ONLINE APPENDIX

FOR

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

Svetlana Pashchenko and Ponpoje Porapakkarm

APPENDIX A. CALIBRATION OF THE BASELINE MODEL

A.1 Demographics, preferences and technology

The conditional survival probabilities ζ_t were adjusted for the difference in medical expenses following Attanasio et al. (2011). The population growth rate was set to 1.35 percent to match the fraction of people older than 65 in the data.

The consumption share in the utility function χ is set to 0.6, which is in the range estimated by French (2005).[1] The parameter σ is set to 5, which corresponds to the risk-aversion over consumption equal to 3.4.[2] The discount factor β is calibrated to match the aggregate capital output ratio of 3. The labor supply of those who choose to work (l) is set to 0.4

Fixed leisure costs of work $\phi_{t,e}$ are calibrated to match the employment profiles in each educational and health group.[3] The fixed costs for people in good health $\phi_1(t,e)$ are assumed not to vary with age, whereas the additional fixed costs of people with bad health

[1] Given that we have an indivisible labor supply, this parameter cannot be pinned down using a moment in the data.

[2] The relative risk aversion over consumption is given by $-cu_{cc}/u_c = 1-\chi(1-\sigma)$.

[3] A person is defined as employed if he works at least 520 hours per year, earns at least $2,678 per year in base year dollars (this corresponds to working at least 10 hours per week and earning a minimum wage of $5.15 per hour), and does not report being retired or receiving Social Security benefits.

$\phi_2(t,e)$ are assumed to be a linear function of age.[4]

The Cobb-Douglas function parameter α is set at 0.33, which corresponds to the capital income share in the US. The annual depreciation rate δ is calibrated to achieve an interest rate of 4 percent in the baseline economy. The total factor productivity A is set such that the total output equals one in the baseline model.

A.2 Insurance status and medical expenditures

In the MEPS, the question about the source of insurance coverage is asked retrospectively for each month of the year. A person is defined as having employer-based insurance if he reports having ESHI for at least eight months during the year. The same criterion is used when defining public insurance and individual insurance status.

Medical costs in the model correspond to the total paid medical expenditures in the MEPS dataset. These include not only out-of-pocket medical expenses but also the costs covered by insurers. In the calibration, medical expense shock is approximated by a 5-state discrete Markov process. These 5 states are defined by dividing the medical expenditures for each age into 5 bins, using the 30^{th}, 60^{th}, 90^{th} and 99^{th} percentiles. The value of medical expenses in each bin is a coefficient on a corresponding age dummy in the regression of medical expenses on a set of age and year dummies. The estimated coefficients were smoothed with a cubic function of age.[5] The resulting profiles are shown in Figure A1.

[FIGURE A1.]

The parameter x_t^c that separates people into different medical expenses categories is

[4] The fixed costs of work are estimated jointly with the labor income process. The estimation of the labor income process is explained in more detail in Section A.6.
[5] The MEPS tends to underestimate the aggregate medical expenditures (Sing et al., 2002). To bring the average medical expenses computed from the MEPS in line with the corresponding statistics in the National Health Expenditure Account (NHEA), the estimated medical expenses were multiplied by 1.37 for people younger than 75 years old and by 1.93 for people older than 75 years old.

set to the 90th percentile of medical expenses distribution of the corresponding age. In other words, people whose medical expenses are in the lowest three bins are classified as healthy, whereas people whose medical expenses are in the highest two bins are classified as unhealthy. The transition matrix is constructed by measuring the fraction of people who move from one bin to another between two consecutive years separately for people of working age (25-64) and for retirees (older than 65).

The fraction of medical expenses covered by insurance policies $q(x_t, i_t)$ is estimated based on the MEPS. The fraction of medical spending covered by Medicare q_{med} is set to 0.5, following Jeske and Kitao (2009) and Attanasio et al. (2011).

A.3 Government

The tax function $T(y)$ takes the following form, as in Gouveia and Strauss (1994):

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

In this functional form, a_0 controls the marginal tax rate faced by the highest income group, a_1 determines the curvature of marginal taxes and a_2 is a scaling parameter. The parameters a_0 and a_1 are set to the original estimates in Gouveia and Strauss (1994), which are 0.258 and 0.768, respectively. The parameter a_2 is used to balance the government budget in the baseline economy. The proportional income tax τ_y is set to 6.62 percent to match the fact that approximately 65 percent of tax revenues come from income taxes that are approximated in the calibration by the progressive function $T(y)$. When considering policy experiments, we keep a_2 as in the baseline economy and adjust τ_y to balance the government budget.

The minimum consumption floor $c_{\min}$ is set to $2,700, following the estimates of De Nardi et al. (2010). The Social Security replacement rates were set to 40 and 30 percent of the average labor income for people with low and high education, respectively, reflecting the progressivity of the system.

