U.S. Tax Policy and Health Insurance Demand: Can a Regressive Policy Improve Welfare? Supplementary document

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This document accompanies Jeske and Kitao (2008) and covers the materials that are not included in the paper due to space constraints. The first section defines the stationary competitive equilibrium of the full dynamic general equilibrium model of Jeske and Kitao (2008). The second section provides a summary of heterogeneous insurance opportunities and outcomes of the model. The third section discusses more details on the data and methodology that we used for the calibration of our model. The last section provides robustness and sensitivity analysis of the model, as well as additional policy experiments that were not discussed in the paper.

1 Stationary competitive equilibrium

Individual states are $s_y = (a, z, x, i_{HI}, i_E)$ for young agents and $s_o = (a, x)$ for old agents. Therefore let $a \in \mathbb{A} = \mathbb{R}_+$, $z \in \mathbb{Z}$, $x \in \mathbb{X}$, $i_{HI}, i_E \in \mathbb{I} = \{0, 1\}$ and $j \in \mathbb{J} = \{y, o\}$ and denote by $\mathbb{S} = \{\mathbb{J}\} \times \{\mathbb{S}_y, \mathbb{S}_o\}$ the entire state space of the agents, where $\mathbb{S}_y = \mathbb{A} \times \mathbb{Z} \times \mathbb{X}_y \times \mathbb{I}^2$ and $\mathbb{S}_o = \mathbb{A} \times \mathbb{X}_o$. Let $s \in \mathbb{S}$ denote a general state vector of an agent.

The equilibrium is given by interest rate r, wage rate w and adjusted wage w_E; allocation functions $\{c, a', i'_{HI}\}$ for the young and $\{c, a'\}$ for the old; government tax system given by income tax function $T(\cdot)$, consumption tax τ_c, Medicare, social security and social insurance program; accidental bequests transfer b; individual health insurance contracts given as pairs of premium and coverage ratios $\{p, q\}$, $\{p_m(x), q\}$; a set of value functions $\{V_y(s_y)\}_{s_y \in \mathbb{S}_y}$ and $\{V_o(s_o)\}_{s_o \in \mathbb{S}_o}$; and distribution of households over the state space $\mathbb{S}$ given by $\mu(s)$, such that

1. Given prices, policies and health insurance contracts, the allocations solve the maximization problem of each agent.

2. Factor prices satisfy marginal productivity conditions, i.e. $r = F_K(K, L) - \delta$ and $w = F_L(K, L)$.

3. A firm that offers employer-health insurance benefits pays the wage net of cost, given as $w_E = w - c_E$.

4. The accidental bequests transfer matches the remaining assets (net of health care expenditures) of the deceased.

$$b = \rho_d \int \left[a'(s) - \sum_{x'} p_o(x'|x) \left\{ (1 - q_{med}(x')) x' \right\} \right] \mu(s|j = o) ds \tag{1}$$

5. The health insurance company is competitive, and satisfies conditions (**??**) and (**??**).

6. The government's budget is balanced.

$$G + \int T_{SI}(s) \mu(s) ds = \int [\tau_c c(s) + T(y(s))] \mu(s) ds \tag{2}$$

   where $y(s)$ is the taxable income of an agent with a state vector s.

7. Social security system is self-financing.

$$ss \int \mu(s|j = o) ds = \tau_{ss} \int (\tilde{w}z - 0.5 i'_{HI} \cdot i_E \cdot p(1 - \psi)) \mu(s|j = y) ds \tag{3}$$

8. Medicare program is self-financing.

$$\begin{aligned} \int q_{med}(x) x \mu(s|j = o) ds &= \tau_{med} \int (\tilde{w}z - 0.5 i'_{HI} \cdot i_E \cdot p(1 - \psi)) \mu(s|j = y) ds \\ &\quad + p_{med} \int \mu(s|j = o) ds \end{aligned} \tag{4}$$

9. Capital and labor markets clear.

$$K = \int [a(s) + b] \mu(s) ds + \int i'_{HI} (i_E p + (1 - i_E) p_m(x)) \mu(s|j = y) ds \tag{5}$$

$$L = \int z \mu(s|j = y) ds \tag{6}$$

10. The aggregate resource constraint is satisfied.

$$G + C + X = F(K, L) - \delta K, \tag{7}$$

    where $C = \int c(s)\mu(s)ds$ and $X = \int x(s)\mu(s)ds$.

11. The law of motion for the distribution of agents over the state space $\mathbb{S}$ satisfies $\mu_{t+1} = R_\mu(\mu_t)$, where R_μ is a one-period transition operator on the distribution.

2 Summary of health insurance offer and coverage status

In this section, we summarize the heterogeneous outcomes of health insurance coverage. Ex-ante, young agents are heterogeneous in their access to employer-provided GHI, which is determined exogenously to the agents. Those who are offered can select into one of the three coverage outcomes; insured by GHI, insured by IHI, or uninsured. Those who have no access to GHI can choose either to be covered by IHI or to be uninsured.

