# Estimate Average Marginal Tax Rate (MTR) for Earned Income Tax Credit (EITC)

We want to explore how feasible it is to use an econometric approach for estimating implicit MTR welfare and transfer programs, without building models for each program. We started with EITC as an example for two reasons. First, Tax-Calculator has already included EITC and thus is capable to replicate EITC implicit MTR. Thus we are able to compare the econometric estimates with Tax-Calculator results, to see how accurate those econometric estimates are. Second, EITC is a national level credit that has relatively simple program rules, which means the example covers main steps without getting too complicated in program specific problems.

For EITC, we first identify the key factors for the program by reading the program rules and plot EITC on Earned Income. There are two key factors in addition to Earned Income: number of eligible children and filing status. Number of eligible children determines the phase-in, phase-out rates and the maximum credits allowed. Filing status influence phase-out starting income for joint filers but has no effect on phase-in or phase-out rates. EITC on Earned Income plots confirm these two key factors. The first plot is based on all taxpayers excluding joint filers. Taxpayers of a certain number of children are bounded by trapezoid shape frontiers, with childless taxpayers in the bottom trapezoid and 1, 2, 3 children taxpayers stacked on top.

Figure 1. Taxpayers of all number of children excluding joint filers
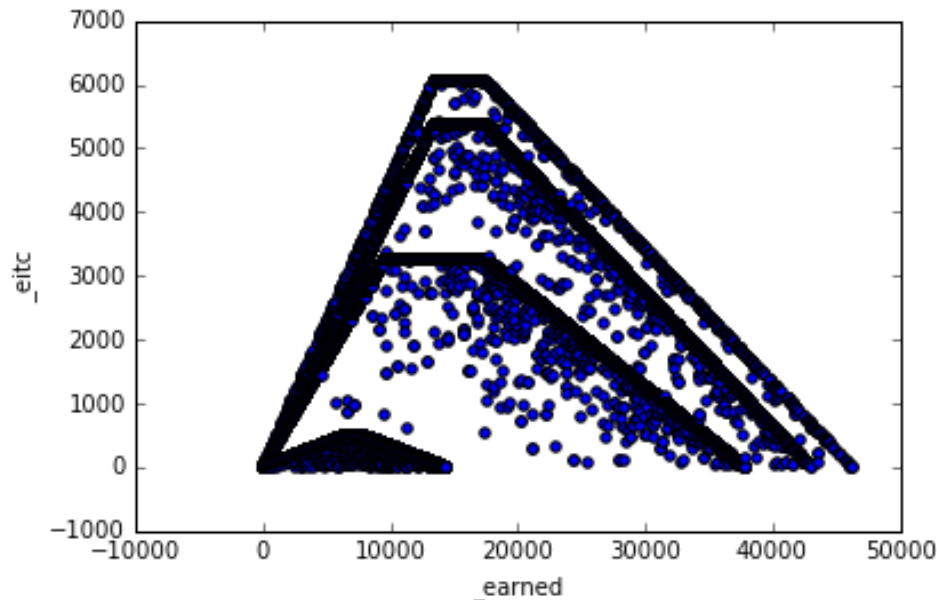
If we just look at taxpayers of one eligible child, in all filing status, joint filers are on a paralleled downward line during the phase-out period.

Figure 2.  Taxpayers with one eligible child
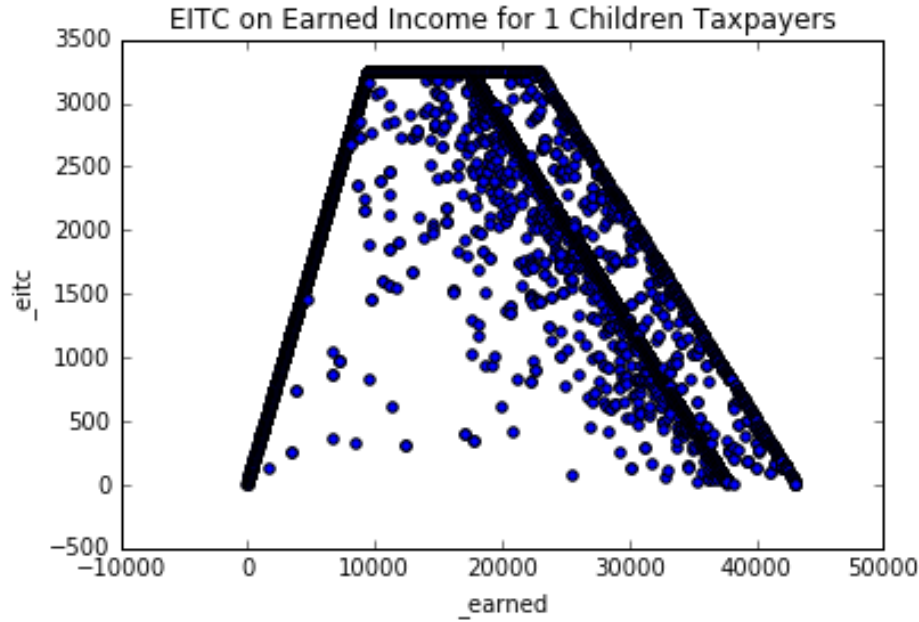


