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More Sports, More Crimes? An Analysis for the Metropolitan Region of Porto Alegre

Mais esportes, mais crimes? Uma Análise para a Região Metropolitana de Porto Alegre

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ABSTRACT

Does the occurrence of crimes increase or decrease on sporting event days? There is no conclusive answer in the literature. This article uses a database that combines crime occurrences in the Metropolitan Region of Porto Alegre and the performance of soccer matches in a panel of daily data for the period 2014-2018. Considering matches as an exogenous variable, we estimated an autoregressive distributed lag model (ARDL). We found that the hypothesis of reduction of crime due to the greater security adopted in 2014 - the year in which Brazil hosted the World Cup - is supported. Also, we found a 4-day delayed small, but positive effect of matches on crime.

Palavras-chave: Crime; Soccer; ARDL.

JEL: K14; Z20; B23.

RESUMO

A ocorrência de crimes aumenta ou diminui em dias de eventos esportivos? Não há uma resposta conclusiva na literatura. Este artigo utiliza um banco de dados que combina a ocorrência de crimes na Região Metropolitana de Porto Alegre e a realização de partidas de futebol em um painel de dados diários do período 2014-2018. Considerando os jogos como uma variável exógena, estimamos um modelo de defasagem distribuída autorregressiva (ARDL). Verificamos que a hipótese de redução da criminalidade em função da maior segurança adotada em 2014, ano em que o Brasil sediou a Copa do Mundo, é consistente. Além disso, encontramos uma pequena defasagem de 4 dias, mas um efeito positivo dos jogos sobre o crime.

Keywords: Crime; Futebol; ARDL.

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1. Introduction

The organization of major sporting events demands an intense concern for infrastructure and security. Few years ago, Brazil hosted two major events, the 2014 Fifa World Cup and the Rio de Janeiro Olympics in 2016.

Among Brazilians, the most popular sport is soccer. However, the passion for the teams generates unwanted effects such as violence and the dispute between fans of rival clubs. In this context, in the city of São Paulo, Law No. 12,299/10 prohibits two teams from this locality from holding matches on the same day.

Despite the issue of violence among fans, other crimes may have their pattern changed on match days, for two reasons: (i) there is an increased policing in the neighborhood of the stadium's location these days and (ii) fans who cannot go to the stadium will probably watch the game in their homes or in some public place that will broadcast the match, reducing the chance of street crimes. In this sense, the sporting event could have, *ceteris paribus*, a decreasing impact on the number of crimes in the municipality in which the sporting event takes place.

In this context, this preliminary work aims to verify the relationship between crime and the performance of soccer matches in the Metropolitan Region of Porto Alegre (hereinafter, RMPA). Porto Alegre is the capital of the state of Rio Grande do Sul, located at the extreme South of Brazil. The RMPA has a population estimate of 4 million inhabitants (approximately 37.7% of the population of the state)[6].

We use an original database of crime occurrence data in the RMPA, from May 2, 2014 to April 21, 2018. This database was complemented by information on the occurrences of soccer matches and climatic variables. To perform the estimates were used a model Autoregressive Distributed Lags (ARDL) model. Thus, we verify that there is a positive relationship between the occurrence of a soccer match and the number of crimes. However, this relationship has a lagged effect, that is, the occurrence of a match four days earlier increases the number of crimes on the current day.

This lagged relationship may be due to the climatic and environmental conditions of the match, for example, several fans that went to the stadium, which may also positively influence criminals going through to the arena in the next game. Additionally, there are indications that the security measures related to the organization of the World Cup were important to reduce the number of crimes.

Finally, this work is structured in four sections, beginning with this introduction. Section two reviews the empirical studies regarding the relationship between sports and crimes. In the third one, we explain how the variables were built. The fourth section presents the results of our model. Finally, section five concludes.

2. Literature Review

The relationship between crime and sports, in the framework of economic theory, is relatively recent.

[6] See, for details: https://atlassocioeconomico.rs.gov.br/regiao-metropolitana-de-porto-alegre-rmpa

In general, studies relate the occurrence of sporting events with 'violence', whether it is involving crimes or not. There are studies of microeconomic flavor (violence between fans, violence between participants of a match) and there are some that use a macroeconomic framework, with comparisons among countries. A panoramic view of the relationship between sports and violence is found in Jewell (2011)[7] .

