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# HAPPY LOTTERY WINNERS AND LT BIAS

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The world spends a remarkable $250 billion a year on lottery tickets. Yet, perplexingly, it has proved difficult for social scientists to show that lottery windfalls actually make people happier. This is the famous and still unresolved paradox due initially to Brickman and colleagues. Here we describe an underlying weakness that has affected the research area, and explain the concept of *lottery-ticket bias* (LT bias), which stems from unobservable lottery spending. We then collect new data—in the world's most intense lottery-playing nation, Singapore—on the amount that people spend on lottery tickets ($n$ = 5626). We demonstrate that, once we correct for LT bias, a lottery windfall is predictive of a substantial improvement in happiness and well-being.

**JEL Codes**: A12, I31

**Keywords**: happiness, income, well-being, GHQ, mental-health, lottery

> "Lottery winners … were not significantly.
>
> different … in how happy they… were."
>
> Brickman *et al.*, 1978.

A large modern literature examines the economics of human happiness and argues—consistent with intuition—that richer people tend to be happier and that poverty is a social "bad." Recent work includes the review by Clark (2018), and articles such as Clark, Fleche and Senik (2016), De Neve *et al.* (2018), Brodeur and Fleche (2019), Welsch and Biermann (2019), and Budria and Ferrer-I-Carbonell (2019). Yet, as pointed out by Clark (2018), an important problem is that income is not exogenous. That makes causal inference difficult.

*Notes*: The first draft of this paper was written in 2017. We thank many international colleagues, and especially 2 referees and Peter Kuhn and Erik Lindqvist, for helpful comments. The current paper is on the same topic as continuing research by Rainer Winkelmann on German panel data. The current paper uses data from the Singapore Life Panel(SLP) conducted by the Centre for Research on the Economics of Ageing (CREA) at Singapore Management University. The SLP data collection was financially supported by the Singapore Ministry of Education (MOE) Academic Research Fund Tier 3 grant MOE2013-T3-1-009. We also thank the CAGE centre at Warwick University for support, and Susann Rohwedder for comments on the design of lottery questions.

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For this reason, researchers in a number of fields have tried to study lottery windfalls. That has produced a famous and largely unsolved paradox. A widely-cited 1978 paper by Brickman, Coates, and Janoff-Bulman concluded that winning the lottery does *not* affect people's subjective well-being. It seems rather likely that normal human beings would take a different view, and would look askance at any behavioral scientist who quoted to them the Brickman idea. The organizations within the World Lottery Association, for example, have combined revenue of over 250 billion US dollars. In some European countries, half of adult citizens regularly buy tickets. The majority of US states operate lotteries with large prizes (WLA 2017). It is also known that humans are reluctant to give up lottery tickets for cash (Risen and Gilovich, 2007).

Our study points to a methodological difficulty with almost all lottery analyses and it describes a potential solution. We collect new data on the nation of Singapore. This country has the largest purchases of lottery tickets per-person in the world (WLA 2017). We then show how to reach the opposite conclusion from the ideas begun by Brickman and his colleagues. Lottery wins do improve happiness and life satisfaction.

The background is familiar to many kinds of social scientists. Money seems to matter to human beings. Although it depends how one spends it (Dunn *et al.*, 2008; Dunn *et al.*, 2011; Whillans *et al.*, 2017), asymmetries seem to exist (Boyce et al., 2013; De Neve *et al.*, 2018), and people may be subject to significant affective-forecasting errors about how happy they will feel after events (Dunn, Wilson, and Gilbert, 2003), there is now a great deal of correlational evidence that richer people tend to be happier than poorer people (including earlier work such as Diener and Biswas-Diener 2002; Blanchflower and Oswald, 2004; Boyce *et al.*, 2010). This happiness-income correlation has been found in cross-sectional and longitudinal data. Recent research suggests that it may continue to hold even at extreme levels of wealth (Donnelly *et al.*, 2018), although it is possible that there is also some form of reverse link running from well-being to later levels of income (De Neve and Oswald, 2012).

When it comes to money that is received in a lottery win, however, the pattern is not so clear (Brickman *et al.*, 1978). Nearly half a century ago, these authors conducted what is generally seen as the first formal attempt to use lottery data to test whether a windfall of money induces greater happiness. In a much-cited paper in social psychology (approx. 3000 citations in Google Scholar), their article documented an indifferent-winner puzzle.

It is certainly possible to raise objections to the Brickman et al. method, which is crude when viewed alongside today's methods. The authors' article used cross-sectional data on only 22 lottery winners and compared them to 22 control individuals. Moreover, among the winners, a higher percentage (32 percent of them) had no educational qualifications (compared to 18 percent of the controls). The authors of the study did not do regression analysis to adjust for such differences. Hence, the authors' 1978 paper would not have been easy to publish in the current era of scientific research. The difficulty for quantitative social science is that modern inquiries have not produced clear evidence against Brickman's paradoxical result (for example, Nissle and Bschor, 2002; Kuhn *et al.*, 2011), although, in passing, it should be noted that Brickman et al. viewed their own result as logical

and as explained by habituation to income. This matters both scientifically and practically.

The closest the journal literature has come to proving that lottery wins make people happier is arguably longitudinal analysis using the British Household Panel Survey (Gardner and Oswald, 2007; Apouey and Clark, 2015). However, the first of these two articles finds no immediate well-being benefit from winning the lottery (within, for example, the first 12 months). The authors' main positive result is that, two years after winning, the mental-health GHQ score of medium-size winners seems to be better than that of controls who won only a trivial sum of money.

