

Health, education, and time preference

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Abstract

Education has been shown to be the most important correlate of health. However, the mechanism through which education influences health has been largely unexplained. Grossman argued that education improves health production efficiency. In contrast, Fuchs argued that the association between health and education is not primarily causal but reflects unobserved causes of both outcomes. Instead of education causing better health, some 'third' variables may be related to both education and health. The 'third' variable most frequently mentioned is time preference. The aim of this paper is to investigate the role of time preference in the relationship between education and health. The role of risk attitude is also investigated. The paper exploits a unique dataset of households which incorporated stated preference questions eliciting individuals' time preferences. The results show that the effect of education reduces but does not disappear when controlling for individuals' time preferences.

Keywords: education; health; time preference

1. INTRODUCTION

Education has been shown to be “the most important correlate of health” (Fuchs, 1982). For an overview of the extensive empirical evidence see Grossman (2006) and Grossman (2000). On the basis of the evidence, it can be argued that increasing levels of education is an effective way of improving population health. However, the mechanism through which education influences health has been largely unexplained and has been heavily debated. Grossman argued that education improves health production efficiency. Due to education, individuals have better knowledge about the relationship between certain health production inputs and health outputs (Grossman, 1975). In contrast, Fuchs argued that the association between health and education is not primarily causal but rather reflects unobserved causes of both outcomes. Instead of education causing better health, some unobservable factors or ‘third’ variables may be related to both education and health.

The ‘third’ variable most frequently mentioned is time preference. Both education decisions and health decisions involve trade-offs of outcomes over time. Individuals’ time preferences, preferences over the timing of outcomes, will therefore influence how individuals make intertemporal choices such as whether or not to invest in education, whether to save or borrow and whether to engage in health affecting behaviours such as smoking, drinking and drug use. The time preference rate represents the individuals’ preference for current outcomes over future outcomes. Given that individuals with high time preference will tend to invest in both less healthy behaviour and less education, failure to control for individuals’ time preference may bias the estimated effect of education on health. It could even be the case that all of the association between education and health can be attributed to time

preferences. That is, education does not have a direct effect on health. It is however more likely that only part of the association can be attributed to time preference. If this holds, policies aimed at improving health through education may not be as effective as previously thought.

Time preference has been mentioned as a potentially important third variable in numerous papers (for example Grossman (2006) devotes a relatively large part of his chapter on exploring this issue). However, empirical research investigating the role of time preference in the relationship between education and health has been very limited. There are in principle two approaches for dealing with a third variable like time preference. The first is to use an instrumental variable approach where the omitted variable (time preference) is instrumented for. For example, Lleras-Muney (2005) and Arendt (2005) use changes in compulsory education laws as an instrument. Other instruments used in the literature include parental education, parental occupation, and local unemployment rates (Grossman, 2006). The challenge with this first approach is to find the right instrument. The right instrument is a variable that is correlated with education, correlated with health only through its effect on education and not correlated with the omitted variable. Often instruments have limited explanatory power and therefore not valid instruments or they may be correlated with health. It has been shown that even small correlations between instruments and health lead to misleading estimates (Auld, 2006). So whilst this approach theoretically is a good solution for dealing with the third variable problem, it is often difficult to implement in practice.

The second approach is to elicit information on the third variable, in this case individuals' time preference, and directly control for this variable in the health equation. The challenge with this approach is to obtain robust information on individuals' time preferences. The use of revealed preference methods, which involve observing actual choice behaviour, is limited since it is difficult empirically to separate the effects of time preference from all of the other considerations that influence an individual's choices. Some papers have used proxies for time preference such as saving behaviour (see for example Ippolito, 2003) or planning horizon (Leigh and Dhir, 1997). These proxies tend to have limited explanatory power. A more promising approach which is becoming increasingly popular is to use stated preference methods to elicit individuals' time preferences. With stated preference methods, individuals are asked what they would do in particular hypothetical circumstances. In the case of time preferences, they are asked to trade off outcomes over time. For example, they may be asked whether they prefer £100 now or £110 in 1 years' time. If they choose the £100 now, their implied time preference rate is higher than 0.10 whilst if they choose £110 in 1 years' their implied time preference rate is lower than 0.10.

