C-TAM v0.1.1
CPS Transfer Augmentation Model

Technical Documentation

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Preface

Benefits and participation for welfare and transfer programs are systematically underreported in the Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC). For some programs, such as Medicaid and Medicare, participation is reported, but benefits are excluded entirely.

This report documents the open-source CPS Transfer Augmentation Model (C-TAM). C-TAM adjusts the CPS for the underreporting of welfare and transfer program participation and benefits, imputes benefits where they are excluded, and imputes marginal tax rates that stem from welfare and transfer programs.

Among other uses, a C-TAM-adjusted CPS file can serve as the basis for micro-simulating policy reforms that would replace existing welfare and transfer programs.

The code that implements C-TAM is available on Github.

Overview

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Among other uses, a C-TAM-adjusted CPS file can serve as the basis for microsimulating policy reforms that would replace existing welfare and transfer programs with alternative policies.

The code that implements C-TAM is available on Github. This report describes the model for users and highlights areas that could be improved by open-source contributions.

Capabilities

C-TAM adjusts underreported coverage and benefits for the following programs:

- Supplemental Security Income (SSI)
- Supplemental Nutrition Assistance Program (SNAP)
- Veterans' Benefits
- Social Security

Additionally, C-TAM imputes benefits for the following programs:

- Medicare
- Medicaid
- Affordable Care Act Premium Tax Credits (ACA PTC)

C-TAM imputes marginal tax rates for the following programs:

- SSI
- SNAP
- Social Security
- ACA PTC

I. Methodological Overview

C-TAM adjusts CPS files in three steps. First, it corrects the CPS for the underreporting of welfare and transfer program participation and benefits. Second, it imputes benefits where they are excluded entirely from the CPS. Third, it imputes marginal tax rates that stem from welfare and transfer programs.

This section provides a high-level overview of the methodologies employed at each step. Further details on individual programs and summary statistics captured before and after adjustment are included in the next section.

Adjust Participant and Benefits Underreporting. The CPS has micro-data on participation and benefits for several welfare and transfer programs. For these programs, we adopt a two-step procedure to ensure that the total number of participants and benefits conforms to administrative totals.[1]

The first step of the procedure imputes participation, ensuring the total number of participants in the CPS approximates administrative estimates. Specifically, we use a logit regression to estimate the probability of participation for each program, either at the individual or household level depending on the program's income rule. We then model simple representations of program eligibility rules. We add participants to the program by drawing from eligibility records based on their probability of participation obtained by the logit regression.

The second step of the procedure assigns newly imputed households or individuals an average benefit amount and adjusts the benefits using a uniform ratio for all participants. This ensures that the file total approximates administrative totals.

The total number of participants and benefits on the adjusted file remains lower than the administrative targets for many programs. This is because the institutional population is excluded in the CPS universe.

This two-step imputation procedure is straightforward in theory but more complicated in practice. We discuss many caveats and complications that affect individual programs in the following sections.

Impute Missing Benefits. For some programs, such as Medicaid and Medicare, the CPS reports program participation but not benefits. The CPS does not include benefit information because survey participants have limited knowledge of how much the benefits are worth.

For these programs, C-TAM imputes benefits from data sources where such information is provided by knowledgeable entities—for example, hospitals and insurance companies in the case of Medicaid and Medicare. More details on these imputations are outlined in the corresponding "Program Assumption" sections below.

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[1] Robert A. Moffitt and John Karl Scholz, "Trends in the Level of Distribution of Income Support" (working paper, National Bureau of Economic Research, 2009), http://www.nber.org/papers/w15488.

Impute Marginal Tax Rates. One foreseen use of C-TAM is to facilitate microsimulation analyses of reforms that replace existing welfare and transfer programs with alternative policies. Such reforms generally shift the after-benefit price of various forms of economic activity and affect recipient behavior.

To enable microsimulation modelers to capture behavioral effects, C-TAM imputes implicit current-law marginal tax rates (MTRs) that stem from existing welfare and transfer programs. A long-term goal is to impute MTRs with respect to several types of income, including savings and investment income. Currently we only impute MTRs with respect to earned income to capture the labor/leisure trade-off.

We define MTRs as the change in benefits at the family level for an additional dollar of earned income at the individual level. The decision to capture the change in benefits at the family level rather than the individual level rests on the assumption that individuals respond to family-level circumstances.

We estimate the MTR for primary and secondary earners separately based on program rules. As we will discuss, for some programs we use representations of the program eligibility rules, while for others we use the eligibility rules explicitly.

II. Program Assumptions

Supplemental Security Income

SSI is an income supplement that is designed to help the elderly, the blind, and people with disabilities with little or no income.[2] The CPS underreports both participation and benefits for SSI, and so we apply a two-stage adjustment as described in the "Methodological Overview" section.

Participation and Benefits Adjustment. According to our calculations, SSI participation is underreported by, at most, 3.1 million on the 2014 CPS, and SSI benefits are underreported by, at most, $12.5 billion.

We derive these estimates by subtracting the 2014 CPS participation and benefits totals from administrative totals for 2014. The raw 2014 CPS reports 6.1 million SSI participants and $47.1 billion in benefits. The Social Security Administration (SSA) reports 9.3 million participants in 2014 and $55 billion in federal benefits. Additionally, state governments supplement the federal-level benefit with roughly $4.6 billion in state-administered benefits.[3]

The CPS question on SSI benefits does not distinguish between federal- and state-administered benefits, and so we assume that the file total should not exceed the federal and state total of $59.2 billion. We also assume that no state-level benefits are administered to individuals who do not receive federal-level benefits, and so the file total should not exceed the 9.3 million participants reported by SSA. We generate

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[2] Social Security Administration, "What Is Supplemental Security Income?," 2017, https://www.ssa.gov/ssi/.

[3] The most recent state-level benefits we could find were for 2010, and so we extrapolated the 2010 state-administered benefit levels to 2014 using the growth rate for federal individual-level benefits.

our estimate of underreporting by subtracting 6.1 million from 9.3 million and $47.1 billion from $59.6 billion. We report these as an upper bound because the CPS does not contain the institutional population, meaning the adjusted CPS total should always be under the national total.

Stage 1: Participation Adjustment. To impute additional SSI participants onto the CPS, we first estimate the probability that an individual will participate in SSI according to his or her countable income, disability status, age, and an interaction term between age and disability. The following regression is used to perform this imputation.

$$y = \alpha + \beta_1\ Countable\ Income + \beta_2\ Disability + \beta_3\ age + \beta_4\ age * Disability + \varepsilon$$

The countable income variable is a proxy for SSI countable income, constructed with income variables available in the CPS.[4] The disability variable is constructed as the union of work disability variables available in the CPS.[5] The last term is to capture the interactions between age and disability, since age may not always increase the possibility of participation in the presence of disability. Regression results are shown in Table A1.

When imputing SSI participants, we constrain the universe of CPS correspondents to those below the 95th percentile of annual family earned income among those reporting receipt of SSI. This truncation means that no families with incomes in excess of $57,500 are imputed participants. Moreover, we replace existing participants with incomes greater than $57,500 with imputed participants. We assume high-income families in the sample reported their SSI participation incorrectly or had eligibility during only part of the year, although the latter is likely rare. Close examination of the data reinforces this assumption; for example, one family with parents making $200,000 and $50,000 annually has their child enrolled in SSI and receives $9,000 in benefits during the year.[6]

During the cell-based imputation, we impose three additional constraints on the candidates. The first two constraints are based on the state and age of SSI participants. In particular, we only impute participants into state and age cells for which the CPS totals are lower than the administrative totals reported in administrative tables.[7] We derive the last constraint from the SSI program rules regarding income and

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[4] Income variable used as countable income includes wages, self-employed income, Social Security benefits, pensions, unemployment compensation, disability payments, and interest income.

[5] US Census Bureau, "CPS Annual Social and Economic Supplement (CPS ASEC)," 2012, https://www.census.gov/people/disability/methodology/cps.html.

[6] Center for Economic and Policy Research, "March CPS Documentation," 2016, http://ceprdata.org/cps-uniform-data-extracts/march-cps-supplement/march-cps-documentation/. Some children are marked as participants but are recorded as receiving no benefits, suggesting that their benefits may be included on their parents' records.

[7] Under 18, 18–64, and 65 or over age groups had participant totals at 1.299, 4.913, and 2.122 million, respectively, in December 2014. The three groups have annual participation totals of 1.401, 5.532, and 2.344 million, respectively. All aggregates are from the SSI annual report for 2014.

disability. Specifically, prime-age workers have to be both disabled and low-income to qualify for SSI.[8] Those under 18 or over 65 need to fulfill only the low-income requirement.

Descriptive statistics for participation before and after the imputation are included in Table 1 and Figure 1.

Table 1. Average SSI Participation Rate, by Family Wage Decile

Decile	Decile Wage Upper Bound	Raw CPS Participation	Adjusted Participation	Raw CPS Participation Rate	Adjusted Participation Rate
1	$0	1,906,339	3,032,641	0.062	0.094
2	$0	1,974,749	2,860,711	0.062	0.094
3	$15,500	791,712	1,307,844	0.025	0.042
4	$28,000	489,693	900,022	0.016	0.029
5	$40,000	344,450	742,954	0.011	0.024
6	$56,000	174,777	479,954	0.006	0.015
7	$75,000	148,216	40,383	0.005	0.001
8	$99,927	117,073	0	0.004	0.000
9	$140,000	74,925	0	0.002	0.000
10	$2,199,998	31,117	0	0.001	0.000
Total		6,053,051	9,364,509	0.019	0.030

Note:
The original participants in the top three brackets are the top 5 percentile of participants whose family wages are more than $57,500.

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[8] We use current CPS SSI participants to define low-income, since the countable income variable that we construct from the CPS is only an approximation of true countable income for SSI eligibility. As different groups have dramatically different income ranges, we create fifth percentile countable income benchmarks for four groups according to age and disability: over 65 and disabled, $0; over 65 and not disabled, $0; under 65 and disabled, $429; and under 65 and not disabled, $15,607.

Figure 1. Participation Rate Before and After Imputation,
by Family Wage Percentile[9]

Note:
Family wage percentiles are constructed with family wage and individual
weight. The curves have been smoothed using local linear estimates.
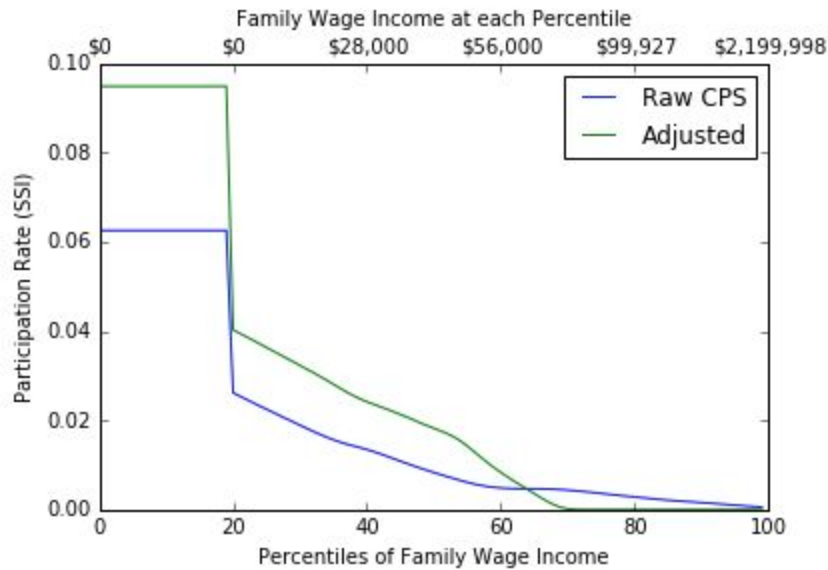The original participants in the top three brackets are the top 5 percentile of
participants whose family wage is more than $57,500.

Stage 2: Benefit Adjustment. After identifying SSI participants in Stage 1, we assign new participants benefits in Stage 2 and then adjust the benefits for all participants to approximately match administrative totals.

We assign benefit amounts to new participants with a cell-based approach, in which each cell is determined by state and age groups. The age-group categories are under 18, 18–64, and 65 and over. We assign new participants the average benefit of corresponding cells from administrative data.

