Original Article

Correlation analysis of a horse-betting portfolio: the international official horse show (CSIO) of Gijón

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Abstract:
        The aim of this paper is to analyse the trend and distribution of sales among different horse-betting products and to test whether some complementary and substitution effects exist. The International Official Horse Show of Gijón's betting portfolio includes five different betting products and provides a good opportunity to analyse the aforementioned effects as well as the portfolio design itself. A correlation analysis is performed to test for the complementarity or substitutability among bets by examining Pearson correlation coefficients.
Key words: horse show, horse-betting portfolio, single-win bet, reverse dual forecast bet, triple reverse dual forecast bet, Pearson correlation coefficient.

Introduction

        The 2016 statement and yearly report on gambling from the Directorate General for the Regulation of Gambling (DGOJ) states that, within regulated gambling products, offline play accounts for 93.91% of the total expenditure made in games of chance, while online gambling barely exceeds 6%. However, the trend of online spending is remarkably positive, while offline gambling expenditure is decreasing.

        The main gambling operator in Spain is the *Sociedad Estatal Loterías y Apuestas del Estado* (SELAE), assigned to the Ministry of Finance and Public Administration. In 2016, offline gambling products operated by SELAE, such as horse betting for the International Official Horse Show (CSIO) of Gijón, included the National Lottery (57.14%), lotto games (40.03%), sports betting (2.78%) and horse racing betting (0.04%). In the particular case of horse racing betting (*Lotto Turf* and *Quintuple Plus*), offline sales reached 3.89 million euros.

        In Spain, horse betting is based on a pari-mutuel wagering system in which the amount allocated to prizes constitutes a percentage of the volume of betting sales, unlike the British fixed odds horse-betting system. In the case of the CSIO of Gijon, a pari-mutuel system is used. The racetrack betting market is studied in-depth in Hausch and Ziemba (2008), and betting strategies at the track are analysed in Thaler and Ziemba (1988), among other studies. A seminal study of betting market efficiency with respect to subjective information can be found in Figlewski (1979).

        In 2016, 448,194.90 euros were staked at the CSIO of Gijón, which represents 11.52% of the horse-betting market in Spain, according to the DGOJ's yearly report. This is a significant outcome for a contest that occurs in just one city over only six days. In 2017, the value of bets placed was 485,747.05 euros, representing an increase of 10.84% from the previous year.

        A portfolio of several different horse-betting products is usually offered to bettors. However, gambling literature has not paid much attention to judging the effectiveness of operators/organizers in generating revenues. Apart from Pérez and Forrest (2011), who analyse this issue for the Spanish lotto market, there are few previous studies of the complementarities and substitutions within a gambling portfolio.

        The horse-betting portfolio of CSIO consists of five different bets: a *single-win bet*, in which bettors guess the winner of either each 'class' or 'series'[1]; *reverse dual forecast bet*, in which bettors have to guess the best two horses of a single 'series'; *triple reverse dual forecast bet*, in which bettors have to guess the best two horses of three 'series'; the last betting option is called '*special Nations Cup bet*', in which bettors bet on the first five classified teams in the same order in which they have classified. However, it should be noted that the latter is insignificant in terms of the volume of stakes wagered. In general, the payout rate is set at 70%.

        The aim of this paper is to analyse the trend and distribution of sales among the various horse-betting products available at CSIO Gijón and to identify whether they are complements or substitutes for bettors. The paper is structured as follows. The next section describes the database. Then, a correlation analysis is performed to determine if a complementarity or substitutability effect exists among bets. Following that, a discussion and

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[1] Horses entered for each 'class' are included in groups called 'series'.

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evaluation of the composition of the CSIO Gijón horse-betting portfolio is presented. Finally, the paper ends with some concluding remarks.

Material & methods

In this paper, the sample data includes information on sales from all the bets within the CSIO Gijón horse-betting portfolio for four years (2012-2015). The Pearson correlation coefficient is examined to test for complementarities and substitutions among the different horse-betting products. The five allowed betting options are regulated by the Resolution of the Presidency of the Municipal Sports Board of the City of Gijon (*Ayuntamiento de Gijón*, 2012a), which sets different prices for each bet: 1 euro for the 'series' *single-win bet*, 2 euros for the *reverse dual forecast bet*, and 3 euros for the *triple reverse dual forecast bet* (30 cents must be added for each of the combinations chosen by the bettors). For both the 'class' *single-win bet* and the '*special Nations Cup bet*', the price of a bet is set at 2 euros. These five modalities and the price of the different bets were maintained for the four years of this study.

As mentioned, each year's contest occurs over six days. The number of series is not the same on each day. Table 1 reports the day-to-day sales of the various horse-betting products available at CSIO Gijón during the twenty-four days of competition studied[2]. It should be noted that the Nations Cup is celebrated on the fourth day each year.