The book includes studies on violence in various types of sports and, in its last two chapters, there is the relationship between sports and crime. In one of the studies, evidence is shown that the relationship between violence of fans (*hooliganism*) leads to a drop in demand for tickets and, in the second, there is evidence of a kind of displacement effect of crimes, *i.e.,* on matchdays, the amount of crimes does not change much, but the relative occurrence increases near the stadiums[8] .

The first of them, Avgerinou & Giakoumatos (2011), analyzes data from the main Greeks soccer clubs, Olympiakos, PAOK, Aris, AEK and Panathinaikos. The authors recall that the literature has studies with the concern of studying (a) violence in the field or aggressive play (there is a demand for this) and others that (b) highlight violence among spectators (threat to sport or social problem).

Hooliganism is the term used to describe violence among soccer spectators that refers to the problems experienced in England at the end of the 19th century and persisted until the end of the 20th century. They suggest that the causes of hooliganism found in the literature would be associated with social class problems and regional inequalities in England, religious sectarianism in Scotland and Northern Ireland, linguistic sub nationalism in Spain and specificities in Italian cities.

The fact is that violence reduces the usefulness that soccer is derived from his experience in the stadium. The authors analyze data from the Greek First Division of soccer (23 seasons). The data comes from 4426 incidents of misconduct of the clubs and 1430 decisions of the Sports Court of the country. In this sense, clubs are punished for the inappropriate behavior of their fans. Punishments are, for example: financial fines, matches with closed gates, impediments to the transmission of games, etc. The incidents evaluated by the authors are of various types, such as: chanting inappropriate chants, setting smoke bombs, field invasion, stadium destruction, violence outside the stadium, injuries and deaths, etc. It is worth noting that the data are subject to underreporting.

Avgerinou & Giakoumatos (2011) estimate the determinants of the average number of tickets sold by club i in the period t. As explanatory variables, in addition to the number of violent events, there are also the position of the team in the league, the average price of the ticket, level of economic activity (GDP) Greek in t and *dummies* for seasons in which deaths outside stadiums occurred. The dynamic model for panel data is estimated by GMM following Arellano & Bond (1991).

The results suggest that, controlled by other factors, a greater number of violent events in the past would negatively affect the average frequency of matches. Specifically, in the long run, the 1% reduction in violence increases the average number of tickets sold by 1.73%, on average. That is, their results suggest economic gains for clubs that somehow control the behavior of fans.

The study by Billings & Depken II (2011) is more aligned with the objective of our article, namely, to evaluate the impact of sporting events on criminal activity in a given region. One of the motivations is that the places that hosts these events are more prone to criminal activity (where

[7] Spaaij (2014) reviews the literature in order to understand the various views of the relationship between violence and sport, given the multidisciplinary nature of the topic.
[8] Respectively Avgerinou & Giakoumatos (2011) e Billings & Depken II (2011).

there are distracted regulars carrying mobile phones, cameras, etc.). In order to avoid crimes, event promoters invest in additional security, comparing marginal benefits and costs (in addition to increased state surveillance in some cases). The net effect can thus be an increase or reduction in crime in the region.

The authors used crime data reported to the Charlotte-Mecklenburg Police Department Mecklenburg in January 2005 and December 2008, crimes from 39 aggregated categories and classified as total reported crimes, total violent crimes (homicides, kidnappings, etc.) and total property crimes (vehicle theft, vandalism, etc.). and detailed the distance from the crime venue to the venues of the games (Stadium (NFL games) and Arena (NBA matches).

The dependent variable was the number of type *i* crimes, on day *t,* in the distance interval j and its models explore the data panel characteristic (using fixed effects) by means of a negative binomial specification.

Their results indicate that crime (violent and against property) grew in the neighborhood of the events held at the Stadium. The result repeats for the Arena.

