MULTIPLE OWNERSHIP, COLLUSION AND UNUSUAL RESULT PATTERNS

- EVIDENCE FROM THE CROATIAN SOCCER LEAGUE

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Abstract

This paper finds a very unusual result pattern between two closely connected clubs competing in the Croatian soccer league - Lokomotiva and Dinamo. Our findings offer some support to the allegations of questionable fairness and regularity of the competition, though cannot be viewed as definitive proof of it. We analyze all matchups in competition's 25-year history and compare the expected and realized number of points won by teams in each matchup. Results indicate that Lokomotiva's underperformance against Dinamo is so far in the tail of normal distribution that it has a lower occurrence probability than being hit by a lightning. (*JEL classification:* Z29, K21, L83)

*Keywords***:** antitrust, Croatian soccer league, Elo ranking, ClubElo formula, underperformance, unfair competition

1   INTRODUCTION

This paper deals with the possible connection between close business relationships and skewed sporting performances in soccer. We analyze a peculiar case of two clubs competing

in the Croatian top soccer division (1.HNL) - Lokomotiva Zagreb and Dinamo Zagreb. Their close sporting and business relationship has raised many eyebrows among the public and raised questions about the fairness and even the legality of the competition. In this study, we analyze whether the sporting performances of teams in question in their mutual matches offer any foundation for these allegations. The objective of the analysis is twofold. First, we aim to determine whether the result patterns of the Lokomotiva - Dinamo matchup are skewed in any way, i.e. are they characterized by the consistent long run underperformance by one club against the other. If so, the second part tests how significant this deviation is compared to all other underperformances involving all other matchups in the league history. Results of this analysis could prove very interesting with respect to currently one of the biggest controversies in Croatian soccer.

Ever since Lokomotiva Zagreb entered 1.HNL in 2009, a cloud of controversy has surrounded the organization. Their participation in the same level of competition as Dinamo Zagreb, the most successful club in Croatia and the club they have been closely connected to, prompted reactions from many stakeholders in Croatian soccer. For instance, Hajduk Split – the second most successful Croatian club and historically the biggest rival of Dinamo Zagreb – issued a formal request towards the Croatian soccer federation (CFF) to abstain from issuing Lokomotiva the license for participating in 1.HNL (Hajduk Split, 2015).

In their request, Hajduk claimed that Dinamo and Lokomotiva are too closely connected in their sporting and business ventures, and that Lokomotiva are directly dependent on Dinamo. They stated that as much as 50-70 percent of players that had played for Lokomotiva over the previous five years had once been registered as Dinamo's players and that the number of players that had previously been, or at the time were, on loan from Dinamo to Lokomotiva is unprecedentedly high (Hajduk Split, 2015). Other research has shown that no other club

relationship in the league comes even close to the number of player transfers and loans as the one between Dinamo and Lokomotiva (Tribina.hr, 2015).

Civil association "Naš Hajduk" even issued a booklet with media excerpts, print-screens and document scans that, according to them, prove that Lokomotiva and Dinamo are two closely connected entities that form "a cartel", with Lokomotiva sometimes even being presented as Dinamo's "B team" (Naš Hajduk, 2014). Among other things, the publication contains claims that some Lokomotiva's employees were simultaneously the members of Dinamo's assembly which has a power to appoint the club's executive board; claims that Lokomotiva used Dinamo's domain for their e-mail account; the alleged evidence that Lokomotiva is extremely financially dependent on selling players to Dinamo, as these transfers constitute a substantial proportion of their annual budget; etc.

All this, according to Hajduk Split (2015), makes competition in 1.HNL unfair, casts a shadow over the regularity of the competition and questions the fairness and legality of allowing these two clubs to simultaneously participate in the same level of competition. They argue that both clubs gain an unfair advantage over the remaining eight competitors in the league because of this relationship. They claim that Lokomotiva have preferential access in player loans and transfer deals with Dinamo, which makes them privileged vis-à-vis their competitors, as they do not need to perform business and transfer players under market conditions like the rest of the league. Preferential access to players from Dinamo, who are above domestic average in quality, also could help Lokomotiva achieve better results.

On the other hand, Hajduk Split (2015) claim that Dinamo gain an unfair advantage in that they get to develop their players, not yet ready to play at the highest level, by sending them on loan to Lokomotiva where they can gain experience playing in the top tier domestic competition and, depending on Lokomotiva's results, even in the European competition (UEFA Europa League). The advantage for Dinamo could also be viewed result-wise. Dinamo and

Lokomotiva play four matches per season against each other. If the allegations are true, and Dinamo have an easier path towards victory than other teams against Lokomotiva, these points could prove decisive in winning the championship title.[1] Winning the domestic league further provides access to the qualification for UEFA Champions League, which in turn entails enormous financial benefits for participating clubs, perpetuating Dinamo's dominance over the domestic competitors.[2]

In 2014 the media reported that the newly formed Sports Inspection of the Ministry of Science, Education and Sports of the Republic of Croatia issued a report in which they ordered CFF to retroactively revoke Lokomotiva the license for the season 2009/10 due to reasons "mainly related to the close sporting and business relationship between soccer clubs Dinamo and Lokomotiva" (Novi list, 2014). CFF immediately dismissed all allegations, disputed the report and maintained that the relationship between Lokomotiva and Dinamo is in accordance with the law and competition regulations which have been approved by the main administrative body for European soccer - UEFA (Hrvatski nogometni savez, 2014). Both the Croatian High Administrative Court and Croatian Competition Agency dealt with the case and concluded that the matter in question is not within their field of jurisdiction as they do not consider the Lokomotiva - Dinamo relationship as a business, but rather a sporting one, to which the usual market competition rules do not apply (AZTN, 2013; Visoki upravni sud, 2015).

