Parimutuel versus Fixed-Odds Betting: Evidence from a Hybrid Market*

Alasdair Brown†
University of East Anglia

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†School of Economics, University of East Anglia, Norwich NR4 7TJ, U.K.
Email: alasdair.brown@uea.ac.uk

Abstract

Betting markets on horse races have typically taken one of two forms: 1) a parimutuel pool, where prices are uncertain until the market is closed, or 2) a fixed-odds market, where prices are fixed at the time the bet is placed. I study a hybrid betting market where a pool is run side-by-side with a fixed-odds market, and the two are then combined to determine final pool prices. I find that the fixed-odds market is quicker to aggregate information, and produces comparatively efficient prices from the start of betting. Interim prices in the parimutuel pool are largely uninformative, but improve as betting progresses. The parimutuel pool in this hybrid market also serves two additional purposes. It allows bettors to avoid thin early trading, and also provides a mechanism for extracting information in late leftover quotes in the fixed-odds market.

JEL Classification: D82, D84, G13
Keywords: betting, gambling, parimutuel pools, fixed-odds betting

1 Introduction

There are two common market mechanisms for the trading of bets on horse races. One is a parimutuel pool, where gamblers specify the volume they wish to bet, and winning bets are paid out (in proportion to stakes wagered) from the losing bets. In this system, the betting price or odds are not set until the market is closed and all bets are in. The second common market mechanism is a fixed-odds market. In this type of market, a price is fixed – either by a bookmaker or by participants on a betting exchange – at the time of the bet. Parimutuel pools can be found in horse race betting in the U.S., Australia, and France, while both pools and fixed-odds markets can be found in horse race betting in the U.K.. Fixed-odds markets dominate for wagers on other sports and for betting on politics.

There is an extensive literature on the efficiency of prices produced in these betting markets: see Griffith (1949), Ali (1977), Figlewski (1979), Vaughan Williams and Paton (1997), Smith *et al.* (2006), Snowberg and Wolfers (2010), Brown and Yang (2017), and many, many, others. The main reason for this interest is that these bets have clear terminal values which, unless the race is fixed, are exogenous to the trading process (Thaler and Ziemba, 1988, Sauer, 1998). This contrasts with financial markets where many assets are potentially infinitely-lived (e.g. stocks), and where even payoffs in finite-maturity assets (e.g. options) are affected by trading in related markets. Horse racing, in particular – with its large number of short-lived markets on plausibly independent events (races) with exogenous terminal values – makes an ideal setting for testing market efficiency (Fama, 1970) and the price formation process.

The literature on prediction markets (Wolfers and Zitzewitz, 2004) – which are effectively betting markets but with forecasting as the primary aim – has also brought about renewed interest in the design of betting markets. For example, Plott *et al.* (2003), Lambert *et al.* (2015), Gillen *et al.* (2017), Court *et al.* (2018) all apply parimutuel-type mechanisms to study forecasting problems. Cowgill and Zitzewitz (2015) study the application of different fixed-price prediction markets at Google, Ford and an unnamed corporation.

In this paper I study a hybrid market – with elements of parimutuel and fixed-odds betting – run by Betfair, the world's largest betting exchange. In the lead-up to horse races, participants in this market can place fixed-odds bets on the exchange, or parimutuel bets at the 'Betfair Starting Price'. There are therefore continuous updates on the latest transaction price in the fixed-odds market and the latest pool price (based on volumes wagered thus far) as each race approaches. Unmatched quotes in the fixed-odds market, plus sums wagered in the pool, are then merged at the end of pre-race trading to determine the final pool prices.

I study 2.85 million pool and fixed-odds bets relating to 1,030 races in June 2017. These bets are timestamped to the millisecond by a common clock, allowing for a precise analysis of the timing of price discovery in the two betting market mechanisms. Given this rich data, I begin with one simple research question. Which market mechanism aggregates information most quickly and most effectively?

I find that the fixed-odds market is much quicker to aggregate information, and produces relatively efficient prices throughout the trading window. In comparison, interim parimutuel prices – which are not binding until all bets are in – are largely uninformative. (Interim) pricing errors in the parimutuel market are 247% larger than pricing errors in the fixed-odds market, as measured by Brier Scores. This discrepancy does reduce as betting progresses. In the final tenth of the trading window, interim pricing errors for parimutuel bets are only 15% larger than the contemporaneous pricing errors for fixed-odds bets. Nevertheless, this shows that parimutuel markets are much slower to aggregate information than fixed-odds (price) markets.

This fits in with the view, documented by Asch *et al.* (1982) and Suhonen *et al.* (2018), that informed gamblers bet late in parimutuel pools. The rationale is that the placement of an early informed bet reveals this private information to other participants and causes a negative payoff externality for the informed bettor as the odds plunge before they are declared (Ottaviani and Sørensen, 2004, 2005, and Koessler *et al.*, 2008). Better, in such a situation, to bet as late as possible and attempt to hide this information from other participants. This contrasts with the behaviour of an informed trader in a fixed-odds (price) market, where it is either optimal for a monopolist to *gradually* incorporate their information into prices through trade, as in Kyle (1985), or, in a competitive scenario, *immediately* incorporate private information into prices through trade (Holden and Subrahmanyam, 1992).

It should be noted, however, that in all of these models parimutuel pools and fixed-price markets operate in isolation, not in parallel. Indeed, there do appear to be two factors connected with the hybrid nature of this market which impede the efficiency of interim pool prices. Firstly, the parimutuel pool is largely neglected. Just 12.8% of the 2.85 million bets in the sample are placed in the pool.[1] Competition between parimutuel and fixed-odds market structures does not work out favourably for parimutuel betting. Secondly, the pool will be combined with leftover quotes in the fixed-odds markets at the end of trading – which will bound the final inefficiency of prices – and this reduces the incentive to even incorporate public information into interim prices. As a result, interim pool prices for the majority of the trading window are little more than noise.