Heckelman & Yates (2003) uses the economic theory of crime to verify whether the variation in the number of judges in hockey matches in the 1999-2000 *national* hockey *league* season has an impact on penalties[9]. According to the traditional model of the crime economy:

> For a given crime rate, increases in police budgets and forces enable greater monitoring of criminal activity and consequently lead to more arrests. The crime rate, however, is itself a function of the level of policing resources. Rational criminals realize that greater monitoring increases the probability that their actions will result in arrest and may be deterred from committing crimes. This decreases the crime rate. The net effect on the total number of arrests is ambiguous because it depends on whether the monitoring or deterrent effect dominates. (Heckelman & Yates (2003), p.705)

Their results, however, do not support the hypothesis that *more judges, fewer infractions.*

Eventually, violence in the field could have as determinants "macro" factors such as political or economic aspects of the country. There are several works in this direction.

Caruso, Domizio & Savage (2015) studied the theme using match data from the final stages of the World Cup and Eurocup in the period 1994-2012[10] . The results find no support for those macro factors. There is evidence of the importance of microeconomic factors such as awards to players, performance of judges and of fans. A similar result is found by Cuésta & Bohórquez (2012), for a sample of games from the 2008 round of the Copa Libertadores, that is, "national" factors such as some supposed "national culture of violence" do not seem to influence the performance of players on the pitch.

Caruso (2011) finds evidence that participation in sports activities is inversely related to crimes against property and, also with crimes committed for *juvenile crimes*. On the other hand, it finds a positive relationship with violent crimes. However, the article has several problems.

[9] According to the authors, there is a distinction between "infractions" and "penalties". The first would be a violation of the rules by the player and the second occurs when the judge determines that there was this infraction. Faced with the infraction, the judge may or may not call a penalty. This distinction gives rise to a complex discussion about the costs and benefits of players in committing infractions.

[10] Curiously, Caruso & Domitius (2013), analyzing the same data, but for the period 2000-2012, they find evidence that macro factors could be important. In other words, there may be a certain sensitivity of the results to the time window and the econometric specification.

Although the author makes use of a data panel built for the Italian regions, at no time does he explain how participation was measured, which makes the interpretation of the results problematic.

In the case of *e-sport,* it is assumed that exposure to violent games increases the propensity to crime (the effect, theoretically, may be short- and long-term).[11] Cunningham, Engelstätter & Ward (2016), with a sample for the U.S., not only do not find evidence favorable to the positive relationship between violent *videogames* and crime, but they still find even the opposite effect[12].

Copus & Laqueur (2018) compare the occurrence of various types of crimes in Chicago on the days and times of the week when super bowl games, National Basketball Association Finals and Major League Baseball World Series are broadcast with the same days and times without transmissions through a fixed effects model and find a drop in crimes on game days. The result supports the hypothesis that criminals could replace crimes for leisure (i.e., both would be activities seen by potential criminals as *recreational*) [13].

Mares & Blackburn (2019), analyzing daily data (approximately 23 years of games) of *Major League Baseball* in St. Louis, find that, *ceteris paribus*, during the games of the St. Louis Cardinals, the occurrence of crimes increases around large stadiums. Specifically:

> This is particularly the case for larcenies, motor vehicle thefts, simple assaults, disorderly conduct, and destruction of property. Not surprisingly, results show proportionally large increases in the immediate stadium area, but given their overall magnitude, increases also occur at the city level. (Mares & Blackburn (2019), p.898)

Its results allow an estimate of the municipal costs of hosting sporting events, besides illustrating an aspect not always considered by analysts of the relationship of violence with sports that are crimes not related to organized fans or some supposed national culture.

The national economic literature on the subject is limited. It is worth mentioning the article by Shikida, Araujo Jr. and Pinho (2018) in which the authors use the focus of economic analysis of crime to understand the determinants of punishments for rule violations in the series A matches of the Brazilian soccer Championship in 2012.

The authors estimate models on the determinants of the most serious faults committed by athletes of the clubs of the Series A of the Brazilian soccer Championship, punished with yellow and red cards (Poisson and Binomial Negative regression models) and find evidence that athletes seem to respond to incentives.

The results suggest that the athletes of the home team receive, on average, a smaller number of cards and that there is a growing trend of punishments during the championship. The results also suggest the existence of nonlinearity between the punishments and the goals (relationship as an inverted "U").

This brief review of the literature shows that there are several possible relationships between sports practice and violence. However, this article has a very specific focus that is to find out a little more about the possible transmission mechanisms that potentially exist between the

[11] Obviously, measuring long-term impacts in this case can be more difficult.