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

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

A.4 Insurance sector

The share of the health insurance premium paid by the firm (ψ) was chosen to match the aggregate ESHI take-up rate. The resulting number is 76.3 percent. The proportional loads for group and individual insurance policies (γ) is set to 1.11 (Kahn et al., 2005). The fixed costs of buying an individual policy π is set to \$23 to match the aggregate fraction of people with individual insurance.

A.5 Offer rate

The probability of receiving an offer of ESHI coverage is a logistic function[6]:

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

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

[6] An individual is defined as having an offer if any member of his HIEU reports having an offer in at least two of three interview rounds during a year. Household heads whose income was below \$1,000 were excluded when estimating the logistic regression.

$$u_t = \eta_0^e + \eta_1^e \log(inc_t) + \eta_2^e[\log(inc_t)]^2 + \eta_3^e[\log(inc_t)]^3 + \eta_4^e 1_{\{g_{t-1}=1\}} + \Theta^e D_t \tag{25}$$

Here, $\eta_0^e, \eta_1^e, \eta_2^e, \eta_3^e, \eta_4^e$ and Θ^e are education-specific coefficients, inc_t is individual labor income (normalized by the average labor income), and D_t is a set of year dummy variables.[7],[8]

A.6 Labor income

Households are divided into two educational groups: high-school dropouts and people with at least a high-school degree. The fraction of each group in the population is 15 and 85 percent respectively. Individuals with different education and health have different productivity, which is specified as follows:

$$z_t^{e,x} = \lambda_t^{e,x} \exp(v_t)\exp(\xi_t) \tag{26}$$

where $\lambda_t^{e,x}$ is the deterministic function of age, education and health, and

$$v_t = \rho v_{t-1} + \varepsilon_t,\ \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \tag{27}$$

$$\xi_t \sim N(0, \sigma_\xi^2)$$

For the persistent shock v_t, ρ is set to 0.98 and σ_ε^2 to 0.018 following the incomplete market literature (Storesletten et al. (2004); Hubbard et al. (1994); Erosa et al. (2011); French (2005)). The variance of the transitory shock (σ_ξ^2) is set to 0.1 which is in the range estimated by Erosa et al (2011).

To identify the deterministic part of productivity $\lambda_t^{e,x}$, we need to take into account that in the data, we only observe labor income of workers and we do not know the potential

---

[7] The model's counterpart of the variable inc_t is individual productivity divided by the average productivity $\left(z_t^{e,x} / E\left(z^{e,x}\right)\right)$.

[8] In all experiments, the offer probability is the same as in the baseline. Aizawa and Fang (2012) use an equilibrium search model to examine how firms offering ESHI would respond if the tax subsidy were removed. They find only a small change in the equilibrium offer rate.

income of non-workers. To address this problem, we use the method developed by French (2005). We start by estimating the labor income profiles of workers based on the MEPS dataset. We do this by running a regression of labor income on a set of age and year dummies to control for time effects.[9] Then, we guess $\lambda_t^{e,x}$ and feed these productivity profiles into our model. After solving and simulating the model, we compute the average labor income profile of workers in our model and compare it with the income profiles estimated from the data. We adjust $\lambda_t^{e,x}$ until the labor income profile generated by our model is the same as in the data for each health group.

Tables A1 and A2 summarize the parametrization of the baseline model. The parameters in Table A1 were set outside the model, and the parameters in Table A2 were used to match the targeted statistics.

[TABLE A1.]

[TABLE A2.]

APPENDIX B. EFFECT OF TAX EXCLUSION REFORM

Table A3 shows the change in the insurance and employment behavior as a result of the tax subsidy reform before the ACA. Table A4 shows these changes after the ACA.

[TABLE A3.]

[TABLE A4.]

APPENDIX C. CHANGES INTRODUCED BY ACA

This section describes how the ACA provisions change the baseline model.

[9] Household labor income is defined as the sum of wages and 75 percent of the income from business.

C.1 Household problem

After the reform, a working-age household may be subject to penalties if he remains uninsured or may receive subsidies to buy *individual* health insurance. In addition, more households will be eligible for Medicaid. The eligibility for subsidies and the Medicaid expansion depends on a household's total income (y_t^{tot}), whereas penalties are a function of the taxable income (y_t). We can rewrite the budget constraint of a working-age household (4) in the following way:

$$\begin{aligned} k_t(1+r) + \overset{\circ}{w} z_t^{e,x} l_t + T_t^{SI} + Beq_e + Sub(y_t^{tot}, i_H^{'}) = \\ (1+\tau_c)c_t + k_{t+1} + x_t\left(1 - q(x_t, i_t)\right) + P_t + Tax + Pen(y_t, i_H^{'}). \end{aligned}$$

