# WINNING BIG BUT FEELING NO BETTER? THE EFFECT OF LOTTERY PRIZES ON PHYSICAL AND MENTAL HEALTH*

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We use British panel data to explore the exogenous impact of income on a number of individual health outcomes: general health status, mental health, physical health problems, and health behaviors (drinking and smoking). Lottery winnings allow us to make causal statements regarding the effect of income on health, as the amount won is largely exogenous. These positive income shocks have no significant effect on general health, but a large positive effect on mental health. This result seems paradoxical on two levels. First, there is a well-known status gradient in health in cross-section data, and, second, general health should partly reflect mental health, so that we may expect both variables to move in the same direction. We propose a solution to the first apparent paradox by underlining the endogeneity of income. For the second, we show that exogenous income is associated with greater risky health behaviors: lottery winners smoke more and engage in more social drinking. General health will pick up both mental health and the effect of these behaviors, and so may not improve following a positive income shock. This paper presents the first microeconomic analogue of previous work which has highlighted the negative health consequences of good macroeconomic conditions.

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## 1. Introduction

The relationship between individual income and health is the subject of what is by now a very substantial literature, with the broad finding that higher socio-economic status is associated with better health. This kind of relationship has now been identified in a large number of countries and for a wide variety of health variables (see Deaton and Paxson (1999), Marmot and Bobak (2000), Van Doorslaer et al. (1997), and Winkleby et al. (1992)).

While this association does indeed appear to be widespread, there is less common ground regarding its causal interpretation. That income, or socio-economic status more broadly, be correlated with health may indeed reflect a causal effect of the former on the latter. However, it is entirely possible that poor health also influences income, by reducing the ability to work for example. In addition, there are likely hidden common factors that affect both variables, such as the individual's genetic endowment, birth weight, or the quality of the school that she attended. In this case, income and health will be correlated, but not in any causal way.

The vast majority of the existing literature is not able to distinguish between these three alternative readings of the income-health correlation. Testing the causal impact of income on health requires exogenous movements in income, which can be identified in an instrumental or experimental setting. This is the approach to which we appeal here, using lottery wins as an exogenous source of income variation in a large-scale panel dataset.

Most existing work on this question has used a general health status variable as the dependent variable. We are able here to provide much more detail by assessing the impact of exogenous changes in income on a number of different health measures: self-assessed overall health, a psychological measure of mental stress (the 12-item General Health Questionnaire, or GHQ-12), physical health problems, and health-related behaviors (smoking and drinking).

The effect of income on these different health variables is far from uniform. There is first no correlation between lottery winnings and general health. However, this lack of a relationship actually masks statistically significant correlations in different health domains. Winning big does indeed improve mental health; however we un-

cover counteracting health effects with respect to risky behaviors. Those who win more on the lottery smoke more and engage in more social drinking, both of which are likely detrimental to general health. The positive effect on mental health and the negative effect from risky behaviors may well sum to a negligible overall relationship between income and general health.

The paper is organized as follows. The following section briefly presents the related literature and discusses our approach. Section 3 presents the data from the British Household Panel Survey, and Section 4 discusses identification of the effect of income on health. Section 5 contains the main results, and Section 6 presents robustness checks and some additional findings. Last Section 7 concludes.

## 2. Empirical findings on the income-health relationship and our approach

### *2.1. The causal effect of income on health*

*Some intuition*

It is commonplace to hypothesize that higher income causes better health. If we assume that individuals maximise a utility function defined over health and other goods subject to budget and time constraints, a positive shock to income will loosen the budget constraint and will thus yield better health, if health is a normal good. However, it seems unlikely that health will be independent of the other elements of the utility function. We can in particular imagine certain "risky behaviors" or lifestyle choices which are positively correlated with utility (and which are themselves also normal goods), but which are negatively correlated with health. In this case, higher income will have an ambiguous effect on health, by increasing smoking, drinking or other risky activities which are detrimental to general health.

*Findings in the previous literature*

The positive relationship between income and health for adults is open to a number of interpretations, as underlined by Smith (1999): the causality may run from income to health, from health to income, or both may be determined by common hidden factors. Below, we discuss the small number of papers that have investigated this relationship by appealing to exogenous changes in income.

Ettner (1996) estimates the effect of income on health using American data. The

health variables she uses are self-assessed health (SAH), a scale of depressive symptoms, and daily limitations due to both physical and mental difficulties. The effect of income on physical and mental health is therefore not systematically separately evaluated. She addresses the problem of reverse causality via instrumentation, using the state unemployment rate, work experience, parental education, and spousal characteristics as instruments. A substantial impact of income on all of the health variables is found. It can however be countered that the instruments used here are not exogenous. As noted by Meer et al. (2003), the unemployment rate will only be a valid instrument if regional variations in health only reflect variations in income, which may well not be the case.

Lindhal (2002) appeals to Swedish longitudinal data, and constructs an overall health measure comprised of both the physical and mental aspects of health. Lottery prizes are used to provide exogenous variations in income.[1] A positive causal relationship between income and this general health measure is found. However, the separate components of health are not evaluated separately.

Meer et al. (2003) use self-assessed health as their main dependent variable, but also carry out robustness checks using a binary variable indicating physical or nervous disabilities which limit the individual's ability to work. In instrumental variable estimation (using data on inheritances), wealth is not found to have a significant effect on health.

Frijters et al. (2005) analyze the relationship between self-assessed health and income. They try to correct for both reverse causality and hidden common factors, using an exogenous change in income (due to the fall of the Berlin wall) in a fixed-

[1]Lottery winnings are an arguably under-exploited source of exogenous variation in income. One of the first systematic uses of which we are aware is Brickman et al. (1978), although in a small sample, and cross-sectional, context. Their more recent appearance in panel datasets has led to their use in what still remains a relatively small number of papers. Apart from work on health and well-being, described in this Section, they have appeared in empirical Labour Economics. Henley (2004) considers the determinants of labour supply, and Lindh and Ohlsson (1996) and Taylor (2001) the decision to become self-employed, where lottery gains are supposed to relax liquidity constraints. Both Henley (2004) and Taylor (2001)use the same database as we do, the British Household Panel Survey. A separate literature has traced out the reaction of consumption and savings to exogenous movements in income. An early example is Bodkin (1959), using an unexpected National Service Life Insurance dividend paid out to World War II veterans in 1950; more recent examples include Imbens et al. (2001), who appeal to differences in winnings amongst major-prize winners of the Megabucks Lottery in Massachusetts between 1984 and 1988, and Kuhn et al. (2008), who appeal to differences in winnings in the Dutch postcode lottery.

effects framework. They find that income has a positive, but only very small, effect on health.

Last, recent work by Gardner and Oswald (2007) has explored the causality running from exogenous variations in income (from medium-sized lottery wins) to changes in mental health, as measured by the GHQ. They find that money has a significant and positive effect on mental health.

Table 1 summarizes the findings presented above.

*2.2. Our approach*

We appeal to monetary lottery wins to try to establish a causal link between exogenous movements in income and changes in a number of different health outcomes.

We do not construct a score summarizing the different aspects of health, as we wish to see whether these latter react differently to income shocks, and we clearly distinguish mental from physical health. Our reason for doing so, unlike most of the existing literature, is based on the results in Ruhm (2000), which called into question the notion of one holistic concept of health, in particular in relation to the economic cycle.

Ruhm (2000) considered various measures of both individual-level and aggregate-level health, and tracked their movements over periods of boom and bust. His key finding is that different aspects of health move in different directions during recessions:

. First, short-run recessions seem to be associated with better physical health. The common belief that physical health declines during temporary economic contractions is wrong, and mortality is largely procyclical in US data. Regressions at the US-state level highlight that poor economic conditions are associated with lower death rates in general, and with reduced prevalence of a number of specific causes of death in particular (cardiovascular diseases, pneumonia, and motor vehicle accidents). This aggregate relationship is supported by evidence relating individual health outcomes to aggregate economic conditions. Using individual data from the Behavioral Risk Factor Surveillance system,

Ruhm (2000, 2005) relates individual behaviours to the local unemployment rate (but not to the individual's labor-market status). He uncovers significant behavioral effects, in that individuals modify their lifestyles during short-term recessions: both tobacco consumption and BMI fall (so that individuals are more likely to have a healthier body weight), while regular physical activity increases. Physical health is therefore counter-cyclical, and this specifically seems to apply to the behavioral correlates of health.

