Quantitative Analysis of Health Insurance Reform: Separating Regulation from Redistribution

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Abstract

Two key components of the upcoming health reform are a new regulation 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 twice and generates substantial welfare gains. 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 substantially 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 effects of the new regulation of the individual market from the effects 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. People with high medical expenses have higher disutility from work and suffer a loss in productivity. We allow agents to be heterogeneous by educational level (exogenously fixed), which together with age determines their ability to generate income.

We replicate 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 the lowest-income individuals, while people with high income are more likely to get 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 who purchase 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 called the Bill).

These changes can be broadly divided into two groups. First, there is a new regulation 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 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 by insurers, another provision in the Bill is guaranteed issue which prevents insurance companies from denying coverage to individuals based on their health status. A possible outcome of a combination of community
rating with guaranteed issue is an adverse selection spiral and to prevent this, the Bill requires all individuals without health insurance to pay a penalty, unless the insurance premium constitutes too high a proportion of their income.

Second, the Bill includes a set of redistributional 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 a threshold that varies significantly from state to state\(^1\). After the reform all people under 65 year old with income below 133% of the Federal Poverty Line (FPL) will 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, we use two welfare criterions: i) ex-ante expected lifetime utility of a newborn in a stationary equilibrium, and ii) average lifetime utility of people who are alive at the beginning of the reform and have to live through a transition period. Both welfare functions favor 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). Since neither of these new redistributional 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. To adequately gauge welfare effects of these redistributive channels we need to carefully measure the correlation between labor income and medical expenses. We do this by explicitly accounting for the fact that people with high medical expenses have lower productivity and lower labor supply.

We find that the reform has a large effect on the fraction of uninsured in the economy: this number decreases from 20.2 to 8.9%. The largest effect the reform has on young people in the lowest educational group with the fraction of uninsured among high-school dropouts aged 25 to 29 year old decreasing from 54.0 to 7.5%. Also the reform induces more participation in the individual market with the fraction of individually insured increasing from 7.6 to 18.5%.

In terms of welfare, we find that the reform brings substantial gains equivalent to

\(^1\)As of 2009, 14 states had Medicaid eligibility thresholds below 50% FPL, 20 states had it between 50 to 99% FPL, and 17 states had it higher than 100% FPL. The U.S. average constitutes 68% of FPL (Kaiser Family Foundation, 2009).
0.64% or 0.70% of the annual consumption depending on whether we take the transition period into account or not. 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 from 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 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 who 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 effects of different Medicare reforms; Kopecky and Koreshkova (2009) study the effect of medical expenses risk on wealth accumulation over a 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 endogenous labor supply, 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 of its potentially significant redistributive consequences.

Our paper is also related to the literature studying different versions of health insurance reform in the U.S. Feng (2009) studies the macroeconomic consequences of four alternative reform proposals. Hansen et al (2011) analyse the reform that expands Medicare towards people aged 55-64 year old. Close to ours are Janicki (2011) and Jung and Tran (2010) who also study the current health reform. In contrast to these two studies, our focus is welfare decomposition between the two key components of the reform: new regulation of the individual market and income redistribution. Their framework
Jung and Tran (2010) impose a simplifying assumption that the individual market has age-adjusted community rating even before the reform and thus abstract from changes the reform brings into this market. And Janicki (2011) abstracts from modeling the individual insurance market altogether. Another two differences of our work from these two papers are worse mentioning. First, we allow for educational heterogeneity since education is an important determinant of access to different health insurance options. Second, in our calibration of labor income we take into account the potential selection bias arising because we do not observe labor income of people who do not work. This is important since the fraction of non-workers differs substantially by education and health group.

Finally, our work relates 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 the saving decisions of retirees. Scholz, Seshadri, and Khitratrakun (2006) study 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 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. During the first \( R - 1 \) periods of life an individual can choose whether to work or not; at age \( R \) all individuals retire. We denote the labor supply decision of a household by \( l_t, l_t \in \{0, \bar{l}\} \).

Agents are endowed with one unit of time that can be used for either leisure or work. There is a fixed cost of work \( \phi_{t,e} \) treated as a loss of leisure. Thus working individuals’ leisure time can be expressed as \( 1 - \bar{l} - \phi_{t,e} \). The fixed cost of work depends on age \( t \) and education \( e \). In addition, individuals in bad health incur higher costs of work:

\[
\phi_{t,e} = \phi_1(t, e) + \phi_2(t, e) \mathbf{1}_{\{\text{health=bad}\}}
\]

where \( \mathbf{1}_{\{\}} \) is an indicator function mapping to one if its argument is true, \( \phi_1(t, e) \) and \( \phi_2(t, e) \) are non-negative functions.

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2 Using the MEPS dataset we find that the working hours profiles for employed are not much different among people with different educational attainment or different medical expenses. However, there is noticeable difference in their labor force participation profiles. Similar patterns are reported by French (2005). Because of this we focus on the extensive margin for labor supply adjustment.
We assume Cobb-Douglas specification for preferences over consumption and leisure:

\[ u(c_t, 1 - l_t) = \frac{c_t^\chi (1 - l_t - \phi_{t, e} 1_{\{l_t > 0\}})^{1-\chi}}{1 - \sigma}. \]

Here \( \chi \) is a parameter determining the relative importance of consumption, \( \sigma \) is the risk-aversion over the consumption-leisure composite.

Agents discount the future at a rate \( \beta \) and survive till the next period with conditional probability \( \zeta_t \), which depends on age and health. We assume that the savings (net of medical expenses) of each household who does not survive are equally allocated among all survived agents of a working age within the same educational group. The population grows at a rate \( \eta \).

### 3.1.2 Health expenditures and health insurance

Each period an agent faces a stochastic medical expenditure shock \( x_t \). Medical shocks evolve according to a Markov chain \( G(x_{t+1}|x_t, t) \). We categorize individuals into two groups according to their medical expenses. Individuals with low medical expenses \( (x_t \leq \overline{x}_t) \) are referred to as healthy or people in good health, while individuals with high medical expenses \( (x_t > \overline{x}_t) \) are referred to as unhealthy or people in bad health. Here \( \overline{x} \) is a threshold separating people into two medical expenses groups.

Every individual of working age can buy health insurance (HI) against a medical 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 \( \text{Prob}_t \) an agent of working age gets an offer to buy employer-sponsored health insurance (ESHI). The variable \( g_t \) characterizes the status of the offer: \( g_t = 1 \) if an individual gets an offer, and \( g_t = 0 \) if 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 \( \overline{p} \) where:

\[ \overline{p} = (1 - \psi) p. \]

Low-income individuals of working age can obtain their health insurance from Medicaid for free. There are two pathways to qualify for Medicaid. First, an individual can become eligible if his total income is below a threshold \( y^{cat} \). Second, an individual can become eligible through the Medically Needy program. This happens if his total income...
minus medical expenses is below a threshold $y^{need}$ and his assets are less than a limit $k_{pub}$.  

We use $i_t$ to index the current health insurance status as follows:

$$i_t = \begin{cases} 
0 & \text{if uninsured} \\
1 & \text{if insured by Mediciad} \\
2 & \text{if privately insured} 
\end{cases}$$

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

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 medical costs.

### 3.1.3 Labor income

Households differ by their educational attainment $e$. Educational attainment can take two values: $e = 1$ corresponds to the absence of any degree, $e = 2$ corresponds to at least high-school degree. Earnings are equal to $\bar{w}z_{i}^{e,x}x_t$, where $\bar{w}$ is wage and $z_{i}^{e,x}$ is the idiosyncratic productivity that depends on educational level ($e$), age ($t$) and medical expenses ($x_t$) of an individual.

### 3.1.4 Taxation and social transfers

All households pay income taxes that consist of two parts: a progressive tax denoted by $T(y_t)$ and a proportional tax denoted by $\tau_y$. Taxable income $y_t$ is based on both labor and capital income. Working households also pay payroll taxes - Medicare tax ($\tau_{med}$) and Social Security tax ($\tau_{ss}$). Social Security tax rate for earnings above $\bar{y}_{ss}$ is zero. The U.S. tax codes allows households to subtract out-of-pocket medical expenditures that exceed 7.5% of their income when calculating taxable income. In addition, ESHI premium ($\bar{p}$) is tax-deductible in both income and payroll tax calculations. Consumption is taxed at a proportional rate $\tau_c$.

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4As of 2009 35 states operate the Medically Needy program. All states running this program have asset test when determining eligibility. As for the general Medicaid program, most of the states do not have asset test as a part of eligibility requirement (Ross et al, 2009, and Kaiser Family Foundation statistics available at www.statehealthfacts.org).

