Playing It Safe?

A Fibonacci Strategy for Soccer Betting

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Soccer betting in Europe has grown rapidly in the past two decades. It is well known that such sports betting markets can be analyzed similarly to financial markets. The present article differs from others in the literature in two respects. The first is that the outcome of betting interest is the draw. The second is the betting strategy, which relies on the Fibonacci sequence to generate bets. Using this approach on International Federation of Football Association World Cup Finals data, it is possible to earn economic profits through this strategy in expectation, albeit with fairly large risk.

Keywords: *soccer world cup; Fibonacci sequence; betting strategy*

Soccer betting in Europe has grown rapidly in the past two decades. Some betting firms in the United Kingdom have 1,500 to 2,000 locations with tens of thousands of employees. More than a decade ago, Jackson (1994) could characterize sports betting as one of the fastest growing areas in the UK's betting industry, and Forrest and Simmons (2001) depict soccer betting in particular as the fastest-growing type of gambling there.

However, this betting market, like most in sports, appears to be inefficient in the same way as international financial markets (e.g., Osborne, 2001). Indeed, there is some evidence that many such markets are systematically far from being efficient. In an analysis of sports betting markets Sauer (1998) provides—within the context of an article generally arguing that such markets are efficient—a list of anomalies that must be resolved to be consistent with standard zero-profit conditions. In a

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market based on fixed-odds betting, there are mixed results. Pope and Peel (1989) examine the efficiency of such markets generally and find that although there was some evidence of ex post inefficiency, there did not appear to be profitable betting strategies that could have been implemented ex ante during the sample period. But Dixon and Coles (1997) propose a Poisson parametric model, similarly motivated by the possibility of inefficiencies in the soccer-betting market. Their model does yield positive profits. To the extent that such inefficiencies exist, a natural question is whether they can be systematically exploited.

The present work differentiates itself from the others in the relevant literature in that the only random outcome of interest is the draw, which Pope and Peel (1989) speculate is the most difficult for bookmakers to predict. They conclude that odds-setting practices among bookmakers (p. 328) "could simply reflect a general inability to predict draw outcomes with any degree of reliability."

We also seek to bridge the gap between the theory (i.e., the numerous theoretical papers regarding soccer betting markets) and the practice—that is, the relatively scarce literature regarding simple applied techniques on gambling. We do this by finding a good estimate of the distribution of soccer-match results and propose a way of taking advantage of this information. Furthermore, we use the results of previous researchers regarding the distribution of game results and consider a variation of the martingale casino strategy as the betting method. A Fibonacci sequence is used to define a consistent betting-quantity strategy. Most of the sports-betting literature has paid little attention to strategy with respect to betting amounts, concentrating instead on which way to bet.

Fibonacci numbers are used in finance in technical analysis of stock markets (Goetzmann, 2004; Murphy, 1986). It will be shown that for fixed odds given for a draw of at least 2.618, the betting rule proposed is profitable in expectation. The strategy will then first be applied to actual International Federation of Football Association (FIFA) 2002 World Cup Finals Tournament (WCFT) data. We also explore the distribution of actual WCFT draw odds, consider them as a random variable, and employ Monte Carlo tactics to further explore profit opportunities.

The rest of the article is organized as follows: Section 2 explains how fixed odds work and briefly describes the data; Section 3 measures draw probabilities over several iterations of the WCFT and tests their robustness across time; the betting rule is discussed in Section 4; and Section 5 concludes.

ANALYSIS OF FIXED ODDS AND DATA SET

There is a wide variety of information that can be extracted from a single soccer match. The final score, the half-time score, the total number of goals scored, the players who scored, in which minute the goals were scored, and many other uncertain outcomes can and do serve as betting propositions. This article distinguishes itself from similar literature in betting on U.S. sports such as the National Basketball Association (e.g., Brown & Sauer, 1993) and the National Football League (Dana & Knetter, 1994; Gray & Gray, 1997) because draws are rare in the National Football

League and do not exist in the National Basketball Association and Major League Baseball. Thus, for both gamblers and scholars, the main outcome of interest is whether a particular team wins. But in soccer, draws occur approximately 30% of the time. Hence, we choose to use this as the uncertain outcome on which bets are placed.

