Investigation into Rational Choice: Optimism in the Market for Thoroughbred Yearlings

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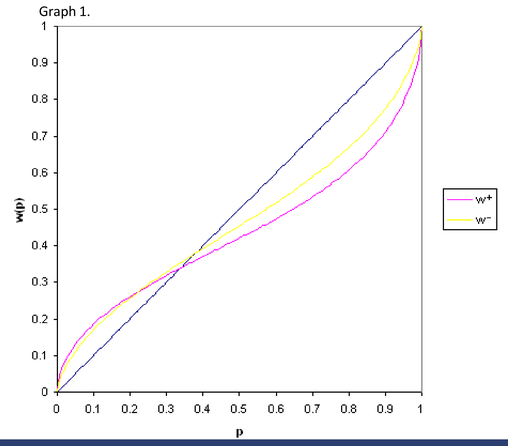
INTRODUCTION

The thoroughbred industry is surrounded by uncertainty and motivated by small chances of winning big. Buyers in search of the next Triple Crown winner must first take on the risky gamble of bidding for a one-year-old horse before it ever reaches the track. Investment decisions are primarily based on pedigree and conformation since these yearlings have not yet begun race training. Previous analyses suggest that yearling prices are largely dependent on attributes related to quality of pedigree and racing performance. However, other studies suggest that sale prices are poor predictors of track earnings. In addition, numerous studies provide evidence of net negative returns on the purchases of thoroughbred yearlings.

There are two distinct theories that can be used to explain the persistence of these conditions existing in the market. Starting with a strict adherence to axioms of rationality, expected utility theory (EUT) would describe a case where additional nonpecuniary utility is derived from the ownership of thoroughbred racehorses (Gamrat & Sauer, 2000). Alternatively, non-expected utility theory, such as cumulative prospect theory (CPT), relaxes the assumptions of EUT to allow for outcome ranking and probability weighting for values placed on yearlings at auction. In contrast to EUT, looking at decision making in this context allows agents to make systematic judgments of probability weights across outcomes. CPT deals with "loss aversion" as a function of individuals' expectations for the cumulative probabilities of uncertainty. The Allais paradox is a prime illustration of this and counterexample to the assumptions that support expected utility theory. Graph 1, is an illustration of the probability weighting function.

Graph 1.



OBJECTIVE

The objective of this study is to determine whether rank-dependent preferences, such as cumulative prospect theory, describe buyer behavior in the market for thoroughbred yearlings. Evidence that buyers overweight small probabilities could suggest the presence of optimism among the set of individuals that purchase thoroughbreds as yearlings.

METHODS

Field data containing all thoroughbreds from the 1998 foal crop that were sold as yearlings in 1999 were used in the analysis. Yearlings' total value were tracked by collecting both racetrack earnings and measures of breeding value. For colts, breeding value is measured by multiplying advertised stud fee by the number of live foals. Breeding value for mares is measured in two different ways. The first is estimated by a sum of first sale auction prices for progeny that were sold. The second uses total racetrack earnings as the residual value for progeny that did not go to auction before the starting of a race career. Analyses of the expected values are estimated by career earnings within a particular group categorized by yearling prices. Historical data allows us to construct lifetime value distributions for different sales prices, which in turn facilitates the calculation of the expected value for a yearling that sold for a particular price. From that, we can estimate parameters on the probability weighting function, which would rationalize buyer behavior in the context of cumulative prospect theory.

Tversky and Kahneman (TK) explain CPT using a power utility function, equation (1) with equation (2) the cumulative probability weighting function over rank dependent outcome of x^{α}. The TK version incorporates loss aversion parameters of the utility function equals $\lambda(-x)^{\delta}$ for negative outcomes. The estimated value function assumed risk neutrality to losses over gains; lambda equals one and delta equals alpha.

$$U(x) = x^{\alpha} \quad (1)$$

$$w(p) = p^{\gamma} / [\, p(+ (1-p)^{\gamma} \,]^{1/\gamma} \quad (2)$$

Maximum likelihood estimation modeled the equations to solve for alpha and gamma. The Newton-Raphson algorithm was the chosen optimization technique to solve for the two unknown parameters. Correlations between samples from grouping yearling prices into blocks was adjusted using clustering by year, gender, and price group.

