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EFFECTIVENESS OF THE SPORTS MANAGEMENT SYSTEM IN EUROPE: HIGH ACHIEVEMENTS, PUBLIC FUNDING AND A HEALTHY LIFESTYLE

Vitaliia Koibichuk
Economic Cybernetics Department,
Sumy State University,
Sumy, Ukraine
E-mail:
v.koibichuk@biem.sumdu.edu.ua
ORCID 0000-0002-3540-7922

Serhii Drozd
Economic Cybernetics Department,
Sumy State University,
Sumy, Ukraine
E-mail:
s.drozd@uabs.sumdu.edu.ua
ORCID 0000-0002-0716-3078

Angéla Somogyi*
Széchenyi István University, Győr,
Hungary
somogyi.angela@sze.hu
ORCID 0000-0001-7966-1159
** Corresponding author*

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ABSTRACT. The article proposes an original approach to evaluating the effectiveness of the sports management system, which differs from the classical linear and non-linear optimization methods due to its use of quantile regression models. Three main indicators were chosen for creating the quantile regressions: (i) number of participants in the Olympic Games - as a feature of the effectiveness of the high-achievement sports; (ii) total number of people engaged in sports - as a feature of an effective mass sports system, which ensures a healthy lifestyle of the population; and (iii) state expenses on recreational and sports services. The quality of quantile regressions was validated by the Fisher test and the two-factor variance analysis. The research focused on the data of 30 European countries, which officially and publicly provide access to statistical reports on these issues. The countries were divided into two groups with above-average and below-average effectiveness of the sports management system. Two hypotheses were proposed and tested in the study. Hypothesis H1 was that the effectiveness of high-achievement sports depends on the amount of state funding for developing the sports industry. Research results confirmed this hypothesis for countries with an above-average level of sports management system effectiveness, but refuted it for the other group. Hypothesis H2 stated that the more massive the development of sport in a country, i.e., the more people are engaged in sports and lead a healthy lifestyle, the more likely this country is to achieve victories in high-achievement sports. This hypothesis was confirmed for both groups of countries.

JEL Classification: C12, C61, Z2

Keywords: bibliometric analysis, man and health, sport industry, effectiveness of sports management, state expenses, quantile regression.

Introduction

Sport achievements are the results of the sports science development, the use of advanced technologies for athletes' training, and significant efforts in sports management. Sports achievements depend not only on the personal skills of athletes and the hard work of coaches but also on the quality of joint work by a significant number of specialists involved in sports management processes. Their task is to organize effective supervision of athletes, provide funding for their activities, work on advertising sports competitions to increase the number of fans, etc. Services most often offered by sports management companies include hiring and firing athletes, coordinating activities related to negotiations and conclusion of contractual agreements, monitoring and controlling sports performance, searching and selecting qualified specialists to work with a team or an individual, and scouting for talented athletes.

Quality of the sports management system at the state level is evaluated by the number of podium finishes in various types of competitions (from the Olympic Games to local and regional competitions) by age categories of participants (middle school, high school, seniors, teenagers, etc.). At the same time, it must be emphasized that notable achievements in sports competitions of any type, either physical sports or esports, depends on the quality of training, which is affected by physical, biochemical, biological, moral, psychological, and mental factors that determine the state of health (Lyeonov et al., 2021 (a), (b); Pozeriene et al., 2021).

This study proposed to consider the effectiveness of the sports management system the high-achievements sports results, i.e., the country's achievements at the Olympic Games. This article tests two hypotheses regarding the determinants of a country's success or failure in high-achievements sports. According to the first hypothesis H1, the country's success in the world sports arena mainly depends on funding the state invests in developing sports and recreational services. According to the second hypothesis, the dominant factor does not include the funding but rather the prevalence of sports among the population, i.e., the number of people involved in regular sports and those who lead a healthy lifestyle. The purpose of the article is to develop an approach to evaluating the effectiveness of the sports management system based on quantile regressions, to calculate this indicator for 30 European countries (for which there are relevant statistics in the open access), to divide the studied countries into two groups (above- and below-average level of the sports management system effectiveness), as well as check the validity of the proposed hypotheses for each group of countries.