Having said all that, the parimutuel pool in this hybrid market does appear to serve two

[1]This figure overrepresents the level of pool betting interest: just one gambler is needed for each new pool bet while at least two are needed for each fixed-odds bet.

purposes. Firstly, it allows bettors to place early bets which will ultimately be executed at the end of trading, when markets are thickest (and transaction costs lowest) and when the latest information is in prices. In essence, the pool allows early bettors to access later markets. This would explain why 38.3% of bets in the first tenth of the trading window are pool bets, compared with 0.4% for the final tenth of the trading window. Secondly, the parimutuel pool in this hybrid market provides a mechanism for extracting information in the latest quotes in the fixed-odds market. One of the problems with using fixed-odds bets to forecast outcomes is that many of these bets are placed a long time before the race begins without the most up-to-date information. The 'Betfair Starting Price' – which combines pool bets with leftover quotes in the fixed-odds market at race time – provides smaller pricing errors and a lower degree of favourite-longshot bias than executed fixed-odds bets.

Parimutuel and fixed-odds market mechanisms have, in the main, been studied in isolation in the literature. Beginning with Gabriel and Marsden (1990), however, there have been a number of studies which compare parimutuel and fixed-odds prices for horse race betting in the U.K.. (e.g. Law *et al.*, 1999, Cain *et al.*, 2001, Cain *et al.*, 2003, Peirson and Blackburn, 2003, Johnson *et al.*, 2010, Buraimo *et al.*, 2017). These authors examined whether the final declared parimutuel ('Tote') prices and the final on-course bookmaker 'starting prices' violated the law of one price. In this paper, I want to study the evolution of these prices, and not just the final prices. The timestamping of bets and price changes to the millisecond allows me to test theories of price discovery in these alternative market mechanisms. As the markets are then combined at the end of betting, I can also examine the forecast accuracy of a unique hybrid market mechanism.

The rest of the paper is structured as follows. In Section 2, I describe the operation of the hybrid parimutuel and fixed-odds market. The analysis can be found in Section 3, with concluding remarks in Section 4.

2 The Hybrid Market

The setting for this study is Betfair, the world's largest betting exchange, founded in 2000. Betfair allow bettors to wager that a horse/competitor will win, with a 'back' bet, or wager that a horse/competitor will lose, with a 'lay' bet. Allowing ordinary bettors to take short/lay positions, which was previously the preserve of professional bookmakers, is one of the main innovations of the exchange. Bettors can post quotes, or accept quotes posted by others. The Betfair exchange operates as a standard limit order book, common in financial markets (Parlour and Seppi, 2008) and now in use in other betting and binary option exchanges.

An example of fixed-odds prices on the Betfair exchange can be found in Figure 1. This screenshot is taken from the 14.40 at Ascot on the 20th October 2018. Pre-race, there were 'back' quotes of 2.14 on Lah Ti Dar (ridden by Frankie Dettori) to win, and 'lay' quotes of 2.16 on the same outcome. Betfair odds include the stake. Therefore, if one wished to back this horse, they would receive 1.14 GBP for each 1 GBP they staked if the horse won. At the time of the screenshot, bettors could stake up to 3,437 GBP at this price. If one wished to bet against this outcome, with a lay bet, they would need to offer a potential payoff of 1.16 GBP for each 1 GBP staked by the other side of the bet. There was 1,952 GBP waiting to be staked at these odds of 2.16 at the time the screenshot was taken.

