Simulating Tax Policy: Agent Utility, Elections, and the Economic Dynamics of Labor and Taxation with LLM Generative Agents

PROBLEM

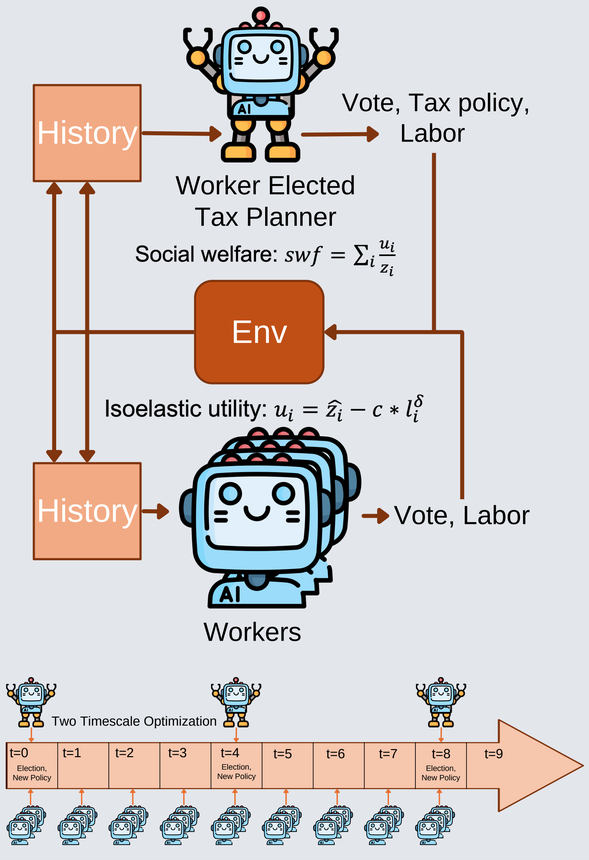
Policy experimentation is prohibitively expensive and politically infeasible. Optimal income taxation theory creates sup-optimal policies because of simplifying assumptions about human behavior.

SOLUTION

We use large language models [LLMs] to generate synthetic human data facilitating policy mechanism design, testing, and optimization with in-context learning. We model policy decisions as a Stackelberg game between a tax planner (leader) and workers (followers), optimizing for equilibria that maximize social welfare. We investigate the effect of three simulation scenarios and two skill distributions on social welfare. We learn policies in simulations with 100 agents where calculating equilibria through backwards induction is intractable.

METHODOLOGY

Democratic Scenario



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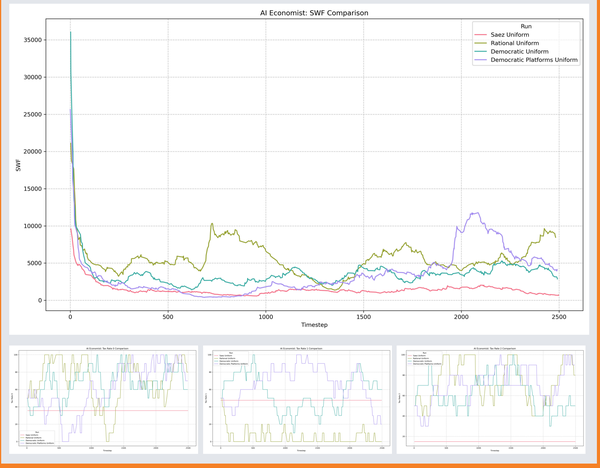
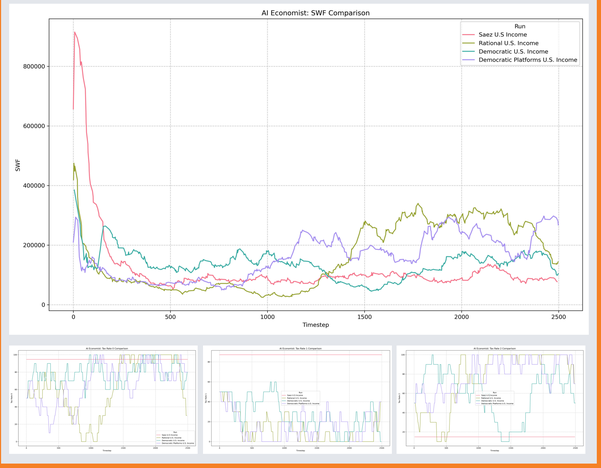
100 Agent Simulations with Different Skill Distributions

Uniform Distribution



U.S. Income Distribution



All **learned policies** result in **higher social welfare** than Saez's policy from optimal income taxation theory.

THESIS & POSTER LINK

RESULTS

Method Validation: Ablations

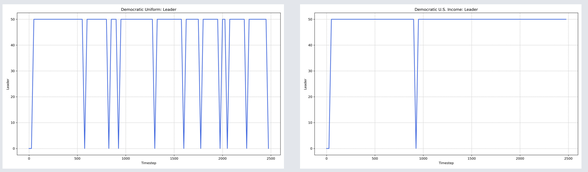
LLM Workers, LLM Tax Planner Trial

Optimal tax rates: [100, 0]. Optimal labor: 60.

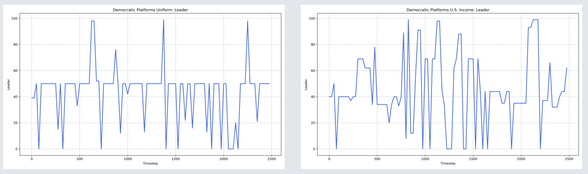
Election Analysis

Platforms feature encourages more exploration

Leaders: Democratic Scenario



Leaders: Democratic Scenario with Platforms



DISCUSSION

- Skill distribution does not affect policy shape
  - Learned policies: "U-shape" (higher rates at low and high incomes)
  - Saez's policies: approximately flat rate for low and middle incomes with extremely low rates for high earners
- Learned policies avoid optimal income taxation theory's zero tax rate for highest earner
- Higher social welfare scores with U.S. Income distribution show importance of highly skilled individuals in raising tax revenue

FUTURE WORK

- Influence of Utility Distributions
- Multi-LLM Interactions
- Multi-Agent Communication
- Extensions to Saez's Formulas
- LLM-based Simulation in Other Policy Areas