After we have assigned benefits to new participants according to their residence state, we apply state-level ratios to approximately match the state-level targets. Ratios and targets are in Table A2. After applying the ratio, the total benefits on the file is $59.6 billion.

Descriptive statistics for SSI benefits before and after the imputation are included in Table 2 and Figure 2.

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[9] The participation rates are calculated at the individual level in each percentile. We used the total weights of all participants of one program over the total weight of people in that percentile as the participation rate.

Table 2. Average SSI Benefits at Family Level, by Family Wage Decile

Decile	Family Income Upper Bound	Raw CPS Average Benefit	Adjusted Average Benefit	Raw CPS Total Benefits (Millions)	Adjusted Total Benefits (Millions)
1	$0	$8,327	$7,211	$10.16	$13.03
2	$0	$8,327	$7,211	$11.14	$14.86
3	$3,200	$8,533	$7,324	$10.24	$12.20
4	$17,200	$9,019	$7,204	$4.15	$5.75
5	$29,000	$8,960	$7,319	$3.59	$4.87
6	$41,000	$8,149	$6,517	$2.37	$4.08
7	$58,000	$9,139	$6,842	$1.34	$2.85
8	$80,000	$7,293	-	$1.16	-
9	$119,000	$7,237	-	$0.78	-
10	$2,199,998	$6,291	-	$0.40	-
Total		$8,428	$7,192	$45.33	$57.64

Note: Weighted by family reference person's weight (fsup_wgt), total benefit amount is $57.6 billion after adjustment, which is different from the $59.6 billion based on personal level weight (marsupwt). Income range is based on the entire CPS database. Average and total benefit amounts are based on SSI recipients.

Figure 2. Family-Level Benefit Before and After Imputation,
by Family Wage Percentile
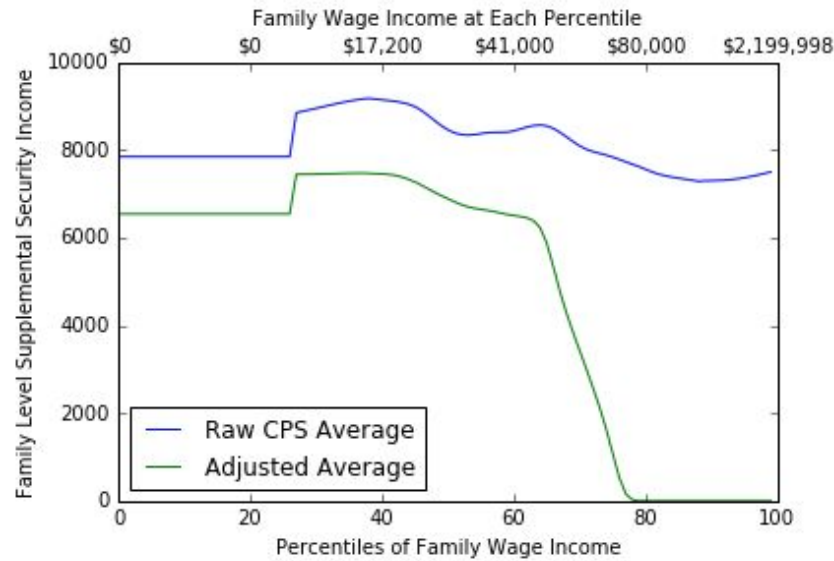
Note:
Family wage percentile is constructed based family wage and family
weight. Benefits are averaged among participants.
The adjusted average is lower than raw CPS average because raw CPS is
about one third (3.1/9.3) short on participation, but one fifth short
($12.1/$59.6) on benefits. We have to shrink both original and imputed
participants' benefit to hit the target.
The curves have been smoothed using local linear estimates.

MTR Imputation. We impute MTRs for primary and secondary earners, defining the MTR as the change
in benefits at the family level for an additional dollar of earned income at the individual level. Currently,
we only impute MTRs with respect to earned income.

SSI benefits are reduced by one dollar for every dollar of a recipient's countable income. Countable
income is defined by SSI program rules as excluding one-half of earned income, after subtracting various
deductions.[10] We ignore the various deductions at the moment and assume that every SSI participant's
MTR with respect to their own earned income is 50 percent.

Individuals who do not qualify for but have family members enrolled in SSI may also face nonzero MTRs
from the program. Above a certain threshold, the income of nonparticipating family members is deemed
to otherwise-eligible members in the family, meaning their income will reduce the family's total SSI

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[10] These deductions include the first $20 of most income received in a month and the first $65 of earnings.

benefits. There is no 50 percent deduction for deemed earned income, and so the MTR for nonparticipating family members with income over the threshold is 100 percent. The threshold is based on the living cost for SSI-ineligible family members. For simplification, we assume that the each nonparticipating family member will need the difference between the single and couple benefit amount, which is $362[11] for each month.[12] When a nonparticipating individual's income is higher than the total annual living cost of all SSI-ineligible individuals of his or her family, we will assume this person's MTR is 100 percent; otherwise, this person will be given an MTR of zero.

Descriptive statistics for SSI MTRs are included in Table 3 and Figure 3.

Table 3. Earned Income MTR at Family Level, by Family Wage Decile

Decile	Primary Earner MTR	Secondary Earner MTR	Average Participants MTR	Average Income
1	0.519	0.036	0.509	$0
2	0.519	0.036	0.509	$0
3	0.519	0.036	0.509	$0
4	0.519	0.036	0.509	$0
5	0.519	0.036	0.509	$0
6	0.645	0.121	0.560	$1,005
7	0.908	0.380	0.632	$12,516
8	0.993	0.400	0.677	$22,363
9	0.996	0.435	0.710	$33,495
10	1.000	0.747	0.724	$47,610

[11] Social Security Administration, "OASDI Beneficiaries by State and County," 2015, https://www.ssa.gov/policy/docs/statcomps/oasdi_sc/2014/index.html. The benefit is $1,082 per month for a single individual and $721 for a couple.

[12] TRIM deducts the living expense from countable income, which has already excluded one-half of earned income and a few more items of disregard. We deduct the living expenses directly from earned income, so in practice, we double the difference to $722 since no earned income deduction is considered in this section.

Figure 3. Marginal Tax Rate at Family Income Level for a $1 Increase in Earned Income
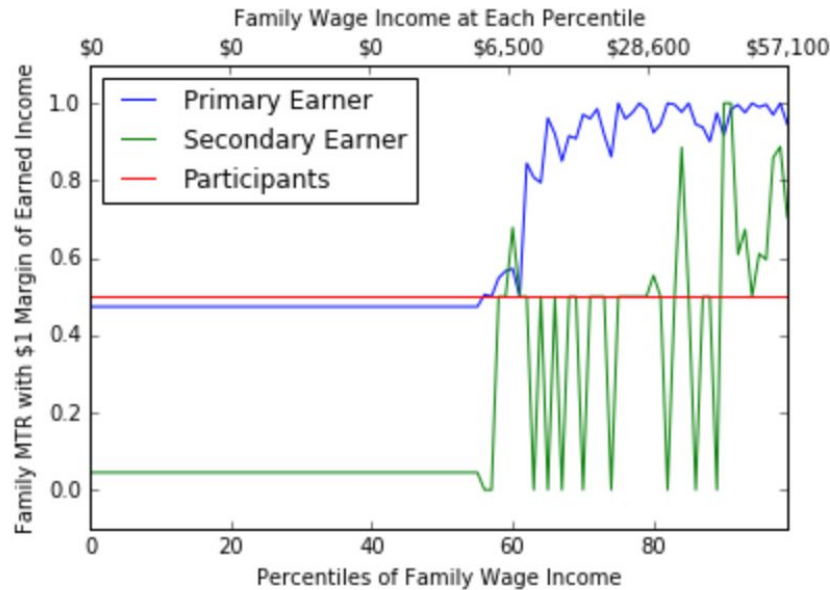
Note:

This figure includes only participating families.

Primary earners are defined as the highest earner in a family. In most families, the primary earner is also the family head. But in some cases, the primary earner may be the spouse or an adult child who is not marked as the head in the CPS but has the most wage income. If there are several non-head family members who earn the same earned income, they are all counted as primary earners. All non-primary earners in a family are defined as secondary earners. Therefore, one family can have several secondary earners.

For zero-income families, the CPS head is marked as the primary earner, and the spouse is marked as the secondary earner. The average includes everyone (SSI participants and their nonparticipating family members) who are assigned a MTR.

Primary and secondary earners may not receive SSI but have their income deemed to family members who receive SSI. Non-earner SSI participants are assigned a 50 percent MTR.

Supplemental Nutritional Assistance Program

SNAP provides benefits to low-income individuals and families for purchasing food. Most individuals and families must meet resource and net income limits, but households with disabled or elderly members are subject to only the net income tests.[13]

Participation and Benefit Adjustment. We estimate that original CPS SNAP benefits data are underreported by, at most, $30.4 billion and that average monthly participation is underreported by 10.5 million participants in approximately 10.3 million households.

The US Department of Agriculture (USDA) reports roughly $74.2 billion total expenditure in 2014 on SNAP, with $70.0 billion spent on benefits. The raw CPS has only $39.6 billion in total benefits on file, leaving a gap of $30.4 billion at most. This is an upper bound on underreporting because members of the institutional population who are excluded from the CPS may receive some benefits.

The USDA administrative data show a monthly average of 46.5 million participants in nearly 22.7 million households in 2014.[14] The raw CPS reports 2014 annual participation of 39.6 million individuals in 13.5 million households. To compare the administrative monthly averages with the CPS annual counts, we convert the CPS annual participation numbers into monthly averages. Among the 39.7 million raw CPS participants, 7.8 million received benefits for fewer than 12 months, and the rest received SNAP for the full year. By weighing the CPS participants by the number of months they participated, we calculate the average monthly participation in the raw CPS is 36.0 million individuals in 12.4 million households. Subtracting the CPS monthly averages from the administrative monthly averages, we generate the monthly average underreporting estimate of 10.5 million participants and 10.3 million households.

Stage 1: Participation Adjustment. SNAP is primarily a household-level benefit, and the CPS provides only household-level benefit data.[15] We impute both participation and benefits at the household level. We first approximate the net income of each household according to SNAP rules,[16] and then we use the following regression to determine the likelihood a household will enroll in SNAP. The model is shown below.

$$Indicator = \alpha + \beta_1 \, Net \, Income + \beta_2 \, Household \, Size + \beta_3 \, Disability + \beta_4 \, Number \, of \, Children + \varepsilon$$

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[13] Center for Economic and Policy Research, "March CPS Documentation."

[14] US Department of Agriculture, "Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2014," 2016, https://www.fns.usda.gov/snap/characteristics-supplemental-nutrition-assistance-program-households-fiscal-year-2014.

[15] SNAP is not a household-level benefit if grocery bills are not shared. However, these situations are rare.

[16] First we sum earned and unearned income from available variables including wages, self-employed income, Social Security benefits, pensions, unemployment compensation, disability payments, and interest income. We then subtract a 20 percent earned income deduction from combined earned income and a standard deduction according to household size. We also subtract child support expense, dependent care, shelter expenses, and medical expenses for elderly individuals over 65.

Regression results are shown in Table A2.

When imputing participation, we impose constraints based on income. In particular, only families with monthly income under $5,490[17] are imputed.

In addition to income restraint, we attempt to maintain the ratio of individual participants and household participants in the file, which we control through the size of the households we impute.

Because we estimate that the average monthly underreporting on the CPS is almost the same for individual participants as it is for households (10.5 million participants in 10.3 million households), we add only one-person households to the file.

For simplicity, we assume all imputed participants are covered for the entire year. After the adjustment, the file has 50.7 million total annual participants in 23.7 million households.

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[17] SNAP limits monthly income at $5,490 for a 14-member family.

Descriptive statistics for annual SNAP participation before and after the imputation are included in Table 4 and Figure 4.

