



RELATIONSHIP BETWEEN PLAYER PERFORMANCE AND SALARY IN A PROFESSIONAL BASEBALL LEAGUE

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Abstract:

This study aimed to investigate whether teams in Taiwan's Chinese Professional Baseball League (CPBL) are paying their players fairly and equitably based on their performance. Possible performance criteria of professional baseball players are gathered from past literature before subjecting these criteria to regression analysis to obtain criteria that are significant and their corresponding weights. The TOPSIS method is then used to calculate player performance value, and with Quadrant Analysis, relationship between player performance and salary is analyzed. These were used to project salary adjustment for these players for the coming season. Finally, to determine the fairness of salary adjustments, this study employed McNemar test to examine whether adjustments are made based on player performance. This study has found innings pitched (IP), earned run average (ERA) and walks plus hits per inning pitched (WHIP) to be significant abilities in evaluating performance of pitchers, while for fielders, significant abilities for performance evaluation were batting average (BA), slugging average (SLG), hits (H) and on base percentage (OBP). Based on these derived performance evaluation criteria, more than half of these players gave above average performance, yet their salary adjustments were not made accordingly nor were they made based on the above-mentioned criteria.

Keywords: players' salary, player performance, Chinese Professional Baseball League, performance evaluation, TOPSIS, Quadrant Analysis

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1. Introduction

This year marks the 26th years of professional baseball in Taiwan. Over the years, the Chinese Professional Baseball League (CPBL) has produced many local heroes, some of whom have brought much joy and tears to baseball fans. Yet as each season comes to an end, these professional players not only have to get themselves physically ready for the upcoming season, they need to enter into a tense negotiation over salary with their respective teams too. Even though professional baseball players generally earn higher salaries than other industries in Taiwan, they have a much shorter career span as compared to other professionals. For many professional players, once he loses his chance to compete, he loses his livelihood as well. Unless they are paid well, quality players may not be willing to continue playing in Taiwan, which consequently would hinder the growth and development of CPBL. Thus, the issue of players' salary is not a matter to be overlooked in the development of professional baseball.

Salary is a form of remuneration used by organizations in exchange for their employees to work towards organizational goals. Salaries has been known to influence important organizational indicators such as recruitment and retention of staff, staff performance, staff skill development, development of organizational culture, and influence on organizational structures, operating costs and job satisfaction. Bryson *et al.* (2011) showed that when referees are paid a salary as opposed to a short-term contract, their performance improved. Furthermore, salary has always been a point of contention in industrial relations. Employees hope to get higher salaries while the employers aim to minimize labor cost as much as possible in order to maximize their profits. With only four teams (or not more than seven teams at its peak), CPBL can be categorized as a small professional sports league (San and Jane, 2008). Thus, small demand for players meant that team managements have the market advantage and control over most salary negotiations. Even so, teams must still remunerate theirs players accordingly, based on the players' last season performances. Those who have performed well should be rewarded with salary increases or, the very least, be given the same salary, while players who did not perform as expected should be given a cautioning, either with reduced pay or in more severe cases, being released from his contract. In other words, teams and players within the professional baseball league take on the conventional roles of employers and employees respectively. Consequently, salary adjustment is a valuable instrument in the teams' toolkit for rewarding or cautioning players. Yet how do the teams decide which of their players to reward and which to caution? This is a very tough question to answer for the teams' management.

Performing their utmost best in every single competition is what every professional sports person strives for. Nonetheless, other than being closely linked to the teams' ranking (Hakes and Sauer, 2007), players' performance on field is also influenced by their salaries. Yet what constitutes a good performance? It is to do the right thing, followed by doing the thing right. In other words, identify what constitute effectiveness and then improve on its efficiency. In most competitive sports, victory is secured by obtaining the highest score in the competition as with professional baseball

games all around the world. In the movie *Moneyball* which was based on a nonfiction book by Michael Lewis (2003) of the same name, the general manager Billy Beane said, "Your goal shouldn't be to buy players; it should be to buy wins. And to buy wins you need to buy runs." To win games, baseball teams need to score more runs than their opponent, while stop allowing runs at the same time. In short, a team's ability to accomplish both becomes a critical performance measurement. Furthermore, there are many player performance criteria to take into consideration when negotiating salaries. Thus determining which indicators to use to evaluate baseball players has become a popular research topic for many scholars.