Once the (gross) expenditure shocks are realized, out-of-pocked expenditures are determined depending on the insurance status. In case an agent's assets fall below the level of consumption $\bar{c}$ after the payment of medical expenditures, the agent will be eligible for the social insurance, which encompasses the role of Medicaid. The eligibility for this public safety net depends only on individual asset levels (means-tested) and it can be available to anyone irrespective of other individual states. Obviously, the uninsured, who face high expenditure shocks are the most likely recipients of the social insurance. Therefore, ex-post, the expenditures can be covered by group or individual insurance if the agent has purchased one, by the agent's out-of-pocket, by the government, or any combination of the three.

All old agents are insured by Medicare, which covers a large fraction of expenditures. The rest is paid out of agents' own savings. The social insurance is available if their asset falls below $\bar{c}$, as with the young agents.

3 Data and calibration details

This section will discuss additional details regarding the calibration of endowment, health insurance and expenditure processes.

3.1 MEPS data

3.1.1 Selection of individuals

The MEPS database does not explicitly identify a head of household, but rather one "reference person" per dwelling unit, usually the owner or renter. If more than one person owns/rents the unit then the interviewer picks *exactly* one of them. Unfortunately, the definition of one household in the model as one dwelling unit in the data is inappropriate for our purposes. This is because if multiple households live in one single dwelling unit we may miss a large fraction of the population. This happens if roommates share a unit, in which case we want to capture each person as a separate economic unit. Another example would be adult children living with their parents or the elderly living with their adult children, where we want to capture the parents and the children as separate economic units.

Our definition of a household, therefore, is based on the Health Insurance Eligibility Unit (HIEU) defined in the MEPS database. A HIEU is a unit that includes adults and other family members who are eligible for coverage under typical family insurance plans. Thus, each dwelling unit is composed of potentially multiple HIEUs. A HIEU includes spouses, unmarried natural or adoptive children of age 18 or under and children under 24 who are full-time students. The definition of a head is the single adult member in case of an unmarried couple. For a household with a married couple, we choose the one with a higher income as the head of the household. We tried other definitions as head of a household, for example the older adult, but the calibration results did not change materially.

MEPS also provides a longitudinal weight for each individual which we use to compute all of the statistics in our calibration, and all moments are weighted by the MEPS weight.

Next, we stack individuals in the five different panels into one large data set, converting all nominal values into dollars of the base year 2003. Ho do we handle the longitudinal weights across multiple panels? For each panel we rescale the weights such that sum of the weights in that panel is equal to the number of heads of households age 20 and older. That way within each panel people get a weight proportional to their longitudinal weights, and each panel gets a weight proportional to the number of heads of household in the age groups we consider. The number of observations in each panel is as follows.

Table 1: MEPS panel sample size

Panel	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	Total
Individuals	6,099	4,839	9,863	7,381	7,612	35,794

3.1.2 Earnings

To calibrate the earnings process, wage income of all heads of households (both male and female) is considered, unlike many existing studies in the literature on stochastic income process (for example, Storesletten et al, 2004, who use households to study earnings process, and Heathcote et al, 2004, who use white male heads of households to estimate wage process). We choose heads instead of all individuals since many non-head individuals are covered by their spouses' health insurance. Our model also captures those with zero or very low level of assets, who would be eligible for public welfare assistance. Many households that fall in this category are headed by females, and therefore we include both males and females. Most of the existing studies on the income process are focused on samples with strictly positive income, often above some threshold level and such treatment does not fit in our model, either. Moreover, we want to capture the heterogeneity in health insurance opportunities (group and individual) across earnings groups, which is possible by using a comprehensive database like MEPS.

The endowment process is calibrated jointly with the stochastic probability of being offered employer-based health insurance. We specify the earnings distribution over five states and in each year. An equal number of agents belong to each of the five bins of equal size. We determine for each individual in which bins of earnings he or she resides over two consecutive years and construct the joint transition probabilities $p_{Z,E}(z, i_E; z', i'_E)$ of going from bin z with insurance status i_E to bin z' with i'_E. The Markov process is defined over $N_z \times 2$

states with a transition matrix $\Pi_{Z,E}$ of size $(N_z \times 2) \times (N_z \times 2)$. We average the transition probabilities over the five panels weighted by the number of people in each panel.

Finally, in order to get the grids for earnings z, we compute the average earnings in each of the five bins in 2003 dollars. The z grids relative to average earnings of $32,800 in 2003 dollars are $\mathbb{Z} = \{0.07, 0.46, 0.81, 1.24, 2.44\}$. The earnings shocks may look different from the ones normally used in the literature in that we include all heads of households, even those with zero earnings. This generates an extremely low earnings shock of less than $3,000 for a sizeable measure of the population. We assume that the agents cannot borrow, i.e. $\underline{a} = 0$. Given that the lowest possible earnings are quite small, the constraint is not very different from imposing a natural borrowing limit.

3.1.3 Health expenditures

In the calibration of health expenditure shocks, we use seven states for the expenditures with the bins of size $(20\% \times 4, 15\%, 4\%, 1\%)$, separately for young and old generations. An advantage of our procedure is that we can specify the size of the bins and there is no need to assume a specific form of health expenditure distribution and transition. The expenditures are less than 1% of average labor income in the first and second bins but substantial in the top bins. For example, the top 1 percentile have average expenditures of about 1.6 times the average earnings (over $52,000 in 2003 dollars). The next 4% have average expenditures of 50% of average earnings (over $16,000) while among the following 15% the ratio falls to 17% of average earnings (about $5,600).