That result has been successfully replicated on a larger British sample (Apouey and Clark, 2015) where the authors' primary and novel conclusion is that lottery wins appear to worsen people's chosen health behaviors (for example, through increased smoking). Apouey and Clark, however, do find a positive result on life satisfaction immediately, by using a lottery variable that is de-meaned, and some other evidence of a one-to-two-year lagged effect, as in their Table 3 Column 2. The de-meaned statistical specification implants a particular kind of non-linearity into their regression equation. Later in the current study we discuss the implications. A Dutch lottery study (Kuhn *et al.*, 2011) was also unable to find a statistically significant effect on happiness, even though the methodological design was strong. Another important and early paper (Lindahl, 2005), although not on happiness or subjective well-being *per se*, found some evidence that lottery income appeared to have a negative impact on a number of poor mental-health symptoms (i.e. to improve mental health). The author's specific categories were: general tiredness; sleeping problems; nervousness and anxiety; depression; and mental illness. Most recently, Lindqvist *et al.* (2018) have used interesting Swedish data to establish a positive link between lottery wins and later psychological well-being. Very recently, Raschke (2019) finds rather mixed results for German data, while new work by Oswald and Winkelmann (2019) obtains some evidence of positive well-being effects of lottery wins. An earlier paper by van Kippersluis and Galama (2014) examined links between lottery wins and health.

## 1. The Problem of LT Bias

Common sense suggests that a financial windfall ought to lead to greater enjoyment of life. One reason is that with extra income a person can purchase extra goods and services. Money also brings with it rank and status.

Nevertheless, a key problem is the following. If a scientific investigator observed someone who won 1000 dollars, the scientist would not expect the person to be happier if that individual had already had to spend 1000 dollars in order to get the lottery tickets. Empirical studies of lotteries have usually been forced to ignore this point, because investigators traditionally have not had data on ticket purchases. Yet, by definition, the way to get lottery wins is to buy tickets, and the greater is the number of tickets, the larger is the expected size of a person's win. Hence, *in situations where information on ticket purchases is not available to the researcher, there will be an innate downward bias in estimates of the happiness from lottery wins.* We term this *lottery-tickets (LT) bias.* The current study attempts to

correct for this form of bias (the potential existence of which has been pointed out before in the literature, such as in Apouey and Clark, 2015, although the authors were only able to control for fixed effects as a partial fix for the problem).

This form of LT bias will not, in fact, explain the Brickman et al. study *per se* because Brickman's work examined tiny numbers of winners of huge amounts, and we suspect that that study simply had non-representative people who were happy being interviewed. Instead, the current paper's point is that the LT bias is relevant to the modern studies that came afterwards and have struggled to reject the paradoxical conclusion that winners are not happier.

## 2. Data

This study uses data from the Singapore Life Panel (SLP). Since July 2015, approximately 8,000 individuals regularly participate in this survey each month, mainly via the Internet. Respondents who do not have access to the Internet participate in the survey through telephone-based interview. The SLP collects rich information on a variety of questions such as consumption expenditure, income, wealth, health, labour market outcomes, and subjective well-being. It is a monthly survey of a nationally representative sample of Singapore citizens and permanent residents (mostly) aged between 50 and 70 years.

Background information on Singapore's lottery system is given in (NASPL, 2017; Singapore National Council on Problem Gaming (2015); Singapore Pools (2017); World Lottery Association (2017)). There are three types of lotteries (Toto, 4D, and Singapore Sweep) but we do not have information on which exact lotteries the individuals play.

From time to time, the SLP asks additional information to address specific topics. Fortunately, for this project, we were able to persuade the organizers of the SLP to insert a set of new questions asking survey participants about both their lottery ticket purchases and their lottery wins in the 16$^{th}$ wave of the SLP (November 2016). This is the primary reason we use data from Singapore. Specifically, we ask whether a respondent bought lottery tickets at least once in the last 12 months. If the respondent says "yes" to the this question, we ask follow-up questions on (1) how often s/he purchased lottery tickets in the last 12 months, (2) how much s/he spent on lottery tickets in the last 12 months, and (3) what winnings s/he has received in total from any lottery tickets in the last 12 months.

The dependent variables we use are conventional measures of well-being. SLP asks: *Taking all things together, how satisfied are you with your life as a whole these days?* And *During the past 30 days, how much of the time have you been a happy person?*

Each variable is measured on a 5-point Likert-type scale. For life satisfaction, it runs from "very satisfied" down to "very dissatisfied." For happiness, it runs from "all of the time" to "none of the time." We treated these as cardinal data, but the regression results are robust even if we redo them with estimation methods that rely on ordinal data.

In addition to basic demographic and socio-economic information, we use the scores from a financial literacy test surveyed in Wave 5 (December 2015) and a

cognitive reflection test (CRT) surveyed in Wave 14 (September 2016). The financial literacy test asks a respondent's knowledge about inflation, compound interest, and risky assets.[1] The CRT is a three-item cognitive ability test to measure "the ability or disposition to reflect on a question and resist reporting the first response that comes to mind."[2] It is related to a form of IQ test and seems likely that it serves also as a measure of a person's far-sightedness.

