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Chasing rainbows: On the relationship between lottery tickets and common stocks

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**Chasing rainbows: On the relationship between lottery tickets
and common stocks**

by

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Wirtschafts- und Sozialwissenschaftliche Fakultät
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Chasing rainbows: On the relationship between lottery tickets and common stocks

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Abstract. This paper analyses the relationship between lottery tickets and common stocks using cross sectional household data for the U.K. and Germany. In contrast to a previous empirical finding that predicts a complementary effect and nonexpected utility models that predict a substitutional effect, we find that lottery tickets purchases and stock market investments are independent.

JEL Classification: G11, D12

1. Introduction

National lottery tickets purchases and stock market investments are two popular representatives for risk seeking behavior. Both activities share common features, such as bearing high risk and positive skewness. However, the relationship between national lottery tickets and common stocks is not clear. In this paper, we shed light on this problem by providing empirical evidence of whether they act as complements or as substitutes.

To our knowledge, there is no paper which addresses this problem explicitly. Research addressing this issue implicitly are the papers by Polkovnichenko (2005), Barberis and Huang (2008), Kumar (2009), and several papers on behavioral portfolio theory, such as Shefrin and Statman (2000), Statman (2002), Statman (2004), and Das, Markowitz, Scheid, and Statman (2010). Polkovnichenko (2005) and Barberis and Huang (2008) show that an investor with cumulative prospect theory preferences may take an undiversified position in a positively skewed security in order to add skewness to his portfolio. In a plausible scenario, this undiversified position can be filled by either one lottery ticket or one positively skewed stock. From this result we conclude that lottery tickets and common stocks may act as substitutes.

Like cumulative prospect theory investors in Polkovnichenko (2005) and Barberis and Huang (2008), behavioral portfolio theory investors make decisions under so-called nonexpected utility preferences. In behavioral portfolio theory (Shefrin and Statman, 2000; Statman, 2002, 2004; Das, Markowitz, Scheid, and Statman, 2010), investors form portfolios using layered pyramids where each layer acts as a subportfolio with a specific investment goal, similar to Maslow's hierarchy of needs. Each subportfolio is optimized independently and total wealth is allocated among layers. In the bottom layer of the pyramid the largest fraction of wealth is invested in securities designed to provide investors with security, such

as savings accounts, insurance policies, and money market funds. Further up the pyramid less wealth is invested for riskier securities, such as investment funds and real estate. At the pinnacle of the pyramid, where the smallest fraction of wealth is allocated, lie the most speculative investments, such as out-of-the-money call options, stocks and lottery tickets (Shefrin, 2002, pp. 122). Thus, the pinnacle layer refers to an undiversified and positively skewed subportfolio. For the same reason as for cumulative prospect theory investors in Polkovnichenko (2005) and Barberis and Huang (2008), we conclude from behavioral portfolio theory that lottery tickets and common stocks may act as substitutes.

In contrast, Kumar (2009) uses data on portfolio holdings and trades of individual investors at a large U.S. discount brokerage house and concludes the opposite. In particular, he regresses the preference for lottery-like stocks, which are defined as low-priced stocks with high idiosyncratic volatility and high idiosyncratic skewness, on, among other things, the mean annual per capita expenditure in state lotteries in the investor's state of residence and the number of years since the lottery adoption date in the investor's state of residence. The coefficient estimates for both lottery variables are positive and statistically significant, from which Kumar concludes that lottery-type stocks and state lotteries act as complements.

In this paper, we use data for the U.K. and Germany in which micro-level information on lottery expenditures and stock market investments is available. This allows us to address the question on the relationship between lottery tickets and common stocks more precise. Cross sectional regressions for four datasets, two for each country, draw a consistent picture that both activities are independent. This result confirms neither our conclusions from asset pricing models with nonexpected utility preferences nor the empirical finding by

Kumar (2009). Thus, the relationship between lottery tickets and common stocks remains puzzling.

