

HOME BIAS AND INTERNATIONAL BETTING MARKETS: CAN INSTITUTIONAL CONSTRAINTS AND BEHAVIORAL BIASES LEAD TO ARBITRAGE PROFITS?

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ABSTRACT

The international sports betting markets are becoming more global, but there is still a large concentration of local bettors in gambling markets of individual countries. Home loyalty and other patterns of human behavior might lead to odds for international competitions being different in different countries with less favorable odds being quoted in the home country; the home bias effect. In this paper we explain the logic of this phenomena and examine a small data set to show the existence of the bias in three different sports: tennis, golf, and European football. We also suggest ideas for a more thorough investigation of the home bias phenomenon.

JEL Classification: G0, DO3

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1 INTRODUCTION

In the finance literature, there is a long outstanding puzzle known as the home bias puzzle. It was documented early on in the finance literature by French and Poterba (1991). U.S. equity traders allocated nearly 94 percent of their funds to domestic securities, even though the U.S. equity market

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comprises less than 48 percent of the global equity market. It has also been documented in other countries as well, where investors appear to invest only in their home country, virtually ignoring foreign opportunities (Lewis (1999), Coval and Moskowitz (1999), and Veldkamp and Nieuwerburgh (2009)).

There have been various attempts to explain this phenomenon with rational agents, including that domestic equities might provide better hedges for risks that are specific to people in the home country; that there are significant costs to international diversification that may outweigh the benefits; or informational asymmetries between home and foreign companies, but no explanation has provided a definitive answer as to why domestic investors do not invest more heavily internationally.

Another arena in which home bias may be exhibited is in the gambling markets. Of course, it would take on a slightly different role here. In international sporting events, one might believe that bettors in a given country would have a bias to bet on teams from their country *ceteris paribus*. This behavioral bias in conjunction with the gambling houses wanting to match their books could lead to a dispersion of odds across gambling houses in different countries for the same sporting event. If such a home bias in international sports betting did exist, it would be hard to reconcile with information or other stories of rational agents, but might be better classified as a behavioral bias due to human emotions.

While the financial markets are much more liquid and most likely consist of much more sophisticated investors, a home bias puzzle nevertheless exists. One might imagine that international sports betting markets might exhibit an even stronger home bias for a couple of reasons. First, prior to the Internet revolution and even after, it is probably true that most betting is done in local markets. That is, one registers a betting account in one's country of residence. Second, that behavioral biases in sport betting play a larger role than in financial markets. That is, when one is betting on a world cup match between Italy and England, one might believe that there will be a bias for English bettors to bet on England and Italian bettors to bet on Italy.

In this paper we examine these ideas and propose directions for further research on this topic. The paper is organized as follows: section 2 describes home bias concept; section 3 discusses the data and evidence of home bias in the gambling markets; and section 4 concludes with ideas for further research into this area.

2 THE HOME BIAS CONCEPT

It might help to illustrate the home bias concept with an example from boxing. On March 16, 1996, Frank Bruno of England was to fight Mike Tyson of the USA for the WBC heavyweight title of the world. The odds in Las Vegas and England were very different for this match. Some lines in Las Vegas had the match 20-1 for Tyson, while some in England had the match at 1-1. In some cases, the differences were not so extreme, with one line in

Vegas giving 8-1 odds versus Ladbrokes, the English gambling organization, giving odds of 4-1. In either case, these disparities were huge. The first question is why were the odds so different in the countries? It seems plausible to ascribe the differences to home bias. Most clients of the English betting organizations were presumably English. Most bettors in Las Vegas were presumably American. Thus, an overwhelmingly large amount of the dollar bets in England were for Bruno and an overwhelmingly large amount of bets in the United States were for Tyson. Betting agencies do take both wanted and unwanted positions at times because of order imbalance. However, the ultimate goal for a betting shop is to balance both the buy and sell orders on a spread, so that the betting house has a net zero position and makes profits simply from the betting spread or the commissions. Thus, if one betting house has a huge amount of orders for one side of the transaction, they will continue to move the odds until there is an equilibrium between demand and supply. This is how odds in two different betting agencies could differ so dramatically from one another.

