การวิเคราะห์ผลจากประตูโดยผู้เล่นต่างชาติต่อผลการแข่งขันฟุตบอล ด้วยตัวแบบการถดถอยลอจิสติกปัวซงและตัวแบบการถดถอยลอจิสติกอันดับ: กรณีศึกษาการแข่งขันไทยพรีเมียร์ลีก

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บทคัดย่อ

ผู้เล่นฟุตบอลชาวต่างชาติเป็นปัจจัยหนึ่งที่มีผลต่อความสำเร็จในแง่การเพิ่มความแข่งขันภายในทีมและการสนับสนุนเพื่อนร่วมทีมทั้งในระดับชาติและระดับสโมสร การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ผลจากประตูที่ได้โดยผู้เล่นชาวต่างชาติในการแข่งขันฟุตบอลไทยพรีเมียร์ลีกซึ่งจัดอยู่ในอันดับที่ 8 ของเอเชีย ผลการศึกษาพบว่าจำนวนประตูที่ได้โดยผู้เล่นชาวต่างชาติส่งผลต่อผลการแข่งขันอย่างมีนัยสำคัญทางสถิติทั้งในรูปของจำนวนประตูที่ได้หรือผลการแข่งขันชนะ-เสมอ-แพ้ นอกจากนี้ ความได้เปรียบของการเป็นเจ้าบ้านยังส่งผลต่อผลการแข่งขันอย่างมีนัยสำคัญทางสถิติ ขณะเดียวกัน เมื่อวิเคราะห์จำนวนประตูที่ได้โดยผู้เล่นในประเทศพบว่าจำนวนประตูดังกล่าวเป็นปัจจัยเสริมที่มีผลต่อความสำเร็จในการแข่งขันเช่นกัน

คำสำคัญ: ผลการแข่งขัน, ผู้เล่นต่างชาติ, ไทยพรีเมียร์ลีก, ปัวซงอิสระ, ลอจิสติกอันดับ

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Assessing Impact of Goals by Foreign Players on Football Match Outcomes using Poisson and Ordered Logistic Regression Models: An Evidence from Thailand Premier League

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Abstract

Foreign football players have been widely accepted for their competitive and complementary effects on the success of both national and club levels. This study investigates the contributions from the goals scored by the foreign players in the Thailand premier league, which is a top-eight league in Asia. Using the match- level data, the goals by foreign players have a strong and positive impact on the match outcomes either as the team's total number of goals or the win-draw- lose results. In addition, home advantage also has the considerable positive and negative effects, respectively on the match outcomes. The similar analysis is also performed for the case of goals by local players and reveals the complementary effect of the goals by foreign players.

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1. Introduction

The professional football league in Thailand was first introduced in 1996 by the Football Association of Thailand (FAT). Football is one of the most popular sports in Thailand but in the early years its league was not very successful. In 2008, the Asian Football Confederation (AFC) announced "Vision Asia" aiming to raise the standards of Asian football at all levels and link football with the business engagement. As a result, FAT strongly promoted and supported the development of professional football clubs. That helped generate financial flows to the clubs so that they can support the players and build fan bases. This becomes the turning point for the football industry in Thailand where the number of supporters increased dramatically and the clubs can have more flexible strategies to improve and compete in the league. One of the key strategies that might underlie the success of football clubs is recruiting foreign players into their team. In many cases, foreign players are believed to have higher quality and superior to Thai players.

As many football clubs in Thailand realized the benefit of having foreign players in their squad, the number of foreign football players increased dramatically over the years since 2008. However, the policy to limit number of foreign players becomes effective in 2015 where football clubs are allowed to have a quota of five foreign players in their team. This policy aims to provide more chances for Thai players and raises the domestic standards. Football clubs, on the other hand, have to be selective and recruit only quality foreign players in response. It is widely perceived that the foreign players contribute significantly to the team performance, especially, through the match results. This is our main aim to investigate in this study.

The role of foreign players has been investigated in both national and club levels. Royuela & Gásquez (2019) found a majority of prior research focused on the effect of foreign players on the performance of the national team where the benefit from spillover effect was discovered. Hence, they analyzed the influence of foreign players in the club level using the model previously developed and implemented by Bernard & Busse (2004) and Gásquez & Royuela (2016). Their model used the Elo rating score as a proxy for football success that implies the club performance. While controlling the effects from economic, demographic, institutional, and other factors, Royuela & Gásquez (2019) included the proportion of foreign players to investigate their impact and found the foreign players contributed to the success of club performance.

In this study, we analyze the role of foreign players deeper in the game level. Precisely, we quantitatively assess that role through the number of goals scored by the foreign players and its contribution to the match results including the total number of goals and the win-draw-lose status. We also control the effects from the yellow and red cards, the home advantage, and the first-goal status on the match results, which, to our knowledge, were rarely considered previously. To make a fair comparison, we also perform the similar assessment for the number of goals scored by the native or local players. This can help us to determine whether the impact from the goals by foreign players is substitutionary or complementary.

Our study is not only the first that attempts to examine the role of foreign players from the game-level perspective, using the number of goals, on the match results, but it also analyzes the game data from a southeast Asian nation with the flourishing football league. Note that in 2020 Thailand premier league was ranked the fourth in the east region or the eight in Asia by AFC. Using the Poisson and ordered logit regression models, respectively, for the total number of goals and the win-draw-lose status, our results suggest that the number of goals scored by the foreign players and the home advantage have the significantly positive impact on the match results. The two regression models also allow us to obtain the marginal probabilities of total goals with respect to each goal scored by foreign players.