Soccer betting typically occurs on an odds basis. In the more familiar notation of the probability of various outcomes, if p_i is the probability of one event, odds on the event are then $1/p_i$. In this instance, the probability space has only two outcomes (draw, not draw) and is defined as follows:

$$p = \text{Prob[game } x \text{ is a draw] and } q = 1 - p = \text{Prob[game } x \text{ is not a draw].}$$

For example, the probability equivalent of a typical fixed-odds set provided by the bookmaker for the result of a soccer match such as 2.25, 3.10, and 2.80 as the odds for home team win, draw, away team win is 0.444, 0.323, 0.357. In a situation of maximum uncertainty, the odds against each of three outcomes will be 2/1 or 3.0, 3.0, 3.0. The associated probabilities in the first example sum to approximately 1.124. This is the odds representation of the well-known fact that bookmakers build a profit margin into their betting propositions so that they can expect to earn profits no matter the outcome. The probability analogue is that to make money in betting based on p one must win by some margin larger than 50%. In the first example, earlier the odds sum to 1.124 so that the bookmaker's profit is 12.4%. To calculate the true probabilities appointed by the bookmaker, one has to scale the bookmakers' announced probabilities by the factor 1.124. Doing so indicates that the true probability for a draw is 0.287, and the full set of probabilities is 0.395, 0.287, and 0.318. For the gambler to make money in the problem here, the gambler must determine the true (underlying) probabilities of a game more accurately than the bookmaker by a margin sufficient to overcome the bookmaker's profit margin.

The World Cup tournament of FIFA is considered to be the most important soccer tournament in the world. The qualifying matches to determine the teams that will play in the finals play out during 2 years, and the finals themselves last almost a month. The data used in the present study come from a 20-year span of WCFT matches, consisting of 336 full-time match results. All data come from the official World Cup Web site, (FIFA, 2002).

Table 1 reports the number and percentage of draws in the data set. In soccer betting, the standard definition of a draw is a game tied after 90 minutes of full regulation time, even if a decisive goal is scored in the extra time or sudden-death period. The WCFT takes place in two stages. In the first stage, the group matches stage, the teams that have qualified for the WCFT are divided into groups; and within each group, there is a round-robin format. The winners of each group plus several other relatively high-finishing teams then move on to the final competition stage, where there is a single-elimination tournament in which teams are seeded based on their play during the group matches stage.

In the group matches stage, there is a 28.75% probability of a draw overall while in the final competition stage of the tournament, where the importance of

TABLE 1: Summary Report of Number of Draws Appeared in Each Group and Final Stages per Tournament Year

	Spain 1982	*México 1986*	*Italy 1990*	*United States 1994*	*France 1998*	*Korea-Japan 2002*
Group matches						
1	5/6	3/6	0/6	1/6	2/6	3/6
2	0/6	2/6	1/6	2/6	4/6	1/6
3	1/6	1/6	0/6	3/6	2/6	1/6
4	2/6	1/6	1/6	0/6	2/6	1/6
5	3/6	2/6	1/6	2/6	4/6	2/6
6	1/6	2/6	5/6	0/6	1/6	3/6
7					1/6	1/6
8					0/6	2/6
Total groups	12/36	11/36	8/36	8/36	16/48	14/48
Final competition						
Round of 16	1/3	1/8	4/8	2/8	2/8	3/8
Quarter finals	2/3	3/4	2/4	1/4	1/4	2/4
(except 1982)	0/3					
	1/3					
Semifinals and finals	1/4	1/4	2/4	1/4	1/4	0/4
Total final competition	5/16	5/16	8/16	4/16	4/16	5/16
Total tournament	17/52	16/52	16/52	12/52	20/64	19/64

NOTE: Total sample observations are $T = 336$.

each game is the highest (and perhaps risk aversion with respect to making a play that leads to a loss higher as well) is 32.29%.