3.2 Transition matrices

3.2.1 Earnings and health insurance offer

MEPS records annual labor income of individuals. We use the variable WAGEPyyX that stands for earnings in the year yy$\in \{99, 00, 01, 02, 03, 04\}$. We keep all individuals in the sample, regardless of the level of earnings. Specifically, even those with zero earnings stay in our sample and such individuals account for almost 9 percent of our samples. MEPS also records whether a person is offered health insurance at the workplace (variables OFFER31X, OFFER42X and OFFER53X). The three variables refer to three subperiods within each year in which interviews were conducted. We assume that an individual is offered insurance if he or she receives an offer in at least one subperiod. We further assume that self-employed who get insurance through the workplace are part of those offered GHI.

Constructing the transition matrix is then simply summing up the longitudinal weights of individuals that jump from one of the $N_z \times 2$ bins in the first year into the $N_z \times 2$ bins in the second year of each panel. We also compute average earnings in each of the N_z bins to use it as the earnings grid point of our Markov process.

The transition matrix for earnings z and group insurance offer status i_E is shown below. Rows 1 to 5 from the top represent the transition of agents in the earnings bins 1 to 5 with employer-based insurance offer and rows 6 to 10 are the five earnings groups without insurance offer. For example, $\Pi_{Z,E}(7,3) = 0.038$ implies that conditional on this period's earnings grid of $z = 2$ and no group insurance offer, the probability of having earnings $z = 3$ and a group insurance offer in the next period is 3.8% if the agent remains "young."

$$\Pi_{Z,E} = \left[\begin{array}{ccccc|ccccc}
0.201 & 0.312 & 0.110 & 0.065 & 0.046 & 0.165 & 0.074 & 0.019 & 0.005 & 0.002 \\
0.068 & 0.439 & 0.252 & 0.079 & 0.018 & 0.051 & 0.065 & 0.022 & 0.008 & 0.002 \\
0.024 & 0.122 & 0.489 & 0.240 & 0.052 & 0.015 & 0.019 & 0.024 & 0.013 & 0.002 \\
0.012 & 0.060 & 0.152 & 0.527 & 0.187 & 0.011 & 0.008 & 0.010 & 0.022 & 0.011 \\
0.009 & 0.025 & 0.048 & 0.134 & 0.724 & 0.009 & 0.004 & 0.008 & 0.008 & 0.030 \\
\hline
0.042 & 0.045 & 0.013 & 0.007 & 0.003 & 0.715 & 0.124 & 0.033 & 0.013 & 0.005 \\
0.025 & 0.119 & 0.038 & 0.022 & 0.004 & 0.219 & 0.373 & 0.136 & 0.040 & 0.025 \\
0.010 & 0.044 & 0.098 & 0.035 & 0.014 & 0.140 & 0.202 & 0.286 & 0.126 & 0.046 \\
0.008 & 0.018 & 0.034 & 0.075 & 0.029 & 0.099 & 0.137 & 0.158 & 0.306 & 0.136 \\
0.010 & 0.017 & 0.008 & 0.013 & 0.070 & 0.088 & 0.100 & 0.094 & 0.170 & 0.430
\end{array}\right]$$

3.2.2 Health expenditure shocks

MEPS reports total health expenditures as well as a breakdown into different sources of payment. Expenditures refer to the amount actually *paid* as opposed to the amount *charged* by providers. See the MEPS documentation HC-089: 2004 pp. C-102, for details about how they impute the actual spending and items included in the total expenditures. We disregard medical expenditures paid for by Veteran's Affairs (TOTVAyy), Workman's Compensation (TOTWCPyy) and other sources (TOTOSRyy). Summing up the remaining categories gives us the total medical expenditures considered in our model.

As before, we assign expenditures in two years of each panel into their respective percentiles and sum up the weights of agents that move from one of the N_x bins in the first year into the N_x bins in the second year. The transition matrices for the health expenditures shocks x_y for young and x_o for old are given as follows.

$$\Pi_{x_y} = \begin{bmatrix}
0.542 & 0.243 & 0.113 & 0.061 & 0.032 & 0.007 & 0.002 \\
0.243 & 0.330 & 0.242 & 0.117 & 0.056 & 0.011 & 0.001 \\
0.119 & 0.224 & 0.296 & 0.232 & 0.098 & 0.025 & 0.006 \\
0.058 & 0.130 & 0.225 & 0.347 & 0.201 & 0.035 & 0.005 \\
0.043 & 0.079 & 0.140 & 0.263 & 0.371 & 0.090 & 0.014 \\
0.030 & 0.063 & 0.080 & 0.203 & 0.359 & 0.200 & 0.065 \\
0.008 & 0.024 & 0.073 & 0.106 & 0.269 & 0.286 & 0.233
\end{bmatrix}$$

$$\Pi_{x_o} = \begin{bmatrix}
0.654 & 0.165 & 0.075 & 0.055 & 0.042 & 0.009 & 0.001 \\
0.191 & 0.385 & 0.199 & 0.126 & 0.075 & 0.021 & 0.003 \\
0.071 & 0.222 & 0.323 & 0.217 & 0.135 & 0.026 & 0.005 \\
0.057 & 0.146 & 0.249 & 0.311 & 0.184 & 0.041 & 0.013 \\
0.027 & 0.084 & 0.173 & 0.318 & 0.292 & 0.083 & 0.024 \\
0.026 & 0.090 & 0.102 & 0.216 & 0.375 & 0.137 & 0.054 \\
0.044 & 0.027 & 0.047 & 0.217 & 0.391 & 0.264 & 0.010
\end{bmatrix}$$