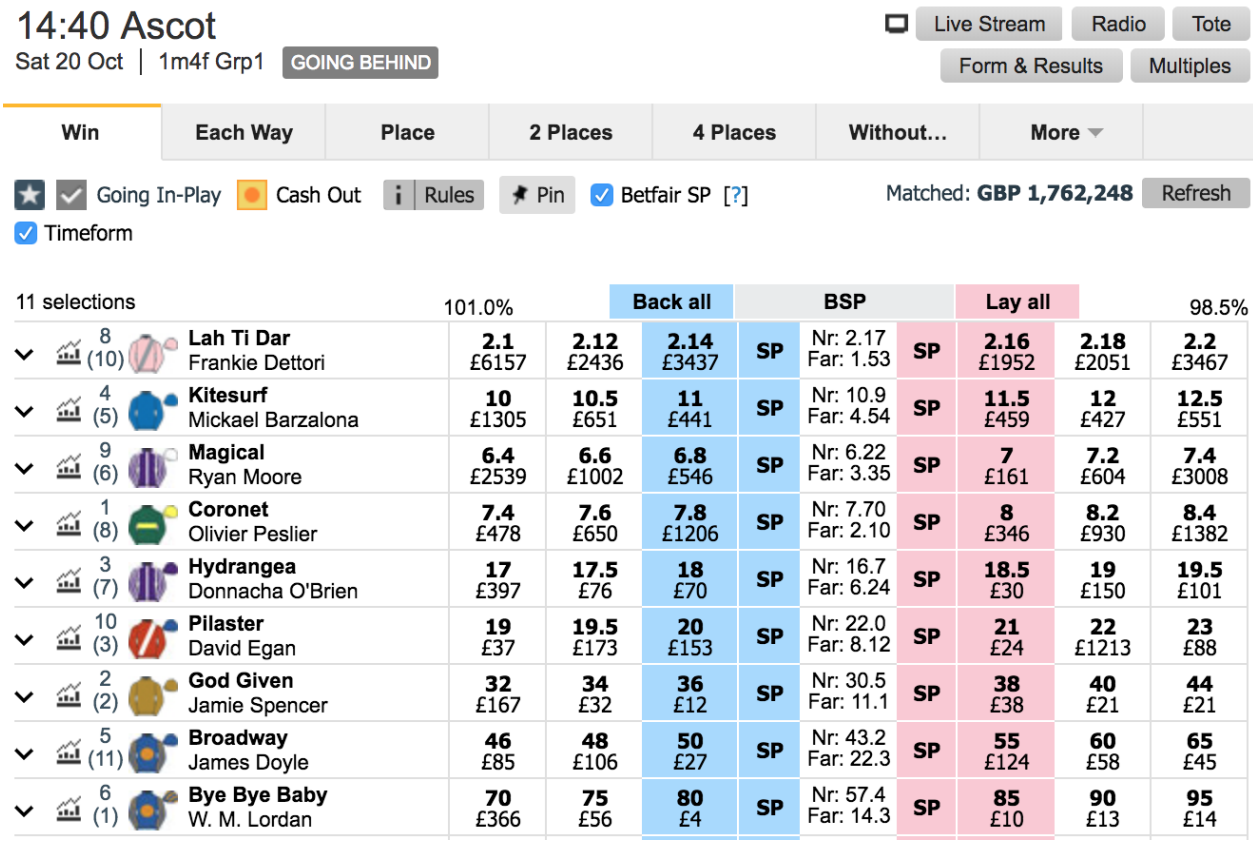

Figure 1: A screenshot of fixed-odds and pool prices on the 14.40 at Ascot on the 20th October 2018. The best fixed-odds back and lay quotes are displayed in blue and pink respectively. The pool prices can be found under BSP (Betfair Starting Price). The Far price incorporates pool bets only, while the near (Nr) price incorporates fixed-odds quotes as well.

In 2007, Betfair augmented their betting exchange with a parimutuel pool for horse races, which they named the 'Betfair Starting Price'. As with other parimutuel pools, bettors specify the volume they wish to bet but not the price. The parimutuel pool has two main differences with standard parimutuel pools, such as the Tote in the U.K.. Firstly, bettors can place back or lay pool bets. Winning back (lay) bets are then paid out from losing lay (back) bets on the same horse. In traditional parimutuel pools, bettors can only take long positions and therefore winning bets are paid out from losing bets on other horses. Secondly, the parimutuel pool on Betfair is merged with the fixed-odds market at post time (as the race begins). This means that the Betfair Starting Price (or BSP) is determined not only by pool volumes but also by unmatched fixed-odds bet prices.

A worked example is the best way to explain the procedure. This example is one provided by Betfair and here I will add some further explanation.[2] Suppose that 831 GBP has been wagered in the parimutuel pool that a horse will win, and 4,428 GBP has been wagered that the horse will lose. If the pool was settled in isolation, then the Betfair Starting Price odds would be $(4,428/831) + 1 = 6.328$. Suppose, however, that there are fixed-odds lay quotes

[2]https://promo.betfair.com/betfairsp/

at race time of 20 GBP at odds of 6.8, and 31.13 GBP at odds of 6.6. These odds are more generous, for backers, than the pool odds. The weighted average of these fixed-odds quotes is $(20 * 6.8 + 31.13 * 6.6)/(20 + 31.13) = 6.68$. If we add these liabilities to the pool bets, then we now have lay liabilities of $4,428 + (5.68 * (20 + 31.3)) = 4,719$. This translates into a new, adjusted Betfair Starting Price of $(4,719/814) + 1 = 6.68$.

Notice that the offered volume of 31.3 at odds of 6.6 is chosen very deliberately in this example. If more than 31.3 is added to the pool bets, then the weighted average price acceptable to the exchange layers is lower than the new Betfair Starting Price. If less than 31.3 is added to the pool bets, then the weighted average price acceptable to the exchange layers is higher than the new Betfair Starting Price and there is scope to add more exchange lay bets. In short, the procedure works by 'walking down the book' as far as possible – applying price and then time priority with the exchange quotes – until the weighted average price acceptable to exchange layers equals the new Betfair Starting Price.[3]

Betfair provide updates of the parimutuel pool prices as trading proceeds. These updates can be found in the centre of Figure 1, under the heading BSP (Betfair Starting Price). There are two prices: the Far price, which is the price based solely on pool bets thus far, and the Nr (near) price, which is calculated based on the assumption that the market is to close now and the pool bets and fixed-odds quotes are to be merged in the manner described above. As can be seen in Figure 1, the near price is much closer to the fixed-odds prices quoted on the exchange at the time. Once the race begins, the Betfair Starting Price is declared. This can be seen in Figure 2. Once the race is underway no more pool bets take place, but fixed-odds bets continue until the end of the race.

[3]A reverse example could be constructed if the odds generated solely by the pool bets were higher than those demanded by backers on the exchange.