Previous studies on professional sports (including professional baseball and basketball) have shown that team managements tend to only focus on a singular performance indicator (scoring for professional basketball players and scoring wins for professional pitchers) or make decision subjectively when it comes to the determination of player salary (Berri *et al.*, 2007; Hakes and Sauer, 2006, 2007). All professional players hope that their management would recognize their contribution for the past season and be rewarded accordingly. Yet how should teams decide the appropriate remuneration? Decision makers should not only take into consideration a singular performance indicator, nor should they make such important decision subjectively. More than one player performance indicator should be adopted. On approaches to evaluate players, many multi-criteria decision making (MCDM) methods have been utilized. Bodin and Epstein (2000) used Analytic Hierarchy Process (AHP) to rank the players of an existing professional baseball team in the Major League Baseball (MLB), the San Diego Padres, in preparation for their expansion draft. Chen *et al.* (2014) developed an evaluation model, based on a hybrid method of AHP and the Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS) to help teams make the optimal selection for starting pitchers in the CPBL. A model utilizing five different multi-criteria techniques was found to better evaluate performance of cricket teams within the Indian Premier League (IPL) (Dey *et al.*, 2013). In summary, player performance evaluation should be a MCDM problem (Bodin and Epstein, 2000; Chen *et al.*, 2014). Thus, the use of MCDM methods to assess player performance is both appropriate and reasonable. There is an array of MCDM methods available, such as Simple Multiple-Attribute Ranking Technique (SMART), Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Data Envelopment Analysis (DEA), Delhi Scoring Method, TOPSIS and Grey Relational Analysis (GRA). These methods have their advantages and disadvantages when used to solve MCDM problems. Among them is TOPSIS, whose basic principle states that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. It is easily understood and popularly practiced in the Asia-Pacific region (Shih, 2015). Therefore, this study used this method to calculate the overall performance of the players.

TOPSIS method requires both criteria and criteria weights for analysis. Often, weights among the criteria in TOPSIS models are assumed to be equal. There are many tried techniques to allocating weights for these criteria, such as equal weights, SMART, AHP, and Regression Analysis (RA) (Olson, 2001, 2004). These techniques each have

their merits and flaws, and in the real world, criteria weights are seldom equal. Each criterion carries a different weight. While evaluating decision attributes in AHP, cognitive differences may arise among experts that would present a skewed result. In SMART, experts will first rank the criteria based on their importance before calculating the weights for these criteria. Although this method presents a much realistic take, experts' background and preferences could influence the criteria ranking which may in the end affect the weights that will be assigned. This study adopted regression analysis (RA), which has been found to overcome the above mentioned biases, to derive the weights of criteria.

In addition, salaries of professional players have always been shown to have a significant positive relationship to their performance during competition (Berri *et al.*, 2007; Jewell and Molina, 2004; Hakes and Sauer, 2007). Players who are performing well should be better remunerated. Based on John S. Adams' equity theory, Annala and Winfree (2011) found that payroll inequality within a team is negatively related to on-field performance in MLB. Thus, while setting player salaries, team management should not only reference the player's performance but also take salary equality among players of the similar caliber into consideration. Only by adopting an objective and reasonable method in the determination of player salaries can players be persuaded. Most of the previous researches on player salary focused on the relationship between team performance and salary structure (Jane, 2010; Jewell and Molina, 2004) or salary gap (Annala and Winfree, 2011; Borghesi, 2008; San and Jane, 2008), and also the possibilities of salary inequality among players of difference races (Holmes, 2011; McCormick and Tollison, 2001). Yet, few has explored whether players are being paid fairly and equitably by their team management and thus the motivation for this study.

In summary, teams should use more than one performance indicators to evaluate their players and this can be treated as a multi-criteria decision making problem. Also, teams must compare their players' performances with other players of the same level when deciding the salaries they are going to pay their own players. To solve these problems, this study first used regression analysis and TOPSIS method to assess the player performances. Then with the help of quadrant analysis (QA), this study analyzed and explained the relationship between player performance and salary. Finally, this study compares player performances among those of the same level to determine players' annual salary adjustment. Additionally, in order to determine the fairness of salary adjustment, this study employed a nonparametric test, specifically McNemar test, to examine whether these adjustments were made accordingly to player performance.

2. Methodology

2.1 Research framework

In this study, annual performance indexes of regular players and their salaries from the Chinese Professional Baseball League between 2012 and 2015 were used. As baseball is a game where competitions are won by scoring more runs than allowing them, this

study first did a literature search to find technical performance criteria that can be used to evaluation pitchers and fielders. These technical performance criteria were then treated as important factors affecting the teams' abilities to lose and score runs. Next, criteria weights were derived through the use of regression analysis, and player performance value was calculated using TOPSIS. This study then used quadrant analysis (QA) to analyze the relationship between player performance and their annual salaries, and also make a comparison between players with similar performance. Finally, McNemar test, a kind of nonparametric test, was conducted to assess if the new annual salaries paid by Taiwan's professional baseball teams are fair and equitable. The research framework is as illustrated in Figure 1.

