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HORSE RACING: TESTING THE EFFICIENT MARKETS MODEL

WAYNE W. SNYDER*

"It is difference of opinion
that makes horse races."

Mark Twain

SINCE THE EARLY 1960s considerable theoretical and empirical work has been published about the efficient markets model. Two important implications are: (1) prices fully reflect all available information and (2) experts do not achieve above normal profits.

If security markets and horse racing seem worlds apart, the difference is more apparent than real and can be explained largely by the social stigma society attaches to the latter. Both have common characteristics including those which form the basis for the theory of perfect competition: large numbers of participants, extensive market knowledge and ease of entry. Also, like security markets, horse racing offers an opportunity to study economic decision making under conditions of risk and uncertainty. Taken together these characteristics render horse racing both fascinating and worthwhile as an important example where the theoretical framework of the efficient markets model can be effectively applied.

The concept of "efficient markets" refers to a perfectly competitive market where prices reflect all available information. This implies that no method can be found to predict accurately future security prices or, alternatively, to detect securities which are presently undervalued by the market. In a major review of the theoretical and empirical work done in capital markets, Fama (1970) proposed three information subsets by which the efficient markets model could be appraised and tested.[1] *Weak form* tests determine whether past prices alone can predict current prices. *Semi-strong* tests use other publicly available information to predict prices. *Strong form* tests are concerned with demonstrating whether any special group is able to achieve a higher than average rate of return.

In this study I will discuss how these three tests can be applied to horse racing. I will show that horse race bettors exhibit strong and stable biases, but these are not

* Sangamon State University. An earlier version of this paper was presented December 20, 1976 at the Third Conference on Gambling, Las Vegas, Nevada. I am slightly embarrassed at the extent to which I am indebted to others for help of various kinds. Ron Sutherland suggested the framework for this study and provided helpful comments on various drafts. Nancy Jacob and Mark Rubinstein also made several recommendations. H. Fabro, J. Jung, N. Ostroot and J. Rogers gave many tireless hours collecting data. Also, I received the cooperation of the Illinois Racing Board and the *Daily Racing Form's* statistical editor Don Anderson. But my list would be totally inadequate without expressing my gratitude to J. Miller's T.A. seminar for requiring me to make a "contract" to complete this study.

1. Fama (1970) reported that a large number of studies applying all three tests generally supported the efficient markets hypothesis, but he did note some exceptions. Subsequently, Downes and Dyckman (1973) cited additional evidence that not all markets are perfectly efficient.

large enough to make it possible to earn a positive profit. Furthermore, I will demonstrate that "expert" race predictions reflect an even greater bias than the general betting public.

I. Parimutuel Betting

Horse race odds have been determined by the parimutuel system in the United States since the 1930s. The race track is authorized by the state to subtract a percentage or "take" from the total pool or "handle" bet on each race. The total take exceeds the state-authorized deduction because the track is also allowed to retain "breakage" which results from only paying odds to the nearest (and lowest) 10¢ or 20¢ on a two dollar bet. The total take is divided by rule between taxes paid to the state and the portion retained by the track to meet its operating costs, provide racing purses and profits.[2] Whatever sum is wagered, minus this total take, is paid to bettors on the winning horse. Since each horse is a potential winner, the bettor determined odds are calculated and published in "charts" for each horse in every race.[3] There is, of course, no *a priori* reason why the subjective bettor determined odds should exactly or even closely approach the empirical probabilities of winning.

II. The Weak Form

A suitable weak test for horse racing is to investigate whether knowledge about the subjective odds assigned by bettors through their dollars placed at parimutuel windows can be used to earn an above average return. Perfect competition assumes that bettors will attempt to maximize profits. If the market is efficient, then the expected rate of return for all types of bets would be identical and simply equal the (negative) take. Horse racing would then be said to fully reflect the public's use of all available information and consequently the market could be called "efficient." However, if bettors systematically assign subjective odds which deviate predictably from the empirical probabilities of winning, then the rates of return will not be invariant over all possible odds. If horses are grouped by the bettor assigned odds, then the rate of return (RR) for any odds-group (O) can be calculated as:

$$RR = \frac{W(O+1) - N}{N} \tag{1}$$

where W is the *ex post* number of winning horses in each group and N is the total number of horses in each group.

