Bleak Expectations: the Role of Pessimism in Smoking, Hazardous Drinking and Exercise

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Abstract. Young people with low "broad" wealth may be more likely to take up hazardous consumption and shun investment in human capital. This could occur directly, through the concavity of utility. But it could also occur indirectly, as low wealth decreases a young person's general expectation of future success. Such pessimism would lower the expected future cost of hazardous consumption and the future expected benefit from investment. *Excessive* pessimism would cause too much of the former and too little of the latter. These hypotheses are tested for the onset of late-adolescent smoking, hazardous drinking, and lack of exercise using a longitudinal study of youth in New Zealand. We find evidence that most components of 15 year olds' "broad wealth" are correlated with their degree of pessimism as assessed by their parents. We find this pessimism predicts the subsequent onset of smoking and lack of exercise, but not hazardous drinking, once factors such as current wealth, risk preference and discount rate are controlled. We find little evidence of bias in expectations, except that children who experience an adverse event (an accident) are too pessimistic that it will recur.

JEL classification: I12, I2, D12, D90

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1. Introduction

Why do people take up goods like cigarettes that bring immediate benefit, but potentially serious future cost? Or shun personal investments that bring immediate cost but future benefit? Are people happiest if left to make such inter-temporal decisions without interference? Such questions vex policy makers and engage researchers from a wide array of disciplines. Economists such as Becker and Murphy (1988) have employed a rational choice framework to address these questions. A person will take up smoking if he perceives the expected present discounted sum of future benefits from doing so will exceed the corresponding costs. And he will be happiest *ex ante* if left to make such decisions unfettered, so long as his beliefs about the consequences are unbiased given the information that is available. Such a person may be disappointed to take up smoking and find *ex post* that he is addicted or has lung cancer, but only as a gambler might who knowingly takes a risk and loses.

The rational choice approach identifies several factors that increase the likelihood that a person will take up addictive goods or shun healthy investment. These include a high discount rate, low current utility, (possibly) high tolerance of risk, optimism concerning low future health risks, or pessimism concerning low future investment benefits.

Critics have questioned the descriptive accuracy of the rational choice approach, particularly its characterization of the way people discount future costs and benefits (Skog (1999)). Economists generally model peoples' discounting behaviour using the exponential function, which imposes time-consistency over decisions made. In contrast, Chung and Herrnstein (1967) and Ainslie (1975) suggest that people use "hyperbolic" discounting, or have today a lower discount rate between two periods in the future than they will when the first of those two periods arrives.[1] Others have questioned the accuracy of people's foresight of

[1] Hyperbolic discounting has received support in psychology experiments, as

addiction costs or investment benefits (Orphanides and Zervos (1995) and Goldberg and Fischhoff (2000)).

One aspect of the rational addiction approach that has received surprisingly little attention is the role of *general* life expectations. In particular, it has long been recognized that low current utility may well increase the immediate marginal benefit of smoking, or marginal cost of investment. But low happiness today may also reduce people's expectations of happiness tomorrow. These diminished expectations could reduce the future expected cost of hazardous consumption today, or the future expected benefit of investment today. From this perspective, the question of *rational* choice hinges on the accuracy of peoples' expectations of future happiness. And unlike peoples' discount rates, which economists take as taste parameters, expectations about the future have the potential to be evaluated for bias using realized outcomes.

This paper will present a simple hypothesis that poor life expectations caused by low initial utility will make addictive goods more attractive and investment goods less attractive. Furthermore, if the pessimism people adopt is excessive, addictive goods will be too attractive and investment goods too unattractive. Both hypotheses are tested using a longitudinal study of youth in New Zealand, the Dunedin Multidisciplinary Health and Development Study (DMHDS). We test the first hypothesis in two steps, asking first whether teens with low "broad wealth" are more pessimistic about the future. We then test whether both low broad wealth *and* pessimistic expectations are significant in predicting which teens are more likely to later start

summarized by Ainslie (1992) and Loewenstein and Prelec (1992). Time-inconsistent preferences were first raised in economics by Strotz (1956), and the implications of hyperbolic discounting in particular have been explored more recently by Laibson (1997) and O'Donoghue and Rabin (1999).

smoking, drinking hazardously, or to abandon exercise once out of high school. We test the second hypothesis concerning the accuracy of expectations using two indirect methods. First, are teens who experience a drop in current utility more pessimistic than teens with consistently low utility? Second, are younger teens more prone to excess pessimism concerning a future bad event (experiencing an accident) if they come from a disadvantaged background or if they themselves have experienced the event?

The paper is organised as follows. Section 2 provides a brief literature review of the connections between life events and expectations, and of the limited attempts to evaluate the accuracy of these expectations. Section 3 presents a simple two period illustration of inter-temporal choice that highlights the role of life expectations. Section 4 describes the DMHDS sample used to test the model. Section 5 describes tests for whether broad wealth affects behaviour via expectations of future success, while Section 6 describes tests for bias in these expectations. The paper concludes with a brief discussion in Section 7.

2. Expectations and Behaviour

Dominitz (1998) has observed that economists have made few empirical studies testing *how* people form expectations, making assumptions instead about how they ought to do so. Psychologists have paid more descriptive attention to people's expectations, particularly in relationship to mood and depression. Indeed, the current clinical definition of depression includes measures of hopelessness for the future (American Psychiatric Association, 1994). Gotlib et al. (1996) review studies of the effects of depression on many aspects of cognitive functioning. Depressed individuals take more personal responsibility for negative outcomes than do the non-depressed, and rate their own performance more negatively than objective ratings. Relevant here, depressed people also tend to report inflated subjective probabilities for adverse future life events.

There is also indirect evidence from longitudinal studies of substance abuse that pessimistic individuals are more likely to initiate consumption of hazardous goods. An older, but well-respected study of mid-western American high school students by Jessor and Jessor (1977) found that "expectation of academic achievement" was significant in explaining a multiple-problem behaviour index that included drinking and smoking marijuana. Orford (1985) reviews a study by Bynner (1969) indicating that boys who smoke "perceive themselves...as lacking educational success relative to non-smokers," and that lower academic aspirations and motivation are predictive of later illicit drug use. While doing poorly at school might lower an adolescent's current utility, it seems likely that it also lowers his expectations of future income or work prestige.