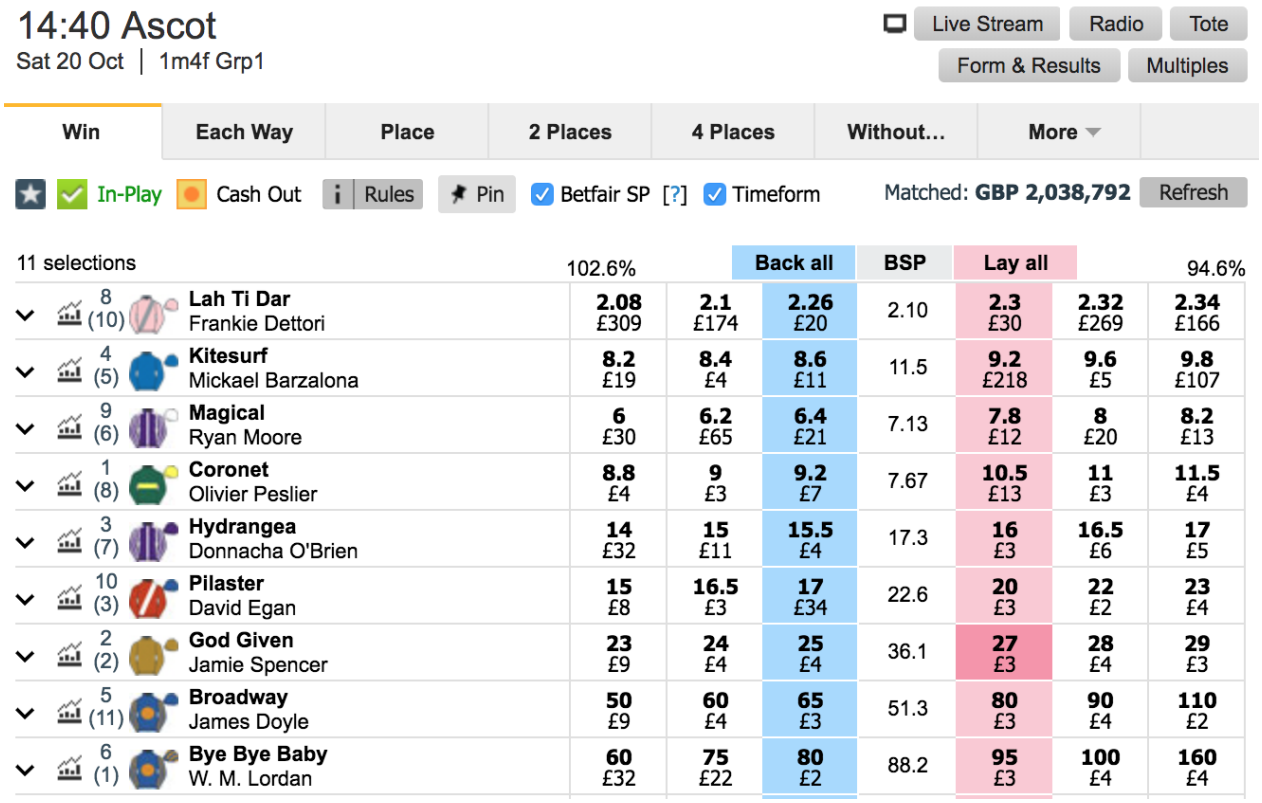

Figure 2: A screenshot of fixed-odds and pool prices on the 14.40 at Ascot on the 20th October 2018. In this screenshot the race has begun, and the Betfair Starting Price (pool plus fixed-odds quotes) has been declared.

3 Analysis

I collected data on the pricing of parimutuel and fixed-odds bets from the Betfair Historical Data Service.[4] This data comes in message traffic form and includes all quotes, trades and changes to the pool prices, both before and during races. All of these messages are timestamped to the millisecond. My sample is for the 1,030 horse races that took place in the U.K. in June 2017. I am interested in two components of the data: fixed-odds trades (i.e. matched bets) and changes in the 'Far' Betfair Starting Price. Recall that the far price is the one based solely on parimutuel pool bets. Changes in this price occur every time a pool bet is placed. I limit my analysis to pre-race betting, when both pool and fixed-odds bets are available. There are 2.85 million bets in my month-long sample. 77.2% (approximately 2.5m) of these are fixed-odds bets, and the remainder are pool bets.

I calculate the implied probability for each bet, which equals $1/odds$ when the odds include the stake. These implied probabilities are equivalent to Arrow-Debreu prices. Summary statistics on the implied probabilities for the pool and fixed-odds bets can be found in Table 1. I married this data with a win indicator for each bet – which equals 1 if the horse ultimately won the race and 0 otherwise – which can be found in the Betfair results database.[5] When

[4] http://historicdata.betfair.com/

[5] http://www.betfairpromo.com/betfairsp/prices/

we average the win indicator we get the actual win probability. We can see that the average implied probability for fixed-odds bets is very similar to the actual win probability (0.177 versus 0.176). For pool bets, however, there is a large discrepancy. The average implied probability for pool bets – which is based on interim prices – is 0.523 while the actual win probability for these bets is 0.136. It is also worth noting at this stage that fixed-odds bets are focused a little more on favourites than the pool bets (see the differences in average win indicator).

	(1)	(2)	(3)	(4)	(5)
Pool	N	mean	sd	min	max
Pool IP	365,152	0.523	0.260	0.0103	0.990
Win Indicator	365,152	0.136	0.343	0	1
Fixed-Odds	N	mean	sd	min	max
Fixed-Odds IP	2,487,609	0.177	0.141	0.00100	0.909
Win Indicator	2,487,609	0.176	0.381	0	1

Table 1: Prices. Summary statistics on pool and fixed-odds implied probabilities (prices). Statistics on the win indicator – equalling 1 if the horse ultimately won the race and 0 otherwise – are included for comparison.

The differing distributions of pool and fixed-odds implied probabilities (prices) is best captured by the histograms in Figure 3. I display pool bets on the left and fixed-odds bets on the right. The implied probabilities in pool bets are almost uniformly distributed between 0 and 1, while the implied probabilities of fixed-odds bets are positively-skewed. Combining this with the information in Table 1 – particularly the discrepancy between implied and actual win probabilities for pool bets – we can get the impression even at this early stage that interim pool prices are not very good predictors of race outcomes.