Rates of return can be calculated for five previously published studies to which I have added my own collection of data.[4] Table 1 describes the six studies; the rates of return are shown in Figure 1. The horizontal axis uses a log scale for convenience of exposition to indicate the *unadjusted* track odds to one dollar. The selected odds-groups have no particular significance and were divided for convenience into eight classes.

2. Track takes have varied from a low of about 13 percent after World War II to a current high of 20 percent in some states.

3. See Fabricant (1965, pp. 22–32) for the economic arithmetic of odds calculation.

4. Too late to be included here, I learned of two other studies by Harville (1973) and Ali (1977) which also support the conclusions reached in this study.

TABLE 1

HORSE RACE STUDIES: AUTHORS, DATES AND NUMBER OF RACES

Author	Date Published	Racing Dates	No. of Races
Fabricant	1965	1955–62	10,000
Griffith	1949	1947	1,124
McGlothlin	1956	1947–53	9,248
Seligman	1975	1975	1,183
Snyder	1978	1972–74	1,730
Weitzman*	1965	1954–63	12,000

*Weitzman did not publish his data, but they were used again and published by Rosett (1965).

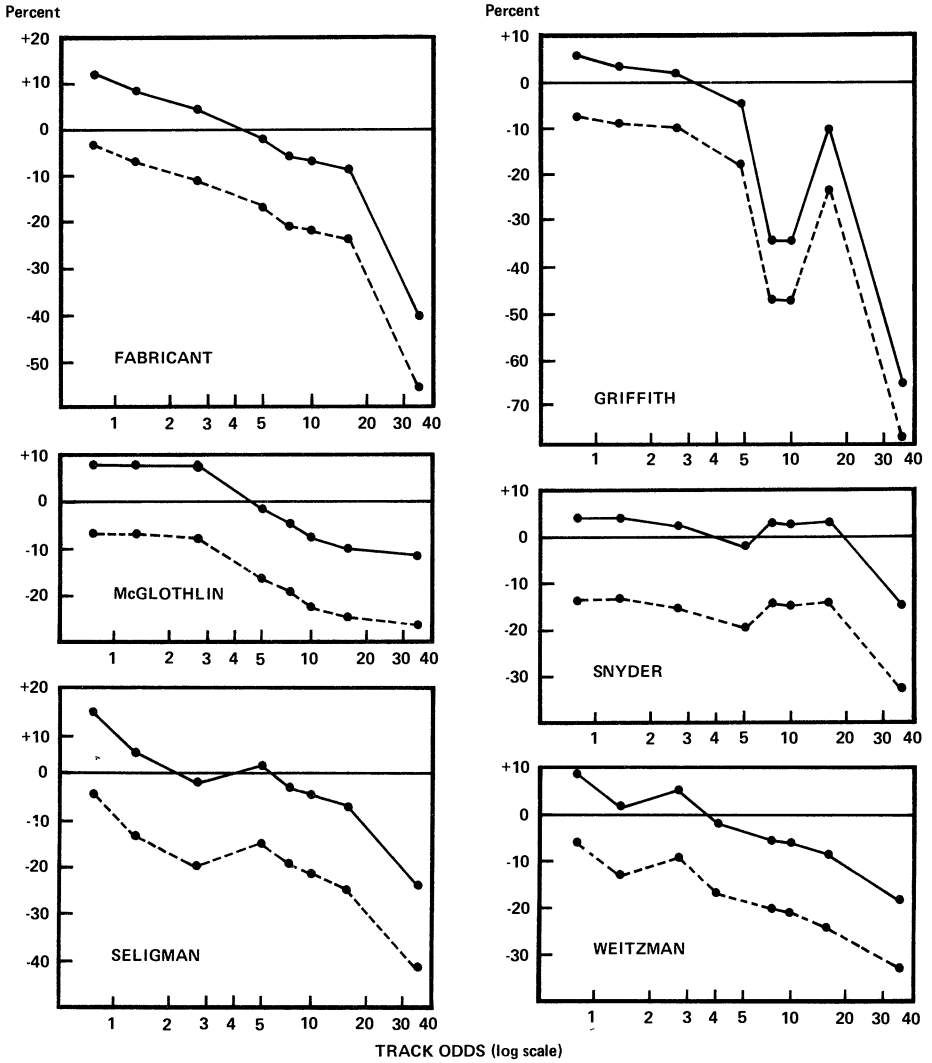

FIGURE 1. Rates of Return for Six Studies:
Actual (dotted line) and Take Added Back (solid line)

Figure 1 also shows the rates of return with the take added back which makes them more comparable since takes have increased substantially in the thirty years since Griffith (1949) collected the earliest data. All six studies show common characteristics. Each study exhibits a clear bettor bias in that the average rate of return would have been positive on all bets which could have been placed at odds below 5 to 1, if the take were added back. Although only two of the studies (Fabricant and McGlothlin) exhibit monotonically decreasing rates of returns from the lowest to the highest odds, the rate of return tends to vary inversely with the odds in the other studies as well. There does not appear to be any clear shift in the shape of the bettor bias from the earliest study (Griffith) to the most recent (Seligman and Snyder). There is some evidence that the bettor bias is accentuated at smaller tracks where greater uncertainty exists.[5]

