

# Dread and Latency Impacts on a VSL for Cancer Risk Reductions

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- ▶ Latency, Dread and Cancer Risks  
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# Overview

- ▶ Motivation (UK Policy)
- ▶ Study Details
  - structural relationship between roads and cancer VSLs
  - methods
  - results: (preliminary) mortality equivalence rates
  - results: systematic examination of context (dread, morbidity) and latency effects
- ▶ 2 UK Policy Applications & Issues Arising for Further Discussion

# MOTIVATION

# UK Policy (1)

- ▶ HSE VPF  $\approx$  £1.5m (2007 prices)
  - road accident risk reductions.
- ▶ Cancer
  - “x2” multiplier for  $VPF_{\text{cancer}}$  (R2P2, HSE 2001)
  - “dread” or horror of cancer  $\Rightarrow$  “cancer premium”?
  - But what about “latency” or timing? Offset any premium?
  - Reviewed literature inconclusive

# UK Policy (1)

- ⇒ *difficult to draw firm recommendations for a  $VSL_{CAN}$  or gain a clearer understanding about the underlying influences of latency and context (morbidity, dread)*
- ▶ A recent paper-based study (Jones-Lee and Loomes) suggests 1:1 but no empirical evidence.
- ▶ This study (i) addresses this gap  
(ii) provides a theoretically motivated investigation into the likely size (and causal factors) of any cancer premium

# STUDY

# Theory: Structural Relationship between C and R

- ▶  $R_t$  means a road accident in year t
- ▶  $C_{t+\alpha}$  means cancer  $\alpha$  years after the road accident would occur (i.e. Cancer with t+ $\alpha$  years' latency)
- ▶ We suggest the following relationship: 
$$C_{t+\alpha} = \frac{R_t(1+x)}{(1+r)^\alpha}$$
  - $1+x$  : dread or context effect: is cancer “worse” than a contemporaneous road accident?
  - $(1+r)^\alpha$  : captures discounting of the future cancer risk (prospect of a future fatality risk is ‘less bad’ than of the same current period fatality risk)
  - $r$  : the discount rate.



# Empirics: Project Details

- ▶ 159 members of the public in Newcastle upon Tyne interviewed Jan–Feb 2012
- ▶ Survey (10 risk–risk trades; Viscusi et al (1991), Jones–Lee and Loomes (1995))
  - Elicit (preliminary mortality equivalence rates
  - Isolate & verify directional effects of context (dread), morbidity and latency, *ceteris paribus*
  - Check if (any) premium may be a “labelling effect”
- ▶ Risk preferences, time preferences, demographics

# Example Risk–Risk Question

INITIALS \_\_\_\_\_  
 DATE \_\_\_\_\_

RRAS

QUESTION 2

Your current risk of dying by each cause is **1000 in 60 million**.  
 Which would you choose, if you had to:

C	D
An increase in my risk of dying in a <b>car accident</b> during the <b>year after next (2014)</b> of 50 in 60 million	An increase in my risk of dying from <b>cancer</b> <b>10 years from now</b> of 50 in 60 million

CIRCLE THE ONE YOU WOULD CHOOSE

Followed by a (matching) table to indicate “switchpoint” i.e. indifference

- ▶ *Also, there are a wide variety of cancers and they all have different characteristics. We can't ask about every cancer separately, so instead we'll try to cover as many as we can using groups of cancers with similar characteristics.*
- ▶ *For the cancers we are concerned with, the symptoms might include unexplained weight loss, having fevers and feeling generally unwell, and also having less energy than before. You will have some pain and might need to be treated using drugs that make you sick.*
- ▶ *You would go through stages of illness, each one a bit more severe than the one before it. It is hard to be precise about how bad the symptoms would be, but usually they get worse as time passes. A longer time with symptoms means you would be in each stage of the illness for a bit longer.*
- ▶ *These are the symptoms of a typical cancer case, and you should imagine that this is what it would be like for you."*

# Theoretical Foundation (Van Houtven et al. [2008])

- ▶ VH show: if indifference probabilities between two types of fatality in two policy options are observable i.e.  $\pi_R^A$ ,  $\pi_R^B$ ,  $\pi_C^A$ , and  $\pi_C^B$ .
- ▶ We can infer the *relative* MRS's of wealth for risk of death(s) [and, by aggregation VPFs]

- ▶ 
$$\frac{VSL_{CANCER}}{VSL_{ROAD}} = 1 - \frac{U(C,w)}{U(H,w)} = \frac{\pi_R^B - \pi_R^A}{\pi_C^A - \pi_C^B}$$

- ▶ Intuition: if a person is indifferent between  
10 in 1,000 risk of R  
5 in 1,000 risk of C

this implies they would accept an increase in their risk of R that is twice as large as the increase in their risk of C i.e. a strength of preference of 2:1

# Survey Questions

Purpose	Question	Code
Premium*	Q1	$C_{10} : R_1$
	Q2	$C_{10} : R_2$
	Q3	$C_{25} : R_2$
Context	Q4	$C_2 : R_2$
	Q5	$C_{10} : R_{10}$
Latency	Q6	$C_2 : C_{10}$
	Q7	$C_2 : C_{25}$
Morbidity	Q8	$C_{10}[12m] : C_{10}[6m]$
	Q9	$C_{10}[36m] : C_{10}[6m]$
Labelling	Q10	$C_{10}[2w] : R_{10}[2w]$

\*Q1-Q5 most closely match those typically asked in the literature.

