An Experimental Study of Decision-Making under Uncertainty – Individual, Group and Panel Data

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Choice under uncertainty

EU theory

→ experiment

→ EU violation

→ competing theories, PT, …

→ more experiments!!

Analysis of data

- Group estimation
  data of 30 subjects → $U(L)$
- Individual estimation
  data of 1 subject → $U(L)$

Individual Estimation

Lottery experiment

Subject I24, 96 pricing data

Estimate *U*(*L*) of I24

True measure of theory?
stability? change 20~30%
stochastic or structural change?

Teddy, June 2005

Teddy, June 2006

Any difference?
Individual stability?

I24, June 05

$U(L)$

estimation

I24, June 06

$U(L)$

estimation

- *Any difference?*

Stability or structural change?

Research Questions

1. Individual stability
   compare *U(L)* of I24 SY 5,6,7
   panel 5&6, 6&7.
1. Consistency of individual and group estimation
2. Comparing EUT vs. PT

Theory

Lottery $L = (\boldsymbol{x}, \boldsymbol{p})$

$\boldsymbol{x} = (x_1, x_2, ..., x_n)$ outcome

$\boldsymbol{p} = (p_1, p_2, ..., p_n)$ probability

Theory

$$U(L) = \sum_{i=1}^{I} \pi(p_i) u(x_i)$$

$$\pi(p_i) = w\left(\sum_{j=1}^{i} p_j\right) - w\left(\sum_{j=1}^{i-1} p_j\right)$$

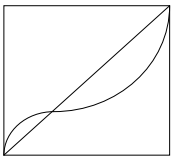
$w(p_i)$: probability weighting function

$u(x_i)$: monetary utility function

Theory

EU: $w(p_i) = p_i$

PT : nonlinear $w(p_i)$



estimation: functional form

Monetary utility : power function

$$u(x_i) = x_i^{\alpha}$$

Theory: functional form of $w(p_i)$

1. $w(p_i) = p_i$, EUT
2. $w(p_i) = \dfrac{p_i^{\gamma}}{\left(p_i^{\gamma} + (1 - p_i)^{\gamma}\right)^{\frac{1}{\gamma}}}$, T&K
3. $w(p_i) = \exp\left(-(-\ln p_i)^{r}\right)$, Pr1
4. $w(p_i) = \exp\left(-s(-\ln p_i)^{r}\right)$, Pr2

4 models: EUT, T&K, Pr1, Pr2

Group I : 26 subjects, 05, 06, 07

Group II: 19 subjects, 06, 07

10 data sets: *Gains and Losses*

IG5, IG6, IG7, IL5, IL6, IL7

IIG6, IIG7, IIL6, IIL7

Experiment Design: gain lottery, *WTA*

sell for ? NT$

WTA

Reward	$200	$50	$0
Probability	0.08	0.02	0.90

BDM procedure:

WTA $\leq$ P, 20 $\leq$ 180, sold, earn P

WTA > P, 20 > 10, not sold, play later

Experiment Design: loss lottery *WTP*

pay ? Insurance

WTP

Losses	$0	$－ 50	$－150
Probability	0.55	0.25	0.20

BDM procedure:

WTP $\geq$ P, 50 $\geq$ 30, pay P, insured

WTP < P, 50 < 100, uninsured, play later

Experiment Design

1. z-Tree program
2. Lottery structure:

   2005**: 96 (3) gain 24 (1) loss

   2006, 07: 54 (2) gain, 54 (1) loss
3. 90~120 minutes, half-time break
4. NT$200 show up fee, payments:$120~$800

Estimations

- Individual single year (SY)
- Individual panel
- Group single year
- Group panel
- *Coef. value, significance*
- *Model selection*
- *Structural change test*
- *Compare: group-individual, EUT-PT*

Result: Individual SY estimation

median coefficients

	EUT	T&K		Pr1		Pr2		
	α	α	r	α	r	α	r	s
IG5	0.919	0.936	0.732	0.936	0.627	0.915	0.918	0.697
IG6	0.998	1.010	0.802	1.006	0.771	0.998	0.978	0.876
IG7	0.987	1.002	0.723	0.997	0.703	0.990	0.803	0.912
IL5	0.959	0.950	0.611	0.967	0.519	0.975	0.668	1.085
IL6	0.998	1.000	0.877	0.999	0.891	0.994	1.057	1.218
IL7	0.997	0.989	0.776	0.997	0.746	0.989	0.819	1.307

Result: Individual SY estimation

1. Within reasonable range.

2. 06 and 07 similar, different from 05

3. α close to 1, $u(x_i) = x_i^{\alpha}$ almost linear.

