Using CPS to Calculate Marginal Tax Rates Through Earned Income Adjustments and Regressions

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Abstract

Using the Current Population Survey, we provide two methods of computing marginal tax rates pertaining to the Earned Income Tax Credit program. The first method involves the computation of EITC from CPS data and adding one dollar to all individuals' income. In the second method we regress EITC on Earned Income, conditioned upon certain Earned Income deciles and number of children.

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1 Introduction

We first create a program that uses a dataset that is derived from the Current Population Survey (CPS) to calculate the Earned Income Tax Credit (EITC) of each individual. After calculating the EITC, we calculate the MTR for each individual using two methods. First we add one dollar to each respondent's Earned Income and recalculate their EITC. Then we find the weighted average of the difference between the two EITC values to determine the Marginal Tax Rate (MTR). Second, we explore how feasible econometric approaches are when used for estimating implicit MTRs for welfare and transfer programs, without building models for each program.

We calculate a first set of MTRs according to two EITC program conditions: Earned Income, and Adjusted Gross Income (AGI). The MTR is found using these two conditions are slightly different from those found when the MTR is conditioned upon only Earned Income, and those that are calculated conditional upon Earned Income, AGI and investment income. Thus we provide three sets of MTRs showing the different results when using these three different levels of detail.

These three levels of detail can show us how important program specifications are when calculating implicit MTRs for other welfare and transfer programs. If the MTR does not vary from one level of detail to another in our EITC example, we may be able to disregard certain details when calculating the MTRs for other government programs. This is useful since many datasets are not rich enough to provide the necessary information to consider all program rules when calculating implicit MTRs. Thus, we provide all three sets of calculations in order to illustrate how program detail influences MTR accuracy.

We started by using the EITC as an example for two reasons. First, AEI's Tax-Calculator module already has included the EITC and thus is capable to replicate the EITC's implicit MTR. This allows us to compare the econometric estimates and the three levels of program detail to the Tax-Calculator results to determine accuracy. Second, the 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.

2 Income Definition and Data

The data we used to calculate the EITC and the MTR come from dataset derived from the Current Population Survey (CPS) that contains the different tax units necessary for determining EITC. This CPSTU, or Current Population Survey Tax Units, was created by John O' Hare. (CITE!)

We used the following variables to derive our Earned Income variable that is used when calculating the EITC:

ICPS27 Disability Income
ICPS47 Income From Non-Farm SoleProprietorships
ICPS48 Income From Farm SoleProperietorships
JCPS021 Wage and Salary Income - Head
JCPS025 Business Income or Loss - Head
JCPS028 Farm Income/Loss - Head
JCPS031 Wage and Salary Income - Spouse
JCPS035 Business Income or Loss - Spouse
JCPS038 Farm Income/Loss - Spouse

The following variables were used to calculate Adjusted Gross Income:

JCPS009 Adjusted Gross Income: Census (Taxpayer)
JCPS019 Adjusted Gross Income: Census (Spouse)

The following variables were used when calculating Investment Income:

JCPS022 Interest Income - Head
JCPS032 Interest Income - Spouse

JCPS023 Dividends - Head

JCPS033 Dividends - Spouse

JCPS027 Rents, Royalties - Head

JCPS037 Rents, Royalties - Spouse

The following variables were used for program qualifications:

XXOCAH Number of Children at Home Exemptions

XXOCAWH Number of Children Away From Home Exemptions

JS Federal Filing Status, 1=Single, 2=Joint, 3=Head of Household

WT Sample Weight Divided by 3.000 for the Pooled CPS Sample.

We note that disability pay was only included in Earned Income for respondents age 65 or younger. Thus Earned Income is defined as follows:

$$\text{EI} = \text{ICPS27(if JCPS001} \leq 65\text{)} + \text{ICPS47} + \text{ICPS48+ JCPS21} + \text{JCPS25}$$

$$+ \text{JCPS28} + \text{JCPS31} + \text{JCPS35} + \text{JCPS38}$$

AGI was is defined as,

$$\text{AGI} = \text{JCPS009} + \text{JCPS019}$$

and investment income as,

$$\text{Invest} = \text{JCPS22} + \text{JCPS32} + \text{JCPS23} + \text{JCPS33} + \text{JCPS27} + \text{JCPS37}$$

In order to see the accuracy of these variables, we compare Earned Income to Adjusted Gross Income for each respondent, using the Euclidean Norm. We found the average difference between Earned Income and Adjusted Gross Income was \$102.91.