# Results: Premia (Current R, Future C)

▶ Q1  $C_{10} : R_1$  1.116 (geom. mean)

Q3  $C_{25} : R_2$  0.280 (geom. mean)

## *Statistical Tests:*

- ▶ ***Cannot reject relativity = 1 for Q1 ,Q2*** (No cancer premium implied)
- ▶ ***Can reject relativity = 1 for Q3*** (relativity declines as cancer postponed; negative cancer premium?)
- ▶ **Can reject relativity = 2 for Q1 and Q3** (UK: current policy)

## Results: Context (Dread) (Contemporaneous Current & Future R & C)

- ▶ Context/Dread premium (Q4 Q5) ( $C_2:R_2$ ,  $C_{10}:R_{10}$ ) is around 9:1.

⇒ **Directional effect** of Context (Dread) validated i.e. holding time of death constant, C is dreaded more than R

i.e. could imply a cancer premium for contemporaneous fatalities

## Results: Morbidity (Contemporaneous C)

- ▶ “Morbidity” questions (Q8 Q9)  
( $C_{10}[12m] : C_{10}[6m]$  and  $C_{10}[36m] : C_{10}[6m]$ )
  - ▶ By “isolating” morbidity, we control for other effects to verify presence (and ‘direction’) of impact:
    - Morbidity premium (geom. mean) is
    - 8:1 for 12m vs 6m morbidity
    - 17:1 for 36m vs 6m morbidity
- ⇒ holding time of death constant, **the longer the morbidity, the greater the disutility of C (directional impact verified)**



## Results: “Labelling” Effect (Contemporaneous R & C; equivalent morbidity)

- ▶ Q10  $C_{10}[2w]:R_{10}[2w]$
  - ▶ both include two weeks of illness prior to fatality ten years from now.
  - ▶ In every case (central tendency measures; trimming levels), the ratio is insignificantly different to one
- ⇒ suggests that the label of “cancer” by itself does not give rise to a cancer premium

# Implication?

- ▶ Together, (Qu.s 4,5, 8,9 & Q.10) imply morbidity is the main component of dread.
- ▶ *Requires further empirical and theoretical study.*

# Results: Latency (Current and Future C)

- ▶ Recall Cancer is dreaded (Qu.s 4,5,8,9), but overall premium =1

⇒ the future cancer risk must be discounted

Q6  $C_2:C_{10}$  geom. mean 21.235

Q7  $C_2:C_{25}$  geom. mean 25.73

- ▶ By “isolating” timing , we control for other effects to verify presence (and ‘direction’) of latency impact  
⇒ **risk increases the year after next are worse than in the future**

# Validity Checks

- ▶ Internal tests (blocks of questions): scope, direction etc (*in paper*)
- ▶ Central tendency measures lend support to the proposed  $C_T R_T$  structural relationship i.e. strong context and latency effects both when isolated and jointly
- ▶ Regression Analysis: demographics; individual level data; respondent heterogeneity

# Regression analysis of logged relativities (pooled) against question characteristics and demographics

	OLS Model 1 n=1137 R <sup>2</sup> = 0.2469	OLS Model 2 n=1099 R <sup>2</sup> =0.2909	Fixed Effects Model 3 n=1278 R <sup>2</sup> =0.2079 $\rho = 0.244$	Fixed Effects Model 4 n=1278 R <sup>2</sup> =0.2456 $\rho = 0.245$
<b>Logged relativity</b>				
Cancer context dummy (1=cancer roads comparison)	0.327 (0.295)	-0.722 (0.300)	<b>0.569*</b> (0.325)	-0.382 (0.341)
Time until death (differential in years)	<b>-0.163***</b> (0.015)	<b>-0.460***</b> (0.048)	<b>-0.154***</b> (0.014)	<b>-0.425***</b> (0.044)
Time until death squared (squared differential)	-	<b>0.013***</b> (0.002)	-	<b>0.012***</b> (0.001)
Morbidity (differential in months)	<b>0.127***</b> (0.014)	<b>0.354***</b> (0.043)	<b>0.122***</b> (0.014)	<b>0.329***</b> (0.040)
Morbidity squared (squared differential)	-	<b>-0.009***</b> (0.001)	-	<b>-0.008***</b> (0.001)
Experience of cancer	<b>1.027***</b> (0.375)	<b>1.030***</b> (0.374)	-	-
Age	0.000 (0.023)	-0.002 (0.024)	-	-
Female	<b>-0.616*</b> (0.337)	<b>-0.622*</b> (0.336)	-	-
No. children in the household	-0.036 (0.126)	-0.041 (0.125)	-	-
Further education	0.499 (0.311)	0.487 (0.311)	-	-
Road accident experience	-0.306 (0.312)	-0.291 (0.311)	-	-
Rent	-0.142 (0.348)	-0.151 (0.347)	-	-
Health state	-0.371 (0.232)	-0.383 (0.231)	-	-
Constant	-0.428 (0.985)	0.052 (0.992)	-0.252 (0.251)	0.086 (0.270)