5In the earlier version of this paper (see Pashchenko and Porapakkarm, 2011) we considered three educational groups: high-school dropouts, high-school graduates and college graduates. The first educational group differs substantially in insurance statistics from the other two, but the difference between high-school and college graduates is quite small. Because of this we combined the last two educational groups into one to reduce the computational costs.
We also assume a public safety-net program, $T_{st}$. The program guarantees that every household will have a minimum consumption level at $c$. This reflects the option available to U.S. households with a bad combination of income and medical shocks to rely on public transfer programs such as food stamp, Supplemental Security Income, and uncompensated care.\footnote{In 2004 85\% of uncompensated care were paid by government. The major portion is through disproportionate share hospital (DSH) payment (Kaiser Family Foundation, 2004).} Retired households receive Social Security benefits $ss_e$ that depend on educational attainment $e$.

### 3.1.5 Optimization problem

**Households of a working age** ($t < R$) The state variables for the working age household’s optimization problem are capital ($k_t \in [R^+ \cup \{0\}]$), medical cost shock ($x_t \in [R^+ \cup \{0\}]$), idiosyncratic labor productivity ($z_t^e, x_t \in [R^+]$), ESHI offer status ($g_t \in \mathbb{G} = \{0, 1\}$), health insurance status ($i_t \in \mathbb{I} = \{0, 1, 2\}$), educational attainment ($e \in \mathbb{E} = \{1, 2\}$) and age ($t$).

In each period a household chooses consumption ($c_t$), labor supply ($l_t$), savings ($k_{t+1}$), and health insurance status for the next period ($i_{t+1}'$). If he is eligible for Medicaid, he can get free public insurance (we call this option $M$). If he works in a firm offering an ESHI, he can buy a group insurance ($G$). In addition, everyone can choose to be uninsured ($U$), or buy individual insurance ($I$). We can summarize insurance choices as follows.\footnote{An individual can buy an ESHI coverage through his/her spouse’s employer. Since we abstract from family structure, only those who work can buy ESHI in our model. In addition, since Medicaid is free, Medicaid-eligible person cannot stay uninsured.} If an individual is eligible for Medicaid:

\[
i_{t}' = \begin{cases} 
\{M, I, G\} & \text{if } g_t = 1 \text{ and } l_t > 0 \\
\{M, I\} & \text{if } g_t = 0 \text{ or } l_t = 0
\end{cases}.
\]

Otherwise

\[
i_{t}' = \begin{cases} 
\{U, I, G\} & \text{if } g_t = 1 \text{ and } l_t > 0 \\
\{U, I\} & \text{if } g_t = 0 \text{ or } l_t = 0
\end{cases}.
\]

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

\[
V_{t,e} (k_t, x_t, z_t^{e,x}, g_t, i_t) = \max_{k_{t+1}, c_t, l_t, i_{t}'} u (c_t, l_t) + \beta \zeta_t E_t V_{t+1,e} (k_{t+1}, x_{t+1}, z_{t+1}^{e,x}, g_{t+1}, i_{t+1})
\]

subject to

\[
k_t (1 + r) + \tilde{w} z_t^{e,x} l_t + T_{st} + Beq_e = (1 + \tau_c) c_t + k_{t+1} + x_t (1 - q (x_t, i_t)) + P_t + Tax
\]
The document contains a mathematical model and economic analysis related to health insurance and labor markets. The equations describe the decision-making process for individuals and households in choosing health insurance plans and labor market participation. The text includes conditions for eligibility for Medicaid, budget constraints, and tax calculations. The equations are as follows:

\[
\tilde{w} = \begin{cases} 
  w & \text{if } g_t = 0 \\
  (w - c_E) & \text{if } g_t = 1 
\end{cases}
\]

\[
P_t = \begin{cases} 
  0 & \text{if } i_t' \in \{U, M\} \\
  p_H (x_t, t) & \text{if } i_t' = I \\
  \bar{p} & \text{if } i_t' = G 
\end{cases}
\]

\[
i_{t+1} = \begin{cases} 
  0 & \text{if } i_t' = U \\
  1 & \text{if } i_t' = M \\
  2 & \text{if } i_t' \in \{I, G\} 
\end{cases}
\]

\[
Tax = T (y_t) + \tau_g y_t + \tau_{med} \left( \tilde{w} z_t^{e,x} l_t - \bar{p} 1 \{i_t' = G\} \right) + \tau_{ss} \max \left( \tilde{w} z_t^{e,x} l_t - \bar{p} 1 \{i_t' = G\}, \bar{y}_{ss} \right)
\]

\[
y_t = rk_t + \tilde{w} z_t^{e,x} l_t - \bar{p} 1 \{i_t' = G\} - \max (0, x_t (1 - q (x_t, i_t)) - 0.075 (\tilde{w} z_t^{e,x} l_t + rk_t))
\]

\[
T_{SI} = \max (0, (1 + \tau_r) \zeta + x_t (1 - q (x_t, i_t)) + Tax - \tilde{w} z_t^{e,x} l_t - k_t (1 + r))
\]

An individual is eligible for Medicaid if

\[
y_t^{tot} \leq y^{cat} \text{ or } y_t^{tot} - x_t (1 - q (x_t, i_t)) \leq y^{need} \text{ and } k_t \leq k^{pub}
\]

\[
y_t^{tot} = rk_t + \tilde{w} z_t^{e,x} l_t
\]

\textit{Beq} is accidental bequest. The conditional expectation on the right-hand side of Equation (3) is over \( \{x_{t+1}, i_{t+1}, g_{t+1}\} \). Equation (4) is the budget constraint. In Equation (5), \( w \) is wage per effective labor unit. If the household has an ESHI offer, his employer partly pays for his insurance premium. To maintain zero profit condition, the employer who offers ESHI deducts an amount \( c_E \) from the wage per effective labor unit, as shown in (5). Equation (7) maps the current HI choice into the next period HI status. In Equation (8), the first two terms are income taxes and the last two terms are payroll taxes.\(^8\)

**Retired households** For a retired household (\( t \geq R \)) the state variables are capital \( (k_t) \), medical expenses shock \( (x_t) \), educational attainment \( (e) \), and age \( (t) \).\(^9\)

\[
V_{t,e} (k_t, x_t) = \max_{k_{t+1}, e_{t+1}} u (c_t, 0) + \beta \zeta_t E_t V_{t+1,e} (k_{t+1}, x_{t+1})
\]

\(^8\)In practice, employers contribute 50% of Medicare and Social Security taxes. For simplicity, we assume that employees pay 100% of payroll taxes.

\(^9\)The problem of a just retired household is slightly different since he is still under insurance coverage from the previous period. Thus, \( i_t \) is an additional state variable and out-of-pocket medical expenses are \( x_t (1 - q (x_t, i_t)) \).
subject to

\[ k_t (1 + r) + s s_e + T^S_I = (1 + \tau_c) c_t + k_{t+1} + x_t (1 - q_{med} (x_t)) + p_{med} + T a x \]

\[ T a x = T (y_t) + \tau_y y_t \]

\[ y_t = r k_t + s s_e - \max (0, x_t (1 - q_{med} (x_t))) - 0.075 (s s_e + r k_t) \]

\[ T^S_I = \max (0, (1 + \tau_c) c + x_t (1 - q_{med} (x_t))) + T a x + p_{med} - s s_e - k_t (1 + r)) . \]

**Distribution of households** To simplify the notation, let \( S \) define the space of a household’s state variables, where \( S = \mathbb{K} \times \mathbb{Z} \times \mathbb{X} \times \mathbb{G} \times \mathbb{I} \times \mathbb{E} \times \mathbb{T} \) for working-age households and \( S = \mathbb{K} \times \mathbb{X} \times \mathbb{E} \times \mathbb{T} \) for retired households. Let \( s \in S \), and denote by \( \Gamma (s) \) 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, \( A K^\alpha L^{1-\alpha} \), 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 but the second stand-in firm does not. Under competitive behavior, the second firm pays each employee his marginal product of labor. Since capital is freely allocated between the two firms, the Cobb-Douglas production function implies that the capital-labor ratios of both firms are the same. Consequently, we have

\[ w = (1 - \alpha) A K^\alpha L^{-\alpha}, \]  \hspace{1cm} (12)

\[ r = \alpha A K^{\alpha-1} L^{1-\alpha} - \delta, \]  \hspace{1cm} (13)

where \( \delta \) is depreciation rate.

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 \( c_E \) from the marginal product per effective labor unit. The zero profit condition implies

\[ c_E = \frac{\psi p \left( \int 1_{\{ q' \mid (s) = G \} } \Gamma (s) \right)}{\int l_t z_t^{x, e} 1_{\{ g_t = 1 \} } \Gamma (s) \}. \]  \hspace{1cm} (14)

The numerator is the total contributions towards insurance premiums paid by the first firm. The denominator is the total effective labor working in the first firm.\(^{10}\)

\(^{10}\) The assumed structure implies a proportional transfer from high-income to low-income workers. An alternative structure is a lump-sum wage reduction. This alternative structure is difficult to implement.
3.3 Insurance sector

Health insurance companies in both private and group markets act competitively. We assume that insurers can observe all state variables that determine future medical expenses of the individuals\textsuperscript{11}. This assumption, together with zero profit conditions, allows us to write insurance premiums in the following way:

\[ p_I(x_t, t) = (1 + r)^{-1} \gamma EM(x_t, t) + \pi \] (15)

for the non-group insurance market and

\[ p = (1 + r)^{-1} \gamma \left( \int \mathbb{1}_{\{x_{t'}(s) = G\}} EM(x_t, t) \Gamma(s) \right) \] (16)

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

\[ EM(x_t, t) = \int x_{t+1} q_{x_t} (x_{t+1}, 2) \mathcal{G}(x_{t+1} | x_t, t). \]

\( \gamma \) is a markup on prices due to the administrative costs in the individual and group markets; \( \pi \) is the fixed costs of buying an individual policy\textsuperscript{12}. The premium in the non-group insurance market is based on the discounted expected medical expenditures of the individual buyer. The premium for group insurance is based on a weighted average of the expected medical costs of those who buy group insurance.