The organization of this paper is as follows: Section 2 reviews the relevant literature and provides the conceptual background. Section 3 discusses the data and methodology. Section 4 presents the results. Section 5 concludes.

2. Literature Review and Conceptual Background

The internationalization of football players has a long history but not until the late twentieth century where the influx of foreign players increased dramatically, especially in England. The growing literature on the effect of foreign players reflected this phenomenon. As shown and reviewed by Royuela & Gásquez (2019) and references therein, the majority of prior works mainly investigated the benefits of importing foreign players on the national team performance.

Complementarity from skills and competition as a better choice are considered to be the major benefits of having foreign players. Many studies concluded that the foreign players had the positive effect on the performance either in the national or in the club level, see Baur & Lehmann (2007), Binder & Findlay (2012),

Berlinschi, Schokkaert, & Swinnen (2013), and Royuela & Gásquez (2019), among others. However, the effect of goals scored by foreign players on the game level or the match results has been rarely investigated.

Analysis on the match results (including goal counts) and the determinants has been well implemented, see Maher (1982), Dixon & Coles (1997), Dixon & Robinson (1998), Karlis & Ntzoufras (2003), Brechot & Flepp (2020), and Pearson, Livingston, & King (2020), among others. Goddard (2005) developed two structural regression models for football forecasting and compare the effectiveness in predicting match outcomes. The first model estimates the number of goals scored or conceded and implies that as the match outcome and team performance. This model treats the number of goals as a count variable that can be predicted using the bivariate Poisson regression. The second model, on the contrary, estimates the match results in the ordinal manner, which is classified as win, draw, and lose. Econometrically, this is a limited dependent model that can be estimated using the ordered regressions such as logit and probit, see e.g. Forrest & Simmons (2000), Goddard & Asimakopoulos (2004), and Forrest, Goddard, & Simmons (2005).

Apart from the ordinal models, there are two other models that are widely mentioned in the field of sport econometrics; the Maher-Type model and the point process model (McHale & Baker, 2014). In the Maher-Type model, the model accounts for the attacking and defending abilities of the team and assumes the number of goals by home and away team is the independent Poisson random variables, which are determined by attacking and defending abilities. The number of goals is predicted based on the ability of the team itself interacting with the opponent's factors, and construct to be a likelihood to score. However, the model entails some shortcomings, which relate to whether the assumptions hold, and the model is only able to capture a static situation. Dixon & Coles (1997) developed a model to overcome these shortcomings by adding a parameter to effectively inflate the probabilities of certain scores that occurred. It gives more dynamic to the estimation by putting more weight in the likelihood of the matches occurring more recently. Developed by Dixon and Robinson (1998), the point process model considers the changing game to predict the match outcome at any point during the game. However, this model is mainly essential for the professional analysis and the betting market as it requires large sets of data including the timing of the events.

There remains an issue regarding the model selection between individual and bivariate Poisson models. The bivariate Poisson model was proposed by Karlis & Ntzoufras (2003) to allow the correlation of scores by the two opposing teams so that the prediction power can be improved. However, Groll, Schauberger, & Tutz (2015) found that if the highly informative covariates of both teams, e.g., home status, are included, the independent Poisson model with the linear predictors might already be sufficient. In addition, Pearson, Livingston, & King (2020) compared three different models including the independent Poisson, Dixon & Coles (1997), and bivariate Weibull count models for the outcome prediction for five leagues from five different countries. They found that the independent Poisson model outperformed the other two models in three leagues.

In this study, we use two approaches from Goddard (2005) to model the match outcomes from the goals and the win-draw-lose results. However, in the first approach, we use the independent Poisson regression model for the number of goals scored and conceded by each team where the home status is included as a covariate. While in the second approach, we use the ordered logit model for the three match results. Since our main objective to investigate the effect or the contribution of foreign players on the match outcomes, we also include the number of goals scored by foreign players as a covariate. In addition, the numbers of yellow and red cards are included as the covariates because they are often quoted as an adverse effect on the match outcomes. First goal is only an additional covariate to assess its effect on the match results in the ordered logit model.

3. Data and Methodology

3.1 Data

The data we used in the analysis are the match outcomes (number of goals and win-draw-lose results) and other relevant information from the Thailand premier league (TPL) in 2015. This is one of the peak years for TPL in which the complete and stable results can be obtained. (For example, in the 2016 season there were some technical issues that caused the suspension of the competition after 31 matches played. After that the TPL popularity has been decreasing, partly due to the national team's worsening performance.) In 2015, the league consists of 18 participating teams where three of them were promoted from the lower division. Throughout the season, the teams played in home-away matches that return 306 matches in total or 612 observations for the analysis. Note that the data were collected from the match fixtures provided by online newspaper websites and were cross-checked with the official results published on Wikipedia.

3.2 Models and Estimation

To assess the game-level effect of goals scored by foreign players, we model the match outcomes using the independent Poisson regression for the number of goals and the ordered logit regression for the win-draw-lose results. In the first model, the contribution of foreign players is examined through the number of goals they score to the total number of goals made by their team. Given the covariates, the (conditional) expected number of goals or the incidence rate (λ_i) for the model is given by

$$\lambda_i = \exp\left(\beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i\right) \tag{1}$$

where i= 1, 2, 3, ..., 612 is the observation index, fgoal is the total number of goals scored by the team's foreign players, lgoal is the total number of goals scored by the team's local players, home is the dummy variable indicating the hosting status where 1 is the home team and 0 otherwise, and yellow and red are the number of the yellow and red cards, respectively, made by the team.

