Research of Investment in Human Capital in a Sports Club

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Abstract — As the new economic growth theory recognizes the importance of human capital, this paper adopts a grey relational analysis method and uses the data samples regarding development of a sports club to explore the correlation between investment in human capital and self-development in a specific sports club. The results have shown that sports club development has a strong correlation with investment in enhanced human capital in sports (physical education, technical training, professional training, etc.) and investment in safeguarding human capital in sports (health care, a variety of benefits, etc.) there is a strong degree of association. A conclusion has been drawn that there is a linear correlation between sports club development and investment in human capital in sports, and that investment in human capital in sports plays a positive role in promoting sports club development. As thus, it is recommended that sports club development should shift their focus from material investment to human capital investment in order to improve the quality of sports club development.

Keywords - grey relational analysis; investment in human capital; sports club development; Correlation

I. COGNITION OF THE IMPORTANCE OF HUMAN CAPITAL IN NEW ECONOMIC GROWTH THEORY

In terms of the relationship between investment in human capital and economic growth, the new economic growth theory indicates a strong correlation between investment in human capital and economic growth, and that like material capital, investment in human capital can become an important factor that drives economic growth through the accumulation of expertise, improvements in the technology level, increase in labor efficiency and enhancement of material capital management capacity. Specifically, in the sports industry, how investment in human capital is relevant with sports club development and sports economic growth has not been deeply studied. By using the grey relational theory, this paper investigates the relationship between investment in human capital in sports and sports club development, with the purpose of having an in-depth understanding of the correlation between sports club development and investment in human capital. The results of quantitative research can help managers develop a more intuitive understanding of the degree of synchronization and clarify the importance and necessity of strengthening investment in human capital in sports clubs.

The new economic growth theory takes investment in human capital as an important factor contributing to economic growth, and establishes economic growth models in which education and training are taken as exogenous variables. With the models, the contribution of investment in human capital to economic growth is profoundly analyzed and the important role of human capital in economic growth is emphasized. Therein, the most representative model is the Romer Economic Growth Model, presented by Romer (1996) in his paper entitled Growth Based on Increasing Returns Due to Specialization. He established a production function:

\[ F_i = F(k_i, K, x_i) \]  

where \( F \) is the output level of manufacturer \( i \), \( k \) is specialized knowledge of a product produced by manufacturer \( i \), \( x \) is vector of other production factors of manufacturer \( i \), and \( k = \sum_{i=1}^{n} k_i \) is the aggregate stock of knowledge in society.

In the production function, for a given value \( k \), \( F \) is an odd function of \( k \). That is to say, when the aggregate stock of knowledge in society is fixed, a single manufacturer invests in production with expertise and production factors and reports constant returns to scale. From the social perspective, as knowledge has a spillover effect, \( F \) has the incremental marginal productivity of global knowledge, and \( F \) is an increasing function of \( k \); accumulation of expertise of a single manufacture is an increasing function of capital accumulation.

The growth model of human capital accumulation is

\[ h(t) = h(0) e^{\delta(1-u(t))} \]  

where \( h(t) \) is denoted as the human capital of labor skills, \( h(0) \) is an increment of human capital, \( \delta \) is output elasticity of human capital, \( u \) is the entire production time, \( 1-u(t) \) is the learning time deviating from production. The equation shows that if \( u = 1 \), \( h(t) = 0 \), meaning no human capital accumulation; if \( u(0) = 0 \), \( h(t) \) grows at a rate of \( \delta \), so \( h(t) \) reaches a maximum. The model has underlined that investment in human capital (human capital that workers
accumulate out of production from formal and informal school education) has a positive role in promoting economic growth.

C. W. Cobb) and P. H. Douglas further investigated the effect degree (contribution rate) of investment in human capital to economic growth[5] and created a production function that presented the relationship between contribution of human capital (labor) \( L \) and material capital \( K \) and output:

\[ Y = AE^L K^\beta \]  

(3)

where \( Y \) is denoted as economic aggregate, \( A \) is the integrated technology level, \( L \) is the investment in human capital (quantity of labor), \( K \) is the investment in material capital, and \( \alpha \), \( \beta \) are the elasticities of output with respect to labor and capital.

The above research has underlined the positive role of investment in human capital in economic growth. On the one hand, we are aware that human capital has an important contribution to economic growth and is an indispensable factor in economic development. On the other hand, however, the above studies are performed from a macroscopic perspective. Concretely, in the sports industry, there has not been any clear evidence to identify the relationship between investment in human capital in sports and sports club development, or what factors in investment in human capital in sports are linearly correlated to sports club development. To this end, based on previous studies concerning the significant role of human capital, as per the connotation and specific content of investment in human capital in sports, this paper is focused on exploring the specific association between investment in human capital in sports and sports club development and finding out sports human capital factors that are directly associated or exert vital influences on sports club development, in the hope of providing insightful references to clarify the content focus of investment in sports human capital and formulate a scientific investment strategy in sports human capital.

