CHAPTER 19

Betting Exchanges: A Technological Revolution in Sports Betting

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Abstract

This chapter offers an introduction to person-to-person betting exchanges, a relatively new market format in sports betting. There is currently a debate concerning the integrity of exchanges, which has elicited a variety of policy responses in different countries, ranging from regulation to outright prohibition. To enable the debate to be conducted on a more informed basis, there is a role for economists in the measurement of the economic costs and benefits of this new type of betting.

The chapter is primarily concerned with the information efficiency of exchanges. Their operation and functionality are discussed, along with some of the initial impacts they have had on betting markets, including the hostile response from some traditional bookmakers. Previous empirical studies concerning information efficiency in exchanges are outlined, although they are few at this relatively early stage of the development of the exchanges. New evidence about the degree of odds bias in exchange horse race markets is then presented. This evidence is found to be consistent with previous studies showing a much smaller degree of favorite-longshot bias in the exchanges than exists in traditional bookmaker markets.

1. INTRODUCTION

We examine a relatively new and rapidly growing market format in sports betting, namely the betting exchange. The discussion is confined to horse race betting markets, as the number of events and turnover is greater than in other sports, enabling more reliable measurement of the impact of information relevant to outcomes.

An outline of the concept and operation of betting exchanges is given in Section 2. Section 3 reviews the previous empirical studies concerned with the information efficiency of betting exchanges, which are scant at this relatively early stage of their development. Section 4 presents some new evidence on the degree of bias exhibited by betting exchange markets, employing a trade weighted regression of objective probabilities on subjective probabilities. Section 5 concludes.

2. THE OPERATION OF BETTING EXCHANGES

It is now widely accepted that the technologies associated with the internet have spawned radical new business models and formats, with potentially far-reaching implications for market structures, behavior, and performance (Kim and Mauborgne, 1999, Amit and Zott, 2001). Aspects of the gambling industry are being transformed by these pervasive technologies, with the internet prompting the innovation of new retail formats and technological platforms to facilitate betting markets (Jones et al., 2006).

Arguably the most notable recent internet innovation in this respect came with the advent of the betting exchange, an interactive web-based platform for placing and laying bets on sporting events. The commercial expertise required to create this business format was imported from the City (London's financial district).

Betting exchanges exist to match people who want to bet on the outcome of an event at a given price with others who are willing to offer that price. The advantage of this form of betting for the bettor is that, by allowing anyone with access to a betting exchange to offer or lay odds, it serves to reduce margins in the odds compared to the best odds on offer with traditional bookmakers. Exchanges allow clients to act as a backer (accepting odds) or layer (offering odds) at will, and indeed to back and lay the same outcome at different times during the course of the market.

The major betting exchanges present clients with the three best odds and stakes which other members of the exchange are offering or asking for. For example, for Take The Stand to win the Grand National, the best odds on offer might be 14 to 1, to a maximum stake of £80, 13.5 to 1, to a further stake of £100, and 12 to 1, to a further stake of £500. These odds, and the staking levels available, may have been offered by one or more other clients who believe that the true odds are longer than they have offered, or who are trying to hedge existing liabilities.

An alternative option available to potential backers is to enter the odds at which they would be willing to place a bet, together with the stake they are willing to wager at that odds level. This request (say £50 at 15 to 1) will then be shown on the request side of the exchange, and may be accommodated by a layer at any time until the event takes place. Every runner in the race will similarly have prices offered, prices requested, and explicit bet limits.

Table 1 illustrates an extract from a *Betfair* horse race market, as accessed via the internet.

TABLE 1 Partial Reproduction of *Betfair* Odds and Bet Limits for a UK Horse Race Betting Market

	BACK			LAY		
Air Wave	3.4	3.45	3.55	3.6	3.65	3.7
	£368	£87	£714	£84	£338	£930
Ratio	6.6	6.8	7	7.2	7.4	7.6
	£854	£623	£373	£312	£350	£5
Crystal Castle	6	6.2	6.4	6.8	7	
	£303	£300	£409	£195	£275	
Fayr Jag	9.2	9.4	9.6	10	10.5	11
	£295	£444	£693	£586	£284	£193
Acclamation	12	12.5	13	13.5	14	14.5
	£34	£115	£531	£811	£315	£196
Rudi's Pet	16	17.5	18	19	19.5	20.5
	£200	£140	£156	£249	£188	£150

Source: http://www.Betfair.com.

