The Affordable Care Act in an Economy with Public Disability Insurance*

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Abstract

This paper examines the effects of the Affordable Care Act (ACA) by considering an important interaction between health insurance and disability insurance, which has received little attention in prior literature. Since the ACA provides insurance coverage to the otherwise uninsured, it increases this group's health investment and reduces their demand for disability insurance. In order to capture this dynamic link, the paper extends the Bewley-Huggett-Aiyagari incomplete markets model by endogenizing health accumulation, insurance, and disability decisions. The model is calibrated to match the 2006 U.S. economy and used to examine the influence of three main components of the ACA: Medicaid expansion, insurance subsidies, and the individual mandate. Findings suggest that the ACA raises tax rates, but reduces the fraction of working-age people receiving disability benefits from 5.7 to 4.9 percent. The associated increase of labor force participation offsets the reduction of working hours and capital, and causes a rise of output by 0.2 percent. Furthermore, 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 revenue by 7 dollars with a fixed tax rate. Relative to the ACA, a health care reform without Medicaid expansion reduces total tax burdens and improves welfare.

Keywords: *Health Care Reforms, Social Security, Welfare Analysis*

JEL Classification: *E21; E62; H51; H55; I13; I18*

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1 Introduction

The Affordable Care Act (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, net cost of the insurance coverage provision of the ACA is $1,168 billion for the period of 2012-2022. On the flip side, if all states choose to expand Medicaid, the ACA will increase the number of non-elderly Americans with health insurance by about 34 million in 2021.[1]

The starting point of this paper is the observation that the provisions of the ACA are likely to interact with pre-existing government programs. The specific program I focus on is public 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 disability benefits, that was 6.2 percent of the US residents aged 18-64. In this paper I argue that the ACA, by expanding health insurance coverage to the previously uninsured, will improve this group's health capital, increase their labor force participation, and reduce their demand for disability insurance.[3] This mechanism implies that by implementing the ACA, the federal government is likely to save money on disability assistance, the size of which is comparable to the estimated annual cost of the ACA. In 2011 the Social Security

[1] More details about the ACA's provisions can be found in Appendix A and the Public Law 111-148 http://www.gpo.gov/fdsys/pkg/PLAW-111publ148/pdf/PLAW-111publ148.pdf.

[2] In the US, there are two types of public disability insurance: the Social Security Disability Insurance (SSDI) provides disability benefits for "insured workers" who worked long enough and paid Social Security taxes; the Supplemental Security Income program (SSI) is another federal program that provides assistance to people with disabilities based on financial need. More details of disability benefits are available in Appendix B.

[3] Massachusetts' experience with health care reform is supportive of this mechanism, and details of the MA results are reported in Section 2.

Administration issued $150.3 billion of disability benefits, while the projected annual cost of the ACA is $106.2 billion for 2012-2022. Taking into account the interaction between health care reform and disability insurance, this paper aims to quantify the effect of the ACA on a broad set of variables, including the government budget, measures of labor supply, income and welfare. By incorporating a disability dimension, this paper also offers a new perspective on the current debate about health care reforms.

In order to provide a quantitative assessment of the ACA's costs and benefits, this paper extends the Bewley-Huggett-Aiyagari incomplete markets general equilibrium framework to allow for endogenous decisions of health capital, insurance, and disability.[4] To the best of my knowledge, this is the first paper that endogenizes all three 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. The drop in the disability rate corresponds to an increase in the labor force participation rate by 0.9 percent. This increase offsets reductions in working hours and capital, leading to an increase in output by 0.2 percent. These findings about labor supply and output are different from previous studies that do not consider a disability margin. Second, the ACA reduces government spending on disability assistance and increases government revenue by enlarging taxable income. 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 increases revenue by 7 dollars even with a fixed tax rate. Last, an alternative health care reform 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 on disability, insurance, consumption, savings, leisure, labor, and medical expenditures. The marginal cost of medical services differs by insurance status. Uninsured agents facing a high price invest less in health capital and are more likely to become disabled. Key parameters of

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

the model are calibrated to match the 2006 US economy, one year before the Great Recession. The calibrated model successfully matches data along several dimensions that are not targeted, such as aggregate statistics about the insurance sector and medical expenditures, changes of 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.

Using the model, this paper examines the long-term effects of three main components of the ACA: Medicaid expansion, insurance subsidies, and an individual mandate. Besides the main findings as previously stated, the ACA also reduces the fraction of working-age people without health insurance (hereinafter referred to as uninsured rates) from 18.1 to 0.1 percent. The benefits from increased insurance coverage are smaller than the costs from increased taxes, such that the ACA produces a welfare loss that is 0.3 percent of consumption.[5] Regarding the three components, I find that insurance subsidies and the individual mandate are the necessary provisions to fix the adverse selection problem in the individual market. Removing either of these two components results in a substantial increase of uninsured rates and a large welfare loss. On the contrary, keeping Medicaid at the before reform level encourages more people to participate in the individual insurance market and reduces the equilibrium premiums and the uninsured rate. If the government provides insurance subsidies to people with income below the poverty line, a reform without Medicaid expansion produces a welfare gain that equals 0.2 percent of consumption.

To determine whether the disability dimension is crucial in evaluating the long-term effects of health care reforms, I also simulate the effects of the ACA using an alternative model in which the disability option is removed. Removing the disability dimension leads to underestimates of the benefits and overestimates of the costs of health care reforms. In

[5]This loss is not a small number in macroeconomic analysis, since the welfare gain from eliminating all consumption fluctuations is about 0.05 percent of consumption (Lucas, 2003).

particular, the fiscal and welfare costs of the ACA simulated by the alternative model are 81.3 percent larger than those simulated by the main model with disability options.

This paper is related to five strands of literature. The first strand of literature analyzes the effects of the liberalized disability screening process after the 1984 disability reform (Autor and Duggan, 2006; Duggan and Imberman, 2009; Autor, 2011).[6] Based on their argument that under the current regime disability decisions are endogenous choices, I study the effects of the ACA on the disability rolls. The second strand of literature is empirical studies that identify a causal relationship between health insurance coverage and health outcomes (Newhouse et al., 1993; Currie and Gruber, 1996; Dow et al., 1997; Doyle, 2005; Courtemanche and Zapata, 2012; Finkelstein et al., 2012; Baicker et al., 2013). Evidence found in these studies is supportive of the main mechanism of this paper—by providing insurance coverage, the ACA improves health outcomes and reduces the demand for disability insurance since healthy people have better alternatives than being on the disability rolls. The third strand of literature is the emerging macro-health literature that endogenizes medical expenditures and health accumulation (Murphy and Topel, 2006; Suen, 2006; Hall and Jones, 2007, Jung and Tran, 2008; Yogo, 2012; Prados, 2012; Zhao, 2012; Halliday, He and Zhang, 2012; Ales, Hosseini and Jones, 2012; Córdoba and Ripoll, 2013). My work extends this literature by considering a disability choice, which is closely related to the stock of health capital. The fourth 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 looking at the interaction between health care reforms and the demand for disability insurance. The last strand of literature looks at the connection between health insurance and disability: Gruber and Kubik (2002) and Maestas, Mullen and Strand (2012) investigate the effect of existing health insurance coverage on disability applications; Kitao

[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 under the relaxed criteria.

(2013) adds exogenous medical expenditures to the framework of Low and Pistaferri (2011) and studies the effect of Medicare benefits on disability decisions. Different from these studies, this paper focuses on the long-run effects of health care reforms in a model with health accumulation.

The paper is organized as follows: Section 2 presents empirical evidence about the relationship between health insurance and disability insurance; Section 3 introduces a one period model to illustrate the main mechanism; Section 4 introduces an overlapping generations model used for quantitative analysis; Section 5 presents the specification, calibration, and evaluation; Section 6 implements policy experiments; Section 7 compares the results of the main model with those generated by an alternative model without disability options; Section 8 presents robustness checks; and Section 9 concludes.

2 Empirical Evidence

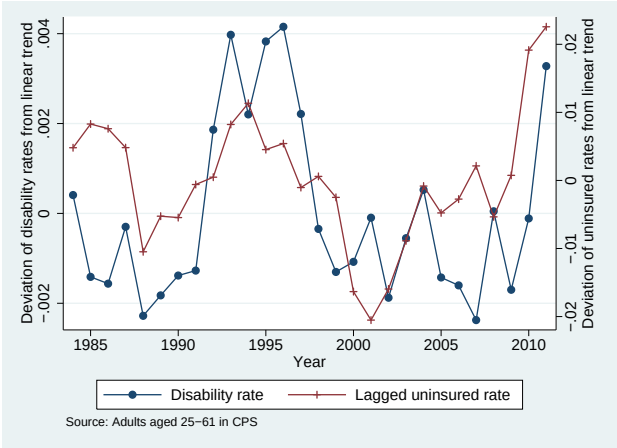
Sections 2.1 and 2.2 use cross-state variations to identify the connection between health insurance coverage and disability rates.

2.1 Cross-State Evidence

Aiming to understand the link between health insurance coverage and disability decisions, this section explores changes of insurance rates and disability rates from 1984 to 2012 using the March Current Population Survey (CPS). Throughout the observational window, respondents in each March CPS are asked about their health insurance coverage and the amount of income they received from the Social Security or the SSI in the previous year. A person is coded as receiving disability benefits if she receives positive income from either of these two sources. Because people can claim social security retirement benefits as early as

age 62, it is hard to tell the reasons for receiving social security benefits among people older than 62. Thus, the sample is restricted to respondents aged 25-61. Furthermore, as the majority of people receiving disability benefits are covered by public insurance, including insurance status of the disabled group weakens the relationship between uninsured rates and disability rates. Thus, only insurance status of non-disabled people is considered in the computation of uninsured rates. During the 23 year span, both uninsured and disability rates rose substantially: the uninsured rate changed from 13.7 to 19.2 percent, and the disability rate changed from 3.7 to 5.5 percent. Increases in both series are partially attributed to a common trend generated by changes of the underlying economy, but beyond that, their deviations from the linear trends are also correlated. In particular, the current uninsured rate is a predictive factor for the future disability rate. As Figure 1 displays, the deviation of disability rates is positively correlated with the lagged deviation of uninsured rates: they both have the troughs around 1988 and 2001, and the peaks around 1995 and 2011.

Figure 1: Deviations of disability and uninsured rates from linear trends



In order to quantify this relationship, I further examine the cross-state differences of disability and uninsured rates using a regression as specified in equation (1).

$$DR_{st} = \beta_1 UI_{st-1} + \beta_2 UE_{st-1} + \alpha_s + \beta_3 t + \beta_4 t^2 + \epsilon_{st} \tag{1}$$

where DR_{st} is the disability rate in state s and year t, UI_{st-1} is the uninsured rate in state s and year $t-1$. The specification includes controls for lagged local unemployment rates UE_{st-1} (collected from the Bureau of Labor Statistics), state dummies α_s. and time trends. ϵ_{st} is a random disturbance term capturing all omitted influences. In order to avoid the influence from the Great Recession, the time period is from 1984 to 2006.

