Integrating Microsimulation Tax Functions into a DGE Macroeconomic Model

A Canonical Example

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Abstract

This paper integrates individual effective tax rates and marginal tax rates computed from a microsimulation (partial equilibrium) model of tax policy with a dynamic general equilibrium (DGE) model of tax policy that can provide macroeconomic analysis or dynamic scores of tax reforms. Our approach captures the rich heterogeneity, realistic demographics, and tax-code detail of the microsimulation model and allows this detail to inform a general equilibrium model with a relatively high degree of heterogeneity. In addition, we propose a functional form in which tax rates depend jointly on the levels of both capital income and labor income.

Introduction

How do tax policy changes affect:

- total revenues
- macroeconomic variables
- distribution of incidence
- distribution of income (inequality)

In this paper we:

- Incorporate richness of microsimulation tax information into DGE macroeconomic model.
  - Estimate smooth functions of labor income and capital income by age
- Show how this works with standard tax reform
  - 10% marginal rate cut and increased standard deduction

Previous Literature

- Fullerton and Rogers (1993) specify total income tax liability functions as functions of age and lifetime income (category)
- Zodrow and Diamond (2013) and Nishiyama (2002) follow similar approach
- The U.S. Joint Committee on Taxaation's model uses individual income tax functions, estimated with administrative data

How our approach differs

- Use microsimulation model
  - Estimate tax functions from output
  - Estimate both marginal tax rates and effective tax rates
  - Allows one to have functions for baseline and policy
- Allow marginal rates to vary over income (not just lifetime income group)
- Very flexible functional forms
- Full integration - run microsimulation model and macro model together

Taxes in a DGE Model

Key Features of the Model

- Individual mortality is stochastic (Aggregate is deterministic)
- OG model with 100-period-lived individuals
  - Overlapping generations
  - Heterogeneity in age and ability
  - Realistic Demographics: Fertility, Immigration, Mortality
  - Households Leave Bequests which are Intentional/Unintentional
- Representative, perfectly competitive firms
- Calibration
  - Lifetime earnings: IRS (SOI) with imputed CPS hours
  - Average labor hours by age
  - Wealth distribution by age and wealth percentile
- Taxes: Income, Payroll/Soc. Sec, and Wealth
  - Income tax: estimated from Tax-Calculator output
  - Payroll tax and Social Security
  - Wealth tax
  - Lump sum transfers
- Government: balanced budget, redistributes only

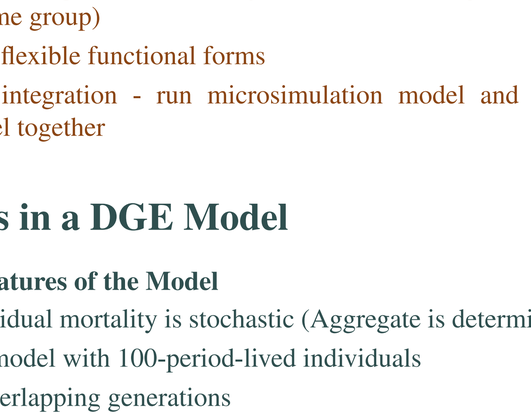

Figure 1: Exogenous Life-Cycle Income Ability Paths

Flexible Tax Functions

We need to design flexible tax functions that allow marginal and average tax rates on capital and and labor income to depend in complex ways on these types of income separately.

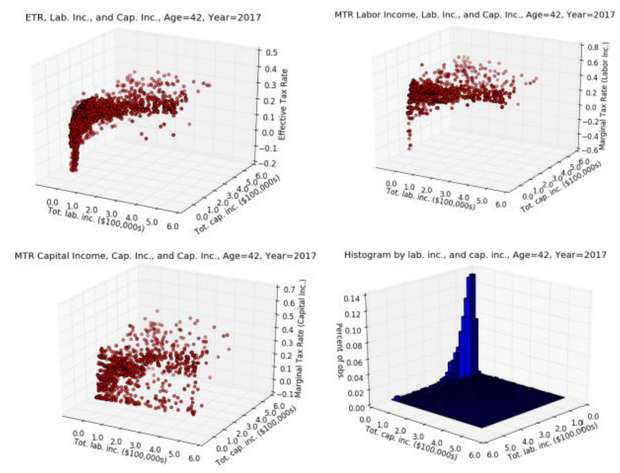

Figure 2: Scatter Plot of ETR, MTRx, MTRy, and Histogram

Let x be total labor income, $x \equiv \hat{w}_t e_{j,s} n_{j,s,t}$, and let y be total capital income, $y \equiv r_t \hat{b}_{j,s,t}$. We then write our tax rate functions as follows.

$$\tau(x,y) = \Big[\tau(x) + shift_x\Big]^{\phi}\Big[\tau(y) + shift_y\Big]^{1-\phi} + shift$$

$$\text{where} \quad \tau(x) \equiv (max_x - min_x)\left(\frac{Ax^2 + Bx}{Ax^2 + Bx + 1}\right) + min_x$$

$$\text{and} \quad \tau(y) \equiv (max_y - min_y)\left(\frac{Cy^2 + Dy}{Cy^2 + Dy + 1}\right) + min_y$$

