OA Online Appendix: Variation in Subsidy Amounts

We can extend our model to incorporate variation in the health insurance subsidy amounts that Massachusetts and ACA extend to subsets of the population. Thus far, we have modeled these subsidies as a share of the total cost of health insurance, μ_x, that is paid by the government. The subscript x indexes the magnitude of the subsidy, which varies based on income. Here, we specify three different income categories as values of x: I for the income category that is not eligible for any subsidies, II for the income category that is eligible for partial subsidies, and III for the income category that is eligible for full subsidies. Before reform, some individuals receive subsidies μ_{III}. After reform, some individuals receive fully subsidized coverage, and others with higher incomes receive partial subsidies μ_{II}. Individuals in the highest income categories do not qualify for any subsidies; therefore, $\mu_I = 0$.

As in the case of the individual mandate, the subsidies only affect an individual's labor supply if he *does* obtain health insurance through his employer. In the face of a penalty, he is *more* willing to work for health benefits instead of wages. However, if he is eligible for a subsidy for health insurance outside of employment, he is *less* willing to work for employer health insurance benefits instead of wages.[1]

Figure OA1: Graphical Model with Variation in Subsidy Amounts

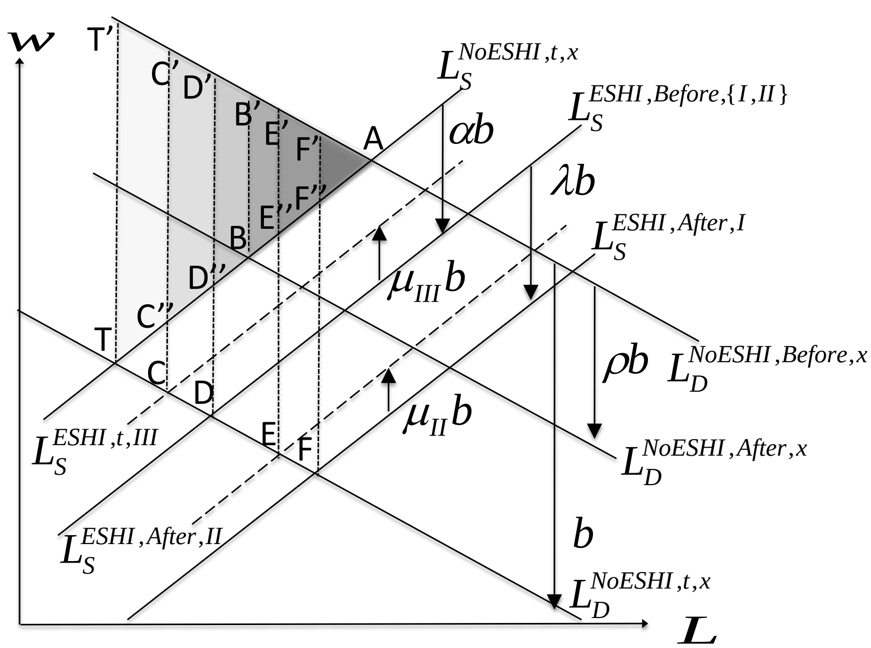

Figure OA1 shows the graphical model that incorporates variation in the subsidy amounts. Individuals who are eligible for a full subsidy but forgo it for ESHI before the reform have wages and hours given by C. They remain at C after the reform because the individual penalty does not

[1] This discussion assumes that health insurance does not affect an individual's ability to work. To the extent that it does, we could introduce separate L_S^{NoESHI} curves for individuals with and without any health insurance. We are unlikely to have enough variation to separate these two curves in our empirical implementation.

apply to them. Individuals who become eligible for a partial subsidy but forgo it for ESHI after the reform have wages and hours given by point E. Individuals with ESHI who are not eligible for any subsidies after the reform have wages and hours given by point F. The other equilibria are unchanged from the original model.

Figure OA1 incorporates the universe of equilibria under mandate-based health reform with three separate subsidy eligibility categories. There are six possible labor market equilibria (A through F) depicted, which depend on ESHI status and the values of the parameters. However, for any given individual, there are only four possible equilibria - equilibria with and without ESHI before and after reform. The first two columns of Table OA1 list the four relevant equilibria for each category of subsidy eligibility.