The rest of the paper is organized as follows: Section 2 presents the four datasets and descriptive statistics of the lottery and stock variables. Section 3 documents cross-sectional regression results and Section 4 concludes.

2. Data

We use four cross-sectional datasets, two for the U.K. and two for Germany, which contain information on lottery expenditures and stock ownership. First, the OPCS Omnibus Survey, December 1995 (OPCS, 1995) is a British multi-purpose survey which was carried out in eight months of the year until April 2005. From this point it has run monthly. Each month's questionnaire consists of two elements: core questions, covering demographic information, and non-core questions that vary from month to month. The non-core questions for the OPCS Omnibus Survey, December 1995 are, among other things: ownership of and investment income from stocks, and National Lottery tickets and scratch cards purchases. It contains a sample of 2,043 households.

Second, the British Social Attitudes Survey 1996 (BSAS, 1996) is part of a survey series which has been conducted almost every year since 1983 and covers a sample of 3,620 households. Like the OPCS 1995, the BSAS 1996 consists of two elements: core questions, which are repeated in most years, and non-core questions that vary from year to year. The non-core questions for the BSAS (1996) are, among other things: stock ownership and National Lottery tickets purchases.

The two German datasets are the Einkommens- und Verbrauchsstichprobe (German survey of household income and expenditure) for 1993 and 2008 (EVS, 1993, 2008). The

Einkommens- und Verbrauchsstichprobe covers about 60,000 households age 18 and older representative for the German population structure. Households are requested every fifth year to supply data on household income and expenditure, savings, durable consumer goods and the housing situation. We use an 80 percent sample of the EVS 1993, the first wave for reunified Germany, and an 80 percent sample of the EVS 2008, the most recent wave. Both waves contain information on expenditures for games of chance and stock ownership. For each of the four datasets we define a variable for lottery expenditures and stock ownership, respectively. Table 1 presents definitions of lottery expenditures, stock ownership, and the demographic variables used in the empirical analysis.

Table 1 Definitions of Variables

Name	Dataset	Definition
Lottery ex- penditures	OPCS 1995	Spending on National Lottery tickets in the week ending last Saturday (in £)
	BSAS 1996	Spending in the latest National Lottery draw (in £)
	EVS 1993	Yearly expenditures on lotteries and other games of chance (in DM)
	EVS 2008	Yearly expenditures on games of chance (in €)
Stock own- ership	OPCS 1995	Dummy = 1 if household owns any shares quoted on the Stock Exchange, including unit trusts

Table 1 continues on next page

Table 1 continues from previous page

Name	Dataset	Definition
	BSAS 1996	Dummy = 1 if household owns any shares quoted on the Stock Exchange, including unit trusts
	EVS 1993	Value of stock portfolio at the time data was recorded (in DM)
	EVS 2008	Value of stock portfolio at the time data was recorded (in €)
Age	All datasets	Age of respondent in years
Male	All datasets	Dummy = 1 if respondent is male
Married	All datasets	Dummy = 1 if respondent is (living as) married
Income	OPCS 1995	Weekly gross personal income (in £): <80, 80 - 159, 160 - 349, >349
	BSAS 1996	Weekly gross household income (in £): <78, 78 - 154, 155 - 346, >346
	EVS 1993	Yearly net household income (in DM/10,000)
	EVS 2008	Yearly net household income (in €/10,000)
Education	OPCS 1995	Not available
	BSAS 1996	Dummy = 1 if respondent owns a degree, higher education below degree, A-level

Table 1 continues on next page

Table 1 continues from previous page

Name	Dataset	Definition
	EVS 1993	Dummy = 1 if respondent owns a university entrance degree (Abitur)
	EVS 2008	Dummy = 1 if respondent owns a university entrance degree (Abitur)

This table presents definitions of lottery expenditures, stock ownership, and the demographic variables used in the empirical analysis.

