CROSS-SUBSIDIZATION IN EMPLOYER-BASED HEALTH INSURANCE AND THE EFFECTS OF TAX SUBSIDY REFORM

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Every individual buying employer-based health insurance receives a tax subsidy because premiums are excluded from taxable income. Since these premiums are independent of individual risk, high-risk individuals also receive implicit cross-subsidies from low-risk individuals. In this paper, we explore ways to reform the tax subsidy by taking this implicit cross-subsidization into account. Using a general equilibrium model, we find that targeting the tax subsidy can result in substantial savings. Specifically, the same level of risk-sharing can be achieved at one-third of current costs if the tax subsidy is targeted only toward low-risk individuals and premiums are age-adjusted.

Keywords: tax reform, tax subsidies, employer-based health insurance

JEL Codes: D91, E65, H24

I. INTRODUCTION

Most non-elderly adults in the United States (63 percent) purchase health insurance in the employer-based market.¹ An important feature of this market is community rating, i.e., the insurance premiums are independent of the health and age of individuals.² For the community-rated market to provide good risk-sharing, there should be a

¹ These calculations are based on the Medical Expenditure Panel Survey (MEPS) dataset, http://meps.ahrq.gov/mepsweb/.
² In this paper, we refer to community rating in the employer-based market to describe the health insurance pricing within the pool of people insured by employer-based insurance. It is important to distinguish it from community rating for employers. The latter refers to the situation in which different employers face the same price for insuring their workers (for example, because they are in the same geographical region). Another pricing scheme for employers is experience rating, a situation in which the insurance price depends on the previous history of claims. It is important to note that even employers who face the experience rating still have to charge all their workers the same insurance premium (as long as they buy the same plan), i.e., they cannot introduce the experience rating to the employer-sponsored health insurance (ESHI) pool.

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significant number of healthy people who are willing to participate. In the employer-based market, an important incentive to participate is provided by tax subsidies, as employer-based premiums are excluded from federal and state taxes. However, these subsidies are costly; the Congressional Budget Office (2015) estimates that in 2013, the total federal cost of the tax exclusion was $250 billion, making it the largest tax expenditures by the federal government and the third largest expenditure on health care after Medicare ($586 billion) and Medicaid and the Children’s Health Insurance Program (CHIP) ($463 billion).³

In this paper, we ask whether it is possible to reduce spending on tax subsidies without destroying the employer-based pool. Our question is motivated by the observation that every participant in the employer-based market receives a tax subsidy, but people have different incentives to participate in this pool. The employer-based pool involves sizeable cross-subsidization from people with low expected medical costs (the young and healthy) to people with high expected medical costs (the old and unhealthy). The former group pays more, and the latter group pays less for their health insurance than they would pay if insurance premiums were adjusted for individual risks. As a consequence, people with high expected medical costs have stronger incentives than people with low expected medical costs to join the pool. Based on this observation, we explore several ways to better target tax subsidies and evaluate the effects of these alternative subsidy schemes on tax expenditures and risk-pooling in the employer-based health insurance market.

Our approach is based on a quantitative heterogeneous agents model developed by Pashchenko and Porapakkarm (2013). The model features medical spending shocks that can be insured through the individual or employer-based markets. An important difference between these two markets is that in the former, premiums are risk-adjusted, whereas in the latter there is community-rating, meaning that healthy and unhealthy people are charged the same premium. People are heterogeneous in their expected medical costs, which creates different incentives to participate in the community-rated market: people with low expected costs may prefer to buy risk-adjusted insurance (or self-insure), while people with high expected costs may prefer to participate in the community-rated pool. The model also captures the differential treatment of health insurance embedded in the tax code: employer-based premiums are excluded from taxable income, while individual market premiums are not. The calibrated model reproduces the key aggregate statistics for the United States, as well as the empirical life-cycle patterns

³ As defined in the Congressional Budget and Impoundment Control Act of 1974, tax expenditures are “revenue losses attributable to provisions of the Federal tax laws which allow a special exclusion, exemption, or deduction from gross income or which provide a special credit, a preferential rate of tax, or a deferral of tax liability” (Sec. 3.3). Tax expenditures usually are calculated with reference to the “normal” tax structure. Joint Committee on Taxation defines the normal structure of the individual income tax as the existing tax rate schedule with several standard deductions and exemptions. Apart from these standard deductions, all other tax benefits (including the tax subsidy for employer-based health insurance) are classified as special provisions (Joint Committee on Taxation, 2015). Thus, tax expenditures are calculated as the difference in tax revenue between the normal tax structure and the tax structure with special provisions.
of employment and insurance coverage constructed based on the Medical Expenditure Panel Survey (MEPS) dataset.

Our findings are as follows. First, we show that if the tax exclusion is replaced with a direct subsidy that is targeted only at people with weak incentives to participate in the employer-based pool, the costs of subsidizing people with employer-based insurance can be decreased by 74 percent without any reduction in risk-sharing. To achieve this outcome, the amount of the direct subsidy should depend on the risk-adjusted premium of each individual. Even higher cost savings can be achieved if premiums in the group market are age-adjusted, i.e., premiums can vary with age (but not with health). Since medical costs increase quickly with age, community rating involves a sizeable cross-subsidization from the young to the old. Therefore, large direct subsidies are needed to motivate young people to participate in this pool. Allowing the premiums to be age-adjusted reduces the size of cross-subsidization inside the pool, thus decreasing the amount of direct subsidies needed to hold the pool together.

Second, using results from the direct subsidy scheme, we explore how to reform the current tax exclusion in order to obtain a similar outcome. We find that the reform that maintains good risk-sharing in the employer-based pool while significantly reducing the tax expenditure consists of two steps: (1) allowing the premiums in the employer-based market to be age-adjusted, and (2) giving tax subsidies only to those participants of the employer-based pool who currently have low medical spending. Under this reform, the spending on the tax subsidy constitutes only a third (34.6 percent) of the amount in the baseline economy and the tax rate decreases by one percentage point, while the take-up rate of the employer-based insurance increases slightly (97.1 percent compared with 94.2 percent in the baseline). In contrast, if tax subsidy is completely eliminated, the take-up rate goes down to 6.3 percent. We repeat the analysis assuming that the health reform described in the Affordable Care Act (ACA) is implemented and find that the proposed tax subsidy reform achieves a similar outcome in terms of the ESHI take-up rate and the reduction in the total tax subsidy costs.

4 Since medical expenditures are persistent, people with low current medical expenses have lower expected expenses; thus, they drive down the average premium in the employer-based market.

5 It is important to draw a parallel between our proposed policy and the ACA: we suggest introducing age-adjusted community rating in the group market while the ACA did the same for the individual insurance market. The question of whether premiums in the individual market should be common for all participants or be allowed to vary by age was debated before the passage of the ACA. One of the rationales for choosing the latter option in the final bill was that expected medical costs (and thus insurance costs) are steeply increasing with age, thus making the young and the old pay the same premium involves considerable cross-subsidization from the former group to the latter. Given that older individuals usually have higher income and have accumulated more assets, this cross-subsidization is not necessarily optimal. The same reasoning applies to our policy proposal. Given that the ACA was passed, we believe that our proposal also is politically feasible. It is also worth stressing the important difference between practices in the United States and in the European countries, since the latter is sometimes used as an argument against the age-adjustment. In most European countries, health insurance is universal and financed by income or payroll taxes. There are no explicit age-adjusted premiums, but, since income increases with age, older people on average pay more into the insurance system.
Finally, our welfare analysis shows that the proposed tax subsidy reform achieves much higher welfare gains if low-income individuals (those with income below 200 percent of the Federal Poverty Line) are also allowed to keep the tax subsidy. This is because the best risk-pooling is achieved when tax subsidies are targeted at low-risk individuals, whereas the best welfare outcomes are achieved when tax subsidies are targeted at low-income individuals.