. However, this negative relationship is not found for all of the health measures. There is one cause of death that is higher during recessions: suicide. As Ruhm (2001) notes, there is "some evidence that mental health is pro-cyclical".

The existing macroeconomic evidence therefore suggests an opposition between (particularly behavioral) physical health and mental health. However, it has not yet been established whether the same results hold at the microeconomic level, when we correlate different individual health measures with individual income. This is what we do below, using data on lottery winnings from nine waves of large-scale panel data.

## 3. Data

We appeal to data from the British Household Panel Survey (BHPS), the first wave of which appeared in 1991. This general survey initially covered a random sample of around 10,000 individuals in around 5,000 different households in Great Britain; increased geographical coverage has pushed these figures to around 16,000 and 9,000 respectively in more recent waves. We here make use of lottery data from waves 7 to 15 (1997-2005), as harmonized lottery information is not available in earlier waves.[2] The BHPS includes a wide range of information about individual and household demographics, mental and physical health, labor-force status, employment and values. There is both entry into and exit from the panel, leading to unbalanced data. The BHPS is a household panel: all adults in the same household are interviewed separately. Further details of this survey are available at the following address: http://www.iser.essex.ac.uk/ulsc/bhps/.

[2]The National Lottery was inaugurated in the UK in November 1994.

The list of the variables used in our analysis of the income-health relationship is presented in Table 2. We describe below in a little more detail the key variables behind our empirical analysis.

*Health*

The BHPS contains a large number of health variables; these allow us to separately investigate general, mental and physical health, and their relationships to income. We consider four main measures of individual health.

*General health status*

Our first health variable is the widely-used measure of self-assessed health (SAH). This comes from the question:

> *"Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been...?"*, with the possible responses *"Excellent, Good, Fair, Poor, and Very Poor"*.

These are coded in the data using the values 1 to 5. In our analysis, we reverse-code this variable so that higher values refer to better health outcomes. This question appears in all waves of the BHPS, except for wave 9, when a special module was introduced to calculate the SF-36 health index. This does include a general self-reported health question (actually the first question in the module), which is however both differently worded (*"In general would you say your health is..."*), and uses different response categories (*"Excellent, Very Good, Good, Fair, and Poor"*). As such, we drop wave 9 of the BHPS from our empirical analysis.

*Mental health*

To measure mental health, we use a score calculated from the General Health Questionnaire (GHQ). This latter is widely-used by psychologists, epidemiologists and medical researchers as an indicator of mental functioning. The BHPS contains the 12-item version of the GHQ, based on the following questions. BHPS respondents are asked:

*"Here are some questions regarding the way you have been feeling over the last few weeks. For each question please ring the number next to the answer that best suits the way you have felt. Have you recently....*

a) *been able to concentrate on whatever you're doing?*
b) *lost much sleep over worry?*
c) *felt that you were playing a useful part in things?*
d) *felt capable of making decisions about things?*
e) *felt constantly under strain?*
f) *felt you couldn't overcome your difficulties?*
g) *been able to enjoy your normal day-to-day activities?*
h) *been able to face up to problems?*
i) *been feeling unhappy or depressed?*
j) *been losing confidence in yourself?*
k) *been thinking of yourself as a worthless person?*
l) *been feeling reasonably happy, all things considered?"*

Question a) is answered on the following four-point scale:

1: *Better than usual*
2: *Same as usual*
3: *Less than usual*
4: *Much less than usual*

Questions b), e), f), i), j) and k) are answered as follows:

1: *Not at all*
2: *No more than usual*
3: *Rather more than usual*
4: *Much more than usual*

And the replies to questions c), d), g), h) and l) are on the following scale:

1: *More so than usual*
2: *About same as usual*
3: *Less so than usual*
4: *Much less than usual*

The main mental health variable used in this paper is the Caseness GHQ score, which counts the number of questions for which the response is in one of the two "low well-being" categories. This count is then reversed so that higher scores indicate higher levels of well-being, running from 0 (all twelve responses indicating poor

psychological health) to 12 (no responses indicating poor psychological health).[3]

*Physical health - Health problems*

The data also contain a number of variables indicating the presence of specific health problems. Amongst these, we retain only those which describe specific physical problems. These refer to:[4]

1) Arms, legs, hands, etc
2) Sight
3) Hearing
4) Skin conditions/allergy
5) Chest/breathing
6) Heart/blood pressure
7) Stomach or digestion
8) Diabetes.

*Physical health - Behaviors*

We consider two separate risky behaviors: smoking and drinking. We have two distinct smoking variables. The first is a binary variable showing whether the respondent is a "current smoker" or not. This variable is called "Smoker". Our second variable called "Cig" indicates the number of cigarettes the individual smokes per day. We recode this number using the following scale:

1: Between 1 and 10 cigarettes per day
2: Between 11 and 15 cigarettes per day
3: Between 16 and 30 cigarettes per day
4: More than 30 cigarettes per day

Drinking is measured via an ordinal variable ("Drink") which indicates the frequency with which the respondent goes for a drink at a pub or club. This variable is coded as follows, where higher values indicate more social drinking:

1: Never/almost never
2: Once a year or less
3: Several times a year

[3]GHQ information from the BHPS has been used by Economists in a number of different contexts: see Clark and Oswald (1994), Clark (2003), Ermisch et al. (2004), Gardner and Oswald (2007), and Powdthavee (2009).

[4]The BHPS also asks about health problems with respect to Alcohol and Drugs, and Epilepsy. We do not analyze these two variables due to the small number of respondents who reported such problems.

4: At least once a month
5: At least once a week

Figures 1 and 2 show the distribution of these six health variables. The mode and the median of self-assessed health is "Good", and the GHQ score exhibits strong right skew. Around one-quarter of BHPS respondents are current smokers, and the modal category for social drinking is "At least once a week", although almost twenty percent never go out to pubs or clubs.

*Lottery wins*

We are interested in the relationship between income and these different health measures. To try to identify a causal relationship between income and health, we appeal to two BHPS questions on lottery wins as a source of exogenous changes in income. These two lottery questions have appeared every year from 1997 onwards. They are worded as follows:

> *"Since September 1st (year before) have you received any payments, or payment in kind, from a win on the football pools, national lottery or other form of gambling?"*

If this question was answered in the positive, then the respondent was asked:

> *"About how much in total did you receive? (win on the football pools, national lottery or other form of gambling)"*

As such, we know both whether the individual won, and how much in total they received. The average win reported, expressed in real 2005 Pounds, is around £170. Five per cent of winners win more than £500, and the largest win is over £140 000.

However, one potential weakness of the lottery data in the BHPS[5] is that it does not contain any direct information about the number of times (if any) that the individual has played the lottery. As such, we cannot distinguish non-players from unsuccessful players. A second point is that, both for lottery winners and playing non-winners, we do not know how much has been gambled.

[5]Which weakness also appears in the Swedish lottery data used by Lindahl (2002), but not in the analysis of Kuhn et al. (2008), who are able to control for the number of lottery tickets purchased.

On the other hand, there are significant advantages in using lottery winnings. Firstly, as noted previously, we can consider their receipt as being largely exogenous. Second, in Britain, as opposed to a number of other countries, many people play lotteries. A recent survey-based estimate (Wardle et al., 2007) is that over two-thirds of the British participate in some kind of gambling in a given year, with 57% of the population playing the National Lottery (and almost 60% of the latter playing at least once a week). The Camelot Group, who are the current National Lottery operators, report that just under £5 Billion was spent on the lottery in the year 2007-2008 (http://www.camelotgroup.co.uk/aboutcamelot/annualreports/2008AnnualReport.html). Consequently, there are a considerable number of lottery winners in the BHPS data.

Lottery winnings are adjusted for inflation via the consumer price index (see Table 3) and are expressed in 2005 Pounds. In the empirical analysis, we will use the logarithm of lottery winnings, partly as income is very often entered in log form in the empirical analysis of health and well-being, and partly because the distribution of lottery winnings is, unsurprisingly, extremely right-skewed.[6]The distribution of the log of lottery winnings for winners is shown in Figure 3.

## 4. Identifying Exogenous Income Effects

Section 3 above highlighted the exogenous income variables that are available in the BHPS. However, the way in which lottery winnings should be used in a causal regression framework merits some reflection. The underlying issue is that, while we suppose that winning the lottery is a random event, conditional on having played, the actual fact of playing the lottery is itself likely to be endogenous: non-players and players are likely to differ in both their observable and unobservable characteristics. As noted above, the BHPS does not include information on whether individuals play the lottery or not: we cannot distinguish players from non-players,only winners from non-winners.