Table 1: Disability and lagged uninsured rates: cross-state variations for 1984-2006

VARIABLES	Rate of disability
Lagged uninsured rate	0.0285**
	(0.0137)
Lagged unemployment rate	5.73e-05
	(0.000242)
Constant	0.0556***
	(0.00332)
Observations	1,173
R-squared	0.809

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1 reports the results. The coefficient of lagged uninsured rates is positive and significant at the 0.05 level but the coefficient of lagged unemployment rates is small and insignificant. Applying this point estimate of 0.285 to historical changes of disability and uninsured rates implies that the increase of uninsured rates explains 8.3 percent of the increase of disability rates between 1984 and 2006.

2.2 Evidence from Massachusetts

In order to obtain a clean identification of the causal relationship between increased insurance coverage and reduced demand for disability insurance, this section examines the effect of the 2006 Massachusetts (MA) health care insurance reform. Both the MA reform and the ACA subsidize health insurance premiums for poor families, impose individual and employer mandates, assist with paying preventative cares, and expand Medicaid coverage.

To a large extent, the result of the MA reform could be assumed to be similar to that of the ACA.

The analysis is based on a difference-in-differences research design that compares percent of disability beneficiaries of MA with the other five New England States: Connecticut (CT), Maine (ME), New Hampshire (NH), Rhode Island (RI) and Vermont (VT).[7] As a preview to the formal regression, Figure 2 displays the percent of disability beneficiaries, including both SSI and SSDI beneficiaries, among the resident population aged 18-64 in MA and the other five New England states.[8]

Figure 2: Disability rates of the resident population aged 18-64 in New England states

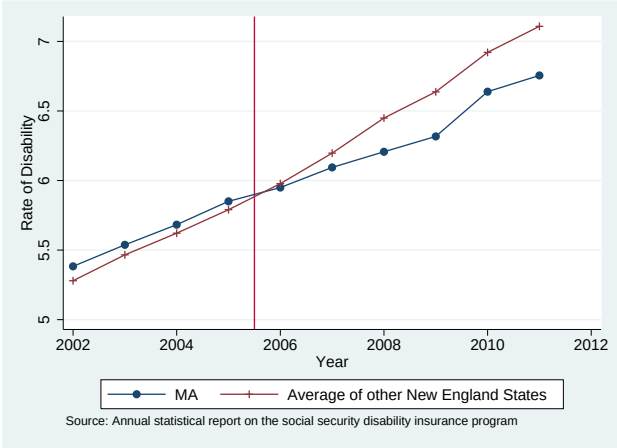


Figure 2 makes clear that before the 2006 reform, the disability rate in MA was larger than the average of the other five New England states. After the 2006 reform, the average disability rate of the other states exceeded MA's. By the end of year 2011, the disability rate in MA was 0.4 percentage point smaller than the average of the other five states.

In order to quantify the post reform effect, a regression equation is specified as follows.

$$DR_{st} = \beta_1(MA_s * POST_t) + \beta_2 X_{st} + \alpha_s + \nu_t + \epsilon_{st} \tag{2}$$

[7]This approach is similar to the one used by Maestas, Mullen and Strand (2012), but their paper looks at application rates and uses a shorter period (from 2002 to 2008) than this paper.

[8]The disability numbers are collected from the Annual Statistical Report on the Social Security Disability Insurance Program, which started to report this number in 2002.

where DR_{st} is the disability rate in state s and year t, MA_s is an indicator for Massachusetts, and $POST_t$ is an indicator for the post reform period (beginning in 2006). The specification includes controls for state-year level economic conditions X_{st} (e.g., unemployment rates), state dummies α_s and year dummies ν_t. ϵ_{st} is a random disturbance term capturing all omitted influences. The coefficient of the interaction term β_1 measures the decline of disability rates in MA after the reform relative to the five control states.

Table 2: Effects of the Massachusetts reform

VARIABLES	Rate of disability
MA*Post	-0.371***
	(0.0861)
Observations	60
R-squared	0.982

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2 reports the results. The coefficient of the interaction term is -0.371, which is negative and statistically significant at the 0.01 level. During the same period, the percent of uninsured adults aged 25-64 in MA dropped from 10.6 in 2005 to 4.3 percent in 2011. These three numbers indicate that a 1 percentage point drop of the uninsured rate causes a 0.06 percentage point drop of the disability rate. Applying the MA's result to the rest of the US implies that in the most optimistic scenario the ACA would help to reduce the country-level disability rate by 1.1 percentage point, a reduction of more than one sixth.

3 One Period Model

This section presents a one period model to illustrate the main mechanism that a health care reform aiming to make health care affordable can help to reduce the demand for disability insurance, and in turn, the savings from disability insurance help pay for the reform's cost. The economy is populated by heterogeneous agents with different income

endowments. Agents face an idiosyncratic health shock and decide whether to purchase health insurance plans before the shock is revealed. The government runs a public disability program paying cash benefits for those with bad health outcomes, i.e., disability. Agents in the economy derive utility from consumption c and health capital h. When making an insurance decision, agents compare the benefits of better health to the costs of reduced consumption. In the benchmark economy, only agents with a high endowment voluntarily purchase health insurance, and agents with a small endowment decline insurance coverage and choose to stay with a bad health outcome when a shock occurs. This static model aims to show that if the government makes health care affordable to agents with small endowments, the fraction of agents receiving disability benefits falls accordingly. This section contains four propositions, and proofs of these propositions are in Appendix C.

3.1 Benchmark Economy

At birth, agents have the same initial health capital $\overline{h}$ but get a random draw z from an endowment space $[\underline{z}, \overline{z}]$. The utility function is assumed to be an additive logarithmic form $u = \ln c + \alpha \ln h$, where α is a weight attached to health capital. With a 0.5 probability, an idiosyncratic health shock ϵ occurs, which lowers individual health capital to $\underline{h}$. Agents with a negative health shock choose whether to use health care, which costs m units of consumption goods and raises their health capital to the status quo $\overline{h}$. For simplicity, this decision is restricted to be a binary choice: either full care or no care. Before a health shock is revealed, agents decide whether to purchase a health insurance plan, which covers the full medical cost with premiums $P = 0.5m$. The government collects a flat rate tax τ on endowments and pays disability benefits b to agents with bad health outcomes $\underline{h}$. The government maintains a balanced budget such that $\int_z \tau z f(z) = \int_z b I(h(z) = \underline{h}) f(z)$, where $f(\cdot)$ is the density function for the endowment distribution, $I(\cdot)$ is an indicator function that equals one if the condition in parentheses is true, and $h(\cdot)$ is the decision rule implied

by the individual problem, which is illustrated in the following game tree.

Figure 3: Game Tree Illustration for the Static Model

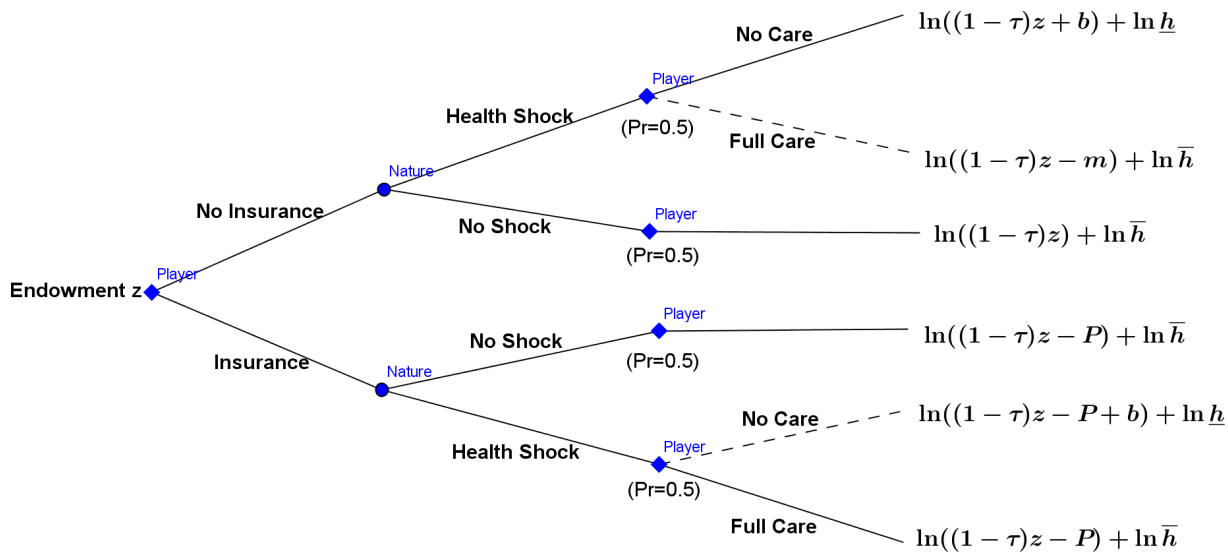


Figure 3 presents the game tree, in which agents have four possible strategies that differ in insurance and health care decisions. It is easy to find two strictly dominant pairs: the strategy of declining insurance coverage and having no care dominates the strategy of obtaining insurance coverage and having no care; the strategy of obtaining insurance coverage and having full care dominates the strategy of declining insurance coverage and having full care. Thus, agents are left with two choices: with insurance (get full care when a negative shock occurs) and without insurance (get no care when a negative shock occurs).

Proposition 1. *If the agent with the largest endowment $\overline{z}$ obtains insurance coverage and the agent with the smallest endowment $\underline{z}$ declines insurance coverage, there exists a cutoff point z^* such that agents with an endowment smaller than the cutoff point decline insurance coverage and agents with an endowment larger than the cutoff point obtain insurance coverage.*

The proposition indicates that agents with a large endowment participate in the insurance market and maintain high health capital; and agents with a small endowment decline

health insurance coverage and receive disability benefits if a negative shock occurs. The cutoff point that separates these two types of agents is a function of insurance premiums or the cost of medical services m. As the cost of health care increases, more agents will take the risk of being uninsured. The cutoff point also depends on the amount of disability benefits that are available. As disability insurance becomes more generous, more agents decline insurance coverage.

This economy differs from an economy without disability insurance in two important aspects. First, in an economy without disability insurance, the cutoff point for obtaining insurance coverage is smaller than in this economy. As such, disability benefits crowd out the demand for private health insurance. Second, unhealthy agents have higher utility in this economy than an alternative economy without disability insurance, because disability program provides cash transfers for people with bad health outcomes. As a result, even without health care reforms, the cost of being uninsured is shared by all agents through taxes.

3.2 Policy Reform

Aiming to make health care affordable for agents with small endowments, the government introduces a new policy. For simplicity, I assume that the government perfectly observes agents' endowments, provides free health care for agents with $z \leq z^*$, and extends the same free care to agents who will receive disability benefits. Agents eligible for the government provision are free to choose whether to take it. In this economy, the tax rate is adjusted accordingly to maintain a balanced budget. If several allocations satisfy the above conditions, I assume that the government picks the one with the smallest tax rate.

Proposition 2. *If $m < b$, the policy reduces the number of disability beneficiaries and makes all agents better off.*

Proposition 3. *If $m = b$, the policy reduces the number of disability beneficiaries and is a*

Pareto improvement.

