Financial Investments and Insurance – Global Trends and the Polish Market

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Streszczenia

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THE EFFICIENCY OF THE FOOTBALL BETTING MARKET IN POLAND

Summary: Great Britain is homeland of the present sports betting. John Moores founded the first betting office in Liverpool in 1922. Gambling games are gaining a new size thanks to the internet. The article concerns the efficiency of the bookmakers' market or its ability to obtain the excess benefits from investments on this market. The author was focused on football as a discipline that arouses strongest emotions among gamblers in Poland. The main goal of this article is to indicate that football betting market is inefficient thus creating opportunities to participate in profitable games using simple strategies. The bookmakers' expectations of sport results of Polish Ekstraklasa matches from the last six years (from season 2008/2009 to 2013/2014) will be analyzed in this research. Data were collected from website http://www.betexplorer.com/. Statistical tests will be used in the present study.

Keywords: market efficiency, betting odds, football.

1. Introduction

Since the year 1922 when John Moores founded the first betting office in the world, the bookmakers' market has evolved very much. Many people interested in sport games started trying to earn money on gambling. Additionally, it seems to be a new source of investing money as well as a way of life. For many years traditional offices have changed and nowadays they are only a small share of the whole bookmakers' market. There are many possibilities of betting money on sport events. One of these options is betting on football results. This article touches this type of sport events because of many reasons. We can group them into some homogeneous sets:

- professional activity – a group of gamblers who treat this kind of activity as a way of earning money (instead of ordinary work); we can call them investors;
- entertainment – a group of gamblers who treat gambling as a way to release emotions;

- psychological biases – a group of gamblers who have emotional relations to the club or athletes.

Football is one of the most popular sport disciplines in the world. Szymanski and Kuper [2008] wrote in their book that a love for football is often intertwined with numbers. Fans like to read much about the football and sometimes try to use their own knowledge to earn money. Unfortunately, this group of "investors" is highly influenced by emotions. It means that they are making investment decisions based on the belief in the victory of their team or in their own professional knowledge about sport [Majewski 2014]. The existence of such a group of investors (gamblers) may cause the whole bookmakers' market seem to be inefficient in the sense of Fama's theory [Forrest, Simmons 2008; Vlastakis, Dotsis, Markellos 2009].

The author is trying to find existing methodology to verify hypothesis that Polish bookmakers' market is inefficient based on the example of Polish Ekstraklasa League. Hence the main goal of this article is to indicate that football betting market is inefficient thus creating opportunity to participate in profitable games using simple strategies. Two additional hypotheses have been put formulated in this research:

1. There are some possibilities to earn money using naïve strategies.
2. It is enough to bet on the home team (Legia Warsaw) to be successful.

The author used ARMA model and statistical methods to verify these hypotheses. The bookmakers' odds of football results of Polish Ekstraklasa matches from the season 2008/2009 to the season 2013/2014 will be used in this research. Data were collected from the website http://www.betexplorer.com/.

2. Efficient Market Hypothesis (EMH)

Fama defined market efficiency as a situation where all important information about financial instrument is reflected in its price [Fama 1970]. After that he had to make a distinction between various types of the efficiency. We can find three forms of market efficiency according to EMH:

- weak,
- semi-strong,
- strong.

These three forms are strictly tied with the type of available information. The weak form is the result of the reflecting historical price information [Verheyden, De Moor, Van den Bossche 2013]. The occurrence of such a situation means that there is no possibility to earn money investing by the use technical analysis. The semi-strong efficiency is connected with all the publicly available information, so if the market is efficient in this form there is no possibility to invest effectively using fundamental tools. The last form of efficiency means that both public and private information is available, so only illegal activity (inside trading) could bring investor over normative profits.

Various methods of testing different forms of EMH are well described in literature. Usually, the weak form of efficiency is verified as a first. We can observe many different tests used for verification. Generally we can divide them into two groups [Majewski 2012]:
- simple methods of the direct measurement,
- complex or indirect methods.

The most popular simple methods are:
- random walk tests (test of randomness, normality tests),
- autocorrelation tests,
- seasonality tests (e.g. Monday effect, week effect, month effect, etc.).

