# The Affordable Care Act in an Economy with Federal Disability Insurance

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**Abstract**

This paper examines the effects of the Affordable Care Act (ACA) by considering a dynamic interaction between extending health insurance coverage and the demand for federal disability insurance. This paper extends the Bewley-Huggett-Aiyagari incomplete markets model by endogenizing health accumulation and disability decisions. The model suggests that the ACA will reduce the fraction of working-age people receiving disability benefits by 1 percentage point. In turn, the changes associated with disability decisions will help fund 47 percent of the ACA's cost. Last, compared to the ACA, an alternative plan without Medicaid expansion will reduce tax burdens and improve welfare. JEL: E21; E62; H51; H55; I13; I18

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The ACA is the most significant change in the U.S. health care system since the passage of Medicare and Medicaid in 1965. One of its principal objectives is to increase the rate of health insurance coverage for Americans by subsidizing the purchase of health insurance through an insurance exchange, expanding state-operated Medicaid, and imposing mandates on health insurance coverage. The challenge of the new policy is to extend coverage while containing the cost of health care provision. According to the 2012 CBO estimates, the net cost of insurance coverage provisions of the ACA is $1,168 billion for the period of 2012-2022.[1]

The starting point of this paper is the observation that provisions of the ACA are likely to interact with pre-existing government programs. The specific program I focus on is federal disability insurance programs under which individuals deemed "disabled" receive cash benefits and gain access to Medicare.[2] In 2011, 9.0 million people aged 18-64 received federal disability benefits, that was 6.2 percent of the US residents aged 18-64. The total cost was about $150.3 billion. In this paper, I argue that the ACA, by extending health insurance coverage to the uninsured, will improve this group's health capital and reduce the relative attractiveness of the in-kind Medicare benefits. These changes will lead to lower demand for federal disability assistance.[3] In addition to the partial equilibrium effects, the ACA also affects the demand for disability insurance via several general equilibrium channels. For instance, the extension of health insurance coverage lowers people's precautionary

[1]More details about the ACA are available in Section 1.1 and the Public Law 111-148 http://www.gpo.gov/fdsys/pkg/PLAW-111publ148/pdf/PLAW-111publ148.pdf.

[2]There are two types of federal disability insurance: the Social Security Disability Insurance (SSDI) and the Supplemental Security Income program (SSI). More details are available in Section 1.2.

[3]This argument is supported by empirical evidence found in Maestas, Mullen and Strand (2012)

saving motives, the capital stock of the economy, and thereby the market wages. Moreover, the implementation of ACA directly changes government expenditures and indirectly affects the equilibrium tax rate. The shifts of both market wages and tax rates impact disability decisions via changing the opportunity cost of being on the disability rolls. The contribution of this paper is to design a general equilibrium model that captures the above mentioned mechanisms. The model is used to evaluate the effects of the ACA on a broad set of variables, including the government budget, measures of labor supply, income, and welfare.

In order to provide a quantitative assessment of the ACA, this paper extends the Bewley-Huggett-Aiyagari incomplete markets general equilibrium framework to allow for endogenous decisions of health capital and disability.[4] To the best of my knowledge, this is the first paper that endogenizes both choices. The quantitative analysis of the model yields three main findings. First, the ACA reduces the fraction of working-age people receiving disability benefits (hereinafter referred to as disability rates) from 5.7 to 4.9 percent. Second, the ACA reduces government spending on disability assistance and increases government revenue through enlarging the labor force. For every 100 dollars the government spends on the ACA, it saves 32 dollars on disability insurance and 8 dollars on Medicare for people with disabilities, and raises tax revenue by 7 dollars via enlarging the tax base. Last, I find that an alternative health care reform plan that, contrary to the ACA, did not expand Medicaid coverage would reduce the equilibrium tax rate and improve welfare.

The model is characterized by heterogeneous agents who make dynamic decisions

[4] See Bewley (1986), Huggett (1993), and Aiyagari (1994).

on disability, insurance, consumption, savings, leisure, labor, and medical expenditures. The marginal cost of medical services differs by insurance status. Relative to insured agents, uninsured agents face a higher price, purchase fewer medical services, have lower health capital, and are more likely to claim disability benefits. Key parameters of the model are calibrated to match the 2006 US economy, one year before the Great Recession. The calibrated model successfully matches data along several important dimensions that are not targeted, such as health related statistics, the variation in disability rates by education and age groups, and life-cycle changes of good consumption, medical expenditures, and working hours. It is also important to note that this model outperforms other models with endogenous health accumulation by producing a long-tail in the distribution of both total and out-of-pocket medical expenditures.

The model is used to examine the long-term effects of the ACA, which includes Medicaid expansion, insurance subsidies, and an individual mandate. Besides the main findings as previously stated, following the ACA, the labor force participation rate increases by 0.9 percent. This increase offsets reductions in working hours and capital and leads to a 0.2 percent rise in output. The ACA also causes the fraction of working-age people without health insurance (hereinafter referred to as uninsured rates) to drop from 18.1 to 0.1 percent. On the flip side, the ACA distorts the incentives to work, save, and invest in health capital. Overall the ACA produces a welfare loss equivalent a 0.3 percent decline of permanent consumption.[5] This observation is consistent with the argument of Feldstein (1973) that the negative

[5]This loss is not a small number in macroeconomic analysis, since the welfare loss from business cycles is equivalent to a 0.05 percent decline of permanent consumption (Lucas, 2003).

effect of moral hazard behaviors associated with low coinsurance rates outweighs the positive effect of risk spreading. On the contrary, an alternative plan excluding Medicaid expansion induces a welfare gain equivalent to a 0.2 percent increase of permanent consumption. This is because compared to the ACA, the alternative plan substantially reduces the number of Medicaid patients and the associated overuse of medical services. Last, in order to determine the importance of the proposed dynamic interaction, I compare the results of the baseline model to an alternative model, in which federal disability insurance programs are removed. Results suggest that omitting the dynamic interaction leads to underpredictions of the benefits and overpredictions of the costs of health care reforms. In particular, the fiscal and welfare costs of the ACA simulated by the alternative model are 81.3 percent larger than those simulated by the baseline model.

This paper is related to five strands of literature. The first strand of literature analyzes how the 1984 disability reform that liberalized disability screening process changed the nature of federal disability insurance programs (Autor and Duggan, 2006; Duggan and Imberman, 2009; Autor, 2011).[6] The assumption of endogenous disability decisions adopted in this paper is consistent with the key message of this literature. The second strand of literature evaluates the long-term effects of the ACA (Jung and Tran, 2011; Janicki, 2012; Feng and He, 2013; Aizawa and Fang, 2013; Tsujiyama, 2013; Pashchenko and Porapakkarm, 2013). This paper contributes to this literature by considering a dynamic interaction between extending health in-

[6] This literature argues that after the legislative change the status of receiving disability benefits becomes an endogenous choice: conditional on having some health problems, people with bad economic alternatives (low market wages) will apply for disability assistance and receive an award in most cases.

surance coverage and the demand for federal disability insurance. The third strand of literature directly studies the interaction between health insurance and disability insurance (Gruber, 2008; Maestas, Mullen and Strand, 2012; Kitao, 2013). My work advances this literature by evaluating the long-term effects of the ACA on federal disability insurance programs. The fourth strand of literature uses natural experiments to identify a causal relationship between health insurance coverage and health outcomes (Newhouse and Rand Corporation, 1993; Courtemanche and Zapata, 2012; Finkelstein et al., 2012; Baicker et al., 2013). Evidence found in these studies is supportive of this paper's main mechanism: the ACA improves health outcomes and reduces the demand for federal disability insurance. The last strand of the literature is the emerging macro-health papers that endogenize medical expenditures and health accumulation (Murphy and Topel, 2006; Suen, 2006; Hall and Jones, 2007; Yogo, 2012; Halliday, He and Zhang, 2012; Zhao, 2012; Ales, Hosseini and Jones, 2012; Córdoba and Ripoll, 2013). My work contributes to this literature by proposing a better estimate for the health production function.

