Research Article

Sports Product Marketing and Economic Growth Econometric Dynamic Analysis Model Based on Random Matrix Theory

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With the development of sports spirit, the proportion of total output value of sports industry in economic growth is increasing day by day, which has become an important factor for the long-term stable medium and high growth of economy in the new normal period. In view of the background of sports economic growth, this paper adopts the data of sports product marketing and selects sports goods sales and GDP as indicators. Through the combination of consumption mode and sports industry, we trace the consumption mode of sports consumers, put forward the segmentation and positioning of sports product consumption market, and establish the dynamic quantitative system of sports economy combined with the random matrix. The dynamic influence mechanism of sports product marketing on economic growth is studied. The results show that all of them are stationary sequences after first-order difference in econometric analysis, and the values of test results are all less than 1. The effect of the model is good, the contribution of sports product sales to economic growth reaches the maximum, and the contribution to economic growth tends to be basically stable.

1. Introduction

With the rapid development of computer network technology and explosive multiplication of big data information in the age of information digitalization, it has always been an urgent problem to be solved regarding how to effectively analyze data and discover the economic value hidden behind data sources in scientific research. Sports industry marketing is the use of sports events to carry out marketing. Media attention to sports events is also large, prompting people to pay attention to sports events. Sports industry marketing uses the publicity of sports events to strengthen their own publicity. The main ways to promote sports events are to sponsor spare parts related to sports events, trophy marks, and related advertisements so as to enhance the publicity of sports industry marketing [1]. Sports media promotes the sports industry to appear frequently in the public eye by means of broadcasting, advertising of sports industry, and sponsoring advertising of sports events and sports organizations. In this way, the sports industry can obtain better economic benefits and provide financial support for the development of the sports industry. In the sports industry, sports products are not only the products of the sports industry and an effective marketing form of the sports industry. Sports products enrich the life of consumers, and consumers create new products by using sports products to obtain benefits. Researchers accurately apply marketing theory to predict economic growth research which has become a hot issue.

Sports industry is the product of social development to a certain historical stage. The management mode of sports has correspondingly changed from amateur to professional, from non-commercial to commercial, and sports has become an important economic resource. It has become an indispensable part of the national economy and industrial structure. Business activities in the field of sports are gradually active, and the image of sports industry has been basically established. Sports industry has become a new
growth point of national economy and shows attractive development prospects and great growth potential. The vigorous development of sports industry has provided an important practical basis for sports economic research, and the continuous updating of sports economic research results has provided important theoretical and practical guidance for the development of sports industry. In this paper, the dynamic quantization system of sports economy combined with random matrix is established by combining the consumption mode with sports industry.

2. Related Work

With the continuous improvement of the income level, the public began to pay more attention to quality of life and healthy consumption. The research on the influence mechanism of sports industry development on economic growth is the focus of attention. As a new growth point of the national economy, the sports industry is closely related to other industries such as tourism, catering, transportation, and clothing. Based on classical economics, Xu and Yang explored all possible macroeconomic variables affecting market equilibrium. The theoretical system considers the whole macroeconomic system as a whole [2]. In real economic life, there is great heterogeneity among different industries, and the sports industry in different regions also has significant differences. Quantitative dynamic analysis is an important tool for comparing differences between various fields of national economy and also a quantitative analysis tool for the interdependence between competitive economies [3]. Kharchenko and Ziming believe that sports industry consumption can drive the development of many related industries and use measurement dynamic technology to study the interdependence between economy and sports industry and use this method to formulate sports marketing strategies. As an emerging industry, sports industry has the potential to become a new growth point of the national economy because it can attract a large amount of investment and consumption, and the growth rate of added value of sports industry has significantly exceeded the growth rate of GDP [4]. Mallick et al. studied from the perspective of cost of sports products and found that the lower the unit cost of sports products, the lower the price of products provided by the sports industry. The advantage of price enables the sports industry to maintain its advantage in competition [5]. Zhao and Wang in the research sponsors fans and points out the relationship among sports team. Professional sports teams have the potential to use their own advantages, to maintain the relationship between the sponsors and fans, help enterprises to form the brand effect and help them achieve marketing efficiency, the business value of the enterprise brand, and help to form brand awareness in the consumers’ mind, thus affecting the consumer behaviour [6]. Abidoye and Oduosola proposed marginal effect and brand image model and constructed structural equation model to verify the relationship between brand image and loyalty in the process of studying enterprise brand and consumer and fan loyalty [7]. Brand consciousness and image attributes are the product of consumers’ accumulation of brand association. Marketing should be based on customers to form unique brand association.

