08-

Saving whilst Gambling: An Empirical Analysis of U.K. Premium Bonds

Peter Tufano

Saving whilst Gambling: An Empirical Analysis of U.K. Premium Bonds

Peter Tufano*

For over three centuries and across the globe, lottery-linked savings (LLS) programs have offered individuals the opportunity to save, and in lieu of paying traditional interest, have given savers periodic chances to win money or prizes. Despite their long history, LLS programs are relatively unstudied by scholars.[1] In this paper, I detail an LLS program that the UK government has offered continuously since 1956, the UK Premium Bond (PB) program. PBs guarantee holders risk-free return of nominal principal. In aggregate, they pay a market-related return, distributed to holders each month by a lottery-like mechanism.

Premium bonds are popular savings vehicles in the UK. Over £31.1 billion of PBs were outstanding as of March 2006, and public reports suggest that they were held by between 22 percent and 40 percent of UK citizens. The 60.2 million residents of the UK had £517 invested in PBs per capita. If held in the banking sector, PB holdings would have accounted for 3.9 percent of household sterling deposits in UK financial institutions.

LLS programs, such as PBs, are fascinating not just because of their size, but because of their appeal to non-savers, especially low income families. Mauro Guillén and Adrian Tschoegl 2002, reviewing LLS programs in Latin America, concluded: "The bankers we spoke with believe that [LLS] are especially successful with low-income depositors, and in cases where there are lots of people outside the banking system." In South Africa, a new LLS program raised over 1.2 billion rand and enrolled 750,000 participants across a wide spectrum of the economy in

* Harvard Business School, Boston, MA 02163 (ptufano@hbs.edu) and NBER. This paper is forthcoming in the *American Economic Review Papers and Proceedings* (2008). Minh Phuong Bui, Jan-Emmanuel De Neve, Emily McClintock Ekins, and Laura Serban provided useful research support. Thanks to Rebecca Blank, Sebastian Lobe, and Olivia Mitchell and to seminar participants at the Oxford Finance Symposium and the University of Regensburg for very helpful comments, and to the Division of Research of the Harvard Business for financial support. An expanded version of this paper is available at http://www.people.hbs.edu/ptufano.

[1] Notable exceptions are Mauro Guillén and Adrian Tschoegl 2002 and Sebastian Lobe and Alexander Hölzl 2007.

two years. In the United Kingdom, while PBs are held by about the same fraction of the population holding stocks, PBs have a stronger appeal to lower-income British households. PBs are held by a larger fraction of British households than are stocks and shares for all households, except those earning over £52,000 annually (Department for Work and Pensions, 2007).

Are PB holders saving, gambling, or engaging in both activities? This question is not just academic, because national laws and regulations in many countries bar private LLS programs on the basis that they are prohibited gambling activities. For example, in South Africa, the government has tried to shut down the popular LLS program mentioned above; in the United States, these programs would violate state lottery laws and federal banking regulations. In this paper, I analyze the time series of net sales of the PB program and conclude that the program appears to be a hybrid of gambling and savings, but with a clear savings element.

I. Theory of LLS and Premium Bond Background

In functional terms, LLS combine a riskless return of principal plus a risky additional payment, as if traditional savers pooled their interest and awarded it on the basis of a drawing. The payoff on an LLS program is like a bond-plus-call position embodied in popular products like guaranteed equity funds or principal protected notes. For all of these products, this asymmetric payoff structure appeals to loss-adverse investors, as described by Daniel Kahneman and Amos Tversky 1992. LLS programs also benefit from the tendencies of consumers to be more risk loving for small gambles than large ones, and to misestimate the probabilities of rare events (see Marie Pfiffelmann 2006).

The appeal of LLS to new savers or nonsavers may reflect the alternative products available to households that seek savings as a buffer for potential emergencies. These savers,

who demand liquidity and no principal loss, are usually limited to low-yielding demand deposits. With short uncertain savings horizons and small balances, the magic of compound interest provides little incentive to save. Further, many would rather give up the certainty of a small payoff for a small chance at a large payoff, explaining why 21 percent of Americans—and 38 percent of lower-income Americans—felt that winning the lottery was the most practical way to accumulate a large sum of money (See http://www.fpanet.org/member/press/releases/010906_personalwealth.cfm).

