Numerical Methods Lecture XIV: Simulated Estimation

(See Keane and Moffitt 1996)

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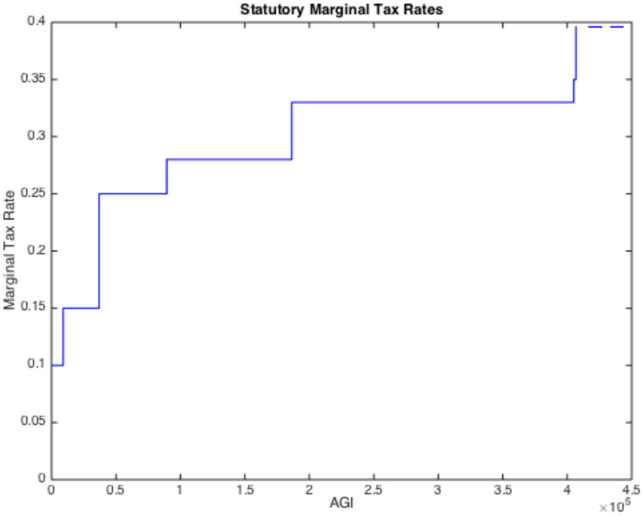
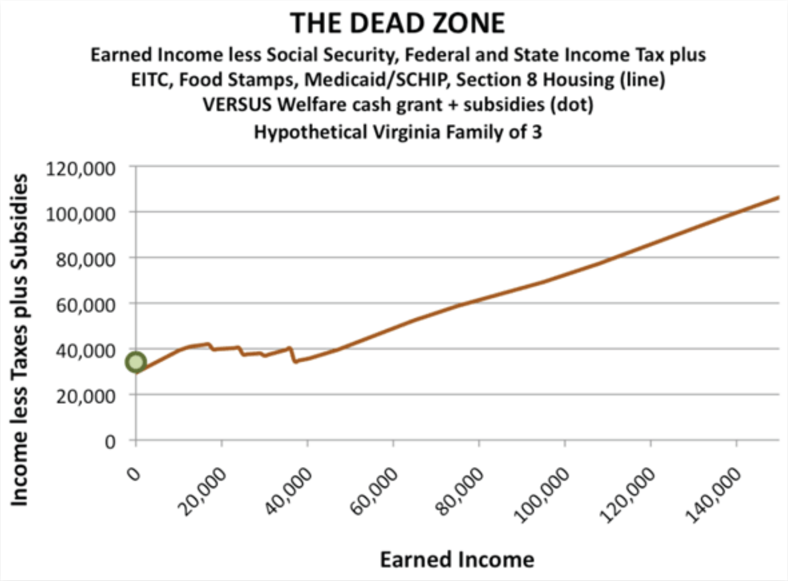
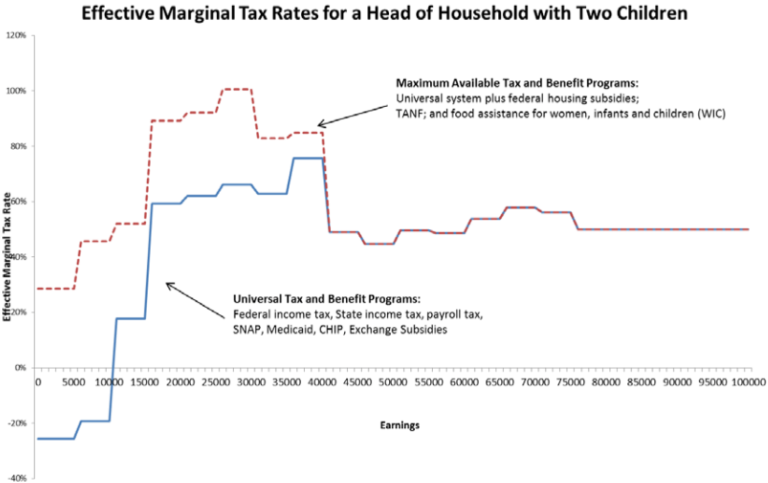
Statutory Marginal Tax Rates-1