To get a first impression of the relationship between both activities, Table 2 shows descriptive statistics of lottery participation, which is one if lottery expenditure is positive and zero otherwise, and stock ownership, which is one if the respondent owns stocks and zero otherwise. The relative frequency of lottery participation is similar within and substantially different across countries. In the U.K., the last week's lottery participation rate lies in the sixties percent, whereas in Germany, the last year's lottery participation rate lies in the forties percent. The relative frequency of stock ownership is similar across countries and ranges between 12 and 24 percent. The conditional relative frequency of lottery participation under the condition that the respondent owns stocks, $f_n(L|S) = f_n(L \cap S)/f_n(S)$, is similar within and different across countries. In the U.K., it is 61 percent, whereas in Germany, it is 44 and 52 percent respectively. The main result from Table 2 is that for all datasets the conditional relative frequencies are almost equal to the relative frequencies, that is $f_n(L|S) \approx f_n(L)$ and $f_n(S|L) \approx f_n(S)$. This observation indicates that lottery participation and stock ownership are independent. Additional descriptive statistics of lottery expenditures, stock ownership, and of the demographic variables are shown in Table 6 in the appendix.

Table 2 Frequencies of lottery participation and stock ownership

	OPCS 1995	BSAS 1996	EVS 1993	EVS 2008
n	2,043	3,620	40,230	44,088
$F_n(L)$	1,284	2231	16,164	22,558
$f_n(L)$	0.628	0.616	0.402	0.466
$F_n(S)$	390	858	4,788	8,244
$f_n(S)$	0.191	0.237	0.119	0.187
$F_n(L \cap S)$	236	520	2,086	4,257
$f_n(L \cap S)$	0.116	0.144	0.052	0.097
$f_n(L S)$	0.605	0.606	0.436	0.516
$f_n(S L)$	0.184	0.233	0.129	0.207

This table shows absolute ($F_n(\cdot)$), relative ($f_n(\cdot)$), and conditional relative ($f_n(\cdot|\cdot)$) frequencies of lottery participation (L), stock ownership (S), and lottery participation and stock ownership ($L \cap S$) for all datasets.

3. Results

We regress lottery expenditures on stock ownership and demographic variables as defined in Table 1. To account for many zeros in the dependent variable, which stem from subjects who did not engage in gambling activities in the sample periods, we use a Tobit model for our baseline regressions.

Table 3 presents the coefficient estimates for the U.K.. Univariate regressions for both OPCS 1995 and BSAS 1996 do not reveal a statistical significant impact from stock ownership to lottery expenditures. However, the multiple regression model for OPCS 1995 reveals a significantly negative relationship between lottery expenditures and stock ownership, which indicates a substitution effect. The effect for BSAS 1996 remains insignificant.

Table 4 shows the coefficient estimates for Germany. Again, univariate regressions do not uncover a significant effect. However, for both German datasets, multiple regressions identify a significant negative, but economic weak, relationship between lottery expenditures and stock ownership, which indicates a substitution effect.

Concerning the demographic variables, Table 3 and 4 draw a consistent picture across all datasets. In Table 5 we compare our results with those of Clotfelter and Cook (1989) for the U.S., Scott and Garen (1994) and Farrel and Walker (1999) for the U.K., and Beckert and Lutter (2008) for Germany. We find an inverse u-shaped age effect, which has been also found by Clotfelter and Cook (1989), Scott and Garen (1994), and Farrel and Walker (1999). For Germany, Beckert and Lutter (2008) find no significant age effect. Men play more than women, which is in line with Clotfelter and Cook (1989) and Farrel and Walker (1999). Scott and Garen (1994) and Beckert and Lutter (2008) find no significant gender effect. Concerning marital status, we find that married people spend more on lottery tickets purchases, which confirms Farrel and Walker (1999), but contradicts Scott and Garen (1994). There is a broad consent among previous and our findings that the lower education the higher the spendings on national lottery tickets purchases. In line with Farrel and Walker (1999) and Beckert and Lutter (2008), we find that absolute lottery expenditures increase with income.