Unfortunately, many of the psychological studies finding links between tough starts and pessimism provide no test of the validity of peoples' expectations. What if people with disadvantaged starts in life are right to be pessimistic? Such a possibility is suggested by Rabbitt et al.'s (1995) cross-sectional study of 4,200 English adults. They found that people with higher scores on the widely-used Beck Depression Inventory were significantly more likely to be from lower socioeconomic groups and to have poorer measures of cognitive ability.

There are a few papers within economics that try to test the accuracy of people's expectations, specifically with regard to future income. Dominitz (1998) follows up respondents in three consecutive rounds of the United States Survey of Economic Expectations. In the second and third rounds earnings realizations are analysed. Subject to sample attrition problems, Dominitz finds that overall people were too optimistic about changes in future income. At the same time, expectations were revised more sharply in response to income drops than income rises. Das and van Soest (1997), (1999) follow up data on expected and realized income changes over six consecutive years of the Dutch Socio-Economic Panel. These authors also contend with sample attrition problems, and unlike Dominitz must use ordered categorical data. In contrast to Dominitz, Das and van Soest find that heads of households are generally too pessimistic concerning future income changes. Not surprisingly, those who had experienced a drop in income were more pessimistic than others in forecasting future drops, ceteris paribus, and continued to be more pessimistic throughout the sample period. More importantly, these households *underestimated* future realized income gains. This result was robust over all 6 years of the panel, causing the authors to conclude that households whose income had fallen were too pessimistic, and viewed negative income changes as too permanent. The Das and van Soest studies raise the possibility that people not only revise their expectations downward following unusual negative events, but do so excessively.

3. The Hypothesis

Consider a simple model where a person lives for two periods. Period utility is a stationary concave function of "broad wealth," W:

$$U(W_t) \qquad\qquad t = 1, 2 \qquad\qquad (1)$$

W_t includes liquid assets, M_t, but also non-pecuniary wealth such as family and social cohesion, good health, social status, school or work achievement, etc. For simplicity, assume that a person can enter period 1 with either high, W_1^H or low W_1^L wealth. While each knows his period 1 endowment with certainty, he must form a probability distribution over future wealth states in period 2. These expectations are conditioned on his initial wealth and the actions he takes in period 1. Again for simplicity, we shall restrict the future broad wealth states to high W_2^H or low W_2^L.

Suppose next that the person considers an activity in period 1 like smoking that brings immediate net benefit $B = b\text{-}c$, but possible future cost from health or addiction-related problems. The person perceives the future cost of smoking as a decrease in the probability that he will experience high broad wealth in period 2. Assuming smoking is affordable ($M_1 \$ c$), a person with high initial wealth will choose to smoke if

$$U\ (W_1^H + B) + \delta\ \{ p_{H,S}\ U\ (W_2^H) + (1 - p_{H,S})\ U\ (W_2^L) \} \quad > \quad U\ (W_1^H) + \delta\ \{ p_{H,NS}\ U\ (W_2^H) + (1 - p_{H,NS})\ U\ (W_2^L) \}\ . \qquad (2)$$

δ is the person's discount factor, which in a two period model may be exponential or hyperbolic. $p_{H\ S}$ is his expectation of high future wealth conditional on his initial high (H) wealth and on choosing to become a smoker (S) in period 1. Similarly, $p_{H,NS}$ is his expectation of high future wealth conditional on high (H) initial wealth and not smoking in period 1 (NS). We assume that $p_{H,NS}\ \$\ p_{H,S}$.

Similarly, if he can afford it, a person with low initial wealth will smoke if

$$U\ (W_1^L + B) + \delta\ \{ p_{L,S}\ U\ (W_2^H) + (1 - p_{L,S})\ U\ (W_2^L) \} \quad > \quad U\ (W_1^L) + \delta\ \{ p_{L,NS}\ U\ (W_2^H) + (1 - p_{L,NS})\ U\ (W_2^L) \}\ , \qquad (3)$$

where again $p_{L,NS}\ \$\ p_{L,S}$.

Does low initial wealth raise the probability that the person will start smoking? The question may be divided into a comparison of the benefits and costs of smoking for the rich and poor. The immediate (net) benefits are, respectively,

$$U\ (W_1^H + B) \quad - \quad U\ (W_1^H) \qquad (4)$$

$$U\ (W_1^L + B) \quad - \quad U\ (W_1^L) \qquad (5)$$

Simple concavity of utility is enough to ensure that low wealth directly increases the benefit of smoking, or that (5) exceeds (4). Becker and Murphy (1988) use this concept to explain why rational people who experience serious negative events might suddenly switch to addictive trajectories of consumption.

The future costs of starting to smoke for the rich and poor are, respectively,

$$\{p_{H,NS}\, U(W_2^H) + (1\text{-}p_{H,NS})\, U(W_2^L)\} \ - \ \{ p_{H,S}\, U(W_2^H) + (1\text{-}p_{H,S})\, U(W_2^L)\} \qquad (6)$$

$$\{p_{L,NS}\, U(W_2^H) + (1\text{-}p_{L,NS})\, U(W_2^L)\} \ - \{ p_{L,S}\, U(W_2^H) + (1\text{-}p_{L,S})\, U(W_2^L)\}. \qquad (7)$$

Gathering like terms, low wealth would lower the cost of smoking, or (6) would exceed (7), if

$$\{(p_{L,NS} - p_{L,S}) \ - (p_{H,NS} - p_{H,S})\} \ \{ U \ (W_2^H) - U \ (W_2^L) \} \quad \# \quad 0 \qquad (8)$$

or equivalently,

$$(p_{L,NS} - p_{L,S}) < \ (p_{H,NS} - p_{H,S}) \qquad (9)$$

Equation (9) says that the poor will perceive a lower future cost from smoking *if* their poverty reduces the effect they think their decision will have on their chance of future success. Such "fatalism" could easily arise if low initial wealth caused people to uniformly scale down their expectations of future wealth, independent of their actions, i.e. if $(p_{L,NS} - p_{L,S}) = \gamma\ (p_{H\,NS} - p_{H\,S})$ where $0<\gamma<1$.[2]

In summary, low initial wealth should make an individual more likely to initiate hazardous consumption. This occurs directly, because the immediate benefit of such consumption brings higher marginal utility. But it could also occur indirectly, via pessimistic expectations of future wealth that reduce the future cost of such consumption. Both effects are illustrated in Figure 1.

