Income Manipulation from Subsidized Health Insurance: Evidence from Massachusetts*

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Abstract

This paper analyzes the income manipulation to thresholds in eligibility for a subsidized program in the Massachusetts health insurance reform, the state-level precursor to federal health care reform. Using data from the American Community Survey, I test for the existence of income manipulation and find clear evidence around the thresholds of 150 percent and 300 percent of Federal Poverty Level. The lower threshold falls between plans with zero and positive out-of-pocket premiums, and the effect is concentrated among the self-employed. The higher threshold is the upper limit of income for the eligibility of subsidy, and is concentrated among wage workers. I also estimate the elasticity of labor supply with respect to wage rate using the manipulation evidence, and calculate the welfare loss due to the subsidized program.

Keywords: Massachusetts Health Reform, Health insurance subsidy, Income manipulation, Labor supply response

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1 Introduction

The U.S. health care reform created by the Affordable Care Act (ACA) relies heavily on subsidies to low- and middle-income households to ensure that health insurance purchased through health insurance marketplaces, the Exchanges, is affordable. While these subsidies expand insurance coverage, the income thresholds used for determining eligibility for subsidies may have the unintended effect of reducing incentives to work. This labor supply effect has been a major concern of the reform for both researchers and policymakers. The Congressional Budget Office (CBO) predicts that the ACA will decrease employment by 2 million in 2017 (CBO (2014)). While the employment reduction is affected by multiple polices such as Medicaid expansion and insurance mandate, the greatest impact is from the decrease of labor supply due to insurance subsidy in the Exchanges. Whether and how the population participate in the Exchanges is essential to detect the impact of subsidies to the work incentives in the labor markets.

Previous studies have shown that discrete income thresholds generated by the U.S. income tax schedule and social welfare programs have had a significant impact on labor supply, but current knowledge of the behavioral response to the subsidies in the health insurance Exchanges is very limited (Medicaid: Moffit & Wolf (1992), Yelowitz (1995); Income Tax: Saez (2010), LaLumia (2009); Social Security: Friedberg (2000)). The ACA regulates that individuals are eligible to purchase plans in the Exchanges, only if they have no access to other insurance such as employer-sponsored health insurance or Medicaid. The Exchange population have different social economic characteristics than the population eligible for other programs, suggesting that the estimates from other programs may not appropriate to apply to the Exchanges. Understanding the behavioral response to the Exchange subsidies is crucial for designing the subsidy schedule, projecting the federal budget, as well as estimating the social welfare impacts.

In this paper, I explore the potential for incentive effects of health insurance subsidies, and examine the magnitude quantitatively in the context of Massachusetts health reform, which is implemented in 2006. Since the Massachusetts health reform was a model for national health reform, the subsidy structure is similar to that in the ACA. Both subsidy schedules include multiple income eligibility thresholds with the value of the subsidy falling discretely when income exceeds one of these thresholds. Specifically, I examine the incentives of income manipulation for the population with income around those thresholds, and quantitatively estimate the impact of change of work incentive to the labor supply based on the evidence of income manipulation.

I begin by testing for behavioral response to the subsidy schedule. The subsidized program has a piecewise structure with multiple thresholds. Households with income slightly above the thresholds have incentives to lower their income in order to be eligible for greater subsidies. I use a Regression Discontinuity (RD) approach to explore changes in the income distribution around these thresholds, based on the assumption that the density of income would be continuous around thresholds in the absence of the discontinuous subsidy schedule, but may become discontinuous as enrollees move their income below a threshold (McCrary (2008)). I extend the McCrary approach by comparing the impacts between pre-reform and post-reform periods. This difference-in-difference RD approach takes into account other social programs, such as Medicaid, that may generate time-invariant discontinuities in the income distribution.

I explore the impacts empirically using data from the American Community Survey (ACS), a dataset providing a large enough sample to detect changes in the income distribution. The key variable is household income in relation to the Federal Poverty Level (FPL), which is the measure used to determine subsidies by the Exchanges. Income manipulation in this analysis refers to individuals' control of income that is used to determine the amount of subsidies. The manipulation could be achieved through underreporting of income, or change of labor supply. The income variable in the ACS comes from self-reported surveys, and may include measurement errors. However, since ACS is not used by the Exchanges to determine the subsidies, I assume that individuals have no incentive to misstate their income, or equivalently that the measurement error is not correlated with the subsidy schedule.

I find clear evidence of income manipulation in response to the subsidy schedule, by comparing the income density below and above the thresholds, and between pre-reform and post-reform periods. Among the four thresholds created by the subsidy schedule, income discontinuities emerge at 150 percent of FPL and 300 percent of the FPL.[1] The former is the threshold between plans with zero and positive out-of-pocket premiums, and therefore may be particularly relevant to low-income consumers. The latter is the upper limit of the income range for the eligibility of any subsidies, and is also the threshold with the largest benefit difference for consumers in the schedule. The manipulation around the threshold of 150 percent of FPL is concentrated among the self-employed, the group may be able to manipulate their income more easily. The manipulation around the 300 percent FPL is concentrated among wage-workers, who may only manipulate their income when they notice the existence of the subsidies, or the gains are large enough. These results are similar to findings in previous studies. Dague (2014) shows that consumers' reaction to premium changes in Medicaid is much larger in the zero to positive threshold than other thresholds. Saez (2010) reports that the bunching of earnings a kink in the Earned Income Tax Credit is concentrated among the self-employed.

In order to help interpret the magnitude of the observed changes, I apply a structural model of labor supply to estimate the supply elasticity with respect to the effective wage rate. Consumers face a tradeoff between income and leisure, and choose their level of effort, i.e., hours worked, to maximize utility. In the absence of insurance subsidies, wage income is the only source of income, and the optimal effort is identified from the income distribution in the pre-reform periods. After the implementation of health insurance subsidies, consumers adjust their effort, and the income distribution altered. The labor supply elasticity affects the magnitude of effort adjustment, and is identified from the changes of the income distribution between the pre- and post-reform periods.

Quantitatively, I find the labor supply elasticity to be small, around 0.01, implying that

[1] The four income thresholds are 150, 200, 250 and 300 percent of the FPL.

only the population in a limited income range around the thresholds respond to these incentives. Individuals who adjust their income from just above the threshold to just below benefit from less effort and greater total income (wage income plus the subsidy). Only individuals with higher income face a tradeoff between leisure and income, since, in order to reach the threshold, they must experience large income reductions that are not fully offset by the subsidies. The small labor supply elasticity suggests that individuals with incomes far above the threshold do not have strong incentives to change their effort to reduce income.

I also use the model to examine the implications of the supply response to the subsidies. The behavioral response generates inefficiency by deviating effort from the optimal level, so the decrease of wage income due to the subsidized program is a sufficient statistic of the welfare loss of consumers. The income reduction is estimated to be $2.8 million in 2008, which is only 0.4 percent of the total spending on subsidies of $628 million in that year. In the future, this model can also be used to predict the response of the Exchange population in the ACA where similar subsidy schedules are implemented, either at the state level or nationwide, and to estimate the labor supply elasticity for the ACA Exchange population when data is available.

My work is related to several distinct literatures. Recent studies have focused on the impacts of Massachusetts health care reform on insurance coverage for young adults (Long et al. (2010)) and children (Miller (2012)), insurance premiums (Graves & Gruber (2012)), low income families (Chan & Gruber (2010)), and other aspects (Ericson and Starc (2012), Chandra et al. (2010), Hackmann et al. (2012), Kolstad and Kowalski (2012b)). Two studies have concentrated on the labor markets. Kolstad and Kowalski (2012a) analyze Employer-Sponsored Health Insurance (ESHI), and find evidence of a substantial wage reduction associated with ESHI. Heim and Lurie (2014) show that the Massachusetts reform has decreased job separation. Instead of treating the multiple policy changes as a single reform, my paper focuses on the subsidized program. This approach is similar to Antwi et al. (2013) who focuses on the dependent coverage for young adults. Both the Massachusetts health reform and the ACA contain numerous provisions, with differential impacts by subpopulation. Because my model is calibrated on low- and middle-income individuals in Massachusetts, its results are well suited for predicting the impact of subsidized programs, i.e., the ACA, on low- and middle-income population.

Researchers have studied the labor market effects of insurance market reforms in several states besides Massachusetts, including Oregon (Baiker et al. (2013), Tennessee (Garthwaite et al. (2013)), and Wisconsin (Dague et al. (2013)). In each case, the evidence suggests a negative impact of public insurance provision on employment. While my findings are consistent with these papers, one advantage of my approach is its ability to predict behavioral response for the population targeted by the insurance subsidies in the ACA Exchanges.

My paper is also related to a literature on the incentive effects of the U.S. welfare system (see Moffit (1992) for a review). Previous studies have reported negative effects of welfare programs on labor supply. In Medicaid, for example, Winkler (1991) finds disincentive on female head labor supply. Moffitt & Wolfe (1992) find negative employment rate in Medicaid benefit. Pei (2012) examines labor supply response of parents whose children are eligible for CHIP, and finds no evidence of behavioral response. My work provides evidence of behavior change in the Massachusetts welfare program, and is helpful to examine the population response to the expansion of Medicaid in the ACA as well.

The methodology I use to model consumer tradeoffs between leisure and labor contributes to a growing literature that uses nonlinear budget constraints to estimate labor supply elasticity. For example, Brown (2013) estimates lifetime labor supply elasticity using a reform of the California teachers' pension system. Friedberg (2000) estimates the labor supply elasticity using the social security earnings test. my analytical framework is based on the model developed by Saez (2010), which I extend by embedding income uncertainty in the model to allow for the possibility that people cannot perfectly control their income.

The paper is organized as follows. Section 2 describes the subsidies in the Massachusetts reform and the national reform. Section 3 presents graphical evidence of income manipulation. Section 4 contains the structural model and estimation results. Section 5 assesses the welfare impact, and section 6 concludes.

2 Subsidized Insurance Program in the Massachusetts Reform and the National Reform

2.1 The Massachusetts Reform

In the Massachusetts reform, people are required to purchase insurance plans, or they have to pay penalties. In 2007, the penalty was $219, and in later years the penalty was up to 50 percent of the premium for the lowest cost plan available through the Health Connector, which is the marketplace for insurance plans in Massachusetts.[2] Three programs are provided to the non-elderly population who are not covered by the Employer Sponsored Health Insurance: MassHealth, Commwealth Care (CommCare), and Commonwealth Choice (CommChoice). MassHealth is the Medicaid program that provides free health insurance to low-income individuals. CommCare is a government-subsidized program targeted to the population with low and middle income. Only individuals with household income below 300 percent FPL are eligible for the program. CommChoice is an unsubsidized program. People who are not eligible for either MassHealth or CommCare can purchase plans in CommChoice by paying the full premiums. This paper focuses on the CommCare program, which involves 165,000 enrollees and $805 million government spending in 2009.

The CommCare program has a piecewise subsidy schedule, where four income thresholds (150 percent of the FPL, 200 percent FPL, 250 percent FPL, and 300 percent FPL) sort participants into four income tiers: 0-150 percent FPL, 150-200 percent FPL, 200-250 percent

[2]The information on the regulation in the health reform comes from reports published by the Division of Health Care Finance and Policy (2008-2010), and the Massachusetts Health Connector and the Department of Revenue (2007-2009).

FPL, and 250-300 percent FPL.[3] Health plans are provided by competing insurance firms. Within each tier one firm only provides one plan, and the same firm can provide different plans across tiers. Plans vary at several dimensions, such as benefit design, provider network, and premiums.

The out-of-pocket premium and cost-sharing are the two characteristics that differ for enrollees in different income tiers. I take the plans with the lowest premiums in each tier for example, and show details in Figure 1. In October 2008, the total premium is $396 per month for plan in all tiers, and the out-of-pocket premiums are $0, $39, $77, and $116 per month if their household income are within 0-150 percent FPL, 150-200 percent FPL, 200-250 percent FPL, and 250-300 percent FPL, respectively.[4] The information on out-of-pocket premiums is shown in the first row of Figure 1.