The question of unfair competition and antitrust in the sport business has long been a subject of scientific research. However, researchers have mainly dealt with examples of unfair competition in sports broadcasting, advertising and using altered versions of copyrighted works

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[1] Four wins in a league yield 12 points. 1.HNL is a 36-round competition where the champion typically ends the season with around 85 points. Just by winning the four matches against Lokomotiva, Dinamo could collect around 15 percent of points needed to win the championship.

[2] Since Lokomotiva entered 1.HNL in 2009, Dinamo have won all seven championship titles (with four of them won before Lokomotiva's entry, this makes it 11 consecutive titles) and participated four times in the group stage of the UEFA Champions League. The participation in the UEFA's flagship competition has brought Dinamo the revenue in the amount higher than €50 million (UEFA, 2012; 2013; 2016a; 2016b), which is an unprecedented amount of money for Croatian soccer club standards.

for marketing purposes (see e.g. Deutsch, 2000) and examined the consequences of ambush marketing on the fairness of competition in sports (Townley et al., 1998). The focus of the antitrust literature has mainly been on whether the member clubs of professional sports leagues should be viewed as a single entity and/or be subjected to antitrust laws to deal with franchise relocation restrictions (Lazaroff, 1984), consumer protection (Ross, 1990), protection of the mobility of players and their other rights (Roberts, 1986; Goldman, 1989; Jacobs, 1991).

As evident from previous references, the topic has extensively been covered in the United States, while the case studies concerning European sport markets are much less common. To name a few, Camatsos (2005) examined the effects of European competition law on soccer, particularly the transfer system and its impact on the preservation of healthy competition, while Budzinski (2012) carries out a broader overview of the principles of the EU competition policy in sports.

However, our study touches on the avenue of competition fairness and antitrust literature that is yet to be developed. To our knowledge, this is the first study of this kind, in which we analyze the potentially unusual performance patterns of clubs claimed to be closely connected in their business ventures that participate in the same level of competition. To that note, we have not found any similar matchup-by-matchup analysis of long run under- and overperformances within a league in any sport in the existing scientific literature.[3] This paper breaks new ground in that regard and could prove a very interesting case study of competition fairness and antitrust issues in soccer industry. In fact, we believe it is a unique one, the likes of which, to our knowledge, does not exist anywhere else in the world of sports.[4]

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[3] Perhaps worth mentioning is the study by Noland and Stahler (2016) who analyzed the (under)performance of Asian countries at the Olympic Games. However, that paper has very little common ground to our analysis here.

[4] Although the practice of clubs having "B teams" that compete in national competitions is quite common in European soccer, these clubs are always participating in lower tier leagues, and their participation in the same competition level as "A teams" is strictly prohibited.

To meet the research objectives, we obtained data for over 5000 matches and over 850 matchups that had taken place in 1.HNL throughout all 25 seasons, from 1992 to 2015/16. We singled out 206 matchups suitable for the analysis and applied a three-step methodological approach. First, we calculate the sum of points each team was expected to win in each given matchup applying the Elo ranking principles and the ClubElo formula by Schiefler (2016). The formula provides historical *ex-ante* probabilities for each result (a home-team win, a draw, an away-team win) in each matchup, accounting for the relative strengths of teams, home advantage, and other factors. Then we relate expected points with points that have actually been realized by teams and calculate the historical realized-to-expected point ratios (REPR) to determine under- and overperformers and find outlier matchups. Finally, we test for the statistical significance of obtained values.

The results of our analysis indicate that one matchup extremely deviates from the expected distribution of points between the teams, and that is precisely the Lokomotiva - Dinamo matchup. Lokomotiva have managed to collect only one point in 21 home and away matches against Dinamo in 1.HNL, which falls short of the expected performance by as much as 92%. No other matchup in the league comes even close to this level of underperformance. Its corresponding REPR value even lies outside the 99% confidence interval, far in the tail of normal distribution of REPR values, and has the probability of occurrence that is lower than the probability of a random person being hit by a lightning.

The rest of the paper is structured as follows. The next section explains the three-step methodological approach applied in the analysis and states the data sources. Results of the analysis, i.e. REPR values across matchups and significance tests are reported in Section 3. Section 5 reports robustness checks, while the last section carries out concluding remarks.

2   METHODOLOGY AND DATA

The methodological approach can be divided into three steps. First, the objective is to calculate the number of points each team was *ex-ante* expected to win in each given matchup. In the second step, we calculate the historical realized-to-expected point ratios to determine under- and overperformers and find outlier matchups. Finally, we test for the statistical significance of obtained values.

2.1 Calculating the expected number of points

To calculate the number of points each team was expected to win in each matchup, we utilize the data from Schiefler (2016), i.e. the ClubElo website[5], which reports the historical *ex-ante* probabilities for each result (a home-team win, a draw, an away-team win) in each given matchup for all European soccer leagues and continental competitions. The data for some leagues goes back to as far as 1939.

The ClubElo formula is based on the widely used Elo ranking system to measure the relative strengths of clubs in given points in time. Teams are ranked based on their Elo points, which generally increase with wins and decrease with defeats. However, the formula takes into consideration the time component (with every new match played, the weights of previous matches decrease) and the strength of the opposition (win against a team with a high number of Elo points is valued more than a win against a team with a low number of Elo points). The ranking system, originally used for the ranking of chess players, is modified to fit the club soccer purposes in that it also considers the goal difference in a match, i.e. a win by a higher margin brings more points than a win by a narrower margin. Table 1 reports the Elo rankings and points of teams playing in 1.HNL at the end of the 2015/16 season.