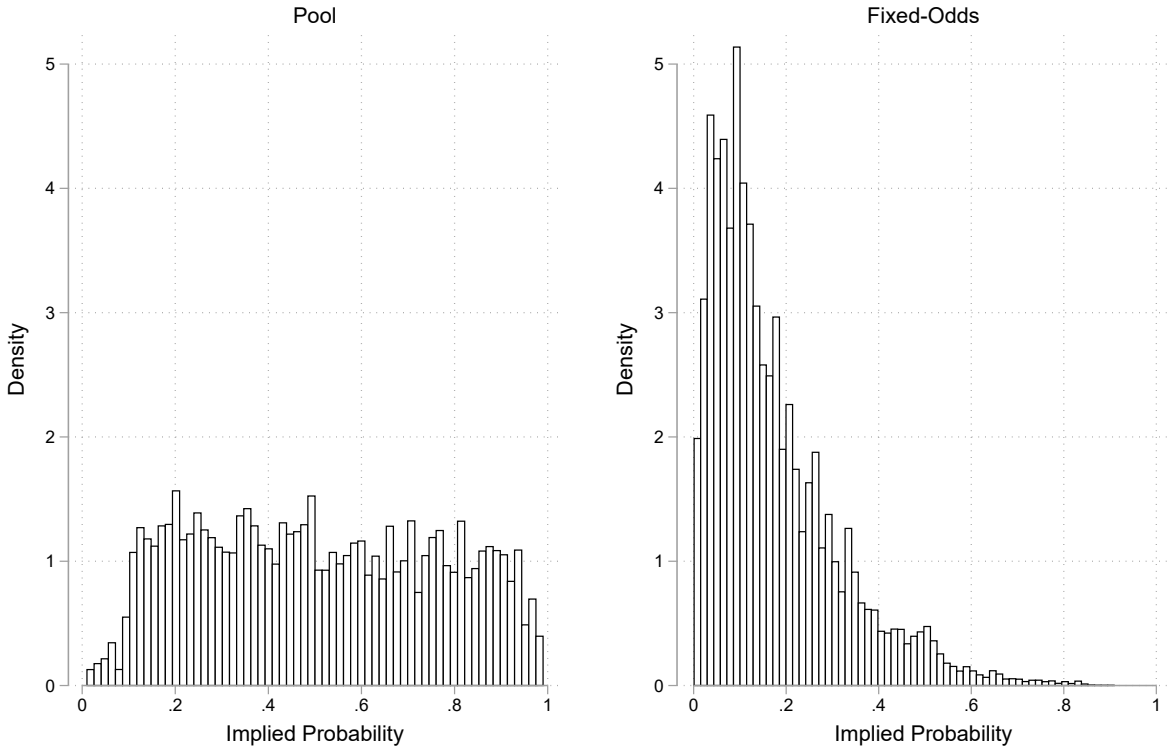

Figure 3: Histograms of pool and fixed-odds implied probabilities (prices).

One way to formally examine this proposition is to estimate the following equation:

$$y_i = \beta_0 + \beta_1 x_i + \epsilon_i \tag{1}$$

y_i is an indicator variable, equalling 1 if horse i won and 0 otherwise, x_i is the implied probability of horse i winning as calculated from the odds, and ϵ_i is an error term. This linear probability model – used by Vaughan Williams and Reade (2016) and Brown and Yang (2019) in studies of forecast accuracy and the favourite-longshot bias – is estimated by OLS. If implied probability (price) is an unbiased predictor of race outcomes, then we will observe an estimate of β_1 of 1.

I estimate this equation separately for pool and fixed-odds bets in Table 2. All bets throughout the pre-race trading window are included. We can see that implied probability (price) is a far superior predictor of race outcomes for fixed-odds bets than pool bets. β_1 is estimated at 0.949 for fixed-odds bets, but only 0.152 for pool bets.

	(1) Win Indicator	(2) Win Indicator
Pool IP	0.152***	
	(0.00225)	
Fixed-Odds IP		0.949***
		(0.00194)
Constant	0.0568***	0.00819***
	(0.00118)	(0.000316)
Observations	365,152	2,487,609
R-squared	0.013	0.123

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Linear Probability Model. The win indicator – equalling 1 if the horse won the race and 0 otherwise – is regressed on the implied probabilities (prices) in pool and fixed-odds markets. Estimation is by OLS.

Perhaps the best way to convey this result is to plot the data. In Figure 4, I plot scatterplots of implied probabilities against actual probabilities for pool and fixed-odds bets. Implied probability is rounded to two decimal places to create sufficiently large bins to average the win indicator. The size of each dot is weighted by the number of bets at that price, and a 45 degree line – corresponding with a β_1 of 1 – is added for comparison. The interim prices of pool bets overestimate the probability of wins right across the probability scale, and pool bet prices are little use in separating out the favourites from the longshots. Overall, there are too many back bets (relative to lay bets) in the pool, and insufficient variation (across horses) in the relative volume of back and lay bets. Although interim pool prices are mostly noise, it should be stressed that this does not imply the existence of arbitrage opportunities. Bettors do not trade at these interim pool prices, but instead trade at the settled Betfair Starting Price. The pool bets will be merged with the unmatched fixed-odds quotes at race time and therefore the odds on the majority of horses will be dragged up in line with the fixed-odds when the Betfair Starting Price is declared, even if there are no further pool bets.