In addition, we compare the following values for total Earned Income and AGI from the CPSTU and the Tax Calculator,

Earned income

CPS : $7,918,422,942,240

TC : $7,443,841,271,828.80

AGI

CPS : $8,742,172,662,670

TC : $10,080,436,530,617

3 Calculating The MTRs

After creating our variables using the CPS, we first calculated the EITC for each respondent according to Earned Income, AGI and number of children. The EITC program rules have two conditions apart from Earned Income and AGI. First, an individual's EITC phases out at different income levels depending on their filing status. For example, married individuals who file jointly, have higher phase-out amounts than single individuals. Secondly, individuals with 0, 1, 2, or 3 or more children receive different EITC amounts, which increase as the number of children increases. This results in four different tiers of EITC amounts, and with filing status included, a total of 8 different trapezoidal regions. The following is a graph illustrating each CPS respondent's EITC amount based on these different program rules,

Figure 1: EITC Amounts From 2015 CPS

Note that the plot contains many data points that are below the trapezoidal boundaries. This seems to contradict the idea that someone would want to claim their maximum eligible EITC. However, since modified AGI can differ from Earned Income, it is possible that AGI produces a lower EITC than Earned Income, which leads to an EITC that is below the trapezoidal boundary that is determined by Earned Income alone. In other words, if taxpayers have non-wage income, i.e. business profit, they would still stay in the EITC eligible pool but their EITC would be reduced significantly due to their relatively large modified AGI.

After calculating the EITC for each respondent we calculated their MTR using two different methods. First, we add one dollar to each respondent's Earned Income and recalculate their EITC. We then take the difference between these two EITC to determine the implicit marginal tax rates (MTR) and then take the weighted averages conditioned upon filing status and number of children. Secondly, we explore how feasible econometric approaches are when used for estimating MTRs.

3.1 Method 1: Adding One Dollar To Earned Income

We first calculated MTRs by doing the following to each respondent:

1. Add $1 to Earned Income.

2. Calculate the new EITC.

3. Find the difference between the EITC before and after the additional dollar was added.

This difference gives us the MTR for each individual in the survey. Our result is a vector of over 90,000 MTRs corresponding to each respondent. In order to compare these results with our MTRs obtained from our econometric approaches we take the weighted average of the MTRs conditioned upon filing status and number of children. This is done as follows,

$$\text{Average MTR}_{N,q} = \frac{\Sigma_i(\vec{\text{weight}} * \vec{\text{MTR}}_{N,q})_i}{\Sigma_i \vec{\text{weight}}_i}$$

where N is the number of children, and q is the decile rank.

3.2 Method 2: Conditioned Regressions

We then tested the econometric approach to calculating implicit MTR using the CPSTU data. Due the the trapezoidal correlation of the EITC to Earned Income, we performed a series of regressions by income deciles, and number of children in order to capture that shape. We regressed our previously calculated variable EITC, on our Earned Income (EI) variable. The regression equation is given as follows,

$$\text{EITC}_{N,q} = \beta_1 \text{EI}_{N,q} + \beta_0$$

Our obtained coefficient β_1 in the equation represents the average implicit MTR for individuals in Earned Income decile q with N children

3.3 Results

The following tables show MTR by Income Decile and number of children. Program MTR refers to the MTRs calculated by adding one additional dollar to Earned Income 3.1, Reg MTR refers to the MTRs calculated using conditional regressions 3.2, and TC MTR refers to the MTRs calculated using the Tax Calculator.

