$$

Note that agents that choose to go on food stamps continue to be eligible for employer-provided health insurance in the following period.

4.2.2 Working-age households without employer-provided health insurance

Let $V^I(s)$ denote the value of agents without employer-provided health insurance. Households without employer-provided insurance choose whether or not to purchase private insurance for the following period. The present discounted value of these choices are then compared to the value of going on food stamps. This yields the following problem:

$$V(s) = \max \left\{ V^I(s), V^F(s) \right\}$$

where $V^I(s)$ is given by:

$$\begin{aligned} V^I(s) &= \max_{c,a',\ell,i'} \; u(c,\ell) + \beta\psi_{ehj} \iint V(s') Q_e(\eta, d\eta') Q_{j,e}(h, dh') \\ s.t. \quad & c + a' + m_{op} + \mathbb{I}_P(i')\pi_{jeh} = w_t(1-\tau_t)\epsilon_{je}\eta\ell + (1+r_t)(a+B_t) + \mathbb{I}_{Med}(s,\ell)m_{op} \\ & m_{op} = \mathbb{I}_P(i)\chi_P m_{j,h} + (1 - \mathbb{I}_P(i))m_{j,h} \\ & \mathbb{I}_{\mathbb{P}}(i) = \begin{cases} 1 & \text{if } i = i_P \\ 0 & \text{otherwise} \end{cases} \\ & \ell \in \{0, \ell_p, \ell_f, \ell_e\} \\ & c, a' \geq 0 \\ & i' \in \{i_P, i_S\} \end{aligned}$$

Here, $i = i_P$ means the household has private health insurance and $i = i_S$ means the household is self-insured. Out-of-pocket medical expenses are given by $m_{j,h}$ for self-insured households and $\chi_P m_{j,h}$ for agents that bought private insurance in the preceding period. Finally, the value of going on food stamps is the same as above with the exception that households are self-insured in the following period, i.e., $i' = i_S$.

4.2.3 Retired households

Let $V^R(s)$ denote the value of a retired household of type s. Similarly to working-age households without employer-provided insurance, retired agents choose whether or not to purchase private insurance for the following period, is compared to the aforementioned value of going on food stamps:

$$V(s) = \max \; \left\{ V^R(s), V^F(s) \right\}$$

where $V^R(s)$ is given by:

$$\begin{aligned} V^R(s) &= \max_{c,a',i'} \; \left\{ u(c,0) + \beta\psi_{jeh} \iint V(s') Q_e(\eta, d\eta') Q_{j,e}(h, dh') \right\} \\ s.t. \quad & c + a' + m_{op} + \mathbb{I}_P(i')\pi_{jeh} = (1+r_t)(a+B_t) + SS_{e,t} + \mathbb{I}_{Med}(s)m_{op} \\ & m_{op} = \mathbb{I}_P(i)\chi_P\chi_{CARE,t} m_{j,h} + (1 - \mathbb{I}_P(i))\chi_{CARE,t} m_{j,h} \\ & \mathbb{I}_P(i) = \begin{cases} 1 & \text{if } i = i_P \\ 0 & \text{otherwise} \end{cases} \\ & i' \in \{i_S, i_P\} \\ & c, a' \geq 0 \end{aligned}$$

All retired agents that choose not to go on food stamps receive social security benefits and Medicare from the government. Out-of-pocket medical expenses are given by $\chi_{CARE,t} m_{j,h}$ for self-insured households and $\chi_{CARE,t}\chi_P m_{j,h}$ for agents that bought private insurance in the preceding period.

4.3 Welfare

We quantify the welfare effects of the policy experiments studied in section (5 ??) by computing the changes in an agent's perfect income index. This index measures how much an individual's lifetime income has to

increase to make her indifferent between the old steady state and the economy under the new policy. The perfect income index for an individual of type s is given by:

$$PII(s) = \left[\sum_{t=1}^{J} E_t \beta^{t-1} (c_t^{\gamma}(1-l_t)^{1-\gamma})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

Integrating across types:

$$PII = \int_s PII(s)\Phi(ds)$$

The difference in perfect income indices can then be used to quantify the welfare effects of various reforms.

