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New Zealand Agricultural and  
Resource Economics Society (Inc.)

## **What can we learn from Horse Racing?**

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# **Summary of Presentation: What can we learn from Horse Racing?**

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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.<sup>1</sup>
- ☐ \$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

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<sup>1</sup> 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.

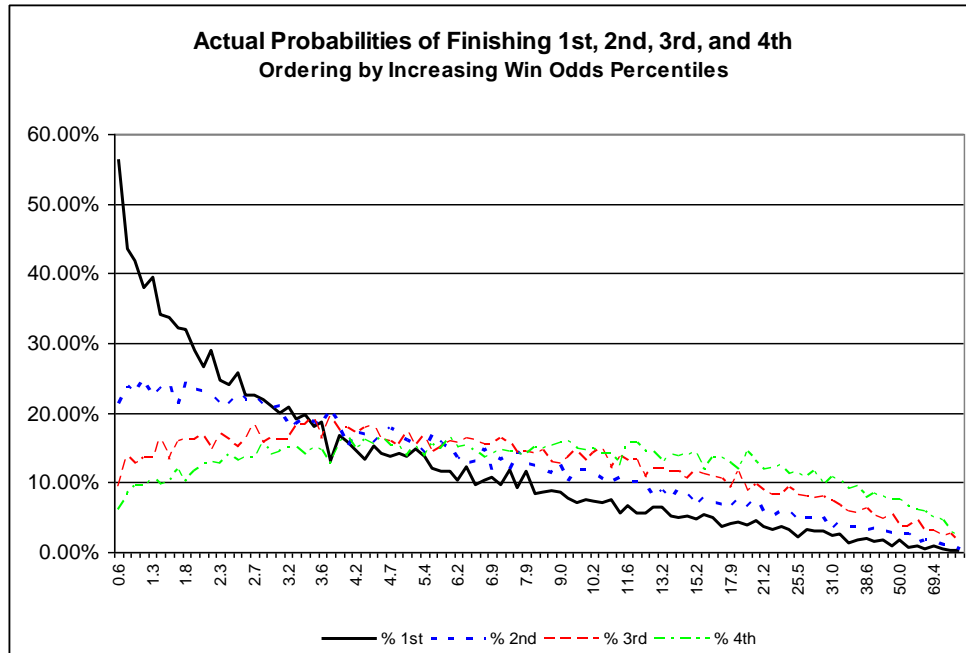
### **4. Inferring Risk-Preferences Using Betting Prices (Odds)**

#### **a. Data**

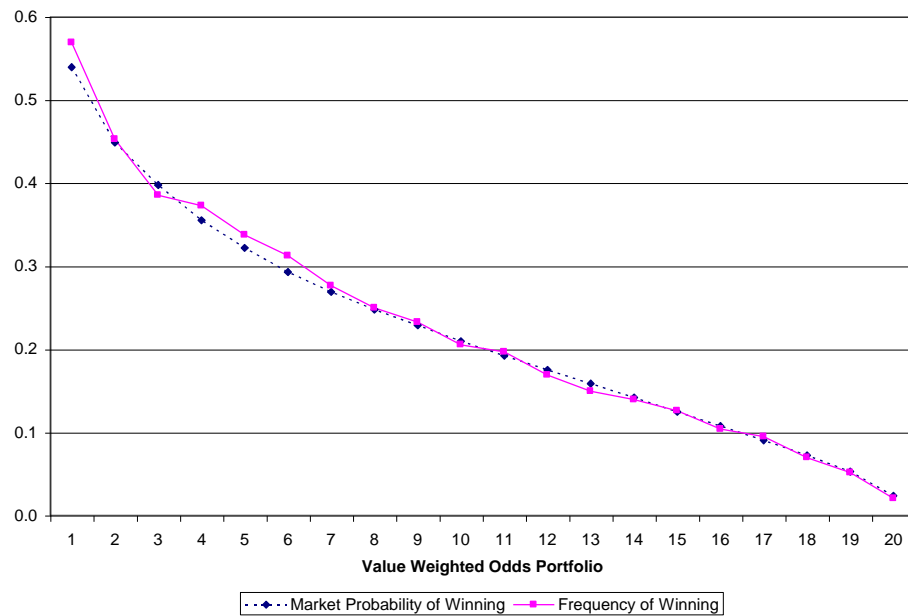
- ☐ 18,509 total races
- ☐ 2004 race meetings in 2004 from the largest North America thoroughbred racetracks
- ☐ 148,863 horses
- ☐ eliminated deadheats, missing odds, zero odds and races where payoffs appear for disqualified horses.