Proposition 4. *If $m > b$ and the agents on the left and the right tails of the endowment distribution keep choosing the same decisions, the policy makes these two groups worse off. The policy has ambiguous effects on the number of disability beneficiaries and the utility of agents in the middle of the endowment distribution.*

This set of propositions indicates that there is a substitution between health insurance and disability insurance: as agents receive free health care provided by the government, their demand for disability insurance drops. On the flip side, government expenditures are funded by taxes. As medical cost increases, tax burdens used to fund the health care reform also raises. If health care is cheaper than disability benefits, the policy is able to reduce equilibrium tax rate and improve ex-post utility. As the cost of health care increases, the gains from providing free care decline. If health care is too expensive, the same policy reform may even generate an ex-ante utility loss.

The one period model captures the substitution between health insurance and disability insurance, but it fails to account for life-cycle changes of health capital. This dimension is important, because it justifies the reasons for using insurance subsidies and the individual mandate to bring the healthy youth with limited financial resources into the individual market. Without modeling life-cycle changes of health capital, however, it is impossible to capture changes of incentives for purchasing individual health insurance over the life cycle. Furthermore, the one period model assumes that the distribution of income endowments is unchanged over time, and as such is not capable of predicting changes of output and taxable income in response to the policy's enactment. This static model also does not capture the variety of public and private insurance options in the market. One important part of the ACA is Medicaid expansion. Compared to private insurance, the coinsurance rate of Medicaid is much lower and thereby Medicaid patients are more likely to overuse medical services. This overuse is eventually funded by an increase of taxes and shared by

all taxpayers. Last, it is hard to capture the details of the ACA using a simple one period model. For these reasons, I develop a full-fledged overlapping generations model.

4 Overlapping Generations Model

Each period, agents make a two-stage decision. In the first stage, agents choose their disability status and insurance coverage. In the second stage, after observing a health shock, agents make decisions on consumption c, leisure l, labor n, savings a' and medical expenditures m. In the economy, there are two firms: a representative production firm producing final goods and a representative insurance firm offering insurance contracts. The government collects a flat rate tax on labor income and pays for Social Security programs and public health insurance programs, including both Medicaid and Medicare.

4.1 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 claim disability benefits if her health capital falls under a disability criterion set by the government. Receiving disability benefits and working are two exclusive states, and thereby people on the disability rolls are restricted from working for one period. 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.[9] The savings of deceased agents are collected and redistributed equally to all alive agents.

[9]Survival probability is exogenous, because this paper focuses on health investment of working-age agents. As shown in Figure 3 of Halliday, He and Zhang (2012), removing the survival motive has almost no effect on medical expenditures of people under age 65. Without the survival motive, medical expenditures of retirees are lower, but this motive only accounts for 7 percent of retirees' medical expenditures. Although changes of late periods may affect decisions of early periods, the effects should not be different before and after a health care reform. Thus, this paper simply abstracts from the survival motive and assumes survival rates are a function of age.

4.2 Individual Problem

Agents are born into different types. The probability of the type z is denoted as $Pr(z)$. This type determines their initial health capital, group insurance status (whether receive group insurance offers), and labor ability.[10] Labor ability affects two aspects of an individual's lifetime opportunities: an age-efficient labor profile $\zeta(z, j)$ and Social Security entitlements $b(z, j)$. Whether agents receive group insurance offers is denoted by $g(z)$, which takes a value of 1 for those receiving offers.

Figure 4: Timing of decisions

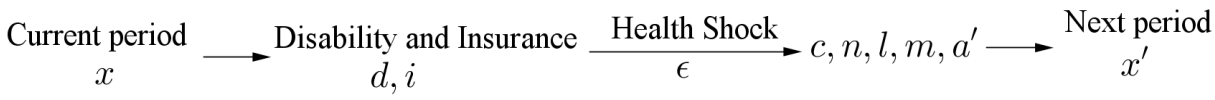


Figure 4 presents the timing of decisions. At the beginning of each period, agents are characterized by a state vector $x = (z, j, h, a, e)$, where h is the current health capital, a is the amount of assets, and e represents Medicaid coverage.[11] At the first period, all agents have zero assets and no Medicaid coverage. The initial health capital depends on types z. Given a state vector, agents make their first stage decisions on disability and insurance. People with health capital below the eligibility criterion of disability insurance ($h < \underline{h}_d$) will be awarded disability benefits if they apply, but agents with health capital above the criterion are not eligible for benefits. The package of disability assistance includes both cash benefits and Medicare coverage. The model denotes the disability status as d, which equals

[10] For simplicity, this paper abstracts from dynamic changes of group insurance status, since the status is very persistent in data. For example, the Medical Expenditure Panel Survey asks questions about whether a person receives a group insurance offer for five times over a two-year span. During this window, 94.3 percent of people under 65 years old report the same answer.

[11] This paper models Medicaid as an explicit contract rather than a consumption floor, because before the ACA many states have categorical restrictions for Medicaid and there is no guarantee of eligibility conditional on hitting the consumption floor. Generally in order to get Medicaid coverage, people need to be in one of the following five categories: children up to age 19; pregnant women; parents (and other caretakers of children) in families with dependent children; individuals with serious disabilities; and the elderly. Because of these categorical restrictions associated with life events, this model assumes that if a person's current income is below an eligibility threshold *pov* (an income restriction) and without Medicare or group insurance (an insurance restriction), in the next period, she has a chance of π to obtain Medicaid coverage.

1 if an agent receives disability benefits and 0 otherwise. In terms of health insurance, the model assumes that depending on eligibility an agent will enroll into a health plan in the order of Medicaid, Medicare, and group health insurance.[12] Agents, who are not eligible for these three options, are free to choose between individual health insurance and no coverage. The insurance status is denoted as i. i takes the value of 0 for no insurance, 1 for group health insurance, 2 for individual health insurance, 3 for Medicare, and 4 for Medicaid.

Between the first and the second stages, a health shock, denoted as ϵ, is revealed.[13] The health shock ϵ takes three values: 0 for no shock, 1 for a mild shock, and 2 for a severe shock. The probability distribution of health shocks $P(\epsilon, j)$ depends on age. Older agents have a larger chance of incurring both mild and severe shocks. Conditional on a state vector x, disability status, first stage decisions, and the health shock, agents make decisions on leisure, labor, consumption, medical expenditures, and savings. Agents in the economy derives utility flows from consumption, leisure, and health capital.

The law of motion for health capital is specified similarly to the health production function introduced by Grossman (1972): future health capital depends on current health capital and medical expenditures. Besides a common depreciation term, this paper also allows future health capital to depend on health shocks, which functions like a random depreciation component as discussed in Grossman (2000).

$$h' = (1 - \delta)h - \delta_\epsilon \epsilon + \omega_1(j) m^{\omega_2} \tag{3}$$

where δ is the common depreciation rate of health capital, δ_ϵ represents additional depre-

[12]The assumption that agents with a group insurance offer accept the offer is consistent with empirical observations. Gruber and Washington (2005) find that the average take-up rate of employers' offered insurance is 75 percent, but the majority of individuals opting out of employers' plan are covered by other family members. The uninsured rate among this group is only 7 percent.

[13]Because people need to wait at least five months or as long as several years to get a disability award upon filing an application, the model assumes that people with bad health shocks can only claim disability benefits in the next period. Although insurance decisions are made based on expectations of future health shocks, this assumption does not exclude the adverse selection problem in the individual insurance market. Ceteris paribus, an unhealthy person is more likely to enroll into individual health plans due to high-expected demand for medical services.

ciation caused by a health shock ϵ, and $\omega_1(j)$ and ω_2 are the parameters governing the process of transforming medical expenditures into health capital.

Given prices and taxes, the individual dynamic problem solved by an individual of age $j = 1, \ldots, Jr - 1$ can be written as followed.[14]

$$V(x) = \max_{d,i} E_{\epsilon|j}\{\max_{c,n,l,m,a'} u(c,l,h) + \beta s(j) E_{e'|x,n} V(x')\} \tag{4}$$

$$s.t. \quad c + a' + Q(m,i,j) \leq (1-\tau) w \zeta(z,j) n I(d=0) + b(z,j) I(d=1) + (1+r)a + Tr \tag{5}$$

$$n + l + st(h) \leq 1 \tag{6}$$

$$h' = (1-\delta)h - \delta_\epsilon \epsilon + \omega_1(j) m^{\omega_2} \tag{7}$$

$$a' \geq 0 \tag{8}$$

$$i \in \begin{cases} \{4\} & \text{if} \quad e = 1 \\ \{3\} & \text{if} \quad e = 0, d = 1 \\ \{1\} & \text{if} \quad e = 0, d = 0, g(z) = 1 \\ \{0,2\} & \text{otherwise} \end{cases} \tag{9}$$

$$d \in \begin{cases} \{0,1\} & \text{if} \quad h < \underline{h}_d \\ \{0\} & \text{otherwise} \end{cases} \tag{10}$$

where $V(x)$ denotes the value function and β is the discount factor between two periods. Between periods, agents face uncertainty about survival and Medicaid coverage (details are available in Section 4.3). Condition (5) corresponds to an individual budget constraint, where Tr is a lump-sum transfer, w is a wage rate, τ is the payroll tax rate, r is an interest rate, and $Q(m,i,j)$ is health related expenditures, which include both insurance premiums and out-of-pocket medical expenditures. This amount depends on the period number because individual insurance premiums are a function of age. More details about the function $Q(m,i,j)$ are discussed in Section 4.4. Condition (6) corresponds to a time

[14]The model abstracts from federal income taxes, because payroll taxes are more important than federal income taxes for the simulated agents. According to the NBER TAXSIM rates, the majority of agents in this model do not pay federal income taxes, and only top earners have a marginal tax rate of 15 percent.

constraint for workers. Each period, agents are endowed with one unit of time, but need to spend some days in bed as sick time $st(h)$. The amount of sick time is a decreasing function with respect to health capital $\frac{\partial st(h)}{\partial h} < 0$. After deducting sick time, agents are able to allocate the residual time between leisure l and labor n. For disability beneficiaries, they are restricted from work and thereby their leisure is $1 - st(h)$. Equation (7) is a law of motion for health capital. Condition (8) is a borrowing constraint. Conditions (9) and (10) 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, health capital directly enters the utility function. Second, larger health capital reduces the amount of sick time. 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.

The problem of retirees is simpler than working-age agents and could be expressed as followed.

$$V(x) = E_{\epsilon|j}\{\max_{c,m,a'} u(c,l,h) + \beta s(j)V(x')\} \tag{11}$$

$$s.t. \quad c + a' + Q(m, i = 3, j) \leq b(z,j) + (1+r)a + Tr \tag{12}$$

Notice that all retirees receive retirement benefits, have Medicare coverage, and do not work.

4.3 Government

The government operates public health insurance programs and Social Security programs, which include both retirement and disability programs. For the disability program, the government sets an eligibility criterion $\underline{h}_d$ and only agents with $h < \underline{h}_d$ are qualified to apply for benefits. All people reaching the retirement age receive retirement benefits.