1. Literature review

Scientists from the United States of America, Canada, South Africa, and Colombia actively study sports management systems. It is necessary to focus on 23 institutions when considering their scientific sports schools, which prepare qualified professionals with bachelor's and master's degree, as well as medical institutions, in which certain courses devoted to rehabilitation sports exercises and therapeutic massage procedures are implemented (Fig. 1). When requesting "sports management" in the Scopus database for the period from 2016 to 2021, there were 191 publications on the analysis of the economic and legal foundations of the sports management system reform, taking into account their social aspects (Kuzmenko et al., 2020; Smiianov et al., 2020 (a), (b)) and financial and economic determinants, as well as the impact on public health (Aliyeva, 2022; Oteh et al., 2021; Lyeonov et al., 2021 (a)) and the life quality of the population by five or more researchers from different countries (Awojobi 2022; Louis 2022).

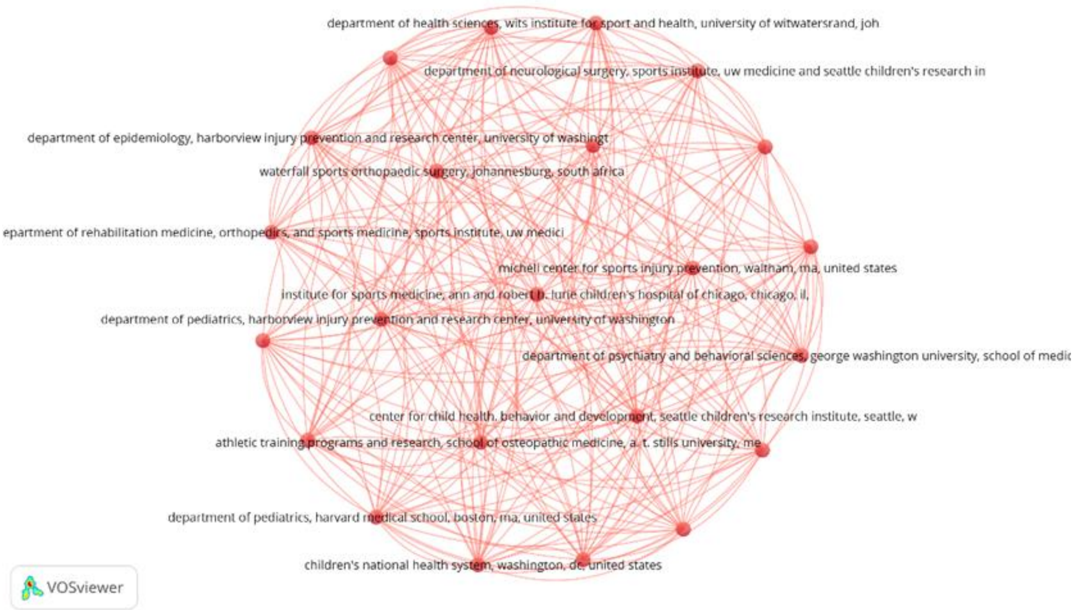

Figure 1. Map of relationships between scientific, medical and educational institutions that are actively engaged in researching the quality of the sports management system
Source: *Compiled by the authors using VOSviewer software*

The direction of ten leading sports education and medical institutions in the world is shown in Table 1.