Differences among the studies are not very significant as can be judged from the *t*-values indicated in Table 2 which gives the rates of return (take added back) for each of the six studies. Although each of the studies contains several thousand observations, the rates of return are only significantly different from zero for the very largest studies (Fabricant, McGlothlin and Weitzman) and even for those studies, not all rates of return are significant. In order to show more clearly the bettor bias inherent in the six studies, they have been combined in Figure 2 where the results are summarized for over 300,000 horses which ran in more than 30,000 races held between 1947 and 1975.

TABLE 2

RATES OF RETURN BY GROUPED ODDS, TAKE ADDED BACK

	Midpoint of grouped odds							
Study	0.75	1.25	2.5	5.0	7.5	10.0	15.0	33.0
Fabricant	11.1[a]	9.0[a]	4.6[a]	−1.4	−3.3	−3.7	−8.1	−39.5[a]
Griffith	8.0	4.9	3.1	−3.1	−34.6[a]	−34.1[a]	−10.5	−65.5[a]
McGlothlin	8.0[b]	8.0[a]	8.0[a]	−0.8	−4.6	−7.0[b]	−9.7	−11.0
Seligman	14.0	4.0	−1.0	1.0	−2.0	−4.0	−7.8	−24.2
Snyder	5.5	5.5	4.0	−1.2	3.4	2.9	2.4	−15.8
Weitzman	9.0[a]	3.2	6.8[a]	−1.3	−4.2	−5.1	−8.2[b]	−18.0[a]
Combined	9.1[a]	6.4[a]	6.1[a]	−1.2	−5.2[a]	−5.2[a]	−10.2[a]	−23.7[a]

[a] Significantly different from zero at 1% level or better.
[b] Significantly different from zero at 5% level or better.

The negative relationship in horse betting between the expected rate of return and risk is in sharp contrast with capital market theory which assumes that security buyers require a *higher* rate of return for assuming greater risk (Sharpe, 1970).[6] Another difference is that the rates of return among securities are often related, but

5. Ali (1977, p. 814) discusses this explicitly and my own analyses suggest that at the smaller tracks bettors have a stronger preference for the longer-odds horses. McGlothlin (1956, p. 610) noted that the bettor bias was smallest in the main race, presumedly because uncertainty was least then.