TABLE 1:

Elo rankings of 1.HNL teams at the end of the 2015/16 season

Country rank	European rank	Club	Elo points
1	100	Dinamo Zagreb	1611
2	175	Rijeka	1530
3	345	Hajduk Split	1401
4	427	Lokomotiva Zagreb	1334
5	441	Slaven Belupo	1319
6	445	RNK Split	1316
7	459	Inter-Zaprešić	1307
8	491	Osijek	1261
9	536	NK Zagreb	1190
10	544	Istra 1961	1180

Source: Schiefler (2016)

The probability distributions for a club's win, draw or defeat against the opposing team directly depend on the difference in Elo points between the two teams on the day the match is played. This means that the higher the Elo point difference (i.e. the difference in strength) between the teams, the higher the win probability of a better-ranked team is, and vice versa. Moreover, the home advantage is taken into account, as an algorithm[6] is used to adjust the Elo point difference slightly in favor of the home team. This increases the probability for a home-team win, as history has shown that teams are more successful when playing at home, rather than away.

Each Elo point difference (adjusted for the home advantage) has its own corresponding probability of a home-team win, a draw, and an away-team win. The match probabilities are calculated based on a result histogram for the corresponding Elo point difference. For instance, if team X has a 400-point home-adjusted advantage over team Y, the probability of a win by team X is determined by the historical percentage of wins by all other teams who had had the same Elo point advantage over their opponents. Probabilities for a draw or a win by team Y are obtained using the same principle.

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[6] For details see http://clubelo.com/system [accessed 16 July 2017].

Due to space limitations, it is not possible to report all details on this rather complex methodology of soccer club rankings and result probabilities, but one can easily find them on the ClubElo website (Schiefler, 2016).

An alternative approach would be to derive the match outcome probabilities from betting odds. We opted against that for several reasons. Firstly, historical betting odds data for the Croatian league is not available for the full time span of the analysis and reaches back only to 2010, which would significantly reduce the number of observations. Secondly, given that the bookmakers are aware of the Lokomotiva - Dinamo controversy, they incorporate their expectations of a probable Dinamo win into their odds. This means that the betting odds would likely undervalue Lokomotiva's win and draw probabilities in matches against Dinamo, compared to the probabilities based solely on the respective strength of teams (captured by Elo rankings). Given that the purpose of our analysis is to capture the discrepancy between realized points and points expected to be won by teams based on their strength, REPR values for Lokomotiva - Dinamo matchup would likely be biased. We revisit this issue in the robustness checks section.

2.2 <u>Calculating the realized-to-expected point ratios</u>

To determine the under- and overperforming matchups and single out extreme outliers we calculate the historical realized-to-expected point ratios (REPR) for all matchups ever played over 25 seasons of 1.HNL. Realized-to-expected point ratio of team i against team j is defined as:

$$REPR_{i,j} = realized_{i,j}/expected_{i,j} \tag{1}$$

where $realized_{i,j}$ denotes the realized total number of points won by team i against team j, both home and away, in all their matches throughout 25 seasons. Specifically, it is defined as:

$$realized_{i,j} = WIN_{i,j} * 3 + DRAW_{i,j} \tag{2}$$

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where $WIN_{i,j}$ is the number of wins of team i over team j, while $DRAW_{i,j}$ is the number of draws between teams i and j. In soccer, a win is worth three points, a draw brings one point to both teams, while a defeat is worth zero points.

On the other hand, $expected_{i,j}$ denotes the total number of points team i was expected to win against team j, both home and away, in all their matches throughout 25 seasons. Specifically, the following formula was used:

$$expected_{i,j} = \sum_{n=1}^{p} [prob(WIN_n) * 3 + prob(DRAW_n)]/100 \qquad (3)$$

where $prob(WIN_n)$ is an *ex-ante* percent probability of team i winning over team j on the day the match n is played; $prob(DRAW_n)$ is an *ex-ante* percent probability of a draw between teams i and j on the day the match n is played, while p is the total number of matches played between teams i and j over 25 seasons of 1.HNL.

All matches ever played in 1.HNL, from its inception in spring 1992[7] to the end of season 2015/16, have been considered for the analysis. The data source for these over 5000 match results was the official website[8] of 1.HNL (MAXtv Prva liga, 2016). The total of 36 clubs have taken part in 1.HNL over this period of time. Theoretically, this provides the potential total of 1260 matchups.[9] However, not all potential matchups have actually taken place, because the structure of the league changes with each season, as bottom teams are relegated to the lower tier competition (2.HNL), and the best ones from 2.HNL are promoted to 1.HNL. Thus, only 866 matchups have actually taken place over the analyzed time period.

Furthermore, not all matchups that have taken place are considered for the calculations of REPR. This is because a low number of matches between two clubs could create biased REPR values. Let us consider two cases. In the first one, teams X and Y have played only two matches

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[7] Due to the war activities in Croatia in autumn 1991, the whole 1991/92 season was played in the spring of 1992. The usual schedule involves one half-season played in autumn, and the other in spring of the following year.

[8] Visit http://prvahnl.hr/povijest/rezultati-i-poretci/ [Accessed 7 November 2016].

[9] The formula is $k(k-1)$, where k is the number of participating clubs.

throughout the analyzed period of time, and both were won by team Y. Here, the value of $REPR_{X,Y}$ equals zero. In the second case, teams X and Y have played as many as 20 matches throughout the analyzed period of time, with all of them also ending with a win by team Y. Here, the value of $REPR_{X,Y}$ equals zero, just like in the first case. However, the two values are not directly comparable, because the second case represents a much bigger underachievement by team X than the first one. The probability of winning zero points in 20 matches against the same opponent is extremely low, whereas the same point tally in only two matches is much more probable. For this reason, the cut-off minimum number of matches between the clubs was set to 15. This decreased the number of matchups entering the analysis to 206.