The next step is to group taxpayers according to key factors we have already identified and run separate regressions for each group. As number of eligible children affects both thresholds and rates for all periods, it seems to be reasonable to separate taxpayers by the number of children first. But it wasn't entirely clear whether joint filers should be separated from other taxpayers, the reason being that we only care about the phase-out rates while filing status doesn't influence phase-out rates at all. So at beginning we tried running regression for each group without considering filing status.

Within each group, all taxpayers were further divided into ten subgroups according to their decile rank of Earned Income. A separate regression was constructed for each subgroup in the following form:

$$EITC_{N,q} = \beta_1 Earned\ Income_{N,q} + \beta_0$$

We extracted the total EITC (_eitc), Earned Income (_earned) for all EITC eligible taxpayers in 2013 from Tax-Calculator, along with information of their filing status and number of eligible children[1].  N is number of eligible children and q is decile rank. Coefficient $\beta_1$ represents the average implicit MTR for taxpayers with N number of eligible children in Earned Income decile q.

---

[1] We chose to use Tax-Calculator results instead of the original PUF data due to the following two reasons. First, 2009 PUF only has EITC after making work pay credit, while making work pay credit is not available. Second, Tax-Calculator does not have tax logic for years before 2013. Using 2009 data would be difficult for comparison.

To compare with the regression-based implicit MTR, we also calculated MTRs through Tax-Calculator, using both current law policy and a hypothetical reform that repeals EITC.

Here's a comparison of MTR in 2013 for taxpayers with only one eligible child. Please refer to Appendix B for the complete list of tables.

Table 1. Coefficients for returns with one eligible child in 2013

| Decile | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|--------|---------------|--------|--------|-------------|
| 1 | 0.3120 | 0.3388 | -0.7743 | 856 |
| 2 | 0.3093 | 0.3343 | 25.0620 | 1006 |
| 3 | 0.0950 | 0.1162 | 2046.6768 | 999 |
| 4 | -0.0037 | -0.0037 | 3262.2343 | 913 |
| 5 | -0.0075 | -0.0137 | 3417.5384 | 921 |
| 6 | -0.0753 | -0.1018 | 4898.4968 | 1022 |
| 7 | -0.1303 | -0.1304 | 5481.9721 | 1127 |
| 8 | -0.1497 | -0.1448 | 5807.8241 | 1000 |
| 9 | -0.1503 | -0.1652 | 6374.3872 | 1098 |
| 10 | -0.1495 | -0.0856 | 3719.1904 | 1186 |

Generally speaking, the regression based MTRs are close to Tax-Calculator results for most deciles, except the last one. The 10th decile error is more significant for childless and one-child taxpayers than two or more children.

To explore why the 10th decile derails from the trend, we plotted the ten deciles separately for one-child taxpayers. It turned out that, as shown in Figure 3, joint filers and other filers have distributions that are far apart from each other, and therefore might not be suitable for a linear regression anymore. The same issue also exists in 7th, 8th and 9th decile, but seems not significant enough to interrupt the overall estimate.