If household income are greater than 300 percent of FPL, people are only eligible for plans in the unsubsidized market, CommChoice, or pay penalties. In CommChoice three types of plans are provided with different generosities: Bronze, Silver, and Gold plans. The generosity of the plan for the 250-300 percent FPL in CommCare is between the level of generosity of Bronze and Silver plans in CommChoice, so individuals need to pay about $238 per month in the non-subsidized program, which is the mean of premiums for the lowest cost Bronze plan and lowest cost Silver plan, in order to obtain a comparable plan in the subsidized program.

For cost-sharing, plans vary at several dimensions, such as copayment, coinsurance rate, and out-of-pocket maximum. In general, the plans in lower income tiers are more generous than those in higher income tiers. For example, in 2011, the plan for 100-150 percent FPL has no copayment, no coinsurance, and a $200 maximum out-of-pocket payment for drugs, while the plan for 200-250 percent FPL has a copayment range from $15 to $250, according to different services, 10 percent coinsurance for medical equipment, and an $800 maximum out-of-pocket payment for drugs. For a typical enrollee, the cost-sharing is estimated as

[3] In 2008, the FPL for a family with a single person was $10,400, and the amount increases by $3,600 with an additional person included in the family.

[4] Premiums are the lowest priced plans available for a 35-year-old individual living in Boston. Data are rounded to the nearest whole dollar.

$0, $78, $265, and $265 per year if their household income are within 0-150 percent FPL, 150-200 percent FPL, 200-250 percent FPL, and 250 percent-300 percent FPL, respectively. The amounts of cost-sharing in different income tiers are shown in the second row in Figure 1. More details on the estimation of cost-sharing are shown in Appendix A1.

Therefore, the total expected out-of-pocket costs (premium plus cost-sharing) for enrollees are $0, $546, $1,189, and $1,657 among the four tiers, and the cost for unsubsidized plans are $3,121, which are displayed in the third row of Figure 1. The difference is $546, $643, $468, and $1,464 at the threshold of 150 percent FPL, 200 percent FPL, 250 percent FPL, and 300 percent FPL, respectively, which is shown in the fourth row in Figure 1. The cost differences provide large incentives for people with household income around those thresholds to lower their income. For example, the 150 percent FPL was $21,000 for a family of two in 2008. If both family members need to purchase plans from the CommCare program, the cost difference can be as high as $1,092 per year.

2.2 The National Reform

The schedule of the insurance subsidy in the national reform is different from the schedule in the Massachusetts reform. Instead of providing different plans for the population who falls in different income ranges, the same set of plans is available to all the population in the national reform. The low- and mid-income households bear lower costs than high-income households through receiving premium subsidy and cost-sharing subsidy, both of which vary by income levels.

The government provides tax credits to households with income up to 400 percent FPL, in order to reduce their premium costs. After receiving the subsidy, households pay the premium with no more than a specific percentage of their income. The details are shown in table 1. The low-income households receive higher subsidies, and pay less out-of-pocket premiums. The schedule is smooth at most income levels except two, 133 percent FPL and

400 percent FPL. The subsidy difference at the lower threshold is 1 percent of income, which is about $115 for a one-person household in 2014. At the greater threshold, individuals pay no more than 9.5 percent of income as out-of-pocket premium if the household income is below the threshold, or bear the full premium cost if the income is above the threshold. According to the Kaiser Health News (2014a, 2014b), the plan premiums vary from less than two thousand dollars to more than five thousand dollars per year, so the subsidy difference can be as high as a few thousand dollars[5].

The government also provides additional protection to households with income up to 250 percent FPL, in order to reduce cost-sharing. The low-income households receive higher subsidies and bear less cost-sharing. Table 2 shows the percentage of the costs the plans would cover, after the enrollees receive the cost-sharing subsidy. According to the schedule, a person with income around 150 percent FPL would have 7 percent of cost-sharing difference. The dollar amount of subsidy varies by individual, since it is based on the ex post health care costs of enrollees.

The largest subsidy difference for health insurance in the national reform is around 400 percent FPL. People with income around this threshold would have similar magnitude of incentives to manipulate income as for people with income around 300 percent FPL in the Massachusetts reform. People with income at other levels would have less incentive to control income, since the premium subsidy is smooth at other income levels, and the amount of the cost-sharing subsidy is uncertain ex ante.

Beside premium subsidy, a feature of "coverage gap" could also create incentives of the population to control income in the national reform. In the states without Medicaid expansion, a group of adults would fall in the gap that their incomes are neither low enough for Medicaid nor high enough for the insurance subsidy.[6] Those people have incentives to either decrease income to satisfy the Medicaid requirement, or increase income to receive subsidies

[5]These numbers are for the lowest-cost silver plan for a 40-year-old person

[6] More details of the coverage gap are discussed by Kaiser Family Foundation (2013).

to purchase insurance.

3 Regression Discontinuity on Income Distribution

3.1 Methodology

I use Regression Discontinuity (RD) methodology to test the existence of income manipulation. This approach was developed by McCrary (2008) and is based on the assumption that the density of the income would be continuous at the thresholds without program intervention, and the density is likely to be discontinuous when people are able to manipulate their income.

As McCrary (2008) states, the estimation proceeds in two steps. In the first step, a finely gridded histogram is obtained. In the second step, the histogram is smoothed by using local linear regression separately on either side of the threshold. McCrary (2008) proposes a formal test on the hypothesis that the discontinuity of the "running variable" at the threshold is zero. The test is based on an estimator for the discontinuity, θ, which is defined as the log difference between the left limit and the right limit of the density at the threshold of the running variable. Specifically, the form is

$$\theta = \ln \lim_{I \downarrow c} f(I) - \ln \lim_{I \uparrow c} f(I) \equiv \ln f^{+} - \ln f^{-},$$

where I is the running variable (in my case, income), $f(\cdot)$ is the density function, and c is the threshold.

The benefit of the RD approach is that it allows for point esitmation and inference. The parameter $\hat{\theta}$ is estimated as

$$\begin{aligned}\hat{\theta} &\equiv \ln \hat{f}^{+} - \ln \hat{f}^{-} \\ &= \ln\{\sum_{x_j>c} K(\tfrac{X_j-c}{h})\tfrac{S^{+}_{n,2}-S^{+}_{n,1}(x_j-c)}{S^{+}_{n,2}S^{+}_{n,0}-(S^{+}_{n,1})^2}Y_j\} \\ &\quad - \ln\{\sum_{x_j<c} K(\tfrac{X_j-c}{h})\tfrac{S^{+}_{n,2}-S^{+}_{n,1}(x_j-c)}{S^{+}_{n,2}S^{+}_{n,0}-(S^{+}_{n,1})^2}Y_j\},\end{aligned}$$

where $S^{+}_{n,k} = \sum_{X_j>c} K((X_j-c)/h)(X_j-c)^k$ and $S^{-}_{n,k} = \sum_{X_j<c} K((X_j-c)/h)(X_j-c)^k$.

McCrary (2008) proves that the $\hat{\theta}$ has the following normal distribution if certain conditions are satisfied:

$$\sqrt{nh}(\hat{\theta}-\theta) \xrightarrow{d} N(B, \frac{5}{24}(\frac{1}{f^{+}}+\frac{1}{f^{-}}))$$

where $B = \frac{H}{20}(\frac{-f^{+''}}{f^{+}} - \frac{-f^{-''}}{f^{-}})$, n is the number of observations, h is bandwith, and $h^2\sqrt{nh} \longrightarrow H \in [0,\infty)$.

3.2 Data

This paper uses data from the American Community Survey (ACS), which is part of the Decennial Census Program by the U.S. Census Bureau.[7] The survey includes monthly rolling samples of households, and the nationally-representative data have been available each year since 2000. I use the samples from 2005 and 2008 that include observations in both pre-reform and post-reform periods. The survey selected 1-in-100 sample households from the population; the sample size is around 27,000 households (65,000 individuals) each year. I

[7] To my knowledge, ACS is the only available data that is large enough to support this analysis, since it focuses on income distribution. The ideal data is the income tax data from the IRS, which has both a large enough sample size and less measurement error than the ACS data. However, the full sample income tax data was not available during the time I was finishing the project. The analysis can be replicated using the tax data when it is available in the future.

exclude individuals under the age of 19, who would be eligible for Medicaid if their household income is below 300 percent FPL, and individuals older than 64, who would be eligible for Medicare. I also exclude individuals with very high income (above 1,500 percent FPL) who would not be affected by the subsidized program. Samples from Connecticut and other years are also included for the robustness check.

Table 3 shows the descriptive statistics for the population in Massachusetts in 2005 and 2008 separately. The number of observations is 36,358 in 2005 and 36,231 in 2008. Mean age is about 42 in both years. The mean of household income is $78,134 in 2005, and $86,387 in 2008. There are about 27% of the population with household income below 300 percent FPL. the percentage of the population that falls in the income ranges of the subsidized program. The table also shows the statistics on sub-group populations by working status (wage worker, self-employed, and unemployed) and age (young being 19-35 and old being 36-64). The majority of the population are wage workers, and about one third of the samples are young adults.

Figure 2 shows the histograms of income distribution for households within income range 0-500 percent FPL in 2005, the pre-reform period, and in 2008, the post-reform period. The blue columns show the frequency of people with income just below each threshold. The graphs show weak evidence on income shift from the right to the left of the thresholds.

3.3 Graphical Evidence

This section shows the estimation results based on the RD methodology. Figure 3A reports the RD estimation at the first income threshold of 150 percent FPL in Massachusetts in 2008. The x-axis is the level of income as percent of FPL, and the y-axis is the income density. Dots represent the density at each income level from 0 percent to 1,500 percent of FPL. The curves are the local linear regression estimates using a triangle kernel based on the income density. The optimal binsize and bandwidth are selected automatically by the program provided by

McCrary (2008). The 95 percent of confidence interval is also shown in each graph.

Figure 3A illustrates the estimation in 2008 when the program was implemented, and the results show significant discontinuity at the threshold. The left limit of the density is higher than the right limit at the threshold. However, it is possible that the discontinuity at the threshold had existed before the reform, therefore I test the hypothesis in 2005 when the program was not implemented. The curve in Figure 3B is smooth and shows no discontinuity at the threshold. Combining results in both years, the graphical evidence suggests that the existence of income manipulation for people with income around the threshold of 150 percent of FPL in the post-reform period.

A statistic is constructed to quantitatively test the discontinuity, which is defined as $\theta_{diff} = \theta_{post} - \theta_{pre}$. θ_{post} is the log difference of the income density between the right and left limit of the threshold in the post-reform period, and θ_{pre} is the log difference in pre-reform period. The estimation and reference of θ_{post} and θ_{pre} are developed by McCrary (2008). θ_{diff} is the difference between θ_{post} and θ_{pre}, representing the change of income discontinuity between the pre-reform and post-reform periods. A negative value of θ_{diff} represents a shift of income distribution from the right to the left of the tested income level. The standard deviation σ_{diff} is defined as $\sigma_{diff}^2 = \sigma_{post}^2 - \sigma_{pre}^2$, where σ_{post} and σ_{pre} are the standard deviation for θ_{post} and θ_{pre}.[8]

Table 4 shows the estimation results. For the whole sample at 150 percent of FPL, θ_{05} is estimated as 0.047 with a standard deviation of 0.048, and θ_{08} is estimated as -0.186 with a standard deviation of 0.048. Therefore $\hat{\theta}_{diff}$ is -0.233 with standard deviation 0.096. The change of income discontinuity is significantly different from zero at 150 percent of FPL, and the income density shift from the right to the left of the threshold after the implementation of the program. As is stated before, 150 percent of FPL is the first income threshold in the subsidy schedule. This discontinuity is a similar finding as Saez (2010) who provides bunching evidence at the first kink point of the Earned Income Tax Credit. The 150 threshold also falls

[8]The definition is based on the assumption that samples in two periods are not correlated, since they are selected independently in different periods.

between plans with zero and non-zero out-of-pocket premiums. The evidence of discontinuity suggests that the population are sensitive to the choices between free and non-free insurance plans.