The "Back" side of the market indicates the best three odds available for runners, to stakes limits advised in each case. These have been offered by *Betfair* clients acting as layers; odds are expressed including stake, therefore the best odds against Air Wave are 3.55/1, or 2.55/1, to a maximum stake of £714. The "Lay" side of Table 1 shows odds which have been requested by traders, with similar interpretation of odds and limits as above. The margin between the best odds on offer and the best odds sought tends to narrow as more clients offer and lay bets, so that in popular markets the real margin against the bettor (or layer) tends toward the commission levied by the exchange. This commission varies up to 5% on a customer's net winnings on a market, the exact rate depending on the history and volume of business conducted by the trader.

Clients can monitor price changes, which are frequent, on the internet Website pages of the betting exchange, and execute bets, lay bets, or request a price, instantly and interactively. It is also now routinely possible for members of major exchanges to monitor prices and place wagers from a mobile phone.

Exchanges also operate "in running" markets, characterized by rapid and frequent price changes as races progress. Such markets are facilitated by the ability of clients to employ joint technologies, observing televised races on the internet or by means of conventional television, with simultaneous access to the interactive internet based markets. The remainder of this chapter is concerned with the more conventional pre-event markets, as in running markets are largely unexplored in terms of empirical analysis.

There are a number of key differences between the betting exchanges and bookmaker markets, principal of which is that whereas the bookmaker sets nominal odds, the betting exchange operator acts merely as a broker and offers an information platform, whereby third parties can offer odds or accept odds, in return for which the exchange charges a commission. The exchange assumes no risk of its own and merely brings together bettors and layers. Odds offers are displayed by value and are anonymous and pooled for similar odds values—individual bettors and layers are not specifically matched.

Exchanges avoid settlement risk by transferring funds from the parties to a bet, for the amount of their respective potential liabilities, into a secure holding account at the time the bet is struck. This system ensures that confidence is maintained in the integrity of settlement arrangements.

Unlike the bookmaker markets, exchanges display bet limits for all horses, which are determined not by the exchange, but by the amounts clients who are acting as layers are prepared to stand at the various odds. The ability to lay odds, which also enables bettors to extinguish existing back (bet to win) liabilities, and to request prices, are also features of the exchange markets not available from bookmakers (for further commentary and details of betting exchange functionality see Vaughan Williams, 2002, 2005). A client may also pursue arbitrage activities, for example, backing at a high price early in the market and laying the same horse at a lower price later in the market, should its general price contract, thus locking in value.

A further attraction of the betting exchanges is their low rate commission structure relative to the profit margin implicit in bookmaker odds. For example, *Betfair* charges a standard commission on net *race* winnings, not individual *horse* winnings—an important factor for bettors who wager on more than one horse in a race. Exchange commissions compare favorably with bookmakers' margins; although the latter make no explicit deductions for either their operation of the market, or for taxation (no tax on winning bets has been paid at the point of sale in the UK since October, 2001), a profit margin is implicit in nominal odds, as the associated sum of probabilities in a race typically exceeds one. The extent of this margin or overround varies from race to race and will typically increase directly with field size, and inversely with liquidity of the market and the extent of race specific competition with other bookmakers. To give an idea of the magnitude of the margin, bookmaker markets analyzed in one recent study (Smith et al., 2006) averaged approximately 20% overround. While betting exchange markets rarely lead to a "Dutch Book" (sum of odds probabilities less than unity), the degree of overround is usually much lower than in book odds.