Several studies examine the effects of reforming the exclusion of health insurance premiums, but none of them investigates the possibilities of targeting the tax subsidy. Gruber (2011) uses a micro-simulation model to evaluate the effect of tax exclusion removal and finds that this reform substantially increases government revenue but significantly decreases insurance coverage. Aizawa and Fang (2015) focus on firms’ decisions to offer health insurance and find that removal of the tax exclusion slightly reduces the number of firms offering employer-based insurance. Our analysis is closest to that of Jeske and Kitao (2009), who address this question using a stochastic aging general equilibrium model featuring individuals who are heterogeneous in their medical expense shocks. They find that eliminating the tax exclusion results in a partial collapse of the employer-based market due to the adverse selection problem. Similar to Jeske and Kitao (2009), we focus on individual decisions related to health insurance but allow for a full life cycle. Because the difference in expected medical expenses between the young and the old is large, the premium in the employer-based market is very sensitive to the age composition of the pool, and thus analyzing the full life-cycle better captures the risk of unraveling of the market.

More generally, we contribute to the literature that examines the implications of government policies related to health and the health insurance market. This literature includes Attanasio, Kitao, and Violante (2011), Hai (2012), Hansen, Hsu, and Lee (2014), Kim (2012), Ozkan (2011), Hsu (2013), St-Amour (2012), and Zhao (2014). We also relate to the literature that studies the life-cycle behavior of individuals in the presence of health uncertainty, such as Capatina (2015), De Nardi, French, and Jones (2010), French and Jones (2011), Kopecky and Koreshkova (2014), and Prados (2012).

The paper is organized as follows. Section II describes a simple model that illustrates the intuition behind our results. Section III introduces the full model. Section IV describes our calibration. Section V evaluates the performance of the baseline model. Section VI describes the results. Section VII concludes.

II. A SIMPLE MODEL

In this section, we construct a simple model to illustrate the intuition behind our results. In this simple framework, we show how different subsidy schemes can be used to keep together an insurance pool of individuals who are heterogeneous in their risks.

Consider a continuum of individuals who differ in their expected medical costs. We denote an actuarial fair insurance price of an individual $i$ by $p_i$. Assume $p_i$ is uniformly distributed over the interval $[0, p_H]$, $p_i \sim F(p)$. If all individuals participate in one insurance pool, the price in this pool will be equal to $\hat{p} = \int_0^{p_H} p dF(p) = p_H / 2$. However, this

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6 We use utilitarian criterion in our welfare analysis.
pool is unstable because individuals with \( p_i < \hat{p} \) want to drop out.\textsuperscript{7} To prevent such an unraveling, we need to introduce subsidies. First, we consider the case in which the size of the subsidy cannot be differentiated, i.e., every individual receives the same subsidy \( s \). To ensure full participation, the subsidy must be equal to \( \hat{p} \) to make an individual with the lowest \( p_i = 0 \) indifferent to staying or leaving, i.e., \( s = \hat{p} \). Total spending on subsidies is

\[
\text{TotSubs}_1 = \int_{0}^{\hat{p}} s \, dF(p) = \frac{p_H^2}{2}.
\]

This is graphically represented by the shaded rectangle in Figure 1 (left panel).

Second, consider the situation in which the size of the subsidy can be differentiated. In this case, each individual receives a subsidy \( s_i = \max \{0, \hat{p} - p_i\} \). Thus, only individuals with \( p_i < \hat{p} \) will receive the subsidy, and the size of the subsidy decreases in \( p_i \). Total spending on subsidies is

\[
\text{TotSubs}_2 = \int_{0}^{\hat{p}} s_i \, dF(p) = \frac{p_H^2}{8}.
\]

This is graphically represented by the shaded triangle in Figure 1 (right panel). Note that the total spending on subsidies can be reduced by a factor of four by taking into account that individuals differ in their incentives to participate in the pool.

To illustrate the importance of pool heterogeneity for subsidy spending, consider another example. Assume that there are two insurance pools instead of one: people with \( p_i < \hat{p} \) participate in the first pool, and people with \( p_i \geq \hat{p} \) participate in the second. The prices in the first pool (\( \hat{p}_1 \)) and in the second pool (\( \hat{p}_2 \)) are equal to \( p_H/4 \) and \( 3p_H/4 \), respectively.\textsuperscript{8}

Consider the total subsidy spending needed to ensure full participation in each pool. If the subsidy is uniform, every individual in the first pool should receive a

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\textsuperscript{7} We assume that individuals are free to buy health insurance at risk-adjusted actuarially fair prices. In our quantitative model, we relax this assumption by introducing a mark-up on individual insurance.

\textsuperscript{8} These prices are determined in the following way: \( \hat{p}_1 = \left[1 / \Pr(p < \hat{p})\right]_0^{\hat{p}} p \, dF(p) = p_H/4 \) and \( \hat{p}_2 = \left[1 / \Pr(p \geq \hat{p})\right]_0^{\hat{p}} p \, dF(p) = (3/4)p_H \).
subsidy equal to \( \hat{p}_1 - 0 = p_{H} / 4 \), and those in the second pool should receive a subsidy equal to \( \hat{p}_2 - \hat{p} = p_{H} / 4 \). Thus, the total spending needed to keep the pools together is \( \text{TotSubs}_3 = (p_{H} / 4) \int_{0}^{\hat{p}} dF(p) + (p_{H} / 4) \int_{\hat{p}}^{\hat{p}_2} dF(p) = \left( p_{H}^2 / 4 \right) \). This is graphically represented by the two small shaded rectangles in Figure 2 (left panel).

In the case of the differentiated subsidy, people in the first pool receive a subsidy equal to \( s_1^1 = \max \left\{ 0, \hat{p}_1 - p_i \right\} \) and people in the second pool receive a subsidy equal to \( s_1^2 = \max \left\{ 0, \hat{p}_2 - p_i \right\} \). Total spending on subsidies is equal to \( \text{TotSubs}_4 = \int_{0}^{\hat{p}} s_1^1 dF(p) + \int_{\hat{p}}^{\hat{p}_2} s_1^2 dF(p) = \left( p_{H}^2 / 16 \right) \). This is graphically represented by the two shaded triangles in Figure 2 (right panel).

From the above illustration there are two important points to note. First, moving from the uniform to differentiated subsidy can substantially reduce the total spending needed to ensure the full participation in the pool. These savings arise from withdrawing subsidies from people who are willing to participate even when they are not subsidized, i.e., people with \( p_i > \hat{p} \). Second, it is much cheaper to ensure full participation if there are two smaller insurance pools instead of one large pool. This is because in the two smaller pools people are less heterogeneous in their risks; thus, the size of cross-subsidization from low risk to high risk is smaller. In particular, in the one large pool, the difference in risk-adjusted premiums between the highest and the lowest risks is \( p_{H} \), whereas in the two smaller pools, it is \( \hat{p} - 0 = p_{H} - p = p_{H} / 2 \). Therefore, a smaller direct subsidy is needed to make low-risk individuals willing to cross-subsidize high-risk individuals.\(^9\)

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\(^9\) Note that as the number of pools keeps increasing, the size of the subsidies required to keep the pools together decreases, but the amount of risk-sharing achieved in each pool decreases as well. As the number of pools approaches the number of people, everyone simply faces a risk-adjusted price.
III. BASELINE MODEL

The model described in this section is developed by Pashchenko and Porapakkarm (2013). Here and in Section IV, we outline the main features of the model and its calibration; we refer the reader to Pashchenko and Porapakkarm (2013) for a more detailed description.