Note that analogous reasoning could predict the effect of initial disadvantage on

[2] This effect would be reinforced if disadvantage lowered expectations more if people smoke than abstain. It would be offset in the reverse case.

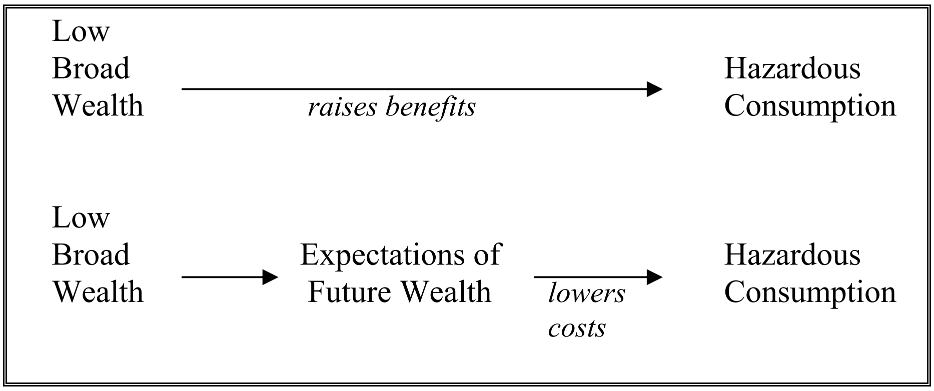

Fig. 1. Direct and Indirect Effects of Low Wealth on Hazardous Consumption Decision

investment decisions that demand immediate net cost but raise the likelihood of future success. As shown in Appendix 1, low initial wealth raises the marginal cost of investment, but can also lower investment's expected future benefit under conditions analogous to those in equation (9).

Finally, we provide a brief word about wealth constraints. When a person's liquid assets rise in value from zero, they eventually cross a threshold that makes either hazardous consumption or investment affordable at given prices. Thus, an increase in M_1 to some threshold c would be associated with an increased likelihood of hazardous consumption or investment. Beyond this threshold, further increases would continue to raise broad wealth and so make hazardous consumption less attractive, and investment more attractive.

3.1 Rational vs. excess pessimism

The hypothesis presented so far has been positive, in that no judgment has been made concerning the accuracy of people's expectations. The discussion can easily be extended, however, to the normative realm. To do so, we need to be able to evaluate the accuracy of the expectations that people form. It is possible, for example, that low initial broad wealth causes people to accurately scale down their expectations of future wealth by an unbiased scalar, γ. In this case, people with tough starts in life will be more likely to become addicted to goods with immediate benefit and deferred cost, and less likely to invest in human capital. But they are making the best of the bad alternatives they face.

Alternatively, low initial wealth may cause people to be *too* pessimistic, excessively scaling down their expectations of future wealth independent of whether they smoke ($\tilde{p}_{L,S}$) or abstain ($\tilde{p}_{L,NS}$). In this case, ($\tilde{p}_{L,NS}$ - $\tilde{p}_{L,S}$) = $\tilde{\gamma}$ $(p_{H\,NS} - p_{H\,S})$ where $0 < \tilde{\gamma} < \gamma < 1$.[3] By analogy with our earlier positive comparison, the overly pessimistic poor:

1. will perceive the same net benefit from smoking as the unbiased poor.
2. will underestimate the future cost.

Conversely for investment, excessive pessimism would not alter the poor's perception of the (high) immediate cost, but would cause them to underestimate the expected future benefit.

3.2 Other factors

In equations (2) through (9) we compared the inter-temporal decisions of individuals who differed only in initial wealth. In comparing consumption or investment decisions across people, other parameters identified in these equations would need to be controlled. For the case of smoking, these are:

1. *The discount factor δ*: positively related to smoking
2. *The price of cigarettes*: negatively related to smoking through net benefits, *B*
3. *Achieving a threshold of liquid assets*: positively related to smoking

[3] We do not need to characterize the accuracy of high wealth agents' expectations for what follows.

4. *The immediate benefit from smoking*: individuals may derive greater gross benefits, *b*, from smoking due to differences in taste or social rewards. Positively related to smoking.
5. *Risk preference*: ambiguously related to smoking. See Appendix 2.

4. Data: The Dunedin Multidisciplinary Health and Development Study

The Dunedin Multidisciplinary Health and Development Study (DMHDS) is an ongoing longitudinal study of people born in 1972/73 in the New Zealand city of Dunedin. Dunedin is situated on the south-east coast of the country's South Island in the province of Otago, and in 1971 had a population of 111,000 (Silva and McCann 1996). Study members were drawn from the 1661 babies born in 1972/73 at the city's only obstetrics hospital. Of 1139 children still residing in Otago three years later, 1037 (91%) had parents who could be located and who agreed to their children's participation. These children have been assessed at the ages of 3, 5, 7, 9, 11, 13, 15, 18, 21, and 26 with a variety of detailed questions pertaining to family environment, health, physical and psychological development, behaviours, and so on. Surveys were also administered to the parents and teachers of study members until the age of 15. An unusual feature of the DMHDS is it high sample retention; study members who have migrated elsewhere are typically returned to Dunedin to complete each study wave. The few who cannot are interviewed in the field. 95% of the surviving sample members were interviewed at 15, and 97% at 18. Compared to New Zealand as a whole the sample is slightly under-representative of children from lower socio-economic backgrounds and of Maori/Pacific Islanders, though the full socioeconomic spectrum is represented. Greater detail concerning the DMHDS can be found in a volume edited by Silva and Stanton (1996).