Table 4 also displays the estimations at other three income thresholds. The parameters $\hat{\theta}_{diff}$ are significantly different from zero at 300 percent of FPL, which is the threshold falling between plans with the largest subsidy difference. The population located around this threshold have the largest incentive to manipulate their income. The results do not suggest income manipulation at the other two thresholds, the 200 and 250 percent of FPL.

I also test income manipulation at other income levels. If the income manipulation is indeed caused by the specific program, the discontinuity should be observed at and only at the thresholds regulated by the subsidy schedule. Income discontinuity should not be found at other income levels. The estimation results are shown in Figure 4 and Figure 5. Figure 4 displays the results for $\hat{\theta}_{pre}$ and $\hat{\theta}_{post}$ in year 2005 and 2008, respectively, and Figure 5 displays the results for $\hat{\theta}_{diff}$ based on the estimations in pre- and post-reform periods. The x-axis indicates the income level as percent of FPL, from 50 to 500 percent of FPL, and the y-axis indicates the estimation of $\hat{\theta}$. The solid line reports the estimation results at every integer level of income, and the dashed lines show the 95 percent confidence interval.

Figure 5 support the conclusion that the subsidized program causes income manipulation of the population. Significant income discontinuity is shown at the income levels of 150 and 300 percent of FPL, which are the income thresholds according to the subsidy schedule. The negative values of $\hat{\theta}_{diff}$ indicate the shift of income density from the right to the left of the tested income levels. There is no significant negative discontinuity at other income levels. [9]

I also analyze the income manipulation for samples by working status and age. Figure 6 illustrates the estimation results on $\hat{\theta}_{diff}$ for wage workers and self-employed. The figures show that the income manipulation at the 300 percent of FPL is concentrated by wage

[9] Significant positive discontinuities are found at several other income levels. The positive value means a shift of income from the left to the right of the tested level. Unfortunately, I do not have a plausible explanation on this trend of income change.

workers, and the manipulation at the 150 percent of FPL is concentrated by self-employed. It is harder for wage workers to control their income, so the manipulation only happens at the threshold with the greatest incentives. The manipulation only happens at the first threshold for self-employed, which is a similar finding as Saez (2010) that the income distribution of self-employed bunches at the first kink point of the Earned Income Tax Credit.

For people with different ages, I expect to see a larger response for the old, who will have larger incentives to manipulate the income than the young. The old tend to be sicker than the young, so they will have higher values for insurance plans than the young. Figure 7 displays the estimation results. There are discontinuities at the thresholds of 150 percent FPL and 300 percent FPL for both samples, and I find that the two groups behave similarly to each other.

Three types of robustness check are conducted to support the conclusion that the subsidized program causes income manipulation. First, the bandwidth of the kernel RD estimation is varied to check the sensitivity of the results. The bandwidth for the main analysis is the optimal bandwidth defined by McCrary (2008), and is around 150 percent FPL. Another two levels of bandwidth, 100 percent FPL and 50 percent FPL, are selected to estimate $\hat{\theta}_{diff}$, and the results are shown in Figure 8. I find that the discontinuities at 150 percent FPL and 300 percent FPL are still significant in both cases.

Second, I change the sample year for the post-reform periods. The program is implemented in 2006, and the main results are based on the samples from year 2005 and 2008. Instead, I choose 2007 and 2009 as post-reform periods to estimate the discontinuity parameter θ_{diff}. The results are illustrated in Figure 9. The discontinuity at the 150 percent threshold still exists but not significant. The discontinuity at the 300 percent FPL is significant in both tests.

Third, I estimate the same parameter using samples from Connecticut, a control state where the population has a similar demographic distribution as in Massachusetts. Figure 10 shows the results. There are several discontinuities around the income levels 100 percent

FPL, 125 percent FPL, 150 percent FPL, and 300 percent FPL, which may be due to other policy changes between the two periods, and the magnitude of these discontinuities is smaller than that in Massachusetts.

4 Elasticity Estimation

In this section, I assume that the change of income all comes from the change of labor supply, and construct a structural model to estimate the labor supply elasticity with respect to wage rate. The methodology is largely based on the model developed by Saez (2010), and with two extensions. First, Saez (2010) observes a bunching pattern in the distribution of income and establishes a correspondence between the pattern and the elasticity. This approach requires a subjective setting on the bandwidth at which the bunching occurs. In my approach, I directly establish an MLE model, which eliminates subjective factors involved.

Second, Saez (2010) assumes that when agents choose their labor supply level, they are unaware of the income uncertainty they face, and hence choose the target income level exactly at the threshold. At the same time, he argues that in reality there is an uncertainty that affects the actual income the agents receive. In my model, I assume that people are aware of the income uncertainty and hence will manage the risk of not receiving the subsidy by further lowering their labor supplies. From the perspective of a researcher, I am able to detect the degree of income uncertainty in my model.

In the following part, Section 4.1 shows the model, Section 4.2 illustrates the estimation strategy, and Section 4.3 provides the estimation results.

4.1 Structural Model

There is a population of heterogeneous agents. Each agent i has an ability b_i. An agent has a utility function of two components, income I_i, and labor z_i. Her utility can be represented by a quasi-linear and iso-elastic function that has the same form as the utility function used by Saez (2010),

$$v_i(I_i, z_i) = I_i - \frac{b_i}{1+\frac{1}{\varepsilon}}(\frac{z_i}{b_i})^{1+\frac{1}{\varepsilon}},$$

where ε is the labor supply elasticity.

Income comes from two potential sources: the wage income W_i, and the subsidy S_i:

$$I_i = W_i + S_i.$$

The expected wage income is proportional to labor, with wage rate w. A disturbance of e_i also contributes to the wage income. The total wage income is

$$W_i = wz_i + e_i,$$

where the error term e_i has normal distribution, $e_i \sim N(0, \sigma^2)$, and is i.i.d.

A subsidy a_i, depending on family characteristics, is granted when the wage income is below an income threshold I^*:

$$S_i = \begin{cases} a_i & if\ W_i \leq I^* \\ 0 & if\ W_i > I^* \end{cases}.$$

Therefore the expected utility can be deduced as

$$Eu_i(z_i) = Ev_i(I_i(z_i), z_i) = wz_i + P(e_i \leq I^* - wz_i) \cdot a_i - \frac{b_i}{1+\frac{1}{\varepsilon}}(\frac{z_i}{b_i})^{1+\frac{1}{\epsilon}}.$$

When there is no subsidy, i.e., $a_i = 0$, the first-order condition (F.O.C.) of the expected utility is

$$\begin{array}{rcl} w & = & (1+\frac{1}{\varepsilon}) \cdot \frac{1}{b_i} \cdot \frac{b_i}{1+\frac{1}{\varepsilon}} \cdot (\frac{z_i}{b_i})^{\frac{1}{\epsilon}} \\ & = & (\frac{z_i}{b_i})^{\frac{1}{\epsilon}} \end{array}. \quad (1)$$

Re-arranging equation (1) yields $\varepsilon = \frac{\partial \ln z_i}{\partial \ln w}$, which shows that ε is the elasticity of labor supply with respect to the wage rate.

I focus on the impact of subsidy to labor supply, so it is convenient to set $w = 1$. In this case, the labor supply is $z_i = b_i$, which means that people will make their effort levels equal to their abilities when there is no subsidy.

Where there is a subsidy, the utility function is deduced as

$$Eu_i(z_i) = Ev_i(I_i(z_i), z_i) = z_i + \Phi(\frac{I^* - z_i}{\sigma}) \cdot a_i - \frac{b_i}{1+\frac{1}{\varepsilon}}(\frac{z_i}{b_i})^{1+\frac{1}{\epsilon}}.$$

Maximize utility function using F.O.C., and it becomes

$$1 + (\phi(\frac{I^* - z_i}{\sigma})(-1)) \cdot a_i - \frac{b_i}{1+\frac{1}{\varepsilon}}(1+\frac{1}{\varepsilon})(\frac{z_i}{b_i})^{\frac{1}{\varepsilon}}\frac{1}{b_i} = 0$$

$$\Rightarrow 1 - \phi(\frac{I^* - z_i}{\sigma})a_i - (\frac{z_i}{b_i})^{\frac{1}{\varepsilon}} = 0. \quad (2)$$

The equation (2) illustrates that the optimal effort level z is determined jointly by $(\varepsilon, \sigma, b, a, I^*)$. (ε, σ) are the parameters to be estimated, and I^* is the income threshold of the subsidized program that is exogenous in the model. I assume that ε, σ and I^* are the same for all the population. The ability b and the subsidy a are family-specific characteristics. There is no explicit expression $z(b, a|\varepsilon, \sigma, I^*)$ that maximizes this utility function, but it can be numerically solved. I denote the optimal effort level as $z(b, a)$ for the convenience of displaying MLE estimation strategy in the next subsection.

4.2 Estimation Strategy

For an individual i with ability level b_i, she chooses the effort level $z(b_i, a)$, and the density at income level I_i is $\phi(\frac{I_i - z(b_i,a)}{\sigma})$. I assume the ability has a distribution $g(b)$, so the overall density across all ability levels is

$$f_i(I_i; g(\cdot), \sigma, \varepsilon) = \int_0^{\infty} g(b) \cdot \phi(\frac{I_i - z(b,a)}{\sigma}) db.$$

The log likelihood function for the whole population is

$$l(\sigma, \varepsilon, g(\cdot)|I) = \frac{1}{N} \sum_{i=1}^{N} \ln \int_0^{\infty} g(b) \cdot \phi(\frac{I_i - z(b,a)}{\sigma}) db.$$

In practice, it is hard to identify the continuous distribution of $g(\cdot)$. Instead, I assume that the ability is distributed over a set of discrete points $\{b_1, b_2, \cdots, b_j, \cdots, b_J\}$. The probability of being b_j is g_j, and I denote $z_j(a) = z(b_j, a)$ and $g = \{g_1, g_2, \cdots g_j, \cdots, g_J\}$. Hence the likelihood function is

$$l(\sigma, \varepsilon, g|I) = \frac{1}{N} \sum_{i=1}^{N} \ln \sum_{j=1}^{J} g_j \cdot \phi(\frac{I_i - z_j(a)}{\sigma}).$$

Among the people with eligible income, only a fraction, p, of the them are affected by the program. Those who are not affected will choose the effort levels that equal to their abilities. The density of income for those people is $\phi(\frac{I_i - b_i}{\sigma})$. Therefore the likelihood function becomes

$$l(\sigma, \varepsilon, g|I) = \frac{1}{N} \sum_{i=1}^{N} \ln \sum_{j=1}^{J} g_j \cdot \left[p\phi(\frac{I_i - z_j(a)}{\sigma}) + (1-p)\phi(\frac{I_i - b_i}{\sigma}) \right]. \quad (3)$$

with constraints $\sigma > 0$ and $\varepsilon > 0$.

The distribution of ability $g(b)$ is estimated using the income distribution in the pre-reform periods when there is no subsidy. I assume that the distribution is stable over time. The labor supply elasticity ε and the standard deviation of income σ are then estimated based on estimated distribution of ability and the infomation in the post-reform period, including the distribution of income I, the subsidy a, and the fraction, p, of people who are affected by the program. Income distribution is directly observed from the data, the subsidies at different income thresholds are the amounts discussed in section 2, and the fraction p is inferred as 27.8% using statistics from public reports. Details of the calculation on p is provided in Appendix A2.

4.3 Estimation Results

Table 5 displays the estimation results at each income threshold for various samples: the whole population, wage workers, and self-employed. I include observations within 30 percent of FPL around the threshold in each estimation. For example, samples with income between 120 and 180 percent of FPL are included when estimating parameters at the threshold 150 percent of FPL. Column (1) shows the number of observation in each estimation. Column (2) provides the estimation results of the labor supply elasticity. I find that the elasticity is almost zero in all the scenarios, which means that the population is inelastic with respect to the change in wage rate.