It should be noted that the matchups "team X vs. team Y" and "team Y vs. team X" are considered as separate matchups, although they cover the same set of home and away matches between the clubs. This is because the $REPR_{i,j}$ values (realized and expected points) differ depending on which club is considered as team i and which one as team j.

2.3   Testing the significance of REPR values

A z-score is assigned to every matchup based on its REPR value, which is then used to calculate the p-value per matchup, i.e. to test the probability that the observed REPR is significantly different from the sample average (μ). This way it is possible to find if there are any opponents that each team significantly under- or overperforms against.

In essence, we test whether the null hypothesis of $REPR_{i,j} = \mu$ can be rejected at the usual levels of significance. In case of statistically significant values of $REPR_{i,j} < \mu$, team i can be considered as an underperformer against team j, as it won less points than expected based on the relative strengths of teams. On the other hand, in case of statistically significant values of $REPR_{i,j} > \mu$, team i can be considered as an overperformer against team j, as it won more points than expected.

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3   RESULTS

First, we deal with the question who are, if any, the opponents each team under- and overperforms against, respectively. To that end, we report the calculated realized-to-expected point ratios per each matchup (Table 2 in the Appendix), together with their respective significance test results. REPR values were calculated based on realized and expected number of points for each matchup, which are available upon request.

Statistically significant values below (above) the sample average (0.99) denote that team i significantly underperforms (overperforms) against team j. Cells without statistically significant values represent matchups in which team i performed according to expectations against team j, as the matchup's REPR value does not significantly deviate from the sample mean at usual significance levels (1% and 5%).

Figure 1 sums the performance distribution of matchups per each club. It is visible that the relative number of underperforming matchups is lowest for Dinamo Zagreb. Only 7% of all their matchups are classified as an underperformance, and that is the one against Hajduk Split, their historically biggest archrivals. The next in line is Lokomotiva Zagreb with only 11% of matchups considered as an underperformance (the one against Dinamo Zagreb). On the other side of the spectrum, the rate of underperformances is the highest for Kamen Ingrad and Istra 1961, with 63% and 62%, respectively. The highest relative number of overperformance matchups can be found at Lokomotiva (67%), followed by Rijeka (63%). Cibalia and Hrvatski dragovoljac have the lowest relative number of overperformances in the league (29% and 30%, respectively).

FIGURE 1:

Distribution of total matchups per club by performances


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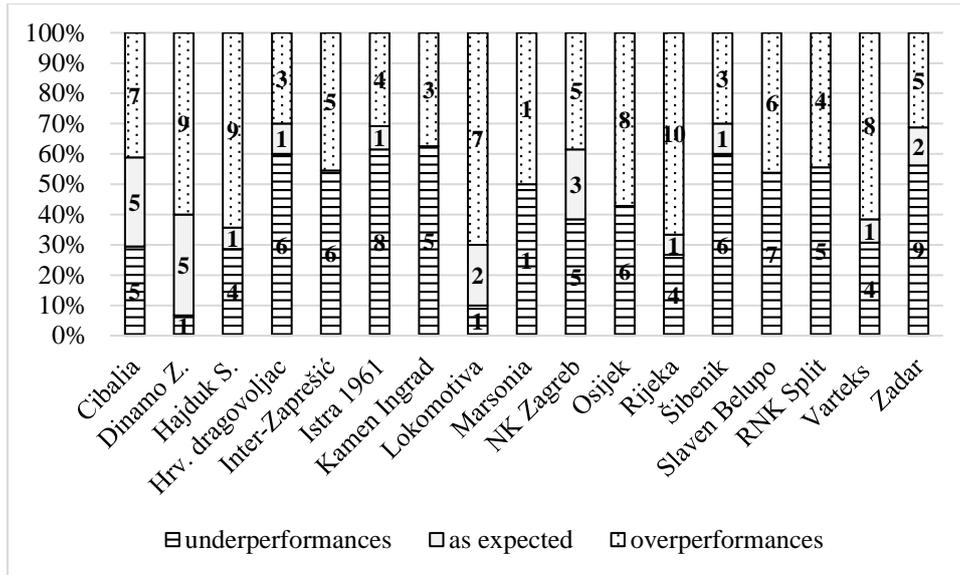
Source: authors' calculations

Next, we aim to differentiate between the levels of under- and overperformance and identify the biggest outliers among these matchups. To that end, we have calculated the respective lower and upper boundaries for non-extreme REPR values in the sample. Specifically, we utilize the fact that 95% of observed values in a standard normal distribution lie within the $\langle \mu - 1.96\sigma, \mu + 1.96\sigma \rangle$ range, where μ is a sample mean and σ a sample standard deviation.

Given that in our sample $\mu = 0.990$ and $\sigma = 0.173$, the lower 95% confidence band is set at the REPR value of 0.650, and the upper band at 1.329. All matchups with REPR values below 0.650 or above 1.329 are outliers, i.e. could be viewed as matchups where team i extremely underperforms (or in the latter case extremely overperforms) against team j.

Judging by the histogram (Figure 2), calculated REPR values seem normally distributed. However, the Jarque-Bera test rejects the null hypothesis of normality in the distribution of data, even at the 1% significance level. The reason can be found in one matchup to the far left of the histogram, i.e. the matchup Lokomotiva - Dinamo, with the REPR value of 0.079. When this matchup is removed from the sample, the Jarque-Bera test statistic plummets from 105.123 to 0.853 and the null hypothesis of normality cannot be rejected any more.