As shown in Table 1, within the whole sample, the first and fourth days of each year's contest exhibit the lowest amount of betting revenue. This could be explained as the bettors' need for a period of adaptation, for example, during the first betting periods of many seasonal sports betting activities, such as the Spanish football pools, called *La Quiniela*[3]. Low betting revenue can also be explained by the insignificance of the Nations Cup in terms of the volume of stakes wagered, as this occurs on the fourth day. On these days, the revenues of the 'series' *single-win bet* and the *reverse dual forecast bet* are also substantially reduced because there are fewer series, while the *triple reverse dual forecast bet* sales are not as affected. However, the *triple reverse dual forecast bet*'s sales produce the biggest daily oscillations because the jackpot rolls over when there is no winner on the previous day, which generates a remarkable increase in revenue. This occurred on days 2 and 6 in 2012, days 2 and 3 in 2013 and day 2 in 2014. However, no rollover occurred in 2015.

Table 1. Daily sales (euros)

	2012					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
'series' *single-win*	14,397.00	16,968.00	17,121.00	14,220.00	19,282.00	19,838.00
reverse dual	55,670.00	56,710.00	58,100.00	45,297.00	68,597.00	67,969.00
'class' *single-win*	488.00	580.00	496.00	758.00	540.00	1,286.00
triple reverse dual	9,905.70	18,208.35	20,916.15	18,846.90	15,784.50	54,361.20
Nations Cup				1,978.00		
TOTAL	80,460.70	92,466.35	96,633.15	81,099.90	104,203,50	143,454.20

	2013					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
'series' *single-win*	13,575.00	17,634.00	17,428.00	13,008.00	22,805.00	20,770.00
reverse dual	50,440.00	54,956.00	58,824.00	38,167.00	73,037.00	71,112.00
'class' *single-win*	566.00	550.00	430.00	628.00	966.00	2,004.00
triple reverse dual	9,655.50	17,772.15	36,287.25	33,470.25	15,834.40	22,357.80
Nations Cup				1,430.00		
TOTAL	74,236.50	90,912.15	112,969.25	86,703.25	112,642.40	116,243.80

	2014					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
'series' *single-win*	10,922.00	16,399.00	15,057.00	5,869.00	14,540.00	20,741.00
reverse dual	42,787.00	54,055.00	49,609.00	19,739.00	58,569.00	78,060.00
'class' *single-win*	358.00	626.00	434.00	356.00	512.00	1,768.00
triple reverse dual	9,200.70	17,338.65	18,432.15	11,675.70	10,170.90	23,008.80
Nations Cup				1,446.00		
TOTAL	63,267.70	88,418.65	83,532.15	39,085.70	83,791.90	123,577.80

	2015					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
'series' *single-win*	12,965.00	18,065.00	13,532.00	9,733.00	17,282.00	9,914.00
reverse dual	47,703.00	55,483.00	47,538.00	29,784.00	65,338.00	45,105.00
'class' *single-win*	206.00	554.00	408.00	460.00	276.00	1,038.00
triple reverse dual	7,969.20	10,664.70	14,179.10	11,142.00	13,062.60	13,092.00
Nations Cup				1,306.00		
TOTAL	68,843.20	84,766.70	75,657.10	52,425.00	95,958.60	69,149.00

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[2] *Ayuntamiento de Gijón* (2012b, 2012c, 2013, 2014, 2015). *Patronato Deportivo Municipal* (2013, 2014, 2015).
[3] See García and Rodríguez (2007).

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Results

To control for the possible existence of some complementarity or substitutability effect among the different betting products, we omit 'class' *single-win bet* and the '*special Nations Cup bet*' since they represent barely 1% of total sales revenue. We first intend to analyse whether any relationship exists between, on the one hand, the 'series' *single-win* and *reverse dual forecast* bets, and, on the other hand, between the *reverse dual forecast* and *triple reverse dual forecast* bets placed in the same series. To assess the correlation between these two kinds of bets we examined the Pearson correlation coefficients.

