“Answers” to Charge Questions

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Question 1: Ramsey

- Descriptive: Problematic
  - Puzzles
  - Restrictive preferences: ‘siblings not triplets’
  - Externalities and other imperfections
  - Ethics of market rates

- Prescriptive
  - A particular SWF
  - Optimal?
General Issues

- Non-marginal impacts
- Aggregation
- Representative agent and population
- Compensation Criterion

- Descriptive vs prescriptive
  - Neither measures changes in welfare precisely
  - Show profiles and distributions of benefits and costs
Question 1b: parameters

- $\eta$: Social siblings
- $\rho$: Social
  - Stern approach seems fair
  - Agent relative ethics?
- Point estimates in time or space?
  - Aggregation
- Applied Social Ethics
  - Reflective
  - ‘Mock referendum’ (Kopp and Portney 1999, Sen 1967?)
Socially revealed inequality aversion

Inequality Aversion
Inequality Aversion (+20%)
Inequality Aversion (-20%)
In growth: Extend Ramsey, welfare analysis
In parameters? Monte Carlo
Uncertainty or heterogeneity?
- Jouini, Marin and Napp (2010), Weitzman (2001)
- Beliefs differ about $\rho$ and $g$: $r_i = \rho_i + \eta g_i$

$$R^{JMN} (H) = - \frac{1}{H} \ln \left[ \sum_i \sum \frac{\omega_i \rho_i}{\omega_i} \exp(-r_i H) \right]$$

$$R^{Weitz} (H) = - \frac{1}{H} \ln \left[ \frac{1}{n} \sum \exp(-r_i H) \right]$$
Gollier and Weitzman (2010):
- General preferences, production economy
- Perfectly elastic supply of the risk free asset
- ENPV valid with log preferences
- Otherwise risk adjustment/’term premium’

Freeman (2010)
- Time inseparable prefs, risk neutral, exchange economy
- C(o) fixed: perfectly inelastic
- ENPV valid more generally
- See Traeger (2011)
G&W (2010) $r = 1\%$ or $5\%$, $\rho = .1\%$
G&W (2010) \( r = 1\% \) or \( 5\% \), \( \rho = 1\% \)
Question 2a: Empirics of Persistence

- Historical Data
  - Model selection: Econometric methods plus intuition
  - Data: inflation, smoothing, negative values, etc.

- Expert Opinion
  - Persistence due to ‘irreducible disagreement’
  - Normative: no true value, irreducible
  - Positive: forecast error about true value
### Historical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>SCC</th>
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<tbody>
<tr>
<td>State Space</td>
<td>14.4</td>
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<tr>
<td>Random Walk</td>
<td>10.4</td>
</tr>
<tr>
<td>Mean Reverting</td>
<td>6.4</td>
</tr>
<tr>
<td>Constant 4%</td>
<td>5.74</td>
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</tbody>
</table>
A Descriptive Approach

- Unbiased: \( r_i = \bar{r}_H + \varepsilon_i, \quad E(\varepsilon_i) = 0 \quad \forall i \)
- \( \Sigma \) is diagonal
- Where the CLT holds:

\[
\phi(\bar{r}_H) \approx N(\bar{r}_H^n, \sigma^2 / n)
\]

\[
E\left[ \exp(-rH) \right] = \int_0^\infty \exp(-r_iH) \phi(\bar{r}_H) \, dr_i
\]

\[
\Rightarrow R^{FG}(H) = \bar{r}_H^n - 0.5 \frac{\sigma^2 H}{n}
\]
Descriptive vs Prescriptive
Mixed Descriptive-Prescriptive

Discount Rate (%)

Year

N = 1000
N = 100
N = 25
N = 10
Jouini and Napp
## Social Cost of Carbon

<table>
<thead>
<tr>
<th>Method</th>
<th>(Weitzman 2001)</th>
<th>(Jouni and Napp, 2010)</th>
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<tbody>
<tr>
<td>Prescriptive</td>
<td>15.02</td>
<td>10.01</td>
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<tr>
<td>(N=10)</td>
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<td>4.65</td>
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<tr>
<td>Descriptive</td>
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<td>Constant 4%</td>
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<td>Constant 5%</td>
</tr>
<tr>
<td></td>
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<td>4.00</td>
</tr>
</tbody>
</table>
Effective independent experts

- Non-independent experts
  - ‘Schools of thought’ vs idiosyncratic

\[ r_i = x\left(\sum_{k}^{K} w_{ik} r_k\right) + (1-x)e_i \]

\[ N = \left[ \frac{x^2}{K} \sigma^* + \frac{1}{n} \left[ 1 - \frac{\alpha x}{\sqrt{K}} \right]^2 \right]^{-1} \]

\[
\begin{align*}
x &= 0.5 & x &= 0.75 \\
K &= 10 & K &= 10 \\
n &= 2160 \Rightarrow N = 34 & n &= 2160 \Rightarrow N = 18
\end{align*}
\]