The Poisson regression provides the information on how the goals scored by foreign players have an impact on the team performance in creating goals. The estimated regression coefficients can be interpreted in terms of incidence rate ratios (IRR) that imply the frequency of the incidence. The IRR explains the rate at which the incidence occurs under specific time and conditions. In this case, the IRR is the ratio of the expected number of goals from a unit increase in each covariate to the expected number of goals. We expect the number of goals scored by foreign players and the home advantage have the positive effect on the final score while the yellow and red cards might have the negative effect.

In the second model, we analyze the win-draw-lose results using the ordered logistic (logit) regression where the differences in the ordered results are assumed to be non-linear, i.e., the difference between win and draw is not the same as that of lose and draw. In the analysis, we code the win, draw, and lose results as 2, 1, and 0, respectively. Let y denote the match results and y^* denote the latent or unobserved value. The ordered logit model is then given by

$$y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i \tag{2}$$

where y = 0 if $y^* \leq \mu_1$, y=1, if $\mu_1 \leq y^* \leq \mu_2$, y = 2 if $\mu_2 \leq y^*$, μ_1 and μ_2 are the unobserved levels, firstgoal is the dummy variable taking the value of 1 if the team scores the first goal and 0 otherwise, and ϵ is the error term. The firstgoal variable is included to determine whether scoring the firstgoal has a positive effect on the match results.

The coefficients of the ordered logit regression can be interpreted in terms of changes in log odds of getting a better match outcome. These coefficients might be better interpreted by exponentiating into odds ratios. The odds ratios indicate the times of changes in factors influencing the match results in getting a win compared to draw or lose. Moreover, the specific impact of having goals scored by foreign players on changing outcomes is examined from the marginal probability. The marginal probability indicates the probability of getting certain match results when foreign players score an additional goal for each number of goals scored.

In both models, the estimation is made through the maximization of the corresponding log-likelihood using Stata statistical software package. In the Poisson regression model, the robust estimation is implemented to maintain the assumption that the expectation or the mean and the variance of y are equal. Hence, we obtain the robust standard errors for inference. In addition to the model spefication in equations (1) and (2), we also substitute the number of goals by local players for that of foreign players and put both of them in the models for a fair comparison and to assess whether the impact of goals scored by the foreign players is substitutionary or complementary.

4. Results

4.1 Data Description

Table 1 shows the summary statistics of total goals from all players and the goals from foreign players. In the 2015 season, there were 870 goals scored in total in which 56.67% of them were scored by the foreign players. On average, there were approximately 1.42 goals scored by each team in a particular match. From Figure 1, it can be seen the total goals and the goals by foreign players are not equally dispersed. In addition, the indices of dispersion of total goals from all players and the goals from foreign players in Table 1 are slightly greater than 1. Hence, the corresponding distribution follows a geometric or negative binomial distribution. However, we examined the over-dispersion by testing the likelihood function between the Poisson and the negative binomial regression for each model, as suggested by Cameron & Trivedi (1990) and Hilbe (2007), and found the distribution is not over-dispersed. We can then use Poisson regression for the total goals. The highest recorded number of goals scored by a team in a match was achieved by Muangthong United and Buriram United, in which both of them had the clean-sheet (7-0) win over the opponents. Particularly for Buriram, it is also the match with the highest number of goals scored by the foreign players at 6 goals. See Table 2 for the 2015 season league table.

Table 1 Summary Statistics for Number of Goals

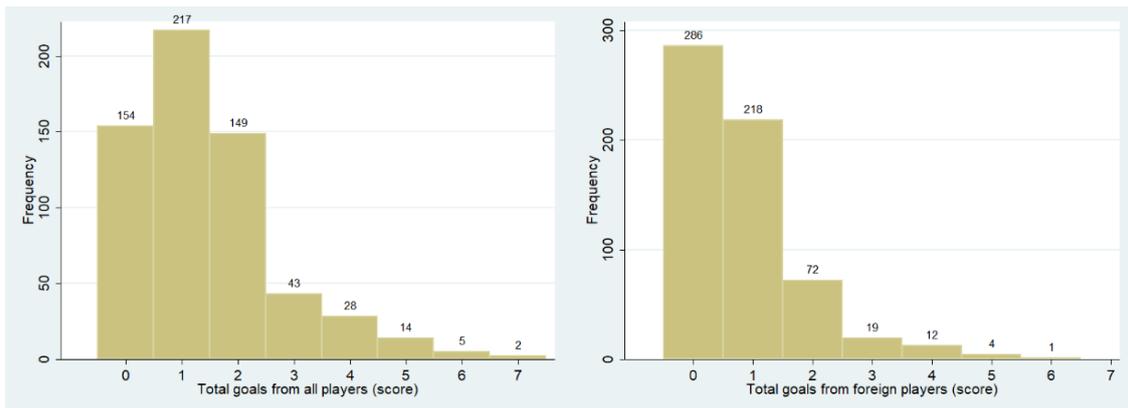| Variable	Sum	Average	S.D.	Min	Max	Index of Dispersion
Total Goals	870	1.4216	1.3042	0	7	1.1959
Goals by Foreign Players	493	0.8056	0.9974	0	6	1.2350

Figure 1 Distribution of Number of Goals

The performance of the foreign players throughout the season seems to be consistent across the game results (Table 3) and the hosting status (Table 4). The remarkable contribution of the goals by foreign players can be seen from the average and the proportion of goals, shown in Table 3, that account for more than half of what their team can achieve in total. The highest proportion of goals came with the draw result. Interestingly, even when the team lost, the foreign players still scored more than their local teammates. Similarly, the hosting status shown in Table 4 didn't deter the foreign players' performance where they scored more in the home games.