A. Households

1. Demographics and Preferences

The economy is populated by overlapping generations of individuals. An individual lives a maximum of $N$ periods. During the first $R - 1$ periods of life, an individual can choose whether to work; at age $R$, all individuals retire. The labor supply decision of a household is denoted by $l_t$, $l_t \in \{0, l\}$. Agents differ in their educational attainment $e$. Educational attainment can take two values: $e = 1$ corresponds to the absence of any degree, whereas $e = 2$ corresponds to at least a high-school degree.

Each agent is endowed with one unit of time that can be used for either leisure or work. There is a fixed cost of work $\phi_{t,e}$, which is treated as a loss of leisure. Thus, a working individual’s leisure time can be expressed as $1 - l - \phi_{t,e}$. The fixed cost of work depends on age ($t$) and education ($e$). In addition, individuals in bad health incur higher costs of work: $\phi_{t,e} = \phi_{1}(t,e) + \phi_{2}(t,e)1_{\text{health=bad}}$, where $1_{\text{health=bad}}$ is an indicator function mapping to one if its argument is true, and $\phi_{1}(t,e)$ and $\phi_{2}(t,e)$ are non-negative functions. Earnings are equal to $\hat{w}z_{t,e,x}l_{t}$, where $\hat{w}$ is wage and $z_{t,e,x}$ is idiosyncratic productivity that depends on the educational level ($e$), age ($t$), and medical expenses ($x_t$) of an individual.

The preferences over consumption and leisure are assumed to take Cobb-Douglas form $u(c_t, l_t) = \left\{c_t^{\phi}(1 - l - \phi_{t,e}1_{[t>0]})^{1 - \phi}\right\}^{1/(1 - \sigma)}$, where $\chi$ is a parameter that determines the relative importance of consumption, and $\sigma$ is the risk-aversion over the consumption-leisure composite. Agents discount the future at the rate $\beta$ and survive until the next period with conditional probability $\zeta_t$, which depends on age and health. The savings (net of out-of-pocket medical expenses) of each household that does not survive are equally allocated among all survived agents of a working age within the same educational group. The population grows at the rate $\eta$.

2. Health Expenditures and Health Insurance

In each period an agent faces a stochastic medical expenditure shock $x_t$, which evolves according to a five-state discrete Markov process $G(x_{t+1}|x_t, t)$. More specifically, $x_t = 1$ corresponds to the average spending at the bottom 30 percent of the medical expense distribution at age $t$, $x_t = 2,3,4$, correspond to the average spending among 30th–60th,
60th–90th, and 90th–99th percentiles respectively, and \(x_t = 5\) corresponds to the average spending of people at the top 1 percent of the distribution at age \(t\).\(^\text{10}\) Individuals are categorized into two groups based on their medical expenses. Individuals with low medical expenses (\(x_t \leq x_t^c\)) are referred to as “healthy” or “people in good health,” whereas individuals with high medical expenses (\(x_t > x_t^c\)) are referred to as “unhealthy” or “people in bad health.” Here, \(x_t^c\) is a threshold separating people into these two groups and corresponds to the 90th percentile of the medical spending distribution.\(^\text{11}\)

Every working age individual 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 the agent’s current medical shock and age and is denoted by \(p_I(x_t, t)\).

In each period, with some probability \(\text{Prob}_t\), an agent of working age receives 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 in the employer-based pool are charged the same premium \(p\) regardless of their current medical expenses and age. The employer pays a fraction \(\psi\) of this premium. If the worker chooses to buy group insurance, he only pays \(\tilde{p}\) where \(\tilde{p} = (1 - \psi)p\).

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 threshold \(y_{\text{cut}}\). Second, an individual can become eligible through the Medically Needy program. This happens if an individual’s total income minus medical expenses is below threshold \(y_{\text{med}}\), and assets are less than the limit \(k_{\text{pub}}\).

Current health insurance status is denoted by \(i_t: i_t = 0\) if an individual is uninsured, \(i_t = 1\) if insured by Medicaid, and \(i_t = 2\) if privately insured. All types of insurance contracts (group, individual, and public) provide only partial insurance against medical expenditure shocks. The fraction of medical expenditures covered by the insurance contract is denoted by \(q(x_t, i_t)\). This fraction is a function of medical expenditures and the type of insurance of a household.

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

### 3. Taxation and Social Transfers

All households pay an income tax that consists of two parts: a progressive tax denoted by \(T(y_t)\) and a proportional tax denoted by \(\tau_y\).\(^\text{12}\) Taxable income \(y_t\) is based on both labor and capital income. Working households also pay payroll taxes, namely, the Medicare.


\(^{11}\) In the data, the fraction of workers among people with high medical expenses (the top 10 percent of the distribution of each age) is much lower than this fraction among people with low medical expenses. We use health category defined in the text to capture this observation when we estimate the preference parameters \(\varphi_{x_t}\).

\(^{12}\) The progressive part \(T(y_t)\) approximates the actual income tax schedule in the United States, whereas the proportional tax represents all other taxes that are not modeled explicitly.
tax ($\tau_{med}$) and the Social Security tax ($\tau_{SS}$). The Social Security tax rate for earnings above $y^c$ is zero. The U.S. tax code allows each household to subtract out-of-pocket medical expenditures that exceed 7.5 percent of their income when taxable income is calculated. In addition, the ESHI premium ($\bar{p}$) is excluded from taxable income for both income and payroll taxes. Consumption is taxed at a proportional rate $\tau_c$.

There is also a public safety-net program, $T^{SL}_t$, which guarantees that every household will have a minimum consumption level at $c_{min}$. This reflects that U.S. households with a bad combination of income and medical shocks can rely on public transfer programs such as food stamps, Supplemental Security Income, and uncompensated care. Retired households receive Social Security benefits $ss_t$ that depend on educational attainment $e$.

4. Problem of Working-Age Households ($t < R$)

The state variables for the working age household’s optimization problem are capital ($k_t \in K = \mathbb{R}^+ \cup \{0\}$), medical cost shock ($x_t \in X = \mathbb{R}^+ \cup \{0\}$), idiosyncratic labor productivity ($z^{ex}_t \in Z = \mathbb{R}^+$), ESHI offer status ($g_t \in G = \{0,1\}$), health insurance status ($i_t \in I = \{0,1,2\}$), educational attainment ($e \in E = \{1,2\}$), 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 an individual is eligible for Medicaid, he can receive free public insurance ($M$). If he works in a firm offering ESHI, he can buy group insurance ($G$). In addition, everyone can choose to be uninsured ($U$) or buy individual insurance ($I$). These choices can be summarized as follows. If an individual is eligible for Medicaid

$$i^1_H = \begin{cases} \{M, I, G\}; & \text{if } g_t = 1 \text{ and } l_t > 0 \\ \{M, I\}; & \text{if } g_t = 0 \text{ or } l_t = 0 \end{cases}$$

otherwise,

$$i^2_H = \begin{cases} \{U, I, G\}; & \text{if } g_t = 1 \text{ and } l_t > 0 \\ \{U, I\}; & \text{if } g_t = 0 \text{ or } l_t = 0 \end{cases}$$

The value function of a working-age individual is

$$V_{t,e}(k_t, x_t, z^{ex}_t, g_t, i_t) = \max_{k_{t+1}, x_{t+1}} u(c_t, l_t) + \beta \mathbb{E}_t \left[ V_{t+1,e}(k_{t+1}, x_{t+1}, z^{ex}_{t+1}, g_{t+1}, i_{t+1}) \right],$$

subject to

$$k_t (1+r) + \tilde{w} z^{ex}_t l_t + T^{SL}_t + Beq_e = (1 + \tau_c) c_t + k_{t+1} + x_t \left(1 - q(x_t, i_t)\right) + P_t + Tax,$$

$$\tilde{w} = \begin{cases} w; & \text{if } g_t = 0 \\ (w - c_E); & \text{if } g_t = 1 \end{cases}.$$
An individual is eligible for Medicaid if \( y_{t,\text{tot}} \leq y_{\text{cat}} \) or \( y_{t,\text{tot}} - x_{t} (1 - q(x_{t}, i_{t})) \leq y_{\text{need}} \) and \( k_{i} \leq k_{\text{pub}} \), where \( y_{t,\text{tot}} = rk_{i} + \tilde{w}z_{t}^{e,x}l_{i} - \bar{p}1_{\{i_{0}=G\}} - 0.075(\tilde{w}z_{t}^{e,x}l_{i} + rk_{i}) \), and

The conditional expectation on the right-hand side of (3) is over \( \left(x_{t+1}, z_{t+1}, e_{t+1}\right) \), (4) is the budget constraint, and \( Beq_{e} \) is an accidental bequest. In (5), \( w \) is wage per effective labor unit. If the household has ESHI coverage, the employer pays part of the insurance premium. The employer that offers ESHI passes these costs onto the employees by deducting an amount \( c_{\text{E}} \) from the wage per effective labor unit, as shown in (5).

