Market efficiency in greyhound racing: empirical evidence of absence of favorite-longshot bias

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Abstract
This research empirically tests greyhound racing betting data for presence of an inefficiency called favorite-longshot bias, which has been widely reported in horse racing. Our analysis of 4723 races from a greyhound track in North America does not support presence of the favorite-longshot bias. We report inefficiency as bettors over-estimate the probability of winning for the favorites by over-betting and under-estimate the winning probability for the longshots.

MARKET EFFICIENCY AND PARIMUTUEL RACETRACK BETTING
Racetracks offer researchers rich experimental settings for testing asset pricing theories of uncertain contingent claims, of which market efficiency price discovery under risk conditions is a prime example. Unlike equity markets, races have a finite and short life span. Bettors' decisions are validated upon the conclusion of the race at which point, value of the asset becomes known to all participants. Economic theory assumes that decision makers act rationally under situations of risk. In the present context, it means they are able to accurately assess the risk/reward balance. Decision situations with imbalanced risk/reward undergo adjustments until those imbalances are corrected. In the long run, investors act upon these opportunities to earn excessive returns and force the returns to converge towards normality. Inefficient markets eventually reach efficiency as the opportunities to generate excessive returns disappear.

Numerous studies on bettor behavior in parimutuel racing in North American racetracks have reported inefficiencies. The inefficiency that has been widely tested using empirical data is the favorite-longshot bias. The studies have concluded that in North American horse racing, longshot horses were overbet while the reverse is true for the favorites, they are underbet. Therefore, returns generated by bets placed on longshots were found to be lower than the assumed risk. On the contrary, returns on favorites were higher than the associated risk.

In parimutuel form of racing, money bet on each class of bets is pooled. The odds are adjusted to the actual bets placed on the entries. If the actual fraction of the pool bet (bet fraction) on an entry is larger than the entry's true odds of winning (win fraction), the winning bet(s) generate gross returns that are less than the assumed risk. In the long run, bettors will learn this fact and the fraction of the pool should decline to reach risk/reward parity. Conversely, if the bet fraction wagered on an entry is smaller than the win fraction, bettors will experience excess returns. Again, the market will recognize the winning potential of such entries by betting larger bet fractions.

Presence of favorite-longshot bias contradicts rational economic decision making under conditions of risk and uncertainty (Thaler and Ziemba, 1988). Such results have been replicated and suggest risk preference by the racetrack bettors (Snyder, 1978, Asch and

Quandt, 1990,). Economists assume that bettors are rational. Empirical results prove otherwise. Bettors are unable to accurately forecast the true odds of winning.

Previous studies have tested market efficiency by comparing the subjective probability (bet fraction) of winning, as derived from the wagers placed by bettors, with the actual win fraction. If wagering markets are efficient then the bet fraction for an entry must equal its true odds of winning. We recognize that there is no *a priori* condition that the subjective odds and win percentage should be the same.

Few studies have reported results that are exception to the favorite-longshot bias. Two such studies are Busche and Hall(1988) and Busche(1994). These authors, while applying the same data analysis techniques, reported results that were contrary to the previous studies. Their results showed that bettors exhibited rational decision-making, meaning bettors were able to correctly estimate the odds of winning, and placed wagers accordingly. The explanations offered for the contrary results were that differences were culture based as those results were observed in racetracks in Hong Kong and Japan. A subsequent study by Busche and Walls(2000), using betting data from Macau, reported results similar to the North American tracks and supported favorite-longshot bias argument. The cultural differences argument was hence invalidated as a possible explanation.

All previous studies used track reported odds data to estimate the subjective odds. Tracks round odds downwards and the payoffs bettors receive are in multiples of 10 cents. Hence a payoff that should actually return $2.78 to the winner is rounded down to $2.70, for a one-dollar bet. These rounded odds are called broken odds. The track operator retains the residual cents. Walls and Busche(2003) offered another explanation for the favorite-longshot bias. These authors analyzed both exact bet volumes data, and broken odds data obtained from Hong Kong and Japanese racetracks. They reported presence of favorite-longshot bias only in the broken odds data. The exact bet data, when analyzed using similar methods, showed no such favorite-longshot bias. The authors concluded that favorite-longshot bias was the result of loss of odd cents in rounding.