#### **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)



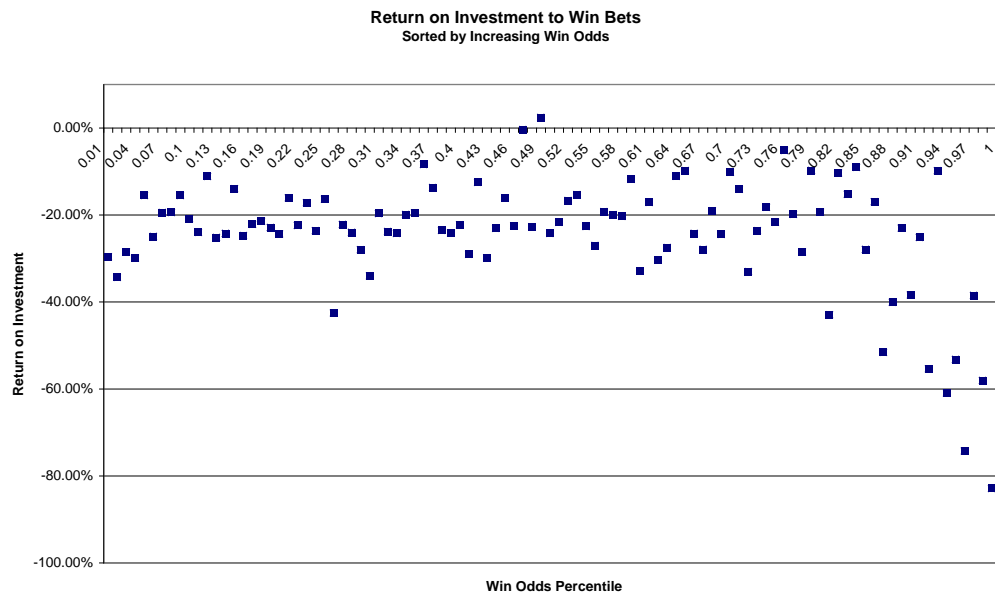
**Figure 1. The probability of finishing 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup>, ordered by starting odds percentiles. Lower payoffs/odds are associated with a higher chance of winning.**



**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 risk.



**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?

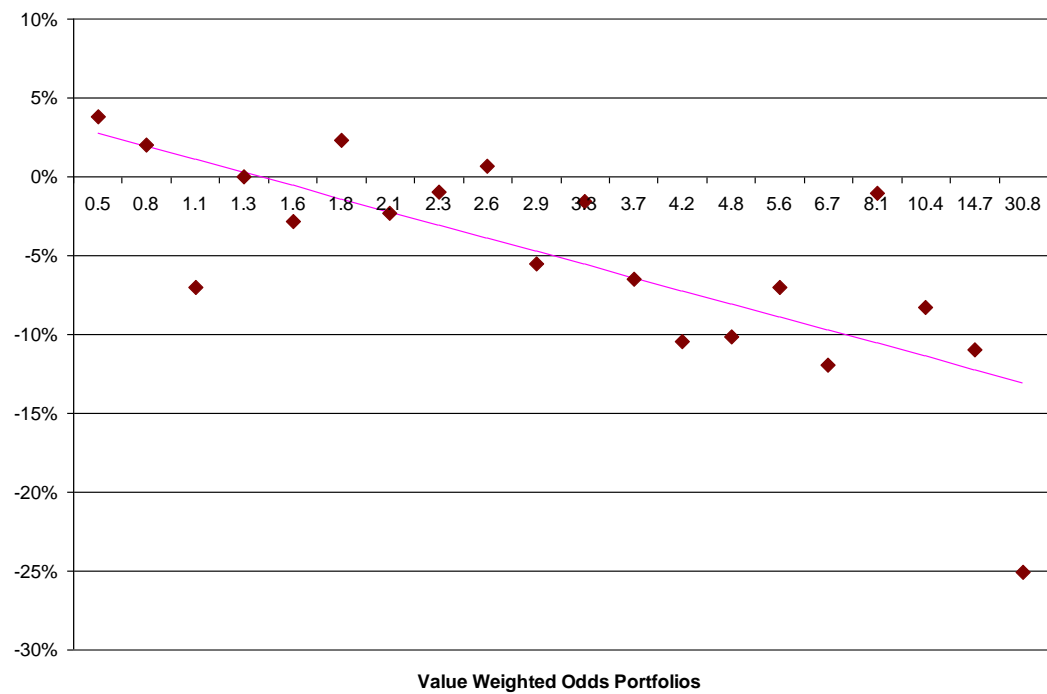
- For example, instead of betting a hot favorite to win, take a synthetic win trifecta and hope that longshots finish second and third.
- When medium-odds horses win, the synthetic win bet has greatest variability.