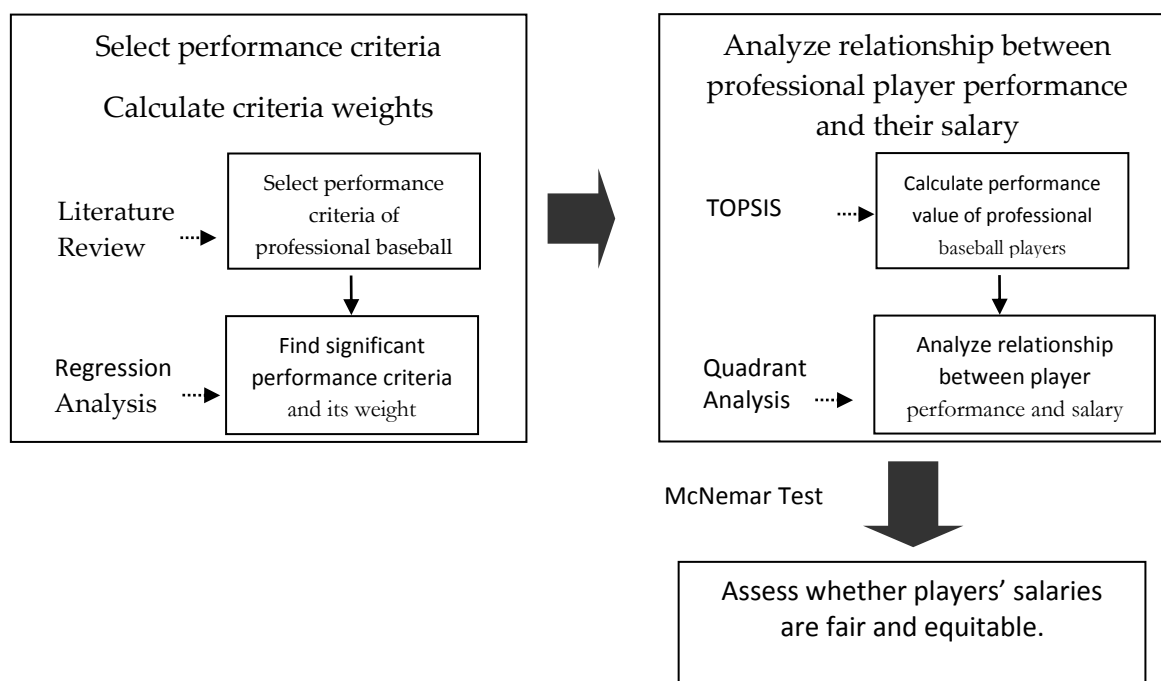


Figure 1: Research Framework

2.2 Performance evaluation criteria for professional pitchers and fielders

To win games, baseball teams need to score more runs than their opponent, while stop allowing runs at the same time. Pitchers need to stop runs, while fielders need to maximize runs. With this in mind, this study has found that innings pitched (IP), earned run average (ERA), strikeouts (K) and walks plus hits per inning pitched (WHIP) to be among the criteria often used to assess the technical abilities of a pitcher (Chen *et al.*, 2011; Chen *et al.*, 2014; Lewis, 2003). For fielders, many studies have utilized hits (H), batting average (BA), steals (S), home run (HR), on base percentage (OBP) and slugging average (SLG) as the technical criteria (Lanoue and Revetta, 1993; Lewis, 2003).

2.3 Data source and limitation

Quantitative performance criteria and player rosters used in this study was obtained through the official CPBL website (<http://www.cpbl.com.tw>). Further, the classification of players, pitcher or fielders, is in accordance with the classification published on the

CPBL website. In addition, although some foreign and local players did play in the league, they were not regular players, thus performance evaluation for these players cannot be adequately done. This information is not included in this study and thus constitutes a limitation to this study.

2.4 Data analysis

2.4.1 Regression analysis

This study first performed a literature search to find technical performance criteria that can be used to evaluate pitchers and fielders. Coefficients of influence (regression coefficient) for performance criteria of both pitchers and fielders can then be derived through the use of stepwise regression analysis. With normalization, weights for each criterion of pitchers and position player are obtained.

2.4.2 TOPSIS

TOPSIS (technique for order performance by similarity to the ideal solution), the concept of distance measures, was initially presented by Hwang and Yoon in 1981 to solve the MCDM problems (Chen *et al.*, 2014; Olson, 2004). The concept of TOPSIS can be expressed in the following steps.

Step 1: Obtain performance data for n alternatives over k criteria. Raw measurements are usually standardized, converting raw measures x_{ij} into standardized measures s_{ij} .

Step 2: Develop a set of importance weights for each of the criteria. For this study, regression analysis was used.

Step 3: Identify the ideal alternative (extreme performance on each criterion) s^+ .

Step 4: Identify the nadir alternative (reverse extreme performance on each criterion) s^- .

Step 5: Develop a distance measure over each criterion to both ideal (D^+) and nadir (D^-).

Step 6: For each alternative, determine a ratio R equal to the distance to the nadir divided by the sum of the distance to the nadir and the distance to the ideal,

$$R = \frac{D^-}{D^- + D^+}$$

Step 7: Rank order alternatives n by maximizing the ratio R in Step 6.

2.4.3 Quadrant analysis

The main objective of this study was to understand the relationship between player performance and their annual salaries, and also to compare players with similar performance, so as to determine whether the salary adjustment for the coming year is fair and equitable. Therefore this study employed Martilla and James' (1977) quadrant analysis (QA) that can be used to allow management to understand the strengths and weaknesses of their organizations (Martins, 2014). By analyzing relative positions of player performance and salaries within the quadrants, this study was able to determine the adjustment direction of players' salaries for the coming year. Figure 2 represents the

QA chart constructed, in which x-axis denotes player performance and y-axis player salary.