3.3 Takeup ratios

MEPS records whether an individual who is offered group insurance through the workplace actually signs up for it (variables HELD31X, HELD42X and HELD53X for each of the three subperiods). As with the offer variables we assume that a person signed up if he or she did so in at least one of the subperiods. We also have data on whether an individual had any kind of private insurance during the year (variable PRVEVyy=1, where yy$\in \{99, 00, 01, 02, 03, 04\}$). We treat those who were not offered GHI but who hold private insurance, are covered by the IHI contract. If a person is offered GHI, did not accept it, but still holds private insurance, we assume that he or she is covered by IHI.

3.4 Calibration of the health insurance coverage ratio $q(x)$

We use the MEPS data to compute the coverage ratios of private insurance for young agents and Medicare for old agents. We estimate a polynomial of the following form:

$$q = \beta_0 + \beta_1 \log(x) + \beta_2 (\log x)^2, \tag{8}$$

where x is the total health expenditures and q corresponds to the coverage ratio of private health insurance for young agents and Medicare coverage ratio for old agents. We consider only agents with positive expenditures in this regression. For the young generation we also restrict our attention to those that actually have private insurance (variable PRVEVyy=1). We use weighted least squares to find the following estimates, where the standard errors in brackets and all coefficient estimates are significant at the 1% level:

Table 2: Insurance coverage ratios. Weighted least square estimates.

	q	q_{med}
β_0	0.3410 (0.0207)	0.5749 (0.0230)
β_1	0.0291 (0.0062)	-0.1392 (0.0061)
β_2	0.0016 (0.0005)	0.0139 (0.0004)
R^2	0.2510	0.3946

We plug in the N_x grid points to attain the coverage ratio for each bin of expenditures according to the estimated function (8). We find the following coverage ratios for each expenditure grid.

Table 3: Insurance coverage ratios by expenditures

grid number	1	2	3	4	5	6	7
$q(x)$	0.341	0.532	0.594	0.645	0.702	0.765	0.845
$q_{med}(x)$	0.228	0.285	0.342	0.406	0.511	0.637	0.768

3.5 Adjustment of $\Pi_{Z,E}$ matrix for lower GHI offer rates

In the policy experiment of eliminating the subsidy, we assume that the share of the workers who are offered GHI falls by 15.5%. This subsection explains how we adjust the transition matrix $\Pi_{Z,E}$.

We target a new stationary distribution p_{sd} such that

$$\begin{aligned} p_{sd}(x, i_E = 1) &= 0.845 * p_{sd}^{bench}(x, i_E = 1) \\ p_{sd}(x, i_E = 0) &= 0.155 * p_{sd}^{bench}(x, i_E = 1) + p_{sd}(x, i_E = 0) \end{aligned}$$

where p_{sd}^{bench} is the stationary distribution from the benchmark.This yields the following probabilities (in percentage) of being offered insurance in each earnings grid.

Table 4: Adjusted stationary distribution over income and GHI offer

earnings grid number	1	2	3	4	5	sum
GHI offered: benchmark	3.2	11.2	15.1	16.4	17.3	62.6
GHI offered: no tax subsidy	2.7	9.5	12.8	13.8	14.6	52.9
Change	-15.5%	-15.5%	-15.5%	-15.5%	-15.5%	-15.5%

This adjustment ensures that the total share of agents offered group insurance is 15.5% lower than in the benchmark, but the distribution of labor income is unchanged.

Recall from Section 3.2.1 that the benchmark transition matrix had the structure

$$\Pi_{Z,E} = \begin{bmatrix} \Pi_{Z,E}^{11} & \Pi_{Z,E}^{10} \\ \Pi_{Z,E}^{01} & \Pi_{Z,E}^{00} \end{bmatrix}$$

where upper left block $\Pi_{Z,E}^{11}$ is the income transition probabilities of agents who have a GHI offer in the current year and keep it in the next year, $\Pi_{Z,E}^{10}$ is the income transition probabilities of agents who have GHI but lose it, etc.