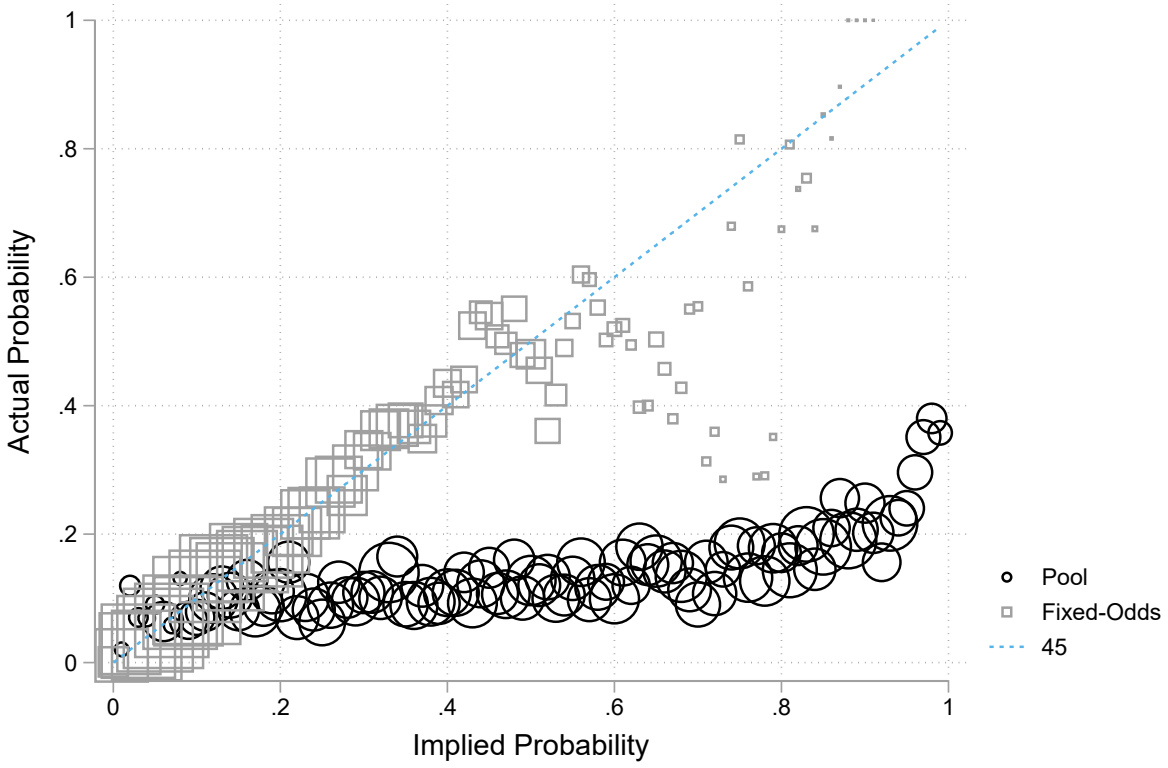

Figure 4: Scatterplots of implied probabilities against actual probabilities for pool and fixed-odds markets. Implied probabilities are rounded to 2 decimal places, and the size of each symbol represents the number of bets at that rounded price. A 45 degree line is added for comparison.

As mentioned in the Introduction, the incentives to incorporate information into prices differ quite substantially between parimutuel pool and fixed-odds (price) markets. In pools there is an incentive to delay informed betting as there are negative externalities from others subsequently betting in the same direction. That is not the case in fixed-odds markets, where prices are fixed at the time of the bet. To investigate this possibility, I re-ran the regressions in Table 2, but this time analysed different stages of the trading window. The results can be found in Table 3. I analysed the first half, 2nd half, first 10% and the last 10% of the trading window. The trading window is not ordered by time but is ordered by bet number as the vast majority of trade is concentrated in the 30 minutes immediately prior to races. Pool bets do become more informative with later bets – β_1 is estimated at 0.252 for the last 10% of trading compared to 0.171 for the first 10% – but still lag significantly behind the accuracy of fixed-odds prices. The accuracy of fixed-odds bets barely improves across the trading window; in fact β_1 drops from 0.991 to 0.97 from the first to the last 10% of trading. This supports the view that fixed-odds bets incorporate information almost immediately, and certainly more quickly than parimutuel pool bets.

	(1) Win Indicator	(2) Win Indicator	(3) Win Indicator	(4) Win Indicator
Pool IP	0.149***		0.144***	
	(0.00233)		(0.00923)	
Fixed-Odds IP		0.957***		0.942***
		(0.00298)		(0.00256)
Constant	0.0598***	0.00943***	0.0342***	0.00725***
	(0.00125)	(0.000496)	(0.00359)	(0.000410)
Trading Period	1st Half	1st Half	2nd Half	2nd Half
Observations	344,730	1,081,995	20,422	1,405,614
R-squared	0.013	0.120	0.013	0.125
	(1) Win Indicator	(2) Win Indicator	(3) Win Indicator	(4) Win Indicator
Pool IP	0.171***		0.252***	
	(0.00412)		(0.0507)	
Fixed-Odds IP		0.991***		0.970***
		(0.00777)		(0.00564)
Constant	0.0595***	0.0110***	0.0232*	0.00559***
	(0.00218)	(0.00127)	(0.0135)	(0.000899)
Trading Period	1st 10%	1st 10%	Last 10%	Last 10%
Observations	109,407	175,946	1,137	284,493
R-squared	0.017	0.118	0.036	0.134

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Early & Late Trading. The win indicator – equalling 1 if the horse won the race and 0 otherwise – is regressed on the implied probabilities (prices) in pool and fixed-odds markets. This time the sample is broken down, for each horse, into the first half of bets, the second half of bets, the first 10% of bets, and the last 10% of bets. Estimation is by OLS.

An alternative measure of price efficiency in betting markets is the Brier Score (Brier, 1950):

$$Brier = \frac{1}{N}\sum_{i=1}^{N}(x_i - y_i)^2 \tag{2}$$

As before, x_i is the implied probability of horse i winning, as calculated from the odds, and y_i is an indicator variable, equalling 1 if horse i won and 0 otherwise. This measure is used by Franck *et al.* (2010) and Štrumbelj (2014), among others. Lower Brier Scores indicate more accurate forecasts. The Brier Score for pool bets is 0.314, which is 247% larger than the Brier Score for fixed-odds bets, which is 0.127. Therefore, as before, interim pool prices are substantially less accurate than fixed-odds bets.

