Executive Report on Rarita Football Brand Development

TEAM MRFGA

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SOCIETY OF ACTUARIES

Contents

Executive Summary

This report details the 10-year plan of constructing a competitive national football team for the country of Rarita to build a football brand with economic benefits under the limit of the initial fund of 995 million Doubloons.

We will outline systems for players and teams evaluation, team selection strategy and outcomes, cost/benefit analysis, a 10-year implementation plan and corresponding economic benefits. Specifically, according to our plan, in 2030:

- The probability of achieving an FSA championship is 78.4%, based on qualifying for the FSA competition in 2025;
- The final fund of the team account is ∂ 1.49 billion;
- Contribution of building a Football "brand" to national gross domestic product (GDP): Direct Impact = ∂ 27.36 billion, Total Impact = ∂ 40.36 billion;
- Contribution to employment (in heads)= 538,764;

The risks of our plan from limited data and assumptions as well as strategies to mitigate these risks were identified before conducting a sensitivity analysis to determine the elements to which the level of the team is more sensitive and hence Rarita should monitor.

Objectives of Analysis

To meet the required objectives given by Commissioner Bayes, namely to construct a "competitive" national team and to determine the key economic impact of building a Football "brand" for the country, we first need to break down the targets into the following specific operational objectives.

What Makes a Great Football Team

I. Game-Based Player Evaluation: To scout competent players, we need an evaluation system based on historical data.

II. Football Team Evaluation: Besides the players' competence, invested funding, formations, and many other factors may also affect the performance of a football team, among which we need to find out what is critical.

The Championship Approach under Cost Constraints

I. Cost/Benefit Analysis: Considering the initial one-time investment of ∂ 995 million and the team's long-term growth, it is necessary to calculate the expected annual cash flow.

II. Outline a Ten-year Implementation Plan: Long-term thinking is vital for practical advice to handle unexpected challenges and trade-offs.

How Will Rarita Benefit Economically

I. Measuring Economic Impact: We need to provide insight into the intangible value of our "brand" reputation.

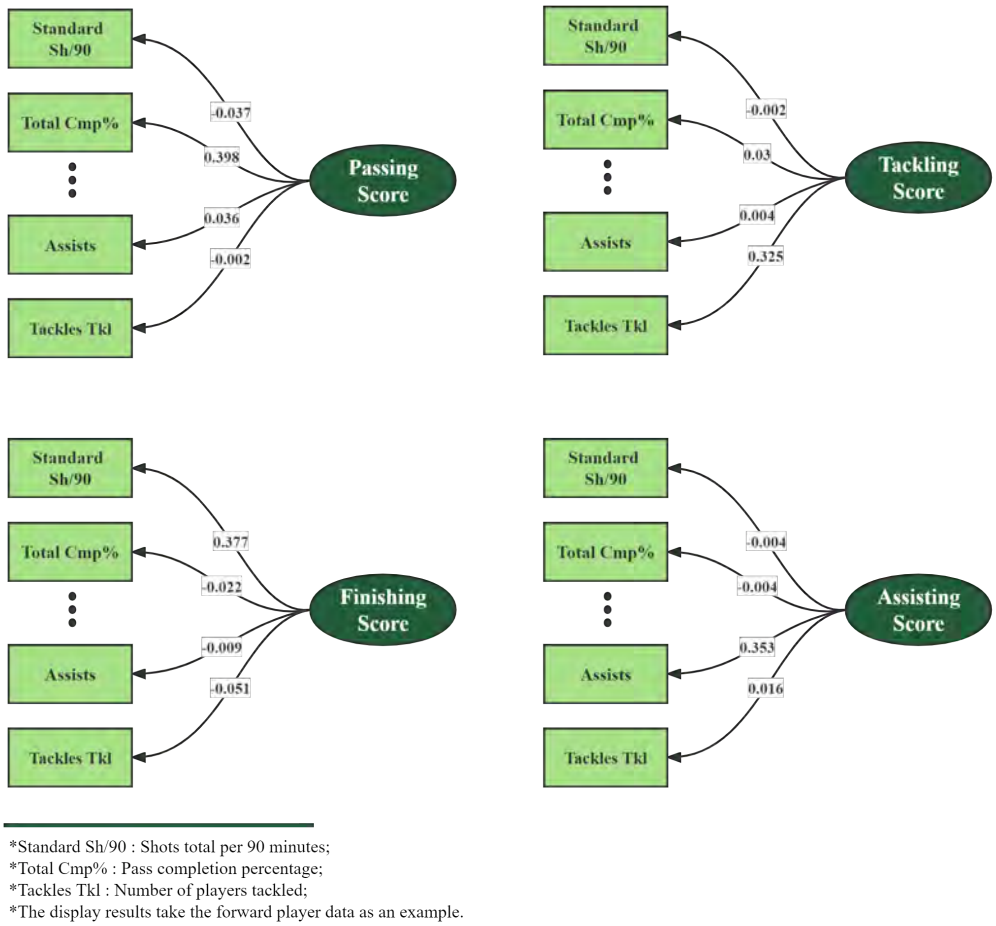
II. Realistic Basis: In the absence of data for Rarita, we need to find the best-fit country in reality for data supplement.

Team Selection

To identify the best squad for a competitive football team within a cost constraint, we construct evaluation systems for players and teams, and then we predict the team ranking with probability. Finally, we derive a dynamic cost/benefit analysis for the team.

Game-Based Player Evaluation

To assess the ability of players using historical performance data, we construct a game-based evaluation system for players in different positions that can change over time.



*Standard Sh/90 : Shots total per 90 minutes;
*Total Cmp% : Pass completion percentage;
*Tackles Tkl : Number of players tackled;
*The display results take the forward player data as an example.

Figure 1 Calculate the key attribute by factor analysis

We first determine the key attributes of players, which include *Finishing*, *Penalty*, *Free Kick*, *Passing*, *Assisting*, *Tackling*, *Marking*, and goalkeeper's *Saving*. See Appendix A-1 for the indicator determination method. Based on the key attributes, we further derived the weights of these attributes of players in each position. See Appendix A-3 for specific calculation process. According to our evaluation system, we can derive a comprehensive score of a player using his historical game performance.

Table 1 Calculate the weight of player ability at different positions by key attribute

Forward		Midfield		Defense		Goalkeeper	
Finishing	0.193	Finishing	0.183	Finishing	0.217	Saving	0.595
Penalty	0.101	Penalty	0.081	Penalty	0.055	Penalty	0.002
Free Kick	0.001	Free Kick	0.001	Free Kick	0.001	Free Kick	0.001
Passing	0.106	Passing	0.114	Passing	0.037	Passing	0.001
Assisting	0.035	Assisting	0.002	Assisting	0.071	Assisting	0.226
Tackling	0.011	Tackling	0.081	Tackling	0.143	Tackling	0.001
Marking	0.003	Marking	0.009	Marking	0.156	Marking	0.156
Age	0.550	Age	0.530	Age	0.320	Age	0.018
DF&FW		**MF&FW**		**DF&MF**			
Finishing	0.277	Finishing	0.213	Finishing	0.238		
Penalty	0.131	Penalty	0.133	Penalty	0.041		
Free Kick	0.001	Free Kick	0.001	Free Kick	0.001		
Passing	0.100	Passing	0.001	Passing	0.089		
Assisting	0.136	Assisting	0.062	Assisting	0.034		
Tackling	0.111	Tackling	0.001	Tackling	0.216		
Marking	0.037	Marking	0.085	Marking	0.044		
Age	0.208	Age	0.505	Age	0.337		

Team Level Evaluation

To assess team level, we mainly consider its squad, age structure, and team funding. Specifically, the team scoring formula is as follows:

$$TeamScore = 0.44FW + 0.22MF + 0.044DF + 0.044GK + 0.22Age + 0.22Expense$$

Based on the team evaluation system, we calculate the score of each team in 2021 FSA Tournament(See Figure 2). According to the result generated by our scoring system, the Mean Absolute Error (MAE) between the estimated ranking and the actual ranking is 3.76.