*Winners versus Non-Winners*

One simple way of using lottery winnings information would be to compare the

[6]experiments using a series of lottery-winnings dummies consistently produced qualitatively similar results to those using log of the prize.

health of those who have not won the lottery (which group consists of both non-players and unlucky players) to the health of winners. However, these two groups are not likely to be comparable, as the decision to play the lottery is probably endogenous, which poses serious problems for the interpretation of the coefficient on lottery winnings.

This phenomenon is illustrated in the Venn diagram in Figure 4. The first, larger, set consists of those who play the lottery. These players likely have different characteristics, both observed and unobserved, to non-players. The key issue in the BHPS data (which we believe is common to many datasets covering lottery winnings) is that this distinction between those who play and those who do not play is unobserved (which is why we have drawn the frontier of this set as a broken line). There is a second set, entirely contained within the first: this is the set of winners, all of whom by definition are players. This is the frontier that we do observe (which is represented as an unbroken line).

While the group of winners in Figure 4 might be fairly homogeneous (we will test this explicitly below), amongst non-winners we have both those who did not play, and those who did play but did not win. If playing the lottery is endogenous, the characteristics of individuals differ between the groups. It can of course be argued that we can condition on any observable differences, once we have identified them. However, non-players and players (and therefore non-winners and winners) may also differ fundamentally in other unobservable ways. For example, non-players (who are included in the group of non-winners) may well be more risk-averse, and as a result invest more in their own health capital. This seriously flaws any comparison of health between winners and non-winners: as such we do not compare these two groups in our analysis.

To illustrate this potential bias, we create a dummy variable for having won the lottery (called "Win"), and regress it on a number of individual characteristics:

$$Win_{it} = F(\alpha + \beta h_{it-1} + \gamma x_{it-1})$$

where $h_{it-1}$ represents health at date $t-1$ and $x_{it-1}$ denotes the other control vari-

ables, including income.[7] The function $F$ here is the cumulative normal distribution, and we estimate this equation as a simple probit.

Table 4 presents the regression results. These show that the probability of winning the lottery is significantly correlated with lagged income, ethnicity, education, labor-market status, number of children and age. It is also correlated with four of the lagged physical health problem variables (those in worse health are more likely to win, and thus, we suggest, are more likely to play the lottery). [8] The results in Table 4 hence underline that those who win and those who do not win differ in a number of observable ways, and thus we suggest likely differ in unobservables too. To overcome this problem, the remainder of the paper concentrates on the health outcomes of big compared to small lottery winners.

*Big versus Small Winners*

Following the discussion above, we restrict our analysis sample to winners only. The exogenous effect of income will then be identified from the comparison of those who have won larger amounts of money to those who won smaller amounts. This distinction is arguably far more exogenous (although it may still depend on how much individuals play). In order to highlight that there is less of an endogeneity problem here, we regress the amount won (for winners only) on the same right-hand side variables as previously used in Table 4:

$$Log(Prize)_{it} = \alpha + \beta h_{it-1} + \gamma x_{it-1} + \epsilon_{it}$$

Table 5 shows the results of this OLS regression. Fewer individual variables are correlated with the amount won. The populations of large and small winners seem to be similar according to labor market status and age, which was not the case in

[7]The non-lottery income variable that we use in this regression, and in our health and well-being regressions, is called "hhnyrde", a derived variable supplied with the BHPS, which measures total household annual income, equivalised using the McClements before housing costs scale, and adjusted for the prices of the reference month.

[8]One dataset that does contain information on whether people played or not is the UK Family Expenditure Survey. Analysis of three cross-sectional waves of this data from 1998/1999, 1999/2000 and 2000/2001 shows that the probability of playing the lottery is related to standard individual demographics in very much the same way as the probability of winning in Table 4. The fact that the FES is not panel, and does not include health information, however renders it inapt for the question we analyze here

Table 4. This relative similarity in observables leads us to suspect a corresponding similarity in unobservables, and it is on this basis that we will evaluate the effect of income on health.

## 5. The Effect of Income on Health Outcomes

In line with the existing literature, our health regressions include a number of fairly standard explanatory variables: age, ethnicity, education, labor-market and marital status, number of children, region and wave. We examine the effect of income on the different health outcomes listed above: self-assessed health, physical health problems, mental health, and smoking and drinking. Our key right-hand side variable is exogenous income: as explained in Section 4 above, exogenous income movements are identified by comparing large and small lottery winnings. For notation purposes, we consider lottery winnings that are reported in year $t$ (for example, someone interviewed in Wave 10, say in October 2000, reports any lottery winnings between September 1999 and the date of their Wave 10 interview). To evaluate the effect of such winnings on health, we imagine that any health investments may take time to bear fruit, and consider health at date $t+2$ as our dependent variable (to continue the example above, we will look at the individual's health in Wave 12, that is between two to three years after the lottery win).[9] Further, as is fairly common in this literature, some of the regressions will control for the individual's lagged health status at $t-1$.[10]

The model below examines the average effect of lottery winnings on different types of health. For all health variables except social drinking, we use the following model:

$$h_{it+2} = F(\alpha + \beta.Log(Prize)_{it} + \gamma_2.x_{it+2})$$

[9]Oswald and Winkelmann (2008) also find a delayed effect of lottery winnings on a measure of well-being. They use GSOEP data to show that financial satisfaction is significantly positively correlated with the amount won by lottery winners, but only three years after the win. There is no significant effect one or two years after a win. They interpret their results as indicating deservingness: individuals only enjoy their winnings when they feel that they have deserved them. Deservingness is endogenous and can be created by the individual, but this costly investment takes time, which explains the lack of any significant effect immediately following the win. Equally, Kuhn et al. (2008) find no effect of the amount won in the Dutch postcode lottery on individual happiness six months later.

[10]In the context of completely exogenous movements in income, any controls for lagged health are not necessary. When lottery prizes are distributed randomly, then controlling for lagged health will not affect the estimated coefficient on lottery winnings in a health equation. We believe that the size of lottery wins (amongst winners) is fairly random; the regression results in Table 5 support this reading. In practical terms, the presence or absence of lagged health in our regressions most often makes little qualitative difference to the estimated coefficient on lottery winnings.

Here $h_{it+2}$ is health at time $t+2$. Because of data availability[11] we are obliged to replace $h_{it+2}$ with $h_{it+1}$ when looking at the effect of lottery prizes on social drinking:

$$h_{it+1} = F(\alpha + \beta.Log(Prize)_{it} + \gamma_2.x_{it+1})$$

In both of the above models $t$ is the year of the lottery win and the $x$ are the other control variables. $F$ represents the cumulative normal distribution: as such we estimate these health equations using ordered probit (or sometimes even simple probit) techniques.

In order to allow for any correlation between errors for observations coming from the same individual in our panel data, we cluster standard errors at the individual level.

The following sub-sections discuss the estimation results for our different health variables in turn.

*5.1. General health status*

The regression results for the most general of our dependent variables, self-assessed health, appear in Table 6. This table shows the effect of lottery winnings reported at $t$ on self-assessed health at $t+2$. There are two columns in this table. The first reproduces the health specification described in the first equation above. The second adds both lagged self-assessed health and log equivalent household income, measured at $t-1$.[12]

The main coefficients of interest here are those on the log prize variables: these are positive but insignificant, and provide no evidence that income improves general health. This mainly insignificant effect of exogenous income on general health is consistent with previous results in Meer et al. (2003). It is worth underlining that this table does indeed reveal the social gradient in health: the significant estimate on log income at the end of the table tells us that individuals with higher incomes are in better health. The fact that lottery winnings do not affect health then leads

[11]Social drinking is only recorded every two years in the BHPS. As we sometimes condition on one-year lags in the health variable under consideration, we are not able to estimate a drinking equation with terms in both $t-1$ and $t+2$.

[12]We do so because there is some evidence in Table 5 that individuals in richer households win larger lottery prizes.

us to suspect that the relationship between income and health is not causal in this direction: either health causes income, or both reflect some other omitted variable such as the quality of the maternal diet, or the type of school the individual attended.

A number of the other right-hand side variables in column (2) (which are not shown in Table 6 for space reasons) attract only insignificant coefficients. This is due to the fact that many of them move only little over time, and as such are picked up by the four lagged health dummies (we exclude category 4, corresponding to "good health", as this is the largest category).

