Quantifying Efficient Tax Reform

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Questions

- How large are welfare gains from efficient tax reform?
  - Baseline: positive economy matched to data
  - Reform: Pareto improvements on efficient frontier

- How sensitive is the answer to modeling choices?
Idea in a Picture
Idea in a Picture

Value for Household B, $v^B$

Value for Household A, $v^A$

Positive Economy
More generally, have vector of values for all households (Here, drawing just two)
Most studies try to improve on the positive economy in hopes of Pareto-improving.
But we would like to know how far we are from the efficient frontier when doing counterfactuals.
Today, I'll quantify gains from efficient reform, assuming all households gain same percentage.
Today, I'll quantify gains from efficient reform. Later we'll use results to inform policy analysis.
Approach

- Solve equilibria for positive economy (●)
  - Inputs: fiscal policy and wage processes
  - Outputs: values under current policy

- Solve planner problem next (●)
  - Inputs: values under current policy
  - Outputs: labor and savings wedges and welfare gains

- Ultimate goal: use results to inform policy reform (➡️)
Positive Economy (●)

- Small open economy
- Overlapping generations
- Household heterogeneity in:
  - Age
  - Education (permanent type)
  - Productivity (private, stochastic)
- Taxes on consumption, labor income, assets
- Estimated with administrative data for the Netherlands
Reform Problem (•)

• Take key inputs from positive economy
  ◦ Parameters of preferences and technologies
  ◦ Wage profiles and shock processes
  ◦ Values under current policy

• Compute maximum consumption equivalent gain
Main Findings

• Maximum consumption equivalent gains:
  ○ 17% for baseline parameterization
  ○ 14-19% varying key parameters

• Comparing allocations:
  ○ Consumption: level $\uparrow$ and variance $\downarrow$ for all groups
  ○ Leisure: level $\downarrow$ and variance $\uparrow$ for all groups
Related Literature

- Theory and application of income tax design
  Vast body of work

- Theory behind dynamic taxation and redistribution

- Pareto-improving reforms with fixed types
  Hosseini-Shourideh (2019)

- What’s new?
  - GE analysis linking positive economy to planner
  - Analysis of Pareto reforms with stochastic types
  - Application with administrative data for NL
Outline

• Theory

• Estimation

• Results
Theory
Positive Economy: HH maximization

\[ v_j(a, \epsilon; \Omega) = \max_{c,n,a'} \{ U(c, \ell) + \beta E[v_{j+1}(a', \epsilon'; \Omega)|\epsilon] \} \]

s.t. \[ a' = (1 + r)a - Ta(ra) + w\epsilon n - Tn(j, w\epsilon n) - (1 + \tau_c)c \]

where

\[ j = \text{age} \]
\[ a = \text{financial assets} \]
\[ \epsilon = \text{productivity shock} \]
\[ \Omega = \text{prices and government policies} \]
\[ c = \text{consumption} \]
\[ n = \text{labor supply} \ (n + \ell = 1) \]
Positive Economy Values

• For simplicity, assume:
  ◦ Small open economy with constant prices, policies
  ◦ No initial assets

• Then, inputs to planner problem:

\[ \vartheta(\varepsilon^{j-1}) \equiv E[v_j(a, \varepsilon; \Omega)|\varepsilon_-] \]

including future generations \( \vartheta(\varepsilon_0) \equiv E[v_1(0, \varepsilon; \Omega)|\varepsilon_0] \)
Solving Planner Problem

- First need:
  - Notion of efficiency
  - Clarification about which reform(s) to consider
Efficient Frontier

Value for Household B, $v^B$

Value for Household A, $v^A$

Efficient Frontier

Positive Economy
How to define efficiency?
Notion of Efficiency

- Our focus is Pareto-improving reforms:
  - There is no alternative allocation that is
    - Resource feasible (only so much to go around)
    - Incentive feasible (induces truthful reports)
  - making all better off and some strictly better off

- Will assume all HHs gain by same percentage
Pareto-improving Reforms

Value for Household B, $v^B$

Value for Household A, $v^A$

Efficient Frontier

Positive Economy
Pareto-improving Reforms

How to compute this?