Stated preference methods provide richer and more robust data on individuals' time preferences. The data are more robust because the researchers can control for factors that may influence an individuals' implied time preference rate. The data are often richer because time preferences can be elicited for different delays and/or different outcomes. The disadvantage of using stated preference methods is that they are time consuming and therefore relatively costly. Only one previous study has used a stated preference method to elicit time preferences in order to explore the role of time

preference in the education-health relationship. Fuchs (1982) elicited time preference rates for monetary outcomes and regressed health status on time preference rate, age and education. In the sample of around 330 respondents, time preference was not statistically significant in the health equation. This is however likely to be due to the small sample size.

The main aim of this paper is to investigate the role of time preference in the relationship between education and health using stated preference data on time preference. This paper exploits a unique dataset of Dutch households (DNB household survey) which, in one of the waves, incorporated stated preference questions eliciting individuals' time preferences (Borghans and Goldsteyn, 2006). The sample size of 2300 is relatively large and therefore provides the opportunity for a more robust analysis of the role of time preference in education-health relationship compared to the Fuchs study. However, the limitation of using the DNB survey is its focus on financial behaviour. Whilst data are collected on the respondents' health and education, information on other potentially important variables that may affect education and health, such as parents' education, childhood experiences, genetic differences and cognitive ability are not available. Moreover, no suitable data are available to instrument for these omitted variables.

This paper also explores the role of risk attitude, in addition to time preference, in the relationship between education and health. There is considerable uncertainty surrounding investments in both health and education. For example, the average effect of giving up smoking is known but the expected return for a given individual is

highly uncertain (Fuchs, 1982). Individuals' risk attitude may therefore affect investments in health and education.

2. METHODS

2.1 Conceptual framework

A useful starting point is the Grossman model which models investment in human capital, in particular health. In the model health is viewed as both a consumption good and an investment good. Education leads to better health as education improves health production efficiency. Due to education, individuals have better knowledge about the relationship between certain health production inputs and health outputs. It is hypothesised that time preference affects the relationship between education and health as time preference affects investments in both health and education.

Investments represent a trade-off between current costs and future benefits.

Investments in health such as giving up smoking involve a trade-off between costs now, such as withdrawal symptoms, and future benefits, such as increased life expectancy. Investments in education also involve costs now, such as financial costs and time, and future benefits of education, such as increased earnings. It can therefore be argued that individuals who are more present oriented, that is, exhibit higher time preference rates, are less likely to invest in both their health and education. This argument holds if human capital directly enters the utility function. Even if human capital does not enter the utility function directly, Grossman (2000) argues that time preferences can affect investments in human capital if borrowing opportunities are limited and individuals therefore have to forego current consumption to invest. Also, individuals who are more present oriented demand relatively more

leisure later earlier in life. They work more later in life and the present value of future benefits of their investments will be lower.

Rather than time preference being exogenous in the relationship between education and health, Fuchs (1982) highlighted another possibility, namely that education lowers time preference resulting in better health increases because of increases in investments in health. Becker and Mulligan (1997) show in their conceptual framework that education lowers time preferences. Cross-sectional surveys such as the one used in the current paper cannot distinguish between the two ways time preference may affect the relationship between education and health.

The role of time preference is investigated by estimating the relationship between education and health both excluding and including a robust measure of time preference. A cross-sectional survey is used which elicited time preferences using stated preference methods.

2.2 Data

Data from the Dutch DNB Household Survey is used. This survey collects data from around 2000 households annually. The focus of the survey is on the economic and psychological determinants of saving behaviour. All members of the household aged 16 and over participate in the survey. The sample is representative of the Dutch population. The time preference questions were presented to the members in a supplementary survey in 2004 in which 2300 respondents took part. Not all respondents from the supplementary survey took part in the main survey in 2004. To

maximise the number of usable observations, data from the 2003 or 2005 waves are therefore also used.