6. However, Miller (1977) suggests that some security buyers may prefer risky investments enough to create a *negative* relationship between the rate of return and risk.

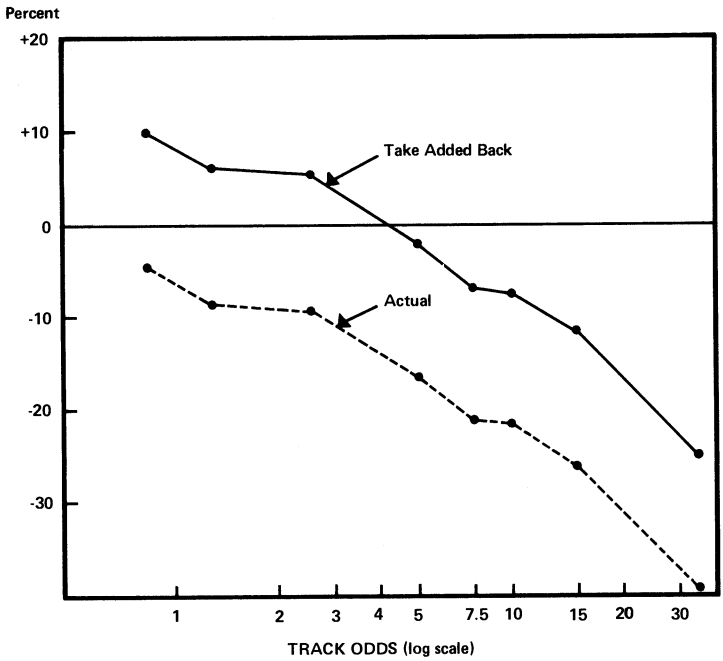

FIGURE 2. Combined Rates of Return

there is no correlation among different horses, nor are race outcomes correlated with the market return (i.e., the negative take).[7]

The direct cause of the bettor bias is clear. In horse racing parlance, bettors create an "overlay" by betting a smaller proportion on lower-odds horses than their actual chances of winning justifies. If the direct cause is clear, there is no agreement about the basic reasons for the bettor bias. Psychologists, Griffith (1949, p. 293) and McGlothlin (1956, p. 614), concluded that the bettor bias was a reconfirmation of a general tendency for all bettors to prefer low probability-high prize combinations over high probability-low prize combinations, findings first reported in laboratory experiments by Preston and Baratta (1948). Thus, they believe that the important psychological variable is subjective probability. Economists Weitzman (1965, p. 26) and Ali (1977, p. 813) have concluded that horse race bettors behave as if they possess a utility function for money which is concave upward (i.e., increasing marginal utility).

There is, of course, no statistical technique which can disentangle the relative importance of "subjective preference for risk" and "increasing marginal utility of money." Every bet also includes, besides a potential monetary gain, the utility derived from all the factors associated with making a bet—analyzing racing forms, pitting one's predictions against others and the elements of luck. These factors are largely absent if one selects a known favorite; there are few players who can skip the challenge of trying to ferret out potential longer-odds winners. Indeed, the main reward of horse betting comes from the thrill of successfully detecting a moderately long-odds winner and thus confirming one's ability to outperform everyone else.

7. Referee's suggestion.

What then should we conclude about horse racing as an efficient market? The evidence collected for the weak form test shows that the public has a clear and strong bias which substantially affects the expected rate of return for various odds-groups, but that bias is not large enough to overcome track takes of nearly 20 percent.

