New Zealand Agricultural and Resource Economics Society (Inc.)

What can we learn from Horse Racing?

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Summary of Presentation:
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This summarizes some of the main features of the conference presentation. Topics included a discussion of the NZ horse racing industry, research on horse genetics, studying horse betting markets as financial markets, and a summary of a recent working paper on inferring risk-preferences from betting data.

1. NZ Horse Racing Industry (source: NZRB Submission on Taxation, 2005)

- 9,250 full-time equivalent (FTE) direct jobs, 0.55% of NZ employment
- 18,320 FTE total jobs, including flow-on effects.
- $1,480 million value-added or 1.3% of GDP, including flow-on effects.
- $120 to $175 million in live horse exports per year 1998-2004.
- Approximately 40% of race foals exported overseas.
- Racing accounts for only 15% of NZ gaming expenditure in FY03.
- Around $44 million in prize-money to horse owners during 2002/03 season.[1]
- $60.2 million in tax revenue to the NZ government during 2002/03 season.

2. Research on Horse Genetics

- Meticulous pedigree records for more than 20 generations
- Carefully documented race performance measures
- Cunningham (1991) estimates:
- Track performance about 35% inheritable
- Yearly improvements in track performance around 0.9 timeform units

[1] Applying estimates from KPMG, Tax Review, October 2004.

3. Studying the Horse Betting Market as a Financial Market

- Similarities
  - uncertainty concerning future cash flows
  - many participants with a wide variety of information
  - a set of prices for bets (stocks) is determined by betting (trading).
- Differences (Advantages)
  - the finite time horizon of the race converts financial prices into certain cash flows
  - the cash payout in a horse race is the results of a real event and, unlike futures and options markets, does not depend on financial prices.
- Horse data does not have serious measurement and survivorship issues like financial market data.

4. Inferring Risk-Preferences Using Betting Prices (Odds)

a. Data

- 18,509 total races
- 2004 race meetings in 2004 from the largest North America thoroughbred racetracks
- 148,863 horses
- eliminated deadheats, missing odds, zero odds and races where payoffs appear for disqualified horses**.**

b. Odds do an excellent job of predicting outcomes

- Lower odds are associated with a higher frequency of winning (see figure 1).
- Market assessed probabilities closely follow actual winning frequencies (see figure 2)

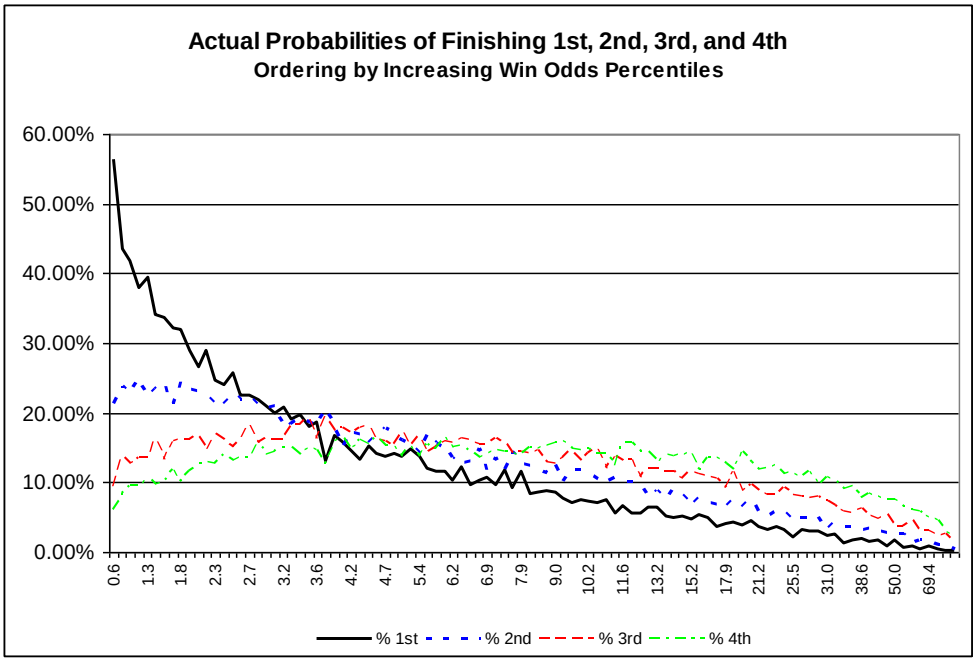

Figure 1. The probability of finishing 1st, 2nd, 3rd, and 4th, ordered by starting odds percentiles. Lower payoffs/odds are associated with a higher chance of winning.