LLS programs have existed since at least the 1694 "Million Adventure" in the United Kingdom (See Anne L. Murphy 2005). In 1896, Henri Levy-Ullmann reported LLS in most of the financial markets of Europe, including Germany, Austria, Spain, Greece, Italy, Sweden, and Switzerland. More recently, Guillén and Tschoegl 2002 identified programs in the United Kingdom, Sweden, Japan, France, Germany, Turkey, Kenya, Indonesia, Spain, Mexico, Argentina, and Pakistan.

British Prime Minister Harold Macmillan launched Premium Bonds in 1956 as "Savings with a Thrill!"—predicting that PBs would "appeal to those who are not attracted by the rewards of interest, but do respond to the incentives of fortune" (www.nsandi.com/pdf/history_pb.pdf). Today, PBs are available for a minimum investment of £100 and a maximum investment of £30,000. PBs are perpetuities with no stated maturity. They can be purchased by UK residents over the age of 16 for themselves, or for children by adult family members. Each non-transferable one-pound bond entitles the holder to one chance to win a cash prize during each monthly drawing. Owning more bonds increases one's chance of winning. Cash prizes currently range from £50 to £1 million, and winnings are exempt from taxation. The investment attractiveness of the program is determined by prizes offered, odds of winning, and aggregate

yield, all of which are publicly disclosed. Over time, the top prizes, odds, and yield for the bond program changed, and its popularity has waxed and waned. Rates on other investments also varied, as have the economic conditions of British citizens. I exploit this time series variation to understand the determinants of PB demand.

II. Savings, Gambling or Both? Three Perspectives

To gauge whether British consumers treat PBs as saving, gambling, or a blend of the two, I conduct three analyses. First, I examine the correlations between net PB sales, gambling activity, and a measure of savings activity. Second, I examine the determinants of net sales of PBs looking at factors that would relate to gambling and savings. Finally, I examine determinants of gross sales and redemption activity of PBs. All of these analyses use annual data expressed in real terms and on a per capita basis. An expanded version of this paper provides additional results, some of which are reported here.

A. Savings and Gambling Correlations. First, I report the correlations among PBs, savings, and gambling. Net PB sales per capita are available from 1957 though 2006. To measure traditional riskless savings, I use the time series of household fixed income holdings (M4) less cash at home and checking accounts ("adjusted M4"). This series, available from 1978 through 2006, measures changes in holdings in savings accounts, time deposits, building society accounts, notice accounts, and certain tax-advantaged accounts; it does not include Premium Bonds (Bank of England 2006). For a measure of gambling activity, I use the time series of general betting, pool betting, bingo betting, and the National Lottery, taken from Her Majesty's Revenue and Customs and available from 1987 through 2006. All of the variables are annual flows (net sales of PBs, changes in adjusted M4 holdings, and annual gambling activity),

expressed in constant 2006 pounds using the Retail Price Index (RPI), and are quoted on a per capita basis.

On an annual basis, premium bond net sales are positively correlated with both gambling activity and changes in adjusted M4, with correlation coefficients (ρ) of 0.766 and 0.269, respectively. The correlation between gambling and M4 is likewise positive ($\rho = 0.479$). Both of the correlations with gambling are significant at conventional levels of 0.05 or better, and the premium bond-M4 correlation has a p-value of 0.16. When the first differences of the series are examined (e.g., changes in net PB sales, changes in M4 flows, and changes in gambling flows), none of the correlations is significantly different from zero. The correlations in levels of flows of the series suggest that they are complements or correlated with a common macro-factor, such as wealth. The first difference results, however, suggest that they are largely independent series.