[12] "(...) we find evidence that violent games cause a modest reduction in crime. Our analysis indicates that crimes are either invariant to or are decreasing in video game popularity". [Cunningham, Engelstätter & Ward (2016), p.1248]

[13] To be more specific, it may be that some types of crimes can be modeled, from the point of view of the criminal, as substitutes in relation to leisure (here, represented as attending a sporting event). The question to be researched more deeply is how much of some types of crimes are, in fact, replaceable with leisure. Note that it is not a question of replacing crimes outside the stadium with crimes within it, since the data relate to the transmissions of sporting events.

transmission of soccer matches and the occurrence of crimes, disregarding violence on the field or even among fans in the sports arena. We want to explore whether the occurrence of soccer matches have any relation with crimes and, if there is this relationship, the question is whether this relationship would be *virtuous* (more games, fewer crimes) or not.

3. Database

The database used in this article is composed of the following daily variables: i) number of occurrences of crimes; ii) variation in atmospheric pressure; iii) average temperature and iv) data related to the matches, collected in various sources.

First, there is the number of crimes in the RMPA, provided by the Military Police of the State of Rio Grande do Sul (also known as "Military Brigade"), from data entered daily in the Operations Registration Module (MCOp), next to the Management Information System of the Military Brigade (SIGBM).

To obtain the number of crimes, the number of daily criminal records was added, with the information of the date and time of the crimes that occurred in the 33 municipalities that make up the RMPA, according to IBGE (Brazilian Institute of Geographic Statistics) definition. The municipalities are: Alvorada, Araricá, Arroio dos Ratos, Cachoeirinha, Campo Bom, Canoas, Capela de Santana, Charqueadas, Dois Irmãos, Eldorado do Sul, Estância Velha, Esteio, Glorinha, Gravataí, Guaíba, Igrejinha, Ivoti, Montenegro, Nova Hartz, Nova Santa Rita, Novo Hamburgo, Parobé, Portão, Porto Alegre, Rolante, Sapiranga, Sapucaia do Sul, Santo Antônio da Patrulha, São Jerônimo, São Leopoldo, Taquara, Triunfo and Viamão.

The series of atmospheric pressure variation and average temperature were obtained from the website of the National Institute of Meteorology (INMET), in the Meteorological Database for Teaching and Research (BDMEP), from daily historical series collected at the weather station of Porto Alegre and serve as a control since some crimes can be impacted by atmospheric conditions. A lower atmospheric pressure is assumed to increase the likelihood of rainfall at the site, which decreases the likelihood of crimes in open places. At the same time, the temperature increase can have a positive impact on crimes (Heilmann & Kahn (2019)).

The data related to soccer matches were compiled from the website of Globo Esporte, a popular TV show in Brazil[14]. The database have, the number of soccer matches, with date and time, held in the RMPA, by the international championships (Libertadores and Copa Sudamericana Conmebol), national championships (Brasileirão, Série A and Série B (1st and 2nd divisions))[15] and regional championships (Gauchão)[16].

To carry out the above estimates, it was decided to select a data set from May 2, 2014 to April 21, 2018. The set of variables used is described in Table 1.

[14] For more details see: https://globoesporte.globo.com/

[15] Both the 1st and 2nd division of Brasileirão have 20 teams each. In the period of analysis, only Sport Club Internacional and Grêmio, from the Rio Grande do Sul's capital, Porto Alegre, were in the 1st division. In 2017, Internacional was in the 2nd division. Juventude, another team from the state, was in the 2nd division in 2017 and 2018.

[16] The "Gauchão", is the regional championship of Rio Grande do Sul state and involves, on average, 14 to 18 (depending on the rules of the year) teams from several municipalities of the state (not all in the RMPA).

Table 1 - Data Description

Variable	Legend	Description	Source
Crimes	Tcrimes	Number of crimes divided by 1,000 inhabitants	Military Police of the State of Rio Grande do Sul
Atmospheric Pressure Variation	Varprec	Weight that air exerts on the thermal surface.	National Institute of Meteorology
Average Temperature	Whereby	Average Temperature Variation in the Day	National Institute of Meteorology
Match	Game	Dummy variable that assumes the value 1, if there was a soccer match in the Metropolitan Region of the day and zero otherwise.	globoesporte.com

Source: Prepared by the authors

Table 2 presents descriptive statistics of the variables.