In order to check the robustness of our results, we run additional regressions using alternative specifications. To see whether our results stem from the large proportion of non-lottery players in the samples, we estimate the model by OLS on the subsample of lottery players (subjects with positive lottery expenditures). Table 7 in the appendix presents the coefficient estimates for all four datasets. The effect of stock ownership on lottery expenditures is not significant, which indicates that the observed significant negative effect

Table 3 Estimation results for OPCS 1995 and BSAS 1996

Tobit model - dependent variable: Lottery expenditures				
	OPCS 1995		BSAS 1996	
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Stock ownership	-0.236 (-1.45)	-0.525 ***(-2.82)	0.451 (0.78)	0.178 (0.33)
Age		0.145 *** (5.19)		0.331 ** (2.33)
Age ²		-0.002 ***(-5.65)		-0.003 **(-2.35)
Male		0.469 *** (3.29)		0.750 *** (2.81)
Married		0.403 *** (2.67)		1.574 *** (2.61)
Income				
< £80 (< 78)		-0.441 **(-1.99)		-1.582 (-1.43)
£80 - 159 (£78 - 154)		-0.195 (-0.89)		-1.117 (-1.21)
£160 - 349 (£155 - 346)		0.046 (0.22)		-0.047 (-0.09)
> £349 (> £346)		ref. group		ref. group
Education				-2.464 **(-2.23)
Constant	0.647 *** (5.75)	-2.342 ***(-3.55)	-1.960 (-1.47)	-8.627 **(-2.33)
Prob > F	0.148	0.000	0.434	0.000
n	2,009	2,009	3,573	3,166

This table presents coefficient estimates for the U.K. from Tobit regressions using heteroscedasticity consistent standard errors. *t*-values are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

Table 4 Estimation results for EVS 1993 and EVS 2008

Tobit model - dependent variable: Lottery expenditures				
	EVS 1993		EVS 2008	
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Stock ownership	0.001 (1.59)	-0.001 *(-1.84)	0.001 (1.57)	-0.001 ***(-2.69)
Age		51.42 *** (13.65)		83.80 *** (9.39)
Age ²		-0.472 *** (-12.86)		-0.608 *** (-8.37)
Male		275.2 *** (12.45)		248.0 *** (6.44)
Married		34.20 * (1.66)		91.41 *** (2.58)
Income		27.20 *** (11.85)		108.4 *** (8.95)
Education		-251.9 *** (-15.86)		-292.8 *** (-8.22)
Constant	-382.0 *** (-18.98)	-1,902 *** (-18.97)	-709.9 *** (-5.60)	-3,692 *** (-9.12)
Prob > F	0.112	0.000	0.117	0.000
n	40,183	40,183	44,026	44,026

This table presents coefficient estimates for Germany from Tobit regressions using heteroscedasticity consistent standard errors. *t*-values are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

Table 5 Comparison with previous literature

Paper/dataset	Country	Age	Male	Married	Income	Education
Clotfelter and Cook (1989)	U.S.	inv u	pos	-	ns	neg
Scott and Garen (1994)	U.K.	inv u	ns	neg	ns	neg
Farrel and Walker (1999)	U.K.	inv u	pos	pos	pos	neg
Beckert and Lutter (2008)	Germany	ns	ns	ns	pos	neg
OPCS 1995	U.K.	inv u	pos	pos	pos	-
BSAS 1996	U.K.	inv u	pos	pos	ns	neg
EVS 1993	Germany	inv u	pos	pos	pos	neg
EVS 2008	Germany	inv u	pos	pos	pos	neg

This table compares the results for all demographic variables, presented in Table 3 and 4, with previous findings for the U.S., U.K, and Germany. “inv u” means a significant inverse u-shaped effect; “pos” a significant positive effect; “neg” a significant negative effect; “ns” not significant; and “-” that the variable is not available.

from the Tobit regressions is due to the large number of non-lottery players. Most of the results for the demographic variables are in line with those from the Tobit regressions presented in Table 3 and 4.

