Appendix D. Time and risk preferences

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Time and risk preferences are key economic concepts which determine the 'investment' individuals are willing to make in their future health through, for example, adopting healthier lifestyles. Health enhancing behaviour choices usually involve short-term 'costs' (i.e. experiencing withdrawal symptoms when quitting smoking) in exchange for long-term benefits (being healthier, living longer). Time preferences; how present or future oriented an individual is, will therefore influence these behaviours. An individual with a very high time preference rate effectively acts as if tomorrow is not going to come. Risk preference, how risk averse or risk seeking an individual is, will also influence health behaviours. The consequences of health behaviours are uncertain, at least at the individual level: for example, an individual does not know with certainty whether smoking will result in lung cancer. Individuals who are more risk seeking are less sensitive to risk and are therefore more likely to engage in risky health behaviours such as drug and alcohol use.

The hypotheses to be tested were:

- Individuals in Glasgow exhibit higher time preference rates for health than individuals in Liverpool and Manchester.
- Individuals in Glasgow are more risk seeking than individuals in Liverpool and Manchester.

If these hypotheses held, health investments were likely to be lower in Glasgow resulting in lower levels of health.

Methods

To measure time preferences, a previously validated set of survey questions were used[1]. The basic format of the discrete choices is as follows. In the first scenario (scenario A) an individual is ill for 20 days in two years from now. This scenario remains constant throughout. In the second scenario (scenario B) the individual is ill for *x* days in seven years from now. The respondent is asked which scenario is least bad. An example of a discrete choice is:

Which scenario is least bad?

□ Scenario A: you are ill for 20 days in two years' time

□ Scenario B: you are ill for 26 days in seven years' time

To explain the design, the trade-off offered in the discrete choice is presented as a time preference rate. The time preference rate (ρ) is equal to:

$$\rho = \left(\frac{x}{20}\right)^{1/5} - 1$$

Where *x* is the number of days of ill-health in scenario B. For example, a discrete choice between 20 days of ill-health in two years' time and 26 days of ill-health in seven years' time implies a rate of $0.057((26/20)^{1/5} - 1)$. If individuals prefer scenario A, their time preference rate is lower than 0.057. If

individuals prefer scenario B their time preference rate is higher than 0.057. After the initial discrete choice, the individual is presented with follow-up choices to establish the range within which their indifference point lies. The implied discount rate in a follow-up choice depends on the answer to the previous choice. If an individual prefers scenario A to scenario B, the follow-up choice will imply a lower discount rate. If an individual prefers scenario B to scenario A, the follow-up choice will imply a higher discount rate. The individuals are presented with additional follow-up choices until their responses indicate an implied time preference rate within an arbitrarily chosen interval of 0.0174, or their responses indicate an implied time preference rate less than -0.083 or greater than 0.196: findings from previous research in a representative sample of the general public using similar questions suggest that around 70% of sample have implied time preference rates within this range. Around 5% have rates less than -0.0830 and around 25% have rates greater than 0.1960[2]. Figure D1 (at the end of this Appendix) shows the structure of the questions. Three different periods of delay are used: now to five years in the future; two to seven years in the future and two to 11 years in the future.

The same health state used in the study by Cairns and van der Pol (2004)[1] was used in the three-city survey: chronic fatigue syndrome. This is thought to be not too severe a condition, but equally one not regarded as minor. It was described as follows: *You will experience a spell of ill health in which you will suffer from muscle and joint pain, headaches and unrefreshing sleep. You will also have impaired concentration severe enough to cause you problems with performing your usual activities (e.g. study, housework, family or leisure activities).*

Risk preferences were elicited using a commonly used general risk question. The question asked individuals how willing they were to take risks in general. Individuals indicated their willingness on a scale from 0 to 10.

Regression analysis was used to explore whether time preferences varied by city whilst controlling for age, gender, education, social class, marital status and religion. Based on estimates from previous studies[1], it was expected that some individuals would have implied rates larger than the highest implied time preference rate offered (0.1960). Censored regression techniques, Tobit, were used to allow for the right censoring[1].