4.4 Definition of a competitive equilibrium

We are now ready to define a competitive equilibrium in the model. Let $j \in \mathbb{J} = \{1, 2, \ldots, J\}$, $e \in \mathbb{E} = \left\{e^{no-college}, e^{college}\right\}$, $h \in H = \{h_1, \ldots, h_N\}$, $\eta \in E = \{\eta_1, \ldots, \eta_M\}$, $a \in \mathbb{R}_+$, $i \in I = \left\{i^S, i^P, i^E\right\}$. The state space is $\boldsymbol{S} = \mathbb{J} \times \mathbb{E} \times H \times E \times \mathbb{R}_+ \times I$.

Definition. Given a replacement rate b_e and initial conditions K_1 and Φ_1, a competitive equilibrium is a sequence of individual functions for the households $\{V_t, c_t, a_t, \ell_t, i_t : \boldsymbol{S} \to \mathbb{R}\}_{t=1}^{\infty}$, sequences of production plans for the firms $\{N_t, K_t\}_{t=1}^{\infty}$, factor prices $\{w_t, r_t\}_{t=1}^{\infty}$, private health insurance premia $\{\pi_{jeh,t} : \forall\, (j,e,h) \in \mathbb{J} \times \mathbb{E} \times H\}_{t=1}^{\infty}$, employer-provided health insurance premia $\{\bar{\pi}_{E,t}\}_{t=1}^{\infty}$, government policies $\{\tau_t, SS_{e,t}, T_t\}_{t=1}^{\infty}$, a sequence of accidental bequests $\{B_t\}_{t=1}^{\infty}$, and a sequence of measures $\{\Phi_t\}_{t=1}^{\infty}$, such that for all t, the following hold:

1. Given prices, insurance premia, government policies, and accidental transfers, $\{v_t, c_t, a_t, \ell_t, i_t : \boldsymbol{S} \to \mathbb{R}\}_{t=1}^{\infty}$ solve the household's problem.

2. Factor prices satisfy:

$$\begin{aligned} r_t &= \theta\alpha \left(\frac{N_t}{K_t}\right)^{1-\alpha} - \delta \\ w_t &= \theta\,(1-\alpha) \left(\frac{K_t}{N_t}\right)^{\alpha} \end{aligned}$$

3. Insurance premia satisfy:

$$\pi_{jeh} = \frac{\psi_{jeh}\chi_P(1 - \mathbb{I}_{j \geq jr}(\chi_{CARE})) \int m_{j',h'} Q_{j,e}\,(h, dh')}{(1 + r_{t+1})}$$

$$\bar{\pi}_E = \frac{\chi_E \int \mathbb{I}_{F=0} m_{j,h} \Phi_t\left(\{1, \ldots, j_r - 1\} \times de \times dh \times d\eta_e \times da \times \left\{i^E\right\}\right)}{\int \mathbb{I}_{\ell > 0} \Phi_t\left(\{1, \ldots, j_r - 1\} \times de \times dh \times d\eta_e \times da \times \{i^E\}\right)}$$

4. Government policies and transfers satisfy:

$$SS_{e,t} = \frac{b_e w_t N_t}{\int \Phi_t\left(\{1, \ldots, j_r - 1\} \times de \times dh \times d\eta_e \times da \times di\right)}$$

$$\tau_t w_t N_t = SS_{e,t} \int \Phi_t\left(\{j_r, \ldots, J\} \times de \times dh \times d\eta_e \times da \times di\right) + gov_t$$

5. Accidental bequests satisfy:

$$B_{t+1} = \frac{\int (1 - \psi_{jeh})\, a_t'\,(j, e, h, \eta_e, a, i)\, \Phi_t\,(dj \times de \times dh \times d\eta_e \times da \times di)}{\int \Phi_{t+1}\,(dj \times de \times dh \times d\eta_e \times da \times di)}$$