It is likely that self-assessed health reflect both physical and mental elements. Following the well-known macro work of Ruhm (2000), it is possible these may move in opposite directions to produce an insignificant net effect of "better economic conditions" (i.e. higher income) at the individual level. With this distinction in mind, we now appeal to the separate measures detailed in Section 3 above to see whether physical and mental health do indeed have sharply different relationships with exogenous income. In line with Ruhm's macro results mentioned above, we will pay particular attention to health behaviors.

### *5.2. Positive income shocks improve mental health*

The results for mental health are shown in Table 7. There are two columns in this table. These show the relationship between lottery winnings at $t$ and the individual's GHQ score at $t+2$ both with and without controlling for lagged mental health and lagged income at $t-1$. We expect the controls for lagged mental health to actually have little effect on the lottery coefficient, as Table 5 showed that, conditional on having won a prize, the size of the prize was uncorrelated with lagged GHQ.

The estimated coefficients on the lottery prize in the two specifications do indeed turn out to be very similar. These show that a positive income shock leads to better mental health two to three years later. This relationship had previously been highlighted by Gardner and Oswald (2007) using the BHPS data. The results in Table 7 show that this finding is robust to additional waves of data (we here use eight waves as compared to the two in Gardner and Oswald), and to a more complete set of individual-level control variables (we control in addition for the number of

children and use more detailed marital status information). The findings in Table 7 also represent a totally micro-econometric counterpart to the correlation between suicide and local economic activity presented in Ruhm (2000, 2001, 2005).[13]

It may appear somewhat paradoxical that income significantly improves mental health, but at the same time has only insignificant effects on general health (as found in a number of papers, including the present). The following sub-sections propose to resolve this paradox by suggesting that income does not alleviate physical health problems, and may even lead to unhealthy lifestyle outcomes.

### *5.3. Positive income shocks have no effect on specific health problems*

To investigate the relationship between income and specific physical, as opposed to mental, health problems, we carry out analogous regressions to those in Table 7, but replace GHQ by information on a series of physical health problems. These latter refer to problems with: Arms, legs, hands, etc; Sight; Hearing; Skin conditions/allergy; Chest/breathing; Heart/blood pressure; Stomach or digestion; and Diabetes. All of these problems are evaluated at $t+2$, whereas the lottery prize was reported at $t$.

We carried out the analysis for each of the above eight problems separately. The regression results (available on request) systematically show no relationship between lottery winnings and these physical health problems. This might be argued to be unsurprising: higher income may well not improve individuals' sight, hearing, or skin conditions. However, one area where income might play a larger role is in the specific behaviors that individuals undertake (i.e. the way in which they live their lives), and their ensuing health effects. In the following, we specifically consider the relationship between lottery winnings, smoking and social drinking.

### *5.4. Positive income shocks lead to worse lifestyles*

[13]The GHQ being a composite index, we can equally re-estimate the mental health equation for each of the twelve component questions listed in Section 3. The positive effect of lottery winnings on well-being is particularly pronounced for the questions referring to feeling constantly under strain, enjoying normal day-to-day activities, and feeling reasonably happy, all things considered. We can confirm the effect of lottery winnings on these latter two more "hedonic" components of well-being by re-running our analysis in Table 7 using the single-item overall life satisfaction score available in the BHPS, which is measured on a one-to-seven scale, instead of the composite GHQ-12 measure. The regression results show a significant correlation, at the one per cent level, between lottery winnings at time $t$ and overall life satisfaction at time $t+2$.

The hypothesis we test in this last sub-section is that positive individual income shocks may have a detrimental effect on physical health due to their effects on lifestyles. In what follows, we specifically consider smoking and drinking.

Around 25% of our estimation sample of lottery winners report being current smokers. Columns (1) and (2) of Table 8 model the probability that the individual be a smoker. The demographic control variables here (not shown) are the same as in Table 7. We are most interested in the effect of lottery winnings on smoking. The first line of Table 8 reveals that positive income shocks (which occurred between $t-1$ and $t$) significantly increase the probability of smoking at $t+2$. Providing more detail on the smoking decision, columns (3) and (4) suggest that lottery winnings increase the probability of smoking a greater number of cigarettes.[14]

In columns (5) and (6) we repeat this exercise for the one measure of social drinking that is available in the BHPS: a categorical variable for the frequency of going out for a drink at a pub or club. The results are qualitatively the same as in columns (1) - (4): the greater is the lottery prize, the greater the probability of more frequent social drinking.[15]

Table 8 therefore shows that, rather than producing better health, higher income is also associated with increased behaviors that are commonly thought to be unhealthy. Much work has shown that, in general, higher income is associated with more favorable health outcomes. Our results here nuance this empirical fact. Positive individual income shocks produce changes in lifestyles which may well be prejudicial to health. This is entirely consistent with Ruhm (2000, 2001, 2005), who

[14]Column (3) is an ordered probit of the four classes of cigarette consumption at $t+2$, described in Section 3, regressed on log winnings at time $t$ and the other explanatory variables at time $t+2$. Current $(t+2)$ non-smokers are thus dropped from this analysis. Column (4) is also an ordered probit of current cigarette consumption, which controls in addition for the $t-1$ values of household equivalent income and cigarette consumption. As this latter is only defined for smokers, the regression sample in column (4) consists of continuing smokers between $t-1$ and $t+2$.

[15]We can calculate the marginal effect of lottery winnings on different types of outcomes. These probabilities are calculated for an individual with characteristics that are fairly representative in our sample of winners. We evaluate the effect of winning £10 000, as opposed to the mean amount won of £170. The marginal effect of these higher winnings on GHQ, from Table 7, is of a four percentage point rise in the probability of reporting the highest mental well-being score (i.e. 12). The same method applied to the results in Table 8 produces another four percentage point increase in the probability of being in the top social drinking category (at least once a week), and a rise of eight percentage points in the probability of increasing the number of cigarettes smoked (given that the person was a light smoker - 1 to 10 a day - before winning the lottery).

considers the relationship between risky health behaviours and economic booms. Ruhm's approach is very similar to ours at one level: by relating individual (and aggregate) health outcomes to local labor market conditions, he is able to appeal to the exogeneity of the latter in determining individual health. Our results above can be read as the micro-econometric analogy of those in Ruhm. At the individual level also, exogenously higher income produces unhealthy living.

The correlations revealed by these exogenous movements are therefore largely contradictory to the commonly-noted positive link between health and social status. In reality positive (exogenous) income shocks seem to lead to lifestyle choices which are associated with worse health outcomes.[16]

## 6. Robustness Checks and Additional Findings

### *6.1. Net or Gross Winnings?*

The BHPS question on lottery winnings asks individuals to report *"about how much in total did you receive"*. Although it is not made explicit, the most likely interpretation of this question is in terms of gross winnings. Playing the lottery costs money, and it is possible that some of our winners could have actually spent more on lottery tickets over the year than they ended up winning. In general, net winnings will be smaller than gross winnings. We are interested here in the effect of an individual's financial resources on their health and well-being. Our measure of (gross) lottery winnings then overstates the movement in the resources that they have available to them. As such, our estimated coefficient on lottery winnings is actually biased downwards. To explore this matter further, we re-estimated Tables 6-8, introducing not only the amount of the lottery win, but also an interaction between winnings and the fact of winning at least £1000 (we imagine that with gross winnings of at least this amount were considerably less likely to be net losers). None of the coefficients on these interactions were close to significant, leading us to suspect that our main health results are robust.

[16]This is arguably also reflected in hospital attendance. The BHPS asks all respondents *"approximately how many times have you attended a hospital or clinic as an out-patient or day patient?"*, with answers on a five-point ordered scale. Using this variable as a health outcome, in the same way as in Table 8, produces some evidence of a positive correlation with the log of the lottery prize: winners end up going to the hospital more often.

*6.2. Household or Individual Income?*

Although it is not the main focus of our paper, we have controlled for (lagged) household equivalent income in some of our regressions (even though the results are often only little changed in this specification). One potential question that can be asked is whether we should use an income measure that picks up the outcomes for other household members, when we have specifically concentrated on lottery winnings at the individual level. To investigate, we have re-estimated all of our analysis tables using a measure of the individual's own annual income (in real terms). The results, in terms of the significance level of the log winnings variable, were not affected.

*6.3. Frequent Social Drinking*

Our analysis of the endogeneity of lottery winnings in Table 5 led to the broad conclusion that health at $t-1$ did not predict the amount won on the lottery at date $t$. One very significant exception to this rule appears in column (6) of that table, where the most frequent social drinkers at $t-1$ systematically win more on the lottery. This raises the possibility that "big winners" are different in some unobservable way from little winners, and that these unobserved variables are correlated with health outcomes. To check whether the most frequent social drinkers were behind the significant lottery winning coefficient in Table 8, columns (5) and (6), we drop those in the top social drinking category at date $t-1$. The qualitative results are unchanged, with the estimated coefficients on lottery winnings remaining significant with t-statistics of over two.