Many researchers in Poland tried to verify this kind of hypothesis for the Warsaw Stock Exchange (e.g. [Tarczyński 1997; Czekaj, Woś, Żarnowski 2001; Papla 2001]). We could also observe some research on the efficiency of options market and the other derivatives. Such instruments require applying other methods. There are some of them in the work by Capelle-Blancard and Chaudhury [2001].

More complicated group of methods is seasonality tests. These methods are trying to prove that the market is inefficient by identifying market anomalies (phenomena) [Cain, Law, Peel 2000]. The most often observed anomalies analysed in the literature are:
- calendar effects,
- multiplier effects (PER, PBV),
- small cap effect,
- dividend effect,
- herding behaviour effect.

If the market is efficient in the weak form we can verify the semi-strong form. Usually, the event analysis is used to describe and explain interactions between public information and price behaviour. This group of the direct measurement methods is a group of methods which refer to the forecasting theory. Basic element of such an approach is to find the fixed regularity in the period of the model's estimation and the forecasting. If there is no regularity in the prices' movement or in the relationship between prices and some fundamental factors such as PER, PBV or DY, there is no possibility for proper forecasting. There remains only possibility for speculation. Most important research for the Polish capital market can be found in the works by Tarczyński [1997] and Czekaj [Czekaj, Woś, Żarnowski 2001].

The last hypothesis and the most difficult to verify is the hypothesis of strong form of efficiency. This kind of research leads to prove that there are some existing possibilities of using confidential information to support investment process.

The specificity of bookmakers market requires using special methods of verifying EMH [Pankoff 1968; Stekler, Sendor, Verlander 2010]. The lack of prices quoted instruments is the most important reason for this situation. There are only

betting odds listed on such market. The weak form of market efficiency for betting market means that the expected return on betting at any identified odds should be identical [Williams 1999]. Thaler and Ziemba wrote that the weak form of market efficiency means that odds reflect the objective probabilities of results such that no strategy yields positive expected returns [Thaler, Ziemba 1988]. Such a definition can clearly coexist with the absence of profitable opportunities for bettors.

Some more popular tests are:

- **test for the potential existence of a differential return on different odds** is the first step in verification process. The first experiments were carried out in laboratory conditions by Preston and Baratta (1948), Yaari (1965) and Rosett (1971), but Grifith (1949) did it in real conditions for the US racetrack;
- **test for the relationship between betting odds and the expected probability of win**. If there is a negative relation between this variables, it undermines the assumptions of the weak form efficiency;
- **test for the match results forecasting model and the probability model**. Models used in this part try to indicate possibilities of using quantitative methods supporting investment decisions [Goddard 2013; Goddard, Asimakopoulos 2004];
- **normality tests for rate of return and the game uncertainty.** Such tests are also used for verification of the weak form of efficiency. The lack of normality distribution means that the bookmaker intuitionally skews the odds that the preferred team more wagers and off course wins less [Levitt 2004].

The semi-strong efficiency for betting markets implies that the expected returns on any bet or type of bet, placed about different events with identical probabilities of success, should be identical [Williams 1999]. It means that there is no possibility to identify any patterns which could help reach above-normal returns.

In the case of the strong market efficiency, there should not be any possibility for those with the access to all information (including private, monopolistic information) to secure a higher expected return than those with access only to publicly available information. It means that there are no differences between all investors on the market [Williams 1999]. Strong market efficiency is also precisely described by Thaler and Ziemba [1988]. Such a situation assumes that all bets have the expected values equal to the total amount betted less transaction costs [Demir, Danis, Rigorni 2012]. But Simmons and Forrest interpret such a situation as a lack of possibility of using any strategies that would improve on the expected return from betting randomly [Forrest, Simmons 2000].

To verify hypotheses of semi-strong and strong market efficiency, the analysts used some popular statistical tests. The most useful tests are:

- **test for two averages of rates of return** (for two different betting markets);
- **test for similarity of distributions;**

- **test for the existence of a "gambler's fallacy"** [Williams 1999]. The concept of this test assumes that bettors overestimate the chances of favourite winning after the series of wins;
- **test for significance of fundamental model.** This approach assumes that if there is possibility to build any econometric model based on the past information about sport discipline and if this model is statistically significant and it is useful to build investment strategy the market is inefficient [Bolton, Chapman 1986].