ESTIMATION OF THE PROBABILITY OF DRAW

The underlying distribution of the results of each game i of T games $y_1, y_2 \ldots, y_T$ is modeled as the Bernoulli. The Bernoulli probability distribution function of each observation is $f(y) = (1 - p)^{1-y} p^y$, where y E {0, 1} is a correct (y = 1) or incorrect prediction (y = 0). The log-likelihood function to be maximized is

$$(p|\mathbf{y}) = \Sigma[(1 - y_i)\log(1 - p) + y_i \log(p)].$$

The first-order conditions are generated by the equation $dl(p;y)/dp = 0$. The corresponding maximum likelihood estimator (MLE) of p is

$$\check{p} = \Sigma y_i / T = \overline{y}$$

From the theorem on the asymptotic normality of the MLE (see, for example, Rice, 1995, for more details) for large samples $\check{p} \approx N(p, p(1-p)/T)$—that is, the MLE of $\check{p}$ follows a Gaussian distribution with mean p and variance $p(1-p)/T$. Thus, an approximate 95% confidence interval (CI) for $\check{p}$ would be

$$\Im = [\check{p} \pm 2\sqrt{p(1-p)/T}\,]$$

From Table 1, the total number of draws is 100, whereas the total number of games is $T = 336$ observations. Hence $\check{p} = \Sigma y_i/T = \bar{y}$, and as a result $\check{p} = 0.2976$. This estimate for the WCFT is similar to those reported for European league soccer by Dixon and Coles (1997) and Stefani (1983).

Figure 1 plots the percentage of draws in each WCFT in the data set and the associated 95% confidence interval. The 1994 tournament held in the United States is an obvious outlier, with notably fewer draws. The 1994 finals were different in two respects. First, the travel requirements were much greater owing to the greater distance across which the tournament was spread. Second, in that year, there was a significant, one-time rule change.

1992: Backpass ruling: Law XII — Fouls and Misconduct

> On any occasion when a player deliberately kicks the ball to his own goalkeeper, the goalkeeper is not permitted to touch it with his hands. If, however, the goalkeeper does touch the ball with his hands, he shall be penalised by the award of an indirect free-kick to be taken by the opposing team from the place where the infringement occurred. (FIFA, 2002)

This rule meant that the goalkeeper could not catch the ball with his hand when receiving a pass by a teammate. This limits defensive options near the own goal and hence raises the probability of yielding a score. Figure 1 indicates that in the next tournament, the number of draws immediately returned to normal levels. It also suggests that the cumulative draw probability for the WCFT games is within the approximate range 0.30-0.35—that is, roughly 1/3 of WCFT games are drawn.

BETTING RULE

The betting rule proposed for draws has similarities with the so-called martingale strategy, used in some casino games (e.g., roulette, in addition to financial markets). It is simple in the sense that one bets only for a draw, but this also makes it easy to apply. The strategy is to bet continuously for a draw with amounts defined by the Fibonacci sequence. The Fibonacci sequence is defined as the element 1, followed by another 1, with each element thereafter the sum of the previous two elements. For example, the first few elements of a Fibonacci sequence are 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, etc. The mathematical sequence is produced by the recursive formula.

$$a_{n+1} = a_n + a_{n-1},$$

where $a_1 = 1$ and $a_2 = 1$.

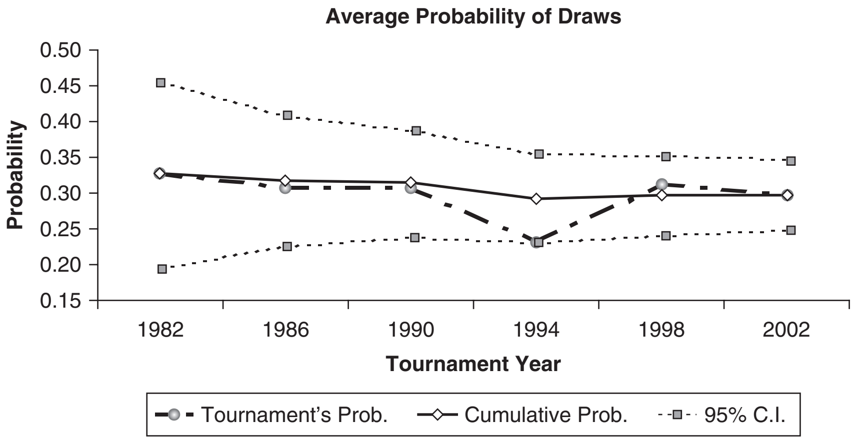

Figure 1: Average Probability of Draws per Tournament and Cumulative Probability Along With Its 95% Confidence Intervals