Wave 16 provides data on 7,840 individuals. We first exclude 437 observations on which there was missing information on key variables such as life satisfaction, annual household income, education, race, etc. We further drop 94 respondents who did not answer the lottery questions, and 376 respondents who claimed to spend more money on lottery tickets than their annual household income, mostly with very small or zero incomes.[3]

A sample-size reduction also comes when we merge the cognitive reflection test (CRT) and financial literacy information; these were surveyed in different waves. Of the respondents who participated in Wave 16, which contains the lottery questions, some of the individuals did not participate in the waves with CRT or financial literacy questions, or they did not answer those questions even if they participated in those waves. As a result, we exclude 665 respondents when we merge the CRT score from Wave 14 and additional 642 respondents when we merge the financial literacy score from Wave 5. The final usable sample is 5626 (If we do not control for the financial literacy and CRT scores, the sample size goes up to 6933, but later regression results remain robust to this).[4]

Table 1 shows that approximately 53 percent of the players—defined here as those who purchased a lottery ticket at least once in the last 12 months—are males. Men account for only 41 percent of the non-players in the sample. The sample respondents are, on average, almost 60 years old, which reflects the original sampling feature of the SLP population.

There are other notable, but perhaps not surprising, differences between lottery players and non-players. Lottery players tend to be less educated than the non-players. People who completed post-secondary education account for 36 percent of players but for 45 percent of non-players. There is a significant racial difference in terms of lottery purchase behavior. The vast majority of lottery players are Chinese. Malay citizens are only 1 percent of lottery players while they account for 11 percent of non-players. Finally, non-players have larger annual household incomes than players (by a margin of 5 percent). Hence we use regression equations.

[1]The SLP uses the following questions: 1) Suppose that you had $100 in a savings account and the interest rate was 2 percent per year. After 5 years, how much do you think you would have in the account if you left the money to grow? 2) Imagine that the interest rate on your savings account was 1 percent per| year and inflation was 2 percent per year. After 1 year, how much would you be able to buy with the money in this account? 3) Do you think that the following statement is true or false? "Buying a single company stock usually provides a safer return than a Unit Trust."

[2]The CRT cognitive reflection test consists of the following questions: 1) "A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?" 2) "If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?" 3) "In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?"

[3]The majority of those who report higher ticket spending than household income are people who are not working. Even if we include these outliers, the results remain robust.

[4]There are 151 respondents who did not answer the happiness question.

TABLE 1
Descriptive Statistics: Means

| Description | All | Players | Non-players |
|---|---|---|---|
| *Panel A: Individual and household characteristics* | | | |
| Male | 0.47 | 0.53 | 0.41 |
| | (0.50) | (0.50) | (0.49) |
| Age | 59.82 | 60.21 | 59.38 |
| | (6.48) | (6.24) | (6.71) |
| Completed secondary education | 0.41 | 0.43 | 0.38 |
| | (0.49) | (0.50) | (0.48) |
| Completed post-secondary education | 0.40 | 0.36 | 0.45 |
| | (0.49) | (0.48) | (0.50) |
| Chinese | 0.88 | 0.95 | 0.80 |
| | (0.33) | (0.22) | (0.40) |
| Malay | 0.05 | 0.01 | 0.11 |
| | (0.23) | (0.08) | (0.31) |
| Indian | 0.05 | 0.03 | 0.06 |
| | (0.21) | (0.17) | (0.24) |
| Married | 0.81 | 0.83 | 0.79 |
| | (0.39) | (0.38) | (0.40) |
| Number of children | 2.88 | 2.83 | 2.93 |
| | (1.12) | (1.05) | (1.18) |
| Employed | .54 | .58 | .49 |
| | (.50) | (.49) | (.50) |
| Household annual income | 64526 | 62926 | 66277 |
| | (151999) | (121441) | (179589) |
| Financial literacy test score | 1.65 | 1.71 | 1.59 |
| | (.71) | (.66) | (.75) |
| Cognitive reflection test (CRT) score | .90 | .92 | .89 |
| | (1.08) | (1.06) | (1.10) |
| Life satisfaction as a whole | 3.52 | 3.47 | 3.57 |
| | (.75) | (.73) | (.77) |
| Happiness | 3.83 | 3.74 | 3.92 |
| | (1.03) | (1.01) | (1.04) |
| *Panel B: Lottery-related characteristics* | | | |
| Ever purchased a lottery ticket last 12 months | .52 (.50) | | |
| Purchase lottery tickets weekly | | .45 (.50) | |
| Annual spending on lottery (S$) | | 1687 (3858) | |
| Ever won on a lottery last 12 months | | .43 (.49) | |
| Annual lottery winnings (S$) | | 353 (1335) | |
| Observations | 5626 | 2940 | 2686 |

*Note*: Standard deviations are reported in parentheses.

Panel B of Table 1 gives further descriptive statistics on the lottery-related variables in the SLP data set. The numbers reveal the extensive use of the lottery in the country of Singapore. Approximately 52 percent of respondents purchased a lottery ticket at least once in the previous 12 months. Of the respondents who purchased lottery tickets at least once, 45 percent of them purchased tickets every week. Average annual spending on lottery tickets per player was S$1687 (US$ 1221 or £994 UK sterling). Of those who purchased a lottery ticket at least once in the last 12 months, 43 percent of them won at least once, with average winnings of

approximately S$353.[5] As would be expected, the data indicate the extent of negative net returns to customers.

In our data set, the minimum and maximum of lottery ticket spending are S$1 and S$72,800. The minimum and maximum of (individual) lottery prizes are S$0 and S$30,000.

Singaporeans are known to be some of the world's most avid lottery players. According to an annual survey on worldwide lottery sales, Singapore has the world's largest lottery spending per-capita (Singapore National Council on Problem Gambling, 2015). An annual lottery ticket spending of S$1687 in our data set is a strikingly large amount by the standards of most nations.