Figure 3. Taxpayers with one eligible child in each decile
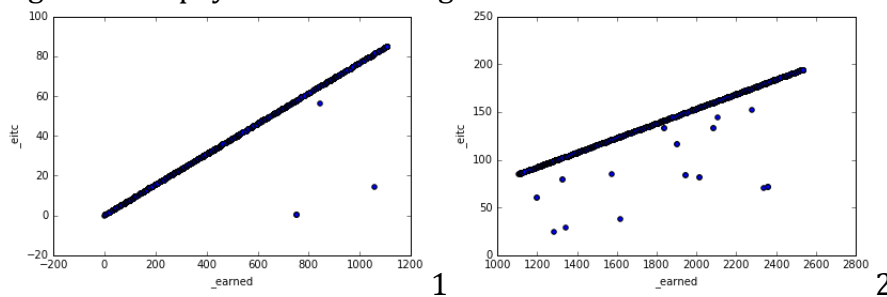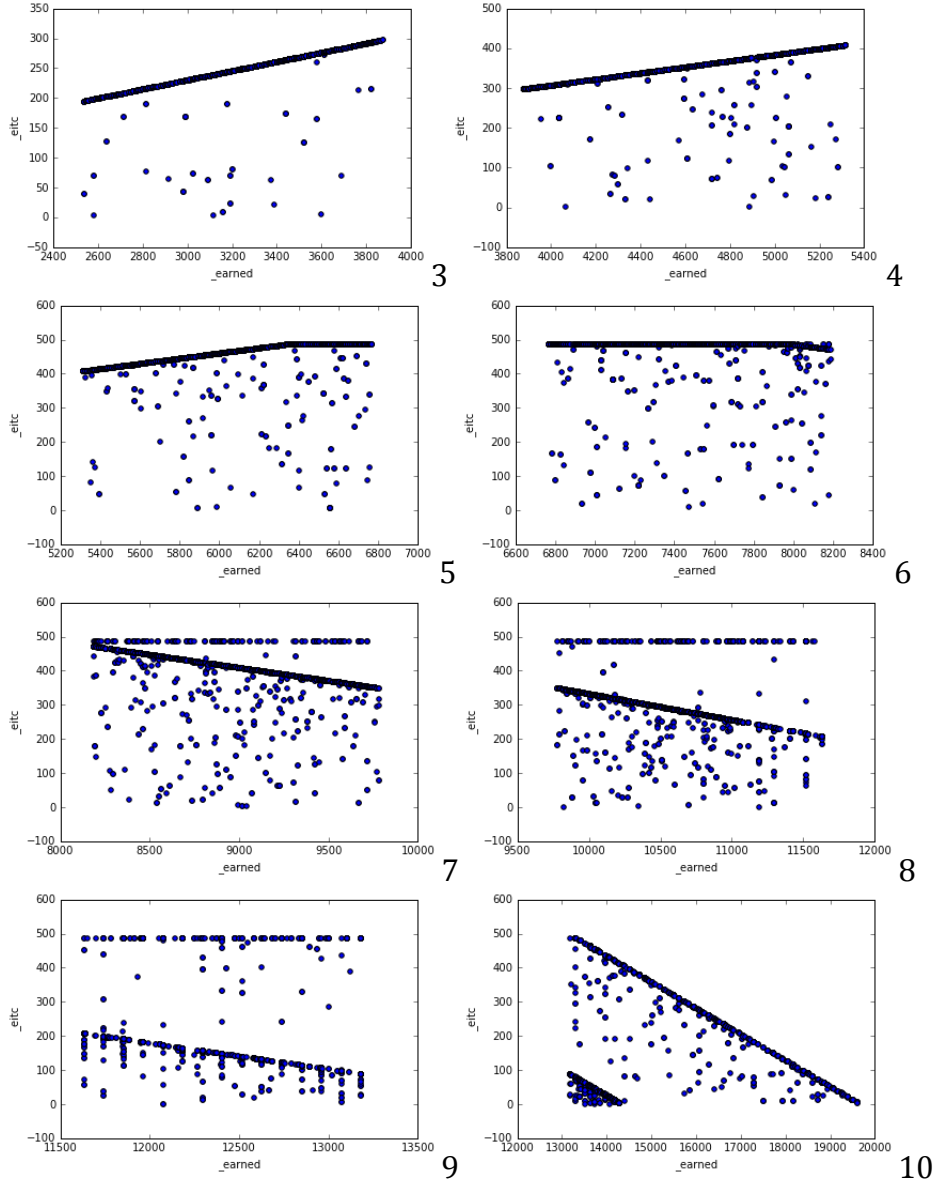
In the EITC case, we can improve 10th decile estimates by separating joint filers from the rest, as the number of joint filers is sufficient for regression.

Table 2. Decile 10 MTR estimates by filing status in 2013

| Filing status | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|---|---|---|---|---|
| Joint | -0.0697 | -0.0513 | 3357.0949 | 2258 |
| Others | -0.0712 | -0.0445 | 3061.3191 | 7870 |

So far it seems this econometric method for estimating MTR produces sensible results using Tax-Calculator as a comparison, but there're two pending issues that are very relevant to whether this method could be applied to other programs for MTR estimates.