*6.4. Sub-regressions*

All of the results to date have concerned the entire sample of lottery winners. Despite the danger of ending up with only a relatively small sample, we have also run the same analyses on various sub-groups of the data. A first split is according to mean income. There is no SAH effect in either group, but we do note a stronger GHQ effect for those with lower income, and an effect on smoking that appears to be stronger for those with higher income. A separate analysis by age (splitting at the age of 45) reveals a stronger SAH and GHQ effect for older respondents, but not for

the younger, while the effect on social drinking is stronger for younger respondents. Last, there is no sharp difference in the shape of the results for men and for women.

## 7. Conclusion

This paper has asked whether money makes individuals healthier. While it seems well-known that the rich enjoy better health, it is far more difficult to establish the causality of this relationship. A small recent literature has appealed to exogenous movements in income, for example lottery winnings and inheritances, to reveal either small or negligible effects of income on general health. At the same time, lottery winnings have been shown to produce better mental health.

We have suggested resolving this apparent paradox by appealing to an entirely individual-level analogy of the well-known work of Ruhm (2000, 2001, 2005), and distinguishing between physical and mental health. Ruhm showed that recessions are associated with healthier living but more suicides. Using a sample of lottery winners only, "better economic conditions", which at our micro level are picked up by greater lottery winnings, produce higher GHQ mental health scores, but also a greater likelihood of smoking and social drinking.

The results presented here have more generally underlined three arguably central points in the analysis of health outcomes. The first is that it is unlikely that income is exogenous, so that instrumentation is essential for the understanding of causal relationships. Second, health is not a holistic concept, and we need to both be clear about what kind of health we are talking about, and be ready for the possibility that different types of health behave in very different ways. Last, the comparison of results from different levels of aggregation of both dependent and explanatory variables is a fruitful avenue of research in the economics of health and well-being.

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Table 1: Findings in the literature

| | General health | | Mental health |
|---|---|---|---|
| | General Health Score | SAH | |
| Ettner (1996) | | + | + (Scale of depressive symptoms) |
| Lindhal (2002) | + | | |
| Meer et al. (2003) | | ns | |
| Frijters et al. (2005) | | + (very small) | |
| Gardner and Oswald (2007) | | | + (GHQ) |

Note: "+" stands for a "positive and significant effect of income on the health score in question" and "ns" stands for "no significant effect".

Table 2: Definition of analysis variables

| | |
|---|---|
| **Health** | |
| General health | |
| SAH | =1 if poor health |
| | to =5 if excellent health |
| Mental health | |
| GHQ | =0 for worst mental health |
| | to =12 for best mental health |
| Physical health | |
| Health Pb X | =1 if reports health problem X |
| Smoker | =1 if the individual smokes |
| Cig | =1 if the individual smokes between 1 and 10 cigarettes per day |
| | to =4 if the individual smokes more than 30 cigarettes per day |
| Drink | =1 if never or almost never goes out for a drink to a pub or club |
| | to =5 if goes out for a drink to a pub or club at least once a week |
| **Lottery** | |
| $Win_t$ | =0 if the individual does not win at date $t$ |
| | =1 if the individual wins at date $t$ |
| Log(Prize) | Logarithm of lottery prize |
| **Control variables** | |
| Log(inc) | Logarithm of income (real annual household income, equivalised using the McClem |
| White | *Reference* |
| Non-white | =1 if not white |
| No. children | Number of children in the household |
| No education | *Reference* |
| O-levels | =1 if has O-levels |
| A-levels | =1 if has A-levels |
| HND, HNC | =1 if has a College degree |
| Degree | =1 if has a University degree |
| Employed | *Reference* |
| Unemp | =1 if unemployed |
| Retired | =1 if retired |
| NLF | =1 if not in the labour force |
| Married | *Reference* |
| Divsep | =1 if separated or divorced |
| Widowed | =1 if widowed |
| Nvrmar | =1 if never married |
| Age | Dummy variables for age groups: |
| | 16-19, 20-24, 25-29, 30-34,.... 75-79, 80+ |
| Region | Dummy variables for each region |
| Year | Dummy variables for each year |

Table 3: The consumer price index for the UK

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|
| CPI | 89.7 | 91.1 | 92.3 | 93.1 | 94.2 | 95.4 | 96.7 | 98.0 | 100.0 |

*Source*. http://www.statistics.gov.uk/statbase/TSDdownload2.asp

Table 4: Probit regressions of winning at date $t$ on individual characteristics at date $t-1$

