EFFICIENCY OF RACETRACK BETTING MARKETS

2008 Edition

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To Joanne

D.B.H.

To my parents

V.S.Y.L.

To Rachel

W.T.Z.

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Contents

PART III. ECONOMIC AND MATHEMATICAL INSIGHTS

Preface to 2008 Edition

Academic Press published the first edition of this volume in 1994. Our goal was to collect the important papers and many new articles for an up-to-date and comprehensive volume on racetrack efficiency. The ensuing years have pushed the volume into classic status. The volume went out of print at the same time that various hedge fund-like racing syndicates were using these ideas as an integral part of their research that led to hundreds of millions in profits for the most successful groups and about US$10 billion in total gains. When the volume went out of print, it became a cult item. Its scarcity, its content, and the dreams of new investment groups drove the price of the volume on eBay and Amazon to thousands of dollars. Hence, the volume was only available to a few. We appreciate the classic and cult status but want to make the book more accessible to students, researchers, academics and others. So, we are pleased that World Scientific is producing this 2008 edition for this purpose. Except for this Preface, the 2008 edition is identical to the original.

This 2008 edition is coming out simultaneously with the *Handbook of Sports and Lottery Markets* edited by Donald B Hausch and William T Ziemba published by Elsevier/North Holland, 2008. That volume complements this 2008 edition by providing new, original surveys of the racetrack, sports betting and lotto investment field. Together they provide an up-to-date treatment of the field of racetrack efficiency plus the key historical and current papers.

There are a number of new developments since 1994 that have altered the racetrack investment markets. These affect the academic research surveyed in this 2008 edition and the Handbook volume as well as the professional and amateur application of these results to racetrack markets across the world.

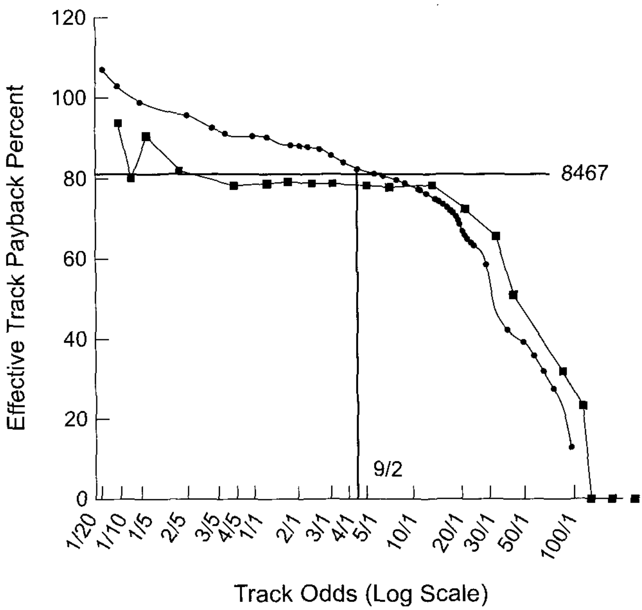
Since circa 2000, we have seen the following important changes in racetrack markets.

1. Rebates on wagers are available to essentially all bettors. These rebates began as simply a reward to large bettors for quantity purchases, similar to discounts when one buys in bulk such as a case of San Pellegrino offered at food stores and other places. However some rebaters have extended these discounts to all bettors. The tracks provide a signal of the pools to the rebaters at a low price. Then the rebaters put the bets of their clients into the track pools, with the rebaters and the bettors sharing the difference between the regular track take and the signal price. So bettors, instead of paying a track take of 13–30% at the track on various wagers, actually face a net track take of about 10%. This lower track take for syndicates disadvantages small

bettors, though, since their effective track take becomes more than the posted track take.