One would think, that just as in financial markets, that if the discrepancies in two betting locations are too large, that arbitrageurs will intervene and force the two betting agency odds to converge. There are reasons why this may not occur as frequently as one might imagine. First, some betting markets have institutional restrictions. For example, in Las Vegas, it requires physical presence to make bets, rather than over the phone or online, unless one has an established bookie relationship in the city. Second, some betting organizations restrict the type of customers. For example, currently, most UK betting agencies do not allow U.S. residents to make bets due to U.S. laws, thus further restricting the type of bettor. Third, different betting organizations sometimes have slightly different betting contracts, thus it takes a bit of calculation and understanding to translate one set of odds to another. For example, many betting organizations in England offer spread bets. That is, rather than bet on whether Tyson or Bruno wins or loses, one would bet on whether the match ends in one round, two rounds, three rounds, and so on. Fourth, even once all these considerations are accounted for, the liquidity in some betting organizations and in certain contracts is extremely small so as to discourage smart money from involving itself in the trades and hence correcting the mispricing.

The liquidity and arbitrage opportunities in betting markets is best illustrated by an example that two of my trading colleagues were directly involved with. It was during the 2000 presidential election.³ My two trading colleagues had placed the maximum bets on the Iowa Electronic markets in favor of George Bush winning the popular election. Both of them were fairly sure that George Bush would win the 2000 popular vote. The Iowa markets had a trade where you could trade either DEM or REP to win the popular vote. In a series of trades beginning on October 16, 2000, they began buying

³This trade has been documented in Strumpf and Rhode (2008).

REP (Republican candidate, i.e. George Bush) and selling DEM (Democrat candidate, i.e. Al Gore). Their main goal was to be SHORT the DEM and LONG the REP candidate. By the close of business on November 7, 2000, they had a position that was short 172 contracts of the DEM at an average price of 0.4864 and long the REP of 1025 contracts at an average price of 0.60512.

The election was on November 8, 2000. The way things worked, if they were right and the REP nominee got the popular vote, then that contract would be worth 1, while the DEM contract would be worth 0. Thus, on average, they stood to profit by $\$488 (1025 \cdot (1 - 0.60512) + 172 \cdot 0.4864)$. By the evening of November 8, 2000 it was quite clear that Al Gore had won the popular vote. Thus, rather than profiting, they should have lost about \$708.59. That morning, they arrived in the office before the Iowa markets opened. The two colleagues began trying to sell the REP bet as fast as they could. One of them was clicking on his computer furiously and he had a fast Internet connection. They were hoping to hit other people's limit orders before they could cancel them. To their surprise, they started selling REP at reasonable prices. They began selling at 0.75, 0.70, and 0.24. They were so happy with this success that they began buying the DEM as well. By the end of their series of transactions, they had bought 1025 DEM contracts at an average price of 0.82879 and sold 733 REP contracts at an average price of 0.435. At the end of their trading session, they had actually made a profit of \$495.07. Thus, rather than losing \$415.10, they had actually profited, even though the popular vote was already publicly known.

They were happy, but puzzled by their experience. They believed that since the Iowa markets were relatively illiquid markets with few professionals, they were able to hit people's limit orders because they simply didn't take the time to go and cancel them. These customers had not gone in to delete their limit orders. Thus, by being first in the system that morning, they were able to hit everyone's limit orders. It was a great fun experiment in testing the liquidity of markets. Since then, other experts in the area of online betting have told them that they should not exclude the possibility that many bettors simply were confused by the contracts that they were buying and selling. It may have been the case that many bettors believed that the contracts were not about the popular vote but rather who would win the presidency. The episode was described in Strumpf and Rhode (2008) as the single trader that brought the market to efficiency.

The purpose of this story is to illustrate the fact that these small betting markets often have exploitable arbitrage opportunities due to gambler ignorance, institutional constraints, and illiquidity.

Thus, home bias could likely exist and persist since some of this bias may not be arbitrageable due to institutional constraints and some of the bias may linger due to the lack of smart money in these small markets.

3 THE DATA AND SOME EVIDENCE

In order to test the hypothesis of home bias in international betting markets, it is necessary to collect information on sports betting odds of gambling houses in different countries. Even though many betting agencies now allow bettors from other countries, it is probably still reasonable to assume that the majority of bettors in a particular betting house of a particular country are from that country. Our first task was to identify as many international betting houses and then collect information on their historical

Table 1: Summary of Country Specific Gambling Websites

	Country	Website
1.	Australia	www.acttab.com ^a
2.	Austria	www.bwin.ag
3.	Denmark	www.danskespil.dk
4.	England	www.betfair.com ^b
5.	Germany	www.digibet.com
6.	Ireland	www.boylesports.com
7.	Netherlands	www.ciga.an
8.	South Africa	www.casasa.org
9.	Sweden	www.unibet.com ^c
10.	Switzerland	www.swisslos.ch
11.	USA	www.vegasinsider.com ^d
General Gambling Websites		
1.	International Gaming	www.igwb.com
2.	American Gaming Association	http://www.americangaming.org/
3.	World Lottery Association	http://www.world-lotteries.org/cms/
4.	Odds of Various Websites	www.tip-ex.com
5.	Odds from Many Websites	www.betbrain.com