Value for Household B, \( v^B \)

Value for Household A, \( v^A \)

Efficient Frontier

Positive Economy
Maximize present value of aggregate resources

subject to

- Incentive constraints for every household and history
- Value delivered exceeds $\vartheta(\epsilon^{j-1})$
Planner Problem in Practice

- Exploit separability to solve household by household

- Include only local downward incentive constraints
  - Verify numerically that all ICs satisfied

- Solve recursively by introducing additional states:
  - $V = \text{promised value for truth telling}$
  - $\tilde{V} = \text{threat value for local lie}$
Planner Problem for a Household
Planner Problem for a Household

Max present value of household resources
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right. \\
+ \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \]
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i|\epsilon_-)[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \]

\[ + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \]

s.t. Local downward incentive constraints
Planer Problem for a Household

$$\Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right. $$

$$+ \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \left. \right]$$

s.t. \[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \]

$$\geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \ i \geq 2$$

where \[ \ell_j^+(\epsilon_{i-1}) = 1 - n_j(\epsilon_{i-1})\epsilon_{i-1}/\epsilon_i \]
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-)[w_\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i)] \]

\[ + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \]

s.t. \[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \]

\[ \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \ i \geq 2 \]

Deliver at least the promised value
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right] \]

\[ + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i) / R \]

s.t. \quad \begin{align*}
U(c_j(\epsilon_i), l_j(\epsilon_i)) + \beta V_j(\epsilon_i) & \geq U(c_j(\epsilon_{i-1}), l_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \; i \geq 2 \\
V_- & \leq \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ U(c_j(\epsilon_i), l_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right]
\end{align*}
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right. \]
\[ \left. + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i) / R \right] \]

s.t. \quad U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)
\[ \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \ i \geq 2 \]

\[ V_- \leq \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right] \]

Deliver no more than the threat value
Planner Problem for a Household

\[ \Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \epsilon} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right. \\
\left. + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i) / R \right] \]

s.t. \[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \]

\[ \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \ i \geq 2 \]

\[ V_- \leq \sum_{\epsilon_i \in \epsilon} \pi_j(\epsilon_i | \epsilon_-) \left[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right] \]

\[ \tilde{V}_- \geq \sum_{\epsilon_i \in \epsilon} \pi_j(\epsilon_i | \epsilon_-^+) \left[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right] \]
Planner Problem for Future Generation ($j = 1$)

$$\Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \right]$$

$$+ \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R$$

s.t.  

$$U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \ i \geq 2$$

$$V_- \leq \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right]$$

No threat value
Planner Problem for Future Generation \((j = 1)\)

\[
\Pi_j(V_-, \tilde{V}_-, \epsilon_-) \equiv \max \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ w \epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) + \Pi_{j+1}(V_j(\epsilon_i), \tilde{V}_j(\epsilon_{i+1}), \epsilon_i) / R \right]
\]

s.t. \( U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \)

\[
\geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \tilde{V}_j(\epsilon_i), \quad i \geq 2
\]

\[
V_- \leq \sum_{\epsilon_i \in \mathcal{E}} \pi_j(\epsilon_i | \epsilon_-) \left[ U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right]
\]

Replace arbitrary \(V_-\) with \(\vartheta(\epsilon_0) + \vartheta_\Delta\)
Planner Problem Deliverables

- Welfare gains
  - Total consumption equivalent
  - Decomposition

- Wedges
  - Labor
  - Savings
Welfare Gain Decomposition

- If $U(c, \ell) = \gamma \log c + (1 - \gamma) \log \ell$

- Consumption equivalent gain $\Delta$:

$$\log(1 - \Delta) = \log((1 - \Delta_c^L)(1 - \Delta_c^D)) + (1 - \gamma) \log((1 - \Delta_\ell^L)(1 - \Delta_\ell^D))/\gamma$$

$$1 - \Delta_c^L = \frac{\sum \pi(\epsilon^j)\hat{x}(\epsilon^j)}{\sum \pi(\epsilon^j)x(\epsilon^j)}, \quad \hat{x}: \text{positive}, \ x: \text{planner}$$

$$1 - \Delta_c^D = \sum \beta^j \pi(\epsilon^j) \log \left( \frac{\hat{x}(\epsilon^j)}{\sum \pi(\epsilon^j)\hat{x}(\epsilon^j)} \right)$$

$$- \sum \beta^j \pi(\epsilon^j) \log \left( \frac{x(\epsilon^j)}{\sum \pi(\epsilon^j)x(\epsilon^j)} \right)$$
Wedges

- Labor wedge:
  \[
  \tau_n(\epsilon^j) = 1 - \frac{1}{w} \frac{U_\ell(c(\epsilon^j), \ell(\epsilon^j))}{U_c(c(\epsilon^j), \ell(\epsilon^j))}
  \]

