

*MACROECONOMIC AND DISTRIBUTIONAL
EFFECTS OF A CARBON TAX UNDER
ALTERNATIVE REVENUE RECYCLING OPTIONS*

John W. Diamond

and

George R. Zodrow

Baker Institute, Rice University

Introduction and Overview

- Examine macroeconomic and distributional effects of a carbon tax under different revenue recycling options
- Use Diamond-Zodrow overlapping generations, dynamic, computable general equilibrium model of US economy
 - Firms choose investment and labor to maximize firm value, subject to costs of adjusting investment
 - Households choose consumption and leisure to maximize lifetime income, and make a fixed nominal “target bequest”

- Model has intergenerational structure, with households that have an economic life of 55 years (45 working years and 10 retirement years)
- Each of 55 generations alive at a given point in time is divided into 12 lifetime income groups
 - 10 lifetime income deciles, with bottom decile split into bottom 2% and remaining 8% and top decile split into top 2% and remaining 8%

- Both firms and households characterized by perfect foresight – less over-reaction to policy changes than myopic models
- Track effects year-by-year so simulate all short-run and long-run effects – do not need to measure aggregate present values of total changes over many years
- Economy must begin and end at a steady state equilibrium and grows at exogenous growth rate (sum of population and productivity growth rates)

Modeling of Tax Structures

- Much detail on business and individual tax structures
 - Separate taxation of corporations and pass-through entities
 - Separate taxation of old and new assets
 - Separate taxation of owner-occupied and rental housing
 - Progressive taxation of labor income of lifetime income groups
 - Different types of capital income taxed at different flat rates
- Separate modeling of Social Security by lifetime income group

Carbon Tax Reforms Modeled

- Three cases analyzed, focusing on first benchmark case
 - In all cases, environmental benefits of carbon tax ignored
 - Benchmark Case: \$50 per metric ton of CO₂ in 2020, increasing at path specified by Rhodium Group until 2050, and then held constant in real terms
 - High Tax Case: \$73 per metric ton of CO₂ in 2020
 - Low Tax Case: \$14 per metric ton of CO₂ in 2020

- Use as inputs the price increases calculated for these carbon taxes by Rhodium Group (RHG)
- Price increases for 19 consumer goods calculated by RHG are mapped into price changes for four producer/consumer goods in our model
 - (1) Corporate (C corps), and (2) “non-corporate” or pass-through entities
 - (3) Owner-occupied housing, and (4) rental housing

- Three carbon tax revenue recycling options simulated, relative to “current law” benchmark including TCJA
 - Uniform rate payroll tax reduction
 - Simulations for benchmark, high tax, and low tax cases
 - Uniform per household rebates
 - Reductions in debt for 10 years, followed by uniform per household rebates
- Assume that SS benefits and transfers indexed for carbon-tax-induced inflation in consumer prices