Table 1 Scientific institutions of the sports industry

Institution	Description
Oklahoma State University: Center for health sciences (Oklahoma State University, 2022)	The institution educates Masters in Sports Training to become competent and independent clinicians who will improve patient care and advance the sports training profession through practice and research.
Pediatric Brain Injury Program (Hennepin Healthcare, 2022)	The institution rehabilitates children with traumatic brain injuries. Team members evaluate patients to identify problems with cognitive, behavioral, or physical function and provide treatment to help each child reach their maximum potential while providing family nurturing and support.
Seattle Children's Research Division (Seattle Children's Hospital, 2022)	It is one of the best children's hospitals in the United States, as a pediatric and adolescent academic medical center. It is also one of the top five pediatric research centers in the country, internationally recognized for its work in neuroscience, immunology, infectious diseases, prevention of sports and other injuries
Research University of Washington: Harborview Injury Prevention and Research Center (Harborview Injury Prevention & Research Center, 2022)	Interdisciplinary lecturers and staff conduct research, educate scientists and public health practitioners, and implement preventive programs to achieve high quality of health, including those related to sports injuries
University of Iowa Center for Advancement: Department of Health & Human Physiology (The University of Iowa, 2022)	The institution focuses on understanding health, sports, and recreation through education, research, and community collaboration
Wits Sport and Health (University of Witwatersrand, 2022)	The institution implements sports and physical medicine programs based on high-quality, internationally recognized training programs to promote maximum performance and rehabilitation. In addition, the university's activities are aimed at combining public and private services for the benefit of sports science and medicine

University of Illinois at Urbana-Champaign: (College of Applied Health Sciences, 2022)	The main direction of activity is aimed at studying the effectiveness of work, transmission and distribution of energy related to physical culture, health, and the human body. It provides studying the master's and PhD programs in the sports medicine.
American Sports Medicine Institute (American Sports Medicine Institute 2022)	It is a non-profit sports medicine foundation engaged in improving the understanding, preventing and treating sports-related injuries through research and education.
The Micheli Center for Sports Injury Prevention (The Micheli Center for Sports Injury Prevention, 2022)	The institution conducts world-class medical and scientific research aimed at preventing sports injuries and the impact of exercises on health and well-being; develops innovative ways to encourage children and adolescents to exercise using evidence-based strategies that help reduce injury risk and improve sport results.
Sports Medicine Fellowship: Columbia University's Department of Rehabilitation and Regenerative Medicine (Columbia University, 2022)	The sports medicine fellowship training program includes sports medicine didactic material combined with orthopedic surgery, radiology, adolescent medicine, and hands-on training in sports medicine primary care

Source: *built by the authors*

The bibliometric analysis performed using modern Bibliometrix software (Aria et al., 2017), the RStudio programming language and the R package, identified the top 30 scientific journals indexed in the Scopus database, which publish articles investigating the issue of "sports management" (Fig. 2).

Figure 2 shows the number of articles published in the specified journals. 10,924 articles related to sports management for the period from 2017 to 2022 were found. It emphasizes the importance and relevance of research issues on the sports management system effectiveness in different countries.

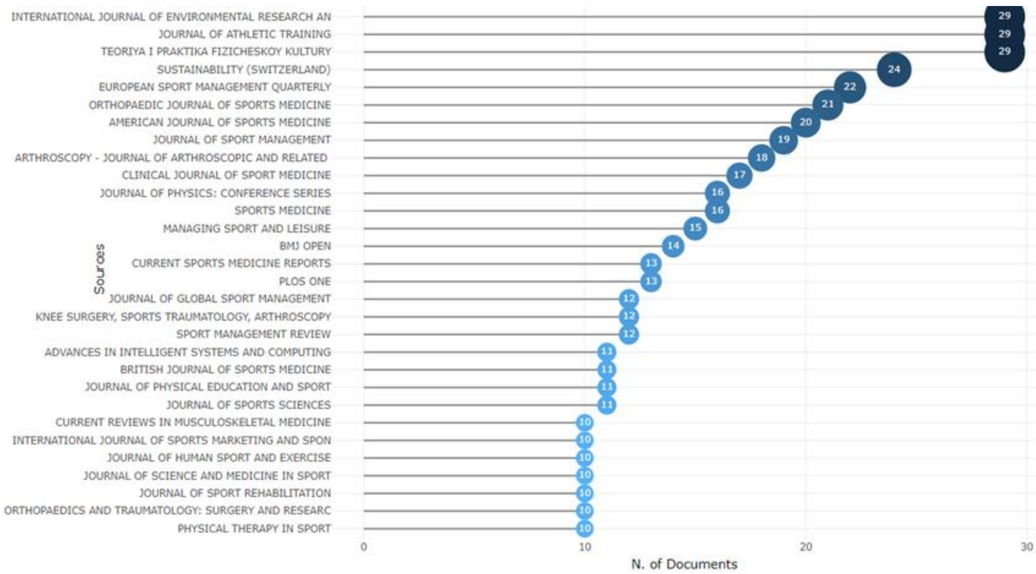

Figure 2. Top 30 journals by the number of articles published on the topic of "sports management"
Source: *compiled by the authors using Rstudio package and Bibliometrix sofware*

Table 2 shows the most frequently mentioned keywords in sports management publications and their frequency of use.