6. Markets clear:

$$\begin{aligned} K_{t+1} &= \int a_t'(j,e,h,\eta_e,a,i)\,\Phi_t(dj\times de\times dh\times d\eta_e\times da\times di) \\ &\quad + \int \pi_{jeh}\mathbb{I}_P\left(i'(j,e,h,\eta_e,a,i)\right)\Phi_t(dj\times de\times dh\times d\eta_e\times da\times di) \\ N_t &= \int \eta\epsilon_j\ell_t(j,e,h,\eta_e,a,i)\,\Phi_t(dj\times de\times dh\times d\eta_e\times da\times di) \end{aligned}$$

$$\begin{aligned} &\int c_t(j,e,h,\eta_e,a,i)\,\Phi_t(dj\times de\times dh\times d\eta_e\times da\times di) + K_{t+1} \\ &\quad + \int m_{j,h,t}(j,e,h,\eta_e,a,i)\,\Phi_t(dj\times de\times dh\times d\eta_e\times da\times di) \\ &\quad = \theta K_t^{\alpha}N_t^{1-\alpha} + (1-\delta)K_t \end{aligned}$$

7. Law of motion for Φ_t:

$$\Phi_{t+1} = f(\Phi_t)$$

We refer the reader to the appendix for further details about the equilibrium.

5 Calibration and results

Before we present the policy experiments and results, let us briefly discuss our calibration strategy. We start by presenting the parameters that are determined outside the model, a summary of which is given in Table (1 ??). Agents enter the model at the age of 20. We set set $jr = 47$ to match a retirement age of 66. The maximum life span is set to 86 years to match the average U.S. dependency ratio, i.e., the ratio of retired agents to the working-age population. We set $g_n = 0.011$ to match an average population growth rate of 1.1 percent per year (over what time span, and according to what source ??). Capital's share of income is set to 0.36 and the depreciation rate to 0.059. We set the consumption share in intratemporal utility, γ, to 0.574 to match the median estimate in French (2005). Finally, σ is set to 2.667 to match an intertemporal elasticity of substitution of 0.5.

Table 1: Non-insurance parameters determined outside the model

Parameter	Description	Source	Value
J	Maximum life span (86 years)		67
jr	Retirement age (66 years)		47
g_n	Population growth rate		0.011
α	Capital income share	BEA	0.360
δ	Depreciation rate	BEA	0.059
γ	Consumption share in utility	French (2005)	0.574
σ	IES = 0.5		2.667
ℓ_p, ℓ_f, ℓ_e	Indivisible labor		0.225,0.300,0.375
	Fraction of agents with college degree	MEPS	0.235

Households are endowed with one unit of time in every period that can be allocated to work and leisure. We set the grid for labor supply to $\ell \in \{0, 0.225, 0.300, 0.375\}$. We pick a grid size of two for educational attainment. Given data from the Medical Expenditure Panel Survey (MEPS), we set the fraction of agents with at least a 4-year college degree to 23.5 percent and let the remaining share be denoted as households without a college degree.

Let us next turn attention to the insurance parameters in the model. Given data from the MEPS, we set the copayment parameter on private insurance and employer-provider insurance to 0.204 and the

copayment parameter on Medicare to 0.5. Recall that there are two ways to qualify for Medicaid. Following Pashchenko and Porapakkarm (2013), we set the categorical income threshold, y^{cat}, to 0.173 to match an earnings threshold of about $\$8,400$, and the categorical asset threshold, a^{cat}, to 0.745 to match an asset threshold of about $\$36,000$. We let the medically needy income threshold, y^{mn}, be the same as y^{cat}, but set the medically needy asset threshold, a^{mn}, to 0.043 to match an asset threshold of about $\$2,100$. A summary of the insurance parameters that are determined outside the model is given in Table (2 ??).

Table 2: Isurance parameters determined outside the model

Parameter	Description	Source	Value
χ_P	Private insurance copayment parameter	MEPS	0.204
χ_E	Employer insurance copayment parameter	MEPS	0.204
χ_{CARE}	Medicare copayment parameter	MEPS	0.500
y^{cat}	Categorical income $\approx \$8,400$	Pashchenko and Porapakkarm (2013)	0.173
a^{cat}	Categorical assets $\approx \$36,000$	Pashchenko and Porapakkarm (2013)	0.745
y^{mn}	Medically needy income	Pashchenko and Porapakkarm (2013)	y^{cat}
a^{mn}	Medically needy assets $\approx \$2,100$	Pashchenko and Porapakkarm (2013)	0.043