Its characteristic equation is $g(\lambda) = \lambda^2 - \lambda - 1 = 0$, with characteristic roots equal to

$$\lambda_{1,2} = \frac{(1 \pm \sqrt{5})}{2}.$$

The positive root $(1+\sqrt{5})/2$ is also known as the golden ratio and is approximately equal to $\phi = 1.618$, because for consecutive Fibonacci terms it is known that their ratio $a_{n+1}/a_n \rightarrow \phi$ as $n \rightarrow \propto$. The nth Fibonacci term is given by Binet's Formula.

$$a_n = \frac{[(1+\sqrt{5})/2]^n - [(1-\sqrt{5})/2]^n}{\sqrt{5}}.$$

Given the assumptions about the distribution of trial results, the gambler has a probability p of winning on any one of a sequence of bets. A successful bet of a_n monetary units given fixed odds of b yields an amount won of ba_n. The probability of winning for the first time at the xth bet is given by $p(1-p)^{x-1}$ (i.e., it follows the geometric distribution). The mean of x is $1/p$ and its variance is $(1-p)/p^2$.

Formally, the betting rule is to start with a unit bet a_1 and then follow it with another unit bet a_2. From the third bet onwards, the nth bet a_n is the sum of the two prior ones. Table 2 summarizes the Fibonacci betting rule. In Table 2, we denote

TABLE 2: Betting Rule Based on a Fibonacci Sequence

Index n	*Bets* a_n	*Sum* S_n	*Revenue* R_n	*Profit* P_n
1	1	1	b	b-1
2	1	2	b	b-2
3	2	4	2 b	2 b-4
4	3	7	3 b	3 b-7
5	5	12	5 b	5 b-12
6	8	20	8 b	8 b-20
7	13	33	13 b	13 b-33
n	a_n	$a_{n+2}-1$	$a_n\, b$	$a_n\, b-(a_{n+2}-1)$

a current bet as a_n , the sum of previous invested bets (i.e., the total cost) as S_n and the revenue and profit if the bet is successful for the first time in a series at time n as R_n and $P_n = R_n - S_n$, respectively.

We next calculate the minimum fixed odds number b required to earn profits in each series of bets. The following equation should hold for the last entry of Table 2.

$$\text{Profit } P_n = 1, \text{ unit of net gain} \Rightarrow a_n\, b - (a_{n+2} - 1).$$

For profits to occur, the above equation should exceed one. Because $a_{n+2} = a_{n+1} + a_n$, setting the equation equal to 1 yields

$$a_n b - (a_{n+1} + a_n - 1) = 1, \text{ or } b = (a_{n+1} + a_n)/a_n = 1 + a_{n+1}/a_n.$$

But $b \to 1 + \phi = 2.618$ as $n \to \infty$, from the Fibonacci property.

Thus, for given fixed draw-odds b of greater than or equal to 2.618, the betting rule proposed is profitable in expectation. Recall that the average probability for a draw in the WCFT data earlier is $p = .2976$. Translating to fixed odds yields approximately 2.99. Thus, it is worth trying to apply the Fibonacci betting rule. Note that it seems bookmakers apply different odds depending not only on the game itself but also on the country and the league it belongs to. For example, soccer games in Series B, Italy's second league, are expected to yield draws more often than the ones in the Premiership, England's first league. However, there is a serious drawback in applying the Fibonacci betting rule. Notice that for $p = 0.3$, the mean of the geometric distribution is given by $1/p = 10/3$, whereas its variance is $(1 - p)/p^2 = 70/9$, which implies that long intervals before success may be common. Often, the bettor has to be quite patient.[1] This is better seen by trying to answer the following question: How large must the gambler's initial capital be to sustain this betting system through the nth bet, given that he lost all previous $n - 1$ bets?