B. Understanding PBs through Determinants of their Sales. One can analyze the determinants of PB sales to see if they respond more strongly to gambling or savings factors. The dependent variable for this analysis is net PB sales per capita expressed in constant 2006 pounds using the Retail Price Index (RPI). The expanded version of this paper provides data sources and statistics for the explanatory variables described below.

The Terms of the PB Investment/Gamble. In aggregate, PBs pay out and report a periodic rate of interest (or prize rate) equal to prizes paid as a fraction of the value of bonds outstanding. This prize rate, analogous to a bond yield, captures information on the number, size, and odds of the various prizes. The prize rate has generally been lower than the rate paid on comparable government bonds, which suggests that the PB investors voluntarily forgo return to purchase this instrument, a signal that PBs have some noninvestment appeal. To measure their relative quality as an investment, I use the *prize rate spread*, equal to the prize rate less the three-month gilt rate.

One would predict a positive relationship between the prize rate spread and sales if consumers evaluate and compare PBs relative to other savings alternatives.

Research on gambling shows that people might focus not so much on the average return, as much as on the size of the *largest prize*. By itself, the size of the large prize provides less than 2% of the payout to holders, but might be behaviorally salient. Prior research in lotteries finds that participation responds to large prizes in the form of jackpots (see David Forrest, Robert Simmons and Neil Chesters 2002). If PBs were framed as gambling, demand would vary positively with the largest prize. (Lobe and Hölzl 2007 use the skewness of the prizes, but to relate findings more directly to lottery findings, I use the large prize specification.)

Marginal Income Tax Rate. Winnings from premium bonds are not taxable, therefore as tax rates rise, PBs should become relatively more attractive, especially to highly taxed individuals. I use the *highest marginal income tax rate* as an indicator of taxation, but also examine the basic rate applicable to lower income filers.

The Rates Offered by Risky Investments. As discussed above, the prize rate spread captures the attractiveness of PBs relative to bonds. However, the payoff on the PB is variable, and buyers may frame it more against more risky products, like equities. Therefore, I also examine the response of PB sales to annual returns and the realized volatility of the *FTSE All Shares Index*, a broad index of UK stocks.

Relationship to savings. Net sales of any individual savings products should be strongly positively correlated with periods in which households were savings, i.e., when income exceeded consumption. However, if PBs were especially attractive to nonsavers (or during periods when people were not otherwise saving), this correlation could be negative. For saving, I use *real gross savings per capita*, measured as aggregate household income less consumption.

Income levels, income disparities, and unemployment. One might expect investing activity to rise with income, while gambling and lottery activity may be regressive. While the direction of the predicted relation is unclear, I relate PB sales to *per capita real income levels*.

Psychologists and sociologists have written about factors that promote gambling, including economic disparities between classes (see James H. Frey 1984 for a survey.) To capture economic disparities, I collect two variables: the *unemployment rate* (fraction of adults seeking unemployment benefits) and a standard measure of inequality, the *GINI Coefficient*.

Multivariate Results. I use a linear regression model to investigate the relationship between the net demand for PBs and potential determinants. Virtually all of the variables of interest are integrated of order one and cannot be reliably analyzed in levels. Augmented Dickey-Fuller tests cannot reject the null of unit-root nonstationarity at any acceptable level of confidence for the variables of interest, but can reject the null of unit-root nonstationarity at the 5 percent level of significance for all the first-differenced variables. Therefore, all regressions use first differences (William H. Greene 1997). Table 1 (first column) reports a multivariate model using annual data; the expanded version of this paper adds quarterly and monthly results, alternative specifications, and additional tests. Nominal quantities are expressed in 2006-adjusted pounds.

PB net sales are positively correlated with the size of the largest prize offered, corroborating findings from research on lotteries. The large prize is a salient factor in explaining demand—consistent with the PB as being framed in part as a gambling activity. This result persists in quarterly (but not monthly) specifications. At the same time, PB demand is also related to its quality as an investment and to the return offered by alternative investments. Annual net sales (as well as quarterly and monthly net sales) are higher when the prize rate

spread (prize rate less gilt rate) is larger. These two effects are statistically significant (at the 10 percent level) and economically material, with a one-standard-deviation change in the large prize and the spread corresponding to 23 percent and 13 percent changes in net sales, respectively. Like a gambling activity, large prizes stimulate sales (despite their economic unimportance) and, like a savings vehicle, the relative interest rate stimulates sales.