Public health insurance programs have two components: Medicaid and Medicare. Medicaid provides health insurance coverage for agents without Medicare or group insurance (hereinafter referred to as an insurance restriction) and with limited income (hereinafter referred to as an income restriction). Medicaid is characterized by a coinsurance rate γ_{caid}, zero premiums, and an income cutoff pov. In the benchmark economy, due to categorical restrictions (depicted in footnote 11), the model sets π to represent the probability of having Medicaid coverage conditional on satisfying income and insurance restrictions. Medicare provides health insurance coverage for agents receiving Social Security payments. Medicare plans are characterized by a coinsurance rate γ_{care} and premiums P_{care}. The government maintains a balanced budget and sets a flat rate tax τ on labor income to pay for government expenditures.

4.4 Firms

A representative insurance firm offers two types of insurance contracts: group insurance and individual insurance contracts. The group insurance contract is characterized by a coinsurance rate γ_1 and premiums P_1. The individual insurance contract is characterized by a coinsurance rate γ_2 and age specific premiums $P_2(j)$. Given insurance features, health related expenditures $Q(m, i, j)$ can be expressed as follows.

$$Q(m,i,j) = \begin{cases} m & \text{if} \quad i = 0 \\ P_1 + \gamma_1 m & \text{if} \quad i = 1 \\ P_2(j) + \gamma_2 m & \text{if} \quad i = 2 \\ P_{care} + \gamma_{care} m & \text{if} \quad i = 3 \\ \gamma_{caid} m & \text{if} \quad i = 4 \end{cases} \tag{13}$$

where uninsured agents pay for all medical expenditures out of pocket and insured agents pay for insurance premiums and a fraction of the actual medical costs.

The insurance firm sets premiums to maximize profits. Group and individual insurance markets are separated and there is no cross-subsidization between the two markets. Since the insurance market is competitive, equilibrium conditions imply that profits are zero.

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.

$$\max_{K,L} AK^{\alpha}L^{1-\alpha} - RK - wL \tag{14}$$

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

4.5 Stationary Competitive Equilibrium

Let $z \in \mathbf{Z} = \{z_1, z_2, \ldots, z_n\}$, $h \in \mathbf{H} \subseteq \mathbf{R}_+$, $a \in \mathbf{R}_+$, $j \in \mathbf{J} = \{1, 2, \ldots, J\}$, $e \in \mathbf{E} = \{0, 1\}$, $d \in \mathbf{D} = \{0, 1\}$, $i \in \mathbf{I} = \{0, 1, 2, 3, 4\}$, and $\epsilon \in \boldsymbol{\Upsilon} = \{0, 1, 2\}$. Let $\mathbf{S} = \mathbf{Z} \times \mathbf{H} \times \mathbf{R}_+ \times \mathbf{J} \times \mathbf{E}$. Let $\mathbf{B}(\cdot)$ be a Borel σ-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 policies $\{\tau, b(z), P_{care}, \gamma_{caid}, \gamma_{care}, \underline{h}_d\}$, a lump-sum transfer Tr, policy functions $d : \mathbf{S} \to \mathbf{D}, i : \mathbf{S} \times \mathbf{D} \to \mathbf{I}, c, l, n, m, a' : \mathbf{S} \times \mathbf{D} \times \mathbf{I} \times \boldsymbol{\Upsilon} \to \mathbf{R}_+$, and measures $\Phi \in \mathbf{M}$ such that the following conditions hold.

1. Given prices, government policies, 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.

5 Specification, Calibration, and Evaluation

The benchmark economy is set to match the 2006 US economy. The information about that year's economy is collected from three sources: the Medical Expenditure Panel Survey (MEPS Panel 10), the March Current Population Survey (2007 March CPS), and the American Community Survey (2007 ACS). The MEPS Panel 10 is a two-year panel survey with detailed individual records on demographic features, health conditions, medical diagnoses, and medical costs. Since the MEPS has a relatively small sample and contains a non-trivial amount of missing variable, as a supplement, I use the 2007 CPS to collect health insurance statistics and the 2007 ACS to collect statistics about labor markets and social security programs. Most parameters of the model are directly estimated from the data, but a few important parameters are calibrated by solving the model, in which prices, insurance premiums, the labor tax rate, and the lump-sum transfer are determined endogenously. This section explains the specification and calibration of important parameters, and the full list

of parameters is provided in Table 9. In order to evaluate the model, this section also reports the model's fit for the moments that are not targeted.

5.1 Demographics

One period in the model is defined as five years. Agents 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 period are set to match the 2006 US life table (Figure 7 Panel A).

5.2 Individual Types

Individual types z can take eight values that correspond to the combinations of four educational levels (high school dropouts, high school graduates, with some college and college graduates) and two group insurance types. The probability of having group insurance offers conditional on education is set to the share of agents in each educational level that answered yes to the question "Health Insurance Offered" in any of the five rounds of the MEPS Panel 10. In the sample, high school dropouts have a 60 percent probability of receiving a group insurance offer. This probability rises as agents have higher educational attainments, which is 78, 80, and 87 percent for high school graduates, people with some college, and college graduates, respectively. The probability distribution of types $Pr(z)$ is computed based on the share of adults in each educational level and the mentioned conditional probabilities of receiving a group insurance offer. The amount of Social Security entitlements $b(z, j)$ is set to average benefits reported in the 2007 ACS (Panel B of Figure 7). In particular, the amount of retirement benefits for each educational level is average Social Security benefits for all retirees in the corresponding category. The amount of disability benefits is average income from both SSDI and SSI among respondents receiving

positive income from either of these two sources. Age-efficient labor profiles $\zeta(z, j)$ are set to the product of hourly wages of full-time-full-year workers (Panel C of Figure 7) and the time endowment, which is a standard value of 5200 hours per year (Ales, Hosseini and Jones, 2012).

5.3 Health Capital

In order to avoid changes of reference points of subjective health measures over the life cycle, the model constructs a measure of health capital based on the responses to a set of relatively objective questions, the Short-Form 12 (Ware, Kosinski, and Keller, 1996).[15] The MEPS forms two summary scores—physical component summary (PCS) and mental component summary (MCS)—based on the responses to these 12 short questions. These two summary scores are normalized measures with a mean of 50 and a standard deviation of 10. Because both physical and mental conditions are important aspects of health, the model constructs a health capital measure by summing up these two scores and then transforming the sum into a percentile score measure. In the new scale, if an agent has the health capital of 50, it means her health conditions are better than 50 percent of the 2006 US population. The initial values of health capital are assigned to average values of health capital by educational categories for the MEPS respondents between ages 25 and 29, which are 57.5, 58.1, 58.4, and 64.5 for high school dropouts, high school graduates, people with some college, and college graduates, respectively. Figure 7 Panel D displays the life-cycle change of health capital, which goes down from 59.5 for the youngest age group to 29.9 for the oldest age group.

[15] Short-Form 12 contains the following 12 questions: limitations in performing moderate physical activities, such as moving a table; limitations in climbing several flights of stairs; extent to which pain interfered with normal work; whether one accomplished less than she would like at work or other regular activity as a result of her physical health; whether one were limited in kind of work or other activities as a result of her physical health; how often one felt calm and peaceful; how often one felt downhearted and blue; whether one accomplished less than she would like at work or other regular activity as a result of emotional problems; whether one did not do work or other activities as carefully as usual as a result of emotional problems; how often one felt that she had a lot of energy; how often physical health or emotional problems interfered with social activities; and overall rating of health (from excellent to poor).

The function of 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 sick time declines as health capital improves: sick days drop from 39 days per year for agents from the lowest health decile to 1 day per year for agents from the highest health decile (Figure 7 Panel E).

Despite the fact that the law motion for health care was introduced in 1972, only a few studies (Grossman, 1972; Stratmann, 1999) have estimated this law of motion. None of the previous studies uses objective health measures and allows for random depreciations. Given limited empirical evidence, most papers with endogenous health accumulation assume that changes of health capital reflect the underlying health shocks and calibrate the rest parameters of the law of motion to match life cycle profiles of medical expenditures. This approach underpredicts the variance of health shocks, because the actual change of health capital reflects the effect of health shocks net the effect from medical services, which help to treat diseases and improve health capital. 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 address this issue, the paper utilizes the panel design and the medical condition files of the MEPS to estimate the law of motion. The MEPS contains information about health capital of wave 2 and wave 4 (a one year span), yearly medical expenditures and the occurrence of priority conditions for each wave.[16] The reported priority conditions are interpreted as an indicator for health shocks. 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 chance of incurring health shocks in the model is set to the share of respondents reporting a new priority condition or multiple new priority conditions for each age group in the data. Because the sample does not include adults older than 85

[16]Priority conditions refer to a group of medical conditions that are selected by the Agency for Health-Care 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 stroke.

years old, the model uses linear fitted values to construct the probability distribution of health shocks $P(\epsilon, j)$ (Panel F of Figure 7).

Parameters of the law of motion are estimated using a two-stage GMM approach by fitting the realization of health capital of wave 4 using health shocks, medical expenditures and health capital of wave 2. Equation (15) displays the specification, which restricts the coefficient $\omega_1(j)$ to change linearly with respect to age.

$$h' = (1-\delta)h - \delta_1 I(\epsilon = 1) - \delta_2 I(\epsilon = 2) + (\omega_{11} + \omega_{12} * (age - 25))m^{\omega_2} \tag{15}$$

In order to address the endogeneity that people with poor unobserved health conditions tend to spend more on medical services and have bad health outcomes, the estimation uses family poverty status and health insurance coverage as the instrument for medical expenditures. This instrument strategy is similar to that used by Grossman (1972, 2000). Because there are few variations of insurance coverage among retirees, the sample is restricted to working-age people. Table 3 reports the estimated coefficients with standard errors in parentheses. All estimated coefficients of the law of motion for health capital are significant at the 0.01 level.

Table 3: Estimates of the law of motion for health capital

$(1-\delta)$	δ_1	δ_2	ω_{11}	ω_{12}	ω_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

The GMM estimates imply that health capital depreciates over time even without the presence of shocks. Health shocks further reduce agents' health capital. The effect caused by a severe shock is larger than a mild shock. Although medical expenditures offset health depreciation, the effectiveness of medical expenditures declines as agents age. The curvature parameter ω_2 of 0.128 reflects that health investment is produced via a decreasing return to scale technology, and my point estimate is within the range of estimates 0.098-0.170 in

Grossman (1972) and consistent with the theory of Ehrlich and Chuma (1990).

5.4 Preferences

The utility function is specified in the following form.

$$u(c, l, h) = \frac{[\lambda(c^{\rho} l^{1-\rho})^{\psi} + (1-\lambda)h^{\psi}]^{\frac{1-\sigma}{\psi}}}{1-\sigma} \tag{16}$$

where σ is the relative risk aversion, ψ captures the elasticity of substitution between the consumption-leisure combination and health capital, λ is a weight attached to the consumption-leisure combination, and ρ is the share of consumption in the consumption-leisure combination. In terms of values, σ is set to 2 and ψ 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. λ 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. ρ is calibrated to match the share of working time for workers, that is 0.38. The discount factor between periods is set to match the ratio of capital to yearly GDP, that is 3.