By 2004–2005, betting exchanges accounted for £4,352,000,000 in sports betting turnover, arising from exponential market growth since their inception at the turn of the Millenium (Mintel, 2005). Approximately 90% of this turnover was attributable to *Betfair*, who by 2005 had 300,000 users and claimed to process over 1,000,000 bets per day at peak betting periods (Jones et al., 2006). An embryonic early major player in the industry, *Flutter*, was taken over by *Betfair* in 2002, consolidating its early position as market leader (*The Economist*, May 8, 2003). *Betfair*'s principal marketing pitch is that it claims the best odds it displays to be 20% better than bookmaker odds on average.[1]

The remaining fragmented competition comes from a number of smaller exchanges such as *Betdaq, WBX* (*World Bet Exchange*), and *Betsson*. None of *Betfair*'s competitors currently have the market liquidity to seriously challenge the market leader, although the alternative exchange model of *Intrade* and *Tradesports*, for example, based on buying and selling of contracts in a binary framework (outcome = 0 and 100), is an interesting addition to the marketplace (see Oliver, 2007, for a fuller consideration of binary betting). Bookmakers have challenged the legitimacy of the operations of betting exchanges, claiming them to be illegal and representing unfair competition on a number of grounds, which were examined at some length by the Joint Committee on the Draft Gambling Bill (United Kingdom Parliament, 2004).

The arguments put forward to the Committee revolved around issues of integrity, equity, transparency, and market stability (Jones et al., 2006). The integrity of betting exchanges was called into question by bookmakers, who claimed that following a number of high-profile instances of betting irregularities relating to specific races, betting exchanges were subject to an unacceptable degree of insider activity, notably where stable connections can lay horses, then manipulate the result by taking steps to restrain the relevant runner(s) in the race. *Betfair* responded by establishing a code of practice that commits it to full cooperation with the Police, the Fraud Squad, and the racing

[1]The odds in the *Betfair* dataset utilized in Smith et al. (2006) actually exceeded the mean of an array of matching bookmaker odds by 18.12%, close enough to make the claim credible. In relation to bookmaker outlier odds, however, the corresponding differential was only 5.39%, approximately equal to the commission rate charged by the exchange, suggesting that bookmaker outlier and exchange odds are mutual benchmarks.

authorities in sharing information that might lead to a subsequent arrest for manipulation of markets through insider activity (*Betfair*, 2007), a criminal offense in the UK.[2] This code breaches the client confidentiality that is also part of the betting exchange professional code, but only by exception in the interest of the public and where criminal activity is suspected. Betting exchange operators were able to turn the argument against bookmakers, claiming the same duty of care standards were not currently applied by bookmakers themselves.

The equity or fairness issue concerned the tax treatment of bookmakers and betting exchanges, and the related issue of the Racing Levy by which the sport of horse racing is funded in the UK. Since 2001, bookmakers pay a gross profits tax, whereas betting exchanges pay tax on their commission. Bookmakers claimed this to be unequal treatment; layers on the exchanges are effectively acting as bookmakers, they argued, yet pay only commission. The counter-argument from the exchanges was that the tax applied to the gross profits (commission) of the exchange and not to individual clients of the exchange, whether they were backers or layers.

The exchanges claim to contribute more to consumer (bettor) welfare than bookmakers, with greater market transparency. For example, volumes traded for all horses in a race are explicitly stated on betting exchanges, unlike bookmaker markets. They also claim to offer flexibility to clients by giving them the opportunity in part or in whole to negate betting decisions by facilitating offsetting or hedging opportunities. Other benefits suggested by the exchanges in their evidence to the Joint Committee include some of those already discussed above: namely, that they (the exchanges) offer more generous odds, and a level of commission that is more modest than the bookmaker overround, and which is reduced for those bettors executing a high volume of wagers. Moreover, the commission structure is based on winnings per race rather than the winning horse. In short, the betting exchanges implied that bookmakers' objections were really an attempt to prevent further loss of market share to the exchanges (Jones et al., 2006).

On the grounds of greater flexibility, lower transaction costs, and the injection of new competition from the exchanges, the economist might hold an a priori expectation of greater market efficiency in the betting exchanges than in bookmaker markets, perhaps followed by convergence of the two over time (Carlton and Perloff, 2005, pp. 259–267). If this is the case, governments might be well advised to create a favorable regulatory and fiscal climate for the exchanges to develop, in the interests of consumer welfare. However, the influences leading to an expectation of greater efficiency must be seen in the context of the claims (justified or otherwise) of increased insider trading inspired by exchange betting, and the issue of funding the sport of horse racing in the UK needs to be addressed.