Net PB sales are also positively correlated with annual stock returns. When stock returns are high, perhaps people who do not own shares take more speculative investment to catch up, or equityholders' rise in wealth induces PB sales. Without household level data, it is not feasible to disentangle these two possibilities. This less robust result holds for annual, but not quarterly or monthly, specifications.

The specifications in Table 1 also report some of the other control variables. There is a negative relationship between gross per capita savings (income less consumption) and PB sales for annual observations. As predicted by the casual observations in other countries, PBs are demanded more when UK investors otherwise have less to save. There is no clear relationship between changes in income inequality and changes in net PB sales, nor between unemployment rates and net PB sales.

In addition, I tested a number of specifications not reported in Table 1. There is no relationship between net PB sales and changes in either per capita gross income or total household spending, nor with the basic tax rate or maximum individual holding cap permitted under the program. However, inclusion of some of these variables attenuates the significance but not signs of other regressors in some specifications. Net sales were not related to a range of weather variables (unlike lottery sales and stock markets). Finally, I included changes in

adjusted M4, but it was not statistically significant in any specification. Data problems prevented the inclusion of an appropriate education variable.

One curious result is that annual net PB sales are *negatively* related to the highest marginal tax rates. One would expect a positive relationship, given the tax-exemption on winnings. One possibility is that this coefficient reflects an indirect wealth effect, i.e., higher taxation leads to lower investable wealth.[2]

Overall, these results suggest that Premium Bond demand mixes gambling and savings motives. As a gambling vehicle, changes in the size of the largest prize drive sales, but as a savings vehicle, demand is sensitive to its relative yield, as well as the returns and volatilities of stocks. The increase in sales when savings is low corroborates the anecdotal evidence that the product may appeal particularly to non-savers.

C. Precautionary Saving? If PBs were precautionary savings, idiosyncratic shocks would drive redemptions, whereas sales might reflect the saving or gambling motives. If however, PBs were long-term investments or simple gambles, then sales would be the mirror image of redemptions: whatever factor makes the bonds more attractive would increase sales and decrease redemptions. The second and third columns of Table 1 report, separately, gross sales and gross redemptions, both measured on a per capita real basis. Although the large prize and the prize fund spread are related to PB gross sales, neither has a material relationship with PB redemption. The failure of the large prize or the prize rate spread to predict redemptions is consistent with PB use as precautionary savings. Households might redeem bonds to cover unexpected shocks or planned expenditures.

[2] For comparison, I repeated the analyses in Table 1 using differences in annual adjusted M4 flows as the dependent variable. Like net sales of PBs, changes in M4 are negatively related to the highest marginal tax rates, consistent with a wealth effect. In addition, M4 holdings are reduced when the savings rate falls (in quarterly specifications), contrary to the result that PB sales are higher when savings are low.

III. Conclusions and Future Research

The five-decade-long experience of the United Kingdom in offering Premium Bonds suggests that the program has both savings and gambling elements. The time series of net sales is correlated with gambling, and sales respond to the size of the large prize (as would a lottery), even though this quantity contributes only about 2 percent of the expected value of the return and does not determine the product's fundamental economics. Like an investment, however, net demand responds to the yield provided by these bonds relative to other fixed income investments, and to a lesser degree with the realized returns in broad equity markets. The response of net sales to both the large prize and to the relative interest rate offered by the bonds is a product of gross sales activity, and not gross redemption activity. While the quality of the offer, whether as a gamble or as an investment, drives sales, it does not affect redemptions. This would be consistent with the bonds serving as some sort of precautionary or planned savings vehicle. This savings/gambling hybrid appeals more strongly to lower-income households, and consistent with that observation, sales are negatively correlated with gross savings activity.