Equation (7) maps the current health insurance (HI) choice into the next period HI status. In (8), the first two terms are income taxes, and the last two terms are payroll taxes. Note that contributions by both the employer and employee toward the ESHI premium are excluded from the taxable income.

5. Problem of Retired Households

For a retired household \((t \geq R)\), the state variables are capital \((k_{i})\), medical expenses shock \((x_{i})\), educational attainment \((e)\), and age \((t)\).

\[
V_{t,e}\left(k_{t}, x_{t}\right) = \max_{k_{t+1}, e_{t+1}} u\left(c_{t}, 0\right) + \beta \zeta_{t} E_{t} V_{t+1,e}\left(k_{t+1}, x_{t+1}\right),
\]

There is evidence that firms shift the costs of employer’s contributions to their workers. Gruber (1994) finds that wages of women of childbearing ages decreased after maternity benefits became a mandatory part of employer-based health insurance.

The problem of a newly retired household is slightly different since it is still under insurance coverage from the previous period, so \( i_{t} \) is also a state variable and out-of-pocket medical expenses are \( x_{t}(1 - q(x_{t}, i_{t})) \).
subject to

\[ k_i (1+r) + ss_e + T_{si} = (1 + \tau_e)c_i + k_{i+1} + x_i (1 - q_{med}) + p_{med} + Tax, \]

\[ Tax = T_y y_i + \tau_p y_p, \]

\[ y_i = rk_i + ss_e - \max \left( 0, x_i (1 - q_{med}) - 0.075 (ss_e + rk_i) \right), \]

and

\[ T_{si} = \max \left( 0, (1 + \tau_e)c_{min} + x_i (1 - q_{med}) + Tax + p_{med} - ss_e - k_i (1+r) \right). \]

6. Distribution of Households

To simplify the notation, let \( S \) define the space of a household’s state variables, where \( S = K \times Z \times X \times G \times I \times E \times T \) for working-age households and \( S = K \times X \times E \times T \) for retired households. Let \( s \in S \), and denote by \( \Gamma(s) \) the distribution of households over the state-space.

B. Production Sector

There are two representative firms that act competitively. Their production functions are Cobb-Douglas, \( AK^\alpha L^{1-\alpha} \), where \( K \) and \( L \) are aggregate capital and aggregate labor and \( A \) is total factor productivity. The first firm offers ESHI to its workers, but the second one does not. Under competitive behavior, the wage paid by the second firm equals the marginal product of labor. Because 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, factor prices are determined as

\[ w = (1 - \alpha) AK^\alpha L^{-\alpha}, \]

(12)

\[ r = \alpha AK^{\alpha-1} L^{1-\alpha} - \delta, \]

(13)

where \( \delta \) is the depreciation rate.

The first firm must partially finance the health insurance premium for its employees. The cost is passed on to its employees through a wage reduction. The first firm subtracts an amount \( c_E \) from the marginal product per effective labor unit. The zero profit condition implies

\[ c_E = -\frac{\varphi p \left( \int \int \mathbb{1}_{[w(s) = c]} \Gamma(s) \right)}{\int \int \mathbb{1}_{[s(x) = 1]} \Gamma(s)}. \]

(14)

The numerator is the total contribution toward insurance premiums paid by the first firm. The denominator is the total effective labor working in the first firm.

C. Insurance Sector

Health insurance companies in both private and group markets act competitively. The insurers can observe all state variables that determine the expected medical expenses
Based on this assumption and the zero profit conditions, insurance premiums are

\[ p_t(x,t) = (1+r)^{-1} \gamma EM(x,t) + \pi \]

for the non-group insurance market and

\[ p = (1+r)^{-1} \frac{\gamma \left( \int_{\{i_0(s) = G\}} EM(x,t) \Gamma(s) \right)}{\int_{\{i_0(s) = G\}} \Gamma(s)} \]

for the group insurance market. In (15)-(16), \( EM(x,t) \) is the expected medical cost of an individual of age \( t \) with current medical costs \( x_t \) that will be covered by the insurance company

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

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

### D. Government Constraint

The government runs a balanced budget, which implies

\[ \int [Tax(s) + \tau_e c(s)] \Gamma(s) - G = \int \left[ SS_e + q_{med} x_t - p_{med} \right] \Gamma(s) + \int T_s \Gamma(s) \]

\[ + \int_{t \in R} 1_{\{i_0 = U\}} q(x_t, 1) x_t \Gamma(s). \]

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

---

15 We assume that an insurance company in the individual market can observe all state variables relevant to the pricing of insurance, i.e., there is no asymmetric information. Before the ACA reform, in most states, insurance companies were allowed to underwrite an individual insurance policy. Moreover, individuals who got seriously ill shortly after obtaining a policy could be subject to ex-post underwriting that could result in their policy being retroactively canceled if it turned out that they had concealed some information about their health.

16 Fixed costs capture the difference in overhead costs for individual and group policies, such as marketing and underwriting costs.
IV. DATA AND CALIBRATION

The model is calibrated using nine waves of the Medical Expenditure Panel Survey (MEPS) dataset from 1999 to 2008. The MEPS links people into one household based on their 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 were computed for the head of the HIEU. The head is defined as the male with the highest income in the HIEU. If the HIEU does not have a male member, the female with the highest income is assigned as its head. All statistics were computed using the longitudinal weights provided in the MEPS. Because each wave represents the population each year, the weight of each individual was divided by nine in the pooled sample.

The sample used for calibration includes all household heads who are at least 24 years old and have non-negative labor income (to be defined later). All level variables were converted into the price level of year 2002 (our base year) using the Consumer Price Index (CPI).

In the model, agents are born at age 25, retire at age 65, and can live to a maximum age 99. The model period is one year. We describe the calibration of the model in online Appendix A. The parameterization of the baseline model is summarized in online Appendix Tables A1 and A2.

V. BASELINE MODEL PERFORMANCE

Table 1 compares the aggregate health insurance statistics generated by the model with those observed in the data. The model was calibrated to match the ESHI take-up rates and individual insurance rates.\(^{17}\) However, the model also produces fractions of

<table>
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<th>Table 1</th>
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<tr>
<td><strong>Insurance Statistics: Data and Model, Percent</strong></td>
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<tr>
<td>Insured by ESHI</td>
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<tr>
<td>Individually insured</td>
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<tr>
<td>Uninsured</td>
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<tr>
<td>Publicly insured</td>
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<tr>
<td>ESHI take-up rate</td>
</tr>
<tr>
<td>Offer rate</td>
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<tr>
<td>Group premium/avg. income</td>
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</table>

\(^{17}\) In this paper, we use the term “take-up rate” only in relation to the employer-based market, and define it as the fraction of people among those with an ESHI offer who choose to buy group insurance.
the uninsured and the publicly insured that approximate the data. The last four columns of Table 1 show insurance statistics by educational groups. The model does not target any of these statistics, but it still fares well along these dimensions. For each educational group, the model also closely tracks the employment and insurance profiles over the life cycle for each health group (see Pashchenko and Porapakkarm (2013) for corresponding graphs).