Table 2 - Descriptive Statistics

Variable	Average	Medium	D.p.	Min	Max
Varprec	-0.01	-3.43	11.70	-9.97	87.30
Whereby	-0.02	0.03	2.60	-11.40	9.79
Game	0.17	0.00	0.37	0.00	1.00
Tcrimes	0.25	0.25	0.05	0.08	0.39

Source: Prepared by the authors

According to the data we have that the crime rate has its maximum value at 0.39, that is, 390 crimes committed on a given date. In the sample, in only 17% of the days there are occurrences of soccer matches. The mean temperature variation presents values of -0.02 and the minimum variation on the day was -11.40 and the maximum of 9.79.[17].

4. Empirical Results

To perform the empirical analysis, we used an ARDL model (auto-regressive with distributed lags)[18] that allows to verify the contemporary and lagged relationship between the crime rate and the occurrence of soccer matches at RMPA. The estimated equation can be represented as follows:

$$tcrimes_t = \alpha + \sum_{i=t-1}^{k} \beta_i tcrimes_i + \sum_{j=t-1}^{k} \gamma_j varmed_j + \sum_{h=1}^{6} \delta_h day\_dummy\_h + \sum_{g=t-1}^{k} \lambda_g game_g + \theta_1 D2014 + \theta_2 D2016 + \theta_3 D2018 + \varepsilon_t$$

[17] Rio Grande do Sul is located at the extreme south of Brazil. For this state is not unusual to have extremely low temperatures in the winter season.

[18] For more details, see Greene (2003, chap.19)

As a dependent variable there is the number of crimes per thousand inhabitants (tcrimes) to be explained by their lagged values, the average temperature range in the region (varmed) and also by a dummy variable that assumes one for the occurrence of soccer match on date t or zero otherwise.

In addition, were included six dummies referring to the weekdays and three years: 2014 (world cup), 2016 and 2018 referring to electoral years. To eliminate serial autocorrelation, was chosen seven lags to proceed the estimations.

To proceed, it is necessary, first, to check for the unit roots in the two series. PP tests were performed to verify whether the variables are integrated in zero order, or, I(0)[19]. According to table 3 all series were stationary in level. In this case, we proceed with an ARDL in the levels of the variables.

Table 3 - Stationarity Tests

Variables	Defasagens	N	ADF	p-value	PP	p-value
varmed	0	1438	-12.4	0.00	-17.01	0.00
Game	0	1438	-6.53	0.00	-43.01	0.00
Tcrimes	0	1438	-3.86	0.00	-25.78	0.00

Source: Prepared by the authors

Table 4 - ARDL Model(T = 1444)

Dependent variable: tcrimes

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.0952620	0.0102846	9.263	<0.0001	***
Varmed	0.000115214	0.000338098	0.3408	0.7333	
varmed_1	−8.53495e-05	0.000468660	−0.1821	0.8555	
varmed_2	−3.04130e-05	0.000513031	−0.05928	0.9527	
varmed_3	0.000367269	0.000544768	0.6742	0.5003	
varmed_4	−0.000827747	0.000491532	−1.684	0.0924	*
varmed_5	0.000854906	0.000472880	1.808	0.0708	*
varmed_6	−0.000512041	0.000470231	−1.089	0.2764	
varmed_7	−0.000567604	0.000373658	−1.519	0.1290	
2014	−0.00729445	0.00188348	−3.873	0.0001	***
2016	0.000831354	0.00166815	0.4984	0.6183	

[19] For details about ARDL analysis and unit root tests, see, for example, Hamilton (1994), Greene (2003), Kleiber & Zeileis (2008), Vinod (2008) and Enders (2010).