[2] A recent UK court case, in which a number of jockeys (including ex-champion Kieren Fallon) were accused of race fixing to facilitate insider bets on the exchanges, collapsed in December, 2007.

3. EMPIRICAL MODELS AND EVIDENCE CONCERNING WEAK-FORM INFORMATION EFFICIENCY IN BETTING EXCHANGES

This section is limited to a discussion of the extent and sources of the favorite-longshot bias in betting exchanges. There have been few published studies of this type, as betting exchanges have only existed since 2000 as a significant market format.

In a recent empirical analysis using matched data for 700 UK horse races from betting exchanges and from traditional betting media, evidence of the favorite-longshot bias in exchange markets was found, but significantly less so than in the corresponding bookmaker odds (Smith et al., 2006). We further suggested that, based on an application of the methodology of Sobel and Raines (2003), an information-based model explains the favorite-longshot bias more convincingly than earlier explanations based on bettors' risk preferences.

Smith et al. (2006) set out to test the Hurley and McDonough (1995) cost-based explanation for the bias, which states that the higher are transactions costs, the greater will be the favorite-longshot bias. As transactions costs are observed to be lower in exchange markets than those implicit in the overround characteristic of bookmaker markets, the favorite-longshot bias should be less pronounced in exchanges than in bookmaker markets.

Information costs are integral to the Hurley and McDonough explanation of odds bias. High transaction costs imply that better information is required to achieve positive returns; this is a variation on the assertion that where transaction costs exist, it is impossible to discount all information, since a financial incentive must exist for information search (Grossman and Stiglitz, 1990). A further implication in the current market context is therefore that for races where there is less public information one would expect a higher proportion of "casual bettors" and a greater degree of favorite-longshot bias. Vaughan Williams and Paton (1997) and Sobel and Raines (2003) independently found empirical evidence to this effect.

Smith et al. measured the degree of bias employing the Shin's z measure of insider trading, a proxy for bias (Shin, 1991, 1992, 1993). Shin explains the favorite-longshot bias observed in bookmaking markets as the consequence of bookmakers' response to asymmetric information, where some bettors have privileged information concerning the true probability of one or more horses winning a race. The bookmaker response is modeled by Shin as an adverse selection problem, with the empirical consequence that bookmaker odds are depressed below true odds to preserve margins in the face of insider activity.

Shin derives a functional relationship between the sum of odds probabilities, $\boldsymbol{D}$, associated with a race, such that:

$$\boldsymbol{D} = z\,(n-1) + \sum_{k=0}^{K} a_k n^k Var(\boldsymbol{p}) + \sum_{k=0}^{K} b_k n^k [Var(\boldsymbol{p})]^2 \tag{1}$$

where $Var(\boldsymbol{p})$ is the variance of true probabilities of runners in the race,[3] n is the number of runners, and k is the order to which the expression is expanded as a polynomial; for Shin's sample the best fit was achieved by a quadratic function. The coefficient z in Equation (1) is Shin's measure of the proportion of turnover attributable to insider trading, and given the nature of the model, can also be interpreted as a proxy for the degree of odds bias. Shin's estimate of z was 2.46% (calculated as $z \times 100$ to give a percentage) for his sample. Comparable values have subsequently been found for much larger samples of UK races, using bookmaker *SP* data. Vaughan Williams and Paton (1997) and Law and Peel (2002), for example, estimated values of 2.03% (481 races) and 2.7% (971 races), respectively. Coleman (2007) uses an alternative methodology to suggest that at the Melbourne racetrack about 2% of betting is by insiders.

In Smith et al. (2006), we employed Shin's z measure of bias in relation to our betting exchange and bookmaker data. We were interested to establish the relative bias across the two datasets and to test the Hurley and McDonough hypothesis. Our sampled races were categorized by information levels or "classes." Class 1 races were those where publicly available information concerning runners was least, and at the other extreme Class 4 races were those where a great deal of race specific information was available. The results are reproduced in Figure 1.