Although the estimation of the elasticity is zero, it does not mean that people do not have incentive to manipulate their income. Figure 11 illustrates the income ranges affected by the program under different values of labor supply elasticity. People with income between the income threshold I^* and the threshold plus the subsidy $I^* + a$ will lower their income, even when the labor supply is inelastic. The elasticity affects people with income above

$I^* + a$. The greater the elasticity is, the more people with income above $I^* + a$ will lower their income. The elasticity also affects the selection of the targeted effort level. The higher the elasticity, the lower the optimal effort will be chosen.

One explanation for the small elasticity is that the income manipulation largely comes from the population with income slightly above the thresholds. While the benefits of controlling income are the same, people with greater income need to decrease their income more in order to be eligible for greater subsidy, hence they have fewer incentives to lower their income. In practice, individuals face other difficulties in controlling income, so it is possible that only those with large incentives have changed their income. This explains why I have observed clear evidence of income discontinuity and estimated small elasticity of labor supply.

Column (3) in Table 5 shows the estimation of the standard deviation of income. The results are around 0.1 for all the scenarios, which are interpreted as the standard deviation of income is about 0.1 percent of FPL. For a single person, the FPL is about $10,000, so the standard deviation is $10. The results suggest that the income levels are stable for low- and middle-income individuals, and the small variation would have little impacts on the income manipulation of the subsidized program.

5 Welfare Impact

The welfare loss of the subsidized program is measured as the income decrease after the implementation of the program. The dollar value of the reduced income, ΔI, is defined as $\Delta I = P \cdot f \cdot \bar{\delta}$, where P is the number of population falling in the affected income range who have incentive to lower their income, f is the fraction who indeed changed their income, and $\bar{\delta}$ is the average amount of reduced income. Table 6 displays the calculation process and the results. The total welfare loss due to the subsidized program is estimated as $2.8 million in 2008. The details of the estimation are provided as follows.

Welfare loss happens only around the thresholds of 150 and 300 percent of FPL, since there is no evidence of income manipulation at the other two thresholds. Based on the affected income ranges, which are predicted by the parameters estimated from the structural model, the potential affected population, P, is estimated as 34,656 at the 150 threshold and 118,047 at the 300 threshold.

As is mentioned above, in practice people face difficulties in varying their income, such as they cannot change the working contract in short term. The information in Connecticut, a control state, and Massachusetts, the experimental state, is used to estimate the number of population who indeed changed their income after the implementation of the program. I calculate the percentage of population falling in the affected income range for the two states in both pre- and post-reform periods. The difference-in-difference percentage shows the fraction of the population who changed their income after the reform in Massachusetts. The results are 2.76 percent at the threshold of 150 percent of FPL, and 2.83 percent at the 300 threshold.

The average reduced income is determined by the affected income ranges. I assume that people uniformly distributed within the ranges, so the amount of the reduced income equals half of the length of the income range. For example, the affected range is 149.7 to 159.7 percent of FPL at the 150 threshold, and the income change is 5 percent of FPL. The reduced income is then converted to dollar value. The conversion is affected by family size, since FPL is defined according to family structure. Without loss of generosity, I assume that half of the population come from single-person families, and half of them come from two-person families. Under the assumption and the level of FPL, I calculate the average income decrease is $349.5 at the 150 threshold and $751.3 at the 300 threshold.

6 Conclusion and Discussion

limitation: intensive effects, not extensive

not estimate other welfare loss, such as tax transfer

this is short term impact, may have larger impact in the long run

My analysis has found substantial evidence of income discontinuity at the thresholds of 150 percent FPL and 300 percent FPL of the subsidized program in the Massachusetts reform. The 150 percent FPL is the first threshold and falls between plans charging enrollees zero and non-zero out-of-pocket premiums; this discontinuity is concentrated among the self-employed. The 300 percent FPL is the threshold with the largest subsidy difference, and the effect is concentrated among the wage workers. By examining income discontinuity at other income levels as well as a control state, I conclude that the subsidized program causes income manipulation of the potential eligible population.

I construct a model with income uncertainty to estimate labor supply elasticity as well as income variation. The results suggest that the two factors have little impact on the behavioral response to the subsidized program. I simulate the impacted income range based on the estimation results, and assess the welfare loss due to the program. I find that the reduced income, possibly due to reduced labor supply, is about $2.8 million in 2008.

This study is helpful to predict the behavioral response to the insurance subsidies as well as the welfare impacts of the programs in the national reform. The subsidy schedule regulated by the ACA creates similar benefit difference for individuals with income around 400 percent FPL. These people have incentives to manipulate income in order to be eligible for the subsidy. In addition, in states without Medicaid expansion, individuals who fall in the coverage gap have incentives to either decrease income for Medicaid enrollment, or increase income in order to be eligible for insurance subsidy. These features could generate bunching at the thresholds on the income distribution, and the behavioral change could also causes social welfare loss.

The framework of the estimation on elasticity and income variation can be applied to any programs that generate nonlinear budget constraints, such as Medicaid. Income thresholds exist in almost all welfare programs. When people are aware of the threshold information, they will have incentive to manipulate their income. One valuable study could be to explore how much information the population are aware on the subsidized program, especially the regulation on thresholds.

A concern of using the ACS data is that the income is self-reported, and respondents may underreport or overreport their income levels. The results are not affected, if the trend of misreporting is time consistent. The difference-in-difference measure cancels out the time-invariant change of income distribution between two periods. The results should be biased if the population intentionally misreport their income after the implementation of the reform. This is unlikely to happen because the ACS is not designed specifically for the reform, and the level of reported income would not affect the actual eligibility of the subsidized program.

One limitation of this research is that I am not able to identify which individuals are directly affected by the program. My work focuses on income distribution, and the ACS is the only dataset that provides a large enough sample. However, the ACS does not have the information on the type of insurance coverage in both pre- and post-reform periods, so I can only include all the population with eligible income levels in my analysis.[10] In the national reform where the policy change is implemented in 2014, the impacts of those programs should be estimated more accurately by differentiating directly and indirectly affected population.

Another limitation is that when estimating the labor supply elasticity, I assume the change of income all comes from the change of labor supply. There are different ways to change income, and the change of labor supply is among one of them. It is more interesting to identify the source of income change. In addition, a future research could be to explore the ways the population use to control labor supply, such as reduce working hours or change to a job with lower wage rate.

[10] The ACS starts to provide the information on the type of insurance coverage in 2008.

References

Antwi Y. A., Moriya A. S., Simon K., 2013. Effects of Federal Policy to Insure Young Adults: Evidence from the 2010 Affordable Care Act's Dependent-Coverage Mandate. American Economic Journal: Economic Policy 5(4), 1-28.

Baiker K., Finkelstein A., Song J., Taubman S., 2013. The Impact of Medicaid on Labor Force Activity and Program Participation: Evidence from the Oregon Health Insurance Experiment. American Economic Review: Papers & Proceedings 2014, 104(5): 322–328

Brown K. M., 2013. The Link between Pensions and Retirement Timing: Lesson from California Teachers. Journal of Public Economics 98, 1-14.

Chan D., Gruber J., 2010. How Sensitive are Low Income Families to Health Plan Prices? American Economic Review: Papers & Proceedings 100, 292-296.

Chandra A., Gruber J., McKnight R., 2010. Patient Cost Sharing in Low Income Populations. American Economic Review: Papers & Proceedings 100, 303-308.

Cogressional Budget Office, 2014. The Budget and Economic Outlook: 2014 to 2024, Appendix C: Labor Market Effects of the Affordable Care Act: Updated Estimates, 117-127. [Accessed on April 3rd, 2014] URL: http://www.cbo.gov/sites/default/files/cbofiles/attachments/45010-breakout-AppendixC.pdf

Dague L., 2014. The Effect of Medicaid Premiums on Enrollment: A Regression Discontinuity Approach. Journal of Health Economics 37, 1-12.

Dague L., DeLeire T., and Leininger L., 2013. The Effect of Public Insurance Coverage for Childless Adults on Labor Supply. Unpublished.

Division of Health Care Finance and Policy, 2008-2010. Health Care in Massachusetts: Key Indicators. URL (February 2011 Edition): http://www.mass.gov/chia/docs/r/pubs/11/2011-key-indicators-february.pdf

Ericson K. M., Starc A., 2012. Heuristics and Heterogeneity in Health Insurance Exchanges: Evidence from the Massachusetts Connector. American Economic Review: Papers & Proceedings 102(3), 493-497.

Friedberg L., 2000. The Labor Supply Effects of the Social Security Earnings Test. The Review of Economics and Statistics 82(1), 48-63.

Graves J. A., Gruber J., 2012. How Did Health Care Reform in Massachusetts Impact Insurance Premiums? American Economic Review: Papers & Proceedings 102(3), 508-513.

Garthwaite C., Gross T., Notowidigdo M. J., 2013. Public Health Insurance, Labor Supply, and Employment Lock. NBER working paper 19220.

Hackmann M. B., Kolstad J. T., Kowalski A. E., 2012. Health Reform, Health Insurance, and Selection: Estimating Selection into Health Insurance Using the Massachusetts Health Reform. American Economic Review: Papers & Proceedings 102(3), 498-501.

Health Connector, 2010. Health Reform Facts and Figures: March 2010. URL: https://www.mahealthconnector.org/portal/site/connector/menuitem.d7b34e88a23468a2dbef6f47d7468a0c/?fiShown=default

Heim B. T., Lurie, I. Z., 2014, Does Health Reform Lead to Increased Job Mobility? Evidence from Massachusetts. Unpublished.

Kaiser Health News, 2014a. The 10 Least Expensive Health Insurance Markets in the U.S..[Accessed on Feb 13, 2014] URL: http://www.kaiserhealthnews.org/Stories/2014/February/13/10-Least-Expensive-Health-Insurance-Markets-In-US.aspx?utm_campaign=KFF%3A+The+Latest&utm_source=hs_email&utm_medium=email&utm_content=11979925&_hsenc=p2ANqtz--nAFG9BLYXuynhwjzMjfZnjt21hjvKiBzzWzXfwNd1WSk6dcGYV1wHlz6vUg4WvOh-nbwVyg-eRLXnPEnOvSwAwqcUSQ&_hsmi=11979925

Kaiser Health News, 2014b. The 10 Most Expensive Health Insurance Markets in the U.S..[Accessed on Feb 13, 2014] URL: http://www.kaiserhealthnews.org/Stories/2014/February/03/most-expensive-insurance-markets-obamacare.aspx?utm_campaign=KFF%3A+The+Latest&utm_source=hs_email&utm_medium=email&utm_content=11979925&_hsenc=p2ANqtz--pWnZXwO0fZ3Calt_HFvpUZNT6AAtntCinW8R3zCuPW_xULq-xONk3inG_0JgOPD5wZcNDhtZiZG0YWcDjPErhGm2RSA&_hsmi=11979925

Kaiser Family Foundation, 2013. The Coverage Gap: Uninsured Poor Adults in States that Do Not Expand Medicaid. [Acceessed on Feb. 21, 2014] URL: http://kff.org/health-reform/issue-brief/the-coverage-gap-uninsured-poor-adults-in-states-that-do-not-expand-medicaid/

Kolstad J. T., Kowalski A. E., 2012a. Mandate-Based Health Reform and the Labor Market: Evidence from the Massachusetts Reform. Unpublished.

Kolstad J. T., Kowalski A. E., 2012b. The Impact of an Individual Health Insurance Mandate on Hospital and Preventive Care: Evidence from Massachusetts, Journal of Public Economics 96 (11-12), 909-929.

LaLumia S., 2009. The Earned Income Tax Credit and Reported Self-Employment Income. National Tax Journal 62(2): 191-217.

Long S. K., Yemane A., Stockley K., 2010. Disentangling the Effects of Health Reform in Massachusetts: How Important Are the Special Provisions for Young Adults? American Economic Review: Papers & Proceedings 100, 297-302.