Table 2. Most frequent words

Words	Frequency	Words	Frequency	Words	Frequency	Words	Frequency
human	765	athlete	207	sports medicine	120	diagnostic imaging	82
male	671	athletic injuries	172	athletes	113	decision making	81
female	587	priority journal	171	scoring system	113	Pathophysiology	81
humans	585	exercise	170	follow up	105	retrospective studies	80
sports	510	information management	163	retrospective study	100	Incidence	78
adult	449	treatment outcome	154	students	97	human resource management	74
article	433	major clinical study	143	physical activity	91	Education	73
adolescent	369	procedures	143	clinical article	90	Injury	73
child	258	return to sport	143	football	90	cohort analysis	71
sport injury	251	controlled study	142	aged	89	outcome assessment	70
sport	241	middle aged	140	physiology	89	risk assessment	70
young adult	231	united states	131	questionnaire	85	organization and management	67
brain concussion	225	review	123	risk factor	83	quality of life	67

Source: *compiled by the authors using Rstudio package and Bibliometrix software (Aria et al. 2017)*

Figure 3 shows the results of the bibliometric analysis, characterizing the formalized relationships in the research environment in the coordinates "country - a scientific or educational institution for training athletes or researching in the sports management effectiveness - priority areas of research or work to improve the sports management system quality ". The results of this analysis are visualized in a three-dimensional graph constructed by means of the RStudio package and the Bibliometrix software developed by Aria et al. 2017.

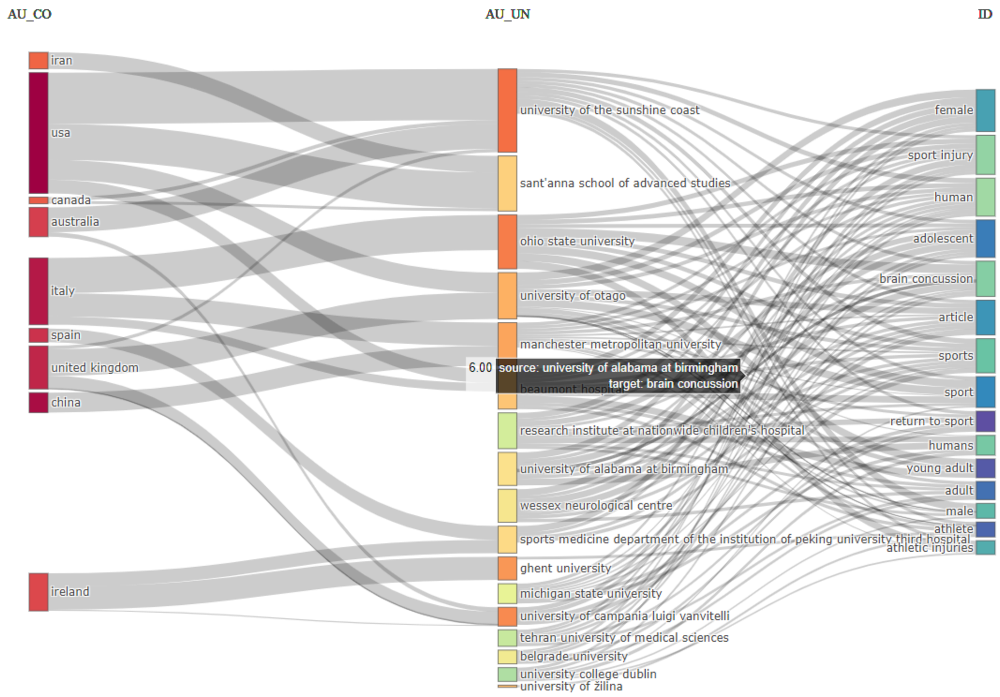

Figure 3. Three-dimensional graph of the scientific works' distribution
Source: *compiled by the authors using Rstudio package and Bibliometrix software*