Table OA1: Wages in Terms of Coefficients by Subsidy Amounts

I: 300 FPL+

w_{AI}	noeshi, before	0
w_{BI}	noeshi, after	β_{11}
w_{DI}	eshi, before	β_8 [$+\beta_{8e}$]
w_{FI}	eshi, after	$\beta_1+\beta_8+\beta_{11}$ [$+\beta_{1e}+\beta_{8e}$]

II: 150 to 300 FPL

w_{AII}	noeshi, before	0
w_{BII}	noeshi, after	$\beta_7+\beta_{11}$
w_{DII}	eshi, before	$\beta_5+\beta_8$ [$+\beta_{5e}+\beta_{8e}$]
w_{EII}	eshi, after	$\beta_1+\beta_3+\beta_5+\beta_7+\beta_8+\beta_{11}$ [$+\beta_{1e}+\beta_{3e}+\beta_{5e}+\beta_{8e}$]

III: <150 FPL

w_{AIII}	noeshi, before	0
w_{BIII}	noeshi, after	$\beta_6+\beta_{11}$
w_{CIII}	eshi, before	$\beta_4+\beta_8$ [$+\beta_{4e}+\beta_{8e}$]
w_{CIII}	eshi, after	$\beta_1+\beta_2+\beta_4+\beta_6+\beta_8+\beta_{11}$ [$+\beta_{1e}+\beta_{2e}+\beta_{4e}+\beta_{8e}$]

OA.1 Identification

For identification of the additional parameters, we incorporate variation across subsidy eligibility categories. Table OA2 presents all of the sufficient statistics in terms of differences between equilibria. Within each subsidy eligibility category, we can estimate all possible sufficient statistics from the original model. For example, we can derive the slope of the supply curve within each of the three eligibility categories, resulting in sufficient statistics s_I, s_{II}, and s_{III}, as shown in the first three rows of the table. As drawn, our graphical model assumes that the slopes of the labor supply curves are the same within each category. We can test the assumption by allowing the slopes to vary within each eligibility category. We can identify all sufficient statistics identified by the baseline specification, using the same variation in the full specification.

Table OA2: Sufficient Statistics in Terms of Differences between Equilibria by Subsidy Amounts

Sufficient statistic	Expression in wages and employment
s_I	$\frac{w_{BI}-w_{AI}}{L_{BI}-L_{AI}}$
s_{II}	$\frac{w_{BII}-w_{AII}}{L_{BII}-L_{AII}}$
s_{III}	$\frac{w_{BIII}-w_{AIII}}{L_{BIII}-L_{AIII}}$
d_I	$\frac{w_{FI}-w_{DI}}{L_{FI}-L_{DI}}$
d_{II}	$\frac{w_{EII}-w_{DII}}{L_{EII}-L_{DII}}$
d_{III}	$\frac{w_{CIII}-w_{DIII}}{L_{CIII}-L_{DIII}}$
ρ_I	$\frac{d_I(L_{BI}-L_{AI})-(w_{BI}-w_{AI})}{b}$
ρ_{II}	$\frac{d_{II}(L_{BII}-L_{AII})-(w_{BII}-w_{AII})}{b_{II}}$
ρ_{III}	$\frac{d_{III}(L_{BIII}-L_{AIII})-(w_{BIII}-w_{AIII})}{b_{III}}$
b_I	$d_I(L_{FI}-L_{AI})-(w_{FI}-w_{AI})$
b_{II}	$d_{II}(L_{EII}-L_{AII})-(w_{EII}-w_{AII})$
b_{III}	$d_{III}(L_{CIII}-L_{AIII})-(w_{CIII}-w_{AIII})$
α_I	$\frac{s(L_{DI}-L_{AI})-(w_{DI}-w_{AI})}{b_I}$
α_{II}	$\frac{s_{II}(L_{DII}-L_{AII})-(w_{DII}-w_{AII})}{b_{II}}$
λ_I	$\frac{s(L_{FI}-L_{DI})-(w_{FI}-w_{DI})}{b_I}$
$\alpha_I+\lambda_I$	$\frac{s(L_{FI}-L_{AI})-(w_{FI}-w_{AI})}{b_I}$
$\alpha_{II}+\lambda_I-\mu_{II}$	$\frac{s_{II}(L_{EII}-L_{AII})-(w_{EII}-w_{AII})}{b_{II}}$
$\alpha_I-\mu_{III}$	$\frac{s_{III}(L_{CIII}-L_{AIII})-(w_{CIII}-w_{AIII})}{b_{III}}$
μ_{III}	$\alpha_I-\frac{s_{III}(L_{CIII}-L_{AIII})-(w_{CIII}-w_{AIII})}{b_{III}}$
μ_{II}	$\alpha_{II}+\lambda_I-\frac{s_{II}(L_{EII}-L_{AII})-(w_{EII}-w_{AII})}{b_{II}}$

In addition, we can separately identify the subsidy parameters from the other parameters by comparing across categories. For example, to identify μ_{III}, we first identify $\alpha-\mu_{III}$ by comparing individuals who are eligible for full subsidies who move from not having ESHI before the reform (equilibrium A) to having ESHI after the reform (equilibrium C). Next, we net this sum out of the value of α obtained from the category that is not eligible for any subsidies. We identify μ_{II} with a similar comparison across categories. We do note, however, that separate identification of each μ_x requires the assumption that α does not vary by subsidy eligibility group. Were we to relax that assumption, we could not separately identify subsidy effects from differences in the underlying valuation.