In addition to examining the effect of goals scored by foreign players, we also consider the home advantage or the hosting status as a determinant of the match outcome. Table 5 shows the number and proportion of games by match result and hosting status. We found that the home advantage returns the better outcome both in terms of (more) win and (less) lose results. This seems consistent with the higher average number of goals scored by the home team in Table 4.

Table 2 2015 League Table

Position	Team	Played	Won	Drawn	Lost	Goals for	Points
1	Buriram United[a]	34	25	9	0	98	84
2	Muangthong United[b]	34	21	8	5	81	71
3	Suphanburi	34	16	11	7	60	59
4	Chonburi[b]	34	15	12	7	62	57[c]
5	Bangkok United	34	16	9	9	59	57[c]
6	Bangkok Glass	34	15	11	8	47	56
7	Ratchaburi	34	17	4	13	48	55
8	Nakhon Ratchasima	34	13	10	11	37	49
9	Chiangrai United	34	12	8	14	42	44
10	Army United	34	11	8	15	43	41
11	Osotspa Samut Prakan	34	10	9	15	40	39
12	Chainat Hornbill	34	9	10	15	42	37
13	Sisaket	34	9	9	16	30	36
14	Saraburi	34	8	11	15	41	35
15	Navy	34	10	5	19	42	35
16	BEC Tero Sasana	34	7	14	13	42	35
17	Port[d]	34	10	3	21	31	33
18	TOT[d]	34	3	7	24	25	16

Source: Wikipedia
Notes: a = champion and qualified to the AFC champion league group stage
b = qualified to the AFC champion league play-o
c = Chonburi got the better head-to-head results
d = relegated

Table 3 Average and Proportion of Goals by Foreign Players and Match Result

Match Result	Average		Proportion of Goals by Foreign Players
	Total Goals	Goals by Foreign Players	
Win	2.4779	1.4159	57.14%
Draw	1.0253	0.6013	58.64%
Lose	0.6491	0.3421	52.70%
Overall	1.4134	0.8056	56.67%

Table 4 Average and Proportion of Goals by Foreign Players and Hosting Status

Hosting Status	Average		Proportion of Goals by Foreign Players
	Total Goals	Goals by Foreign Players	
Home	1.6340	0.9444	57.80%
Away	1.2092	0.6667	55.14%

Table 5 Number and Percentage of Games by Match Result and Hosting status

Match Result	Hosting Status		Total
	Home	Away	
Win	142 (46.40%)	84 (27.45%)	226 (36.93%)
Draw	79 (25.82%)	79 (25.82%)	158 (25.82%)
Lose	85 (27.78%)	143 (46.73%)	228 (37.25%)
Total	306 (100%)	306 (100%)	612 (100%)

Notes: Number in the parenthesis is the percentage of games.

The other variables taken into consideration are the number of yellow and red cards. From Table 6, it is interesting to see that the teams with 4 or more yellow cards had the higher percentage of winning than losing and drawing. This is probably caused by the attacking strategy of the teams to get the better results. However, the teams with 1-3 yellow cards were likely to lose. This implies that the yellow card is not only a sign of punishment that suppresses the team performance but it can also indicate how the team play, especially, with a more aggressive strategy. Similarly, the teams with red cards were likely to lose. That means the red card is associated with a chance of losing.

Table 6 Number and Percentage of Games by Number of Yellow and Red Cards and Match Result

Match Result	Yellow Card			Red Card		
	0	1-3	≥ 4	0	1	2
Win	59 (43.38%)	130 (34.03%)	37 (39.36%)	214 (38.56%)	12 (22.22%)	0 (0.00%)
Draw	26 (19.12%)	103 (26.96%)	29 (30.85%)	138 (24.86%)	19 (35.19%)	1 (33.33%)
Lose	51 (37.50%)	149 (39.01%)	28 (29.79%)	203 (36.58%)	23 (42.59%)	2 (66.67%)

Notes: Number in the parenthesis is the percentage of games.

4.2 Poisson Regression on Match Outcome

In estimating the impact of goals scored by foreign players on the total number of goals, we use the Poisson regression that also includes other covariates, i.e., the home advantage and the numbers of yellow and red cards. In addition to assessing the effect on match outcome, these covariates also help mitigate the dependence among the number of goals scored by each team, especially the yellow cards that can indicate the team strategy against the opponent. In the Poisson regression, the model treated the dependent variable as the count variable where only a limited set of countable numbers is specified.

Table 7 shows the results from the estimation of the Poisson regression model in three cases where the number goals by local and foreign players are included and excluded. The regression coefficients represent the expected change in log-count of total goals for a one-unit change in the covariates. The major implications of the regression rely on the sign and the statistical significance of these covariates. Note that the log-count interpretation is generally not useful to some implications, however, its transformation, which is discussed below, is more meaningful. We found that the number of goals scored by either foreign or local players, or both have the strong (in terms of statistical significance) and positive effect on the total number of goals where the coefficient from the goals by foreign players is slightly higher.

The home advantage has also the strong and positive effect on the total number of goals when the numbers of goals by foreign and local players are included separately. However, the home advantage turns to be an insignificant factor when both foreign and local players' goals are jointly included. This is possibly due to the fact that the number of goals by both foreign and local players incorporate and mitigate the effect of home advantage. This can also be confirmed by the information from Tables 4 and 5 where the contributions from the goals by home team and the match results can be obviously observed.

The effect from yellow and red cards are not statistically significant when the number of goals by foreign and local players is not included at the same time. However, the effect from yellow card is positively and strongly significant when the number of goals by foreign and local players is all included. This implies the yellow cards are an effective measure as more than two-third of the games resulting in either winning or drawing status when yellow cards were given (see Table 6). Note that a yellow card might be given following a more defensive strategy from the leading team to pretect their results. The McFadden's adjusted pseudo-R2 of 28.4% indicates the reasonable amount of variation in the dependent variables can be explained by the variation in the covariates when the goals by foreign and local players are both included. This seems to be best-fitted model as its McFadden's adjusted pseudo-R2 is higher than those when the two variables are included separately.