Massachusetts Department of Revenue, 2008. Data on the Individual Mandate and Uninsured Tax Filers: Tax Year 2007. URL: http://www.mass.gov/dor/docs/dor/news/pressreleases/2008/2007-demographic-data-report-final-2.pdf

Massachusetts Health Connector and Department of Revenue, 2010. Data on the Individual Mandate: Tax Year 2008. URL: http://archives.lib.state.ma.us/bitstream/handle/2452/113592/ocn769687107.pdf?sequence=1

Massachusetts Health Connector and Department of Revenue, 2011. Data on the Individual Mandate: Tax Year 2009. URL: http://www.mass.gov/dor/docs/dor/health-care/2011/2009-health-care-report.pdf

McCrary J., 2008. Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test. Journal of Econometrics 142, 698-714.

Miller S., 2012. The Impact of the Massachusetts Health Care Reform on Health Care Use Among Children. American Economic Review: Papers & Proceedings 102(3), 502-507.

Moffit R., 1992. Incentive Effects of the U.S. Welfare System: A Review. Journal of Economic Literature XXX, 1-61.

Moffit R., Wolfe B., 1992. The Effect of the Medicaid Program on Welfare Participation and Labor Supply. The Review of Economics and Statistics 74(4), 615-626.

Pei Z., 2012. Eligibility Recertification and Dynamic Opting-in Inceitives in Income-tested Social Programs: Evidence from Medicaid/CHIP. Unpublished.

Saez E., 2010. Do Taxpayers Bunch at Kink Points? American Economic Journal: Economic Policy 2, 180-212.

Schwartz A., Wallace, J., 2014. The Subsidy Cliff: Incentives For Increasing Projected Income To Qualify For Exchange Subsidies. Health Affairs, April 29th, 2014.

Winkler A. E., 1991. The Incentive Effects of Medicaid on Women's Labor Supply. The Journal of Human Resources 26(2), 308-337.

Yelowitz A. S., 1995. The Medicaid Notch, Labor Supply, and Welfare Participation: Evidence from Eligibility Expansions. The Quarterly Journal of Economics 110(4), 909-939.

Figure 1. Cost Difference for Enrollees in the Plans with the Lowest Premiums in Different Income Tiers

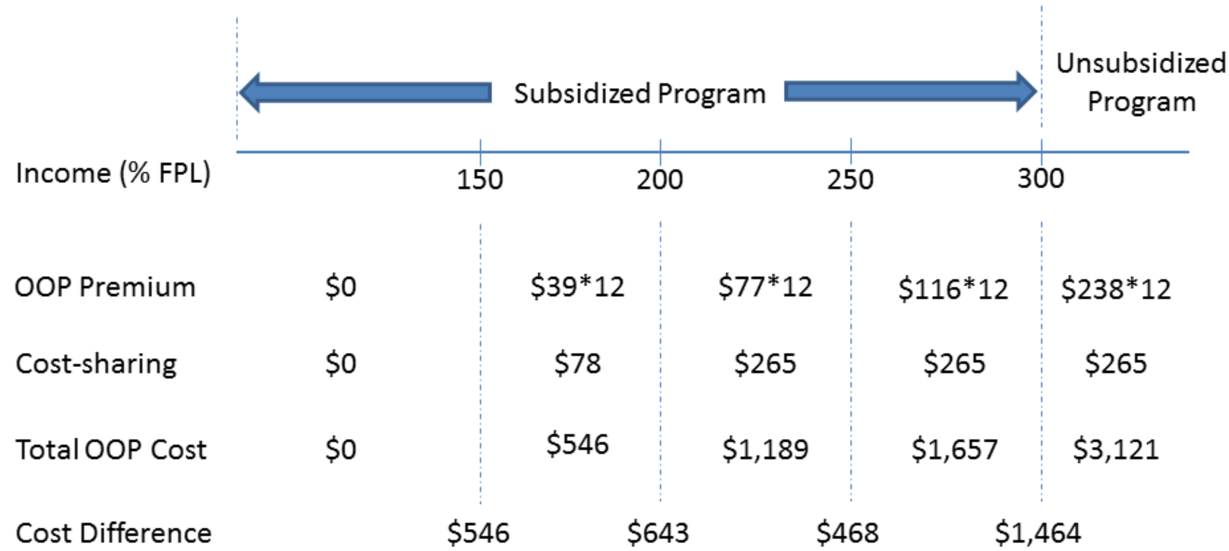
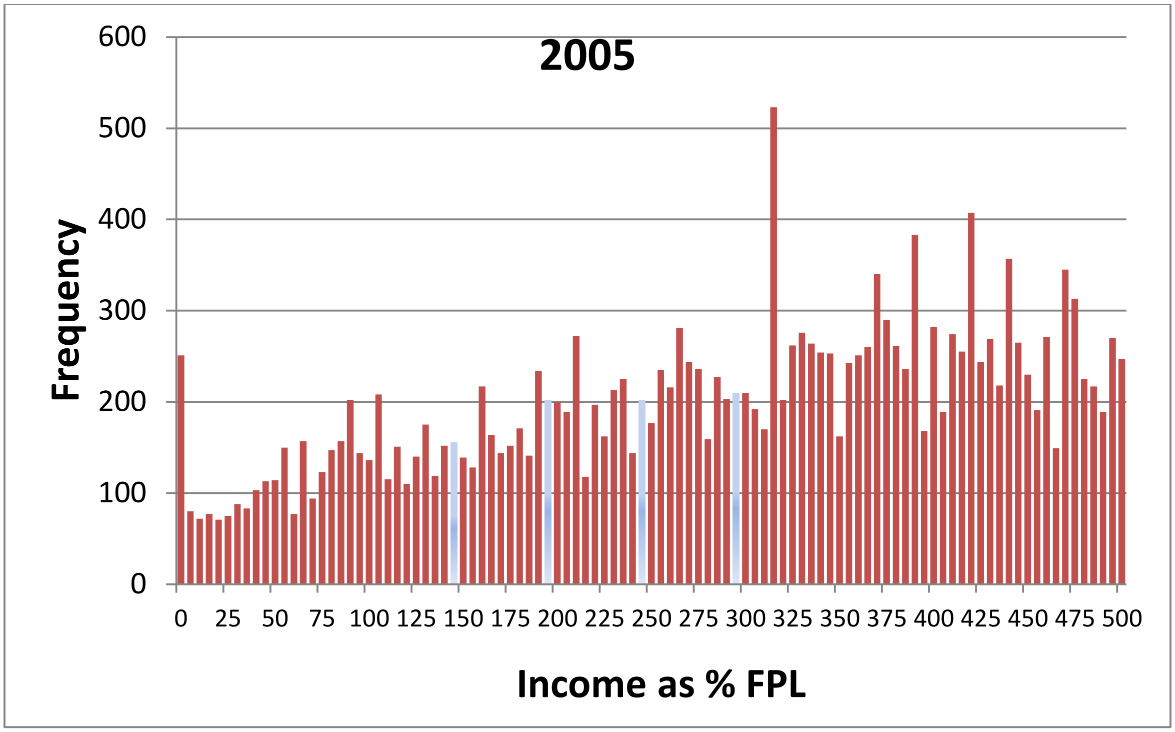


Figure 2. Income Distribution by FPL in 2005 and 2008



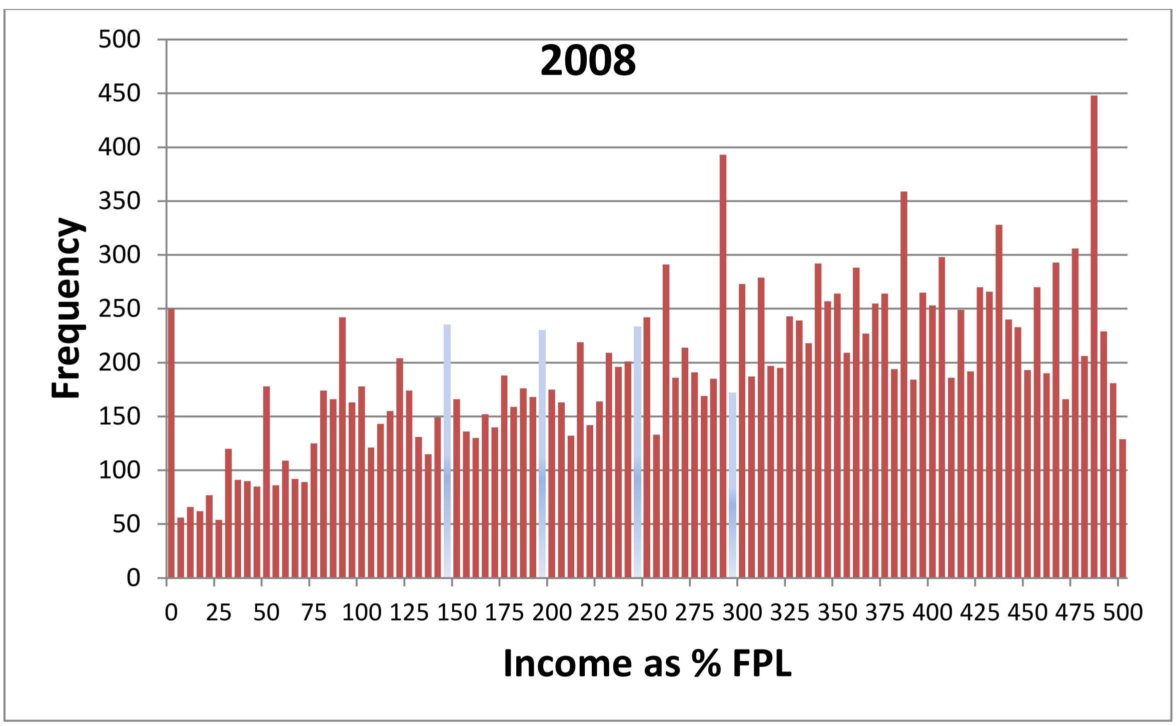


Figure 3. RD Estimation at the Threshold of 150 percent FPL in 2005 and 2008

Figure 3A. 2008, binsize: 3.3, bandwidth: 143.7, $\hat{\theta}$: -0.186 (0.048)