3.4 Government constraint

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

\[ \int [\text{Tax} (s) + \tau_c t_l (s)] \Gamma (s) - G = \] (17)

\[ \int_{t \geq R} [s s_e + q_{\text{med}} (x_t) x_t - p_{\text{med}}] \Gamma (s) + \int_{t < R} T_{t}^{S I} \Gamma (s) + \int_{t = M} \mathbb{1}_{\{x_t = M\}} q(x_t, 1) x_t \Gamma (s) \]

The left-hand side is the total tax revenue from all households net of exogenous government expenditures (\( G \)). The first term on the right-hand side is the net expenditures on Social Security and Medicare for retired households. The second term is the costs of

\textsuperscript{11}Currently most states allow insurance firms to medically underwrite applicants for health insurance.

\textsuperscript{12}Fixed costs capture the difference in overhead costs for individual and group policies. An alternative setup would be to assume different proportional loads \( \gamma \). We choose fixed costs because this way we can better match the life-cycle profile of individual insurance rates.
guaranteeing the minimum consumption floor for households. The last term is the costs of Medicaid.

### 3.5 Definition of stationary competitive equilibrium

Given the government programs \( \{ c, s, q_{med}(x, t), p_{med}, y_{i}^{cat}, y_{i}^{need}, k^{pub}, G \} \), the fraction of medical costs covered by private insurers and Medicaid \( \{ q(x, i) \} \), and the employers’ contribution \( (\psi) \), the competitive equilibrium of this economy consists of the set of time-invariant prices \( \{ w, r, p, p_{I}(x, t) \} \), wage reduction \( \{ c_{E} \} \), households’ value functions \( \{ V_{t}(s) \} \), decision rules of working-age households \( \{ k_{t+1}(s), c_{t}(s), l_{t}(s), \psi_{H}(s) \}_{t=1}^{R-1} \) and retired households \( \{ c_{t}(s), k_{t+1}(s) \}_{t=R}^{T} \), and the tax functions \( \{ T(y), \tau_{med}, \tau_{ss}, \tau_{c}, \tau_{y} \} \) such that the following conditions are satisfied:

1. Given the set of prices and the tax functions the decision rules solve the households’ optimization problems in equations (3) and (11).

2. Wage \( (w) \) and rent \( (r) \) satisfy equation (12) and (13), where

\[
K = \int k_{t+1}(s) \Gamma(s) + \int_{t<R} \{ \psi(s) = G \} p_{I}(x, t) \Gamma(s),
\]

\[
L = \int_{t<R} z_{i}^{c} l_{t}(s) \Gamma(s).
\]

3. \( c_{E} \) satisfies equation (14); thus the firm offering ESHI earns zero profit.

4. The non-group insurance premiums \( p_{I}(x, t) \) satisfy equation (15), and the group insurance premium satisfies equation (16), so health insurance companies earn zero profit.

5. The tax functions \( \{ T(y), \tau_{med}, \tau_{ss}, \tau_{c}, \tau_{y} \} \) balance the government budget (17).

### 4 Changes introduced by the reform

This section describes what modifications we introduce 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 of getting an ESHI offer and the employer contribution rate \( (\psi) \) do not change after the reform\(^{13} \). This assumption is relaxed in the Appendix G.

\(^{13}\)This assumption results from the absence of consensus in the literature about the firms response to the reform. Some economists express the concern that the reform will induce many small firms to drop coverage due to the availability of subsidized insurance for their employees in the individual market. On the other hand, Brugemann and Manovskii (2010) show in a quantitative model that the number of firms
4.1 Household problem

After the reform, a working-age household may be subject to penalties or receive subsidies to buy individual health insurance. Also, more households will be eligible for Medicaid. The eligibility for subsidies and the Medicaid expansion depends on a household’s total income \((y^t_{tot})\); penalties are a function of the taxable income \((y^t)\). We can rewrite the budget constraint of a working age household (4) in the following way:

\[
k_t (1 + r) + \bar{w} z^e x^t l_t + T^{SI}_t + B e q + S u b(y^t_{tot}, i'_H) = (1 + \tau_c) c_t + k_{t+1} + x_t (1 - q (x_t, i_t)) + P_t + T a x + P e n(y_t, i'_H).
\]

(18)

Here \(S u b(y^t_{tot}, i'_H)\) and \(P e n(y_t, i'_H)\) are subsidies and penalties correspondingly. A household with income above 400% of Federal Poverty Line (FPL) cannot get subsidies. People having income below 400% of FPL and receiving an ESHI offer are eligible for premium subsidies in the individual market only if their employee’s contribution \((p)\) exceeds 9.5% of their total income. The subsidy structure ensures that individuals within a certain income category do not pay for health insurance more than a certain fraction of their income. More specifically, spending on individual insurance premiums are limited to the following percentage of total income\(^\text{14}\):

<table>
<thead>
<tr>
<th>Maximum premium spending (% of income)</th>
<th>Income categories (% of FPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>133-150</td>
</tr>
<tr>
<td>5.2</td>
<td>150-200</td>
</tr>
<tr>
<td>7.2</td>
<td>200-250</td>
</tr>
<tr>
<td>8.8</td>
<td>250-300</td>
</tr>
<tr>
<td>9.5</td>
<td>300-400</td>
</tr>
</tbody>
</table>

The income eligibility threshold for the general Medicaid program is increased to 133% of FPL. There are no changes in the Medically Needy program.

An uninsured person whose insurance premium in the individual market is less than 8% of his total income has to pay a penalty. The penalty is determined as

\[
P e n(y_t, i'_H) = \max\{0.025y_t, \$695\} \quad \text{if} \quad i'_H = U
\]

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 their workers. However, these tax credits are only in effect for two years.

\(^{14}\)The subsidy function specified in the Bill is slightly more complicated: for each income category it specifies the range of maximum premium spending as a fraction of income. We approximate this range by a midpoint of a corresponding interval. For example, the range for the first income category (133-150% of FPL) is 3-4% and we approximate it by the midpoint 3.5%. 

13
4.2 Insurance sector after the reform

The reform imposes a heavy regulation on the individual insurance market. Insurance companies can no longer condition premiums on the current medical costs of individuals. The insurance premium of an individual of age $\hat{t}$ will be determined by

$$p_I(\hat{b}) = (1 + r)^{-1} \gamma \left( \int_{t=\hat{b}}^{\hat{t}} 1 \{ \hat{t}'_H = \hat{t} \} EM (x_t, t) \Gamma (s) \right) \left( \int_{t=\hat{b}}^{\hat{t}} 1 \{ \hat{t}'_H = \hat{t} \} \Gamma (s) \right) + \pi.$$

4.3 Government constraint

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

$$\int [Tax (s) + \tau_c \int_{t=R}^{t<R} Pen (y_t, x_t) x_t \Gamma (s)] = \int \left[ ss_e + q_{med} (x_t) x_t - p_{med} \right] \Gamma (s) + \int T^S_I (y_t) \Gamma (s) + \int 1 \{ \hat{t}'_H = M \} q (x_t, 1) x_t \Gamma (s)$$

$$+ \int Sub (y_t^\text{tot}, x_t) \Gamma (s)$$

The left-hand side now has an additional source of revenue - penalties from those unwilling to purchase insurance. The right-hand side has an additional expenditure - subsidies. To balance the government budget we adjust $T (y_t)$ to make it more progressive (details are provided in the next section). This is done to reflect the fact that the current administration plans to finance the reform by increasing the tax burden on people with the highest income.$^{15}$

5 Data and calibration

5.1 Data

We calibrated the model using the Medical Expenditure Panel Survey (MEPS) dataset. The MEPS collects detailed records on demographics, income, medical costs and insur-

$^{15}$More specifically, the Bill introduces hospital insurance payroll tax on people with income above $200,000. However, this tax on top-earners is estimated to contribute less than half to the overall financing of the reform (see CBO, 2010). Moreover, our model uses the standard income process that is able to capture some important cross-section statistics over the life-cycle (more on this see the next section) but fails to reproduce the empirical fraction of very rich people. Because of this we do not change payroll taxes but increase the progressivity of the general tax code to capture the main idea of financing the reform.
ance for a nationally representative sample of households. It consists of two-year overlapping panels and covers the period of 1996-2008. We use nine waves of the MEPS - from 1999 to 2008.