Table 1: Childless

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income < 1100	0.0717891	0.0749477	0.0706
$1100 \leq$ income < 2500	0.0715924	0.0709922	0.0682
$2500 \leq$ income < 3900	0.0714506	0.0616463	0.0663
$3900 \leq$ income < 5300	0.066889	0.0735019	0.0619
$5300 \leq$ income < 6700	0.0616205	0.0654906	0.0404
$6700 \leq$ income < 8100	-0.00421558	0.0075194	-0.0171
$8100 \leq$ income < 9800	-0.0612944	-0.050404	-0.0658
$9800 \leq$ income < 11600	-0.0605452	-0.0689626	-0.0627
$11600 \leq$ income < 13200	-0.0599481	-0.0754736	-0.0644
$13200 \leq$ income < 19600	-0.0184475	-0.0137392	-0.0705

Table 2: One Child

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$44 \leq$ income < 4930	0.32151	0.322453	0.3120
$4930 \leq$ income < 8600	0.327575	0.325668	0.3093
$8600 \leq$ income < 10700	0.106091	0.248494	0.0950
$10700 \leq$ income < 13000	-0.00788191	0.162318	-0.0037
$13000 \leq$ income < 15958	-0.00645202	-0.0328873	-0.0075
$15958 \leq$ income < 19500	-0.0355169	-0.00185882	-0.0753
$19500 \leq$ income < 23372	-0.109368	-0.0909142	-0.1303
$23372 \leq$ income < 27450	-0.152137	-0.152636	-0.1497
$27450 \leq$ income < 32400	-0.154274	-0.146921	-0.1503
$32400 \leq$ income < 43200	-0.109581	-0.114399	-0.1495

Table 3: Two Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income < 7233	0.377706	0.37123	0.3680
$7233 \leq$ income < 11900	0.378353	0.346876	0.3591
$11900 \leq$ income < 14150	0.287995	0.392858	0.1968
$14150 \leq$ income < 15830	-0.00965042	-0.0317303	-0.0100
$15830 \leq$ income < 18720	-0.0293278	-0.0738909	-0.0803
$18720 \leq$ income < 22700	-0.127653	-0.122884	-0.1574
$22700 \leq$ income < 26700	-0.191236	-0.2345	-0.1966
$26700 \leq$ income < 31800	-0.20504	-0.163385	-0.1978
$31800 \leq$ income < 37100	-0.206332	-0.203142	-0.1969
$37100 \leq$ income < 48300	-0.171021	-0.176585	-0.1966

Table 4: Three or more Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$1 \leq$ income $<$ 7620	0.438811	0.444678	0.4291
7620 $\leq$ income $<$ 12160	0.440659	0.436026	0.3884
12160 $\leq$ income $<$ 14470	0.236224	0.447933	0.1653
14470 $\leq$ income $<$ 17060	-0.00849115	-0.0966498	-0.0201
17060 $\leq$ income $<$ 21270	-0.0954322	-0.0814759	-0.1331
21270 $\leq$ income $<$ 25030	-0.164597	-0.166058	-0.1692
25030 $\leq$ income $<$ 29900	-0.207045	-0.201289	-0.1956
29900 $\leq$ income $<$ 34670	-0.204224	-0.207295	-0.1975
34670 $\leq$ income $<$ 41430	-0.202187	-0.173123	-0.1979
41430 $\leq$ income $<$ 51500	-0.177526	-0.18178	-0.1956

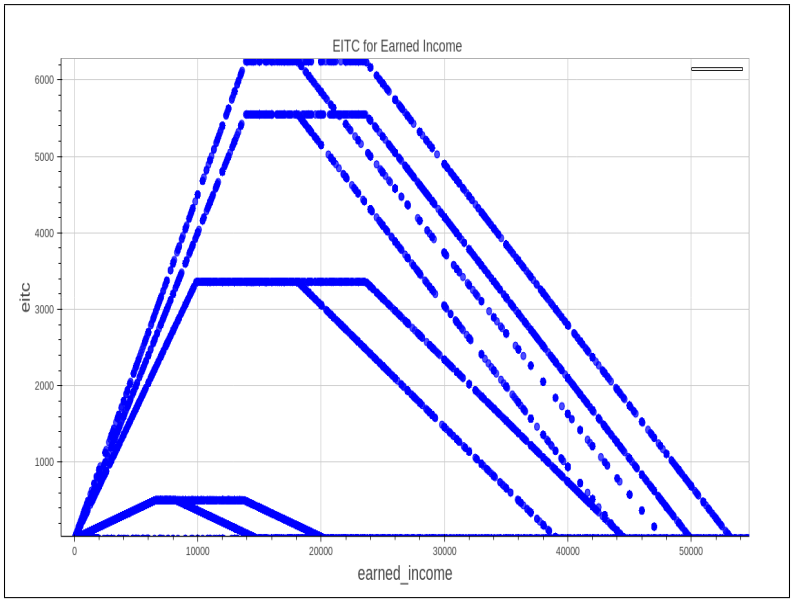
4 Comparing MTR Under Two More Conditions

The previous calculations where made conditional upon the EITC's Earned Income and AGI program rules. Now we consider calculations conditional upon just Earned Income, then upon Earned Income, AGI and investment income.