II. A GREY RELATIONAL ANALYSIS OF INVESTMENT IN SPORTS HUMAN CAPITAL AND SPORTS CLUB DEVELOPMENT

To clarify the relationship between investment in human capital in sports and sports club development, the paper mainly investigates the correlation between the content elements of investment in human capital in sports and sports club development by constructing a grey relational model and explores the correlation between investment in human capital in sports and sports club development in accordance with the computational results of the grey relational model. According to research needs, this paper begins with a deep understanding of the content elements and related concepts of investment in human capital in sports. Afterwards, it calculates the correlation degree between the content elements of investment in human capital in sports and sports industry development as well as the overall correlation degree between investment in human capital in sports and sports club development grounded upon the sample data.

A. Applicability of Applying a Grey Relational Analysis to Correlation Between Investment in Human Capital in Sports and Sports Club Development

The grey relational analysis is a method that mainly finds out and quantifies the relevance of multiple random time factor sequences through data processing of various factors to be analyzed in incomplete information. Its essence is to compare the time sequences that reflect changes in factors, with the purpose of finding the principal influential factors in the system development process. The grey relational analysis has a low requirement of samples. The sample size may be small, so a relational analysis can be made of system factors in case that the distribution of samples is unknown. This method can effectively remedy a defect of high sample requirement in traditional methods (such as regression analysis, variance analysis and principal component analysis). Meanwhile, the grey relational analysis is particularly suitable for time series data. It can fully consider the characteristic that data objects change over time, and when time changes its changing trends, the grey relational theory can more accurately and quickly reflect these changes. The grey relational grade is a measure of relevance changed over time or different objects for the factors between two systems. In the course of system development, if two factors have much consistency in developmental trends, namely high degree of synchronous changes, which can be described as a high-related degree of two factors, on the contrary, it is relatively low. As a consequence, based on some relevant data, by applying the grey relational analysis method to calculate the relational degree and analyze the similarity or diversity of developmental trends of these factors, we can measure and determine the relevance of these factors.

Investment in human capital in sports is a human-orientated management activity to develop, expand the stock and improve the quality of human resources. Conforming to different investment subjects, it can be classified into individual investment, organizational investment and governmental investment. From the content elements of investment in human capital in sports, individual investment is comprised of fitness investment, educational investment, investment to upgrade sports technical skills, healthcare investment and investment concerning job-seeking at various stages; organizational investment encompasses wage payment, professional training, job training, adult education and health care, among others. Governmental investment includes fiscal appropriation to physical education, financial aid to sports professional training and payment of public medical care, to name just a few. The sports industry is the aggregate of various industries producing material and spiritual sports products and delivering sports services. The important features of its products is to improve the physical fitness of inhabitants, develop social production, inspire the national spirit, and achieve full personal development and social civilization. In addition to having characteristics different from other industrial sectors, the sports industry as a national economic sector also shares some commonalities - commercial, which is to focus on market efficiency and economic effectiveness, and specifically to seek profit and
pay attention to economic efficiency is an important purpose of the sports industry. Sports clubs as a kind of social service sports have many influential factors during its development. Although human capital is just one of the factors, pursuing to the new economic growth theory, sports human capital as an endogenous growth factor driving sports club development has greater persistency to stimulate sports club growth. By comprehensively analyzing the influence of Investment in human capital in sports in the development of sports clubs, the feature of multi-attribute dynamic change has been detected.

Since the return and investment of sports human capital is a dynamic process, there is an effectiveness lag. In addition, human capital in sports is characterized by attachment, variability implicitness and difficulty to measure. As per the relevance features of investment in human capital in sports and the development of sports clubs, using grey relational analysis to calculate relevance is very suitable for analyzing the relationship between investment in human capital in sports and sports club development. By constructing a relevance model for investment in human capital in sports and sports club development to calculate relevance coefficients, we can more clearly and intuitively know the correlation between sports club development and investment in human capital in sports.

B. Calculation of Grey Relevance Between Investment in Human Capital in Sports and Sports Club Development

Grey relational analysis provides a quantitative measure for system development changes, so it is very suitable for the dynamic process analysis. When characterizing the relevance between two things, the correlation coefficient is usually adopted. According to the grey relational analysis principle, the calculation steps for grey relational analysis are as follows:

① Establish system time series
Assume the time series of the system’s characteristic behavior as \( X_0 = (X_0(1), X_0(2), \ldots, X_0(n)) \) and the behavior series of relevant factors in the system as \( X_i = (X_i(1), X_i(2), \ldots, X_i(n)) \).