'Series' single-win and reverse dual forecast bets

To analyse the behaviour of the 'series' single-win and the reverse dual forecast bets, the number of bets placed on each horse in each of the series during the four years under examination are analysed. A correlation measure is used to test if the same horses are chosen (or not) by bettors, no matter the kind of bet. If a high positive correlation exists between the considered betting products, we can conclude that bettors have similar behaviours and no cannibalization exists. Therefore, bettors may adopt the same betting strategy; for example, they may always bet on the best horses. The more positive the correlation coefficient is, the less substitution there is between bets. This may lead to the conclusion that these two betting products are well designed because they do not significantly reduce the total betting sales of CSIO of Gijón.
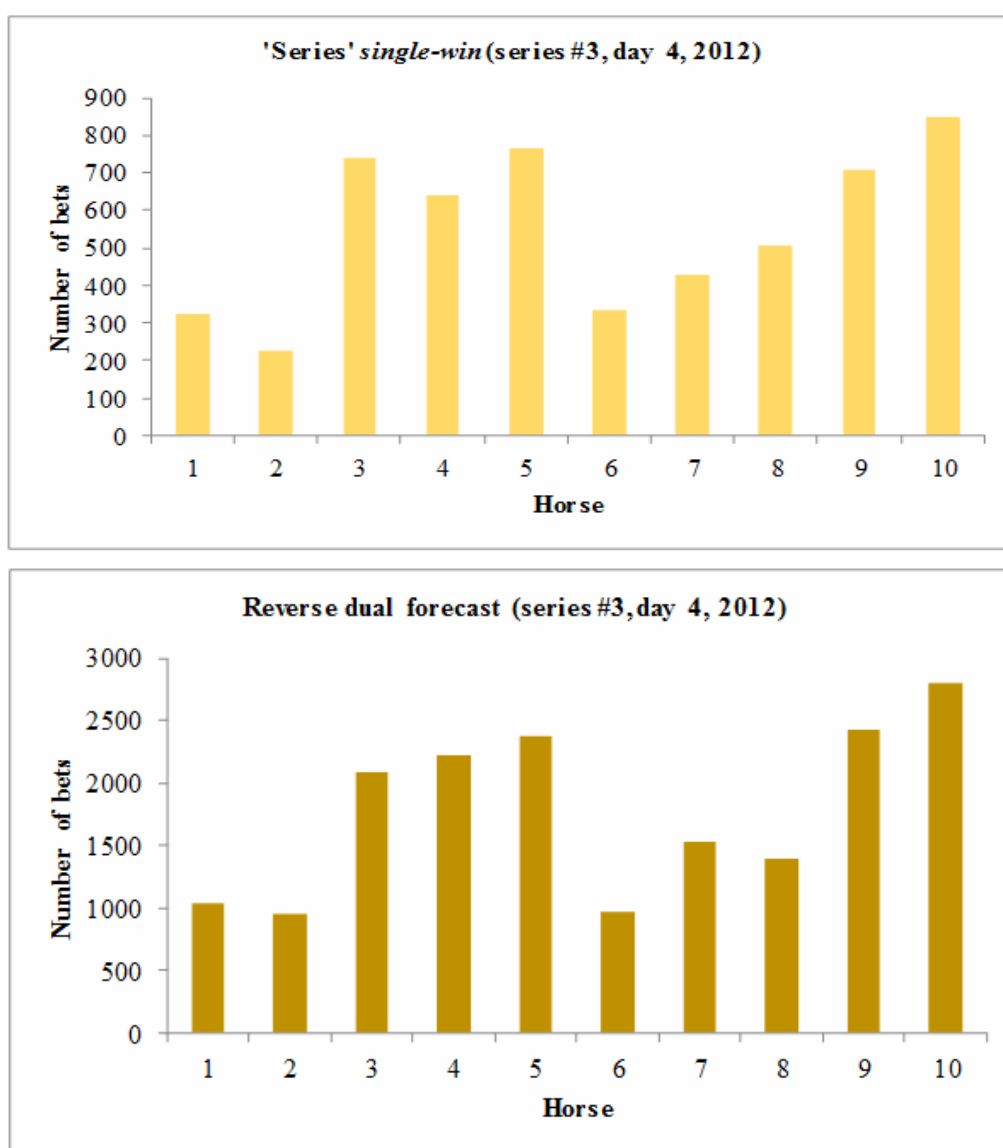

Fig. 1. Bets on horses from 'series' single-win and reverse dual forecast bets

Figure 1 shows that the choices made by bettors are quite similar in terms of the horse, regardless of the kind of horse-betting product ('series' *single-win* and *reverse dual forecast* bets). The y-axis represents the number of times a bet is placed on a certain horse for the 'series' single-win (upper graph) and reverse dual forecast bets (lower graph), respectively.

To assess the correlation between these two kinds of bets we examined the Pearson correlation coefficients[4].

Table 2. Correlation between 'series' *single-win* and *reverse dual forecast* bets

	Pearson correlation coefficient	p-value
2012-2015	0.9623795	< 0.001

Year	Pearson correlation coefficient	p-value
2012	0.971566	< 0.001
2013	0.9637916	< 0.001
2014	0.9598587	< 0.001
2015	0.952805	< 0.001

As observed in Table 2 (covering the entire sample period and each year separately), the Pearson correlation coefficients are very close to 1 in all cases and, according to the calculated p-values, are statistically significant. These findings indicate that these two types of bets are complementary, and therefore, there is no cannibalization between them. Their coexistence is positive for the total sales of CSIO of Gijón's betting portfolio.