The final set of parameters are determined jointly in equilibrium, a summary of which is given in Table (3 ??). We calibrate θ to 0.683 to match a steady state GDP per capita of 1 in the benchmark economy. The discount factor is set to 0.904 to generate a capital-to-output ratio of 3.0. b_c and b_{nc} are calibrated to match the average social security benefits of agents with and without a college degree. We set the consumption floor, $\underline{c}$, to 0.028 to match average annual food stamps of about $\$1,400$. In the model, a fraction of workers have health insurance provided by their employer. We assume the mass of 20-year olds with private insurance to be equal to zero. Given this assumption, we calibrate the initial distribution of health insurance to match the 65 percent share of working-age agents with employer-provided insurance observed in the MEPS. Finally, we scale the medical costs to match the 16 percent share of health expenditures-to-output ratio observed in the U.S..

Table 3: Parameters determined joinly in equilibrium

Parameter	Description	Target	Value
θ	Total factor productivity	GDP pc = 1.0	0.683
β	Discount factor	Capital/output = 3.0	0.904
b_c	SS college replacement rate	Average SS benefits college $\approx \$14,200$	0.386
b_{nc}	SS non-college replacement rate	Average SS benefits non-college $\approx \$11,900$	0.322
$\underline{c}$	Consumption floor	Average food stamps $\approx \$1,400$	0.028
	Eligible: employer insurance	Fraction with employer insurance = 0.65	0.771
$m_{j,h}^{scale}$	Scale for health care costs	Health expenditure/output = 0.16	1.415

We follow Castaneda, Diaz-Giminez, and Rios-Rull (2003) and calibrate the parameters of the labor earnings process to match the labor earnings distribution in the U.S. The productivity shock process and corresponding transition matrix is shown in Table (4 ??). A summary of the calibration is given in Table (5 ??). The right skewness of the productivity shock process is chosen to match the top decile of the labor earnings distribution. A comparison of the labor earnings distribution in the model and in the data is given in Table (6 ??), which shows that the model successfully matches the distribution at the top. A similar comparison of the wealth distribution is given in Table (7 ??). Although we do not calibrate the model to match this distribution, the table shows that the model generates a dispersion of wealth which is very similar to what we observe in the data.

Table 4: Labor earnings process

Productivity Shocks (η_e)	$\frac{1}{\sigma_\eta}$	1	σ_η	η_{top}
Transition Probabilities	ρ_η	$1-\rho_\eta-\pi_{top}$	0	π_{top}
	$\frac{1-\rho_\eta-\pi_{top}}{2}$	ρ_η	$\frac{1-\rho_\eta-\pi_{top}}{2}$	π_{top}
	0	$1-\rho_\eta-\pi_{top}$	ρ_η	π_{top}
	0	0	$1-\rho_{top}$	ρ_{top}

Table 5: Moments for the labor earnings process

Parameter	Description	Target	Value
σ_η	Variance	Gini coefficient = 0.63	5.361
η_{top}	Productivity at the top	Top 1 percentile = 0.148	28.581
π_{top}	Probability at the top	Top 10 percentile = 0.435	0.003
ρ_n	Persistence	Bottom 80 percentile 2 year persistence = 0.94	0.902
ρ_{top}	Persistence at the top	Top 1 percent 2 year persistence = 0.58	0.776

	Non-College				College			
Productivity Shocks (η_e)	0.1	0.3	1.0	10.0	0.2	0.5	2.0	20.0
Transition Probabilities	0.90	0.095	0	0.005	0.94	0.05	0	0.01
	0.00475	0.90	0.00475	0.005	0.025	0.94	0.025	0.01
	0.00	0.095	0.90	0.005	0.00	0.05	0.94	0.01
	0.00	0.00	0.5	0.5	0.00	0.00	0.4	0.6

5.1 Policy experiments

We use the model developed earlier to run several policy experiments. First, we eliminate Medicare. Second (...).