In the experiment with the supply side effect we assume that those agents who lose the GHI offer retain the same earnings transition matrix as those agents with GHI. We thus use a 15×15 transition matrix

$$\Pi_{Z,E}^{exp} = \begin{bmatrix} 0.845\Pi_{Z,E}^{11} & 0.155\Pi_{Z,E}^{11} & \Pi_{Z,E}^{10} \\ 0.845\Pi_{Z,E}^{11} & 0.155\Pi_{Z,E}^{11} & \Pi_{Z,E}^{10} \\ 0.845\Pi_{Z,E}^{01} & 0.155\Pi_{Z,E}^{01} & \Pi_{Z,E}^{00} \end{bmatrix}$$

One can think of this as introducing an additional i_E state for people without GHI who have the earnings transition matrix as those with the GHI offer. If we instead assume that agents who lost their GHI are subject to the earnings transition matrix $\Pi^{00}_{Z,E}$, the welfare effects of eliminating the policy is even more negative by an order of magnitude. This fails, however, to capture the welfare effect of losing GHI, but rather the effect of falling into the income process of those agents who were without GHI in the benchmark, which has a significantly lower average earnings.[1]

4 Extensions and discussions of the model

4.1 Rise in medical expenditures

In the paper, we focused on the response of individuals to the changes in tax policy, while keeping all the other parameters of the model fixed, including the levels of the medical expenditures. One of the serious concerns, however, that the current government faces is the consequence of the rise in medical expenditures, which is associated with the development of the medical technology and the rapidly aging demographics. Although it goes beyond scope of our paper to fully address these issues, we will simulate our model assuming that all the medical expenditures rise proportionally by a fixed percentage and study the implications of the rising medical expenditures.

The first column of Table 5 reproduces the results of our baseline model for the purpose of comparison. The second column shows the results when there is no change in policies or parameters from the benchmark except for the medical expenditures that go up by 50%. We raise the grid of health expenditures proportionally for both young and old generations by the same percentage points. Given the significantly increased expenditure risks, the demand for insurance will rise and the overall take-up ratio increases from 75.7% in the baseline model to 81.3%. The take-up of group insurance remains nearly perfect and the rise comes from the increased demand among those who are not offered group insurance, which goes up from 35.5% to 51.4%. Saving and consumption will fall since a larger fraction of available resources is used for the payment of medical expenditures or the insurance premium. The aggregate capital falls by 4.53% compared to the baseline model. Given that the size of the tax deductions for the group insurance premium are much larger and that the labor income tax base is smaller due to the fall in the wage rate, the income tax rate τ_y has to rise by 1.8% to 6.23%. It also includes the higher fiscal cost of the social insurance, which now covers 8.82% of the population, well above 6.34% in the baseline model. Agents are exposed to larger expenditure risks and more likely to deplete their assets to the level of the consumption floor $\bar{c}$.

[1] Also notice that this transition matrix implicitly assumes the GHI loss due to the supply side effect of the tax policy change is a) iid across time and b) equally distributed across earnings groups. However, the GHI losses may well be persistent rather than than iid and according to Gruber and Lettau (2004), the GHI losses will occur disproportionately among lower income agents. Therefore one can interpret our calculations for the welfare loss as a lower bound.

Table 5: Rise in medical expenditures

	Baseline	Benchmark	Policy A
Medical expenditures	–	+50%	+50%
Group insurance premium	\$2,018	\$3,017	\$24,053
Take-up ratio: all	75.7%	81.3%	72.6%
Take-up ratio: group insurance not offered	35.5%	51.4%	59.4%
Take-up ratio: group insurance offered	99.0%	98.7%	82.1%
Group insurance	99.0%	98.7%	81.4%
Individual insurance	0.0%	0.0%	0.7%
Aggregate capital	–	−4.53%	−4.24%
Aggregate consumption	–	−8.32%	−8.16%
Interest rate	4.99%	5.34%	5.24%
Wage rate	–	−1.53%	−1.09%
Income tax rate τ_y	4.46%	6.23%	5.21%
Social ins. covered (% of pop.)	6.34%	8.82%	9.28%
CEV from transition			
all (young)	–	–	−0.71%
young w/ GHI offer	–	–	−1.00%
young w/o GHI offer	–	–	−0.21%
$w/CEV > 0$ (% of young agents)	–	–	22.33%

In the last column labeled "Policy A," we run the experiment of completely abolishing the deductibility of group insurance premium. As we observed in the policy experiment in the baseline model, eliminating the subsidy will trigger a collapse of the group insurance market, but now in a greater magnitude. The market is almost completely eliminated, leaving only the most unhealthy taking up the group insurance. The majority of those who opt out of group insurance choose to be insured in the private insurance market. Although the drop in the group insurance take-up is more severe, the fall in overall coverage is somewhat subdued since the demand for insurance itself is larger given the increased expenditure risks.

Given the lower insurance coverage, there will be more precautionary saving motives under Policy A, compared to the benchmark with high medical expenditures, and the aggregate capital will rise (while it is still much lower than in the baseline model with no rise in expenditures). The cost of social insurance will rise further given the lower insurance coverage when the tax policy is eliminated and 9.28% of the population will be eligible for the benefit.

To assess the welfare effect of the policy in the economy with higher expenditures, we compute the transition dynamics between the benchmark economy and the economy under Policy A, both with the same level of expenditures.[2] As before, the welfare effect expressed

[2]Using the original baseline economy with lower expenditures as the initial steady state does not assess

in terms of consumption equivalent variation ("CEV") is negative and the majority of agents (about 80%) will prefer to keep the subsidy policy, despite the higher income tax to finance the benefit and the higher wage (relative to the benchmark with high expenditures). Those who are offered group insurance will experience a large welfare loss of 1.0% in consumption equivalent variation, and those with no group insurance will also face a welfare loss since the group insurance offer that they may get in future no longer offers a diversified pool of health risks and what is available to them in essence is only the individual insurance.