2.3 Health measures

The main health measure used is self-assessed health. Self-assessed health has been shown to be a good predictor of subsequent mortality (Idler and Benyammi, 1997). This holds with respect to all socio-economic groups (Burström and Fredlund, 2001). However, it should be noted that self-assessed health may be prone to measurement error (Hernandez Quevedo *et al.*, 2005). Respondents were asked: “In general, would you say your health is: Excellent, Good, Fair, Not so good; Poor”. Table 1 shows the descriptive statistics of the health measures for the sample. The majority of respondents (69%) reported their health to be excellent or good. The number of respondents reporting fair, poor and not so good health is low and the self-assessed health variable is therefore also dichotomised into good health (Excellent and Good categories) and fair to poor health (Fair, Not so good and Poor categories). Other health measures that are investigated are whether respondent suffers from a long-term illness, their Body Mass Index (BMI), whether they are obese ($BMI \geq 30$).

In addition to health outcomes above, a health behaviour is also investigated namely smoking. Health behaviours are an input into the production of health. Health behaviours are under direct control of the individual whilst health status is at least partly determined by genetic makeup. It could therefore be hypothesised that a stronger relationship between time preference and health behaviour may be found. It should be noted though that smoking is an addictive good and this is likely to influence individuals’ consumption choices. However, Becker and Murphy (1988)

show in their rational addiction model that individuals with high time preference rates are more likely to end up with such sub-optimal consumption levels of addictive goods.

2.4 Education

Educational attainment is generally measured in either years of formal schooling or educational credentials obtained. Only the latter is available in the survey. It could be argued that this is a more appropriate measure than years of schooling. Chevalier et al. (2004) argued that “knowledge may [...] come in indivisible “lumps” and it makes sense for these to be associated with credentials”. The household survey collects information on both the highest level of education attended and completed. The categories are: (continued) special education; kindergarten/primary education; VMBO (pre-vocational education); HAVO, VWO (pre-university education); senior vocational training; vocational colleges; university education; and other sort of education/training. Given that the numbers in the “special education“ category and in the “other sort of education” category are small and given that they are difficult to interpret, the respondents in these two categories are excluded from the analysis. The impact of highest level of education *completed* on health is of main interest in the analysis. Respondents younger than 25 are excluded given that they may not yet have obtained their highest level of education.

The education variable is treated as a continuous variable. It could be hypothesised that the impact of individuals’ time preferences on both health and education is non-linear. This is explored by including dummy variables to indicate each of education categories. University education is used as the base case.

2.5 Time preference

The elicitation of individuals' time preference has received considerable empirical interest (Frederick *et al.*, 2002). The literature has shown that individuals' time preference rates may be a function of elicitation method used (van der Pol and Cairns, 2008). The methods can be classified as open-ended, closed-ended and rating pricing methods. Empirical evidence also shows that individuals' time preference rates are a function of the magnitude of the outcome, the delay until the nearest the outcome, delay between the two outcomes, and sign of the outcome (loss or gain) (Frederick).

The Dutch DNB household survey used six closed-ended intertemporal choices to elicit time preferences for monetary outcomes (Borghans and Goldsteyn, 2006). The intertemporal choices are shown in Appendix 2. The timing of the nearest outcome (t_1) was either now or 1 year from now. The period of delay was either 1, 3, or 4 years. There were two versions of the questionnaire. In version 1, the magnitude of the nearest outcome (x_1) was either €50 or €100 and the magnitude of the more distant outcome (x_2) was either €70, €90, €100, €125, €150, or €300. In the second version all outcomes were multiplied by 10. The implied time preference rates, assuming the Discounted Utility (DU) model and a linear utility function, ranged from 0.00 to 0.80. Appendix 2 also reports the percentage of respondents choosing the nearest outcome for each choice. Comparing the two versions it can be seen that for each choice this percentage is lower for version 2 compared to version 1. This is not surprising as previous evidence suggests that larger outcomes are discounted at a lower rate than small outcomes (Frederick *et al.*, 2002). The main analysis uses the aggregate dataset

but the analyses will be repeated by version to explore whether the magnitude effect has an effect on the results.