5.1.1 Eliminating Medicare

Our first policy experiment involves an unexpected elimination of Medicare. Starting from an initial steady state with Medicare, we lower the copayment parameter on Medicare, $\chi_{CARE,t}$, to zero and study the macroeconomic impact as the economy transitions to the new steady state without Medicare. By macroeconomic impact we mean the effects of the policy experiment on consumption, assets, output, insurance choice, and welfare. Attention is not only given to comparative statics but to the full transition path between the economies, which has been shown to be crucial for policy evaluation (see e.g. Conesa and Krueger (1999, RED)).

Table (8 ??) compares the steady state of the economy with and without Medicare. Reducing the copayment parameter on Medicare from 50 percent to 0 percent leads to an increase in capital per capita of 2.1 percent. Higher capital lowers the marginal product of capital, which leads to a reduction in interest rates of 0.2 percentage points. Capital increases as agents accumulate more assets compared to the economy with Medicare to finance the higher cost of medical expenses during retirement. This surge in capital raises marginal product of labor, which increases wages by 0.7 percent and average hourly labor supply by 0.1

Table 6: Labor Earnings Distribution

	Quintiles					Top			
	1st	2nd	3rd	4th	5th	90-95	95-99	99-100	Gini
Data	-0.40	3.19	12.49	23.33	61.39	12.38	16.37	14.76	0.63
Benchmark model	0.47	6.65	8.57	16.05	68.25	13.54	15.55	14.65	0.63

Table 7: Wealth Distribution

	Quintiles					Top			
	1st	2nd	3rd	4th	5th	90-95	95-99	99-100	Gini
Data	-0.39	1.74	5.72	13.43	79.49	12.62	23.95	29.55	0.78
Benchmark model	0.17	0.20	4.60	21.65	73.38	16.34	22.12	13.06	0.73

percent. The removal of Medicare lowers the government's expenditures and leads to a reduction in payroll taxes by 1.2 percentage points. Finally, the combination of lower tax rates and higher wages raises labor income and leads to a 0.5 percent increase in consumption per capita.

Table 8: Comparative statics: economy with and without Medicare

	Variable	Without Medicare (Percentage change from benchmark)
y	Output pc	0.8
k	Capital pc	2.1
h	Avg hours 20-65	0.1
c	Consumption pc	0.5
N	Effective labor pc	0.0
w	Wage rate	0.7
		(Percentage point change from benchmark)
τ	Tax rate	-1.2
r	Interest rate	-0.2

What happens to households' insurance choice as we eliminate Medicare? Table (9 ??) reports the insurance distribution for the two steady states. As households are allowed to combine some of the health insurance policies (e.g., a retired agent on Medicare can purchase private insurance), we define an agent's insurance type based on who pays for the largest share of her medical expenses. For instance, an agent is defined to be on employer-provided health insurance if most of her medical expenses are paid by her employer. The table also reports the share of total medical expenses covered by each insurance policy. In the benchmark economy, 15.3 percent of households have Medicare as their primary health insurance provider. Not surprisingly, eliminating Medicare leads to a surge in the number of agents with private insurance as their main provider, with the share increasing from 8.3 to 13.3 percent. We also observe a small increase in the share of households on employer-provided insurance and self-insurance, but no change in the share of households with food stamps as their primary health insurance provider.

However, these changes are small compared to the effects on Medicaid. Eliminating Medicare leads to an increase in the share of households with Medicaid as their primary health insurance provider from 6.1 to 13.7 percent. As the Medicaid take-up rate increases, total medical expenses covered by Medicaid also goes up, with the share increasing from 18.0 to 32.8 percent. This increase accounts for more than 3/4 of the decline in medical expenses covered by Medicare, which falls from 19.2 to 0.0 percent as we eliminate the program.