However, there is a sharp improvement in pool bet accuracy as trading progresses. In Figure 5 I plot the average Brier Score for pool and fixed-odds bets against the bet number. Bet number is rescaled between 0 and 1 for each horse and rounded to two decimal places, and therefore captures the ordering from the first bet to the last. Recall that the majority of trading takes place in the last 30 minutes so for clarity it makes sense to plot Brier Scores

against bet number rather than against time. Brier Scores for fixed-odds bets start low and stay around the same level. Brier Scores for parimutuel bets, however, show sharp declines as the end of trading approaches. Although there is some noise at the end – due to few pool bets (more on this later) – the Brier Score for pool bets in the last 10% of trading is 0.143 compared to a contemporaneous Brier Score of 0.124 for fixed-odds bets. In other words, by this measure, the accuracy of interim parimutuel pool prices almost (but not quite) converges on the accuracy of fixed-odds prices as trading comes to an end.

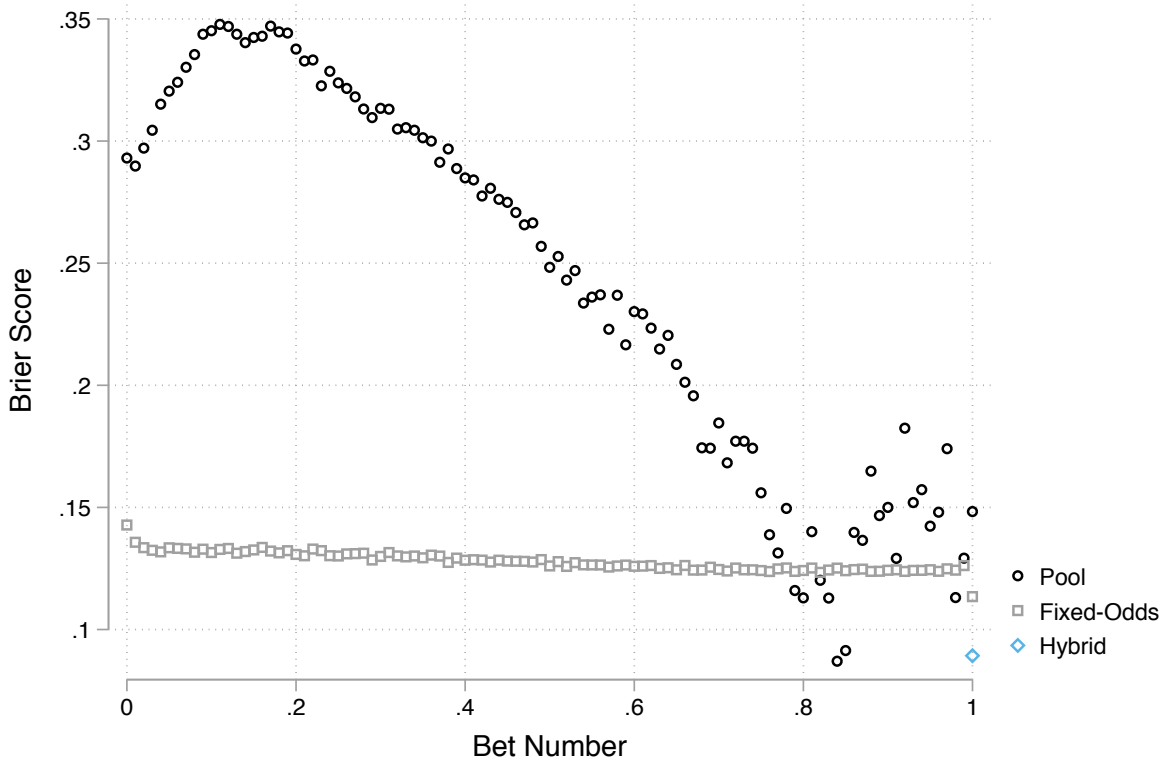

Figure 5: Brier Scores for pool and fixed-odds bets, plotted against bet number. Bet number is rescaled between 0 and 1 for each horse and rounded to two decimal places, and therefore captures the ordering from the first bet to the last.

To sum up, I find support for the notion that information is much slower to get into parimutuel prices than fixed-odds prices. This is likely due, in part, to the incentives for informed bettors to bet late in parimutuel pools, but is also likely due to the competition created by the parallel fixed-odds market.

However, it is worth noting two purposes that the parimutuel pool may serve in this hybrid market. Firstly, the pool is largely neglected: just 12.8% of the 2.85 million bets in the sample are placed in the pool. But this statistic masks variation across the trading window. In Figure 6 I plot the proportion of bets placed in the pool (as opposed to the fixed-odds market) against the bet number (again rescaled between 0 and 1 for each horse and rounded to two decimal places). In the early stages of trading the pool is quite popular. 38.3% of bets in the first tenth of the trading window are placed in the pool; this drops to

0.4% in the final tenth of trading. The parimutuel pool allows bettors to place early bets which will be executed at the end of betting when markets are thickest (and transaction costs lowest) and when more information is in the price. Early parimutuel bets in this hybrid market are, in effect, executed in late trading in the fixed-odds market.