The MEPS links people into one household based on eligibility for coverage under a 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 were computed for the head of the HIEU. We define the head as the male with the highest income in the HIEU. If the HIEU does not have a male member we assign a female with the highest income as its head. We use longitudinal weights provided in the MEPS to compute all the statistics. Since each wave is a representation of population in each year, the weight of each individual was divided by nine in the pooled sample.

In our sample we include all household heads whose age is at least 24 and who have non-negative labor income (defined later). 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).

<table>
<thead>
<tr>
<th>Panel</th>
<th>99/00</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
<th>07/08</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs.</td>
<td>5,290</td>
<td>4,165</td>
<td>8,648</td>
<td>6,471</td>
<td>6,628</td>
<td>6,569</td>
<td>6,380</td>
<td>6,876</td>
<td>5,165</td>
<td>40,343</td>
</tr>
</tbody>
</table>

Table 1: Number of observations in nine waves of MEPS (1999-2008)

5.2 Demographics, preferences and technology

In the model, agents are born at age 25 and can live to a maximum age of 99. The model period is one year so the maximum lifespan $N$ is 75. Agents retire at age 65, so $R$ is 41.

To adjust conditional survival probabilities $\zeta_t$ for the difference in health we follow Attanasio et al. (2008). In particular, we use Health and Retirement Survey (HRS) and MEPS to estimate the difference in survival probabilities for people with different health and use it to adjust the male life tables from the Social Security Administration (more details are available in the Appendix B). The population growth rate was set to 1.35% to match the fraction of people older than 65 in the data.

We set the consumption share in the utility function $\chi$ to 0.6 using the estimates of French (2005)\footnote{Given that we have indivisible labor supply we cannot pin down this parameter using some moment in the data.}. The parameter $\sigma$ is set to 5 which corresponds to the risk-aversion over consumption equal to 3.4 and it is in the range commonly used in the life-cycle literature.\footnote{The relative risk aversion over consumption is given by $-cu_c/u_c = 1 - \chi(1 - \sigma)$.} The discount factor $\beta$ is calibrated to match the aggregate capital output
ratio of 3. We set labor supply of those who choose to work (\( \bar{l} \)) to 0.4.

Fixed leisure costs of work \( \phi_{t,e} \) are calibrated to match the employment profiles in each educational and health group.\(^{18}\) More specifically, we assume that \( \phi_1(t,e) \) (fixed costs for people in good health) do not vary with age and use this parameter to match the employment rate for the age group 55-59 for each educational group.\(^{19}\) For the additional fixed costs of people with bad health \( \phi_2(t,e) \) we assume it is a linear function of age. For each educational group we adjust the intercept and the slope of this function to match two moments: employment rate of people in age groups 25-29 and 55-59 who have bad health. The resulting fixed costs are presented in Table 2.\(^{20}\)

<table>
<thead>
<tr>
<th></th>
<th>High-school dropouts</th>
<th>HS and College graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi_1 )</td>
<td>0.2800</td>
<td>0.2650</td>
</tr>
<tr>
<td>( \phi_2 ) intercept</td>
<td>0.0200</td>
<td>0.0450</td>
</tr>
<tr>
<td>( \phi_2 ) slope</td>
<td>0.0008</td>
<td>0.0025</td>
</tr>
</tbody>
</table>

Table 2: Parameters characterizing disutility from work

The Cobb-Douglas function parameter \( \alpha \) is set at 0.33, which corresponds to the capital income share in the US. 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 output equals one in the baseline model.

### 5.3 Government

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

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

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

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\(^{18}\) We define a person as employed if he works at least 520 hours per year, earns at least $2678 per year in base year dollars (this corresponds to working at least 10 hours per week and earning minimum wage of $5.15 per hour), and does not report being retired or receiving Social Security benefits.

\(^{19}\) Our model tends to overestimate the employment among healthy young people. Matching employment at young ages will result in counter-intuitive decreasing leisure costs over the life-cycle.

\(^{20}\) We find that for both educational groups the fixed costs from work are similar when they are healthy. But when they become unhealthy the fixed costs increase more for the group with high education. This implies that unhealthy highly educated people have a stronger preference towards leisure.
reform we keep $a_2$ fixed at a level that balances the budget in the baseline economy. To achieve a balanced budget in the reformed economy, we adjust the parameter $a_0$.

We set proportional income tax $\tau_y$ to 6.62% to match the fact that approximately 65% of income tax revenues come from progressive taxes. The minimum consumption floor $c$ was set to $2,700 following the estimates of De Nardi et al. (2010). Social Security replacement rates were set to 40% and 30% of average labor income for people with low and high education correspondingly, reflecting the progressivity of the system.

Medicaid eligibility rules were taken from the data. The income eligibility threshold for general Medicaid ($y^{cat}$) is set to 64% of FPL which is the median value for this threshold among all states in 2009. The income eligibility threshold for the Medically Needy program ($y^{need}$) and asset test for this program ($k^{pub}$) are set to 53% of FPL and $2,000 correspondingly. These numbers are equal to the median values for the corresponding eligibility criteria in 2009 in the states that have Medically Needy program.

The Medicare, Social Security and consumption tax rates were set to 2.9%, 12.4% and 5.67% correspondingly. The maximum taxable income for Social Security is set to $84,900. The fraction of exogenous government expenses in GDP is 18%.

5.4 Insurance sector

The share of health insurance premium paid by the firm ($\psi$) was chosen to match the aggregate ESHI take-up rate. The resulting number (76.3%) is consistent with the one observed in the U.S. economy, which is in the range of 75-85% (Kaiser Family foundation Employer Health Benefits Survey, 2002-2009).

We set the proportional loads for group and individual insurance policies ($\gamma$) to 1.11 (Kahn et al., 2005). The fixed costs of buying an individual policy $\pi$ is set to $23 to match the aggregate fraction of people with individual insurance.

5.5 Labor income

We divide households into two educational groups: high-school dropouts and people with at least high-school degree. The fraction of each group in the population is 15% and 85% correspondingly. Individuals with different education and health have different productivity, specified as follows:

$$z_t^{e,x} = \lambda_t^{e,x} \exp(v_t) \exp(\xi_t)$$

21 In this paper we use the term “take-up rate” only in relation to the employer-based market, and it defines the fraction of people among those with an ESHI offer who choose to buy group insurance.
where $\lambda_{t}^{e;x}$ is the deterministic function of age, education and medical expenses category, and

$$v_{t} = \rho v_{t-1} + \varepsilon_{t}, \quad \varepsilon_{t} \sim N(0, \sigma_{\varepsilon}^{2})$$

$$\xi_{t} \sim N(0, \sigma_{\xi}^{2})$$

For the persistent shock $v_{t}$ we set $\rho$ to 0.98 and $\sigma_{\varepsilon}^{2}$ to 0.018 following incomplete market literature (Storesletten, Telmer and Yaron (2004); Hubbard, Skinner, and Zeldes (1994); Erosa et al (2011); French (2005)). We set the variance of the transitory shock ($\sigma_{\xi}^{2}$) to 0.1 which is in the range estimated by Erosa et al (2011).

In our computation we discretize the stochastic shocks $v_{t}$ and $\xi_{t}$ using the method in Floden (2008). To construct the distribution of newborn individuals, we draw $v_{1}$ in equation (20) from $N(0,0.124)$ distribution following Heathcote et al. (2010).

To identify the deterministic part of productivity $\lambda_{t}^{e;x}$ we need to take into account that in the data we only observe labor income of workers and we do not know the potential income of non-workers. This creates a selection problem when estimating labor income from the data. In our case the selection problem is important because healthy and unhealthy people have similar average labor income but differ substantially in their employment profiles.

To overcome this problem we use the method developed by French (2005). We start by estimating labor income profiles from the MEPS dataset for workers. Then we guess $\lambda_{t}^{e;x}$ in equation (19) and feed these productivity profiles into our model. After solving and simulating the model we compute the average labor income profile of workers in our model and compare it with income profiles from the data. If our simulated labor income is too high we update the deterministic part of productivity $\lambda_{t}^{e;x}$ downwards, and if it is too low - upwards. We reiterate until the labor income profile generated by our model is the same as in the data. The advantage of this approach is that we can reconstruct the productivity $\varepsilon_{t}^{e;x}$ of individuals whom we do not observe working in the data.

Figure (1) plots the labor income profiles for workers observed in the data and simu-
lated by the model and compares them with the average potential labor income computed for everyone in the model. The later profile takes into account the unobserved productivity of those people who do not work. The average labor income of workers is higher than the average labor income that include potential income of non-workers because people with low productivity tend to drop out from the labor force. This also suggests that if we do not use the correction described above we would overestimate the labor income for non-participating individuals and this bias is especially strong for the case of unhealthy workers and workers of pre-retirement ages, i.e. for groups that tend to have lower employment. Our estimates also show that unhealthy people are inherently less productive. The drop in productivity due to bad health depends on age but it can be as high as 22% for high-school dropouts and as high as 15% for people with at least high-school degree.