OA.2 Estimation

To estimate all of the relevant parameters of our model, we specify and estimate wage and hours equations of the following form:

$$Y_{it} = [\beta_1(MA*ESHI*After*Large)_{it} + \beta_2(MA*ESHI*1(<150FPL)*After*Large)_{it}+$$

$$\beta_3(MA*ESHI*1(150to300FPL)*After*Large)_{it}+\beta_4(MA*ESHI*1(<150FPL)*Large)_{it}+$$
$$\beta_5(MA*ESHI*1(150to300FPL)*Large)_{it}+\beta_6(MA*1(<150FPL)*After*Large)_{it}+$$
$$\beta_7(MA*1(150to300FPL)*After*Large)_{it}+\beta_8(MA*ESHI*Large)_{it}+$$
$$\beta_9(MA*1(<150FPL)*Large)_{it}+\beta_{10}(MA*1(150to300FPL)*Large)_{it}+$$
$$\beta_{11}(MA*After*Large)_{it}+\beta_{12}(ESHI*After*Large)_{it}+$$
$$\beta_{13}(ESHI*1(<150FPL)*After*Large)_{it}+\beta_{14}(ESHI*1(150to300FPL)*After*Large)_{it}+$$
$$\beta_{15}(ESHI*1(<150FPL)*Large)_{it}+\beta_{16}(ESHI*1(150to300FPL)*Large)_{it}+$$
$$\beta_{17}(1(<150FPL)*After*Large)_{it}+\beta_{18}(1(150to300FPL)*After*Large)_{it}+$$
$$\beta_{19}(ESHI*Large)_{it}+\beta_{20}(1(<150FPL)*Large)_{it}+\beta_{21}(1(150to300FPL)*Large)_{it}+$$
$$\beta_{22}(After*Large)_{it}+\beta_{23}(large)_{it}+(\phi_s*Large)_{it}+]$$
$$\beta_{1[e]}(MA*ESHI*After)_{it}+\beta_{2[e]}(MA*ESHI*1(<150FPL)*After)_{it}+$$
$$\beta_{3[e]}(MA*ESHI*1(150to300FPL)*After)_{it}+\beta_{4[e]}(MA*ESHI*1(<150FPL))_{it}+$$
$$\beta_{5[e]}(MA*ESHI*1(150to300FPL))_{it}+\beta_{6[e]}(MA*1(<150FPL)*After)_{it}+$$
$$\beta_{7[e]}(MA*1(150to300FPL)*After)_{it}+\beta_{8[e]}(MA*ESHI)_{it}+$$
$$\beta_{9[e]}(MA*1(<150FPL))_{it}+\beta_{10[e]}(MA*1(150to300FPL))_{it}+$$
$$\beta_{11[e]}(MA*After)_{it}+\beta_{12[e]}(ESHI*After)_{it}+$$
$$\beta_{13[e]}(ESHI*1(<150FPL)*After)_{it}+\beta_{14[e]}(ESHI*1(150to300FPL)*After)_{it}+$$
$$\beta_{15[e]}(ESHI*1(<150FPL))_{it}+\beta_{16[e]}(ESHI*1(150to300FPL))_{it}+$$
$$\beta_{17[e]}(1(<150FPL)*After)_{it}+\beta_{18[e]}(1(150to300FPL)*After)_{it}+$$
$$\beta_{19[e]}(ESHI)_{it}+\{\beta_{20[e]}(1(<150FPL)\})_{it}+\{\beta_{21[e]}(1(150to300FPL)\})_{it}+\beta_{22[e]}(After)_{it}+$$
$$\phi_s+\delta_i+\varepsilon_{it}$$

where all of the terms are as defined in the estimating equation in the paper, which is a special case of this equation. Because our data do not include information on subsidy eligibility, we proxy for subsidy eligibility with income categories. We assume that people above 300 percent of the federal poverty line (FPL) are not eligible for any subsidies before or after reform. People between 150 and 300 percent of FPL are eligible for partial subsidies after the reform, and we represent them with the indicator $1(150to300FPL)$. People under 150 percent of FPL are eligible for full subsidies before and after the reform, and we represent them with the indicator $1(<150FPL)$. We classify individuals into income groups using the first period of available data to avoid regressing wages on contemporaneous measures of income. Therefore, β_{20e} and β_{21e} are shown in $\{\}$ and omitted because they are collinear with the individual fixed effects. From the estimated coefficients, we can derive each of the sufficient statistics as shown in Table OA3.