## **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.

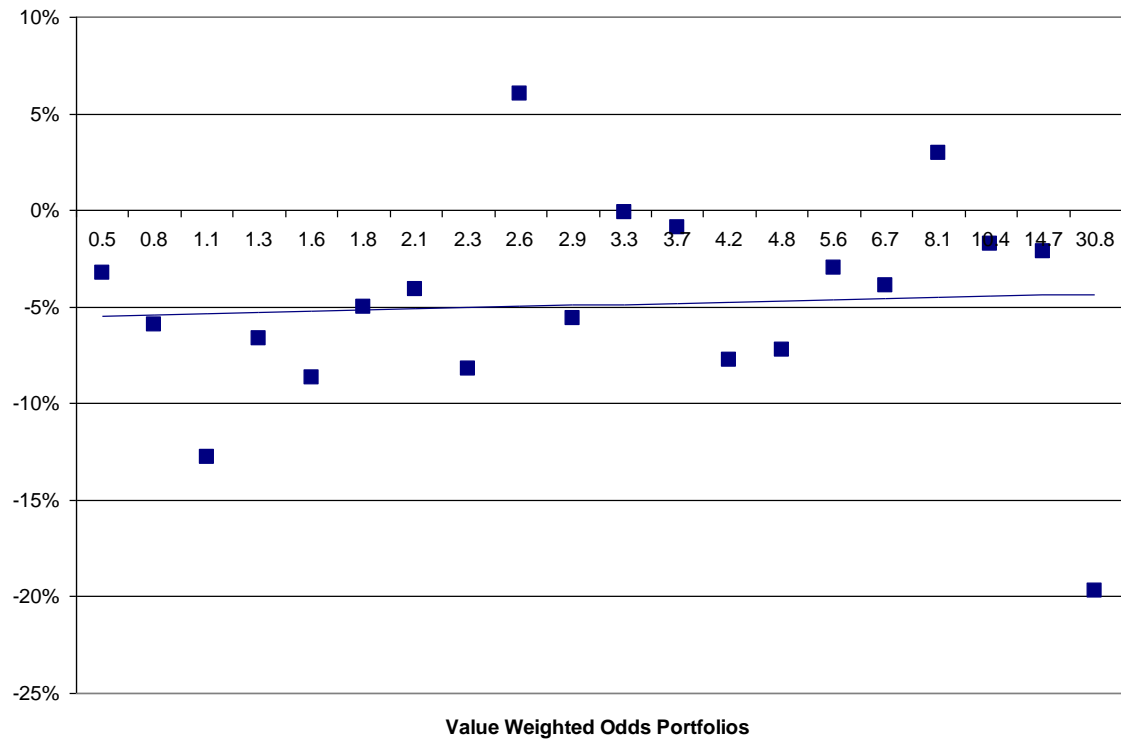
## **ii. Returns to Synthetic Win bet by increasing odds for Exactas, Trifectas, and Superfectas.**

- 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.