5.5 Health Insurance Market

Coinsurance rates of group and individual health insurance are assigned to the corresponding medium ratio of out-of-pocket payments to total medical expenditures, which are 0.27 and 0.47, respectively. 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.[17] The equilibrium base premiums, the individual

[17] This paper uses a number of 3 because the Affordable Care Act imposes a limit of ratio 3, which is very close to the ratio before the health care reform (See http://www.healthpocket.com/healthcare-research/infostat/age-gap-bigger-than-gender-gap-for-health-insurance-premiums#.UdtLg7WyB8k).

insurance premiums of the youngest age group, are determined endogenously by solving the insurance firm's zero-profit conditions.

5.6 Government

The disability cutoff point $\underline{h}_d$ is calibrated to match the share of working age agents receiving disability benefits, that is 5.8 percent.[18] The coinsurance rates of Medicare and Medicaid are set to the corresponding medium ratio of out-of-pocket to total medical expenditures, which are 0.25 and 0.11, respectively. Medicare premiums are set to the sum of Part B and Part D premiums in 2006 of $1,446 per year. The Medicaid income cutoff *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 π of obtaining Medicaid coverage conditional on satisfying income and insurance restrictions is set to the corresponding fraction of working-age adults that receive Medicaid coverage, which is 0.27. The payroll tax rate is solved endogenously from the government budget constraint.

5.7 Evaluation of the Model

To evaluate the model, Table 4 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: average health capital of the age group 80-84 is 57.6 percent of that of the age group 25-29 in the model versus 52.3 percent in the data. The model is capable of generating this decline because the model allows the probability of getting health shocks increases with age and the effectiveness of medical expenditures declines with age.

[18]The 2006 Annual Statistical Report on the Social Security Disability Insurance Program reports that 6.6 million disabled workers between ages 25-64 receive SSDI, which is 4.2 percent of U.S. population in this age category. Since 28 percent of disabled adults lack access to SSDI and receive SSI for their disability, the actual fraction of working-age adults receiving disability income from SSDI and SSI is 5.8 percent.

Table 4: Moments that are not targeted: model versus the 2006 US economy

Variable (percent)	Model	Data
Panel A: health statistics		
Ratio of health capital for age groups 80-84 to 25-29	57.6	52.3
Medical expenditure/output	10.9	15.4
Panel B: insurance coverage among non-retirees		
Uninsured	18.1	18.0
Privately insured	74.5	72.2
Publicly insured	7.4	9.9
Panel C: rate of disability among non-retirees		
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

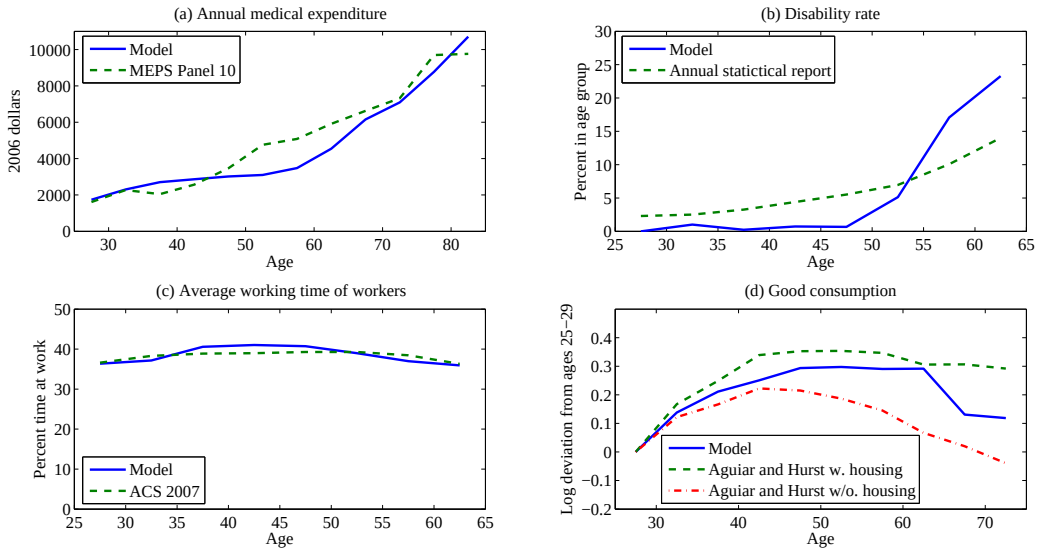
Second, the model does not target the fraction of output used in health care sector. The model predicts people spend 10.9 percent of output on medical expenditures.[19] This number is smaller than the data counterpart, because MEPS does not contain good information on the end-of-life care. Nevertheless, the model captures changes of medical expenditures from ages 25 to 84. As Panel A of Figure 5 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.

Third, the model closely matches the distribution of health insurance coverage among non-retirees. As Panel B of Table 4 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 2007 CPS. Both in the model and in the data, private health insurance covers a much larger fraction of working-age adults than public health insurance: 74.5 percent versus 7.4 percent in the model, and 72.2 percent versus 9.9 percent in the data.

[19] Data numbers are constructed from the 2006 national health expenditure data reported by 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 cost, since these two components are not included in the MEPS.

Fourth, the model correctly predicts changes of disability rates across educational levels and age groups (Panel C of Table 4 and Panel D of Figure 5). 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 larger for agents with higher education. Moreover since agents with higher education are more likely to be covered by group health insurance, they are more likely to have better health outcomes and less demand for disability insurance. In addition to changes by educational levels, the model also correctly predicts that disability rates increase with respect to age, because older agents are more likely to have low health capital and to be qualified for disability assistance than younger agents.[20]

Figure 5: Life-cycle features of the benchmark economy



Fifth, the model fairly well matches the empirically observed life-cycle profiles of working time and consumption. Panel C of Figure 5 compares the percent of time allocated to work among workers generated by the model and that in the data. The model successfully

[20]Because the model abstracts from labor productivity shocks after birth, it indicates that college graduates have a zero disability rate. In reality, as people face income shocks, some college graduates with bad income realization may find the disability option being more attractive than work. For the same reason, the model also predicts a relatively low disability rate for the middle age agents, who are at the peak of their age-efficient labor profiles. In reality, some of the middle age agents may have a negative income shock and thereby move to the disability rolls.

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 similar to the reported profile with housing services in Aguiar and Hurst (2013): average good consumption increases quickly from ages 20s to 40s, remains mostly unchanged at its peak from ages 40s to 60s, and drops after the retirement (Figure 5 Panel D). The borrowing constraint and the precautionary saving motive for health shocks contribute to an upward trend of the consumption profile for the youth. 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. This drop after retirement is more like the reported profile without housing services in Aguiar and Hurst (2013).

Table 5: Distribution of medical expenditures

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	1191	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, that is to produce a small fraction of people incurring large medical expenditures. Table 5 compares the distribution of medical expenditures observed in the data with the ones generated by the model. In terms of total medical expenditures, the model closely matches the average number 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 substantially increase. 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, especially 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 the law of motion for health capital.

6 Policy Experiments

This section implements policy experiments to study the steady state effects of health care reforms. The first experiment incorporates three components of the ACA: Medicaid expansion, individual insurance subsidies, and an individual mandate. The rest experiments aim to decompose the overall effects into the three components and sequentially remove each of them.

6.1 The Affordable Care Act

The considered reform has three components. First, the Medicaid program is expanded to all people satisfying income and insurance restrictions, which is equivalent to set π to 1. Second, insurance premium subsidies are provided to people with income up to 400 percent of the poverty level and without group insurance offers. According to the 2009 CBO estimates, people with income below 150 percent of the poverty line participating into the individual market will receive the largest subsidy, which is equal to 94 percent of their insurance premiums. The subsidy rate declines as income increases, and people with income between 351 and 400 percent of the poverty line will only be compensated with 13

percent of their individual insurance premiums[21] Last, the government places an individual mandate that levies tax penalties of 2.5 percent of total income on people without health insurance. In the new steady state, the government also runs a balanced budget: using labor income taxes and penalties from the individual mandate to pay for Social Security programs, public health insurance programs, and individual insurance subsidies.

Columns 1 and 2 of Table 6 report summary statistics of the benchmark economy and the new steady state after the ACA. The labor tax rate is raised from 19.7 to 20.0 percent to pay for Medicaid expansion and insurance subsidies (Panel E). In contrast to the overall increase of tax rates, the Social Security tax rate declines from 14.3 to 14.1 percent, because fewer people claim disability benefits after the ACA. Different from previous papers without a disability state (Jung and Tran, 2011; Feng and He, 2013), this paper finds that aggregate labor supply and output increase after the ACA (Panel A). This is because the ACA provides insurance coverage to the previously uninsured; these people use more medical treatments, have better health outcomes, and are less likely to become disabled and more likely to participate in the labor force. The effects from increased labor force participation dominates the effects from declining working hours and capital, and results in an overall increase of labor and output. The findings about other aggregate variables are similar to previous studies. After the ACA, aggregate capital is smaller because the previously uninsured people are now mostly insured and have less incentive to accumulate precautionary savings; annual working hours are smaller due to the increased tax rate; aggregate medical expenditures take up a larger share of output because more people are insured; consequently, the share of good consumption declines. Differing from models with exogenous medical expenditures, this model is able to capture a moral hazard problem associated with health insurance contracts: as the marginal cost of medical services drops, people want to take more medical services, which raises both medical expenditures and health capital.

[21] Table 10 reports details. 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 data.

Table 6: Steady state comparison

	Benchmark (1)	ACA (2)	No Medicaid 1 (3)	No Medicaid 2 (4)	No subsidy (5)	No mandate (6)
Panel A: aggregate statistics († indicates normalizing benchmark output as 100)						
Output†	100.00	100.23	100.55	100.41	99.52	99.89
Capital†	59.87	59.67	59.88	59.88	59.21	59.59
Labor†	67.00	67.37	67.42	67.45	66.89	67.07
Labor force participation rate	65.07	65.67	65.62	65.65	64.93	65.28
Annual working hours	2001.65	1998.92	2002.87	2002.59	2001.82	1999.06
Medical expenditure†	10.89	11.32	11.09	11.08	11.29	11.17
Consumption†	65.27	65.05	65.43	65.28	65.38	64.90
Panel B: statistics of non-retirees						
Disability rate	5.73	4.87	4.94	4.90	5.95	5.43
w/o. group	8.48	4.14	4.58	4.61	6.15	6.74
Health capital	62.96	64.26	63.97	64.06	63.93	63.64
w/o. group	56.64	64.01	61.29	61.39	63.59	61.11
Panel C: insurance coverage of non-retirees (percent)						
Uninsured rate	18.08	0.13	0.10	0.09	2.71	11.59
Private insurance	74.50	87.74	93.02	93.16	83.25	75.74
Group insurance	74.50	74.42	74.44	74.50	73.78	74.42
Individual insurance	0.00	13.32	18.58	18.66	9.47	1.31
Public insurance	7.42	12.13	6.88	6.75	14.04	12.68
Medicaid	1.82	7.52	1.97	1.88	8.35	7.61
Medicare	5.60	4.62	4.91	4.87	5.69	5.07
Panel D: prices (annually)						
Interest rate (percent)	3.02	3.09	3.07	3.07	3.09	3.07
Wage*100	100.00	99.71	99.80	99.78	99.69	99.81
Group insurance premiums	2457.97	2419.00	2458.52	2458.53	2385.73	2415.45
Individual base premiums	N.A.	526.77	491.47	493.17	619.30	724.88
Panel E: labor tax rate(percent)						
Total tax	19.66	19.98	19.48	19.46	20.42	20.19
Social Security	14.29	14.05	14.02	14.03	14.44	14.24
Health related	5.37	5.93	5.46	5.43	5.98	5.95
Panel F: consumption equivalent variation (percent)						
All		−0.27	0.20	0.09	−0.86	−0.41
w/o. group		0.77	0.49	−0.05	−0.23	0.87
w. group		−0.56	0.09	0.09	−1.04	−0.77
Dropout		0.70	0.39	−0.03	0.13	0.56
High school		−0.49	0.18	−0.03	−1.08	−0.61
Some college		−0.45	0.09	0.12	−1.07	−0.54
College		−0.45	0.23	0.18	−1.02	−0.71

Panel B of Column 2 shows that average health capital among working-age people in the new steady state is 2.1 percent larger than the benchmark economy. This increase is attributed to the people without group insurance offers, whose health capital increases

by 13.0 percent after the reform. Consequently, the disability rate among people without group insurance offers drops dramatically from 8.5 to 4.1 percent, and the overall disability rate drops from 5.7 to 4.9 percent. This 0.9 percentage point decline produced by the model is very close to the 1.1 percentage point decline predicted by the MA reform, which lends additional support to the model.