# 1 Background

## 1.1 The Affordable Care Act

The ACA is a United States federal statute signed into law by President Barack Obama on March 23, 2010. The ACA aims to increase the rate of health insurance coverage for Americans by making a number of legislative changes. The three main components of the reform are Medicaid expansion, insurance subsidies, and an individual mandate. The reform also incorporates other components, such as imposing an employer mandate, introducing community rating, limiting profits of private health insurance companies, and restructuring Medicare reimbursement.

According to the 2012 CBO estimates, net cost of the insurance coverage provision of the ACA is $1,168 billion for the period of 2012-2022. Although the increase in spending is partially offset by the cost reduction of Medicare, the government still needs to raise taxes to balance its budget. Currently, the government raises the Medicare payroll tax on the individual side from 1.45 to 2.35 percent and places a 3.8 percent tax on net investment income for high income earners, imposes a 40 percent excise tax on insurance plans with high annual premiums, collects fees on imports of pharmaceutical drugs and medical devices, and levies a 10 percent sales tax on indoor tanning services.

## 1.2 Federal Disability Insurance

The government operates two types of federal disability insurance: the SSDI provides disability benefits for "insured workers" who worked long enough and paid social security taxes; the SSI is another federal program that provides assistance to people with disabilities based on their financial need. To receive disability benefits, either from the SSDI or the SSI, a person needs to be determined by the Social Security Administration that due to a medical condition that has lasted or is expected to last for at least one year or result in death, this person is unable to either do the work that one did before or to adjust to other work. The Social Security Administration uses a list of medical conditions combined with the applicant's medical history to make a determinant. If benefits are awarded, people will receive monthly cash payments started five month after the onset of disabilities. In 2011, the average monthly benefits for newly awarded SSDI worker beneficiaries are 1,189 dollars. Besides cash benefits, beneficiaries receiving the SSDI also obtain Medicare coverage after a 24 month waiting period. People deemed disabled continue to receive cash and Medicare benefits until they experience a medical recovery, pass away, or reach the Full Retirement Age. Most people on the disability rolls do not work due to the high implicit tax rate and the threat of continuing disability reviews.

Over the past four decades, the percent of U.S. residents aged 20-64 receiving the SSDI almost tripled: from 1.3 percent in 1970 to 4.5 percent in 2011. The number of SSI recipients grew at a similar rate as the SSDI. In 2011, these two programs cost the federal government $150 billion. Due to large benefit outlays and limited revenue from payroll taxes, the Social Security Disability Insurance Trust Fund is projected to be depleted by 2016. Economists attribute the Social Security Disability Benefits Reform Act of 1984 that liberalized the disability screening process as the main cause for the skyrocketing disability rolls (Duggan and Imberman, 2009). In 1983, beneficiaries with a main diagnosis as musculoskeletal disorders (e.g. back pain) or mental disorders constituted 29.7 percent of new awards, but in 2011 this number rose to 53.1 percent. Autor and Duggan (2006) argue that in response to liberalized disability criteria, the status of receiving disability benefits becomes an endogenous choice. Conditional on having some health problems people with bad economic alternatives will apply for disability benefits and receive an award in most cases.

# 2 Model

The model is designed to capture the general equilibrium effects of health care reforms. In addition to agents' behaviors, the model allows tax rates, insurance premiums, and factor prices to respond to policy reforms.

## 2.1 Demographics

The economy is populated by a constant size of overlapping generations. Agents live up to $J$ periods. In the first $Jr - 1$ periods, agents decide whether to work or claim disability benefits. From the period of $Jr$, all agents retire, receive retirement benefits, and Medicare coverage. Between periods, agents face an exogenous survival probability $s(j)$, where $j$ is a period index.[7]

## 2.2 Individual Problem

Agents are born into different types $z$, and $Pr(z)$ denotes the probability for each type. This type determines agents' initial health capital, group insurance eligibility, and labor abilities.[8] Labor abilities affects two aspects of lifetime opportunities: age-efficient labor profiles $\zeta(z, j)$ and social security benefits $b(z, j)$. The group insurance eligibility is denoted as $g(z)$, which takes a value of 1 for those eligible for group insurance.

[7]This paper sets survival probability as exogenous, because it focuses on behaviors of working-age agents. As shown in Figure 3 of Halliday, He and Zhang (2012), relaxing this assumption does not affect medical expenditures of working-age people.

[8]For simplicity, this paper abstracts from dynamic changes of group insurance eligibility, since this variable is very persistent in the data (Medical Expenditure Panel Survey).

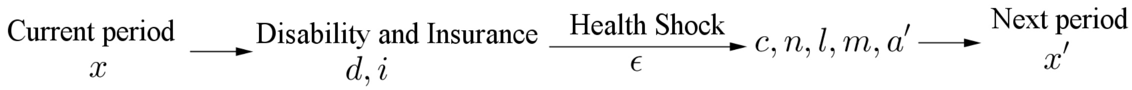


Figure 1: Timing of decisions

Figure 1 presents the timing of decisions. For each period, agents are characterized by a state vector $x = (z, j, h, a, e)$, where $h$ is the current health capital, $a$ is the amount of assets, and $e$ represents Medicaid eligibility. Given a state vector, agents make a two-stage decision. First, they choose insurance coverage and disability status. Agents with health capital below the eligibility criterion of disability insurance $(h < \underline{h}_d)$ have the option to apply for disability benefits. Agents claiming disability benefits are restricted from work for one period. The disability status is denoted as $d$, which equals 1 if an agent receives disability assistance. Depending on eligibility an agent will enroll into an insurance plan in the order of Medicaid, Medicare, and group health insurance.[9] Agents lacking access to these three options are free to choose between individual health insurance and no coverage. $i$ denotes the insurance coverage, and takes the values of 0, 1, 2, 3, and 4 to represent no insurance, group insurance, individual insurance, Medicare, and Medicaid, respectively. Following the first stage decisions, a health shock $\epsilon$ is revealed.[10] The probability distribution of health shocks is denoted as $P(\epsilon, j)$. In the second stage, after observing the value of health shocks, agents make decisions on leisure, labor, consumption, medical expen-

[9] The assumption that agents eligible for group insurance enroll into group plans is consistent with empirical evidence found in Gruber and Washington (2005) that the uninsured rate among this group is only 7 percent.

[10] Because upon filing an application people need to wait at least five months or as long as several years to get a disability award, the model assumes agents cannot immediately adjust their disability status after observing the value of health shocks.

ditures, and savings. Agents' decisions are made to maximize the life-time utility flows from consumption, leisure, and health capital.