Note: ^a This website provides gambling odds for Casino Canberra and other Australian casinos related to sports betting. ^b England has a variety of gambling websites including www.sportingindex.com, www.ladbrokes.com, www.willhill.com, and others. ^c The location of this Swedish website is Malta. ^d Provides odds for many Las Vegas casinos.

odds for various matches were country of origin could be mapped. After searching the Internet and making many calls, we settled on the websites in Table 1 to represent a sample of gambling sites in various countries.

We then decided to focus on sports in which a country bias could be noted and sports in which there was enough international competition. The sports we identified were European football (a.k.a. soccer), tennis, and golf.⁴ We then began calling all of these betting houses to retrieve historical daily odds on all international tennis matches, all world cup matches, all European cup matches, all boxing matches, and all major golf tournaments for the last 10 years. We attempted to collect all of this data but ultimately could not obtain the data. Some organizations were simply not interested in cooperating with us. Some argued that obtaining the data was too difficult. Some argued that they did not keep detailed historical records of the data. For example, a representative of Sportrader, a betting organization headquartered in Switzerland, but with offices in other countries, at first told us that they would cooperate, but two weeks later, they wrote us the following email:

*Hi Ludwig, I think there must be a misunderstanding – due to legal obligations we're not allowed to provide these detailed information.
Regards XXX.*

We then attempted to go to websites that collect a huge amount of historical data from existing gambling sites, but once we examined the vast amount of data (over 30 GB), we found that it did not contain sufficiently detailed information for our purposes.⁵

For the purposes of this paper, then, we collected our own small sample of data and investigated whether there were any signs of home bias and any arbitrage possibilities. We obtained data on four events for the Summer of 2008. The events were the 2008 US Open golf tournament, the 2008 US Open tennis tournament, the 2008 PGA Championship, and the 2008 European Cup.

3.1 Evidence of Home Bias

For the PGA Championship in Golf, we considered the betting websites of 5 countries: Australia, Austria, Sweden, UK, and the USA. Each website had slightly different ways of computing the odds to which player would win the outright tournament, thus we converted them to dollar equivalents. Thus, for each player we looked at how much one would win if \$100 were bet on that player to win the PGA Championship. There were 113 players with odds from at least one of the betting sites, of those 10 were Australian, 12 were English,

⁴One could also imagine many other sports that could be used, including boxing, rugby, and others. We did not use these, because at the time of this study, there were not significant international competitions occurring in these sports.

⁵Our dataset was obtained from Betbrain.

4 were Swedish, and 87 were from the US. In order to measure home bias, we looked at the odds for a given player winning the PGA Championship both on websites in their home country and websites in other countries. This eliminated many of the 113 players who did not have odds on more than one site. For each player we computed the average dollar payoff for betting \$100 on that player. We then computed the difference in average winnings per player from odds on the home gambling site versus the equal-weighted average of the foreign gambling sites. The results are produced in Table 2. One can see from the table that there seems to be a consistent home bias for odds on players in the PGA championship. For example, a \$100 bet on the collection of Swedish players to win the PGA championship would pay out \$60,000 at the home betting site, but a total of \$65,300 on average of the foreign gambling sites.

Table 2: Home Bias Evidence from Various International Sporting Events

Country	Home Payoff	Average Foreign Payoff	Difference	Nobs
Golf: PGA Championship 2008				
Australia	\$25,800.00	\$27,150.00	\$(1,350.00)	4
England	\$26,675.00	\$30,900.00	\$(4,225.00)	5
Ireland	\$5,000.00	\$6,037.50	\$(1,037.50)	2
Sweden	\$60,000.00	\$65,300.00	\$(5,300.00)	3
United States	\$10,512.50	\$10,911.65	\$(399.15)	32
Golf: US Open 2008				
Australia	\$8,416.67	\$9,213.89	\$(797.22)	6
England	\$7,900.00	\$5,991.67	\$1,908.33	5
Sweden	\$6,500.00	\$6,825.00	\$(325.00)	1
United States	\$3,713.33	\$6,229.95	\$(2,516.62)	9
Tennis: US Open 2008				
England	\$900.00	\$1,037.00	\$(137.00)	1
United States	\$5,700.00	\$14,233.11	\$(8,533.11)	3
Australia	\$10,100.00	\$11,364.00	\$(1,264.00)	1
Football: European Cup 2008				
Austria	\$336.67	\$537.50	\$(200.83)	3
Sweden	\$250.00	\$312.33	\$(62.33)	1