Figure 1: Labor income for workers (data and model) and for everyone (model)
5.6 Offer rate

We assume that probability of getting an offer of ESHI coverage is a logistic function:\textsuperscript{26}

\[ \text{Prob}_t = \frac{\exp(u_t)}{1 + \exp(u_t)}, \]

where the variable \( u_t \) is an odds ratio that takes the following form:

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

Here \( \eta_0^e, \eta_1^e, \eta_2^e, \eta_3^e, \eta_4^e \) and \( \Theta^e \) are education-specific coefficients, \( inc_t \) is individual labor income (normalized by the average labor income), and \( D_t \) is a set of year dummy variables. To construct the initial offer rate (\( g_1 \) in equation (21)) we run a separate logistic regression for people aged 24-26 where we do not include offer in the previous period but include dummies for medical expenses categories.

5.7 Insurance status

In the MEPS the question about the source of insurance coverage is asked retrospectively for each month of the year. We define the person as having 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 months, 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 altogether lasts for more than eight months, we define that individual as having public insurance\textsuperscript{27}.

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 divide

\textsuperscript{26}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 household heads whose income was below $1,000 when estimating the logistic regression.

\textsuperscript{27}The results do not significantly change if we change the cutoff point to 6 or 12 months.
medical expenditures for each 5-year age group into 5 bins, corresponding to 30th, 60th, 90th and 99th percentiles (more details on this are available in the Appendix C). We set $x_t$ that separates people into different medical expenses categories to the 90th percentile of medical expenses distribution of the corresponding age. In other words, people whose medical expenses are in the lowest three bins are classified as healthy, while people whose medical expenses are in the highest two bins are classified as unhealthy. 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).

We use MEPS to estimate the fraction of medical expenses covered by insurance policies $q(x_t, i_t)$ (we explain more in the Appendix C). We find that for low medical expenses Medicaid provides better coverage than private insurance but for higher expenses private insurance is more generous. For retired households we set $q_{med}(x_t)$ to 0.5 to match the fraction of medical expenses of the retirees financed by the government in GDP (3.0%).

The model parametrization is summarized in Table 10 in Appendix A.

6 Baseline model performance

Figure (2) compares the employment profiles observed in the data with the ones generated by the model. The model tracks the employment profiles for each educational and health group quite closely though it slightly overestimates employment of the youngest group.

![Figure 2: Employment profiles for people with low education (left panel) and high education (right panel)](image)

Table 3 compares the 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 rates and individual insurance rates. However, the model also produces numbers on the fractions of uninsured and publicly insured close to the data. Table 4 shows insurance statistics by educational groups. Our model does not target any of these statistics, but it still fares well along these dimensions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insured by ESHI (%)</td>
<td>63.0</td>
<td>64.4</td>
</tr>
<tr>
<td>Individually insured (%)</td>
<td>7.6</td>
<td>7.3</td>
</tr>
<tr>
<td>Uninsured (%)</td>
<td>20.2</td>
<td>19.7</td>
</tr>
<tr>
<td>Publicly insured (%)</td>
<td>9.2</td>
<td>8.6</td>
</tr>
<tr>
<td>ESHI take-up rate (%)</td>
<td>94.3</td>
<td>94.2</td>
</tr>
<tr>
<td>Offer rate (%)</td>
<td>67.6</td>
<td>68.3</td>
</tr>
<tr>
<td>Group premium/income (%)</td>
<td>7.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Table 3: Insurance statistics: data vs. model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individually insured (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No High-School degree</td>
<td>5.5</td>
<td>3.8</td>
</tr>
<tr>
<td>High-School+ degree</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Uninsured (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No High-School degree</td>
<td>39.5</td>
<td>43.2</td>
</tr>
<tr>
<td>High-School+ degree</td>
<td>16.6</td>
<td>15.6</td>
</tr>
<tr>
<td>Publicly insured (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No High-School degree</td>
<td>21.7</td>
<td>23.8</td>
</tr>
<tr>
<td>High-School+ degree</td>
<td>6.9</td>
<td>5.9</td>
</tr>
<tr>
<td>ESHI take-up rate (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No High-School degree</td>
<td>85.9</td>
<td>81.6</td>
</tr>
<tr>
<td>High-School+ degree</td>
<td>93.9</td>
<td>95.3</td>
</tr>
</tbody>
</table>

Table 4: Insurance statistics for educational groups

The top panel of Figure (3) plots the percentage of uninsured and publicly insured people in the model and in the data. The model tends to overpredict the number of publicly insured among people of preretirement age. This happens because in reality the eligibility for Medicaid does not depend only on income but also on some demographic characteristics such as having a dependent child. People of preretirement age are less likely to satisfy these demographic eligibility requirements. As a result, we see less people in this age group on Medicaid in the data than in the model.

The bottom panel of Figure (3) compares the life-cycle profiles of the fraction of people with private insurance for different educational groups in the model and in the data. The model reproduces the general life-cycle pattern and differences in educational group in insurance rates. However, for low educated people it underestimates the fraction of people with ESHI among older group which happens because we overestimate the
fraction of publicly insured for this age category. The model also tends to underpredict the fraction of people with individual insurance among young low-educated people. Part of this discrepancy is accounted for by low educated people with high-deductible plans and part by difference in Medicaid rules by state.

It is well-known that a standard incomplete-market model cannot generate wealth concentration as in the data. However, we are able to reproduce a reasonable amount of wealth inequality. People in the top 20th, 40th and 60th percentiles in our model hold 55.2%, 81.5% and 95.1% of aggregate wealth while in the data these numbers are 84.4%, 95.7% and 99.6% correspondingly (Wolff, 2010). The numbers produced by our model are similar to the numbers produced by other quantitative models featuring incomplete labor markets and medical expenses shocks (see, for example, Imrohoroglu and Kitao, 2012).
7 Effects of the reform

This section describes the new steady-state that the economy converges to after the reform is implemented (the transition dynamics is described in the Appendix E).

7.1 Effect on the employment

The reform does not have a significant impact on the aggregate employment rate which slightly decreases from 89.7% to 89.1% (Table 5). Figure (4) compares employment profiles before and after the reform. There is a noticeable change in employment observed among people with bad health. Unhealthy people with low education increase their labor supply while for unhealthy people with high education labor supply goes down. This opposite direction of adjustment in labor supply is due to the effect of Medicaid and ESHI. In general, for unhealthy group health insurance is very valuable but very expensive if obtained through the individual market. Before the reform, unhealthy people with low education have to rely on Medicaid while highly educated have to rely on ESHI. In order to satisfy income eligibility requirements for Medicaid, unhealthy low educated people may need to stop working. In contrast, unhealthy people with high education have to work in order to be eligible for ESHI. After the reform, given the relaxed eligibility requirements for Medicaid and availability of subsidies these distorting effects are substantially diminished.\(^{28}\)

![Figure 4: Employment profiles before and after the reform for people with low education (left panel) and high education (right panel)](image)

\(^{28}\)Pohl (2011) finds similar patterns when using a structural model of labor supply to simulate the effects of the current reform on single mothers. In particular, he finds that individuals with medical conditions are more likely to increase labor supply in response to the Medicaid expansion and the introduction of subsidies, and to quit job that offers ESHI.
7.2 Effect on insurance

Table 5 compares aggregate insurance statistics between the two steady-states - in the baseline and in the reformed economies.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>Reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insured by ESHI (%)</td>
<td>64.4</td>
<td>62.5</td>
</tr>
<tr>
<td>Individually insured (%)</td>
<td>7.3</td>
<td>18.5</td>
</tr>
<tr>
<td>Uninsured (%)</td>
<td>19.7</td>
<td>8.9</td>
</tr>
<tr>
<td>Publicly insured (%)</td>
<td>8.6</td>
<td>10.1</td>
</tr>
<tr>
<td>ESHII takeup rate (%)</td>
<td>94.2</td>
<td>94.2</td>
</tr>
<tr>
<td>Group premium ($)</td>
<td>2,300</td>
<td>2,061</td>
</tr>
<tr>
<td>Employment</td>
<td>89.7</td>
<td>89.1</td>
</tr>
<tr>
<td>Aggregate capital</td>
<td>3.00</td>
<td>2.92</td>
</tr>
</tbody>
</table>

Table 5: Insurance statistics before and after the reform

The fraction of people with ESHI stays almost the same. This is not surprising given our assumption that neither ESHI offer rates nor employer contribution rates change in response to the reform. The percentage of people with individual insurance increases more than twofold: from 7.3% to 18.5%. At the same time, there is a big drop in the uninsurance rate which goes down from 19.7% to 8.9%. The number of publicly insured increases from 8.6% to 10.1% due to the expansion of Medicaid.

The top panel of Figure (5) compares the percentage of people without health insurance before and after the reform. In all educational and age groups there is a noticeable decline in the fraction of uninsured. The largest reduction in the number of uninsured is observed among high-school dropouts especially at young ages (for ages 25-29 the uninsurance rate goes down from 54.0% to 7.5%).