It should also be noted that some respondents (96 in total) have an implied time preference rate lower than 0.00. These responses may indicate that the respondents did not understand the exercise as they state they prefer a smaller money amount later to a larger money amount sooner. To explore this further, the relationship between this response and education was investigated. Individuals with lower educational status were more likely to have an implied time preference rate smaller than 0.00 (chi square statistic of 34.06). The main analysis includes all respondents but the analyses are repeated excluding the 96 respondents to explore the impact of these responses on the results.

Participant's pattern of response indicates the interval in which their time preference rate falls as shown in Appendix 3. A relatively large number of respondents (21%) have 'inconsistent' responses in that they cannot be classified into one of the intervals. However, evidence suggests that individuals' time preference rates are a function of the period of delay (Frederick *et al.*, 2002). There is also evidence of an immediacy effect, where people attach enhanced significance to outcomes that occur in the present (Frederick *et al.*, 2002). Assuming a constant rate for all delays and starting point may therefore result in apparent inconsistent responses. The responses are therefore also classified using questions 4 and 6 which share the same point and period of delay and offer a classification into reasonable intervals. The number of inconsistent responses is much lower but this will in part be due to the fact that the number of questions is lower and the intervals larger. This is the main measure used

for time preference in the analyses. Analyses are repeated using the categories based on the full number of questions.

2.6 Risk attitude

Fuchs (1982) highlights that investment behaviour is also likely to be influenced by risk attitude. Future outcomes of investments are inherently uncertain and an individual's attitude towards uncertainty (or risk) is therefore likely to influence investment decisions. The availability of measures indicating risk attitude in the DNB household survey is limited. Ideally, robust and rich information on risk attitude would have been obtained from individuals using lotteries (see for example van der Pol and Ruggeri (2008)). The data used in the current paper is derived from agreement with the following statement: "I am prepared to take the risk to loose money, when there is also a chance to gain money". Agreement is indicated on a 7-point scale ranging from 1 (Totally disagree) to 7 (Totally agree).

2.7 Econometric techniques

The dependent variable takes on several different forms which require different regression techniques. Self-assessed health is ordinal and consists of five different categories. Ordered probit regression is therefore used. Fair to poor health, smoking, and obesity are all binary dependent variables and probit regression is used in the analysis. Finally, BMI is a continuous variable and therefore OLS is used. All analyses were performed in STATA. For just over half of the sample, more than one member of the household took part in the survey. To allow for a potential clustering effect at household level, the cluster option was used in STATA.

The main independent variables of interest, education and time preference, are introduced into the regression model one at the time to explore the impact of each of these variables. Other socio-economic characteristics that are known to impact health are subsequently included. These are age, gender, whether they live with a partner, household size, household income, and degree of urbanization. Because there are relatively many missing data on household income, the model is estimated both including and excluding income.

Measurement error is likely to vary across the main independent variables of interest. Larger measurement error of the time preference variable compared to the education variable may result in a downward biased coefficient and t-statistic of the time preference variable. This is explored by randomly altering the education variable for 20% of the sample.

3. RESULTS

Table 2 shows mean self-reported health by education and time preference. The first thing to note in the table is that some cells have very small numbers. From the totals columns, it can be concluded that there is a positive relationship between educational attainment and self-rated health. There is a negative relationship between time preference and health. These trends are also present for each educational attainment where cell numbers are sufficient.