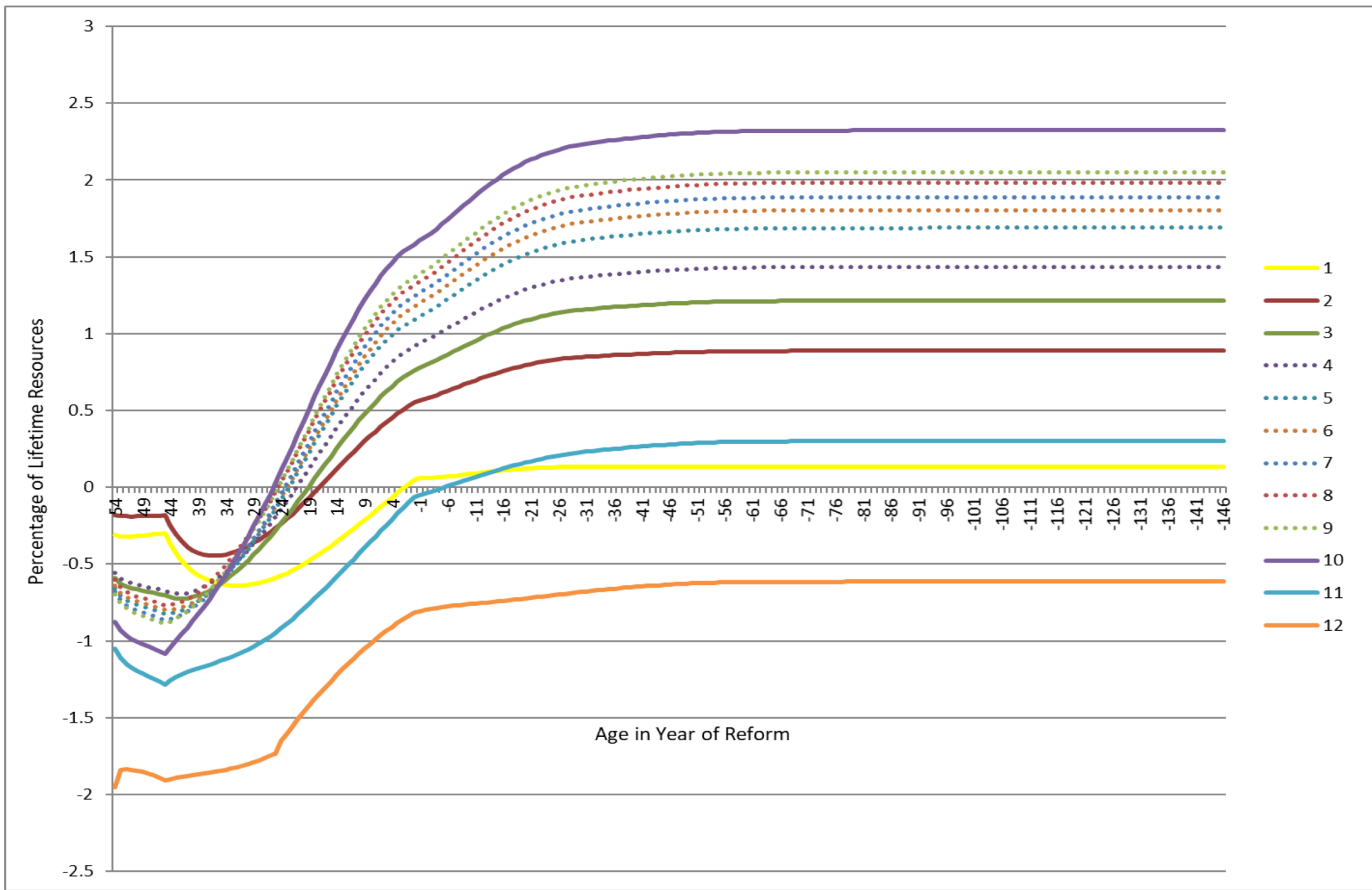
Measurement of Effects

- Macroeconomic effects: Measure effects on GDP, investment, aggregate consumption, consumption by sector, employment, etc. on a year-by-year basis
- Distributional effects
 - Use “equivalent variation” measure of welfare changes for each generation alive at time of reform and future generations (measured as percentage of remaining lifetime resources) – a natural lifetime measure in model

- Note: Capture distributional effects of price changes only to extent captured by changes in prices of four producer/consumer goods in model
- Most other studies find that distributional effects of changes in consumer prices (e.g., changes in prices of electricity, fuel oil, and gasoline) are swamped by changes due to revenue recycling that are the focus of our study