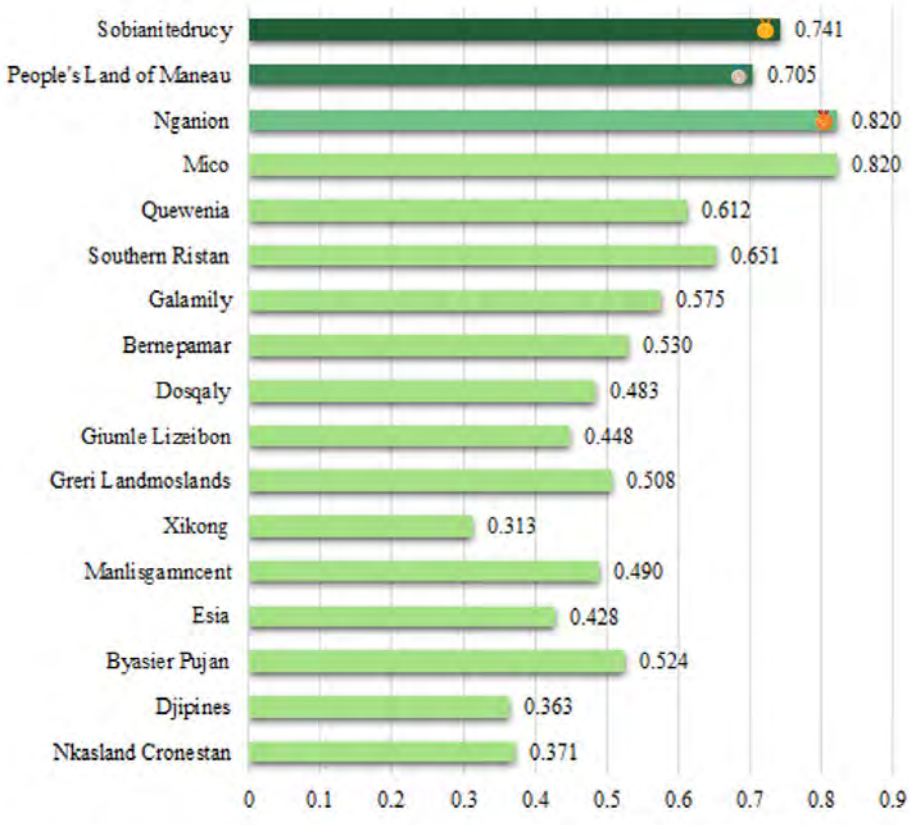


Figure 2 The scores of each team displayed from top to bottom according to the 2021 Tournament team rankings

Probability Ranges of the "Success" of Being Competitive

To fulfill the long-term target of constructing a competitive team step by step, we establish a 10-year team selection plan with limited invested fundings, which is based on the above evaluation systems. (See Appendix B)

Through a Monte Carlo Simulation with 10,000 iterations, which simulates future players' ability, we determine that the expected score of our national team in the fifth year is 0.592, with a 94.9% probability of being able to rank within the top ten members of the FSA for the season. In the 10^{th} year, the expected score is 0.693, with a 78.4% probability of achieving an FSA championship. (See Appendix D)

Cost/Benefit Analysis for Team Establishment

To accurately assess the team's financial position in 10 years according to planned team establishment, we build a cost/benefit model for football team. We first identify indicators that might be related to the team revenues and expenses, including team level, visibility, number of social media followers, attendance, and national economy.

Table 2 shows different methods we use to predict the revenues and expenses with these indicators. Specific results of detailed cashflows are shown in our 10-year implementation plan below. (See Appendix C for the determination process of the prediction methods)

Table 2 Methods of different items we use

Item		Related to the team level	Method	Formula
Expense	Staff Costs	Y	Ordinary Least Squares Regression	$Staff\ Costs = 261.869 \times Score + 0.001 \times GDP - 14.023$
	Other Expenses	N	Linear Interpolation	$Other\ Expenses = 5.882 \times (Year - 2020) + 50.440$
Revenue	Broadcast	N	Linear Interpolation	$Broadcast = 6.817 \times (Year - 2020) + 56.270$
	Commercial	Y	Ordinary Least Squares Regression	$Commercial = 242.048 \times Score + 1.625 \times Instagram - 18.321 \times Tiktok - 7.862$
	Matchday	Y	Ordinary Least Squares Regression	$Matchday = 83.420 \times Score - 0.316 \times Facebook + 1.886 \times Twitter - 4.278 \times Tiktok + 0.0003 \times League\ Attendance - 24.250$
	Loaning Players	N	According to New "Loan" Provision	$Loan\ Revenue = 0.1 \sum_{i=1}^{n} S_i I(X_i)$
	Bonus	Y	Reference to Euro 2020	$Bonus(x) = \begin{cases} 0, & x < 0.59 \\ 200 \times 1.14, & 0.59 \le x < 0.64 \\ 500 \times 1.14, & 0.64 \le x < 0.68 \\ 1000 \times 1.14, & x \ge 0.68 \end{cases}$

Implementation Plan

We divide the 10-year period into three stages: the initial stage (1-4 years), the ascending stage (5-8 years), and the final stage (9-10 years), and the selection strategy of foreign players varies from period to period.

Table 3 Selection strategy in different period

Period	Selection Strategy		
	Salary Limits (Single Player)	Foreign Players Number Limits	Foreign Players Rank
Initial (1 - 4 Year)	35,000,000	Forward: 1 Midfielder: 2 Defender: 2 Goalkeeper: 1	World 100-200
Ascending (5 - 8 Year)	40,000,000	Forward: 2 Midfielder: 4 Defender: 4 Goalkeeper: 2	World 50-100
Final (9 - 10 Year)	45,000,000	Forward: 3 Midfielder: 4 Defender: 4 Goalkeeper: 2	World 1-50
*The players consist of 3 goalkeepers, 8 defenders, 8 midfielders and 4 forwards. *The annual team salary does not exceed the limit of the funds given. According to the above evaluation system, we first build the strongest lineup in Rarita, and then compare the score with the target team, and select foreign high-level players to replace domestic low-level players to achieve target score.			

A possible 10-year player selection plan is as follows.