Table 4. Annual SNAP Participation, by Household Wage Decile

Decile	Household Wage Upper Bound	Raw CPS Individual	Adjusted Individual	Raw CPS Household	Adjusted Household	Raw	Adjusted
		2014 Participants				Participation Rates at Household Level	
1	$0	7,118,839	11,400,947	3,357,020	7,511,503	0.223	0.360
2	$5,000	8,418,056	12,254,015	3,622,972	7,336,096	0.273	0.395
3	$20,800	11,358,823	13,203,013	3,362,286	5,146,666	0.362	0.421
4	$35,000	6,613,803	7,069,232	1,673,907	2,098,698	0.211	0.226
5	$48,000	3,524,228	3,570,359	794,043	863,339	0.112	0.114
6	$63,000	2,037,404	2,014,096	466,848	463,972	0.065	0.064
7	$80,500	1,087,085	999,313	225,947	212,868	0.035	0.032
8	$105,000	462,090	168,479	86,481	32,062	0.015	0.005
9	$146,000	130,917	0	29,941	0	0.004	0.000
10	$2,199,998	18,730	0	3,023	0	0.001	0.000
Total		40,769,975	50,672,369	13,622,469	23,665,205	0.096	0.159

Figure 4. Participation Rate Before and After Imputation, by Total
Household Income Percentile
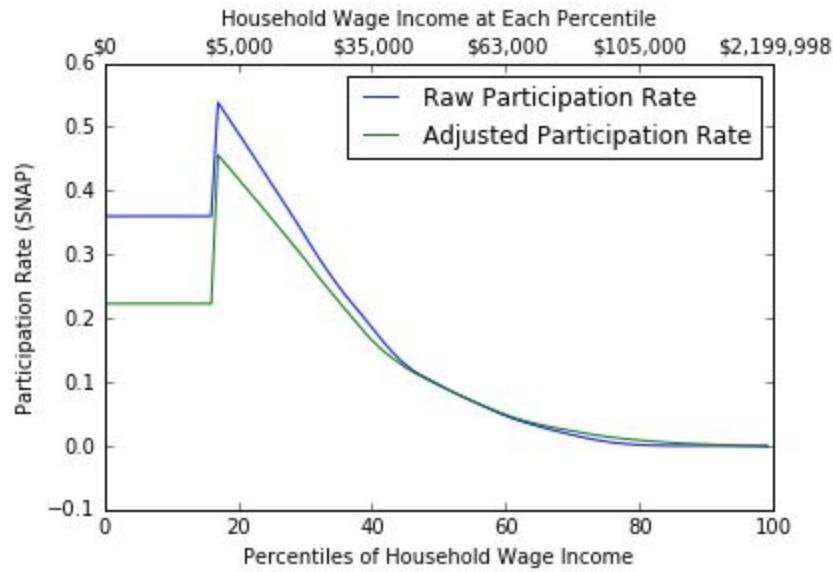
Note:
Household wage income percentiles are constructed based on household
wage and individual weight. Only families with monthly income under
$5,490[18] are imputed.
The curves have been smoothed using local linear estimates.

Stage 2: Benefit Adjustment. After identifying SNAP household participants in Stage 1, we assign the new
participants benefits at the household level for each state in Stage 2 and then adjust the benefits for all
participants to approximately match administrative totals.

We assign benefit amounts to new participants with a cell-based approach in which each cell is
determined by state and age group. We assign new participants the average benefit of the corresponding
cell from administrative data.

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[18] SNAP limits monthly income at $5,490 for a 14-member family.

Descriptive statistics for SNAP benefits before and after the imputation are included in Table 5 and Figure 5.

Table 5. Average SNAP Household Benefit, by Household Wage Income Decile

Decile	Household Wage Upper Bound	Raw CPS Average	Adjusted Average	Raw CPS Total Benefit (Millions)	Adjusted Total Benefit (Millions)
1	$0	$2,444	$2,833	$5,695	$14,432
2	$0	$2,444	$2,833	$5,466	$14,848
3	$8,000	$2,859	$3,055	$8,883	$16,475
4	$23,000	$3,089	$3,114	$9,688	$14,883
5	$36,000	$3,068	$3,062	$4,512	$5,593
6	$50,000	$2,770	$2,780	$2,163	$2,224
7	$68,500	$2,937	$2,928	$1,333	$1,305
8	$91,000	$2,597	$2,920	$492	$446
9	$130,000	$2,729	-	$194	-
10	$2,199,998	$870	-	$15	-
Total		$2,826	$2,963	$38,439	$70,206

Figure 5. Household-Level SNAP Benefit Before and After Imputation,
by Household Wage Percentile
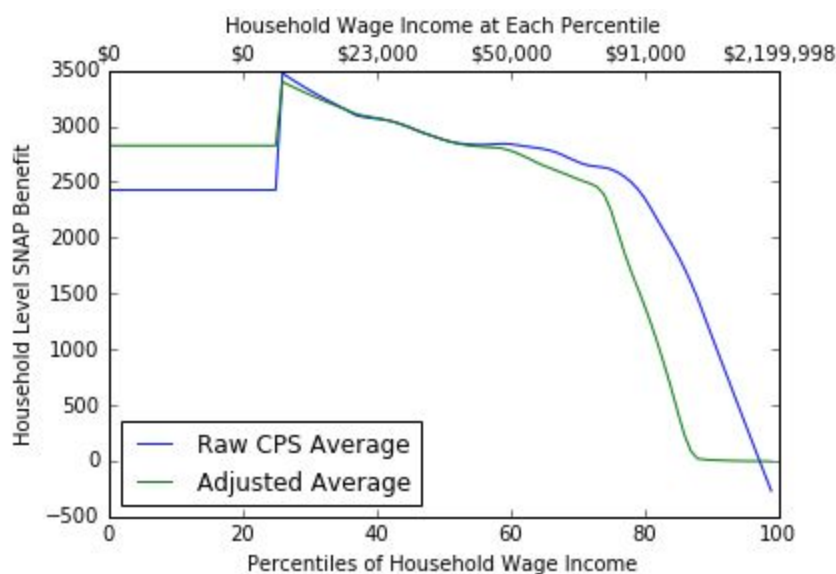
Note:
Household wage income percentiles are constructed based on household
wage and household weight. Only families with monthly income under
$5,490[19] are imputed.
The curves have been smoothed using local linear estimates.

MTR Imputation. According to SNAP rules, benefits are reduced in relation to a participating
household's net income, which contains earned income and several other income sources. MTRs with
respect to earned income for SNAP participants are influenced by two key income rules—the earned
income deduction and the net income phaseout rate.[20] Both of these rules are based on household
earnings.

The earned income deduction allows participants to deduct 20 percent of their earned income from their
net income. The net income phaseout rate reduces benefits by 30 cents for each dollar of net income. By
combining the earned income deduction and net income phaseout rate, we see that each extra dollar of
earned income dollar will reduce benefits by 24 cents.[21] Therefore, we assign each individual in
participating households an MTR of 24 percent.

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[19] SNAP limits monthly income at $5,490 for a 14-member family.
[20] Other income rules are not deemed as relevant to earned income MTR. US Department of Agriculture,
"Supplemental Nutrition Assistance Program (SNAP)," 2017, https://www.fns.usda.gov/snap/eligibility#Income.
[21] 0.8 * 0.30 = 0.24

Veterans Benefits

The US Department of Veterans Affairs (VA) administers a wide range of benefits and services to provide assistance to veterans, their dependents, and their survivors. The assistance includes but is not limited to compensation, education training, home loans, life insurance, and vocational rehabilitation.

Participation and Benefits Adjustment. We estimate that the CPS underestimates all categories of Veterans Benefits (VB) direct payments by, at most, $37.5 billion and participants by, at most, 1.5 million participants. In addition to direct payments, we impute VB medical care benefits—which are entirely excluded from the CPS—to current and imputed participants by evenly splitting a total of $59.4 billion of administratively reported expenditures.[22]

The CPS has five categories of VB available: disability compensation, survivors benefits, pension, education assistance, and other payments. Approximately 3.5 million out of 19.7 million veterans are receiving benefits in one of these five categories, for a total benefit amount of $51.4 billion.

According to administrative data from the VA, the total benefit amount in 2014 is about $161.2 billion,[23] which is broken down by expenditures on compensation and pension, construction, education and vocational rehabilitation or employment, general operation, and medical care.

The CPS categories are not perfectly aligned with VA expenditure categories. To find a proper target for CPS total VB benefits, we exclude expenditures on general operating and construction, as they are not direct payments to beneficiaries. Similarly, medical care is not considered a direct payment by the CPS and should not be counted as part of the target for the CPS aggregate.

Summing the two major categories of VA expenditure—compensation and vocational rehabilitation—we get a total benefits target of $88.9 billion. Subtracting CPS benefits of $51.4 billion from $88.9 billion, we estimate underreporting at $37.5 billion.

Since medical care expenditures are significant and excluded from the CPS, we impute them to recipients separately.

Stage 1: Participation Adjustment. We targeted 5.0 million total recipients from all categories instead of each category of benefits separately. Similar to other imputation procedures, we first constructed a regression to estimate the probability of receiving VB.

$$y = \alpha + \beta_1 * age + \beta_2 * sex + \beta_3 * income + \sum_{i=1,2,..,6} \beta_{i+3} * d_i + \beta_{10} * active + \varepsilon$$

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[22] We overestimate the amount of benefits by not downward adjusting the total benefits according to the amount spent on the institutional population.

[23] The expenditure table for 2014 is used. US Department of Veterans Affairs, "National Center for Veterans Analysis and Statistics," 2016, https://www.va.gov/vetdata/Expenditures.asp.

In this regression, we consider veterans' age, gender, income,[24] disability severity, and past active-duty experiences. The level of disability will affect the amount of eligible benefits, so we added all six types of disabilities as dummies in the regression (d1 to d6). The *active* variable indicates whether this veteran ever participated in active duties during his or her service. Please refer to Table A5 for the regression results.

The regression results show that gender, income and three types of disabilities[25] do not have significant predicting power. This is unsurprising given that the VA eligibility rules do not discuss these variables specifically. Based on the p-value of the variables, we dropped them from the regression and proceeded with the following specification.

$$y = \alpha + \beta_1 * age + \sum_{i=2,5,6} \beta_{i+1} * d_i + \beta_6 * active + \varepsilon$$

Please refer to Table A6 for the updated regression results for VB.

Using the probability estimated, we imputed 5.0 million total recipients.[26]

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[24] Income includes wages, self-employed income, Social Security benefits, pensions, unemployment compensation, disability payments, and interest income.

[25] d1 indicates a dressing or bathing disability; d3 indicates a seeing disability; and d4 indicates doctor visit or shopping alone disability.

[26] The CPS has about 19.7 million veterans on file, which does not include institutionalized veterans. In theory, the adjusted total number of participants should be below 5.0 million since some of them may live in nursing homes or other type of public institutions. Our current imputation misrepresents a portion of noninstitutional veterans as institutional. We hope to improve this in the future.

Table 6. Average Veterans Benefit Participation Rate Before and After Imputation,
by Total Individual Income Decile

Decile	Decile Wage Upper Bound	Raw CPS Participation	Adjusted Participation	Raw CPS Participation Rate	Adjusted Participation Rate
1	$0	0	11,925	0.000	0.000*
2	$0	0	11,925	0.000	0.000*
3	$0	0	11,925	0.000	0.000*
4	$8,161	149,255	220,739	0.005	0.007
5	$15,000	269,718	576,143	0.009	0.018
6	$23,000	339,414	735,518	0.011	0.023
7	$33,000	518,077	800,316	0.017	0.026
8	$47,030	626,311	810,640	0.020	0.026
9	$72,027	841,433	984,560	0.027	0.031
10	$1,409,999	773,138	841,453	0.025	0.027
Total		3,517,346	5,005,144	0.011	0.016

Note: Adjusted participation rates are 0.0004 for the first three deciles.

