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# **Quantitative Analysis of Health Insurance Reform: Separating Community Rating from Income Redistribution**

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23. October 2010

Online at <https://mpra.ub.uni-muenchen.de/26158/>

MPRA Paper No. 26158, posted 27. October 2010 14:31 UTC

# Quantitative Analysis of Health Insurance Reform: Separating Community Rating from Income Redistribution <sup>\*</sup>

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October 23, 2010

## Abstract

Two key components of the upcoming health reform are a reorganization of the individual health insurance market and an increase in income redistribution in the economy. Which component contributes more to the welfare outcome of the reform? We address this question by constructing a general equilibrium life cycle model that incorporates both medical expenses and labor income risks. We replicate the key features of the current health insurance system in the U.S. and calibrate the model using the Medical Expenditures Panel Survey dataset. We find that the reform decreases the number of uninsured more than four times. It also brings significant welfare gains equivalent to almost one percent of the annual consumption. However, these welfare gains mostly come from the redistributive measures embedded in the reform. If the reform only reorganizes the individual market, introduces individual mandates but does not include any income-based transfers, the welfare gains are much smaller. This result is mostly driven by the fact that most uninsured people have low income. High burdens of health insurance premiums for this group are relieved disproportionately more by income-based measures than by the new rules in the individual market.

Keywords: health insurance, health reform, risk sharing, general equilibrium

JEL Classification Codes: D52, D91, E21, E65, I10

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# 1 Introduction

In Spring of 2010 the President of the U.S. signed the Patient Protection and Affordable Care Act which culminated a long and vigorous health reform debate. This bill introduces a wide range of measures aiming primarily to increase health insurance coverage. In particular, the bill significantly changes the rules under which the individual insurance market operates and introduces penalties for those without insurance. At the same time it contains a set of measures that increase income redistribution in the economy. The goal of this paper is to provide a quantitative analysis of the upcoming reform in order to isolate the welfare effect of the reorganization of the individual market from the effect of the increased income redistribution.

To do this we construct a general equilibrium life cycle model where agents face two types of risks: uninsurable labor income risk and persistent medical expenses risk that can be partially insured. We allow agents to be heterogeneous by educational level (exogenously fixed) that together with age determines agents' ability to generate income.

We replicate the key features of the current health insurance system. First, in our model the insurance system consists of three components: individual market, employer-based market, and public insurance. Second, public insurance is available only for lowest-income individuals, while people with high income are more likely to get an employer-based coverage. Third, the majority of uninsured can obtain insurance only from the individual market because they do not have access to the employer-based market and are not eligible for public insurance. At the same time this group of people tends to have low income. Fourth, public insurance is free and employer-based premiums are community rated. Those purchasing insurance in the individual market face premiums that depend on their current medical shock and thus are exposed to premium fluctuations. After calibrating the model to the key facts of the U.S. insurance system using the Medical Expenditures Panel Survey, we introduce the changes specified in the Patient Protection and Affordable Care Act (hereafter the Bill).

These changes can be broadly divided into two groups. First, there is a reorganization of the health insurance market that aims to create a risk-pooling mechanism outside the employer-sponsored market. In particular, insurance companies will be banned from conditioning premiums on the individuals' health status or the history of claims. The price of an insurance policy can only vary by age. This restriction is known as age-adjusted community rating. To prevent cream-skimming behavior of insurers another provision in the Bill is a guaranteed issue. Under this provision insurance companies are not allowed to deny coverage to individuals based on health status. A possible outcome of community rating combined with guaranteed issue is adverse selection spiral. To prevent this outcome the Bill requires all individuals without health insurance coverage to pay a

penalty unless the insurance premium constitutes a too high portion of their income.

Second, the Bill includes a set of redistributive measures. In particular, the Bill includes provisions to expand Medicaid. Currently Medicaid covers several categories of population (for instance, adults with dependent children, pregnant women) with income below some threshold that significantly varies by state<sup>1</sup>. After the reform *all* people with income below 133% of FPL become eligible for Medicaid. Also low-income people will be able to get subsidies when buying insurance in the individual market. The goal of the subsidy is to keep premiums people pay for a standard insurance policy below some prespecified percentage of their income.

When evaluating welfare effects of the reform as a welfare criterion we use ex-ante expected lifetime utility of a newborn in a stationary equilibrium. This welfare function favors redistribution across people with different income net of medical expenses. The reform introduces two additional channels of redistribution in the economy: first, from healthy to sick (through community rating in the individual market), second, from high-income to low-income (through subsidies and Medicaid expansion). Because neither of these new redistributive mechanisms is conditioned on income net of medical expenses, the resulting welfare effect of each mechanism is unclear: any redistribution from healthy to sick involves some redistribution from healthy who are poor to sick who are rich. Similarly every redistribution from rich to poor will involve some redistribution from rich who are sick to poor who are healthy.

We find that the reform has a big effect on the fraction of the uninsured in the economy: this number decreases from 22.2 to 4.7%. The largest effect the reform has on young people in the lowest educational group: the fraction of the uninsured among high-school dropouts aged 25 to 29 year old decreases from 62.1 to 9.9%. Also the reform induces a larger participation in the individual market: the fraction of individually insured increases from 7.4 to 18.3%.

In terms of welfare, we find that the reform brings significant gains equivalent to almost 1% of the annual consumption. However, these welfare gains mostly come from the redistributive measures embedded in the reform. If the reform is implemented without subsidies and Medicaid expansion its welfare effects are significantly smaller.

The intuition behind this result is as follows. Welfare gains of the reform are largely driven by the change in welfare of low-income people. For the majority of this group insurance premiums constitute a high fraction of income and they gain a lot from having a subsidized coverage. On the other hand, the reorganization of the individual market by itself has a limited effect on health insurance affordability for low-income people and

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<sup>1</sup>As of 2009, 14 states had Medicaid eligibility threshold below 50% FPL, 20 states had it between 50 to 99% FPL, and 17 states had it higher than 100% FPL. U.S. average constitutes 68% of FPL (Kaiser Family Foundation, 2009).

they often prefer to stay uninsured if not subsidized.

The paper is organized as follows. Section 2 reviews the related literature. Section 3 introduces the model. Section 4 describes the changes introduced by the reform. Section 5 explains our calibration. Section 6 compares the performance of the model with the empirical facts about the U.S. insurance system. Section 7 describes the quantitative effects of the reform and decomposes its welfare effects. Section 8 concludes.

## 2 Related literature

Our paper is related to the literature on dynamic general equilibrium models with heterogeneous agents and incomplete markets (Imrohoroglu (1989), Hugget (1993), Aiyagari (1994)). We belong to the branch of this literature that augments the standard incomplete market model with an idiosyncratic health expenditure risk. For example, Attanasio, Kitao, and Violante (2008) evaluate general equilibrium effect of different Medicare reforms; Kopecky and Koreshkova (2009) study the effect of medical expenses risk on wealth accumulation over the life-cycle. The closest paper to ours is Kitao and Jeske (2009) who study tax subsidies for employer-based health insurance in the environment where private health insurance markets are explicitly modeled. Relative to Kitao and Jeske, our model introduces public health insurance and also has more dimensions of heterogeneity of individuals: we allow for a full life-cycle and different educational levels. This augmented heterogeneity is important for studying the health insurance reform because it has potentially significant redistributive consequences.

Our paper is also related to the literature studying different versions of the health insurance reform in the U.S. Feng (2009) studies macroeconomic consequences of four alternative reform proposals. His framework is three generations OLG model with endogenous medical expenses and with two health insurance options: Medicaid and employer-sponsored insurance (ESHI). Jung and Tran (2009) evaluate the welfare of introducing universal medical vouchers in the U.S. economy using OLG model with endogenous medical expenditures. Brügemann and Manovskii (2010) study how the Patient Protection and Affordable Care Act affects firms' decisions to offer health insurance.

Finally, we relate to the literature that studies individual's life cycle behavior in the presence of exogenous out-of-pocket medical expenses shocks. Palumbo (1999) and De Nardi, French, and Jones (2010) analyze savings decisions of retirees. Scholz, Seshadri, and Khitatrakun (2006) study people's decisions to save for retirement given that the retirees face out-of-pocket medical expenses. Unlike these studies we introduce total charged medical expenses in a life-cycle model and allow individuals to buy a partial insurance in the health insurance market.

## 3 Baseline Model

### 3.1 Households

#### 3.1.1 Demographics and preferences

The economy is populated by overlapping generations of individuals. An individual lives to a maximum of  $N$  periods, works during the first  $R - 1$  periods of life and retires at age  $R$ .

The population is assumed to remain constant. Agents who die are replaced by the entry of newborn agents. There are intergenerational transfers through accidental bequests. The savings of each household who does not survive is transferred to a newborn agent.

Preferences are described with CRRA utility function with risk aversion  $\sigma$ :

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

Agents discount future at a rate  $\beta$  and survive till next period with conditional probability  $\zeta_t$  which depends on age.

#### 3.1.2 Health insurance

Each period an agent faces a stochastic medical expenditure shock  $x_t$ . Medical shocks evolve according to a Markov chain  $G(x_{t+1}|x_t, t)$ . Every individual of a working age can buy health insurance (HI) against this shock in the individual health insurance market. The price of health insurance in the individual market is a function of an agent's current medical shock and age and is denoted by  $p_I(x_t, t)$ .

Every period with some probability  $Prob_t$  the agent of a working age gets an offer to buy insurance through the employer-based pool (ESHI offer). The variable  $g_t$  characterizes the status of the offer:  $g_t = 1$  in case an individual gets an offer,  $g_t = 0$  in case he does not. All participants of the employer-based pool are charged the same premium  $p$  regardless of their current medical expenses and age. An employer pays a fraction  $\psi$  of this premium. If the worker chooses to buy group insurance he only pays  $\bar{p}$  where:

$$\bar{p} = (1 - \psi) p.$$

Low-income individuals of a working age obtain their health insurance from Medicaid for free. To qualify for this public insurance individual labor income adjusted for out-of-

pocket medical expenses<sup>2</sup> ( $y_t^{adj}$ ) should be below some threshold value  $y_t^{pub3}$ .

All types of insurance contracts - group, individual, and public - provide only partial insurance against medical expenditure shocks. We denote by  $q(x_t)$  a fraction of medical expenditure covered by the insurance contract. This fraction is a function of medical expenditures.

We denote the health insurance status of individual by  $i_t$ . If  $i_t = 1$  individual is insured, otherwise  $i_t = 0$ .

All retired households are enrolled in the Medicare program. The Medicare program charges a fixed premium of  $p_{med}$  and covers a fraction  $q_{med}(x_t)$  of the medical cost.

### 3.1.3 Labor income

Working-age agents supply labor inelastically. Households differ by their educational attainment denoted by  $e$ . Educational attainment can take three values.  $e = 1$  corresponds to absence of any degree,  $e = 2$  corresponds to a high-school degree, and  $e = 3$  corresponds to a college degree. Earnings are equal to  $\tilde{w}z_t^e$ , where  $\tilde{w}$  is wage and  $z_t^e$  is idiosyncratic productivity of a person with educational level  $e$  and age  $t$ .

### 3.1.4 Taxation and social transfers

Households pay income taxes in the amount  $\mathcal{T}(y_t)$ . The taxable income  $y_t$  is based on both labor income and capital income. Since the ESHI premium is tax-deductible, a household who buys a group insurance can subtract  $\bar{p}$  from his taxable income.

We also assume a social welfare system,  $T_t^{SI}$ . The social welfare system guarantees that every household will have a minimum consumption level at  $\underline{c}$ . This reflects the option available to the U.S. households with bad combination of income and medical shocks to rely on public transfer programs. Retired households receive Social Security benefits ( $ss_e$ ) that depend on educational attainment  $e$ .

### 3.1.5 Optimization problem

**Working age household ( $t < R$ )** The state variables for the working age household's optimization problem are liquid capital ( $k_t \in \mathbb{K} = \mathbb{R}^+ \cup \{0\}$ ), medical cost shock

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<sup>2</sup>When determining Medicaid eligibility we do not take capital income into account because it decreases the accuracy of the computational algorithm. The results of the model are robust to this assumption because most of the people who get Medicaid in our model have very low asset income.

<sup>3</sup>In reality the eligibility for Medicaid is not based only on income. Major categories of low-income population that qualify for Medicaid are children, their parents and pregnant women. Given limited demographic heterogeneity in our model we avoid this complication by providing Medicaid to all people with low-income. We adjust labor income to account for the fact that many states (35) operate medically needy program which is a part of Medicaid. This program allows individuals to subtract medical expenses from their income when determining Medicaid eligibility.

( $x_t \in \mathbb{X} = R^+ \cup \{0\}$ ), idiosyncratic labor productivity ( $z_t \in \mathbb{Z} = R^+$ ), ESHI offer status ( $g_t \in \mathbb{G} = \{0, 1\}$ ), HI status ( $i_t \in \mathbb{I} = \{0, 1\}$ ), educational attainment ( $e \in \mathbb{E} = \{1, 2, 3\}$ ) and age ( $t \in \mathbb{T} = \{1, \dots, N\}$ ).

In each period the household chooses his consumption ( $c_t$ ), savings ( $k_{t+1}$ ), and HI choice for the next period ( $i'_H$ ). If adjusted labor income  $y_t^{adj}$  of the individual is below  $y_t^{pub}$  he is enrolled in Medicaid (we call this option  $BM$ ). Otherwise, if he is offered an ESHI, he has three options: not buying HI ( $NB$ ), buying an individual HI ( $BI$ ), and buying a group HI ( $BG$ ). If he does not have an ESHI offer, he has only two options:  $NB$  and  $BI$ .

$$i'_H = \left\{ \begin{array}{ll} BM & ; \text{ if } y_t^{adj} \leq y_t^{pub} \\ NB, BI, BG & ; \text{ if } g_t = 1 \text{ and } y_t^{adj} > y_t^{pub} \\ NB, BI & ; \text{ if } g_t = 0 \text{ and } y_t^{adj} > y_t^{pub} \end{array} \right\} \quad (1)$$

The value function of a working-age household can be written as follows:

$$V(k_t, x_t, z_t, g_t, i_t, e, t) = \max_{c_t, k_{t+1}, i'_H} u(c_t) + \beta \zeta_t E_t V(k_{t+1}, x_{t+1}, z_{t+1}, g_{t+1}, i_{t+1}, e, t+1) \quad (2)$$

$$s.t. \quad k_t(1+r) + \tilde{w} z_t^e + T_t^{SI} = c_t + k_{t+1} + x_t(1 - i_t q(x_t)) + P(x_t, i'_H) + \mathcal{T}(y_t) \quad (3)$$

where

$$\tilde{w} = \left\{ \begin{array}{ll} w & ; \text{ if } g_t = 0 \\ w - c_E & ; \text{ if } g_t = 1 \end{array} \right\} \quad (4)$$

$$P(x_t, i'_H) = \left\{ \begin{array}{ll} 0 & ; \text{ if } i'_H = NB \text{ or } i'_H = BM \\ p_I(x_t, t) & ; \text{ if } i'_H = BI \\ \bar{p} & ; \text{ if } i'_H = BG \end{array} \right\} \quad (5)$$

$$y_t = \left\{ \begin{array}{ll} \tilde{w} z_t^e + r k_t & ; \text{ if } i'_H \neq BG \\ \max(0, \tilde{w} z_t^e + r k_t - \bar{p}) & ; \text{ if } i'_H = BG \end{array} \right\} \quad (6)$$

$$T_t^{SI} = \max(0, \underline{c} + x_t(1 - i_t q(x_t)) + \mathcal{T}(\tilde{w} z_t^e + r k_t) - \tilde{w} z_t^e - k_t(1+r)) \quad (7)$$

$$i_{t+1} = \left\{ \begin{array}{l} 0 ; \text{ if } i'_H = NB \\ 1 ; \text{ if } i'_H \neq NB \end{array} \right\}. \quad (8)$$

The conditional expectation on the RHS of equation (2) is over  $\{x_{t+1}, z_{t+1}, g_{t+1}\}$ . The second equation is the budget constraint.  $w$  is wage per effective labor unit. If the household has an ESHI offer, the employer partly pays for his insurance premium. To maintain zero profit condition, the employer who offers HI deducts some amount  $c_E$  from the wage per effective labor unit.