2. The extent of off-track betting from other racetracks and other betting sources has expanded greatly and is now about 87% of all wagers at a typical race track (see Hausch and Ziemba, 2008). There are also delays in adding these monies to the host track pools, which can lead to substantial differences between the odds posted at the time the race begins and the final odds that determine the actual payoffs. Indeed, about 50% of all bets are not shown in the pools until after it is too late to bet at the host track and the horses are running (see Ziemba, 2008). Hence, a 4-1 horse at 1 minute to post time could end up paying 5-2. This uncertainty is challenging for any system that incorporates the public's odds. An example is the Dr Z place and show system, which is discussed in two Hausch and Ziemba (one with Rubinstein) papers in Section V of this volume and which estimates a horse's win probability based on the public's win odds. Ziemba's (2008) update of this earlier work demonstrates the challenge, but also shows that, with rebates, the system may still yield profits.
3. The 1999 introduction of Betfair and other betting exchanges allows bettors to lock in prices for win, place and show and other wagers by betting not against the house but against other bettors. The house, say Betfair of London (the biggest by far), then takes a 1–5% commission on all net winning wagers. So bettors can lock in odds rather than bear the risk of changing odds in the on-track parimutuel betting system. Equally important, the betting exchanges allow short as well as long bets. Hence, bettors can wager against over-priced horses just as hedge fund managers can short over-priced stocks, stock index futures, currencies or precious metals. This feature also allows for long-short hedging akin to long-short equity hedge funds. While these exchanges are not legal in the US, they have had an impact on some important US horse races. See Snowberg, Wolfers and Zitzewitz (2008) and Smith and Vaughan Williams (2008) for a discussion of prediction markets in politics and other areas and betting on myriad sports and other events, respectively.
4. The figure below shows the return from wagers on different odds-levels. The steeper of the two lines is from Ziemba and Hausch (1986) and is based on data from the 1980s and earlier. The flatter line is from Ziemba (2004) and is based on Equiform data from 1997 to 2004. Both lines are based on data of more than 300,000 horses, and both exhibit the favorite-longshot bias where favorites are underbet relative to the true odds and longshots are

overbet. However, the extent of the bias is clearly weaker in recent years, so the expected return on longshots is higher and the expected return on favorites is lower. Further, the positive expected return on extreme favorites is no longer available. Betting exchanges appear to partly explain this recent shift. Snowberg and Wolfers (2008) show similar results based on horses in 647,903 races, which are all races run in the US from 1992 to 2001.



Since the original papers were published, some have been extended. Some of these extensions are in Vaughan Williams (2003, 2005), two books we strongly recommend, and Hausch and Ziemba (2008). A few of them are now discussed.

Reference 31 in the annotated bibliography was published as Lo and Bacon-Shone (2008). They provide a discount model that is a simple approximation to the Henery and Stern models for computing ordering probabilities superior to those obtained by the Harville formulas. They show the accuracy of the approximation and the method is applied in Lo, Bacon-Shone and Bushe (1995).

The MacLean, Ziemba and Blazenko paper was extended by MacLean and Ziemba (2006) and an updated table and discussion of the good and bad properties of the Kelly criterion appear in Ziemba and Ziemba (2007).

The crosstrack betting paper by Hausch and Ziemba has evolved into a procedure for going long on horses with rebates at the host track and short on Betfair or other betting exchanges plus long/shorts across betting exchanges.

An extension of Ziemba and Hausch (1987) on the Dr Z place betting system in England arises because of the different way place pools were computed in England and other locales by splitting the net bets among the collecting horses. Hence, once about 24.5% is bet on any horse, the payoff is at its minimum. We noted this, but Jackson and Waldron (2003) extended Hausch and Ziemba's system for locks to exploit this rule. See also Edelman and O'Brian (2004) for a more general analysis of these tote arbitrages.

We hope that the readers of this 2008 edition and the Hausch and Ziemba (2008) Handbook find these papers stimulating and useful.

Donald B. Hausch, Madison
Victor S.Y. Lo, Boston
William T. Ziemba, Vancouver
February 2008

References

Edelman, D. C. and N. G. O'Brian (2004). Tote arbitrage and lock opportunities in racetrack betting. *European Journal of Finance*, **10**: 370–378.

