What Happens to People after Winning the Lottery?

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Abstract

Neoclassical economics rests upon the assumption that utility is an increasing function of income (and wealth). Yet causal evidence is scarce. This paper reports one of the first large-scale longitudinal studies of randomly-selected lottery winners. We document evidence that it takes approximately two years before winners enjoy their money. As a possible explanation for this puzzle, the paper describes a model of lagged deservingness. We also provide evidence that human beings weight differently a number of different kinds of income that accrue to them, so it is apparently not true empirically that 'a dollar is a dollar'.

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"One of the main things for me was whether I deserved it, deserved to win".
— A recent US state lottery winner (quoted in Smith 2002)

"When we won, we looked at each other, me and Karen, and thought why us?" Mr Ryan said candidly after his win. *"Because to be honest, I'm not the most deserving person".*
— Quoted in The Independent newspaper in the UK (Independent 1996)

1. Introduction

Economists are deeply interested in income and its consequences for human beings. One of the building-block ideas in the discipline is that, because it allows individuals to buy extra goods, greater financial resources bring higher utility. However, there are almost no direct tests of this in the published literature. Scientifically, the optimal approach would be to construct a true random-assignment study involving large sums of money, and have a control group of people who receive little or nothing. For ethical and funding reasons, this is almost impossible in an advanced economy. The paper suggests an alternative approach. Exploiting a large random sample of the German population, it compares the satisfaction levels of lottery winners before and after they receive windfalls of money. The key, and puzzling, result is that winners report higher satisfaction levels but that this effect takes some years to come through.

The tradition in economics has been to assume that a dollar is a dollar is a dollar -- in other words that income from one source is the same as that from another[1]. We provide longitudinal evidence that sheds doubt on this way of thinking. We study lottery windfalls. The main contribution of the paper is empirical. After laying out the data, however, the paper sketches a possible analytical framework. The conceptual approach, which is motivated partly by the quotes at the beginning of the paper, builds upon the possibility that lottery winners may not immediately feel that they *deserve* their win. We are conscious that such terminology is unfamiliar in, and perhaps even antithetical to, standard economics (although the idea of endogenous

[1] The tradition is, of course, to assume that people maximize v(x) st. y=px, so that utility can be written as a function of income u(y) with given prices p suppressed from the notation, and x a vector of goods. Then y is a kind of sufficient statistic for utility or well-being.

deservingness has been explored before, in innovative work by Armantier 2006). Our paper uses a specific empirical example to try to draw wider implications.

We use data on satisfaction and subjective well-being. Such data are being used more in modern social science than they were in past decades; a recent attempted demonstration of their validity is given in Oswald and Wu (2010). More broadly, the paper can be seen as a contribution to the incorporation of emotions into economics (Elster 1998). Cognitive dissonance (Akerlof and Dickens 1982) later in the paper plays a particular role.

2.Lotteries as a Natural Experiment in Exogenous Income Windfalls

Real-life lotteries provide the economist with a quasi-laboratory setting in which individuals receive much bigger sums than can be distributed in a conventional social-science laboratory experiment. The first part of the paper is straightforwardly empirical. Using data from a German panel, it examines how an approximately exogenous windfall of cash affects people's well-being[2].

Strikingly, in the year of the interview in which the lottery win is reported, we cannot find any statistically significant effect within our sample of winners. The reasons we take seriously what is, in a sense, a non-result, and do not view it merely as a consequence of measurement error, are threefold:

(i) the data set is particularly suitable for the task, and is, to the best of our knowledge, the world's largest source of longitudinal data on lottery winners;

(ii) the paper's point estimates themselves are close to zero;

(iii) there are precedents for the non-finding in the literature (both the results of Brickman et al 1978 and the work of Kuhn et al 2008 conclude that lottery winners are not happier).

Nevertheless, we find that lottery wins have large effects on satisfaction eventually, by the second year after a win.

[2] We do not study health, but Lindahl (2005) and Apouey and Clark (2008) attempt to do so.

The design is the following.

First, we use a random sample of individuals. These are nationally representative data (for Germany). We follow people for some years, and observe them before and after a windfall.

Second, by studying lottery winners, we argue that it is reasonable to treat windfall money as approximately exogenous. More exactly, we examine those with substantial lottery wins among the set of those who have ever played. This design allows us to come close to the ideal kind of test -- one that no social-science funder would authorize -- which would be a giant experiment where some subjects were randomly allocated large sums of cash.

Third, the lottery prizes are not small: they range in size up to the equivalent of one million US dollars. These are paid as lump sums.

Fourth, although our sample size on substantial winners is inevitably not enormous (at approximately 1300 observations), the data set spans a long enough period to allow us to check the key finding over a fairly long period of years. We also do a variety of checks. We find, robustly, a delayed effect of a lottery windfall upon reported levels of contentment. We contrast this with the consequences of other kinds of financial windfalls and events.

