

Improving Risk-Risk Trade-Offs: an Experimental Approach
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Policy Background:

- In applying results from a CBA in regulatory decision-making it is assumed that preferences (values) are **well-behaved** and **elicited from a representative sample of the total population**.
- If not, it raises validity concerns over some responses
- However, **discarding responses is not desirable**: it might question the representativeness of the study.

Improving Risk-Risk Trade-Offs: an Experimental Approach

Academic Background

- Risk-Risk Trade-Off** method (RTO) introduced as an alternative (to WTP) SP technique.
- Establishes relative trade-offs between changes in mortality and/or morbidity risks (VSL)**
- Are SP problems found in RTO?
- Can they be ameliorated?

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RISK (per decade)	
Non-fatal R	600 in 100,000
Fatal	50 in 100,000

Area 2:
An increased risk of Non-Fatal R

YOUR RISK INCREASE (per decade)	
Non-Fatal R	5 in 100,000
Fatal	0 in 100,000

Area 3:
An increased risk of Fatal F

YOUR RISK INCREASE (per decade)	
Non-Fatal R	0 in 100,000
Fatal	5 in 100,000

- ? in 100,000 risk increase that leaves you indifferent between the two areas

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Two General SP Problems considered:

- Scope insensitivity:** RTO ⇒ reluctance to trade-risks (apparently accepting 'large' increases in serious risks) or reluctance to accept vanishingly small increases in serious risks
- Sensitivity to framing effects:** RTO ⇒ how risk described (marginal, total)

- We term (1) as **affixing behaviour**.
- (2) may have an exacerbating effect on (1)

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- Methodology:
- Risk- risk trade-offs survey of fatal, serious and less serious accident.
- Four different treatments.**
- Two treatments: information set included an **incentivised learning task** prior to making choices.
- Two treatments: marginal risk frame (**MRF**) and two a total risk frame (**TRF**).

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Experimental design

Mortality Spillover (MS)	Marginal Risk Frame (MRF)		Total Risk Frame (TRF)
	None	T1	T2
Yes		T3	T4

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Survey format (all treatments):

- Respondent makes pairwise choices between the same jobs in two areas, differing only in risk exposures.
- Each area was characterized by two risks:

the risk of one of two non-fatal injuries (NS or S)

the risk of a fatal injury (F)

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- **Injury NS**
- If an accident occurs and you suffer a type W injury you will be:
 - In Hospital
 - 2-7 days
 - slight to moderate pain
 - After Hospital
 - some pain/discomfort for several weeks
 - some restrictions to work and/or leisure activities for several weeks/months
 - after 3-4 months, return to normal health with no permanent disability
- **Injury S**
- If an accident occurs and you suffer a type R injury you will be:
 - In Hospital
 - several weeks, possibly several months
 - moderate to severe pain
 - After Hospital
 - continuing pain/discomfort for the rest of your life, possibly requiring frequent medication
 - substantial and permanent restrictions to your work and leisure activities - possibly some prominent scarring

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Risk information

Injury Severity	Risk per decade
Fatal	50 in 100,000
Serious	600 in 100,000
Non-Serious	5,000 in 100,000

Current Risk (MgI increase)

RISK (per decade)	
Non-fatal R	50 in 100,000
Fatal	50 in 100,000

Area 2:
An increased risk of Non-Fatal R

YOUR RISK INCREASE (per decade)	
Non-Fatal R	5 in 100,000
Fatal	0 in 100,000

Area 3:
An increased risk of Fatal F

YOUR RISK INCREASE (per decade)	
Non-Fatal R	0 in 100,000
Fatal	5 in 100,000

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The RSD game:

- Conveys the "intuition" behind RTOs (incl. mechanism); gives **experience** in real/consequential decisions over very small probability risks; (may reduce) impact of affixing behaviour
- Each respondent received 10 experimental tokens. 1 token = £1. respondent loses some money depending on the outcome of a "money wheel" spin.
- Three "money wheel" games of two rounds each; one practice game
- two real, incentivised games.
- Round 1, choose between two different "money wheels"
- Chosen wheel spun, result noted.
- Round 2, indifference points between the two wheels elicited by making the subject's preferred wheel worse. Coin toss determines which wheel played out

MONEY WHEEL

Wheel A

MONEY WHEEL

- Consisted of 100,000 segments in three different colours and a dial (4 colours varied across games).
- All probabilities expressed in a baseline out of 100,000; (as in the following section, traffic risk).
- Dial spun. Stopped randomly by the moderator, observed by respondents.
- Different colours = different outcomes i.e. blue no tokens lost, green three tokens lost, yellow eight tokens lost.