Note: The odds for the tennis and golf are the payoffs from a \$100 bet. Because of the very low probability of any one golfer or tennis player to win the entire event, the odds are typically quite high. Hence, a bet of \$100 on one of the Australian players in the home market to win the PGA Championship results in an average payout of \$25,800. For the European cup events, the

bettor can bet on a win by the home team, a win by the foreign team, or a draw. The payoffs here are for a win by the home team for a bet of \$100.

We also looked at the US Open golf championship. There is generally a home bias here as well, except for England, where there does not seem to be any home bias.

Another sport we examined was tennis in the 2008 US Open event. We used the same methodology as with the golf odds. We computed the average payoff to tennis players of the home gambling site versus the average payoffs to the same tennis players on foreign gambling sites for a set of countries. Very few players in the tournament had odds quoted on more than one website. Thus, our sample is restricted to very few players from Australia, the UK, and the USA. Table 2 shows the results the payoffs from an average \$100 bet. The table shows that in all cases, there is a home bias in betting on tennis players.

For the European Cup of 2008, we used only the first round games. There were only four games that were relevant given the country gambling sites we had access to. They were Austria versus Croatia, Greece versus Sweden, Austria versus Poland, and Austria versus Germany. Thus, the table has only two entries, one for Austria's home bias and one for Sweden's home bias. In both cases, there seems to be an indication of home bias in the betting markets.

3.2 *Arbitrage Possibilities*

In the previous section, we documented the presence of a home bias in international betting markets. The next obvious question is to ask whether these discrepancies could be arbitrated by a person with multiple betting accounts in various countries. It should be noted that arbitrage possibilities are not available in the tennis and golf betting markets. This is because these markets display only the odds for a player to win the event outright and do not allow for betting against the player winning the event. One could collect data on individual tennis matches and then this data could also be used to test arbitrage. We did not collect any data on individual tennis matches and thus could not test for arbitrage possibilities in the tennis market. For the small sample of European Cup football matches, there is the possibility of arbitrage. It would involve shorting the home team in the home team's gambling country (or buying the foreign team) and buying the home team in the foreign gambling market. As long as the bid-ask spreads are not too large, an arbitrage might be possible. In order to take an arbitrage position on a international football match, one must essentially create a position that profits whether there is a win, loss, or tie by the two teams involved.⁶ To do this

⁶This becomes slightly more complicated in later stage, elimination matches, since there is always one winner. It will depend on the rules of the particular gambling house. Some have bets for regulation play and separate bets for extended play.

arbitrage, one should look at the home market and the foreign market(s). For exposition, we shall assume that one picks the foreign market with the best odds, rather than using more than one. The typical gambling house shows the odds for a head-to-head match as shown in Table 3.

Table 3: Sample Odds from Home and Foreign Gambling Houses for Football Game

Home Odds			Foreign Odds		
1	X	2	1	X	2
H_1	H_x	H_2	F_1	F_x	F_2
Example: Austria versus Germany					
4.35	3.35	1.5	8.40	1.50	4.30

The two teams are typically listed as Team 1 versus Team 2. The odds are then listed as 1, X, and 2. The first is the payoff for betting on team 1 and team 1 wins, the X represents the payoff if the bet is for a tie and a tie occurs, and the last payoff is a bet that team 2 wins. In the table, we use H to represent the home gambling house's odds and F to represent the foreign team's gambling odds. Using our notation, the "favorite" team is revealed by whether $H_1 <> H_2$ and $F_1 <> F_2$. For example, if $H_1 > H_2$, then Team 2 is the favorite. Home bias is revealed by whether $H_1 <> F_1$ or $H_2 <> F_2$. For example, in the case of Austria versus Germany, it is clear that Germany is the favorite, since $H_1 > H_2$ and also $F_1 > F_2$. It is also clear that there is home bias, since $H_1 < F_1$ (that is, the Austrian gambling house is paying much less for Austria to win than the foreign house is paying for Austria to win). Similarly, $H_2 < F_2$ (that is, the Austria gambling house is paying much less for Germany to win).