2018	−0.00381551	0.00251502	−1.517	0.1295	
Game	−0.000814646	0.00196791	−0.4140	0.6790	
game_1	−0.000522963	0.00211954	−0.2467	0.8051	
game_2	−0.00191807	0.00223145	−0.8596	0.3902	
game_3	−0.000288937	0.00198180	−0.1458	0.8841	
game_4	0.00428096	0.00216964	1.973	0.0487	**
game_5	0.000607486	0.00261792	0.2320	0.8165	
game_6	0.000887510	0.00192771	0.4604	0.6453	
game_7	0.00169677	0.00192315	0.8823	0.3778	
Monday	−0.0203055	0.00421768	−4.814	<0.0001	***
Tuesday	−0.0290315	0.00449973	−6.452	<0.0001	***
Wednesday	−0.0327208	0.00467132	−7.005	<0.0001	***
Thursday	−0.0344013	0.00414689	−8.296	<0.0001	***
Friday	−0.0706911	0.00463284	−15.26	<0.0001	***
Saturday	−0.0844394	0.00462701	−18.25	<0.0001	***
tcrimes_1	0.242283	0.0298346	8.121	<0.0001	***
tcrimes_2	0.137870	0.0295838	4.660	<0.0001	***
tcrimes_3	0.0332783	0.0318811	1.044	0.2967	
tcrimes_4	0.0728383	0.0289963	2.512	0.0121	**
tcrimes_5	0.0686243	0.0267113	2.569	0.0103	**
tcrimes_6	0.0797428	0.0264198	3.018	0.0026	***
tcrimes_7	0.141127	0.0323650	4.360	<0.0001	***

Mean dependent var	0.248805	S.D. dependent var	0.045116
Sum squared resid	1.028763	S.E. of regression	0.027002
R-squared	0.649740	Adjusted R-squared	0.641797
F(32, 1411)	108.0890	P-value(F)	0.000000
Log-likelihood	3183.253	Akaike criterion	−6300.507
Schwarz criterion	−6126.426	Hannan-Quinn	−6235.532
Rho	−0.006958	Durbin-Watson	2.005495

Source: Authors
Notes: For correction of serial autocorrelation heteroscedasticity, HAC standard errors were used. * significant at 10%, ** significant at 5% and *** significant at 1%

The dummy referring to 2014, the year that the World Cup took place, is significant at 1%. For the realization of this international event, several preventive measures were taken in relation to security, which could explain the value of the coefficient of -0.7%.

The average crimes seem to be higher on Sundays since the weekday's dummies are all negative. Also, a curious delayed effect (of four days) in the realization of a match with the occurrence of crimes was also found. For example, if one match took place on Sunday (Wednesday), it would increase, on average, 0.4% the number of crimes on Wednesday (Sunday). Considering the average of crimes, 250/day, this would translate to an increase of 1 crime four days later of the match. This pattern could be the result of the fact that almost all soccer matches in Brazil are scheduled on Wednesdays and Sundays, except for games in Brasileirão Série B (the 2nd division)[20].

5. Final Considerations

The occurrence of sporting events, such as soccer matches, makes public and private authorities work together to maintain the safety of all involved. One of the aspects related to this factor is the increase of the police force around the stadium as a way to curb the occurrence of crimes in this region.

However, there is no consensus in the literature if soccer matches help to increase or decrease crimes. For example, matches involve concentration of fans in the stadium and its neighborhood, which with adequate policing, can avoid criminal activity. However, criminals could act far away from the soccer arena. On the other hand, criminals could act far away from the soccer's arena.

In this context, this study had the main objective to verify the relationship between the crime rate that occurred in the Metropolitan Region of Porto Alegre and the performance of soccer matches in this region.

To achieve this goal, we used a database from March 2, 2014 to April 21, 2018, consisting of the crime rate, the occurrence of soccer matches and weather controls. To perform the empirical analysis of the data, we used an Autoregressive Distributed Lags (ARDL) model where matches are exogenous to crimes. We found a negative effect of the World Cup on crimes. We think this could be evidence in favor of the economic theory of crime, as the additional security measures taken by the authorities would, in theory, increase the probability of detection. We also found a curious and positive relationship from matches to crime, with a 4-day lag.

One limitation of our conclusions is that we cannot say anything about crimes that occurred around the stadium, as in Mares & Blackburn (2019), since the database does not present this degree of detail. Finally, an extension of this research would be the decomposition of the indicator of the crime rate, in order to verify the possibility of different patterns between, for example, armed robberies and family conflicts on game days.

[20] There are exceptions, of course. Due to climatic reasons, sometimes games are postponed. Another exception to this "Wednesday-Sunday" rule are the World Cup, Libertadores and Sudamericana Conmebol.

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