Table 3 shows the regression results for self-reported health. The first set of regression results shows that education and health are positively correlated. The

second set of results indicates that the higher the individuals' rate of time preference the poorer their health. When both education and time preference are included, the coefficient on education reduces in size, from 0.089 to 0.081. This 9% reduction is relatively small. Moreover, the coefficient on education remains highly significant. The same conclusions hold when the other co-variables are included. The coefficient on education reduces by 7%, from 0.075 to 0.070, when time preference is included in the regression model. When household income is included, the number of observations is reduced from 1863 to 1747 and individuals' time preference is statistically significant at a 10% level only. The coefficient on education reduces by 5%, from 0.057 to 0.054, when time preference is included in the regression model.

As hypothesised randomly altering the education variable for 20% of the sample increased the coefficient and t-value of the time preference variable. The coefficient on the time preference variable increased to -0.115 and the t-value to -3.17 in the model with no controls and the coefficient increased to -0.086 and the t-value to -2.35 in the model with controls excluding income. The coefficient and t-value on the education variable decreased in all models. In the model with no controls the coefficient decreased to 0.051 (t-value of 3.01) when the time preference variable was excluded and to 0.044 (t-value of 2.64) when the time preference variable was included. In the model with controls excluding income the coefficient decreased to 0.038 (t-value of 2.23) when the time preference variable was excluded and to 0.035 (t-value of 2.03) when the time preference variable was included.

Education dummies are also used to explore whether the relationship between health and education is non-linear. The results in Table 4 show that the impact of education

on health is non-linear. The conclusions regarding the impact of including time preference in the health education equation is the same for all education categories. The size of each of the education dummies is reduced when time preference is included. The relative reduction in coefficient size ranges from 6% (for pre-vocational education) to 14 % (vocational colleges) but follows no obvious pattern.

The analyses were repeated using the time preference measure based on all responses. Similar results were found but the explanatory power was lower than with the original time preference measure. This is most likely due to the smaller sample size as 'inconsistent' respondents had to be dropped from the analysis. The main analysis was also repeated for each version as the magnitude of the outcomes in the time preference questions varied. The results were consistent with those from the main analysis but there was a reduction in explanatory power. Finally, the analysis was repeated for the sample excluding the respondents who exhibited negative time preferences. Very similar results were found.

Table 5 shows the regression results when risk attitude is included. Because of missing data, the sample is reduced from 1812 to 1714 observations. In the basic model, the coefficient on risk attitude is statistically significant and indicates that individuals who are more risk seeking are in poorer health. When including both time preference and risk attitude the coefficient on education decreases from -0.081 to 0.069. This decrease is much smaller when other individuals' characteristics are included. It should also be noted that risk attitude and time preference are correlated (correlation coefficient of -0.0885 with a p-value of 0.0001).

Table 6 shows the results for the other health measures. Only the coefficients on education are reported (full results are available from the author). The finding that coefficient on education is reduced but remains statistically significant when time preference is included is repeated for all health measures. However, individuals' time preferences had limited explanatory power in the case of smoking, BMI and obesity.

4. CONCLUSIONS

This paper investigated the role of time preference in the education-health relationship. It is often hypothesised that individuals with low time preference rates invest in both more healthy behaviour and more education. Failure to control for individuals' time preference may therefore bias the estimated causal effect of education. Despite the fact that this third variable is mentioned in numerous papers, empirical research has been limited. This paper used a unique data set, the DNB household survey, which incorporated in a supplementary survey, stated preference questions to elicit individuals' time preferences. Self-reported health was regressed on education and other individual characteristics. When including time preference the coefficient on education was reduced. This was also shown for other health measures, including smoking. However, the reductions in the education coefficient were relatively small. Moreover, the coefficient on education remained statistically significant indicating that there is a substantial exogenous effect of education on health. The largest reduction in the education coefficient occurred when income was included in the regression model. Given that education and income are correlated, this may suggest that one of the mechanisms through which education affects health is by raising income levels. However, the education coefficient remained statistically

significant suggesting that there are likely to be other mechanisms through which education affects health. This should be explored in further research.

The use of cross-sectional data meant that it was not possible to test whether time preference is exogenous or whether the increase in health was a result of education lowering individuals' time preferences. Further research attempting to allow for the potential endogenous relationship between education and time preference is clearly required.