Reassuringly, the sample statistics from our SLP data set are similar to the statistics reported in official government-run surveys. According to the National Gambling Participation Survey (NGPS), a tri-annual government survey on gambling, the average monthly lottery spending over all ages (including those below 18) was surveyed at S$212 per month in 2011 (S$2544 a year) and S$70 per month in 2014 (S$840 a year).[6] Given that the SLP sample is older than the NGPS sample, the annual lottery spending of S$1688 a year in SLP appears to be reasonable. The lottery participation rate in the SLP (52 percent) is also close to the gambling participation rate for individuals who are 50 years old and over in the 2014 NGPS (53%).

Figure 1 describes the distribution of spending on lottery tickets across deciles. It shows that the majority of lottery players are betting relatively small amounts of money while the top 10 percent of lottery players spend a remarkable $9,000 + a year. Figure 2 depicts the distribution of prize amounts among the lottery winners. Not surprisingly, even after excluding individuals who never win any lottery in the last 12 months, most winners receive only a small prize. Major wins are, of course, relatively uncommon.

To summarize, life satisfaction as a whole is on a scale of 0-5 based on the response to the question: "taking all things together, how satisfied are you with your life as a whole these days?" The responses can run from "very satisfied" (5) down to "very dissatisfied" (1). Happiness is on a scale of 6 points based on the response to the question: "during the past 30 days, how much of the time have you been a happy person?" The responses can run from "all of the time" (6) to "none of the time" (1). The cognitive reflection test CRT is on the scale of 0-3. Financial literacy is on the scale of 0-3. On this, there are three questions, so the variable is the total number of questions that are correctly answered.

## 3. Results

Tables 2 and 3 report regression equations. We begin, in column 1 of Table 2, by showing the famous conclusion that lottery wins make no difference to

[5]S$1 is equivalent to US$.72 at the time of writing.

[6]The big difference between the 2011 average and the 2014 average is probably due to the small sample as acknowledged by the report. Note that the NGPS include gambling activities in casinos, cruises, and local clubs as well as horse betting, the participation rate in those gambling activities is only 1-2% and the majority of gambling participation is lottery ticket purchases, so we argue that the statistics in the NGPS can be compared to our lottery-related statistics in the SLP.

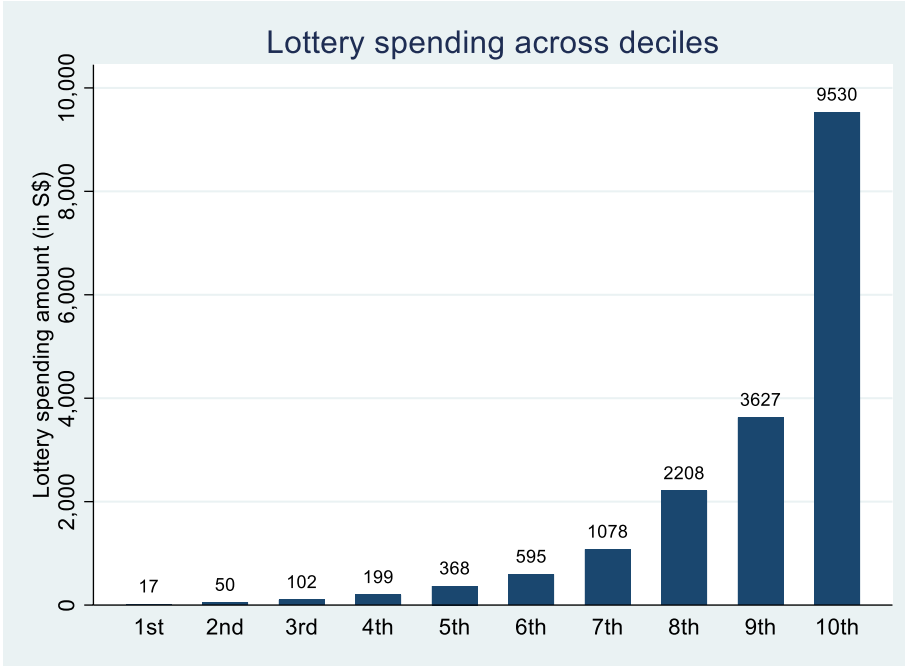


Figure 1. Distribution of Lottery Spending (Conditional on Lottery Participation)
*Source*: (here and throughout the paper) is the Singapore Life Panel 2016.