Table 4 Player hiring plans for the next decade

Position	Year 1	Year 2	Year 3	Year 4	Year 5
Forward	K. Kazlo	K. Kazlo	K. Kazlo	K. Kazlo	K. Kazlo
	I. Saha	I. Saha	Z. Zziwa	Z. Zziwa	Z. Zziwa
	P. Rabiu	H. Makumbi	I. Saha	U. Shoko	R. Nkosi
	U. Katushabe	U. Katushabe	C. Abramov	M. Gómez	F. Among
Midfielder	O. Wanjala	O. Wanjala	O. Wanjala	O. Wanjala	O. Wanjala
	J. Namirembe	J. Namirembe	J. Namirembe	J. Namirembe	J. Namirembe
	B. Ayuba	B. Ayuba	B. Ayuba	B. Ayuba	B. Ayuba
	X. Leroy	X. Leroy	X. Leroy	X. Leroy	G. Jankowski
	G. Jankowski	G. Jankowski	G. Jankowski	G. Jankowski	J. Pedro
	M. Pedersen	M. Pedersen	M. Pedersen	L. Leibowitz	K. Behera
	I. Campbell	Y. Zia	S. Kor	X. Aminah	L. Nahwera
	K. Koppel	W. Nabuuma	G. Foong	I. Brown	M. Gómez
Defender	X. Takagi	X. Takagi	X. Takagi	X. Takagi	X. Takagi
	C. Baluka	C. Baluka	C. Baluka	C. Baluka	C. Baluka
	Y. Thungu	Y. Thungu	Y. Thungu	Y. Thungu	Y. Thungu
	K. Musah	K. Musah	K. Musah	Q. bin Ismail	R. Namutebi
	K. Shibata	K. Shibata	K. Shibata	R. Namutebi	K. Nalwanga
	M. Pedersen	T. Okoro	R. Namutebi	K. Musah	O. Mapfumo
	J. Khoh	C. Amoding	L. Fuchs	L. Fuchs	C. Amoding
	P. Mlotshwa	P. Mlotshwa	O. Bošnjak	M. Ayebazibwe	S. Chelangat
Goalkeeper	A. Omar	A. Omar	A. Omar	A. Omar	Z. Nyamahunge
	Z. Nyamahunge	Z. Nyamahunge	Z. Nyamahunge	Z. Nyamahunge	K. Kanyesigye
	C. Hamed	X. Neri	X. Neri	X. Neri	C. Hamed
Position	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Forward	K. Kazlo	K. Kazlo	K. Kazlo	K. Kazlo	K. Kazlo
	Z. Zziwa	W. Martinez	Z. Zziwa	V. Apio	U. Katushabe
	R. Nkosi	R. Nkosi	R. Nkosi	E. Kiyingi	M. Ogbonna
	C. Abramov	C. Abramov	F. Among	C. Abramov	F. Among
Midfielder	O. Wanjala	O. Wanjala	O. Wanjala	O. Wanjala	O. Wanjala
	J. Namirembe	J. Namirembe	J. Namirembe	J. Namirembe	J. Namirembe
	B. Ayuba	B. Ayuba	P. Villa	B. Ayuba	B. Ayuba
	G. Jankowski	G. Jankowski	I. Diallo	U. Katushabe	D. Makumbi
	L. Mirzaei	Y. Nartey	N. Bondarenko	G. Jankowski	D. Nabutono
	Q. Demir	L. Kaur	E. Kiyingi	M. Gómez	V. Amini
	D. Kayira	F. Pellegrini	K. Chisi	K. Chisi	K. Chisi
	M. Gómez	K. Chisi	C. Arineitwe	M. Braun	M. Gómez
Defender	X. Takagi	X. Takagi	X. Takagi	X. Takagi	X. Takagi
	C. Baluka	C. Baluka	C. Baluka	C. Baluka	C. Baluka
	Y. Thungu	Y. Thungu	Y. Thungu	Y. Thungu	Y. Thungu
	R. Namutebi	K. Nalwanga	T. Monteiro	T. Monteiro	O. Mapfumo
	F. Okon	A. Davies	E. Schmitz	L. Fuchs	P. Mlotshwa
	E. Patra	D. Adu	F. Mugide	F. Mugide	L. Fuchs
	L. Yusof	D. Nabutono	P. Mlotshwa	T. binti Osman	M. Ayebazibwe
	C. Amoding	L. Fuchs	U. Ban	E. Schmitz	H. Korosec
Goalkeeper	Z. Nyamahunge	Z. Nyamahunge	Z. Nyamahunge	Z. Nyamahunge	Z. Nyamahunge
	P. Kabugo	P. Kabugo	J. Vásquez	J. Vásquez	F. Yaakv
	R. Owere	F. Yaakv	X. Neri	X. Neri	V. Kumwenda

*All players in green font are Rarita domestic players.

The possible *Starting 11* of the team in 1st year, 5th year, and 10th year are shown below.

Figure 3 The team's start eleven in the first, fifth and tenth years

So far, we have built a team arrangement schedule for the next ten years, listing the indicators that need to be traced in the next ten years. Particularly, we do not need any private investment in addition to the initial fund.(See Appendix C)

Table 5 Revenues and expenses schedule for the next decade

Year	Fund	Other Expenses	Staff Costs	Interest	Broadcast	Commercial	Matchday	Loan	Bonus	Surplus	Team Score
1	**995.000**	693.894	1716.981	0.369	865.575	1340.616	307.943	43.988	0.000	137.406	**0.479**
2	**1132.406**	766.361	1776.793	0.449	949.561	1388.823	324.558	45.780	0.000	157.274	**0.495**
3	**1289.680**	838.828	1877.252	0.553	1033.547	1465.351	350.932	44.525	0.000	-3.670	**0.520**
4	**1286.010**	911.295	1911.517	0.460	1117.533	1505.221	364.673	46.753	0.000	189.121	**0.534**
5	**1475.131**	983.762	2106.486	0.603	1201.520	1661.259	418.451	40.726	0.000	-3.670	**0.586**
6	**1471.461**	1056.229	2137.425	0.509	1285.506	1665.109	419.778	42.915	0.000	-18.240	**0.587**
7	**1453.221**	1128.695	2243.794	0.398	1369.492	1727.866	441.406	40.646	2.268	39.621	**0.608**
8	**1492.842**	1201.162	2499.138	0.358	1453.478	1853.956	484.862	43.609	5.670	-3.670	**0.651**
9	**1489.172**	1273.629	2519.847	0.264	1537.465	1908.622	503.703	40.343	11.340	-18.240	**0.669**
10	**1470.932**	1346.096	2590.055	0.153	1621.451	1943.673	515.782	39.609	11.340	14.200	**0.681**

*In this schedule, all values except *Team Score* are expressed in million Rarita Doubloons(∂).
*Other Expenses are paid at the beginning of the year, and Staff Costs are paid at the end of the year.
*All income is received at the end of the year.

Economic Impact

GDP and Employment

According to SpEA[8], the flourishing of sport will stimulate national economic development and growth. We utilize an indicator, called Direct Multiplier, to measure the influence of football "brand" on the national economy. See Appendix E for detailed definition and calculation.

According to *Assumption Direct Multiplier*, assuming that our implantation plan of team selection results in a “competitive” team over the next 10 years, Rarita's direct multiplier equals 10.29 in five years, and the multiplier will grow to 30.58 within the next 10 years. Then the direct impact of football-related economic activities on

national GDP is calculated as below:

$$FGDP_{direct} = Multiplier_{direct} \times Revenue$$

where $FGDP_{direct}$ indicates the contribution of football on national GDP in broad definition and revenue indicates the net income of the team for the year.

It was found that growing the sport-related economy leads to a more than proportional growth of employment, which indicates that sport overall is labor-intensive[8]. A brand for football will achieve a positive employment impact for the country. According to *Assumption Supplemental Data*, using Greece as a comparison, in reality, the impact of Football "brand" on employment can be derived. The specific impact on Rarita's GDP and employment over the next decade is shown in Table 6.

Table 6 The impact of football brands on Rarita GDP and employment over the next decade

Year	Direct Impact on GDP	Total Impact on GDP	Employment
1	2,798.754	4,128.264	55,103
2	3,733.971	5,507.744	73,516
3	4,848.437	7,151.621	95,458
4	5,925.547	8,740.399	116,664
5	7,670.492	11,314.255	151,019
6	8,936.529	13,181.707	175,945
7	11,841.978	17,467.350	233,149
8	18,666.161	27,533.269	367,506
9	22,099.895	32,598.152	435,110
10	27,364.620	40,363.813	538,764

*In this data sheet, *Direct Impact on GDP* and *Total Impact on GDP* are expressed in million Rarita Doubloons(∂).

Specific Sector

According to *Assumption Supplemental Data*, using Input-Output (IO) analysis, we derive the direct and total impact of building a building Football "brand" on Rarita's GDP by specific sector. The following table shows the results for the tenth year.

Table 7 The impact of football brands on some Rarita industries over the next decade

Description	% of Total	Sector-specific Multiplier	Direct Impact on GDP #5	Total Impact on GDP #5	Direct Impact on GDP #10	Total Impact on GDP #10
Recreational, cultural and sporting services	50.113%	1.570	3,843.881	6,034.894	13,713.117	21,529.594
Post and telecommunication services	6.522%	1.210	500.273	605.330	1,784.732	2,159.526
Hotel and restaurant services	5.910%	1.520	453.334	689.068	1,617.277	2,458.262
Construction work	0.812%	1.670	62.290	104.025	222.222	371.111
Food products and beverages	0.608%	1.790	46.664	83.529	166.476	297.993

*In this data sheet, *Direct Impact on GDP* and *Total Impact on GDP* are expressed in million Rarita Doubloons(∂).
*The 4th and 5th columns are the fifth year data, and the 6th and 7th columns are the tenth year data.