Though originally designed to address questions of physical and psychological development, the DMHDS contains data that seem amenable to a rational-choice approach to the study of hazardous consumption or investment. Adolescents were asked in confidential interviews at 15 and 18 about cigarette and alcohol use, exercise, overall happiness, and life circumstances at home and school. Regarding expectations, at age 15 the parents of study members were asked to assess whether their son or daughter felt they could succeed in general, and at age 18 adolescents themselves were asked how they felt about their futures. Personality measures were also constructed from the questionnaires that may be used as proxies for other relevant variables. For example, teens' risk preferences may be represented using the "Harm Avoidance" Sub-scale of the Multidimensional Personality Questionnaire (MPQ) designed by Tellegen and Waller (1994). Similarly, their discount rates may be approximated using questions put to parents concerning their teen's general ability to wait versus wanting everything immediately. Table 1 provides a key and description of the variables constructed from the DMHDS that will be used in this paper. Note that virtually all variables are measured in ordinal categories, and that usable sample sizes vary.[4]

5. Positive Analysis on Broad Wealth, Expectations and Choice

To test for a causal relationship from broad wealth and expectations to behaviour as in Figure 1, we proceed in two steps. First, we test whether a 15 year olds' general expectation of success (as assessed by a parent) is indeed conditioned on the teen's broad wealth. Second, we ask whether behaviour initiated *after* age 15 can be predicted by both broad wealth and expectations at age 15, once variables identified by the rational choice approach are controlled. This two-step procedure enables us to identify whether broad wealth does indeed affect

[4] Usable sample sizes vary because 1) not all study members were asked all questions, 2) study non-response, and 3) item non-response. In general constructed indices and regressions use only those individuals with complete responses for all required variables.

Table 1:
Variables constructed from the DMHDS

Variable	N	Range	Mean	Description
Hazardous Consumption or Investment				
SMOKE.18	781	0, 1	.204	Equals 1 if subject usually smokes every day at 18, equals 0 if not. SMOKE.18 excludes those subjects already smoking daily at 15.
DRINK.18	625	0, 1	.246	Equals 1 if subject reports tolerance or withdrawal symptoms to drinking at age 18, and 0 otherwise. DRINK.18 excludes those subjects drinking more frequently than once a week at age 15.
EXERCISE.18	872	0-1109	187.5	Number of occasions subject reports having participated in aerobic activity in the year prior to interview at 18.
Components of Broad Wealth				
SCHOOLATTACH.15	943	1-5	3.02	involvement and sense of attachment to school-related activities at age 15
FAMILY.15	945	0-9	7.45	sub-component of Moos Family Environment Scale pertaining to "family cohesion" at age 15 (Holohan and Moos 1983).
FRIENDS.15	958	1-4	3.84	rating of statement "I feel alone or apart when I am with my friends" at age 15. Reverse coded so that high value represents disagreement with statement.
HEALTH.15	960	1-4	3.38	own rating of general health over last year (1-4)
SOCIOECON	1031	1-6	3.75	average of the higher of socio-economic status of mother or father of study member at ages 3, 5, 7, 9, 11, 13 and 15. Status is based on parental occupation according to the education and income levels associated with that occupation using data from the New Zealand census. See Elley and Irving (1985).
Expectations				
PESSIMISM.15	952	0- 2	.25	Parent of member at 15 asked if son or daughter "feels he or she can't succeed." 0 is No, 1 Somewhat, 2 Yes.
PESSIMISM.18	923	1-4	1.82	Subject asked at age 18 "How do you feel about your future?" with 1 "very happy" and 4 "very unhappy."

Table 1
Continued:

Variable	N	Range	Mean	Description
Discount Rate:				
IMPATIENT.15	951	0-2	.43	Equals 2 if the parent of the subject reports he/she cannot stand to wait, and wants everything right now. 0 is No, 1 is "somewhat."
Minimum Liquid Income:				
PARTTIMEJOB.15	959	0,1	.706	Equals 1 if at age 15 a subject currently had a part time job or had had one in the previous two years.
Risk Preference:				
HARMAVOID.18	938	0-100	61.9	Sub-scale of Multidimensional Personality Questionnaire at age 18 pertaining to "harm avoidance" (Tellegen and Waller, 1994). Increases with aversion.
Proxies for Taste/Benefits:				
SEX	1037	1,2	1.52	1 equals female, 2 equals male
NEIGHBORHOOD	883	1-10	7.30	Socio-economic decile rating of the families sending children to a study member's high school as of 2000. This ranking is applied to study members' schools in 1987/88. The decile rating was calculated by the New Zealand Ministry of Education, based on household income and crowding, parental occupation and qualifications, income support, and ethnicity. 10 is high. (N.Z. Ministry of Education, 1997)
FITNESS.15	839	34.2-71.3	46.7	Cardio-respiratory response to a submaximal bicycle test, adjusted for weight. Increasing in fitness.
EXERCISE.15	828	0-1292	379	Number of occasions subject reports having participated in aerobic activity in the year prior to interview at 15.
INSCHOOL.18	873	0,1	.265	Equals 1 if subject still in high school in the year prior to interview at age 18.

Table 1
Continued:

Variable	N	Range	Mean	Description
Accident Related Variables:				
ACCIDENT.11	908	0-4	.428	Number of accidents reported from previous two years at age 11. Accidents must have been serious enough to require consultation with a doctor or admission to hospital.
ACCIDENT.13	835	0-2	.601	Analogous to ACCIDENT.11, except 2 refers to two or more accidents..
EXPECTACCID.11	779	0-2	.820	Expectation at age 11 that the child is less likely (0), as likely (1) or more likely (2) to experience an accident in the next year as other children he or she knows.
IQTEST.11	917	40-153	108	An IQ test: The Wechsler Intelligence Scale for Children (Wechsler, (1974))
SOCIOECON.11	810	1-6	3.27	Higher of socio-economic status of mother or father at age 11. Uses Socio-Economic Status index of Elley and Irving (1985)

behaviour indirectly via expectations, as well as directly once expectations are controlled.