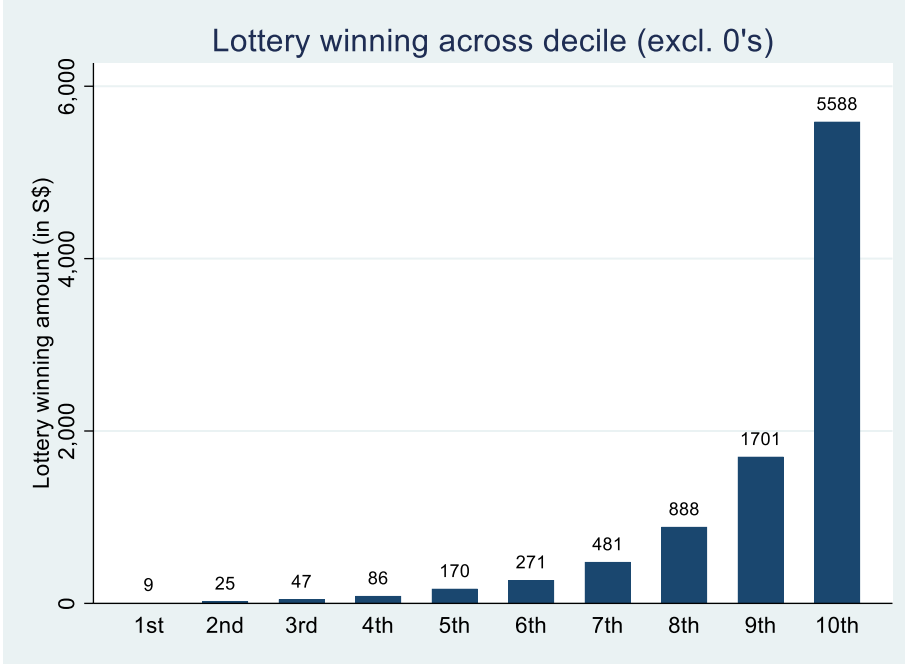


Figure 2. Distribution of Lottery Winning

TABLE 2
Effect of Lottery Winnings on Life Satisfaction

| | (1) | (2) |
|---|---|---|
| Log (lottery winning amount) | −.0010 | .0031** |
| | (.0013) | (.0015) |
| Log (lottery spending) | | −.0173** |
| | | (.0077) |
| Log (household income) | .0052* | .0071** |
| | (.0029) | (.0029) |
| Observations | 5,626 | 5,626 |
| $R^2$ | .031 | .035 |
| Individual characteristics | Yes | Yes |

*Notes*: This table gives life-satisfaction regression-equation results in which the key independent variables in the equation are listed vertically. Later tables adopt the same format.

Robust standard errors are reported in parentheses.

All specifications also include age, age squared, education attainment-fixed effect, race fixed effect, gender, marital status, number of children, cognitive reflection test score, financial literacy, and employment status. Column (2) includes a binary indicator for lottery participation in the last 12 months. Column 1 deliberately does not: see the main text. Life satisfaction as a whole is defined as a response to the question "Taking all things together, how satisfied are you with your life as a whole these days?." Respondents answer "very satisfied" (coded as 5), "satisfied" (coded as 4), "neither satisfied nor dissatisfied" (coded as 3), "dissatisfied" (coded as 2), and "very dissatisfied" (coded as 1). Unless specified, no interaction terms were used in this or later tables.

*Denotes significance at .10; **Denotes significance at .05; ***Denotes significance at .01.

TABLE 3
Effect of Lottery Winnings on Happiness

| | (1) | (2) |
|---|---|---|
| Log (lottery winning amount) | .0001 | .0062*** |
| | (.0017) | (.0021) |
| Log (lottery spending) | | −.0085 |
| | | (.0111) |
| Log (household income) | .0062 | .0094** |
| | (.0042) | (.0042) |
| Observations | 5,472 | 5,472 |
| $R^2$ | 0.024 | 0.030 |
| Individual characteristics | Yes | Yes |

*Notes*: Robust standard errors are reported in parentheses. All specifications include age, age squared, education attainment-fixed effect, race fixed effect, gender, marital status, number of children, cognitive reflection test score, financial literacy, and employment status. Column (2) includes a binary indicator for lottery participation in the last 12 months. Happiness is defined as a response to the question "During the past 30 days, how much of the time have you been a happy person?" Respondents answer "All of the time" (coded as 6), "Most of the time" (coded as 5), "A good bit of the time" (coded as 4), "Some of the time" (coded as 3) "A little of the time" (coded as 2) and "None of the time" (coded as 1).

*Denotes significance at .10; **Denotes significance at .05; ***Denotes significance at .01.

well-being. The dependent variable in Table 2 is the level of a person's life satisfaction, which is measured here on a five-point scale.[7] Column 1 in the table includes a set of independent variables as covariates: age, age squared, education, race, marital status, number of children, a cognitive ability test score, a financial-literacy

[7]If we use an ordered estimator, such as a logit, we obtain the same substantive results.

score, and employment status. Most of these are well-known from the statistical literature on happiness and subjective well-being (Diener and Biswas-Diener, 2002; Blanchflower and Oswald, 2004). The complete specification, with the coefficients on each of the covariates, is available as an illustration in the Appendix.

Column 1 of Table 2 provides a coefficient estimate on the variable for lottery winnings. The variable is entered as the natural logarithm of the amount won (expressed in Singapore dollars). It can be seen in column 1 that the coefficient on the lottery-winning-amount variable[8] is small, and negative, at −0.001. The standard error is 0.0013, so the estimated coefficient is not significantly different from zero at conventional cut-off levels. This is an illustration of the famous, and perplexing, finding that lottery winners appear to be hedonically indifferent to their financial win. They are not more satisfied with their lives than other people. Column 1 of Table 2 might be viewed as a modern-day version of Brickman's paradoxical conclusion.

This result changes, however, in column 2 of Table 2. The key alteration to the equation specification here is the inclusion of an extra independent variable, namely, a variable for the log of lottery spending. Now, in column 2 of Table 2, the coefficient on log of lottery winnings rises, to 0.003, and becomes statistically significantly different from zero at the 95 percent confidence cut-off.

For completeness, a lottery-participation dummy variable is also included in column 2. Quite deliberately, it should be explained, we do not include a lottery-participation dummy in the first column. This is because we are trying to mirror previous standard work on lotteries and happiness. That collection of studies could not observe those who participated in the lottery (assuming they did not win), so in the analysis here we leave out the participation dummy in the column 1 specifications of Table 2.