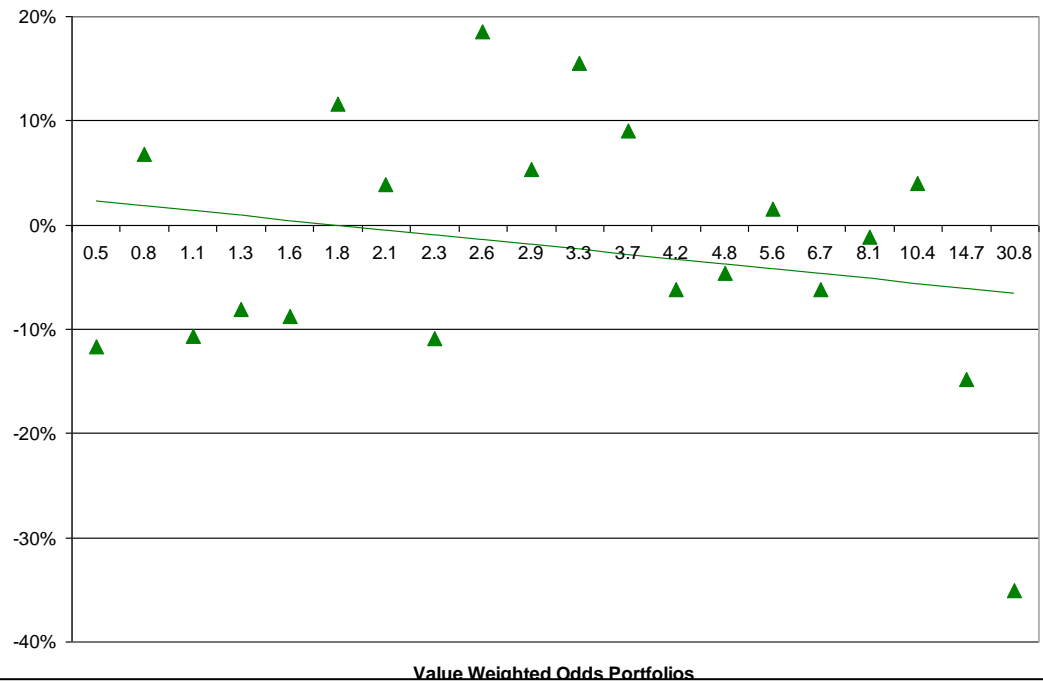


**Figure 4. Figure 5. Synthetic win payoff for Exactas (1<sup>st</sup> and 2<sup>nd</sup>) by increasing odds vicesiles**





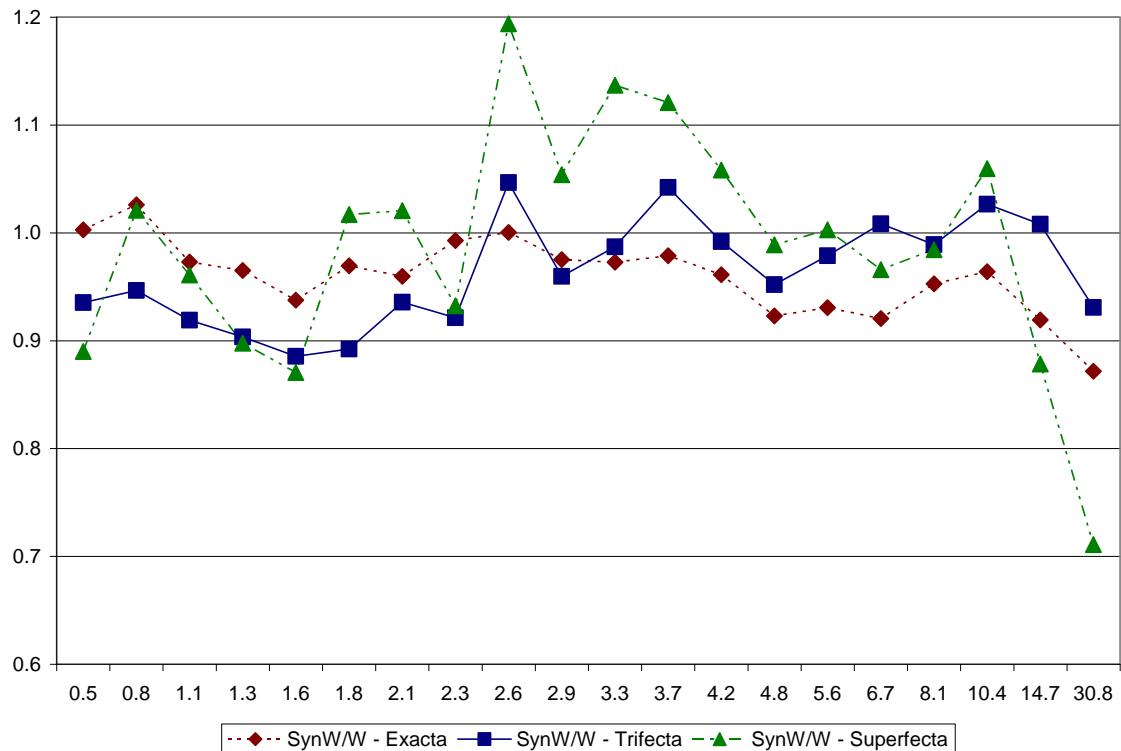
**Figure 7. Synthetic win payoff for Trifectas (1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup>) by increasing odds vicesiles**