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| SAH=1 at $t-1$ | -0.013 | | | | | |
| | (0.050) | | | | | |
| SAH=2 at $t-1$ | -0.053 | | | | | |
| | (0.029)* | | | | | |
| SAH=3 at $t-1$ | -0.019 | | | | | |
| | (0.018) | | | | | |
| SAH=5 at $t-1$ | -0.033 | | | | | |
| | (0.018)* | | | | | |
| GHQ=0 at $t-1$ | | -0.066 | | | | |
| | | (0.050) | | | | |
| GHQ=1 at $t-1$ | | -0.040 | | | | |
| | | (0.054) | | | | |
| GHQ=2 at $t-1$ | | -0.070 | | | | |
| | | (0.054) | | | | |
| GHQ=3 at $t-1$ | | -0.047 | | | | |
| | | (0.048) | | | | |
| GHQ=4 at $t-1$ | | -0.011 | | | | |
| | | (0.046) | | | | |
| GHQ=5 at $t-1$ | | 0.001 | | | | |
| | | (0.040) | | | | |
| GHQ=6 at $t-1$ | | -0.025 | | | | |
| | | (0.038) | | | | |
| GHQ=7 at $t-1$ | | -0.016 | | | | |
| | | (0.034) | | | | |
| GHQ=8 at $t-1$ | | 0.011 | | | | |
| | | (0.031) | | | | |
| GHQ=9 at $t-1$ | | 0.012 | | | | |
| | | (0.026) | | | | |
| GHQ=10 at $t-1$ | | -0.001 | | | | |
| | | (0.023) | | | | |
| GHQ=11 at $t-1$ | | -0.019 | | | | |
| | | (0.018) | | | | |
| Pb Arms, legs, | | | 0.056 | | | |
| hands at $t-1$ | | | (0.018)*** | | | |
| Pb Sight at $t-1$ | | | 0.008 | | | |
| | | | (0.033) | | | |
| Pb Hearing | | | 0.034 | | | |
| at $t-1$ | | | (0.030) | | | |
| Pb Skin condi | | | 0.085 | | | |
| tions/allergy at | | | (0.024)*** | | | |
| $t-1$ | | | | | | |
| Pb Chest/Brea | | | 0.024 | | | |
| thing at $t-1$ | | | (0.023) | | | |
| Pb Heart/Blood | | | 0.057 | | | |
| pressure at $t-1$ | | | (0.023)** | | | |
| Pb Stomach | | | 0.045 | | | |
| at $t-1$ | | | (0.027)* | | | |
| Pb Diabetes | | | -0.022 | | | |
| at $t-1$ | | | (0.049) | | | |
| Smoker at $t-1$ | | | | 0.012 | | |
| | | | | (0.020) | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cig=2 at $t-1$ | | | | | 0.088 | |
| | | | | | (0.036)** | |
| Cig=3 at $t-1$ | | | | | 0.087 | |
| | | | | | (0.034)** | |
| Cig=4 at $t-1$ | | | | | 0.063 | |
| | | | | | (0.093) | |
| Drink=2 at $t-1$ | | | | | | -0.009 |
| | | | | | | (0.038) |
| Drink=3 at $t-1$ | | | | | | 0.097 |
| | | | | | | (0.029)*** |
| Drink=4 at $t-1$ | | | | | | 0.082 |
| | | | | | | (0.030)*** |
| Drink=5 at $t-1$ | | | | | | 0.154 |
| | | | | | | (0.029)*** |
| Log(inc) at $t-1$ | 0.104 | 0.102 | 0.105 | 0.106 | 0.146 | 0.105 |
| | (0.015)*** | (0.014)*** | (0.014)*** | (0.015)*** | (0.027)*** | (0.017)*** |
| Non-white | -0.356 | -0.370 | -0.379 | -0.355 | -0.287 | -0.275 |
| | (0.068)*** | (0.069)*** | (0.067)*** | (0.068)*** | (0.105)*** | (0.067)*** |
| No. children | -0.067 | -0.058 | -0.056 | -0.067 | -0.082 | -0.058 |
| at $t-1$ | (0.012)*** | (0.011)*** | (0.011)*** | (0.012)*** | (0.020)*** | (0.013)*** |
| O-levels at $t-1$ | 0.063 | 0.055 | 0.062 | 0.066 | 0.095 | 0.061 |
| | (0.025)** | (0.025)** | (0.025)** | (0.025)*** | (0.042)** | (0.027)** |
| A-levels at $t-1$ | 0.004 | 0.007 | 0.012 | 0.007 | 0.027 | 0.016 |
| | (0.028) | (0.027) | (0.027) | (0.028) | (0.048) | (0.030) |
| HND, HNC | -0.080 | -0.092 | -0.085 | -0.077 | -0.002 | -0.099 |
| at $t-1$ | (0.039)** | (0.038)** | (0.038)** | (0.039)** | (0.075) | (0.042)** |
| Degree at $t-1$ | -0.239 | -0.244 | -0.237 | -0.236 | -0.226 | -0.241 |
| | (0.035)*** | (0.035)*** | (0.035)*** | (0.036)*** | (0.078)*** | (0.038)*** |
| 16-19 at $t-1$ | 0.093 | 0.060 | 0.135 | 0.090 | 0.041 | -0.010 |
| | (0.075) | (0.074) | (0.074)* | (0.075) | (0.174) | (0.085) |
| 20-24 at $t-1$ | 0.184 | 0.143 | 0.204 | 0.178 | 0.140 | 0.082 |
| | (0.072)** | (0.071)** | (0.071)*** | (0.072)** | (0.169) | (0.082) |
| 25-29 at $t-1$ | 0.183 | 0.134 | 0.189 | 0.176 | 0.071 | 0.129 |
| | (0.069)*** | (0.069)* | (0.069)*** | (0.070)** | (0.167) | (0.079) |
| 30-34 at $t-1$ | 0.223 | 0.193 | 0.243 | 0.216 | 0.121 | 0.153 |
| | (0.069)*** | (0.068)*** | (0.068)*** | (0.069)*** | (0.166) | (0.078)** |
| 35-39 at $t-1$ | 0.285 | 0.260 | 0.302 | 0.278 | 0.188 | 0.268 |
| | (0.069)*** | (0.068)*** | (0.067)*** | (0.069)*** | (0.166) | (0.077)*** |
| 40-44 at $t-1$ | 0.266 | 0.240 | 0.283 | 0.261 | 0.152 | 0.205 |
| | (0.068)*** | (0.068)*** | (0.067)*** | (0.069)*** | (0.166) | (0.077)*** |
| 45-49 at $t-1$ | 0.249 | 0.232 | 0.268 | 0.243 | 0.155 | 0.204 |
| | (0.067)*** | (0.067)*** | (0.066)*** | (0.068)*** | (0.164) | (0.076)*** |
| 50-54 at $t-1$ | 0.253 | 0.228 | 0.263 | 0.248 | 0.138 | 0.221 |
| | (0.066)*** | (0.065)*** | (0.064)*** | (0.066)*** | (0.161) | (0.074)*** |
| 55-59 at $t-1$ | 0.217 | 0.188 | 0.219 | 0.213 | 0.027 | 0.197 |
| | (0.064)*** | (0.064)*** | (0.063)*** | (0.064)*** | (0.160) | (0.073)*** |
| 60-64 at $t-1$ | 0.162 | 0.143 | 0.170 | 0.159 | 0.068 | 0.141 |
| | (0.062)*** | (0.061)** | (0.060)*** | (0.062)** | (0.156) | (0.070)** |
| 65-69 at $t-1$ | 0.203 | 0.199 | 0.222 | 0.200 | 0.176 | 0.188 |
| | (0.060)*** | (0.060)*** | (0.059)*** | (0.060)*** | (0.154) | (0.067)*** |
| 70-74 at $t-1$ | 0.117 | 0.116 | 0.128 | 0.116 | -0.016 | 0.081 |
| | (0.059)** | (0.059)* | (0.058)** | (0.059)* | (0.160) | (0.067) |
| 75-79 at $t-1$ | 0.027 | 0.001 | 0.018 | 0.026 | -0.056 | -0.022 |
| | (0.059) | (0.059) | (0.058) | (0.059) | (0.166) | (0.069) |
| Unemployed | -0.224 | -0.195 | -0.204 | -0.228 | -0.213 | -0.239 |
| at $t-1$ | (0.047)*** | (0.044)*** | (0.044)*** | (0.047)*** | (0.064)*** | (0.054)*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Retired at $t-1$ | -0.019 | -0.041 | -0.056 | -0.021 | -0.037 | 0.014 |
| | (0.035) | (0.034) | (0.034) | (0.035) | (0.070) | (0.041) |
| NLF at $t-1$ | -0.091 | -0.096 | -0.124 | -0.096 | -0.037 | -0.059 |
| | (0.025)*** | (0.024)*** | (0.024)*** | (0.024)*** | (0.039) | (0.027)** |
| Div/sep at $t-1$ | -0.072 | -0.064 | -0.071 | -0.075 | -0.152 | -0.063 |
| | (0.031)** | (0.030)** | (0.030)** | (0.031)** | (0.046)*** | (0.033)* |
| Widowed at $t-1$ | -0.112 | -0.105 | -0.104 | -0.115 | -0.131 | -0.094 |
| | (0.039)*** | (0.038)*** | (0.037)*** | (0.039)*** | (0.075)* | (0.043)** |
| Nvrmar at $t-1$ | 0.016 | 0.019 | 0.016 | 0.016 | -0.066 | 0.029 |
| | (0.029) | (0.028) | (0.028) | (0.029) | (0.048) | (0.031) |
| Female | -0.231 | -0.232 | -0.235 | -0.231 | -0.159 | -0.221 |
| | (0.019)*** | (0.019)*** | (0.018)*** | (0.019)*** | (0.033)*** | (0.021)*** |
| Constant | -1.964 | -2.106 | -2.212 | -1.988 | -2.288 | -2.235 |
| | (0.163)*** | (0.158)*** | (0.157)*** | (0.163)*** | (0.314)*** | (0.183)*** |
| Region Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| No. Observations | 84029 | 93333 | 95812 | 84032 | 25017 | 51026 |

*Notes.* Omitted categories: White, No education, Age≥80, Employed, South-East, Male.
Omitted health categories: SAH=4, GHQ=12, Cig=1, Drink=1.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: OLS regressions of the amount won on the lottery by winners at date $t$ on individual characteristics at date $t-1$