Regional Economy

The share of the gross domestic product of sport shows a broad division between high-income states to low-income states according to the study of SpEA[8]. On a cross-section basis, the national income elasticity of sports is 1.14, which means that if national income rises by 1%, the gross value added related to sport rises by 1.14%. As we can see in Figure 4, the economic impact on GDP distinguishes between Rarita different provinces based on their income level.

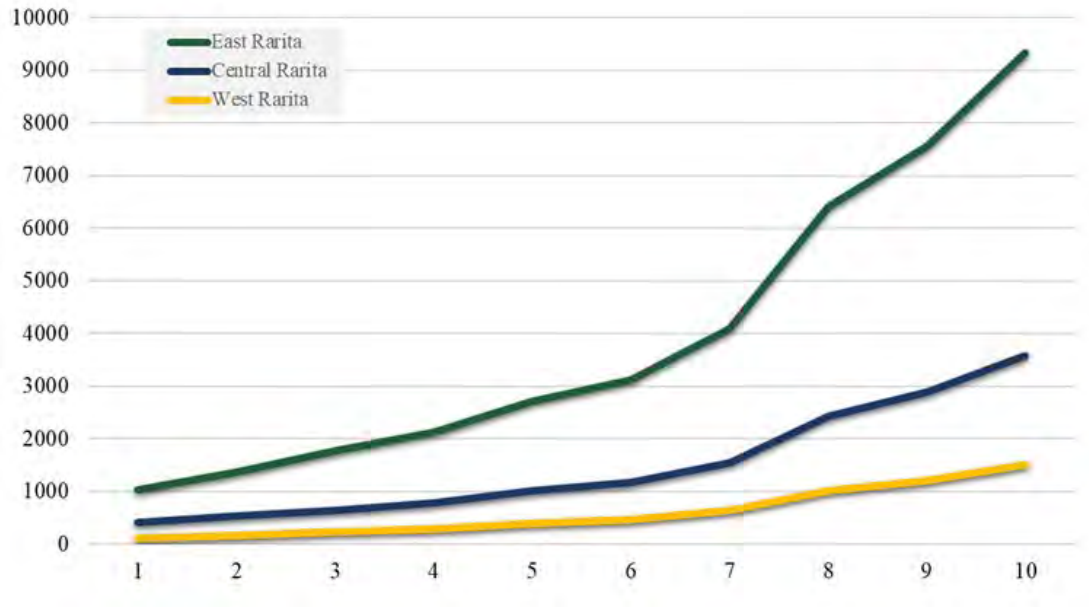


Figure 4 The total economic impact of football brands on Rarita provinces (per capita)

Assumptions

Player Ability

We assume that the key attributes of players remain stable over time, and player

ability mainly varies with age.

Rationality: Statistically, the score derived from key attributes of the player fits well with the salary to reflect a player's value. Empirically, the physical strength, experience, and adaptability in the competition are related to the age of the players. Therefore, it is reasonable to use the combination of key attributes and age to predict the player's ability in the future.(See Appendix A)

Run-in Period for a Team

We assume that the run-in period for the team is short.

Rationality: Based on the limited data, we cannot measure the impact of factors such as the time of cooperation between players and team chemistry on the team level. At the same time, player ability, lineup configuration, and capital investment are the main factors that affect the team level. Therefore, it is reasonable to ignore the running-in period for the team when measuring the level of the team.

Stable Score Segment

We assume that the score of the teams at a certain level will be stable in a range in the next ten years, the team's ranking can be roughly estimated by the team's score.

Rationality: Football is a competitive sport about human performance and teamwork. Despite the rapid technological progress in the world, the football team level still mainly depends on player ability and lineup configuration. Therefore, the score of the teams at a certain level is stable relatively.

Rates

We assume that interest rates, inflation rates, and exchange rates remain stable for the next ten years.

Rationality: According to historical data, Rarita's interest rate, inflation rate, and exchange rate have no obvious trend, and future changes are greatly affected by unknown factors such as national macroeconomic policies, which are hard to predict accurately. Therefore, we assume that interest rates, inflation rates, and exchange rates remain stable and equal to their averages over the past five years.

Direct Multiplier

We assume that the economic influence of the football industry is consistent with the average economic influence of all sports industries.

Rationality: As an important part of the sports industry, especially for European countries, the impact of the football industry on the country should be consistent with the average impact of all sports industries.

Supplemental Data

We assume that the industrial structure of Rarita and Greece is the same and remains stable for ten years.

Rationality: According to the national macro data in the past ten years, Rarita and Greece have similar population sizes and economic levels, so we believe that Rarita and Greece have the same industrial structure. Therefore, we can use the Greek Input-Output Table: Sport(IOT:S) as a supplement to Rarita's data. Furthermore, according to the core idea of Leontief's theory, the structure of the intermediate product matrix will remain stable over periods. Please refer to Appendix E for specific instructions.

Risk and Mitigation Strategies

Table 8 Risk matrix

		Risk Severity		
		Minor	Moderate	Major
Risk Likelihood	Unlikely			Fund Risk
	Possible	Injury or Default Risk		
	Likely	Loan Risk	Scoring Risk	

Fund Risk

The cash flow is subject to uncertainty due to team rankings, fan numbers, attendance, and the level of the national economy, which can cause fund shortage.

Mitigation:

I. Increase the proportion of fixed income by signing long-term initial payment contracts with advertisers, television stations, etc.
II. Focus on the fluctuation of interest rate, exchange rate, and inflation rate in the future.

Scoring Risk

The systems for scoring the level of players and teams don't cover all the information about players as well as other relative data, which can lead to a score that deviates from the true levels.

Mitigation: Adjust the scoring system yearly according to future update data.

Injury and Default Risk

When players are injured or default, the planned squad may not be met.

Mitigation:

I. Establish a medical care system.

II. Charge high penalty.

Loan Risk

Loans between teams are subject to reality factors, such as players' wish, which leads to the risk of not being able to adjust the squad.

Mitigation: Figure out the acceptable range of loaned players' ability to have more choices.

Sensitivity Analysis

Uncertainty of fluctuating quantitative data may affect the fund and team level. With the previously assumed inflation rate of 3.52% and one-year interest rate of 1.27%, the remaining fund in the 10th year would be ∂ 1,470.923 million and the team score would be 0.681. When the inflation rate varies from 3.00% to 4.10%, and the one-year interest rate varies from 1.10% to 1.50%, there is approximately a ∂ 156.36 million range in the 10th year remaining fund. (See Table 9)

Table 9 Sensitivity analysis results of fund

		Inflation Rate				
		3.00%	3.30%	3.50%	3.80%	4.10%
One-year Interest Rate	1.10%	1,481.234	1,449.971	1,445.561	1,363.908	1,358.991
	1.20%	1,492.163	1,458.034	1,454.661	1,403.795	1,393.922
	1.30%	1,495.832	1,462.167	1,456.451	1,411.325	1,401.424
	1.40%	1,508.029	1,475.897	1,464.580	1,431.055	1,404.299
	1.50%	1,515.348	1,482.853	1,476.311	1,446.259	1,418.701

*In this data sheet, all values are expressed in million Rarita Doubloons(∂).