3. The bookmakers market

Bernstein in his book found a root of measuring risk [Bernstein 1997]. According to this work, gambling activity of people forced searching for the adequate risk measurement for every investment activity. As we can see, the basic points are different forms of gambling. Nowadays, one of the most popular is bookmakers market (sometimes called as betting market). There are four basic segments of the bookmakers market [Jędraszka, Zatoń 2011]:

1) ground – offering bets in betting offices,
2) internet – offering bets via internet,
3) mixed – offering bets in branches and via internet,
4) the segment of sports betting exchanges – the market of trading in probabilities, where a gambler has a possibility of betting on sporting events and to sell them.

But all these segments have one element in common – betting odds. Sometimes they are referred to as the probabilities of subjective forecasts [Ayton 1997]. Such a simplification is possible only when the axioms of probability theory are not treated rigorously. First of all, because betting odds include bookmakers margin. Secondly, because there are different standards of listing odds.

There are three basic standards of betting odds determination:

1) decimal – betting odds are decimal fractions greater than 1 – in this case the probabilities are the inverse of betting odds,
2) fractional – betting odds are common fractions,
3) "moneyline" – betting odds are integral numbers with signs "+" or "–".

The decimal system of betting odds determination is prevailing in Europe, excluding Great Britain and Ireland. Such a system is more transparent and the access to information about betting odds is free – it is enough to multiply betting odds by amount. And what is more, it is enough to inverse betting odds to have the expected probability.

There are no bookmakers who do not earn on profit margins, and the level of these profits mainly depends on [Jędraszka, Zatoń 2011]:

- the rank of a sport event,

- the form of business,
- the country of taxation,
- the margin policy.

4. Data

The set of data used for verification of EMH on the betting market in Poland contains betting odds listed on the internet website http://www.betexplorer.com/. The period of time used for analyses in this research covers football seasons from 2008/2009 to 2013/2014 (it was 1440 football matches). The research was focused on the football games played in highest Polish League – Ekstraklasa. For this analysis we used three variables:

- the expected rate of return, given by equation ([Page 2009] following [Coleman 2004]):

$$r_{ij} = \log(odd_{ij}),$$

- the expected probability, given by equation:

$$p_{ij} = \frac{1}{odd_{ij}},$$

- spread of betting odds, given by equation:

$$spread = odd_{wij} - odd_{lij},$$

- the game uncertainty is given by equation [Palomino, Rennenboog, Zhang 2009]:

$$pdiff_{ij} = p_{wij} - p_{lij},$$

where odd_{ij} is the betting odd of the match i of team j and odd_{wij} and odd_{lij} are the betting odds for the win and lose of the match by the team *j* in the match *i* and *p* with indexes *w* and *l* are probabilities of a win and loss of the match.

4.1. Historical background of the Polish football

The author decided to verify the Polish betting market on the example of football because it is the most popular sport discipline. The emotions related to football games influence investment process.

It is important to present some information about organization of football games in Poland. The first Polish national federation was the Polish Football Union (PZPN) founded in Kraków in 1919 and after four years (in 1923) PZPN joined FIFA. The first league match was played in Warsaw in 1927. After the Second World War

PZPN was reactivated, which resulted in the changed names of football clubs that "gained" new sponsors, the state-owned companies. Formally, all clubs were amateur and players were employed as workers in companies that controlled the clubs. The first league clubs and PZPN established Ekstraklasa company in 2005. The role of this company is to protect the rights of clubs and to distribute financial sources from the sales of rights of TV broadcasting and sponsor contracts. The last modification in the football game system in Poland was carried out in 2012. From the season 2012/2013 clubs played 30 matches in the main round and after that the first eight clubs play in champions group, and the last eight in decreasing group. In this way clubs played minimum official 37 matches in the season.

All of these analyses were conducted based on the listings of betting odds of Legia Warszawa and Ruch Chorzów. They were chosen for the analyses because, on the one hand, the author would like to have a team with high probability of the win (Legia was the Champion of Poland in the season 2013/2014), whilst on the other hand, he would like to have an unpredictable team (in one year Ruch is one of the best teams and in another year it is on the brink of falling from Ekstraklasa).