The bottom panel of Figure (5) displays the fraction of people with public insurance. For both educational groups the fraction of people insured by Medicaid increases at young ages but decreases at preretirement ages. In our calibration Medicaid provides a better coverage for low medical expenses but for high medical expenses private insurance is more generous. Since medical expenses increase steeply with age, subsidized private insurance becomes more attractive than Medicaid as people get older. As shown in the bottom panel of Figure (6), the fraction of people with individual insurance increases fast with age.

The top panel of Figure (6) compares the fraction of people with ESHI before and after the reform. For people after age 40 there is a decrease in ESHI coverage for both educational groups. This is due to the crowd-out by Medicaid and subsidized individual
insurance. Older people have higher disutility from work especially when unhealthy and after the reform they do not need to continue working in order to be eligible for ESHI since they have access to alternative insurance options.

### 7.3 Effect on government finances

Table 6 displays changes in government finances after the reform. The increase in government spending on subsidies net of penalties and on Medicaid expansion constitutes 124%. On the other hand, there is a significant decline in spending on transfers to guarantee the minimum consumption floor. For working-age households these transfers drop by almost 46%. The marginal tax rate for a person with average income increases

---

29Cutler and Gruber (1996) also found that Medicaid expansion over the 1987-1992 period caused crowd-out of ESHI.

30The decrease in the group premium reported in Table 5 happens because of this tendency of older unhealthy people to leave employment pool resulting in better risk composition.
Figure 6: Percent of people with ESHI and individual insurance before and after the reform for people with low education (left panel) and high education (right panel) by 1.73 percentage points in the reformed economy.31

<table>
<thead>
<tr>
<th>Change in</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spending on health insurance for working-age (%)</td>
<td>+124.1</td>
</tr>
<tr>
<td>Spending to guarantee minimum consumption for working-age (%)</td>
<td>-45.6</td>
</tr>
<tr>
<td>Marginal tax for average wage (percentage point)</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Table 6: Change in the government finances after the reform

7.4 Welfare analysis

Consumption equivalent variation for the reformed economy is presented in Table 7. The reform brings a significant welfare improvement: a newborn in the baseline economy

---

31 Even though the reform increases income redistribution in the economy it does not have a noticeable impact on wealth inequality. Gini coefficient after the reform changes very slightly going down from 0.556 to 0.552.
is willing to give up 0.70% of consumption every period to be born in the reformed economy. The average welfare gains of people who live through the transition period are equal to 0.64%. More than 65% of people gain from the reform. People who gain the most are low educated people: both CEV of newborns in the steady-state and the average CEV of people living through the transition exceed 1%. People with high education also gain from the reform though their gains are substantially lower. High welfare gains for low educated people are not surprising since they are the main beneficiaries of the expanded Medicaid and subsidies for health insurance purchase. The fact that even highly educated people tend to gain despite the higher tax burden is due to the improved risk-sharing in the economy. Before the reform highly-educated people rely on ESHI as a main source of insurance coverage and this has several disadvantages. First, people face the risk of loosing ESHI every period and this event is likely coincides with negative income shock. If this happens the availability of public or subsidized health insurance become valuable especially if a person is unhealthy. Second, an individual can buy ESHI only if he works which may be a constraint for older people in bad health whose disutility from work is high but insurance is very valuable. The availability of subsidized coverage not conditioned on working substantially increases welfare of this group.

<table>
<thead>
<tr>
<th>CEV(%)</th>
<th>Low education</th>
<th>High education</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newborns</td>
<td>0.70</td>
<td>1.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Steady-state comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns</td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>Low education education</td>
</tr>
<tr>
<td>High education education</td>
</tr>
<tr>
<td>Age 25-64</td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>Low education education</td>
</tr>
<tr>
<td>High education education</td>
</tr>
<tr>
<td>Age 65-99</td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>Low education education</td>
</tr>
<tr>
<td>High education education</td>
</tr>
<tr>
<td>% who gains</td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>Low education education</td>
</tr>
<tr>
<td>High education education</td>
</tr>
<tr>
<td>Table 7: Welfare effects of the reform</td>
</tr>
</tbody>
</table>

If we decompose welfare effects by age we see that retirees loose from the reform (Table 7) with the average loss equal to -0.65%. This happens because the reform does not improve insurance possibilities for retirees who already are covered by public insurance. However, they share the burden of reform financing through higher taxes.

32This result is different from Janicki (2011) who found that main beneficiaries of the reform are high-income people. This finding of Janicki (2011) is mostly driven by the fact that the consumption minimum floor in his model decreases after the reform. This disproportionately hurts low-income households outweighing any benefits they may have from the reform. In contrast, Jung and Trun (2010) also find that poor people gain more from the reform.
For people of working age the average CEV is equal to 0.95%. People who gain most are those with low education/ high productivity and high education/ low productivity (Figure (7)). People with low education/ low productivity do not gain much because they get access to government means-tested transfers even before the reform. And highly productive people with high education are not usually eligible for benefits of the reform so their gains are small. Unhealthy people tend to gain substantially more than healthy. There is a noticeable drop in welfare for people after age 50-55 which happens because this group has less time to enjoy the benefits of the reform.

![Figure 7: Consumption equivalent variation by health and productivity for low educated (top panel) and highly educated (bottom panel)](image)

**7.5 Decomposing the effect of the reform**

To decompose the 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

---

[33] In Figure (7) we define a person as having high productivity if his persistent shock falls in the highest two grids, and as having low productivity if this shock is in the lowest three grids.
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 penalties. We call this version of the reform “only redistribution”.

Table 8 compares the results of these modified reforms with the original one for the case of the steady-states (welfare calculations that include the transition period are presented in the Appendix F). 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 disappear, decreasing from 0.70 to 0.03%.

<table>
<thead>
<tr>
<th>CEV(%)</th>
<th>Agg. capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low education</td>
</tr>
<tr>
<td>Reform</td>
<td>0.70</td>
</tr>
<tr>
<td>Only CR</td>
<td>0.03</td>
</tr>
<tr>
<td>Only CR+high penalties</td>
<td>-0.08</td>
</tr>
<tr>
<td>Only redistribution</td>
<td>0.72</td>
</tr>
<tr>
<td>Only Medicaid expansion</td>
<td>0.18</td>
</tr>
<tr>
<td>Only subsidies</td>
<td>0.40</td>
</tr>
<tr>
<td>Only redistribution+penalties</td>
<td>0.56</td>
</tr>
<tr>
<td>Reform+high penalties</td>
<td>0.61</td>
</tr>
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</table>

Table 8: Welfare effect of different versions of the reform

<table>
<thead>
<tr>
<th>ESHI</th>
<th>Individual insurance</th>
<th>Uninsured</th>
<th>Public insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reform</td>
<td>62.5</td>
<td>18.5</td>
<td>8.9</td>
</tr>
<tr>
<td>Only CR</td>
<td>65.3</td>
<td>0.7</td>
<td>25.4</td>
</tr>
<tr>
<td>Only CR+high penalties</td>
<td>67.1</td>
<td>11.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Only redistribution</td>
<td>61.9</td>
<td>18.1</td>
<td>9.9</td>
</tr>
<tr>
<td>Only Medicaid expansion</td>
<td>62.0</td>
<td>5.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Only subsidies</td>
<td>64.3</td>
<td>21.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Only redistribution+penalties</td>
<td>62.9</td>
<td>26.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Reform+high penalties</td>
<td>62.7</td>
<td>23.3</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Table 9: Insurance statistics for counterfactual reforms

After the implementation of the reform with only community rating the individual market suffers from the adverse selection spiral. As can be seen from the left panel of Figure (8), the premium in the individual market is at 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 row of Table
9 clarifies this point by showing that participation in the individual market decreases to 0.7%. This suggests that penalties are not high 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 penalties that are three times higher than in the original reform. In this case we do not observe the adverse selection spiral in the individual market for people younger than 55\textsuperscript{34}: as shown in the right panel of Figure (8), the price of the individual insurance is much lower and closer to the average premium in the unregulated market. Also, the participation in the individual market increases to 11.4% (third row of Table 9). However, welfare effects of this modified reform become negative going down to -0.08 (third row of Table 8). This suggests that even though more severe penalties eliminate adverse selection spiral they impose welfare losses on individuals and the better risk-sharing in the individual market is not enough to compensate for these losses.

\textbf{Figure 8:} Individual market premiums before the reform, after the original reform and after the reform with only community rating (left panel) or community rating with high penalties (right panel)

The fourth row of Table 8 shows the results for the reform with only redistribution. This version of the reform has almost the same welfare gains than the original reform: the consumption equivalent variation is equal to 0.70%.