Consider the random variable S_n, the amount of capital that the gambler needs to sustain the Fibonacci betting strategy. From Table 2 and the nature of the geometric distribution, the random variable S_n has a probability density given by

$Pr[S_n = a_{n+2} -] = p(1-p)^{n-1}$, with $p = 0.3$. Hence, the expected value of S_n is given by $E[S_n] = \Sigma(a_{n+2} -)\, p(1-p)^{n-1}$, for $n = 1,2,3$, etc.. It follows that $E[S_n] \to \propto$ as $n \to \propto$—that is, no finite amount of money is sufficient to sustain the Fibonacci betting system. However, the WCFTs have only 64 games and there have always been more than 10 draws in this series of games. Thus, a draw occurs every 6 games on average. So the strategy is not without potentially dramatic risk but is in expectation profitable.

To test the Fibonacci approach, the full results of the FIFA WCFT 2002 are gathered and three betting strategies are tested. In Strategy A, the same amount is bet on every game. Strategy B is to bet according to the Fibonacci rule. Strategy C is to double bets after each loss. All draw odds were assumed[2] to be equal to 3.0. These three betting strategies were applied to the games numbered 1 to 32. The reason for this choice is that although usually games take place sequentially, the last two matches of the same group of the Group Matches round (numbered 33 to 48) took place at the same time to avoid match-fixing. As a result, a complicated modified betting rule would have to be applied to address each combination of outcomes for simultaneous games. No restriction on the upper limit for the amount of bets has been applied. As seen in the appendix, Strategy A loses money, Strategy B has a modest gain, and Strategy C has a huge gain. The concern with Strategy C is that in the event of a run of non-draws (as in games 21 to 28 in the appendix) one is obliged to bet an amount many times higher than in Strategy B.

To investigate in more detail the expected gains of the profit distribution, we consider the bookmaker's odds b to follow a Gamma random variable G (with mean μ and variance σ^2), and the model is implemented by a Monte Carlo simulation experiment. The odds data are taken from two well-known betting firms. They consist of posted bookmakers' odds for a pooled sample of 102 games from major national championships (England, France, Germany, Italy, and Spain), international friendlies between national teams and champion league games. The empirical distribution (see Figure 2) has a sample mean $\mu = 3.25$ and standard deviation $\sigma = 0.42$, whereas the range of the bookmaker's odds of a draw span from 2.75 to 5.00.

Using the earlier information and via the method of moments, we have fit a gamma probability distribution $G(t;\alpha,\beta) = \beta^{\alpha} t^{\alpha-1} exp(-\beta t)/\Gamma(\alpha)$ to the data. From the empirical mean and variance, we derive its estimated parameters $\alpha = 60$ and $\beta = 18.5$. Note that with a gamma distribution using these parameters, over a small portion of the distribution on the left the assumption that the bookmaker's odds b will be at least as large as 2.618 will be violated. This makes the Monte Carlo simulation more realistic. It clearly shows that although the mean of the profit distribution is positive and larger than unity, it is accompanied by a very large standard deviation. In fact, the profit distribution's density is centered in an area relatively near 0, as is also seen in Table 3 and in Figure 3.