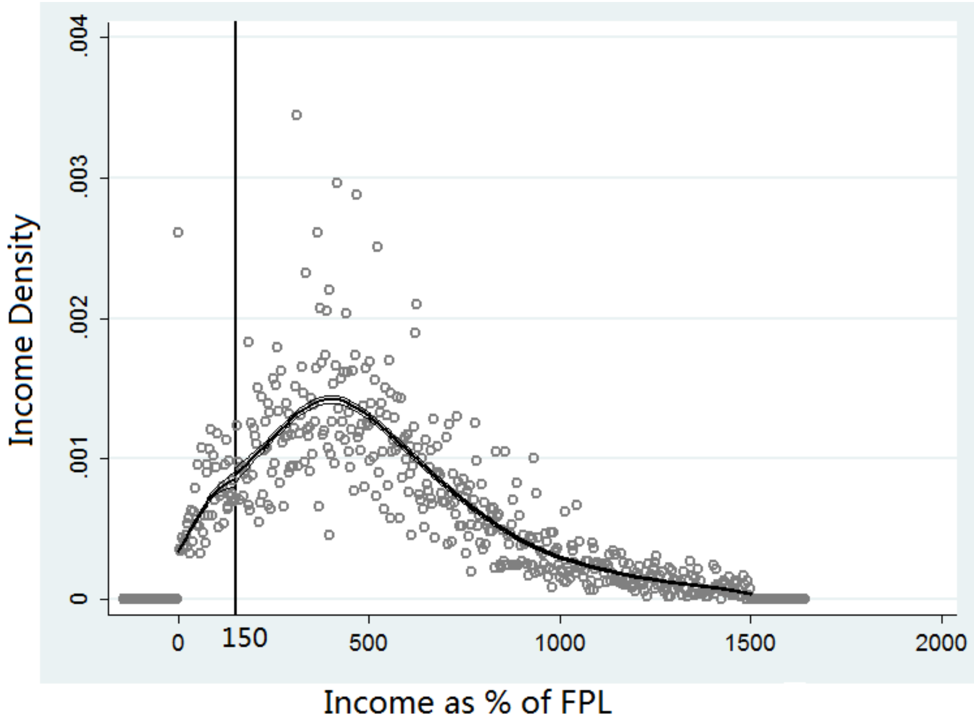
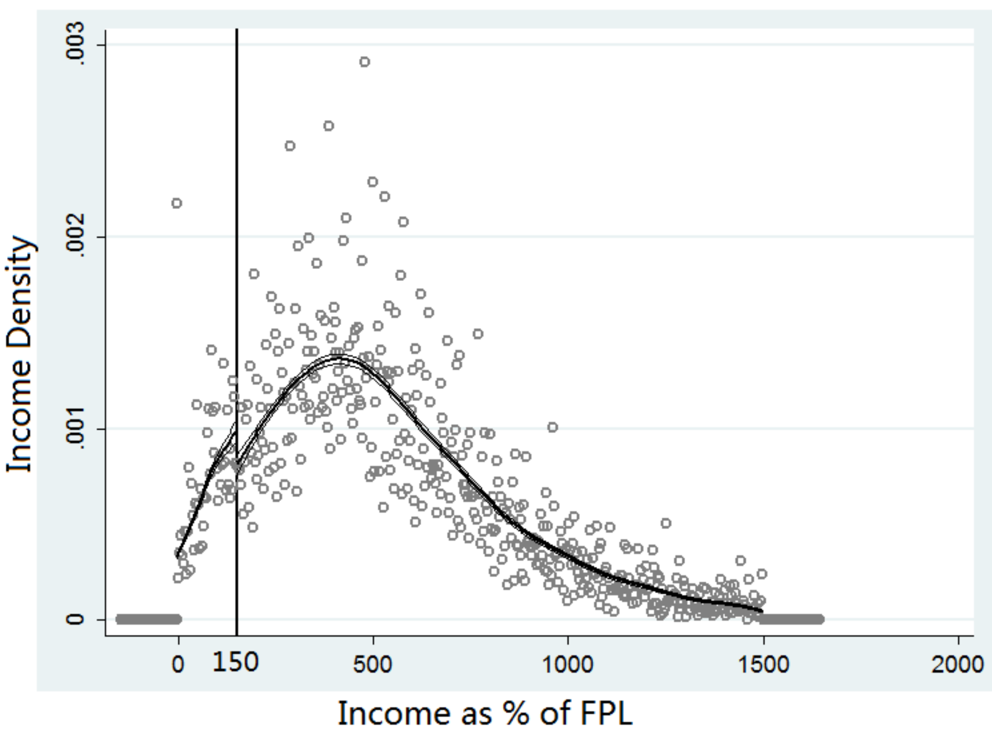


Figure 3B. 2005, binsize: 3.2, bandwidth: 141.7, $\hat{\theta}$: 0.047 (0.048)



Note: The standard deviation of $\hat{\theta}$ is shown in the parentheses.

Figure 4. Estimation Results on $\hat{\theta}_{\text{pre}}$ and $\hat{\theta}_{\text{post}}$ in 2005 and 2008

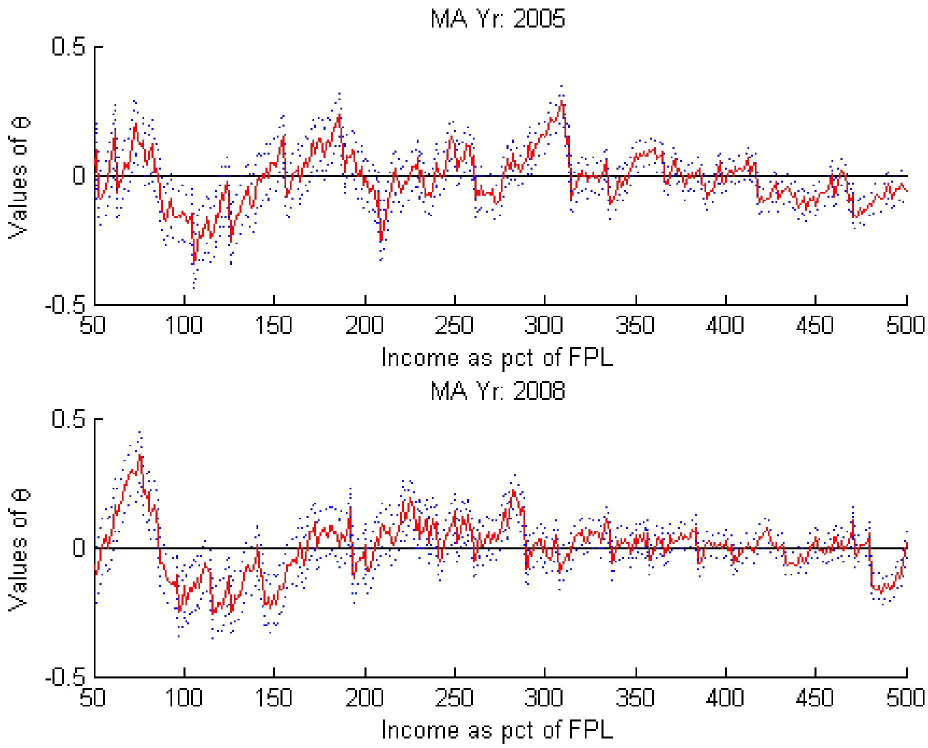


Figure 5. Estimation Results on $\hat{\theta}_{\text{diff}}$ between 2005 and 2008

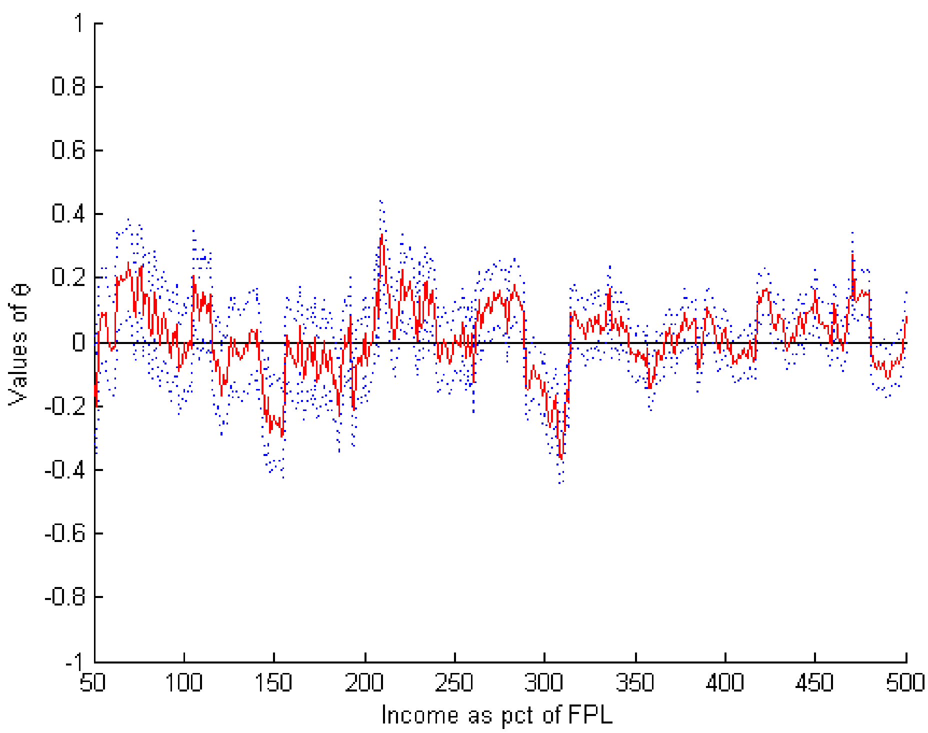


Figure 6. Estimation Results on $\hat{\theta}_{diff}$ between 2005 and 2008: Wage Workers Versus Self-employed

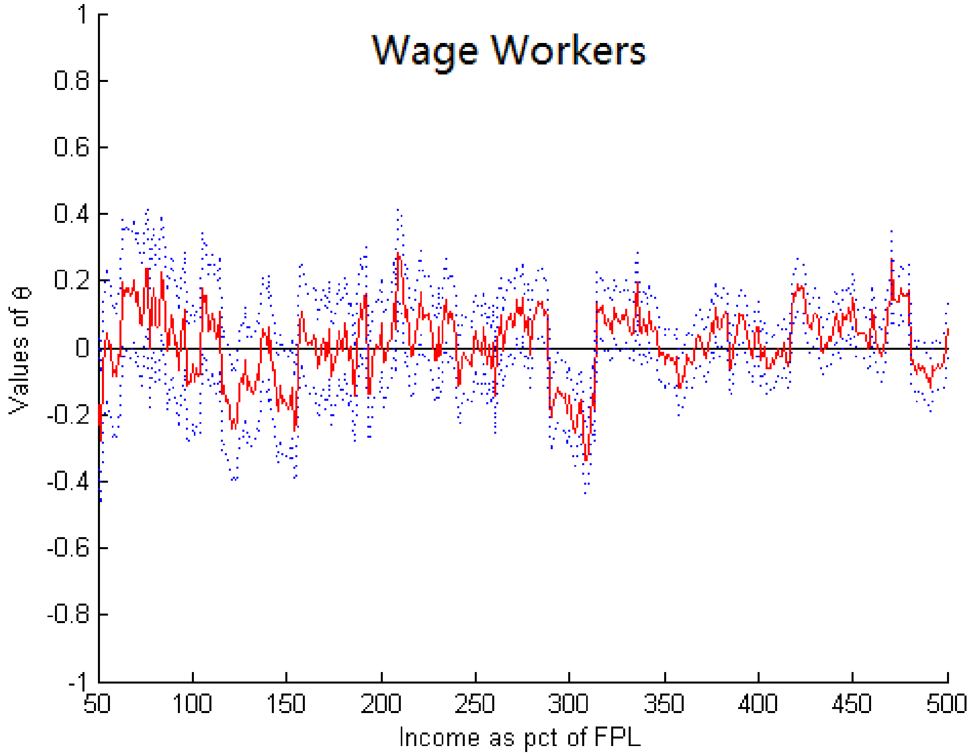


Figure 7. Estimation Results on $\hat{\theta}_{diff}$ between 2005 and 2008: Young (19-35) Versus Old (36-64)