5.1 Broad Wealth and Expectations

Unfortunately, the DMHDS provides only a limited measure of expectations for study members at age 15. Specifically, a parent of each study member rated the accuracy of the statement that the teen "feels he or she can't succeed" on a 3 point scale (0,1,2). To begin, we run an ordered logit regression of this reported expectation, *PESSIMISM.15*, on five variables that seem intuitively vital to broad wealth: the teen's self-assessed connection to family, friends and school, good health, and family socio-economic status.[5]

5 Quadratic terms were fitted for this and all subsequent regressions. Few were significant, and lacking *a priori* theoretical justification for selective retention, we present results for the

$$\beta_0 + \beta_1\, FAMILY.15 + \beta_2\, FRIENDS.15 + \beta_3\, SCHOOLATTACH.15 + \beta_4\, HEALTH.15 + \beta_5\, SOCIOECON + \varepsilon \quad (9)$$

The estimation results of (9) are provided under regression (1) of Table 2.6 based on study members with complete observations.[6] Not surprisingly, the study members' pessimism concerning success (as assessed by parents) is significantly negatively correlated with four of five components of broad wealth: their own self-reported sense of attachment to school, their families, their friends, and to their perception of their own health. Thus, there is support for the hypothesis that the non-pecuniary aspects of current broad wealth shape individuals' expectations of future success. Surprisingly, however, these expectations do not seem affected by family socio-economic status, at least as measured by parental occupation in the DMHDS (see Table 1). In particular, the coefficient on *SOCIOECON* has the "wrong" sign and is not significant (*p*value = .186). If anything, the prestige of parental occupation may *lower* expectation of success.

5.2 Expectations, Wealth and Behavior

We turn now to ask if broad wealth *and* expectations at age 15 can predict which young people will go on to smoke regularly, drink hazardously, or to abandon physical exercise once out of high school. We begin with smoking. By age 15 14.8% of study members already reported that they were smoking cigarettes daily. By age 18 this had risen to 30.1%. Our approach will be to follow the sub-sample of adolescents who were *not* already smoking daily at

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simpler linear form. Our main results are unaffected.

6 To check the robustness of these results, missing values were imputed for members lacking an observation for a single explanatory variable. Missing values were forecast with OLS using the other regressor variables. This raised the usable number of observations for smoking to 714, for hazardous drinking to 608, and for exercise to 744. The results of these augmented regressions were very similar to those reported.

Table 2:
Regression results on the relevance of broad wealth and expectations

		(1) PESSIMISM.15 Ordered Logit	(2) SMOKE.18 Logit	(3) DRINK.18 Logit	(4) EXERCISE.18 OLS
BROAD WEALTH	SCHOOLATTACH.15	-.392*** (.099)	-.357*** (.124)	.062 (.131)	14.58* (7.61)
	FAMILY.15	-.148*** (.043)	-.059 (.055)	-.057 (.058)	-2.00 (3.62)
	FRIENDS.15	-.285** (.136)	.590** (.255)	.034 (.223)	-7.96 (11.72)
	HEALTH.15	-.393*** (.144)	.148 (.181)	-.342* (.182)	6.78 (10.94)
	SOCIOECON	.098 (.074)	- .286*** (.098)	.093 (.101)	1.51 (5.80)
EXPECT-ATIONS	PESSIMISM.15		.607*** (.207)	.099 (.224)	-25.18* (13.37)
DISCOUNT RATE	IMPATIENT.15		.286 (.183)	.069 (.180)	8.70 (11.00)
RISK PREFERENCE	HARMAVOID.18		-.006 (.005)	-.017*** (.005)	-.637** (.303)
MINIMUM INCOME	PARTTIMEJOB.15		.153 (.220)	-.229 (.229)	-23.98* (13.26)
TASTE	SEX (female = 1 male = 2)		-.155 (.213)	.593*** (.230)	-28.98** (14.14)
	NEIGHBORHOOD.15		.094 (.075)	-.221*** (.077)	.874 (4.31)
	FITNESS.15				4.89*** (1.19)
	EXERCISE.15				.160*** (.025)
	INSCHOOL.18				38.22*** (13.36)
	CONSTANT		-1.98 (1.39)	1.54 (1.37)	-40.59 (85.26)
	Pseudo R^2	.045	.066	.069	
	Log likelihood	-518.4	-324.0	-288.7	
	Adjusted R^2				.129
	N	910	673	567	711

***,**, * refer to significance at the 1%,5% and 10% levels, respectively on two tailed tests. Run on Stata Version 7.

age 15 and ask if their smoking status by age 18, *SMOKE.*18, can be predicted by their broad wealth, expectations, and other rational choice variables at age 15:

$$\beta_0 + \beta_1\, FAMILY.15 + \beta_2\, FRIENDS.15 + \beta_3\, SCHOOLATTACH.15 + \beta_4\, HEALTH.15$$
$$+ \beta_5\, SOCIOECON + \beta_6\, PESSIMISM.15 + \beta_7\, IMPATIENT.15 + \beta_8\, HARMAVOID.18$$
$$+ \beta_9\, PARTTIMEJOB.15 + \beta_{10}\, SEX + \beta_{11}\, NEIGHBOURHOOD.15 + \varepsilon \qquad (10)$$

Note that the measure of risk aversion, *HARMAVOID.18*, is taken by necessity at age 18, the first time it is available. It is hoped that study members' overall risk preferences were stable between the two ages.[7] *PARTTIMEJOB.15* is included to (imperfectly) measure threshold ability to afford cigarettes, while *SEX* and *NEIGHBORHOOD.15* serve as proxies for taste or peer effects that are known to alter the immediate benefit from smoking, (Moene, 1999). Unfortunately, a cigarette price variable is not available in the DMHDS, and so is not included in the regression. It is unlikely, however, that price would have varied substantially across the sample for the overwhelming majority of study members who resided in Dunedin at the age of 15.

The results of the logit regression for (10) are reported in Table 2. Multicollinearity between explanatory variables may be at play, however no bivariate Spearman correlation exceeds *-.16* save that between risk aversion and sex (.369). As predicted, regression (2) indicates that the probability of becoming a regular smoker after age 15 increases with general pessimism at that age, and decreases in two components of broad wealth: socio-economic status and involvement/attachment to school. Contrary to our hypothesis, however, smoking becomes more likely with sense of attachment to friends. With the exception of own-rated health and neighbourhood, all other variables have the predicted signs, but none are significant. Overall the

[7] Individual differences in this personality trait are known to be partly heritable (Tellegan et al. 1988), predictable from early childhood (Caspi and Silva, 1995), and stable over adulthood (McGue, Bacon and Lykken, 1993).

fit of the model is somewhat poor, indicating that much of the variation in smoking initiation between ages 15 and 18 remains unaccounted for. Comparing the results of regression (1) and (2), we can say that higher socio-economic status decreases the likelihood of smoking directly through lower marginal benefit, but not indirectly via expectations. Conversely, attachment to family and own-rated health decrease the likelihood of smoking only indirectly, via improved expectations. Attachment/ involvement at school discourages smoking via both direct and indirect effects. Finally, attachment to friends reduces smoking via indirect effects on expectations as predicted, but increases it via direct effects, contrary to our expectation. In summary, we find that four of five components of broad wealth do work indirectly via higher expectation of success to make smoking initiation less likely. Two of the five components also work directly to discourage smoking, but a third actually encourages it.