The second part of the paper suggests a model in which lottery wins lead to cognitive dissonance. Initially, people do not feel they deserve the money as fully as they deserve their actual earned income. Over time they adapt, and eventually come to enjoy their lottery income. The model is highly stylized, but it captures the idea. It builds upon and is inspired by the (non-mathematical) theorizing of the psychologist Norman Feather, in sources such as Feather (1999), Feather et al (2001), and Feather and Johnstone (2001), and the work of economists such as Akerlof and Dickens

(1982) and Konow (2000). Fong and Luttmer (2007) is one of the few recent papers by economists to touch empirically upon the idea of deservingness[3].

The paper's evidence also disposes of one much-repeated idea, namely, the view that lottery wins initially make people very happy but that this happiness erodes away over the ensuing years as winners habituate to the money. Our data suggest the reverse. There is initially no impact[4] and then eventually a large one.

3. Empirics

We are interested in estimating the dynamic effect of a win in the lottery on subjective well-being. Specifically, we consider the following distributed lag model

(Eq.1) FS(t) = alpha + sum_j=0^J beta(j) win(t-j) + error

where FS(t) stands for financial satisfaction at time t, win(t-j) indicates whether the person won in the lottery in period t-j, and beta(j) is the impact of such a win on satisfaction in t. Previous studies of financial satisfaction include papers such as Easterlin (2006).

The data at our disposal come from the German Socio-Economic Panel (GSOEP). The GSOEP has an annual frequency, hence t stands for a year in this case. Information on lottery wins has been collected since the year 2000. The latest available wave is 2008. The theoretically feasible maximum number of lags is therefore eight. However, using that many lags automatically reduces the sample to a simple cross-section, with satisfaction data available for a single year, 2008. By choosing a J less than eight, we obtain a panel structure, as information on satisfaction is available for the same person in different years. In practice, we set J=3 such that satisfaction is observed over six years (t = 2003, ... , 2008).

[3] A search on the American Economic Review, Economic Journal, and Quarterly Journal of Economics finds no papers with 'deservingness' or 'deservedness' in the title, abstract or key-words. The same is true of a search on Psychological Science and Psychological Review.

The way the lottery information is solicited in the GSOEP deserves some comment. First, it is important to know that only substantial prizes are recorded in the GSOEP. The definition of what it means to be significant has shifted over time. The initial cut-off imposed by the questionnaire design was 5000 DM in 2000 and 2001. It was then converted to 2500 Euros between 2002 and 2004, and lowered to 500 Euros from 2005 onwards. Most lottery wins fall below these thresholds and are therefore not recorded at all.

Second, the information on lottery wins is provided by the household head in the household questionnaire. Thus, there is no way to distinguish the winning person. The individual-level satisfaction Eq. 1 includes a win as a right hand side variable without making adjustments for the within household distribution of resources. This approach is fully compliant to the inclusion of unadjusted household income (often with a separate control for household size) in the standard specification used in the satisfaction literature.

Third, the household head is asked at the time of the interview, which typically takes place in the month of April, for any lottery win during the previous calendar year; the exact month of win is not provided. As a consequence, there is a substantial lag between the time of a win and the first time after a win that household members report their financial satisfaction. In principle, the win could have occurred at the beginning of the previous calendar year, in the case of which reported satisfaction at an interview in April is measured up to 16 months later. If wins are evenly distributed over the year, the average lag is 10 months. Thus, in Eq. 1, beta_0 measures not the immediate impact, but the impact almost a year later.

These caveats notwithstanding, the GSOEP provides a valuable opportunity for analyzing lottery wins from a truly dynamic perspective with longitudinal data, even though one should recognize that the uncertainty associated with an estimate will not be negligible and not all parameters of interest (such as the truly immediate impact) can be identified. Studies such as Clark et al (2008a) and Oswald and Powdthavee (2008) have examined the time-series impact of other kinds of life shocks.

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[4] It might well be plausible to expect an initial elation effect, in the first week of hearing the

The distribution of lottery wins in the GSOEP, together with the average amounts, is shown in Table 1. The annual number of wins ranges from 14 to 50. The reason for the marked increase of the number of wins after 2005 is the aforementioned reduction in the minimum reporting threshold from 2500 to 500 Euros. For the same reason, the annual average winning amounts (adjusted for inflation in year 2000 Euros) tend to be lower after 2005 than before. 2002 was exceptional, as a lottery win of 681'000 Euros was reported in that year. The total average over all years amounts to 11250 Euros. Our estimation will include year dummies.

Table 1

The previous literature on the economic effects of winning in the lottery (Imbens et al. 2001, Gardner and Oswald, 2007, Apouey and Clark, 2009) has emphasized the potentially non-random selection into lottery playing. While winning in the lottery plausibly is random conditional on playing, it is then no longer random in the total population. Household surveys such as the GSOEP or the BHPS do not collect information on whether or not a person plays in the lottery. However, in such datasets, one can compare winners before they win with non-winners (a mix of unsuccessful players and non-players). For example, Apouey and Clark (2009) report that winning the lottery is significantly correlated with past income, ethnicity, education, labor market status, number of children and age. They argue that the extent of selection on observable characteristics makes the absence of selection on unobservables quiet unlikely. In this case, the orthogonality between win_t-j and error in (1) does not hold, and parameter estimates are inconsistent.