Regression analysis was also used to explore whether risk preferences varied by city whilst controlling for the effects of the same co-variates as above (age, gender, education, social class, marital status and religion). Ordered probit regression was used to allow for the ordinal categorical nature of the dependent variable.

Results

The questionnaire was designed such that time preference rates between -0.0830 and 0.1960 would be observed. It was expected that around 70% of the sample have implied time preference rates within this range. Table D1 shows the distribution of responses over three categories: always chose nearest option (rate unobserved <-0.0830); always chose delayed option (rate unobserved >0.1960); and chose within range of -0.0830 and 0.1960.

[1] Left censoring was not considered as it was expected that only a small number of individuals would have time preference rates smaller than the lowest rate offered (-0.0830).

Table D1. Distribution of responses across three periods of delay.

	Glasgow		Liverpool		Manchester	
	N	%	N	%	N	%
Delay 0 → 5						
All immediate Rate < -0.0830	677	52.5	506	42.1	353	29.1
All delayed Rate >0.1960	176	13.7	349	29.0	386	31.9
Observed within range -0.0830<rate>0.1960	433	33.6	347	28.9	456	37.7
Missing	3		0		16	
Delay 2 → 7						
All immediate Rate < -0.0830	691	53.6	487	40.5	354	29.2
All delayed Rate >0.1960	175	13.6	351	29.2	390	32.2
Observed within range -0.0830<rate>0.1960	420	32.6	364	30.3	449	37.1
Missing	3		0		18	
Delay 2 → 11						
All immediate Rate < -0.0830	712	55.2	439	36.5	342	28.2
All delayed Rate >0.1960	152	11.8	307	25.5	347	28.7
Observed within range -0.0830<rate>0.1960	422	32.7	456	37.9	504	41.6
Missing	3		0		18	

A relatively large number of respondents always chose the immediate option. Over half of the individuals in Glasgow followed this pattern of response. This pattern of response implies a very low, negative time preference (lower than -0.0830). Negative time preferences are not uncommon in the health literature and some individuals may, knowing that they have to be ill, prefer to experience it sooner rather than later. However, the proportion of individuals with a negative time preference was unusually high in this study[3].

To explore the validity of the responses analysis was undertaken to identify which individual characteristics were associated with always choosing the more immediate option across the three questions (N=1259). The results below (Table D2) show a strong education effect which may suggest that cognitive complexity may have resulted in this pattern of response. The results also show that individuals with no religious affiliation were less likely to always choose the immediate option. It could be hypothesised that individuals may not have been willing to engage in the exercise due to their religious beliefs (for example, they may have felt it was up to God what happens, not them): this has also been found in the health valuation literature[4]. Respondents over 64 years of age were also less likely to always choose the more immediate option.

Table D2. Factors associated with always choosing immediate option.

	Coefficient	t-value
Liverpool	-0.850	-9.44***
Manchester	-1.141	-11.84***
Age 30-44	-0.004	-0.04
Age 45-64	-0.050	-0.46
Age 65+	-0.387	-3.22***
Female	0.112	1.45
University education	-0.279	-2.20**
Unemployed	0.017	0.14
Social class I&II	0.003	0.03
Non-British	-0.040	-0.35
Married	0.001	0.02
No religion	-0.393	-4.56***
Constant	0.116	0.95
N	3,454	
Pseudo R^2	0.0463	

*** statistically significant at 1% level; ** statistically significant at 5% level; * statistically significant at 10% level.

Table D3 shows the regression results excluding observations where individuals always chose the immediate option. The regression analysis tests whether Glasgow respondents differed from those of the other two cities in terms of implied time preference rate, after controlling for socioeconomic characteristics. The results show that contrary to the main hypothesis, individuals in Glasgow have a lower implied time preference rate compared with Manchester and Liverpool.

Table D3. Regression results time preference rate.