Changes in interest rates and inflation rates have no significant effect on team scores in the 10th year. (See Table 10)

Table 10 Sensitivity analysis results of team scores

		Inflation Rate				
		3.00%	3.30%	3.50%	3.80%	4.10%
One-year Interest Rate	1.10%	0.68	0.69	0.68	0.69	0.68
	1.20%	0.71	0.71	0.70	0.68	0.70
	1.30%	0.68	0.70	0.69	0.69	0.68
	1.40%	0.69	0.68	0.73	0.67	0.71
	1.50%	0.68	0.69	0.68	0.68	0.67

Data and Data Limitation

Data Limitation

- We only have data about the on-field performance of the players, but we lack off-field data such as player's personalities, fitness, and potential. Without knowing such specific data, we are limited in assessing the member’s ability comprehensively.
- We only have 2020/2021 Tournament results, but we lack data such as team chemistry, team coaching, and training. Without knowing such specific data, we are limited in assessing the team level comprehensively.
- About financial data, we only have historical interest rates, exchange rates, and inflation, which prevents us from analyzing the future revenue and expenditure accurately.
- Little data for estimating the economic impact of building the Football "brand", which limits us to projecting the Rarita-specific economic impact exactly.

Data Source

- The bonus standard of Euro 2020 from *Sporting News*[3].
- FIFA Men’s Ranking from 1993 to 2021[4].
- Economic data of the 27 EU member states, latest from OECD[5].
- Input-Output Tables: Sport of 27 EU member states[8].

Appendix

Appendix A – Player Evaluation

Section A-1: Score of Player's Key Attributes

To assess players' skills, we need to establish a game-based method to make a qualitative evaluation of players' abilities. Considering players in different positions distinguishes in different attributes, we build seven independent models for each different role in a team. This section describes the process of building such a player evaluation system.

I. Classify the player's position. As shown in Table 11, we classify different positions into seven categories.

Table 11 Explanation of the adjusted position

Original Position	Adjusted Position
FW	FW
MF	MF
DF	DF
GK	GK
GKMF	
DFFW	DF&FW
FWDF	
DFMF	DF&MF
MFDF	
MFFW	MF&FW
FWMF	

II. Screen variables. For example: for variables with similar meanings, such as "Standard SoT" and "Standard SoT/90", the latter was reserved, that is, "the average shot per field". For strongly correlated variables, such as "Short Cmp" and "Short Att" ($\rho(ShortCmp, ShortAtt) = 0.982^{**}$), the latter was reserved, that is, "the total number of short transfers".

III. Find the key attributes of players using factor analysis on the screened data. Testing the data, we first find that the KMO values of the performance data of players in each position are all greater than 0.6, which means the players' game data is suitable for factor analysis.

Table 12 KMO value of the adjusted position

Adjusted Position	KMO
FW	0.735
MF	0.738
DF	0.733
GK	0.639
DF&FW	0.686
DF&MF	0.728
MF&FW	0.740

Based on cliff rubble plots and cumulative variance interpretation rates, we retain 6–7 main factors for each adjusted position. Then, explain the practical meaning of each factor according to the factor load coefficient matrix, thus we determine the key attributes of the players in different positions. Finally, utilizing the component score coefficient matrix, the formula of each attribute score is obtained. The following assessing process takes Forwards as an example.

Table 13 Calculate the coefficient of the key attribute of forward

Player Statistics	Passing Score	Tackling Score	Finishing Score	Marking Score	Penalty Score	Assisting Score
Gls	-0.002	0.006	0.358	-0.002	0.052	-0.014
Standard Sh/90	-0.037	-0.002	0.377	0.033	-0.086	-0.004
Standard SoT/90	-0.111	-0.069	0.441	0.072	-0.102	0.029
Standard G/Sh	0.001	-0.074	0.270	-0.023	-0.069	0.003
Standard Dist	0.045	-0.025	0.158	-0.014	0.027	-0.019
Expected xG	0.030	0.010	0.313	0.027	0.128	-0.011
Expected G-xG	-0.030	0.001	0.238	-0.030	-0.043	-0.027
Performance PK	-0.038	-0.008	-0.062	0.020	0.562	-0.013
Performance PKatt	-0.044	0.003	-0.092	0.016	0.558	0.010
Total Cmp	0.085	0.004	-0.009	0.005	-0.005	-0.012
Total Cmp%	0.398	0.030	-0.022	-0.045	-0.022	-0.004
Total TotDist	0.093	0.002	-0.009	0.006	-0.006	-0.042
Total PrgDist	0.089	-0.001	-0.003	0.008	0.002	-0.109
Short Cmp	0.084	0.005	-0.010	0.004	-0.007	0.014
Short Cmp%	0.378	0.048	-0.084	-0.068	-0.006	-0.001
Medium Cmp	0.089	0.004	-0.006	0.008	-0.010	-0.039
Medium Cmp%	0.276	-0.012	0.005	0.064	-0.053	0.005
Long Cmp	0.079	-0.002	-0.002	0.005	0.007	-0.095
Long Cmp%	0.058	-0.130	0.040	0.038	-0.029	0.002
Ast	0.036	0.004	-0.009	0.002	-0.012	0.353
xA	0.058	-0.001	-0.003	0.000	-0.013	0.069
A-xA	-0.038	0.010	-0.020	0.002	0.004	0.805
Tackles Tkl	-0.002	0.325	-0.051	-0.075	0.005	0.016
Tackles TklW	0.049	0.321	0.002	-0.034	-0.036	0.029
Tackles Def 3rd	-0.007	0.070	0.026	-0.116	-0.001	0.101
Tackles Mid 3rd	-0.014	0.240	-0.132	-0.045	-0.009	-0.068
Tackles Att 3rd	0.019	0.277	0.030	0.018	0.025	0.018
Pressures Press	-0.008	-0.052	0.032	0.376	0.018	0.012
Pressures %	-0.094	-0.002	-0.092	0.091	-0.016	-0.042
Pressures Def 3rd	-0.027	-0.134	0.069	0.153	0.012	0.049
Pressures Mid 3rd	0.003	-0.049	-0.004	0.318	0.019	-0.006
Pressures Att 3rd	-0.004	0.036	0.027	0.328	0.009	-0.001

Section A-2: Influence of Age

Considering that players' skills change with age, we need to determine how age affects players' ability. Since salary is a simple and direct quantitative indicator that reflects a player's value, by drawing a line chart of the median compensation of players in each age by position, we choose the age between 20 and 30 years old reaching the maximum salary as the golden age in this position. Set the formula of age-score as follows:

$$AgeScore = \frac{1}{|CurrentAge - PeakAge| + 1}$$

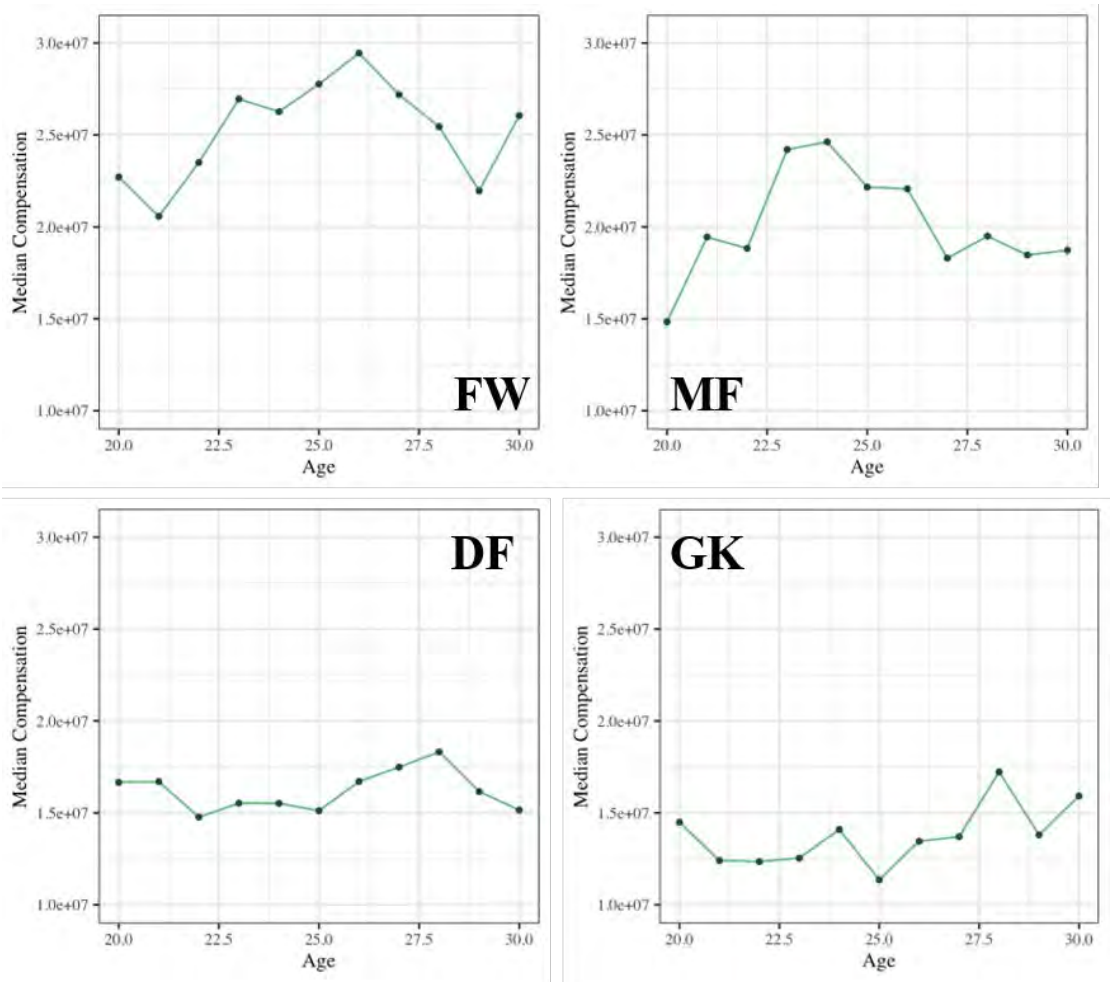


Figure 5 Player age and median salary

It can be seen that the closer to the golden age, the closer the age-score is to 1. By combining the age score with the player's attribute score, we complete the player evaluation indicator.

Section A-3: Comprehensive Ability

To measure a player's expected contribution to the team, a few decentralized technical indicators are not enough. Inspired by the game *Football Manager 2022*, we adopt the simple idea of linear weighting to get a comprehensive ability. In terms of weight setting, considering that players distinguish in different important attributes and a reasonable weight should effectively reflect the value of players in identical roles, the weight determination method is as follows:

To make full use of existing data, 2020 and 2021 league data are used as input to examine the accuracy of our evaluation system. With the optimal target of getting the highest correlation coefficient between our player's comprehensive score and the player's real salary, we use the gradient descent algorithm to determine the best weights of each indicator.

Thus, we get the player's comprehensive evaluation method. As below, salary -- as a quantitative measure of a player's value -- is significantly correlated with a player's

score:

Table 14 Correlation coefficients of the adjusted positions

Adjusted Position	Correlation Coefficient
FW	0.377
MF	0.395
DF	0.337
GK	0.250
DF&FW	0.460
MF&FW	0.310
DF&MF	0.436

So far, we have constructed the player's ability evaluation system.

Appendix B – Team Level Evaluation

Section B-1: Determine Team Evaluation Indicators

Based on constructing a player scoring system, we construct team level evaluation system.

We think forward, midfielder, defender, goalkeeper, and age structure are five basic indicators, in addition, according to the regression analysis(See Appendix C-1), the economic investment team will also be good for the team's performance so we finally constructed six indicators, striker, midfielder, defender, goalkeeper, age structure, and the team expense to measure team level.

Table 15 Explanation of the indicator

Indicator	Explain
FW	Average score of forwards
MF	Average score of midfielders
DF	Average score of defenders
GK	Average score of goalkeepers
AGE	Average score of players' age
Expense	Total expense per capita

Section B-2: Solve the Team Indicator Weight

After determining the main evaluation aspects of the team level, we hope to further make full use of existing data to find an evaluation model that can best reflect the competitiveness of national teams. Therefore, the data of each national team in the 2021 Tournament is used as input and the minimum mean absolute error between the estimated ranking and actual ranking of the evaluation system is taken as the optimization objective to solve the best indicator weight to measure the comprehensive strength of the team. The specific calculation process is explained below.

First, the factor score of each player is normalized according to the maximum and minimum value method and then sorted from large to small. Then, the average score of

each player in each position and the average score of age structure is calculated for each country. Similarly, team expenditure is normalized according to the method of maximum and minimum. The normalized formula of the player score is as follows:

$$score_i^* = \frac{score_i - min(score)}{max(score) - min(score)}$$

where $score_i$ is the score of a player, min($score$) is the lowest score of the player in his position, max($score$) is the highest score of the player in his position, $score_i^*$ is the normalized score. The normalized data shows the player's approximate position among all players.

Since there are only 17 teams' expenditure data in the 2021 Tournament, we select these 17 teams to fit the weights and convert the original absolute rankings into relative rankings. Finally, the scores of each indicator of all teams are calculated as follows.

Table 16 Scores of different teams

Nation	FW	MF	DF	GK	AGE	EXPENSE
Bernepamar	1.000	0.221	0.198	0.479	0.407	0.000
Byasier Pujan	0.702	0.360	0.768	0.220	0.466	0.355
Djipines	0.250	0.000	0.544	0.526	0.153	0.926
Dosqaly	0.582	0.357	0.572	0.410	0.481	0.407
Esia	0.275	0.795	0.627	0.344	0.617	0.304
Galamily	0.662	0.603	0.433	0.366	0.598	0.442
Giumle Lizeibon	0.718	1.000	0.365	0.330	0.704	0.265
Greri Landmoslands	0.945	0.579	0.685	0.355	0.762	0.427
Manlisgamncent	0.945	0.488	0.278	0.356	0.634	0.540
Mico	0.885	0.990	0.656	0.274	0.490	0.731
Nganion	0.924	0.733	0.568	0.090	0.299	1.000
Nkasland Cronestan	0.644	0.973	0.551	0.452	0.432	0.080
People's Land of Maneau	0.296	0.753	0.608	0.000	0.000	0.395
Quewenia	0.717	0.674	0.678	0.510	0.670	0.336
Sobianitedrucy	0.768	0.904	0.508	0.000	0.629	0.742
Southern Ristan	0.730	0.313	0.755	0.111	0.952	0.861
Xikong	0.288	0.439	0.000	0.331	1.000	0.159

Second, taking team ranking as the dependent variable, the weight of each indicator was fitted with the method of minimizing the mean absolute error. The weight of each ability indicator is multiplied by the corresponding ability score and then added up to get the final score of each team, which reflects the relative level of the team among all the teams, and the prediction ranking is obtained according to the score. The "optimr" package of R 4.1.3 is used to solve the weight. After 20000 iterations, the optimal mean absolute error is determined to be 3.76. The resulting weights are as follows.

Table 17 Weight of different indicators

Indicator	Weight
FW	0.440
MF	0.220
DF	0.044
GK	0.044
AGE	0.044
Expense	0.220

Appendix C – Team Cost/Benefit Analysis

Section C-1: Team Expense

Staff Costs: We use OLS to establish a linear regression model, and use stepwise regression to select variables. The results of the model are shown in Table 18. It can be seen that team level and national GDP have a significant impact on staff costs. The regression equation is:

$$Staff\ costs\ =\ 261.868885 \times score + 0.001077 \times GDP - 14.023$$

Other Expense: Neither team level nor national GDP has a significant impact on other expenses, and we choose to forecast based on a linear increase in trends over the past 5 years.

Table 18 Regression results for costs

Term	Staff Costs	Other Expenses
Score	261.869*	
GDP	0.001*	
(Intercept)	-14.023	92.727***
Adjusted R-squared	0.417	
p-value	0.012	
Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Section C-2: Team Main Revenue

Broadcast: The team level has no significant impact on broadcast revenue, and we choose to forecast based on a linear increase in trends over the past 5 years.