We also run a Probit regression with a dichotomous dependent variable that equals one if the subject purchases lottery tickets and zero otherwise. In this regression (estimation results presented in Table 8 in the appendix), we find a significant negative effect between stock ownership and lottery expenditures. This result indicates that the negative impact from stock ownership to lottery expenditures stems from differences in stock ownership between people who purchase lottery tickets and people who do not.

4. Conclusion

Motivated by a recent stream of finance literature, this paper investigates the relationship between lottery tickets and common stocks. Based on cross-sectional regressions for the U.K. and Germany we do not find evidence that they act as substitutes or as complements. In addition to our conclusion from so-called nonexpected utility models that both activities may act as substitutes and Kumar's (2009) empirical finding that they may act as complements, we argue that both activities are independent from each other. Thus, the relationship between lottery tickets and common stocks remains puzzling.

However, our's as well as Kumar's analysis suffers from the same methodological drawback. Since we use cross-sectional data, price dynamics are not available. Hence, we are not able to estimate cross price elasticities and to argue in a correct (micro)economic sense. Our results are therefore only proxies for a possible direction. Time series data or data from which price dynamics can be generated provide a more accurate foundation to analyze this problem. As this problem has raised recent interest in the finance literature and as it remains puzzling, we encourage researchers and practitioners to further investigate this relationship.

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Appendix

Table 6 Summary statistics

Variable/dataset	n	Mean	Std. Dev.
Lottery expenditures			
OPCS 1995	2,043	1.365	2.031
BSAS 1996	3,618	1.593	7.669
EVS 1993	40,202	247.9	563.7
EVS 2008	44,032	442.4	1,299
Stock ownership			
OPCS 1995	2,009	0.194	0.396
BSAS 1996	3,575	0.243	0.429
EVS 1993	40,185	2,709	19,154
EVS 2008	44,027	4,591	32,803
Age			
OPCS 1995	2,043	48.52	18.71
BSAS 1996	3,605	46.27	17.79
<i>Table 6 continues on next page</i>			

Table 6 continues from previous page

Variable/dataset	n	Mean	Std. Dev.
EVS 1993	40,230	50.78	16.57
EVS 2008	44,088	51.61	16.53
Male			
OPCS 1995	2,043	0.442	0.497
BSAS 1996	3,620	0.457	0.498
EVS 1993	40,230	0.650	0.477
EVS 2008	44,088	0.600	0.490
Married			
OPCS 1995	2,043	0.541	0.498
BSAS 1996	3,615	0.657	0.475
EVS 1993	40,230	0.571	0.495
EVS 2008	44,088	0.460	0.498
Income			
OPCS 1995			
<£80	2,043	0.278	0.448
£80 - £159	2,043	0.239	0.427

Table 6 continues on next page

Table 6 continues from previous page

Variable/dataset	n	Mean	Std. Dev.
£160 - £349	2,043	0.256	0.437
> £349	2,043	0.143	0.351
BSAS 1996			
< £78	3,182	0.164	0.371
£78 - £154	3,182	0.220	0.414
£155 - £346	3,182	0.329	0.470
> £346	3,182	0.287	0.452
EVS 1993	40,205	5.268	3.600
EVS 2008	44,033	4.141	2.517
Education			
OPCS 1995	-	-	-
BSAS 1996	3,591	0.395	0.489
EVS 1993	40,230	0.374	0.484
EVS 2008	44,088	0.480	0.500

This table presents mean and standard deviation of lottery expenditures, stock ownership and the demographic variables after outlier correction.