Figure 6. Veterans Benefit Participation Rate Before and After Imputation,
by Total Individual Income Percentile
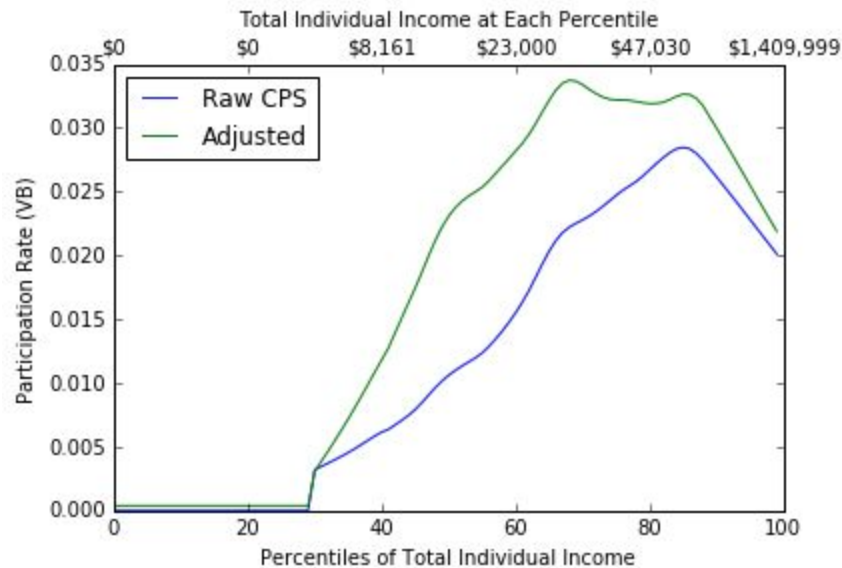
Note: CPS personal total income includes not only earned income but also payments from various federal- and state-level programs. Thus, if a person has zero total income, then he or she does not receive any benefits from any of those programs.

The curves have been smoothed using local linear estimates.

Stage 2: Benefit Adjustment. For the direct payments portion of benefits, we assign an average benefit amount to each imputed participant according to his or her state of residence. We adjust the total benefit amount by state to match the geographic distribution reported in VA's state-level aggregate tables for compensation and vocational training.[27]

For medical care, we evenly split the $59.4 billion so that each participant is assigned a medical benefit of roughly $11,647.[28]

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[27] US Department of Veterans Affairs, "National Center for Veterans Analysis and Statistics."

[28] An improvement for later versions may be to exploit variations in health spending by age, state, gender, and disability status from an external data source to assign benefits.

Table 7. Average Veterans Benefits, by Total Individual Income

Decile	Individual Income Upper Bound	Raw CPS Average Benefit	Adjusted Average Benefit	Raw CPS Total Benefit (Millions)	Adjusted Total Benefit (Millions)
1	$0	$0	$7,196	$0.00	$0.10
2	$0	$0	$7,196	$0.00	$0.00
3	$0	$0	$7,196	$0.00	$0.54
4	$8,161	$2,607	$21,103	$0.46	$4.62
5	$15,000	$6,104	$22,428	$1.72	$12.94
6	$23,000	$8,322	$22,904	$3.04	$17.16
7	$33,000	$9,988	$26,538	$5.86	$20.59
8	$47,030	$14,139	$29,927	$9.08	$24.64
9	$72,027	$19,566	$36,989	$17.36	$36.63
10	$1,409,999	$17,989	$35,087	$13.97	$29.54
Total		$14,712	$29,352	$51.49	$146.8

Figure 7. Veterans Benefits Before and After Imputation,
by Total Individual Income Percentile
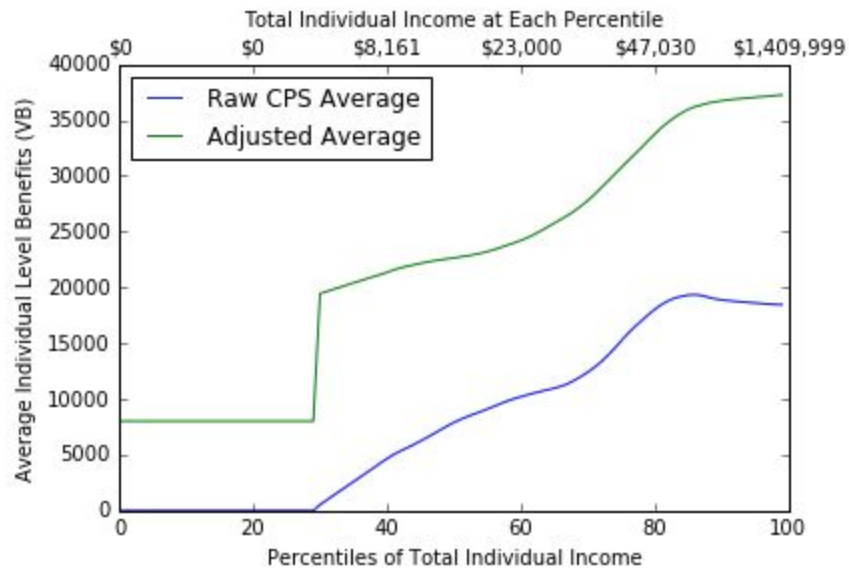
Note:
Adjusted average benefit includes medicare care value, so adjusted average is
significantly higher than raw CPS average.
The curves have been smoothed using local linear estimates.

Social Security

Old-Age, Survivors, and Disability Insurance (OASDI) provides benefits to insured workers and their families at retirement, death, or disability.[29] The benefit imputation for Social Security includes payments for OASDI. MTRs are estimated for working-age adults between 18 and 65 and capture the interaction between current earnings and future benefits. As with all other programs, MTRs associated with financing the programs are excluded.

Participation and Benefits Adjustment. We estimate that the CPS underestimates annual OASDI benefits by, at most, $172.3 billion and total participants by, at most, nine million. In 2014, the SSA

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[29] The Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds, *The 2016 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, June 22, 2016, https://www.ssa.gov/OACT/TR/2016/tr2016.pdf.

reports total benefit payments at $848.5 billion[30] and total recipients at 57.4 million.[31] The raw CPS has $676.2 billion in benefits and 48.4 million recipients. The administrative totals include benefits for the institutionalized population, whereas the CPS universe does not contain the entire institutional population. However, we have not been able to collect reliable statistics on institutional portion benefits and participation and therefore impute participation and benefits to match the overall totals. This suggests OASDI participants are overrepresented in the adjusted file.

Stage 1: Participation Adjustment. We estimate an individual's likelihood of receiving OASDI benefits according to three characteristics: age, disability, and widow status. The disability indicator used here refers to health problems or disabilities that prevent working.[32] After fitting the regression with all current participants, we applied the model to nonrecipients and added the records by states to the participation pool according to the estimated probability. The regression model is below.

$$SS\ indicator\ =\ \beta_0\ +\ \beta_1 * Aged\ +\ \beta_2 * Disabled\ +\ \beta_3 * widowed\ + \varepsilon$$

Regression results are shown in Table A7. Descriptive statistics for participation before and after the imputation are included in Table 8 and Figure 8.

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[30] Social Security Administration, "Old-Age, Survivors, and Disability Insurance Trust Funds, 1957-2016," 2016, https://www.ssa.gov/oact/STATS/table4a3.html.
[31] Social Security Administration, "OASDI Beneficiaries by State and County."
[32] Marked as dis_hp = "Yes" in the CPS.

Table 8. Participation Rates of Social Security, by Individual Wage Decile

Decile	Decile Wage Upper Bound	Raw CPS	Adjusted	Raw CPS Participants	Adjusted Participants
1	$0	0.266	0.294	8,329,419	9,211,397
2	$0	0.277	0.312	8,693,511	9,765,456
3	$0	0.223	0.260	6,992,479	8,159,465
4	$0	0.243	0.278	7,607,844	8,717,461
5	$0	0.255	0.288	7,994,951	9,027,502
6	$10,400	0.136	0.159	4,275,684	4,981,791
7	$24,900	0.058	0.078	1,821,711	2,457,269
8	$40,000	0.035	0.056	1,087,520	1,760,648
9	$64,000	0.025	0.052	771,227	1,615,077
10	$1,249,999	0.025	0.053	795,828	1,665,919
Total		0.154	0.183	48,370,175	57,361,987

Figure 8. Participation Rates of Social Security, by Individual Wage Income
Percentile
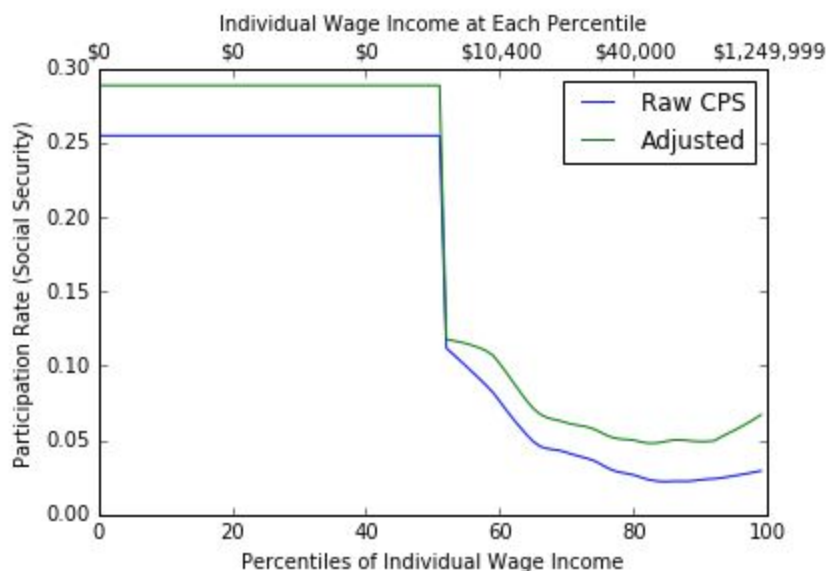
Note: The curves have been smoothed using local linear estimates.

Stage 2: Benefit Adjustment. For each imputed participant, we assign an average benefit according to age, gender, and eligibility type (retirement or disability). Among many tables provided by SSA, we use two average benefit tables,[33] one for retirement and the other for disability, both by age and gender. The retirement table starts from age 62 and covers all the way to age group 95 and over. The disability table starts from the age group under 20 and goes to age 65. We currently assign the average disability benefit to individuals under age 65 with work disabilities and assign average retirement benefit by age and gender to the rest of imputed individuals.

After the benefit assignment, we get $811.6 billion in benefits for both current CPS participants and imputed individuals. Then we apply a uniform ratio of 1.045 to every participant to augment the total benefits to $848.5 billion.

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[33] Social Security Administration, "Annual Statistical Supplement," 2015, Tables 5.A.1.1 and 5.A.1.2, https://www.ssa.gov/policy/docs/statcomps/supplement/2015/5a.html.

Descriptive statistics for average Social Security benefits before and after the imputation are included in Table 9 and Figure 9.

Table 9. Average Benefit of Social Security, by Individual Wage Income Decile

Decile	Individual Income Upper Bound	Raw CPS Average	Adjusted Average	Raw CPS Total Benefits (Millions)	Adjusted Total Benefits (Millions)
1	$0	$13,887	$14,640	$115.25	$137.08
2	$0	$13,887	$14,640	$115.25	$137.08
3	$0	$13,887	$14,640	$115.25	$137.08
4	$0	$13,887	$14,640	$115.25	$137.08
5	$0	$13,887	$14,640	$115.25	$137.08
6	$10,400	$13,203	$13,988	$31.62	$42.53
7	$24,900	$13,770	$14,647	$25.29	$36.14
8	$40,000	$14,189	$15,267	$15.10	$26.74
9	$64,000	$15,871	$16,396	$12.99	$27.22
10	$1,249,999	$18,546	$18,139	$14.91	$30.43
Total		$13,979	$14,791	$676.2	$848.4

Figure 9. Average Benefit of Social Security, by Individual Wage Income Percentile
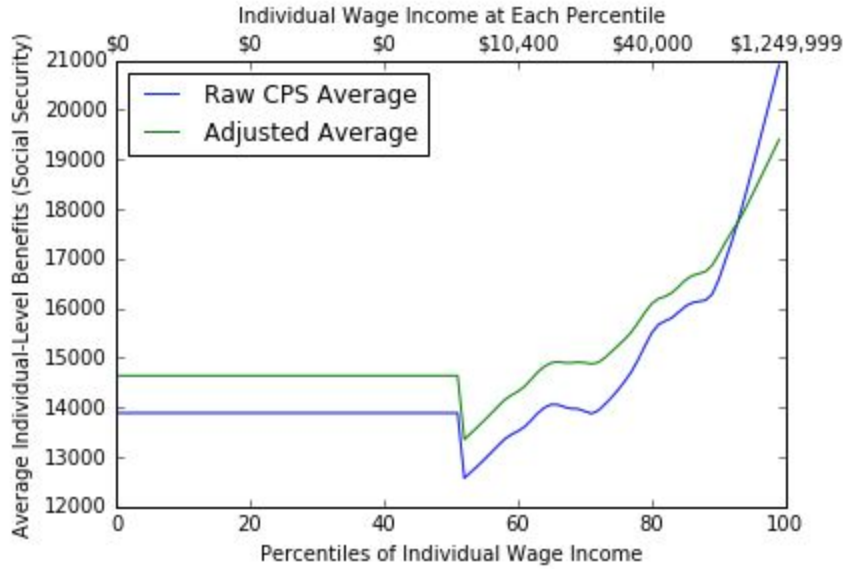
Note: The curves have been smoothed using local linear estimates.