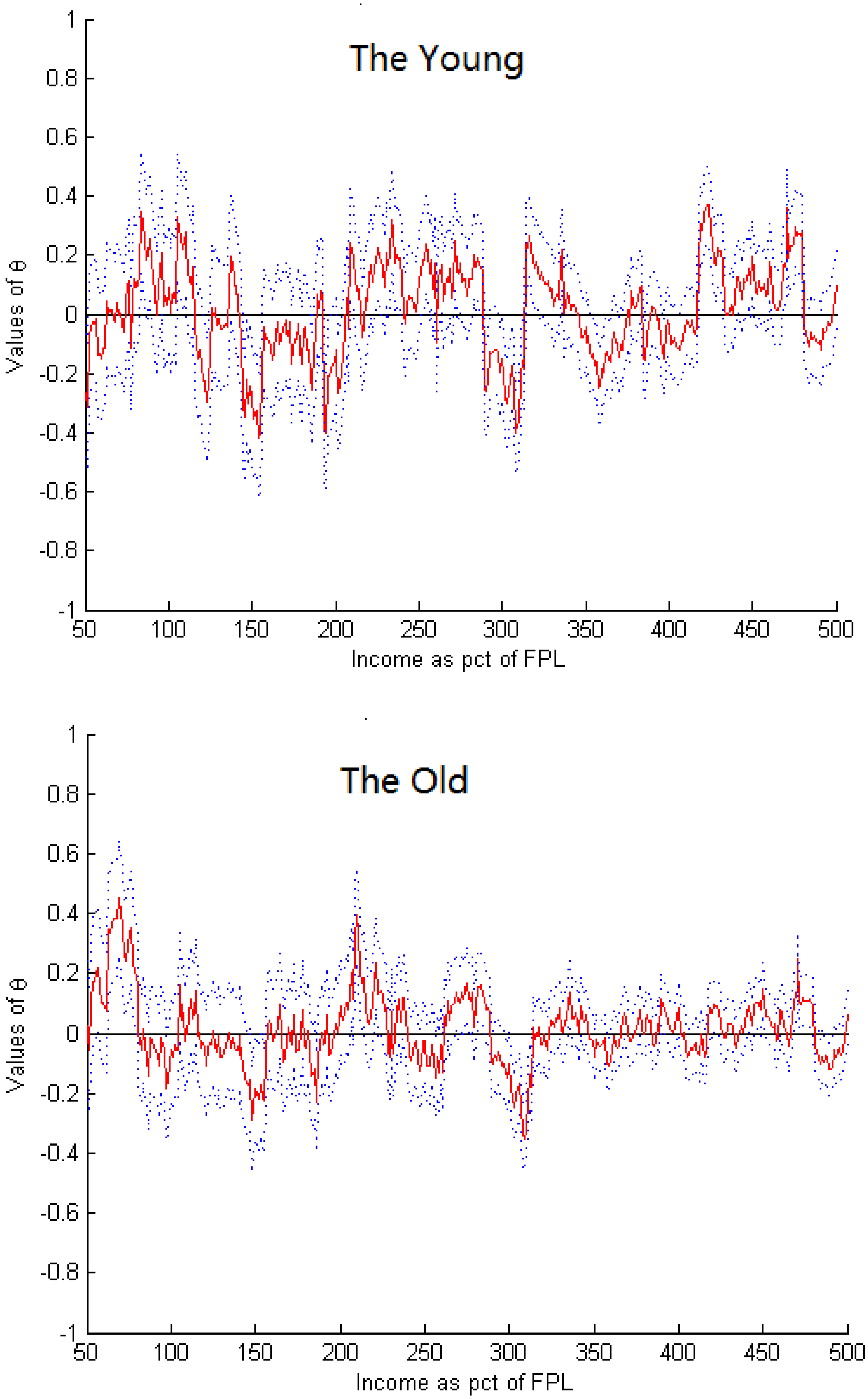


Figure 8. Estimation Results on $\hat{\theta}_{diff}$ with Bandwith 100 and 50 Percent of FPL

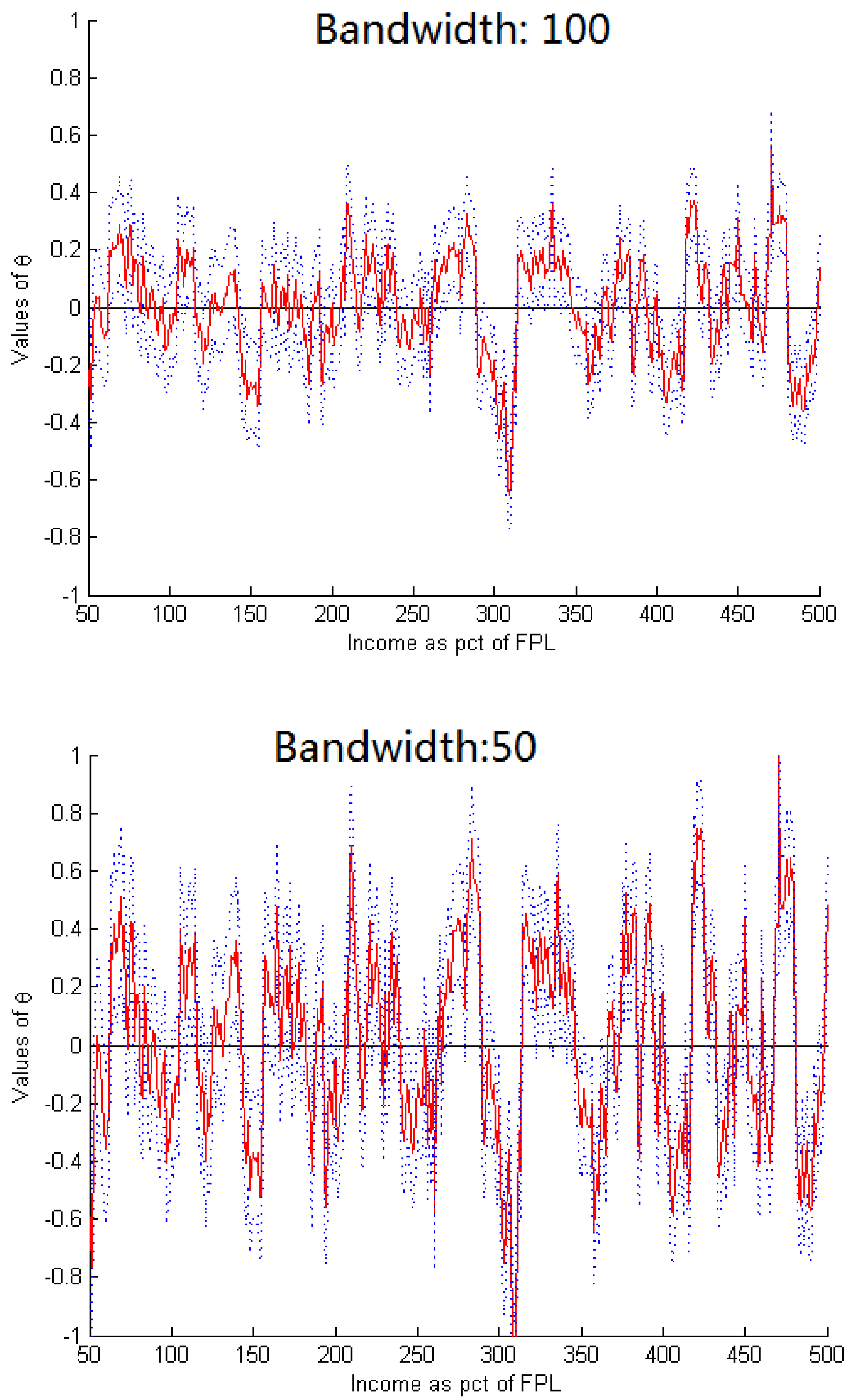
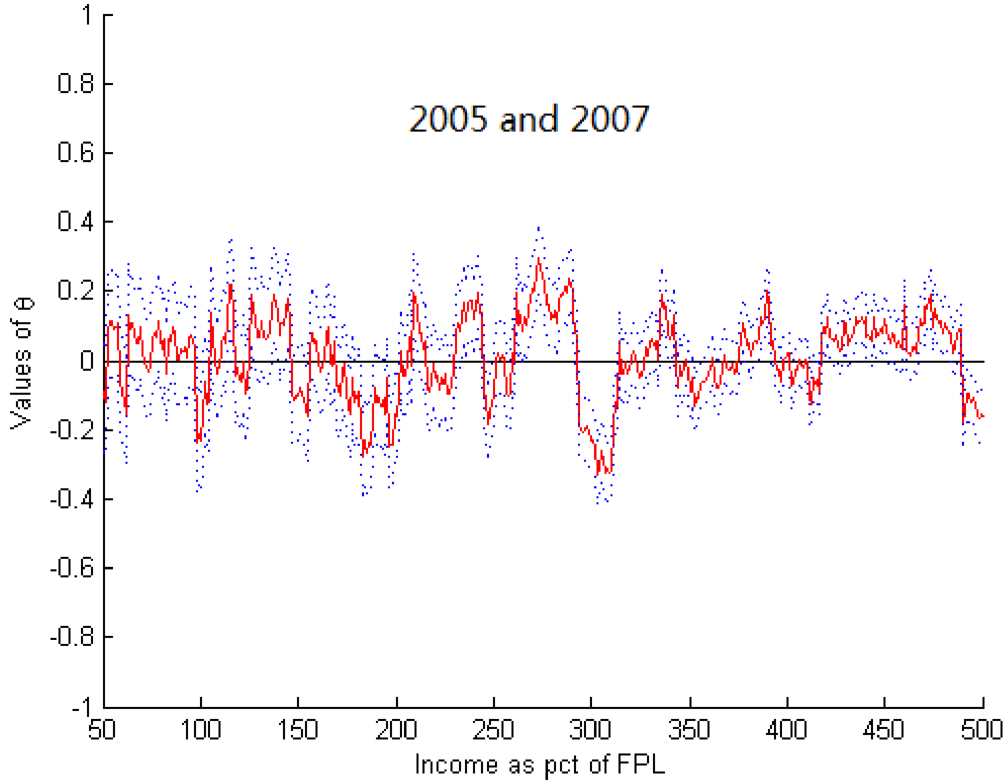


Figure 9. Estimation Results on $\hat{\theta}_{diff}$ between 2005 and 2007, and between 2005 and 2009



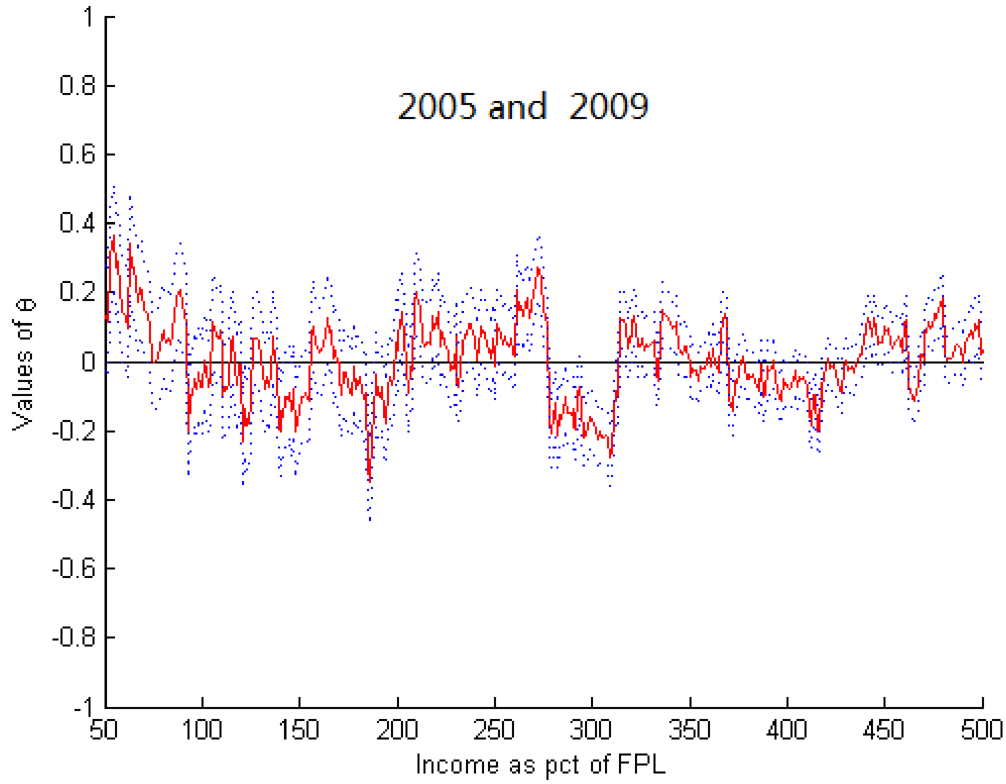


Figure 10. Estimation Results on $\hat{\theta}_{diff}$ between 2005 and 2008 in Connecticut