Individual SY model selection

Subject I24, IG7, 4 models

Pr2 best !

1. significant parameters, nested

2. AIC criteria

20

Individual SY model selection proportions

	(1) EUT	(2) T&K	(3) Pr1	(4) Pr2	(5)=(2)+(3)+(4) Total PT
IG5	19.23	15.38	15.38	50.00	80.77
IG6	19.23	11.54	19.23	50.00	80.77
IG7	11.54	30.77	15.38	42.31	88.46
IIG6	21.05	10.53	26.32	42.11	78.95
IIG7	15.79	26.32	10.53	47.37	84.21
IL5	19.23	23.08	53.85	3.85	80.77
IL6	19.23	11.54	23.08	46.15	80.77
IL7	15.38	26.92	3.85	53.85	84.62
IIL6	10.53	21.05	26.32	42.11	89.47
IIL7	5.26	15.79	21.05	57.89	94.74

Individual SY model selection proportions

- Best model: Pr2
- PT over 80%
- Exception: IL5, only 24 lottery

Individual panel estimation

- Subject I26, Model Pr2, Panel IG5&6

H0: $\alpha_t = \alpha_{t+1}$, $r_t = r_{t+1}$ and $s_t = s_{t+1}$

LR 24.862*, reject H0

Structural changes exist!

Individual panel estimation

Model Pr2, Panel IG5&6

- Not 2Y-sig: 4 (15%)
- No ST change: 1 (4%)
- ST changes: 21 (81%)

Repeat for all models, all data sets

Individual panel structural change

- Test ST changes for four models
- Different for different models
- No ST changes: 20~30%
- Structural changes for more subjects

Individual: SY model selection consistency

- For IG6&7
- 2Y-EUT 7.69%
- 2Y-T&K 3.85%
- 2Y-Pr1 3.85%
- 2Y-Pr2 23.08%
- 2Y-PTdif 46.15%

76.92%

- EUT-PT Change 15.38%

Group single-year estimation

- Demographic factors

$$u(x_i) = x_i^{\alpha + g \times \text{Gender} + m \times \text{Major}}$$

- Compare coefficients
  group -- individual median
  very close, *exists consistency !*
  compare literature

Group single-year model selection

- Gains: Pr2 individual Pr2 highest%
- Losses:
  IL6, IIL7 group T&K, indi. Pr2
  IIL6, group Pr1~Pr2, indi. Pr2
- Never EUT : some EUT indi.
  model selection results: Different!

Group single-year estimation

- Demographic factors
- Sex: not sig. for gains, sig. for losses
  Female more risk averse for losses
  Repeated results!
- Major: not sig.

Group panel estimation

- Mostly structural changes,
  same as individual
- Not all para. are equal
- Changes are sig. but small

Conclusions:

Structural change:

- most subjects: not all para. equal
- Stable subjects: ~30%

Group vs Individual

- Consistent in parameter value
- Some difference in model selection

EUT vs. PT

- Definitely PT

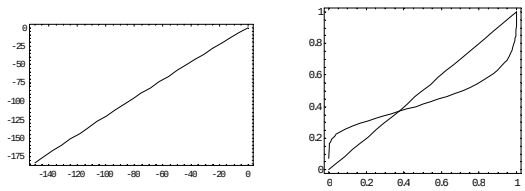
More things to do:

1. More panel data??
2. Nonparametric estimation

The End

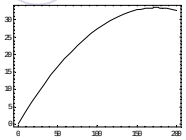
Some beautiful graphs

I4, Pr1

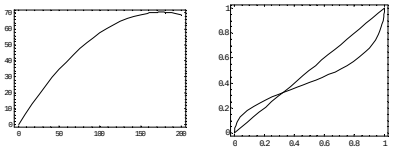


Some beautiful graphs

I6, EUT



I25, T&K



Truly The End *!!*