RESULTS

There were 35,836 thoroughbreds sold as yearlings from 1992 to 1996 used in the estimation of alpha and gamma. Robust standard error terms where adjusted down to 80 clusters. Table 1. shows the estimated coefficients and significance for a 95% confidence level. Tversky and Kahneman (1992) estimations from analysis of comparative choice studies found alpha to be 0.88 and gamma 0.61 which are similar to those in table 1.

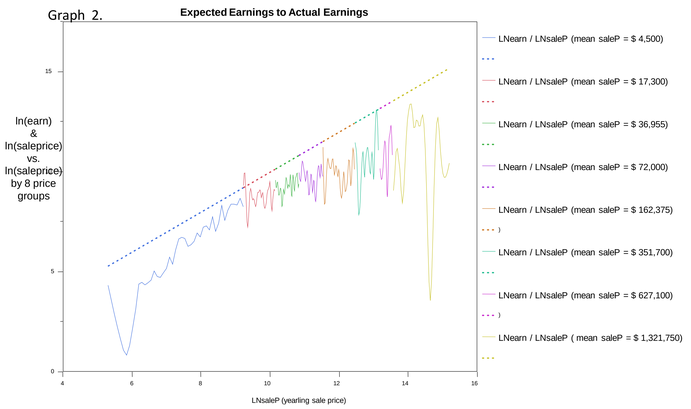
Table 1.

	Coefficient Estimate	Standard Error	P > |z|	95% Confidence Interval lower	upper
alpha	0.8965	0.0503	0.000	0.798	0.995
gamma	0.4303	0.2125	0.043	0.014	0.847

As gamma approaches 1, the probability weighting function becomes flatter, and the weighted probabilities approach the actual probabilities; as gamma approaches 0, the probability weighting function becomes more curved, and the weighted probabilities are more distorted relative to the actual probabilities. Gamma estimated at 0.43 illustrates more distorted judgments in probability in relation to Tversky and Kahneman (1992). This suggests that the exacerbated difference between yearling auction price and expected earnings could originate from optimistic probabilities of large stakes winners.

This may be reason that half of the 7,955 first time thoroughbred purchases made during the 1999 yearling auctions indicated negative realized returns. When consideration towards time value preferences with a rate of five percent, the net present expected value is discounted to a zero gain position. Indications of aggregate positive net gains is found in this cohort and is particularly evident with lower sale priced thoroughbreds that went to auction as yearlings. Horses that sold for less than $20,000 were the only consistent categories that had a one-in-two probability of positive percent return. The probability of positive returns fell as yearling sale prices increased. The estimated probability weighting function as one factor in expected value distributions of returns were correlated with yearling prices as a distinguishable trend across price categories. This is illustrated in graph 2, where the smoothing line between changes in mean earnings over changes in sale price is compared to the sale price by yearling price category.

Graph 2.



CONCLUSION

Cumulative prospect theory has gained support through studies across the social sciences. An understanding of rational choice can by gained from the probability-weighting values buyers placed on pedigree as evidence in support of CPT. An explanation into the optimism shared by yearling buyers can replace derived nonpecuniary utility as rationale for net losses that typically characterize the behavior found in thoroughbred industry. Yearling buyers benefit by becoming aware of the tendency of overweighting low probabilities of grand earnings, but more importantly, evidence can be documented in support of the general formulation of the model delineating the rank dependent probability weighting function.

REFERENCES

Fischhoff, B. (1982). Calibration of probabilities. *Judgment under uncertainty: Heuristics and Biases,* 306-334

Gamrat, F.A. and Sauer, R.D. (2000). The utility of sport and returns to ownership: Evidence from the thoroughbred market. *Journal of Sports Economy, 1*(3), 219-235

Harrison, G.W. (2008) Maximum Likelihood Estimation of Utility Functions Using *Stata. Working Paper 06-12*, Department of Economics, College of Business Administration, University of Central Florida

Kahneman, D., and Tversky, A. (1982). A On the Psychology of Prediction. *Judgment under uncertainty: Heuristics and Biases,* 48-68

Kahneman, D., and Tversky, A. (1992) “Advances in Prospect Theory: Cumulative Representations of Uncertainty,” *Journal of Risk & Uncertainty, 297-323; references to* reprint in D. Kahneman and A. Tversky (eds.), *Choices, Values, and Frames (New York:* Cambridge University Press, 2000).

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