III. The Semi-strong Form

No satisfactory semi-strong test of horse racing has yet been reported. Clearly, what is needed is a general multi-information model capable of incorporating the previous performance data available for each horse and also including whatever new information is made known (e.g., new weights, jockey changes, workouts). While several models have been proposed, they have not been tested sufficiently. Dowst's *Straight, Place and Show: You can beat the races if you know how* (1945) is typical of models which fail to provide any reliability tests of their predictive ability. But there have been three attempts to develop complete models for predicting winning horses: Cohn and Stephens (1963), Fabricant (1965), and Sullivan and Adams (1974). However, only Fabricant (1965, p. 177) reported that his results were statistically significant at the one percent level of confidence. While he has presented an important study which deserves further attempts to reconfirm his results, his evidence alone is too small to conclude that the market for horse racing is not efficient by the semi-strong test.

IV. The Strong Form

Horse race lore is full of persons with potential special information which would permit them to outperform the general public. Scott (1968) identifies and describes with considerable knowledge the individual roles played by owners, trainers, jockeys, grooms and clockers who all aspire to corner special information about each race's potential outcome. Thus, horse racing in one more aspect is similar to the stock market where knowledgeable "insiders" may be able to profit from their unique positions. No one has yet collected systematically the predictions of any of these "experts" and submitted them to a strong test. Fortunately, however, there are three major groups who make their predictions public knowledge: race track officials, the *Daily Racing Form*, and city newspapers.[8]

Each publishes a "line" of predicted odds for every horse entered in each race. The race track presents its line in the official track program. This is established by the track handicapper who at some tracks is also the track secretary. Since the track secretary is responsible for putting together each event, in those instances where the secretary and handicapper are the same person, the official track odds should reflect the most expert opinion about the winning chances of the various horses. Even at tracks where the two functions are assumed by different persons, a close working relationship exists between the two officials; so the handicapper's odds should reflect his special position. However, since the track secretary is

8. "Tip" sheets are a fourth potential source of published predictions. These, however, select only two or three horses in each race without attempting to estimate their winning probabilities. Several studies have shown that tip sheets generally produce a return that is worse than a strategy of simply betting each race's favorite.

responsible for putting together a program of similarly qualified horses, it might be predictable that the official track odds would not suggest the wide range of odds that generally prevails when the horses leave the starting gate (and as we have seen above the parimutuel odds substantially understate the true variability between horses with the most and least empirical probabilities of winning).

The *Daily Racing Form* maintains a staff of several handicappers each of whom makes a daily selection of the three horses he believes will finish as win, place and show. In addition, the *Daily Racing Form* publishes its line, a complete list of predicted odds for each horse entered in the day's events.

City newspapers also maintain handicapping experts—although often on a part-time basis only—and they too publish a line of predicted odds in addition to one or more selections of the three top horses in each event.

In order to evaluate the handicapping ability of each of the above experts, I collected and analyzed a second set of races, independent from those in Table 1. The charts for the 1975 summer meeting at Arlington Park, Chicago, were collected for the 846 races run during the 94-day meet. These results were then classified in the same manner as the data discussed in Section II above. Figure 3 shows how this sample of 7,657 entries compares with the combined data shown in Figure 2. Two differences need explaining: (1) there were too few data to warrant using a class with midpoint odds of 0.75 so the class interval was adjusted to coincide with 1.25, and (2) few experts quote odds larger than 30 to 1 so that figure was used in place of the 33 to 1 for the combined study. This new sample once again reconfirms the existence of a clear and substantial bettor bias.

In addition to the official track handicapper's odds and those of the *Daily Racing Form*, three major Chicago newspapers publish an individual line of odds for each