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FIGURE 2:

Histogram of calculated REPR values
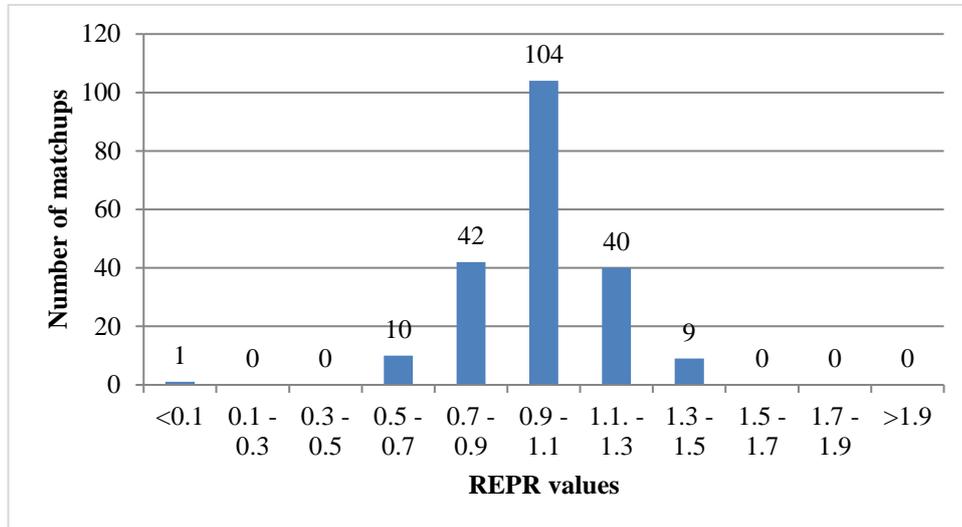
Source: authors' calculations

Figure 3 orders all matchups by ascending REPR values along with 95% and 99% confidence bands[10]. Out of the total 206 matchups, 193 of them lie within the 95% confidence interval. This leaves 13 matchups that can be considered as outliers, with nine of them categorized as extreme underperformances and four as extreme overperformances.

Only one matchup is well beyond the 99% confidence interval, and that is, again, Lokomotiva - Dinamo. In 21 matches against Dinamo in 1.HNL, home and away, Lokomotiva managed to collect only one point (0 wins, 1 draw, 20 defeats), while the expected point tally was 12.79, which is the performance of 92% below expectation considering the relative strength of clubs. No other matchup comes even close to this level of underperformance, as evident from Figure 3.

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[10] The lower 99% confidence band is set at the REPR value of 0.543, and the upper band at 1.436.

All 206 matchups ordered by ascending REPR values
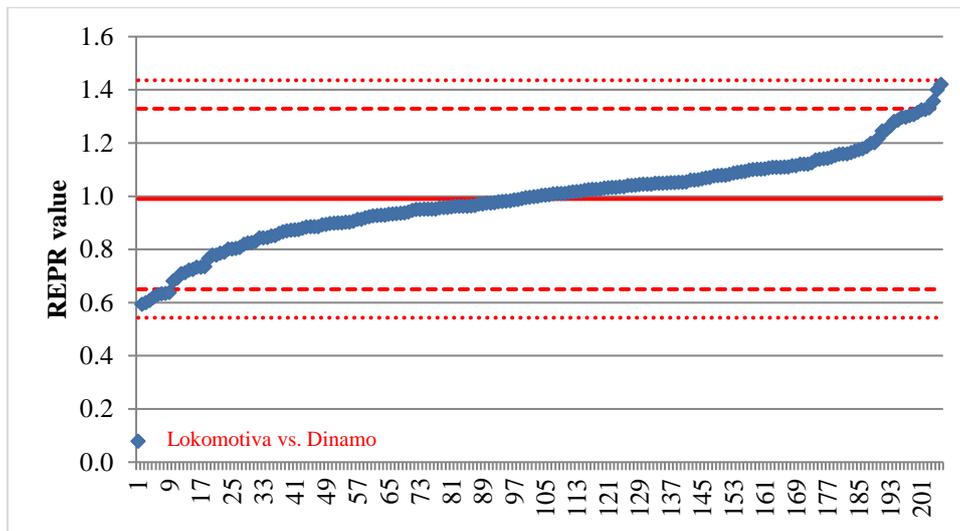
Note: Full line represents the sample average, dashed lines represent 95% confidence bands, dotted lines represent 99% confidence bands.
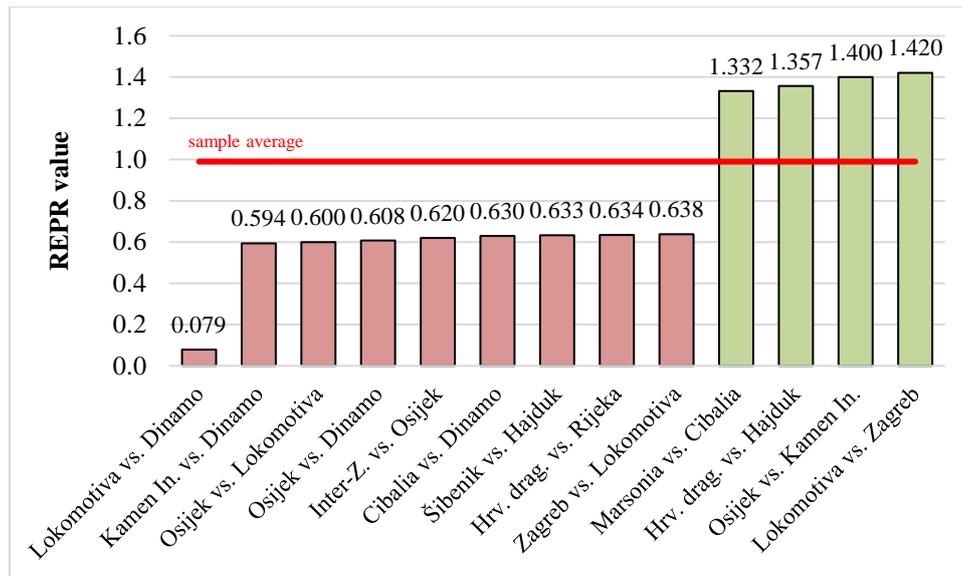
Source: authors' calculations

Figure 4 reveals the details on other outlier matchups. It is interesting to note that seven out of nine extreme underperformance matchups involve at least one of Dinamo, Lokomotiva or Osijek.