The first issue is whether subgroups could have enough data points for regressions. Luckily for the filing status factor, PUF has enough records on both joint filers and non-joint filers, which might not be the case for other programs given they may contain more factors and thus end up with smaller size subgroups. The second issue is how deep we should go into the program income rules. The plots so far in this report contain many data points that are below the trapezoid, which doesn't make much sense in that why would someone claim less than the maximum eligible. After examining the EITC forms more carefully, we realize that modified AGI, if different from Earned Income, would be the income to phase out ETIC upon. In other words, if taxpayers have non-wage income, business profit for example, they would still stay in the EITC eligible pool but their EITC gets reduced a lot due to their large amount of modified AGI. The following is a comparison between taxpayers without non-wage income, and the original plot.

Figure 4. One-Child taxpayers without non-wage income
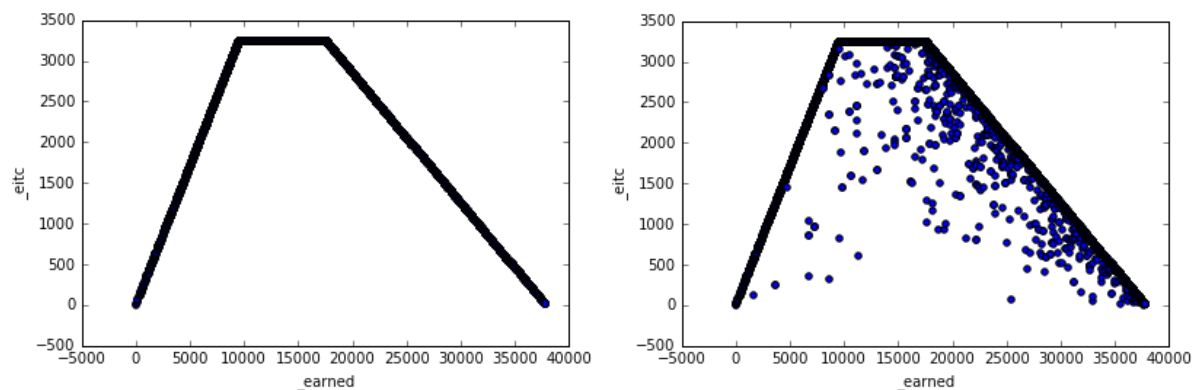


The comparison above points out how important it is to be precise on program income rules, which may influence the accuracy of MTR estimates. But at the same time, if we dig into the program rules at this detail level for each program, the econometric method may lose its simplicity advantage.

Appendix A. EITC on Earned Income plots for taxpayers with different number of children
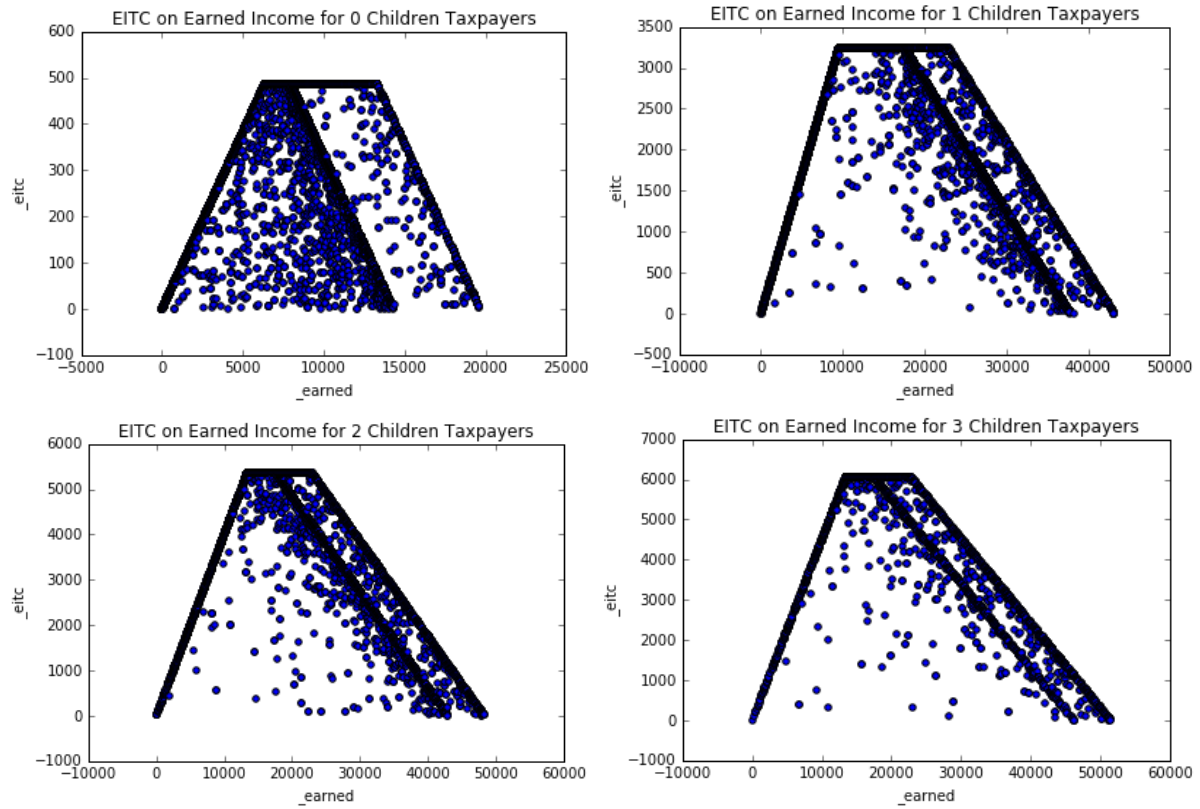
Appendix B. Comparison of MTRs between Tax-Calculator and regression by number of eligible children and Earned Income Deciles