2. Methodological approach

For ensuring the country's success in high-achievement sports, it is necessary to have the clearly defined system of multi-level selection of athletes, work with children and youth sports clubs, mentoring programs for athletes at different levels of their careers, etc. (Tovmasyan, 2022; Lopushniak et al., 2022). Sports management is a type of specific management (Nguyen, et al., 2021), which regulates the development vectors of physical culture and sports oriented organizations (Kollmann et al., 2022). Sports management considers physical culture and sport (Nufer, 2019; Čingienė 2020) not only as human motor activity, confirmed in the physical culture theory, but also as a set of special means (Caratas et al., 2021) and methods (Gavurova et al., 2021), aimed at the development of people's physical activity (Sylwestrzak et al., 2022). In addition, physical culture and sports are objects of social management (Winiarski et al., 2021; Seguer 2022; Vasilyeva et al., 2021), which function thanks to various physical culture and sports organizations, sports schools, and clubs, sports facilities and playgrounds, sports and health centers (Awojobi, 2022), sports teams in all possible sports, sports federations, International sports federations.

The state funding of sports, the number of educational institutions training professional athletes, coaches, doctors-rehabilitators of sports and other injuries (Cabinova et al., 2021; Kumar et al., 2021; Sarihasan, 2022) directly and indirectly describe the sports management system of any country (Afrifa et al., 2021; Marsova et al., 2021). At the same time, one should emphasize that the investment decision-making process (Moskalenko et al., 2022; Prokopchuk et al., 2022;) in financial markets is complicated in modern conditions due to chaotic behavior and high uncertainty in the development of prices for investment instruments (Carmen et al., 2022; Jankova et al., 2021; Millia et al., 2022).

The development of the social economy extends the scale of the sports industry. Investing in sports is profitable for most countries of the world (Vasanicova et al., 2022; Ramli et al., 2022). The dynamics of the contributions made by states of the European Union for the period from 2007 to 2020 in the development of sporting and recreational services is shown in Table 3 (Eurostat, 2020).

For most countries (Table 3), state expenses for developing the sports industry are constantly increasing. However, there are also European countries where deductions in sports in 2020 were significantly less than in 2007. These are Greece, Ireland, and Spain. In addition, analyzing the sparklines of Table 3, one can see that the Czech Republic, Denmark, Germany, Estonia, France, Italy, Luxembourg, Poland, Hungary, Finland, Sweden, Iceland, Norway, and Switzerland have increased state deductions several times compared to the last decade in the development of the sports industry. Slovenia and Bulgaria have left their contributions almost unchanged over the past 13 years or with a small increase in 2010-2016.

Therefore, it is proposed to evaluate the quality of the sports management system based on the analysis of state expenses for recreational and sporting services in 2020 (Classification of the function of government, COFOG, Eurostat, 2022 (a)), the mass involvement of the population in sports as of 2021 (Eurostat, 2022 (b)), and the performance of the country in high-achievements sports (results of the participants of XXXII Summer Olympic Games (the games of the XXXII Olympiad)) (Arba, 2021).