Equation (8) maps the current HI status and HI choices into the next period HI



status. If the household does not buy HI and do not get Medicaid, he will be uninsured in the next period.

**Retired household** For a retired household ( $t \geq R$ ) the state variables are liquid capital ( $k_t$ ), medical cost shock ( $x_t$ ), educational attainment ( $e$ ), and age ( $t$ ).<sup>4</sup>

$$V(k_t, x_t, e, t) = \max_{c_t, k_{t+1}} u(c_t) + \beta \zeta_t E_t V(k_{t+1}, x_{t+1}, e, t+1) \quad (9)$$

$$s.t. \quad k_t(1+r) + ss_e + T_t^{SI} = c_t + k_{t+1} + x_t(1 - q_{med}(x_t)) + p_{med} + \mathcal{T}(y_t) \quad (10)$$

where

$$y_t = rk_t + ss_e$$

$$T_t^{SI} = \max(0, \underline{c} + x_t(1 - q_{med}(x_t)) + \mathcal{T}(y_t) + p_{med} - ss_e - k_t(1+r)) \quad (11)$$

**Distribution of households** To simplify the notations, let define  $\mathbb{S}$  as the space of households' state variable where  $\mathbb{S} = \mathbb{K} \times \mathbb{Z} \times \mathbb{X} \times \mathbb{G} \times \mathbb{I} \times \mathbb{E} \times \mathbb{T}$  for working-age households and  $\mathbb{S} = \mathbb{K} \times \mathbb{X} \times \mathbb{E} \times \mathbb{T}$  for retired households. Let  $\mathbf{s} \in \mathbb{S}$ . Denote by  $\Gamma(\cdot)$  the distribution of households over the state-space.

### 3.2 Production sector

There are two stand-in firms which act competitively. Their production functions are Cobb-Douglas,  $AK^\alpha L^{1-\alpha}$ , where  $K$  and  $L$  are aggregate capital and aggregate labor and  $A$  is the total factor productivity. The first stand-in firm offers ESHI to its workers. The second stand-in firm does not.<sup>5</sup> Under the competitive behavior, the second firm pays each employee his marginal product of labor. Because capital is freely allocated between the two firms, Cobb-Douglas production function implies that the capital-labor ratios of both firms are the same. Consequently we have

$$w = (1 - \alpha) AK^\alpha L^{-\alpha}, \quad (12)$$

$$r = \alpha AK^{\alpha-1} L^{1-\alpha} - \delta. \quad (13)$$

where  $\delta$  is depreciation rate.

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<sup>4</sup>The problem of a newly retired household is slightly different from a retired household. The insurance status of a newly retired household depends on his insurance decision before the retirement. Thus the state variables are  $\{k_t, x_t, i_t\}$ . Also out-of-pocket medical expenses are equal to  $x_t(1 - i_t q(x_t))$ .

<sup>5</sup>An alternative setup is that there are two islands which are different in terms of ESHI offer. Worker are allocated randomly between the two islands while there is no friction on the capital market. Inside each island, the labor market is competitive.

The first firm has to partially finance the health insurance premium for its employees. These costs are passed on to its employees through a wage reduction. In specifying this wage reduction we follow Jeske and Kitao (2009). The first firm subtracts an amount of  $c_E$  from marginal product per effective labor. Zero profit condition implies

$$c_E = \frac{\psi p \left( \int \mathbf{1}_{\{i'_H(\mathbf{s})=BG\}} \Gamma(\mathbf{s}) \right)}{\left( z_t^e \int \mathbf{1}_{\{g_t=1\}} \Gamma(\mathbf{s}) \right)}. \quad (14)$$

$\mathbf{1}_{\{\cdot\}}$  is a function mapping to one if its argument is true; otherwise the function is zero. The nominator is the total contributions towards insurance premiums paid by the first firm. The denominator is the total effective labor working in first firm. Thus  $c_E \exp(z_t^e)$  is the wage reduction of every employee with an ESHI offer.<sup>6</sup>

### 3.3 Insurance sector

Health insurance companies both in private and group markets act competitively. We assume that insurers can observe all state variables that determine future medical expenses of the individuals<sup>7</sup>. This assumption together with zero profit conditions allow us to write insurance premiums in the following way:

$$p_I(x_t, t) = (1+r)^{-1} \gamma^I EM(x_t, t) + \pi \quad (15)$$

for the non-group insurance market and

$$p = (1+r)^{-1} \frac{\gamma^G \left( \int \mathbf{1}_{\{i'_H(\mathbf{s})=BG\}} \times EM(x_t, t) \Gamma(\mathbf{s}) \right)}{\int \mathbf{1}_{\{i'_H(\mathbf{s})=BG\}} \Gamma(\mathbf{s})} \quad (16)$$

for the group insurance market. Here  $EM(x_t, t)$  are expected medical costs of an individual of age  $t$  and current medical costs  $x_t$  covered by the insurance company:

$$EM(x_t, t) = \zeta_t \int x_{t+1} q(x_{t+1}) G(x_{t+1}|x_t, t).$$

$\gamma^I$  and  $\gamma^G$  are markups on actuarially fair prices due to administrative costs in the individual and group markets correspondingly;  $\pi$  is fixed costs of buying individual policy<sup>8</sup>. The premium in the non-group insurance market is based on the discounted expected

<sup>6</sup>The assumed structure implies a proportional transfer from high incomes to low incomes. An alternative structure is a lump-sum wage reduction. This alternative structure is difficult to implement in our setup since some workers will end up earning zero or negative wage.

<sup>7</sup>Currently most states allow insurance firms to medically underwrite applicants for health insurance.

<sup>8</sup>We add fixed costs only to individual insurance contracts because we assume in a group market these costs almost disappear due to the economy of scale.

medical expenditures of the individual buyer. The premium of the group insurance is based on a weighted average of the expected medical costs of those who buy the group insurance.

### 3.4 Government constraint

We assume that the government runs a balanced budget. This implies

$$\int \mathcal{T}(y_t) \Gamma(\mathbf{s}) = \int_{t \geq R} (ss_e + q_{med}(x_t) x_t - p_{med}) \Gamma(\mathbf{s}) + \int T_t^{SI} \Gamma(\mathbf{s}) + \int_{t < R} \mathbf{1}_{\{i'_H(\mathbf{s})=BM\}} \times q(x_t) x_t \Gamma(\mathbf{s}) \quad (17)$$

The LHS is a total income tax from all households. The first term on the RHS is the net expenditures on Social Security system and Medicare for retired households. The second term is the cost of guaranteeing minimum consumption floor for households. The last term is the cost of Medicaid.

### 3.5 Definition of stationary competitive equilibrium

Given the government programs  $\{\underline{c}, ss_e, q_{med}(x_t), p_{med}, y_t^{pub}\}$ , the fraction of medical costs covered by private insurers and Medicaid  $\{q(x_t)\}$ , and the employers' contribution  $(\psi)$ , the competitive equilibrium of this economy consists of the set of time-invariant prices  $\{w, r, p, p_I(x_t, t)\}$ , wage reduction  $\{c_E\}$ , households' value functions  $\{V(\mathbf{s})\}$ , decision rules of the working-age households  $\{c_t(\mathbf{s}), k_{t+1}(\mathbf{s}), i'_H(\mathbf{s}); t = 1, \dots, R-1\}$  and of retired households  $\{c_t(\mathbf{s}), k_{t+1}(\mathbf{s}); t = R, \dots, T\}$ , and the tax function  $\{\mathcal{T}(y)\}$  such that the following conditions are satisfied:

1. Given the set of prices and the tax function, the decision rules solve the households' optimization problem.
2. Wage ( $w$ ) and rent ( $r$ ) satisfy equation (12) and (13), where

$$K = \int k_{t+1}(\mathbf{s}) \Gamma(\mathbf{s}) + \int_{t < R} \mathbf{1}_{\{i'_H(\mathbf{s})=BG\}} p \Gamma(\mathbf{s}) + \int_{t < R} \mathbf{1}_{\{i'_H(\mathbf{s})=BI\}} p_I(x, t) \Gamma(\mathbf{s}),$$

$$L = \int_{t < R} z_t^e \Gamma(\mathbf{s}).$$

3.  $c_E$  satisfies equation (14); thus the firm offering ESHI earns zero profit.
4. The non-group insurance premiums  $p_I(x_t, t)$  satisfies equation (15) and the group insurance premium satisfies equation (16). So health insurance companies earn zero profit.

5. The tax function  $\{\mathcal{T}(y)\}$  satisfies the government budget balance (17).

## 4 Changes introduced by the reform

This sections describes what modifications are introduced to the baseline model after the reform. When modeling the reform, we assume that there is no response from production firms. In other words, the probability to get ESHI offer and the employer contribution rate do not change after the reform<sup>9</sup>. This assumption is relaxed in the Appendix.

### 4.1 Household problem

After the reform a working-age household has to take into account the fact that depending on his insurance decision he may be subject to penalties or receive subsidies. Also, more households become eligible for Medicaid. Subsidies and Medicaid eligibility penalties depend on a household's labor income; penalties are a function of total income<sup>10</sup>. If we denote labor income of a household by  $y_t^{lab}$ ,  $y_t^{lab} = \tilde{w}z_t^e$ , we can rewrite his budget constraint in the following way:

$$k_t(1+r) + \tilde{w}z_t^e + T_t^{SI} + Sub(y_t^{lab}, i'_H) = c_t + k_{t+1} + x_t(1 - i_t q(x_t)) + P(x_t, i'_H) + \mathcal{T}(y_t) + Pen(y_t^{lab} + rk_t, i'_H)$$

where

$$P(i'_H) = \left\{ \begin{array}{ll} 0 & ; \text{ if } i'_H = NB \text{ or } i'_H = BM \\ p_I(t) & ; \text{ if } i'_H = BI \\ \bar{p} & ; \text{ if } i'_H = BG \end{array} \right\}$$

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<sup>9</sup>This assumption results from the absence of consensus in the economic literature about the firms response to the reform. Some economists express the concern that the reform will make many small firms drop coverage due to the availability of subsidized insurance for their employees in the individual market. On the other hand, Brugemann and Manovskii (2010) in a quantitative model show that the number of firms offering coverage may increase. There is also a view that the reform will not change the number of firms offering coverage. The Bill requires firms with more than 50 employees to pay penalties if they do not offer coverage. However, 96% of firms with more than 50 employees already offer coverage and among firms with more than 200 employees this number goes up to 99%. Also, the Bill allows for tax credits for firms with less than 25 employees who offer health insurance coverage to its workers. However, these tax credits are in effect for only two years.

<sup>10</sup>In the Bill subsidies depend on total income. Given our earlier assumption that Medicaid is a function of labor income, we maintain the same assumption for subsidies as well. This is done to preserve the relationship between Medicaid and subsidies eligibility rules specified in the Bill. In general this assumption is unlikely to affect the main results because majority of people benefiting from the reform have low labor and asset income. Thus counting asset income will not affect the eligibility for this group.

A subsidy is determined in the following way

$$Sub(y_t^{lab}, i'_H) = \left\{ \begin{array}{ll} 0 & ; \text{ if } i'_H = NB, BG \text{ or } y_t^{lab} \geq th_6 FPL \text{ or } (g_t = 1 \text{ and } \frac{\bar{p}}{y_t^{lab}} > t-g) \\ \frac{p_I(t)}{t_{c1}} - y_t^{lab} & ; \text{ if } \frac{p_I(t)}{y_t^{lab}} > t_{c1} \text{ and } th_1 FPL \leq y_t^{lab} < th_2 FPL \\ \frac{p_I(t)}{t_{c2}} - y_t^{lab} & ; \text{ if } \frac{p_I(t)}{y_t^{lab}} > t_{c2} \text{ and } th_2 FPL \leq y_t^{lab} < th_3 FPL \\ \frac{p_I(t)}{t_{c3}} - y_t^{lab} & ; \text{ if } \frac{p_I(t)}{y_t^{lab}} > t_{c3} \text{ and } th_3 FPL \leq y_t^{lab} < th_4 FPL \\ \frac{p_I(t)}{t_{c4}} - y_t^{lab} & ; \text{ if } \frac{p_I(t)}{y_t^{lab}} > t_{c4} \text{ and } th_4 FPL \leq y_t^{lab} < th_5 FPL \\ \frac{p_I(t)}{t_{c5}} - y_t^{lab} & ; \text{ if } \frac{p_I(t)}{y_t^{lab}} > t_{c5} \text{ and } th_5 FPL \leq y_t^{lab} < th_6 FPL \end{array} \right\}$$

A penalty is determined in the following way

$$Pen(y_t^{lab} + rk_t, i'_H) = \left\{ \begin{array}{ll} 0 & ; \text{ if } i'_H = BI, BG \text{ or } \frac{p_I(t)}{y_t^{lab} + rk_t} > p-c \\ \max\{\varkappa y_t^{lab} + rk_t, \bar{\varkappa}\} & ; \text{ otherwise} \end{array} \right\}$$

Here  $Sub(y_t^{lab}, i'_H)$  is a subsidy to individual that depends on his labor income and decision to purchase insurance. Only individuals purchasing insurance outside the employer-based market can get subsidy. The subsidy is determined on a sliding scale in the following way. Individuals qualify for subsidy if their labor income is less than some factor  $th_6$  of the federal poverty line ( $FPL$ ). An individual with labor income in the bracket  $[th_i FPL, th_{i+1} FPL]$  receives a subsidy that guarantees that his health insurance premium does not exceed a fraction  $t_{c_{i+1}}$  of his income ( $i = 1, \dots, 5$ ). Individuals who get an ESHI offer can qualify for a subsidy only if the share of employee's contribution to their income is higher than some number  $t-g$ .

People with income below  $th_1 FPL$  qualify for Medicaid. At the same time individuals who qualified for Medicaid before the reform maintain their eligibility. In other words even if individual's labor income is above  $th_1$  but after subtracting medical expenses his income is below  $y_t^{pub}$  he still qualifies for Medicaid<sup>11</sup>.

Penalty  $Pen(y_t^{lab} + rk_t, i'_H)$  works in the following way. If an individuals purchase insurance or if the insurance premium exceeds fraction  $p-c$  of his income, he does not pay a penalty. Otherwise the penalty is equal to the greater of a flat rate  $\bar{\varkappa}$  and a fraction  $\varkappa$  of his income.