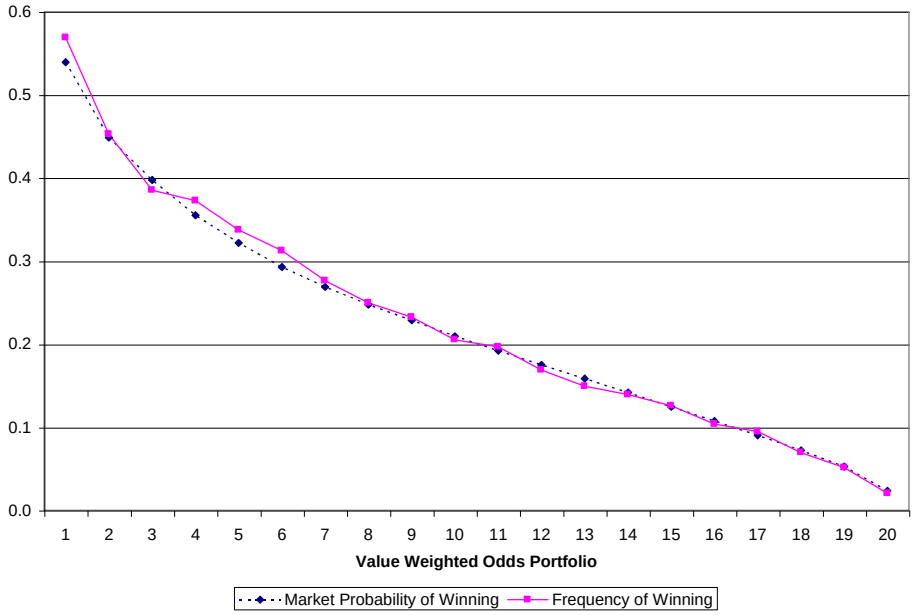

Figure 2. The relationship between market assessed probabilities of winning and the actual frequency of winning, for odds vicesiles.

c. Previous research attributes a favorite-longshot bias to bettor risk-seeking behavior.

- Betting on horses with larger odds (longshots) has lower returns than betting on horses with lower odds (favorites), see figure 3.
- Larger odds also have a higher standard deviation, so that higher risk bets have lower returns.
- Thaler and Ziemba (1988) summarizing 40 years of horse betting studies concluded that horse bettors are risk-seeking and use mental accounting.
- However, Golec and Tamarkin (1998) show that bettors (weakly) like skewness: the chance of a big payoff for little risked.

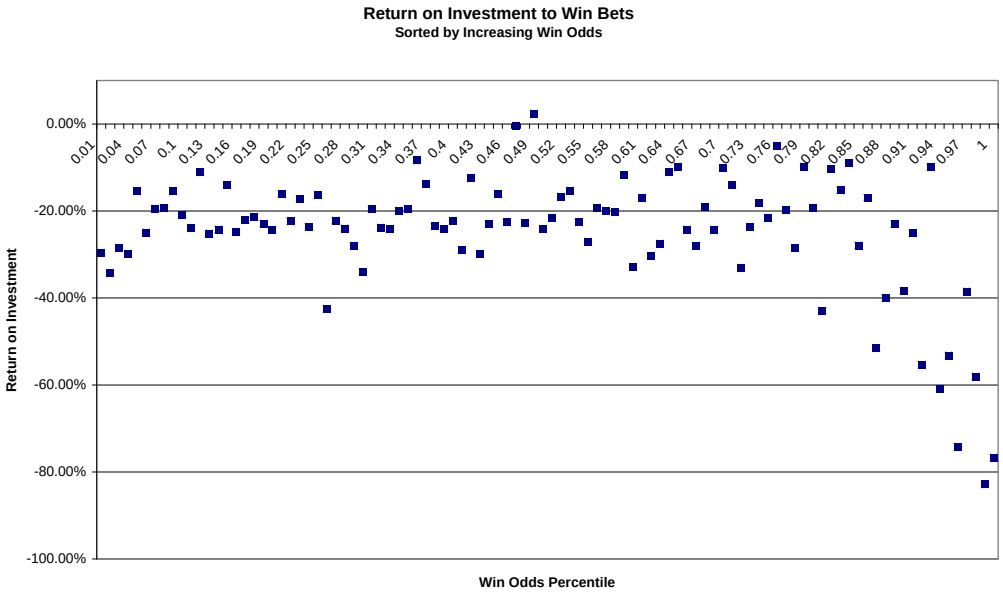

Figure 3. The return on investment for increasing odds percentiles. Notice that the larger odds have lower returns.