Finally, Figure 5 shows where most matchups lie within the standard normal distribution; where all outliers, except for one, are located, and confirms how far in the tail of the distribution (i.e. how improbable) the Lokomotiva - Dinamo matchup actually is.

FIGURE 4:

Extreme under- and overperformance matchups
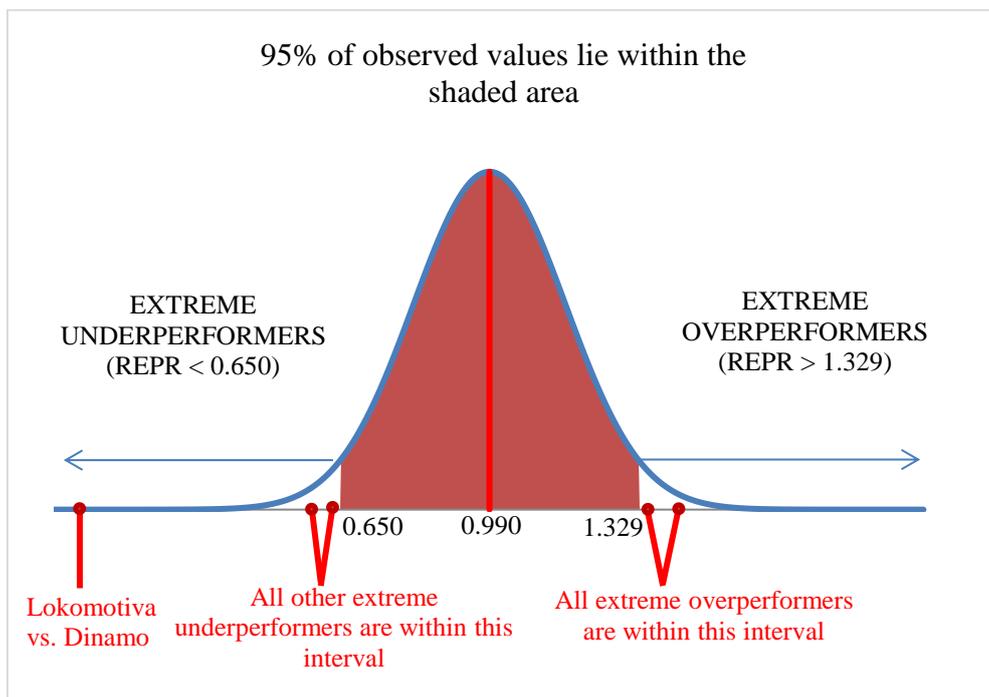
Source: authors' calculations

The particular REPR value of 0.079 has a z-score of -5.26. In a standard normal distribution and a sample where $\mu = 0.990$ and $\sigma = 0.173$, the probability $\Pr(z \leq -5.26)$ is equal to 0.00003. This means that the probability for an underperformance of the scale recorded by the matchup in question is only 0.003%, or 1 in 33,333. For comparison, according to the data from the US National Weather Service (2016) the chance of being struck by a lightning once during a lifetime is approximately 2.5 times bigger than one club having this big of an underperformance against the other.

These findings are even more unusual given the fact that Lokomotiva have not underperformed against any other club in the league against whom they played at least 15 matches (see Table 2 in the Appendix). Quite contrary, they have recorded a statistically significant overperformance in 67% of their total matchups (Figure 1), a feat matched by no other club in the league history. Furthermore, Lokomotiva have continuously proven to be a member of the upper quality class of Croatian soccer. In their seven seasons in the top division of Croatian soccer, they were once vice-champions (2012/13), placed four times in the top 5, and for six out of seven seasons finished in the upper half of the table. They qualified for

European competitions several times and Elo ranking placed them as the fourth strongest Croatian club at the end of the 2015/16 season (Table 1). All this makes the aforementioned findings even more surprising.

FIGURE 5:

Normal distribution of REPR values

Source: authors' calculations

It is worth comparing this result to one other (somewhat) similar case of close business relationships in European soccer leagues. Feyenoord and Excelsior, two Rotterdam clubs from the Dutch top division (Eredivisie), formed a cooperation in 1997 in that several Feyenoord players, who were not first team regulars, were sent on loan to Excelsior. In 2010 the youth academies of the two clubs merged into one, with clubs agreeing on sharing the pool of young players, performing joint regional youth training and lending of players and staff members.

To determine was there any evidence of extreme over- or underperformances of one club against the other, we calculated the REPR values for the matchup concerning Feyenoord and Excelsior based on their results in the Eredivisie. It turns out that there is no indication whatsoever that Feyenoord got any "free points" from Excelsior. Although the number of matches is relatively small ($p = 14$), the realized-to-expected point ratio equals 0.746 for the Excelsior - Feyenoord matchup and 1.151 for Feyenoord - Excelsior. Both values are well within usual confidence intervals, not indicating any extreme over- or underperformances. Although publicly deemed as success by both clubs, the cooperation failed to deliver as many growing talents as Excelsior and Feyenoord hoped for, so it was officially terminated in 2015.[11]

4   ROBUSTNESS CHECKS

To test the robustness of obtained results, we made several changes to our methodology. First, we calculated REPR values for the case where teams are awarded two instead of three points for a win. One could argue that the three-point rule[12] may artificially inflate or deflate REPR values, because winning and losing is worth more than drawing twice, while in fact both scenarios mean that teams are on average equally good. To test whether this had any impact on our results, we changed equations (2) and (3) in that $WIN_{i,j}$ and $prob(W_n)$ were respectively multiplied by 2 instead of 3. Although the REPR value for the Lokomotiva - Dinamo matchup increased from 0.079 to 0.101, it remained by far the biggest outlier among all 206 matchups, and the only one significant at the 1% level. Furthermore, all of the findings presented previously remained intact as a result of this change.