We turn next to the initiation of hazardous drinking. DMHDS study members answered confidential questions on the frequency of drinking at age 15, and a more comprehensive questionnaire on alcohol consumption at age 18. Defining a threshold for hazardous alcohol use is not straightforward. Our definitions at ages 15 and 18 are described in Table 1, and involve drinking more than once a week at age 15 (17.0% of the sample), and having experienced symptoms of either tolerance or withdrawal to alcohol use at age 18 (24.6% of the sample). Once again, we will try to predict the hazardous drinking status (*DRINK.18)* of those who were not already drinking hazardously at age 15, using the same explanatory variables as for smoking.

Regression (3) in Table 2 presents our results. The fit of this model is similar to that for smoking, with much of the variation in behaviour unexplained. The results here do not confirm the importance of broad wealth for hazardous drinking, either indirectly via expectation, or directly once expectations are controlled. That is, close family, friends, school and good health may all improve expectations, but regression (3) suggests such expectations are not significant in predicting the onset of hazardous drinking. *PESSIMISM*.15, though correctly signed, is not significant (*p* value = .66). In addition, only one of the five components of broad wealth, *HEALTH.15*, significantly reduces the likelihood of initiating hazardous drinking directly. Instead, other variables identified by the rational choice approach, such as high discount rate, low risk aversion, being male, or poor neighbourhood, have significant predictive power. In short, while most variables are signed as predicted, the results of regression (3) do not suggest significant direct or indirect links between a teenager's broad wealth and subsequent hazardous drinking. All parents beware!

We turn finally to physical exercise. Exercise may be viewed conversely to smoking or hazardous drinking, as an investment in health capital that is made *less* likely by low wealth and pessimism. DMHDS study members reported frequency of exercise over the past year at ages 15 and 18 and underwent a fitness test at age 15. Unlike smoking and drinking, minimum levels of physical education are mandated in most New Zealand high schools, which affects virtually all study members at age 15, but only a minority still in school at age 18. Thus, in examining frequency of exercise at 18 (*EXERCISE.18*), we cannot condition out members who do not exercise at age 15. Instead, we shall use ordinary least squares to forecast the frequency of exercise of *all* study members at age 18, using exercise at age 15 as an explanatory variable. In addition to the explanatory variables identified in (10), we also include a measure of cardio-respiratory fitness at 15, *FITNESS*.15 as a proxy for differences in taste for exercise, and high school attendance at 18 to control for ongoing compulsory physical education.

Regression (4) in Table 2 presents our results. With exercise viewed as an investment in health, the coefficient signs on wealth and expectations should be the reverse of those in regressions (2) and (3). The overall fit is slightly improved from the case for smoking and drinking. The results seem intermediate to the first two. As with smoking, low expectations of success at 15 are significant in predicting which study study members will drop exercise once out of high school (one tailed p = .03, two tailed p = .06). Four of the five components of broad wealth can thus be said to promote exercise indirectly via expecations. As with hazardous drinking, however, only one component of broad wealth, attachment to school at age 15, has a signficant direct effect. Aside from broad wealth and expectations, exercise frequency at 18 is predicted by low risk aversion, being female, not having a part time job, exercising frequently at age 15, being physically fit at 15, and still being in high school at age 18.

Summarizing our positive analysis, study members' self-reported sense of attachment to school, family, friends, and good health at age 15 were significantly correlated with their expectations of success at that age (as assessed by a parent). These pessimistic expectations in turn significantly raised the likelihood that a study member would go on to smoke regularly and exercise less frequently within the next three years, but not that they would begin to drink hazardously. Thus we find evidence that broad wealth has indirect effects on two of three types of inter-temporal choice via its effect on general expectations of success. Some components of broad wealth also have direct effects, most noticeably on the initiation of smoking, and to a lesser extent on hazardous drinking and exercise frequency.

6. Normative Analysis on Expectations Bias

We have found evidence that adolescents with pessimistic life expectations are more likely to take up smoking and shun exercise. We look next for evidence as to the accuracy of these expectations. A direct test for bias requires a benchmark against which expectations can be measured. One method would be to compare study members' expectations of future events with their subsequent realizations. Unfortunately, the expectations elicited from members at age 15 or 18 do not allow for immediate realization. We did, however, devise an indirect test of the "reasonableness" of expectations at these ages, and a more direct test for bias from data available when study members were ages 11 and 13.

For the indirect test, we ask whether 15 year olds who experience a relative drop in broad wealth by age 18 become more pessimistic on average than those with consistently low wealth. It seems reasonable that study members with relatively low levels of broad wealth ought to be more pessimistic about success the longer they have been in such a condition. On the other hand, excessive pessimism following drops in broad wealth might cause previously well-off people to be more pessimistic than the habituated poor. Figure 2 presents a *PESSIMISM.18* measure for 18 year olds conditioned on their relative combined scores for broad wealth at ages 15 and 18.[8] An individual is classed as having "low" broad wealth at a given age if his wealth score is below the median at that age, and "high" if above. As Figure 2 makes clear, individuals who have had relatively low wealth longer are on average more pessimistic than those more recently disadvantaged. Thus at first blush there is no evidence here of irrational pessimism following recent declines in relative wealth.

For a more direct test of accuracy in expectation, we use accident and injury data collected from study members at ages 11 and 13, together with their responses at 11 concerning their relative likelihood of having an accident within the coming year. We test whether 11 year olds from disadvantaged socio-economic backgrounds or who have been involved in serious accidents are excessively pessimistic that they will be involved in subsequent ones. In particular,

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[8] Broad wealth at age 15 is a simple sum of the five component variables identified in Table 1, each calibrated to a 10 point scale. Broad wealth at age 18 is a simple sum of six analogous component variables, each calibrated to a 6 point scale. The sixth variable that emerges at age 18 is a binary variable for unemployment of at least 6 months duration.

