Is Prevention Better than Cure? Framing Effects in Public Good Provision

Iñigo Iturbe-Ormaetxe
Universidad de Alicante

Giovanni Ponti
Universidad de Alicante
and Università di Ferrara

Josefa Tomás
Universidad de Alicante

Luis Úbeda
Universidad de Alicante

PET06, HANOI

SAMUELSON CONDITION

With one private good (x) and one public good (G):

$$\sum_{i=1}^{N} MRS^{i}_{G,x} = MRT_{G,x}$$

MRS^i: how much i is willing to pay for 1 additional unit of G in terms of x

MRT: social cost of producing 1 additional unit of G in terms of x

If G is financed by voluntary contributions, theory predicts that there will be under-provision relative to the efficient amount.

EXPERIMENTAL EVIDENCE

Groups of size N = 3, 4, 5,..

Each individual receives some "tokens"

She can invest tokens either in private account or a public account

If private, she gets A

If public, everybody in the group gets B

Interesting case: $B < A < NB$ (Non contributing is a dominant strategy, but contributing all tokens is efficient)

"Contribution lies somewhere between the efficient level and the prediction of the game" Ledyard (1995), Handbook Exp. Economics

VOLUNTARY CONTRIBUTION THRESHOLD GAMES (VCTG)

(From Palfrey and Rosenthal (1991). Very useful in experiments)

N individuals

Each has 1 unit of input. She has a binary decision: {C, NC}

The PG is provided iff at least k individuals decide to contribute, $0 \leq k \leq N$

Input of individual i has private value c_i

Individual i knows c_i but she does not know the values of the others. She knows that they come from a Uniform distribution on (0, 1)

All individual value equally the public good. This value is g

PAY-OFF MATRIX

(n = number of individuals other than i that are contributing)

States of the world	$n > k-1$	$n = k-1$	$n < k-1$
Probabilities	p	q	1-p-q
C	g	g	0
NC	g+c	c	c

When $n = k-1$ the individual is pivotal

If individuals are expected utility maximizers, a symmetric Bayesian Nash equilibrium (BNE) has the form of a cut-point rule:

Contribute $\Leftrightarrow c \leq c^*$ where c^* is common to all individuals

Example: $N = 3$, $g = 1$.

If $k = 1$, the unique BNE is $c^* = 0.382$

If $k = 2$, there are 2 BNE: $c^* = 0$ and $c^* = 0.5$

If $k = 3$, there are 2 BNE: $c^* = 0$ and $c^* = 1$

A DIFFERENT SET-UP

N individuals

Each has 1 unit of input. She has a binary decision: {C, NC}

Individuals already have the public good (value g)

The PG is lost unless at least k individuals decide to contribute, $0 \leq k \leq N$

Input of individual i has private value c_i

Individual i knows c_i but she does not know the values of the others. She knows that they come from a Uniform distribution on (0, 1)

Think, for example, of an already existing bridge. The base of the bridge is damaged and, unless a major reparation is done, it will eventually collapse.

We call this case Prevention of Public Good Deterioration (PPGD), and we refer to the former (standard) case as Public Good Provision (PGP).

The crucial difference between PGP and PPGD is whether individuals have initially the public good or not.

The aim of this paper is to answer, both theoretically and experimentally, to this very simple question:

Do people contribute more in PPGD, rather than in PGP?

REMARK: If individuals are expected utility maximizers, the same BNE in PGP and PPGD

What do we do next?

- We use Prospect Theory to compute the equlibria in the 2 different set-ups. Why PT?
- We use simulations to compute the equilibria. Because theoretical predictions are not completely clear.
- We present some experimental evidence and we highlight its relationship with the theoretical predictions

PROSPECT THEORY

With Expected Utility Theory (EUT), lotteries that pay x_i with probability p_i are valued as:

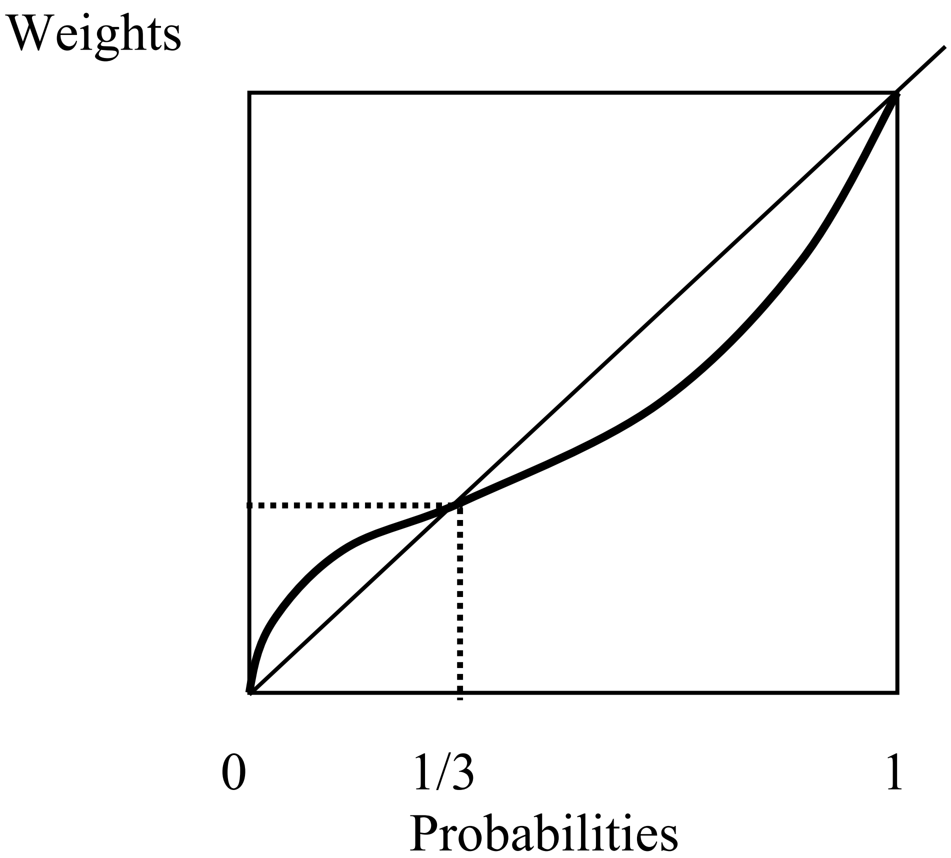
$$\Sigma_i \, p_i \, u(x_i),$$

where $u(x_i)$ is the utility under the outcome x_i.

With Prospect Theory (PT) lotteries are valued as:

$$\Sigma_i \, w(p_i) \, v(x_i - r).$$

Here $w(p_i)$ is a function that weights probabilities. This function over-weights low probabilities (below 1/3 or so) and it under-weights large probabilities (above 1/3 or so)



2. Individuals compute gains and losses from a reference point called r

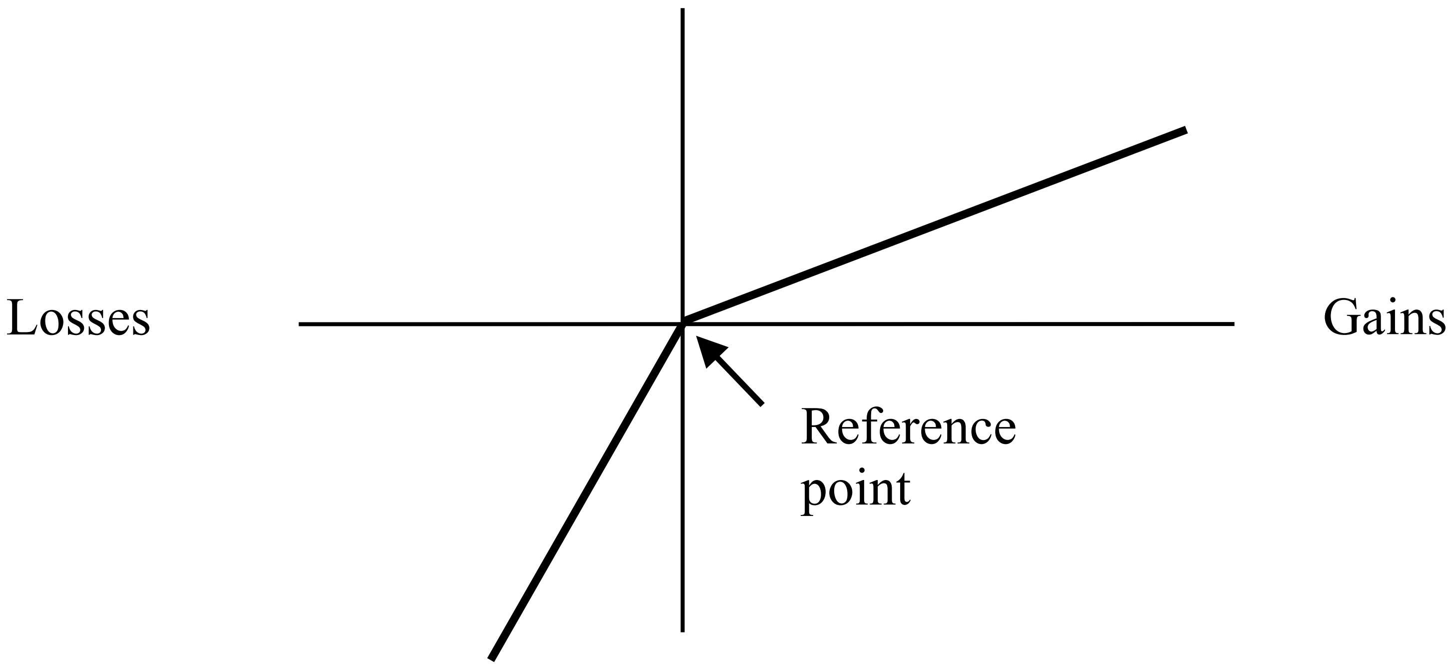
3. The carriers of value are gains and losses from the reference point rather than final states. The value function has loss aversion:

$$-v(-x) > v(x) \text{ for } x > 0.$$

In particular, if we define a coefficient of loss aversion as $\lambda(x) = -v(-x) / v(x)$, the existing empirical evidence suggests a value of around 2.