MTR Imputation. We rely on a detailed benefits calculator provided by SSA to estimate MTRs with respect to earned income for Social Security retirement income. According to program rules, Social Security benefits depend on past, current, and future earnings.

We estimate past earnings according to current earnings, years of education, and years of work experience. We project past earnings backward according to the following Mincer function.

$$ln(y) \,=\, ln(y_0) \,+\, r*S \,+\, \beta_1*X \,+ \beta_2*X^2$$

In this equation, y is earnings, y_0 is the earnings of somebody with no education or experience, S is years of education, and X is years of work experience.

We project future earnings based on two scenarios, one with constant current-year wages and the other with projected earnings based on the Mincer regression. After getting the entire lifelong earnings vector, we scale the earnings with the ratio of CPS wages in 2014 to projected earnings in 2014 to ensure earnings stay coherent between the two systems.

Finally, we feed the lifelong earnings profile and other demographic information into the SSA calculator twice, the first time using current-year wages and the second time adding a $500 margin to the current-year wages. We use $500 as the margin because it is the lowest margin that affects Average

Indexed Monthly Income (AIME). The difference between the two calculated Primary Insurance Amounts (PIA) represents the amount of benefit change due to the margin.

We have made several assumptions in addition to those mentioned above. First, people who are out of the labor force are not included in this process since it is harder to project their future incomes. Second, everyone is assumed to retire at 65 and live until 78, which is the average life expectancy in the US.[34]

Table 10. Average MTR by Individual Earned Income Decile,
for Primary Earners and Secondary Earners

		Future Earnings Projected by Regression			Future Earnings Constant		
Decile	Income	Primary Earner	Secondary Earner	Average	Primary Earner	Secondary Earner	Average
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	$4,600	–0.085	–0.062	–0.069	–0.123	–0.095	–0.103
4	$14,750	–0.127	–0.111	–0.118	–0.195	–0.170	–0.181
5	$22,099	–0.074	–0.075	–0.074	–0.104	–0.103	–0.103
6	$30,000	–0.081	–0.083	–0.081	–0.108	–0.107	–0.108
7	$40,600	–0.082	–0.086	–0.083	–0.110	–0.112	–0.111
8	$55,000	–0.077	–0.081	–0.078	–0.112	–0.112	–0.112
9	$80,000	–0.066	–0.066	–0.066	–0.074	–0.075	–0.074
10	$1,409,999	–0.029	–0.031	–0.029	–0.031	–0.032	–0.031

Note: Includes everyone between age 18 and 65. Some are not in workforce.

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[34] US life expectancy was about 78.74 in 2012, according to Google Public Data, Life Expectancy, 2017, https://www.google.com/publicdata/explore?ds=d5bncppjof8f9_&met_y=sp_dyn_le00_in&idim=country:USA:GBR:JPN&hl=en&dl=en.

Figure 10. Average Social Security MTR, by Individual Wage Income Percentile
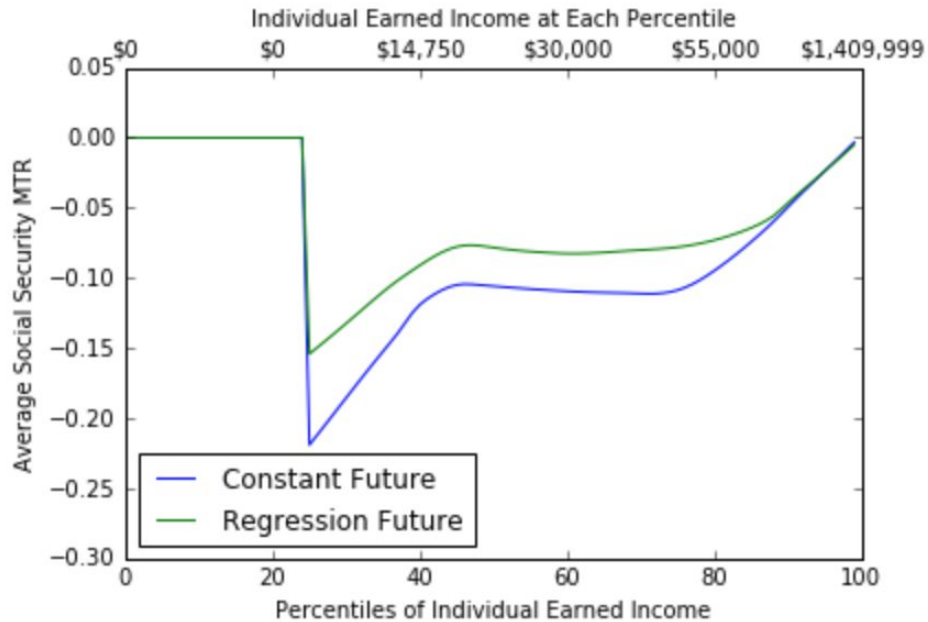
Note:
Only includes people between age 18 and 65. PIA is a step function on AIME. The first step has a rate of 0.9 for AIME below $816, the second step has a rate of 0.32 for AIME between $816 and $4,917, and the third step has a rate of 0.15 for AIME higher than $4,917. Thus, the MTR curves, under both scenarios, are relatively low on the low-income range since a large portion of people's AIMEs in this range are subject to 0.9 step rate. The MTR curves bend upward and eventually end up at zero because wage income beyond the maximum taxed earning ($117,000 in 2014) will not further increase Social Security benefits.
We assume that individuals with zero income have not fulfilled the 40-quarter-eligibility requirement for Social Security, and we therefore assign their MTR as zero. We will reexamine this assumption in future versions.
The curves have been smoothed using local linear estimates.

Figure 11. Average Social Security MTR for Primary and Secondary Earners, by Individual Wage Income (Assumes Constant Future Earnings)
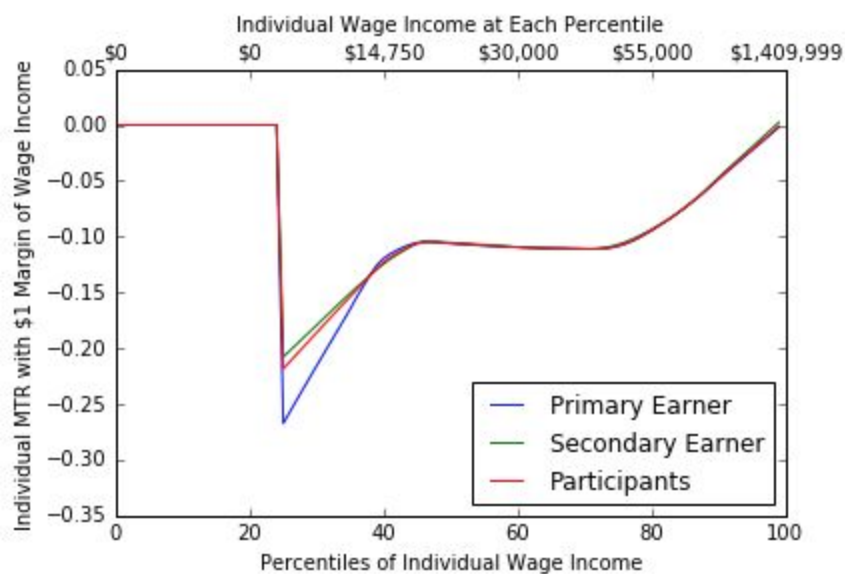
Note: The curves have been smoothed using local linear estimates.

Figure 12. Average Social Security MTR for Primary and Secondary Earners, by Individual Wage Income (Future Earnings Estimated Through Regression)
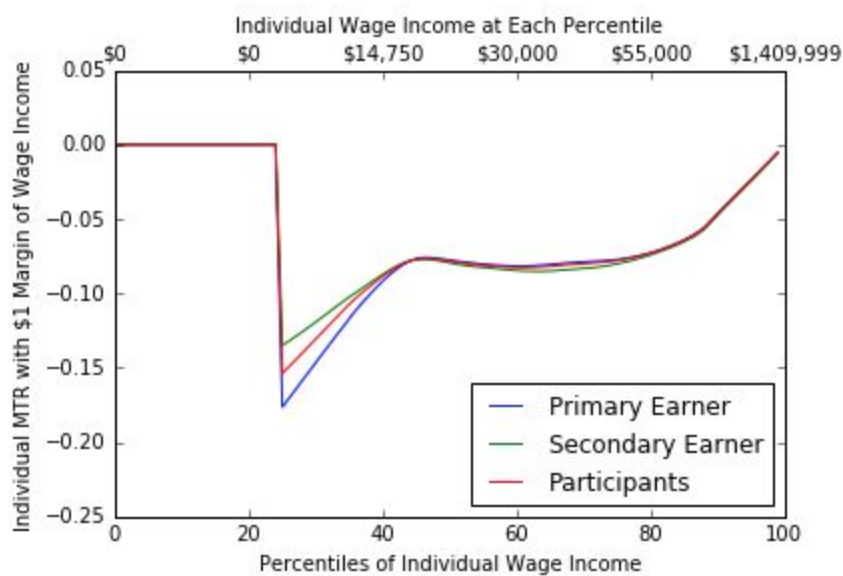
Note: The curves have been smoothed using local linear estimates.

Medicaid and Medicare

Medicaid is a joint federal-state program that provides health coverage to low-income families and people with disabilities.[35] Medicare is a federal health insurance program for people who are 65 or older, certain younger people with disabilities, and people with end-stage renal diseases.[36]

The CPS reports participation for both Medicaid and Medicare, but does not report benefits for either. Even though these two program are quite different in terms of coverage provided and beneficiary demographics, we include them in the same section because our goal is the same for these two health insurance programs—meet administrative participation targets for the noninstitutionalized population and impute average insurance values for participants.

We currently do not impute MTRs for either Medicare or Medicaid. For Medicare, income is not a factor in calculating enrollment or benefits. For Medicaid, there is an MTR spike at the upper bound of the income-eligible range. We currently ignore this cliff. Medicaid enrollees above and below the spike face no MTR from the program.

Participation and Benefits Adjustment. We estimate that the CPS underreports Medicaid participation by about 9.3 million and reports Medicare enrollment fairly accurately.[37] Medicaid enrollment was estimated at 64.8 million in 2014, according to the 2015 Medicaid Actuarial Report,[38] including around 1.4 million institutional enrollees.[39] The raw CPS reports total Medicaid enrollment of 54.1 million. Subtracting the CPS enrollment from the noninstitutional administrative total, we find a 9.3 million enrollee gap. For Medicare, the gap between CPS enrollment (48.9 million) and the noninstitutional administrative total (53.8 million)[40] is relatively small, and we currently proceed without adjusting the CPS Medicare participation.

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[35] US Department of Health and Human Services, "Overview," 2016, https://www.medicaid.gov/medicaid/index.html.

[36] US Department of Health and Human Services, "What's Medicare?," https://www.medicare.gov/sign-up-change-plans/decide-how-to-get-medicare/whats-medicare/what-is-medicare.html.

[37] CPS questions on Medicaid and Medicare ask if the participant is "covered" by either program, not if the participants have received medical care paid for by either program.