With the continuous development of national economy and the continuous improvement of residents’ disposable income, the forward correlation of sports products begins to increase. Rajabov and Mustafakulov captured the spatial diffusion between sports competitions by using the impulse response function estimated by the spatial autoregression model [8]. Sadiku et al. studied the spillover effect of sports products in various countries by using the vector autoregression model and impulse response analysis. On this basis, it tested the causality and verified the spatial diffusion phenomenon with IRA and put forward the problem of nonstandard or excessive parameterization in the standard VAR model estimation. To solve this problem, VAR model and generalized prediction error variance decomposition (FEVD) method are used to construct connectivity network, providing an intuitive method to explain the VAR model [9]. Kais and Sami proposed a VAR-based dependent regression model and applied functions before VAR coefficients to solve the problem of dimension [10]. Seghir et al. analyzed the relationship between economic growth and real estate by using impulse response function and variance analysis. Based on the data of granger causality test, this paper analyzes the economic growth under the new economic situation of real estate investment depending on the change of the situation [11]. Sharma established a vector autoregressive model and cointegration test to obtain the relationship between GDP ratio and real estate price. That is, the GDP ratio is rising, and the real estate price is also rising [12]. Scholars at home and abroad have made a series of studies on economic analysis by using the random matrix, but there is almost no research on the economic growth brought by sports marketing. Therefore, this paper uses the random matrix theory to quantify the economic growth of sports.

3. Building the Sports Product Marketing Model Based on the Random Matrix

3.1. Positioning Marketing Model Based on the Sports Consumption Segmentation Market. The construction of sports product marketing model based on the consumption mode needs to study the causes of the consumption mode, which will help marketers to understand the consumption mode and grasp the consumption type of the consumer group. The formation of consumption pattern comes from the joint action of internal and external factors [13]. The external influencing factors mainly include culture, subculture, social class, family life cycle, and demographic factors. The internal influencing factors mainly include personality, values, emotions, motivation, and past experience. Under the joint influence of internal and external factors, consumers differ in activities, interests, and opinions, and marketers describe consumers’ different lifestyles. From this point of view, individual consumers will lead to a wide range of consumption patterns. From the perspective of market segmentation in marketing, these diversified lifestyles are divided into different consumer groups according to certain standards. Marketers target different sports consumer
groups for market positioning and develop corresponding marketing strategies [14]. Based on the universal and scientific consumption mode types, this paper studies six consumption mode types suitable for the sports industry based on the actual consumption: avant-garde, new, performance competitive, health and sports, home life, economic practical, casual, and comfortable. Based on the research and classification of sports market consumption as the core, through the combined consumption and sports industry, it traces the causes of consumption patterns and reset type sports consumption consumer lifestyle, puts forward various market segments corresponding to orientation direction, and builds a simple model based on consumer market of sports product marketing which is shown in Figure 1.