Equation (1) presents the production function for health. This specification is consistent with the theory of Grossman (1972*a*,*b*) that future health capital depends on current health capital and purchased medical services. This specification also incorporates the influence of health shocks, which functions like a random depreciation component as discussed in Grossman (2000).

$$h' = (1 - \delta)h - \delta_\epsilon + \omega_1(j)m^{\omega_2} \tag{1}$$

where $\delta$ is a depreciation rate, $\delta_\epsilon$ represents the additional depreciation caused by a health shock $\epsilon$, $\omega_1(j)$ and $\omega_2$ are the parameters governing the process of transforming medical expenditures into health capital.

Given prices and taxes, the dynamic problem solved by an individual of age

$j = 1, \ldots, Jr - 1$ can be written as follows.[11]

$$V(x) = \max_{d,i} E_{\epsilon|j}\{\max_{c,n,l,m,a'\geq 0} u(c,l,h) + \beta s(j) E_{e'|x,n} V(x')\} \quad (2)$$

$$\begin{aligned} s.t. \quad & c + a' + Q(m,i,j) \leq (1-\tau)w\zeta(z,j)n\mathcal{I}_{d=0} + b(z,j)\mathcal{I}_{d=1} \\ & \qquad + (1+r)a + Tr \quad (3) \\ & n + l + st(h) \leq 1 \quad (4) \\ & h' = (1-\delta)h - \delta_\epsilon + \omega_1(j)m^{\omega_2} \quad (5) \\ & i \in \begin{cases} \{4\} & \text{if} \quad e = 1 \\ \{3\} & \text{if} \quad e = 0, d = 1 \\ \{1\} & \text{if} \quad e = 0, d = 0, g(z) = 1 \\ \{0,2\} & \text{otherwise} \end{cases} \quad (6) \\ & d \in \begin{cases} \{0,1\} & \text{if} \quad h < \underline{h}_d \\ \{0\} & \text{otherwise} \end{cases} \quad (7) \end{aligned}$$

where $V(x)$ denotes the value function, and $\beta$ is a discount factor. Condition (3) corresponds to an individual budget constraint, where $w$ is a wage rate, $\tau$ is the payroll tax rate, $r$ is an interest rate, $Tr$ is a lump sum transfer redistributing the savings of deceased agents equally to all alive agents, $Q(m,i,j)$ is health related expenditures, and $\mathcal{I}$ is an indicator function that takes the value of 1 if the subscript condition is true.[12] Condition (4) corresponds to a time constraint. Following Grossman (1972$b$), the model incorporates the term of sick time $st(h)$ to represent

[11]The dynamics of Medicaid eligibility is discussed in section 2.3

[12]More details about function $Q(m,i,j)$ are available in Section 2.4

the lost time of being sick. After deducting the sick time, agents are able to allocate the residual time between leisure $l$ and labor $n$. Equation (5) is the health production function. Conditions (6) and (7) summarize the choice sets of insurance and disability decisions.

The recursive problem makes clear that agents want to invest in health for three reasons. First, agents derive utility flows from health. Second, larger health capital reduces the amount of sick time and allows agents to enjoy extra leisure and supply more labor. Third, current period's health capital composes a part of next period's health capital, and thereby there is a continuation value of good health.

Similarly, the individual dynamic problem solved by an individual of age $j = Jr, Jr+1 \ldots, J$ can be written as follows.

$$V(x) = E_{\epsilon|j}\{\max_{c,m,a'} u(c,l,h) + \beta s(j)V(x')\} \tag{8}$$

$$s.t. \quad c + a' + Q(m, i=3, j) \leq b(z,j) + (1+r)a + Tr \tag{9}$$

## 2.3 Government

The government operates public health insurance programs and social security programs, including both retirement and disability programs. Public health insurance programs have two components: Medicaid and Medicare. Medicaid provides health insurance coverage for agents with income less than an income threshold *pov* (hereinafter referred to as an income restriction) and ineligible for neither Medicare nor group insurance (hereinafter referred to as an insurance restriction). The Medicaid contract is characterized by a coinsurance rate $\gamma_{caid}$, zero premiums. Prior to the

ACA, besides income and insurance restrictions, agents also need to satisfy a categorical restriction (e.g. pregnant women and parents in families with dependent children) to be eligible for Medicaid coverage, and the model denotes the chance of meeting the categorical restriction for each period as $\pi$. Medicare coverage serves as an in-kind benefits for agents receiving social security payments, and the Medicare contract is characterized by a coinsurance rate $\gamma_{care}$ and premiums $P_{care}$. The government maintains a balanced budget and sets a flat rate tax $\tau$ on labor income to pay for government expenditures.

## 2.4 Insurance Firm

A representative insurance firm operates in a competitive market and offers two types of insurance contracts: group insurance and individual insurance. The group insurance contract is characterized by a coinsurance rate $\gamma_1$ and premiums $P_1$. The individual insurance contract is characterized by a coinsurance rate $\gamma_2$ and age specific premiums $P_2(j)$. Insurance premiums are picked by the insurance firm to maximize profits. Group and individual insurance markets are separated and there is no cross-subsidization between these two markets.

Given insurance characteristics, health related expenditures $Q(m, i, j)$, including both insurance premiums and out-of-pocket payments, can be formally expressed as follows.

$$Q(m,i,j) = \begin{cases} m & \text{if} \quad i = 0 \\ P_1 + \gamma_1 m & \text{if} \quad i = 1 \\ P_2(j) + \gamma_2 m & \text{if} \quad i = 2 \\ P_{care} + \gamma_{care} m & \text{if} \quad i = 3 \\ \gamma_{caid} m & \text{if} \quad i = 4 \end{cases} \tag{10}$$

## 2.5 Production Firm

A representative production firm uses capital $K$ and labor $L$ to produce one type of final goods. Given rental prices $\{R, w\}$ for capital and labor, the firm chooses the amount of two production factors to maximize profits.

$$\max_{K,L} AK^{\alpha}L^{1-\alpha} - RK - wL \tag{11}$$

where $A$ is total factor productivity, and $\alpha$ is the output elasticity of capital. Capital depreciates at a constant rate of $\delta_k$ each period, and such that the interest rate $r$ is equal to $R - \delta_k$.

## 2.6 Stationary Competitive Equilibrium

Let $z \in \mathbf{Z} \subseteq \mathbf{N}_+$, $h \in \mathbf{H} \subseteq \mathbf{R}_+$, $a \in \mathbf{R}_+$, $j \in \mathbf{J} = \{1, 2, \ldots, J\}$, $e \in \mathbf{E} = \{0, 1\}$, $d \in \mathbf{D} = \{0, 1\}$, $i \in \mathbf{I} = \{0, 1, 2, 3, 4\}$, and $\epsilon \in \mathbf{\Upsilon} \subseteq \mathbf{N}_+$. Let $\mathbf{S} = \mathbf{Z} \times \mathbf{H} \times \mathbf{R}_+ \times \mathbf{J} \times \mathbf{E}$. Let $\mathbf{B}(\cdot)$ be a Borel $\sigma$-algebra and $\mathbf{P}(\cdot)$ be a power set. Let $\mathfrak{S} = \mathbf{P}(\mathbf{Z}) \times \mathbf{B}(\mathbf{H}) \times \mathbf{B}(\mathbf{R}_+) \times \mathbf{P}(\mathbf{J}) \times \mathbf{P}(\mathbf{E})$. Let $\mathbf{M}$ be the set of all finite measures over the measurable space $(\mathbf{S}, \mathfrak{S})$.