- Savings wedge:
  \[
  \tau_s(\epsilon^j) = 1 - \frac{U_c(c(\epsilon^j), \ell(\epsilon^j))}{\beta R E[U_c(c(\epsilon^j+1), \ell(\epsilon^j+1))|\epsilon_j]}
  \]
Wedges

- Labor wedge:
\[
\tau_n(\epsilon^j) = 1 - \frac{1}{w} \frac{U_\ell(c(\epsilon^j),\ell(\epsilon^j))}{U_c(c(\epsilon^j),\ell(\epsilon^j))}
\]

- Savings wedge:
\[
\tau_a(\epsilon^j) = 1 - \frac{U_c(c(\epsilon^j),\ell(\epsilon^j))}{\beta RE[U_c(c(\epsilon^j+1),\ell(\epsilon^j+1))][\epsilon^j]}
\]

⇒ Hopefully informative for reforming current policy
Data
Netherlands

- Merged administrative data, 2006-2014
  - Earnings from tax authority
  - Hours from employer provided data
  - Education from population survey

- National accounts

- Tax schedules
Advantages over US Data

• Administrative data:

  NL:
  Individual earnings linked across HH members
  Individual hours linked across HH members
  Individual education linked across HH members

  US:
  Individual earnings *not* linked across HH members

• Survey data:

  US:
  Years of schooling linked across HH members
  Hours and wages linked across HH members
Estimation of Shock Processes

- Construct hourly wages $W_{ijt}$ ($j$=age, $t$=time)

- Classify degrees:
  - High school or practical (Low)
  - University of applied sciences (Medium)
  - University (High)

- Bin households into 6 groups
  - Assign singles to LL, MM, or HH
  - Use average wage rates for couples

- Construct residual wages $\omega_{ijt}$:
  \[
  \log W_{ijt} = A_t + X_{ijt} + \omega_{ijt}
  \]
Estimation of Shock Processes

- Pool data across cohorts
- Estimate (for each education group):

\[
\omega_{ij} = \epsilon_{ij} + \eta_{ij}
\]
\[
\epsilon_{ij} = \rho \epsilon_{ij-1} + u_{ij}
\]
\[
\eta_{ij} \sim \mathcal{N}(0, \sigma_\eta^2)
\]
\[
u_{ij} \sim \mathcal{N}(0, \sigma_u^2)
\]
\[
\epsilon_{i0} \sim \mathcal{N}(0, \sigma_{\epsilon_0}^2)
\]

- Apply method of simulated moments:
  - Moments: variance, autocovariances of \(\omega_{ij}\)
  - Parameters: \(\rho, \sigma_u, \sigma_\eta, \sigma_{\epsilon_0}\)
Wage Process Estimates

<table>
<thead>
<tr>
<th>Group</th>
<th>$\hat{\rho}$</th>
<th>$\hat{\sigma}_u^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low, Low</td>
<td>.9542</td>
<td>.0096</td>
</tr>
<tr>
<td>Low, Medium</td>
<td>.9660</td>
<td>.0087</td>
</tr>
<tr>
<td>Low, High</td>
<td>.9673</td>
<td>.0162</td>
</tr>
<tr>
<td>Medium, Medium</td>
<td>.9570</td>
<td>.0099</td>
</tr>
<tr>
<td>Medium, High</td>
<td>.9616</td>
<td>.0109</td>
</tr>
<tr>
<td>High, High</td>
<td>.9564</td>
<td>.0172</td>
</tr>
</tbody>
</table>
Wage Profiles

The diagram shows the normalized wage profile across different age groups labeled HH, MH, MM, LH, LM, and LL. The x-axis represents age, ranging from 25 to 60, and the y-axis represents the normalized wage profile, ranging from 0.5 to 1.75. Each line corresponds to a different category, with HH showing the highest peak around age 45 and LL showing the lowest peak around the same age.
An Aside

- Government:
  - Can *ex-post* infer type from choices
  - Can’t *ex-ante* observe type

- But, can design policy to *induce* truthful reporting of type
Other Key Parameters

- Number of types $\epsilon_i \in \mathcal{E}$

- Preferences

- Status quo policy

Baseline: 20 types, log preferences, NL wages & policy
Baseline Results
Labor Wedge

Higher distortions with age in part because opportunity to promise future payoffs wanes

Higher distortions with overall wage variance in part because IC multipliers tighten as planner provides more insurance
Welfare