In order to overcome this problem, the traditional solution has been to condition on winning and compare outcome variables for small and big winners, or use the winning amount directly (the assumption being that the size of the win is random conditional on playing and winning). The problem with this approach is that it first-hand only

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news, but we are unable to examine that in our annual data.

identifies the effect of winning a big as opposed to a small amount. But this is not really what we are interested in. We would ideally like to know the effect of a big lottery win, rather than none, on subsequent satisfaction and well-being. This is equal to the estimated effect only under the additional assumption that a small win has no effect on satisfaction. A violation of this assumption means that the effect of interest is not identified. There are two further potential problems with this approach. First, the separation into big and small wins relies on an arbitrary threshold, and the results may be sensitive to its location (this problem is avoided if the amount is used, but then, functional form assumption may become critical). Second, it ignores another potential source of selection, the intensity of play. Big wins are more likely for high-intensity players, and selection into high-intensity playing may again be based on unobservables.

We therefore develop an alternative identification strategy, namely one based on within-individual variation of winning and non-winning years. Specifically, we estimate (1) including individual-specific fixed effects, thereby accounting for any non-random selection into playing and winning as long as it is time-invariant and can thus be treated like a personal trait. The "experiment" is then the random timing of a lottery win, given that it takes place at some stage. This identification strategy avoids the assumptions of the previous approach that winning has no effect on small winners and that average play intensity does not matter. In addition, the approach has higher statistical power, as non-winning years of sometimes winners serve as control group which increases the number of observations substantially. Since lottery wins are a rare event, this is likely to be an important advantage. While a comparison of big and small winners can only use 282 observations, the maximum number of observations increases to 1969 in our panel analysis of winners (the effective number is reduced to 1346 due to the use of lags).

Of course, our analysis is only valid if the timing of a win is random indeed. Table 2 provides some evidence to that effect. It shows means and standard errors of potentially time-varying socio-economic characteristics among sometimes winners, comparing the years of a win and the years without win for this group of people. Randomization implies that the two set of means should be approximately the same.

Table 2

The mean values are close to each other and, with one exception, not statistically different. The mild exception is log household income which is somewhat higher in the year of a win. A first conjecture could be that the win is included as income, explaining the increase. However, this should not be the case, as the GSOEP explicitly omits household windfall income from the reported post government income (which includes earnings, asset income, transfers and pensions). Another and more plausible explanation can be a change in the household composition. The mean number of household members is slightly larger in years with a win. Such a change can automatically increase the probability of a win if more persons play within a household. At the same time, additional (adult) persons also tend to increase household income. All reported analyses therefore control for household size.

Winning the lottery

We start, in Table 3, by estimating Eq. 1 by OLS and with fixed effects in a sample of 'sometimes winners' with 1346 person-year observations. Here, in other words, the sample is all those who in at least one point in the entire data period of the German Panel reported a lottery win. The underlying aim is to eliminate from the data those individuals who would never play a lottery.

The first Table 3 specification uses a binary indicator variable for the occurrence of a win; the second, the logarithmic amount of the win for winning years, and a zero else. All models include a standard set of controls (household size, age, gender, employment, marital status, education, health and year effects). These controls reduce the residual variation and can therefore be expected to increase the precision of the parameter estimates of interest.

Table 3

Reassuringly, the parameter patterns are similar for the incidence and the amount of a win. Without fixed effects, both the year t and the year t-1 effects on satisfaction are positive and statistically significant, with the t-1 effect being about 50 percent larger. Once fixed effects are included, the year t effect becomes insignificantly different from zero, and only the year t-1 effect remains significant. A formal F-test always rejects the null hypothesis of homogeneous intercepts, confirming our a-priori preference for the fixed effects specification, where the effect of a win is identified from the random timing of such a win.

The empirical result is thus one of delay: lottery wins do increase financial satisfaction, but, once individual fixed effects are included, only after a substantial amount of time. While we cannot determine with perfect accuracy how many months have passed since the win at time t-1 (since only the year of the win is known), it approaches two years (22 months would be the time elapsed between a mid-year win reported in t-1 and an interview month of April, the mode, in year t).

Table 4

In Table 4, results are shown where wins are split into large wins and small wins. This acts as a robustness test and seems of substantive interest in itself. The classification is based on the size of the lottery win relative to household income. In 44 percent of cases, the size of the win exceeds 10 percent of annual household income. These cases are classified as "large wins". We again focus on the fixed effects results in the right-hand columns of Table 4. We find a delay for big wins, and no effect for small wins. The coefficient of 0.447 on lagged lottery wins, for example, translates into almost half a point on a satisfaction scale.

Regular income and other windfalls

As a further robustness check, we re-estimated Eq. 1 with other types of income rather than lottery wins on the right hand side. These are regular household income, an income windfall through a gift, and an income windfall through an inheritance. The

GSOEP records these income windfalls through gifts and inheritances in the same way as those from lotteries. The same minimum amounts apply, and, as for lotteries, the information is available only from 2000 onwards.