Table 7 Estimated Coefficients of Poisson Regression Model for Number of Goals

Variable	(A)		(B)		(C)	
	Coefficient	IRR	Coefficient	IRR	Coefficient	IRR
fgoal	0.4458 ***	1.5618 ***	0.4785 ***	1.6136 ***		
	(0.0237)	(0.0371)	(0.0246)	(0.0396)		
lgoal			0.4712 ***	1.6019 ***	0.4255 ***	1.5257 ***
			(0.0292)	(0.0468)	(0.0363)	(0.0554)
home	0.1284 **	1.1370 **	0.0482	1.0494	0.1837 ***	1.2017 ***
	(0.0541)	(0.0615)	(0.0330)	(0.0346)	(0.0608)	(0.0731)
yellow	0.0055	1.0055	0.0293 **	1.0297 **	-0.0159	0.9842
	(0.0173)	(0.0174)	(0.1240)	(0.0128)	(0.0204)	(0.0201)
red	-0.0615	0.9404	0.0552	1.0568	-0.0540	0.9474
	(0.0778)	(0.0732)	(0.0495)	(0.0523)	(0.0899)	(0.0852)
Constant	-0.2132 ***	0.8080 ***	-0.6596 ***	0.5171 ***	-0.0647	0.9373
	(0.0651)	(0.0534)	(0.0538)	(0.0278)	(0.0743)	(0.0697)
McFadden's Adj R2	0.157		0.284		0.117	
Observations	612		612		612	

Notes: (A) $\lambda_i = \exp\left(\beta_0 + \beta_1 fgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$
(B) $\lambda_i = \exp\left(\beta_0 + \beta_1 fgoal_i + \beta_2 lgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$
(C) $\lambda_i = \exp\left(\beta_0 + \beta_2 lgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$
*** and ** indicate the statistical significance at 1% and 5% level, respectively.
Number in the parenthesis is the robust standard error.

To analyze further, we consider the transformation of the log-count to the incidence rate ratio (IRR) by exponentiating the estimated equation in (1). The IRR shows the rate at which the incidence occurs and can be interpreted in terms of probability. It is the estimated rate ratio for a one-unit increase in goals scored by a player (foreigner or local) given the other covariates being constant. For example in the model where the goals by local players is excluded, if a foreign player were to score an additional goal for the team, the total number of goals is expected to increase by a factor of 1.5618, while holding other covariates constant. This indicates the value of a unit of goal scored by the foreigner is worth more than 1 goal as this might increase the overall performance and help the team to score more goals. When the goals by foreign and local players are all included, the rates are even higher for both of them with a slightly higher rate by the foreign players. This indicates the complementary effect of the goals by foreign players as the goals by local players can also contribute more. For the statistically significant effect from the yellow cards, the IRR coefficient at 1.0297 implies that on average being given (at least) a yellow card is expected to yield the marginally higher number of goals by 1.0297 times.

The impact of goals scored by foreign and local players can also be illustrated using the predicted number of total goals by the team. According to Table 8, when the foreign player scores 1 goal, on average, the team can score 1.3516 goals in total. Similarly, if the foreign players score 2 goals, on average, the team can score 2.1109 goals in total. This implies the value of goals scored by the foreign players is worth more than a goal itself. That means when a foreign player scores the goals, other teammates are likely to perform better and add more goals on the scoreboards. This is clearly an influential and complementary effect on the other teammates. We also obtain the similar results when the goals by local players are included. Note that the contributions made from the goals by the foreign players are non-linear with the exponential increase as the number of goals increases. That is, when the number of goals by the foreign players reaches 6 goals, the predicted total number of goals that can be made by the team is more than 12. This is also the case with the inclusion of local players' goals.

Table 8 Predicted Total Number of Goals of the Team by the Incremental Change of Foreign Players' Goals

fgoal	(A)			(B)		
	Predicted Total Goal	[95% CI]		Predicted Total Goal	[95% CI]	
0	0.8654	0.7884	0.9424	0.75226	0.7026	0.8026
1	1.3516	1.2720	1.4311	1.2144	1.1710	1.2577
2	2.1109	1.9887	2.2331	1.9595	1.8564	2.0627
3	3.2968	3.0100	3.5836	3.1619	2.8636	3.4603
4	5.1489	4.4952	5.8026	5.1021	4.3866	5.8176

Notes: (A) $\lambda_i = \exp(\beta_0 + \beta_1 \text{fgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i)$
(B) $\lambda_i = \exp(\beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i)$
CI = Confident Interval

To make a fair comparison, we also calculate the total predicted goals resulting from the goals by local players (Table 9). We found in both cases that the contribution from the local players' goals is slightly higher than those of foreign players. Note that the total predicted goals from the local players' goals in the case where both variables are included are higher when the local players' goals are four or more. This indicates the complementary effect to both goals by foreign and local players.