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| SAH=1 at $t-1$ | 0.002 | | | | | |
| | (0.143) | | | | | |
| SAH=2 at $t-1$ | 0.074 | | | | | |
| | (0.085) | | | | | |
| SAH=3 at $t-1$ | 0.095 | | | | | |
| | (0.048)** | | | | | |
| SAH=5 at $t-1$ | 0.039 | | | | | |
| | (0.050) | | | | | |
| GHQ=0 at $t-1$ | | -0.137 | | | | |
| | | (0.124) | | | | |
| GHQ=1 at $t-1$ | | 0.049 | | | | |
| | | (0.148) | | | | |
| GHQ=2 at $t-1$ | | -0.083 | | | | |
| | | (0.114) | | | | |
| GHQ=3 at $t-1$ | | 0.060 | | | | |
| | | (0.118) | | | | |
| GHQ=4 at $t-1$ | | -0.199 | | | | |
| | | (0.120)* | | | | |
| GHQ=5 at $t-1$ | | 0.002 | | | | |
| | | (0.122) | | | | |
| GHQ=6 at $t-1$ | | -0.072 | | | | |
| | | (0.089) | | | | |
| GHQ=7 at $t-1$ | | -0.157 | | | | |
| | | (0.087)* | | | | |
| GHQ=8 at $t-1$ | | -0.148 | | | | |
| | | (0.082)* | | | | |
| GHQ=9 at $t-1$ | | -0.016 | | | | |
| | | (0.065) | | | | |
| GHQ=10 at $t-1$ | | 0.056 | | | | |
| | | (0.058) | | | | |
| GHQ=11 at $t-1$ | | 0.030 | | | | |
| | | (0.048) | | | | |
| Pb Arms, legs, | | | 0.020 | | | |
| hands at $t-1$ | | | (0.043) | | | |
| Pb Sight at $t-1$ | | | -0.153 | | | |
| | | | (0.078)** | | | |
| Pb Hearing | | | 0.072 | | | |
| at $t-1$ | | | (0.065) | | | |
| Pb Skin condi- | | | -0.000 | | | |
| tions/allergy at | | | (0.059) | | | |
| $t-1$ | | | | | | |
| Pb Chest/Brea- | | | -0.058 | | | |
| thing at $t-1$ | | | (0.056) | | | |
| Pb Heart/Blood | | | -0.042 | | | |
| pressure at $t-1$ | | | (0.055) | | | |
| Pb Stomach | | | 0.073 | | | |
| at $t-1$ | | | (0.069) | | | |
| Pb Diabetes | | | 0.094 | | | |
| at $t-1$ | | | (0.139) | | | |
| Smoker at $t-1$ | | | | 0.066 | | |
| | | | | (0.050) | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cig=2 at $t-1$ | | | | | 0.136 | |
| | | | | | (0.097) | |
| Cig=3 at $t-1$ | | | | | 0.085 | |
| | | | | | (0.091) | |
| Cig=4 at $t-1$ | | | | | 0.065 | |
| | | | | | (0.225) | |
| Drink=2 at $t-1$ | | | | | | 0.068 |
| | | | | | | (0.088) |
| Drink=3 at $t-1$ | | | | | | 0.011 |
| | | | | | | (0.073) |
| Drink=4 at $t-1$ | | | | | | 0.107 |
| | | | | | | (0.077) |
| Drink=5 at $t-1$ | | | | | | 0.255 |
| | | | | | | (0.074)*** |
| Log(inc) at $t-1$ | 0.234 | 0.215 | 0.215 | 0.235 | 0.259 | 0.241 |
| | (0.049)*** | (0.044)*** | (0.043)*** | (0.049)*** | (0.079)*** | (0.049)*** |
| Non-white | -0.398 | -0.312 | -0.358 | -0.399 | -0.016 | -0.385 |
| | (0.139)*** | (0.133)** | (0.127)*** | (0.141)*** | (0.340) | (0.128)*** |
| No. children | 0.042 | 0.039 | 0.036 | 0.043 | -0.015 | 0.096 |
| at $t-1$ | (0.034) | (0.029) | (0.029) | (0.034) | (0.048) | (0.034)*** |
| O-levels at $t-1$ | -0.010 | -0.033 | -0.035 | -0.009 | -0.012 | -0.046 |
| | (0.060) | (0.053) | (0.053) | (0.060) | (0.102) | (0.061) |
| A-levels at $t-1$ | -0.046 | -0.081 | -0.077 | -0.037 | -0.010 | -0.118 |
| | (0.069) | (0.061) | (0.061) | (0.069) | (0.110) | (0.068)* |
| HND, HNC | -0.000 | -0.023 | -0.025 | 0.001 | -0.364 | -0.036 |
| at $t-1$ | (0.110) | (0.096) | (0.096) | (0.110) | (0.129)*** | (0.106) |
| Degree at $t-1$ | -0.288 | -0.326 | -0.320 | -0.278 | -0.475 | -0.368 |
| | (0.091)*** | (0.082)*** | (0.082)*** | (0.092)*** | (0.225)** | (0.089)*** |
| 16-19 at $t-1$ | -0.381 | -0.317 | -0.272 | -0.398 | -0.377 | -0.543 |
| | (0.219)* | (0.214) | (0.207) | (0.219)* | (0.573) | (0.222)** |
| 20-24 at $t-1$ | 0.046 | -0.028 | 0.022 | 0.020 | -0.269 | -0.221 |
| | (0.208) | (0.207) | (0.199) | (0.208) | (0.560) | (0.208) |
| 25-29 at $t-1$ | 0.002 | 0.021 | 0.049 | -0.016 | -0.295 | -0.123 |
| | (0.200) | (0.199) | (0.191) | (0.200) | (0.558) | (0.197) |
| 30-34 at $t-1$ | -0.019 | 0.019 | 0.053 | -0.033 | -0.167 | -0.198 |
| | (0.193) | (0.195) | (0.186) | (0.193) | (0.553) | (0.192) |
| 35-39 at $t-1$ | 0.161 | 0.100 | 0.125 | 0.144 | -0.081 | -0.007 |
| | (0.194) | (0.195) | (0.186) | (0.194) | (0.553) | (0.191) |
| 40-44 at $t-1$ | 0.105 | 0.101 | 0.133 | 0.090 | -0.046 | -0.079 |
| | (0.195) | (0.195) | (0.187) | (0.195) | (0.562) | (0.193) |
| 45-49 at $t-1$ | 0.252 | 0.212 | 0.239 | 0.236 | 0.073 | 0.143 |
| | (0.196) | (0.197) | (0.188) | (0.196) | (0.556) | (0.191) |
| 50-54 at $t-1$ | 0.068 | 0.021 | 0.051 | 0.058 | -0.274 | -0.021 |
| | (0.187) | (0.190) | (0.179) | (0.187) | (0.548) | (0.183) |
| 55-59 at $t-1$ | 0.081 | 0.044 | 0.069 | 0.071 | -0.565 | 0.037 |
| | (0.181) | (0.185) | (0.174) | (0.181) | (0.549) | (0.176) |
| 60-64 at $t-1$ | 0.211 | 0.169 | 0.205 | 0.212 | -0.131 | 0.183 |
| | (0.178) | (0.181) | (0.170) | (0.178) | (0.543) | (0.174) |
| 65-69 at $t-1$ | 0.174 | 0.242 | 0.279 | 0.172 | -0.069 | 0.196 |
| | (0.166) | (0.170) | (0.157)* | (0.166) | (0.476) | (0.159) |
| 70-74 at $t-1$ | 0.151 | 0.129 | 0.165 | 0.149 | -0.124 | 0.174 |
| | (0.168) | (0.171) | (0.157) | (0.168) | (0.485) | (0.163) |
| 75-79 at $t-1$ | -0.237 | -0.210 | -0.160 | -0.235 | -0.461 | -0.238 |
| | (0.167) | (0.169) | (0.157) | (0.166) | (0.491) | (0.160) |
| Unemployed | 0.233 | 0.176 | 0.178 | 0.229 | 0.143 | 0.229 |
| at $t-1$ | (0.144) | (0.122) | (0.121) | (0.146) | (0.190) | (0.156) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Retired at $t-1$ | -0.023 | -0.028 | -0.043 | -0.016 | -0.103 | -0.171 |
| | (0.104) | (0.097) | (0.095) | (0.103) | (0.249) | (0.099)* |
| NLF at $t-1$ | 0.030 | 0.010 | -0.001 | 0.044 | 0.087 | -0.115 |
| | (0.067) | (0.057) | (0.056) | (0.065) | (0.113) | (0.067)* |
| Div/sep at $t-1$ | 0.097 | 0.145 | 0.150 | 0.095 | 0.061 | 0.162 |
| | (0.078) | (0.070)** | (0.071)** | (0.078) | (0.128) | (0.079)** |
| Widowed at $t-1$ | 0.327 | 0.277 | 0.313 | 0.332 | -0.014 | 0.306 |
| | (0.113)*** | (0.100)*** | (0.099)*** | (0.113)*** | (0.163) | (0.108)*** |
| Nvrmar at $t-1$ | 0.296 | 0.255 | 0.261 | 0.291 | 0.308 | 0.370 |
| | (0.088)*** | (0.078)*** | (0.077)*** | (0.087)*** | (0.142)** | (0.085)*** |
| Female | -0.223 | -0.194 | -0.195 | -0.223 | -0.170 | -0.148 |
| | (0.046)*** | (0.041)*** | (0.042)*** | (0.046)*** | (0.084)** | (0.047)*** |
| Constant | 1.364 | 1.579 | 1.484 | 1.392 | 1.367 | 1.421 |
| | (0.529)*** | (0.479)*** | (0.466)*** | (0.530)*** | (0.954) | (0.521)*** |
| Region Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| No. Observations | 5854 | 8087 | 8241 | 5856 | 1851 | 5006 |
| R-squared | 0.04 | 0.04 | 0.04 | 0.04 | 0.06 | 0.06 |