A similar pattern emerges from the results in Table 3, which calculates the effect of lottery winnings on a happiness variable. Column 1 of Table 3 produces, as before, a small coefficient (of 0.0001) that is not significantly different from zero. When there is no control for the amount of lottery spending, therefore, a lottery-win variable is estimated to enter with a negligible effect on people's well-being. Yet that finding alters, in column 2 of Table 3, when a variable for the log of lottery spending is included in the equation. The coefficient on log of lottery winnings rises to 0.0062, and becomes statistically significantly different from zero at the 99 percent confidence cut-off level.[9]

The scientific attraction of this kind of test is that lottery winnings are random, of course, once the number of tickets purchased is held constant. Thus, in principle, in our analytical framework the lottery winning amount is orthogonal to everything else, so that cross-sectional estimates should then be unbiased. The logarithmic specification in Tables 2 and 3 seem to work effectively. In a later table

[8]Because of the logarithmic form, those players who won nothing are here, following statistical convention, assigned in the regression equation a value of epsilon (here set to 0.00001).

[9]A referee has pointed out that controlling for person fixed-effects might go some way to alleviating the problem of omitted information on lottery spending. Adjusting for those person effects, where possible, might be a practical way for future researchers to address some of the difficulty discussed in this paper. However, it cannot be a complete fix for the problem, because some lottery players vary their spending.

TABLE 4
Effect of Lottery Winning by Banded-Size-of-Prize Amounts

| | Dependent Variable | |
|---|---|---|
| | Life Satisfaction | Happiness |
| | (1) | (2) |
| 0 < Lottery prize ≤ $1,000 | .0204 | .0740* |
| | (.0295) | (.0417) |
| $1,000 < Lottery prize ≤ $5,000 | .184*** | .200** |
| | (.0538) | (.0821) |
| $5,000 < Lottery prize ≤ $10,000 | .257** | .518*** |
| | (.102) | (.184) |
| Lottery prize> $10,000 | .260 | .666*** |
| | (.159) | (.184) |
| Log (lottery spending) | −.0203*** | −.0116 |
| | (.00779) | (.0111) |
| Log (household income) | .0069** | .0092** |
| | (.0029) | (.0042) |
| Observations | 5,626 | 5,472 |
| $R^2$ | .037 | .031 |
| Individual characteristics | Yes | Yes |

*Notes*: Robust standard errors are reported in parentheses. All specifications include age, age squared, education attainment-fixed effect, race fixed effect, gender, marital status, number of children, cognitive reflection test score, financial literacy, employment status, and lottery participation.
*Denotes significance at .10; **Denotes significance at .05; ***Denotes significance at .01.

below (Table 4), however, we will offer a different specification and discuss effect sizes.

It can be seen in Tables 2 and 3 that a control variable for the log of household income is estimated to have positive consequences for a person's well-being, with a coefficient in, for example, column 1 of Table 2 of 0.0052 (with standard error 0.0029). This coefficient on household income changes somewhat, in column 2 of Table 2, when the extra variable for lottery spending is introduced. It should be mentioned—as household income is not strictly exogenous—that dropping income from these two tables does not alter the key finding that lottery wins become statistically significant once lottery expenditure is held constant.

The persistence, in Tables 2 and 3, of the statistically significant coefficient on lottery winnings suggests that these equations are picking up a reliable feature of the data. That, in turn, raises a number of conceptual and practical issues. Why does a control for lottery spending bring about a reversal of the famous null finding and lead to the more common-sense conclusion that humans like lottery windfalls? A mechanical explanation would be that any kind of other spending should, in principle, reduce that person's ability to purchase other items. In more detail, however, it is possible to think of individuals as caring about a utility function, defined by the maximum value over a constrained maximization problem, where utility is denoted $v$ below:

$$v = v(\text{income from the lottery, expenditure on the lottery, other forms of income, personal characteristics})$$

In Tables 2 and 3, both lottery winnings and lottery spending enter with a logarithmic form, but the coefficients are not close to being of equal size but opposite in sign. Hence winnings and spending are apparently not here being treated in the same way, consciously or subconsciously, by the consumer of tickets. It is not sufficient to analyze "net" lottery income. This fact seems consistent with a form of psychological "separation," joy of winning, or mental accounting, and inconsistent with the life-cycle model of economics (in which individuals try to equate the discount-adjusted level of marginal utility in each period of their lives, and in which utility gains should thus be fairly small in any single period).

The paper's central result is not due to the use of a single dependent variable (as was adopted in Brickman's study). Table 3 reveals that the pattern is essentially the same for both a life satisfaction and happiness dependent variable.[10] Other outcome variables are studied in the Appendix.

Is a positively-sloped logarithmic form of win variable perhaps being forced unreasonably on the data, or might it be that the main result here stems from the influence, statistically, of just a tiny number of huge winners? The evidence suggests not.

Table 4, for example, repeats the same statistical method as earlier but, for generality, uses a set of banded size-of-win dummy variables rather than a logarithmic form. Encouragingly, the estimated coefficients on the sizes of the lottery-windfalls steadily rise (recalling that the base, in each of the two equations in Table 4, is a zero win). At the 95 percent confidence level it is admittedly not possible to reject the null hypothesis of zero on each of the very lowest coefficient numbers, such as 0.0204 and 0.0740, nor one of the very highest coefficient estimates for life satisfaction, 0.260, probably due in that case to few big-prize winners. Nevertheless, monotonicity holds in Table 4 across the eight lottery-win coefficients.[11] Changing the table's format to one with banded expenditure dummies does not alter the main conclusions (results available upon request). In passing, as lottery prizes extend far above the minimum point on the band defined as ">10,000," there is some reason, although we would be reluctant to make the case strongly without extra data, to believe in the kind of concavity that a logarithmic form captures. Future research may be able to return to the issue.