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

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

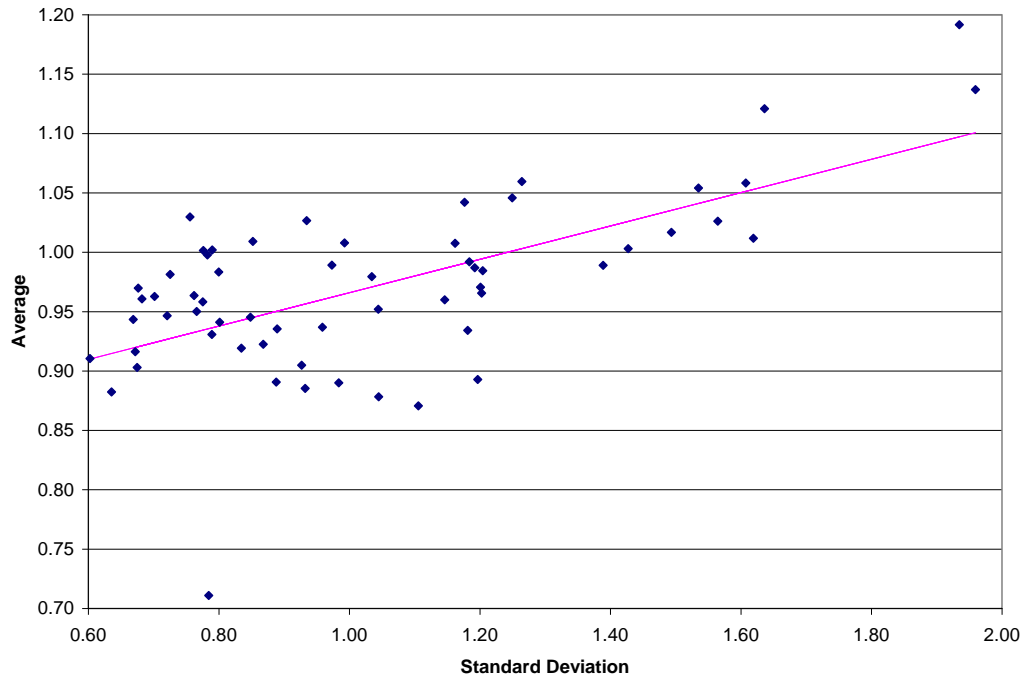
- ☐ Figure 7 shows the relationship of the synthetic win bet payoff divided by the win payoff as odds increase.
- ☐ The payoff tends to be larger for medium-odds horses winning.
- ☐ Medium-odds synthetic win bets have a larger standard deviation.