## 4.2 Insurance sector

After the reform premiums in the individual insurance market are not allowed to depend on the current medical costs of policy buyers. The insurance premium of an

<sup>11</sup>The Bill changes general Medicaid eligibility rules but does not introduce changes in the Medically needy program which stays at the discretion of the states.

individual of age  $\tilde{t}$  is determined in the following way:

$$p_I(\tilde{t}) = (1+r)^{-1} \gamma^I \frac{\left( \int \mathbf{1}_{\{i'_H(\mathbf{s})=BI, t=\tilde{t}\}} \times EM(x_{\tilde{t}}, \tilde{t}) \Gamma(\mathbf{s}) \right)}{\int \mathbf{1}_{\{i'_H(\mathbf{s})=BI, t=\tilde{t}\}} \Gamma(\mathbf{s})} + \pi^{12}.$$

### 4.3 Government constraint

We maintain the assumption that the government runs a balanced budget. This implies

$$\begin{aligned} \int \mathcal{T}(y_t) \Gamma(\mathbf{s}) + \int_{t < R} Pen(y_t^{lab} + rk_t, i'_H) \Gamma(\mathbf{s}) = & \quad (18) \\ \int_{t \geq R} (ss_e + q_{med}(x_t, t) x_t - p_{med}) \Gamma(\mathbf{s}) + \int T_t^{SI} \Gamma(\mathbf{s}) + \int_{t < R} Sub(y_t^{lab}, i'_H) \Gamma(\mathbf{s}) \\ + \int \mathbf{1}_{\{i'_H(\mathbf{s})=BM\}} \times q(x_t, t) x_t \Gamma(\mathbf{s}) \end{aligned}$$

The LHS now has an additional source of revenue - penalties from those unwilling to purchase insurance. The RHS has an additional category of expenditures - subsidies.

## 5 Data and calibration

### 5.1 Data

The dataset used for calibration of the model is the Medical Expenditure Panel Survey (MEPS). The MEPS collects detailed records on demographics, income, medical costs and insurance for a nationally representative sample of households. It consists of two-year overlapping panels and covers periods of 1996-2006. We use eight waves of the MEPS - from 1999 to 2007<sup>13</sup>.

The MEPS links people into one household based on an eligibility for coverage under typical family insurance plan. This Health Insurance Eligibility Unit (HIEU) defined in the MEPS dataset corresponds to our definition of a household. All statistics we use was computed for the head of the HIEU. We define the head as a person who has the highest income in the HIEU. A different definition of the head (based on gender) does not give statistically different results. When computing all the statistics we use longitudinal

<sup>12</sup>We maintain the assumption that there are fixed costs associated with issuing the individual insurance contract after the reform. This way we can measure how much does the welfare change due to the reorganization of the individual market not due to the possible gains in efficiency.

<sup>13</sup>We do not use the first two waves of the MEPS because they do not contain the variables we use in constructing a household unit.

weights provided in the MEPS. Given that all individuals are observed for at most two years, we pool together all eight waves of the MEPS. Since each wave is a representation of population in each year, the weight of each individual was divided by eight in the pooled sample.

In our sample we include all households' heads whose age is at least 24 year old and who have a labor income (defined later) which is non-negative. In addition, we exclude people who are younger than 65 and receive Medicare. Most of non-elderly Medicare beneficiaries are disabled and this status is not present in our model. The sample size for each wave is presented in Table 1.

We use 2003 as a base year. All level variables were normalized to the base year using Consumer Price Index (CPI). We also adjust for the growth rate of average medical expenditures.

Table 1: Number of observations in eight waves of MEPS (1999-2007)

Panel	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	Total
Obs.	4,291	3,360	6,848	5,149	5,179	5,198	5,005	5,313	40,343

## 5.2 Demographics, preferences and technology

In the model agents are born at age 25 and can live to a maximum of age 80<sup>14</sup>. The model period is one year so the maximum lifespan  $N$  is 56 periods. Agents retire at age 65, thus  $R$  is 40 periods. For the conditional survival probabilities  $\zeta_t$  we use female life tables from Social Security Administration.

The risk aversion parameter  $\sigma$  is set to 4 which is in the range of values commonly used in the life-cycle literature. The discount factor  $\beta$  is calibrated to match the aggregate capital output ratio of 3.

The Cobb-Douglas function parameter  $\alpha$  is set at 0.33 which corresponds to the U.S. economy capital income share. The annual depreciation rate  $\delta$  is calibrated to achieve an interest rate of 4% in the baseline economy. The total factor productivity  $A$  is set such that the average labor income equals one in the baseline model.

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<sup>14</sup>Agents in our model have shorter than usual lifespan because the MEPS has very few observations on individuals that are older than 80 year old.

### 5.3 Government

In calibrating the tax function  $\mathcal{T}(y)$  we use a nonlinear relationship specified by Gouveia and Strauss (1994):

$$\mathcal{T}(y) = a_0 [y - (y^{-a_1} + a_2)^{-1/a_1}]$$

This functional form is commonly used in the quantitative macroeconomic literature (for example, Conesa and Krueger (2006), Jeske and Kitao (2009)). In this functional form  $a_0$  controls the marginal tax rate faced by people with the highest income,  $a_1$  determines the curvature of marginal taxes and  $a_2$  is a scaling parameter. We set  $a_0$  and  $a_1$  to be equal to the original estimates in Gouveia and Strauss (1994), 0.258 and 0.768 correspondingly. The parameter  $a_2$  is used to balance the government budget. When implementing the reform we keep  $a_2$  fixed at a level that balances the budget in the baseline economy. To achieve the balanced budget in the reformed economy, we adjust the parameter  $a_0$ . This is done to reflect the fact that the current administration plans to finance the reform by increasing a tax burden on people with the highest income.

The minimum consumption floor  $\underline{c}$  was calibrated to match the fraction of people with assets below \$5,000 in the baseline economy: the fraction of people whose assets are non-negative and less than \$5,000 was 12.1% in 2001 (Kennickel, 2003). Social security replacement rates were set to 55, 45 and 35% of average education-specific labor income for high-school dropouts, high-school and college graduates correspondingly. These replacement rates result from applying Social Security benefit calculation formula to the average income profiles for each educational group.

Medicaid eligibility threshold  $y_t^{pub}$  was set to match age-profile of the fraction of uninsured among people with the lowest educational attainment<sup>15</sup>. In particular, we allow  $y_t^{pub}$  to take two values by increasing Medicaid eligibility threshold for those older than 55 year old. This reflects the fact that Medicaid primarily covers people with dependent children and pregnant women, and after age 55 fewer individuals fall under these categories.

### 5.4 Insurance sector

The share of health insurance premium paid by the firm ( $\psi$ ) was chosen to match aggregate ESHI take-up rate<sup>16</sup>. The resulting number (77.5%) is consistent with the one observed in the U.S. economy, which is in the range of 75-85% (Kaiser Family foundation

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<sup>15</sup>We choose to match the fraction of uninsured among high-school dropouts because people in this group are most likely to become eligible for Medicaid.

<sup>16</sup>In this paper we use the term "take-up rate" only in relation to employer-based market, and it defines a fraction of people among those with ESHI offer who choose to buy group insurance.



Employer Health Benefits Survey, 2002-2009).

We set proportional loads for group and individual insurance policies ( $\gamma^I$  and  $\gamma^G$ ) to 1.11. This number comes from the study of Kahn et al.(2005). Fixed costs of buying individual policy  $\pi$  is set to 0.45% of average labor income (the average labor income in our sample was 38,950 in 2003) or 253 in dollar terms. This parameter was used to match the aggregate fraction of people with individual insurance.

## 5.5 Labor income

We divide households into three educational groups: high-school dropouts, high-school and college graduates. The fraction of each group in the population is 15, 50, and 35% correspondingly. Workers with different education have different income processes, specified as following:

$$z_t^e = \exp(\lambda_t^e) \exp(v_t)$$

where

$$\begin{aligned} \lambda_t^e &= \varphi_0^e + \varphi_1^e t + \varphi_2^e t^2 + \varphi_3^e t^3 \\ v_t &= \rho v_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \end{aligned} \tag{19}$$

The education-specific coefficients  $\varphi_0^e, \varphi_1^e, \varphi_2^e$  and  $\varphi_3^e$  were estimated from the MEPS dataset. These coefficients are based on the following regression equation:

$$\log(\text{inc}_t) = \varphi_0^e + \varphi_1^e t + \varphi_2^e t^2 + \varphi_3^e t^3 + \Phi D_t$$

where  $\text{inc}_t$  is a household labor income normalized by the average labor income (\$38,950), and  $D_t$  is a set of dummies for each year<sup>17</sup>. Household labor income was defined as a sum of wages (variable WAGEP) and 75 percent of income from business (variable BUSNP). This definition is the same as used in the Panel Study of Income Dynamics Dataset (PSID), which is commonly used for income calibration in the macroeconomic literature.

For the persistence parameter in the stochastic part of income  $\rho$  we use the value 0.985 and the variance of innovation  $\sigma_\varepsilon^2$  was set to 0.02. These values were chosen so the model can reproduce the empirical fact that the cross-sectional variance of log of consumption increases over the life-cycle,<sup>18, 19</sup>. Our parameters are in the range estimated in Storesletten, Telmer and Yaron (2004) and Hubbard, Skinner, and Zeldes (1994).

<sup>17</sup>Since the dependent variable is a log of income, we restrict the sample to individuals whose annual income is greater than \$1,000.

<sup>18</sup>The dynamics of variance of log of consumption over the life cycle is extensively discussed in Deaton and Paxson (1994); Storesletten et al (2004); and Guvenen (2006).

<sup>19</sup>We approximate the income process in this way as opposed to estimating it from the MEPS because in this dataset each individual is observed only for two periods. The transition matrix for income constructed from a two-year panel fails to produce a high persistence of the income process and thus underestimates a lifetime income risk in a full life-cycle model.

In our computation we use a discretized version of the income process. To construct the age and education-specific grids and transition matrix we use the method suggested by Floden (2008)<sup>20</sup> to discretize the stochastic part of the income process  $v_t$ . Then we scale each grid by the deterministic education-specific component  $\lambda_t^e$ . To construct the distribution of newborn individuals, we draw  $v_1$  in equation (19) from the normal  $N(0, \sigma_\varepsilon^2)$  distribution. Figure (1) compares actual and simulated labor income profiles.

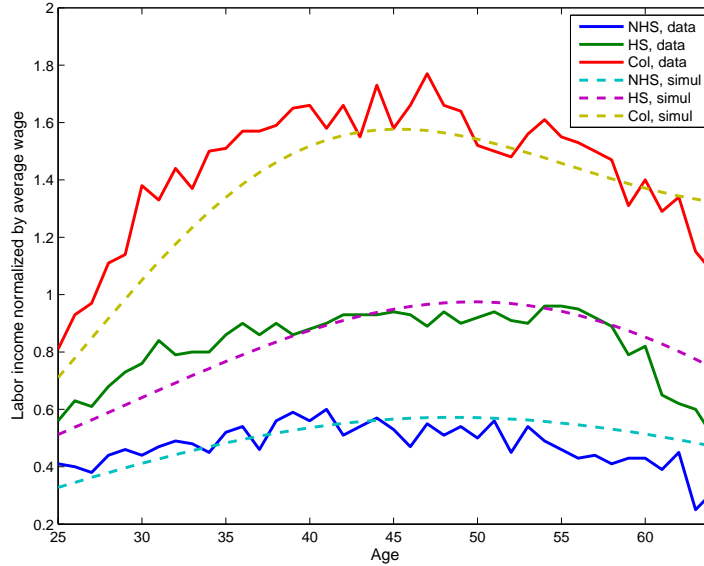


Figure 1: Simulated vs. actual labor income

## 5.6 Offer rate

We assume that probability to get an offer of ESHI coverage is a logistic function<sup>21</sup>:

$$Prob_t = \frac{\exp(u_t)}{1 + \exp(u_t)}$$

where the variable  $u_t$  is an odds ratio that takes the following form:

$$u_t = \eta_0^e + \eta_1^e \log(inc_t) + \eta_2^e [\log(inc_t)]^2 + \eta_3^e [\log(inc_t)]^3 + \eta_4^e \mathbf{1}_{\{g_{t-1}=1\}} + \Theta^e D_t \quad (20)$$

<sup>20</sup>The method suggested by Floden (2008) gives higher accuracy than more commonly used Tauchen and Hussey (1991) discretization method if the persistence parameter of the AR(1) process is high, as it is in our case.

<sup>21</sup>In our estimation we assume that an individual has an offer if any member of his HIEU reports having an offer in at least two out of three interview rounds during a year (variables OFFER31x, OFFER42x, OFFER53x). In addition we exclude households' heads whose income was below \$1,000 when estimating the logistic regression.

Here  $\eta_0^e, \eta_1^e, \eta_2^e, \eta_3^e, \eta_4^e$  and  $\Theta^e$  are education-specific coefficients. The initial offer rate ( $g_0$  in equation (20)) was constructed based on the fraction of people having an offer at age 24 for each educational group. Simulated and actual offer rates are presented in Figure (2). Our simulated offer rates can replicate large differences in age profiles of ESHI offer rates among educational groups. We are also able to capture the dynamics of the offer rate. Table 2 compares the probability to get an offer this period conditional on having an offer last period for different educational groups.

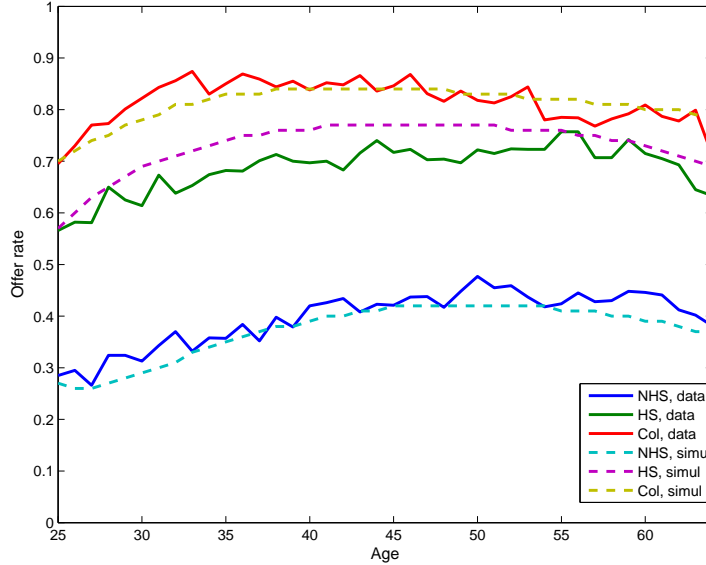


Figure 2: Simulated vs. actual offer rates

<b>NHS</b>	Data	Model
Offer previous period	0.87	0.87
No offer previous period	0.06	0.08

<b>HS</b>	Data	Model
Offer previous period	0.94	0.94
No offer previous period	0.14	0.19

<b>College</b>	Data	Model
Offer previous period	0.96	0.96
No offer previous period	0.19	0.21

Table 2: Conditional probability to get ESHI offer: data vs. model

## 5.7 Insurance status

In the MEPS the question about the source of insurance coverage is asked retrospectively for each month of the year. When measuring the insurance status in the data we use the following approach. We define the person as having an employer-based insurance if he reports having ESHI for at least eight months during the year (variables PEGJA-PEGDE). The same criteria was used when defining public insurance (variables

PUBJA-PUBDE) and individual insurance status (variables PRIJA-PRIDE). For those few individuals who switch sources of coverage during the year, we use the following definition of insurance status. If a person has both ESHI and individual insurance in one year, and each coverage lasted for less than eight month, but the total duration of coverage lasted for more than eight months, we classify this person as individually insured. Likewise, when a person has a combination of individual and public coverage that together lasts for more than eight months, we define individual as having public insurance<sup>22</sup>.