[38] US Department of Health and Human Services, Centers for Medicare and Medicaid Services, *2015 Actuarial Report on the Financial Outlook for Medicaid*, 2015, https://www.medicaid.gov/medicaid/financing-and-reimbursement/downloads/medicaid-actuarial-report-2015.pdf.

[39] US Department of Health and Human Services, *2015 CMS Statistics*, 2015, 4. Approximately four million persons received care in nursing facilities, including skilled nursing facilities (SNFs).

[40] The Boards of Trustees, Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, *2015 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds*, 2015, Table II.B1, https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/reportstrustfunds/downloads/tr2015.pdf.

For both Medicaid and Medicare benefits, we aim to approximate the noninstitutional administrative totals, which exclude nursing homes and hospice services. We estimate noninstitutional Medicaid medical assistance spending is about $397.4 billion, the difference between total medical spending of $468.8 billion[41] and institutional long-term service spending of $71.2 billion.[42] For Medicare, we estimate that noninstitutional benefit expenditures are $575.7 billion, the difference between total benefit expenditures of $604.5 billion[43] and $28.8 billion benefits distributed to skilled nursing facilities.[44]

We impute medical care expenses for both Medicaid and Medicare from the Medical Expenditure Panel Survey (MEPS) for each enrollee. We choose MEPS because it provides the amount and source of payments information collected from hospitals and insurance companies. Although not all enrollees receive medical services in a given year, we take the additional step of reassigning all participants the average benefit value by income quintiles to capture the insurance value.[45]

Stage 1: Participation Adjustment for Medicaid. Starting in 2014, the Affordable Care Act expands eligibility to all adults under 65 who live in families with income below 138 percent of the poverty line.[46] We randomly draw individuals in similar families to fill the gap between CPS enrollee aggregate and administrative total. As a simplification, we rely on the CPS's poverty line variable (povll) rather than calculating the poverty level directly, and we only draw families below 125 percent of the poverty line. We end up with 63.0 million participating families.

Descriptive statistics for Medicare and Medicaid enrollment before and after the imputation are included in Table 11 and Figure 13.

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[41] US Department of Health and Human Services, *2015 Actuarial Report on the Financial Outlook for Medicaid*, Table I. Medical assistance payments ($468.8 billion) includes four major categories: acute care, long-term care benefits, capitation payments and premiums, and disproportionate share hospital payments. Among all four categories, we assume only long-term care benefits has major payments to public institutions, and we neglect potential institutional components in other categories.

[42] Steve Eiken et al., *Medicaid Expenditures for Long-Term Services and Supports (LTSS) in FY 2014: Manages LTSS Reached 15 Percent of LTSS Spending*, Truven Health Analytics, April 15, 2016, https://www.medicaid.gov/medicaid/ltss/downloads/ltss-expenditures-2014.pdf. This research defines institutional services as nursing homes, intermediate care facilities for individuals with intellectual disabilities, and mental health facilities.

[43] The Boards of Trustees, Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, *2015 Annual Report of the Boards of Trustees*, Table II. B1. To get this number, we subtract $8.8 billion from total expenditures of $613.3 billion.

[44] Total benefit expenditures consists of seven categories: hospital, SNF, home health care, physician fee schedule, private health plans, prescription drugs, and other. We assume most expenditures in SNFs are institutional. Although Medicare enrollees can use Part D for prescription drugs, we have not been able to approximate the institutional portion due to lack of data.

[45] In a future version, we may use age and gender rather than income group to derive a risk-related insurance value following Timothy M. Smeeding et al., "Poverty, Inequality, and Family Living Standards Impacts Across Seven Nations: The Effect of Noncash Subsidies for Health, Education and Housing," *Review of Income and Wealth* 39, no. 3 (September 1993), http://www.roiw.org/1993/229.pdf.

[46] US Department of Health and Human Services, "2015 Actuarial Report on the Financial Outlook for Medicaid."

Table 11. Enrollment and Enrollment Rate for Medicare and Medicaid, by Individual Earned Income Decile

	Medicare		Medicaid			
Decile	Raw Enrollment	Raw Enrollment Rate	Raw Enrollment	Raw Enrollment Rate	Adjusted Enrollment	Adjusted Enrollment Rate
1	8,266,350	0.264	9,019,503	0.288	10,161,072	0.324
2	8,090,447	0.258	8,961,542	0.286	10,062,145	0.321
3	7,822,582	0.250	9,045,821	0.289	10,156,468	0.324
4	8,228,200	0.263	8,150,500	0.260	9,369,583	0.299
5	8,280,836	0.264	8,417,064	0.269	9,721,799	0.310
6	3,143,898	0.100	4,608,393	0.147	6,644,051	0.212
7	1,594,434	0.051	2,914,325	0.093	3,798,696	0.121
8	1,215,641	0.039	1,488,009	0.047	1,591,839	0.051
9	1,125,438	0.036	773,071	0.025	776,067	0.025
10	1,188,749	0.038	702,268	0.022	702,268	0.022
Total	48,956,576	0.156	54,080,497	0.173	62,983,987	0.201

Note:
Individuals younger than 65 who are temporarily laid off are eligible for Medicaid if their income is below 138 percent of federal poverty line.
This table includes enrollment and enrollment rate for Medicaid before and After Adjustment, but only raw data for Medicare since there's no adjustment.

Figure 13. CPS Medicaid and Medicare Enrollment Rate,
by Individual Earned Income Percentile
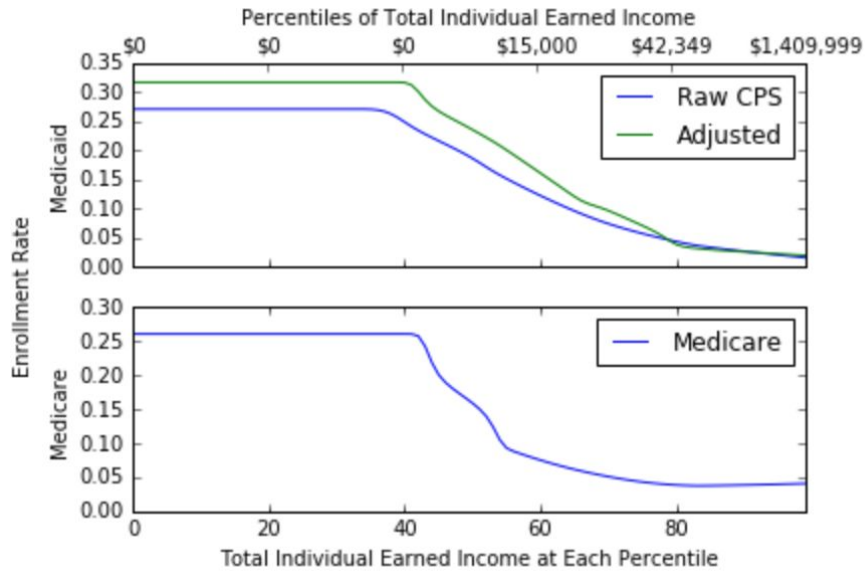
Note: Medicaid enrollment has been imputed to match the noninstitutional
total. Medicare enrollment is CPS raw data without any imputation.
The curves have been smoothed using local linear estimates.

Stage 2: Benefit Adjustment. For both Medicare and Medicaid, we define the insurance value as the average benefit amount by total income quintile, and we augment the insurance value of each enrollee to match total spending for the noninstitutionalized population.

The first step is to match individual information from the MEPS to the CPS using age, gender, state of residence, and income.[47] Both original and imputed CPS enrollees receive an expenditure amount from an MEPS record with the same gender and age (within plus or minus two years), state of residence, and income (within plus or minus $100).

The second step is to rank all participants by their total income (provided by the CPS), average the expenditures by income quintile, and assign average expenditures as the insurance value.

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[47] If no MEPS individual exists under all four requirements, we first release the income requirement and then state of residence, making sure at least age and gender matches between the MEPS and the CPS. Then if there is still no one who meets only the age and gender requirements, we leave the enrollee without any benefit in this step.

The third step is to adjust aggregates to match administrative totals. After imputing the average insurance value from the MEPS match, the program aggregates (Medicaid, $168.8 billion; Medicare, $398.0 billion) are still below total benefit amounts for both programs. This is likely because the MEPS aggregates do not include a portion of independent lab tests[48] and underreport high-cost cases.[49] We apply a uniform ratio to each program to match the total spending on benefits for noninstitutional beneficiaries. The ratios are 2.35 for Medicaid and 1.45 for Medicare.

Table 12. Average Insurance Value for Medicaid and Medicare, by Total Individual Income Quintile

	Medicaid		Medicare	
Quintile	Income Upper Bound	Insurance Value	Income Upper Bound	Insurance Value
1	$0	$5,927	$0	$12,404
2	$0	$5,927	$0	$12,404
3	$0	$5,927	$0	$12,404
4	$1,780	$5,911	$0	$12,404
5	$1,099,999	$5,911	$900,000	$8,776

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[48] The MEPS does not field a follow-up survey to independent labs and diagnostic and testing facilities.
[49] The MEPS might miss some high-cost physician or hospital expenditures that occurred right before the patient died, according to Merrile Sing et al. "Reconciling Medical Expenditure Estimates from the MEPS and NHEA, 2002," *Health Care Financing Review* 28, no. 1 (Fall 2006): 25–40, http://search.proquest.com/openview/0d2193b191b2e593fda30a764f769fc6/1?pq-origsite=gscholar&cbl=5416.

Figure 14. Medicaid and Medicare Insurance Value, by Individual Earned
Income Quintile (Participants Only)
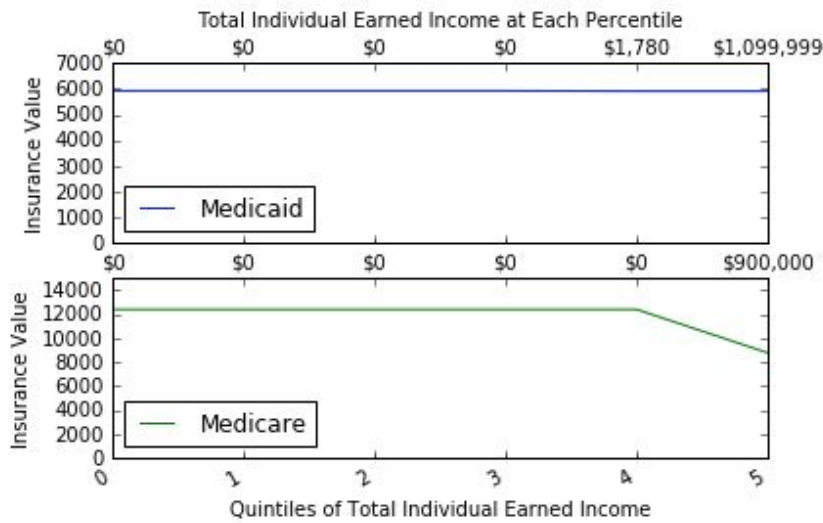
Note: The curves have been smoothed using local linear estimates.

Cumulative Program Summary

Figure 15. Benefits of Six Programs Stacked, by Household
Wage Income Percentiles
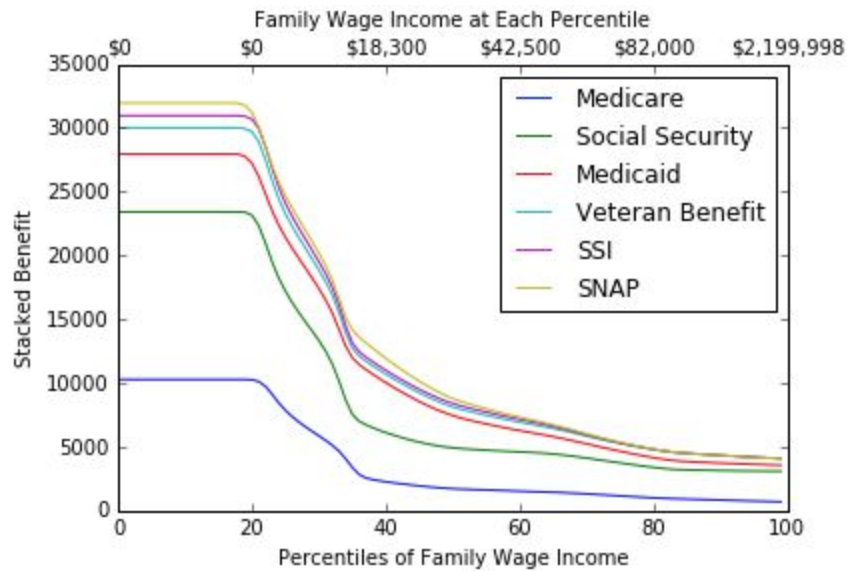
Note: The curves have been smoothed using local linear estimates.