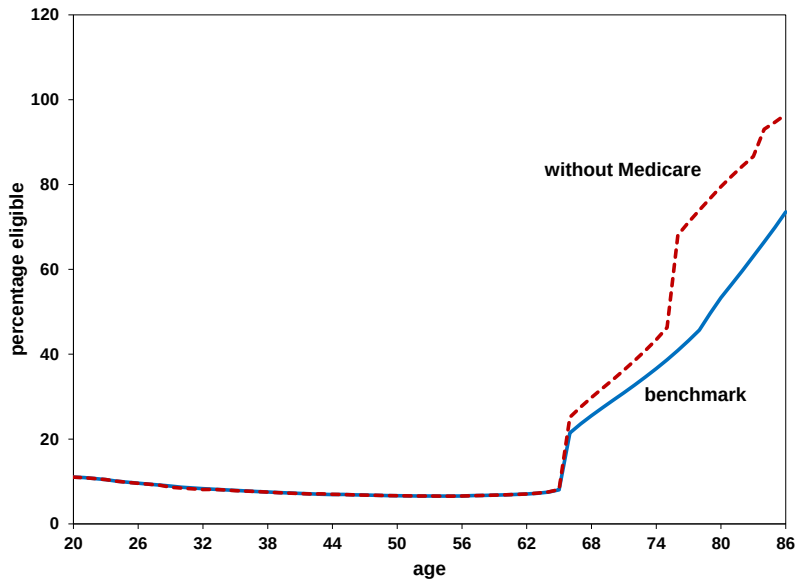
It is reasonable to assume that most of the increase in the Medicaid take-up rate is driven by retirees. This is confirmed by Figure (1 ??), which plots the percentage of agents in different age brackets that are eligible

Table 9: Insurance distribution and medical expenses

	Head count by main provider		Medical expense	
	Benchmark	Without Medicare	Benchmark	Without Medicare
Private	8.3	13.3	10.6	14.1
Employer	54.5	54.6	32.5	32.5
Self	4.8	7.6	12.9	13.8
Medicare	15.3	0.0	19.2	0.0
Medicaid	6.1	13.7	18.0	32.8
FS+MR	10.9	10.9	6.9	6.9

for Medicaid in an economy with an without Medicare. Recall that the "eligibility based on medical need" criterion for Medicaid dictates that households qualify for Medicaid if the sum of their gross labor income and interest earnings minus out-of-pocket medical expenses is below a threshold y^{mn} and their assets are less than a^{mn}. Eliminating Medicare increases out-of-pocket medical expenses for retirees and hence makes it more likely for their income to fall below the threshold, y^{mn}. As shown in the graph, the percentage of retired households that are eligible for Medicaid is monotonically higher in the economy without Medicare. This lets us conclude that most of the result is driven by retirees, who respond to the removal of Medicare by substituting Medicare for Medicaid.

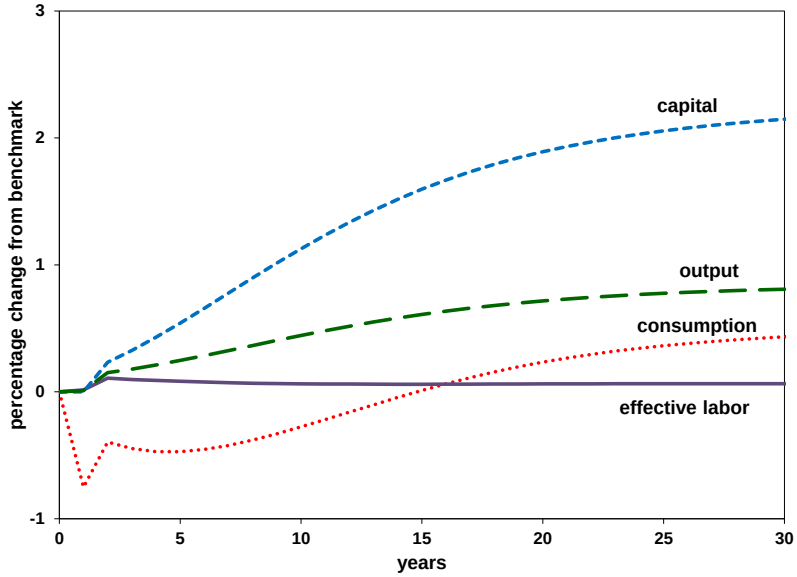
Figure 1: Medicaid eligibility by age



Let us now examine the transition path between the economy with and without Medicare. Starting from an initial steady state with Medicare, Figure (2 ??) shows how capital, output, consumption, and effective labor supply evolves during the first 30 years following the elimination of the program. Although the comparative statics exercise in Table (8 ??) showed that consumption per capita is 0.8 percent higher in the economy without Medicare, the transition path shows that consumption initially drops by about 0.75 percent. Indeed, the percentage change in consumption compared to the initial steady state remains negative for more than a decade following the elimination of Medicare. Consumption declines during the transition

as households accumulate assets to finance the higher cost of medical expenses during retirement. As noted earlier, the surge in capital leads to higher wages and effective labor supply, which in turn yields higher output and factor income to the households, thus enabling them to both save and consume more.