Some human beings rarely buy a ticket. If only active lottery players are considered, so that all non-players (in that particular year) are discarded from the data set being used in estimation, are the results sensitive to that? The answer seems to be: only rather marginally. Table 5 re-estimates Table 2 by using the active-player subsample alone. That necessarily leads to a marked reduction—almost a halving—in the size of sample. However, the paper's substantive conclusion goes through again: the inclusion, in column 2 of Table 5, leads to a significant increase in the lottery-win coefficient to 0.0030 and to a sufficiently small standard error. However, the estimated coefficient on income has risen very noticeably. It is

[10]While the life satisfaction question is asked in the SLP every month, the happiness question is asked in only once a quarter. Hence, we used the happiness data collected in Wave 15 because it was not included in Wave 16.

[11]We also checked a specification where banded lottery-expenditure variables were included in the equation.

TABLE 5
Effect of Lottery Winnings on Life Satisfaction using only Lottery Players

| | (1) | (2) |
|---|---|---|
| Log (lottery winning amount) | .00143 | .0030** |
| | (.00141) | (.0015) |
| Log (lottery spending) | | −.0245*** |
| | | (.0080) |
| Log (household income) | .0481*** | .053*** |
| | (.0099) | (.0100) |
| Observations | 2,940 | 2,940 |
| $R^2$ | .032 | .035 |
| Individual characteristics | Yes | Yes |

*Notes*: Robust standard errors are reported in parentheses. Column (2) includes a binary indicator for lottery participation in the last 12 months. Individual characteristics include age, age squared, education attainment-fixed effect, race fixed effect, gender, marital status, number of children, cognitive reflection test score, financial literacy, and employment status.

*Denotes significance at .10; **Denotes significance at .05; ***Denotes significance at .01.

TABLE 6
Effect of Lottery Winnings on Happiness using only Lottery Players

| | (1) | (2) |
|---|---|---|
| Log (lottery winning amount) | .0051** | .0063*** |
| | (.0020) | (.0021) |
| Log (lottery spending) | | −.0180 |
| | | (.0114) |
| Log (household income) | .0534*** | .0571*** |
| | (.0150) | (.0150) |
| Observations | 2,860 | 2,860 |
| $R^2$ | .026 | .027 |
| Individual characteristics | Yes | Yes |

*Notes*: Robust standard errors are reported in parentheses. Column (2) includes a binary indicator for lottery participation in the last 12 months. Individual characteristics include age, age squared, education attainment-fixed effect, race fixed effect, gender, marital status, number of children, cognitive reflection test score, financial literacy, and employment status.

*Denotes significance at .10; **Denotes significance at .05; ***Denotes significance at .01.

difficult to know the right interpretation of that, even though the coefficient on household income is not to be viewed as a causal estimate of the consequences of greater income.

An equivalent table (Table 6) holds for happiness, where the patterns are essentially the same as in Table 5, except that in this sub-sample, interestingly, even without a control for lottery spending there is evidence of a significant coefficient in column 1. However, the same direction of LT bias continues to be visible. Adding in the extra variable for lottery spending, within Table 6, leads to a rise in the lottery-win coefficient estimate to 0.0063 with a standard error of 0.0021. As before, lottery expenditure enters negatively in Tables 5 and 6. It would also be possible to adjust for a lagged dependent variable, and we have checked in each of the estimations that it also does not affect the main conclusion of the study.

It might be argued that the age profile of the participants in the current data set is a disadvantage. We are cognizant of that possibility. The original sampling frame was, of necessity, out of our hands. Nevertheless, it can be seen in the estimation

tables that, for this sample of people, the coefficients alter in the way that would be expected once allowance is made for LT bias for omitted lottery spending.

## 4. Discussion

Might the correlation between well-being scores and lottery wins merely be because, in the questionnaire, the happiness and life satisfaction scores came shortly after people were asked about lottery wins, so that individuals somehow felt psychologically "obliged" to say they were happy if they had just told the interviewer that they had received windfall money? This explanation does not seem correct. In the SLP questionnaire, interviewees are asked early on about their level of life satisfaction. The lottery–related questions only appear after answering more than 50 other questions on different subjects.

Do lottery prizes have implications for other kinds of well-being measures, such as health? That was not the objective of the project, so we had not considered this until late in the research project when asked it by colleagues. Some extra equations are given in Table A.1 in the Appendix. The first four columns are for health satisfaction and self-reported health. Here we follow the paper's earlier methods, and the patterns are similar to the previous results in the paper. The inclusion of lottery spending alters the key lottery-win coefficients; there is also a significant and negative coefficient on spending. For the last six columns of Table A.1, roughly equivalent conclusions emerge (here the equations are for "ill-being," so the signs reverse). Lottery wins in Table A.1 are therefore associated with a range of improved outcomes. However, we prefer to be cautious about interpretations of the results of Table A.1. The reason is that no adjustment here is made here for the multiple-comparisons problem of applied statistics (sometimes called the multiple-hypothesis testing problem). If formal Bonferroni adjustments were applied, for example, the standard errors would be far larger, even though the qualitative sign of all the coefficients is in the appropriate direction so a different test might be natural. As the intended purpose of this project was to scrutinize the Brickman paradox, and the appropriate standard-error adjustment that would be required for the extra outcome-variable equations is open to debate, Table A.1 is included as a statement of exploratory associations rather than as one designed to be definitive. Tables A.2 and A.3 give more details; A3 checks that the null hypothesis of random lottery wins cannot be rejected.