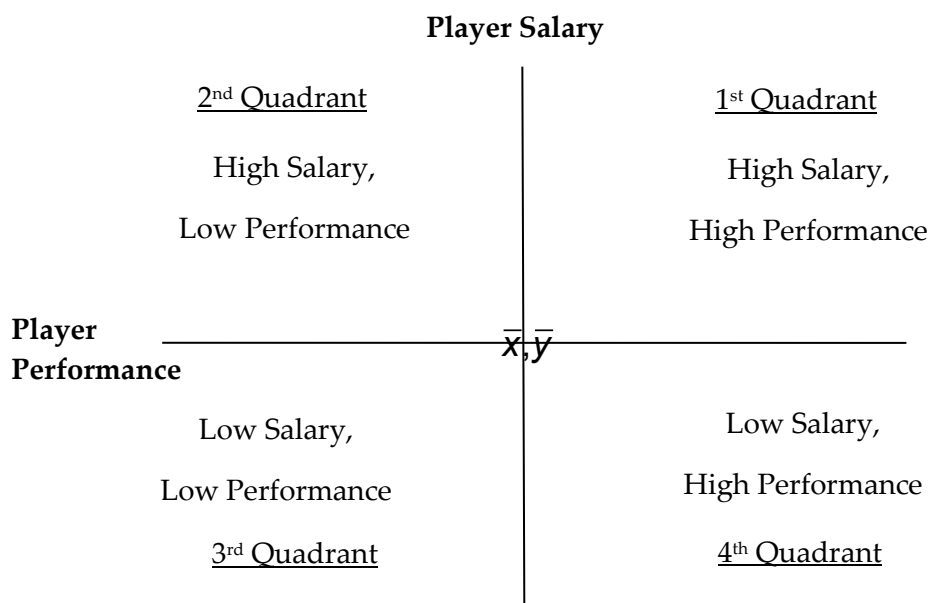


Figure 2: Quadrant Analysis Diagram

When the relative position of player performance and salary falls within the first and fourth quadrant, it is an indication that this particular player has performed well for the current year. The only difference between these two quadrants is that player in the first quadrant was paid a higher salary than player in the fourth quadrant. Thus, teams can decide to increase the salary of players within these two quadrants for the coming year. Conversely, players in the second and third quadrant did not perform well in the current year, while the former earned a higher salary than the latter. For these low performance players, teams can decide to cut their salaries for the coming year or release them from their contracts.

2.4.4 McNemar test

Lastly, this study adopted McNemar test to find out if there is any discrepancies between projected and actual salary adjustment for these players.

2.4.5 Significant level

The level of significance (α) for this study was .05.

3. Results

3.1 Selection of technical performance criteria and weight calculation

Professional baseball matches are won by scoring more runs than allowing them, and abilities to lose and score runs constitute performance criteria that can be used to evaluate pitchers and fielders of teams. This study used annual team win/loss data

taken from official CPBL website, starting from the league’s inauguration game in 1990 to the year 2014. Through the use of stepwise regression analysis, significant technical performance criteria of pitchers and fielders are identified. To evaluate pitchers , this study treated single-season loss records as dependent variables, while taking four technical performance criteria, namely single-season innings pitched (IP), earned run average (ERA), strikeouts (K) and walks plus hits per inning pitched (WHIP) of each players, as independent variables. After applying stepwise regression analysis, only strikeouts (K) was found to be insignificant, thus this study treated innings pitched (IP), earned run average (ERA) and walks plus hits per inning pitched (WHIP) as performance criteria for pitchers (as shown in Table 1). For fielders, this study adopted single-season win records as dependent variables, while six technical performance criteria (hits (H), batting average (BA), steals (S), home run (HR), on base percentage (OBP) and slugging average (SLG)) are counted as independent variables. The results obtained after applying stepwise regression analysis showed hits (H), batting average (BA), on base percentage (OBP) and slugging average (SLG) to be significant. Dropping steals (S) and home run (HR), this study adopted these four performance criteria to assess fielders (as shown in Table 2). In order to determine the suitability of using the above performance criteria to evaluate pitchers’ ability to stop allowing runs and fielders’ ability to score runs, this study found that the explanatory power of pitchers’ technical performance criteria to be 97.7% (adjusted $R^2 = .976$) and the explanatory power of fielders’ performance criteria is 93.4% (adjusted $R^2 = .932$). Both results showed that these selected criteria are able to effectively evaluate the abilities of these professional baseball players.