4.2 Credit policy with income limit

In Jeske and Kitao (2008) we considered a policy of providing a refundable credit of $1,000 to supplement for the purchase of individual insurance, if the person is not offered group insurance (Policy D). In this subsection, we study a policy that is similar but the provision of the subsidy is subject to the income threshold of $30,000, above which the subsidy phases out (Policy E). Table 6 summarizes the results and compare them to those of Policy D.

The comparison of the results in Policy D and E reveals the tradeoff between the cost and efficiency in targeting beneficiaries. By restricting the eligibility to the lower income households in Policy E, the required increase in the proportional tax rate τ_y is 0.42% as opposed to 0.65% in Policy D. The policies increase the overall take-up ratio by 15% and 19%, respectively. It becomes more costly to provide an incentive to be insured if the agent's income is higher. Wealthy households with more assets are better insured by their accumulated savings and the marginal price that makes them indifferent between buying a contract and not buying is higher.

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the welfare effect of the policy change properly. The exogenous rise of the expenditures will unambiguously reduce the welfare since it reduces the disposable assets while the increased spending on medical services has no direct effect on utility.

Table 6: Credit policy experiments

	Benchmark	D	E
Group insurance premium	\$2,018	\$2,016	\$2,016
Take-up ratio: all	75.7%	94.5%	90.5%
Take-up ratio: group insurance not offered	35.5%	86.7%	75.7%
Take-up ratio: group insurance offered	99.0%	99.1%	99.1%
Group insurance	99.0%	99.1%	99.1%
Individual insurance	0.0%	0.0%	0.0%
Aggregate capital	–	−1.77%	−1.59%
Aggregate consumption	–	−0.62%	−0.51%
Interest rate	4.99%	5.13%	5.11%
Wage rate	–	−0.59%	−0.53%
Income tax rate τ_y	4.46%	5.11%	4.87%
Social ins. covered (% of pop.)	6.34%	6.15%	6.16%
CEV from transition			
all (young)	-	0.58%	0.55%
young w/ GHI offer	-	0.37%	0.39%
young w/o GHI offer	-	0.95%	0.84%
$w/CEV > 0$ (% of young agents)	-	99.3%	99.8%

4.3 Supply side response

In policy experiment A of Jeske and Kitao (2008), where the tax policy is completely eliminated, we allow firms to react in both extensive and intensive margins based on empirical studies. In this section, we present results under alternative assumptions about the supply side reactions upon the policy change.

Instead of assuming that GHI offers are exogenously given, one could model the demand and supply decisions of workers and firms jointly. Dey and Flinn (2005) build and estimate a model using a search, matching and bargaining environment and study how employer-based health insurance affects job mobility. There is a clear tradeoff between the richness of the model and the tractability. The structural model of Dey and Flinn, for example, while richer in the labor market frictions, assumes an exogenous health insurance premium and abstracts from a market for individual health insurance or decisions about savings as an alternative insurance device. Therefore some aspects of their model are not suitable for the policy analysis we have in mind, i.e. to understand how the agents decide to choose a particular insurance over alternatives, when the relative price is affected by a policy change. We choose to focus on the details on the demand side and abstract from the supply side decisions. Our main results, however, that the current policy enhances the pooling of the group insurance and improves the welfare is found to be robust to some variations of the supply side reactions that we consider below.

Table 7 summarizes the results of three alternative policy experiments. In the first experiment *(i) no adj.*, we make an assumption at one extreme that firms do not respond at all to the policy change. They continue to pay 80% of the premium as a subsidy no matter how high the price is and the offer probability is not affected. In experiments *(ii) ext.* and *(iii) int.*, firms adjust only one margin (extensive or intensive) at one time.

As shown in Table 7, the elimination of the policy triggers a partial collapse of the group health insurance market in all the cases considered, making the healthy agents leave the pool. The adjustment of the intensive margin directly raises the marginal price of the contract and reduces the conditional take-up ratio among those offered group insurance more significantly. The negative welfare effect of the policy change is robust across experiments under alternative specifications and it is sizeable even under an extreme assumption of no adjustment at all.

4.4 Correlation between health expenditures and earnings

In the baseline model, we imposed an assumption that health expenditure and earnings processes are independent. It is conceivable, however, that poor health may negatively affect labor productivity. Looking at the panel data we found that overall there is only a small negative correlation between the two variables. Closer inspection, however, reveals that this small number disguises the fact that it is mainly a small share of individuals with very high expenditures who have significantly lower earnings, while among the rest of the majority, the correlation is extremely small. We found that the average earnings in highest expenditure bins x_6 and x_7 are lower than the unconditional mean by 12 and 31%, respectively. In contrast, earnings in the first five bins are marginally higher than the aggregate, by only 0.8%.

As a robustness check we introduce a negative correlation between expenditure and earnings shocks by scaling up or down the labor income based on the current health expenditure shock.[3] We recalibrate the model with the correlated process of earnings and expenditures and present the results of the benchmark and the main experiment of eliminating the tax policy in Table 8 in columns labeled "x−z correlation." We find a stronger demand for health insurance than in the baseline model with no such correlation. Health insurance has more value since it pays out more when agents face negative earnings shocks associated with very high health expenditures. Implicitly, it provides insurance not only against health expenditure shocks but also against earnings shocks as well, although the price does not reflect the value.