The model for the regressions of Table 5 is otherwise left unchanged, i.e., we are interested in the dynamic effects of these income types from year t to t-3. The same control variables are included. However, the sample definitions are adjusted. In the case of gift receipts, we use all people who received such a gift at least once during the 9 year period. In the case of inheritances, we use all people who received an inheritance at least once during the 9 year period. Finally, we also estimate a comprehensive model, where all four income types (regular income, gifts, inheritances, and lottery wins) are included simultaneously. In this case, the sample comprises all available observations, without conditioning on any windfall.

To start with the last specification in Table 5, the dynamic lottery effects are noticeably similar to those obtained from the winners-only sample. Again, only the t-1 effect is statistically significant in the fixed effects specification. The similarity between the results seems supportive of our identifying assumption that selection into the playing lottery, if any, is approximately time-invariant and therefore accounted for by exploiting the panel structure of the data and including individual-specific fixed effects.

Table 5

Perhaps the most important result from Table 5 is captured, however, in the dynamic pattern of the other income variables. In all three cases (namely, other than lottery windfalls), it is the year t effect that is positive and statistically significant. While there is also a positive year t-1 effect for regular household income, no such effect can be found for gifts and inheritances. This outcome holds regardless of whether the windfall sub-samples or the full sample are used. This result seems quite striking: it appears that there is something special about winning in a lottery, that causes the benefits of such an additional income to materialize later than would be the case for

income from other sources, be it regular earned income, or income from gifts and inheritances. One possibility is that lottery wins are genuinely unpredicted windfalls. If so, that may make them particularly suitable, from the economist's point of view, as empirical proxies for the concept of exogenous income and wealth shocks.

Some further, and indirect, corroboration comes from the work of Gardner and Oswald (2007) and Apouey and Clark (2008). They find no immediate effect of lottery wins on mental health in Great Britain, but can detect an effect some years later. Because of the rather different nature of the dependent variable, and the much smaller lottery prizes in these investigators' British data, we do not wish to emphasize those results too strongly. But they are consistent with the tenor of the current paper's conclusions.

Alternatively, might it be that the phenomenon is a result of people using a technical definition of income -- as answering implicitly: "no, my satisfaction with income is not higher, because although I have received a large windfall I do not count that as household income"? First, for the average citizen, technical sophistication in the distinction between income and wealth windfalls lacks the ring of plausibility. Second, such an interpretation would not predict the near-2-year delay followed by the observed large rise in satisfaction. Instead, if the effect happens merely because people count as income only the interest on lottery windfalls, then the effect would show up as soon as it arrives in their bank accounts, namely, immediately in our annual data. Third, the qualitative pattern through time is seen also in the life-satisfaction responses, which would not be predicted by a windfalls-are-not-income account.

Finally, one could reason in the following way. A possible explanation for the lag is that a lottery win disrupts identity ("Who am I? What do I value? Who are my friends?") and it takes time to develop a new one. In the first few years, having money is inconsistent with a person's normal way of living, and it takes some years to learn to be a person who has money. So it may not be that lottery money is less valuable than salary money; rather, winnings may do what salary money does to make us feel good, but it may have the 'additional' effect of making us feel bad in different ways. However, the difficulty with this line of argument here is that it seems likely to apply

to the winning of millions rather than, as typically in our data set, the winning of thousands. Receiving 30,000 Euros may be an important event to a person but not in itself identity-changing. [5]

5. Deservingness and Lottery Wins: A Model of Cognitive Behaviour

We now try to make sense of this pattern[6]. It is not possible to establish unambiguously why the individuals in our sample take so long to gain satisfaction from their windfall. Nevertheless, this section proposes a utility-maximizing model of a lottery winner.

Assume that the lottery win has just been announced. Let *u(.)* be a concave utility function defined over total income. Income comes in two forms: a fixed salary *y* and a flow of income *i* taken from the lottery win. An endogenous salary can be introduced into the model without altering the main points.

The win is a given sum of money, *L*, that is announced at time 0. The individual decides at each point in time how much of the cash to use per annum -- that is, how large the drawings *i* should be in each period -- from the entire stock of lottery winnings *L*; she can, for example, consume it all early on, or wait and spend money later. Time is continuous and runs from 0 to *T*.

Earned income is seen by the person as money which she intrinsically deserves. Lottery income, by contrast, is not viewed in the same way. The individual does not think immediately that she is fully 'deserving' of the money. In her mind, she marks down the utility value of the flow of lottery income by a coefficient D, which lies

[5] We thank Dan Gilbert for valuable suggestions on this.

[6] Two possibilities are that (i) people take some years to purchase goods with their lottery winnings or (ii) it takes time to appreciate money just as it does to appreciate fine wine. However, neither of these is predicted by standard economic theory, and neither seems plausible. A third, a 'lucky charm' theory, is that winners feel good because they interpret the financial luck as a sign of a generic change in their chances in future random events; but, contrary to our data, this theory would predict a flat-rate effect, independently of the windfall size. A fourth, which is close in spirit to the changed-identity theory discussed earlier, is a disruption theory: winning shakes up people's lives in an uncomfortable way. But this would predict a fast drop at time t1 rather than a higher utility level per se later on. Moreover, again, most of our wins are too small for this account to seem truly persuasive.

between zero and unity. Intuitively, until the individual comes to terms with the win, this is a kind of psychic 'tax'. If *D* is 0.5, for example, the person is indifferent between salary income of $1 and lottery income of $2.