In the figure, the sports industry market is divided into six corresponding submarkets according to the six types of sports consumption mode. According to the characteristic description of these six types, the basic market positioning of these six markets can be carried out, and the corresponding marketing mix strategy can be formulated. For the “avant-garde and new style” market, the core of the market positioning is to meet consumers’ demand for “novel” or “unconventional.” Consumers of this type are more willing to participate in innovative sports activities, buy novel sports goods, and watch unique sports events. For the “performance competitive” market, the core of the market positioning is to meet consumers’ pursuit of “performance” or “ranking.” Consumers of this type prefer to see their achievements after participating in sports activities or buying sporting goods. They are more enthusiastic about competitions and pay attention to the ranking obtained in the competition. For example, the APP sports crowd is particularly keen on moving up the leaderboard in terms of daily steps. For the market of “healthy sports,” the core of the market positioning is to meet consumers’ demand for “health” or “effect.” Consumers of this type want to see the physical benefits brought by sports, and they are concerned about the improvement of their health status or the effect of physical changes [15]. For the “home lifestyle” market, the core of the market positioning is to meet consumers’ attention to “quality of life,” “lifestyle,” and other aspects. This type of consumers takes sports as a part of the lifestyle, especially care about daily physical exercise. For the “economic and practical” market, the core of market positioning is to satisfy consumers’ sensitivity to “economy,” “affordable,” and “cost-effective”. Consumers of this type pay more attention to the cost performance of sports consumption, that is, they hope to get more results with less investment [16]. For “random” ease the market, market positioning is the core of “guide consumers” and “boost consumer.” This type of consumer is highly selectable. Sports consumption often comes from temporary decisions under certain conditions, which is more like a relaxed and comfortable state. Consumers need more guidance and stimulation from marketing personnel.

3.2. Economic Dynamic Quantization System Based on the Random Matrix. In this paper, the sports industry is divided into sports goods sales, sports facilities construction, and sports services when the development indicators are selected. Due to the lack of overall statistics on the development of sports industry, this paper takes large sports suppliers as an example to reflect the development level of sports industry through sales activities. The GDP of the tertiary industry is selected as the economic development index. Compared with the national index, this index can be more precise and reduce the impact of multivariable fluctuations [17]. The sports product sales trend chart and monthly economic growth data description are drawn by econometrics software, and the time series trend of sporting goods product sales and GDP economic growth from 2011 to 2021 is generally described. The trend of sporting goods product sales growing steadily and GDP growing steadily is shown in Figure 2.

In order to eliminate the heteroscedasticity possible in the time series data, logarithmic processing is performed on the original data, which does not change the trend and attributes of the original data. At present, there is no authoritative index to measure the dynamic relationship
between sports and economic development. The development of the sports industry largely depends on the sports atmosphere. Sports events are selected as the economic growth index and the per capita GDP index as the evaluation of the regional economic development speed [18]. Research framework is developed based on the dynamic relationship between GDP per capita and sports events on the economy. Based on the more mature theoretical structure of dynamic measurement, this study establishes a dynamic quantitative method system aiming at the characteristics of sports economy. The basic structure of the system theory and method generally consists of association analysis, multidimensional evaluation, optimization modelling, result prediction, system decision, reasonable planning, and measurement control. The specific content of the theoretical framework combined with sports economy is shown in Figure 3.

Correlation analysis is the basic content of the dynamic measurement method of sports economy. In the process of sports economic measurement research, we should first make clear the various correlation relations in the system, so as to have a thorough understanding of the sports economic system and distinguish which are the leading factors and which are the restricting factors so as to lay a solid foundation for further systematic analysis, prediction, decision-making, evaluation, planning, and future development strategy research. Compared with traditional sports statistics, the biggest advantage of factor analysis using this method is that it has obvious short time limitation and dynamic characteristics, so as to understand the changes of
the relationship between various factors in the system in a relatively short period of sports economic events.