d. Synthetic Win Bets

- Put your selection in first position
- Put all other runners in:
  - 2nd for exacta
  - 2nd and 3rd for trifecta
  - 2nd, 3rd, 4th for superfecta
- The synthetic win bet pays off if your selection wins. However, payoff depends on who gets second (and third etc.), and their odds.
- Strategy name: Anchor/bank/wheel

i. The synthetic win bet is a natural lottery

- Do bettors prefer certain types of lotteries over others?

    - For example, instead of betting a hot favorite to win, take a synthetic win trifecta and hope that longshots finish second and third.
- When medium-odds horses win, the synthetic win bet has greatest variability.

ii. Some notes about synthetic win bet

- Not using any probability information to construct synthetic bet – there is evidence that place and show pools have additional information.
- Equally weight longshots and favorites in 2nd, 3rd, 4th (use win probabilities for win).
- Larger payoffs of longshots finishing in the money offset by lower frequency that that occurs.
- If there is mispricing of longshots and favorites in 2nd, 3rd, 4th in exotic pools, could be a terrible/great bet.

ii. Returns to Synthetic Win bet by increasing odds for Exactas, Trifectas, and Superfectas.

- Figure 4 shows the return on investment to the synthetic-win exacta bet by increasing odds
- Figure 5 shows the return on investment to the synthetic-win trifecta bet by increasing odds.
- Figure 6 shows the return on investment to the synthetic-win superfecta bet by increasing odds.

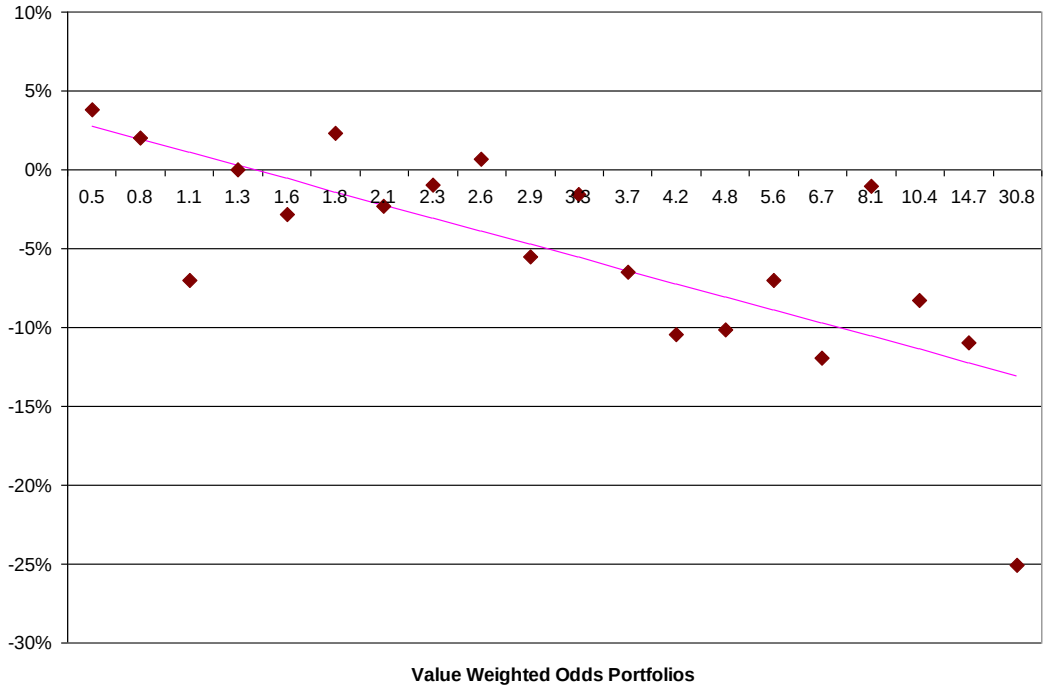

Figure 4. Figure 5. Synthetic win payoff for Exactas (1st and 2nd) by increasing odds vicesiles