	Coefficient	t-value
Liverpool	0.045	6.67***
Manchester	0.026	3.74***
Delay from now to two years	0.005	1.99**
Delay from two to 11 years	-0.019	-9.46***
Age 30-44	0.012	1.55
Age 45-64	0.026	3.36***
Age 65+	0.068	7.68***
Female	-0.001	-0.13
University education	-0.040	-5.04***
Unemployed	0.002	0.21
Social class I&II	-0.005	-0.58
Non-British	0.010	1.23
Married	-0.002	-0.39
No religion	-0.026	-4.24***
Constant	0.111	12.09
N	6,102	

*** statistically significant at 1% level; ** statistically significant at 5% level; * statistically significant at 10% level.

To check the robustness of the results, the analysis was rerun for university-educated individuals only. It could be argued that cognitive complexity had less of an impact on responses for these individuals and the results in Table D2 do indeed show that individuals with a university education

were less likely to always choose the immediate option. The results of the reanalysis in Table D4 show that individuals in Glasgow still had a lower implied time preference rate compared with Liverpool but the difference was significant at a 10% level only. The difference in time preference rates between Glasgow and Manchester was no longer statistically significant. The analysis was also rerun for the full sample of university-educated individuals including responses where individuals always chose the immediate option (N=506). The main results held with individuals in Glasgow having a lower implied time preference rate compared with Manchester and Liverpool.

Table D4. Regression results time preference rate – university-educated only.

	Excluding observations of always immediate option		**Full sample**	
	Coefficient	**t-value**	**Coefficient**	**t-value**
Liverpool	0.027	1.76*	0.082	3.29***
Manchester	0.007	0.46	0.080	3.17***
Delay from now to two years	0.001	0.22	-0.003	-0.36
Delay from two to 11 years	-0.017	-3.31***	-0.008	-1.25
Age 30-44	-0.013	-0.86	0.011	0.46
Age 45-64	0.031	1.81*	-0.005	-0.19
Age 65+	0.064	2.41**	0.052	1.24
Female	-0.006	-0.54	-0.005	-0.24
Unemployed	0.050	1.77*	0.071	1.31
Social class I&II	-0.004	-0.33	-0.009	-0.43
Non-British	0.024	1.56	0.001	0.04
Married	-0.001	-0.04	0.032	1.54
No religion	0.001	0.07	0.007	0.34
Constant	0.075	3.92	-0.096	-2.97
N	804		1,310	

***statistically significant at 1% level; **statistically significant at 5% level; *statistically significant at 10% level.

Table D5 shows the mean risk preferences across the three cities. The table shows that individuals in Glasgow and Manchester were more risk seeking on average (more willing to take risk) compared with Liverpool. Risk preferences were similar across Glasgow and Manchester.

Table D5. Risk preferences.

	N	**Mean**
Glasgow	1,288	5.80
Liverpool	1,202	5.15
Manchester	1,211	5.81

Table D6 shows the regression results for risk preferences. The results show that individuals in Liverpool and Manchester were more risk averse compared with those in Glasgow after controlling for age, gender, education, social class, unemployed, nationality and marital status. Individuals in Glasgow were more risk seeking than individuals in Liverpool and Manchester. The difference between Glasgow and Manchester was significant at a 10% level only.

Table D6. Regression results for risk preferences.

	Coefficient	t-value
Liverpool	-0.198	-4.58***
Manchester	-0.080	-1.83*
Age 30-44	-0.336	-6.65***
Age 45-64	-0.560	-10.90***
Age 65+	-0.896	-15.88***
Female	-0.283	-7.83***
University education	0.319	5.58***
Unemployed	-0.011	-0.19
Social class I&II	0.141	2.40**
Non-British	-0.042	-0.80
Married	0.008	0.21
No religion	0.141	3.54***
N	3,454	
Pseudo R^2	0.0336	

*** statistically significant at 1% level; ** statistically significant at 5% level; * statistically significant at 10% level.

To summarise, the results showed that individuals in Glasgow have lower rather than higher rates of time preference. Individuals in Glasgow were more risk seeking than individuals in Liverpool. They were also more risk seeking than individuals in Manchester but this difference was significant at a 10% level only.

