Experiential Regret Aversion

Experimental and Behavioural Forum

Thursday 1st July 2010

Introduction

- Regret is a fairly developed concept in behavioural economics
  - Easy to write down
  - Has good supporting intuition
    - Marketing
    - Lottery tickets
  - Fits within the existing literature of Non-EUT
    - Bell (1982) ; Loomes & Sugden (1982)
    - Introduced “regret aversion”

Introduction

- Development of Regret Aversion has been limited
  - Prospect Theory and Rank-Dependent Utility Theory more popular (transitive)
  - Experimentally difficult
    - Hard to produce “emotion” in a lab
    - Hard to record or measure
    - Hard to distinguish from disappointment etc.
  - Is Regret Theory “dead”?

Introduction

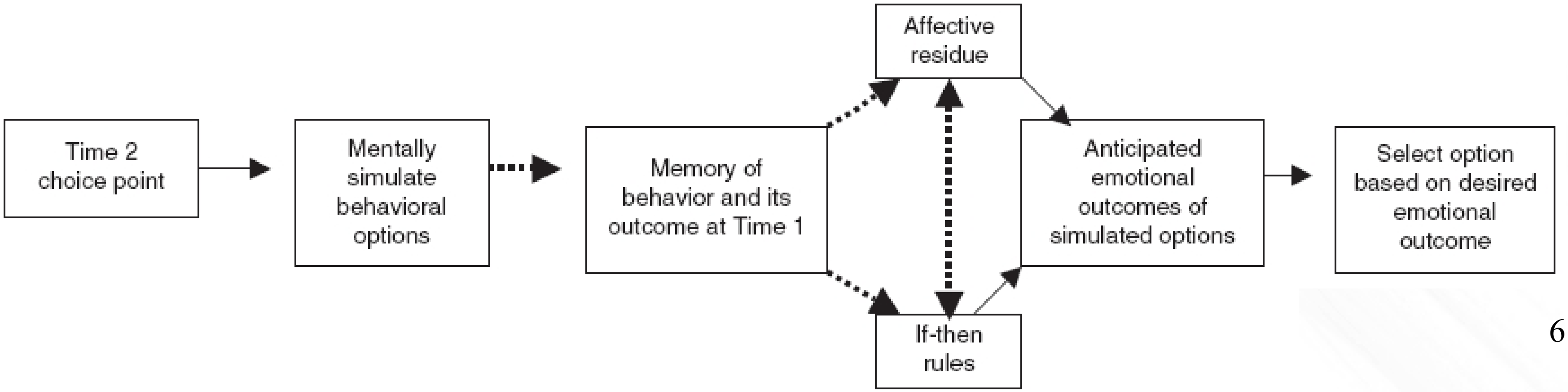
- No!
- New theoretical models
  - Hayashi (2008) & Sarver (2008)
- New experimental research using neuroscience
  - Coricelli et al (2005)
- Incorporation into dynamic game theory
  - Hart & Mas-Colell (2003)

Introduction

- My contribution
  - Distinguish different types of regret
  - The role of memory
    - The relationship between memory and emotion
    - Bounded and imperfect memory
  - Numerical simulation
    - Using Hayashi (2008)
    - Introducing an emotional feedback loop

Predicted, Decision, Experienced and Remembered Utility

- Kahneman et at. (1997) discussed utility with reference to Bentham (1789)
  - Why should “decision” and “experienced” hedonic utility be the same?
- Also in psychology, Baumeister et al, (2007)



Predicted, Decision, Experienced and Remembered Utility

- Baumeister frames this as “emotion” rather than “utility”
- This links to affective forecasting literature
- Thinking in a regret context
  - Is predicted regret the same as experienced regret?
  - Are you “averse” to regret because of affective residue from past experience?
  - How does regret appear in memory?