In order to establish whether an arbitrage is possible, we need to determine whether there is a series of bets that can lead to a positive profit in all possible states of the world; that is, a win by team 1, a win by team 2, or a draw. When only long bets exist in the markets of concern, the general strategy when home bias exists would be to place a bet of w_1 for the home team to win in the foreign market, place a bet of w_2 for the foreign team to win in the home market, and take a bet of w_x in the cheapest of the two markets for a draw. Thus, the final payoff for the arbitrage would be:

$$Net\ Payoff = \begin{cases} w_1 F_1 - w_1 - w_2 - w_x & \text{if Homewins,} \\ w_x \psi_x - w_1 - w_2 - w_x & \text{if Draw,} \\ w_2 H_2 - w_1 - w_2 - w_x & \text{if Foreignwins.} \end{cases}$$

where ψ_x is the odds for the cheaper of the two markets for a draw and the sum of the weights is normalized so that $w_1 + w_2 + w_x = 1$.⁷ The arbitrageur can then use an optimizer to find a possible combination of weights to provide an arbitrage opportunity. That is, a combination of weights such that the product of the three outcomes is maximized and there is no loss in any outcome of the football match.⁸ In addition to this, we must constrain all weights to be positive, since these are all bets for one of the events to occur. Thus, $w_i \geq 0 \quad \forall i$.

In the particular case of Austria versus Germany, there are no optimal weights that lead to an arbitrage profit. The best case are weights of 0.119, 0.299, and 0.582 respectively on the home team winning, a draw, and the foreign team winning. However, this can only guarantee no loss if the home team wins, no loss if there is a draw, but a -0.13 loss in the case of a foreign team win. Thus, arbitrage is not possible using this method, even though a home bias exists between the two markets.

Some gambling houses allow for both backing and laying odds.⁹ This means that you can both bet for a team and also bet against a team. If there is both a home and foreign gambling house, this is the more direct way to arbitrage a home bias. If the spreads are not too large between back and lay bets, there could be arbitrage possibilities. In the case of Austria and Germany, the two houses that we used did not offer lay odds and thus this bet was not possible. However, for the purposes of illustration, we continue with the example. Typically, the spread between back and lay odds is about 0.1. Thus, it would be reasonable to assume that the lay odds at home for the Austria-Germany match would be something like 4.45. Thus, the investor would lay odds at home and back odds abroad at 8.40. If there was a draw or Germany won, the investor would break-even, making \$1 and losing \$1 respectively. However, if Austria won, the investor would have to pay 4.45 times at home and receive 8.40 times abroad, thus making an arbitrage profit. A more elaborate weighting scheme could be constructed which would place some additional bets on a draw and a German win that would lead to the investor profiting in all scenarios.

In our investigation of the betting odds for our small sample of the European Cup of 2008, we did not find arbitrage profits for either of the discussed arbitrage mechanisms. The former due to an impossible combination that would lead to profits and in the latter due to restrictions of the websites on laying odds.

⁷This can later be scaled up to any value depending on the liquidity of the market or funds available to the arbitrageur.

⁸Depending on the odds, this optimization problem may not have a solution.

⁹This is the terminology used by BetFair.

4 CONCLUSION AND FURTHER THOUGHTS

The behavioral biases inherent in investors of all types are present in the bets of sporting gamblers. In fact, there is a systematic home bias in the small sample of sporting events we examined. In some ways, this seems quite natural, as betting on one's home country is more emotionally driven than betting on financial markets. Our dataset was very small and it would be very interesting for future research to acquire a large historical data set of all types of international matches on a variety of exchanges across the globe to examine the home bias issue in more detail. There are also liquidity issues that need to be taken into account when doing a large study of this sort. Thus, we believe it will be essential to obtain a historical time series of gambling odds from a variety of websites with dollar volume of the bets as well to get some sense of the liquidity and hence reliability of different markets' quotes. It will also be advantageous to look for gambling houses that allow both backing and laying odds to allow for the greater exploration of arbitrage possibilities. Although most likely a minor detail, it might be worth considering the effects of foreign exchange issues, although most international betting sites allow for dollar accounts or accounts in one particular currency. Other important data to acquire would be the percentage of dollars of the clientele for each website and their country of origin. This will be hard to obtain, but as gambling sites are becoming less geographically based, this will become more important for any study of this sort. There will likely be also a time component to the home bias effect and the arbitrage. That is, as international betting has become easier to access through the Internet and other sources, the home bias effect may have declined over the last 15 years.

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