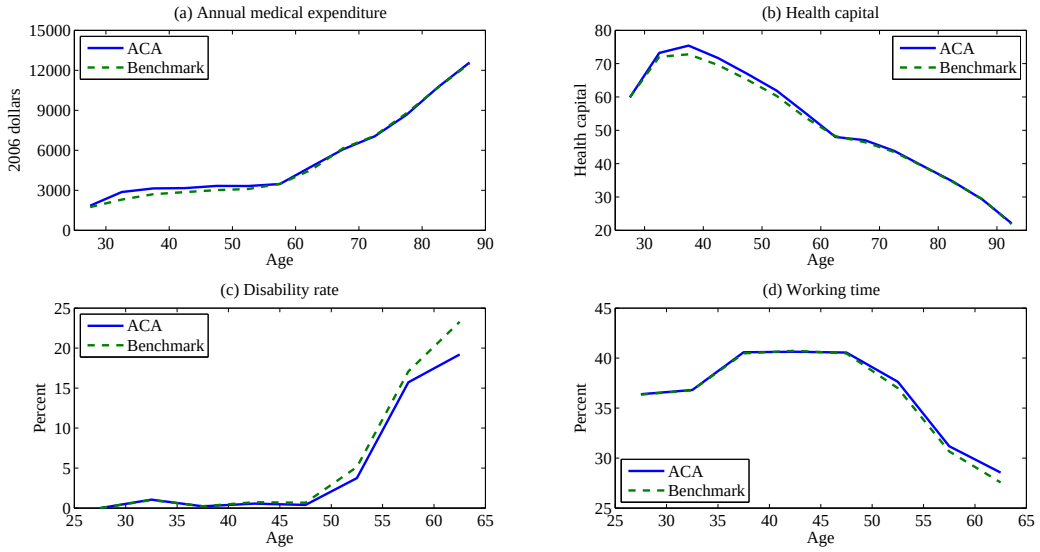
The ACA's implementation reduces the uninsured rate among working-age people from 18.1 to 0.1 percent. In the new steady state, the Medicaid program provides coverage to 7.5 percent of working-age population, which is 12 percent larger than the fraction of people satisfying income and insurance restrictions in the benchmark economy. This observation indicates that the income restriction of Medicaid coverage encourages people with pre-reform income above the cutoff level to reduce their labor supply to be eligible for Medicaid coverage. This effect is absent in models without endogenous working hours, and thereby those models underestimate the cost of Medicaid expansion. Besides expanding Medicaid coverage, the ACA also helps 13.3 percent of working-age people obtain health insurance coverage through the individual market. Subsidized premiums and the individual mandate encourage healthy people to participate into the individual insurance market, which in turn, lowers individual insurance premiums. Equilibrium premiums paid by the age-group 25-29 in the individual market (individual base premiums) are only 21.8 percent of group insurance premiums.

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 change improves welfare and a negative number indicates a welfare loss. Panel F of Table 6 reports that the ACA produces a welfare loss that is equivalent to a 0.27 percent drop of consumption, which implies that the gains from the previously uninsured do not compensate for the losses from increased taxes. The liter-

ature lacks a consensus on welfare implications of health care reforms: some studies (Jung and Tran, 2011; Janicki, 2012; Tsujiyama, 2013; Pashchenko and Porapakkarm, 2013) conclude that the provision of insurance coverage improves welfare, and others (Hansen, Hsu, and Lee, 2012; Feng and He, 2013) find negative numbers. This paper finds a negative result, because it allows continuous choices of medical expenditures and labor supply. This assumption makes it more expensive to expand Medicaid relative to alternative settings.

Besides investigating the overall welfare implications, the paper also computes the CEV for different types by asking the percent change of consumption required for a new born of a certain type in the benchmark economy to be indifferent between living in the alternative and the benchmark economies. The decomposition indicates that people without group insurance offers benefit from the reform at the cost of people with group insurance offers. The reform also produces gains for high school dropouts at the cost of people with higher educational attainments.

Figure 6: Steady state comparison



In order to understand the effects of the ACA on people of different ages, Figure 6 plots average statistics by age groups along eight dimensions. The ACA encourages people under age 65 to spend more money on medical services, but medical expenditures of retirees do not

change much. Consequently, the ACA improves health capital for working-age people, but does not change that of retirees. Due to the improvement of health capital, the disability rate among people close to the retirement age drops substantially. In particular, for the age group 60-64, after the ACA, the disability rate drops from 23.3 to 19.2 percent. This drop contributes to an increase in labor force participation among older people.

Table 7: Decomposition of fiscal changes

	ACA (1)	No Medicaid 1 (2)	No Medicaid 2 (3)	No subsidy (4)	No mandate (5)
Reform spending	100.00	28.74	23.91	95.71	94.15
Medicaid	89.95	2.58	0.24	105.64	91.40
Subsidy	10.43	26.44	23.93	0.00	2.75
Mandate penalties	−0.38	−0.28	−0.26	−9.93	0.00
Savings from disability assistance					
Disability insurance	31.94	29.04	31.68	−12.46	10.07
Medicare	7.64	4.45	4.84	−0.63	3.78
Revenue increase with a fixed tax rate					
Revenue growth	6.82	16.61	12.27	−14.29	−3.44

Finally and most importantly, the reduced disability rate also alleviates tax burdens caused by the ACA. Column 1 of Table 7 reports that every 100 dollars spent on the ACA saves the spending of disability insurance by 31.9 dollars and Medicare for people with disability by 7.6 dollars, and increases revenue by 6.8 dollars even with a fixed tax rate. Specifically, spending savings from disability assistance and revenue growth from enlarged taxable income offset 46.4 percent of the cost of the ACA.

6.2 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. For this purpose, the chance of receiving Medicaid coverage

conditional on satisfying income and insurance restrictions is reset to the benchmark value of 0.27. The other two components remain the same as the ACA.

This section considers two alternative designs. In the first design (referred to as No Medicaid 1), people without Medicaid coverage and satisfying income and insurance restrictions can always receive insurance subsidies. This design means that the federal government will pick up all the poor left out by the states and hand in insurance subsidies. The second design (referred to as No Medicaid 2) represents the current policy that only people with income between 100 and 400 percent of the poverty line are eligible to receive insurance subsidies. Thus, people with income below the poverty line and no access to Medicare or group insurance suffer from the provision gap and have a probability of $1 - \pi$ to receive neither Medicaid nor insurance subsidies.

Column 3 of Table 6 provides summary statistics of the first experiment, in which people below the poverty line are entitled to insurance subsidies. In this economy, Medicaid provides insurance to only 2.0 percent of working-age people. This reduction of public coverage, however, does not result in a significant increase of uninsured rates. This is because the majority of low income people, who are left out by Medicaid, purchase their coverage in the individual market. Due to high participation, equilibrium premiums in the individual market are 6.7 percent lower than the ACA steady state. Furthermore, since most people have health insurance coverage, the disability rate in this economy is similar to that in the ACA economy. Because providing insurance subsidies costs much less than expanding Medicaid, the labor tax rate in the new steady state is 0.5 percentage point lower than the ACA economy, and 0.2 percentage point lower than the benchmark economy. Given the reduced tax rate in this economy, people want to work more and are able to accumulate more capital, which accounts for the steady state increases of capital, labor, and output relative to the ACA economy.

The disability rate in this economy is slightly larger than that in the ACA economy,

because relative to Medicaid, people on individual insurance plans will invest less on health capital and have larger demand for disability insurance. Since it is much cheaper to fund an alternative plan without Medicaid expansion, the full cost of this plan could be covered by changes in the disability dimension (Column 2 of Table 7). Therefore, this alternative plan not only helps expand health insurance coverage, but also helps reduce tax burdens and make almost every one better off.

The policy without Medicaid expansion produces a welfare gain that is equal to 0.2 percent of consumption. This welfare implication differs from that of the ACA mainly because the cost of insurance subsidies is cheaper than the cost of Medicaid. Removing the Medicaid component will help mitigate the moral hazard problem with Medicaid patients and improve the welfare of the economy. If look at the decomposition, this policy benefits people from all educational and insurance type groups.

Table 6 Column 4 and Table 7 Column 3 report the statistics of the second design, in which people with income below the poverty line are not eligible to receive insurance subsidies. In terms of economic statistics, this plan does not differ much from the first plan: both generate similar declines in disability and uninsured rates and similar increases in labor and output. Two plans, however, differ in their welfare implications. The second plan produces a welfare gain that is only half as large as the first plan, because the second plan benefits people with group insurance offers and high educational attainments at the cost of people without group insurance offers and low educational attainments.

Results of these counterfactual experiments suggest two normative recommendations. First, it is better for the government to implement a health care reform without Medicaid expansion. Compared to the ACA, a reform without Medicaid expansion does not significantly change uninsured and disability rates but costs the government much less. Second, given the current states' decisions of not moving forward, it is better for the federal government to hand in premium subsidies to people with income below the poverty line, because

it produces large welfare gains.

6.3 No Insurance Subsidy

In this experiment, the government does not subsidize insurance premiums for people below 400 percent of the poverty line, but still expands Medicaid program and imposes the individual mandate. Column 5 of Table 6 reports summary statistics of this economy. Without insurance subsidies, the participation rate of individual insurance market drops substantially from 13.3 to 9.5 percent. Correspondingly, insurance premiums increase by 17.6 percent. In response to the price increase and the removal of subsidies, 6.9 percent of people aged 45-59 choose to pay penalties and be uninsured. For older people aged 60-64, however, the uninsured rate drops to almost zero due to an increase in Medicare coverage via disability assistance. The disability rate for this age group rises to 27.9 percent, 8.7 percentage points higher than the ACA experiment. The increases of disability rates and tax rates jointly contribute to a decline of labor supply and final output.