Also it is assumed that the function is steeper for losses than for gains.

A typical representation of the value function is:



We apply PT to our model. The only difference between the two frames is the reference point from which individuals compute gains and losses

In PGP the reference point is c: The provision of the public good is seen as a gain, but contributing involves a loss

In PPGD the provision of the public good is seen as avoiding a loss and the cost of contributing is seen as not realizing a gain

PGP (PPGD)

	n > k-1	n = k-1	n < k-1
C	g-c (0)	g-c (0)	-c (-g)
NC	g (c)	0 (-(g-c))	0 (-(g-c))

We calibrate equilibria under PT assuming a linear value function and using the weighting function proposed by Kahneman and Tversky (1992):

$$w(p) = \frac{p^{\delta}}{\left(p^{\delta} + (1-p)^{\delta}\right)^{1/\delta}}$$

We fix $\delta = 0.56$, following Camerer and Ho (1994)

We perform several simulations with different values of λ

SIMULATIONS (N = 3)

(Efficient interior equilibrium)

	$\lambda = 1.25$		$\lambda = 2$		EUT
	PGP	PPGD	PGP	PPGD	
k = 1	.46	.42	.46	.48	.37
k = 2	.20	.31	.13	.34	.45
k = 3	0	.27	0	.27	0

Except for the case when k = 1 and λ is low, we obtain more contribution in PPGD than in PGP

EXPERIMENTS

- 4 sessions in December 2005 of 60 minutes each. Total of 96 undergraduate students from University of Alicante
- Sessions were run in the computer lab
- 48 rounds of 2 treatments (PGP and PPGD) in each session
- In each round we assign individuals to groups of 3 randomly
- g = 50 pesetas
- The cost is drawn from a Uniform distribution on (0, 55 pesetas)
- $k \in \{1, 2, 3\}$ is chosen randomly
- Individuals are told the values of k and c
- They must decide between {C, NC}

- They are asked for the number of contributors in the group (excluding themselves)
- After each round they are informed on the number of contributors and her payoff
- At the beginning they get an endowment of 1,000 pesetas ($\approx$ 6 euros)
- In PGP they gain g = 50 pesetas if k individuals contribute.
- In PPGD they lose g = 50 pesetas from their endowment if less than k contribute
- Average payoff was 15 euros

RESULTS FROM THE EXPERIMENTS

	PGP	PPGD	Observations
k = 1	.34	.26	1525
k = 2	.43	.44	1525
k = 3	.31	.52	1528
Observations	2274	2304	4578

PGP: Contribution highest when k = 2. PPGD: Contribution rises with k

When k = 1, more contribution in PGP. When k = 3 the opposite. When k = 2, same in both

Interesting: When k = 2 EUT predicts better than PT

When k = 3, there is more contribution than predicted by PT or EUT

Regarding our question, we find more contribution with PPGD only when k = 3 (but this is not PG)

There are clear framing effects

But the direction of the effects depends on k

What about the elicited beliefs?

k	0	1	2
1	90	252	42
%	**23.44**	**65.63**	**10.94**
2	69	236	79
%	**17.97**	**61.46**	**20.57**
3	151	115	118
%	**39.32**	**29.95**	**30.73**
Total	310	603	239
%	**26.91**	**52.34**	**20.75**

k	0	1	2
1	134	218	32
%	**34.90**	**56.77**	**8.33**
2	60	228	96
%	**15.63**	**59.38**	**25.00**
3	70	87	227
%	**18.23**	**22.66**	**59.11**
Total	264	533	355
%	**22.92**	**46.27**	**30.82**

There is a big difference when k = 3

Panel Regressions (Probability of contributing)

	k = 1		k = 2		k = 3	
effort	Coef.	St. Er	Coef.	St. Er	Coef.	St. Er.
c	-0.27816***	.06766	-.12215**	.05952	-.37000***	.09169
csquare	.00676**	.00293	.00110	.00253	.01207***	.00374
ccube	-.00006*	.00004	-0.00008	.00003	-.00014***	.00004
belief	-.31531	.25566	-.11653	.22289	.27001***	.34027
treatment	-.19052	.33767	1.07435***	.37325	1.42698**	.61741
belief_treat	-.65843*	.35182	-.65585**	.30459	-.06941	.41100
forecast_1	.17613	.12501	.09579	.10596	-.07701	.15540
outcome_1	.29642	.22397	.03785	.20941	.34734	.31901
sequence	-.55679***	.20620	-.31334*	.18280	-.94790***	.27876
superperiod	.00436	.04460	.00168	.03981	-.07892	.06677
_cons	3.65746***	.88885	1.48707*	.78824	-.40438	1.18812