Figure 1 shows that odds bias, proxied by Shin's z, was lower in the betting exchange odds than in bookmaker markets, a result consistent with the Hurley and McDonough contention that the regular favorite-longshot bias will be greater in those markets where transaction costs are greatest. Further, in both exchange and traditional betting markets, the level of bias was lower the greater the amount of public information that is available to traders, again consistent with the Hurley and McDonough theoretical model. The Shin's z coefficients were confirmed to be significant and independent using the Breusch Pagan test. These results are therefore consistent with an information based model of the favorite-longshot bias, explaining the structural characteristics within and between the two markets in terms of available information and transaction costs.

Aside from identifying bias, a further question of interest is whether the structural differences in odds between betting exchanges and bookmaker or other market odds can be exploited by employing arbitrage or quasi-arbitrage strategies (Paton and Vaughan Williams, 2005; see also Smith et al., 2005; Vaughan Williams, 2000, 2001). Exploitability is important since if a trading profit cannot be made in relation to an imperfection, then markets are operating efficiently to the point where the benefits of further arbitrage are offset by transaction costs, reflecting the Grossman and Stiglitz hypothesis.

Studies conducted prior to the advent of widespread bettor access to the internet show mixed evidence concerning the possibility of profitable arbitrage between markets.

In a study of parlay[4] markets, Ali (1979) found that returns to the parlay were not significantly different from those in the win markets of the constituent races, suggesting

[3]Shin's term $Var(\boldsymbol{p})$ is a measure of distance of vector p from the vector $1/n$, as opposed to variance in the normal statistical sense.

[4]A parlay is a double win bet that succeeds only if the two nominated runners, competing in separate races, both win.

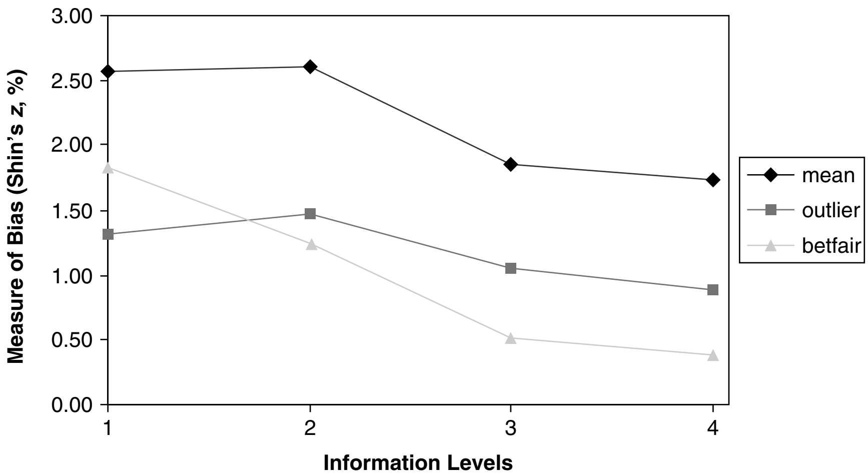

FIGURE 1 Degree of bias for mean, outlier, and *Betfair* prices for matched data in relation to 700 horse races run in the UK during 2002.

NOTE: (i) The y axis shows the coefficient of $n - 1$, or Shin's z, multiplied by 100. The interpretation of this value is that it indicates the percentage of insider trading volume in the market concerned, and also acts as a direct proxy measure of the degree of bias. (ii) Odds were derived from internet arrays of competitive bookmaker prices for 700 races acquired at 10:30 AM on race days, yielding mean odds and outlier odds values for each horse. Matching *Betfair* prices were acquired at the same time, being the best price available to non-trivial stakes. (iii) Class 1 = least public information; Class 4 = most public information. (iv) Mean = mean bookmaker odds from a competitive array of prices per horse per race; outlier = the corresponding bookmaker outlier odds per horse per race; Betfair = the corresponding best odds to non-trivial bet limits on the exchange; all matched data. *Source*: Smith et al. (2006).

weak-form efficiency. Hausch and Ziemba (1985), on the other hand, found persistent weak-form inefficiencies in North American place, show, and exotic betting markets, which are related to win betting markets in complex ways. They were able to demonstrate profits to an arbitrage strategy in these pools, known as "Dr. Z's system," based on estimations of true probabilities from win odds, with wagers subsequently made in the place and show pools.