Table 1: Stepwise regression analysis of performance criteria for the ability of pitchers to allow runs and their weights

Dependent Variable	Independent Variable	Standardized β	<i>t-value</i>	Weights
Loss	IP	.494	26.383*	.404
	ERA	.551	11.487*	.451
	WHIP	.177	3.602*	.145
	<i>F-value</i>	1073.925*		
	R^2	.977		
	ΔR^2	.976		

* $p < .05$

The value of standardized β coefficients are first added together before normalizing to obtain the weights for each technical criterion. After normalizing, the weights obtained are as follows: innings pitched (.404), earned run average (.451) and walks plus hits per inning pitched (.145) for pitchers’ technical criteria. Technical criteria weights for fielders are hits (H), batting average (BA), on base percentage (OBP) and slugging average (SLG) are .398, .199, .178 and .225 respectively.

Table 2: Stepwise regression analysis of performance criteria for the ability of fielders to score runs and their weights

Dependent Variable	Independent Variable	Standardized β	<i>t-value</i>	Weights
Win	H	.820	22.045*	.398
	BA	.409	8.655*	.199
	OBP	.367	8.027*	.178
	SLG	.463	7.055*	.225
	<i>F-value</i>	422.539*		
	R^2	.934		
	ΔR^2	.932		

* $p < .05$

3.2 Relationship between CPBL players' performance and salary

The relationship between salaries of professional players and their performance during competition have always been found to be significantly positive. With this in mind, this study focused on the technical criteria of both pitchers and fielders of CPBL for the year 2012, 2013 and 2014. The TOPSIS method is first used to derive the player performance value and these values are then normalized. With the help of Quadrant Analysis (QA), the relationship between player performance and salary is mapped onto the QA chart so as to assess whether player should be given a pay raise (or no change) or a pay cut (or be released) for the coming year. The following are descriptions of the charts for those three years.

Firstly, for the 2012 season, the CPBL has 133 players, with 51 of them pitchers and the rest fielders. From Table 3 and Figure 3, it can be seen that 17 out of the 51 pitchers were sorted into the 1st Quadrant, 2 pitchers were in the 2nd Quadrant, 12 pitchers in the 3rd Quadrant and 20 were in the 4th Quadrant. Among the 82 fielders, 22 players were sorted into the 1st Quadrant, 2 player in the 2nd Quadrant, 42 players in the 3rd Quadrant and 16 players fell in the 4th Quadrant. Based on this information, this study projects 75 players will get a pay raise or continue to receive the same salary, and 58 players will have their pay cut or be released from their contracts for the 2013 season.

Table 3: Relationship between performance and salary of CPBL players for 2012

Salary Status Quadrant	Pay raise or No change		Pay cut or Release	
	1 st Quadrant	4 th Quadrant	2 nd Quadrant	3 rd Quadrant
No. of Pitchers	17	20	2	12
No. of Fielders	22	16	2	42
No. of Players Evaluated	75		58	

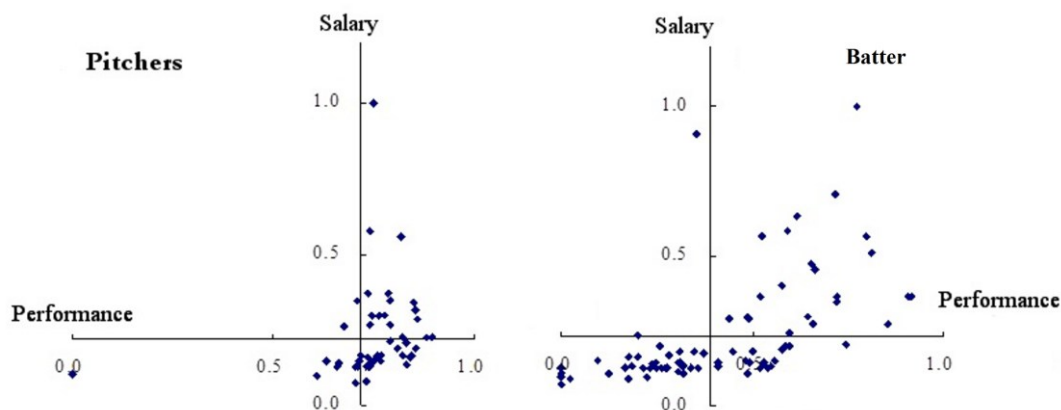


Figure 3: Quadrant charts for player performance-salary relationship for 2012

In the season of 2013, the CPBL has 164 players playing in the league, with 69 pitchers and 95 fielders. Again, through using QA, 23 pitchers were placed in the 1st Quadrant, 18 pitchers were in the 3rd Quadrant and 28 pitchers were in the 4th Quadrant. No pitcher was sorted into the 2nd Quadrant. Similarly, 28 fielders out of 95 were sorted into the 1st Quadrant, 7 were in the 2nd Quadrant, 35 were in the 3rd Quadrant and 25 fell in the 4th Quadrant (Table 4 and Figure 4). Based on these information, this study projects that for the coming 2014 season, 104 players will get a pay raise or continue to receive the same salary, and 60 players will have their pay cut or be released from their contracts.