Table OA3: Sufficient Statistics in Terms of Coefficients by Subsidy Amounts

Sufficient statistic	Expression in coefficients
s_I	$\frac{\beta_{11}}{\gamma_{11}}$
s_{II}	$\frac{\beta_7+\beta_{11}}{\gamma_7+\gamma_{11}}$
s_{III}	$\frac{\beta_6+\beta_{11}}{\gamma_6+\gamma_{11}}$
d_I	$\frac{\beta_1+\beta_{11}\ [+\beta_{1e}]}{\gamma_1+\gamma_{11}\ [+\gamma_{1e}]}$
d_{II}	$\frac{\beta_1+\beta_3+\beta_7+\beta_{11}\ [+\beta_{1e}+\beta_{3e}]}{\gamma_1+\gamma_3+\gamma_7+\gamma_{11}\ [+\gamma_{1e}+\gamma_{3e}]}$
d_{III}	$\frac{\beta_1+\beta_2+\beta_6+\beta_{11}\ [+\beta_{1e}+\beta_{2e}]}{\gamma_1+\gamma_2+\gamma_6+\gamma_{11}\ [+\gamma_{1e}+\gamma_{2e}]}$
ρ_I	$\frac{d_I(\gamma_{11})-(\beta_{11})}{b_I}$
ρ_{II}	$\frac{d_{II}(\gamma_7+\gamma_{11})-(\beta_7+\beta_{11})}{b_{II}}$
ρ_{III}	$\frac{d_{III}(\gamma_6+\gamma_{11})-(\beta_6+\beta_{11})}{b_{III}}$
b_I	$d_I\left(\gamma_1+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{8e}]\right)$ $-\left(\beta_1+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{8e}]\right)$
b_{II}	$d_{II}\left(\gamma_1+\gamma_3+\gamma_5+\gamma_7+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{3e}+\gamma_{5e}+\gamma_{8e}]\right)$ $-\left(\beta_1+\beta_3+\beta_5+\beta_7+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{3e}+\beta_{5e}+\beta_{8e}]\right)$
b_{III}	$d_{III}\left(\gamma_1+\gamma_2+\gamma_4+\gamma_6+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{2e}+\gamma_{4e}+\gamma_{8e}]\right)$ $-\left(\beta_1+\beta_2+\beta_4+\beta_6+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{2e}+\beta_{4e}+\beta_{8e}]\right)$
α_I	$\frac{s_I(\gamma_8\ [+\gamma_{8e}])-(\beta_8\ [+\beta_{8e}])}{b_I}$
α_{II}	$\frac{s_{II}(\gamma_5+\gamma_8\ [+\gamma_{5e}+\gamma_{8e}])-(\beta_5+\beta_8\ [+\beta_{5e}+\beta_{8e}])}{b_{II}}$
λ_I	$\frac{s_I(\gamma_1+\gamma_{11}\ [+\gamma_{1e}])-(\beta_1+\beta_{11}\ [+\beta_{1e}])}{b_I}$
$\alpha_I+\lambda_I$	$\frac{s_I(\gamma_1+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{8e}])-(\beta_1+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{8e}])}{b_I}$
$\alpha_{II}+\lambda_I-\mu_{II}$	$\frac{s_{II}(\gamma_1+\gamma_3+\gamma_5+\gamma_7+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{3e}+\gamma_{5e}+\gamma_{8e}])-(\beta_1+\beta_3+\beta_5+\beta_7+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{3e}+\beta_{5e}+\beta_{8e}])}{b_{II}}$
$\alpha_I-\mu_{III}$	$\frac{s_{III}(\gamma_1+\gamma_2+\gamma_4+\gamma_6+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{2e}+\gamma_{4e}+\gamma_{8e}])-(\beta_1+\beta_2+\beta_4+\beta_6+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{2e}+\beta_{4e}+\beta_{8e}])}{b_{III}}$
μ_{III}	$\alpha_I-\frac{s_{III}(\gamma_1+\gamma_2+\gamma_4+\gamma_6+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{2e}+\gamma_{4e}+\gamma_{8e}])-(\beta_1+\beta_2+\beta_4+\beta_6+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{2e}+\beta_{4e}+\beta_{8e}])}{b_{III}}$
μ_{II}	$\alpha_{II}+\lambda_I-\frac{s_{II}(\gamma_1+\gamma_3+\gamma_5+\gamma_7+\gamma_8+\gamma_{11}\ [+\gamma_{1e}+\gamma_{3e}+\gamma_{5e}+\gamma_{8e}])-(\beta_1+\beta_3+\beta_5+\beta_7+\beta_8+\beta_{11}\ [+\beta_{1e}+\beta_{3e}+\beta_{5e}+\beta_{8e}])}{b_{II}}$