This gap can be thought of as a form of cognitive dissonance. Through time, however, the individual can persuade herself that she is deserving of the lottery money. This -- the erosion of the dissonance -- happens slowly. It requires effort *e*. The cost of effort is a convex function *c(e)*. By investing psychological resources, she can gradually build up the deservingness level, *D*, in her own mind. But doing so causes mental strain along the way. This is a kind of reverse-adaptation theory.

In terms of the earlier data, we will think of *u(.)* as proxying the satisfaction from income. Overall satisfaction or well-being, correspondingly, is instead given each period by *u(.) – c(e).*

Discounting does not alter the nature of the optimization, so for simplicity is omitted. A discount rate *r* can easily be introduced into the model.

The person thus maximizes lifetime utility subject to, first, a lottery-win budget constraint and, second, a differential equation constraint on the rate of change of deservingness D. The problem in full is: in each period choose psychological effort, *e*, and the amount of lottery winnings drawn down, *i*, to solve

$$\text{Maximize} \int_0^T [u(y+iD)-c(e)]dt \qquad \textit{Lifetime utility}$$

subject to four constraints:

$$\int_0^T idt \le L \qquad \textit{Lottery-win budget constraint}$$

$$\dot{D} = e - \delta D \qquad \textit{Adjustment-of-deservingness equation}$$

$$0 \le D \le 1 \qquad \textit{Bounded deservingness}$$

$0 \le e \le \bar{e}$ *Bounded effort*

where deservingness *D* lies in the unit interval, *e* lies between zero and e-bar, the time rate of change of a variable is marked by a dot, and *D* depreciates at rate δ. It is not necessary for the analysis that the rate of depreciation be strictly positive, and we return to this issue at a later point.

A value of *D*=1 corresponds to full deservingness. In this case, the person treats wage income and lottery income as identically valuable inside their utility function. By assumption, the deservingness parameter *D* cannot exceed unity, nor go negative. Effort *e* is assumed to lie in a closed interval, and also, by assumption, cannot go negative.

Form the Hamiltonian

$$H = u(y + iD) - c(e) + \lambda[L - i] + \psi(e - \delta D)$$

where lambda is a multiplier that is constant (ie, independent of time) and psi is a multiplier that is dependent on time. Lambda here is independent of t because it corresponds to an integral constraint. In the model, the value of lambda is closely linked to the marginal utility of income, whereas psi is the shadow price of deservingness.

The necessary conditions for an optimum, from Pontryagin's Maximum Principle, are:

$$H_i = u'(y + iD)D - \lambda = 0 \qquad (1)$$

$$H_e = -c'(e) + \psi \le 0 \qquad (2)$$

$$\dot{\psi} = -H_D = -u'(y + iD)i + \psi\delta \qquad (3)$$

$$\dot{D} = e - \delta D \qquad (4)$$

$$D(T)\psi(T) = 0. \qquad (5)$$

When (2) holds as a strict equality, these characterize an optimal interior solution. In some circumstances, bang-bang solutions (with variables set at corners) may be the optimal outcome.

Equation 1 requires that the (deservingness-adjusted) marginal utility of income be the same in each time period. With *D*=1, the condition collapses to the conventional form found in optimal lifetime consumption models. Equation 2 determines the instantaneous value of the shadow price of deservingness, which is given by the marginal cost of psychological effort, namely, the first derivative of *c(e)*. Equation 3 is the equation of motion of deservingness's shadow price, ψ. Equation 4 reproduces the dynamics of how deservingness builds up over time. Equation 5 is a transversality condition.

Figure 1 describes a typical outcome. Over time, a rational individual invests -- perhaps only subconsciously -- in building up his or her sense of deservingness. When that deservingness level hits a value D*, a steady state ensues.

It seems natural to assume that deservingness *D* begins, in time t=0 when the individual learns of the lottery win, close to zero. The model requires some assumption of this type about the initial value D(0).

From equation 1, the derivative of utility with respect to income is in each period

$$u'(y + iD) = \frac{\lambda}{D} \qquad (6)$$

where the multiplier lambda is a constant. This can be thought of as the deservingness-scaled marginal utility of income. The expression means that as deservingness *D* rises so the right hand side of (6) declines and hence the value of

$u'(.)$ must itself decline. The value of *D* cannot literally be zero at the starting point, t=0, if (6) is to hold as a well-behaved interior optimum.

Equation (6)'s form is simple but powerful. Because *u(.)* is strictly concave, *y+iD* must move inversely with D. Thus total effective income *y+iD* rises through time as *D* increases. Hence the income-driven part of the utility function, *u(.),* is also increasing over time. This establishes that as deservingness *D* increases it must be the case that the utility from income goes up. Within this framework, as depicted in Figure 1, the characteristic of all but pathological cases is thus that utility starts close to, or lower than, the pre-lottery level.