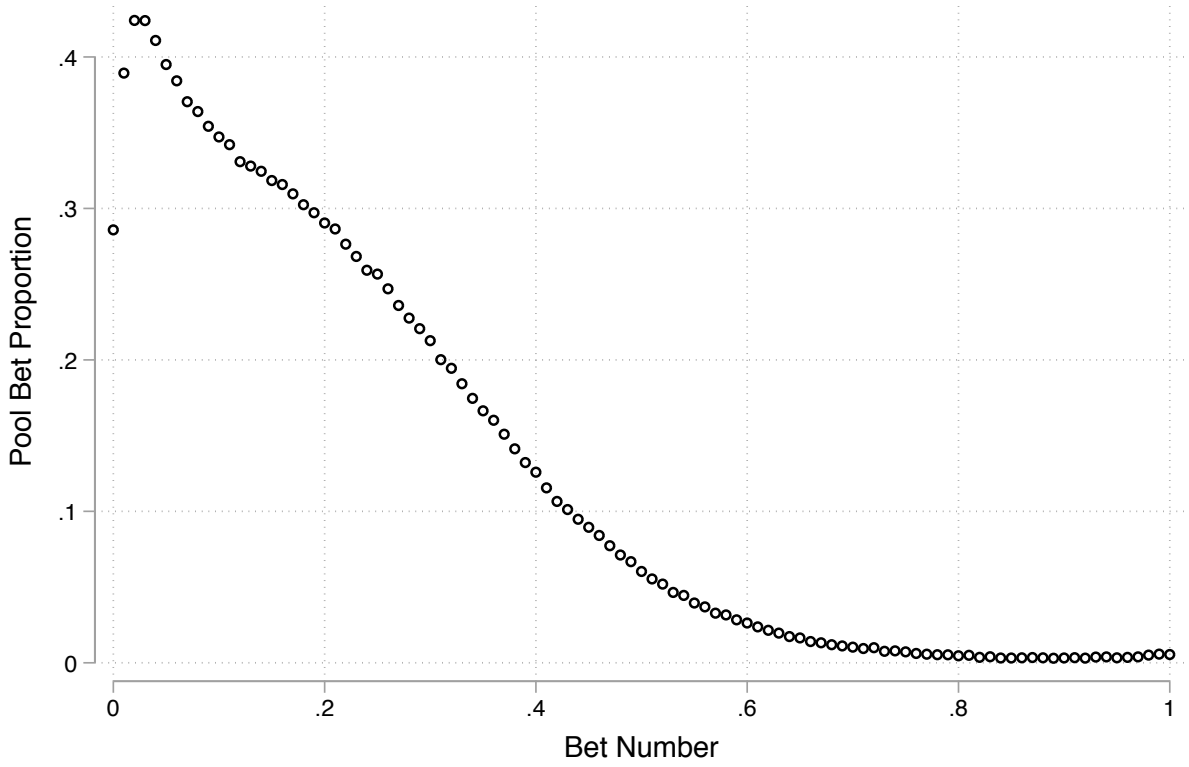

Figure 6: The proportion of bets placed in the pool (as opposed to the fixed-odds market), plotted against bet number. Bet number is rescaled between 0 and 1 for each horse and rounded to two decimal places, and therefore captures the ordering from the first bet to the last.

Secondly, the parimutuel pool in this hybrid market may play an informational role. One problem in relying on fixed-odds bets for forecasting purposes is that many of these bets are executed long before the race has begun and without the information (e.g. from the parade ring, on the way to the start etc.) available to participants at post time. The parimutuel pool provides a mechanism not just for extracting information from a last minute fixed-odds trade, but from a broad section of quotes available at race time. Backing up this view, the Brier Score for the Betfair Starting Price – based on pool bets plus quotes in the fixed-odds market – is 0.089, significantly lower than the Brier Score for fixed-odds bets (0.127). I have added a dot for this Hybrid price in Figure 5 for comparison. Furthermore, if we estimate Equation (1) for Betfair Starting Prices (as I do in Table 4) – with one observation per horse rather than per bet – we get an estimate of β_1 of 0.975, which suggests that the Hybrid price is a less biased predictor of outcomes than the prices of fixed-odds bets. In short, while interim parimutuel pool bets are uninformative for all but the last stages of trading – and

even then perform worse than fixed-odds bets – the hybrid market mechanism produces more efficient prices than the fixed-odds market in isolation.

	(1) Win Indicator
Hybrid Market IP	0.975***
	(0.0389)
Constant	0.00257
	(0.00393)
Observations	8,923
R-squared	0.123
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Table 4: Hybrid Market. The win indicator – equalling 1 if the horse won the race and 0 otherwise – is regressed on the Hybrid Market implied probabilities (prices). The prices produced by the hybrid market are labelled 'Betfair Starting Prices' (BSPs).

Before I conclude, I should stress one main caveat with this analysis. The parimutuel pool is largely neglected in this setting with only 12.8% of bets placed in the pool, but there is likely to be a selection effect at play here. Betfair is well-known for its fixed-odds betting exchange facility, and not for its parimutuel market mechanism, which is only operated for horse racing and not other sports. If the Tote – famous for parimutuel bets but not fixed-odds betting – were to run a hybrid parimutuel and fixed-odds market mechanism it is possible that participants in that market would display a greater propensity to bet in the pool element. That may, in turn, make pool prices more efficient earlier in the trading window.

4 Conclusion

There are two main market mechanisms for the trading of bets on horse races: parimutuel pools and fixed-odds betting. In the former, prices are uncertain until all bets are in. In the latter, prices are fixed – either by bookmakers or by participants on a betting exchange – at the time of the bet. My research question is: which of these two mechanisms aggregates information most quickly and effectively?

To answer this question I analyse a hybrid market, where a fixed-odds betting exchange is run side-by-side with a parimutuel pool. All bets in this hybrid market are timestamped to the millisecond by a common clock, allowing me to precisely identify when information gets into prices. I find – consistent with theory on price discovery in these two alternative market mechanisms – that fixed-odds (price) markets are significantly quicker to impound information into prices than parimutuel pools. In fact, fixed-odds prices are comparatively efficient from the very first bet.

The efficiency of parimutuel bets does, however, increase as race time approaches. Furthermore, in this hybrid mechanism, the parimutuel pool appears to serve two important

purposes. The pool allows bettors to place early bets which will ultimately be executed cheaply and efficiently later in the trading window. Secondly, the combination of parimutuel bets with fixed-odds at race time provides a mechanism for extracting information in the betting (limit order) book. The information extracted from these quotes provides more accurate predictions of outcomes than fixed-odds bets alone.

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