In this paper, we study the possible consequences of reform of the tax exclusion of health insurance premiums, so it is important that the model captures the price elasticity of demand for group health insurance. To compute price elasticity in the model, we consider how much the take-up rate changes in response to changes in the ESHI premium and then compute the implied elasticity.\footnote{The elasticity is equal to $100\% \times \frac{(\Delta \text{Takeup} / \text{Takeup})}{(\Delta \text{Premium} / \text{Premium})}$.} We find that the price elasticity in the model is non-linear, i.e., its magnitude depends on how much we change the ESHI premium compared with the baseline case. To make our elasticity comparable to micro estimates, we construct experiments in which we change the premium in the same way as in the studies we consider. More specifically, Chernew, Frick, and McLaughlin (1997) simulate the change in the take-up rate in response to a 50 percent subsidy to the out-of-pocket ESHI premium, and their implied elasticity is $-0.072$. Based on the same change in the premium, the model produces an elasticity of $-0.11$.\footnote{In all our experiments, we consider a partial equilibrium environment, i.e., we do not allow the change in the composition of the ESHI pool to have feedback effects on premiums. We do this to be consistent with the way the micro studies we consider construct their elasticities.} Gruber and Washington (2005) estimate the sensitivity of the ESHI take-up rate to the share of after-tax employee costs in total premiums.\footnote{This share is defined as $\frac{\text{Employee's contribution} - \text{Tax savings}}{\text{Total premium}}$, where tax savings is the reduction in tax liability resulting from the tax exclusion of the ESHI premium.} They consider the introduction of tax exclusions of employee’s contributions for federal employees and find an elasticity equal to $-0.02$. The policy episode they consider is equivalent to lowering the share of the employee contribution by approximately 10 percent. Constructing an equivalent experiment, we find the elasticity of the take-up rate with respect to the after-tax share of employee premium to be equal to $-0.08$. Overall, the elasticities produced by the model are broadly consistent with existing micro estimates.

**VI. RESULTS**

This section is organized as follows. In Section VI.A, we illustrate the role of the existing tax subsidies in preventing the ESHI pool from unraveling. Next, in Section VI.B, we construct the following policy experiment: instead of the current tax exclusion, we introduce an individually-adjusted direct subsidy that only goes to individuals who will leave the pool if not subsidized. The subsidy in this experiment is comparable with the simple example in Section II. Our main goal in constructing this experiment is to understand how the ESHI take-up and total subsidy spending change compared with the baseline economy. In Section VI.C, we propose a reform of the current tax subsidy
that aims to mimic the allocation of transfers, as in the case of individually-adjusted direct subsidies. The effects of this tax subsidy reform after the implementation of the Affordable Care Act (ACA) are discussed in Section VI.D. Finally, we discuss the welfare effects of this reform in Section VI.E.

A. The Role of the Tax Exclusion in Keeping the ESHI Pool Together

To understand the role of the current tax subsidies in keeping the ESHI pool together, we consider an experiment in which the ESHI premium is not excluded from taxable income. In this case, total taxable income in (9) is

\[ y_i^{ND} = r_k + \bar{w}z_i^{c,x}l_i + \psi p1_{\{i_u=G\}} - \max\left(0, x_i \left(1 - q\left(x_i, i_i\right)\right) - 0.075\left(\bar{w}z_i^{c,x}l_i + r_k\right)\right). \]

The total amount of tax is

\[ \text{Tax}^{ND} = T\left(y_i^{ND}\right) + \tau_y y_i^{ND} + \tau_{med} \left(\bar{w}z_i^{c,x}l_i + \psi p1_{\{i_u=G\}}\right) + \tau_{ss} \min\left(\bar{w}z_i^{c,x}l_i + \psi p1_{\{i_u=G\}}, y_i^{c}\right). \]

Note that compared with (8) and (9), people who buy ESHI now must count both the employee’s and employer’s contributions as a part of their taxable income. For people who do not buy ESHI, the tax code remains the same.

The first row of Table 2 shows that the elimination of the tax exclusion of health insurance premiums results in the unraveling of the employer-based market: the take-up rate drops from 94.2 to 63.3 percent. At the same time, the uninsured rate increases to 62.4 percent (Row 1 of Table 3). This suggests that tax subsidies are important to maintaining good risk-sharing in the employer-based pool.

<table>
<thead>
<tr>
<th>Table 2</th>
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<tr>
<td>The Effect of Direct Differentiated Tax Subsidy: The ESHI and Subsidies</td>
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<tr>
<td>Baseline</td>
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<td>No tax subsidy</td>
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<tr>
<td>Differentiated subsidy</td>
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<tr>
<td>Differentiated subsidy+age-adjusted CR</td>
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</table>

Notes: LE (HE) denotes groups with low (high) education. BS denotes the baseline. CR denotes community rating.
It is also important to note that there is some evidence that the adverse selection pressure in community rated markets (especially with voluntary participation) is significant. The first piece of evidence comes from a policy episode in the early 1990s, when several states in the United States introduced community rating regulations in the individual health insurance market. Clemens (2012) finds that these restrictions significantly decreased health insurance coverage and that this decline in coverage escalated over several years, which is consistent with the adverse selection spiral scenario. Moreover, Clemens finds that the market unraveling stopped once states with the community rating started expanding Medicaid. This happened because many unhealthy individuals switched from private to public insurance, resulting in better average health among the remaining participants of the individual market.

The second piece of evidence comes from episodes of adverse selection against a specific health insurance plan in the employer-based market. A notable case of complete unraveling happened in the mid-1990s at Harvard University (for a full description see Cutler and Zeckhauser, 1998). Harvard offered two insurance plans that significantly differed in their generosity but initially cost almost the same to employees. In the mid-1990s, the premiums of the two plans diverged, which triggered the adverse selection spiral: more healthy people were choosing the cheaper but less generous plan, resulting in worse risk composition among those purchasing the more generous plan, which increased its premium. This trend reinforced itself every year and eventually the generous plan was abandoned.

It is important to compare our results in Table 2 with those of Jeske and Kitao (2009), who also study the effects of the removal of the tax subsidy in the employer-based market. They find that elimination of the tax exclusion results in a less dramatic unraveling of the ESHI market; the take-up rate in their model decreases by approximately 36 percent. The key difference between our modeling approach and theirs is that we construct a full life-cycle model. In contrast, Jeske and Kitao (2009) use a stochastic aging framework, under which individuals can be either young or old. Only young individuals can work

<table>
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<tr>
<th>Employment (Percent)</th>
<th>Insurance (Percent)</th>
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<tbody>
<tr>
<td>All</td>
<td>LE</td>
</tr>
<tr>
<td>Baseline</td>
<td>89.7</td>
</tr>
<tr>
<td>No tax subsidy</td>
<td>86.9</td>
</tr>
<tr>
<td>Differentiated subsidy</td>
<td>88.8</td>
</tr>
<tr>
<td>Differentiated subsidy+age-adjusted CR</td>
<td>88.6</td>
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Notes: LE (HE) denotes groups with low (high) education. BS denotes the baseline. CR denotes community rating.
and participate in the employer-based pool whereas all old individuals are retired and covered by Medicare, so that the only difference in the risk of participants in the ESHI pool is due to health. In our model, participants in the ESHI pool differ not only by health but also by age. Average medical spending increases quickly with age, meaning that cross-subsidization between the young and the old is substantial. Our simple model in Section II shows that it is more difficult to keep a pool together as its heterogeneity increases. Because having people of different ages in the ESHI pool makes it much more heterogeneous, the removal of the tax subsidy results in greater exit from the pool and thus a stronger adverse selection spiral.