# POLICY APPLICATIONS AND ISSUES FOR FURTHER RESEARCH

# UK Policy: Potential Application (1)

## Reconstructing the VSL from Latency and Morbidity Parameters to Address the “cancer premium” on a Case-by-Case Basis

Matrix of reconstructed relativities comparing risks of cancer with specified morbidity and time until death, relative to instantaneous road accident fatality risks (Model 4).

Relativity		Morbidity (y)				
		0	6	12	18	24
Time until death (y)	0	0.744	.	.	.	.
	5	0.12	0.647	0.196	3.35	3.212
	10	0.035	0.19	0.577	0.984	0.944
	15	0.019	0.102	0.309	0.527	0.505
	20	0.018	0.099	0.301	0.514	0.493
	25	0.033	0.176	0.535	0.938	0.875

# UK Policy: Potential Application (2)

- ▶ Application (1) suggests:
    - short latency/long morbidity periods → increase the  $VSL_{\text{CANCER}}$  relative to cancers with long latency/short morbidity periods
  - ▶ Practicalities of such an approach not straightforward...
- ⇒ a simpler policy interpretation of our results



# Calculation of implicit values underpinning the premium

- ▶ Using elicited relativities  $C_{10}R_2$  &  $C_{25}R_2$  and with functional form assumptions, we calculate implied values for  $x$  (dread premium) and  $r$  (effective discount rate) (Appendix2)

- Assume

$$C_{t+\alpha} = \frac{R_t(1+x)}{(1+r)^\alpha}$$

- ▶ Based on these assumptions, the values are
  - $r = 7.5\% \text{p.a.}$
  - $x = 0.4$

# Testing the “X2” UK Cancer Premium

- ▶ Using the generic descriptions of C (12 month morbidity) the  $VSL_{\text{CANCER}}$  is 1.43 times as high as  $VSL_{\text{ROAD}}$  for contemporaneous fatalities, discount rate of 7.37%.
  - ▶ In combination, these parameters mean that a latency of 10 years or more reduces the relative value of the latent cancer fatality and the current period road accident fatality to 1:1.
- ⇒ no evidence to support the application of a “x2” cancer premium based on the preferences of this particular sample of the general public.

# Issues for Further Investigation/Discussion

## Cancer Premia in Policy

- ▶ Reconciling differing results/signals from the literature – can they be explained? By heterogenous preferences (over time, morbidity) or survey confounds?
- ▶ Can a ‘consensus’ on premia, morbidity & latency be reached for policy purposes based on current evidence?

# Issues cont.

## Morbidity

- ▶ Should morbidity and mortality be valued separately? If so, how to disentangle the effects?
- ▶ Duration & severity in the structural relationship?

## Latency

- ▶ Latency has a significant effect (here)→ any premium should accommodate this, unless morbidity effects are taken out and valued separately.
- ▶ Appropriate discounting functional form (Hyperbolic; sub-additive vs. exponential)

*Thank you!*

# Appendix 1: Survey text extract describing cancer

- ▶ Symptoms of cancer were derived from the American Cancer Association website and chosen to be as specific as possible without losing generality by becoming cancer-specific.
- ▶ *We are interested in those cancers that are caused by exposure to harmful substances that you come across on a day-to-day basis, for example at work or from near to where you live. They are NOT caused by lifestyle choices like smoking or drinking to excess, or solely by genetics. Please notice that this distinction means that your personal risk level is unlikely to differ much from the average risk.*
- ▶ *Another important point is that we are talking about cancers where the chance of survival is extremely small and we shall treat them as terminal. Please be aware that although cures for some types of cancer might be developed over time, it is extremely unlikely that a cure would be found for all of the cancers we are thinking about.*

- ▶ *Also, there are a wide variety of cancers and they all have different characteristics. We can't ask about every cancer separately, so instead we'll try to cover as many as we can using groups of cancers with similar characteristics.*
- ▶ *For the cancers we are concerned with, the symptoms might include unexplained weight loss, having fevers and feeling generally unwell, and also having less energy than before. You will have some pain and might need to be treated using drugs that make you sick.*
- ▶ *You would go through stages of illness, each one a bit more severe than the one before it. It is hard to be precise about how bad the symptoms would be, but usually they get worse as time passes. A longer time with symptoms means you would be in each stage of the illness for a bit longer.*
- ▶ *These are the symptoms of a typical cancer case, and you should imagine that this is what it would be like for you."*