Intuitively, this is for three reasons. First, the individual sets high effort e to try to bring up her sense of deservingness *D*. That is a source of mental strain and acts, ceteris paribus, to pull down the person's utility from the level prevailing just before the announcement of the lottery win (when the person had had no need to put in effort to rationalize their own income, which was only from salary). Second, the optimizing individual does start to draw upon lottery income, because now recognizes that she will be richer over her lifetime, so that it is rational for her to bring forward new spending. But now the consequence of every dollar spent is a smaller utility gain than from an equivalent dollar of salary income; this is because each lottery dollar is downgraded by parameter *D*. Third, in turn, this downgrading makes it less desirable in the early periods to consume from the lottery winnings *L*. Other things constant, it is preferable to wait a few periods, to allow the deservingness level to rise, and thus to allow the money eventually to be more fully enjoyed.

If horizon time *T* goes to infinity, the model's solution converges to a steady state path, and that solution is characterized by

$$u'(y+i*D*)i* = c'(e*)\delta \qquad (7)$$

$$e* = \delta D*. \qquad (8)$$

The individual continues to put in psychological effort to maintain her sense of deservingness, but only at level e* necessary to cover the level of depreciation.

Two special and simple cases are the following.

A: When *u(.)* is linear, it is optimal to build up *D* as slowly as possible, and to consume all the *L* lottery win in the final few periods, or whenever *D* first reaches the value of unity. The reason is that there is no gain from consuming in any particular period, so it pays to wait as long as feasible.

B: When *c(.)* is zero as well, there is a so-called bang-bang solution. It is optimal straight away to set effort e to its maximum level, $\bar{e}$. The individual adjusts psychologically as quickly as possible, while leaving the lottery winnings intact. Then, when *D* hits unity, the consumption of lottery winnings can begin.

One issue is how the per-period lottery-drawings *i* are set in each period as the level of deservingness *D* rises through time. Here the structure of equation 1 means that what matters is the conventional degree of relative risk aversion of the *u(.)* utility function.

This follows easily from differentiating throughout the inter-temporal optimality requirement, equation 1:

$$D^2u''(.)di + iDu''(.)dD + u'(.)dD = 0 \quad (9)$$

which, after rearrangement, and multiplication throughout by *D/i*, gives the expression:

$$\frac{di}{dD}\frac{D}{i} = -[1 + \frac{u'(.)}{u''(.)}\frac{1}{Di}] \quad (10)$$

Or simply

$$\frac{di}{dD}\frac{D}{i} = \frac{1}{\eta} - 1 \qquad (11)$$

where eta is the degree of relative risk aversion.

Therefore, in the useful benchmark case where eta is equal to unity, it follows that if deservingness increases through time the variables *i* and *D* rise together in exact proportion. Then, as eta lies above (or below) unity, lottery income is drawn on less (or more) through time.

6. Conclusions

A standard prediction of economic theory is that human beings enjoy winning lotteries and that such wins quickly improve the quality of people's lives. This is what most economists would expect. The evidence in this study, however, does not greatly support such a conclusion.

Instead, these longitudinal data, which have the advantage of following randomly selected people before they win the lottery and for some years afterwards, reveal a strong and delayed effect. Even for a measure of financial satisfaction -- chosen here because it is so naturally a subjective well-being variable in the domain of lottery winnings -- we cannot discern any impact upon people for almost 2 years[7]. Then, a large effect becomes visible. A person's satisfaction with their household's income is markedly higher if they earlier had a substantial win on the lottery. The estimated effect is robust in subsamples. [8]

[7] It is worth noting that 2 years is how long it takes humans to adapt to other hedonic shocks, such as bereavement and divorce (Clark et al 2008a). In this paper, we study what might be thought of as a form of 'negative adaptation'.

[8] As explained in the paper, this effect cannot be because winners draw a subtle definitional distinction between windfall wealth and income. If as a lottery winner I put 100,000 dollars into the bank, at an interest rate of 5%, then I get 5000 dollars per annum straight away, namely, in the first year. After three years, I am still receiving 5000 dollars a year in interest (or marginally more if, contrary to the spirit of the life-cycle model, I have compounded it all). Therefore it is not true that investing the windfall sum will only slowly lead to an up-rating of my income, and correspondingly not true that the patterns in our data can be explained by such an account.

The paper's evidence is consistent with the (non-longitudinal) experimental findings of Kuhn et al 2008. Both run counter to one commonly heard idea -- the view that lottery wins can initially make people happy but that such an effect on well-being quickly erodes as individuals adapt hedonically to a new standard of living. There is much folk-lore on this, and Brickman et al (1978) proposes the same idea, but it is apparently not consistent with these data. In a sense, the reverse is true: enjoyment from a lottery win emerges slowly rather than dissipates slowly.