To provide the intuition behind our result of the unraveling of the ESHI market, Figure 3 compares the risk-adjusted premiums in the individual market with the out-of-pocket costs of ESHI in the baseline economy. The out-of-pocket costs of ESHI ($p_{OOP}$) are defined as $p_{OOP} = p(1 - \psi) + \Delta Tax$, where $p(1 - \psi)$ is the employee’s contribution and $\Delta Tax$ is the difference in tax payments resulting from the purchase of ESHI, $\Delta Tax = Tax^{i \neq G} - Tax^{i \neq G}$. If the ESHI premium is excluded from taxable income, an individual can save on taxes by buying employer-based insurance, i.e., $\Delta Tax < 0$. If the

![Figure 3](image-url)

**Figure 3**

Individual Premiums by Medical Grids and Average Out-of-Pocket Costs of ESHI

Note: Premiums are normalized by the average GDP per capita.
tax exclusion is removed, an individual buying ESHI must pay additional taxes because the employer’s contributions are now counted as taxable income, i.e., $\Delta Tax > 0$.

The difference between out-of-pocket ESHI costs with and without the tax exclusion is large enough to trigger the adverse selection spiral. As shown in Figure 3, for young people in the two lowest medical expenses grids (i.e., with medical expenses less than the 60th percentile), the out-of-pocket costs of ESHI exceed their risk-adjusted prices in the individual market after the tax subsidy is removed.\(^{21}\) These individuals initiate the unraveling by dropping out of the employer-based market, which leads to an increase in the ESHI premium and a further unraveling of the pool.

Another observation from Figure 3 is that for older people and people in the high medical costs grids ($x_t = 3,4,5$), the out-of-pocket costs of ESHI are substantially lower than their risk-adjusted individual premiums even when the tax exclusion is removed. These people enjoy large implicit cross-subsidies from individuals with low expected medical costs and have incentives to buy ESHI even without tax subsidies. Figure 4 illustrates this point further by showing the markup that individuals with different expected medical costs face in the ESHI pool. The markup is measured as the percentage difference between the risk-adjusted price in the individual market and the out-of-pocket costs of ESI.\(^{22}\) A negative markup means that an individual is overpaying compared with his risk-adjusted price, thus cross-subsidizing other participants in the pool, whereas a positive markup means that an individual is cross-subsidized. The solid lines in Figure 4 show that community rating imposes a large burden on healthy people younger than age 35 — their markup can be as high as $-250$ percent. In contrast, people over age 60 with bad health enjoy a discount of approximately 90 percent of their risk-adjusted price when they participate in the group market. We will explore the possibilities of designing subsidies that take this cross-subsidization into account in the next section.

Another important observation from Table 3 is that the elimination of the tax subsidy leads to a significant decrease in employment: the percentage of the working population decreases from 89.7 percent in the baseline economy to 86.9 percent in the economy without the tax subsidy. This happens because in the economy without the tax subsidy, the employer-based market unravels. ESHI is an important part of compensation for many people, and its elimination decreases their incentives to work. Feng and Zhao (2014) explore the interaction between labor supply and ESHI in detail and find that health insurance provides an important work incentive. French and Jones (2011) show that employer-based health insurance has significant effects on retirement decisions.\(^{23}\)

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\(^{21}\) When constructing Figure 3, the premium used to compute $p^{OOP}$ after removing the tax exclusion is fixed as in the baseline. After the unraveling starts, this price will substantially increase.

\(^{22}\) More specifically, the markup is computed as $100\% \times \left[ p_t(x,t) - p^{OOP}_t \right] / \left[ p_t(x,t) \right]$.

\(^{23}\) It is important to point out that the negative effect of the elimination of ESHI on labor supply happens despite the fact that the costs of employer’s contributions are fully shifted back to employees. This is because for some individuals (especially the old and unhealthy), health insurance is worth more than the offset in their wage. Elimination of employer-based insurance decreases their incentives to work despite the increase in earnings because the total value of their compensation decreases.
B. The Effects of Direct Differentiated Subsidies

In this section, we consider an alternative subsidy scheme that only targets people with weak incentives to participate in the ESHI pool. More specifically, we remove the tax exclusion of the ESHI premium and replace it with a direct differentiated subsidy. This subsidy compensates people with low expected medical costs more because, in the pool, they cross-subsidize people with high expected medical costs. The subsidy is determined as \( subs_i = \max\{0, p_{OOP} - EM(x, t)/(1 + r)\} \). An individual with a positive subsidy receives the difference between his actuarially fair price, \( EM(x, t)/(1 + r) \), and...
his out-of-pocket costs of ESHI, $p^{OOP}$. Note that only individuals who are likely to leave the pool if they are not subsidized receive a positive subsidy.

The results of the implementation of this subsidy scheme are presented in the second row of Table 2. Differentiation of the subsidy results in a small decrease in the take-up rate from 94.2 to 85.4 percent.\textsuperscript{24} At the same time, total spending on direct subsidies represents only 26.4 percent of the tax expenditures used to keep the ESHI pool together in the baseline economy.\textsuperscript{25} In other words, removing the subsidy from those who have already been cross-subsidized in the pool results in almost the same level of risk-sharing at \textit{one-fourth} of the costs.

The left panel of Figure 5 illustrates how the size of the subsidy varies by age and health. Not surprisingly, people who receive the highest subsidies are those younger than age 35 and in the lowest medical cost grid (with medical expenses in the bottom 30\textsuperscript{th} percentile of the distribution for each age). These people have the lowest expected medical expenses and are the most disadvantaged group in the employer-based pool (see the top left panel of Figure 4); therefore, they should receive the highest compensation. It is important to note that people over age 55 and those in medical cost grids 4 and 5 (with medical expenses in the top 10 percent of the distribution for each age) never get subsidized yet still remain in the pool. This suggests the inefficiency of uniform subsidization.

The left panel of Figure 5 illustrates that young healthy people are the most “costly” participants in the community-rated pool because they have to be highly subsidized to stay in the pool. This happens because all people face the same premium under uniform community rating. Because expected medical costs increase steeply with age, this implies a large cross-subsidization from the young to the old. The whole system of transfers inside this pool can be summarized as follows: the young cross-subsidize the old, and the government directly subsidizes the young so they will stay in the pool. In contrast, if community rating in the ESHI market is age-adjusted, there will be no cross-subsidization from the young to the old but only from the healthy to the unhealthy. Because the difference in expected medical costs between healthy and unhealthy individuals of the same age is smaller than the difference in costs between the healthy young and the unhealthy old, age-adjusted pools imply less cross-subsidization; thus, smaller direct subsidies are needed to maintain a high participation rate in the pool.

In the next experiment, we consider the above differentiated subsidy scheme when we introduce an age-adjusted community rating in the group market, i.e., we allow the ESHI premium to depend on age (but not on the current medical costs) of an individual. Thus, the ESHI premium in (16) is replaced by an age-dependent premium, or

$$p(i) = (1+r)^{-1} \gamma \left[ \int_{i=1}^{\infty} \frac{1}{\{x_i(t)=G\}} EM(x_i(t)) \Gamma(s) \right] / \left[ \int_{i=1}^{\infty} \frac{1}{\{x_i(t)=G\}} \Gamma(s) \right].$$

\textsuperscript{24} Note that not all individuals are willing to buy health insurance, even at actuarially fair prices, because health insurance covers only part of medical costs. At the same time, uninsured individuals can rely on government means-tested transfers provided through the consumption minimum floor. Pashchenko and Porapakkarn (2015) illustrate the effect of the consumption floor on insurance demand in more detail.