Figure 2: Transition results from economy with Medicare to economy without: aggregates

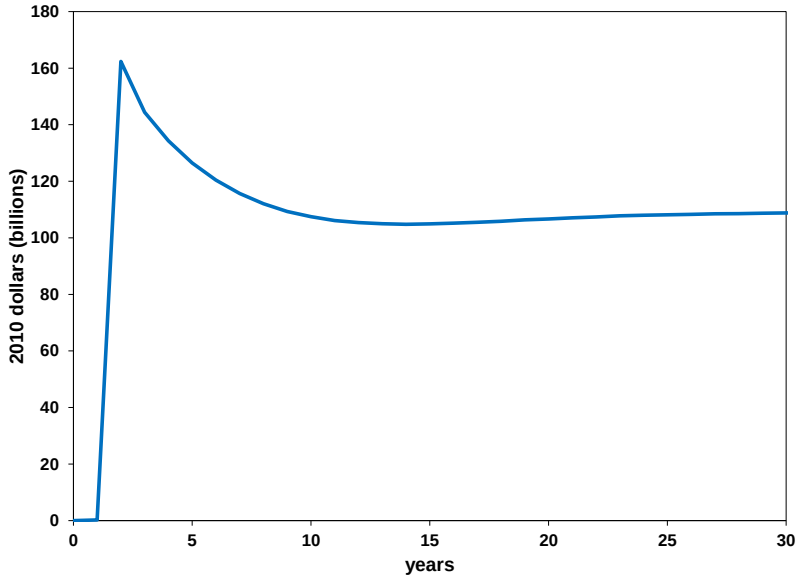


We have shown that retirees respond to the removal of Medicare by substituting Medicare for Medicaid. Part of the reduction in government spending is thus offset by an increase due to higher Medicaid expenses. Figure (3 ??) plots the reduction in government spending during the first 30 years of the transition. Eliminating Medicare initially leads to a $162 billion cut in government spending. However, during the transition, part of this reduction is offset by a surge in Medicaid expenses as the share of retirees that qualify for the program increases. As the economy approaches the new steady state, the reduction in government spending converges to about $104 billion. This shows that the government saves less than 65 cents for every dollar they cut on Medicare expenses. Since the government balances its budget period-by-period, taxes will also follow a similar path. Non-reported results show that the tax rate initially drops by 1.7 percentage points, after which they increase and eventually converge to the new steady state where the tax rate is about 1.2 percentage points lower compared to the benchmark economy.

What are the welfare effects of this policy experiment? We quantify the welfare effects by computing the changes in households' perfect income index, which measure how much their lifetime income has to increase to make them indifferent between the initial economy and the economy under the new policy. Let us start by comparing the steady state of the economy with and without Medicare. We find that lifetime income has to increase by 0.72 percent for an unborn agent under the veil of ignorance to be indifferent between the steady state with and without Medicare. Put differently, lifetime income of an unborn agent who does not know what type she will be has to increase by 0.72 percent for her to be as well off in the economy with Medicare compared to the economy without Medicare. The observation that welfare is higher without Medicare is largely driven by the fact that capital, and hence wages, are higher compared to the benchmark economy. Higher wages enables households to both save and consume more. Our results show that this more than compensates for the loss of Medicare.