Spending of this reform is similar to the ACA, but this reform does not produce any savings for disability insurance (Column 4 of Table 7). As a result, a plan without insurance subsidies causes the largest tax rate increase of 0.76 percentage points and the largest welfare loss of 0.86 percent of consumption. This reform does not even produce gains for people without group insurance offers, because the individual mandate distorts their decisions by pushing some of them to pay penalties, some to purchase individual plans at the full price, and some to reduce labor supply in order to gain Medicaid access. This reform also produces the largest welfare loss for people with group insurance offers, and merely benefits high school dropouts but at large costs of the rest educational groups.

6.4 No Individual Mandate

This experiment removes the individual mandate but expands Medicaid and provides insurance subsidies. Without the mandate, the individual insurance market almost collapses, only 1.3 percent of working-age people participate in the market (Column 6 of Table 6). The low participation rate is associated with both high premiums—which are 37.6 percent higher than the ACA plan—and a high uninsured rate of 11.6 percent. These findings on insurance coverage and premiums are in line with the studies by the CBO (2011), Gruber (2011), and Eibner and Price (2012). The disability rate in the new economy is 0.3 percentage point lower than the benchmark economy, because the expanded Medicaid coverage reduces the poor's demand for disability insurance. This slight increase of labor force participation does not offset the declines of labor and capital. As a result, output in the new steady state is smaller than the benchmark economy. Regarding fiscal burdens, a health care reform without the individual mandate costs less than a reform without insurance subsidies, because the removal of the individual mandate lowers the demand for Medicaid and disability assistance.

This plan produces a welfare loss that is equal to 0.41 percent of consumption. Although expanding Medicaid improves health capital of people with income below 133 percent of the poverty line and reduces their demand for disability insurance, the high premiums in the individual market still discourage people with income above 133 percent of the poverty line to participate even with insurance subsidies. As such, this second group does not benefit from the reform. Because the benefits of the first group do not compensate for the costs of a higher tax rate, the policy produces a welfare loss. In terms of welfare decomposition, the reform without an individual mandate benefits people without group insurance offers and low educational attainments but imposes costs on people with group insurance offers and high educational attainments.

Table 8: Steady state changes caused by the ACA

	w/o. disability	w. disability
% change of labor	0.08	0.54
% change of output	0.01	0.23
Δ tax rate	0.58	0.32
CEV (%)	-0.48	-0.27

7 Removing the Disability Dimension

To determine the importance of the disability dimension, this section considers an alternative model, in which the disability option is removed. To make the size of government comparable between settings, the alternative model adds exogenous government expenditures equivalent in size to the spending on disability assistance of the benchmark economy. The alternative model is recalibrated to match the same data moments and used to simulate the long-term effects of the ACA.

Table 8 compares the steady state changes in response to the ACA generated by two competing models: the main model with disability options and the alternative model. Without the disability dimension, the ACA still increases labor and output because the reform raises health capital and lowers the amount of sick time. Nevertheless, the observed increases in labor and output generated by the alternative model are, respectively, 85.1 and 95.9 percent smaller than those generated by the main model. Thus, removing the disability dimension leads to underestimates of the ACA's benefits. Moreover, results simulated by the alternative model indicate that the ACA raises the equilibrium labor tax rate by 0.58 percentage point and causes a welfare loss equivalent to a 0.48 percent reduction of consumption. These two numbers are 81.3 percent larger than the corresponding numbers predicted by the main model. Thus, removing the disability dimension leads to overestimates of the ACA's costs.

8 Robustness Check

This section aims to understand whether the main mechanism of the model—the provision of health insurance crowds out the demand for disability insurance—is robust in a variety of different settings. Therefore, I have done several changes, e.g., change the individual insurance premium increment, remove the lump-sum transfer, change the elasticity of substitution between the consumption-leisure combination and health, vary the elasticity of intertemporal substitution, and manipulate the relative price of medical services. The main finding—the ACA reduces the disability rates among people without group insurance offers—is robust in all settings.

9 Conclusion

This paper considers an important interaction between health care reforms and public disability insurance, and examines the long-term effects of the ACA. In order to provide a quantitative assessment, I build a dynamic incomplete markets general equilibrium model with endogenous health accumulation, disability, and insurance decisions. The calibrated model fits the data well by matching statistics about the insurance sector and medical expenditures, changes of disability rates by education and age groups, and life-cycle changes of good consumption, medical expenditures and working hours. Especially, unlike other models with endogenous health accumulation, this model is able to create a long tail in the distribution of both total and out-of-pocket medical expenditures.

Counterfactual results suggest that by increasing health insurance coverage, the ACA also reduces the demand for disability insurance. As fewer people are on the disability rolls, more people participate in the labor market, which in turn, increases output and alleviates tax burdens. Furthermore, after adding this disability dimension, 47 percent of the cost of

the ACA is compensated by spending savings of disability assistance and revenue growth from enlarged labor supply.

Regarding the three components, I find that insurance subsidies and the individual mandate are the key contributing components to the success of health care reforms. Removing either of them results in large welfare losses and the collapse of the individual insurance market. Medicaid expansion, however, is an optional component. Without this provision, the individual insurance market still operates well, the subsidized insurance premiums are affordable to the majority, and the reduction of disability demand is similar in size to the ACA. Since the cost of insurance subsidies is much smaller than the cost of Medicaid, this policy produces tax savings and benefits all types of people. Therefore, compared to the ACA, an alternative health care reform without Medicaid expansion improves welfare.

Results produced by the model differ from previous studies because this model considers a substitution between health insurance and disability insurance, and allows labor to adjust both extensively and intensively. Extensions of the model include considering the transitional path, introducing income dynamics, and finding optimal taxation. These extensions are left for future research.

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Table 9: Parameters

Para.	Meaning	Value	Note
		Demographics	
Jr	Period of retirement	9	Retirement age of 65
J	Maximum period	14	Maximum age of 94
$s(j)$	Survival probability	Fig. 7 Panel A	2006 US life table
		Firm production	
α	Share of physical capital	0.33	Standard value
δ_k	Depreciation of physical capital	0.40	Per-year rate of 8 percent
A	Productivity	1.55	Benchmark economy's wage of 1
		Health insurance market	
γ_1	Coinsurance rate of group insurance	0.27	MEPS Panel 10
γ_2	Coinsurance rate of individual insurance	0.47	MEPS Panel 10
		Government	
$b(z,j)$	Social security benefits	Fig. 7 Panel B	2007 ACS
γ_{care}	Coinsurance rate of Medicare	0.25	MEPS Panel 10
γ_{caid}	Coinsurance rate of Medicaid	0.11	MEPS Panel 10
P_{care}	Annual Medicare premiums	1446	Sum of Part B and Pard D premiums
π	Chance of Medicaid coverage	0.27	2007 March CPS
		Individual problem	
$Pr(z)$	Distribution of types	Section 5	2007 ACS
$\zeta(z,j)$	Age-Efficiency labor profiles	Fig. 7 Panel C	2007 ACS
$st(h)$	Sick time	Fig. 7 Panel E	MEPS Panel 10
$P(\epsilon,j)$	Probability of health shocks	Fig. 7 Panel F	MEPS Panel 10
δ	Health capital depreciation	Table 3	Estimates
δ_ϵ	Influence from health shocks	Table 3	Estimates
$\omega_1(j)$	Efficiency of expenditure function	Table 3	Estimates
ω_2	Curvature of expenditure function	Table 3	Estimates
ψ	Elasticity of substitution	-0.67	Yogo (2012)
σ	Relative risk aversion	2	Standard value

Calibrated parameters

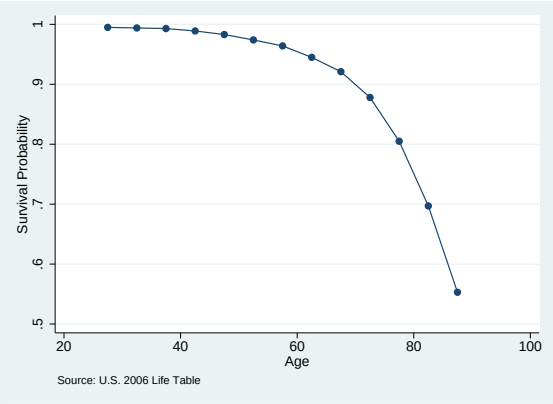
Para.	Meaning	Value	Target	Data	Model
$\underline{h}_d$	Health cutoff for disability	29.385	Rate of disability	0.058	0.057
β	Discount factor	0.921	K/GDP (annual)	3.000	2.994
ρ	Share of c in the c-l combination	0.352	Share of working time	0.384	0.386
λ	Weight on the c-l combination	0.921	Ratio of health capital for age groups 65-69 to 25-29	0.778	0.776
pov	Medicaid annual income restriction	\$26,000	Fraction under 65 below 133% of the poverty line	0.129	0.130

Table 10: Income levels and insurance subsidies

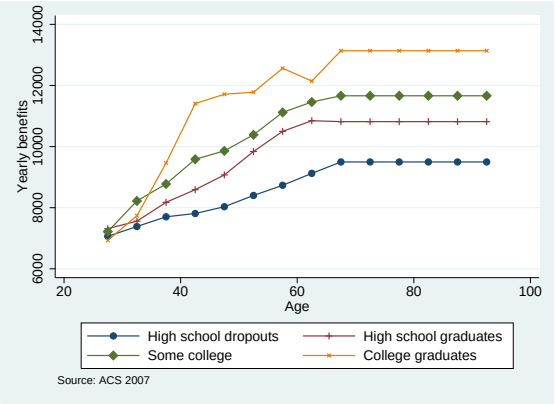
Income in percent of FPL	Premium subsidy rate (CBO 2009 estimates)	Population share (Benchmark economy)
0-150	94%	15.4%
151-200	77%	7.3%
201-250	62%	8.1%
251-300	42%	7.8%
301-350	25%	7.2%
350-400	13%	6.9%

Figure 7: Features of the 2006 US economy

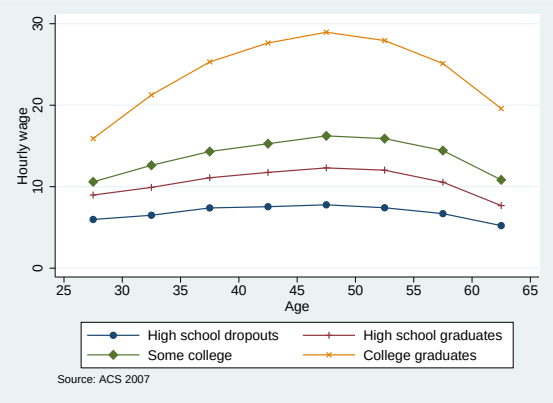
(a) Survival probability



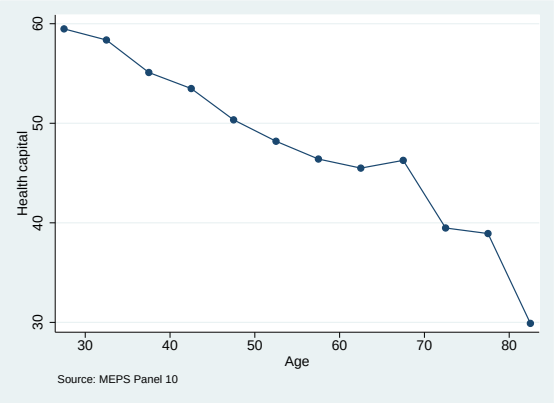
(b) Yearly benefits by educational levels