Table 9 Predicted Total Number of Goals of the Team by the Incremental Change of Local Players' Goals

lgoal	(B)			(C)		
	Predicted Total Goal	[95% CI]		Predicted Total Goal	[95% CI]	
0	0.8277	0.7768	0.8786	0.9917	0.8993	1.0842
1	1.3260	1.2769	1.3750	1.5131	1.4226	1.6037
2	2.1240	1.9665	2.2815	2.3087	2.0944	2.5229
3	3.4025	2.9697	3.8352	3.5224	2.9793	4.0656
4	5.4504	4.4543	6.4464	5.3743	4.1837	6.5650

Notes: (B) $\lambda_i = \exp(\beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i)$
(C) $\lambda_i = \exp(\beta_0 + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i)$
CI = Confident Interval

Note that we want to consider the relationships among the total number of goals, the number of goals by foreign players, and the number of goals by local players through correlation coefficients. We found the higher correlation of 0.75 between the total number of goals and the goals by foreign players whereas the correlation between the total number of goals and the goals by local players is slightly lower but still high at 0.65 while there is almost no correlation between the goals by foreign and local players at -0.028. This is merely a rough estimate of the relationships among variables as we understand the linear correlation we used is not an appropriate measure of the count data. Note, however, that based on the calculated correlations we can deduce the goals by foreign players are rather complementary than substitutionary.

We also assess the impact of the number of goals scored by both foreign and local players and match results where we separate the results into win, draw, and lose, and estimate the Poisson regression for each of them. From Table 10, we found that goals by foreign players still contribute significantly in all results with the increasing scale from win to lose. This reflects the remarkable contributions from the goals by foreign players, especially when the team faces difficult situations. Indicated by the negative coefficient, the yellow cards may lead to lower chances of getting more goals from the limited players' abilities and result in the loss status. On the other hand, the red cards seem to have a statistically and positively significant effect on the total goals when the team wants to equalize the match outcome. Including the yellow and red cards as the covariates in the model clearly justify the use of independent Poisson as the cards reflect the defending strategy.

The similar results were also obtained in the case where the only goals by local players are included. However, the adverse effect from yellow cards is obvious when the team won. This can be caused by the cautious strategy that the team got the yellow cards to protect their results where the local players scored more goals. Note that when both the number of goals by foreign and local players are included, the effects from the goals by foreign players are slightly higher than those of local players in all three match results. Being the host now turns to be disadvantageous as the coefficient in the case of win is negative and statistically significant. This is possibly due to the fact that the home team scored less. Though not statistically significant, this effect can also be observed when the goals by foreign and local players are not jointly analyzed. The positive coefficients from the hosting status when the team lost also confirmed this effect. High pressure from the fans might be a contributing factor to the limited abilities to score for the home team.

The contributions from the goals made by the foreign and local players towards the team's total goals are also evident from the predicted total number of goals in the win-draw-lose results, see Tables 11 and 12, respectively. When the foreign players score no goals, the other teammates contribute differently by the order of the results. It is higher when the team wins and lower when the team, respectively, draws and loses. With the goals by foreign players, it is not only the incremental increase in the predicted total goals but also the contributions that make a substantial difference, especially when the team faces more difficult situations. For example, in the case of win in Model (A) from Table 11, when foreign players score one additional goal from 0 to 1, the predicted total number of goals increases from 1.6772 to 2.1351 indicating the approximate contribution of additional 0.5 goals. These contributions slightly increase when they score more goals. On the other hand, when the team draws or loses, the contributions from foreign players are even higher, e.g., in the case of loss, one additional goal from 2 to 3 by foreign players leads to the additional contribution of 5.1 goals. That means, even when the team loses, the contributions from foreign players are substantial but that is not sufficient to produce the preferred results. However, either in the case of the goals by foreign or local players, the complementary effect from both of them is obvious when both of them are jointly included in the model. Note that the purpose of presenting the predicted total goals by match result is only for comparison and assessing the incremental change. The resulting numbers of predicted goals may seem unrealistic but useful to analyze the players' contributions from their goals.

Table 10 Estimated Coefficients of Poisson Regression Model for Number of Goals by Match Result

Variable	(A)			(B)			(C)		
	Win	**Draw**	**Lose**	**Win**	**Draw**	**Lose**	**Win**	**Draw**	**Lose**
fgoal	0.2414 ***	0.6439 ***	1.0248 ***	0.3331 ***	0.9600 ***	1.1917 ***			
	(0.0179)	(0.0620)	(0.0831)	(0.0129)	(0.0705)	(0.0690)			
lgoal				0.3296 ***	1.0386 ***	1.0868 ***	0.2171 ***	0.5710 ***	0.9832 ***
				(0.0146)	(0.0650)	(0.0808)	(0.0189)	(0.0790)	(0.0775)
home	-0.0560	0.0790	0.1790 **	-0.0334 *	0.0073	0.0445	-0.0165	-0.0063	0.2165 *
	(0.00553)	(0.0902)	(0.1224)	(0.0184)	(0.0545)	(0.0936)	(0.0626)	(0.1017)	(0.1166)
yellow	-0.01384	0.0003	-0.0664 *	0.0070	0.0092	0.0554 *	-0.0462 **	0.0457	-0.0014
	(0.0194)	(0.0240)	(0.03925)	(0.0067)	(0.0129)	(0.0329)	(0.0195)	(0.0306)	(0.0450)
red	-0.0910	0.2359 ***	-0.2445	-0.0069	0.0457	0.0897	-0.1001	0.1607 *	0.2127
	(0.1121)	(0.0884)	(0.1553)	(0.0380)	(0.04466)	(0.0976)	(0.1334)	(0.0965)	(0.1858)
Constant	0.5821 ***	-0.5437 ***	-0.9175 ***	-0.0189	-1.2960 ***	-1.7640 ***	0.7408 ***	-0.3919 ***	-1.0384 ***
	(0.0743)	(0.1246)	(0.1380)	(0.0386)	(0.1025)	(0.1247)	(0.0808)	(0.1266)	(0.1516)
McFadden's Adj R2	0.066	0.077	0.142	0.172	0.195	0.307	0.045	0.028	0.132
Observations	226	158	228	226	158	228	226	158	228

Notes: (A) $\lambda_i = \exp\left(\beta_0 + \beta_1 fgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$

(B) $\lambda_i = \exp\left(\beta_0 + \beta_1 fgoal_i + \beta_2 lgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$

(C) $\lambda_i = \exp\left(\beta_0 + \beta_2 lgoal_i + \beta_3 home_i + \beta_4 yellow_i + \beta_5 red_i\right)$

***, **and * indicate the statistical significance at 1%, 5% and 10% level, respectively.

Number in the parenthesis is the robust standard error.