Table 3 Recreational and sporting servicesy by EU counties, Million euro

Country/Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Sparkline
Belgium	1 268,5	1 324,9	1 458,8	1 502,0	1 539,8	1 784,3	1 635,9	1 479,1	1 551,3	1 656	1 679	1 921,7	1 910,8	1 699,5	
Bulgaria	37,3	59,4	35,5	48,0	53,3	70,5	55,2	249,7	181,2	81,4	110,9	89	64,9	148,1	
Czechia	611,9	692,2	731,2	668,4	628,5	600,5	592,1	632,8	646,5	660,7	810,9	1 014	1 031,6	1 027,5	
Denmark	1 086,5	1 176,5	1 084,6	1 008,0	995,9	1 025,6	1 029,4	1 017,3	1 083,4	1 099	1 108,3	1 166,2	1 214,3	1 232,9	
Germany	7 140	7 598	7 635	7 987	7 634	7 209	7 217	7 421	7 594	7 370	7 927	8 443	8 882	9 541	
Estonia	71,3	76,7	70,5	67,9	59,1	62,3	86,9	85,2	80,8	94,6	131,9	137,4	162,9	158,4	
Ireland	476,1	581,2	325,0	280,5	247,7	247,3	276,4	255,2	270,9	308,5	281,3	359,4	366	361,6	
Greece	461	491	467	395	361	397	412	587	618	633	665	789	787	844	
Spain	4 655	4 802	5 172	5 727	5 040	3 857	3 767	3 806	4 207	4 205	4 488	4 777	5 165	4 959	
France	10 578	10 798	11 264	11 722	12 033	12 331	12 747	12 418	12 012	12 119	12 539	12 747	13 750	12 908	
Croatia	181,6	201,8	243,0	237,5	229,7	220,3	212,6	219,3	213,6	186,9	150,4	165,6	184,6	187,3	
Italy	3 825	3 667	3 723	3 625,1	3 749,4	3 377,4	4 189,7	4 306,0	4 315	4 516	4 450	4 694	4 881,8	4 390,2	
Cyprus	74	80,1	84,0	81,2	82,5	71,2	58,1	53,8	58,0	52,8	59,8	61,6	82,6	76,5	
Latvia	82,1	95,1	50,3	37,6	98,4	38,5	39,5	62,3	64,1	63,9	86,5	93,4	76,1	68,8	
Lithuania	49,0	60,1	58,2	49,6	81,3	48,8	48,7	57,9	53,9	70,9	87,9	99,1	122,7	155,7	
Luxembourg	129,7	143,6	164,0	170,5	165,3	197,3	240,2	240,6	241,1	261,1	293,5	313,5	333,3	316,5	
Hungary	353,5	408,5	352,7	352,9	341,5	353,9	380,3	490,9	578,1	1 278,9	1 464,1	1 329,5	1 579,3	1 789,9	
Malta	5,2	4,7	6,6	8,9	11,1	12,1	10,8	7,9	12,5	9,6	21,9	29,5	27,8	21,7	
Netherlands	3 391	3 722	4 152	3 985	3 833	3 593	3 589	3 422	3 802	3 712	3 732	3 960	4 165	4 333	
Austria	849,3	910,8	876,9	866,9	832,8	877,9	888,1	937,9	1 002,0	990,1	1 014,5	1 077,8	1 090,3	1 111,8	
Poland	1 020,4	1 484,3	1 607,6	2 277,4	2 157,8	1 849,4	1 594,2	1 770,8	1 658,0	1 448,8	1 776,8	2 250,1	2 352,1	2 078,5	
Portugal	649,9	715,9	715,8	707,5	676,4	573,3	624,2	507,6	576,2	492,2	542,5	637,3	668,3	694,9	
Romania	445,7	510,7	421,5	433,8	466,6	446,4	358,2	470,1	468,0	434,0	490,2	585,2	662,4	651,4	
Slovenia	92,9	107,9	106,3	232,3	127,0	121,2	119,8	115,8	131,0	110,2	119,4	145,8	134,4	137,9	
Slovakia	81,4	96,9	114,6	157,9	127,8	116,9	91,2	103,8	133,0	122,6	126,7	175,2	218,0	219,2	
Finland	764	839	840	876	889	973	970	936	1 016	1 053	1 188	1 331	1 370	1 313	
Sweden	1 481,2	1 648,1	1 567,8	1 882,1	2 088,1	2 206,2	2 341,4	2 471,8	2 422,6	2 562,8	2 557,8	2 588,6	2 748,8	3 043,4	
Iceland	278,6	184,1	150,4	169,1	148,1	151,1	174,1	187,3	226,2	263,2	319,7	342,3	333,1	326,7	
Norway	776,4	849,6	1 017,6	1 103,2	1 158,7	1 193,3	1 191,3	1 251,3	1 172,9	1 401,8	1 596,1	1 631	1 825	1 703,8	
Switzerland	1 229	1 351,3	1 379,4	1 541,2	1 785,4	1 750,5	1 748,5	1 805,9	2 096,3	2 096,0	2 168,5	2 177,9	2 335,4	2 517,6	

Source: *Created by the authors (Eurostat, 2022)*

The study was conducted for 30 European countries: Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, Iceland, Norway, Switzerland. The choice of these countries was determined by the availability of open and publicly available statistical data for calculations.