Table 4: Relationship between performance and salary of CPBL players for 2013

Salary Status Quadrant	Pay raise or No change		Pay cut or Release	
	1 st Quadrant	4 th Quadrant	2 nd Quadrant	3 rd Quadrant
No. of Pitchers	23	28	0	18
No. of Fielders	28	25	7	35
No. of Players Evaluated	104		60	

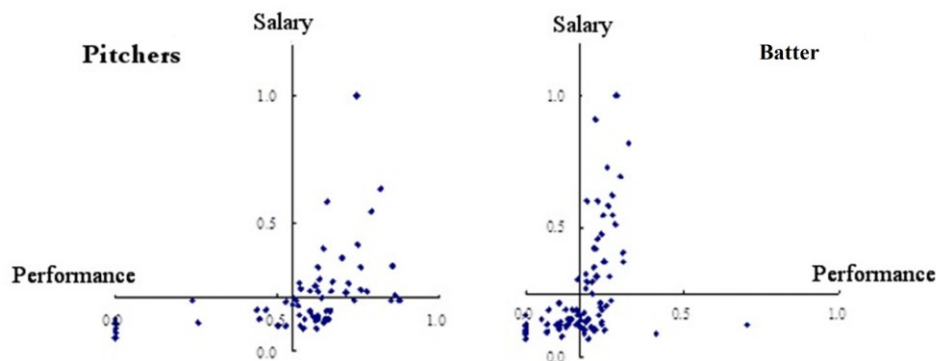


Figure 4: Quadrant chart for player performance-salary relationship for 2013

The Chinese Professional Baseball League has 197 players playing in the 2014 season. Among them 81 are pitchers and 116 are fielders. As can be seen from Table 5 and Figure 5, 21 out of the 81 pitchers were sorted into the 1st Quadrant, 2 pitchers were in the 2nd Quadrant, 21 pitchers in the 3rd Quadrant and 37 were placed in the 4th Quadrant. Among the 116 fielders, 28 players were put in the 1st Quadrant, 6 players in the 2nd Quadrant, 59 players in the 3rd Quadrant and 23 players fell in the 4th Quadrant. Based on this information, this study projects that for the 2015 season, 109 players will get a pay raise or continue to receive the same salary, and 88 players will have their pay cut or be released from their contracts.

Table 5: Relationship between performance and salary of CPBL players for 2014

Salary Status Quadrant	Pay raise or No change		Pay cut or Release	
	1 st Quadrant	4 th Quadrant	2 nd Quadrant	3 rd Quadrant
No. of Pitchers	21	37	2	21
No. of Fielders	28	23	6	59
No. of Players Evaluated	109		88	

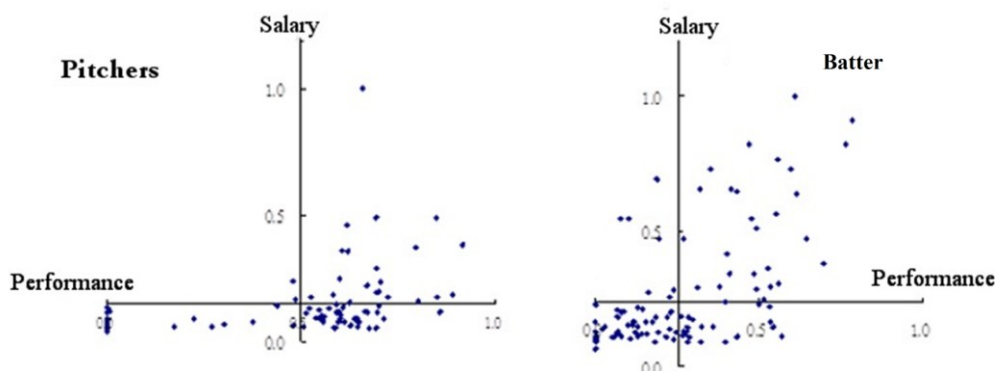


Figure 5: Quadrant charts for player performance-salary relationship for 2014

3.3 Fairness and equitability of CPBL players' salary

When the 2012 season ended, teams in the CPBL have to decide the salaries of their 133 players for the coming 2013 season. Should they be given a pay raise or a pay cut? Should they be released from their contracts? Or should they continue to receive the same salary?

Table 6: Salary projection and actual outcome for CPBL players for 2012

Position	Projected Outcome	Actual Outcome		Total	Accuracy Rate	McNemar test <i>p-value</i>
		Pay raise or No Change	Pay cut or Release			
Pitchers	Pay raise or No Change	26	11	37	73%	.057
	Pay cut or Release	3	11	14		
	Total	29	22	51		
Position Players	Pay raise or No Change	27	11	38	51%	.007*
	Pay cut or Release	29	15	44		
	Total	56	26	82		
Overall	Pay raise or No Change	53	22	75	59%	.221
	Pay cut or Release	32	26	58		
	Total	85	48	133		

* $p < .05$

Based on the information shown in Table 6, 29 out of the 51 pitchers in the CPBL were given actual pay raise (or the same salary) by the their teams and 22 pitchers did suffer a pay cut (or were released from their contracts) for the coming 2013 season. Compare these with this study's projection of 37 pitchers getting a pay raise (or the same salaries) and 14 pitchers suffering a pay cut (or be released from their contracts), the study's projection accuracy is 74%. Further, for the coming 2013 season, teams in the CPBL gave