5. The methods and the empirical results

According to the previous considerations about the methods of testing market efficiency in the field of betting, for this analysis the author has chosen following methods:

- tests for normality of distribution for the uncertainty parameter *pdiff*,
- statistical tests for averages and fractions,
- ARMA models (autoregressive-moving- average models).[1]

At first, we checked the normality of distribution of game's uncertainty separately for Legia and Ruch. Figures 1 and 2 present the distribution of *pdiff* parameter with the normal distribution line.

Figure 1 presents the distribution of *pdiff* – parameters for matches played by Legia in seasons 2008/2009 to 2013/2014 (180 matches). It is easy to see that this distribution is not normal and the estimated value of the Chi-square normality test statistic is 18.809 (*p*-value equals 0.0001). This distribution is clearly asymmetrical.

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[1] Autoregressive (AR) models were first introduced by G. Yule in 1926 and the moving averages scheme (MA) was presented 11 years later by E. Slutsky. The combination of AR and MA was proposed by H. Wold in 1938, but the general ARMA model was described by P. Whittle in 1951. G. Box and G. Jenkins have the greatest role in popularization of this model (1971). The general ARMA(p,q) model of X_t series could be described by an equation [Makridakis, Hibon 1997]:

$$X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + ... + \varphi_p X_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - ... - \theta_q e_{t-q} .$$

So, the time series of X_t could be expressed by past values of X_t and past errors e_t.
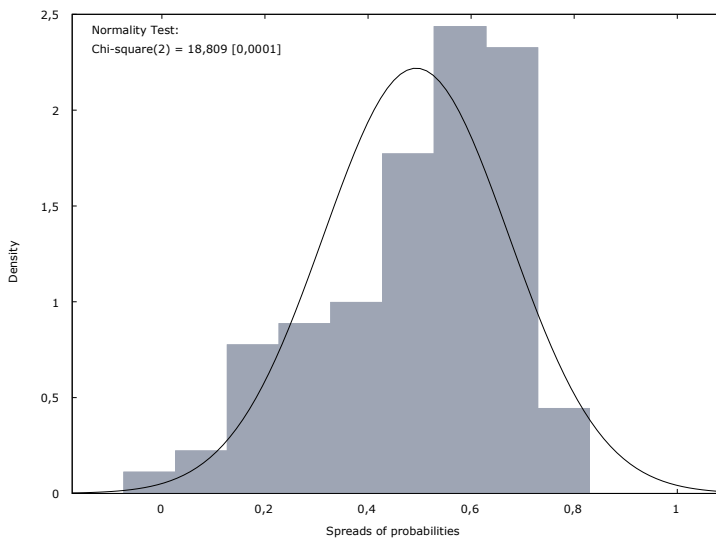
Figure 1. The distribution of the game's uncertainty parameter for Legia Warsaw (2008–2014)

Source: own study.
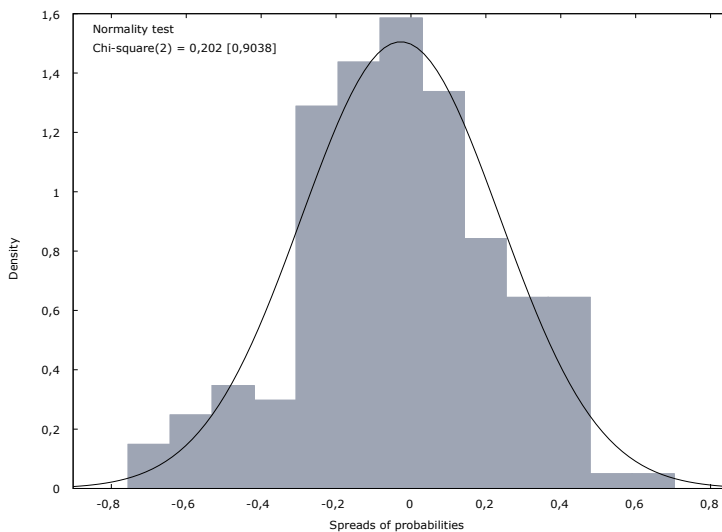
Figure 2. The distribution of the game's uncertainty parameter for Ruch Chorzów (2008–2014)

Source: own study.