② Solve absolute relevance
As per the time series of the system’s characteristic behavior \( X_0 \) and the behavioral series of relevant factors in the system \( X_i \), solve the difference series \( X_0^c \) and \( X_i^c \) of the characteristic series and behavioral series, where
\[
X_0^c = X_0(k) - X_0(1)
\]
\[
X_i^c = X_i(k) - X_i(1)
\]
Hence, the calculation equation for absolute relevance is:
\[
e_{0i} = \frac{1}{1 + |s_0| + |s_i| + |s_i - s_0|}
\]
where,
\[
|s_i| = \frac{\sum_{k=2}^{n} X_i^c(k) + X_i^c(n)}{2}
\]
③ Solve relative relevance
Let \( X_0 = \frac{X_0^c(k)}{X_0(1)} \), \( X_i = \frac{X_i^c(k)}{X_i(1)} \) Then the time difference between \( X_0^c \) and \( X_i^c \) is:
\[
\left| s_0 \right| = \sum_{k=2}^{n} X_0^c(k) + \frac{1}{2} X_0^c(n)
\]
\[
\left| s_i \right| = \sum_{k=2}^{n} X_i^c(k) + \frac{1}{2} X_i^c(n)
\]
The calculation equation for relative relevance is:
\[
r_{0i} = \frac{1 + |s_0| + |s_i|}{1 + |s_0| + |s_i| + |s_i - s_0|}
\]
④ Calculation of integrated grey relevance
Let integrated grey relevance be \( \rho_{0i} \), then
\[
\rho_{0i} = \theta e_{0i} + (1 - \theta)r_{0i}
\]
where \( \theta \in [0,1] \).

According to the calculation steps of grey relational analysis, to take a large-scale, well-operated sports club as an example, data over a span of nearly 15 years from January 1998 to December 2012 were collected as the basis (based on data confidentiality and research exploration, the collected data only serve for the purpose of academic research, so the name of the club is not disclosed here); a relevance analysis is performed in investment in human capital and its development of this particular sports club. Since the investment in human capital in sports includes fitness investment, educational investment, investment to upgrade sports technical skills, wage payment, professional training, job training, adult education and health care, various welfare measures and labor migration (consisting of regional talent import and intra-region labor migration), in order to simplify the calculation process and improve the reliability of analytical results, after conducting an in-depth analysis of the content elements and their connotation of investment in human capital in sports, this paper synthesizes the complex elements into two dimensions (the basis of classification is to see whether the stock of human capital can be directly formed or increased). The concrete combined result is: knowledge accumulation and promotion of qualifications are taken as the main tasks to directly form or increase the stock of sports human capital; together with investment related to education and training, it is referred to as “investment in enhanced human capital in sports”. On the other hand, health care or optimizing allocation of sports human capital are taken as the main tasks to not directly form or increase the stock of sports human capital; together with welfare health and labor migration, it is referred to as “investment in safeguarding human capital in sports”. According to the classified investment elements in human capital in sports, a sequence is established and sports club development is taken as the characteristic sequence \( X_0 \); “investment in enhanced human capital in sports” and “investment in safeguarding human capital in sports” are
behavioral sequences $X_i$ and $X_k$. According to the sample data, it is calculated as follows:

1) Solve absolute grey relational grade

$$X_0 = \{0.998, 2793, 5081, 6434, 5221, 7757, 7690, 7327, 9885, 13152, 13985, 14393, 14338, 14716\}$$

$$X_1 = \{1.156, 2794, 4895, 5174, 6589, 7678, 8304, 9221, 10617, 13342, 14611, 15343, 16424, 16001\}$$

$$|\varepsilon_{01}| = \frac{1 + |k_0| + |k_1|}{1 + |k_0| + |k_1| + |k_2| - s_0} = \frac{1 + 341 + 131127}{1 + 341 + 131127 + 130786} = 0.5013$$

$$|\varepsilon_{02}| = \frac{1 + |k_0| + |k_1|}{1 + |k_0| + |k_1| + |k_2| - s_0} = \frac{1 + 341 + 140420}{1 + 341 + 140420 + 140079} = 0.5012$$