Table 7 OLS estimation results for OPCS 1995, BSAS 1996, EVS 1993, and EVS 2008

OLS regression - dependent variable: Lottery expenditures				
	OPCS 1995	BSAS 1996	EVS 1993	EVS 2008
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Stock ownership	-0.267 (-1.64)	-0.658 (-0.44)	-0.000 (-0.08)	0.002 (1.16)
Age	0.023 (1.29)	0.338 (1.44)	4.946 (1.60)	11.43 *** (6.92)
Age ²	-0.000 ** (-2.07)	-0.003 (-1.39)	-0.012 (-0.41)	-0.067 *** (-4.09)
Male	0.530 *** (4.50)	2.162 (1.22)	124.4 *** (6.84)	46.42 *** (4.53)
Married	-0.112	3.254	-115.4	-35.97
<i>Table 7 continues on next page</i>				

Table 7 continues from previous page

	OPCS 1995	BSAS 1996	EVS 1993	EVS 2008
	(-0.86)	(1.41)	***(-5.11)	**(-2.10)
Income			31.70	17.02
			*** (11.46)	*** (3.57)
<£80 (<£78)	-0.750	8.950		
	**(-2.51)	(1.03)		
£80 - 159 (£78 - 154)	-0.657	1.781		
	**(-2.13)	(0.10)		
£160 - 349 (£155 - 346)	-0.608	1.988		
	**(-1.97)	(0.79)		
>£349 (>£346)	ref. group	ref. group		
Education		1.017	-66.59	-51.77
		(0.46)	***(-5.51)	***(-5.85)
Constant	2.440	-9.497	204.0	-156.8
	*** (6.19)	(-1.12)	*** (2.86)	*** (-3.64)
Prob > F	0.000	0.189	0.000	0.000
n	1,192	1,982	16,164	20,531

This table presents coefficient estimates for the U.K. and Germany for the reduced samples of lottery players. We run OLS regressions using heteroscedasticity consistent standard errors. t -values are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

Table 8 Binary regression for OPCS 1995, BSAS 1996, EVS 1993, and EVS 2008

Probit model - dependent variable: Lottery dummy				
	OPCS 1995	BSAS 1996	EVS 1993	EVS 2008
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Stock ownership	-0.228 ***(-2.89)	-0.098 *(-1.70)	-0.000 **(-1.91)	-0.000 ***(-3.66)
Age	0.060 *** (5.75)	0.048 *** (5.98)	0.051 *** (16.52)	0.048 *** (17.03)
Age ²	-0.001 ***(-6.01)	-0.001 ***(-6.57)	-0.000 ***(-15.88)	-0.000 ***(-14.16)
Male	0.018 (0.27)	0.166 *** (3.47)	0.209 *** (11.97)	0.042 *** (2.90)
Married	0.292	0.264	0.103	0.150

Table 8 continues on next page

Table 8 continues from previous page

	OPCS 1995	BSAS 1996	EVS 1993	EVS 2008
	*** (4.43)	*** (4.93)	*** (5.74)	*** (9.74)
Income			0.012	0.041
			*** (6.06)	*** (13.96)
<£80 (<£78)	-0.143	-0.221		
	(-1.33)	** (-2.20)		
£80 - 159 (£78 - 154)	-0.042	-0.213		
	(-0.39)	*** (-2.80)		
£160 - 349 (£155 - 346)	0.106	-0.005		
	(1.08)	(-0.08)		
>£349 (>£346)	ref. group	ref. group		
Education		-0.339	-0.283	-0.157
		*** (-6.23)	*** (-20.75)	*** (-12.41)
Constant	-0.999	-0.641	-1.682	-1.698
	*** (-3.85)	*** (-3.31)	*** (-22.89)	*** (-23.70)
Prob > χ^2	0.000	0.000	0.000	0.000
<i>n</i>	1,872	3,182	40,228	44,033

This table presents coefficient estimates from binary regressions with a dichotomous dependent variable that equals one if the household purchases lottery tickets and zero otherwise. We run Probit regressions using heteroscedasticity consistent standard errors. *t*-values are in parentheses. Significance level: * 10%, ** 5%, *** 1%.