Pope and Peel (1989) conducted the first study of efficiency in betting markets characterized by an array of odds rather than singular values, in relation to bookmaker odds on English football (called soccer in America). They found that more efficient forecasts could be made by pooling competing odds values, but not to the extent that positive returns could be generated.

Smith et al. (2007) measured the relative accuracy of exchange relative to bookmaker odds for all horses in the 700 race sample outlined above, applying conditional logistic regression to establish which set of odds were the best predictors of race outcomes.

Our principal finding was that, after adjusting for the favorite-longshot bias in both sets of odds, and with the exception of low liquidity markets, exchange odds were significantly better predictors than bookmaker odds. This may be because betting exchanges offer opportunities for the most skilled or informed bettors not available in bookmaker markets. For example, skilled traders, insiders, and bettors seeking hedging opportunities are all able to lay odds on the exchanges that may as a result reflect the chances of the horses concerned more accurately than those offered by bookmakers. In the main, therefore, this result would suggest that an arbitrage strategy based on differences in parallel odds between the two markets should employ exchange odds as a proxy for true odds, with the exception of low liquidity races.

4. NEW EVIDENCE ON THE DEGREE OF BIAS IN BETTING EXCHANGE ODDS

An alternative to the Shin method of identifying odds bias is the regression of objective probabilities (derived from results) on subjective probabilities (as contained in the odds), or the equivalent analysis of returns distribution by odds value (e.g., Snyder, 1978, Bruce and Johnson, 2000). The virtue of this method is that it allows clear exposition of odds bias through a comparison of results or returns against their expected values across the full range of odds. It further permits comparison of results with empirical studies conducted prior to the advent of the Shin methodology.

Regression of objective on subjective probabilities was adopted for the current study using trade weighted betting exchange data to shed further light on the degree of bias implied by the Shin methodology employed in Smith et al. (2006) in relation to nominal exchange odds.

The specific estimation procedure adopted here is that used by Bruce and Johnson (2000). For their dataset of starting prices (*SP*) for 2,109 races run in 1996, Bruce and Johnson estimated a polynomial function:

$$\ln(pre\_b) = \alpha + \beta \ln(o^b) + \chi[\ln(o^b)]^2 + \cdots + \delta[\ln(o^b)]^n \tag{2}$$

where the dependent variable *pre_b* is the predicted or expected value of the objective probability of winning for an odds class, and the independent variable o^b is a vector of odds. Weighted least squares regression was used to estimate the values of coefficients α, β, χ, and so on, such that all terms in the polynomial expression were significant. The log of subjective probabilities corresponding to o^b was used as a reference class, against which $\ln(pre\_b)$ could be compared to establish the existence of any bias. Bruce and Johnson found that a quadratic function best fitted their *SP* data, while a cubic function fitted a separate Tote dataset.

For our study of exchanges, price-volume data for approximately 6,000 UK horse races run between August 2001 and April 2002 were acquired from the market leading betting exchange, *Betfair*. The number of winners and total runners in each category was not available.

The betting exchange prices are expressed on a decimal odds scale calibrated to as little as 0.01 odds points at the short end of the odds scale, 0.1 intervals in the middle

TABLE 2 Extract of *Betfair* Trading Data

Odds	Total traded	Profit/loss
1.01	261, 262.86	−61, 371.715
1.02	192, 049.4	−54, 493.033
1.03	131, 869.3	−24, 464.527
1.04	125, 528.3	−1, 706.982
1.05	102, 851.83	−12, 420.479
1.06	14, 553.03	−1, 010.142
1.07	7, 058.38	371.59
1.08	4, 132.4	−157.563
1.09	7, 593.95	398.615
1.1	104, 705.51	−21, 670.373
1.11	72, 559.54	701.648
1.12	225, 130.48	−368.582
1.13	254, 993.53	22, 609.789
1.14	311, 237.27	37, 526.379
1.15	334, 900.49	25, 356.147
1.16	404, 864.35	23, 850.829
1.17	439, 536.15	51, 681.652
1.18	380, 297.83	34, 160.065
1.19	347, 850.95	48, 919.749
1.2	446, 096.03	17, 301.557

Source: *Betfair*, 2003.

odds, and 1 point intervals at long odds. Thus, categories exist not only for 2.0 to 1, but also 2.1, 2.2, and so on.