**Definition** A stationary competitive equilibrium is a collection of factor prices $\{r, R, w\}$, production plans $\{L, K\}$, insurance contracts $\{P_1, P_2(j), \gamma_1, \gamma_2\}$, government policy $\{\tau, b(z), P_{care}, \gamma_{caid}, \gamma_{care}, \underline{h}_d\}$, a lump-sum transfer $Tr$, policy functions $d, i : \mathbf{S} \to \mathbf{D}, \mathbf{I}$, $c, l, n, m, a' : \mathbf{S} \times \mathbf{D} \times \mathbf{I} \times \mathbf{\Upsilon} \to \mathbf{R}_+$, and measures $\Phi \in \mathbf{M}$ such that the following conditions hold.

1. Given prices, government policy, insurance contracts and the lump-sum transfer, individual decisions solve the recursive problem.
2. Aggregate quantities are consistent with individual decisions.
3. Given prices, the representative production firm makes optimal decisions.
4. The representative insurance firm earns zero profits in both group and individual insurance markets.
5. The government budget is balanced.
6. Total transfers equal the assets of deceased agents.
7. All markets clear.
8. The distribution of agents is stationary.

# 3 Specification, Calibration, and Evaluation

This paper sets the benchmark economy to match the 2006 US economy and uses three sources to collect the data information: the Medical Expenditure Panel Survey Panel 10 (MEPS), the 2007 March Current Population Survey (CPS), and the 2007 American Community Survey (ACS). The MEPS Panel 10 is a two-year panel survey with individual records on demographic features, health conditions, medical diagnoses, and medical costs. As a supplement to the MEPS, I use the CPS to collect health insurance statistics and the ACS to collect statistics about labor markets and social security programs. This section focuses on explaining the specification and calibration of several important parameters, and a complete list of parameters is provided in Table 8, Table 9, and Figure 3.

## 3.1 Demographics

One period in the model is defined as five years. People enter the economy at age 25, retire at age 65, and definitely exit at age 95. This age structure corresponds to set $Jr$ and $J$ to 9 and 14, respectively. Survival rates between periods are set to match the 2006 US life table (Figure 3 Panel A).

## 3.2 Individual Types

Individual types $z$ correspond that people enter the economy with different group insurance eligibility and educational levels (high school dropouts, high school graduates, some college, and college graduates). The probability of being eligible for group insurance is estimated for each educational level as the share of people that answered yes to the question "Health Insurance Offered" in any of the five rounds of the MEPS. Multiplying these numbers with the share of adults in each educational level gives the distribution of types $Pr(z)$. The amount of social security entitlements $b(z, j)$ is set to the average benefits reported in the ACS. Age-efficient labor profiles $\zeta(z, j)$ are set to the product of hourly wages of full-time-full-year workers and the time endowment, which is a standard value of 5200 hours per year (Ales, Hosseini and Jones, 2012).

## 3.3 Health Capital

Most papers in the literature uses subjective health status as the measure for health capital, but the problem is that the reference point for this measure changes substantially over the life cycle. For example, the excellent condition at age 65 is not comparable to the excellent condition at age 25. To solve the problem, this paper constructs an alternative measure of health capital based on the responses to a set of relatively objective questions, the Short-Form 12 (Ware, Kosinski and Keller, 1996). Based on the responses to these 12 short questions, the MEPS forms two summary scores: physical component summary (PCS) and mental component summary (MCS). These two summary scores are normalized measures with a mean of 50 and a standard deviation of 10. The health capital measure is constructed by summing up these two scores and then transforming the sum into a percentile score. In the new scale, if an agent has the health capital of 50, it indicates her health conditions are better than 50 percent of the 2006 US population. Figure 3 displays the life-cycle change of health capital. Health capital declines as people age: from 59.5 for the youngest group to 29.9 for the oldest group.

The constructed measure of health capital is used to specify several parameters. First, the initial endowment of health capital is measured for each educational level as the average health capital among MEPS respondents aged 25 and 29. Second, the sick time $st(h)$ is estimated in a nonparametric way by calculating the sum of sick days missing from work and lying in bed for each decile of the health capital distribution. Estimated results indicate that the sick time declines quickly as health improves: from 39 days per year among the lowest health decile to 1 day per year among the highest health decile. Third, health measures are used to estimate the health production function. Despite the fact that this function was first introduced in 1972, only a few studies (Grossman, 1972*a*; Stratmann, 1999) estimated it. None of the previous studies uses objective health measures and allows for random depreciation. Thus, most papers with endogenous health accumulation assume that the changes in health capital reflect the underlying health shocks and calibrate the rest parameters of health production function to match life-cycle profiles of medical expenditures. This approach underestimates the variance of health shocks, because the actual change of health capital reflects the compound effects of health shocks and purchased medical services. As a result, most calibrated models fail to produce a long tail in the distribution of medical expenditures, i.e., there is a small probability of incurring a catastrophic health shock and very large medical expenditures. To overcome this common problem, this paper directly estimates the health production function from the MEPS, which contains information on yearly medical expenditures, the incidence of priority conditions, and health capital for two waves (a one year span).[13] The reported incidence is interpreted as an indicator for health shocks,

[13] Priority conditions refer to a group of medical conditions that are selected by the Agency for HealthCare Research and Quality for their prevalence, expense, or relevance to policy. Priority conditions include hypertension, heart disease, high cholesterol, emphysema, chronic bronchitis, diabetes, cancer, arthritis, asthma, attention deficit/hyperactivity disorder (ADHD or ADD), and

which is assumed to take three values: 0 for no shock, 1 for a mild shock, and 2 for a severe shock. A mild health shock is defined as having one new priority condition in either wave 3 or wave 4, and a severe health shock is defined as having multiple new priority conditions. The probability of mild and severe health shocks is estimated for each age group as the share of people reporting one and multiple new priority conditions, respectively. Because the sample does not include adults older than 85 years old, the model uses linear fitted values to construct their probabilities (Figure 3 Panel F). Equation (12) specifies the regression equation, in which the coefficient of medical expenditures is restricted to change linearly with respect to age.

$$h_i' = (1-\delta)h_i - \sum_{q\in\{1,2\}} \delta_q \mathcal{I}_{\epsilon_i=q} + (\omega_{11} + \omega_{12}(j_i - 1))m_i^{\omega_2} + \varsigma_i \tag{12}$$

where $h_i'$ is the future health capital for individual $i$, $h_i$ is the current health capital, $\epsilon_i$ is a health shock indicator, $j_i$ represents the period number, $m_i$ is the total medical expenditures, and $\varsigma_i$ is a random disturbance term capturing all omitted influences.

An OLS regression returns negative coefficients of medical expenditures, which indicates medical expenditures are an endogenous variable that people with poor unobserved health conditions tend to spend more on medical services and have worse health outcomes. To overcome the endogeneity issue, parameters are estimated using a two-stage GMM, in which medical expenditures are instrumented by family poverty status and health insurance coverage.[14] This instrument strategy is similar to that used by Grossman (1972*a*, 2000).

stroke. The incidence of priority conditions is reported in medical condition files of the MEPS.

[14]Due to the limited variation of instruments after retirement, the sample is restricted to working-age people.