Memory

- What happens to regret aversion if you only remember bad regrets?
  - The affective residue will skew what how you calculate “aversion”
- We need to model the memory process to see the impact of potential biases
  - But this has not been done in economics
- If memory is uncontrollable then we can get “rational” bad decision making

Modelling

- Starting with Hayashi (2008)
  - Axiomatic
  - "Smooth" Regret Aversion (α parameter)

2. *Smooth model of regret aversion*: Given a probabilistic belief $p \in \Delta(\Omega)$ and a coefficient of regret aversion $\alpha > 0$, the choice is determined by

$$\varphi(B) = \arg\min_{f \in B} \sum_{\omega \in \Omega} \left(\max_{g \in B} u(g(\omega)) - u(f(\omega)) \right)^{\alpha} p(\omega)$$

  - Loomes & Sugden style regret aversion occurs when α > 1
  - α = 1 gives subjective expected utility

Modelling

- I will allow emotional feedback to operate via α
  - Previous remembered experience can vary α
- This is a model of "predicted regret aversion"
  - But we can introduce experienced regret and remembered regret in a dynamic model
  - Using literature on affective forecasting and emotional memory
- We can create a memory stock
  - Populated with experienced regrets

Example

- Driving to see my girlfriend in Birmingham
  - Have to decide where to park
    - Main road, side road or car park


Example

- Walking from the main road takes 3 mins
  - But, if I turn down the side road and there is no space, it takes 3 mins to drive back to the main road
- Occasionally there is no space on either roads
  - And I need to park in a car park which is a 10 minutes walk away
    - And a 3 mins drive from the main road
- Can represent this in a payoff matrix

Example

Payoff matrix	Space only on main road (0.7)	Space only on side road (0.03)	Spaces on both roads (0.25)	No spaces on either road (0.02)
Stay on main road	-3	-13	-3	-13
Go down side road	-6	0	0	-16
Park in car park	-10	-10	-10	-10

- Payoffs are time lost in minutes
- Maximising EV suggests stay on main road
  - Also if risk averse
- Loss aversion could suggest going down the side road
- Alternatively we can use the Hayashi method

Example

Regret matrix	Space only on main road (0.7)	Space only on side road (0.03)	Spaces on both roads (0.25)	No spaces on either road (0.02)
Stay on main road	0	13	3	3
Go down side road	3	0	0	6
Park in car park	7	10	10	0

- How many mins could I have saved had I chosen the optimal action give the state of the world
- Computing the "expected regret" of each action
  - $\alpha = 1$ says choose the main road
  - $\alpha = 2$ says go down the side road
    - Not the same result as risk aversion

Example

- So why do we need a dynamic model?
  - Why do I change my behaviour?
  - Regret and Payoff matrices are not changing
- Maybe “noisy” or “fuzzy” preferences
- Maybe the probabilities or payoffs are unknown to start with
  - But this should suggest convergence of behaviour

Example

- But experimental evidence suggests the experience of regret can affect future behaviour
- So, using the Hayashi model, we can let α be determined by past experience
  - Through a memory stock of regrets
  - Which won't converge if memory is imperfect
- Simplifying the example
  - to a P-Bet, $-Bet and safe option