There are other variables such as cognitive ability and genetic differences which the analysis could not control for. Unfortunately no valid instruments were available and an instrumental variables approach could not be used. The paper did explore the role of another preference parameter, namely individuals' attitude towards risk. There is considerable uncertainty surrounding investments in both health and education. The results showed that individuals who are more risk seeking tend to be in poorer health. When including both time preference and risk attitude the coefficient on education decreased more substantially. It was also found that time preference and risk attitude were correlated. Little is known about the interrelationship between time preferences and risk attitude as both types of preferences have mostly been investigated separately. Anderhub *et al.* (2001) found a correlation between risk attitude and time preferences, while Barsky *et al.* (1997) found no relationship. Exploring the interrelationship between time preferences and risk attitude would be a fruitful line of enquiry. Especially given that both time preferences and risk attitude affect the utility function for health.

Several different health measures were used in this study and the results were consistent across the different measures. In addition to health status a health behaviour, namely smoking, was also investigated. Because health behaviours are under direct control of the individual the relationship with time preference was expected to be stronger compared to health status. However, this hypothesis did not hold. This may have been due to the fact that there were relatively few smokers (455 in total) in the analysis sample.

There are several limitations to this study including measurement error. This may have been issue with respect to self-reported health, time preference and risk attitude. The time preference questions were hypothetical and it can therefore be questioned whether individuals would make the same kind of choices in real life. Time preference questions are complex and many people will be unfamiliar with making these explicit trade-offs. Measurement error is less likely to be issue with respect to the education variable. These relative differences in measurement error across the independent variables of interest may have resulted in a downward biased coefficient and t-statistic of the time preference variable. Randomly altering the education variable for 20% of the sample did increase both the coefficient and t-statistic on the time preference variable. The main results and conclusion did not change however as a result of introducing more random error in the education variable.

It was also implicitly assumed that a single time preference rate drives both education and health choices. There is relatively little evidence to suggest that health and monetary time preferences are closely related and this assumption may therefore not hold. The measure of risk attitude was limited. Finally, the closed-ended questions

used to estimate individuals' time preferences varied in terms of starting point, period of delay and magnitude. This complicated the estimation of a robust individual time preference rate. The question arises whether the relatively small reduction in the education coefficient in the health equation is the result of the time preference measure not accurately reflecting individuals' preferences. Repeating the analyses with more robust measures of both time preference and risk attitude would be a fruitful line of future enquiry.

It should be noted that the correlation between time preference and health is of direct policy relevance. It suggests that one way of improving population health may be through interventions that are aimed at making people more future-oriented. However, further evidence is required on the relationship between time preference and health before this conclusion would be other than tentative.

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Table 1
Descriptive statistics of health measures

	N	%
Self-assessed health		
Excellent	255	11.1
Good	1,338	58.2
Fair	339	14.7
Not so good	83	3.6
Poor	18	0.8
Missing	267	11.6
Fair to poor health		
No	1,593	69.3
Yes	440	19.1
Missing	267	11.6
Smoking		
No	1,554	67.6
Yes	479	20.8
Missing	267	11.6
Long-term illness		
No	1,491	64.8
Yes	542	23.6
Missing	267	11.6
Obese		
No	1,789	77.8
Yes	236	10.3
Missing	275	12.0
		Mean
Body Mass Index (BMI)	2025	25.4

Table 2**Mean (N) self-reported health by education and time preference**

Education	Time preference rate			Total
	<0.25	0.25-0.80	>0.8	
Kindergarten/primary education	3.67	3.62	3.37	3.50
	12	21	35	68
VMBO (pre-vocational education)	3.84	3.76	3.77	3.78
	86	184	231	501
HAVO, VWO (pre-university education)	3.98	3.87	3.62	3.80
	52	93	91	236
Senior vocational training	3.77	3.90	3.87	3.86
	71	147	152	370
Vocational colleges	4.03	3.83	3.79	3.86
	105	207	158	470
University education	4.00	4.05	3.92	4.00
	76	91	51	218
Total	3.92	3.85	3.77	3.83
	402	743	718	1863