Commercial: We use OLS to establish a linear regression model, and use stepwise regression to select variables. The results of the model are shown in Table 19. It can be seen that the team level has a significant impact on commercial revenue. The regression equation is

$$Commercial = 242.048 * score + 1.6252 * Instagram - 18.321 * Tiktok - 7.8618$$

Matchday: We use OLS to establish a linear regression model, and use stepwise regression to screen variables. The results of the model are shown in Table 19. It can be seen that the team level also has a significant impact on matchday revenue. The regression equation is

$$Matchday = 83.42 * score - 0.3155 * Facebook + 1.886 * Twitter - 4.278 * Tiktok + 0.0003399 * League\ attendance - 24.25$$

Table 19 Regression results for revenue

Term	Broadcast	Commercial	Matchday
Score		242.048*	83.421*
Facebook			-0.315*
Instagram	0.654*	1.625**	
Twitter			1.886**
Youtube			
Tiktok		-18.321*	-4.278*
League_Attendance	-0.001*		0.001*
GDP			
(Intercept)	191.5***	-7.862	-24.25
Adjusted R-squared	0.239	0.696	0.819
p-value	0.067	0.001	0.001
Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Section C-3: Players' Salary and Loan Expense

Team players' salary: The team has the option of loaning top players from abroad. In addition to the basic salary, the team also pays 10% of the player salary of the loaned country, thus, the team's player salary is calculated as follows.

$$Team's\ Player\ Salary = 1.1 \sum_{i=1}^{n_f} S_i + \sum_{j=1}^{n_d} S_j$$

where n_f indicates the number of foreign players, S_i indicates the salary of foreign player i. n_d indicates the number of domestic players, S_j indicates the salary of domestic players j.

Loan out domestic players: We have established criteria for loaning domestic players out on loan because strong players will be more desirable in the international market, while weak players may be few buyers. We consider a rule that a national player can be loaned out if he is above the average of all the players in his position in that year, and there must be another team loaning him. The following table shows the average score of players for each position over the next decade:

Table 20 The average ability for each position over the next decade

Year	FW	MF	DF	GK
1	0.372	0.437	0.338	0.502
2	0.344	0.429	0.338	0.504
3	0.362	0.449	0.332	0.504
4	0.370	0.424	0.309	0.503
5	0.373	0.439	0.333	0.501
6	0.371	0.418	0.340	0.502
7	0.378	0.436	0.342	0.504
8	0.386	0.410	0.344	0.505
9	0.388	0.434	0.344	0.507
10	0.383	0.441	0.343	0.502

For the annual loan revenue of the team, the formula is as follows

$$LoanRevenue = 0.1 \sum_{i=1}^{n} S_i \, I(X_i)$$

Where indicates the number of players in total, S_i indicates the salary of player in this year. $I(x)$ is an indicator function. The value equals 1 if the player is better than the average player in his position and is not in the current national team, and 0 otherwise.

Section C-4: Team Interest Revenue

We assume that only "other expenses" in all expenditure columns are paid at the beginning of the year and all other expenses are paid at the end of the year. In this way, after "other expenses" are paid at the beginning of the year, the remaining funds can reap one year's interest. The interest value of the team after inflation at the end of the year is calculated as follows.

$$Interest\ Revenue = \frac{(Fund - Other\ Expenses) \times Norm\ Interest\ Rate}{1 + Inflation}$$

Section C-5: Team Bonus Revenue

When reaching a higher level, the team will have a chance to win tournament prize money. As for the bonus revenue of the team, according to the bonus standard of Euro 2020[3], the team will receive 2 million euros if it finishes in the top 8, 5 million euros if it finishes in the top 4, and 10 million euros if it wins the championship. The bonus will be calculated using the average historical exchange rate.

Firstly, the average exchange rate is 1.14. And the average score of the teams ranked 4th to 12th in the 2021 Tournament is 0.59. If Rarita's score exceeds this score, the team is considered to be able to enter the top 8 and is expected to get a bonus of 2 million euros. The average score for teams ranked from 1st to 8th is 0.64. If the team's score exceeds this score, the team is considered to be able to enter the top 4 and will receive a bonus of 5 million euros. In the end, based on previous calculations, if the team scored more than 0.68, it is considered to win the championship and is expected to receive a bonus of 10 million euros. The team bonus is calculated as follows:

$$Bonus(x) = \begin{cases} 0, & x < 0.59 \\ 200 \times 1.14, & 0.59 \le x < 0.64 \\ 500 \times 1.14, & 0.64 \le x < 0.68 \\ 1000 \times 1.14, & x \ge 0.68 \end{cases}$$

where x indicates the score of a team in the year. The function value is in million Rarita Doubloons(∂).

Appendix D – Team Ranking Simulation

To estimate the FSA ranking of Rarita's national team, it is necessary not only to assess the strength of the national team from year to year but also to determine the relative position of this strength among FSA members. Therefore, the estimation of the team ranking will be carried out in two steps:

I. Determine the overall level of the world teams:

According to *Assumption Run-in Period for a Team*, the overall level of world football in the future can be estimated through the average scores of national teams at all levels in historical matches. Using the 2021 Tournament data, we get an average score of 0.680 for the top 5 teams in the FSA and 0.585 for the 6th through 14th teams. Based on this, the criteria for a chance to enter the top 10 are a team with a score greater than 0.585; The criteria for having a chance to win the championship is defined as a team with a score greater than 0.680.

II. Simulating the level of the national team:

The Player's ability prediction has certain randomness, so random perturbations are added to the player's ability of each position every year, where $\varepsilon \sim N(0, \sigma^2)$, σ^2 is the variance of the player's ability in his position. Through Monte Carlo simulation, 10,000 iterations are carried out to obtain the fifth and tenth-year team scores. The specific performance is as follows:

Through simulation, the team scored 0.592 points on average in the fifth year, giving it a 94.9 percent chance of being able to finish in the top 10 in the fifth year.

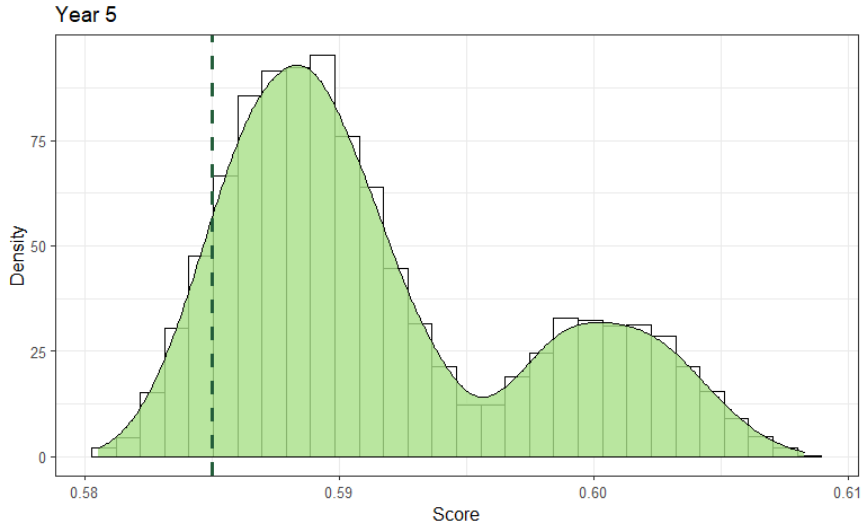


Figure 6 Monte Carlo simulation results of the fifth year

In the simulation, the team averaged 0.693 points in its 10th year, giving it a 78.4 percent chance of winning the championship.