## 5.8 Medical expenditures

Medical costs in our model correspond to the total paid medical expenditures in the MEPS dataset (variable TOTEXP). This includes not only out-of-pocket medical expenses but also the part of costs covered by the insurer. In calibration we categorize medical expenditures for each age into seven bins with the bin of size 20th, 40th, 60th, 80th, 95th and 99th percentiles. To adjust for medical costs growth, we normalize each year's medical expenses by a health inflation index. This index was constructed by computing growth rate of average medical expenses for each year relative to the base year 2003. To construct the transition matrix we measure the fraction of people who move from one bin to another between two consecutive years separately for people of working age (25-64) and for retirees (older than 65). The mean and variance of medical expenses simulated by our model and observed in the data are compared in Figures (3) and (4). Our medical shock process tracks closely empirical mean and variance. It also captures the fact that both mean and variance of medical expenses increase steeply with age.

To determine the fraction of medical expenses covered by insurance policies  $q(x_t)$  and  $q_{med}(x_t)$  we use the following approach. For working age households we estimated medical expenditures paid by insurers (variable TOTPRV) as a quadratic function of total paid medical expenditures and year dummy variables. For retired households we estimated Medicare payments (variable TOTMCR) as a linear function of total paid medical expenses<sup>23</sup> and year dummy variables. We include only single households with positive health expenses in our sample. We use these estimates to compute the ratio of medical costs covered by the insurance for each gridpoint of medical expenses for each age. Estimated ratios for private insurance and Medicare are presented in Figures (5) and (6). The lines show the fraction of medical costs covered by the private insurance (for working age households) or Medicare (for retired households) for each discretized

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<sup>22</sup>The results do not significantly change if we change the cutoff point to 6 months or 12 months.

<sup>23</sup>The second order term is not significant, so we removed it from the estimated equation. The  $R^2$  for working age people is 0.75, while for retirees is equal to 0.72.

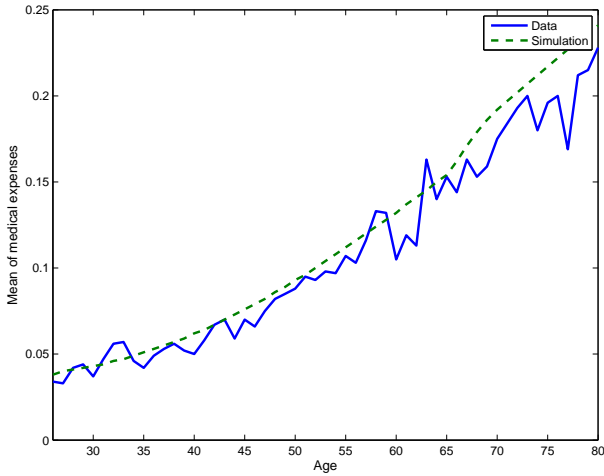


Figure 3: Mean of medical expenses normalized by average wage

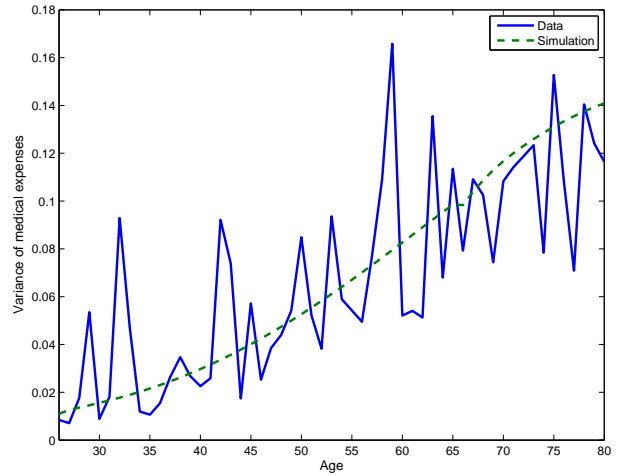


Figure 4: Variance of medical expenses normalized by average wage

medical expenses grid.

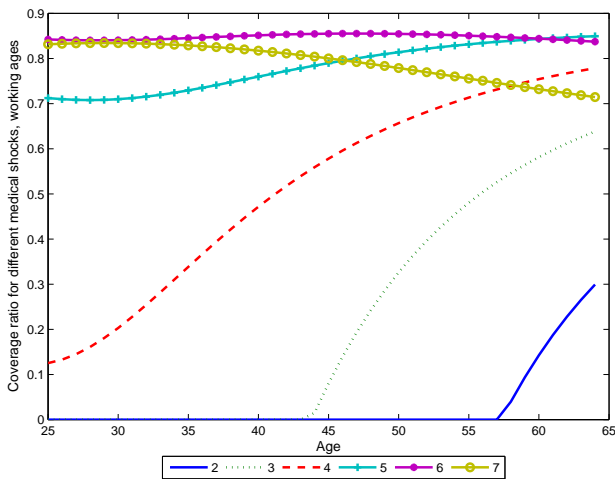


Figure 5: Coverage ratio, private plans

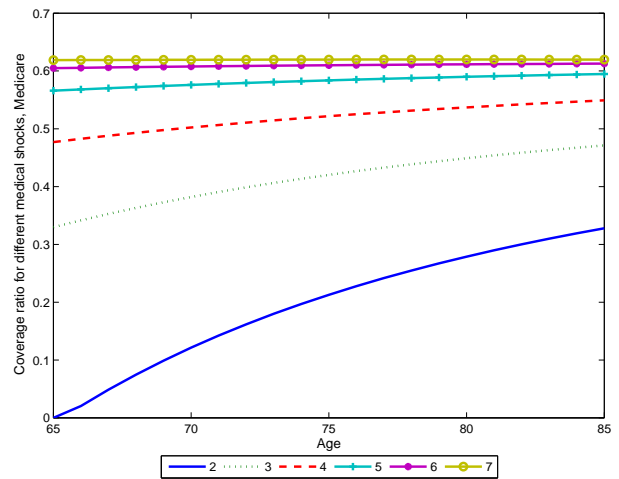


Figure 6: Coverage ratio, Medicare

## 5.9 Summary of the parametrization of the baseline model

The model parametrization is summarized in Tables 3 and 4. Table 3 presents parameters that were set outside the model, and Table 4 shows parameters that were used to match some targets in the model.

## 5.10 Health reform parameters

The values for the parameters of the reform are taken from the Patient Protection and Affordable Care Act signed on March 23, 2010. These values are summarized in Table 5.

Parameter name	Notation	Value	Source
Risk aversion	$\sigma$	4	-
Cobb-Douglas parameter	$\alpha$	0.33	Capital share in output
<i>Tax function parameters:</i>	$a_0$	0.258	Gouveia and Strauss (1994)
	$a_1$	0.768	Gouveia and Strauss (1994)
<i>Social Security replacement rates:</i>			
Below High-School	$ss_1$	55%	SS Benefits formula
High-School	$ss_2$	45%	SS Benefits formula
College	$ss_3$	35%	SS Benefits formula
Insurance loads:			
Individual market	$\gamma^I$	1.11	Kahn et all (2005)
Group market	$\gamma^G$	1.11	Kahn et all (2005)
Medicare premium	$p^{med}$	\$1,055	Total premiums =2.11% of $Y$
Federal Poverty Line	$FPL$	\$9,573	Data

Table 3: Parameters set outside the model

The penalty as a fraction of taxable income ( $\varkappa$ ) is set to 2.5%. The lowest fraction of health insurance premium in taxable income that allows for exemption from penalties ( $p_c$ ) is set to 8%. For the fractions of the highest allowable share of insurance premium in income we use the numbers that correspond to the midpoints of the intervals specified in the Bill.

The lowest share of employee contribution to taxable income that allows an individual with ESHI offer to qualify for subsidies ( $t_g$ ) is set to 9.5%. Federal Poverty Level ( $FPL$ ) is set to 23% of average labor income. This corresponds to the Census poverty line for family of one in 2009 (\$9,573).

## 6 Baseline model performance

Table 6 compares aggregate health insurance statistics generated by the model with the ones observed in the data. The model was calibrated to match the data on ESHI take-up and individual insurance rates. However, the model also produces numbers on the fractions of uninsured and publicly insured close to the data. The model slightly underestimates the fraction of publicly insured (4.5 in the model vs. 6.1% in the data). This is due to the fact that our model has a very stylized representation of Medicaid. An underestimation of publicly insured leads to an overestimation of uninsured given that both publicly insured and uninsured are predominantly composed of low income people without an ESHI offer.

Table 7 shows insurance statistics by educational groups. Our model does not target most of these statistics (except the uninsurance rate among high-school dropouts), but

Parameter name	Notation	Value	Source/Target
Discount factor	$\beta$	0.962	$\frac{K}{Y} = 3$
Depreciation rate	$\delta$	0.07	$r = 0.04$
<i>Tax function parameters:</i>	$a_2$	0.652	Balanced government budget
Consumption floor	$\underline{c}$	\$5,265	% with assets < \$5,000 = 12.1%
Insurance loads:			
Fixed costs	$\pi$	\$253	% of individually insured = 7.6%
Employer contribution	$\psi$	77.5%	ESHI take-up rate = 94%
<i>Stochastic productivity process</i>			
Persistence parameter	$\rho$	0.985	Life-cycle profile of
Variance of innovations	$\sigma_\varepsilon^2$	0.02	log of consumption variance
Medicaid eligibility threshold	$y_t^{pub}$	$\begin{cases} 0.95\text{FPL if age} \leq 55 \\ 0.65\text{FPL if age} > 55 \end{cases}$	% of uninsured HS dropouts

Table 4: Parameters used to match some targets

it still fares well along these dimensions.

Figures (7) and (8) compare life-cycle profiles of fraction of people with ESHI and ESHI take-up rates for different educational group in the model and in the data. The model reproduces the general life cycle pattern and differences in educational group in employer-based insurance rates and ESHI take-up rates. However it underestimates the take-up rates for young people. This is due to the fact that in our model there is only one insurance policy available from the employer. Individuals of all ages have to pay the same price for employer-based insurance and it involves significant cross-subsidization from young to old. Many young are unwilling to buy this unfair insurance. The fact that in the data the take-up rates for young are higher may indicate that there is some risk-separation exists in firms that offer several insurance policies, some contracts are more suited for the young and some - for the old.

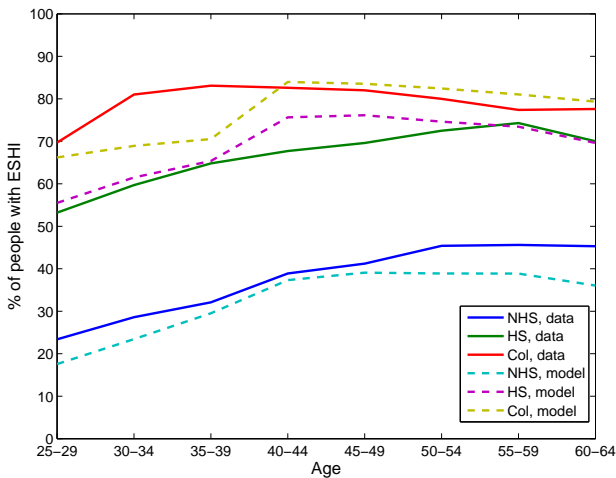


Figure 7: Percent of people with ESHI

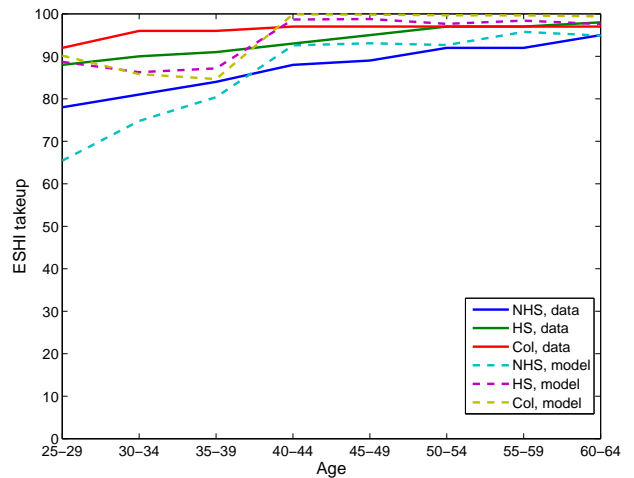


Figure 8: ESHI take-up rate

Parameter name	Notation	Value
Penalty (fraction of taxable income)	$\varkappa$	2.5%
Flat penalty rate	$\bar{\varkappa}$	\$695
Premium/income for penalty exempt	$p_c$	8%
Income level thresholds for subsidies	$th_1$	1.3
	$th_2$	1.5
	$th_3$	2.0
	$th_4$	2.5
	$th_5$	3.0
	$th_6$	4.0
Premium/income targeted by subsidy	$t_{c1}$	2.0%
	$t_{c2}$	3.5%
	$t_{c3}$	5.2%
	$t_{c4}$	7.2%
	$t_{c5}$	8.8%
	$t_{c6}$	9.5%
Premium/income to get subsidy with ESHI offer	$t_g$	9.5%

Table 5: Parameters of the reform

In general the insurance purchase decision depends on agent's wealth in a non-linear way. People don't buy insurance if they are very poor because in this case when hit by a big medical shock they rely on the consumption minimum floor. Also people do not buy insurance when they accumulate enough wealth to self-insure. The preference for self-insurance arises because available health insurance contracts are not actuarially fair because of administrative costs. The preferences for self-insurance as opposed to health insurance is especially strong for individuals with low expected medical expenses.

Figure (9) compares the percentage of uninsured produced by the model with those in the data. The model was calibrated to match the uninsurance rates for high-school dropouts, but it is able to capture the life-cycle uninsurance profiles for people with

Variable	Data	Model
Insured by ESHI (%)	66.1	66.2
Individually insured (%)	7.6	7.4
Uninsured (%)	20.2	22.2
Publicly insured (%)	6.1	4.1
ESHI take-up rate (%)	93.8	93.9
Group premium (\$)	3,383	2,643

Table 6: Insurance statistics: data vs. model



Variable	Data	Model	Variable	Data	Model
<b>Individually insured (%)</b>			<b>Publicly insured (%)</b>		
No High-School degree	5.7	6.6	No High-School degree	15.8	17.6
High-School degree	7.5	8.1	High-School degree	6.1	2.5
College degree	8.6	6.9	College degree	1.9	0.4
<b>Uninsured (%)</b>			<b>ESHI take-up rate (%)</b>		
No High-School degree	42.0	43.3	No High-School degree	87.4	87.3
High-School degree	20.5	20.5	High-School degree	93.4	94.2
College degree	10.3	15.7	College degree	95.9	94.8

Table 7: Insurance statistics for educational groups

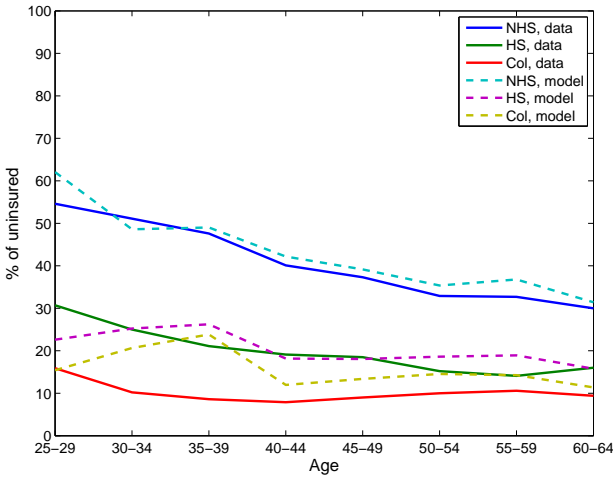


Figure 9: Percent of people without insurance

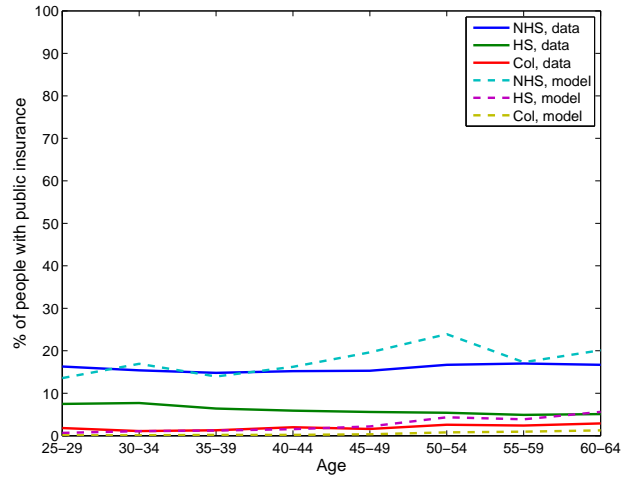


Figure 10: Percent of people with public insurance

high-school degree. However, the model overestimates the number of uninsured among college graduates. Our model predicts that insurance behavior for high-school and college graduates should be more similar than in the data. This suggests that differences in life-cycle labor income profiles alone are not enough to generate the observed differences in insurance behavior. In reality college and high-school graduates differ not only in labor-income profiles, but also in initial wealth and the quality of available insurance policies.