Table 3**Regression results self-reported health**

	With no controls						With controls excl income						With controls incl income					
	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value		
Education	0.089	5.00			0.081	4.30	0.075	4.02	0.070	3.77	0.074	3.83	0.057	2.87	0.054	2.74		
Time preference			-0.124	-3.45	-0.103	-2.81			-0.078	-2.13					-0.064	-1.67		
Age							-0.010	-4.37	-0.009	-4.09	-0.010	-4.59	-0.011	-4.73	-0.010	-4.52		
Gender							-0.146	-2.78	-0.140	-2.67	-0.133	-2.44	-0.124	-2.26	-0.119	-2.18		
Living with partner							0.180	2.19	0.175	2.14	0.208	2.53	0.142	1.68	0.142	1.68		
Household size							0.035	1.24	0.037	1.33	0.032	1.13	0.033	1.19	0.035	1.25		
Urbanization							0.022	1.02	0.021	1.00	0.021	0.95	0.025	1.13	0.025	1.12		
Household income													0.083	3.02	0.079	2.86		
N	1863		1863		1863		1863		1863		1747		1747		1747			
McKelvey and Zaviona R ²	0.017		0.009		0.023		0.052		0.055		0.056		0.063		0.065			

Table 4**Regression results self-reported health with education dummies**

	With no controls				With controls excl income				With controls incl income			
	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value
Kindergarten/primary education	-0.790	-5.26	-0.746	-4.98	-0.672	-4.37	-0.649	-4.22	-0.591	-3.77	-0.576	-3.68
VMBO (pre-vocational education)	-0.380	-4.20	-0.340	-3.70	-0.375	-4.04	-0.351	-3.73	-0.342	-3.42	-0.326	-3.22
HAVO, VWO (pre-university education)	-0.343	-3.26	-0.315	-2.99	-0.318	-2.97	-0.301	-2.80	-0.320	-2.86	-0.307	-2.75
Senior vocational training	-0.227	-2.35	-0.195	-1.98	-0.322	-3.24	-0.296	-2.93	-0.316	-3.01	-0.297	-2.79
Vocational colleges	-0.242	-2.64	-0.219	-2.37	-0.266	-2.90	-0.250	-2.71	-0.301	-3.13	-0.289	-2.99
Time preference			-0.101	-2.74			-0.073	-1.96			-0.058	-1.50
Age					-0.010	-4.33	-0.009	-4.04	-0.011	-4.70	-0.010	-4.47
Gender					-0.144	-2.73	-0.138	-2.62	-0.121	-2.19	-0.116	-2.11
Living with partner					0.184	2.22	0.179	2.17	0.152	1.80	0.152	1.79
Household size					0.035	1.27	0.037	1.34	0.035	1.24	0.036	1.29
Urbanization					0.025	1.14	0.024	1.10	0.028	1.26	0.027	1.23
Household income									0.078	2.83	0.075	2.69
N	1863		1863		1863		1863		1747		17470	
McKelvey and Zaviona R ²	0.022		0.028		0.057		0.060		0.069		0.070	

Table 5**Regression results with risk attitude included**

	With no controls				With controls excl income					
	β	t-value	β	t-value	β	t-value	β	t-value		
Education	-0.081	-4.37			-0.069	-3.65	-0.064	-3.29	-0.059	-3.01
Time preference			0.099	2.91	0.087	2.52			0.060	1.74
Risk attitude			-0.052	-2.86	-0.042	-2.29			-0.028	-1.47
N	1714		1714		1714		1714		1714	
McKelvey and Zaviona R ²	0.014		0.013		0.023		0.048		0.051	