Hausch, D.B. and W.T. Ziemba (Eds.) (2008). *Handbook of Sports and Lottery Markets*. Elsevier.

Jackson, D. and P. Waldron (2003). Parimutuel place betting in Great Britain and Ireland, in L. Vaughan Williams (Ed.), *The Economics of Gambling*, 18–29.

Lo, V. and J. Bacon-Shone (2008). Approximating the ordering probabilities of multi-entry competitions by a simple method, in D.B. Hausch and W.T. Ziemba (Eds.), *Handbook of Sports and Lottery Markets*. Elsevier.

Lo, V., J. Bacon-Shone and K. Bushe (1995). The application of ranking probability models to racetrack betting, *Management Science*, **41**: 1048–1059.

MacLean, L.C. and W.T. Ziemba (2006). Capital growth: Theory and practice, in S.A. Zenios and W.T. Ziemba (Eds.), *Handbook of Asset-Liability Management, Volume I: Theory and Methodology*, pp. 429–473. Elsevier.

Smith, M.A. and L. Vaughan Williams (2008). Betting exchanges: A technological revolution in sports betting, in D.B. Hausch and W.T. Ziemba (Eds.), *Handbook of Sports and Lottery Markets*. Elsevier.

Snowberg, E. and J. Wolfers (2008). Examining explanations of a market anomaly: Preferences or perceptions?, in D.B. Hausch and W.T. Ziemba (Eds.), *Handbook of Sports and Lottery Markets*. Elsevier.

Snowberg, E., J. Wolfers and E. Zitzewitz (2008). Prediction markets: From politics to business, in D.B. Hausch and W.T. Ziemba (Eds.), *Handbook of Sports and Lottery Markets*. Elsevier.

Vaughan Williams, L. (2003). *The Economics of Gambling*. Routledge.

Vaughan Williams, L. (2005). *Information Efficiency in Financial and Betting Markets*. Cambridge University Press.

Ziemba, W.T. (2004). Behavioral finance, racetrack betting and options and futures trading, Mathematical Finance Seminar, Stanford University, January 30.

Ziemba, W.T. (2008). Efficiency of racetrack, sports and lottery betting markets, in D.B. Hausch and W.T. Ziemba (Eds.), *Handbook of Sports and Lottery Markets*. Elsevier.

Ziemba, W.T. and D.B. Hausch (1986). *Betting at the Racetrack*. Dr Z Investments Inc, San Luis Obispo, CA.

Ziemba, W.T. and D.B. Hausch (1987). *Dr Z's Beat the Racetrack*. William Morrow.

Ziemba, R.E.S. and W.T. Ziemba (2007). *Scenarios for Risk Management and Global Investment Strategies*. Wiley.

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Preface in 1994 Edition

Racetrack betting interests not just gamblers and those seeking casual entertainment, but also academics across many disciplines. Gamblers and investors certainly enjoy the sport, but making profits is their challenge. Academics are interested in this came challenge. Their approach is to determine whether the racetrack betting market is efficient and, if not, whether positive risk-adjusted returns are possible. In addition to market efficiency, active research areas include methods for analyzing racetrack data, determining probabilities of complex events, explaining gambling behavior, and developing betting strategies. Racetrack betting is of particular interest because, beyond just allowing a forum for theoretical questions of efficiency and gambling behavior, abundant and easily-accessible data from racetracks around the world permits extensive empirical consideration of these questions.

Studies related to racetrack betting have appeared in the academic literature for over 40 years. The number of articles in this area has been growing recently. A need for a book-length treatment of racing efficiency research covering its economic, psychological, financial, statistical and mathematical aspects has been felt for quite some time. This volume of collected papers is the result of collaboration with many colleagues in a variety of disciplines and from countries around the world. This volume is intended for two audiences: academics across many fields who are interested in the subject and those of the general public who wish to know more about the academic research on racetrack betting.