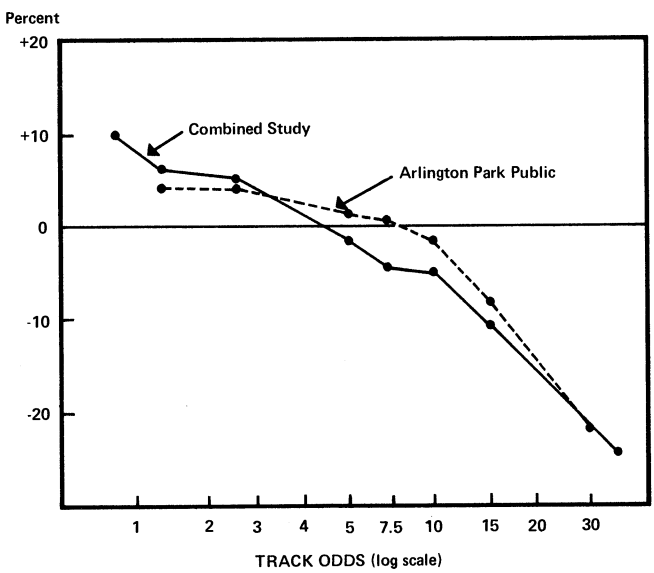

FIGURE 3. Rates of Return With Take Added Back

racing event. The predicted odds of each expert were grouped by the same midpoints used in Figure 3 for the public's parimutuel odds. The rates of return were then calculated by equation (1) using each expert's own predicted odds "as if" they were the actual pay-out odds. Figure 4 compares each expert's rate of return with the public's own.

The most important observation is that nearly all of the experts' odds diverged more from an unbiased prediction than did the general betting public's own parimutuel odds. This can be seen by the extent to which the experts' rates of return are both larger (at low odds) and smaller (at high odds) than the public's rates of return.