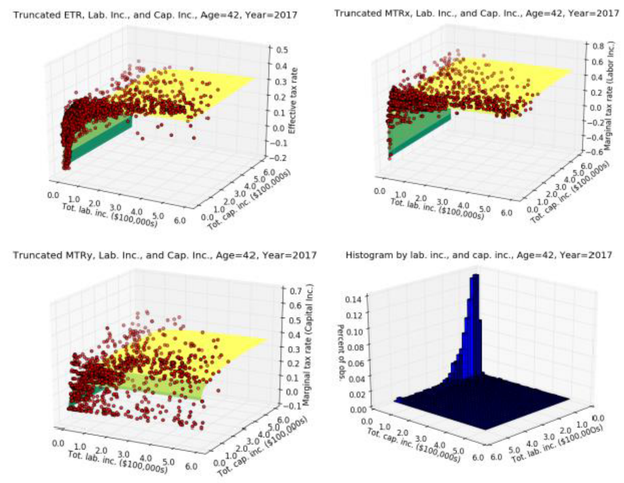

Figure 3: Estimated Functions for ETR, MTRx, MTRy, and Histogram

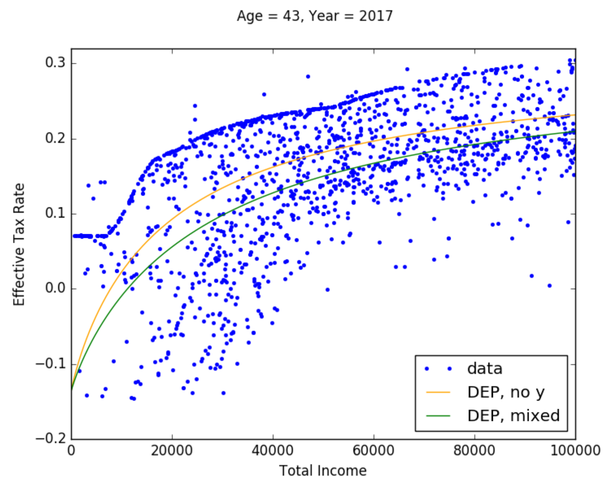

Figure 4: Plot of ETR functions

GS is the functional form from Gouveia and Strauss (1994).

DGE and Microsimulation Integration

Open Source Policy Center's Tax Calculator

- Based on 2009 IRS PUF + CPS match
- Extrapolate/Age 2009 data to 2017-2026
- Tax calculator similar to NBER's TaxSim
- Rich detail on federal individual income tax code
- No state taxes

Microsimulation Output The output from a run of the Tax Calculator includes:

- Static revenue estimates
- Select distributional tables
- Micro-data based in tax inputs:
  - Marginal tax rates
  - Total tax liability
  - Amounts of income and deduction items

Itegrating the Results of the Microsimulation

- For each year 2017 - 2026, age 20 - 80, and earnings group, we estimate the effective tax rate (ETR) and the marginal tax rates on wage and capital income (MTRx and MTRy) using the output from the microsimulation model.
- We use these tax functions in our simulation of the economy and generate endogenous responses of savings and labor supplies for all ages and income ability groups over the 10-year horizon.
- These generate different revenue effects than those from the microsimulation which holds savings and labor constant as the tax code changes.

Results of Tax Experiments

Standard deduction by filer type under the baseline current law versus policy change

Filing Status	Baseline	Policy
Single	$6,350	$12,700
Married, Filing Jointly	$12,700	$25,400
Married, Filing Separately	$6,350	$12,700
Head of Household	$9,350	$18,700
Widow	$12,700	$25,400
Dependent	$1,050	$2,100

Static Revenue Estimates

Tax Revenue	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Income Tax	-204.3	-211.6	- 218.4	-226.3	-234.6	-243.3	-253.5	-264.0	-275.1	-286.8
Payroll Tax	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Combined	-204.3	-211.6	- 218.4	-226.3	-234.6	-243.3	-253.5	-264.0	-275.1	-286.8

Percent Change in Macroeconomic Variables

Variables	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2017-26	SS
GDP	-0.11	0.71	0.71	0.72	0.82	0.83	0.91	0.91	0.86	0.94	0.73	1.44
Consumption	0.44	0.47	0.51	0.57	0.61	0.65	0.69	0.72	0.77	0.79	0.62	1.16
Investment	-1.36	1.24	1.16	1.06	1.30	1.22	1.38	1.34	1.08	1.27	0.98	2.09
Hours Worked	-0.19	1.13	1.06	1.03	1.14	1.09	1.18	1.14	1.02	1.11	0.97	1.09
Avg. Wage	0.09	-0.42	-0.36	-0.31	-0.32	-0.27	-0.27	-0.23	-0.16	-0.17	-0.24	0.35
Interest Rate	-0.30	1.45	1.23	1.07	1.12	0.95	0.96	0.81	0.57	0.63	0.85	-1.33
Total Taxes	-1.08	-7.71	-8.99	-9.81	-8.52	-8.65	-8.33	-8.97	-9.14	-8.78	-7.93	-7.08

Conclusions

- We propose a method to integrate the rich heterogeneity of a microsimulation model into a DGE model
- The idea is to bring the advantages of the two models together
- To do this, we propose one estimate a parameterized tax function that takes advantage what heterogeneity exists in the DGE model
- This has the additional advantage of using the micro model to help avoid ad hoc adjustments to the DGE model for specific policy proposals

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