Table 1: Estimates of the health production function

| $(1-\delta)$ | $\delta_1$ | $\delta_2$ | $\omega_{11}$ | $\omega_{12}$ | $\omega_2$ |
|---|---|---|---|---|---|
| 0.727 | 6.988 | 12.743 | 8.403 | -0.442 | 0.128 |
| (0.015) | (0.783) | (1.361) | (3.010) | (0.123) | (0.047) |

Standard errors in parentheses.
Number of observations is 5837.

As Table 1 reports, all estimated coefficients of the health production function are significant at the 0.01 level. Results imply that health capital depreciates over time. The incidence of health shocks reduces agents' health capital. The negative impact caused by a severe shock is larger than a mild shock. Medical expenditures help to improve health capital, but the effectiveness of medical expenditures declines quickly as people age. The curvature parameter $\omega_2$ of 0.128 reflects that health capital is produced via a decreasing return to scale technology. This point estimate is within the range of estimates 0.098-0.170 in Grossman (1972*a*) and consistent with the theory of Ehrlich and Chuma (1990).

## 3.4 Preferences

The utility function is specified in the following form.

$$u(c,l,h) = \frac{[\lambda(c^{\rho}l^{1-\rho})^{\psi} + (1-\lambda)h^{\psi}]^{\frac{1-\sigma}{\psi}}}{1-\sigma} \tag{13}$$

where $\sigma$ is the relative risk aversion, $\psi$ captures the elasticity of substitution between the consumption-leisure combination and health capital, $\lambda$ is a weight attached to the consumption-leisure combination, and $\rho$ is the share of consumption in the consumption-leisure combination. In terms of values, $\sigma$ is set to 2, and $\psi$ is set to -0.67 to match the elasticity estimate of 0.6 in Yogo (2012). The rest parameters of the utility function are calibrated to match data moments. $\lambda$ is calibrated to match the decline of health capital over the life cycle, specifically, the ratio of average health capital of the age group 65-69 to the age group 25-29, that is 0.78. $\rho$ is calibrated to match the share of time spent on work among workers, that is 0.38. The discount factor between periods is set to match the ratio of capital to yearly GDP, that is 3.[15]

## 3.5 Health Insurance Market

Coinsurance rates of group and individual health insurance are estimated for each insurance type as the medium ratio of out-of-pocket payments to total medical expenditures. This number is 0.27 for group insurance and 0.47 for individual insurance. The model assumes that individual premiums change linearly respect to age and the premiums paid by people aged 60-64 are three times as much as the premiums paid by people aged 25-29.[16] Insurance premiums are determined endogenously by solving the insurance firm's zero-profit conditions.

## 3.6 Government

The disability cutoff point $\underline{h}_d$ is calibrated to match the share of working-age people receiving disability benefits, that is 5.8 percent (the 2006 Annual Statistical Report

[15]The algorithm is reported in Appendix A.

[16]This paper uses a number of 3, because this is the ACA imposed limit, and this number is also close to the market ratio before the ACA (See http://www.healthpocket.com/healthcare-research/infostat/age-gap-bigger-than-gender-gap-for-health-insurance-premiums#.UdtLg7WyB8k).

on the Social Security Disability Insurance Program). The coinsurance rates are measured for each insurance type as the medium ratio of out-of-pocket payments to total medical expenditures. This number is 0.25 for Medicare and 0.11 for Medicaid. Medicare premiums are set to the sum of Part B and Part D premiums in 2006, which is $1,446 per year. The Medicaid income threshold *pov* is calibrated to match the fraction of working-age-non-disabled adults with income below 133 percent of the poverty line, which is 12.9 percent. The probability $\pi$ of obtaining Medicaid coverage conditional on satisfying income and insurance restrictions is set to 0.27, which is calculated from in the CPS. The payroll tax rate is solved endogenously from the government budget constraint.

### 3.7 Evaluation of the Model

To evaluate the model, Table 2 compares the moments observed in the data with those generated by the model along several important dimensions that are not targeted. First, the model reproduces the decline of health capital after retirement: in the model, average health capital of the age group 80-84 is 57.6 percent of that of the age group 25-29, which is very close to the data number of 52.3 percent. The model is capable of generating this decline because the model allows the probability of getting health shocks to increase and the effectiveness of medical expenditures to decline with respect to age.

Table 2: Aggregate features: model versus data

| Variables (percent) | Model | Data |
|---|---|---|
| Panel A: health statistics | | |
| Ratio of health capital for age groups 80-84 to 25-29 | 57.6 | 52.3 |
| Medical expenditures/GDP | 10.9 | 15.4 |
| Panel B: insurance coverage$^{\dagger}$ | | |
| Uninsured | 18.1 | 18.0 |
| Privately insured | 74.5 | 72.2 |
| Publicly insured | 7.4 | 9.9 |
| Panel C: disability rate$^{\dagger}$ | | |
| High school dropouts | 17.3 | 13.7 |
| High school graduates | 8.3 | 7.2 |
| Some college | 2.4 | 4.8 |
| College graduates | 0.0 | 1.8 |

*Notes:* $^{\dagger}$ indicates statistics among working-age people

Second, the model does not target the fraction of output used in health care sector. The model predicts people spend 10.9 percent of output on medical expenditures.[17] This number is smaller than the data counterpart, because the model is set to match the MEPS expenditure moments which do not reflect well the expenditures on expensive end-of-life care.

Third, the model closely matches the distribution of health insurance coverage among non-retirees. As Panel B of Table 2 shows, the model produces an uninsured rate of 18.1 percent, which is almost the same as the data counterpart of 18.0 percent calculated from the CPS. Both in the model and in the data, private health insurance provides coverage to a much larger fraction of working-age adults than public health

[17]Data numbers are constructed from the 2006 National Health Expenditure Data reported by the Centers for Medicare & Medicaid Services. The amount of medical expenditures is the total expenditures of the health care sector deducting nursing home expenditures and administration costs, since these two components are not included in the MEPS.

insurance: 74.5 percent versus 7.4 percent in the model, and 72.2 percent versus 9.9 percent in the data.

Fourth, the model correctly predicts changes of disability rates across educational levels and age groups (Panel C of Table 2 and Panel D of Figure 2). Consistent with the data, the model predicts that people with higher educational attainments are less likely to receive disability benefits. This is because the opportunity cost of becoming disabled in terms of market wages is higher for people with better education. Moreover this group of people are more likely to receive group insurance coverage, and thereby purchase more medical goods and achieve better health outcomes. Further, the model matches well the data fact that disability rates increase with respect to age, because it generates a decreasing life-cycle profile of health capital.