There were concerns over the quality of the data, with a large number of respondents always choosing the immediate option which implied time preference rates lower than -0.0830. It may be the case that these respondents did not fully understand the questions. Time preference questions are cognitively complex. Previous studies have mainly used postal questionnaires. Response rates are generally low which may be the result of individuals who do not understand the questions not returning the questionnaire (i.e. they self select). In this setting non-response may be perceived as more 'difficult'. Whilst individuals were allowed to opt out, numbers are small and individuals were encouraged to complete the questionnaire. It was explored what individual characteristics were associated with this pattern of response. It was found that those with university education were less likely to always choose the immediate option which may suggest that cognitive complexity may have resulted in this pattern of response. Individuals who stated that they have no religion or do not belong to a religious domination were also less likely to always choose the immediate option. It could be hypothesised that individuals may not be willing to engage in the exercise due to their religious beliefs. This has also been found in the health valuation literature where individuals are asked to trade off quality of life with life expectancy[4].

References for Appendix D

1. Cairns J van der Pol M. Repeated follow-up as a method for reducing non-trading behaviour in discrete choice experiments. *Social Science and Medicine* 2004;58(11):2211-2218.

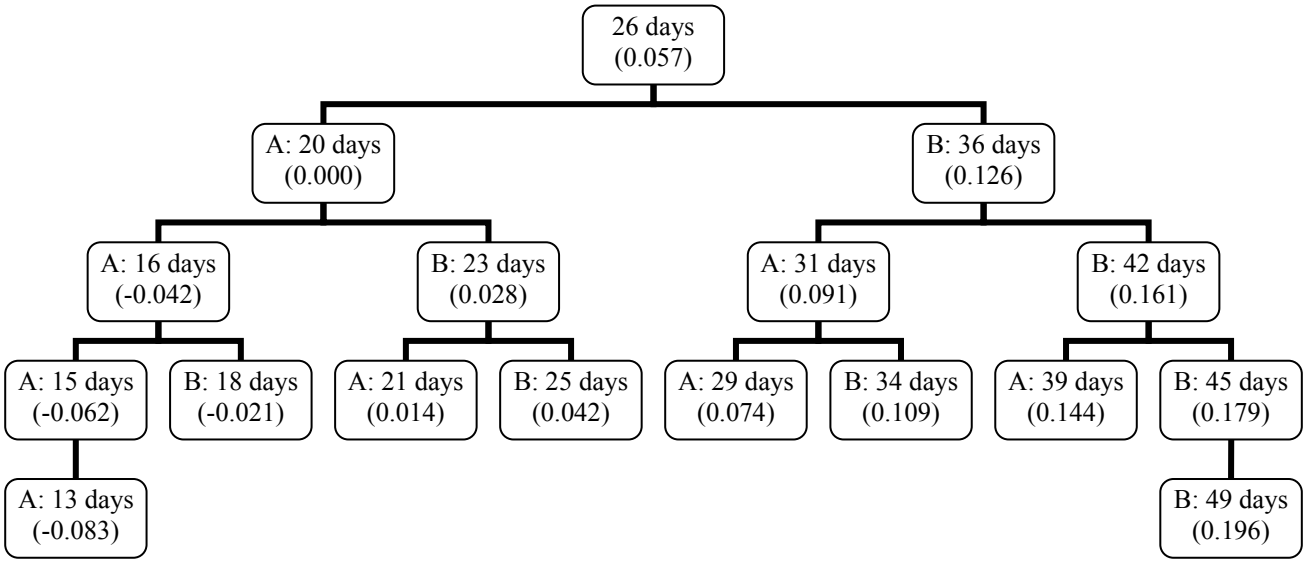
2. Cairns J, van der Pol M. The estimation of marginal time preference in a UK-wide sample (TEMPUS) project. *Health Technology Assessment* 2000;4(1):1-83.

3. Pol van der M, Cairns J. Negative and zero time preference for health. *Health Economics* 2000;9(2):171-175.

4. Robinson A, Dolan P, Williams A. Valuing health status using VAS and TTO: what lies behind the numbers? *Social Science and Medicine* 1997;45(8):1289-1297.

Figure D1. Structure of iterative procedure.

Five-year delay (rate in parentheses).



Nine-year delay (rate in parentheses).