Figure 16. Stacked MTR for SSI, SNAP, and Social Security
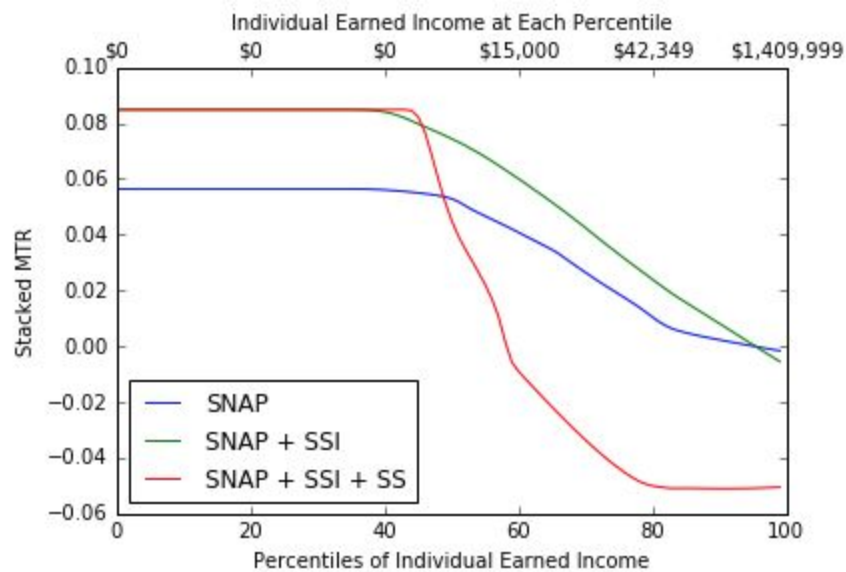
Note: The curves have been smoothed using local linear estimates.

Figure 17. Stacked Primary Earner's MTR, by Individual Wage Income
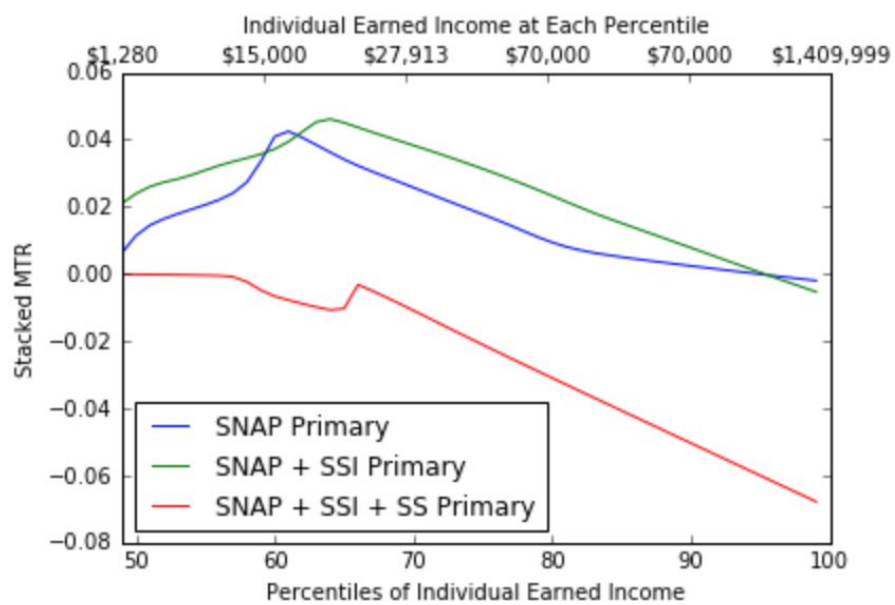
Note: The curves have been smoothed using local linear estimates.

Figure 18. Stacked Secondary Earner's MTR, by Individual Wage Income
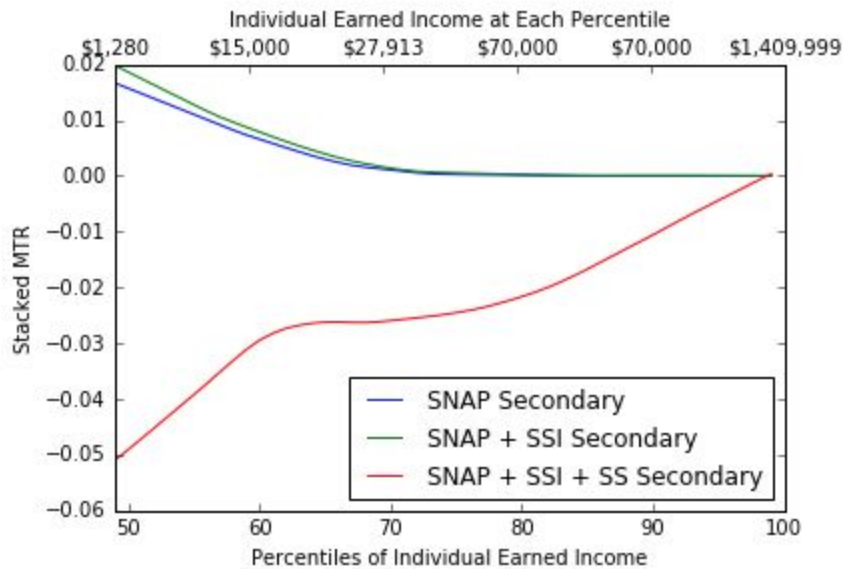
Note: Secondary earners are sparser than primary earners in the low-income range, and they are more likely to get lower MTR rates than primary earners for SSI, 0.5 versus 1. Thus, when some secondary earners get large negative MTRs from Social Security, the averaged MTR curve goes downward. The curves have been smoothed using local linear estimates.

Affordable Care Act: Premium Tax Credits

The premium tax credit (PTC) is a refundable tax credit for individuals who purchased health insurance in the Affordable Care Act marketplace and have a household income between 100 and 400 percent of the federal poverty line. IRS Commissioner John Koskinen reported that through October 2015, 3.0 million returns claimed $10.3 billion in PTCs.[50] The IRS projects that 4.8 million taxpayers will file Form 8962 for PTC or advance payments of the PTC (APTC) reconciliation, bringing total PTC claims above their 2014 levels of $15.5 billion.[51]

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[50] On January 8, 2016, IRS Commissioner John Koskinen updated members of Congress on preliminary results from the 2015 filing season related to Affordable Care Act provisions as of October 2015. John Koskinen, letter to Congress, January 8, 2016, https://www.irs.gov/pub/newsroom/irs_letter_aca_stats_010816.pdf.

[51] Treasury Inspector General of Tax Administration found errors in the IRS financial accounting and reporting errors in PTC-related fund outlays. Treasury Inspector General for Tax Administration, *Affordable Care Act: Controls over Financial Accounting for the Premium Tax Credit Should Be Improved*, March 2, 2016, https://www.treasury.gov/tigta/auditreports/2016reports/201613021fr.pdf.

We use a microsimulation model to determine eligibility and benefit amount, without matching the aggregates to administrative targets. We impute insurance area rating codes for a significant portion of returns that are missing that field. This results in 2.0 million PTC recipients receiving $10.1 billion in benefits.

The average PTC per tax unit is higher on the adjusted file than the average indicated by the IRS commissioner, since every imputed participant receives benefits for the full year, whereas there are likely many actual participants who receive benefits for under a full year. We seek to improve the model in the near future.

Participation, Benefit and MTR Calculation. The OSPC PTC calculator[52] determines eligibility and calculates the PTC amount using IRS Form 8962. To replicate IRS Form 8962, this calculator requires tax-unit-level health insurance coverage information; insurance rating area code of residence; modified adjusted gross income (AGI); ages of the filer, spouse, and dependents; and regular tax variables such as filing status and total number of people in tax unit.

Currently the input data set is a tax-unit data set created by John O'Hare from the most recent three years of the CPS ASEC[53], which includes the employer health insurance coverage[54] and age[55] of each member in tax unit. Modified AGI[56] is the sum of AGI, the nontaxable portion of OASDI benefits,[57] and tax-exempt interest income. One last input is insurance area rating code, which is mapped through the county[58] of residence information in the CPS tax-unit data set. However, this county field is not available

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[52] The OSPC-ACA calculator was developed by Martin Holmer and Nikolai Boboshko. Martin Holmer and Nikolai Boboshko, "OSPC-ACA," 2014, http://chiselapp.com/user/mrh/repository/OSPC-ACA/doc/trunk/www/home.wiki.

[53] Current version includes files from 2013, 2014, and 2015.

[54] When employer insurance coverage is not consistent with either the filing status or total number of tax-unit members, we adjust insurance coverage based using the best assumption. For example, if a single filer reports to have employer coverage for both filer and spouse, we change this record to cover for filer only.

[55] If a joint record is missing the spouse's age, we assign the spouse the same age as the filer.

[56] Our approximation does not include foreign earned income (Form 2555), since no data are available.

[57] We use the IRS Public Use File (PUF) data to impute taxable ratio of the benefit and then use the ratio to calculate the nontaxable portion of OASDI. As indicated by PUF variables (e01500 and e01700), most people's pension benefits are either fully taxable or fully nontaxable. Among all tax returns with positive pension benefits, 8 percent returns have no taxable pension benefits, 6 percent returns have less than 50 percent taxable benefit (average taxable ratio at 0.0596), 23 percent returns have more than 50 percent taxable benefit (average taxable ratio at 0.921), and 63 percent returns have fully taxable benefits. So we used a random number generator and assign taxable benefits according to the following specifications.

Random Number Range	Taxable Ratio
0 <= x < 0.08	0
0.08 <= x < 0.14	0.0596
0.14<= x < 0.37	0.0921
x >= 0.37	1

[58] This variable is missing for many records. We drop those records in this version and will impute them in the near future.

for every record, so we impute the area rating code based on county population table for 2014 with a random number generator.[59]

We feed the information above to the calculator and then get the PTC amount for each eligible tax unit. To obtain MTR, we add one dollar to the modified AGI, re-run the calculator, and get the different PTC amounts, which is MTR by definition.

Descriptive statistics for benefits and MTRs are included in Table 13 and Figure 19.

Table 13. Average PTC Amounts and MTR, by Modified AGI Percentage to Federal Poverty Line Decile

Decile	Modified AGI Upper Bound (Percentage to FPL)	Average Benefits	Average MTR
1	123	$5,718	0.020
2	142	$5,989	0.026
3	157	$5,831	0.040
4	174	$5,283	0.048
5	192	$4,953	0.055
6	214	$4,966	0.064
7	245	$4,453	0.073
8	276	$4,502	0.083
9	323	$4,085	0.094
10	400	$4,012	0.096

[59] Specifically, since multiple counties might share one insurance area rating code, we estimate the probability of residing in each area from current CPS county-level population and official county population. Then we use random numbers to assign tax units to different areas according to this probability.