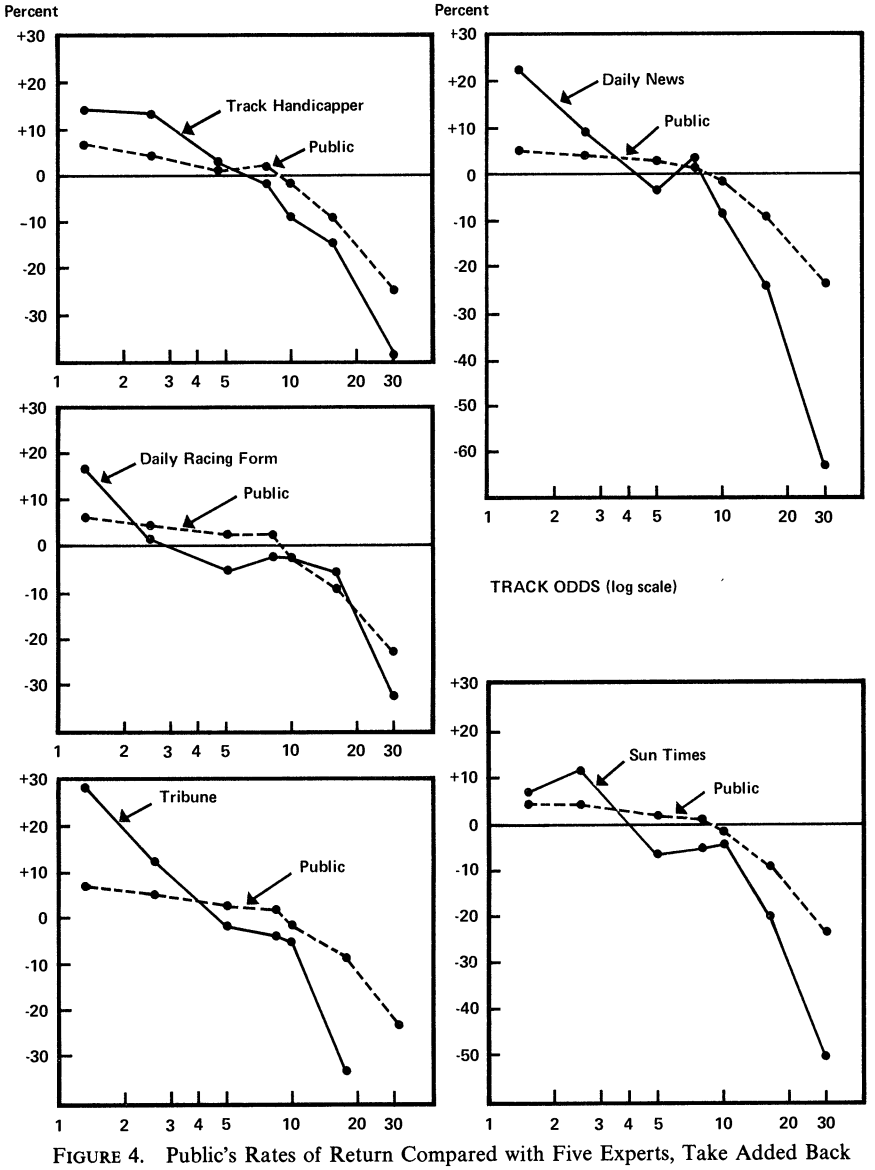

FIGURE 4. Public's Rates of Return Compared with Five Experts, Take Added Back

It might not seem too surprising that the newspaper experts as a group did substantially worse than the other two as in some instances they are part-time employees with no greater expertise than many of the well informed betting public. But it is indeed surprising that the track handicapper should exhibit a similar bias. There are several reasons why each expert's prediction exhibits an even greater bias than the general public.

My interviews with the experts revealed that they do not attempt to predict each horse's actual winning chances, rather they attempt to estimate the odds the public will create through its parimutuel betting. Figure 4 shows clearly that each expert's odds does generally approach closer the public's odds (as illustrated by the public's rate of return) than they do an unbiased estimate. But this doesn't help to explain why the bias in the experts' predictions is generally greater than the public's itself.

When I asked one of the *Daily Racing Form's* handicappers why his predictions deviated from the public's, especially at the lowest and highest odds, he offered two explanations. There was an "unwritten rule never to quote odds larger than 30 to 1." No one, however, remembered when the rule came into being or why it exists! As for the lower odds, he explained that due to his newspaper's power to influence bettor opinions, "we don't want to point the finger too clearly at a horse's winning chances." Thus, for reasons which are perhaps similar to the official track handicapper, the *Daily Racing Form's* policy is to constrain their odds predictions within a smaller range than is actually assigned by the public through its parimutuel betting.

It is possible that greater uncertainty plays a role. Each expert must make his prediction up to 30 hours before the actual race time. Other information which becomes available after their predictions may explain why the public's odds have greater variance than the experts'.[9]

The relative accuracy of each expert's predictions can be evaluated by comparing the root-mean-square differences between the public's and the expert's rates of return which are (in increasing order): official track handicapper (6.2%), *Daily Racing Form* (6.2%), *Sun-Times* (7.1%), *Daily News* (10.8%), and *Chicago Tribune* (14.8%). Thus three of the experts did about equally well while the predictions of two of the newspapers were less accurate.

These five strong tests of market efficiency have each failed to reveal any means of making a positive return after the track take is subtracted. Indeed, each expert reveals a greater bias than does the public itself.

V. Conclusion

I have shown through several weak and strong tests that above average and positive profits cannot be expected from horse race betting, a conclusion which is similar to that reached for security markets. While there are statistically significant differences between the subjective and empirical probabilities of winning for particular odds-groups of horses, these differences are not so large as to exceed the price of betting—the track take. Specifically, at the lower-odds the subjective probabilities significantly underestimate the empirical probabilities of horses in these groups to actually win races, whereas at the higher-odds the opposite prevails

9. Rogers offered this explanation.

as the subjective probabilities greatly exceed the empirical probabilities. Moreover, this bias exists for both the betting public and the experts. The reasons for this bias, however, are not identical. The betting public clearly prefers longer-odds to shorter-ones, and due to the parimutuel betting system this substantially decreases the (already negative) expected earnings of longer-odds bets while raising somewhat the earnings of the lower-odds horses. The expert bias arises more from perceived constraints on the range at which the experts quote entries; there appears no reason why experts should prefer longer-odds horses. As for semi-strong tests, only one model has purported to demonstrate absence of an efficient market, hence more tests are required.

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