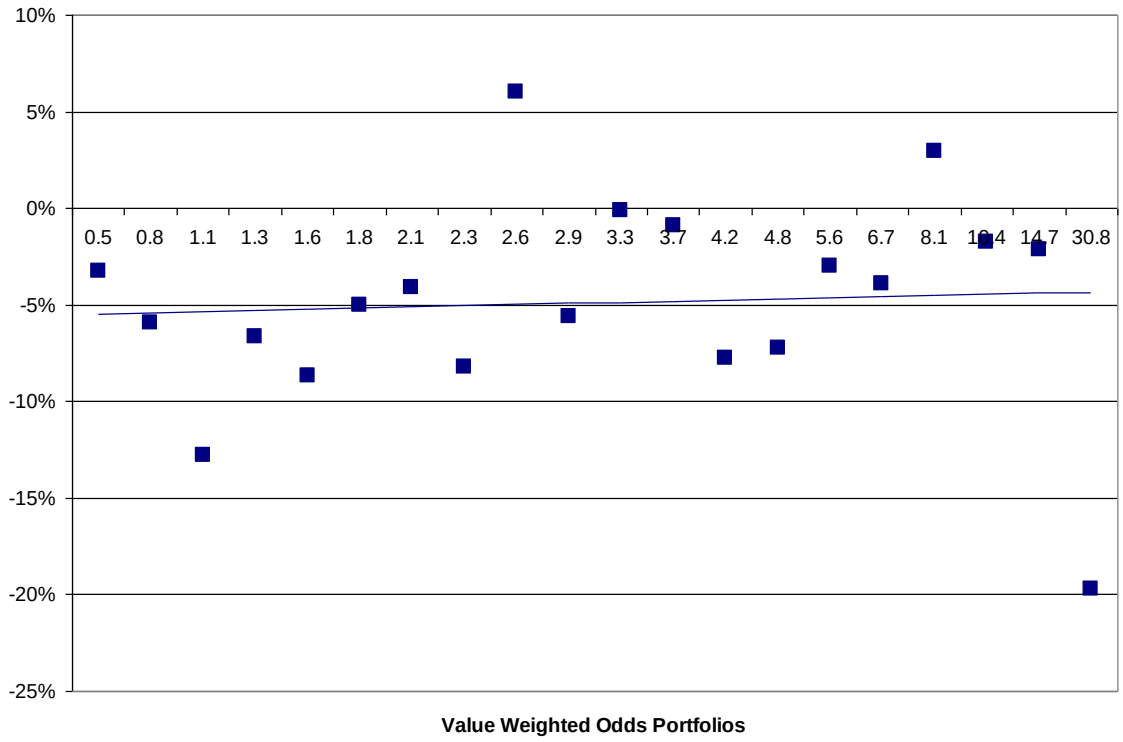

Figure 7. Synthetic win payoff for Trifectas (1st, 2nd, and 3rd) by increasing odds vicesiles