- Consumption equivalent gain of 17%

- Comparing allocations:
  - Consumption: level ↑ and variance ↓ for all groups
  - Leisure: level ↓ and variance ↑ for all groups
Welfare

- Consumption equivalent gain of 17%

- Comparing allocations:
  - Consumption: level ↑ and variance ↓ for all groups
  - Leisure: level ↓ and variance ↑ for all groups

- Next, consider welfare decomposition...
## Welfare Decomposition ($\Delta = 17\%$)

<table>
<thead>
<tr>
<th>Education group</th>
<th>Consumption</th>
<th>Leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta^L_c$</td>
<td>$\Delta^D_c$</td>
</tr>
<tr>
<td>Low, Low</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Low, Medium</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>Low, High</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Medium, Medium</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>Medium, High</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>High, High</td>
<td>17</td>
<td>8</td>
</tr>
</tbody>
</table>
Welfare Decomposition \((\Delta = 17\%)\)

<table>
<thead>
<tr>
<th>Education group</th>
<th>(\Delta_c^L)</th>
<th>(\Delta_c^D)</th>
<th>(\Delta_\ell^L)</th>
<th>(\Delta_\ell^D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low, Low</td>
<td>22</td>
<td>2</td>
<td>-11</td>
<td>4</td>
</tr>
<tr>
<td>Low, Medium</td>
<td>21</td>
<td>3</td>
<td>-12</td>
<td>5</td>
</tr>
<tr>
<td>Low, High</td>
<td>16</td>
<td>5</td>
<td>-10</td>
<td>6</td>
</tr>
<tr>
<td>Medium, Medium</td>
<td>21</td>
<td>3</td>
<td>-13</td>
<td>5</td>
</tr>
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<td>6</td>
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<tr>
<td>High, High</td>
<td>17</td>
<td>8</td>
<td>-15</td>
<td>7</td>
</tr>
</tbody>
</table>

Find significant gains for level increase in consumption
A Look Under the Hood: Group LL
Intuition using Static Problem

- No insurance:

\[
\max \gamma \log c + (1 - \gamma) \log \ell \\
\text{s.t. } c = (1 - \tau(\epsilon))w\epsilon(1 - \ell)
\]
Intuition using Static Problem

- No insurance:

\[
\max \gamma \log c + (1 - \gamma) \log \ell \\
\text{s.t. } c = (1 - \tau(\epsilon))w\epsilon(1 - \ell)
\]

\Rightarrow \text{variation in consumption, constant leisure}
• No insurance:

\[
\begin{align*}
\max \; & \; \gamma \log c + (1 - \gamma) \log \ell \\
\text{s.t.} \; & \; c = (1 - \tau(\epsilon))w\epsilon(1 - \ell) \\
\Rightarrow \; & \; c(\epsilon) = \gamma w(1 - \tau(\epsilon))\epsilon, \; \ell(\epsilon) = 1 - \gamma
\end{align*}
\]
Intuition using Static Problem

- No insurance:

  \[
  \max \gamma \log c + (1 - \gamma) \log \ell
  \]

  \[
  \text{s.t. } c = (1 - \tau(\epsilon))w\epsilon(1 - \ell)
  \]

  \[\Rightarrow c(\epsilon) = \gamma w(1 - \tau(\epsilon))\epsilon, \ell(\epsilon) = 1 - \gamma\]

- Full insurance:

  \[
  \max \int [\gamma \log c(\epsilon) + (1 - \gamma) \log \ell(\epsilon)]dF(\epsilon)
  \]

  \[
  \text{s.t. } \int [c(\epsilon) - (1 - \tau(\epsilon))w\epsilon(1 - \ell(\epsilon))]dF(\epsilon) \leq 0
  \]
Intuition using Static Problem

- No insurance:
  \[
  \begin{align*}
  \text{max} & \quad \gamma \log c + (1 - \gamma) \log \ell \\
  \text{s.t.} & \quad c = (1 - \tau(\epsilon)) w \epsilon (1 - \ell) \\
  \Rightarrow & \quad c(\epsilon) = \gamma w (1 - \tau(\epsilon)) \epsilon, \quad \ell(\epsilon) = 1 - \gamma
  \end{align*}
  \]