4.1 Using Only Earned Income

Here we calculate MTRs using our program and regressions but only conditional upon Earned Income thresholds. The following is the graph of the calculated EITC from the CPSTU conditional upon only Earned Income.

Figure 2: EITC Amounts From 2015 CPS



Notice that no EITC amount lies beneath the trapezoidal boundary since we are not considering AGI.

Here are the results from our MTR calculations using Method 1 3.1, Method 2 3.2, and Tax Calculator:

Table 5: Childless

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income < 1100	0.0765	0.0765	0.0706
$1100 \leq$ income < 2500	0.0765	0.0765	0.0682
$2500 \leq$ income < 3900	0.0765	0.0765	0.0663
$3900 \leq$ income < 5300	0.0765	0.0765	0.0619
$5300 \leq$ income < 6700	0.0752072	0.0760031	0.0404
$6700 \leq$ income < 8100	0	0	-0.0171
$8100 \leq$ income < 9800	-0.0624266	-0.0593288	-0.0658
$9800 \leq$ income < 11600	-0.0631547	-0.0599945	-0.0627
$11600 \leq$ income < 13200	-0.0627697	-0.0709021	-0.0644
$13200 \leq$ income < 19600	-0.0240875	-0.0177241	-0.0705

Table 6: One Child

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$44 \leq$ income < 4930	0.3399	0.3399	0.3120
$4930 \leq$ income < 8600	0.3399	0.3399	0.3093
$8600 \leq$ income < 10700	0.111203	0.265119	0.0950
$10700 \leq$ income < 13000	0	0	-0.0037
$13000 \leq$ income < 15958	0	0	-0.0075
$15958 \leq$ income < 19500	-0.027745	-0.0292107	-0.0753
$19500 \leq$ income < 23372	-0.105666	-0.11512	-0.1303
$23372 \leq$ income < 27450	-0.158298	-0.143061	-0.1497
$27450 \leq$ income < 32400	-0.1598	-0.160562	-0.1503
$32400 \leq$ income < 43200	-0.126376	-0.12849	-0.1495

Table 7: Two Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income < 7233	0.4	0.4	0.3680
$7233 \leq$ income < 11900	0.4	0.4	0.3591
$11900 \leq$ income < 14150	0.298991	0.3767	0.1968
$14150 \leq$ income < 15830	0	0	-0.0100
$15830 \leq$ income < 18720	-0.0132779	-0.00885272	-0.0803
$18720 \leq$ income < 22700	-0.123012	-0.111432	-0.1574
$22700 \leq$ income < 26700	-0.194094	-0.200291	-0.1966
$26700 \leq$ income < 31800	-0.2106	-0.212218	-0.1978
$31800 \leq$ income < 37100	-0.2106	-0.212351	-0.1969
$37100 \leq$ income < 48300	-0.187199	-0.191822	-0.1966

Table 8: Three or more Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$1 \leq$ income $<$ 7620	0.45	0.45	0.4291
7620 $\leq$ income $<$ 12160	0.45	0.45	0.3884
12160 $\leq$ income $<$ 14470	0.260764	0.381338	0.1653
14470 $\leq$ income $<$ 17060	0	0	-0.0201
17060 $\leq$ income $<$ 21270	-0.0896429	-0.111519	-0.1331
21270 $\leq$ income $<$ 25030	-0.162402	-0.16653	-0.1692
25030 $\leq$ income $<$ 29900	-0.2106	-0.195736	-0.1956
29900 $\leq$ income $<$ 34670	-0.2106	-0.197584	-0.1975
34670 $\leq$ income $<$ 41430	-0.2106	-0.198197	-0.1979
41430 $\leq$ income $<$ 51500	-0.192896	-0.192566	-0.1956

4.2 Using Earned Income, Adjusted Gross Income, and Investment Income

Here we calculate MTR using our program and regressions conditioned Earned Income, AGI and investment income thresholds (investment income is required to be below $3,600). The following is a plot representing the calculated EITC using the CPSTU conditional upon these three program rules.