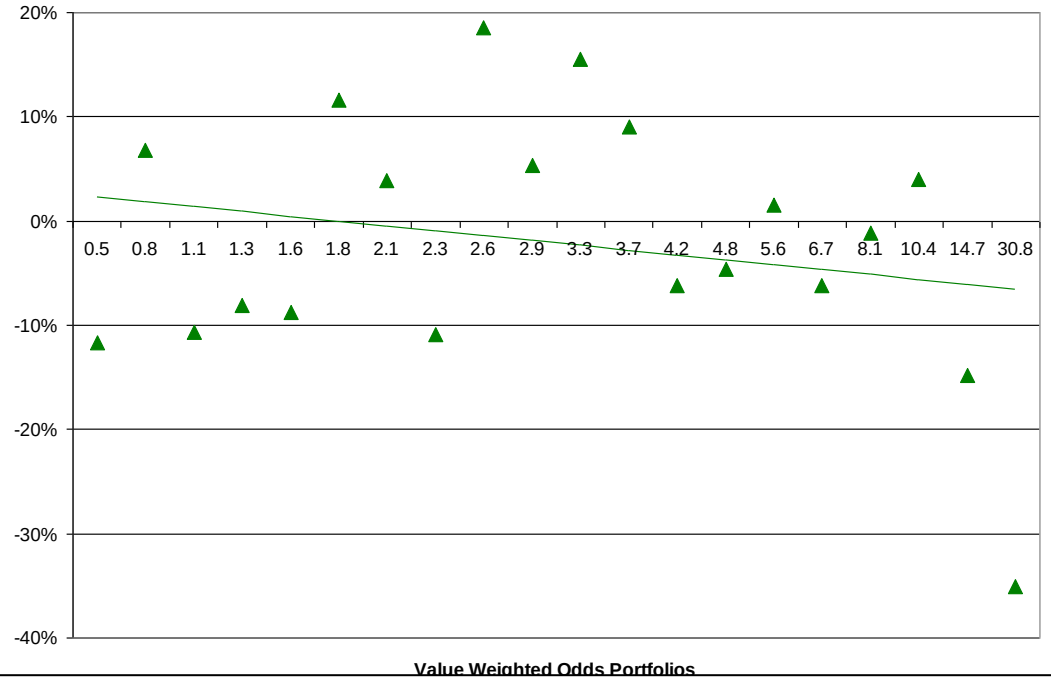

Figure 6. Synthetic win payoff for Superfectas (1st, 2nd, 3rd and 4th) by increasing odds vicesiles

iii. Synthetic Win payoff relative to win payoff for Synthetic Win Exacta, Trifecta and Superfecta.

- Figure 7 shows the relationship of the synthetic win bet payoff divided by the win payoff as odds increase.
- The payoff tends to be larger for medium-odds horses winning.
- Medium-odds synthetic win bets have a larger standard deviation.

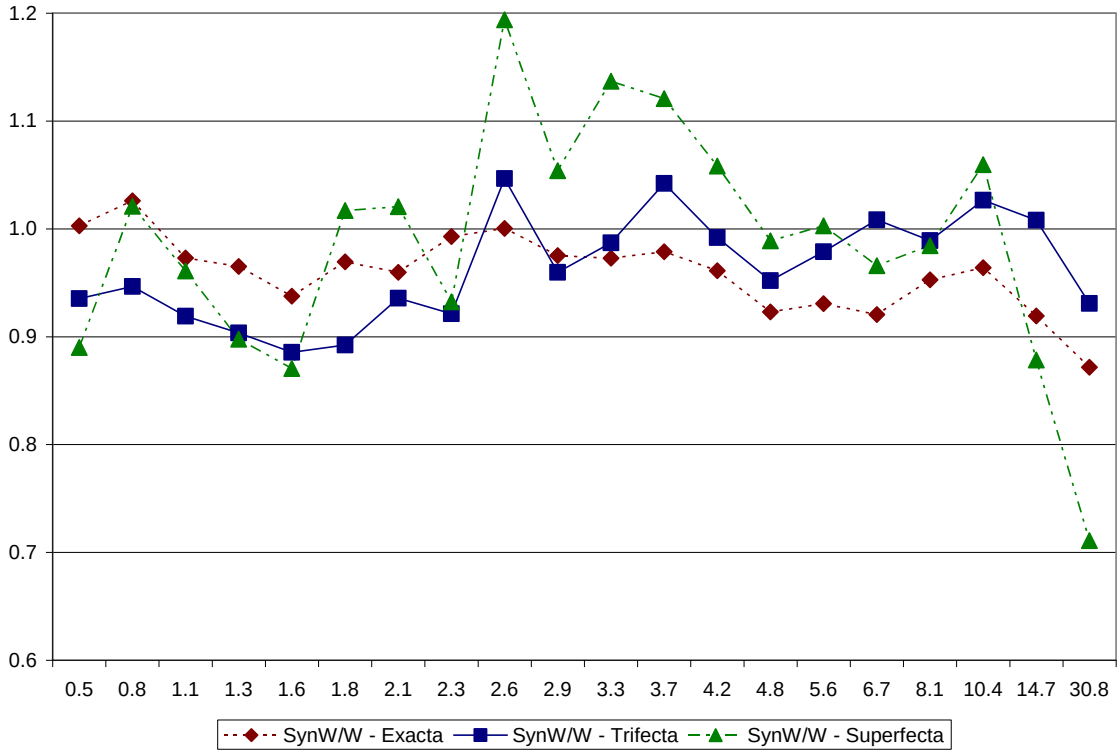

Figure 8. Payoff of Synthetic Win bet divided by Win payoff, for increasing odds vicsiles.

iv. Risk-return tradeoff.