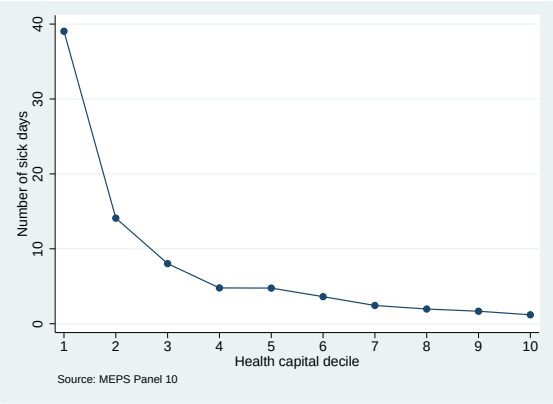
(c) Hourly wage by educational levels



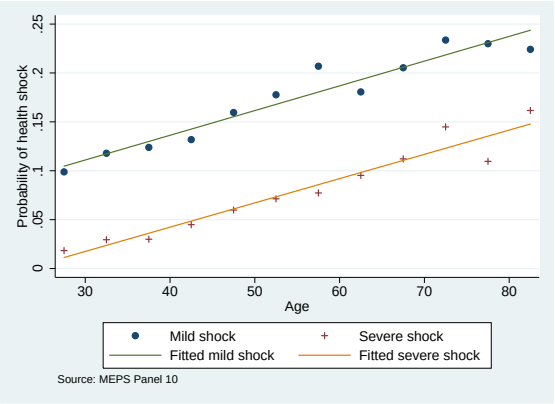
(d) Health capital by age groups



(e) Sick days



(f) Probability of health shocks



Appendices

A 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 include Medicaid expansion, insurance subsidies and an individual mandate. The first two components want to make health insurance affordable for people with limited financial resources and without employer-provided group insurance or existing public plans, e.g., Medicare and Medicaid. Medicaid expansion asks states to provide Medicaid coverage for people with income below 133 percent of the poverty line. The federal government provides insurance subsidies to people with income between 100 and 400 percent of the poverty line if they purchase individual health insurance plans through an insurance exchange. In order to bring healthy youth and wealthy people to the individual market, the federal government also places an individual mandate such that people without health insurance pay an additional 2.5 percent income tax. 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 for wages above 200,000 dollars a year (250,000 for joint filers), places a 3.8 percent tax on net investment income for people with high gross income, 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.

Opponents of the ACA challenge the constitutionality of the legislation in the federal courts. The decision of the Supreme Court upholds most provisions of the law but allows states to opt out of Medicaid expansion without losing pre-existing Medicaid funding from the federal government. As of September 30, 2013, 26 states chose not to expand Medicaid at this time. The low-income uninsured residents of these states, who do not satisfy the state's Medicaid categorical restrictions, can only obtain coverage in the individual market. The current law, however, does not provide insurance subsidies for people below the

poverty line. There are political debates on whether to extend insurance subsidies to the poor residents in states opting out of Medicaid expansion. Thus, it is of particular interest to understand the effects of a reform without Medicaid expansion with variations on subsidy arrangements.

B Public Disability Insurance

In the US, there are two types of public 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 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 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 starting five month after the onset of disability. In 2011, average monthly benefits for new SSDI award workers are 1,189 dollars. Besides cash benefits, beneficiaries receiving the SSDI also get Medicare 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. The current US social safety nets provide good assistance for people with diagnosed long-term disabilities. The screening process and continuing disability reviews, however, restrict most disability applicants and beneficiaries from working and pursuing gainful activities.

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 percent of SSI recipients grew at a similar rate as the SSDI. By the end of 2011, 12.3 millions of Americans receive benefits from these two programs with a total yearly cost of 150 billion dollars. 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 relaxes disability screening criteria as the main cause for the skyrocketing disability rolls (Autor and Duggan 2006; Duggan and Imberman 2009). After the 1984 reform, the disability screening process places a significant weight on reported discomfort and pain, and allows a determinant to be made based on applicant's own medical records. This regulatory change causes large increases of disability beneficiaries with a main diagnosis as musculoskeletal disorders

(e.g. back pain) or mental disorders: in 1983, these two diagnosis groups constituted 29.7 percent of new awards, and in 2011, this number rose to 53.1 percent. Thus, under the current system, it is relatively easy to satisfy disability criteria as long as one can provide some medical evidence and emphasize the severity of subjective pain. Autor and Duggan (2006) argue that in response to relaxed disability criteria, the status of receiving disability benefits becomes an endogenous choice. Conditional on having some health problems people with bad alternatives (low market wage) will apply for it and receive an award in most cases.

C Proof

C.1 Proposition 1

Proof. Agents want to obtain insurance coverage if this choice produces higher ex-ante utility than the alternative choice, that is

$$\begin{aligned}
&\ln((1-\tau)z-P)+\alpha\ln\overline{h} > 1/2(\ln((1-\tau)z)+\alpha\ln\overline{h})+1/2(\ln((1-\tau)z+b)+\alpha\ln\underline{h})\\
\Rightarrow &1/2\ln(((1-\tau)z-P)^2\overline{h}^{\alpha}) > 1/2\ln((1-\tau)z((1-\tau)z+b)\underline{h}^{\alpha})\\
\Rightarrow &((1-\tau)z-P)^2\overline{h}^{\alpha} > (1-\tau)z((1-\tau)z+b)\underline{h}^{\alpha}\\
\Rightarrow &(\overline{h}^{\alpha}-\underline{h}^{\alpha})(1-\tau)^2z^2-(2P\overline{h}^{\alpha}+b\underline{h}^{\alpha})(1-\tau)z+P^2\overline{h}^{\alpha} > 0
\end{aligned} \tag{17}$$

The left hand side of condition (17) is a quadratic function with a parabola opening upward. Based on properties of quadratic functions and the proposition assumption, there exists a cutoff point z^* (equation (18)), such that for agents with $z > z^*$ condition (17) is satisfied and for agents with $z < z^*$ condition (17) is violated.

$$z^* = \frac{2P\overline{h}^{\alpha}+b\underline{h}^{\alpha}+\sqrt{4P\overline{h}^{\alpha}\underline{h}^{\alpha}(P+b)+b^2\underline{h}^{2\alpha}}}{2(\overline{h}^{\alpha}-\underline{h}^{\alpha})(1-\tau)} = \frac{m\overline{h}^{\alpha}+b\underline{h}^{\alpha}+\sqrt{m\overline{h}^{\alpha}\underline{h}^{\alpha}(m+2b)+b^2\underline{h}^{2\alpha}}}{2(\overline{h}^{\alpha}-\underline{h}^{\alpha})(1-\tau)} \tag{18}$$

The tax rate is solved endogenously by balancing the government budget constraint: $\int_z \tau z f(z) = \int_{z<z^*} b f(z)$.

□

C.2 Proposition 2

Proof. Given a tax rate τ', an agent chooses to take free health care if

$$\ln((1-\tau_2)z) + \alpha \ln \overline{h} > 1/2(\ln((1-\tau_2)z) + \alpha \ln \overline{h}) + 1/2(\ln((1-\tau_2)z + b) + \alpha \ln \underline{h}) \tag{19}$$

$$\Rightarrow z > \frac{b\underline{h}^{\alpha}}{(1-\tau_2)(\overline{h}^{\alpha} - \underline{h}^{\alpha})} \tag{20}$$

In this economy, there is a new cutoff point $z^{\circ} = \frac{b\underline{h}^{\alpha}}{(1-\tau')(\overline{h}^{\alpha} - \underline{h}^{\alpha})}$ such that agents with $z > z^{\circ}$ take free health care and agents with $z \leq z^{\circ}$ decline free care. After the reform, agents can be grouped into three categories. In response to a health shock, agents with $z \leq z^{\circ}$ keep receiving disability benefits, agents with $z^{\circ} < z \leq \max\{z^*, z^{*'}\}$ use the free care provided by the government, and agents with $z > \max\{z^*, z^{*'}\}$ purchase insurance beforehand and let the insurance company pay for their health care. The measure of the second category is not zero, because $z^{\circ} < \max\{z^*, z^{*'}\}$. The measure of first category is zero if $\underline{z} > z^{\circ}$.

Given this decision structure, it is easy to show that there exists a $\tau' < \tau$, such that agents with an endowment between z° and z^* will take health care rather than receiving disability benefits if a health shock occurs. As such, compared to the old economy, government spending drops from $\int_{z \leq z^*} 0.5bf(z)$ to $\int_{z \leq z^{\circ}} 0.5bf(z) + \int_{z^{\circ} \leq z^*} 0.5mf(z)$. All agents are better off after the policy change: agents with $z \leq z^{\circ}$ or $z > z^*$ benefit from the reduced tax rate; agents in the middle of the endowment distribution $z^{\circ} < z \leq z^*$ benefit from both reduced taxes and free health care. □

C.3 Proposition 3

Proof. Similar to the proof of Proposition 2, agents in this economy could be grouped into the same three categories. The minimum tax rate that the government could collect is the same as the old economy $\tau' = \tau$. It is easy to show that agents with $z^{\circ} = \frac{b\underline{h}^{\alpha}}{(1-\tau)(\overline{h}^{\alpha} - \underline{h}^{\alpha})} < z \leq z^*$ stop receiving disability benefits and are better off after the policy change. The rest agents keep the same utility levels. □

C.4 Proposition 4

Proof. If $m > b$, the tax rate in this economy is larger than the old economy ($\tau' > \tau$). Supposing the opposite is true, then the proof of Proposition 2 suggests that agents with an endowment between

$\frac{b\underline{h}^{\alpha}}{(1-\tau')(\overline{h}^{\alpha}-\underline{h}^{\alpha})}$ and z^* will choose health care if a shock occurs. Consequently, the average government spending on them is raised from $0.5b$ to $0.5m$, and the government needs to raise tax rates to pay for the policy, which violates the assumption.

In this new economy, agents can still be grouped into the same three categories. The additional assumption of Proposition 4 guarantees that $\underline{z} < z^{\circ}$ and $\overline{z} > z^{*'}$. As such, the first and the third categories contain a positive number of agents. These agents are worse off in the new economy due to an increase of tax rates. The effect on agents with $z^{\circ} < z \leq z^*$ might be positive if the benefits from the free care dominate the losses from larger tax rates; otherwise the effect is negative. Last, if $z^{\circ} < z^*$ the number of disability beneficiaries will go down; otherwise it will be go up. □

D Computational Method

This paper discretizes the state space for health capital and assets by choosing a finite number of grids: 21 grids for health capital and 50 grids for asset holdings. Given the problem's structure, equilibrium is solved using the following steps:

1. Guess prices $r, R, w, P_a, P_w(j)$, a tax rate τ and a transfer Tr.
2. Solve the model backwardly for optimal policy functions at each grid point.
3. Simulate decisions of 10,000 agents by using the initial distribution and the policy functions derived in step 2 (the seed of the simulation is kept unchanged).
4. Update prices, the tax rate and the transfer using firm's first order conditions, insurance firm's zero profit conditions, the government budget constraint, and the rule of transfers.
5. Repeat from step 2 until convergence.