2) Solve relative grey relational grade

$$X_0 = \{1.10759, 1.3066, 1.2067, 0.804, 1.1359, 1.8015, 1.5449, 1.5815, 1.8224, 2.4191, 3.4463, 4.1176, 4.5758, 6.1477\}$$

$$X_1 = \{1.0149, 1.0416, 1.0757, 1.0959, 1.0778, 1.1156, 1.1146, 1.1092, 1.1473, 2.1960, 2.1084, 2.1245, 2.1317, 2.1293\}$$

$$X_2 = \{1.0169, 1.0408, 1.0715, 1.0756, 1.0021, 1.1122, 1.1213, 1.1347, 1.1551, 1.1949, 1.2134, 1.2241, 1.2399, 1.2338\}$$

$$\varepsilon_{01} = \frac{1 + |k_0| + |k_1|}{1 + |k_0| + |k_1| + |k_2| - s_0} = \frac{1 + 36.0596 + 36.4541}{1 + 36.0596 + 36.4541 + 16.4541 - 36.0596} = 0.7319$$

$$\varepsilon_{02} = \frac{1 + |k_0| + |k_1|}{1 + |k_0| + |k_1| + |k_2| - s_0} = \frac{1 + 36.0596 + 16.5513}{1 + 36.0596 + 16.5513 + 16.5513 - 36.0596} = 0.7295$$

3) Calculate integrated grey relational grade

$$\rho_{01} = \theta \varepsilon_{01} + (1 - \theta) r_{01} = \frac{1}{2} \times 0.5013 + \frac{1}{2} \times 0.7319 = 0.6166$$

$$\rho_{02} = \theta \varepsilon_{02} + (1 - \theta) r_{02} = \frac{1}{2} \times 0.5012 + \frac{1}{2} \times 0.7295 = 0.6154$$

From the analysis results, the relevance between investment in human capital in sports and sports club development is 0.6166, while the relevance between investment in safeguarding human capital in sports and sports club development is 0.6154.

C. An Analysis of Calculation Results of the Relevance Between Investment in Human Capital in Sports and Sports Club Development

Calculation results of the relevance between investment in human capital in sports and sports club development demonstrate a strong correlation between investment in human capital in sports and sports club development. On the one hand, both investment in enhanced human capital in sports and investment in safeguarding human capital in sports are strongly related to sports club development. On the other hand, the relevance between investment in enhanced human capital in sports and sports club development is slightly higher than that between investment in safeguarding human capital in sports and sports club development. Because investment in human capital in sports contains a wide range of content and is a multi-attribute decision making problem, it is a dynamic process for logic analysis and synthesis judgment of the multi-attribute system. In the development of sports clubs, while laying great emphasis on both investment in enhanced human capital in sports and investment in safeguarding human capital in sports, we must also recognize that in sports the knowledge economy has become increasingly prominent in the development of the sports industry. If not taking sports human capital as an independent endogenous variable in the sports industry, we cannot explain the development of the sports industry and sports economic growth. Since the new century, the knowledge economy features have become increasingly highlighted. Based upon production, distribution and use of knowledge and information, the knowledge economy develops at an astonishing rate depending on people, the carrier of knowledge. Sports human capital has become an important element to boost economic growth and sports industrial development, and the quantity and quality of human capital in sports has been playing an increasingly greater role in the development of the sports industry. More efficient investment in human capital in sports means an increase in effective labor input or improvement of material capital utilization efficiency. Moreover, sports human capital accumulation can lead to improved labor quality, while the quality of labor directly determines the level of production efficiency. Therefore, during the development of sports...
industry, it is an inevitable choice to shift the focus from material capital to sports human capital, heighten sports human capital investment and increase the stock of human capital in sports.

III. CONCLUSION AND RECOMMENDATIONS

Regarding the relational analysis between investment in human capital in sports and sports club development, the results have pointed out significant relevance between investment in human capital in sports and sports club development, wherein the relevance between investment in enhanced human capital in sports and sports club development is slightly higher than that between investment in safeguarding human capital in sports and sports club development, suggesting that investment in enhanced human capital in sports such as investment in education, professional training, job training play a more direct role in promoting sports club development. Given this strong relevance, relevant departments should improve the awareness of taking human capital in sports as a vital element in sports economic prosperity and sports industrial development and intensity the investment strength in regional human capital in sports; sports clubs should take positive and effective measures to transform human resources in sports into human capital in sports, continue to increase the stock of human capital in sports and promote their sustainable, rapid, healthy and stable development. In the development of sports clubs, investment in human capital in sports is a multi-attribute decision-making problem, so the correctness of investment decisions in human capital in sports depends on the scientificity of the decision-making process. Therefore, only by comprehensively considering many factors can people make scientific investment decisions of human capital in sports. In order to improve the scientificity of investment decisions of human capital in sports and enhance its effectiveness, we can employ the multi-objective decision-making method for ordering the schemes, choosing the best options and providing a reference for investment in human capital in sports.

REFERENCES