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[11] For details see https://www.feyenoord.nl/nieuws/nieuwsoverzicht/feyenoord-en-excelsior-be%C3%ABindigen-samenwerkingsverband [Accessed 16 July 2017].

[12] This rule was officially introduced by FIFA in 1994 for the World Cup, after which all other competitions followed the practice. The rationale for the change was the aim to encourage more attacking play, because teams would be less willing to settle for a draw if they had the possibility to gain two extra points by scoring a winning goal, which outweighs the prospect of losing one point by conceding a losing goal.

The second change deals with the fact that Lokomotiva shared the same stadium with Dinamo in the first five seasons of their participation in 1.HNL, after which they moved to another venue. One could argue that Lokomotiva's win and draw probabilities should not be adjusted upwards for the home field advantage in home matches against Dinamo, given that the latter club has also been playing their home games at that ground. We adjusted the outcome probabilities for the games between Lokomotiva and Dinamo during the period when the teams shared the same stadium (from 2009/10 to 2013/14). We considered two cases: a) no team gets the home field advantage, i.e. matches are considered as neutral venue games; b) Dinamo get the home field advantage as they have been playing at the stadium in question for a longer period of time.

In case a) Lokomotiva's win and draw probabilities in each of the seven matches in question decrease by roughly 5 percentage points respectively, thus increasing Dinamo's win probability by approximately 10 percentage points per match.[13] This results in a new REPR value for the Lokomotiva - Dinamo matchup, increasing from 0.079 to 0.088. In case b) Lokomotiva's win and draw probabilities decrease by roughly 10 percentage points respectively, thus increasing Dinamo's win probability by approximately 20 percentage points. This adjustment increases the REPR value from 0.079 to 0.101. In both cases, the REPR value for the Lokomotiva - Dinamo matchup remains by far the biggest outlier in the league, with no other matchup coming even close.

Finally, we calculate the expected number of points for each matchup based on outcome probabilities derived from betting odds. We utilize the odds from *Pinnacle* and *bet365* and calculate the average of the two respective sets of probabilities for each match. The data for the Croatian league covers only the period between seasons 2010/11 and 2015/16, which

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[13] It could be argued that the matches in which Dinamo hosted Lokomotiva at the same stadium should also be viewed as neutral ground games, which would result in lower win probabilities for Dinamo and higher draw and win probabilities for Lokomotiva. This would essentially result in no change in the matchup's REPR value. For the sake of scrutiny, we ignored that fact and assigned the home field advantage only to Dinamo in matches in question.

considerably reduced the number of observations entering the analysis. Based on the betting odds data, we found that the bookmakers undervalue the Lokomotiva's expected number of points against Dinamo by as much as 16.5% compared to the expected points based on Elo rankings. This is the highest spread in the whole league, together with one other matchup (Istra 1961 - Hajduk Split), confirming that the bookmakers' expectations of easier-than-normal Dinamo wins make Lokomotiva's underperformance less emphasized. However, the REPR value of the Lokomotiva - Dinamo matchup in this case increased only slightly, from 0.079 to 0.100, not enough to change any of the aforementioned findings. Detailed results of all robustness checks are not reported due to space limitations, but are available upon request.

5   CONCLUSION

This paper dealt with the possible connection between close business relationships and skewed sporting performances between Lokomotiva Zagreb and Dinamo Zagreb, two clubs competing in the Croatian top soccer division. Their close sporting and business relationship has raised many questions about the fairness and legality of the competition. The reason are the claims that Lokomotiva have an unusually high number of players transferred or on loan from Dinamo, are extremely financially dependent on Dinamo and have employees who were simultaneously the members of Dinamo's assembly. The relationship between the clubs has been dubbed as "a cartel" by some, with suspicion that both teams gain an unfair advantage in business and result performances over their competitors because of this cooperation.

The paper analyzed whether the historical result patterns of Lokomotiva against Dinamo provide any supporting evidence to these claims. We test whether the performance of the two clubs in their mutual matches are skewed in any way, deviate from other matchups in the Croatian soccer league and, if so, by how much. To our knowledge this is the first research of this kind. To do so, we obtained data for over 5000 matches and all matchups that have ever

taken place in 1.HNL throughout 25 seasons since the competition's inception. We singled out 206 matchups suitable for the analysis and applied a three-step methodological approach.

In the first step, we calculated the number of points each team was *ex-ante* expected to win in each given matchup. To construct the expected number of points for each team in each matchup, we used the ClubElo formula that utilizes the widely used Elo ranking system to measure the relative strength of teams. In the second step, we analyzed and compared the realized number of points won by teams in each matchup with the number of points each team was expected to win against the same opponent. To do so, we calculated the historical realized-to-expected point ratios to determine under- and overperformers and find outlier matchups. Finally, we tested for the statistical significance of obtained REPR values.