56 fielders actual pay raise (or the same salary) and cut the salary of (or released) 26 fielders. Again, compare with this study's projection of 38 fielders getting a pay raise (or keep the same salary) and 44 players suffering a pay cut (or be released from their contracts), the accuracy is 51%. From among the 133 players (both pitchers and fielders) who had played in the 2012 season, 85 players did receive a pay raise (or the same salary) from their teams while 48 players suffered a pay cut (or were released from their contracts) for the coming 2013 season. The projection provided by this study only had an accuracy rate of 59%, as this study projected 75 players be given a pay raise (or the same salary) and 48 players be given a pay cut (or released from their contracts).

Table 7. Salary projection and actual outcome for CPBL players for 2013

Position	Projected Outcome	Actual Outcome		Total	Accuracy Rate	McNemar test <i>p-value</i>
		Pay raise or No Change	Pay cut or Release			
Pitchers	Pay raise or No Change	34	17	51	64%	.108
	Pay cut or Release	8	10	18		
	Total	42	27	69		
Position Players	Pay raise or No Change	48	5	53	68%	.001*
	Pay cut or Release	25	17	42		
	Total	73	22	95		
Overall	Pay raise or No Change	82	22	204	66%	.178
	Pay cut or Release	33	27	60		
	Total	115	49	164		

* $p < .05$

At the end of 2013 season, teams in the CPBL have to decide the salaries of their 164 players for the coming season. Out of the 69 pitchers, 42 pitchers were awarded a pay raise (or the same salary), while 27 pitchers were slapped with a pay cut (or released from their contract). Compare with this study's projection of 51 pitchers getting a pay raise (or the same salary) and 18 pitchers suffering a pay cut (or be released from their contracts), the projection accuracy rate is 64%. For the 95 fielders, teams have decided to give 73 of them a pay raise (or the same salary), and to dock the salary of (or released) 22 fielders for the coming season. Again, compare these with this study's projection of 53 fielders getting a pay raise (or the same salary) and 42 players suffering a pay cut (or be released from their contracts), the projection accuracy is 68%. Among the 164 players who had played in the 2013 season, 115 players did receive a pay raise (or the same salary) while 49 players suffered a pay cut (or released from their contracts) for the coming 2014 season. As shown in Table 7, this study's projection had an accuracy rate of 66%.

Table 8: Salary projection and actual outcome for CPBL players for 2014

Position	Projection Outcome	Actual Outcome		Total	Accuracy Rate	McNemar test <i>p-value</i>
		Pay raise or No Change	Pay cut or Release			
Pitchers	Pay raise or No Change	35	23	58	52%	.337
	Pay cut or Release	16	7	23		
	Total	51	30	81		
Position Players	Pay raise or No Change	46	5	51	59%	.000*
	Pay cut or Release	43	22	65		
	Total	89	27	116		
Overall	Pay raise or No Change	81	28	109	56%	.001*
	Pay cut or Release	59	29	88		
	Total	140	57	197		

* $p < .05$

Once again, the annual salary adjustment commenced when the 2014 season ended. From Table 8, it can be clearly seen that when the 2014 season ended, the four teams in the CPBL decided to give 51 pitchers, out of a total of 81 pitchers, a pay raise (or the same salary), and to cut the salary of (or release) 30 pitchers. The projection provided by this study only had an accuracy rate of 52%, as this study projected 58 pitchers getting a pay raise (or the same salary) and 23 pitchers suffering a pay cut (or be released from their contracts). Further, for the coming 2015 season, CPBL gave 89 fielders actual pay raise (or the same salary) and cut the salary of (or released) 27 fielders. Again, compare these with this study's projection of 51 fielders getting a pay raise (or the same salary) and 65 players suffering a pay cut (or be released from their contracts), the projection accuracy is 59%. From among the 197 players who had played in the 2014 season, 140 players did indeed receive a pay raise (or the same salary) while 57 players suffered a pay cut (or released from their contracts) for the coming 2015 season. As shown in Table 8, the projection provided by this study only had an accuracy of 56%, as this study projected 109 players getting a pay raise (or the same salary) and 88 players suffering a pay cut (or be released from their contracts).

In order to assess if the annual salaries paid by CPBL's teams are fair and equitable, this study used a nonparametric test, namely McNemar test, to deduce if discrepancy between projected and actual salary adjustment does exist. From Table 6, 7 and 8, it can be seen clearly that there is a significant difference between the projected salary adjustment and the players' actual salary adjustment, especially for fielders in the league.