3.3. Establishment of the Random Matrix Model. Matrix model is a typical representative of the parameterized model, which is composed of univariate time series observed in space. It elaborates the dependence between multidimensional time series [19]. By introducing the weight matrix specified in the figure into the model before analyzing the data, N time series are simultaneously modelled as a linear combination of past observations and perturbations at adjacent locations. The model contains not only time-dependent structure but also space-dependent structure. The model-based impulse response function and variance decomposition decompose the dynamic structure of the research object, understand the trend of the research object, and analyze the impact of this trend on the system [20]. The model does not require zero constraint on parameters, so the significance of parameter estimation can be ignored. The stationary condition of the model requires that the p-order vector autoregression model be expressed in the form of the first-order vector autoregression model, and several random processes are defined as follows:

\[
\xi_t = \begin{bmatrix} y_t + \delta \\ y_{t-1} + \delta \\ \vdots \\ y_{t-p} + \delta \end{bmatrix},
\]

\[
\tilde{\xi}_t = \begin{bmatrix} \varphi_1 & \varphi_2 & \cdots & \varphi_p \\ i_n & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & i_n \end{bmatrix},
\]

\[
\tilde{\xi}_{t-1} = \begin{bmatrix} \delta \\ 0 \\ \vdots \\ 0 \end{bmatrix}.
\]

Therefore, the model is simplified into the form of first-order vector autoregressive model as follows:

\[
\tilde{\xi}_{t-s} = \mu_{t-s} + \lambda \mu_{t-s-1} + \cdots + \lambda_s \mu_t.
\]

Under this representation, the eigenvalues of the coefficient matrix need to be investigated for the stationary test of the model. If the eigenvalues all fall within the unit circle, the system is stable.

4. Econometric Dynamic Analysis Based on the Random Matrix Model

In the process of analyzing the research object, in order to eliminate the factors related to the random disturbance terms, the method of unit root test is used to determine whether the time series is stable or not. The ADF test method is mainly used to predict whether the time series is stable by comparing the ADF critical value with the judgment parameter T value. The value of parameter T is compared with the ADF critical value. When the value is less than the ADF critical value, we can draw the conclusion that the time series is stable. Cointegration test is mainly used to determine whether the sequence has long-term stable correlation, it is difficult to explain the estimated value of a single parameter in the model, which is the deficiency of the vector autoregression model [21]. The impulse response function is used to represent the impact of each variable on each other,
the interaction of each variable is obtained, the impact of new orthogonal variables is studied, and then the dynamic results of the model are expressed. The impulse response function of the model is used in the analysis of practical problems because it is considered to be a nontheoretically model. Therefore, the effect of variable parameter estimation is not studied, and the focus of the study is the impact of the change trend of error on the whole. The impulse response function applies the influence of standard deviation to the random perturbation shock to study the influence of the shock on the later value of the endogenous variable. Due to the particularity of the model structure, adding an impact effect on a variable can not only produce a shadow on itself but also transmit the influence to other endogenous variables, so the dynamic relationship between variables can be obviously observed. The principle of impulse response function analysis is to give a shock to the endogenous variable and then study the impact of the shock on itself and the sweep effect of other variables. Variance decomposition focuses on studying the contribution degree of shock to endogenous variables so as to analyze and compare the importance of shock response.

4.1. Economic Growth and Sports Product Marketing Cointegration Test. The monthly sales revenue of sporting goods manufacturing products fluctuated with time and showed an increasing trend year by year. The time series was non-stationary. According to the autocorrelation coefficient diagram to determine whether sports product sales revenue is a stable time series, using Eviews10 software, the stationarity test was carried out on the three-factor time series of macroeconomic variables with significant influence and return rate at the confidence level of 5%. The method was ADF unit root test. The original sequence cannot reject the null hypothesis, because it is a nonstationary time series and does not conform to the modelling principle. Therefore, the original sequence is processed by first-order difference. After difference, all the test results of time series showed that the null hypothesis could be rejected, and subsequent cointegration regression could be carried out if the integration of the same order was satisfied. The test results are shown in Figure 4.

As can be seen from the figure, all the investigated sequences in the econometric analysis are nonstationary sequences, and they are all stationary sequences after first-order difference. Therefore, all-time series meet the premise of cointegration; on this basis, the cointegration method can be used to test the long-term stable relationship between the series. Time series data are a common type of data. In the time series regression analysis, it is necessary to test the stationarity of time series.