Our study differs in that we tested the efficiency of bettor behavior in parimutuel greyhound racing. All previous studies studied horse racing. The question we tried to answer is: do bettors in greyhound racing exhibit risk neutral or risk preference behavior? Applying the same methods, we tested for the presence of favorite-longshot bias.

GREYHOUND RACING

The present study focused on wagering in greyhound racing. There are significant differences in these two forms of racing. First, we provide a brief overview of greyhound racing.

The number of entries in a greyhound races is always eight. The greyhounds are randomly assigned to starting positions of one to eight. At the start, greyhounds take their respective positions inside what is called the “box”. In unusual situations, where an entry had to be scratched, the race is conducted with less than the full complement. Also, in some races not all eight greyhounds cross the finish line.

Greyhounds are subjected to a strict grading system, which is mandated by the gaming commission of the state in which the track is located. Racing secretary at the track is responsible for proper grading of greyhounds. On the track we studied, greyhounds are graded A, B, C, D, E or M (maiden), with A being the highest grade. Greyhounds are trained for racing by their trainers and before starting racing careers participate in several practice races, which are assigned the grade M. A greyhound can move up in a grade or slide down a grade depending on recent performance. The rules a track follows in grade adjustments are public information.

A greyhound currently graded E, if fails to finish in the top four (4) positions in four (4) consecutive races may be dropped from further races. The racing secretary is responsible for exercising that discretion. Greyhounds that finish lower than 4^{th} in three (3) consecutive starts (except grade D) or fail to finish higher than a 3^{rd} are lowered a grade. In grade D, a greyhound may fail to achieve a spot in the top four, in four consecutive starts, before the grade is lowered. Winner of each race is advanced to the next higher grade until they reach the top grade of A. Thus, to maintain the grade a greyhound must finish in the top four positions in three consecutive starts (four starts for D).

Track managers assign similarly graded greyhounds to a race. Therefore in a B grade race, all greyhounds are graded B and may include greyhounds that were recently upgraded from the grade C or down graded from grade D. At the discretion of the track, greyhounds of different grades or of the same grade may be raced in races that are designated by a special letter 'T'. Starts on all "T" races do not count towards the application of the downgrading or upgrading rules.

WAGERING AND TRACK TAKE

A bettor can place several types of bets. The simplest are win, place, or show bets. These bets are placed on a single entry. Other exotic bets, which involve 2 or more greyhounds, are also available. In the present study we focused on the win bets only.

All wagers made in a race on a type of bet (win, place or show etc.) are pooled. The track retains a percentage of the pool, called track take, to cover expenses, taxes, and profits etc. Track take for win bets on the track we studied is 27 percent.

The tracks establish what are called the opening odds, which are transmitted with the race program. In the past, these racing programs were available for purchase at the racetrack. These days, almost all racetracks post the programs on their web site. These programs include a wealth of information that bettors use in handicapping the race. Betting window opens 20 minutes before the start of the race. Track reports current odds electronically, every 30 seconds, up to the start of the race. When the race starts, the betting stops and the final odds are reported. The odds are derived from fraction of the pool that is bet on the entry. The odds(O_i) for an entry are:

$$O_i = (1 - t) * (\Sigma X_i / X_i) - 1$$

Where t is the "track take", ΣX_i is the total pool bet on a bet class of which X_i was bet on an entry.

MARKET EFFICIENCY TESTS

The statistical methods used to test market efficiency in wagering markets were first reported by Ali(1977). We used the same grouping method to compute the test statistics. In this method, greyhounds in a race are rank ordered based on the betting volume (fraction of the betting pool). Greyhound attracting the largest volume of bets is ranked first with the lowest ranked entry (eighth) attracting the least fraction of the betting pool. Gross returns (R_i) bettors generate, for one-dollar bet, from an entry are dependent on the fraction of the betting pool and are shown as:

$$R_i = (1 - t) * (\Sigma X_i / X_i)$$

Where the bet fraction(BF_i) of the pool bet on entry i is:

$$BFi = X_i / \Sigma X_i$$

Bet fractions in each rank are compared with the actual win fractions. If bettors are able to accurately estimate the odds of winning for a given entry, then in equilibrium conditions, the fraction of the pool bet on the entry should not deviate from those odds. In the long run, if the efficient market assumptions hold, the average returns to the bettors should equal the track take of –t. If there is a significant difference between the odds of winning and the fraction of the pool bet then the returns to the bettors would significantly deviate from –t.