Table 3 suggests that it is unlikely that the strategy will always yield positive profits for any reasonably small series of bets. For instance, in the case where the simulated odds violate the assumption $b \geq 2.618$, there may be a long series of

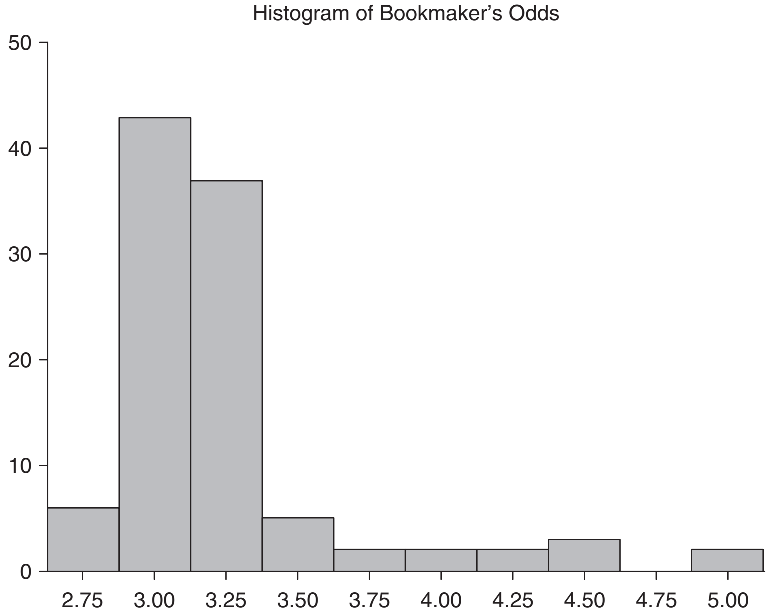

Figure 2: Bookmaker's Odds for a Pooled Sample of 102 Observations

$N - 1$ non-draws followed by a draw with low odds (i.e., with $b < 2.618$, which will yield $P_N < 0$). Thus, the Fibonacci betting rule is not profitable for some plausible combinations of draw odds, adding to overall uncertainty.

CONCLUSION

This article considers the unexplored fact in the wagering literature that the event of a draw between two soccer teams can be thought of as random and has yet to be modeled. This idea of draw odds as a random variable is especially appealing when bookmakers set the odds. By using a 20-year set of soccer World Cup data, we find that the probability of a draw is relatively stable at 29.76%.

The betting strategy suggested is to bet on draws, where bets are placed consecutively until victory using the Fibonacci sequence. There are two primary results. First, for fixed odds of a draw of at least 2.618, the betting rule proposed is profitable in expectation. This adds to the extensive empirical literature indicating that profitable betting strategies can be consistently applied to sports-gambling markets. In addition, because the average for the fixed odds of a draw are often greater than 3.0, we consider the odds also as a random variable and the model is implemented by a Monte Carlo simulation. The simulation experiment

TABLE 3: Simulation Results of Betting Experiment

Number of Replications	*Simulated Mean of Profit Distribution*	*Simulated Standard Deviation of Profit Distribution*
10	7.25	10.27
20	4.79	9.53
30	3.66	6.22
60	5.69	12.22
100	8.19	45.52
200	41.19	305.93
500	34.82	561.44
1,000	17.58	158.13
5,000	49.47	1,786.10
10,000	47.11	2,482.20
100,000	1,054.10	280,200.00