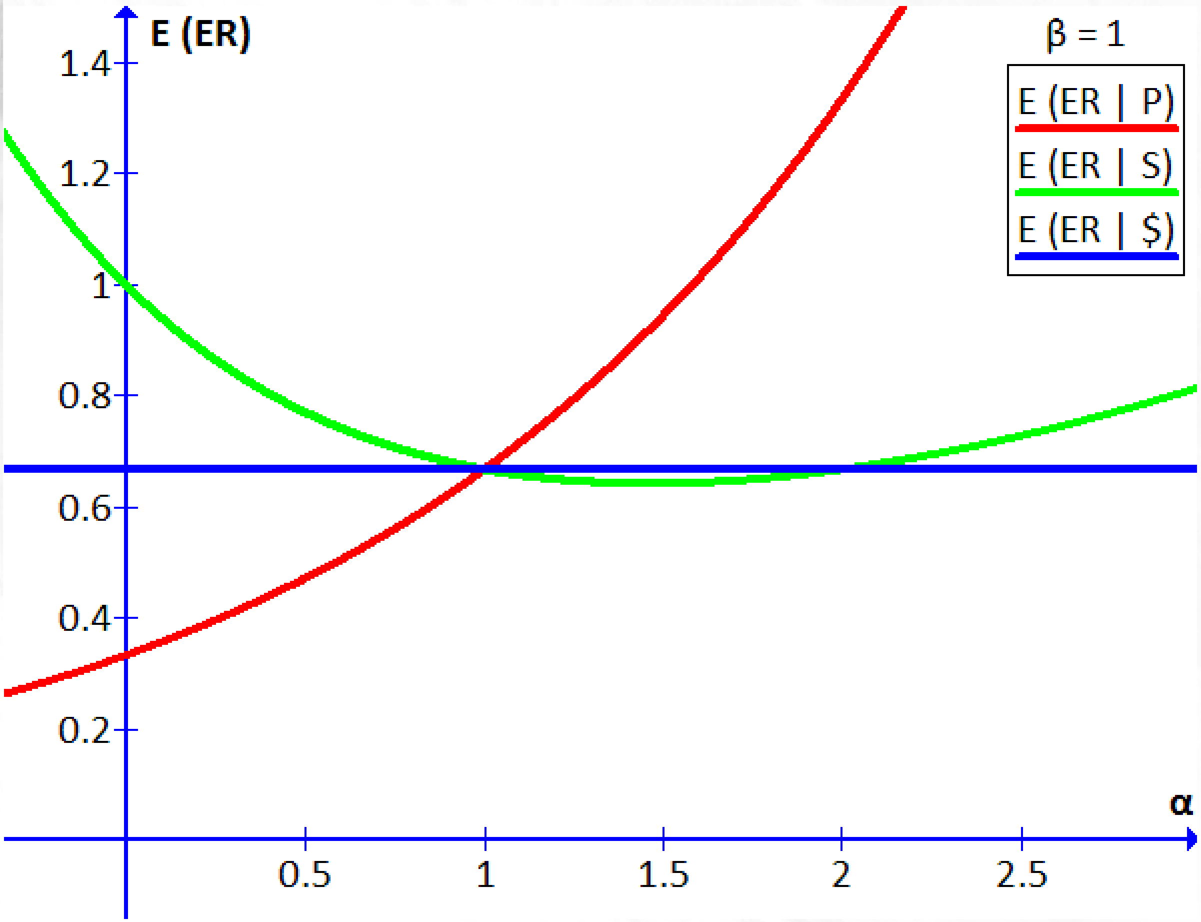
The Static Model

Payoff Matrix	w_1 (1/3)	w_2 (1/3)	w_3 (1/3)
P - Bet	β	β	0
Safe option	$2\beta/3$	$2\beta/3$	$2\beta/3$
\$ - Bet	0	0	2β

Regret Matrix	w_1 (1/3)	w_2 (1/3)	w_3 (1/3)
P - Bet	0	0	$(2\beta)^\alpha$
Safe option	$(\beta/3)^\alpha$	$(\beta/3)^\alpha$	$(4\beta/3)^\alpha$
\$ - Bet	$(\beta)^\alpha$	$(\beta)^\alpha$	0

- Calculating the expected regret of each action
  - $ER(P) = 2^\alpha/3 \times \beta^\alpha$
  - $ER(Safe) = (2 + 4^\alpha)/3 \times (\beta/3)^\alpha$
  - $ER(\$) = 2/3 \times \beta^\alpha$
- Regret minimising action depends on α but not β

The Static Model



- $0 < \alpha < 1$ => P-Bet
- $\alpha = 1$ gives EUT and indifference
- $1 < \alpha < 2$ => safe option
- $\alpha > 2$ => $-Bet
- Regret aversion => risk seeking

The simulation

- Run multiple rounds of the previous problem
  - β is exponentially distributed random variable
- If α is constant, nothing much happens
  - So α needs to vary somehow
- α being randomly distributed on (0,3) isn't particularly interesting
  - but can serve as a baseline case
- Each action will be picked 1/3 of the time

The simulation

- We want to record the *experienced* utility and regret
  - So we need to make a distinction between the *anticipated* regret aversion parameter
    - How bad you thought it would be
  - And the *experienced* regret aversion parameter
    - How bad it was
  - If these are the same, then the $-Bet yields the highest average experienced regret
    - Followed by safe option then P-Bet