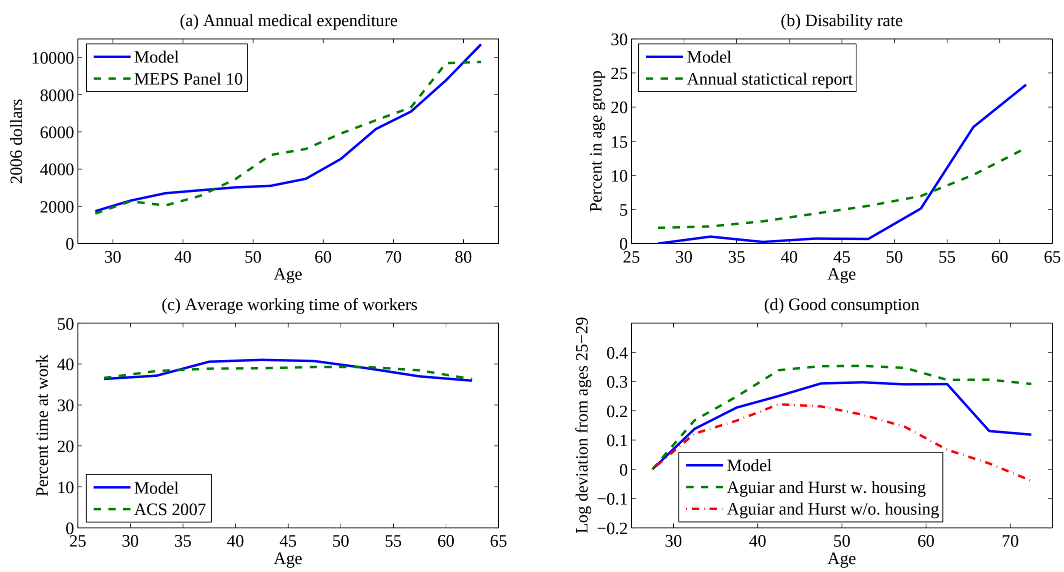


Figure 2: Life-cycle features: model versus data

Fifth, the model fairly well matches the empirically observed life-cycle profiles of medical expenditures, working time, and consumption. As Panel A of Figure 2 displays, the model correctly predicts that the amount of annual medical expenditures is around $2,000 for the age group 25-29 and increases to $10,000 for the age group 80-84. Besides matching the two end points, the model also captures the gradual increase of medical expenditures over the life cycle. Panel C of Figure 2 compares the percent of time that workers allocate to work generated by the model and that in the data. The model successfully replicates labor supply features of the data because it uses a hump-shaped age-efficient labor profile. The model also produces a hump-shaped good consumption profile (Figure 2 Panel D) similar to the reported profiles in Aguiar and Hurst (2013). The increase in consumption for early periods is attributed to the borrowing constraint and the precautionary saving motive. After accumulating enough assets, middle-age agents are able to enjoy an almost constant consumption flow. Passing the retirement age, as agents have more leisure, average consumption drops.

Table 3: Distribution of medical expenditures: model versus data

Panel A: Distribution of total medical expenditures

| | Average | 0-60% | 60-80% | 80-95% | 95-100% |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Data | 4,244 | 757 | 3,721 | 9,300 | 33,039 |
| Model | 4,282 | 2,004 | 4,694 | 7,490 | 20,415 |

Panel B: Distribution of out-of-pocket medical expenditures

| | Average | 0-60% | 60-80% | 80-95% | 95-100% |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Data | 824 | 186 | 845 | 1,836 | 5,358 |
| Model | 1,191 | 625 | 1,277 | 2,006 | 5,228 |

The sample includes people aged 25-84; all numbers are in 2006 dollars

Last, it is well known that a standard model with endogenous health accumulation can hardly generate the distribution of medical expenditures observed in the data, which is to produce a small fraction of people incurring large medical expenditures. Table 3 compares the distribution of medical expenditures observed in the data with the ones generated by the model. As Panel A indicates, the model closely matches the average total medical expenditure even if this moment is not targeted. The model also correctly predicts that the bottom 60 percent of people spend very little on medical services, and as people move to the right tail of the distribution their medical expenditures increase substantially. Specifically, the top 5 percent of people in the model on average spend $20 thousand per year on medical services, which is close to the data number of $33 thousand. Besides matching the distribution of total medical expenditures, the model also matches well the distribution of out-of-pocket medical expenditures, particularly, the right tail of the distribution. The model is able to produce the long tail in both distributions because it incorporates a better specification for health production function and the complementary relationship between health capital and good consumption.

# 4 Policy Experiments

This section implements policy experiments to study the steady state effects of two different health care reforms: the ACA and an alternative plan without Medicaid expansion. In order to determine the importance of the disability dimension, this section also compares the results of the baseline model versus an alternative model without federal disability insurance programs.

## 4.1 The ACA

The evaluation of the ACA is based on studying the joint effects of its three main components: Medicaid expansion, insurance subsidies, and the individual mandate. Medicaid expansion is equivalent to remove the categorical requirement and set $\pi$ to 1. Insurance premium subsidies are provided to people lacking access to either group insurance or Medicare. The subsidy rate declines as income rises, and the subsidy rate is zero for people with income above 400 percent of the poverty line. Table 4 reports subsidy rates by income brackets. The cutoff points of income levels are computed in the benchmark economy to match the fraction of working-age-non-disabled adults in corresponding income brackets in the ACS. The individual mandate is interpreted as a new 2.5 percent income tax placed on people lacking health insurance coverage. In the new steady state, the government also runs a balanced budget and adjusts payroll taxes to fund the additional government expenditures.

Table 4: Income levels and insurance subsidies

| Income in percent of FPL | Premium subsidy rate (CBO 2009 estimates) | Population share (Benchmark economy) |
|---|---|---|
| 0-150 | 94% | 15.4% |
| 151-200 | 77% | 7.3% |
| 201-250 | 62% | 8.1% |
| 251-300 | 42% | 7.8% |
| 301-350 | 25% | 7.2% |
| 350-400 | 13% | 6.9% |

Columns 1 and 2 of Table 5 report summary statistics of the benchmark economy and the new steady state after the ACA. The ACA will reduce the uninsured rate from 18.1 to 0.1 percent in the long run. The increased individual insurance coverage accounts for two thirds of the decline, and the increased Medicaid coverage explains the other one third. As more people obtain health insurance coverage, the fraction of GDP spent on medical expenditures increases by 4.0 percent, and the average health of working-age population rises by 2.1 percent.

Several factors affect people's demand for disability insurance. On the favorable side, the extension of health insurance coverage crowds out the demand for disability insurance through improving people's health capital and reducing the relative attractiveness of the in-kind Medicare benefits. On the adverse side, the ACA may push up the demand for disability insurance through its general equilibrium feedback that lowers after tax wages. Overall, the favorable effects dominate, and the disability rate drops from 5.7 to 4.9 percent.

The shrink of the disability rolls corresponds to an enlarged labor force. The model predicts that the ACA will increase the labor force participation rate by 0.9 percent. This implication is different from the recent CBO's estimate (CBO, 2014), because the CBO does not take into account the long-term effects of the ACA on disability decisions. The prediction along the intensive margin of labor adjustments is consistent with the CBO's estimate and the argument of Mulligan (2013): following the ACA people work for fewer hours per week due to the implicit high marginal tax rate created by the reform. By extending insurance coverage, the ACA also reduces the individual risk exposure to high out-of-pocket medical payments, and thereby lowers the precautionary saving motives and the capital stock of the economy. This observation is consistent with the findings of Gruber and Yelowitz (1999). Final output will increase by 0.2 percent in the new steady state, because the adjustment of labor force participation dominates other changes.