Broad Wealth 15	Broad Wealth 18	Mean Life Expectations at 18. Scale 1-4, (Higher = Pessimistic)	N
Low	Low	1.93	197
High	Low	1.84	118
Low	High	1.79	117
High	High	1.73	228

Fig. 2. Expectations conditioned on wealth at 15, 18

at age 11 each study member was asked "within the next year, do you think you are less likely, as likely, or more likely to have an accident [than other children you know]?" Data on the number of accidents requiring a visit to a doctor or hospital over the next two years were collected at age 11 and 13.[9] Study members were to have an average of .65 accidents over the two intervening years.

The survey question on expectations does not allow for a cardinal assessment of error denominated in number of accidents. A measure of *relative* bias can be constructed, however, as follows. Using the last group of variables defined in Table 1:

$$
\begin{aligned}
BIAS = (EXPECTACCID.11 - ACCIDENT.13)\ &0\ (\ 0,\ 1,\ 2) && \text{If } ACCIDENT.13=0 \\
&0\ (-1,\ 0,\ 1) && \text{If } ACCIDENT.13=1 \\
&0\ (-2,\ -1,\ 0) && \text{If } ACCIDENT.13=2
\end{aligned}
$$

Since both *EXPECTACCID.11* and *ACCIDENT.13* are measured on three point scales, the values *BIAS* is eligible to take on depend on the outcome of *ACCIDENT.13*. For example, if an 11 year

[9] Accident realizations are recorded for two years combined whereas expectations were asked only for one. It seems unlikely, however, that the forecasts elicited would have differed if children compared themselves to peers over two years rather than one.

old rated himself more likely to experience an accident than his peers (*EXPECTACCID11*= 2) yet goes on to have 0 accidents by age 13 (*ACCIDENT.13* = 0), he is measured to be strongly over-pessimistic (*BIAS* = 2). If he rated himself "as likely" and has 0 accidents he is rated mildly over-pessimistic (*BIAS* = 1). And if he rated himself "less likely" and has 0 accidents he rates *BIAS* = 0. Conversely, those who go on to suffer 2 or more accidents may predict they are less likely (*BIAS* = -2), as likely (*BIAS* = -1), or more likely (*BIAS* = 0) to experience an accident than their peers. Note that by construction those who go on to suffer 2 or more accidents can only be unbiased or too optimistic, while those who go on to suffer no accidents can only be unbiased or too pessimistic. Those who go on to suffer one accident can be any of the three. In all cases positive values of *BIAS* represent excess pessimism, and negative values excess optimism.

To see if 11 year olds with disadvantaged backgrounds are more prone to excess pessimism than others we have run an ordered logit regression of *BIAS* on their intelligence test scores (*IQTEST.11*), *SEX,* and their household's socio-economic status (*SOCIOECON.11*). Also, motivated by Das and van Soest's (1997) findings that income drops precede excess pessimism of future income drops, we included the number of accidents the 11 year old had experienced in the previous two years (*ACCIDENT.11*). The results are reported in Table 3.

The fit of the three regressions suggests that little of the variance in the bias of 11 year olds' expectations is being explained. Two things emerge, however. First, 11 year olds are not more likely to be biased in their expectations because they come from a lower socio-economic background or because they score more poorly in intelligence testing. Second, having experienced an accident in the last two years makes 11 year olds too pessimistic in expecting subsequent ones.[10] Indeed, the Spearman correlation between the number of accidents at 11 and

[10]It may be argued that 11 year olds who had previously experienced accidents might alter their behaviour to make future accidents less likely. This also could make forecasts at age 11 too pessimistic. For this to have happened, however, the 11 year olds must have

Table 3
Regression results on bias in expectations

	(1) $BIAS^*_{ACCIDENT.13=0}$	(2) $BIAS^*_{ACCIDENT.13=1}$	(3) $BIAS^*_{ACCIDENT.13=2}$
SOCIOECON.11	-.1011	.0994	-.0913
	(.0901)	(.1018)	(.1456)
IQTEST.11	.0160	.0172	-.0090
	(.0082)	(.0102)	(.0124)
SEX	.1295	.0630	-.2416
	(.2251)	(.2769)	(.4132)
ACCIDENT.11	.5101***	.3821**	.5169**
	(.1630)	(.1862)	(.2565)
Log Likelihood	-281.48	-196.97	-95.41
Pseudo R^2	.031	.019	.025
N	333	217	100

Standard errors in parentheses. ***, ** refer to two tailed significance at the 1% and 5% levels, respectively. Run on Stata Version 6.0. Stata estimates two cut-points for $\boldsymbol{\beta X}$ rather than a constant.

13 is only .07, but the correlation between accidents at 11 and forecasts of (relative) future likelihood is .18 (N=821).

To see the effects of past accidents in greater detail, we have calculated the marginal effect of a one standard deviation increase in *ACCIDENT.11* on the probability that *BIAS* will take its eligible values. Since these eligible values depend on the outcome of *ACCIDENT.13* a regression is run for each possible case. For those who go on to have no accidents (Column (1),) a one standard deviation increase in *ACCIDENT.11* reduces the probability of zero bias by 6.6%, and increases the probability of mild or strong excess pessimism by 3.9% and 2.7%, respectively. For those who go on to have one accident (Column (2)), a standard deviation increase in *ACCIDENT.11* reduces the probability of excess optimism by 5.1%, and increases the

experienced accidents in the two years prior to the interview but only revised their behavioural intentions after interview.

probability of zero bias and excess pessimism by 1.5% and 3.5% respectively. For those in Column (3) where pessimism is ruled out an increase in *ACCIDENT.11* reduces the probability of strong and mild excess optimism by 6.4% and .4% respectively.[11]

7. Conclusion

This paper has considered the effect of broad wealth on people's choices concerning hazardous consumption and investment in human capital. Low broad wealth could affect these decisions directly, by increasing the immediate marginal benefit of addictive goods and immediate marginal cost of investment in human capital. But low wealth could also affect these choices indirectly, by lowering general expectations of future success. Such pessimism would lower the expected future cost of addiction and benefit of investment. If this pessimism were excessive, individuals might choose too much of the former, and too little of the latter. Such bias has been suggested by studies of people's expectations of future income after experiencing income drops, and from psychological studies of expectations of future adverse events among the depressed.