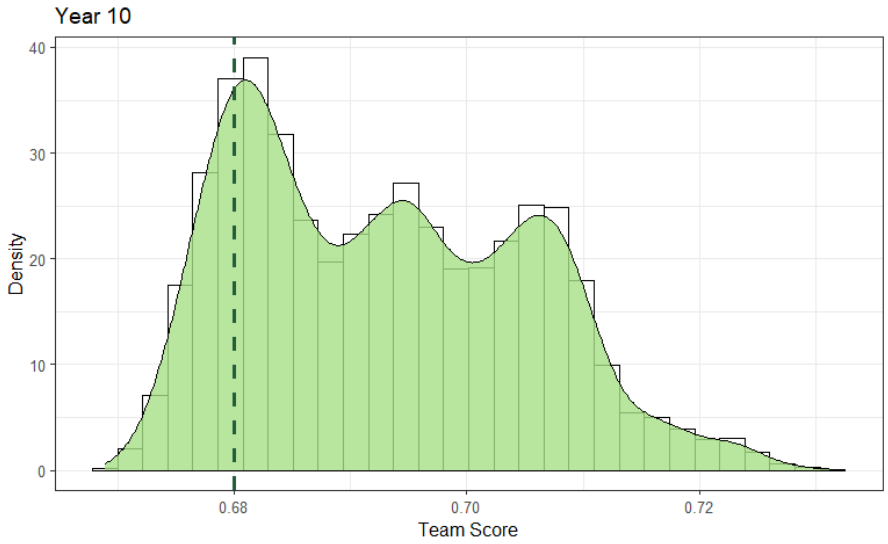


Figure 7 Monte Carlo simulation results of the tenth year

Appendix E – The Input-Output: Sport Analysis of Football "Brand" Economic Effects

To determine the total impact as well as the sector-specific impact of Football "Brand" on Rarita's economy, we used the Input-Output Tables: Sport (IOT: S) in a study led by SportsEconAustria (SpEA) in 2011-2012 commissioned by the European Commission, Directorate-General Education, and Culture. The following sections will describe the analysis in detail.

Section E-1: Definition of Football in the Economic Sense

Although the team's economic impact is limited, a wide range of economic

activities is directly or indirectly football-related. To measure the influence of Football's "brand" on the national economy, it is necessary to determine a definition of football in the economic sense. Drawing on the Vilnius Definition of sport, we define football as an economic activity distinguishing between a statistical, a broad, and an overall definition of sport as follows:

- Statistical Definition: operation of football stadiums and clubs, organization of football leagues and other competitions, comprised of NACE 93.1 Rev.2.
- Broad Definition: all activities which are inputs to sport or require sport as an input plus the Statistical Definition, such as the production of soccer shoes and other football-related facilities, and soccer fans' transportation expenses.
- Total Definition: consumption and investment that indirectly influenced by football, plus the Broad Definition.

Section E-2: Calculation of Direct Multiplier

The formula for Direct Multiplier is as follows:

$$Multiplier_{direct} = \frac{FGDP_{direct}}{FGDP_{statistical}}$$

where $FGDP_{direct}$ indicates the direct impact of Football "brand" on GDP in broad definition, and $FGDP_{statistical}$indicates GDP of the national football team in the statistical definition.

According to the study by SpEA, the average direct multiplier of FSA top 10 states is 30.58, while the average direct multiplier of other states is 10.29, which means that if a country breaks into FSA top 10, each Doubloon invested in its national football team generates an average return of ∂ 30.58.

Section E-3: Direct Impact of Football "brand" on GDP

To calculate the direct impact of football "brand" on GDP in broad definition, we use 10.29 as Rarita's direct multiplier for the first five years and 30.58 for the five years after that. $FGDP_{direct}$ is calculated as follows:

$$FGDP_{direct} = Multiplier_{direct} \times FGDP_{statistical}$$

where $FGDP_{statistical}$ is the annual revenue of the team.

Section E-4: Specific Sector and Total Impact on GDP

To measure the sector-specific impact of Football "brand", we use Input-Output analysis (IO) to derive decomposition of total effects. Considering the "brand effect", the indirect impact of Football "brand" on different sectors cannot be ignored. As the team ranking rises in FSA, Rarita's global visibility will increase, attracting more tourists, consumption, and investment. We define the total impact (direct impact combined with indirect and induced impact) of football on the k^{th} industry as:

$$FDGP_{direct\,k} = Multiplier_{indirect\,k} \times FGDP_{total\,k}$$

Lack of Rarita's detailed economic data, we find Greece as the best-fit country for Rarita[5]. The comparison of macroeconomic indicators (GDP, GNI, population and population density) of these two countries is as follows.

Table 21 Comparison of industrial structure data between Greece and Rarita

Population (million)										
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Greece	11,105,000	11,045,000	10,965,000	10,892,000	10,821,000	10,776,000	10,755,000	10,733,000	10,722,000	10,708,000
Rarita	12,088,000	12,138,000	12,176,000	12,222,000	12,273,000	12,331,000	12,393,000	12,463,000	12,549,000	12,569,000

Population Density (People/km²)										
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Greece	86.150	85.690	85.070	84.500	83.950	83.600	83.430	83.270	83.180	83.130
Rarita	89.550	89.900	90.170	90.480	90.830	91.210	91.620	92.110	92.720	92.870

GDP ($US/capital)										
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Greece	24,960	25,120	25,986	26,798	26,738	27,378	28,461	29,291	30,080	27,805
Rarita	22,546	21,067	22,077	23,739	20,435	22,184	23,031	24,901	24,664	24,102

GNI ($US/capital)										
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Greece	24960	25120	25986	26798	26738	27378	28461	29291	30080	27805
Rarita	27851	25906	27061	28902	24716	25110	26893	29443	29368	28421

We assume that specific sectors in Rarita have a similar economic response to Football "brand" to Greek. As is seen in table 22, Football "brand" has a particularly significant influence on industries such as Food, Construction, and Transportation.

Table 22 A sector-specific multiplier of football brands on various industries

Description	Sector-specific Multiplier
Products of agriculture, hunting and related services	1.450
Food products and beverages	1.790
Textiles	1.350
Wearing apparel; furs	1.390
Leather and leather products	1.230
Printed matter and recorded media	1.520
Coke, refined petroleum products and nuclear fuels	1.720
Chemicals, chemical products and man-made fibres	1.230
Rubber and plastic products	1.380
Fabricated metal products,exc. machinery and equipment	1.680
Machinery and equipment n.e.c.	1.180
Medical, precision and optical instrum., watches, clocks	1.080
Motor vehicles, trailers and semi-trailers	1.040
Other transport equipment	1.240
Furniture; other manufactured goods n.e.c.	1.330
Construction work	1.670
Trade, maintenance and repair services of motor vehicles	1.360
Wholesale trade and commission trade services	1.440
Retail trade services	1.370
Hotel and restaurant services	1.520
Land transport; transport via pipeline services	1.640
Water transport services	1.560
Air transport services	1.410
Supporting and auxiliary transport services;travel agency	1.210
Post and telecommunication services	1.210
Financial intermediation services	1.300
Insurance and pension funding services	1.470
Renting services of machinery and equipment	1.550
Research and development services	1.590
Other business services	1.650
Public administration and defence services	1.350
Education services	1.130
Health and social work services	1.340
Recreational, cultural and sporting services	1.570
Other services	1.280

The total impact of Rarita's national football team on GDP can be obtained by the sum of each sector:

$$FGDP_{total} = \sum_{i=1}^{n} FGDP_{total\,i}$$

Section E-5: Employment

It was found that growing the sport-related economy leads to a more than proportional growth of employment, which indicates that sport overall is labor-intensive. We assume that the ratio of football-related GDP to a share of football-related employment in Rarita is the same as that in Greece, thus we can derive the employment impact of Rarita's football team.

Section E-6: Regional Analysis

The share of the football-related GDP Eastern, Central, and West Rarita as of the total football-related GDP in the next 10 years is shown as follows:

Table 23 Football-related GDP as a percentage of sports-related GDP in the provinces of Rarita

Year	East Rarita	Central Rarita	West Rarita
1	48.484%	30.359%	21.157%
2	48.044%	29.156%	22.800%
3	48.132%	27.299%	24.568%
4	47.373%	27.109%	25.518%
5	46.634%	26.907%	26.459%
6	46.077%	26.789%	27.134%
7	45.591%	26.695%	27.714%
8	45.264%	26.678%	28.058%
9	45.032%	26.703%	28.265%
10	44.942%	26.800%	28.259%

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