Figure 19. Affordable Care Act: Premium Tax Credits
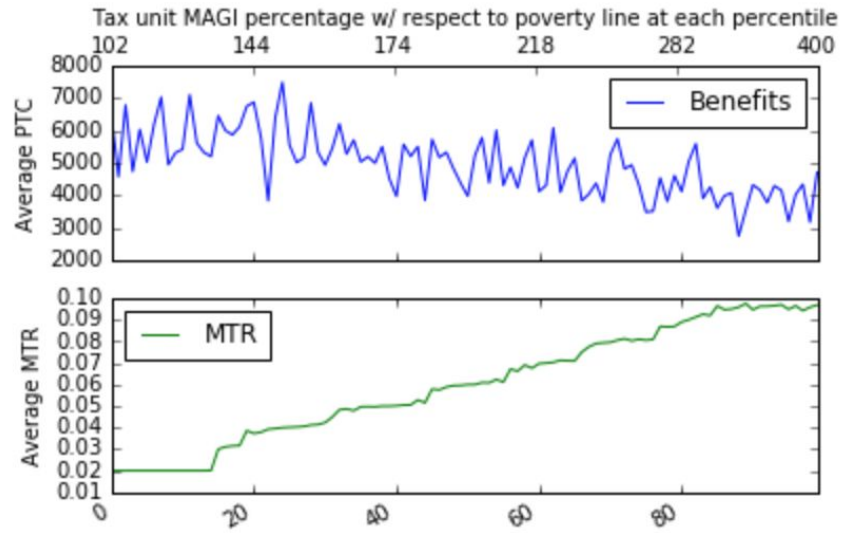
Appendix

Table A1. SSI Participation Regression Results

```
                        Logit Regression Results
==============================================================================
Dep. Variable:           ssi_indicator   No. Observations:            139415
Model:                           Logit   Df Residuals:                139410
Method:                            MLE   Df Model:                         4
Date:                 Tue, 25 Apr 2017   Pseudo R-squ.:               0.4621
Time:                         13:59:10   Log-Likelihood:             -6925.1
converged:                        True   LL-Null:                    -12873.
                                         LLR p-value:                  0.000
======================================================================================
                       coef    std err          z      P>|z|      [95.0% Conf. Int.]
--------------------------------------------------------------------------------------
intercept            -7.7857      0.191    -40.682      0.000      -8.161     -7.411
countable_income     -0.0001   7.45e-06    -14.703      0.000      -0.000   -9.5e-05
combined_disability   7.7408      0.202     38.399      0.000       7.346      8.136
a_age                 0.0386      0.003     12.108      0.000       0.032      0.045
age_X_disability     -0.0629      0.003    -18.440      0.000      -0.070     -0.056
======================================================================================
```

Note: The universe to draw participants is truncated to the bottom 95 percent of SSI participants according to their annual family earned income, or $57,000.

Table A2. SSI Benefit Adjustment Ratios Applied at State Level

State	Imputed (Millions)	Admin (Millions)	Adjust Ratio
Alabama	$1,227.12	$1,096.08	0.893
Alaska	$95.11	$133.73	1.406
Arizona	$953.70	$779.02	0.817
Arkansas	$799.81	$710.06	0.888
California	$10,680.17	$12,336.77	1.155
Colorado	$473.67	$498.73	1.053
Connecticut	$507.80	$464.08	0.914
Delaware	$141.25	$110.75	0.784
District of Columbia	$216.24	$195.72	0.905
Florida	$4,228.91	$3,589.73	0.849
Georgia	$1,876.89	$1,667.66	0.889
Hawaii	$175.90	$189.02	1.075
Idaho	$265.27	$200.86	0.757
Illinois	$2,408.29	$1,863.42	0.774
Indiana	$1,137.42	$859.60	0.756
Iowa	$378.40	$323.75	0.856
Kansas	$423.84	$312.33	0.737
Kentucky	$1,596.56	$1,203.03	0.754
Louisiana	$1,434.18	$1,155.53	0.806
Maine	$365.99	$236.15	0.645
Maryland	$972.03	$819.20	0.843
Massachusetts	$1,404.35	$1,399.90	0.997
Michigan	$2,065.93	$1,902.76	0.921
Minnesota	$654.64	$699.76	1.069
Mississippi	$992.63	$782.72	0.789

Missouri	$1,380.83	$918.77	0.665
Montana	$158.63	$112.19	0.707
Nebraska	$231.44	$179.84	0.777
Nevada	$431.03	$344.69	0.800
New Hampshire	$196.45	$121.42	0.618
New Jersey	$1,595.36	$1,281.12	0.803
New Mexico	$392.18	$397.25	1.013
New York	$5,641.45	$4,894.69	0.868
North Carolina	$1,922.85	$1,575.42	0.819
North Dakota	$59.90	$47.35	0.790
Ohio	$2,732.00	$2,118.75	0.776
Oklahoma	$902.60	$664.30	0.736
Oregon	$712.23	$569.73	0.800
Pennsylvania	$3,270.02	$2,641.85	0.808
Rhode Island	$284.74	$229.84	0.807
South Carolina	$888.19	$771.51	0.869
South Dakota	$88.35	$91.35	1.034
Tennessee	$1,337.30	$1,180.37	0.883
Texas	$4,811.65	$4,060.68	0.844
Utah	$251.60	$202.54	0.805
Vermont	$109.65	$110.19	1.005
Virginia	$1,037.77	$1,031.30	0.994
Washington	$1,339.61	$1,055.27	0.788
West Virginia	$601.12	$501.24	0.834
Wisconsin	$965.16	$911.76	0.945
Wyoming	$51.78	$41.19	0.796

Table A3. SNAP Participation Regression Results

```
                      Logit Regression Results
==============================================================================
Dep. Variable:              indicator   No. Observations:                37780
Model:                          Logit   Df Residuals:                    37774
Method:                           MLE   Df Model:                            5
Date:                Tue, 25 Apr 2017   Pseudo R-squ.:                  0.2746
Time:                        15:56:21   Log-Likelihood:                -12199.
converged:                       True   LL-Null:                       -16817.
                                        LLR p-value:                     0.000
==============================================================================
                 coef    std err          z      P>|z|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
hh_net       -8.248e-05   1.42e-06    -58.246      0.000   -8.53e-05 -7.97e-05
hh_size         0.2759      0.022     12.328      0.000       0.232      0.320
disability      0.3761      0.030     12.482      0.000       0.317      0.435
child_yn        0.4034      0.028     14.400      0.000       0.349      0.458
ssi_yn          1.0193      0.049     20.796      0.000       0.923      1.115
intercept      -1.4484      0.040    -36.279      0.000      -1.527     -1.370
==============================================================================
```

Table A4. SNAP Adjustment Ratios Applied at State Level

State	Imputed	Admin	adjust ratio
Alabama	1,367,596,445	1,318,133,562	0.964
Alaska	160,650,587	174,241,813	1.085
Arizona	1,474,280,245	1,476,761,898	1.002
Arkansas	638,284,696	663,719,268	1.040
California	7,458,475,030	7,411,483,685	0.994
Colorado	801,052,581	765,737,085	0.956
Connecticut	763,790,510	697,435,672	0.913
Delaware	240,670,276	220,352,805	0.916
District of Columbia	229,793,386	222,604,041	0.969
Florida	5,701,161,950	5,472,834,001	0.960
Georgia	2,772,399,320	2,827,853,876	1.020
Hawaii	514,970,645	525,397,960	1.020
Idaho	277,178,915	295,662,973	1.067
Illinois	3,334,968,858	3,202,509,863	0.960
Indiana	1,335,498,547	1,311,468,403	0.982
Iowa	540,502,801	532,085,213	0.984
Kansas	382,128,163	395,209,994	1.034
Kentucky	1,262,487,438	1,170,989,948	0.928
Louisiana	1,277,623,435	1,288,316,273	1.008
Maine	331,407,151	321,550,513	0.970
Maryland	1,165,878,419	1,133,135,874	0.972
Massachusetts	1,331,277,968	1,272,977,488	0.956
Michigan	2,755,333,516	2,576,165,148	0.935
Minnesota	671,154,474	670,202,668	0.999
Mississippi	942,818,173	912,985,504	0.968

Missouri	1,026,933,084	1,236,444,630	1.204
Montana	170,803,133	176,169,543	1.031
Nebraska	232,716,383	238,904,358	1.027
Nevada	499,133,787	536,711,313	1.075
New Hampshire	137,339,479	140,718,624	1.025
New Jersey	1,335,888,659	1,290,688,313	0.966
New Mexico	666,887,521	629,160,453	0.943
New York	5,192,129,583	5,200,758,093	1.002
North Carolina	2,374,768,118	2,383,571,501	1.004
North Dakota	71,349,485	75,765,024	1.062
Ohio	2,271,048,526	2,582,757,967	1.137
Oklahoma	888,112,098	865,049,765	0.974
Oregon	1,231,777,923	1,161,871,005	0.943
Pennsylvania	2,632,411,502	2,573,657,445	0.978
Rhode Island	274,624,365	279,843,287	1.019
South Carolina	1,114,251,740	1,235,696,260	1.109
South Dakota	140,491,002	148,938,276	1.060
Tennessee	2,003,907,157	1,951,918,832	0.974
Texas	5,529,801,508	5,330,650,619	0.964
Utah	304,909,808	316,671,764	1.039
Vermont	142,503,694	130,324,476	0.915
Virginia	1,282,815,752	1,303,281,631	1.016
Washington	1,673,054,804	1,547,545,882	0.925
West Virginia	492,883,707	476,134,200	0.966
Wisconsin	1,168,760,245	1,112,980,884	0.952
Wyoming	51,065,342	49,272,569	0.965

Table A5. VB Participation Regression 1 Results

```
                     Logit Regression Results
==============================================================================
Dep. Variable:              indicator   No. Observations:           139415
Model:                          Logit   Df Residuals:               139404
Method:                           MLE   Df Model:                       10
Date:                Wed, 19 Apr 2017   Pseudo R-squ.:              0.3372
Time:                        17:14:34   Log-Likelihood:            -5284.0
converged:                       True   LL-Null:                   -7971.7
                                        LLR p-value:                 0.000
==============================================================================
                 coef    std err          z      P>|z|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
a_age          0.0103      0.002      6.022      0.000       0.007      0.014
sex           -0.1083      0.085     -1.273      0.203      -0.275      0.058
income     -7.65e-07   6.32e-07     -1.210      0.226      -2e-06   4.74e-07
d1             0.0049      0.169      0.029      0.977      -0.326      0.336
d2             0.3849      0.096      4.028      0.000       0.198      0.572
d3            -0.1346      0.169     -0.796      0.426      -0.466      0.197
d4            -0.0927      0.145     -0.640      0.522      -0.376      0.191
d5             0.6277      0.094      6.688      0.000       0.444      0.812
d6             0.3730      0.122      3.058      0.002       0.134      0.612
active         3.8798      0.084     46.197      0.000       3.715      4.044
intercept     -6.4267      0.104    -61.935      0.000      -6.630     -6.223
==============================================================================
```

Table A6. VB Participation Regression 2 Results

```
                        Logit Regression Results
==============================================================================
Dep. Variable:              indicator   No. Observations:              139415
Model:                          Logit   Df Residuals:                  139408
Method:                           MLE   Df Model:                           6
Date:                Wed, 19 Apr 2017   Pseudo R-squ.:                 0.3369
Time:                        17:10:47   Log-Likelihood:               -5285.8
converged:                       True   LL-Null:                      -7971.7
                                        LLR p-value:                    0.000
==============================================================================
                 coef    std err          z      P>|z|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
a_age          0.0106      0.002      6.255      0.000       0.007       0.014
d4            -0.1074      0.131     -0.817      0.414      -0.365       0.150
d2             0.3858      0.094      4.086      0.000       0.201       0.571
d5             0.6329      0.091      6.947      0.000       0.454       0.811
d6             0.3748      0.122      3.084      0.002       0.137       0.613
active         3.9190      0.074     52.715      0.000       3.773       4.065
intercept     -6.5189      0.089    -73.601      0.000      -6.693      -6.345
==============================================================================
```

Table A7 . Social Security Participation Regression Results

```
                        Logit Regression Results
==============================================================================
Dep. Variable:           ss_indicator   No. Observations:              139415
Model:                          Logit   Df Residuals:                  139411
Method:                           MLE   Df Model:                           3
Date:                Fri, 21 Apr 2017   Pseudo R-squ.:                 0.5534
Time:                        10:49:39   Log-Likelihood:               -24214.
converged:                       True   LL-Null:                      -54217.
                                        LLR p-value:                    0.000
==============================================================================
                 coef    std err          z      P>|z|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
Aged_yn        4.7600      0.028    167.145      0.000       4.704       4.816
Disabled_yn    2.9466      0.032     91.863      0.000       2.884       3.009
Widowed_yn     1.0360      0.050     20.862      0.000       0.939       1.133
intercept     -3.7441      0.019   -194.554      0.000      -3.782      -3.706
==============================================================================
```