Childless

| Decile | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|--------|----------------|--------|--------|-------------|
| 1 | 0.0706 | 0.0758 | 0.1354 | 1261 |
| 2 | 0.0682 | 0.0758 | 0.2589 | 1325 |
| 3 | 0.0663 | 0.0785 | -11.2400 | 1428 |
| 4 | 0.0619 | 0.0691 | 22.4451 | 1581 |
| 5 | 0.0404 | 0.0436 | 177.6024 | 1694 |
| 6 | -0.0171 | -0.0058 | 506.2219 | 1715 |
| 7 | -0.0658 | -0.0656 | 979.9706 | 1917 |
| 8 | -0.0627 | -0.0626 | 954.8888 | 2040 |
| 9 | -0.0644 | -0.0663 | 1004.7484 | 1767 |
| 10 | -0.0705 | 0.0021 | 103.9227 | 1750 |

One Child

| Decile | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|--------|----------------|--------|--------|-------------|
| 1 | 0.3120 | 0.3388 | -0.7743 | 856 |
| 2 | 0.3093 | 0.3343 | 25.0620 | 1006 |
| 3 | 0.0950 | 0.1162 | 2046.6768 | 999 |
| 4 | -0.0037 | -0.0037 | 3262.2343 | 913 |
| 5 | -0.0075 | -0.0137 | 3417.5384 | 921 |
| 6 | -0.0753 | -0.1018 | 4898.4968 | 1022 |
| 7 | -0.1303 | -0.1304 | 5481.9721 | 1127 |
| 8 | -0.1497 | -0.1448 | 5807.8241 | 1000 |
| 9 | -0.1503 | -0.1652 | 6374.3872 | 1098 |
| 10 | -0.1495 | -0.0856 | 3719.1904 | 1186 |

Two children

| Decile | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|--------|----------------|--------|--------|-------------|
| 1 | 0.3680 | 0.3986 | 1.6043 | 652 |
| 2 | 0.3591 | 0.4070 | -99.9656 | 760 |
| 3 | 0.1968 | 0.2725 | 1580.3476 | 665 |
| 4 | -0.0100 | 0.0166 | 5073.9471 | 627 |
| 5 | -0.0803 | -0.0940 | 6850.7548 | 702 |
| 6 | -0.1574 | -0.1641 | 8134.5567 | 890 |
| 7 | -0.1966 | -0.1915 | 8832.6822 | 745 |
| 8 | -0.1978 | -0.2078 | 9291.4598 | 895 |

| | | | | |
|---|---|---|---|---|
| 9 | -0.1969 | -0.1897 | 8688.1585 | 847 |
| 10 | -0.1966 | -0.1234 | 6090.0954 | 1002 |

Three children

| Decile | Tax-Calculator | Beta_1 | Beta_0 | Data points |
|---|---|---|---|---|
| 1 | 0.4291 | 0.4387 | 28.2749 | 264 |
| 2 | 0.3884 | 0.4366 | 72.9872 | 296 |
| 3 | 0.1653 | 0.1842 | 3387.5940 | 247 |
| 4 | -0.0201 | -0.0429 | 6605.0734 | 273 |
| 5 | -0.1331 | -0.1271 | 8134.6339 | 330 |
| 6 | -0.1692 | -0.1490 | 8622.2405 | 289 |
| 7 | -0.1956 | -0.1693 | 8938.1306 | 349 |
| 8 | -0.1975 | -0.1931 | 9588.2652 | 331 |
| 9 | -0.1979 | -0.2047 | 10071.3853 | 384 |
| 10 | -0.1956 | -0.1558 | 8090.3222 | 402 |