It is not easy to say why Kuhn *et al.* (2011) does not find a similarly positive effect (as they, interestingly, were able to control for the number of tickets purchased). It may be because their maximum prizes were somewhat smaller and shared with others in the locality.

Finally, and particularly importantly, it should be emphasized that one published paper (Apouey and Clark, 2015) has concluded that there is a statistically significant effect of lottery wins on current life satisfaction. Apouey and Clark use the British Household Panel, over a large number of years, and also explain the difficulty that they have been unable to control for the number of tickets purchased (though do not discuss in full detail the nature of LT bias). In their Table 3, Panel G, Column 9, the authors report a positive coefficient on lottery winnings in a current-period life satisfaction equation. Their two key variables are Demeaned

Log Prize, which has a coefficient that is significantly different from zero at the 95 percent confidence level, and Any Win, which is a dummy variable that has a coefficient not significantly different from zero. This specification seems fairly successful. It should be perhaps be noted, however, that the specification has one unusual and perhaps un-intuitive feature. Because of the de-meaning, lottery prizes of below-average size lead to a reduction in life satisfaction (relative to no win) unless the coefficient on Any Win is treated as statistically significant and always sufficiently large. The authors' formulation leads to a kind of non-linearity in the statistical specification. One possible way to make sense of the authors' interesting finding is that below-average lottery prizes show up as having negative consequences because the de-meaning of the variable is standing in for, and indirectly capturing, the omitted number of lottery tickets purchased. "Small" winners have paid out more in lottery tickets than they have won (because in the British lottery, like many other lotteries, only half of ticket spending is paid back in prizes, and those go disproportionately on a few giant prizes). Hence small winners are, in effect, losing money. This may help to make consistent Apouey and Clark (2015) and the results in Tables 2–6.

## 5. Conclusion

The lottery industry is a multi-billion-dollar global business. Although it seems strange to have to ask the question, does a lottery windfall have a beneficial effect on well-being? Do winners actually become happier?

For nearly half a century, it has proved remarkably difficult to produce evidence that a financial windfall improves a person's immediate level of happiness or psychological well-being[12]. The method of the early and seminal 1978 paper by Brickman *et al.* (1978) would not be considered adequate by today's empirical standards, but its remarkable finding—of the "indifferent" lottery winner—remains famous. Despite being counter-intuitive, the authors' null result has proved tenacious.

The current paper probes the consequences of a particular form of bias in lottery studies. This LT bias[13] stems from the fact that—by the arithmetic of lottery design—the typical winner has, on average, to spend a considerable prior amount on tickets.[14] Unless information on ticket purchases is available to the researcher, therefore, there will be an inevitable tendency for estimates of the happiness from lottery wins to be biased downwards. LT bias arises from the fact that (1) buying tickets is costly, (2) lotteries are specifically designed so that the probability of a prize is proportional to the amount a person spends on tickets, and (3) by definition those people with larger wins must on average have paid out more—in a

[12]However, the paper discusses, above, an important and particular result in Apouey and Clark (2015).

[13]As explained earlier, our paper does not explain the Brickman et al. study per se, because they had winners of huge amounts (and thus the expenditure on tickets would have been minor). As a referee has pointed out, it is also possible that unhappy people are drawn to play the lottery. Overall, it seems likely that they simply had unrepresentative individuals.

[14]Otherwise lotteries would be unable to provide their current large sums towards charitable donations and government funding.

predominantly unobservable way—on tickets. It is here that a hypothetical RCT windfall-experiment design is different from a lottery natural-experiment.[15]

The organizers of the SLP survey agreed to our request to insert new questions into their regular survey. This study thus collects and uses new data, from the intensely lottery-playing nation of Singapore, on the amount of income that people spend on lottery tickets. When happiness equations and life satisfaction equations are estimated without any adjustment for the amount spent on tickets, the famous null result is found. The coefficient on lottery winnings is small and statistically insignificantly different from zero (as in column 1 of Table 2, for example). However, once a lottery-expenditure variable is used as a control in happiness and life satisfaction equations, the long-standing puzzle disappears. Lottery wins improve well-being.

In closing, it should perhaps be emphasized that the present study concentrates on people's well-being levels approximately 12 months after a lottery win. However, it is possible, with data newly released to us, to show—as in the final Tables A.4 and A.5, of the Appendix—that significant well-being gains seem to persist into the following year.

Declaration of Interests. None.

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[15]LT bias would be negligible if national lotteries restricted people to be able to buy only a single ticket, but that is not how current lotteries have evolved.

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## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

**Appendix:**

**Table A.1**: Lottery Winnings and Additional Outcomes

**Table A.2**: Effect of Lottery Winnings on Life Satisfaction (Full Specification: Table 2)

**Table A.3**: Checking the Unpredictability of Winning: A Regression of the Ratio of Lottery Winning Amount over Lottery Ticket Spending

**Table A.4**: Effect of Lottery Winnings on Next Year's Life Satisfaction (t+1)

**Table A.5**: Effect of Lottery Winnings on Next Year's Happiness (t+1)