Table 11 Predicted Total Number of Goals of the Team by the Incremental Change of Foreign Players' Goals and Match Result

fgoal	(A) Predicted Total Goal			(B) Predicted Total Goal		
	Win	Draw	Lose	Win	Draw	Lose
0	1.6772	0.6236	0.3674	1.3804	0.4376	0.2720
1	2.1351	1.1873	1.0238	1.9260	1.1429	0.8657
2	2.7180	2.2604	2.8527	2.6872	2.9848	2.9491
3	3.4601	4.3034	7.9492	3.7493	7.7952	9.7102
4	4.4048	8.1930	22.1505	5.2311	20.3582	31.9714

Notes: (A) $\lambda_i = \exp\left(\beta_0 + \beta_1 \text{fgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i\right)$

(B) $\lambda_i = \exp\left(\beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i\right)$

Table 12 Predicted Total Number of Goals of the Team by the Incremental Change of Local Players' Goals and Match Result

lgoal	(B) Predicted Total Goal			(C) Predicted Total Goal		
	Win	Draw	Lose	Win	Draw	Lose
0	1.9000	0.7580	0.3925	1.5588	0.5018	0.2929
1	2.3606	1.3417	1.0492	2.1675	1.4175	0.8685
2	2.9329	2.3749	2.8045	3.0138	4.0048	2.5750
3	3.6440	4.2035	7.4961	4.1905	11.3145	7.6344
4	4.5276	7.4403	20.0367	5.8266	31.9655	22.6350

Notes: (B) $\lambda_i = \exp\left(\beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i\right)$

(C) $\lambda_i = \exp\left(\beta_0 + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i\right)$

4.3 Ordered Logistic Regression on Match Results

In the previous section, we consider the contributions from the number of goals made by foreign players with the comparison to the number of goals by the local players. The contributions were still obvious even we separated the match results into win, draw, and lose. However, scoring goals do not necessarily lead to preferred results. In this section, we pay more attention to the match outcome through the win-draw-lose results using the ordered regression. The key question is whether having foreign players scoring goals raises the probability for the team to win or get a better result and how large the impact of the contribution is. Using the regression coefficients and their odd-ratios (the relative probability of the team getting a win compared to the probability of getting draw and lose) can help answer the question.

The results from Table 13 show from the coefficients that the impact of goals scored by the foreign players is strongly positive and statistically significant. This implies that having foreign players scoring goals induces a higher probability of getting a win or a better result. Having an additional goal scored by the foreign players, there is a 0.8026 increase in the log-odds of getting a better match outcome. However, it is more meaningful to interpret the coefficients in terms of the odd-ratios. That is, the odd ratios of the number of goals scored by foreign players imply that an additional goal by foreign players leads to the odds of getting a win 2.2314 times higher than that of getting a loss or draw, holding other variables constant. This indicates a significant effect of goals scored by foreign players that can help the team to get a win.

Table 13 Estimated Coefficients and Odds Ratio for Ordered Logistic Regression Model on Match Results

Variable	(A)		(B)		(C)	
	Ordered Logit	Odd Ratios	Ordered Logit	Odd Ratios	Ordered Logit	Odd Ratios
fgoal	0.8026 ***	2.2314 ***	1.0761 ***	2.9334 ***		
	(0.1184)	(0.2643)	(0.1312)	(0.3849)		
lgoal			1.1136 ***	3.0452 ***	0.8263 ***	2.2849 ***
			(0.1354)	(0.4123)	(0.1219)	(0.2784)
home	0.4559 **	1.5776 **	0.4234 **	1.5272 **	0.4671 ***	1.5953 ***
	(0.1767)	(0.2788)	(0.1862)	(0.2844)	(0.1767)	(0.2820)
yellow	0.0274	1.0278	0.0486	1.0498	0.0413	1.0422
	(0.0554)	(0.0570)	(0.0569)	(0.0597)	(0.0548)	(0.0571)
red	-0.6502 **	0.5219 **	-0.5950 **	0.5516 **	-0.5909 **	0.5539 **
	(0.3008)	(0.1570)	(0.2836)	(0.1564)	(0.2638)	(0.1461)
firstgoal	2.5208 ***	12.4390 ***	2.1560 ***	8.6363 ***	2.7693 ***	15.9479 ***
	(0.2087)	(2.5959)	(0.2141)	(1.8492)	(0.2012)	(3.2082)
Constant (cut 1)	1.0025	1.0025	1.5948	1.5948	1.0318	1.0318
	(0.1890)	(0.1890)	(0.2168)	(0.2168)	(0.1935)	(0.1935)
Constant (cut 1)	2.8315	2.8315	3.6295	3.6295	2.8631	2.8631
	(0.2187)	(0.2187)	(0.2429)	(0.2429)	(0.2227)	(0.2227)
McFadden's Adj R2	0.263		0.319		0.261	
Observations	612		612		612	

Notes: (A) $y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$
(B) $y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$
(C) $y_i^* = \beta_0 + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$
*** and ** indicate the statistical significance at 1% and 5% level, respectively.
Number in the parenthesis is the robust standard error.