- Full insurance:
  \[
  \begin{align*}
  \text{max} & \quad \int [\gamma \log c(\epsilon) + (1 - \gamma) \log \ell(\epsilon)] dF(\epsilon) \\
  \text{s.t.} & \quad \int [c(\epsilon) - (1 - \tau(\epsilon)) w \epsilon (1 - \ell(\epsilon))] dF(\epsilon) \leq 0 \\
  \Rightarrow & \quad \text{constant consumption, variation in leisure}
  \end{align*}
  \]
Intuition using Static Problem

- No insurance:

\[
\max \gamma \log c + (1 - \gamma) \log \ell \\
\text{s.t. } c = (1 - \tau(\epsilon))w\epsilon(1 - \ell) \\
\Rightarrow c(\epsilon) = \gamma w(1 - \tau(\epsilon))\epsilon, \ell(\epsilon) = 1 - \gamma
\]

- Full insurance:

\[
\max \int [\gamma \log c(\epsilon) + (1 - \gamma) \log \ell(\epsilon)]dF(\epsilon) \\
\text{s.t. } \int [c(\epsilon) - (1 - \tau(\epsilon))w\epsilon(1 - \ell(\epsilon))]dF(\epsilon) \leq 0 \\
\Rightarrow c(\epsilon) = \gamma w \int (1 - \tau(\epsilon))\epsilon dF(\epsilon) \\
\ell(\epsilon) = (1 - \gamma) \int (1 - \tau(\epsilon))\epsilon dF(\epsilon) / ((1 - \tau(\epsilon)\epsilon)
Intuition using Static Problem

• No insurance:

$$\max \gamma \log c + (1 - \gamma) \log \ell$$

s.t. $c = (1 - \tau(\epsilon)) \omega \epsilon(1 - \ell)$

$$\Rightarrow c(\epsilon) = \gamma w(1 - \tau(\epsilon)) \epsilon, \ell(\epsilon) = 1 - \gamma$$

• Full insurance:

$$\max \int [\gamma \log c(\epsilon) + (1 - \gamma) \log \ell(\epsilon)] dF(\epsilon)$$

s.t. $\int [c(\epsilon) - (1 - \tau(\epsilon)) \omega \epsilon(1 - \ell(\epsilon))] dF(\epsilon) \leq 0$

$$\Rightarrow c(\epsilon) = \gamma w \int (1 - \tau(\epsilon)) \epsilon dF(\epsilon)$$

$$\ell(\epsilon) = (1 - \gamma) \int (1 - \tau(\epsilon)) \epsilon dF(\epsilon)/(1 - \tau(\epsilon) \epsilon)$$

$$\Rightarrow c \text{ level } \uparrow \& \text{ variance } \downarrow, \ell \text{ level } \downarrow \& \text{ variance } \uparrow$$
Sensitivity

- How do results change with
  - Number of types: $\epsilon_i \in \mathcal{E}$
  - Wage profile: varying or constant over lifecycle
  - Preferences: varying elasticity in $v(\ell)$
  - Wage process: choices of $\rho, \sigma^2_u$

- Compare welfare gains and allocations to baseline
Double Number of Types

- Little change in total gain: 16%
- Hardly any change in decomposition:

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<td>3/3</td>
</tr>
<tr>
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<td>16/17</td>
<td>5/5</td>
</tr>
<tr>
<td>MM</td>
<td>21/21</td>
<td>3/3</td>
</tr>
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<td>5/5</td>
</tr>
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<td>HH</td>
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<td>8/6</td>
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Double Number of Types: A Look at LL
Changing Preferences

• Consider alternative preferences:

\[ U(c, \ell) = \gamma \log c - \kappa \frac{(1 - \ell)^\alpha}{\alpha} \]

• Set \( \alpha = 3 \Rightarrow \) lower labor elasticity of 1/2
## Changing Preferences

- Lower overall gain: 14%
- No gain from lower dispersion in leisure:

<table>
<thead>
<tr>
<th>Group</th>
<th>Consumption</th>
<th>Leisure</th>
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</table>
Changing Preferences: A Look at LL
No Wage Growth

- Lower overall gain: 14%
- No gain from lower dispersion:

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<tr>
<td>HH</td>
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No Wage Growth: A Look at LL
Decay Shock Variance by $2/3$

- Higher overall gain: 19%
- Shows up mostly in levels:

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Decrease $\sigma_u^2$: A Look at LL
Summary

- Gains from efficient tax reform are large

- How sensitive is answer to modeling choices?
  - Found large gains across all trials
  - Found decomposition sensitive to key parameters
  - But more work needed

- Next step: Using results to inform policy reform