Effects of the policy experiment are similar, qualitatively and quantitatively in most cases. The loss of subsidy will trigger the partial collapse of the group insurance market as

[3]Specifically, we assume that an agent with labor productivity shock i and health expenditure shock j has $z_i \cdot \xi_j$ efficiency units of labor available, where the scaling factor ξ_j is such that ξ_j=1.0085 for $j = 1, ..., 5$, ξ_6=0.8773 and $\xi_7 = 0.6879$. The ξs are chosen so that such that their average (weighted by the stationary distribution of expenditures) is one and the average and total expenditures are not affected.

in the baseline model, but the effect is less severe since more people choose to remain insured despite the increase in the marginal price, because of the additional value of the insurance contract.

4.5 Risk aversion

We assess the effects of the tax policy in a model with an alternative level of risk aversion, namely with the relative risk aversion coefficient σ in utility function $u(c) = \frac{c^{(1-\sigma)}}{1-\sigma}$ at 2 and 4 as opposed to 3 in the baseline calibration. As we show in columns labeled "RRA σ=2 and 4" of Table 8, the demand for insurance increases with the degree of risk aversion and the overall insurance coverage in the benchmark economy is 68%, 76% and 83%, when σ is set at 2, 3 and 4, respectively. This is intuitive: with higher risk aversion agents are more willing to stay in the insurance contract and shield their consumption from fluctuations associated with expenditure shocks.

We also find that with $\sigma = 4$ the share of agents eligible for the social insurance coverage decreases after eliminating the tax subsidy rather than increases. This is due to a large increase in precautionary savings evident in the rise of the aggregate capital stock by more than 1%. Being more self-insured, fewer agents are eligible for the social insurance coverage.

As shown in Table 8, the policy elimination will cause a significant welfare loss in a very similar magnitude across the wide range of the risk aversion we consider. With a low risk aversion, although the agents value the insurance less, the coverage declines more significantly and they are exposed to much larger risk ex-post. With a high risk aversion, the relatively small drop in the coverage causes large welfare effects in terms of welfare since they care more about smoothing consumption.

4.6 Premium mark-up of group and individual insurance

We assumed that the same mark-up is added to the insurance premium for both group and individual insurance contracts. In this experiment, we consider a case where there is a difference in the markup, in particular, administering individual contracts incur more overhead costs and the mark-up is 50% above that of the group insurance. We set the mark-ups at 13.2% and 8.8% for individual and group contracts so that it is 11% on average.

The last columns labeled "Mark-up $\sigma_I > \sigma_G$" in Table 8 show the results. In the benchmark, the coverage among the agents who have no access to group insurance goes down, from 35.5% with the baseline calibration to 28.3% with the higher mark-up. Eliminating the deduction will cause a collapse of the group insurance market in a similar magnitude, although the demand for the individual insurance is somewhat lower due to the higher marginal cost (34.1% vs. 39.8%). The welfare effects are more negative since many agents now only have the access to the individual contracts that are more expensive.

4.7 Exogenous health expenditures and moral hazard

We treat health expenditures as an exogenous shock that follows a Markov process. A challenging, yet interesting extension of our work would be to endogenize medical expenditures.[4] In terms of the results of our main experiment, adding endogenous health expenditures would have the following effects associated with moral hazard. Taking away the tax deductibility may reduce over-investment in health, at least for those who drop out of the group insurance market and choose not to sign up for an individual coverage. This effect could improve the social welfare given the better allocation of available resources.

Bajari et al (2006) also show that moral hazard is concentrated among relatively healthy individuals, i.e. their demand for medical services is more elastic to the price change than unhealthy individuals.[5] It implies that in response to eliminating the tax deductibility on group insurance, healthy agents will respond more elastically, by opting out of the group insurance contract faced with a higher marginal price and reduce the consumption of medical services. Those left in the group insurance pool will face a more significant increase of the premium than we saw in a model without moral hazard since the pool will lose a larger number of healthy agents. Therefore, the mechanism of the collapse of the group insurance market that we emphasized will remain in place and we conjecture that welfare cost of losing risk-sharing opportunities more severely will be large, although the exact magnitude is unknown until we build and simulate a model.

4.8 Self-selection into GHI jobs

We assume that agents take the GHI offer as exogenously given. Another major extension of our model would be to allow for the self-selection of individuals into jobs that do or do not offer group health insurance plans.

We conjecture that endogenizing the mobility decision, i.e., the decision in what sector (GHI or non-GHI) to work in, will make our results of the effect of abolishing the subsidy policy even stronger. This is because of the response of healthy agents in the GHI-offering firm to the removal of the tax subsidy. In our baseline economy, healthy individuals continued to cross-subsidize the agents with high expenditures in their firm, even after they dropped out of the GHI contract: the wage of all workers in the GHI firm, even those who don't sign up, is scaled down to cover the employer share of the GHI premium. In an alternative model with a sector choice, however, healthy agents who no longer want to sign up for GHI can escape that disadvantageous cross-subsidization and simply work in a firm that does not

[4]For example, one could model health expenditures that directly affects the utility or introduce an interaction between the expenditures and mortalities. See for example Bajari et al (2006) and Hall and Jones (2007).