From both the regression coefficients and odd-ratios, the effect from the dummy variable indicating whether the team scored the first goal can lead to a better match result is positive and statistically significant. That means the team scoring the first goal of the match has a higher probability to end up with a better match outcome. In other words, the advantage of the first goal significantly influences the match outcome. The odd-ratios indicate the influential impact of the team that can score the opening goal with the odds ratios of getting a win being 12.44 times higher than the other results. Home advantage is another dummy variable that indicates the positive and statistically significant effect on the match result. That means the home team is likely to get the better results, regardless of number of goals they score. As expected, the number of red cards leads to the worse result while the effect of yellow cards is not statistically significant.

We also obtain the similar results when the number of goals by local players is solely or jointly included. Note that the coefficients from the number of goals by local players are slightly higher than those of the number of goals by foreign players. However, when they were jointly analyzed, the coefficients are obviously higher than the cases where one of them is excluded. This can confirm the complementary effect of the goals by both foreign and local players.

Considering the marginal probability from an additional goal by foreign players reveals some interesting information. Table 14 shows the marginal probability by match result where the number of goals by foreign players is solely included and jointly analyzed with the number of goals by local players. In the case with only foreign players' goals, when foreign players score no goals, that creates a chance of 19.20% for the team to win, and 40.47% to draw, and 40.33% to lose, respectively. As the number of goals scored by foreign players increases, the probability of winning rises exponentially while the probabilities of getting draw and lose decline dramatically. Among the three match results, the probability of win is higher when foreign players score two or more goals. The results from marginal probabilities confirm the significant contribution to the match outcome from the goals scored by foreign players.

Table 14 Estimated Probability of Match Result by Number of Goals from Foreign Players

fgoal	(A)			(B)		
	Win	Draw	Lose	Win	Draw	Lose
0	0.1920	0.4047	0.4033	0.1557	0.4295	0.4148
1	0.3464	0.4211	0.2325	0.3511	0.4543	0.1946
2	0.5419	0.3386	0.1195	0.6134	0.3105	0.0761
3	0.7252	0.2174	0.0573	0.8232	0.1495	0.0273
4	0.8549	0.1186	0.0265	0.9318	0.0588	0.0095

Notes: (A) $y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$
(B) $y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$
Number in the table is the marginal probability.

After the number of goals by local players is included, the marginal probability of win is slightly lower when foreign players score no goals. However, the marginal probabilities of win increase significantly if foreign players start scoring the goals. This again confirms the contribution from the goals by foreign players and their complementary effect to the desired winning result. We also perform the similar analysis for the contribution of goals by local players (Table 15) and find the probabilities of win are obviously lower when the only goals by local players is included, especially when the local players score one or no goals where the probabilities of draw are higher.

Table 15 Estimated Probability of Match Result by Number of Goals from Local Players

fgoal	(A)			(B)		
	Win	**Draw**	**Lose**	**Win**	**Draw**	**Lose**
0	0.2116	0.4146	0.3737	0.1810	0.4473	0.3716
1	0.3802	0.4127	0.2071	0.4023	0.4351	0.1626
2	0.5836	0.3138	0.1026	0.6721	0.2680	0.0600
3	0.7621	0.1903	0.0476	0.8619	0.1176	0.0205
4	0.8798	0.0988	0.0214	0.9500	0.0432	0.0068

Notes: (A) $y_i^* = \beta_0 + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$

(B) $y_i^* = \beta_0 + \beta_1 \text{fgoal}_i + \beta_2 \text{lgoal}_i + \beta_3 \text{home}_i + \beta_4 \text{yellow}_i + \beta_5 \text{red}_i + \beta_6 \text{firstgoal}_i + \epsilon_i$

Number in the table is the marginal probability.

In summary, the findings from this study indicate foreign players' goals can make a substantial contribution to the match results in TPL in 2015. However, we only focus on the effect of goals on match results, which is only one aspect of many from the foreign players and TPL. There are still other interesting topics for TPL such as financing, coaching, and influences for national performance but we leave these for future research.

5. Conclusion

Foreign players have been considered as a key factor to many football clubs' success in Thailand. As a result, its football league is flourishing and now ranked a top eight in Asia. This study examines the contribution from the number of goals scored by the foreign players towards the match outcome, both in terms of the total number of goals and the win-draw-lose results. The estimation results from the Poisson regression model on the total number of goals reveals that each goal is scored by foreign players is worth more than a goal in total made by their team. Precisely, an additional goal by the foreign players has an influence on the overall team's performance, which creates an exponential increase in the team's total number of goals. Interestingly, this contribution is highest when their team does not perform well, e.g., when it loses. The similar analysis from the number of goals by local players also reveals the complementary effect from the foreign players' goals

Furthermore, the evidence from the ordered logistic regression model on the match results shows that the goals scored by the foreign players yield a higher probability of getting the better match results. When the number of goals by foreign players increases, the probability of getting a win rises exponentially while the probabilities to lose or draw drop significantly. These probabilities of win are even higher when both of the numbers of goals by foreign and local players are included.

In addition to the contribution by the foreign players, this study also considers the effect from other factors including the red and yellow cards, the home advantage, and the first goal (in the case of match results), on the match outcome. We found that the home advantage has a higher probability to win. While the teams that score the first goal have a higher chance to win, the red cards create the opposite effect. Based on the results from this study, we can conclude that the number of goals by foreign players contribute significantly and complementarily that leads to success in both the club and league levels in Thailand. There are also other interesting topics for TPL such as financing, coaching, and influences for national performance but we leave these for future research.

6. Acknowledgements

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