Table 6**Results for different health measures**

	With no controls		With time preference		With all controls excl time preference		With all controls incl time preference		
	β	t-value	β	t-value	β	t-value	β	t-value	N
	Education		Education		Education		Education		
Fair to poor health*	-0.109	-4.86	-0.102	-4.50	-0.096	-4.08	-0.092	-3.90	1863
Long-term illness*	-0.084	-3.84	-0.077	-3.50	-0.057	-2.48	-0.054	-2.35	1863
Smoking*	-0.077	-3.45	-0.074	-3.30	-0.125	5.14	-0.121	-4.96	1863
BMI***	-0.371	-6.27	-0.361	-6.05	-0.334	-5.44	-0.328	-5.32	1849
Obese*	-0.097	-3.86	-0.093	-3.70	-0.093	-3.38	-0.090	3.28	1849

* probit regression; ** OLS

Appendix 1

Descriptive statistics of sample

Variable	N	%
Highest level of education completed (attended)		
(continued) special education	9 (7)	0.4 (0.3)
Kindergarten/primary education	134 (29)	5.8 (1.3)
VMBO (pre-vocational education)	577 (547)	25.1 (23.8)
HAVO, VWO (pre-university education)	283 (261)	12.3 (11.4)
Senior vocational training	425 (402)	18.5 (17.5)
Vocational colleges	528 (591)	23.0 (25.7)
University education	241 (360)	10.5 (15.7)
Other sort of education/training	12 (14)	0.5 (0.6)
Missing	91 (89)	4.0 (3.9)
Gender		
Male	1,155	50.2
Female	1,056	45.9
Missing	89	3.9
Living with partner		
No	448	19.5
Yes	1,763	76.7
Missing	89	3.9
Household size		
1	381	16.6
2	905	39.4
3	251	10.9
4	443	19.3
5	178	7.7
>5	53	2.3
Missing	89	3.9
Urbanization		
Very high degree of urbanization	340	14.8
High degree of urbanization	561	24.4
Moderate degree of urbanization	495	21.5
Low degree of urbanization	485	21.1
Very low degree of urbanization	330	14.4
Missing	89	3.9
Household income		
<€10,000	81	3.5
€10,000 - €14,000	36	1.6
€14,000 - €22,000	112	4.9
€22,000 - €40,000	398	17.3
€40,000 - €75,000	880	38.3
>€75,000	368	16.0
Don't know	26	1.1
Missing	399	17.4
	Mean	Range
Age (N=2211)	47.7	16-89

Appendix 2

Time preference questions

Question	x_1	t_1	x_2	t_2	Implied rate	% respondents
					DU	choosing x_1
<i>Version 1</i>						
Q1	€ 50	Now	€ 70	1 year	0.40	60.6
Q2	€ 100	1 year	€ 150	4 years	0.14	79.6
Q3	€ 100	Now	€ 100	1 year	0.00	95.7
Q4	€ 50	1 year	€ 90	2 years	0.80	45.3
Q5	€ 50	Now	€ 300	4 years	0.57	25.2
Q6	€ 100	1 year	€ 125	2 years	0.25	80.9
<i>Version 2</i>						
Q1	€ 500	Now	€ 700	1 year	0.40	47.8
Q2	€ 1000	1 year	€ 1500	4 years	0.14	70.2
Q3	€ 1000	Now	€ 1000	1 year	0.00	96.0
Q4	€ 500	1 year	€ 900	2 years	0.80	33.1
Q5	€ 500	Now	€ 3000	4 years	0.57	19.7
Q6	€ 1000	1 year	€1250	2 years	0.25	73.8

Appendix 3

Time preference rate intervals

Categories	Total N	Version 1 N	Version 2 N
< 0.00	26	16	10
0.00-0.14	319	131	188
0.14-0.25	76	37	39
0.25-0.40	326	154	172
0.40-0.57	335	197	138
0.57-0.80	330	194	136
>0.8	407	258	149
'Inconsistent'	481	239	242
Categories using Q4 and Q6 only ($t_1=1$ year and $t_2= 2$ years)			
<0.25	493	220	273
0.25-0.80	897	451	446
>0.80	888	541	347
'Inconsistent'	22	14	8