In the unit root test, the difference of the nonstationary microinfluencing factors is made to make it stable, which will lose the long-term information of the total amount, and this information is necessary for the analysis of the problem, so it needs to use cointegration to solve this problem. After determining the single-order integration of variables, the cointegration test is also needed to determine whether there is a long-term stable equilibrium relationship between variables. The cointegration test results are shown in Figure 5.

It can be seen from the figure that, under the four different indicator systems, there is at least one cointegration relationship between variables at the significance level of 5%. Moreover, it can be seen that in each cointegration equation, all variables’ T statistics except the growth rate of net interest rate are significant, that is, each independent variable has a strong explanatory power to the dependent variable. The net interest rate on sales, return on total assets and liabilities are significantly negatively correlated with assets, which indicates that the net interest rate on sales of sports industry improves the asset liability structure of listed companies. Enterprises with strong profitability are more likely to obtain more internal financing and the debt ratio will decrease. There is a significant negative correlation between assets and liabilities turnover, accounts receivable turnover, and total assets turnover. It shows that sports industry enterprises should further improve the management level and the utilization rate of assets. Equity reduces leverage, especially in the long run. The current ratio is the ratio of current assets to current liabilities, which is used to measure the ability of an enterprise’s current assets to be converted into cash to repay liabilities before short-term debt matures. The results show that the higher the asset-liability ratio, the lower the liquidity ratio. There is a significant positive correlation between assets and liabilities and quick capital ratio, indicating that the higher the asset-liability ratio, the lower the liquidity ratio. If the liquidity ratio is high but the quick capital ratio is very low, the short-term solvency of the enterprise is still not high. There is a negative correlation between the growth rate of net profit and net assets, but only the growth rate of net assets has a significant negative impact on the asset-liability ratio. That is to say, the increase of the company’s net asset growth rate has a significant role in promoting the reduction of the asset-liability ratio. The reason is that it reflects the prospect and space of the increase of corporate shareholders’ interests. Enterprises with high growth tendency tend to adopt low debt ratio.

4.2. Model Causality Test. Causality test cannot be used as a basis for accepting or rejecting causality. It is a test of the
temporal sequence of variables in a statistical sense. The Granger causality test is conducted and analyzed for the models of return level factor, slope factor, and curve factor of sports products. The analysis results of Granger causality test are shown in Figure 6.

In Figure 6, 95% confidence level is selected. In the Granger causality test of the level factor model, the level factor can be explained by the information index of the previous period. The lag term of the index contributes to improving the accuracy of the level factor measurement and improves the overall interpretation degree of the model. In the Granger causality test result, in addition to the level factor, slope factor, and curve factor as the explained variables, the Granger causality test result can also be generated with other macroeconomic indicators in the model as the explained variables, including the three factors of return. The test results show that Granger causality exists between the three factors and macroeconomic variables, and the variables are interdependent and restricted, which verifies that the establishment of the vector autoregression model is reasonable.

4.3. Model Stability Test. A sufficient and necessary condition for the stability of the model is that the reciprocal of the characteristic polynomial must be less than 1, which is displayed in the image as falling within the unit circle. If it falls outside the unit circle, the model will be unstable and the subsequent pulse analysis and variance decomposition will be meaningless. The simplest and intuitive method is to use the reciprocal root graph of the characteristic polynomial generated by Eviews to judge. If it falls near the circumference of the unit circle, it is difficult to directly judge whether it falls inside the circle with the image.

If the specific value in the root table of the characteristic polynomial is less than 2, the test results are shown in Figure 7.