\textsuperscript{25} In the baseline economy, the costs to keep the pool together represent the tax revenue foregone because of the tax exclusion and equal $[\text{Tax}^{ND}(s) - \text{Tax}(s)]\Gamma(s)$. In the economy with the differentiated subsidy scheme, these costs equal direct subsidy spending.
The third row in Table 2 shows that the implementation of the differentiated subsidy together with age-adjusted community rating results in a take-up rate equal to 90.0 percent (compared with 94.2 percent in the baseline). Importantly, total spending on subsidies now represents only 16.2 percent of tax expenditures in the baseline economy. In other words, when cross-subsidization along the dimension of age is removed, it is much cheaper to maintain good risk-sharing in the employer-based market. The dashed lines in Figure 4 show that the markup young people face under age-adjusted community rating is much lower than that under the uniform community rating. As the right panel of Figure 5 illustrates, only people in the lowest medical cost grid (those with medical expenses in the bottom 30th percentile for each age) can receive a direct subsidy. The amount of this subsidy increases with age because the expected medical expenses of people in the first medical cost grid increase much more slowly with age than average medical expenses. As they age, people who stay in the lowest medical cost grid need higher compensation to agree to pool their risks with people in higher medical cost grids.

**C. Reform of the Current Tax Exclusion of ESHI Premiums**

The previous section illustrates that we can use direct differentiated subsidies to maintain good risk-sharing in the employer-based pool at relatively low costs. In this section, we investigate whether the current tax subsidy can be modified to achieve a similar outcome. Tax exclusion is a less flexible instrument than direct subsidy. However, one result from the previous section that can still be applied is that only people with weak incentives to participate in the ESHI pool should be subsidized. To mimic this result, we consider a tax subsidy reform that targets only people who receive the direct

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**Figure 5**

Direct Differentiated Subsidies: One Pool (Left Panel) and Age Pool (Right Panel)

Notes: On the left panel, the lines for medical cost grids 3, 4, and 5 lie on the horizontal axis. On the right panel, the lines for medical cost grids 2, 3, 4, and 5 lie on the horizontal axis. Subsidies are normalized by the average GDP per capita.
subsidy in the experiment described in Section VI.B. At the same time, we remove the tax exclusion from people who do not receive any direct subsidy.\textsuperscript{26}

The left panel of Figure 5 illustrates that in the direct differentiated subsidy scheme, two groups are subsidized: people in the lowest medical expense grid (with medical expenses in the bottom 30\textsuperscript{th} percentile for each age) and younger than age 55, and people in the second lowest medical expense grid (with medical expense above the 30\textsuperscript{th} percentile but below the 60\textsuperscript{th} percentile) and younger than age 43. To imitate these results, we consider a policy under which only these two groups are allowed to keep the tax exclusion. The second row of Table 4 illustrates the effect of this reform (Table A3 in Appendix B shows the effect on employment and insurance status). Allowing young and healthy people to keep the tax exclusion prevents the ESHI pool from unraveling; the take-up rate is 92.5 percent, which is only 2 percentage points lower than in the baseline. At the same time, the costs of the tax subsidy go down more than twofold compared with the baseline level (43.9 percent).\textsuperscript{27} Note that even though these savings are considerable, they are not as high as in the case of direct differentiated subsidies. This happens because the size of the tax subsidy (unlike the size of the direct subsidy) cannot be adjusted for individual risks. The left panel of Figure 5 shows that the size of the direct subsidy decreases steeply with age, and this represents a significant source of savings because older people need fewer incentives to join the pool.

The results in Section VI.B demonstrate that a high participation rate in the ESHI pool can be achieved at significantly lower costs if community rating in the ESHI market is age-adjusted. In the next experiment, we introduce age-adjusted premiums in the ESHI market. At the same time, we allow only people in the lowest medical expense grid (with medical expense in the bottom 30\textsuperscript{th} percentile) to keep the tax exclusion because only this group receives direct subsidies in this case, as shown in the right panel of Figure 5. Row 3 of Table 4 shows that this reform results in the take-up rate being slightly higher than the baseline level (97.1 percent). At the same time, the costs of these tax subsidies represent only one-third (34.6 percent) of the baseline level.

D. Elimination of the Tax Exclusion after the ACA

This section considers the effects of our proposed tax exclusion reform after the implementation of the ACA. The main changes that the ACA introduces to the economy are as follows. First, there is age-adjusted community rating in the individual market, meaning that premiums can depend only on age but not on the health conditions of individuals. Second, low-income individuals receive subsidies to buy health insurance in the individual market, with the subsidy based on a sliding income scale. People with income below 133 percent of the Federal Poverty Line (FPL) receive the highest subsidy,

\textsuperscript{26} In this experiment, taxable income and tax payments are determined according to (8) and (9) for the ESHI participants that are allowed to keep the tax exclusion, and according to (18) and (19) for the rest of the ESHI participants.

\textsuperscript{27} In each experiment considered in Tables 4 and 5, we evaluate the total subsidy spending (or forgone tax revenue) from $\int [\text{Tax}^{\text{ND}}(s) - \text{Tax}(s)] \Gamma(s)$, where the tax parameters are the equilibrium tax rate in that economy. Note that for individuals who are not allowed to keep the tax exclusion, $\text{Tax}^{\text{ND}} = \text{Tax}.$
but people with income above 400 percent of FPL do not receive any subsidy. Third, the income eligibility threshold for the general Medicaid program ($y_{cat}$) increases to 133 percent of FPL. Fourth, people who remain uninsured pay penalties. Appendix C details how the ACA changes our baseline model.\footnote{In our modeling of the post-ACA economy, we abstract from two provisions of this reform: the limit on the age-adjustment of premiums in the individual market and the employer mandate. We abstract from the former provision because there can be multiple equilibria in the age-adjusted community-rated individual market with limits on the age-adjustment. We abstract from the latter provision because the employer mandate only applies to large firms (more than 50 employees), and, in the pre-ACA economy, most large firms already offer group insurance (96 percent).}

The first row of Table 5 reports the ESHI take-up rate for the long-run equilibrium after the implementation of the ACA. Table A4 in Appendix B reports employment and insurance statistics. We will use this economy as a reference when comparing the effect of the tax subsidy reforms after the ACA is implemented. When implementing the ACA, we assume that all additional government spending needed to pay for subsidies and expanding Medicaid are financed by increasing the progressive income tax. This increase disproportionally falls on high-income people to reflect that an important source of the ACA financing comes from levying higher taxes on the rich. More specifically, we adjust the parameter $a_0$ of the tax function to balance the government budget during the implementation of the ACA. As a result, this parameter increases from 0.258 (baseline level) to 0.285. The resulting average tax rate for a person with the average income increases by 1.2 percentage points.\footnote{For a full analysis of the effects of the ACA on the economy, see Pashchenko and Porapakkarm (2013).}

Row 1 of Table 5 shows the effects of the complete elimination of the tax exclusion after the reform (Table A4 in Appendix B reports the corresponding changes in employment and insurance). In contrast to the economy before the ACA, removing the tax subsidies does not lead to the full unraveling of the employer-based pool; the take-up

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<td><strong>The Effects of Tax Subsidy Reforms</strong></td>
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<tr>
<td>ESI Take-Up (Percent)</td>
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<tr>
<td>All</td>
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<tr>
<td>Baseline (pre-ACA economy)</td>
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<tr>
<td>No tax subsidy</td>
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<tr>
<td>Tax subsidy only to a certain group:</td>
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<tr>
<td>($x_t = 1$ and age $\leq 55$) or ($x_t = 2$ and age $\leq 43$)</td>
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<tr>
<td>$x_t = 1 +$ age-adjusted CR</td>
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Notes: LE (HE) denotes groups with low (high) education. BS denotes the baseline. CR denotes community rating.
rate only decreases to 52.6 percent. Row 2 of Table 5 shows that this high take-up rate is due to the penalty for being uninsured. If the penalty is removed, the elimination of the tax subsidy brings the take-up rate down to 5.3 percent.