The betting exchange data contained fields for odds, total traded, and profit/loss before commission (aggregated across all races for which there were markets in the eight month period covered). An extract from the *Betfair* trading information is in Table 2.

The data continues in this way for 7,954 odds ticks, with increases of 0.01, until the odds become large, when the ticks frequently increase with odds intervals of 1 or more, for all values at which bets were struck, up to an odds value of 1,000.

As prices on the exchanges include a unit stake, the initial step in preparing the data for use was to subtract one from the advertised price to obtain an odds value. For example, the odds of 1.01 are actually odds of 0.01.

Objective odds probabilities, the dependent variable, were derived for a range of odds categories from the observed values of exchange “Total traded” and “Profit/loss” as follows.

As the distribution of bet sizes, the incidence and proportion of winners and losers within each odds category were all unknown, an initial assumption that all bets within each odds category are of equal value was made; the alternative assumption that winners at a given level of odds are distributed evenly among bets of different sizes is equivalent. Either assumption enables the following procedure to be employed to estimate true probabilities.

Let p_{nv} be the probability corresponding to a *Betfair* nominal odds value, o_v, less an adjustment for the exchange operator's rate of commission on net winnings, c, here applied at *Betfair*'s standard rate of 5%, so that $c = 0.05$. This adjustment is made to ensure comparability with starting prices, where bookmakers' margins are implicit in the odds. Then

$$p_{nv} = \frac{1}{o_v\,(1-c)+1}. \tag{3}$$

For example, for the odds of 1.01 above, the actual odds value was recorded as 0.01, and by substitution in Equation (3), $p_{nv} = 0.9906$.

Now let p_{tv} be the probability corresponding to an odds value that would yield zero profits; this is a proxy for the true probability of a horse winning at the nominal odds corresponding to p_{nv}.

Let π_v = profit/loss at the *Betfair* odds value, for example, $-$£61,371 at odds of 0.01.
Let ϕ_v = total traded at the *Betfair* odds value, for example, £261,262.86 at odds of 0.01. Then

$$p_{tv} = p_{nv}\left(1 + \frac{\pi_v}{\phi_v}\right) \tag{4}$$

Equation (4) derives the probability equivalent to odds that would adjust actual profit/loss to zero. These odds are by implication the true probability of a horse winning in the odds category v.

The next step is to compute a weighted average of p_{tv} for a range of odds categories to enable a regression, as specified in Equation (2) above, of these computed values against average nominal odds probabilities associated with specified odds categories. The precise method of odds classification used is traceable to Weitzman (1965), whereby normalized odds probabilities are categorized according to a measure of the monetary return to a nominal winner at given odds to a unit bet, with categories increasing in one unit increments. This largely solves the problem of classes having an insignificant number of runners, especially in the shortest odds categories, and gives a rational basis for choice of odds boundaries.

Monetary returns, as defined by Weitzman, in the range 1–120 (inclusive of unit stake) were adopted for the purpose of the regression. Let j be the Weitzman category and $n = 120$.

Then the weighted true odds probability values, P_{tj} for Weitzman categories are computed as:

$$P_{tj} = \frac{\sum_{j=1}^{n} \phi_v p_{tv}}{\sum_{j=1}^{n} \phi_v} \tag{5}$$

P_{tj} becomes the dependent variable in Equation (2) for the betting exchange data. Average nominal odds corresponding to the Weitzman categories, adjusted for commission, are generated in the same way to give values of the independent variable. Let O_j be the weighted average nominal odds for Weitzman category j. Then:

$$O_j = \frac{\sum_{j=1}^{n} \phi_v o_v}{\sum_{j=1}^{n} \phi_v} \tag{6}$$

The results of the ensuing regression are shown in Table 3 and Figure 2. In Figure 2 the betting exchange odds suggested by the reference curve of log subjective probabilities closely matches the expected values of the objective probabilities. There does not appear to be an appreciable bias in the exchange across the range of odds values, with the possible exception of the highest prices, where the odds are more generous than is warranted by the true chances of such horses. This bias at long odds is modeled by the cubic term in the estimation of Equation (2) with respect to the exchange data. Subjective and objective probabilities converge at about 3/1.