Building upon the psychological literature on deservingness[9], we have suggested a formal model that is consistent with the facts observed in our data. In the model, people suffer from cognitive dissonance when they win. Initially, they do not feel they deserve the windfall, and this reduces the marginal utility of their lottery income. They slowly invest in psychological effort to persuade themselves of their deservingness, and the utility from income then rises through time. They come to enjoy the money. In the model, we have attempted to distinguish between the satisfaction from income $u(.)$ and overall satisfaction or utility $u(.) - c(e)$. The model is placed second in the paper because it is an attempt ex post to make sense of the patterns found empirically.

Interestingly, in the German language, there is a single verb "verdienen" which means both "to earn" (as a payment for work) and "to deserve". The main hypothesis of this paper -- that some forms of income are perceived as more deserved than others -- is thus in a sense anticipated in the culture and vocabulary.

Whatever the correct theoretical interpretation, and further inquiry will be necessary, the paper has shown that lottery income, gift income, inheritance income, and wage income are not identical in their empirical consequences. Despite the traditions of economics, human beings seem to weight differently the different kinds of income that accrue to them. If so, it is not sufficient to describe utility by a function u(y), and it is not true that 'a dollar is a dollar'. We believe the idea may have applications in

[9] We have found little published empirical research on deservingness and lottery wins, although Callan et al (2006) touches upon the issue.

many settings in social science. Money may not be as homogeneous, and psychologically fungible, as the discipline of economics[10] has presumed.

[10] With honorable exceptions such as Thaler (1990).

Table 1. Lottery winnings in the GSOEP (in Euros)

Year	# of reported wins	average amount
2000	32	6514
2001	17	6558
2002	16	99786
2003	29	15730
2004	14	5413
2005	38	4659
2006	49	4998
2007	37	2703
2008	50	4040
Total	282	11250

Table 2. Lottery winnings in the GSOEP

	Years without win		Years with win	
	mean	std.err.	mean	std.err.
Employed (yes=1)	0.67	0.011	0.68	0.028
Household size	2.71	0.026	2.77	0.074
Age	49.5	0.312	50.3	0.797
German (yes=1)	0.92	0.006	0.93	0.015
Married (yes=1)	0.74	0.010	0.75	0.026
Log household income	10.4	0.013	10.5	0.035
Satisfaction with health	6.41	0.054	6.22	0.133
Number of observations	1687		282	

Table 3. Financial satisfaction equations (with variables for lottery wins)

	Lottery win (Yes=1)		Log winning amount	
Win in t	0.318*	0.124	0.038*	0.016
	(0.125)	(0.117)	(0.016)	(0.014)
Win in t-1	0.480**	0.336**	0.053**	0.035*
	(0.131)	(0.128)	(0.016)	(0.015)
Win in t-2	-0.022	-0.168	-0.001	-0.018
	(0.167)	(0.137)	(0.019)	(0.016)
Win in t-3	-0.152	-0.087	-0.017	-0.010
	(0.195)	(0.152)	(0.022)	(0.018)
Individual fixed effects	No	Yes	No	Yes
Number of observations	1346	1346	1346	1346

Standard errors in parentheses
* p<0.05, ** p<0.01
Sample includes all people with at least one reported lottery win. Controls include household size, age, gender, employment, marital status, education, health and year effects.

Table 4. Financial satisfaction equations (the effects of large and small lottery wins)

Large lottery win (Yes=1)	0.441*	0.199
	(0.205)	(0.176)
Large lottery win in t-1	0.709**	0.447*
	(0.173)	(0.182)
Large lottery win in t-2	0.065	-0.103
	(0.228)	(0.183)
Large lottery win in t-3	-0.092	-0.030
	(0.253)	(0.193)
Small lottery win (Yes=1)	0.212	0.058
	(0.159)	(0.154)
Small lottery win in t-1	0.257	0.225
	(0.186)	(0.179)
Small lottery win in t-2	-0.134	-0.248
	(0.244)	(0.201)
Small lottery win in t-3	-0.256	-0.166
	(0.316)	(0.235)
Fixed effects	no	yes
N	1346	1346