- Figure 8 shows that there is an increasing average return for increasing standard deviation.
- Figure 9 shows that there is an increasing gain for increasing loss.

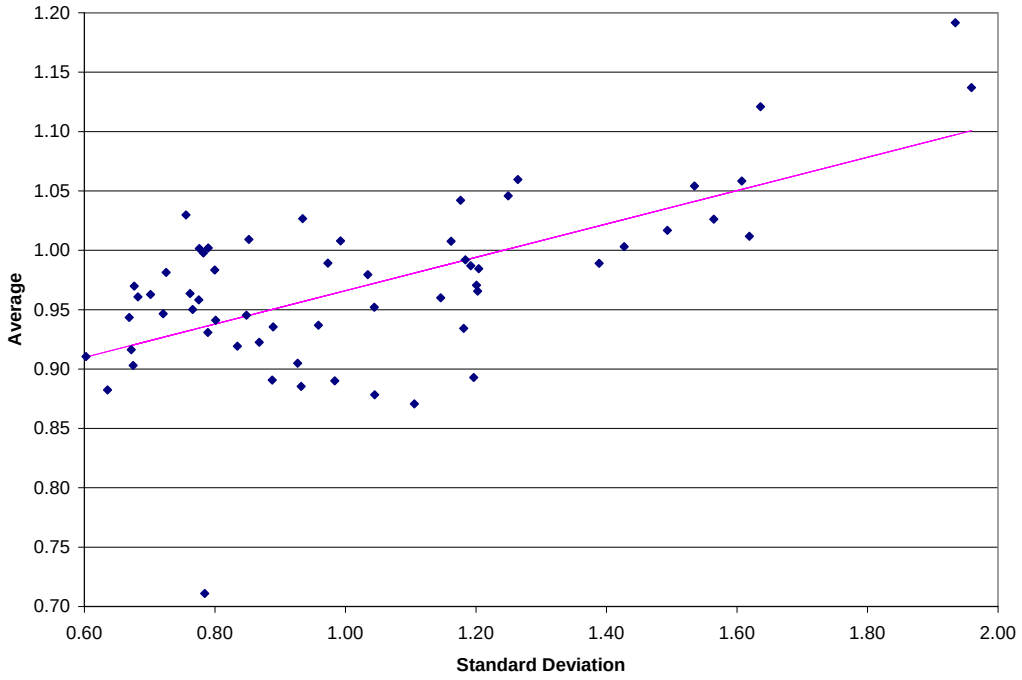

Figure 9. The relationship between average return and standard deviation of returns for synthetic win relative to win, by increasing odds vicesiles.