The results of our analysis indicate that one matchup significantly deviates from the expected distribution of points between the teams, and that is the Lokomotiva - Dinamo matchup. Lokomotiva have managed to collect only one point in 21 home and away matches against Dinamo in 1.HNL, which falls short of the expected performance by 92%. No other matchup in the league comes even close to this level of underperformance. Its corresponding REPR value even lies outside the 99% confidence interval, far in the tail of normal distribution of REPR values. The occurrence probability of such an event is lower than the probability of a random person being hit by a lightning. Our results are robust across various specifications of the model.

These findings seem even more unusual given the fact that Lokomotiva have not underperformed against any other club in the league, have the highest overperformance rate in the competition's history, and have continuously proven to be a member of the upper quality class of Croatian soccer by their rankings in the competition. Analyzing a somewhat similar case of a close business relationship between two clubs in the Dutch soccer league, we failed

to find any level of underperformance that is even remotely close to that of Lokomotiva versus Dinamo.

Although the findings of this paper certainly will not decrease the levels of suspicion regarding the issue, this research does not aim to assert that such extraordinary levels of sporting underperformance are the definitive proof that the simultaneous participation of Lokomotiva and Dinamo in 1.HNL makes the competition illegal or unfair. These questions are beyond the scope of this paper and need to be answered by higher instances. However, we do hope that this paper offered an innovative and unique case study of unfair competition and antitrust in the soccer industry that could entice further dialogue on these issues in sports and could perhaps serve as a seminal paper for other studies of a similar kind in the sporting business.

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APPENDIX

Calculated REPR values

team *i/j*	Cibalia	Dinamo Zagreb	Hajduk Split	Hrv. drag.	Inter-Zaprešić	Istra 1961	Kamen Ingrad	Lokomotiva	Marsonia	NK Zagreb	Osijek	Rijeka	RNK Split	Šibenik	Slaven Belupo	Varteks	Zadar
Cibalia		0.630[a]	0.981	0.996	1.045[a]	0.962[b]	0.850[a]		0.681[a]	0.995	0.986	1.033[a]		1.147[a]	1.002	1.077[a]	0.733[a]
Dinamo Z.	1.109[a]		0.947[a]	1.051[a]	0.971	1.030[a]	1.110[a]	1.325[a]		0.990	1.121[a]	1.010	1.054[a]	1.025[a]	1.098[a]	0.983	0.971
Hajduk S.	0.960[b]	1.090[a]		0.852[a]	1.041[a]	0.885[a]	0.941[a]	1.005		1.060[a]	1.082[a]	0.950[a]	1.091[a]	1.164[a]	1.102[a]	1.137[a]	1.093[a]
Hrv. drag.	0.964[b]	0.804[a]	1.357[a]							0.872[a]	1.245[a]	0.634[a]		0.974	0.786[a]	0.709[a]	1.143[a]
Inter-Z.	0.926[a]	1.106[a]	0.843[a]			1.175[a]				0.893[a]	0.620[a]	1.249[a]		0.870[a]	1.179[a]	0.951[a]	1.087[a]
Istra 1961	1.062[a]	0.860[a]	1.326[a]		0.866[a]			0.920[a]		0.736[a]	0.913[a]	0.893[a]	1.170[a]	0.987	1.018[b]	0.962[b]	0.913[a]
Kamen In.	1.109[a]	0.594[a]	1.315[a]							0.928[a]	0.725[a]	0.935[a]			1.121[a]	0.956[a]	
Lokomotiva		0.079[a]	1.052[a]		1.159[a]					1.420[a]	1.303[a]	0.976	0.974		1.043[a]		1.153[a]
Marsonia	1.332[a]										0.923[a]						
NK Zagreb	0.952[a]	0.903[a]	1.040[a]	0.999	1.066[a]	1.199[a]	1.079[a]	0.638[a]			0.879[a]	1.009	0.779[a]	1.024[a]	0.765[a]	0.979	1.120[a]
Osijek	1.032[a]	0.608[a]	0.898[a]	0.825[a]	1.307[a]	1.026[a]	1.400[a]	0.600[a]		1.115[a]		1.079[a]	0.874[a]	1.070[a]	0.801[a]	1.142[a]	1.014[b]
Rijeka	0.951[a]	1.005	1.076[a]	1.297[a]	0.819[a]	1.052[a]	1.201[a]	1.022[a]	1.186[a]	1.035[a]	0.928[a]		1.049[a]	1.051[a]	0.962[b]	1.050[a]	0.958[a]
RNK Split		0.934[a]	0.693[a]			0.830[a]		0.886[a]		1.286[a]	1.041[a]	0.932[a]			1.264[a]		1.068[a]
Šibenik	0.874[a]	0.902[a]	0.633[a]	1.049[a]	1.159[a]	0.998				1.036[a]	0.886[a]	0.937[a]			0.808[a]	0.952[a]	1.114[a]
Slaven B.	0.963[b]	0.733[a]	0.722[a]	1.017[b]	0.899[a]	0.929[a]	0.958[a]	0.900[a]		1.281[a]	1.218[a]	0.935[a]	0.713[a]	1.139[a]		1.110[a]	1.101[a]
Varteks	1.061[a]	1.126[a]	0.801[a]	1.158[a]	1.103[a]	1.045[a]	1.109[a]			1.017[b]	0.885[a]	0.824[a]		1.010	0.900[a]		1.045[a]
Zadar	1.297[a]	1.034[a]	0.779[a]	0.845[a]	1.011	1.101[a]		0.906[a]		0.843[a]	1.027[a]	1.049[a]	0.952[a]	0.790[a]	0.980	0.963[b]	

Note: Significant at: [a] 1 percent, [b] 5 percent. Statistically significant values below (above) 0.99 denote that team *i* significantly underperforms (overperforms) against team *j*. Some cells are empty because less than 15 matches were played between the clubs.

Source: authors' calculations