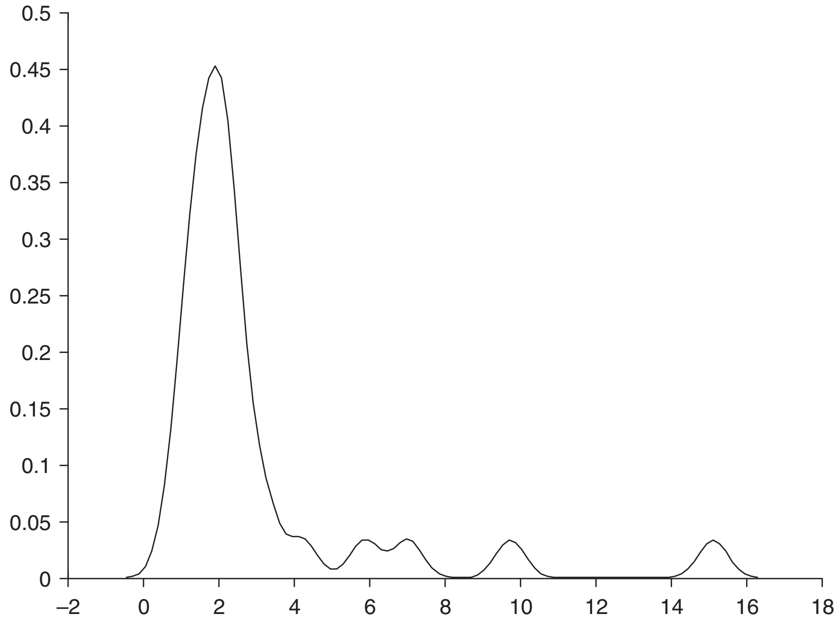

Figure 3: Example of a Probability Density Function Estimate for the Profit Distribution by Using the Fibonacci Betting Rule (n = 30)

reveals that the Fibonacci betting rule, although profitable in expectation, is risky. In particular, there is the possibility of gambler's ruin, the rapid increase in losses as draws fail to appear for an extended period.

APPENDIX
World Cup Korea-Japan 2002 Betting Application

Match No.	*Date*	*City*	*Teams*	*Final*	*Half-Time*	*Draw*	*Betting Strategy A*	*Revenue for Betting Strategy A*	*Betting Strategy B*	*Revenue for Betting Strategy B*	*Betting Strategy C*	*Revenue for Betting Strategy C*
1	May 31	Seoul	FRA : SEN	0:1	0:1		1		1		1	
2	June 1	Niigata	IRL : CMR	1:1	0:1	X	1	1	1	1	2	3
3	June 1	Ulsan	URU : DEN	1:2	0:1		1		1		1	
4	June 1	Sapporo	GER : KSA	8:0	4:0		1		1		2	
5	June 2	Saitama	ENG : SWE	1:1	1:0	X	1	0	2	2	4	6
6	June 2	Busan	PAR : RSA	2:2	1:0	X	1	2	1	2	1	2
7	June 2	Ibaraki	ARG : NGA	1:0	0:0		1		1		1	
8	June 2	Gwangju	ESP : SVN	3:1	1:0		1		1		2	
9	June 3	Niigata	CRO : MEX	0:1	0:0		1		2		4	
10	June 3	Ulsan	BRA : TUR	2:1	0:1		1		3		8	
11	June 3	Sapporo	ITA : ECU	2:0	2:0		1		5		16	
12	June 4	Gwangju	CHN : CRC	0:2	0:0		1		8		32	
13	June 4	Saitama	JPN : BEL	2:2	0:0	X	1	–4	13	6	64	65
14	June 4	Busan	KOR : POL	2:0	1:0		1		1		1	
15	June 5	Kobe	RUS : TUN	2:0	0:0		1		1		2	
16	June 5	Suwon	USA : POR	3:2	3:1		1		2		4	
17	June 5	Ibaraki	GER : IRL	1:1	1:0	X	1	–1	3	2	8	9
18	June 6	Busan	FRA : URU	0:0		X	1	2	1	2	1	2
19	June 6	Saitama	CMR : KSA	1:0	0:0		1		1		1	
20	June 6	Daegu	DEN : SEN	1:1	1:0	X	1	1	1	1	2	3
21	June 7	Kobe	SWE : NGA	2:1	1:1		1		1		1	
22	June 7	Jeonju	ESP : PAR	3:1	0:1		1		1		2	
23	June 7	Sapporo	ARG : ENG	0:1	0:1		1		2		4	
24	June 8	Daegu	RSA : SVN	1:0	1:0		1		3		8	

(Continued)

APPENDIX
(continued)