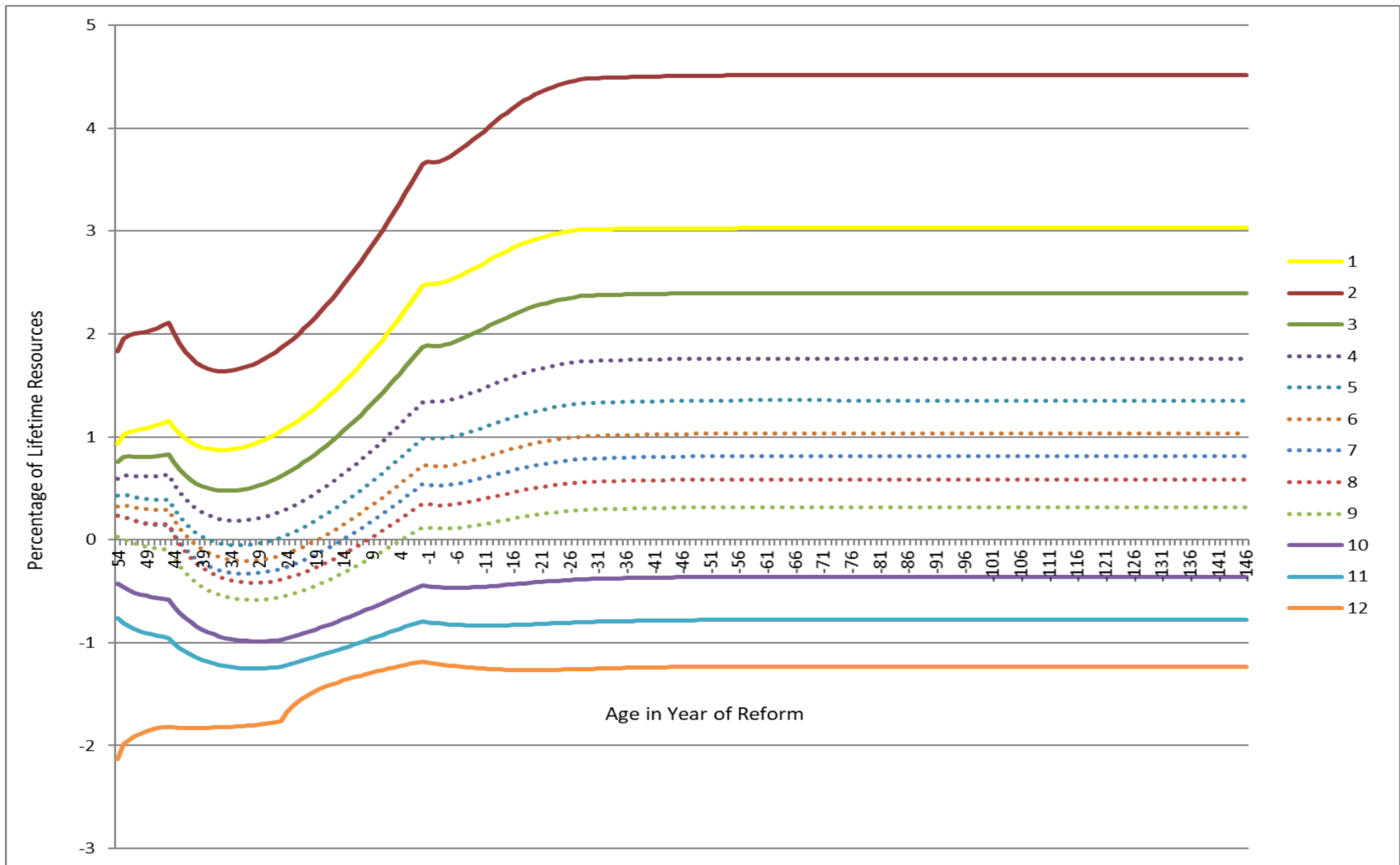
DZ Simulation Results: Payroll Tax Reduction