Following an introduction, the papers in this volume are divided into seven sections: psychological studies, utility preferences of racetrack bettors, economic and mathematical insights, efficiency of win markets and the favorite-longshot bias, place and show anomalies, efficiency of exotic wagering markets, and research in the Commonwealth and Asia.

We are pleased to be part of this distinguished series on Economic Theory, Econometrics, and Mathematical Economics, and we thank Academic Press for the opportunity to publish this volume.

Donald B. Hausch, Madison
Victor S.Y. Lo, Vancouver
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"Probability and Utility Estimates for Racetrack Bettors." *Journal of Political Economy* 83, 1977, 803-815.

"Some Evidence on the Efficiency of a Speculative Market." *Econometrica* 47, 1979, 387-392.

Peter Asch, Department of Economics, Rutgers University, Newark, New Jersey, USA; Burton G. Malkiel and Richard E. Quandt, Department of Economics, Princeton University, Princeton, New Jersey, USA.

"Racetrack Betting and Informed Behavior." *Journal of Financial Economics* 10, 1982, 187-194.

"Market Efficiency in Racetrack Betting." *Journal of Business* 57, 1984, 165-174.

"Market Efficiency in Racetrack Betting: Further Evidence and a Correction." *Journal of Business* 59, 1986, 157-160.

Peter Asch, Department of Economics, Rutgers University, Newark, New Jersey, USA; and Burton G. Malkiel, Department of Economics, Princeton University, Princeton, New Jersey, USA.

"Efficiency and Profitability in Exotic Bets." *Economica* 54, 1987, 289-298.

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"Tests of the Efficiency of Racetrack Betting Using Bookmaker Odds." *Management Science* 33, 1987, 1552-1562.

Stephen R. Blough, Research Department, Federal Reserve Bank of Boston, Boston, Massachusetts, USA.

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"Searching for Positive Returns at the Track: A Multinomial Logit Model for Handicapping Horse Races." *Management Science* 32, 1986, 1040-1059.

Kelly Busche and Christopher D. Hall, School of Economics, The University of Hong Kong, Hong Kong.

"An Exception to the Risk Preference Anomaly." *Journal of Business* 61, 1988, 337-346.

Brian R. Canfield and Bruce C. Fauman, Vancouver, British Columbia, Canada; William T, Ziemba, Faculty of Commerce, University of British Columbia, Vancouver, British Columbia, Canada.

"Efficient Market Adjustment of Odds Prices to Reflect Track Biases." *Management Science* 33, 1987, 1428-1439.

N.F.R. Crafts, Department of Economics, University of Warwick, Coventry, UK.

Jack Dowie, Faculty of Social Sciences, Open University, Milton Keynes, UK.

"On the Efficiency and Equity of Betting Markets." *Economica* 43, 1976, 139-150.

Stephen Figlewski, Department of Finance, Leonard N. Stern School of Business, New York University New York, New York, USA.

"Subjective Information and Market Efficiency in a Betting Model." *Journal of Political Economy* 87, 1979, 75-88.

Paul E. Gabriel, School of Business Administration, Loyola University of Chicago, Chicago, Illinois USA; and James R. Marsden, Department of Operations and Information Management, School of Business Administration, University of Connecticut, Storrs, Connecticut, USA.

"An Examination of Market Efficiency in British Racetrack Betting." *Journal of Political Economy* 98, 1990, 874-885.

"An Examination of Market Efficiency in British Racetrack Betting: Errata and Corrections." *Journal of Political Economy* 99, 1991, 657-659.

Richard M. Griffith, Veterans Administration Hospital, Lexington, Kentucky, USA.

"Odds Adjustments by American Horse-Racing Bettors." *American Journal of Psychology* 62, 1949, 290-294.

"A Footnote on Horse Race Betting." *Transactions Kentucky Academy of Science* 22, 1961, 78-81.