The important result is that the reform with only redistribution brings substantially higher welfare gains than the reform with only community rating. This suggests that income-based transfers improve the welfare of people more than the new rules in the

\textsuperscript{34}Even increasing penalties five times does not allow to eliminate adverse selection spiral for people of pre-retirement ages. This happens because medical expenses for unhealthy members of this group are very high and the community rated premium for many people exceeds their income.
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 (9) compares the fraction of individual market premiums in average income for low educated people before the reform and after the two versions of reform: with only community rating (keeping premiums as low as in the original reform) and with only income redistribution. If the reform is implemented with only community rating, the share of premiums in income increases for people with low medical expenses and decreases for people with high medical expenses. However, the share of community rated premium in income is high: it increases fast and reaches 30% 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 is significantly lower even for people with high medical expenses.

![Diagram showing the share of individual premiums in income for people with the lowest and second highest medical costs](image)

Figure 9: Fraction of individual insurance premiums in income for people with the lowest (left panel) and second highest (right panel) medical costs

To understand how much different redistributive measures embedded in the reform contribute to its welfare outcome we consider two versions of the reform with only redistribution: i) the reform that only expands Medicaid, and ii) the reform that only introduces subsidies. The welfare effects of these reforms are presented in rows fifth and sixth of Table 8. In welfare terms, subsidies is the most important element of the reform: just introducing subsidies brings CEV equal to 0.40% while Medicaid expansion alone gives twice lower welfare gains (0.18). This happens because the subsidy scheme has transfers well targeted at people with low income and/or high medical expenses. This directly addresses the affordability problem and thus have a large impact on welfare.

\[\text{35 The actual share of premium in income for the reform with only community rating is substantially higher than 30\% due to the adverse selection spiral in the market for this age group (see Figure(8))}.\]
7.6 Obtaining universal coverage

An important result from Table 9 is that even though the reform substantially decreases the number of uninsured the insurance coverage is far from universal: around 9% of people will stay uninsured. People who stay uninsured after the reform have low expected medical expenses and they are not eligible for subsidies. These people prefer to pay penalties because community-rated health insurance is substantially more expensive than the premium they face in the unregulated market. To understand how important is near universal coverage and how to achieve it we consider another two versions of the reform.

First, we remove community rating from the original reform. We call this version of the reform "only redistribution with penalties". Table 9 shows that in such a reform the fraction of uninsured decreases almost to zero - only 0.5% of people do not have coverage. This implies that if healthy individuals face risk-adjusted insurance prices, penalties can effectively induce them to buy insurance. Second, we increase penalties in the original reform three times. We call this version "reform with high penalties". In this case the fraction of uninsured also substantially decreases (to 3.9%) but it stays above the level achieved by the reform "only redistribution with penalties". This means that actuarial unfairness of premiums due to the community rating is a serious problem preventing healthy people to buy insurance, and even large penalties can only partially solve this problem.

It is also important to note, that the near universal health insurance coverage does not necessarily imply the highest welfare. As Table 8 illustrates, the welfare gains from the original reform are higher than from the reform with only redistribution and penalties or reform with high penalties.

8 Conclusion

The health reform bill recently signed by the President includes a wide range of measures which aim 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 new regulation of the individual market, and the part that is due to the increased income redistribution in the economy.

We construct a general equilibrium heterogeneous model with a rich representation of the current U.S. health insurance system. We calibrate the model using Medical Expenses Panel Survey to match key insurance statistics of the U.S. economy.
We find that the reform brings significant welfare gains both for people who are going to be born in the economy after the reform is implemented and for people who are going to live through the transition. However, these welfare gains are mostly achieved by the redistributive part of the reform. If the reform only changes the regulation of the individual market and introduces penalties for uninsured the welfare gains almost disappear. Many individual market participants have low-income and they gain a lot from having subsidized health insurance. Reorganizing the individual insurance market alone has a 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.
A Summary of the parametrization of the baseline model

<table>
<thead>
<tr>
<th>Parameters set outside the model</th>
<th>Parameter name</th>
<th>Notation</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk aversion</td>
<td>σ</td>
<td>5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Consumption share</td>
<td>κ</td>
<td>0.6</td>
<td>French (2005)</td>
<td></td>
</tr>
<tr>
<td>Cobb-Douglas parameter</td>
<td>α</td>
<td>0.33</td>
<td>Capital share in output</td>
<td></td>
</tr>
<tr>
<td>Labor supply</td>
<td>l</td>
<td>0.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cutoff medical expenses</td>
<td>ξ</td>
<td>90th percentile</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Consumption floor</td>
<td>c</td>
<td>$2,700</td>
<td>De Nardi et al., 2010</td>
<td></td>
</tr>
<tr>
<td>Tax function parameters</td>
<td>a₀</td>
<td>0.258</td>
<td>Gouveia and Strauss (1994)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a₁</td>
<td>0.768</td>
<td>Gouveia and Strauss (1994)</td>
<td></td>
</tr>
<tr>
<td>Social Security replacement rates</td>
<td>ss₁</td>
<td>40%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ss₂</td>
<td>30%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Insurance loads</td>
<td>γ</td>
<td>1.11</td>
<td>Kahn et all (2005)</td>
<td></td>
</tr>
<tr>
<td>Medicaid income threshold</td>
<td>yₘₐᵦ₇</td>
<td>64%</td>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>Medicaid Needy</td>
<td>yₚₑₐ₇</td>
<td>53%</td>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>Asset test for Medically Needy</td>
<td>kₚₑₐ₇</td>
<td>$2,000</td>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>Medicare premium</td>
<td>yₚₑₐ₇</td>
<td>$1,055</td>
<td>Total premiums =2.11% of Y</td>
<td></td>
</tr>
<tr>
<td>Persistent shock</td>
<td>ρ</td>
<td>0.98</td>
<td>Heathcote et al (2010)</td>
<td></td>
</tr>
<tr>
<td>Variance of innovations</td>
<td>σ₂ₕ</td>
<td>0.018</td>
<td>Heathcote et al (2010)</td>
<td></td>
</tr>
<tr>
<td>Variance of transitory shock</td>
<td>σ₂ₜ</td>
<td>0.10</td>
<td>Erosa et al (2011)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters used to match some targets</th>
<th>Parameter name</th>
<th>Notation</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>β</td>
<td>0.992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>δ</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population growth</td>
<td>η</td>
<td>1.35%</td>
<td>% of people older than 65</td>
<td></td>
</tr>
<tr>
<td>Tax function parameter</td>
<td>σₚ</td>
<td>0.652</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportional tax</td>
<td>τₚ</td>
<td>6.62%</td>
<td>Composition of tax revenue</td>
<td></td>
</tr>
<tr>
<td>Fixed costs for insurance</td>
<td>τ</td>
<td>$22.7</td>
<td>% of individually insured</td>
<td></td>
</tr>
<tr>
<td>Employer contribution</td>
<td>ψ</td>
<td>76.3%</td>
<td>ESHI take-up rate</td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td></td>
<td></td>
<td>Employment profiles</td>
<td></td>
</tr>
<tr>
<td>low education</td>
<td>φ₁(1)</td>
<td>0.2800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>high education</td>
<td>φ₁(2)</td>
<td>0.2650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unhealthy, low educ:</td>
<td>φ₂(t,1)</td>
<td>0.2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intercept</td>
<td>-</td>
<td>0.0200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>slope</td>
<td>-</td>
<td>0.0008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unhealthy, high educ:</td>
<td>φ₂(t,2)</td>
<td>0.0450</td>
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<tr>
<td>intercept</td>
<td>-</td>
<td>0.0450</td>
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<tr>
<td>slope</td>
<td>-</td>
<td>0.0025</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Parameters of the model
B Adjustment of survival probabilities

To adjust survival probabilities for difference in health we follow Attanasio et al (2008). We use the HRS dataset to estimate the survival probability as a function of a cubic polynomial in age, health and gender through a probit model. We define health in the same way as we did in the current model - based on the category of medical expenses. Then we use our estimates to find ‘survival premium’ - the difference between survival probabilities of males in good and bad health. From the Social Security Administration life table we know the average survival probability of males and we can construct from the MEPS the fraction of people in good and bad health in each period. Using this information we can reconstruct the survival probability of a person in good and in bad health for each age. Figure (10) illustrates the resulting survival probabilities for healthy and unhealthy individuals.

Figure 10: Survival probabilities for people in different health status

C Medical expenses and insurance coverage

To calibrate medical expenses we start by separating our sample into 13 age groups (25-29, 30-34,...,85+). We assign the age of each group to the mid-point of a corresponding age interval. For example, 27 for 25-29, 32 for 30-34 etc. For each year and each age group we categorize medical expenditures into 5 bins, corresponding to 30th, 60th, 90th and 99th percentiles. To get a value of medical expenses in each bin we run a regression of medical expenses on a set of age and year dummies. Since 9 waves of MEPS cover 10 years and there are 13 age groups we have 130 observations for each such regression. The coefficients on age dummies in this regression correspond to the average medical expenses
for the corresponding age in a particular bin. Then we fit our estimated coefficients with a cubic function of age.