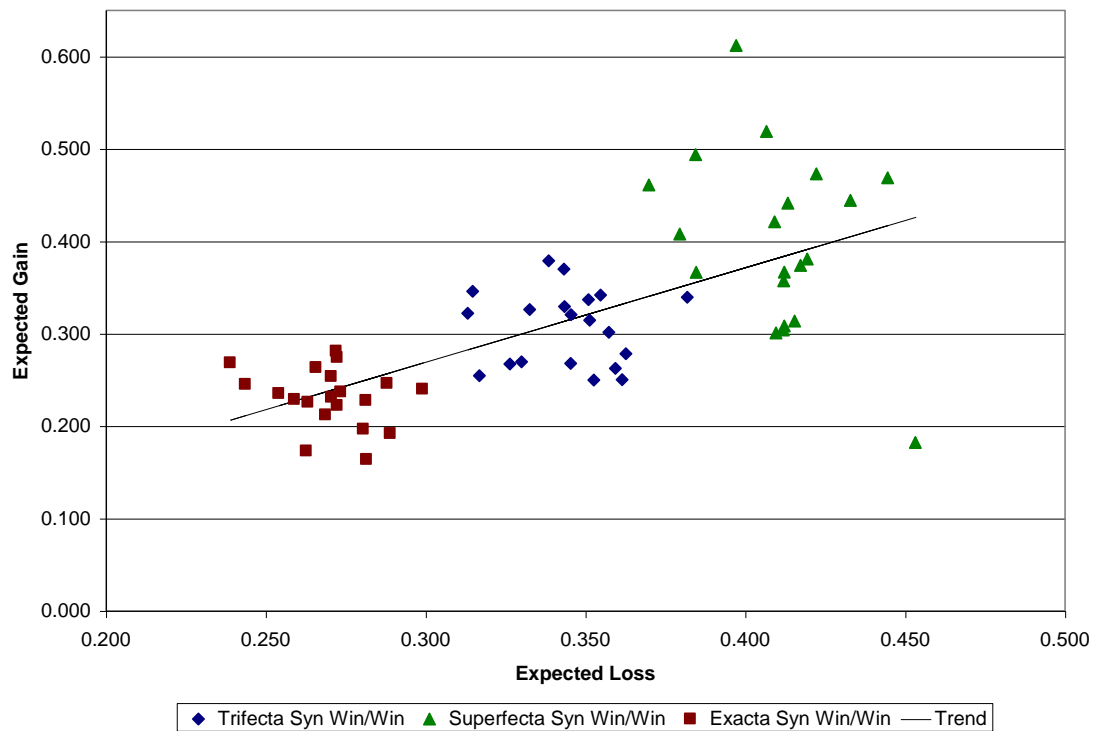
**Figure 8. Payoff of Synthetic Win bet divided by Win payoff, for increasing odds vicibles.**

### 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  $x=0$ :

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

- ☐ Assuming constant expected utility,  $c$ , across odds portfolios:

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

- ☐ 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<sup>2</sup>, payoff<sup>3</sup>, payoff<sup>4</sup>**

$E\{x\}$	<i>Exacta</i>	<i>Trifecta</i>	<i>Superfecta</i>	<i>All</i>
Intercept	<b>0.385*</b>	<b>0.781*</b>	<b>0.464*</b>	<b>0.666*</b>
p-value	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
Trifecta dummy				<b>-0.084*</b>
p-value				<b>0.000</b>
Superfecta dummy				<b>-0.059*</b>
p-value				<b>0.001</b>
$E(x^2)$	<b>0.684*</b>	<b>0.148*</b>	<b>0.326*</b>	<b>0.261*</b>
p-value	<b>0.000</b>	<b>0.006</b>	<b>0.000</b>	<b>0.000</b>
$E(x^3)$	<b>-0.153*</b>	<b>-0.018*</b>	<b>-0.029*</b>	<b>-0.026*</b>
p-value	<b>0.000</b>	<b>0.012</b>	<b>0.000</b>	<b>0.000</b>
$E(x^4)$	<b>0.0098*</b>	<b>0.0005*</b>	<b>0.0007*</b>	<b>0.0007*</b>
p-value	<b>0.000</b>	<b>0.017</b>	<b>0.000</b>	<b>0.000</b>
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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