The simulation

E (β)	# of repetitions	Ave. per period regret (PPR)	Ave. PPR | P-bet	Ave. PPR| Safe	Ave. PPR | $-bet
0.5	741	0.35	0.22	0.31	0.53
1	741	1.33	0.43	0.77	2.84
2	741	6.57	0.69	2.9	15.38

- Applying an "affective forecasting" transformation on α (so we get α_P and α_E)

E (β)	α_E	# of repetitions	Ave. per period regret (PPR)	Ave. PPR | P-bet	Ave. PPR| Safe	Ave. PPR | $-bet
1	$= \alpha_P$	741	1.33	0.43	0.77	2.84
1	$= 1$	741	0.66	0.66	0.66	0.66
1	$= (\alpha_P)^{0.5}$	741	0.71	0.5	0.71	0.93

- "fallacy of regret" ; "believe the hype" ; "intermediate case (tails exaggerated)"

The simulation

- Introducing an emotional feedback loop
- Create a memory stock M
    - stores the last m strictly positive regrets
        - anything beyond m is forgotten
    - can also apply a discount factor δ
        - or set an entry requirement
- We need an estimate of α_P from M
    - Max/ave/min ratio or modified skewness

The simulation

- So the process goes as follows
  - At time t, agent calculates α_P from M
  - Observes β, solves regret minimisation and chooses action
  - Nature resolves and agent obtains payoff and experiences regret according to α_E
  - If regret is > 0, it gets added to M
  - Process repeats at t+1

The simulation

α_E	δ	% P-Bet	% Safe	% \$-Bet	Ave PPR	Ave. PPR P-bet	Ave. PPR Safe	Ave. PPR \$-bet
= 1	1	0.39	0.31	0.3	0.65	0.54	0.73	0.72
$= (\alpha_P)^{0.5}$	1	0.29	0.34	0.37	0.81	0.61	0.81	0.94
$= \alpha_P$	1	0.28	0.3	0.42	1.39	0.51	0.93	2.32
= 1	0.9	0.32	0.4	0.28	0.65	0.6	0.68	0.65
$= (\alpha_P)^{0.5}$	0.9	0.38	0.31	0.3	0.68	0.43	0.83	0.84
$= \alpha_P$	0.9	0.16	0.25	0.59	1.54	0.37	0.71	2.21
= 1	0.5	0.12	0.29	0.59	0.66	0.66	0.63	0.68
$= (\alpha_P)^{0.5}$	0.5	0.11	0.21	0.68	0.85	0.62	0.63	0.95
$= \alpha_P$	0.5	0.06	0.18	0.75	3.51	0.51	0.84	4.41

- At first glance, not much appears to change
  - Ave PPR in first 3 rows is equivalent to previous table
  - Frequency of each bet around 0.33
    - Slight increase in $-Bet from rows 1 to 3

The simulation

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- Moving from $\delta = 1$ to $\delta = 0.9$
  - Proportion of $-Bets increases, P-Bet falls
    - agent choosing riskier options more
  - Ave PPR for P-Bet is low, reflecting low frequency of choice and low α_E in this small sample

The simulation

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- Behaviour exacerbates when δ = 0.5
    - Frequency of \$-Bet now at high of 0.75 (addiction?)
    - High Ave PPR (choosing \$ very often with chance of high α_E)
        - Driven by memory and \$-Bet action

Conclusions

- Work in progress!
  - Limited class of memory and affective forecasting types
  - Small number of periods for simulation
  - Tweaks needed to feedback loop (only positive values of α)
- Observing some interesting behaviour
  - Especially with regards to addiction
  - Showing persistent risk seeking

Conclusions

- Extensions and developments
  - Non-equal probability states of the world
  - Losses as well as gains in the simulation
  - Generating α_P with a fixed "cold" component (the true α_E) and a "hot" component coming from M
  - Looking further into experienced vs. encoded regret
  - Analysing the impact of "runs" of behaviour