Variable	% Change in Year:	2020	2024	2029	2039	2069	LR
GDP		-0.12	0.12	0.18	0.26	0.42	0.45
Total Consumption		-0.30	-0.15	-0.08	0.00	0.13	0.16
Corporate Good		0.18	0.32	0.37	0.43	0.53	0.57
Non-Corporate Good		-0.60	-0.39	-0.31	-0.09	0.12	0.16
Owner-Occupied Housing		-1.17	-1.03	-0.88	-0.96	-0.93	-0.93
Rental Housing		-1.41	-1.38	-1.22	-1.26	-1.16	-1.13
Total Investment		0.36	1.10	1.03	1.16	1.41	1.40
Total Capital Stock		0.00	0.22	0.42	0.66	1.12	1.22
Total Employment (hours worked)		0.11	0.12	0.12	0.15	0.18	0.18
Payroll tax rate (change in % points)		-2.34	-2.22	-2.34	-2.80	-3.07	-3.09



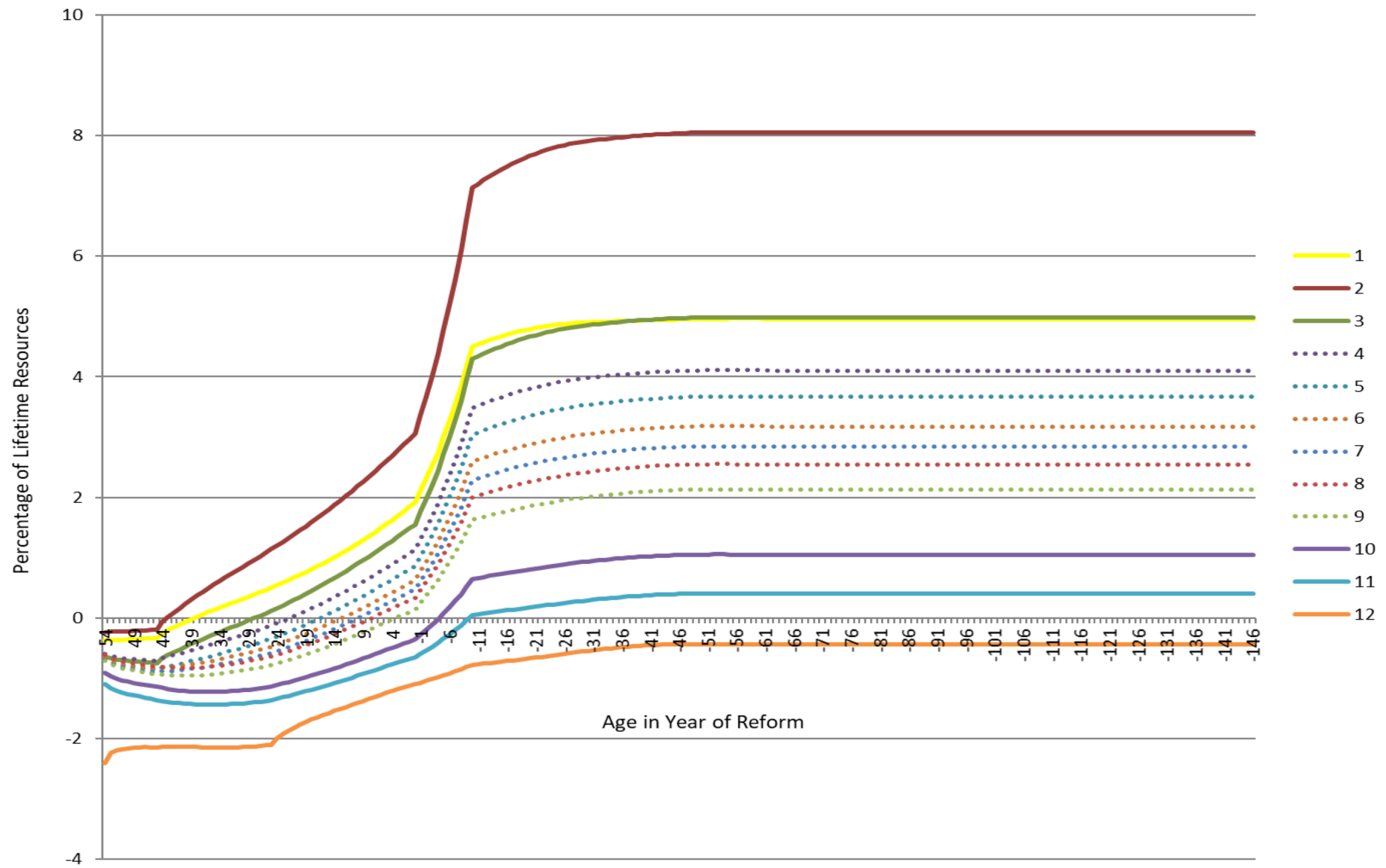
DZ Simulation Results: Equal Household Rebate