The relevance of broad wealth and expectations to the initiation of smoking, hazardous drinking, and to frequency of exercise was tested using a longitudinal study of New Zealand youth, the Dunedin Multidisciplinary Health and Development Study. Four of five components

[11] An alternative test that could leave all subjects pooled would be to use an ordered logit to regress EXPECTACCID.11 on ACCIDENT.11, ACCIDENT.13, IQTEST.11, SOCIOECON.11 and SEX. Rational, unbiased expectations would imply that the coefficient on ACCIDENT.11 should not affect EXPECTACCID.11 once ACCIDENT.13 is included. This test was carried out, yielding a large positive coefficient on ACCIDENT.11 that was significant at the .000 level.

of broad wealth – self-reported attachment to family, friends, school and own health, but not socio-economic status – were significantly negatively correlated with pessimism at age 15, as assessed by a parent. Non-smoking teens assessed to be pessimistic at age 15 were significantly more likely to take up regular smoking between ages 15 and 18, once broad wealth, risk aversion and other rational choice variables at age 15 were controlled. Thus low broad wealth was indeed found to raise the likelihood of smoking indirectly via expectations, as well as directly in the case of socio-economic status and attachment to school. In contrast, we found no evidence that low wealth promotes the initiation of hazardous drinking indirectly though expectations, nor directly through any component other than poor health. Finally, low wealth was found to discourage subsequent exercise indirectly via pessimism, but had direct effects only through lack of attachment to school at age 15.

The accuracy of expectations could be addressed only indirectly among study members at 18, but a plausible pattern was found. People who had low relative wealth the longest were on average the most pessimistic and vice versa. Similarly, people who experienced falls in relative broad wealth were on average more pessimistic than those who had not, but less so than those who had been relatively poor all along. Such patterns do not rule out excess pessimism following declines in wealth, but do suggest such effects are not virulent enough to offset realistic adjustments. More conclusive results emerged from examining the realizations of study members' expectations concerning future accidents at age 11. Those from disadvantaged socio-economic backgrounds or with lower intelligence test scores were no more likely to be biased in their forecasts than others. On the other hand, those 11 year olds who had themselves experienced accidents in the previous two years were excessively pessimistic in judging their relative likelihood of doing so again. This finding is consistent with that of Das and van Soest that household heads experiencing drops in income are too likely to expect future income drops.

These findings suggest that people's decisions concerning some types of hazardous consumption or investment in human capital are influenced by their expectations of general future success. The rationality of these expectations, and of the decisions that rest on them, may be threatened most when individuals must forecast the likelihood of adverse states that they already know from first-hand experience.

Appendix 1: Broad Wealth, Expectations and Investment

Converse to hazardous consumption, investment in human capital can be modelled as requiring an initial net cost *C*, but offering a greater probability of high future broad wealth. Taking the case of exercise, those with high initial wealth will do so if

$$U\ (W_1^H\ - C) + \delta\ \{\ p_{H,E}\ U\ (W_2^H) + (1-\ p_{H,E})\ U\ (W_2^L)\ \} \quad >$$

$$U\ (W_1^H) + \delta\ \{\ p_{H,NE}\ U\ (W_2^H) + (1-p_{H,NE})\ U\ (W_2^L)\ \}\ . \qquad \text{(A1.1)}$$

Those with low initial wealth will exercise if

$$U\ (W_1^L - C) + \delta\ \{\ p_{L,E}\ U\ (W_2^H) + (1-p_{L,E})\ U\ (W_2^L)\ \} \quad >$$

$$U\ (W_1^L) + \delta\ \{\ p_{L,NE}\ U\ (W_2^H) + (1-p_{\ L,NE})\ U\ (W_2^L)\ \} \qquad \text{(A1.2)}$$

By concavity, low wealth will increase the immediate cost of exercise:

$$U\ (W_1^L - C) - U\ (W_1^L)\ \ \$\ \ U\ (W_1^H\ - C) - U\ (W_1^H) \qquad \text{(A1.3)}$$

Low wealth will also lower the future expected benefit of exercise if

$$\{p_{L,E}\ U\ (W_2^H) + (1-p_{L,E})\ U\ (W_2^L)\}\ - \{\ p_{L,NE}\ U\ (W_2^H) + (1-p_{L,NE})\ U\ (W_2^L)\} \quad \#$$

$$\{p_{H,E}\ U\ (W_2^H) + (1-p_{H,\ E})\ U\ (W_2^L)\}\ \ -\ \{\ p_{H,NE}\ U\ (W_2^H) + (1-p_{H,NE})\ U\ (W_2^L)\}, \qquad \text{(A1.4)}$$

or if

$$(p_{L,E} - p_{L,NE})\ \#\ (p_{H,E} - p_{H,NE}). \qquad \text{(A1.5)}$$

(A1.5) would be satisfied if a low start made the person scale down their expectation of future happiness across their decision space, as described in the text.

Appendix 2: Risk Preference and Smoking

The ambiguous effect of risk preference on an individual's decision to smoke can be illustrated as follows. Consider agents *i* and *j* who are identical in every respect except that *i* is more risk averse than *j* (as measured, for example, by the Arrow-Pratt measure of absolute risk aversion). Given an initial level of wealth, W_1, the immediate net benefit from smoking will be greater for *j* than for *i* if

$$U^j(W_1 + B) - U^j(W_1) > U^i(W_1 + B) - U^i(W_1) \qquad \text{(A1.1)}$$

This would follow if, for example, *j* were risk neutral and *i* were risk averse. However, from (6) the future cost of smoking will also be greater for *j* than for *i* if

$$U^j(W_2^H) - U^j(W_2^L) > U^i(W_2^H) - U^i(W_2^L) \qquad \text{(A1.2)}$$

The same risk preference that would make (A1.1) hold suggest that (A1.2) will also hold. Intuitively, greater risk aversion reduces the benefit to *i* from smoking today, but it also reduces the cost to *i* of not achieving the better outcome tomorrow. Thus *i* may be more or less likely to smoke than *j*, depending on specific functional forms and parameter values.

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