The MEPS tends to underestimate the aggregate medical expenditures (Sing et al, 2002). To account for this fact we compare the total medical expenses constructed from the MEPS with the number reported in the National Health Expenditure Account (NHEA) in 2002. The downward bias in the medical expenses from the MEPS is much higher for the elderly (particulary after age 75) than for the young\textsuperscript{36}. Because of this, we multiply our estimated medical expenses by 1.37 for people younger than 75 year old and by 1.93 for people older than 75 year old. This adjustment allows us to match the share of total aggregate expenses in GDP in 2003 (12.6%) and the share of medical expenses of people younger than 65 in GDP (6.5%). The resulting profiles are shown in the left panel of Figure (11).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{medical_expenses.png}
\caption{Medical expenses for each bin (left panel) and fraction of medical expenses covered by private insurance and Medicaid (right panel)}
\end{figure}

To determine the fraction of medical expenses covered by private insurance and Medicaid ($q(x_t, i_t)$), we use the following approach. For working age households we estimate medical expenditures paid by private insurers (variable TOTPRV) or Medicaid (variable TOTMCD) as a quadratic function of total paid medical expenditures and year dummy variables. The right panel of Figure (11) illustrates the fraction of medical expenses covered by private insurance and Medicaid.

\textsuperscript{36}MEPS underepresents institutionalized population and the fraction of people in nursing homes increases dramatically after age 75 (see Kopecky and Koreshkova, 2009).
D Discussion of the assumption of exogenous medical expenses

In our model we treat medical expenses as exogenous shocks, i.e. we abstract from the fact that people have at least some degree of control over their medical expenses. This modeling choice arises because i) medical expenses to a significant extent do represent exogenous shocks, ii) the focus of the current reform is to provide better insurance against these shocks. Our framework allows us to evaluate how well the reform improves the insurance possibilities in the economy. We realize that by treating medical expenses as an exogenous process we can miss some effects of the reform arising from possible adjustments in medical expenses. Here we provide a brief discussion of the potential direction and size of these effects.

In general, most of the models of endogenous medical expenses are based on Grossman’s framework (Grossman, 1972). The key feature of this framework is that medical expenses can increase the stock of health and this way increase utility. Another important aspect of Grossman’s framework is the possibility to intertemporally allocate medical spending. First, people with bad health can delay treatment for several periods. Second, people can invest in preventive care in order to decrease probability to face high medical shocks in the future.

When thinking of medical expenses in this framework the following effects are possible. First, currently uninsured people can increase their medical spending because i) they previously delayed their medical treatment ii) medical spending can increase their utility. This can increase aggregate medical spending and insurance premiums implying higher government spending on subsidies and higher taxes. This will lead to lower welfare gains from the reform. On the other hand, since medical spending can increase utility it will lead to higher welfare gains from the reform.

Second, we can expect that currently uninsured people will increase their preventive medical spending, i.e. increase their investment in health. This can improve the distribution of medical shocks in the future and decrease their exposure to medical risk (for a quantitative examination of such mechanism see Ozkan, 2011). On the aggregate level this can lead to a decrease in medical expenses in the long run partially offsetting the effect of moral hazard described earlier and positively affecting welfare gains of the reform.

In terms of the relative importance of community rating and income redistribution we do not expect the effects described above to change the dominant role of income redistribution. In Grossman’s framework people can adjust their medical expenses in response to change in insurance status. However, our results show that community rating is not an effective instrument to increase the number of people with insurance
because it does not solve the problem of affordability. Thus, even if medical expenses are endogenous, we expect that income redistributive measures will still be a dominant force behind welfare effects of the reform.

E  Transition to the reformed economy

This section describes how the economy makes a transition from the initial steady-state to the new steady-state. The economy is assumed to be in the steady-state in period 0 and in period 1 the reform is announced and implemented. Figure (13) shows how aggregate capital, tax function parameter $a_0$, employment and uninsurance rates for each educational group evolve over time.

Aggregate capital is slowly decumulated until it reaches its new equilibrium value while other variables adjust much faster. The tax rate jumps up immediately because the government needs to start financing the subsidies and the expansion of Medicaid. After the first period the tax sharply decreases and then slowly moves up until it reaches its new steady-state value. This overshoot of the tax happens because at the start of the reform there is still a lot of uninsured people and the government has to provide consumption floor to uninsured with large medical shocks. Once the number of uninsured decreases the government spends less money to finance the consumption floor (see also Table 6). The further increase in taxes happens because of the erosion of the tax base due to decline in the aggregate capital. The employment and uninsurance rates adjust quickly to their new equilibrium values after the transition starts.

Figure 12: CEV of newborns during the transition period

Figure (12) plots consumption equivalent variation of newborns in each period during the transition. People born immediately after the transition have the highest welfare
gains and each new generation has lower welfare. The decline in welfare happens because the aggregate capital gradually declines and the tax rate increases.

Figure 13: Transition of aggregate variables
Welfare effects of the different versions of the reform

Table 11 compares welfare effects of the reform with only community rating and only redistribution with the original reform for the case when the transition is taken into account. Comparing to the steady-state evaluations, the difference in welfare gains become even more pronounced. The average welfare gains for the reform with only redistribution are equal to 0.50% while the reform with only community rating results in welfare losses for each educational group. Also much more people gain from the reform with only redistribution (60.1% vs 4.7%). Figure (14) compares average welfare gains form different versions of the reform for people with different productivity and health. The reform with only community rating results in zero or negative welfare effects for all groups. The biggest loss from this version of the reform are experienced by people with low education and high productivity. This group use the individual insurance market before the reform and they suffer the most from the adverse selection spiral.

<table>
<thead>
<tr>
<th>CEV(%)</th>
<th>Low education</th>
<th>High education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.64</td>
<td>1.43</td>
</tr>
<tr>
<td>Age 25-64</td>
<td>0.95</td>
<td>1.85</td>
</tr>
<tr>
<td>Age 65-99</td>
<td>-0.65</td>
<td>-0.37</td>
</tr>
<tr>
<td>% who gains</td>
<td>66.2</td>
<td>76.7</td>
</tr>
<tr>
<td>Only CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>-0.11</td>
<td>-0.07</td>
</tr>
<tr>
<td>Age 25-64</td>
<td>-0.13</td>
<td>-0.09</td>
</tr>
<tr>
<td>Age 65-99</td>
<td>-0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>% who gains</td>
<td>4.7</td>
<td>19.4</td>
</tr>
<tr>
<td>Only redistribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.50</td>
<td>1.36</td>
</tr>
<tr>
<td>Age 25-64</td>
<td>0.79</td>
<td>1.77</td>
</tr>
<tr>
<td>Age 65-99</td>
<td>-0.74</td>
<td>-0.42</td>
</tr>
<tr>
<td>% who gains</td>
<td>60.1</td>
<td>76.1</td>
</tr>
</tbody>
</table>

Table 11: Welfare effects of different versions of the reform including transition
Figure 14: CEV for different versions of the reform for healthy (left panel) and unhealthy (right panel) medical costs
G The 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 the 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 their 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 the welfare effects of the reform if there is no change in the employer contribution rate ($\psi$) to a case when it decreases to 50%.

<table>
<thead>
<tr>
<th>CEV(%)</th>
<th>Agg. capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>$\psi$ does not change</td>
<td>All</td>
</tr>
<tr>
<td>Steady-state</td>
<td>0.70</td>
</tr>
<tr>
<td>With transition</td>
<td>0.64</td>
</tr>
<tr>
<td>$\psi$ decreases to 50%</td>
<td>All</td>
</tr>
<tr>
<td>Steady-state</td>
<td>0.40</td>
</tr>
<tr>
<td>With transition</td>
<td>0.47</td>
</tr>
</tbody>
</table>

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

When the reform induces firms to decrease contribution rates this mostly affects people with high education: their CEV goes down from 0.17 to -0.22 for the case of the steady-state comparison and from 0.51 to 0.32 for the case when the transition is taken into account. For people in this educational group 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 reduces the welfare of people buying ESHI. For people with lower educational attainment who rely less on ESHI, the welfare changes much less. Because of this the overall welfare effects of the reform are still large and positive despite a large decline in the employer contribution rate.

\[\text{37} \text{The scenario when an average employer contribution rate decreases from more than 70 to 50\% after the reform is unlikely because the Bill requires employers whose workers face high group premiums to pay penalties. However we construct this experiment to emphasize the directions of the welfare change.}\]
H 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 $p$, the amount the firm offering ESHI subtracts from the wage of their workers $c_E$, tax parameter $a_2$, and bequest $Beq_e$.

2. Solve for the households’ decision rules using backward induction. We evaluate the value function for points outside the state space grid using a Piecewise Cubic Hermite Interpolating Polynomial (PCHIP).

3. Given policy functions simulate the households distribution using a non-stochastic method as in Young (2010).

4. Using the distribution of households and policy functions check if market clearing conditions and zero profit conditions for insurance firms hold; and government budget balances. If not, update $r$, $p$, $c_E$, $a_2$, and $Beq_e$, and repeat steps 1-3.

The computation of the steady-state for the reformed economy is complicated by the fact that we now 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 4. As was mentioned in the main text, in the case of the original reform the multiplicity of equilibriums 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 equilibriums. 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.

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.
References