Reverse dual forecast and triple reverse dual forecast bets

To analyse the behaviour of the *reverse dual forecast* and the *triple reverse dual forecast* bets, the number of bets placed on each horse in each of the series from 2012 to 2014[5] are analysed for the three series in which it is possible to place a bet on both betting products at the same time. As in the previous exercise, the Pearson correlation coefficient between these two betting products is calculated to test if the same horses are chosen (or not) by bettors, no matter the kind of bet.

An example of the data that was used for each series is shown in Figure 2.
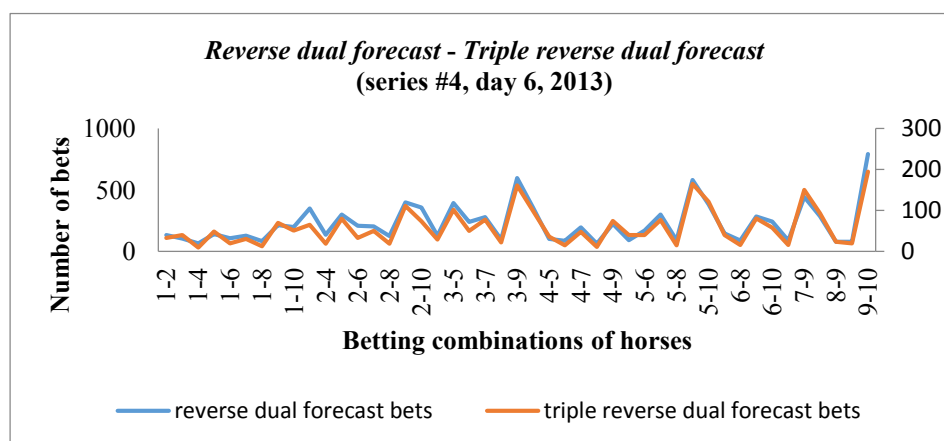

Fig. 2. Reverse dual forecast and triple reverse dual forecast bets

The results for the Pearson correlation coefficient are shown in Table 3.

Table 3. Correlation between *reverse dual forecast* and *triple reverse dual forecast* bets

	Pearson correlation coefficient	p-value
2012-2014	0.8080918	< 0.001

Year	Pearson correlation coefficient	p-value
2012	0.7890354	< 0.001
2013	0.8631309	< 0.001
2014	0.7196954	< 0.001

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[4] The Pearson correlation coefficient is a measure of the linear correlation between two variables. It has a value between +1 and −1, where +1 is total positive linear correlation, 0 is no linear correlation, and −1 is total negative linear correlation. A value of 1 implies that a linear equation describes the relationship between the two variables perfectly, with all data points lying on a line for which one variable increases as the other increases.

[5] Unfortunately, we have no data for the number of bets placed on the triple reverse dual forecast bet in 2015.

Although the Pearson correlation coefficients in the case of the reverse dual forecast and triple reverse dual forecast bets are lower than in the 'series' single-win and reverse dual forecast bets, they are, in general, still large positive values (above 0.8) and statistically significant.

Discussion

A portfolio of several different horse-betting products is usually offered to bettors at most international horse shows worldwide. Here, we employ data from CSIO of Gijón to conduct a correlation analysis in order to judge the effectiveness of CSIO organizers in generating revenue from horse-betting. The results suggest that the operator is successful in designing the betting portfolio. The Pearson correlation coefficients are proven to be positive and statistically significant in all analysed cases.

It should be noted, however, that, in line with Pérez and Forrest (2011), this article is not about potential displacement effects because the whole portfolio of bets was available throughout the sample period.

Conclusions

In the analysis of the betting portfolio for the CSIO of Gijón it is clear that, overall, the portfolio is well designed in terms of the kinds of allowed bets. No substitution effect was found in the analysed cases: 'series' *single-win*, *reverse dual forecast* and *triple reverse dual forecast* bets. Betting on the 'class' *single-win* and the special Nations Cup bet - both insignificant in terms of the volume of stakes wagered - seems not to affect bettors' behaviour in regard to deciding which bets to place. However, it is established that betting revenue from each contest's day 4 is substantially reduced because those days have only three 'series' *single-win* and *reverse dual forecast* bets.

Even though it is clear that the Nations Cup gives prestige to the contest and therefore attracts the greatest audience for the CSIO of Gijón, which may result in higher sales, it seems to deserve a better design than the betting system for this contest. Of course, the competition system may not be able to be changed, but new technological developments (e.g., online betting) may help.

Conflicts of interest

The authors have no conflicts of interest to declare.

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