Implicit Marginal Tax Rates-1

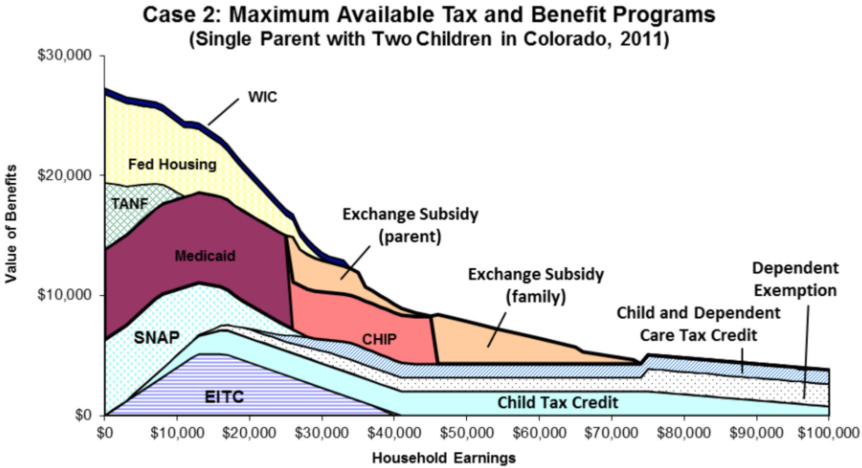


Implicit Marginal Tax Rates-2



Average effective marginal tax rates facing a single parent with two children living in Colorado. The effective marginal rate is the the marginal tax rate faced in the formal tax system (federal, state, and payroll) in addition to the rates arising from the reduction in disposable income from the loss of transfer benefits. The tax rules used for federal and state income taxes are for CY2011. The payroll tax rate does not include the temporary reduction of the employee portion of the tax. Hypothetical exchange subsidy values were calculated to display the eventual impact of the Affordable Care Act for a worker without employer provided coverage based on CBO estimates discounted back to 2011.

Implicit Marginal Tax Rates-3



The problem is complicated!

- We spend trillions on transfer programs
- Implicit marginal tax rates frequently bigger deal than statutory tax rates
- Now, if you're on one program you're on a lot of them
- In Keane and Moffitt (circa 1989)
  - 89% of AFDC recipients were on Medicaid and Food Stamps
  - 42% of AFDC recipients were on some fourth program (like housing)
- Enormous implicit marginal tax rates interact

Keane & Moffitt

- Look at female heads
- AFDC, Food stamps, housing, and labor supply
- Produce four-equation model
- Simulate outcomes given parameters
- Estimate parameters

Illustrative Cumulative Tax Rates: CA

	Weekly Income			Tax Rate from H=0 to H=20	Tax Rate from H=20 to H=40
	$H = 0$	$H = 20$	$H = 40$		
California					
Earnings	0	104	208	.	.
AFDC	124	30	0	0.90	0.29
Food Stamp	16	16	0	0	0.15
Housing	138	132	107	0.06	0.24
Taxes	0	-8	-26	0.08	0.17
Work Expns.	0	-21	-21	0.20	0
Net Income	278	253	268	.	.
Cumulative Tax Rate	.	.	.	1.24	0.86

Illustrative Cumulative Tax Rates: MN

	Weekly Income			Tax Rate from H=0 to H=20	Tax Rate from H=20 to H=40
	$H = 0$	$H = 20$	$H = 40$		
Minnesota					
Earnings	0	104	208	.	.
AFDC	117	25	0	0.88	0.24
Food Stamp	19	19	0	0	0.18
Housing	97	91	64	0.06	0.26
Taxes	0	-8	-26	0.08	0.17
Work Expns.	0	-21	-21	0.20	0
Net Income	233	210	225	.	.
Cumulative Tax Rate	.	.	.	1.22	0.86

Illustrative Cumulative Tax Rates: OH

	Weekly Income			Tax Rate from H=0 to H=20	Tax Rate from H=20 to H=40
	$H = 0$	$H = 20$	$H = 40$		
Ohio					
Earnings	0	104	208	.	.
AFDC	60	0	0	0.58	0
Food Stamp	44	30	4	0.13	0.29
Housing	87	71	37	0.15	0.33
Taxes	0	-8	-26	0.08	0.17
Work Expns.	0	-21	-21	0.20	0
Net Income	191	176	202	.	.
Cumulative Tax Rate	.	.	.	1.14	0.75