Figure (10) plots percent of publicly insured people in the model and in the data. The model tends to underpredict the number of publicly insured with high-school and college degree. This is due to the fact that we use uniform eligibility criteria while in reality all states have different Medicaid rules. For some states Medicaid eligibility income threshold can go up to 200% FPL which explain why in the data we observe college graduates with public insurance more often than in the model<sup>24</sup>.

<sup>24</sup>An alternative strategy is to introduce a probability to enroll in Medicaid as in Feng (2009). However, this requires an additional state variable, thus, exponentially increases computational costs.

Figure (11) plots percent of people with individual insurance for each educational group. The model approximately matches the overall participation in the individual market, however the number of people purchasing individual insurance at very young ages is too high. This is due to the fact that in our model people start working life at age 25 being relatively poor. In the data many people by age 25 have already accumulated some assets. As was mentioned before, once a healthy person accumulates capital he has a strong preference for self-insurance, that is why we observe a sharp decline in individual insurance purchases in later ages. The difference in individual insurance take-up rates observed in the model and in the data is thus due to the differences in wealth distribution of 25 years old.

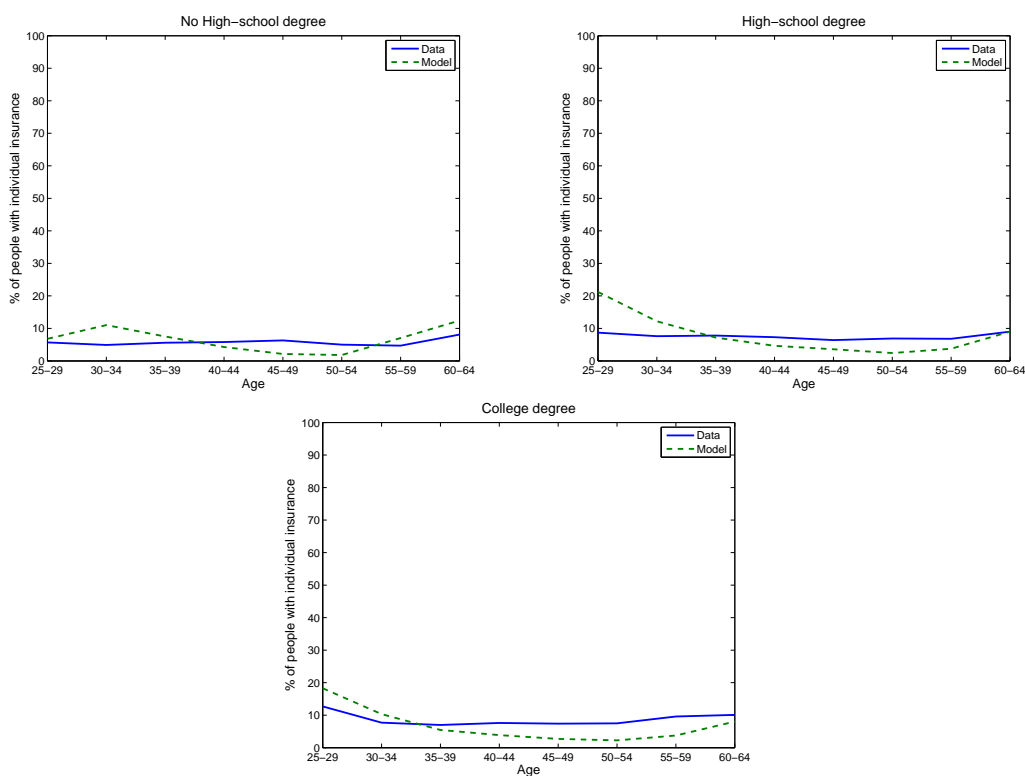


Figure 11: Percent of people with individual insurance

## 7 Effect of the reform

This section describes the new steady-state that economy converges to after the reform is implemented.

## 7.1 Aggregate insurance statistics

Table 8 compares aggregate insurance statistics between the two steady-states: in the baseline and in the reformed economies.

Variable	Baseline	Reform
Insured by ESHI (%)	66.2	67.5
Individually insured (%)	7.4	18.3
Uninsured (%)	22.2	4.7
Publicly insured (%)	4.1	9.4
ESHI takeup rate (%)	93.9	95.7
Group premium (\$)	2,643	2,510
Aggregate capital	3.40	3.24

Table 8: Insurance statistics before and after the reform

The fraction of people with ESHI stays almost the same which is not surprising given our assumption that neither ESHI offer rates nor employer contribution rates change in response to the reform. The percent of people with individual insurance increases more than twice: from 7.4 to 18.3%. At the same time there is a big drop in the uninsurance rate: it goes down from 22.2 to 4.7%; thus the uninsurance rate decreases by 78%<sup>25</sup>.

The number of publicly insured increases from 4.1 to 9.4% due to the expansion of Medicaid. Finally, there is a small increase in ESHI take-up rate from 93.9 to 95.7% which is due to the effect of penalties.

Table 9 displays changes in government finances after the reform. The increase in government spending on subsidies net of penalties and on Medicaid expansion constitutes around 130%. On the other hand, there is a significant decline in spending on transfers to guarantee consumption minimum floor. For working age households these transfers drop by more than 70%. This explains why the marginal tax rate for a person with average income increases by only 0.91 percentage points in the reformed economy<sup>26</sup>.

## 7.2 Effect on different educational groups

Left panel of Figure (12) compares the percent of people without health insurance at each age and educational group before and after the reform. In all educational and age groups there is a noticeable decline in the fraction of uninsured. The largest reduction

<sup>25</sup>This number is close to the results of the health reform in Massachusetts which has design similar to the national health reform. In Massachusetts the fraction of uninsured dropped by around 75% after the reform - from 11% in 2005 to 2.7% in 2009 (Massachusetts Health Connector).

<sup>26</sup>The change in the tax rates after the reform is discussed in more details in the Appendix.

Change in	Value
Spending on health insurance for working-age (%)	+131.3
Spending to guarantee minimum consumption for working-age (%)	-72.6
Marginal tax for average wage (percentage point)	0.91

Table 9: Change in the government finances after the reform

in the number of uninsured is observed among 25-29 year old high-school dropouts: the percent of uninsured in this group goes down from more than 60 to 10%. For older high-school dropouts the decline in uninsurance is less but still large: the minimum decline is 29%. The fact that the reform has the largest effect on the number of uninsured among people without high-school degree is not surprising. People in this educational group have low income and thus are more likely to qualify for Medicaid or subsidies. In contrast, the noticeable decline in the number of uninsured for college graduates is due mostly to the effect of penalties because only few in this group are eligible for expanded Medicaid or subsidies.

Right panel of Figure (12) displays the fraction of people with public insurance. The expansion of Medicaid does not have much effect on college graduates. However its effect is noticeable for high-school graduates and there is a big increase in the number of publicly insured among high-school dropouts. For example, for 25-29 year old high-school dropouts the fraction of publicly insured increases from around 14 to 45%. For all educational group we observe an increase in the number of publicly insured after age 55. In the baseline economy people after age 55 have lower Medicaid eligibility income threshold than younger people. The reform introduced new eligibility threshold which is the same for all people. Thus near elderly who previously did not qualify for Medicaid now get public coverage. This captures the important effect of the reform: it does not only increase income eligibility threshold, but it also treats all people equally by removing categorical eligibility requirement.

Left panel of Figure (13) compares the individual insurance rates in the baseline and reformed economies. The fraction of individually insured increases in all ages and educational groups. Due to income-based subsidies the largest increase in the number of individual market participants is observed among high-school dropouts.

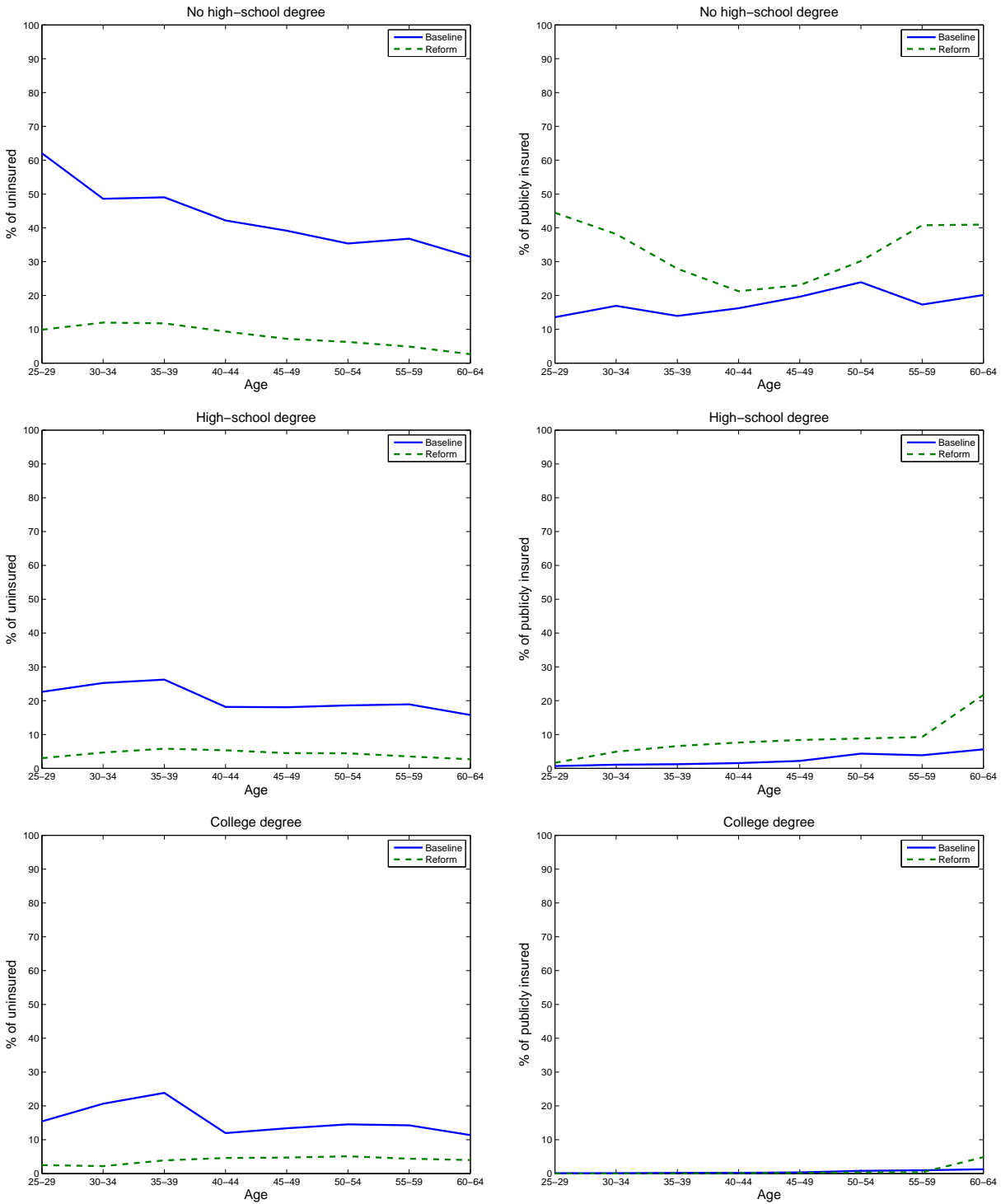


Figure 12: Percent of uninsured (left panel) and publicly insured (right panel) before and after the reform

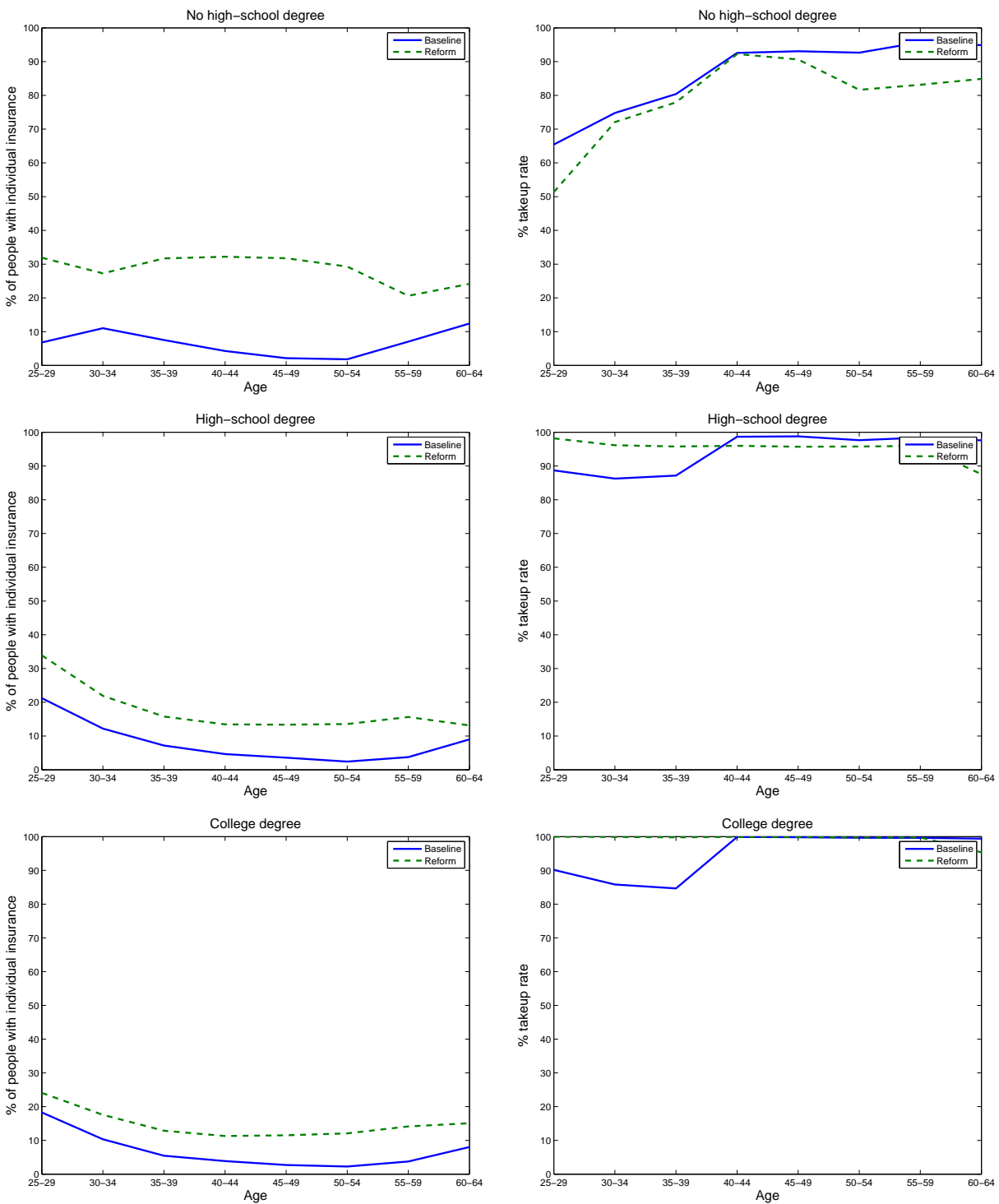


Figure 13: Percent of people with individual insurance (left panel) and ESHI take-up rates (right panel) before and after the reform

Right panel of Figure (13) displays ESHI take-up rates before and after the reform. The direction of change in take-up rates is different across educational groups. For high-school dropouts there is a decrease in take-up rates for all age groups. This is the effect of Medicaid expansion and the fact that only people buying insurance in the individual market qualify for subsidies. Thus we observe a crowd-out of ESHI by Medicaid and subsidized individual insurance<sup>27</sup>.