*Notes.* Omitted categories: White, No education, Age≥80, Employed, South-East, Male.
Omitted health categories: SAH=4, GHQ=12, Cig=1, Drink=1.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Ordered probit regressions of self-assessed health at date $t+2$

| | (1) | (2) |
|---|---|---|
| Log(Prize) at $t$ | 0.010 | 0.007 |
| | (0.010) | (0.011) |
| SAH=1 at $t-1$ | | -1.703 |
| | | (0.134)*** |
| SAH=2 at $t-1$ | | -1.234 |
| | | (0.071)*** |
| SAH=3 at $t-1$ | | -0.567 |
| | | (0.040)*** |
| SAH=5 at $t-1$ | | 0.797 |
| | | (0.045)*** |
| Log(inc) at $t-1$ | | 0.088 |
| | | (0.031)*** |
| No. Observations | 8343 | 5884 |

*Notes.* Other control variables: Ethnicity, No. children, Education, Age, Labour market status, Marital status, Region, Gender, Year, all evaluated at $t+2$.
Omitted health categories: SAH=4 at $t-1$.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: Ordered probit regressions of mental health score (Caseness GHQ) at date $t+2$

| | (1) | (2) |
|---|---|---|
| Log(Prize) at $t$ | 0.026 | 0.025 |
| | (0.010)** | (0.012)** |
| GHQ=0 at $t-1$ | | -1.222 |
| | | (0.136)*** |
| GHQ=1 at $t-1$ | | -1.342 |
| | | (0.147)*** |
| GHQ=2 at $t-1$ | | -1.178 |
| | | (0.125)*** |
| GHQ=3 at $t-1$ | | -1.323 |
| | | (0.104)*** |
| GHQ=4 at $t-1$ | | -1.051 |
| | | (0.109)*** |
| GHQ=5 at $t-1$ | | -1.009 |
| | | (0.089)*** |
| GHQ=6 at $t-1$ | | -0.891 |
| | | (0.088)*** |
| GHQ=7 at $t-1$ | | -0.880 |
| | | (0.072)*** |
| GHQ=8 at $t-1$ | | -0.777 |
| | | (0.064)*** |
| GHQ=9 at $t-1$ | | -0.708 |
| | | (0.055)*** |
| GHQ=10 at $t-1$ | | -0.656 |
| | | (0.051)*** |
| GHQ=11 at $t-1$ | | -0.492 |
| | | (0.041)*** |
| Log(inc) at $t-1$ | | -0.004 |
| | | (0.030) |
| No. Observations | 9801 | 6993 |

*Notes.* Other control variables: Ethnicity, No. children, Education, Age, Labour market status, Marital status, Region, Gender, Year, all evaluated at $t+2$.
Omitted health categories: GHQ=12 at $t-1$.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Regressions of smoking variables at date $t+2$ and social drinking at date $t+1$

| | Smoker at $t+2$ | | No. of cig at $t+2$ | | Social drinking at $t+1$ | |
|---|---|---|---|---|---|---|
| | Probit | | Ordered probit | | Ordered probit | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Log(Prize) at $t$ | 0.029 | 0.049 | 0.038 | 0.036 | 0.059 | 0.027 |
| | (0.014)** | (0.021)** | (0.020)* | (0.022)* | (0.012)*** | (0.013)** |
| Smoker at $t-1$ | | 2.878 | | | | |
| | | (0.067)*** | | | | |
| Cig=2 at $t-1$ | | | | 1.161 | | |
| | | | | (0.085)*** | | |
| Cig=3 at $t-1$ | | | | 2.314 | | |
| | | | | (0.095)*** | | |
| Cig=4 at $t-1$ | | | | 4.137 | | |
| | | | | (0.252)*** | | |
| Drink=2 at $t-1$ | | | | | | 0.460 |
| | | | | | | (0.085)*** |
| Drink=3 at $t-1$ | | | | | | 1.102 |
| | | | | | | (0.069)*** |
| Drink=4 at $t-1$ | | | | | | 1.751 |
| | | | | | | (0.077)*** |
| Drink=5 at $t-1$ | | | | | | 2.964 |
| | | | | | | (0.088)*** |
| Log(inc) at $t-1$ | | -0.069 | | -0.069 | | 0.024 |
| | | (0.052) | | (0.068) | | (0.036) |
| No. Observations | 8343 | 5886 | 2574 | 1861 | 6334 | 5034 |

*Notes.* Other control variables: Ethnicity, No. children, Education, Age, Labour market status, Marital status, Region, Gender, Year, all evaluated at $t+2$ (at $t+1$ in columns 5 and 6).
Omitted health categories: Non-Smoker at $t-1$, Cig=1 at $t-1$, Drink=1 at $t-1$.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 1: Distribution of health variables

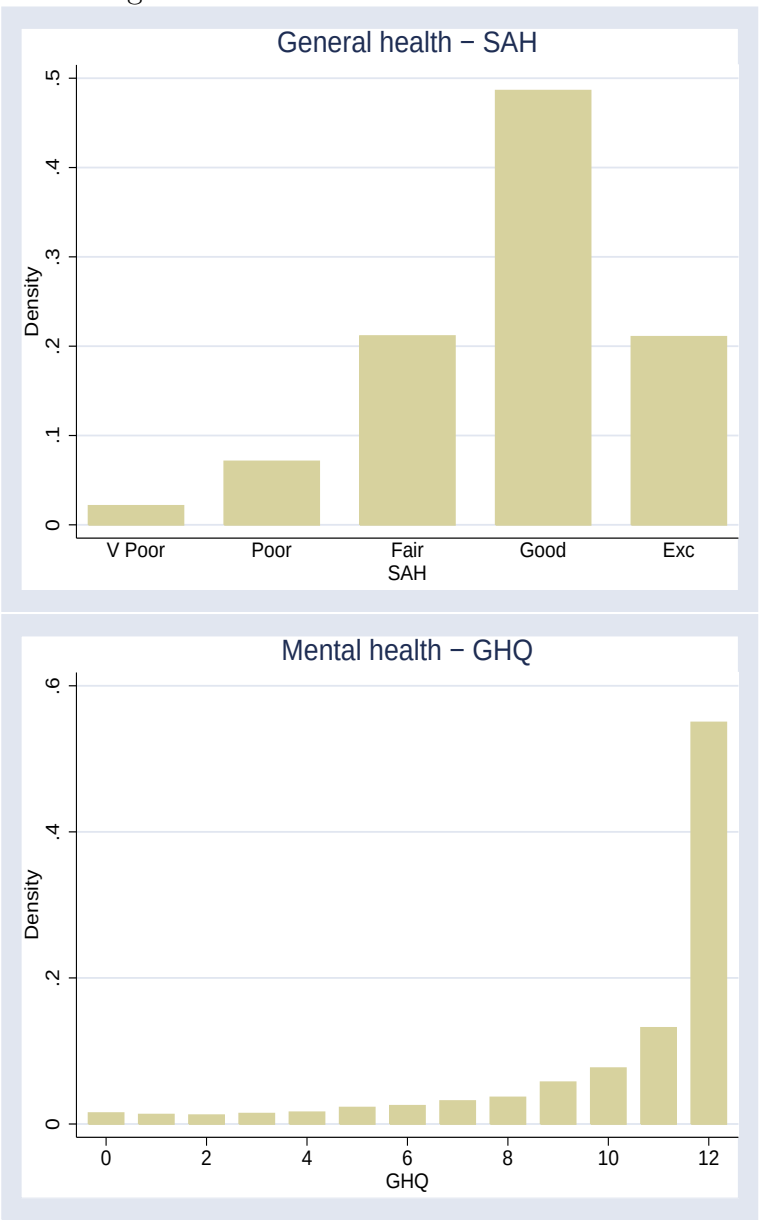

Figure 2: Distribution of health variables

Figure 3: Distribution of the logarithm of prizes for winners

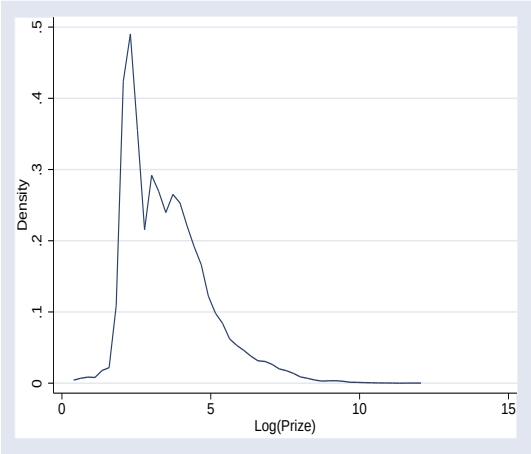

Figure 4: Non-Players, Players who do not win and Winners