Here $Sub(y_t^{tot}, i_H^{'})$ and $Pen(y_t, i_H^{'})$ are subsidies and penalties, respectively. A household with income above 400 percent of the Federal Poverty Line (FPL) cannot receive subsidies. People having income below 400 percent of FPL and receiving an ESHI offer are eligible for premium subsidies in the individual market only if their employee's contribution $\left(\overset{\circ}{p}\right)$ exceeds 9.5 percent of their total income. The subsidy structure ensures that individuals within a certain income category do not spend more than a certain fraction of their income on health insurance. More specifically, spending on individual insurance premiums is limited to the percentage of total income shown in Table A5.[10]

[TABLE A5.]

The income eligibility threshold for the general Medicaid program is increased to 133 percent of FPL. There are no changes in the Medically Needy program. An uninsured person whose insurance premium in the individual market is less than 8 percent of his income must

[10] The subsidy function specified in the ACA is slightly more complicated: for each income category, it specifies the range of maximum premium spending as a fraction of income. We approximate this range by selecting the midpoint of a corresponding interval. For example, the range for the income category 133-150 percent of FPL is 3-4 percent, and we approximate it by the midpoint 3.5 percent.

pay a penalty. The penalty is determined by

$$Pen(y_t, i_H^{'}) = \max\{0.025 y_t, \$695\} \quad \text{if} \quad i_H^{'} = U$$

C.2 Insurance sector after the reform

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

$$p_I\left(\hat{t}\right) = (1+r)^{-1}\gamma \frac{\left(\int_{\mathbf{t}=\hat{t}} 1_{\{i_H^{'}(\mathbf{s})=I\}} EM\left(x_t, t\right)\Gamma\left(\mathbf{s}\right)\right)}{\int_{\mathbf{t}=\hat{t}} 1_{\{i_H^{'}(\mathbf{s})=I\}}\Gamma\left(\mathbf{s}\right)} + \pi .$$

Thus, after the reform the individual market premium p_I will be a function of age only.

C.3 Government constraint

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

$$\int\left[Tax\left(\mathbf{s}\right) + \tau_c c_t\left(\mathbf{s}\right)\right]\Gamma\left(\mathbf{s}\right) - G + \int_{t<R} Pen(y_t, i_H^{'})\Gamma\left(\mathbf{s}\right) =$$

$$\int_{t\geq R}\left[ss_e + q_{med}\left(x_t\right)x_t - p_{med}\right]\Gamma\left(\mathbf{s}\right) + \int T_t^{SI}\Gamma\left(\mathbf{s}\right) + \int_{t<R} 1_{\{i_H^{'}=M\}} q\left(x_t, 1\right)x_t\Gamma\left(\mathbf{s}\right) + \int_{t<R} Sub(y_t^{tot}, i_H^{'})\Gamma\left(\mathbf{s}\right)$$

The left-hand side now has an additional source of revenue - penalties from those unwilling to purchase insurance. The right-hand side has an additional expenditure - subsidies. To balance the government budget, we adjust $T\left(y_t\right)$ to make it more progressive.[11] More specifically, to achieve a balanced budget in the economy with the ACA provisions in place, we adjust the parameter a_0, which controls the marginal tax rate faced by the highest income group.

[11] More specifically, the reform increases the hospital insurance payroll tax on people with income above \$200,000 by 0.9 percent and imposes a 3.8 percent tax on unearned income for higher-income tax-payers (Kaiser Family Foundation, 2011). Our calibration strategy assumes a standard log-normal income process commonly used in the macro-literature, which cannot generate the empirical fraction of top earners. Because of this, we increase the progressivity of the general tax code to capture the main idea of financing the reform by taxing the rich more.

APPENDIX D. COMPUTATIONAL ALGORITHM

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

1. Guess an initial interest rate r, price in the group insurance market p, the amount the firm offering ESHI subtracts from the wage of their workers c_E, tax parameter a_2, and bequest Beq_e.[12]

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

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

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

The computation of the steady-state for the reformed economy is complicated by the fact that we now need to compute additional 40 prices (for each working age) in the individual community-rated market. We modified the algorithm above by guessing these 40 prices at Step 1 and updating them at Step 4.

[12] In general, insurance markets in which firms are not allowed to risk-adjust premiums, as in the group market, can have multiple equilibriums. However, because the major part of the premium is contributed by the employer, people are less sensitive to the price of insurance; thus, the multiplicity of equilibriums becomes less of an issue. In particular, our equilibrium price tends to be invariant to the initial guess.