From top to bottom and from left to right is the reciprocal root diagram of the model containing the horizontal factor, slope factor, and curvature factor. In the coordinate axis, the X-axis represents the real part and the Y-axis represents the coefficient of the imaginary part (i). Therefore, the point falling on the X-axis represents the real characteristic root. The values of the test results are all less than 2, located in the unit circle, and the model effect is good. The established models are all in a stable state.
4.4. Impulse Response Analysis and Variance Decomposition of the Model. Impulse response function is a common method to analyze the results of model estimation. It describes the influence of one unit disturbance shock on the current and future values of other endogenous variables and can better reflect the dynamic relationship between variables. The impulse response result of estimation drawing is shown in Figure 8. The horizontal axis is the time range of the response function, the vertical axis is the impact of the impact on the variable, the solid line is the response line, and the dotted line is the confidence interval of two standard deviations.

As can be seen from the figure, for the impact of sports financial input of one standard deviation, GDP decreases in the short term, but in the long run, the impact of sports financial input on economic growth remains stable, but it is also negative. For the impact of financial input, the development level of sports is improved in the short term, turns negative in about 3 years, and the impact is close to zero in
the long term. Sports financial investment has no direct influence on economic growth, but indirectly promotes economic growth by promoting sports development. However, the proportion of sports undertakings and related industries in China is relatively low. Only by constantly ensuring the development of sports undertakings, developing practical basis and expanding relevant industrial groups can effectively stimulate economic growth. The impact of investment impact is negative in the long run, that is to say, it is not advisable to rely on investment to drive sports development and economic growth in the long run. Blind expansion of investment is easy to cause overcapacity, which is not conducive to its healthy development. We should start from the demand of sports consumption and the demand of the people and improve the endogenous power of its growth.

Impulse response function is mainly used to describe the dynamic interaction between variables. According to the equation of the model between logistics industry and regional economy established above, it can be seen that the three endogenous variables of the model affect itself and other variables, and the impulse response function is generated, as shown in Figure 9. Impulse response studies the fluctuation of endogenous variables at different times in the future when the model is subjected to an external shock. In the figure, the impulse response of the model composed of level factor, slope factor, and curve factor are analyzed, respectively, and the impulse impact of the three factors caused by macroeconomic indicators is observed.

As can be seen from the figure, economic growth is a powerful driving force for the sales growth of sporting goods, and the contribution rate of economic growth to the sales of sports products reaches above at least. The contribution of sports product sales to economic growth reaches the maximum, and the contribution of sports product sales to economic growth tends to be stable. This is consistent with the result of impulse response shock. It is found that such positive utility is relatively small in Chinese, which may be because the sales data of sports products used are based on incomplete statistics. It is believed that more ideal results can be obtained if the sales data of national sports products can be obtained. Impulse response can see the direction of interaction between variables, while variance decomposition can numerically reflect the impact effect of different periods. At the beginning, its own explanatory power is very strong, but with the passage of time, its explanatory power weakens, and contribution rates of other influencing factors begin to appear.

5. Conclusion

This paper uses the method of the stochastic matrix model to test the dynamic effect between the sales of sporting goods products and economic growth and concludes that the sales of sporting goods products show a steady growth trend, and the economic growth shows a significant fluctuation. There is a long-term correlation between the sales of sporting goods products and the GDP of the tertiary industry, and there is a close relationship between economic growth and sporting goods sales. With the effective growth of economy, people’s understanding of health has been strengthened, and more attention has been paid to the sports products needed for exercise, indicating that the sales of sports products to a certain extent effectively reflects the relative increase of the sports population, and the national fitness awareness is more and more widely popularized. Both economic growth and sports product sales are natural number time series with unstable performance, and the time series of first-order difference operator must be carried out. There is a long-term cointegration relationship between sports product sales and economic growth, but there is no obvious cointegration relationship between economic growth and sports product sales. The sales of sports products have the benefit correlation to the economic growth. In general, the economic growth has no significant impact on the sales of sports products, and the short-term effect is not obvious. With the continuous development and improvement of sports industry, when conditions permit, a variety of quantitative economics studies are used to comprehensively analyze investment decisions and relevant policies issued by management organizations to provide more basis. Future studies capture the nonlinear correlation mechanism between time series and directly reflect the essential relationship between data, thus avoiding the possibility of research bias caused by theoretical hypothesis distortion.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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