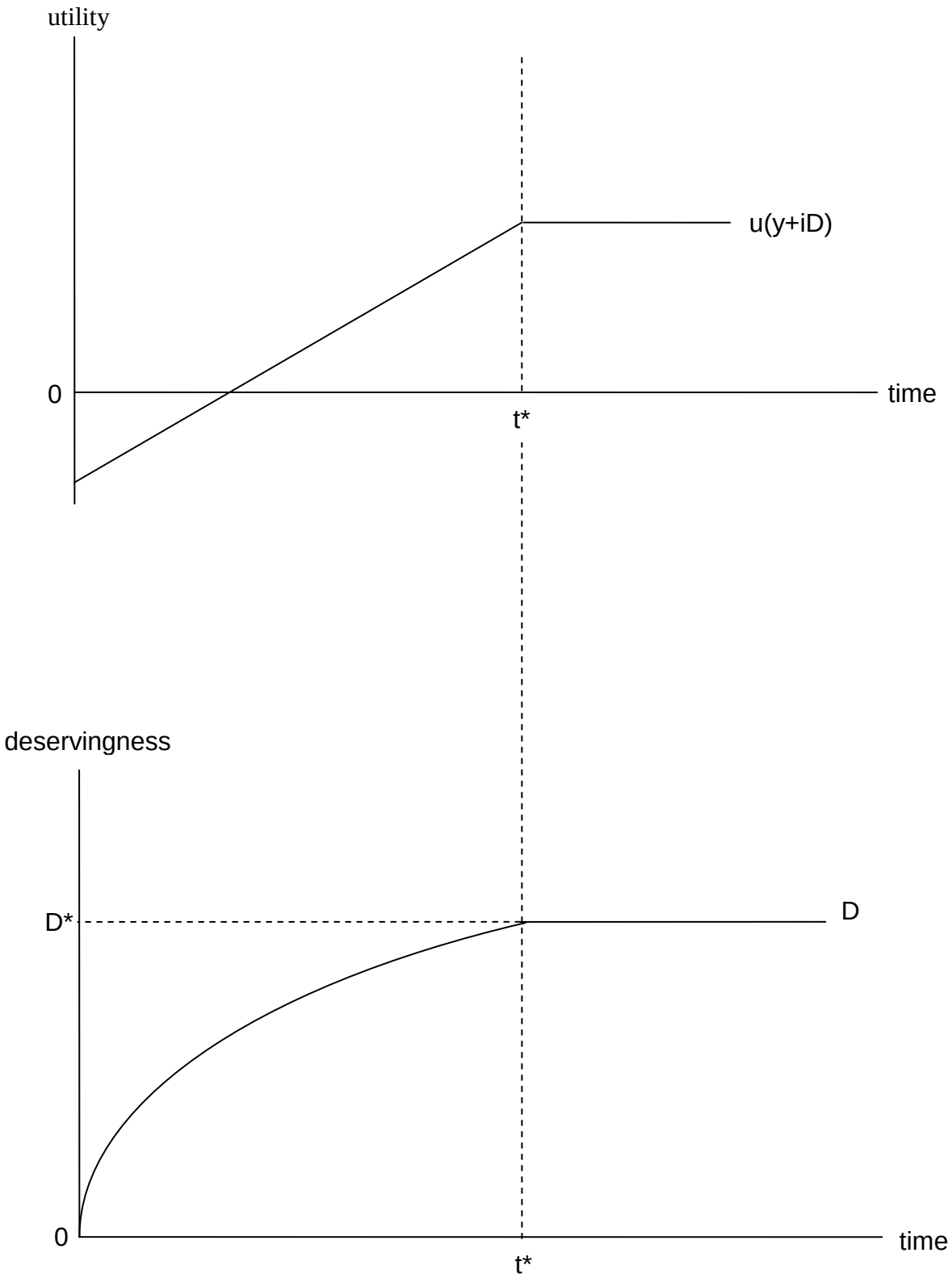
Standard errors in parentheses
* p<0.05, ** p<0.01
A lottery win is classified as "large" if the amount exceeds 10 percent of annual household income.
Sample includes all people with at least one reported lottery win.
Equations controls are as before.

Table 5. Financial satisfaction equations with variables for earned income and different kinds of income windfalls

Log household income	1.263** (0.026)	0.655** (0.019)					1.257** (0.026)	0.659* (0.019)
Log income in t-1	0.283** (0.021)	0.067** (0.018)					0.278** (0.021)	0.067* (0.018)
Log income in t-2	0.090** (0.020)	-0.020 (0.017)					0.090** (0.020)	-0.022 (0.017)
Log income in t-3	0.014 (0.021)	-0.030 (0.016)					0.015 (0.021)	-0.030 (0.016)
Gift received (yes=1)			0.177** (0.048)	0.165** (0.042)			0.307** (0.046)	0.171* (0.042)
Gift received in t-1			0.066 (0.047)	0.037 (0.041)			0.176** (0.045)	0.040 (0.042)
Gift received in t-2			0.106* (0.047)	0.072 (0.042)			0.208** (0.044)	0.071 (0.042)
Gift received in t-3			0.008 (0.052)	0.027 (0.045)			0.079 (0.050)	0.012 (0.045)
Inheritance (yes=1)					0.188** (0.044)	0.124** (0.036)	0.207** (0.045)	0.119* (0.038)
Inheritance in t-1					0.067 (0.043)	0.011 (0.036)	0.084* (0.042)	0.011 (0.037)
Inheritance in t-2					0.047 (0.046)	-0.004 (0.037)	0.054 (0.044)	-0.001 (0.038)
Inheritance in t-3					0.064 (0.051)	0.002 (0.039)	0.071 (0.050)	-0.004 (0.040)
Lottery win (Yes=1)							0.403** (0.127)	0.158 (0.113)
Lottery win in t-1							0.492** (0.125)	0.311* (0.123)
Lottery win in t-2							0.022 (0.158)	-0.149 (0.130)
Lottery win in t-3							-0.157 (0.194)	-0.087 (0.143)
Fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	116147	116147	8822	8822	12010	12010	115979	115979

Source: German Socio-Economic Panel 2000-2008; * p<0.05, ** p<0.01

Figure 1



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