These results, based on exchange odds data weighted by trading volume, are largely consistent with the earlier findings in Smith et al. (2006) based on nominal odds for a much smaller sample of races; if anything, the current result indicates a lower degree of bias than that based on Shin methodology in our previous study.

TABLE 3 Coefficient Estimates for Equation (2)

Coefficient	Value	Standard error	t	Significance
α	−0.6838	0.0056	−122.4803	0.0000
β	−0.5360	0.0069	−77.6772	0.0000
χ	−0.1480	0.0072	−20.6242	0.0000
δ	0.0189	0.0028	6.8530	0.0000
R	0.9990			
R^2	0.9980			
Durbin-Watson	1.962			

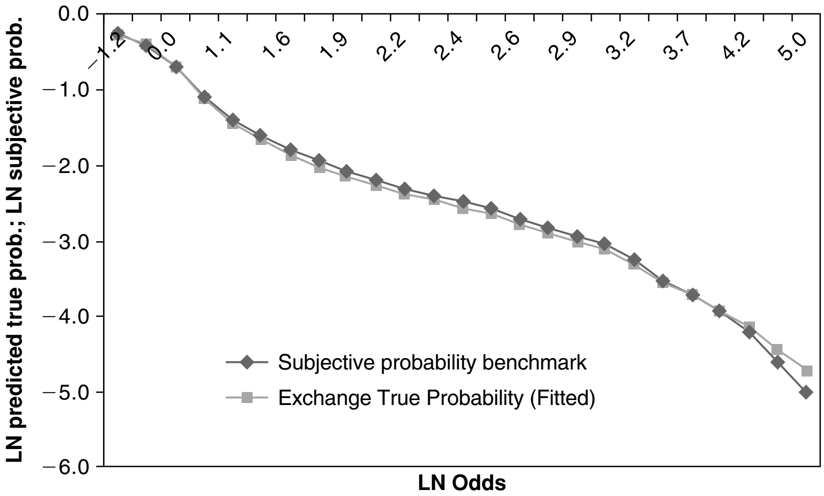

FIGURE 2 Favorite-longshot bias, betting exchange.

5. CONCLUSIONS

Established gambling operators have argued that person-to-person wagering on internet betting exchanges represents unfair competition, on the grounds of differential treatment of the two media for tax purposes, because the exchanges undermine the bookmaker licensing system and because exchange clients are allegedly often exploited by insiders. Prior empirical results and the new evidence presented here suggest that betting exchanges have brought about significant efficiency gains by lowering transaction costs for consumers. In contrast to traditional betting media, it was found that betting exchanges exhibited significantly lower levels of bias and therefore approximated more closely the conditions of weak-form market efficiency. Exchanges contribute to reducing the information barrier; they increase the incentive to process and act on race relevant information by reducing transaction costs and increasing bet flexibility.

The low value of Shin's z found by Smith et al. (2006) in relation to exchange data suggests that only a small proportion of turnover is attributable to "bet to win" insiders. The main controversies surrounding the extent of insider trading in the exchanges, however, relate to "lay" type insider betting. Whether the Shin measure adequately captures such activity is debatable and further research is required in this respect.

Whatever the truth of the inequities and insider abuse claimed by bookmakers to be the result of the exchanges, policy makers contemplating intervention in the industry need to weigh the ensuing economic costs (so far unproven) against the empirically demonstrated welfare gains derived from the exchanges. Betting exchanges are clearly vulnerable to insider activity, especially where laying of "non-triers" or "performance retarded" horses are concerned; the nature of the bet and lay formats would make it incredible for them not to be subject to such influences. Ironically it is the very features that make the exchanges relatively efficient markets that make them subject to potential abuse from insiders. This is not, however, an argument for the prohibition of exchanges, a policy adopted in some countries; rather it is an argument for adequate policing of exchange client activities, and a strong regulatory framework, in order to preserve the welfare gains accruing to mainstream bettors.

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