Comparative statics give at best a partial picture of the effects of policy reforms since it does not take into account the costs of transitioning between steady states. Recall from Figure (2 ??) that consumption initially declines following the elimination of Medicare as households start accumulating assets to finance the

Figure 3: Reduction in government spending



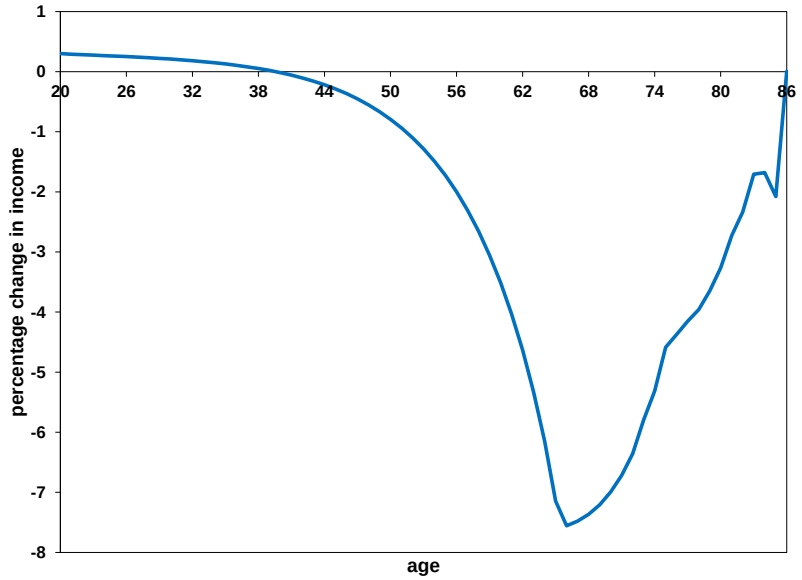
higher cost of medical expenses during retirement. This cost of accumulating assets is particularly severe during the transition since the wage has not yet increased to its new steady state level. After taking these costs into account, we find that lifetime income of a 19 year-old agent under the veil of ignorance (i.e., an agent who is about to enter the workforce but still does not know her type) has to increase by 0.44 percent for her to be indifferent between the benchmark economy and the transition. This shows that agents are still better off without Medicare, but that the welfare gains to eliminating the program goes down when we take the costs of transitioning between the steady states into account.

The cost of going through the transition depends on the individual's type. As an example, a 70 year old in bad health is likely to suffer more from loss of Medicare than a 70 year old in good health. This heterogeneity in welfare effects can be accounted for by computing the welfare effects of the policy reform on the current cohorts. We find that net lifetime income across the population has to decrease by 1.45 percent to make the current cohorts indifferent between the benchmark economy and the transition. In other words, the current cohorts are better off in the initial steady state with Medicare. This observation stands in direct contrast to our previous finding, which showed that a 19 year-old agent under the veil of ignorance would prefer to eliminate Medicare.

In order to understand what is driving this result, Figure (4 ??) plots the percentage change in welfare by age of the current cohorts. Eliminating Medicare leads to a slight increase in welfare for all agents less than 40 years of age. This observation is largely due to the wage effect discussed earlier. Although it takes time to transition to the new steady state, these agents are still young enough to reap most of the benefits associated with higher labor earnings. However, the welfare effects of the policy reform on the currently young agents are negligible compared to the welfare effects on the currently older households. While lifetime income of a 20 year old has to increase by about 0.30 percent to make her indifferent between the benchmark economy and the transition, lifetime income has to decrease by more than 7.50 percent to make a 66 year old as well off without Medicare. Note that the change in welfare by age follows a U-shaped pattern. This is driven by the interplay between Medicare and Medicaid highlighted earlier. That is, more retired households qualify for Medicaid in an economy without Medicare, which in turn lowers their cost of going through the transition.

So far we have shown that net lifetime income across the population has to decrease by 1.45 percent

Figure 4: Welfare by age (percentage change)



to make the current cohorts indifferent between the benchmark economy and the transition. Although younger individuals would benefit from the reform, their gain is outweighed by the loss to the currently older households. That said, we find that 58.34 percent of the population is better off without Medicare. Hence, if agents were allowed to vote on the reform, majority rule would dictate that the planner should go through with the reform and eliminate Medicare. These results highlight one of the key limitations of using majority voting rules to evaluate policy reforms. In contrast to evaluating a policy based on majority voting rules, our preferred method explicitly accounts for the reform's potentially heterogeneous effects on households of different types. This gives a more complete picture of the gains and losses of alternative policies, which in turn better enables us to design welfare-enhancing transition paths.

5.2 Other policy experiments

To be included.

6 Conclusion

To be included.

7 References

To be included.

8 Appendix

To be included.