David A. Harville, Department of Statistics, Iowa State University, Ames, Iowa, USA.

"Assigning Probabilities to the Outcomes of Multi-Entry Competitions." *Journal of the American Statistical Association* 68, 312-316.

Donald B. Hausch, School of Business, University of Wisconsin, Madison, Wisconsin, USA; and William T. Ziemba, Faculty of Commerce, University of British Columbia, Vancouver, British Columbia, Canada.

"Transactions Costs, Extent of Inefficiencies, Entries and Multiple Wagers in a Racetrack Betting Model." *Management Science* 31, 1985, 381-394.

"Arbitrage Strategies for Cross-Track Betting on Major Horse Races." *Journal of Business* 63, 1990, 61-78.

"Locks at the Racetrack." *Interfaces* 20, 1990, 41-48.

Donald B. Hausch, School of Business, University of Wisconsin, Madison, Wisconsin, USA; William T. Ziemba, Faculty of Commerce, University of British Columbia, Vancouver, British Columbia, Canada; and Mark Rubinstein, Department of Finance, Walter A. Haas School of Business, University of California, Berkeley, California, USA.

"Efficiency of the Market for Racetrack Betting." *Management Science* 27, 1981, 1435-1452.

Robert J. Henery, Department of Statistics and Modelling Science, University of Strathclyde, Glasgow, Scotland.

"Permutation Probabilities as Models for Horse Races." *Journal of Royal Statistical Society B* 43, 1981, 86-91.

Rufus Isaacs, The Rand Corporation, Santa Monica, California, USA.

"Optimal Horse Race Bets." *American Mathematical Monthly* 60, 1953, 310-315.

Hyun Song Shin, Department of Economics, University College, Oxford University, Oxford, UK.

"Prices of State Contingent Claims with Insider Traders, and the Favourite-Longshot Bias." *The Economic Journal* 102, 1992, 426-435.

Wayne W. Snyder, Department of Finance, Sangamon State University, Sangamon, California, USA.

"Horse Racing: Testing the Efficient Markets Model." *Journal of Finance* 33, 1978, 1109-1118.

Hal S. Stern, Department of Statistics, Harvard University, Cambridge, Massachusetts, USA.

Richard H. Thaler, Department of Economics, Johnson School of Management, Cornell University, Ithaca, New York, USA; and William T. Ziemba, Faculty of Commerce, University of British Columbia, Vancouver, British Columbia, Canada.

"Anomalies - Parimutuel Betting Markets: Racetracks and Lotteries." *Journal of Economic Perspectives* 2, 1988, 161-174.

R.H. Tuckwell, Macquarie University, New South Wales, Australia.

"Anomalies in the Gambling Market." *Australian Journal of Statistics* 23, 1981, 287-295.

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American Journal of Psychology

Griffith, R.M. (1949) "Odds Adjustments by American Horse-Racing Bettors." 62, 290-294.

McGlothlin, W.H. (1956) "Stability of Choices among Uncertain Alternatives." 69, 604-619.

American Mathematical Monthly

Isaacs, R. (1953) "Optimal Horse Race Bets." 60, 310-315.

Australian Journal of Statistics

Tuckwell, R.H (1981) "Anomalies in the Gambling Market." 23, 287-295.

Econometrica

Ali, M.M. (1979) "Some Evidence on the Efficiency of a Speculative Market." 47, 387-392.

Economica

Asch, P. and Quandt, R.E. (1987) "Efficiency and Profitability in Exotic Bets." 54, 289-298.

Dowie, J. (1976) "On the Efficiency and Equity of Betting Markets." 43, 139-150.

Economics Letters

Kallberg, J.G. and Ziemba, W.T (1979) "On the Robustness of the Arrow-Pratt Risk Aversion Measure." 2, 21-26.

Interfaces

Hausch, D.B. and Ziemba, W.T (1990b) "Locks at the Racetrack." 20, 41-48.