Savings is hard for many families, and often costly for governments to support. LLS are long-tested products that have spurred savings for centuries. Even today, LLS savings programs hold the promise of being "disruptive" innovations that might change the way American families think about savings. Further research is needed to better understand the impact of LLS on household savings and to enlighten policy discussions where governments ban its use.

Table 1

Determinants of Changes in UK Premium Bond Net Sales, Gross Sales and Redemptions, 1968-2006

OLS models of the change in per capita real net sales, gross sales, and redemptions of UK premium bonds. All pound-denominated variables are expressed in real terms adjusted using the 2006 £ RPI deflator. All variables are computed as first-differences. Robust standard errors are reported in parentheses. While PB data is available from 1957, other series limit the test to 38 years through 2006. Significance levels: *** = 1 percent, ** = 5 percent, and * = 10 percent.

Real Large Prize	0.010054		0.011019		0.000940	
	(0.004925)	*	(0.005974)	*	(0.001552)	
Prize Rate Spread	0.000970		0.001098		0.000121	
	(0.000546)	*	(0.000582)	*	(0.000231)	
FTSE Stock Return	0.000075		0.000079		0.000004	
	(0.000042)	*	(0.000049)		(0.000015)	
FTSE Volatility	-0.000292		-0.000365		-0.000071	
	(0.000259)		(0.000327)		(0.000097)	
Gini Coefficient	-0.303360		-0.326584		-0.023542	
	(0.180929)		(0.201487)		(0.000531)	
Unemployment Rate	-0.001811		-0.003331		-0.001538	
	(0.00119)		(0.001400)	**	(0.000530)	***
Gross Savings Rate	-0.017243		-0.025379		-0.008101	
	(0.008685)	*	(0.010623)	**	(0.000231)	***
Highest Marginal Tax Rate	-0.000303		-0.000276		-0.000028	
	(0.000134)	**	(0.000147)	*	(0.000060)	
Constant	0.002332		0.003646		0.001317	
	(0.001374)		(0.001587)	**	(0.000525)	**
R-squared	0.376		0.421		0.319	
Number of Observations	38		38		38	

Sources

Bank of England. 2006. "Monetary and Financial Statistics." 10: T161#. Available at http://www.bankofengland.co.uk/statistics/ms/2006/oct/bankstats_full.pdf

Department for Work and Pensions (U.K. Government). 2007. Family Resources Survey United Kingdom 2005-2006, available at http://www.dwp.gov.uk/asd/frs/2005_06/chapter5.pdf

Forrest, David, Robert Simmons, and Neil Chesters. 2002. "Buying a Dream: Alternative Models of Demand for Lotto." *Economic Inquiry*, 40(3): 485-496.

Frey, James H. 1984. "Gambling: A Sociological Review." *Annuals of the American Academy of Political and Social Science*, 474 (July): 107-121.

Green, William H. 1997. *Econometric Analysis*. New Jersey: Prentice Hall.

Guillén, Mauro and Adrian Tschoegl. 2002. "Banking on Gambling: Banks and Lottery-Linked Deposit Accounts." *Journal of Financial Services Research*, 21 (3), 219-231.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect theory: An Analysis of Decision Under Risk." *Econometrica*, 47 (2): 263-291.

Levy-Ullmann, Henri. 1896. "Lottery Bonds in France and in the Principal Countries of Europe." *Harvard Law Review*, 9 (6): 386-405.

Lobe, Sebastian and Alexander Hölzl. 2007. "Why are British Premium Bonds so Successful? The Effect of Saving With a Thrill." Available at SSRN: http://ssrn.com/abstract=992794

Murphy, Anne L. 2005. "Lotteries in the 1690s: Investment or Gamble?" *Financial History Review*, 12 (2): 227-245.

Pfiffelmann, Marie. 2006. "Which optimal design for LLDAs?" http://ssrn.com/abstract=931130.