Variable	% Change in Year:	2020	2024	2029	2039	2069	LR
GDP		-0.42	-0.31	-0.36	-0.40	-0.37	-0.37
Total Consumption		-0.37	-0.38	-0.45	-0.56	-0.57	-0.57
Corporate Good		0.11	0.09	-0.01	-0.14	-0.19	-0.18
Non-Corporate Good		-0.67	-0.62	-0.69	-0.66	-0.59	-0.59
Owner-Occupied Housing		-0.68	-0.42	-0.30	-0.41	-0.11	0.00
Rental Housing		-1.60	-1.76	-1.71	-1.94	-2.04	-2.06
Total Investment		-1.01	-0.32	-0.28	-0.04	0.14	0.12
Total Capital Stock		0.00	-0.16	-0.26	-0.30	-0.07	-0.05
Total Employment (hours worked)		-0.37	-0.34	-0.36	-0.40	-0.46	-0.47



DZ Simulation Results: 10-Year Debt Reduction + Rebate

Variable	% Change in Year:	2020	2024	2029	2039	2069	LR
GDP		-0.43	-0.15	-0.04	0.07	0.29	0.30
Total Consumption		-0.72	-0.65	-0.61	-0.54	-0.49	-0.42
Corporate Good		-0.22	-0.16	-0.14	-0.07	-0.02	0.06
Non-Corporate Good		-1.01	-0.87	-0.82	-0.59	-0.43	-0.35
Owner-Occupied Housing		-1.33	-1.06	-0.85	-0.70	-0.04	0.33
Rental Housing		-1.97	-2.04	-1.98	-2.15	-2.41	-2.40
Total Investment		0.40	1.72	2.08	2.33	3.13	2.91
Total Capital Stock		0.00	0.28	0.73	1.37	2.58	2.65
Total Employment (hours worked)		-0.30	-0.27	-0.30	-0.39	-0.56	-0.57



Summary: Macroeconomic Effects

- Payroll tax reduction and 10-year debt reduction+rebate have similar modest positive effects on long run GDP
 - Payroll tax reduction increases labor supply and consumption
 - Debt reduction + equal rebate increases investment and capital stock but reduces labor supply and consumption
- Equal household rebate: GDP, capital stock, labor supply, and consumption decline in the long run

Summary: Distributional Effects

- Carbon tax with payroll tax reduction
 - Redistributes from old to young and future generations
 - Is initially roughly proportional (but disproportionately low burden on bottom decile and disproportionately high burden on top decile)
 - In long run, regressive except at very top of income distribution (top decile)

- Carbon tax with equal household rebates
 - Quite progressive as rebates disproportionately benefit lowest income groups
 - SR: Second lowest and oldest lifetime income group gains 2% and highest loses 2%
 - LR: Second lowest lifetime income group gains 4.5% and highest loses 1.2%

- Carbon tax with 10-year debt reduction followed by equal household rebates
- Most progressive policy option, in long run due to capital accumulation followed by rebates favoring poor
 - SR: Oldest and richest group loses 2.4%; others lose between 0.2% to 1.1%
 - LR: Highest lifetime income group loses 0.4% while second lowest group gains 8.1%