Illustrative Cumulative Tax Rates: KS

	Weekly Income			Tax Rate from H=0 to H=20	Tax Rate from H=20 to H=40
	$H = 0$	$H = 20$	$H = 40$		
Kansas					
Earnings	0	104	208	.	.
AFDC	76	0	0	0.73	0
Food Stamp	38	31	0	0.07	0.30
Housing	68	64	31	0.04	0.32
Taxes	0	-8	-26	0.08	0.17
Work Expns.	0	-21	-21	0.20	0
Net Income	82	170	192	.	.
Cumulative Tax Rate	.	.	.	1.12	0.79

Keane & Moffitt: Utility

- U is:

$$U(H, Y, P_1, P_2, P_3) = \overline{U(H, Y)} - \psi_1 P_1 - \psi_2 P_2 - \psi_3 P_3$$

- Where H is hours of work.
- Y is disposable income.
- P_j is a dummy variable for participation in program j.
- ψ_j is the marginal disutility of participating in program j.
- Limit $H \in \{0, 20, 40\}$. Limits to $3 \cdot 2^3 = 24$ possibilities.

Keane & Moffitt: Budget Constraint

- Disposable income is defined as:

  $$Y(H, P_1, P_2, P_3) = wH + N + P_1 B_1(H) + P_2 B_2(H) + P_3 B_3(H) - T(H)$$

- Where w is the hourly wage rate
- N is nontransfer nonlabor income
- $B_j(H)$ is benefit function for program j.
- $T(H)$ is the tax function.

Keane & Moffitt: Optimization

- Households choose from three choices of hours and 8 choices of program participation
- All interact nonlinearly with income
- Choose the best of all activities. Choose j iff:

$$U_j \geq U_k \quad \forall\ k \in \{1, 2, ..., 24\}$$

Keane & Moffitt: Take it to the data!

- Assume a form of utility:

$$\begin{aligned}
U(H, Y, P_1, P_2, P_3) \quad = \quad & \alpha H + Y - \beta_{HH} H^2 - \beta_{YY} Y^2 + \beta_{HY} HY \\
& -\psi_1 P_1 - \psi_2 P_2 - \psi_3 P_3 \\
& +\phi_{12} P_1 P_2 + \phi_{13} P_1 P_3 + \phi_{23} P_2 P_3 \\
& -\delta_1 HP_1 - \delta_2 HP_2 - \delta_3 HP_3 \\
& -\eta_1 YP_1 - \eta_2 YP_2 - \eta_3 YP_3
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- Ordinary utility from hours and income

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- Ordinary utility from hours and income
- Direct disutility from participation

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- Direct disutility from participation
- Interactions from multiple participation

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- Ordinary utility from hours and income
- Direct disutility from participation
- Interactions from multiple participation
- Interaction of program on hours

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- Ordinary utility from hours and income
- Direct disutility from participation
- Interactions from multiple participation
- Interaction of program on hours
- Interaction of program on income

Keane & Moffitt: An issue(?)

$$\begin{aligned} U(H, Y, P_1, P_2, P_3) &= \alpha H + Y - \beta_{HH} H^2 - \beta_{YY} Y^2 + \beta_{HY} HY \\ &\quad -\psi_1 P_1 - \psi_2 P_2 - \psi_3 P_3 \\ &\quad +\phi_{12} P_1 P_2 + \phi_{13} P_1 P_3 + \phi_{23} P_2 P_3 \\ &\quad -\delta_1 HP_1 - \delta_2 HP_2 - \delta_3 HP_3 \\ &\quad -\eta_1 YP_1 - \eta_2 YP_2 - \eta_3 YP_3 \end{aligned}$$

- Why doesn't Y have a coefficient?

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- Why doesn't Y have a coefficient?
- There's an issue...what is it?

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\end{aligned}
$$

- Why doesn't Y have a coefficient?
- There's an issue...what is it?
- Hint:
  - Allow α and ψ_1, ψ_2, and ψ_3 to vary in the population:

$$\alpha = X\bar{\alpha} + \epsilon_\alpha$$

$$\psi_1 = X\overline{\psi_1} + \epsilon_{\psi_1}$$

$$\psi_2 = X\overline{\psi_2} + \epsilon_{\psi_2}$$

$$\psi_3 = X\overline{\psi_3} + \epsilon_{\psi_3}$$

- Assume ϵ_α, ϵ_A, ϵ_F, ϵ_R, ϵ_W are multivariate normal

Keane & Moffitt: One final issue

- Wages for nonworkers are unobserved
- Specify wages as:

$$\log(w) = X\nu + \epsilon_W$$

- How should they estimate this?