A well-known powerful mathematical toolkit for substantiating or refuting a significant relationship between factor features (factors, predictors, extrapolators, prognostic parameters (Cima et al., 2021; Musetescu et al., 2022)) and dependent features (outcome indicators) are the methods of multivariate statistical analysis and multidimensional scaling (Fadilah et al., 2021), namely: methods of descriptive statistics, correlation-regression analysis (Valdes et al., 2022) using both clear metric features (Kolkova et al., 2022), and fuzzy non-metric (Abada et al., 2021; Jencova et al., 2021), cluster analysis (He et al., 2021; Lewicki et al., 2021; Vinska et al., 2021), canonical analysis (Lyoenov et al., 2021 (c)), discriminant analysis, variance analysis, factor analysis (Nastisin et al., 2021), principal component analysis, structural modeling (Nikonenko et al., 2021). Such a mechanism allows developing statistically significant accurate and adequate models, which can be used for further application and the adoption of well-founded objective management decisions (Szostek 2021; Ahmed 2021).

Recently, the development of median and quantile regressions, which is a useful, convenient, and flexible tool for evaluating the effectiveness of the financial economy, risk management, and stress testing, has been of great interest to scientists around the world (Abafe et al., 2022; Agarwal et al., 2022). Median regression investigates what the median of the dependent outcome measure depends on. The quantile regression is a generalization of median regression. It models the links between a set of predictor variables (independent indicators) and defined percentiles or quantiles of the target variable (Koenker et al., 2001; Abdullah, 2022). Unlike linear regression, which uses least squares to determine the conditional mean of a specific distribution, considering various changes, quantile regression, firstly, is not based on assumptions about the distribution of the target variable, and secondly, it is more robust to outlier observations (Koenker et al., 2001; SuperDataScience Team, 2021; Aghamohammadi et al., 2022). Consequently, quantile regression is widely used for research in practical fields such as ecology (El Amri et al., 2020; Keliuotytė-Staniulėnienė et al., 2021), health care (Kraft, 2021; Kaya, 2021) and financial economics (Jeon, 2021).

Quantile regression model equation ϱ for quantile order τ is shown in formula (1) (Dye, 2020; Adebayo 2022):

$$\varrho_r(y_i) = \beta_0(\tau) + \beta_1(\tau)x_{i1} + \cdots + \beta_p(\tau)x_{ip}, i = 1, \ldots, n, \quad (1)$$

where τ – the quantile indicator, which determines its order; p – number of features in the model; n – number of data points; β – a function of dependency on the current quantile. When searching for β values, it is necessary to minimize median absolute deviation:

$$MAD = \frac{1}{n}\sum_{i=1}^{n} \rho_\tau(y_i - (\beta_0(\tau) + \beta_1 x_{i1}(\tau) + \cdots + \beta_p(\tau)x_{ip})) \quad (2)$$

where ρ – a verification function that determines the asymmetric weights of the error of a certain variable depending on the quantile and the sign of the error and is calculated by formula:

$$\rho_\tau(a) = \max(\tau \times a, (\tau - 1) \times a) \quad (3)$$

If the error is negative, the verification function is defined as the product of the error and $(\tau - 1)$, and if the error is positive, the verification function ρ for quantile order τ is calculated by $\tau \times a$ (Ahmed et al., 2021).

3. Conducting research and results

The following input data were used to assess the quality of the sports management system: K1 - the number of participants of XXXII Summer Olympic Games held in Tokyo (Japan) in 2021 (Arba, 2021), units; K2 – the number of the population regularly engaged in sports (Eurostat, 2022 (b)), men and women, thousands of people; K3 – state expenses for recreational and sporting services (Eurostat, 2022 (a)), million Euro.