It also suggests that the probability of winning of Legia is always higher than the probability of losing. The first conclusion is that it should be easy to earn money by betting on the Legia wins, thus the market is inefficient. It also means that the activity of bookmakers on this market influence significantly on the investment decisions of investors.

Figure 2 shows the distribution of differences (spreads) between probabilities of wins and losses for Ruch Chorzów games in the analyzed period of time (180 matches). We can observe that this distribution is consistent with normal distribution (Chi-square value is 0.202 with *p*-value 0.9038). The average value of spreads (–0.027) suggests that building strategy on the basis of the results of this team is risky. But such a distribution can attest to the weak form of market efficiency.

In the next step, the differences between fractions of realized expected probabilities for all clubs played in years 2008–2014 were analyzed using statistical test of the significance (the significance test of the difference between two independent fractions). The results are presented in Table 1.

Table 1. The realized expected probabilities in seasons 2008/2009 – 2013/2014 (in %)

Period	The victory of the host	Draw	The guest victory	The accuracy of an expected probability
2013/2014	45.8	30.4	23.8	46.67
2012/2013	40.4	26.3	33.3	46.25
2011/2012	44.6	27.1	28.3	48.33
2010/2011	51.7	25.0	23.3	48.75
2009/2010	45.0	27.1	27.9	52.50
2008/2009	49.2	24.6	25.8	54.58
All periods	**46.32**	**27.01**	**27.15**	**49.51**

Source: own calculations.

The accuracy of an expected probability is meant as the fraction of cases realized consistent with the most probable bookmakers' expectations.

The results show that in almost all the cases, the expected probabilities of the victory of the host were more feasible for bookmakers than the guest victory (the averages were 46.32% for hosts and 27.15% for guests). The difference between them is statistically significant – the value of the test equals 10.67 with *p*-value 0.0000. Such a result means that the place of the sport game plays an important role in the betting process. So there is no random walk in the listed betting odds. Such a situation could be the confirmation of inefficiency of this market. Generally the conclusion is that betting on the home team gives a possibility to earn money.

We can also observe these probabilities for chosen teams (Legia and Ruch). The observations of effectiveness of bookmakers' expectations were presented in Table 2.

It is possible to observe that the difference between expectations realized (the expectation of the bookmaker is consistent with the match score) for Legia and Ruch and for the matches played home and away is significant. The error tied with bookmakers' expectations for matches played by Legia in Warsaw is extremely small (1.1%). It means that betting on the Legia home (and away to a lesser extent) could give fixed income. Such a situation confirms the existence of market inefficiency.

Table 2. The structure of bookmakers' expectations and their errors for Legia Warsaw and Ruch Chorzów for the whole analyzed period (home and away) (in %)

The type of the event	The victory of the host	Draw	The guest victory	Error 1[*]	Error 2[*]
Legia Warsaw home	70.0	16.7	13.3	1.1	–
Ruch Chorzow home	46.7	25.6	27.8	23.3	–
Legia Warsaw away	32.2	23.3	44.4	–	16.7
Ruch Chorzow away	44.4	21.1	34.4	–	12.2

[*] Errors 1and 2 are the fractions of the missed probabilities of the bookmakers.

Source: own calculations.

The last part of the study aimed at the estimation of some econometric models based on autoregression process. Because of the fact that there was too small number of observations, the author decided to use ARMA models. The estimated results of such a model for Legia Warszawa (home matches) were presented in Table 3. The table presents only the best approximation obtained during the estimation[2].

Table 3. Model 1: ARMA estimation for Legia's the game's uncertainty *pdiff* variables ($N = 90$) with the Kalman's filter

Parameter	Coefficient	Standard error	z value	p value
constant	0.493325	0.0312121	15.81	2.85e–056[*]
phi 1	0.878673	0.101740	8.636	5.80e–018[*]
theta 1	−0.787487	0.123191	−6.392	1.63e–010[*]

[*] Significant at 1% level; average 0.493443; standard deviation 0.179757; likelihood logarithm 28.95999; AIC –49.91999.

Source: own calculations.