Keane & Moffitt: One final issue

- Wages for nonworkers are unobserved
- Specify wages as:

$$\log(w) = X\nu + \epsilon_W$$

- How should they estimate this?
- Two ways:
  - Could do it beforehand
  - Could do it along with the model

Keane & Moffitt: Dealing with Wages

- Because wages are unobserved by econometrician but known by the individual, assuming we know it is wrong
- Keane and Moffit spend a long time on this
- The problem comes from the fact that our wage tells us about working and (not) working tells us about the wage
- Keane and Moffitt "integrate the wage out": take a number of random draws conditional on observables and take their average
- They also add a random error term to all utilities to make things smoother
- I'm not going to worry about these here

Keane & Moffitt: In-Kind Benefits

- Some benefits are in-kind transfers, may not be valued dollar-for-dollar
- Consequently, estimate adjusted budget constraint:

$$\begin{aligned} Y(H, P_A, P_F, P_R) = {} & wH + N + B_A(H)P_A + B_F(H)P_F + \\ & + \gamma_r B_R(H)P_R + \\ & + \gamma_{MED} B_{MED} P_A + \\ & + \gamma_{PHI} B_{PHI} P_{PHI}(1 - P_A) + \\ & - T(H) - E(H) \end{aligned}$$

Keane & Moffitt: Measuring stigma

- Keane and Moffitt argue a better measure of stigma interactions would be to use:

  $$\lambda(\psi_A P_A + \psi_F + \psi_R P_R) + (1-\lambda)\max(\psi_A P_A, \psi_F P_F, \psi_R P_R)$$

  rather than:

  $$+\phi_{12} P_1 P_2 + \phi_{13} P_1 P_3 + \phi_{23} P_2 P_3$$

  in the utility function.
- λ controls the “interactivity” of stigma

Keane & Moffitt: Estimation

- Say we knew the wages
- Given a set of parameters $\Theta =$ $\{\alpha, \sigma_\alpha, \sigma_A, \sigma_F, \sigma_R, \sigma_W, \rho_{\alpha A}, \rho_{\alpha F}, \rho_{\alpha R}, \rho_{\alpha W}, \rho_{AF}, \rho_{AR}, \rho_{AW}, \rho_{FR}, \rho_{FW}, \rho_{RW}, \overline{\psi_1}, \overline{\psi_2}, \overline{\psi_3}, \phi_{12}, \phi_{13}, \phi_{23}, \delta_1, \delta_2, \delta_3, \eta_1, \eta_2\eta_3\}$ and X, we can simulate the distribution and solve everyone's problem.
- They also make some things dependent on X, adding covariates to estimate.
- From that, we can write, for each person,

$$P(j|X, \Theta)$$

- From that we can produce a simulated likelihood and estimate.
- Alternatively, could write down the probabilities and likelihoods and use method of moments
- These are called Simulated Maximum Likelihood (SML) and Method of Simulated Moments (MSM, or SMM).

Data

			Labor Supply			Row Totals
A	F	R	Nonworkers	Part-Time	Full-time	
0	0	0	76	57	383	516
1	0	0	9	1	7	17
0	1	0	36	20	32	88
1	1	0	162	11	2	175
0	0	1	10	6	46	62
1	0	1	3	0	0	3
0	1	1	14	4	9	27
1	1	1	77	2	1	80
Total			387	101	480	968

Results: Estimation

Look at Table 2.

Results: Interpretation

- $\beta_H H$ and $\beta_Y Y$ give wage and income elasticities
  - Uncompensated: 1.82
  - Income elasticity: -0.21
- Big disutilities from participation in everything but housing
- Not big interactive disutilities
- Cash value of housing: \$0.10
- Cash value of Medicaid: \$0.48
- Cash value of private health insurance ϕ: 0.62

Results: Alter the budget constraint

- Increasing eligibility phase out (reducing tax rate) for AFDC (see Table 7)
  - Doesn't really impact labor
  - Increases participation
- Wage shifts decrease participation and increases labor significantly

External Validity

- Test against AFDC tax rate change in 1981
- See Table 8

Takeaways

- Most interesting result:
  - Implicit marginal tax rates are high
  - Reductions in implicit marginal tax rates don't have a huge effect on labor, because program expansion reduces work for new entries even as it increases work for inframarginal participants
- Stigma is significant, interactions in stigma are not too significant