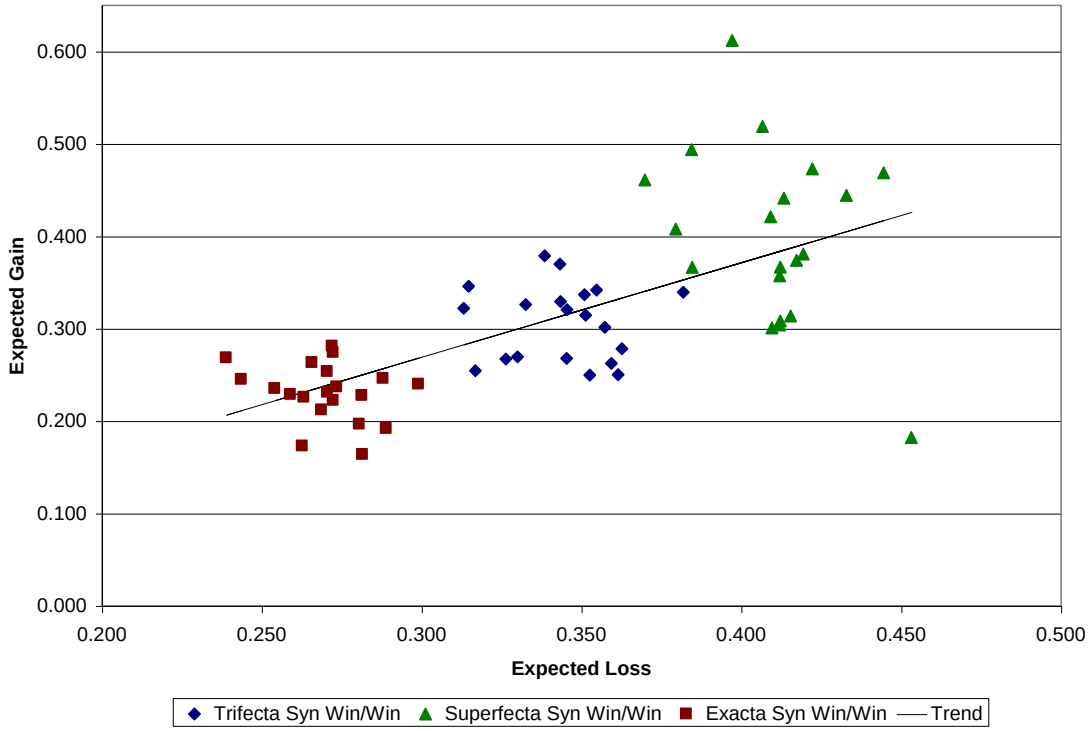

Figure 10. The relationship between expected gain and expected loss for synthetic win to win bets, by increasing odds vicesiles.

v. Analysis of the return of the synthetic win bet relative to win bet

- Does standard deviation, skewness, and kurtosis generate risk premiums?
- Using win returns, standard deviation and skewness are highly coincident.
- Synthetic win to win lottery creates dispersion in standard deviation and skewness across odds categories.
- Empirical Procedure:
  - let y=win payoff, which is known (with high certainty) and z = synthetic win payoff, which is random, then the utility payoff of the synthetic win to win is:
    - pU(***z***)/pU(y), or
    - U(***x***) = U(***z***/y), where x=z/y is the synthetic win-to-win payoff.
- Next take a Taylor series expansion around x=0:

$$EU(x) = U'(x)E(x) + \frac{1}{2}U''(x)E(x^2) + \frac{1}{6}U'''(x)E(x^3) + \frac{1}{24}U''''(x)E(x^4) + ...$$

- Assuming constant expected utility, *c*, across odds portfolios:

$$E(x) = \frac{c}{U'(x)} - \frac{1}{2}\frac{U''(x)}{U'(x)}E(x^2) - \frac{1}{6}\frac{U'''(x)}{U'(x)}E(x^3) - \frac{1}{24}\frac{U''''(x)}{U'(x)}E(x^4) + ...$$

- If bettors are risk averse expected utility maximisers then the $E(x^2)$ co-efficient should be positive($U''(x)<0$, $U'(x)>0$), the $E(x^3)$ co-efficient should be negative, and the $E(x^4)$ co-efficient should be positive.
- Table 1 shows the results of the regression.

Table 1: The Average Synthetic win to win payoff in 20 odds portfolios against the its expected payoff^2, payoff^3, payoff^4

E{x}	*Exacta*	*Trifecta*	*Superfecta*	*All*
Intercept	**0.385***	**0.781***	**0.464***	**0.666***
p-value	**0.000**	**0.000**	**0.000**	**0.000**
Trifecta dummy				**-0.084***
p-value				**0.000**
Superfecta dummy				**-0.059***
p-value				**0.001**
$E(x^2)$	**0.684***	**0.148***	**0.326***	**0.261***
p-value	**0.000**	**0.006**	**0.000**	**0.000**
$E(x^3)$	**-0.153***	**-0.018***	**-0.029***	**-0.026***
p-value	**0.000**	**0.012**	**0.000**	**0.000**
$E(x^4)$	**0.0098***	**0.0005***	**0.0007***	**0.0007***
p-value	**0.000**	**0.017**	**0.000**	**0.000**
Multiple R	0.980	0.434	0.975	0.677
Adjusted R-Square	0.977	0.328	0.970	0.648
F p-value	0.000*	0.024*	0.000*	0.000*
N	20	20	20	60

*Significant at the 5% level.

vii. Results

- Table 1 confirms that bettors are risk-averse expected utility maximisers
- Co-efficient of absolute risk aversion can be estimated as -0.52.

viii. Conclusion

- Thaler and Ziemba claim mental accounting for racetrack bettors
  - This explains why bettors are risk loving
- Alternative, noting that analysis of synthetic win bets shows bettors are risk averse expected utility maximisers:
  - Bettors allocate a stake to risk as a consumption good (know that they will lose on average), which appears to be mental accounting
  - However, winning or losing less increases utility, as do reductions in standard deviation and increases in skewness.
  - Act to maximize utility given a limit to losses.

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