4. Conclusions and remarks

4.1 Selection of technical performance criteria and weight calculation

This study used annual team win/loss data taken from official CPBL website, starting from the league's inauguration game in 1990 to the year 2014. Through the use of stepwise regression analysis, significant technical performance criteria for pitchers and fielders are identified. Innings pitched (IP), earned run average (ERA) and walks plus hits per inning pitched (WHIP) are found to be significant for evaluating the performance of pitchers. Their weights are .451 (earned run average), .404 (innings pitched) and .145 (walks plus hits per inning pitched). Some of this result is similar to the criteria chosen by Chen *et al.* (2014) and Lewis (2003), although the order of these weights is different from those proposed in the two studies. Even though Lewis (2013) did not explicitly specify which is more important, his assumption of equal weight put WHIP and strikeouts (S) at 50% each. Lewis (2013) was describing the Major League Baseball which has far more players in its league and MLB teams played many more matches than teams in the CPBL, thus his data showed a different trend. Further, WHIP was ranked first among the four criteria chosen by Chen *et al.* (2014). The other three criteria being innings pitched (IP), earned run average (ERA) and strikeouts (S). Similar to this study, Chen *et al.* (2014) also used CPBL data for their study. However, they only focused on starting pitchers and the weights of the criteria, which were derived through literature review, were decided by professionals using Analytic Hierarchy Process (AHP). Thus, the differences in criteria ranking and weights between the studies.

For fielders, batting average (BA), slugging average (SLG), hits (H) and on base percentage (OBP) were found to significant performance criteria, with their weights being .398, .225, .199 and .178 respectively. These selected criteria for fielders were similar to those chosen by Lewis (2003) and Olson (2001). BA was ranked in this study as the most important technical criteria for fielders. Similarly, Olson (2001) also found BA to be the most important criteria affecting a team's chance of winning the match. However, this contradicts with Lewis (2003)'s findings of OBP and SLG as most important. These differences could be due to the fact that similar to this study, Olson (2001) used the teams' performance for the entire season as a basis for determining the weights of these criteria, while Lewis (2003) used players scores for criteria evaluation.

Based on the above, this study has identified the performance assessment criteria that can be used to determine player salary for both pitchers and fielders in the Chinese Professional Baseball League. Statistically, the technical criteria for scoring and allowing runs used in this study possessed high explanatory power, and are similar to criteria used in other related studies. Thus, the technical criteria adopted in this study were of considerable validity, and can be readily acknowledged and accepted by baseball fans in general.

4.2 The relationship between CPBL's players performance and salary, and fairness and equitability of their salaries

Performance of professional sportsperson is often reflected in their salary. Thus, good performances should be rewarded, while bad ones should be cautioned. This study has found that more than half of the players (55%) in the CPBL performed well above average between the years of 2012 and 2014. This meant that these players were in for a pay raise or continued to receive the same salary. Conversely, 45% of the players performed below average and were up for a pay cut or risked being released from their contracts with their teams. In terms of player salary, more than 64% of the players received below average salary, which inversely meant that 36% of them are paid salaries that were above average. This ratio is similar to the ratio of starting pitchers and players in the teams' rosters.

In order to find out whether teams within the CPBL uses performance from the previous year to decide their players' salaries for the coming year, this study cross-analyzed team data from 2012 to 2014. The results showed that the number of players projected to receive a pay raise (or the same salary) was lower than the actual number of players who did receive a pay increase (or the same salary). Conversely, the actual number of players who did have their salary cut (or were released) was higher than what this study had projected. If pitchers and fielders are to be evaluated separately, it was found that more pitchers were projected to receive a pay raise (or the same salary) than in actuality, whereas fewer fielders were projected to suffer a pay cut (or be released) than in real life. Based on the above findings, it can be said that teams in the CPBL are more critical of the performance of their pitchers than their fielders. These teams also did not utilize the corresponding performance criteria to evaluate their players.

4.2 Conclusion and Suggestion

The study of salary in professional sports has always been popular. In Taiwan, the Chinese Professional Baseball League (CPBL) is a small-scale professional league where team managements have long been postulated to control most salary negotiations with their players. This study has found that teams in the CPBL did not utilize good performance criteria when evaluating their players during salary negotiations. This may have affected the possibility that the teams had adjusted their players' salaries wrongly, and may consequently cause them to miss out on good players. In any industry, salary is an important tool to motivate employees. Equally important, employers need to have an appropriate set of evaluation criteria to assess the performance of their employees, even more so in professional sports. Undoubtedly, the Chinese Professional Baseball League is smaller in both size and scale, and these professional players here are not paid as highly as professional players in the American, Japanese and South Korean professional leagues. Thus, it is even more imperative that teams in the CPBL pay their players fairly and equitably. In view of this, this study would recommend that all decision makers within the CPBL should utilize scientific

methods in deriving applicable technical performance criteria with which to evaluate the performance of their players. They should forgo traditional methods of using their own subjective judgement and/or stop using less effective criteria to assess their players' performance while determining their salary adjustments. As this study only classified the players into two categories, namely pitchers and fielders, future researchers can separate these players further and look into their specific roles before determining the technical criteria that could help evaluate these players better. In this way, decision makers within the team and/or league will be able to ensure players are paid fairly and equitably for their performance on the field.

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