Match No.	*Date*	*City*	*Teams*	*Final*	*Half-Time*	*Draw*	*Betting Strategy A*	*Revenue for Betting Strategy A*	*Betting Strategy B*	*Revenue for Betting Strategy B*	*Betting Strategy C*	*Revenue for Betting Strategy C*
28	June 9	Incheon	CRC : TUR	1:1	0:0	X	1	–5	21	9	128	129
25	June 8	Ibaraki	ITA : CRO	1:2	0:0		1		5		16	
26	June 8	Seogwipo	BRA : CHN	4:0	3:0		1		8		32	
27	June 9	Miyagi	MEX : ECU	2:1	1:1		1		13		64	
28	June 9	Incheon	CRC : TUR	1:1	0:0	X	1	–5	21	9	128	129
29	June 9	Yokohama	JPN : RUS	1:0	0:0		1		1		1	
30	June 10	Daegu	KOR : USA	1:1	0:1	X	1	1	1	1	2	3
31	June 10	Oita	TUN : BEL	1:1	1:1	X	1	1	1	1	1	1
32	June 10	Jeonju	POR : POL	4:0	1:0		1	–1	1	–1	1	–1
Total Revenues								–3		26		222
33	June 11	Incheon	DEN : FRA	2:0	1:0							
34	June 11	Suwon	SEN : URU	3:3	3:0	X						
35	June 11	Shizuoka	CMR : GER	0:2	0:0							
36	June 11	Yokohama	KSA : IRL	0:3	0:1							
37	June 12	Miyagi	SWE : ARG	1:1	0:0	X						
38	June 12	Osaka	NGA : ENG	0:0		X						
39	June 12	Daejeon	RSA : ESP	2:3	1:2							
40	June 12	Seogwipo	SVN : PAR	1:3	1:0							
41	June 13	Suwon	CRC : BRA	2:5	1:3							
42	June 13	Seoul	TUR : CHN	3:0	2:0							
43	June 13	Oita	MEX : ITA	1:1	1:0	X						
44	June 13	Yokohama	ECU : CRO	1:0	0:0							
45	June 14	Osaka	TUN : JPN	0:2	0:0							
46	June 14	Shizuoka	BEL : RUS	3:2	1:0							
47	June 14	Incheon	POR : KOR	0:1	0:0							

48	June 14	Daejeon	POL : USA	3:1	2:0	
49	June 15	Seogwipo	GER : PAR	1:0	0:0	
50	June 15	Niigata	DEN : ENG	0:3	0:3	
51	June 16	Oita	SWE : SEN	1:2 AET	1:1, 1:1	X
52	June 16	Suwon	ESP : IRL	1:1 AET, 3:2 PSO	1:1, 1:0,	X
53	June 17	Jeonju	MEX : USA	0:2	0:1	
54	June 17	Kobe	BRA : BEL	2:0	0:0	
55	June 18	Miyagi	JPN : TUR	0:1	0:1	
56	June 18	Daejeon	KOR : ITA	2:1 AET	1:1 0:1	X
57	June 21	Shizuoka	ENG : BRA	1:2	1:1	
58	June 21	Ulsan	GER : USA	1:0	1:0	
59	June 22	Gwangju	ESP : KOR	0:0 AET, 3:5 PSO	X	
60	June 22	Osaka	SEN : TUR	0:1 AET	0:0	X
61	June 25	Seoul	GER : KOR	1:0	0:0	
62	June 26	Saitama	BRA : TUR	1:0	0:0	
63	June 29	Daegu	KOR : TUR	2:3	1:3	
64	June 30	Yokohama	GER : BRA	0:2	0:0	

NOTE: ARG = Argentina; BEL = Belguim; BRA = Brazil; CHN = China; CMR = Camaroon; CRC = Cost Rica; CRO = Croatia; DEN = Denmark; ECU = Ecuador; ENG = England; ESP = Spain; FRA = France; GER = Germany; IRL = Ireland; ITA = Italy; JPN = Japan; KOR = Korea; KSA = Saudia Arabia; MEX = Mexico; NGA = Nigeria; PAR = Paraguay; POL = Poland; POR = Portugal; RSA = South Africa; RUS = Russia; SEN = Senegal; SVN = Slovenia; SWE = Sweden; TUN = Tunisia; TUR = Turkey; URU = Urugray; USA = United States; AET = after extra-time; PSO = penalty shoot-out.

NOTES

1. Another issue, which we do not explore, is whether betting firms will allow an extended series of bets on draws.

2. The authors contacted one of the biggest betting companies in the United Kingdom but unfortunately the request for the fixed odds data of the FIFA World Cup 2002 was not granted.

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