We tested the null hypothesis that win fraction was statistically not different from the fraction of the pool bet, by rank. This experiment is a binomial process with a greyhound either winning the race or not winning the race. We calculated the Z score using the methods presented in Walls and Busche (2003).

DATA COLLECTION

We collected results of all races held between May, 2002 and August, 2003 from a greyhound track in North America. The data were downloaded from racetrack's official web site. The racing charts showing results from a session are available on the web site within hours of the conclusion of the session. The racing charts were downloaded in Word and further processed and analyzed using Excel.

This racetrack holds 15 races per session. One session is held daily on weekdays, with no racing on Tuesdays. A second session is held on Saturday evenings. Races are held over two courses of lengths: $5/16^{th}$ of a mile (1650 feet) and $3/8^{th}$ of a mile (1980 feet). On average, the 1650 feet races out number the 1980 feet races by about 8 to 1.

In our analyses, we excluded races, which either started with less that the full box of eight greyhounds or completed the race with less than eight greyhounds crossing the finish line. Number of such races was 5526. To ensure uniformity and consistency, we only focused on races with greyhounds graded A through E and for the shorter distance. This reduced the number of usable races to 4723.

EMPIRICAL RESULTS

Using the final broken odds data we estimated the bet fractions. Average of broken odds for each rank was used to calculate the bet fraction as:

$$X_i / \Sigma X_i = (1 - t) / (O_i + 1)$$

which is consistent with previous work by Ali(1977) , Asche et al.(1982), and Walls and Busche(2003). The bet fractions were compared with the win fraction in each rank. Table 1 shows the z scores.

Table I. Actual WIN fractions and Bet fractions using broken odds data

RANK	Avg. Odds	WIN fraction	Bet fraction	Std Error	Z score
1	2.04	0.223	0.268	0.006052	7.46*
2	3.45	0.176	0.176	0.005535	0.11
3	4.79	0.139	0.136	0.005029	-0.46
4	6.29	0.112	0.109	0.004593	-0.60
5	8.18	0.097	0.087	0.004302	-2.38*
6	10.86	0.083	0.071	0.004010	-3.04*
7	14.94	0.066	0.054	0.003620	-3.46*
8	22.63	0.050	0.043	0.003170	-2.07*

* $p \leq 0.05$

The results show that favorites won their races 22.3% of the time while attracting 26.8% of the betting pool. On the other hand, the greyhounds ranked 5th through 8th won more often that the wagering would indicate.

Walls and Busche (2003) concluded that rounding in the odds data caused a downward adjustment of test statistics that led to the conclusions of presence of favorite-longshot bias. Since the odds are rounded down to the nearest tenth, the distribution of the odds adjustment follows a uniform distribution with a mean of 0.05. To correct for this loss of odd cents, we adjusted the broken odds by 0.05. Table 2 below shows the z-scores.

Table II. Actual WIN fractions and Bet fractions using adjusted broken odds data

RANK	Avg. Odds	WIN fraction	Bet fraction	Std Error	Z score
1	2.04	0.223	0.262	0.006052	6.60*
2	3.45	0.176	0.174	0.005535	-0.29
3	4.79	0.139	0.135	0.005029	-0.73
4	6.29	0.112	0.109	0.004593	-0.79
5	8.18	0.097	0.086	0.004302	-2.50*
6	10.86	0.083	0.070	0.004010	-3.13*
7	14.94	0.066	0.054	0.003620	-3.52*
8	22.63	0.050	0.043	0.003170	-2.13*

* $p \leq 0.05$

We do not experience any change in the observed results. Here again, returns on favorites are less than the risk. Bettors are unable to accurately assess the probability of winning, and thus overbet the favorites.

For greyhounds ranked 5th or lower, the win percentage is higher than the bet fraction. Bettors overestimate the risk and under bet the longshots. These results are in stark contrast to bettor behavior observed in horse racing.

CONCLUSIONS

In our study we did not observe presence of favorite-longshot bias in greyhound racing. Bettors are unable to assess the risks associated in a race. Betting data shows that favorites are overbet and the longshots are underbet. Even though our results are significant but we are unable to provide reasonable explanations for the difference in these two forms of racing. Further work is needed to research the causes.

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