Row 3 of Table 5 shows the effects of the reform that allows only two groups to keep the tax exclusion: people in the lowest medical expense grid (with medical expenses in the bottom 30\textsuperscript{th} percentile) who are younger than age 55, and people in the second lowest medical expense grid (with expenses between the 30\textsuperscript{th} and 60\textsuperscript{th} percentiles) who are younger than age 43. This tax subsidy reform results in a slightly lower take-up rate (93.6 percent compared with 94.2 percent), but the tax expenditure constitutes less than half (47 percent) of the post-ACA baseline level.

Row 4 of Table 5 shows the results of targeting the tax exclusion only at people in the lowest grid of medical expenses combined with the age-adjustment of premiums in the ESHI market. As before, this policy achieves good risk-pooling with the lowest costs; the take-up rate is the same as in the post-ACA baseline (around 94 percent), and the tax expenditure constitutes 35.8 percent of the post-ACA baseline level.

### E. Welfare Effects

The important finding from Sections VI.C and VI.D is that the reform that achieves good risk-sharing in the ESHI market at the lowest costs involves two steps: (1) the existing tax subsidy should be targeted only at low-risk people, and (2) ESHI premiums should be age-adjusted. This section evaluates the welfare effects of this reform and compares them with those that occur when the tax exclusion is completely eliminated. Rows 1 and 4 of Table 6 show that complete elimination of the tax subsidy results in
substantial ex-ante welfare losses, both in the pre-ACA and post-ACA economies; the consumption equivalent variations (CEV) are equal to –0.46 and –0.36 percent of annual consumption, respectively. There is heterogeneity in welfare effects by educational group: people with high education lose approximately 1 percent of their annual consumption, whereas people with low education gain. Many people in the latter group do not have access to the employer-based market, so they do not suffer from its unraveling. Instead, they can enjoy a lower tax rate due to lower government tax expenditures.

Table 6 shows the welfare effects of the tax reform that combines age-adjusted community rating in the ESHI market with the elimination of the tax exclusion for all individuals except those in the bottom 30 percent of the medical spending distribution for each age. Before the ACA, this tax subsidy reform brings positive welfare gains (0.18 percent), but, after the ACA, the welfare effects become negative (–0.15 percent). In general, this policy withdraws subsidies from all people whose

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30 With $V^B$ and $V^E$ denoting the value function of a newborn in the baseline economy and the experimental economy, respectively, $CEV = 100 \left( 1 - \left( \frac{V^B}{V^E} \right)^{\frac{1}{\gamma}} \right)$. The resulting number represents the percentage of annual consumption a newborn in the experimental economy is willing to give up to be indifferent between the baseline and experimental economies. The positive number implies welfare gains.
medical expenses are not in the bottom 30 percent of the medical expense distribution, regardless of their income. However, even though the average income of the ESHI pool participants is relatively high, there is substantial income heterogeneity. The loss of tax subsidies by low-income individuals with high medical costs negatively affects welfare. At the same time, the introduction of age-adjusted premiums in the ESHI market positively affects welfare because it results in a decrease in ESHI premiums for young people, many of whom have low income.\footnote{The introduction of age-adjusted community rating in the ESHI market in the baseline economy results in ex-ante welfare gains equivalent to 0.27 percent of the annual consumption.}

Before the implementation of the ACA, the positive welfare effect from age-adjusted ESHI premiums offsets the negative welfare effect from withdrawing tax subsidies from low-income individuals. In contrast, after the ACA, the opposite is true because the tax rate is higher; thus, the size of the tax subsidy is higher as well. Withdrawing this subsidy from the low-income group yields a larger welfare effect that cannot be fully offset by the age-adjustment of premiums in the group market.

To improve the welfare outcomes, we extend the tax subsidy to people with income below 200 percent of FPL. Rows 3 and 6 of Table 6 show the welfare effects of this modified policy before and after the ACA. Before the ACA, the resulting welfare gains increase to 0.61 percent and, after the ACA, to 0.13 percent. However, the tax expenditure increases only slightly: before the ACA, the tax expenditure increases from 34.6 to 42.4 percent of the baseline level and, after the ACA, from 35.8 to 42.0 percent of the level of the post-ACA baseline. In other words, both before and after the ACA, the spending on tax subsidies can be decreased by almost 60 percent without unraveling the employer-based market and without reducing the welfare. To achieve these results, it is important (1) to target tax subsidies at people with low expected medical expenses and people with low income; and (2) to allow for age-adjusted premiums in the group market.

F. Implementation

The essence of our policy proposal is that instead of subsidizing all people buying employer-based insurance, the tax subsidy should be targeted only at a group of relatively healthy people. With regard to the implementation of this policy, the question is how to identify the group of people who should receive the tax subsidy. Our suggestion is to subsidize people whose current medical expenses are close to zero.\footnote{More specifically, we suggest targeting subsidies at people whose medical expenses are below the 30\textsuperscript{th} percentile of the medical expense distribution of their age. Figure A1 in the Appendix shows that people in this group have almost zero medical spending over most of their life cycle.} This approach should result in very low administrative costs. The ACA requires each individual to obtain health insurance or pay a penalty. Individuals with insurance must obtain a certificate from their insurance company confirming that they are insured. For those indi-
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In general, it is possible to use additional criteria to target people whose presence in the pool is important to keep the premium low. For example, health insurance companies providing employer-based insurance accumulate information on the usage of health care for participating employees. This information can also be used to determine eligibility for tax subsidies. What we show in this paper is that the total amount of unnecessary subsidization is quite large and that even targeting subsidies based on a rather rough risk classification can achieve non-trivial tax savings.35

VII. CONCLUSION

In this paper, we explore possibilities for reform of the current tax subsidy scheme for people who buy employer-based health insurance. We show that even though the complete elimination of tax subsidies leads to the unraveling of the employer-based market, there is room for substantial savings by targeting tax subsidies. We show that good risk-pooling in the employer-based market can be achieved at much lower costs if the tax code takes into account that people have different incentives to participate in the employer-based pool. In the employer-based market, high-risk people receive implicit cross-subsidies from low-risk people and are willing to join the pool even without any subsidies. In contrast, for low-risk people, the employer-based insurance pool is less attractive. By building on this intuition, we propose a tax subsidy reform that can maintain the same level of risk-pooling in the group market as in the baseline economy but at one-third of the cost. To achieve these results, only people in the bottom 30 percent of medical expenses distribution should be allowed to receive the tax exclusion. In addition, the premiums in the group market should be age-adjusted to remove cross-subsidies from the young to the old and to make the ESHI pool more attractive for the young. To improve the welfare outcome of this reform, it is important to extend tax exclusion to people with income below 200 percent of FPL, which results in the tax expenditure being equal to around 40 percent of the baseline level.

33 In our model, the evolution of health is exogenous and cannot be affected by the behavior of individuals or by investments in health. In this environment, the tax subsidy for employer-based insurance is a tool to keep the risk pool together and to avoid the adverse selection spiral. Modeling the endogenous evolution of health is beyond the scope of this paper for computational reasons. However, it is important to note that, in such an environment, a subsidy that is negatively linked to medical spending may have an additional positive role of promoting healthy behavior.

34 In our model, medical spending is exogenous, so we abstract from a possible positive effect of our proposed subsidies on decreasing moral hazard in medical consumption. Pashchenko and Porapakkarm (2016) explore the role of moral hazard in medical consumption and discuss possible ways to decrease it.

35 In practice, our suggested subsidy resembles a pricing scheme in car insurance. An insurance company usually charges lower premiums to drivers who do not have a history of accidents.
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DISCLOSURES

The authors have no financial arrangements that might give rise to conflicts of interest with respect to the research reported in this paper.

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