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- Descriptive Statistics:

	NSS	NSF	SF
Non-movers	26 (15%)	14 (8%)	24 (13%)
Prefer risk increase in best state	142 (79%)	152 (83%)	139 (77%)
Prefer risk increase in worst state	10	9	13
Missing	0	4	2
Language problems	1	1	1
Total	180	180	180
Of which indifference point outside table range	14	31	15

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- The ratio between the risk increases which induced the subject to switch to the other area is their "death risk equivalent" rr_{SF} .
- e.g. subjects indifference point indicates she prefers a 5 in 100,000 risk increase of F to a risk increase of 41 in 100,000 in S
- Individual's "death risk equivalent" rr_{SF} is 5/41.

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- Geometric mean $RR_{NSF} > RR_{NSS} > RR_{SF}$ (no overlapping confidence intervals)
- Consistent (overall ranking $S > SF > NSF$)

	N	Death risk equivalent (rr)
NSF	166	9.15e-04
NSS	168	0.003
SF	163	0.007

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- Treatment Key:**
 - T1 mgl only T2 total only
 - T3 mgl and RSD T3 total and RSD
- Affixing behaviour:** Test the impact of the RSD on the mean and variance of the resulting relative risk trade-offs. If the RSD impacts RR:
 - expect the means to be different across T1/T2 and T3/T4
 - and the variance to be smaller in T3/T4 (expecting RSD to impact on outliers).
- Outliers defined as respondents who display affixing behaviour in one of two different ways:
 - i) "non-movers"
 - ii) "non-traders"

- Compare mean and variance of the responses in T3 and T4 to those in T1 and T2 to test the effect of the RSD on affixing behaviour.

	N	RSD (T3, T4)	No RSD (T1, T2)	mean(ln(RR)) _{no RSD} = mean(ln(RR)) _{no RSD}	var(ln(RR)) _{no RSD} < var(ln(RR)) _{no RSD}
		ln(RR) (std. error)	t-test	Variance-comparison test	
NSF	166 (68+98)	7.45 (0.22)	6.68 (0.29)	p=0.05**	p<0.01***
NSS	168 (71+97)	6.59 (0.21)	5.21 (0.33)	p<0.01***	p<0.01***
SF	163 (68+95)	5.20 (0.28)	4.73 (0.30)	p=0.27	p=0.022**

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Does framing also have an impact?

- Non-movers impacted by RSD
- Non traders impacted by mgl frame.
- NSS is largest difference in outcomes.

Table VI. Probit regressions. Analysing the impact on affixing behavior and number of non-movers and non-traders across treatments

	AFFIXING (dummy variable)	NON-MOVER (dummy variable)	NON-TRADER (dummy variable)
Marg. effects (std. error)			
RSD	-0.150(0.049)***	-0.140(0.057)***	-4.86(-0.016)
TRF	-0.100(0.051)**	0.017(0.038)	-0.120(0.038)***
NSS	-5.1e-03(0.039)	2.8e-03(0.028)	-1.0e-02(0.028)
NSF	0.038(0.034)	-0.063(0.021)***	0.098(0.029)***
Constant	-0.382(0.148)**	-0.84(0.17)***	-1.17(0.20)***
N	497	497	497
Clusters	176	176	176

,**, Significant at 0.1, 0.05 and 0.01 levels, respectively.

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Approach
Conclusions

Context of RTOs

- We demonstrate that the combination of an RSD and the appropriate risk frame can **significantly decrease the affixing behaviour problem** in data
- This **increases its validity** by lowering the variance of the value estimates, potentially reducing the need to discard responses.

Wider context

- Contributes to a small but growing suite of papers demonstrating the potential for **economic experiments in the "information set" to improve SP responses** (Cherry et al. 2003; Nielsen et al. 2010; Chilton et al 2012; Bartczak et al 2015)