For high-school graduates this crowd-out effect is observed only for people older than age 40 while for younger ages the take-up rates actually increase. This asymmetric effect is explained by two things. First, the subsidy is linked both to income and individual market insurance premiums. So to get a subsidy a person not only has to have low-income but he also has to face high enough insurance premiums. Second, insurance premiums in the individual market are age-adjusted and increase with age. Thus many young high-school graduates do not qualify for subsidies because their income is too high relative to premiums. However, older high-school graduates face higher premiums in the individual market which makes it easier for them to qualify for subsidies, hence they drop the employer coverage.

To illustrate this point further Figure (14) plots the share of the individual market premium in average income for each age and educational group in the reformed economy. One can see that for all educational groups we observe an increase in the burden of health insurance with age. For high-school dropouts the share of premium to income is always above 10%. For college graduates this share is always below 10% and reaches 7.5% only by age 55. For high-school graduates the premium to income ratio reaches 7.5% much sooner - by age 40.

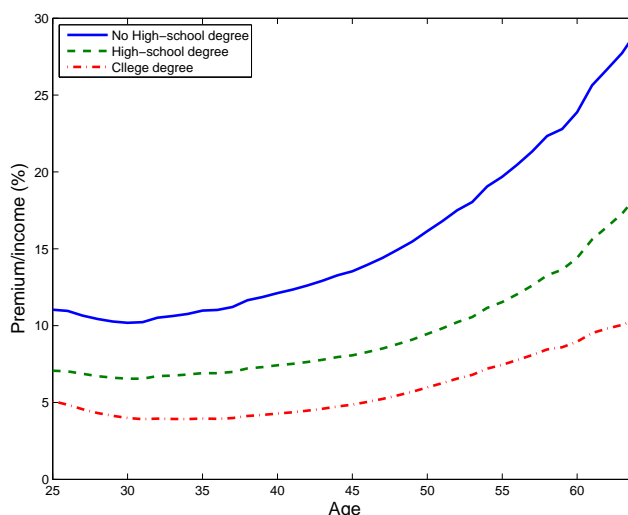


Figure 14: Share of individual premiums in average income for each educational group

<sup>27</sup>Cutler and Gruber (1996) also found that Medicaid expansion over the 1987-1992 period caused crowd-out of ESHI resulting from the fact that employees do not take coverage when it is offered.

College graduates increase take-up rates of ESHI in almost every age except for several years before retirement. This pattern is due to the fact that people in this educational group have to pay penalties if they do not buy insurance and they do not qualify for subsidies in the individual market.

Figure (15) plots the percent of people who receive subsidies or are enrolled in Medicaid. The highest number of beneficiaries is observed among young high-school dropouts: almost 90% of this group is enrolled in Medicaid or receive subsidies. For all educational groups there is an increase in fraction of beneficiaries towards pre-retirement ages because of the raising share of the individual market premium in income.

The average amount of the subsidy for those who receive it is displayed in Figure (16). Average subsidy increases with age because individual market premiums increase with age faster than income for many subsidy recipients. Thus to keep the fraction of premium in income low these people have to receive more subsidies as they age. The average amount of subsidies for those who receive it does not differ much by educational group. In general the average size of the subsidy varies from around \$500 to \$900 for people aged 25-29 year old depending on education. For people of pre-retirement age the size of the subsidy varies from \$3,800 to \$4,000 depending on education.

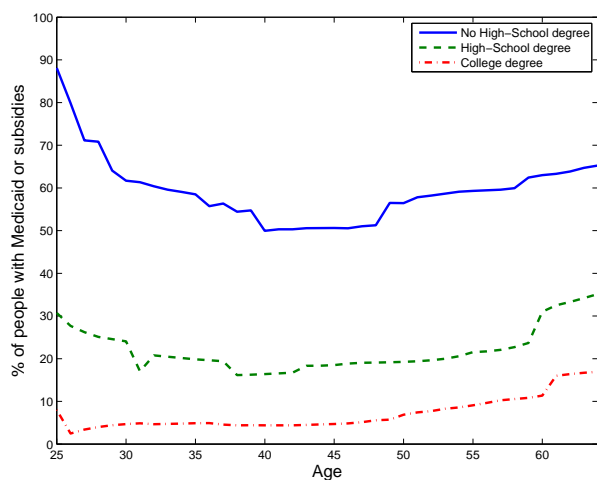


Figure 15: Percent of people getting subsidies and enrolled in Medicaid

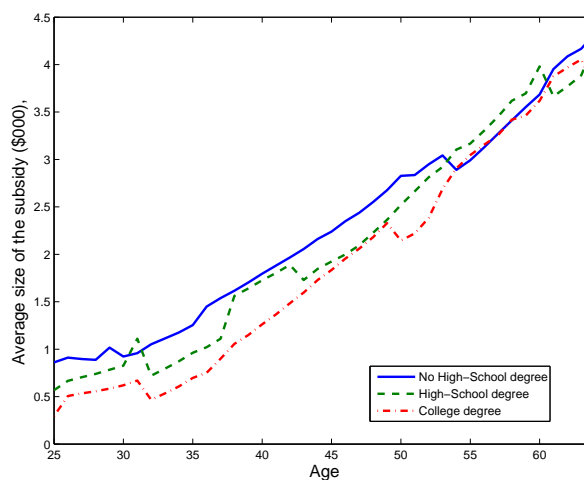


Figure 16: Average size of the subsidy

Figure (17) shows the fraction of people who pay penalties. This fraction is very low for all educational groups: it never exceeds 5%. For all educational group we observe an inverse U-shaped pattern of the fraction of penalty payers after age 30. This is due to the fact that middle-aged people have the highest preferences for self-insurance: their income increased but their expected medical costs are still low so even with the penalty some of them are better off staying uninsured.

Surprisingly for the group aged 30 to 50 year old the highest fraction of people paying penalties is observed among high-school dropouts. However, this is the group that do not



qualify for subsidies due to low premium to income ratio and they do not have an offer of ESHI. In this situation they prefer paying penalties to buying non-subsidized individual insurance.

Figure (18) plots the average size of the penalty for those who pay it. The penalty increases with age because it is linked to individual income. If young people on average pay penalty around \$800, for individuals around retirement age it can go up to more than \$2,000.

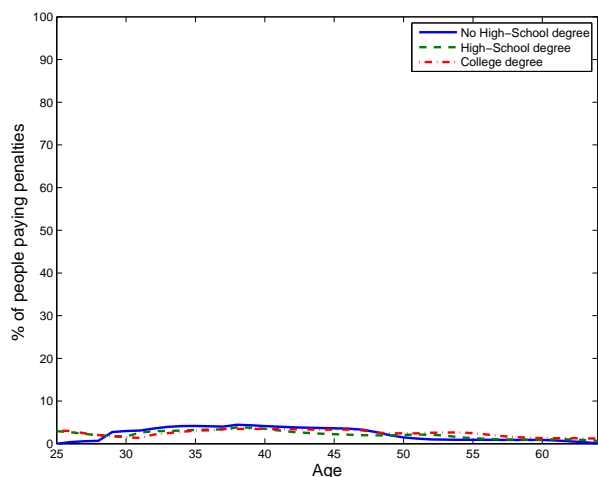


Figure 17: Percent of people getting penalties

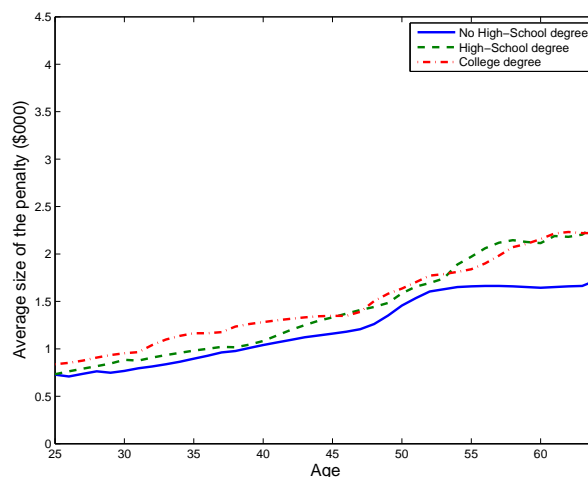


Figure 18: Average size of the penalty

### 7.3 The effect on the individual market insurance premiums

Figure(19) plots the age-adjusted community-rated premium that will be charged in the individual market after the reform<sup>28</sup>. The premium increases with age due to the increase in the mean of medical expenses. Figure(19) allows to compare premiums in the individual and employer-based markets. The latter premium is also community rated though not age-adjusted. The individual market premium stays below the group premium for people younger than age 44, for people older than 44 the individual premium exceeds the group premium, and the gap increases with age.

Figure(19) also allows to compare the community-rated premium in the individual market with risk-adjusted premiums in the unregulated market. The dash lines plot individual premiums conditioned on medical expenses for the five lowest grids of medical expenses. One can see that the community-rated premium exceeds risk-adjusted premium for the three lowest medical expenses groups. It stays around the level of unregulated

<sup>28</sup>Because of the subsidy schedule embedded in the reform we do not have to worry about the possibility of equilibrium when only people with high medical expenses participate in the market and the resulting price is very high. The subsidy guarantees that the fraction of paid insurance premiums in income does not depend on the actual size of the premium. This significantly reduces the sensitivity of market participants to the price of insurance.

premium for people on the 4th grid of medical expenses. The fact that the community rated premium is below the risk-adjusted premiums for the highest three medical expense groups, means that after the reform we observe a good risk-pooling in the individual market without the signs of the adverse selection spiral. Next section will discuss how much this outcome is due to penalties and how much - to subsidies.

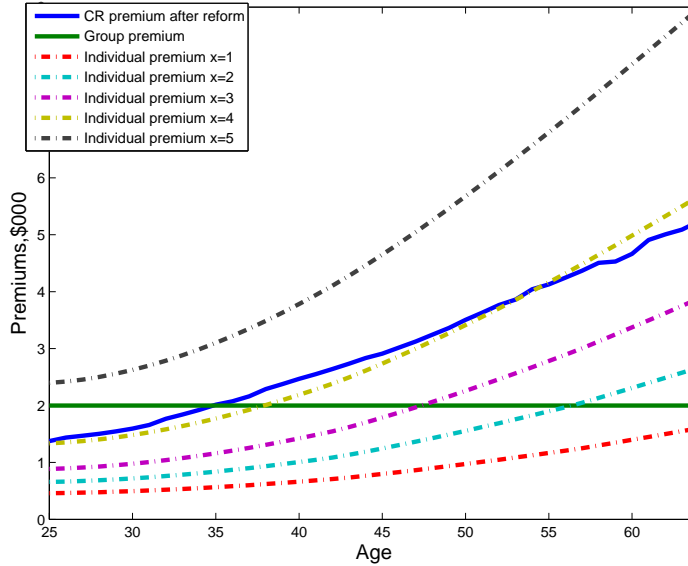


Figure 19: Individual vs group market premiums

## 7.4 Welfare

Consumption equivalent variation for the reformed economy is presented in the first row of Table 10. The reform brings a significant welfare improvement: a newborn in the baseline economy is willing to give up 0.97% of consumption every period to be born in the reformed economy<sup>29</sup>. To illustrate the source of these welfare gains Figures (20) and (21) plot the level and the log-variance of consumption over the life-cycle before and after the reform. On average after the reform we observe a decrease in consumption at all ages. At the same time the reform brings a significant decline in consumption variance. This means the welfare gains of the reform come from the increased risk-sharing in the economy. This increased risk-sharing is a result of two things. First, people with bad labor market outcomes get transfers from people with good labor market outcomes in terms of subsidies for health insurance purchase. Second, people with high medical expenses get cross-subsidized by people with low medical expenses through community rated individual market. Once educational attainment is realized there is a significant variation in welfare

<sup>29</sup>We compare welfare between two steady-states without taking into account the transition period. Since the aggregate capital in the reformed economy is lower than in the baseline, taking transition period into account will make welfare gains even larger.

	All newborns	CEV(%)			Agg. capital
		No high-school degree	High-school degree	College degree	(% of the baseline)
Reform	0.97	2.37	1.79	-0.06	95.3
Only CR	0.05	0.20	0.15	-0.06	100.1
Only CR+high penalties	0.09	0.15	0.13	0.04	99.4
Only redistribution	1.16	2.46	1.98	0.15	95.8
Only redistribution+penalties	1.10	2.38	1.92	0.09	95.3

Table 10: Welfare effect of different versions of the reform

effects of the reform for newborns in different educational groups. High-school dropouts gain the most from the reform: the consumption equivalent variation for this group is 2.37%. On the other hand, newborns with college education prefer the unreformed economy though their welfare losses are very small: the consumption equivalent variation for this group is -0.06%. This asymmetric effect is a result of two things. First, there is an income redistribution embedded in the reform. Second, the reformed economy has a lower aggregate capital (95.3% of the baseline value) and this mostly hurts people with high productivity.