Journal of Business

Asch, P., Malkiel, B.G. and Quandt, R.E. (1984) "Market Efficiency in Racetrack Betting." 57, 165-174.

Asch, P., Malkiel, B.G. and Quandt, R.E. (1986) "Market Efficiency in Racetrack Betting: Further Evidence and a Correction." 59, 157-160.

Busche, K. and Hall, C.D. (1988) "An Exception to the Risk Preference Anomaly." 61, 337-346.

Hausch, D.B. and Ziemba, W.T (1990a) "Arbitrage Strategies for Cross-Track Betting on Major Horse Races." 63, 61-78.

Journal of Economic Perspectives

Thaler, R. and Ziemba, W.T. (1988) "Anomalies - Parimutuel Betting Markets: Racetracks and Lotteries." 2, 161-174.

Journal of Finance

Snyder, W.W. (1978) "Horse Racing: Testing the Efficient Markets Model." 33, 1109-1118.

Losey, R.L. and Talbott, J.C., Jr. (1980) "Back on the Track with the Efficient Markets Hypothesis." 35, 1039-1043.

Journal of Financial Economics

Asch, P., Malkiel, B.G. and Quandt, R.E. (1982) "Racetrack Betting and Informed Behaviour." 10, 187-194.

Journal of Political Economy

Ali, M.M. (1977) "Probability and Utility Estimates for Racetrack Bettors." 83, 803-815.

Figlewski, S. (1979) "Subjective Information and Market Efficiency in a Betting Model." 87, 75-88.

Gabriel, P.E. and Marsden, J.R. (1990) "An Examination of Market Efficiency in British Racetrack Betting." 98, 874-885.

Gabriel, P.E. and Marsden, J.R. (1991) "An Examination of Market Efficiency in British Racetrack Betting: Errata and Corrections." 99, 657-659.

Rosett, R.N. (1965) "Gambling and Rationality." 73, 595-607.

Weitzman, M. (1965) "Utility Analysis and Group Behaviour: An Empirical Study." 73, 18-26.

Journal of Royal Statistical Society B

Henry, R.J. (1981) "Permutation Probabilities as Models for Horse Races." 43, 86-91.

Journal of the American Statistical Association

Harville, D.A. (1973) "Assigning Probabilities to the Outcomes of Multi-Entry Competitions." 68, 312-316.

Management Science

Bird, R. and McCrae, M. (1987) "Tests of the Efficiency of Racetrack Betting Using Bookmaker Odds." 33, 1552-1562.

Bolton, R.N. and Chapman, R.G. (1986) "Searching for Positive Returns at the Track: A Multinomial Logit Model for Handicapping Horse Races." 32, 1040-1059.

Canfield, B., Fauman, B.C. and Ziemba, W.T. (1987) "Efficient Market Adjustment of Odds Prices to Reflect Track Biases." 33, 1428-1439.

Hausch, D.B., Ziemba, W.T. and Rubinstein, M. (1981) "Efficiency of the Market for Racetrack Betting." 27, 1435-1452.

Hausch, D.B. and Ziemba, W.T. (1985) "Transactions Costs, Extent of Inefficiencies, Entries and Multiple Wagers in a Racetrack Betting Model." 31, 381-394.

MacLean, L.C., Ziemba, W.T. and Blazenko, G. (1992) "Growth versus Security in Dynamic Investment Analysis." 38, 1562-1585.

Psychological Reports

Metzger, M.A. (1985) "Biases in Betting: An Application of Laboratory Findings." 56, 883-888.

The Economic Journal

Shin, H.S. (1992) "Prices of State Contingent Claims with Insider Traders, and the Favourite-Longshot Bias." 102, 426-435.

The Quarterly Journal of Economics

Quandt, R.E. (1986) "Betting and Equilibrium." 101, 201-207.

Transactions Kentucky Academy of Science

Griffith, R.M. (1961) "A Footnote on Horse Race Betting." 22, 78-81.