[5]Specifically, they show that the expenditures of healthy agents respond more strongly to insurance by measuring the elasticity of medical expenditures with respect to the derivative of the co-payment function. The coefficient on the dummy variable for excellent health is much larger in absolute value than for that for fair health. In plain words, households have a lot of discretion to skip the doctor's visit for the common cold, but for the acute and very expensive medical conditions like heart attack and stroke, they will likely have no or limited room to adjust the scope of the medical procedures.

offer GHI but does offer a higher wage. This would diminish pooling in the group contract even more severely than in our baseline, exacerbating the welfare losses after the removal of the GHI tax subsidy. Of course, the extent of such mobility is an empirical issue that must take into account the various labor market frictions, which goes beyond the scope of our paper. If, however, such an effect exists, the welfare losses in our economy can be viewed as a lower bound.

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Table 7: Robustness analysis: supply side response

	Benchmark	Policy A	(i) no adjust.	(ii) extensive	(iii) intensive
Group insurance premium	\$2,018	\$5,316	\$3,029	\$3,028	\$5,317
Take-up ratio: all	75.7%	48.4%	60.9%	58.3%	48.6%
Take-up ratio: group insurance not offered	35.5%	38.0%	35.8%	37.3%	36.1%
Take-up ratio: group insurance offered	99.0%	57.4%	75.5%	76.7%	55.9%
Group insurance	99.0%	17.6%	55.1%	55.0%	17.6%
Individual insurance	0.0%	39.8%	20.5%	21.7%	39.3%
Aggregate capital	–	+0.81%	+0.53%	+0.60%	+0.78%
Aggregate consumption	–	+0.38%	+0.23%	+0.27%	+0.35%
Interest rate	4.99%	4.93%	4.95%	4.95%	4.94%
Wage rate	–	+0.27%	+0.18%	+0.20%	+0.26%
Income tax rate τ_y	4.46%	3.74%	3.75%	3.75%	3.74%
Social insurance covered (% of pop.)	6.34%	6.55%	6.40%	6.47%	6.50%
CEV from transition					
all (young)	–	−0.34%	−0.16%	−0.21%	−0.34%
young w/ GHI offer	–	−0.46%	−0.24%	−0.30%	−0.47%
young w/o GHI offer	–	−0.12%	−0.02%	−0.05%	−0.12%
$CEV > 0$ (% of young agents)	–	19.2%	23.9%	19.5%	19.2%

Table 8: Robustness analysis

	Baseline		$x-z$ correlation		RRA σ=2		RRA $\sigma=4$		Mark-up $\phi_I > \phi_G$	
	Bench.	Exp. A	Bench.	Exp. A	Bench.	Exp. A	Bench.	Exp. A	Bench.	Exp. A
Group insurance premium	\$2,018	\$5,316	\$2,018	\$5,292	\$2,017	\$5,300	\$2,017	\$5,318	\$1,978	\$5,210
Take-up ratio: all	75.7%	48.4%	77.9%	58.2%	67.7%	26.4%	82.8%	68.4%	73.0%	42.4%
Take-up ratio: GHI not offered	35.5%	38.0%	41.9%	45.2%	14.2%	14.2%	55.4%	59.3%	28.3%	31.8%
Take-up ratio: GHI offered	99.0%	57.4%	98.8%	69.5%	98.9%	37.0%	98.8%	76.4%	99.0%	51.6%
Group insurance	99.0%	17.6%	98.8%	17.4%	98.9%	17.5%	98.8%	17.6%	99.0%	17.5%
Individual insurance	0.0%	39.8%	0.0%	52.0%	0.0%	19.5%	0.0%	58.8%	0.0%	34.1%
Aggregate capital	–	+0.81%	–	+0.42%	–	+0.42%	–	+1.09%	–	+0.78%
Aggregate consumption	–	+0.38%	–	+0.19%	–	+0.14%	–	+0.41%	–	+0.30%
Interest rate	4.99%	4.93%	5.01%	4.97%	5.01%	4.98%	5.01%	4.93%	4.98%	4.93%
Wage rate	–	+0.27%	–	+0.14%	–	+0.16%	–	+0.36%	–	+0.26%
Income tax rate τ_y	4.46%	3.74%	4.46%	3.80%	4.34%	3.69%	4.51%	3.75%	4.45%	3.76%
Social ins. covered (% of pop.)	6.34%	6.55%	6.36%	6.62%	5.98%	6.30%	7.18%	6.97%	6.34%	6.56%
CEV from transition										
all (young)	–	−0.34%	–	−0.35%	–	−0.34%	–	−0.42%	–	−0.41%
young w/ GHI offer	–	−0.46%	–	−0.50%	–	−0.43%	–	−0.58%	–	−0.55%
young w/o GHI offer	–	−0.12%	–	−0.09%	–	−0.17%	–	−0.16%	–	−0.18%
$CEV > 0$ (% of young agents)	–	19.2%	–	19.8%	–	19.7%	–	14.7%	–	13.9%