Variable	Reform	Only CR	Only CR+ high penalties	Only redistribution	Only redistr+ penalties
Insured by ESHI (%)	67.5	67.8	69.1	64.8	67.6
Individually insured (%)	18.3	2.8	10.1	15.4	22.4
Uninsured (%)					
<i>Total</i>	4.7	25.2	16.8	10.2	0.5
<i>High-school dropout</i>	8.1	47.9	39.8	9.6	0.2
<i>High-school graduates</i>	4.3	24.8	16.5	8.9	0.5
<i>College graduates</i>	3.9	16.2	7.7	12.3	0.6
Publicly insured (%)	9.4	4.1	3.9	9.4	9.4
ESHI take-up rate (%)	95.7	96.2	98.0	92.0	95.9

Table 11: Insurance statistics for counterfactual reforms

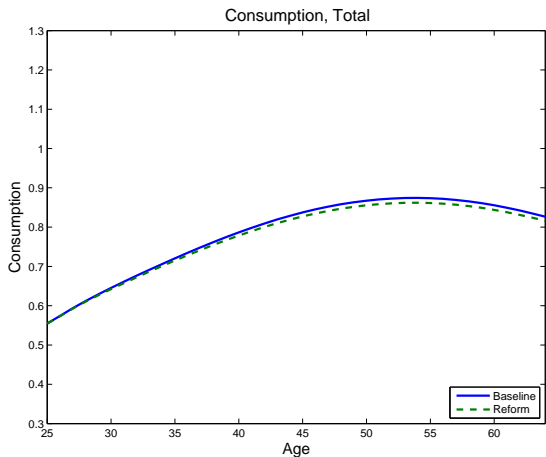


Figure 20: Consumption before and after the reform (normalized by average wage)

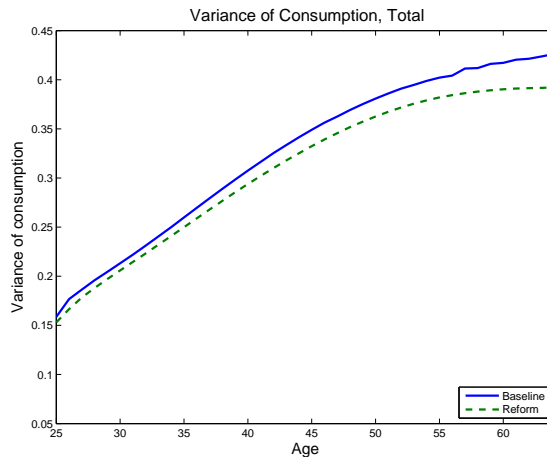


Figure 21: Variance of consumption before and after the reform (normalized by average wage)

Figure (22) compares the level and the log-variance of the average consumption before and after the reform for each educational group. The reform has the opposite effect on the level of consumption for people with low and high educational attainment. For high-school dropouts consumption after the reform is higher for all ages. For high-school and college graduates the reform brings a decline in the average consumption. At the same time, the variance of log consumption decreases in each educational group. It may seem surprising that the variance of log consumption decreases significantly even for college graduates. Majority of this group buys insurance in the employer-based market and are less affected by the new rules in the individual market. However, it is important to note that in the baseline economy these people face the risk of losing ESHI every period. This event likely coincides with a negative income shock. If it also coincides with a large medical shock, these people experience a significant change in the price of their health insurance: instead of community rated group premium they have to buy insurance at a price fully adjusted for their high expected medical costs. After the reform the loss of the ESHI becomes less painful for two reasons. First, the individual market also becomes community rated. Second, people who lose their job with ESHI can become eligible for a subsidized insurance coverage.

## 7.5 Decomposing the effect of the reform

To decompose welfare effects of the reform we use several experiments. First, we remove the subsidies and Medicaid expansion from the original reform but keep provisions for the community rated individual market and penalties for individuals without insurance. We call this case "only community rating". Second, we keep all the redistributive measures embedded in the original reform (subsidies and Medicaid expansion) but we allow for the unregulated individual insurance market (no community rating) and remove

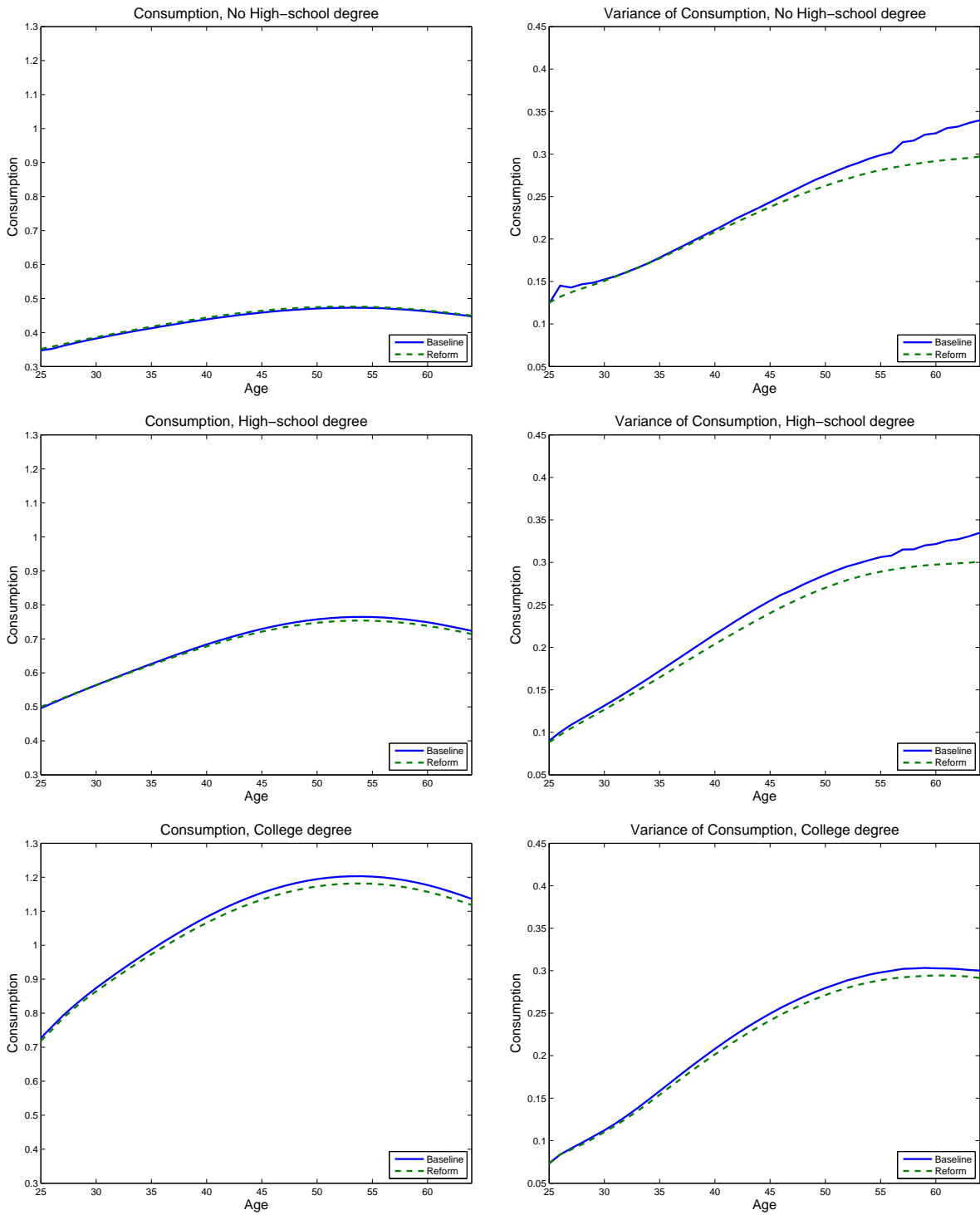


Figure 22: Level (left panel) and variance (right panel) of consumption before and after the reform (normalized by average wage)

penalties. We call this version of the reform "only redistribution".

Table 10 compares the results of these modified reforms with the original one. The second row of the table shows the results of implementing the reform with only community rating. In this case the welfare gains from the reform almost disappears decreasing from 0.97 to 0.05%. The most significant changes are observed among high-school dropouts: their welfare gains go down from 2.37 to 0.20%. For college graduates the welfare effect of the reform with the community rating is the same as in the original reform. This is due to the offsetting effect of the higher aggregate capital which affects this group most.

After the implementation of the reform with only community rating the individual market suffers from the adverse selection spiral. As can be seen from Figure (23) the premium in the individual market increases very fast with age and reaches the level of risk-adjusted premiums for people in the highest grid of medical expenses. In other words, only people with high expected medical expenses participate in the individual market. The second column of Table 11 makes this point even clearer by showing that the participation in the individual market decreases to 2.8%. This suggests that penalties are not big enough to enforce participation in the community rated individual market. The fact that in the original version of the reform many people participate in the individual market is primarily due to the effect of subsidies but not penalties.

To understand whether the small welfare effect of the reform with only community rating is a result of the adverse selection spiral, we implemented the same reform but with twice higher penalties. In this case we do not observe the adverse selection spiral in the individual market: as shown in Figure (23), the price of the individual insurance is much lower and closer to the average medical expenses. Also the participation in the individual market increases to 10.1% (third column of Table 11). The welfare results of this modified reform are presented in the third row Table 10. Comparing to the case with lower penalties the welfare slightly increases (from 0.05 to 0.09%). However it is still much lower than in the original reform.

Fourth row of Table 10 shows the results for the reform with only redistribution. This version of the reform has even larger welfare gains than the original reform: the consumption equivalent variation goes up from 0.97 to 1.16%<sup>30</sup>. The increase in welfare is observed for all educational group: for high-school dropouts CEV increases from 2.37 to 2.46% while for college graduates it goes up from -0.06 to 0.15%. Part of these gains comes from the elimination of penalties that increases welfare of those who prefer to self-insure. To understand to what extent the larger welfare gains of the reform with only redistribution comes from the elimination of penalties we run an experiment where we

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<sup>30</sup>Because households in our model supply labor inelastically we underestimate the distortionary effect of income redistribution. However the income redistribution we are considering here is very specific and has only limited distortionary effects in general. First, subsidies only go towards purchase of health insurance. Second, the amount of subsidies can never exceed the size of a health insurance premium.

keep the penalties but abandon community rating. In other words, the only modification to the original reform is a removal of the ban on insurers in the individual market to condition premiums on risk. We call this version of the reform "only redistribution with penalties" and its results are presented in the last row of Table 10. If we compare the reform with only redistribution and penalties with the original version of the reform, we see that the former still brings higher welfare gains: 1.10 comparing to 0.97%.

The important result is that the reform with only redistribution brings significantly higher welfare gains than the reform with only community rating. This suggests that income-based transfers improve welfare of people much more than the new rules in the individual market. Many individual market participants have low income and insurance premiums constitute a significant fraction of their income. Without subsidies they often prefer to stay uninsured. To illustrate this point further Figure (24) compares the fraction of individual market premiums in average income before the reform and after the two versions of reform: with only community rating (with high penalties) and with only income redistribution. If the reform is implemented with only community rating the share of premiums in income increases for people with the lowest medical expenses and decreases for people with the highest medical expenses. However, for people with low educational attainment the share of community rated premium in income is high: for high-school dropouts it is never below 10% and can go up to almost 60% for people of preretirement age. On the other hand, when reform is implemented without community rating but with subsidies, the share of subsidized individual market premiums in income for low educational groups is significantly lower even for people with the highest medical expenses.

Another result from Table 10 is that elimination of community rating from the reformed economy increases welfare. At the same time, introduction of community rating in the baseline economy increases welfare as well.

The opposite welfare effect of community rating in the reformed and the baseline economy can be explained as follows. On the one hand, community rating has a positive effect on welfare because it pools health risks and allows people to buy insurance at a price independent of their expected medical expenses. In other words, in the environment with persistent medical expenses, community rating protects people against the risk of premium fluctuations. On the other hand, community rating has a negative effect on welfare in the environment where people are exposed not only to medical expenses risk but also to income shocks. This negative effect arises because community rating induces transfers from healthy to sick that are not conditioned on income. In other words, it introduces some welfare-reducing transfers from healthy with low income to sick with high income.

The positive welfare effect of introducing community rating in the *baseline* economy

results from the fact that in this economy people without an access to the employer-based pool do not have any mechanisms protecting them against the risk of premium fluctuations. Thus they value the new risk-pooling mechanism introduced by community rating. However, their welfare gains are small because many low-income people choose not to buy insurance given that premiums constitute a high fraction of their income and they are likely to be exempt from penalties.

In contrast, community rating has negative welfare effect in the *reformed* economy. In this economy people are to a large degree sheltered from the risk of premium fluctuations by the subsidy scheme. The amount of subsidy is such that it keeps the share of insurance premiums in income at a low level. For example, for a person with income between 150 and 200% of FPL the subsidy guarantees that his premium does not exceed 3.5% of his income regardless of how high his premium in the individual market is. Because of subsidies, community rating does not add much value in terms of elimination of the premiums fluctuations risk. Thus the negative effect of transfers from healthy with low-income to sick with high-income dominates.

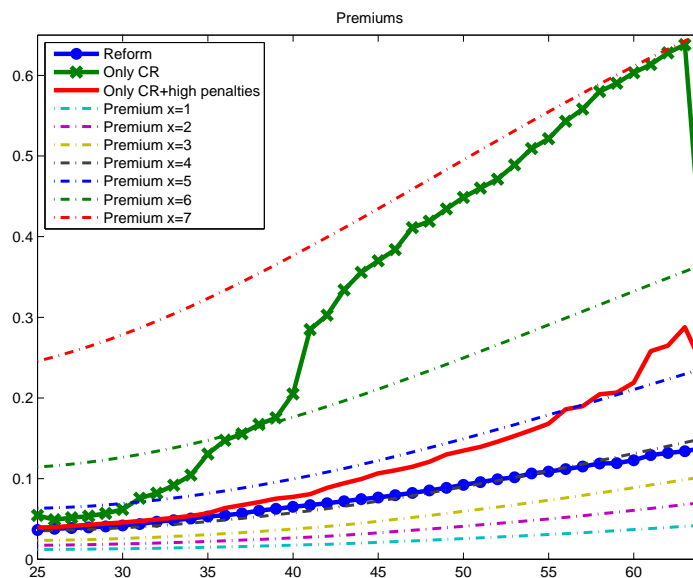


Figure 23: Individual market premiums for different version of the reform



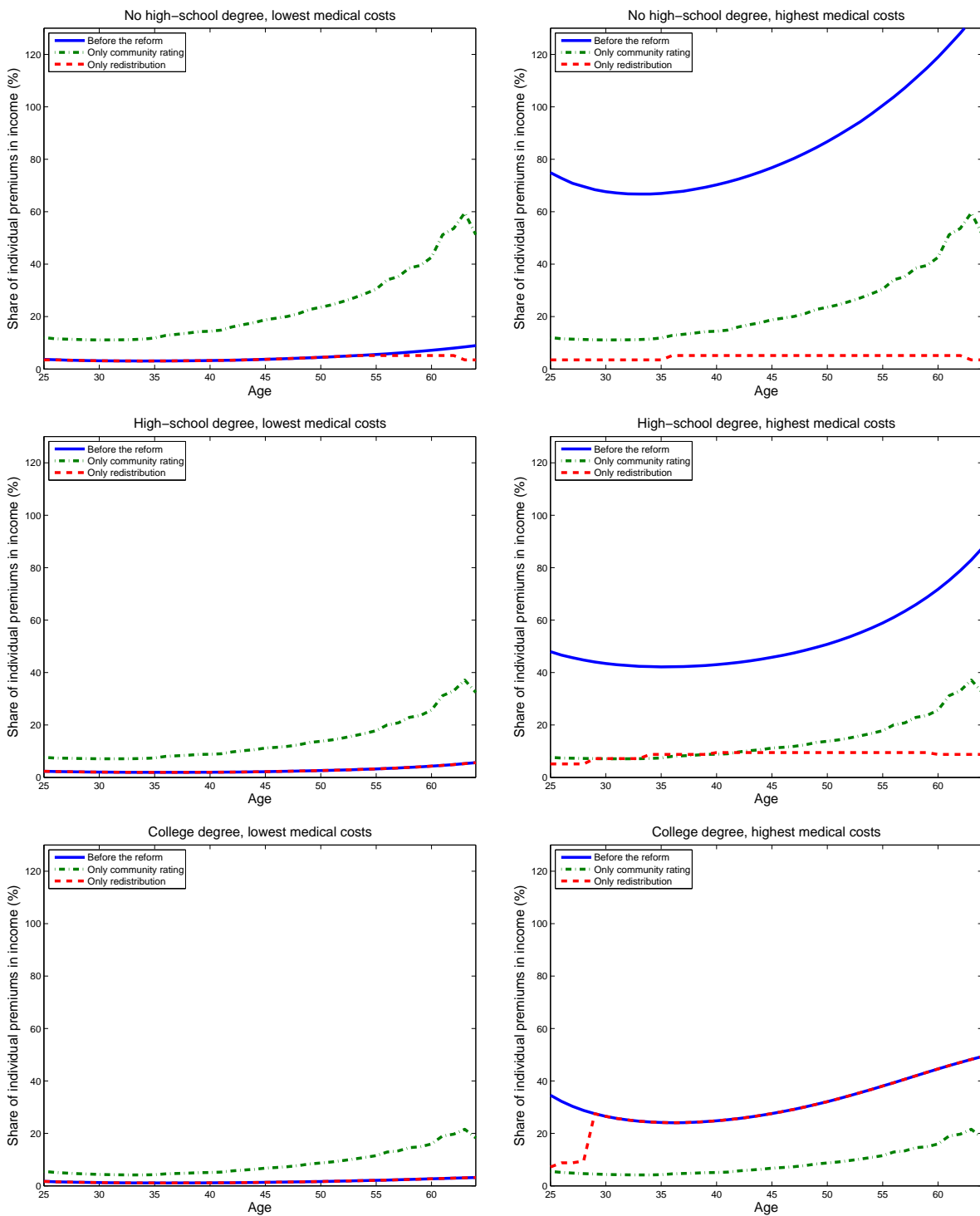


Figure 24: Fraction of individual insurance premiums in income for people with the lowest (left panel) and highest (right panel) medical costs

## 8 Conclusion

Health reform bill recently signed by the President includes a wide range of measures aiming to increase the health insurance coverage in the U.S. The new law significantly changes the rules under which the individual insurance market operates. At the same time it includes a set of redistributive measures that decrease the price of insurance for low-income people. This paper measures the welfare effect of the reform and decomposes it into the part that is due to the reorganization of the individual market, and to the part that is due to the increased income redistribution in the economy.

