Presentation based on the paper
"Social Willingness to Pay under Equity Concerns"

Maddalena Ferranna

Toulouse School of Economics

July 16, 2015

Introduction

- Lively debate on global risks with heterogeneous impacts across the population (e.g. climate change, terrorism, pandemics)
- Standard model in risk management: **Utilitarianism**

$$W^U = \sum_{i=1}^{N} q_i \sum_{s=1}^{S} \pi_s u(c_{i,s})$$

- Drawbacks of utilitarianism:
  - no disentanglement between risk and fairness concerns (which parameter to choose?)
  - characteristics of individual risks do not matter: concentrated vs equally spread; positively vs negatively correlated

Limits of Utilitarianism

- Case 1: concentrated vs equally spread risks (ex-ante approach to equity, Diamond 1967)

	s_1	s_2
Ann	1	1
Bob	0	0

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	s_1	s_2
Ann	1	0
Bob	0	1

- Case 2: positive vs negative correlation (ex-post approach to equity, Hammond 1983, Broome 1991)

	s_1	s_2
Ann	1	0
Bob	1	0

	s_1	s_2
Ann	1	0
Bob	0	1

N.B. Columns=equiprobable states; elements=outcomes

Outline of the presentation

- Define welfare framework for each case
  (no unified approach; ethical choice about the most suitable one)
- Impact of fairness concerns on optimal decisions:
  - **willingness to pay to remove the risk**
  - basic rule: invest/not invest; to some extent, how much to invest (in the small; 'mean-variance' approach)
- Does it matter? Quantify the impact of a change in preferences (in progress). Application: climate change

Literature

- Ex-ante/ex-post debate (Adler 2012)
- Economic implications of ex-ante/ex-post:
  - mortality risk: Fleurbaey and Bovens (2012); Adler, Hammit and Treich (2012)
  - cake sharing problem: Adler and Treich (2014)
- Fairness concerns/disentanglement of preferences in climate change literature: Roemer (2011); Fleurabey and Zuber (2014); Asheim and Zuber (2014); Adler (2015); Broome (2013); Anthoof et al. (2009); Dennig (2013); Cai et al. (2012)

Concentrated vs equally spread individual risks

- Concerns for the distribution of individual risks:

$$W^{EA} = \sum_{i=1}^{N} q_n v \left(u^{-1} \left(\sum_{s=1}^{S} \pi_s u(c_{i,s}) \right) \right)$$

- v more concave than $u \iff$ preference for equally spread risks

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- Example: 2 types; binary risk: $(1, p_i; 0, 1 - p_i)$

	s_1	s_2	s_3	s_4
Ann	1	1	0	0
Bob	1	0	1	0

$$CE_A = u^{-1} \left[p_A u(1) + (1 - p_A) u(0) \right]$$

$$W^{EA} = q_A v(CE_A) + q_B v(CE_B)$$

Policy: ex-ante equity

- *Willingness to pay to eliminate the risk* = uniform tax τ that Society imposes on all individuals to completely remove the risk ($\Leftrightarrow$ the social planner has only statistical information)
- consumption with risk: $c_{i,s} = \omega_i + x_{i,s}$
- consumption with no risk: $c_{i,s} = \omega_i - \tau$
- There might be some initial inequality that is not eliminated with the policy

Characteristics of the policy: ex-ante equity

- Equivalent to signing individual insurance contracts and then introducing a (ex-ante) redistributive tax due to the fact that the most exposed individuals are required to pay a larger insurance premium
- The policy is increasing in the difference $A_v - A_u$: the more Society cares about inequality, the larger the redistributive tax
- It is increasing in the variance of individual risks and in the degree of inequality among individual expected risks
- If the risks are borne mainly by rich individuals, the level of the policy decreases

Positively vs negatively correlated individual risks

- Concerns for the distribution of realized risks (Fleurbaey 2010):

$$W^{EP} = \sum_{s=1}^{S} \pi_s u \left(v^{-1} \left(\sum_{i=1}^{N} q_i v(c_{i,s}) \right) \right)$$

- v more concave than $u \iff$ preference for positively correlated risks

Positively vs negatively correlated individual risks

- Concerns for the distribution of realized risks (Fleurbaey 2010):

$$W^{EP} = \sum_{s=1}^{S} \pi_s u \left(v^{-1} \left(\sum_{i=1}^{N} q_i v(c_{i,s}) \right) \right)$$

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- Example: 2 types; binary risk: $(1, p_i; 0, 1 - p_i)$

	s_1	s_2	s_3	s_4
Ann	1	1	0	0
Bob	1	0	1	0

$$EDE_2 = v^{-1} \left[q_A v(1) + q_B v(0) \right]$$

$$W^{EP} = \sum_{s=1}^{4} \pi_s u(EDE_s)$$

Characteristics of the policy: ex-post equity

- Equivalent to setting a uniform insurance contract targeted to the 'average' individual, and then introducing ex-post redistributive transfers
- The policy is increasing in the difference $A_v - A_u$: the more Society cares about ex-post inequality, the larger the redistributive transfers
- To implement the policy, we need information about: the impact of the risk on the degree of inequality in the society; the risk faced by the 'average' agent
- If rich individuals bear most of the risk, lower policy

Application: climate change risk

- Climate change = global risks, different impacts both inside a generation and across generations
- Focus on intergenerational fairness: individuals=generations
- Climate policy: fraction of consumption to sacrifice, now and throughout the future, to avoid climate change (Pindyck 2012)
- In a utilitarian framework, Pindyck finds that Society is ready to pay $\sim 1\%$ forever to eliminate climate change
- Main assumptions:
  - climate change reduces the growth rate
  - uncertainty over the climate sensitivity parameter (Gamma distribution)
  - no time discount rate; inverse of elasticity of intertemporal substitution $\varphi = 2$

Main features

- Difference between risk aversion and inequality aversion:
  - from data and existing redistributive policies, $A_v \leq A_u$
  - Society prefers concentrated risks and negatively correlated risks (ex-post inequality/catastrophe aversion)
- Who bears the risk:
  - future generations are expected to be richer (positive growth due to technological progress)
  - risk is increasing over time
  - generational risks are positively correlated

Model

- Temperature dynamics:

$$\Delta T = 2S\left[1 - 0.5^{t/100}\right]$$

- Damages:

$$c_t = c_0 e^{(g-\gamma\Delta T)t}$$

- Discrete probability distribution of climate sensitivity:

$$(S, \pi) = (0, 0.37; 3, 0.47; 7, 0.13, 10, 0.03)$$

- Isoelastic utility functions: $RRA = \eta$; $RIA = \varphi$

Results

Welfare approach	Social Willingness to Pay	
	$\eta = 4$	$\eta = 8$
Utilitarianism $\varphi = 2$	1.3%	
Ex ante $\varphi = 2$	1.45%	1.59%
Ex ante $\varphi = 1.5$	2.65%	2.97%
Ex post $\varphi = 2$	1.4%	1.44%
Ex post $\varphi = 1.5$	2.54%	2.67%

Concluding remarks

- Evaluations of policies to remove a risk with unequal consequences. Important aspects:
  - correlation between effects of the risk and initial income
  - parametrization of risk and inequality aversion
- Use of preferences with fairness concerns $\Rightarrow$ relevant impact on policies
- Future work: alleviation of the risk; cost benefit rules; population risks; inter- vs intra-generational inequality; improve application (changes in the probability distribution $\Leftrightarrow$ increase in contingent inequality and inequality across generational risks)

Parameters of the calibration

Parameter	Value
γ	0.001363
g	0.02
T	200
c_0	1