Table 5: Steady state comparison

| | Benchmark | ACA | No Medicaid |
|---|---|---|---|
| | (1) | (2) | (3) |
| Uninsured rate† | 18.08 | 0.13 | 0.10 |
| Medical expenditures/GDP (%) | 10.89 | 11.32 | 11.09 |
| Average health capital† | 62.96 | 64.26 | 63.97 |
| Disability rate† | 5.73 | 4.87 | 4.94 |
| Tax rate | 19.66 | 19.98 | 19.48 |
| CEV (%) | | -0.27 | 0.20 |

*Notes:* † indicates statistics among working-age people

Table 6: The effects of the ACA on government budget

| | Tax rate % | Normalization |
|---|---|---|
| | (1) | (2) |
| Reform spending | 0.65 | 100.00 |
| Medicaid | 0.59 | 89.95 |
| Subsidy | 0.07 | 10.43 |
| Mandate | 0.00 | -0.38 |
| Savings on disability assistance | | |
| Disability insurance | 0.21 | 31.94 |
| Medicare | 0.05 | 7.64 |
| Revenue increase with a fixed tax rate | | |
| Revenue increase | 0.04 | 6.82 |

Table 6 presents the effects of the ACA on government budget. Directly, the ACA will raise the equilibrium tax rate by 0.7 percentage point. The actual increase in taxes, however, are much smaller than the direct expenditures, because a large fraction of the ACA's cost could be funded internally through the changes of existing government programs. If normalize the ACA's direct cost as 100 percent, the fiscal changes associated with federal disability programs will help to pay for 46.4 percent of the cost: 31.9 percent from savings of disability insurance, 7.6 percent from savings of Medicare for people with disabilities, and 6.8 percent from revenue increase associated with larger labor supply.

To understand the welfare influence of the ACA, I compute the consumption equivalent variation (CEV) for this policy as Conesa and Krueger (1999) among others. This measure asks how much additional consumption is needed for a new born in the benchmark economy to be indifferent between living in the new economy and the benchmark economy. A positive number of CEV implies that the policy improves welfare and a negative number indicates a welfare loss. The model suggests that the ACA produces a welfare loss that is equivalent to a 0.27 percent drop of permanent consumption. This implies that gains from additional health insurance coverage do not compensate for losses from larger distortions, such as high marginal tax rates and moral hazard behaviors associated with low coinsurance rates. As discussed in the following section, I find an alternative reform without Medicaid expansion reduces these distortions and creates welfare gains.

## 4.2 No Medicaid Expansion

Expanding Medicaid coverage is the most controversial part of the ACA. According to the Kaiser Family Foundation, as of October 22, 2013, 26 states agreed to implement the expansion, and 25 states chose not to move forward at this time. This part aims to understand the effects of a health care reform without Medicaid expansion, under which all states choose not to move forward and impose the same Medicaid categorical restriction as the benchmark economy.

Column 3 of Table 5 provides summary statistics for this steady state. Relative to the ACA steady state, a reform without Medicaid expansion generates a smaller uninsured rate. This is because the margin people ineligible for Medicaid are able to purchase their coverage in the individual market. This increased participation in the individual market lowers the equilibrium premiums and thereby encourages rich people who are ineligible for subsidies to purchase coverage.

Compared to the ACA economy, those moving from Medicaid to individual plans need to pay a higher price for medical services because individual insurance plans have a higher coinsurance rate than Medicaid. In response to higher prices, this group of people accumulate less health capital. The adverse effect from the decline in health capital dominates the favorable effect from the increase in after tax wages. Overall, the disability rate in this economy is slightly higher than that in the ACA economy.

Because providing insurance subsidies is much cheaper than expanding Medicaid, the equilibrium tax rate in the new steady state is 0.5 percentage point lower than the ACA economy. The difference in cost comes from the fact that a reform without Medicaid expansion greatly diminishes the number of Medicaid patients and the associated overuse of medical services. An additional layer of benefits is that due to lower taxes this economy is able to produce more goods.

The policy without Medicaid expansion produces a welfare gain that is equal to a 0.2 percent increase of permanent consumption. The welfare gain is explained through two channels: the direct benefits of additional health insurance coverage and the indirect benefits of reduced tax rates. The equilibrium tax rate in the new steady state is 0.2 percentage point lower than the tax rate in the benchmark economy. This observation indicates the savings from disability insurance are larger than the cost of this particular reform. In sum, a plan without Medicaid expansion not only produces gains for people participating in the individual markets but also benefits the general public by reducing tax burdens.

## 4.3 No Federal Disability Insurance

To determine the importance of the disability dimension, this section considers an alternative model, in which there is no federal disability insurance. To make the size of government comparable between two models, I add an exogenous government expenditure term equivalent in size to the spending on disability assistance of the benchmark economy of the baseline model. Parameters of the alternative model are recalibrated to match the same data moments.

Table 7: Steady state changes caused by the ACA

| | w. disability (1) | w/o. disability (2) |
|---|---|---|
| % change of labor | 0.54 | 0.08 |
| % change of output | 0.23 | 0.01 |
| $\Delta$ tax rate | 0.32 | 0.58 |
| CEV (%) | -0.27 | -0.48 |

Table 7 compares the steady state changes in response to the ACA generated by two competing models. In both models, the ACA increases labor supply and output, because extending health insurance coverage raises health capital and lowers the amount of sick time. Nonetheless, the observed increases generated by the alternative model are, respectively, 85.1 and 95.9 percent smaller than those generated by the baseline model. Moreover, an alternative model indicates that the ACA will raise the equilibrium labor tax rate by 0.58 percentage point and cause a welfare loss equivalent to a 0.48 percent reduction of permanent consumption. These two numbers are 81.3 percent larger than the corresponding numbers predicted by the baseline model. Thus, omitting changes associated with disability decisions leads to underpredictions of the ACA's benefits and overpredictions of the ACA's costs.

## 5 Robustness Check

This section aims to understand whether the main mechanism of the paper—the provision of health insurance crowds out the demand for disability insurance—is robust in a variety of different assumptions. Specifically, I relax the assumption that the relative price of medical goods is constant before and after the reform. The ACA regulates insurance contracts and encourages the use of preventative care. If this provision successfully reduces the demand for expensive medical treatments, following the ACA, the relative price of medical goods will drop. Nevertheless, a recent study by Taubman et al. (2014) suggests that better insurance coverage results in higher usage of emergency services, which are far more expensive than regular doctor visits. To make a robustness check, I rerun the ACA experiment by relaxing the price assumption. Surprisingly, the steady state disability rate after the ACA is almost invariant to the price shift. This is because there are two forces working in opposite directions and canceling each other out.[18] In summary, the proposed mechanism is robust to price shifts.

## 6 Conclusion

This paper examines the long-term effects of the ACA and considers a dynamic interaction between extending health insurance coverage and the demand for federal disability insurance programs. Results suggest that the ACA will effectively raise health insurance coverage and reduce the demand for disability insurance. The cost of larger distortions induced by the ACA, however, will outweigh the mentioned benefits, and the implementation of the ACA will result in a long-term welfare loss. Nonetheless, I find an alternative plan without Medicaid expansion will produce similar benefits at a much cheaper cost and generate a long-term welfare gain.

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[18]For example, if the relative price of medical goods increases, the partial equilibrium effect indicates that people consume less medical services, have smaller health capital, and thereby be more likely to claim disability benefits; but the general equilibrium effect suggests that in response to the price change people also accumulate more precautionary savings, which raises the unit wage and the opportunity cost of claiming disability benefits. In equilibrium, these two effects cancel each other out.