We construct a general equilibrium heterogeneous models with a rich representation of the current U.S. health insurance system. We calibrate the model using Medical Expenses Panel Survey to match the key insurance statistics of the U.S. economy.

We find that the reform brings significant welfare gains (almost 1% of the annual consumption) measured as ex-ante welfare of a newborn in the steady-state of the reformed economy. However higher welfare gains can be achieved by just the redistributive part of the reform without introducing community rating in the individual market. Majority of individual market participants have low-income and they gain a lot from having subsidized health insurance. In addition, the subsidy scheme also plays a role as insurance against the risk of insurance premiums fluctuations. Reorganizing the individual insurance market alone has limited effect on these people because non-subsidized insurance premiums, whether community rated or not, constitute such a significant portion of their income that they often prefer to stay uninsured if not subsidized. Moreover, community rating induces some transfers from healthy people with low income to sick people with high-income. These transfers can only be partially offset by income-based subsidies and thus reduce welfare.

## 9 Appendix

### 9.1 ESHI response to reform

When evaluating the welfare implications of the reform we assumed that there is no response from the firm offering ESHI. This section reevaluates welfare effects of the reform when this assumption is relaxed. In particular we consider how the results change if in response to the reform firms offering ESHI decrease its contribution rate. This experiment is motivated by the result in Gruber and McKnight (2003) who found that expansion in Medicaid eligibility in the late 1980s and early 1990s led to a decline in employers contributions to health insurance premiums. Table 12 compares welfare effects of the reform if there is no change in the employer contribution rate ( $\psi$ ) to a case when it

decreases to 50%<sup>31</sup>. When the reform induces firms to decrease contribution rates this

	CEV(%)				Agg. capital
	All newborns	No high-school	High-school	College	
		degree	degree	degree	
$\psi$ does not change	0.97	2.37	1.79	-0.06	3.24
$\psi$ decreases to 50%	0.60	2.46	1.44	-0.54	3.26

Table 12: Welfare effects of the reform under different assumptions on ESHI

mostly affects people with a college degree: their CEV goes down from -0.06 to -0.54. For people with the highest educational attainment the employer-based pool is a primary source of coverage. When the employer contribution rate declines, it leads to a partial destruction of this pool because younger people prefer to switch to the individual market where premiums are age-adjusted. This increases the group premium and decreases welfare of people buying ESHI. For people with lower educational attainment who rely less on ESHI the welfare does not change much. Because of this the overall welfare effects of the reform is still significant despite a large decline in the employer contribution rate.

## 9.2 Effective tax rates

Figure (25) compares marginal income tax rates before and after the reform. The burden of the tax increase falls disproportionately on people with high income. If for a person with income at the level of the average wage the marginal tax rate increases by 0.91 percentage points, for a person with income three times higher than the average wage tax rate increases by around 1.2 percentage points.

Apart from changing income tax rates the reform also introduces two additional types of transfers. First, low-income people get subsidies to finance their health insurance purchase. Second, people with low medical expenses cross-subsidize people with high-medical expenses through the community rated individual market. Thus the former group of people pays an implicit health tax, while the later group receives an implicit health subsidy. Figure (26) shows how these additional transfers change the average effective tax rates in the economy<sup>32</sup>. Because implicit transfers through the community rated individual market depend on individual health expenditures, Figure (26) compares

<sup>31</sup>The scenario when an average employer contribution rate decreases from more than 70 to 50% after the implementation of the reform is unlikely because the Bill requires employers whose workers face high group premiums to pay penalties. However we construct this experiment to emphasize the directions of the welfare change.

<sup>32</sup>Note, that both subsidies and implicit transfers through community rating only affect those who participate in the individual market. Thus all the graphs in Figure (26) are constructed for people who buy individual insurance.

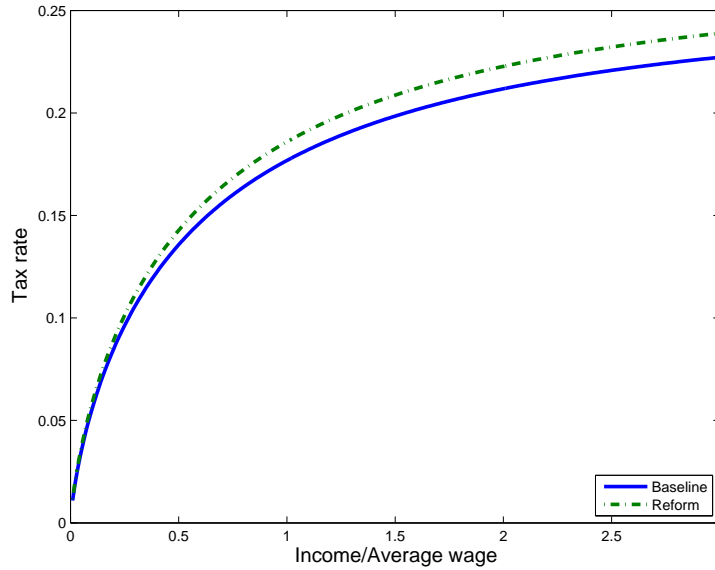


Figure 25: Change in the marginal tax rates after the reform

effective tax rates for people with the lowest and highest medical costs. The comparison is done using an example of a 50 year old person because for this age group the difference in medical costs is very pronounced and this makes illustration more clear.

In all four graphs the solid line represents the average income tax people pay after the reform. The dotted line in the top two figures shows the tax rate once the subsidies are taken into account. Because insurance premiums are the same for people with high and low medical expenses, the size of the subsidy is the same for all people in the same income group. However, once implicit transfers through community rating is taken into account (as represented by dash-dotted line in the top two graphs), the effective tax rates become different for people with low and high medical expenses. For a person with the highest medical expenses the effective tax rate decreases, while for a person with the lowest medical expenses the tax rate increases.

Another observation is that while subsidies decrease effective tax rates only for people with income below 400% FPL (which corresponds to income to average wage ratio equal approximately to one), implicit transfers through community rating change effective tax rates for all categories of income. When implicit health tax is taken into account, people with low medical expenses pay more than what is implied by a pure income tax. At the same time people with high medical expenses pay less.

The bottom two graphs show how the effective tax rates change if the reform is implemented with only redistribution. In this case there is no implicit transfers through community rating. Because people with different medical expenses face different premiums, they receive subsidies of a different size. Moreover, the effective tax rate for people at low income level is the same as effective tax rates in the original reform when

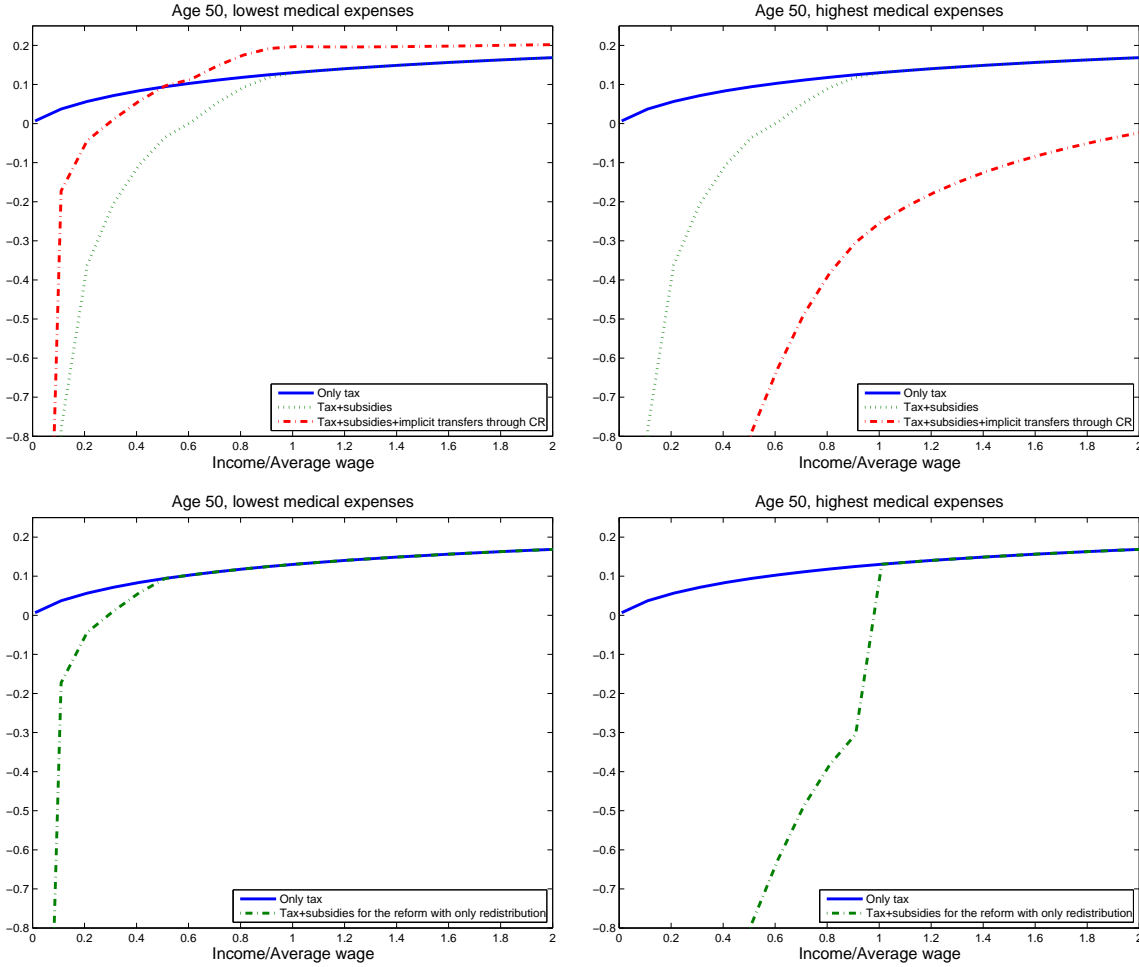


Figure 26: Implicit and explicit transfers and effective tax rates in the reformed economy

implicit transfers are taken into account. This means that after the reform with only redistribution implicit transfers through community rating are incorporated into explicit subsidies. However, in contrast to the original reform, the reform with only redistribution eliminates medical expenses-based transfers to people with high income. For this group of people effective taxes are the same as income taxes.

### 9.3 Computational algorithm

We solved for the steady state equilibrium of the baseline model as follows.

1. Guess an initial interest rate  $r$ , price in the group insurance market  $p$ , and the amount the firm offering ESHI subtracts from the wage of their workers  $c_E$ .

In general, insurance markets where firms are not allowed to risk-adjust premiums, as in the group market, can have multiple equilibriums. However, because the major part of the premium is contributed by the employer, people are less sensitive to the price of insurance and thus multiplicity of equilibriums becomes less of an issue. In particular,

our equilibrium price tends to be invariant to the initial guess.

2. Set initial value for the parameter  $a_2$ .

3. Solve for the households' decision rules using backward induction. In the last period ( $t = N$ ), the value function and policy functions can be solved for analytically. For every age  $t$  prior to  $N$  and for each point in the state space, we optimize with respect to savings and insurance decisions. We evaluate the value function for points outside the state space grid using a Piecewise Cubic Hermite Interpolating Polynomial (PCHIP).

4. Guess an initial asset distribution of newborns (which corresponds to the distribution of bequests).

5. Given policy functions and the distribution of newborns, simulate the households distribution using non-stochastic method as in Young (2010). We reiterate until the distribution of bequests converges.

6. Use the distribution of households and policy functions to compute government budget deficit/surplus. Update tax function parameter  $a_2$  and repeat steps 3-6 until government budget is balanced. More specifically, we use function `zbrent` to find  $a_2$  that balances the budget.

7. Using the distribution of households and policy functions check if market clearing conditions and zero profit conditions for insurance firms hold. If not, update  $r$ ,  $p$ , and  $c_E$  and repeat steps 1-8.

The computation of the steady state for the reformed economy is complicated by the fact that now we need to compute additional 40 prices (for each working age) in the individual community rated market. We modified the algorithm above by guessing these 40 prices at step 1 and updating them at step 8. As was mentioned in the main text, in the case of the original reform the multiplicity of equilibrium is not likely to be an issue; individuals' insurance decisions are less sensitive to equilibrium price because of the subsidy scheme. When the reform is implemented without subsidies we cannot rule out the multiplicity of equilibrium. In this case we trap the price from below starting from a guess that is too low to be an equilibrium. Then we update the price upwards slowly.

## 9.4 Partial equilibrium

The implementation of the reform in the baseline economy leads to a decrease in the aggregate capital from 3.40 to 3.23 due to increased risk-sharing and a decline in precautionary savings. In this section we reevaluate welfare effects of the reform in the partial equilibrium setup. Thus we consider the U.S. as an open economy that faces fixed interest rate. The results of this experiment are presented in Table 13. Under the assumption of partial equilibrium the results do not significantly change because

	All newborns	CEV(%)			Agg. capital
		No high-school degree	High-school degree	College degree	
Reform	1.54	2.31	2.31	0.67	3.40
Only CR+high penalties	0.16	0.16	0.18	0.13	3.40
Only redistribution	1.68	2.34	2.45	0.83	3.40

Table 13: Welfare effect of different versions of the reform in the partial equilibrium

the change in the aggregate capital in the general equilibrium environment was not big. Comparing to the first row of Table 10 most noticeable changes are observed among people with college education: their CEV increases from -0.06 to 0.67. This is due to the fact that this group is the most productive and thus get affected by the decrease in the aggregate capital observed in the general equilibrium case the most. However, the relative importance of the redistributive measures of the reform compared to the regulation of the individual market stays the same. As in the general equilibrium environment most of the welfare gains from the reform come from subsidies and Medicaid expansion.

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