Parameter name	Notation	Value	Source
Risk aversion	σ	5	
Consumption share	ù	0.6	French (2005)
Cobb-Douglas parameter	α	0.33	Capital share in output
Labor supply	l	0.4	
Cutoff medical expenses	x_t^c	90th percentile	
Consumption floor	$c_{\min}$	$2,700	De Nardi et al. (2010)
Tax function parameters:	a_0 a_1	0.258 0.768	Gouveia and Strauss (1994) "
Social Security replacement rates: - Below High-School - High-School & College	 ss_1 ss_2	 40% 30%	
Insurance loads	γ	1.11	Kahn et al. (2005)
Medicaid income threshold: - Medicaid - Medically Needy	 y^{cat} y^{need}	 64% 53%	 Data "
Asset test for Medically Needy	k^{pub}	$2,000	Data
Medicare premium	p_{med}	$1,055	Total premiums =2.11% of Y
Productivity shock: - Persistence parameter - Variance of innovations - Variance of transitory shock	 ρ σ_ε^2 σ_ξ^2	 0.98 0.018 0.10	 Heathcote et al. (2010) " Erosa et al. (2011)

Table A1

Parameters set outside the model

Parameter name	Notation	Value	Source/Target
Discount factor	β	0.992	$K/Y=3$
Depreciation rate	δ	0.07	$r=0.04$
Population growth	η	1.35%	% of people older than 65
Tax function parameter	a_2	0.652	Balanced government budget
Proportional tax	τ_y	6.62%	Composition of tax revenue
Fixed costs for insurance	π	$22.7	% of individually insured
Employer contribution	ψ	76.3%	ESHI take-up rate
Fixed costs of work			
Healthy:			
- low education	$\phi_1(1)$	0.2800	Employment profiles
- high education	$\phi_1(2)$	0.2650	“
Unhealthy, low educ:	$\phi_2(t,1)$		
- intercept		0.0200	“
- slope		0.0008	“
Unhealthy, high educ:	$\phi_2(t,2)$		
- intercept		0.0450	“
- slope		0.0025	“

Table A2

Parameters used to match some targets

	Employment (%)			Insurance (%)		
	All	LE	HE	Uninsured	Individual	MCD
Baseline	89.7	75.6	92.2	19.7	7.3	8.6
1. No tax subsidy	86.9	74.7	89.2	62.4	22.7	10.8
Tax subsidy only to a certain group:						
2. ($x_t = 1$ and age ≤ 55) or ($x_t = 2$ and age ≤ 43)	88.9	75.3	91.4	20.8	7.7	9.1
3. $x_t = 1$ + age-adj CR	88.9	75.5	91.3	18.1	7.5	9.1
4. $x_t = 1$ and income $<$ 2*FPL + age-adj CR	89.5	76.3	91.8	17.3	7.3	8.5

Table A3

The effects of tax subsidy reform before the ACA

	Employment (%)			Insurance (%)		
	All	LE	HE	Uninsured	Individual	MCD
Post-ACA baseline	89.1	79.8	90.8	8.9	18.5	10.1
1. No tax subsidy	88.3	79.9	89.8	31.1	24.2	10.4
Tax subsidy only to a certain group:						
2. ($x_t = 1$ and age ≤ 55) or ($x_t = 2$ and age ≤ 43)	88.6	79.8	90.1	9.6	18.8	10.3
3. $x_t = 1$ + age-adj CR	88.3	79.8	89.8	8.8	19.5	10.1
4. $x_t = 1$ and income $<$ 2*FPL + age-adj CR	88.6	80.1	90.0	8.6	19.2	10.1

Table A4

The effects of tax subsidy reform after the ACA

Maximum premium spending (% of income)	Income categories (% of FPL)
2.0	< 133
3.5	133-150
5.2	150-200
7.2	200-250
8.8	250-300
9.5	300-400

Table A5

Maximum spending on individual insurance after receiving subsidies

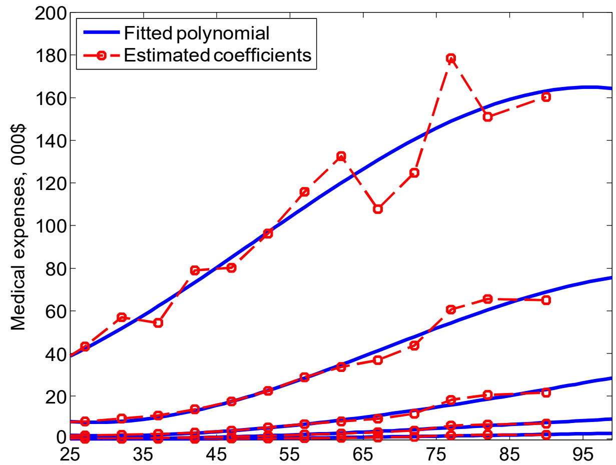

Figure A1

Medical expenses for each medical class