Here are the results from our MTR calculations using Method 1 3.1, Method 2 3.2, and comparing to Tax Calculator:

Figure 3: EITC Amounts From 2015 CPS

Table 9: Childless

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income < 1100	0.0709465	0.0743338	0.0706
$1100 \leq$ income < 2500	0.0709143	0.0707168	0.0682
$2500 \leq$ income < 3900	0.071331	0.0579746	0.0663
$3900 \leq$ income < 5300	0.0669224	0.0705516	0.0619
$5300 \leq$ income < 6700	0.0615447	0.0689154	0.0404
$6700 \leq$ income < 8100	-0.00289353	0.0108536	-0.0171
$8100 \leq$ income < 9800	-0.0605858	-0.0542516	-0.0658
$9800 \leq$ income < 11600	-0.0599463	-0.0679287	-0.0627
$11600 \leq$ income < 13200	-0.0595059	-0.075697	-0.0644
$13200 \leq$ income < 19600	-0.0183274	-0.0137053	-0.0705

Table 10: One Child

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$44 \leq$ income $<$ 4930	0.30974	0.318638	0.3120
$4930 \leq$ income $<$ 8600	0.327723	0.32524	0.3093
$8600 \leq$ income $<$ 10700	0.106091	0.248494	0.0950
$10700 \leq$ income $<$ 13000	-0.00624408	0.137998	-0.0037
$13000 \leq$ income $<$ 15958	-0.0047473	-0.0509731	-0.0075
$15958 \leq$ income $<$ 19500	-0.0333948	-0.0100799	-0.0753
$19500 \leq$ income $<$ 23372	-0.108413	-0.0991987	-0.1303
$23372 \leq$ income $<$ 27450	-0.149284	-0.150368	-0.1497
$27450 \leq$ income $<$ 32400	-0.15164	-0.146736	-0.1503
$32400 \leq$ income $<$ 43200	-0.108528	-0.114032	-0.1495

Table 11: Two Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$10 \leq$ income $<$ 7233	0.373136	0.363637	0.3680
$7233 \leq$ income $<$ 11900	0.371972	0.366652	0.3591
$11900 \leq$ income $<$ 14150	0.286754	0.40762	0.1968
$14150 \leq$ income $<$ 15830	-0.00814719	-0.0199638	-0.0100
$15830 \leq$ income $<$ 18720	-0.0279123	-0.0848346	-0.0803
$18720 \leq$ income $<$ 22700	-0.125531	-0.136038	-0.1574
$22700 \leq$ income $<$ 26700	-0.189397	-0.223559	-0.1966
$26700 \leq$ income $<$ 31800	-0.20316	-0.152609	-0.1978
$31800 \leq$ income $<$ 37100	-0.199646	-0.198611	-0.1969
$37100 \leq$ income $<$ 48300	-0.168162	-0.17177	-0.1966

Table 12: Three or more Children

MTR for Income Decile			
Income Decile	Program MTR	Reg MTR (β_1)	TC MTR
$1 \leq$ income $<$ 7620	0.434894	0.434846	0.4291
$7620 \leq$ income $<$ 12160	0.436132	0.439823	0.3884
$12160 \leq$ income $<$ 14470	0.236224	0.447933	0.1653
$14470 \leq$ income $<$ 17060	-0.00804344	-0.124165	-0.0201
$17060 \leq$ income $<$ 21270	-0.0929892	-0.060698	-0.1331
$21270 \leq$ income $<$ 25030	-0.161095	-0.136958	-0.1692
$25030 \leq$ income $<$ 29900	-0.207045	-0.201289	-0.1956
$29900 \leq$ income $<$ 34670	-0.202038	-0.197005	-0.1975
$34670 \leq$ income $<$ 41430	-0.194671	-0.151967	-0.1979
$41430 \leq$ income $<$ 51500	-0.17619	-0.178928	-0.1956