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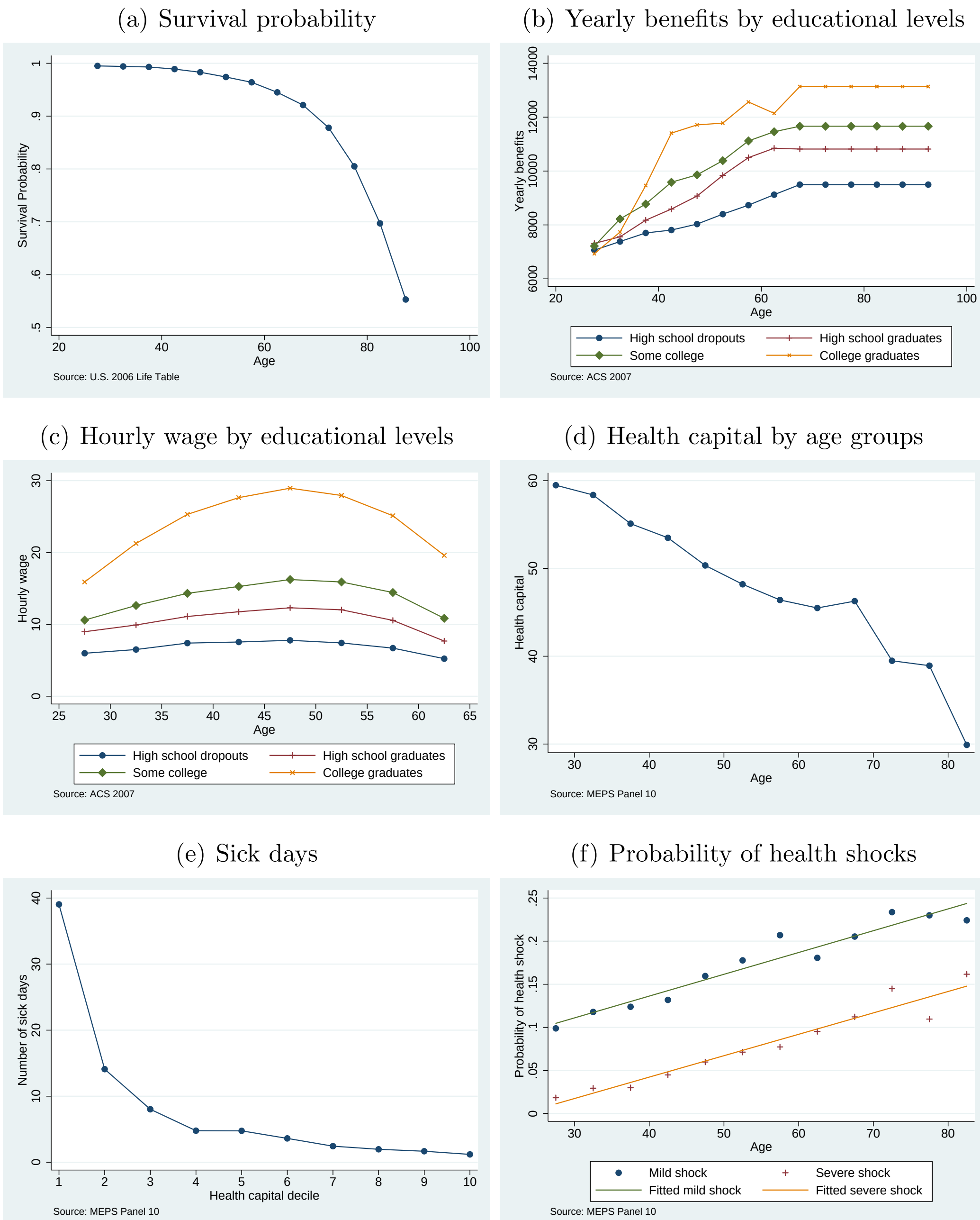


Figure 3: Features of the 2006 US economy

Table 8: A-Priori parameters

| Para. | Meaning | Value | Notes |
|---|---|---|---|
| | | Demographics | |
| $Jr$ | Retirement period | 9 | Retirement age of 65 |
| $J$ | Maximum period | 14 | Maximum age of 94 |
| $s(j)$ | Survival probability | Fig. 3 Panel A | 2006 US life table |
| | | Firm production | |
| $\alpha$ | Share of physical capital | 0.33 | Standard value |
| $\delta_k$ | Depreciation of physical capital | 0.40 | Per-year rate of 8 percent |
| $A$ | Productivity | 1.55 | Normalization |
| | | Health insurance market | |
| $\gamma_1$ | Coinsurance rate of group insurance | 0.27 | MEPS Panel 10 |
| $\gamma_2$ | Coinsurance rate of individual insurance | 0.47 | MEPS Panel 10 |
| | | Government | |
| $b(z, j)$ | Social security benefits | Fig. 3 Panel B | 2007 ACS |
| $\gamma_{care}$ | Coinsurance rate of Medicare | 0.25 | MEPS Panel 10 |
| $\gamma_{caid}$ | Coinsurance rate of Medicaid | 0.11 | MEPS Panel 10 |
| $P_{care}$ | Annual Medicare premiums | 1446 | Part B and Pard D premiums |
| $\pi$ | Categorical restriction | 0.27 | 2007 March CPS |
| | | Individual problem | |
| $Pr(z)$ | Distribution of types | Section 3 | 2007 ACS |
| $\zeta(z, j)$ | Age-Efficiency labor profiles | Fig. 3 Panel C | 2007 ACS |
| $st(h)$ | Sick time | Fig. 3 Panel E | MEPS Panel 10 |
| $P(\epsilon, j)$ | Probability of health shocks | Fig. 3 Panel F | MEPS Panel 10 |
| $\delta$ | Health capital depreciation | Table 1 | Estimates |
| $\delta_\epsilon$ | Impact of health shocks | Table 1 | Estimates |
| $\omega_1(j)$ | Effectiveness parameter | Table 1 | Estimates |
| $\omega_2$ | Curvature parameter | Table 1 | Estimates |
| $\psi$ | Elasticity parameter | -0.67 | Yogo (2012) |
| $\sigma$ | Relative risk aversion | 2 | Standard value |

Table 9: Calibrated parameters

| Para. | Value | Target | Data | Model |
|---|---|---|---|---|
| $\beta$ | 0.921 | $K/GDP$ (annual) | 3.000 | 2.994 |
| $\rho$ | 0.352 | Share of working time | 0.384 | 0.386 |
| $\lambda$ | 0.921 | Ratio of health capital for age groups 65-69 to 25-29 | 0.778 | 0.776 |
| $\underline{h}_d$ | 29.385 | Disability rate | 0.058 | 0.057 |
| $pov$ | \$26,000 | Fraction below 133% of the poverty line | 0.129 | 0.130 |

# A Algorithm

A stationary competitive equilibrium is solved using the following six steps.

1. Discretize the state space for health capital and assets by choosing a finite number of grids.
2. Guess prices $r, R, w, P_a, P_w(j)$, a tax rate $\tau$ and a transfer $Tr$.
3. Solve the model backwards for optimal policy functions at each grid point.
4. Simulate decisions of 10,000 agents by using the initial distribution and the policy functions derived in step 3.
5. Update prices, the tax rate and the transfer using market clear conditions, insurance firm's zero profit conditions, the government budget constraint, and the rule of transfers.
6. Repeat from step 3 until convergence.