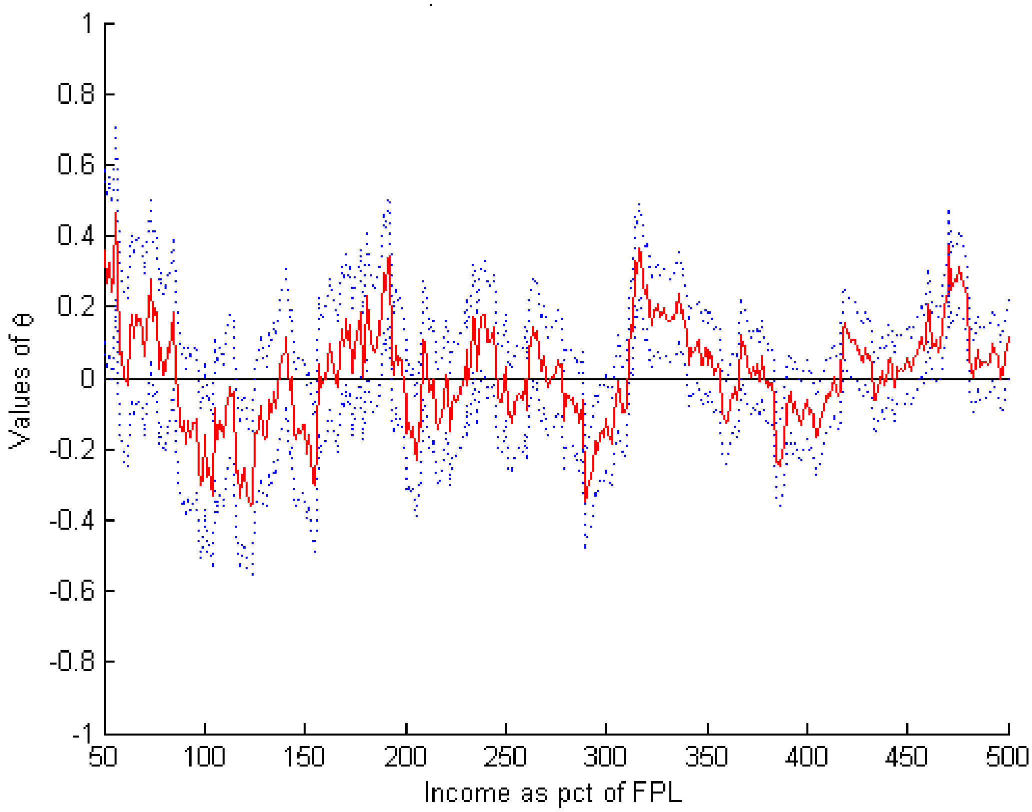


Figure 11. Income Ranges Affected by The Program under Different Values of Labor Supply Elasticity

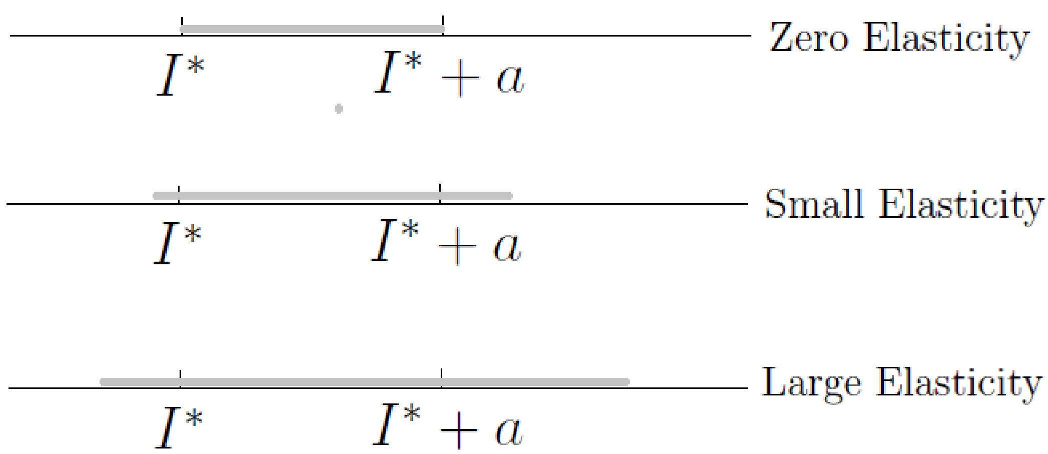


Table 1. Out-of-pocket Premium as Percent of Income in the National Health Care Reform

Income Level	Premium as a Percent of Income
Up to 133% FPL	2% of income
133-150% FPL	3-4% of income
150-200% FPL	4-6.3% of income
200-250% FPL	6.3-8.05% of income
250-300% FPL	8.05-9.5% of income
300-400% FPL	9.5% of income

Note: The out-of-pocket premium is the amount a person pays for the second lowerst cost silver plan after receiving the subsidy.

Source: Summary of the Affordable Care Act, Kaiser Family Foundation, [Accessed on Feb 19, 2014] URL: http://kaiserfamilyfoundation.files.wordpress.com/2011/04/8061-021.pdf

Table 2. Cost-sharing Subsidy in the National Health Care Reform

Income Level	Actuarial Value
100-150% FPL	94%
150-200% FPL	87%
200-250% FPL	73%

Note: The actuarial value is the percentage of a typical enrollee's cost coverd by a silver plan after receiving the subsidy.

Source: Summary of the Affordable Care Act, Kaiser Family Foundation, [Accessed on Feb 19, 2014] URL: http://kaiserfamilyfoundation.files.wordpress.com/2011/04/8061-021.pdf

Table 3. Descriptive Statistics for the Population in 2005 and 2008

3A. 2005	All	Working Status		
		Wage Worker	Self-employed	Unemployed
N	36,358 *	30,047	3,227	3,084
% of the Whole Sample	100.0%	82.6%	8.9%	8.5%
Age				
Mean	42.2	41.4	46.3	46.7
Young (19-35)	31.4%	34.1%	16.1%	20.9%
Old (36-64)	68.6%	65.9%	83.9%	79.1%
Household Income				
Mean	$78,134 **	$80,181	$82,872	$53,229
Std. Dev.	$52,638	$51,418	$56,289	$53,932
Below 150% FPL	10.9%	8.8%	8.8%	33.9%
150-200% FPL	4.8%	4.5%	4.9%	8.2%
200-250% FPL	5.2%	4.9%	6.3%	7.1%
250-300% FPL	6.1%	6.0%	6.5%	7.0%
Above 300% FPL	72.9%	75.8%	73.5%	43.7%

3B. 2008	All	Working Status		
		Wage Worker	Self-employed	Unemployed
N	36,231	29,969	3,131	3,131
% of the Whole Sample	100.0%	82.7%	8.6%	8.6%
Age				
Mean	42.6	41.6	47.2	47.3
Young (19-35)	31.2%	34.2%	14.2%	19.7%
Old (36-64)	68.8%	65.8%	85.8%	80.3%
Household Income				
Mean	$86,387	$89,710	$86,138	$54,830
Std. Dev.	$58,700	$57,862	$60,327	$55,563
Below 150% FPL	11.4%	8.8%	11.5%	36.6%
150-200% FPL	4.6%	4.2%	4.8%	8.1%
200-250% FPL	5.2%	4.9%	6.4%	7.1%
250-300% FPL	6.1%	6.0%	6.6%	6.9%
Above 300% FPL	72.7%	76.1%	70.6%	41.4%

* The sample only includes population within age 19-64 and household income 0-1500% FPL.

** The calculation of the mean of household income in on the individual level, so we put higher weights on larger households than the calculation on the individual level.

Table 4. Estimation for $\hat{\theta}_{\text{pre}}$, $\hat{\theta}_{\text{post}}$, and $\hat{\theta}_{\text{diff}}$ at Four Income Thresholds in Massachusetts

Threshold (% FPL)	All Population			Self-employed			Wage Workers		
	2005	2008	Diff (08-05)	2005	2008	Diff (08-05)	2005	2008	Diff (08-05)
	$\hat{\theta}_{pre}$	$\hat{\theta}_{post}$	$\hat{\theta}_{diff}$	$\hat{\theta}_{pre}$	$\hat{\theta}_{post}$	$\hat{\theta}_{diff}$	$\hat{\theta}_{pre}$	$\hat{\theta}_{post}$	$\hat{\theta}_{diff}$
150	0.047	-0.186***	-0.233**	0.260*	-0.322**	-0.582**	0.051	-0.116**	-0.167
	(0.048)	(0.048)	(0.096)	(0.158)	(0.139)	(0.297)	(0.056)	(0.057)	(0.113)
200	-0.016	0.009	0.026	0.221**	0.060	-0.161	-0.088*	-0.014	0.074
	(0.044)	(0.045)	(0.088)	(0.117)	(0.126)	(0.242)	(0.050)	(0.050)	(0.100)
250	0.118***	0.141***	0.023	0.029	0.087	0.058	0.095**	0.145***	0.049
	(0.037)	(0.038)	(0.074)	(0.107)	(0.103)	(0.209)	(0.041)	(0.039)	(0.079)
300	0.148***	0.022	-0.125*	0.104	0.077	-0.027	0.155***	0.009	-0.146**
	(0.031)	(0.033)	(0.064)	(0.089)	(0.081)	(0.170)	(0.034)	(0.035)	(0.070)

Note: The standard deviation of $\hat{\theta}$ is shown in the parentheses.

* 10% significance, ** 5% significance, *** 1% significance.

Table 5. Estimation for the Elasticity and Income Variation

Income Threshold	Population	N	Elasticity ε	Standard Deviation of Income σ
		(1)	(2)	(3)
150	All	3731	0.013 (0.001)	0.102 (0.002)
(120-180)	Wage Workers	2735	0.012 (0.001)	0.101 (0.003)
	Self-employed	316	0.011 (0.004)	0.075 (0.003)
200	All	4376	0.010 (0.000)	0.095 (0.001)
(170-230)	Wage Workers	3365	0.010 (0.001)	0.094 (0.001)
	Self-employed	428	0.010 (0.005)	0.081 (0.004)
250	All	4923	0.010 (0.003)	0.095 (0.002)
(220-280)	Wage Workers	3930	0.011 (0.000)	0.093 (0.002)
	Self-employed	485	0.012 (0.006)	0.080 (0.003)
300	All	5592	0.005 (0.005)	0.103 (0.002)
(270-330)	Wage Workers	4517	0.005 (0.006)	0.101 (0.003)
	Self-employed	554	0.019 (0.003)	0.083 (0.003)

Note: 1. Bootstrap standard deviation is shown in the parentheses.

2. Observations in 2005 and 2008 are included.

Table 6. The Results of Welfare Loss Estimation

	150 % FPL (149.7-159.7 % FPL)	300 % FPL (299.5-321.0 % FPL)	Total
P	34,656	118,047	
f	2.76%	2.83%	
$\bar{\delta}$	\$349.5	\$751.3	
Welfare Loss	\$334,267	\$2,509,891	\$2,844,158

Appendix

A1. The Estimation of Plan Cost Difference among Different Income Tiers

The amount of cost-sharing is estimated on the benefit design and enrollees' expected health care costs. The plans for the 0-150 percent FPL have no copayment, zero insurance rates. The plans for the 150-200 percent FPL have $10 copayment for the visit to primary care physician, $18 copayment for the visit to the specialist, $50 copayment for the inpatient stay and zero insurance rates. The plans for the 200-250 percent FPL and 250-300 percent FPL have the same benefit design, which have $15 copayment for the visit to primary care physician, $22 copayment for the visit to the specialist, $250 copayment for the inpatient stay and zero insurance rate other than 10 percent for medical equipment. In addition, the plan varies on other characteristics too, such as the copayment on drug and the maximum out-of-pocket payment.

Plans total premium is $396 per month, which is equal to $4,752 per year. I assume a typical enrollee's total health care cost is $5,000 per year, and the health care service includes one visit to primary care physician, one visit to the specialist and one event of inpatient stay. Therefore the cost of cost-sharing for the enrollee is $0 for plans for 0-150 percent FPL, $78 for 150-200 percent FPL, and $265 for 200-300 percent FPL. I assume the amount of cost-sharing for the comparable unsubsidized plans is the same as the amount of the plans for 200-300 percent FPL.

A2. The Calculation on the Fraction of the Population Who Are Affected by The Program

I estimate the fraction of people who were enrolled in the subsidized program, CommCare, in the selected sample using statistics from the public reports. The total sample in the ACS in 2008 is 64,921, and the selected sample used in this analysis is 36,231, so 55.8 percent of the population is included. In 2008, the total population in Massachusetts is 6.469 million, and the selected sample represents 3.610 million. According to the reports published by the Division of Health Care Finance and Policy, as of December 31, 2008, there were 162,725 enrollees in the CommCare program, which equals 4.5 percent of the represented population. There was a total of 16.2 percent of individuals in the selected sample with a household income between 150 percent and 300 percent FPL. If all people with income below 150 percent FPL all enrolled in Medicaid, the percentage of people who were enrolled in the CommCare program in the selected sample is 27.8 percent.