Article Report on "Optimal Betting Odds Against Insider Traders" (Hyun Song Shin, 1991)

ECO-M005 Economics Theory 1

LINDSEY BUTCHER*

The article investigates the optimal pricing strategy of a monopolist price-setter, and the value of insider information, in a market containing both informed and uninformed traders. This is explored in the context of betting on a two-horse race, and attempts to explain the "favourite-longshot bias" recorded by Dowie (1976), who found that, on average, returns were higher for horses with shorter odds.

Shin begins by describing the structure of the game: the monopolist "Bookie" knows the probability of each horse winning the race, as chosen at the beginning by "Nature", and sets his optimal odds accordingly. These odds can be represented as the prices of two types of ticket, each costing i and paying out one dollar if horse 'i' wins (for i=1,2). Nature then randomly chooses the winner based on the previously assigned probabilities, and the "Insider" bets all their wealth, z, on this horse. Finally, each "Outsider" bets optimally according to their subjective belief – uniformly distributed over the interval [0,1] – about the probability with which the first horse will win.

*MSc Economics

Shin then solves the game using backward induction. In the final stage, the Insider will use all their wealth to buy z/π_i tickets for the winning horse, but for the Outsiders there are two possibilities for demand, depending on whether the sum of the two ticket prices is greater, or less, than one. It is,however, shown that we can ignore the case where $\pi_1 + \pi_2 < 1$ since the bookmaker's total expected profit from the Outsiders and Insiders is increasing in the sum of the prices. Shin therefore constructs the Outsiders' demand for the case where $\pi_1 + \pi_2 \geq 1$, where all Outsiders will decide to place a bet, thus spending their aggregate wealth, 1-z, on tickets.

Given the respective ticket demands from the Insider and the Outsiders, and using the true probabilities p1 and p2, the Bookie can then construct his expected profit function and maximise this with respect to each π_i, resulting in the optimal prices of $\pi_i=\min\{1,\sqrt{[p_i/(1-z)]}\}$ for each horse. By combining these equations for the range $\pi_i < 1$ over which bets are accepted on both horses, Shin concludes that the ratio of optimal prices set by the Bookie follows the "square root rule" of $\pi_1/\pi_2=\sqrt{(p_1/p_2)}$. That is, the ratio of probabilities implied by the Bookie's odds should equal the square root of the true probability ratio, thus understating the difference in the horses' chances, and making it relatively "cheaper" to bet on the favourite than on the underdog. By integrating the Insider's payoff across all possible values of pi to find their expected payoff, Shin also finds that the return to insider information is $(1-z)^2/3$. This is falling in z, meaning that the greater the wealth of the Insider relative to the Outsiders', the lower the benefit they can gain from their insider knowledge, due to higher prices.

The model relies on certain assumptions and simplifications, and so in assessing the relevance of the article it is necessary to consider whether these can be expected to hold in reality. A central assumption is the existence of insider trading in horserace betting; clearly without this, the model is meaningless. There is, however, only mixed evidence of this; whilst Crafts (1985) finds evidence that there are "…substantial opportunities for profitable insider trading", the Dowie (1976) article, which Shin's paper cites, concludes that "outsiders" have access to just as much information as "insiders".

The model also assigns rather extreme beliefs to the Outsiders regarding the true probabilities. Whilst there will be some degree of heterogeneity in their estimations, it cannot be considered realistic to

assume that beliefs are spread out so markedly. The probabilities chosen by Nature must surely be closely related to the relative abilities of the two horses, so it seems likely that even bettors with no insider knowledge can gain some idea of the true probabilities by looking at past form. Similarly, it may be unrealistic to assume that the Insider knows with complete certainty which horse will win.

Whilst the assumptions of a monopolist bookmaker and a two-horse race are clear simplifications of the betting market, Shin addresses this in a later paper (1992). There he includes a potential entrant and extends the model to 'n' horses, finding that, under certain conditions, the bias is still predicted. These do not, therefore, seem to be particularly restrictive assumptions in terms of affecting the conclusions drawn.

As a model of the favourite-longshot bias, the article has a significant impact. Existing models had accounted for the bias using ideas such as "psychological odds" (Griffith, 1949), risk-loving behaviour (Weitzman, 1965) and market power by informed bettors (Isaacs, 1953). Shin's paper casts new light on the issue by considering a market in which monopolist bookmakers face some degree of insider trading.

However its impact may be wider reaching than just explaining this anomaly in horserace betting. The author hints at a more pertinent application, claiming that the structure laid out seems "…reasonable […] both on the race track and in the stock market". It is certainly plausible that the logic of this model does extend to financial markets, since the bookmaker knows he loses money from trades with informed traders, so sets odds such that he makes up these losses from the uninformed traders. In the stock market this is analogous to the setting of the bid-ask spread, whereby, according to Glosten & Milgrom (1985) amongst others, the stockbroker sets a positive spread to offset losses made to insider traders with profits in transactions with noise traders. The model's prediction that prices rise, and returns to insider knowledge fall, as the Insider becomes more prominent also corresponds to the widening of the bid-ask spread due to the parallel incentives for the price-setters in each market.

However the specific results derived from the model, such as the square root rule for prices, do not appear to have a clear interpretation when considered in this alternative setting. Furthermore, whilst the horserace betting market is a reasonably good approximation for the stock market, it has several limitations; for example when purchasing shares, the price per unit generally falls with the size of the transaction. Therefore whilst Shin's analysis provides some insight into a possible rationalisation of the favourite-longshot bias, its wider relevance to the investigation into the impact of insider trading in financial markets seems reasonably limited.

Bibliography

Copeland, T., & Galai, D. (1983). Information Effects on the Bid-Ask Spread. The Journal of Finance , 38, 1457-1469.

Crafts, N. (1985). Some Evidence of Insider Knowledge in Horse Race Betting in Britain. Economica , 52, 295-304.

Dowie, J. (1976). On the Efficiency and Equity of Betting Markets. Economica , 43, 139-150.

Glosten, L., & Milgrom, P. (1985). Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders. Journal of Financial Economics , 14, 71-100.

Griffith, R. (1949). Odds Adjustments by American Horse-Race Bettors. The American Journal of Psychology , 62, 290-294.

Isaacs, R. (1953). Optimal Horse Race Bets. The American Mathematical Monthly , 60, 310-315.

Ottaviani, M., & Sorensen, P. (2008). The Favorite-Longshot Bias: An Overview of the Main Explanations. Handbook of Sports and Lottery Markets , 83-101.

Shin, H. S. (1993). Measuring the Incidence of Insider Trading in a Market for State-Contingent Claims. The Economic Journal , 103, 1141-1153.

Shin, H. S. (1991). Optimal Betting Odds Against Insider Traders. The Economic Journal , 101, 1179-1185.

Shin, H. S. (1992). Prices of State Contingent Claims with Insider Traders, and the Favourite-Longshot Bias. The Economic Journal , 102, 426-435.

Weitzman, M. (1965). Utility Analysis and Group Behavior: An Empirical Study. Journal of Political Economy , 73, 18-26.