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[2] The likelihood logarithm and value of AIC equal:
for $p = 2$ and $q = 2$ – 30.62698 and –49.25396,
for $p = 3$ and $q = 3$ – 32.20015 and –48.40030,
for $p = 4$ and $q = 4$ – 32.45582 and –44.91163 (with insignificant parameters).

The results of the estimation ARMA models suggest that the process of autocorrelation exists. All the parameters were statistically significant. It means that we could use such a model to build investment strategies based on betting odds of Legia home matches. This result confirms the hypotheses of Bolton and Chapman that if the fundamental model is statistically significant and it is useful to build investment strategy the market is inefficient.

Similar analysis was conducted also for *pdiffs* of Ruch Chorzow. The results of this estimation were presented in Table 4.

Table 4. Model 2: ARMA estimation for Ruch's the game's uncertainty *pdiff* variables ($N = 90$) with the Kalman's filter

Parameter	Coefficient	Standard error	z value	p value
constant	0.140085	0.0371223	3.774	0.0002[*]
phi 1	0.701879	0.180777	3.833	0.0001[*]
theta 1	–0.477860	0.213521	–2.238	0.0252[**]

[*] Significant at 1% level; [**] significant at 5% level; average 0.135689; standard deviation 0.214108; likelihood logarithm 15.67538; AIC –23.35076.

Source: own calculations.

The ARMA model for Ruch Chorzów matches is not as good as the Legia's but it also confirms that such a relationship exists. The model ARMA(1,1) obtained for uncertainty of home matches of Ruch Chorzów is the best approximated. The parameters of model ARMA(2,2) are as follow: likelihood logarithm – 16.3061261 and AIC – –20.61261. Perhaps the investment strategy built on it will not be as effective as the previous one, but it is worth being noticed. This case is another confirmation of market inefficiency.

6. Conclusions

Many researches were conducted in the area of football betting market efficiency in the literature. This research conducted on the Polish market is one of the very few. The first assumption of this research was that the Polish market is inefficient and it was verified positively. It means that there are possibilities to build simple strategies to make successful investment.

The case of Legia Warszawa shows that the distribution of the game's uncertainty is not normal. The asymmetry of distribution suggests that the accumulation of irrational effects exists and the common knowledge of investors and bookmakers plays a main role in the decision process. There is also a significant difference between odds on Legia matches (home and away) and other clubs such as Ruch Chorzów. The case of Ruch Chorzów shows that the distribution of *pdiffs*

could sometimes be normal, but the existence of autoregression process confirms market inefficiency.

Last examples illustrating market inefficiency are e.g., "the barber's case" (the corruption in Polish football), and the case of referee Hubert Siejewicz (he gambled in betting office when he was a football referee).

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EFEKTYWNOŚĆ INFORMACYJNA PIŁKARSKIEGO RYNKU BUKMACHERSKIEGO W POLSCE

Streszczenie: Ojczyzną współczesnych zakładów bukmacherskich jest Wielka Brytania. W 1922 r. w Liverpoolu powstało pierwsze biuro bukmacherskie założone przez Johna Mooresa. W dobie internetu sportowe zakłady hazardowe zyskały nowy wymiar. Niniejszy artykuł dotyczy efektywności informacyjnej tego rynku, czyli możliwości uzyskiwania ponadnormatywnych korzyści z inwestycji na nim. Uwaga autora skoncentrowała się na dyscyplinie sportu, która wzbudza największe emocje wśród graczy w Polsce – na piłce nożnej. Celem pracy było wykazanie, że rynek bukmacherskich zakładów piłkarskich jest nieefektywny, co daje możliwości uzyskiwania korzyści przy wykorzystaniu prostych strategii inwestycyjnych. W pracy przeanalizowano prawdopodobieństwa bukmacherskie dotyczące meczy ligowych w polskiej Ekstraklasie w ciągu sześciu lat, tj. od sezonu 2008/2009 do sezonu 2013/2014, pobrane z portalu internetowego http://www.betexplorer. com/. W artykule wykorzystano narzędzia statystyki matematycznej do wnioskowania nad występowaniem efektywności badanego rynku.

Słowa kluczowe: efektywność rynku, kursy bukmacherskie, piłka nożna.