Table 4. Initial data for research

Country/Indicator	K1	K2	K3
Belgium	121	25,7	1699,5
Bulgaria	42	10,9	148,1
Czechia	115	29,8	1027,5
Denmark	107	27,9	1232,9
Germany	425	223,0	9541,0
Estonia	33	4,9	158,4
Ireland	116	20,0	361,6
Greece	83	22,7	844,0
Spain	321	221,1	4959,0
France	385	279,1	12908,0

Croatia	59	7,6	187,3
Italy	372	103,9	4390,2
Cyprus	15	3,8	76,5
Latvia	33	6,0	68,8
Lithuania	41	6,6	155,7
Luxembourg	12	1,6	316,5
Hungary	166	27,3	1789,9
Malta	6	0,8	21,7
Netherlands	278	82,2	4333,0
Austria	75	26,0	1 105,7
Poland	210	64,4	2 078,5
Portugal	92	36,6	694,9
Romania	101	12,1	651,4
Slovenia	53	7,9	137,9
Slovakia	41	10,0	219,2
Finland	45	33,1	1313,0
Sweden	134	70,1	3 043,4
Iceland	4	5,4	326,7
Norway	85	30,8	1703,8
Switzerland	107	47,3	2517,6

Source: *compiled by the authors based on (Eurostat, 2022 (a), (b); Arba, 2021)*

Since the input sample of indicators demonstrates data presented in different units of measurement, it is necessary to carry out a standardization procedure for their future use in the development of quantile regressions (Ahmed et al., 2021). Many transformations use additive (Chen et al., 2003) and multiplicative methods and their combination (Celen, 2014). All subsequent calculations depend on the quality of these methods. At the same time, weighting coefficients of the normalization functions can be: 1) weights that determine measures of the central tendency of the indicator (median, mode, average value), measures of variability (dispersion, minimum, maximum value of the variable, range, coefficients of asymmetry and kurtosis); 2) weighted indicators; 3) weights, which are formed based on the results of expert judgments. A logistic function using the values of the stimulus indicators was used to carry out the data standardization procedure:

$$N = \frac{1}{(1 + e\,(-3\,\frac{(x_i - me)}{(max - me)})} \quad (4)$$

where N – normalized value of the observed country, x_i – the current value of the input indicator ($i = \overline{1, \dots, 31}$), me – the median of the input indicator, max – the maximum value of the input indicator (Us et al., 2018).

Results of normalization according to the formula (4) are presented in Table 5.

Table 5. Normalized data

Country/Indicator	K1	K2	K3
Belgium	0,564946	0,499111	0,552985
Bulgaria	0,389254	0,455374	0,456845
Czechia	0,551617	0,511258	0,511406
Denmark	0,533732	0,50563	0,524158
Germany	0,952574	0,911738	0,896851
Estonia	0,37016	0,437799	0,45748
Ireland	0,553844	0,482228	0,470046
Greece	0,479741	0,490223	0,5
Spain	0,887261	0,909909	0,735613
France	0,93337	0,952574	0,952574
Croatia	0,426218	0,445691	0,459264

Italy	0,925706	0,715724	0,707205
Cyprus	0,333212	0,434593	0,45243
Latvia	0,37016	0,441011	0,451956
Lithuania	0,387114	0,442765	0,457314
Luxembourg	0,327234	0,428196	0,467253
Hungary	0,660756	0,503852	0,558535
Malta	0,315447	0,425876	0,449056
Netherlands	0,842331	0,660638	0,704251
Austria	0,461786	0,5	0,516264
Poland	0,743275	0,611864	0,57615
Portugal	0,5	0,531369	0,490732
Romania	0,520259	0,458904	0,488029
Slovenia	0,413055	0,44657	0,456215
Slovakia	0,387114	0,45273	0,461235
Finland	0,395698	0,521027	0,529124
Sweden	0,593482	0,627783	0,633424
Iceland	0,311569	0,439258	0,467885
Norway	0,484239	0,51422	0,55325
Switzerland	0,533732	0,562784	0,602569

Source: *built by the authors*

Thus, the development of quantile regression models for evaluating the effectiveness of the sports management system, based on the indicators of state expenses for recreational and sporting services (Eurostat, 2022 (a)), employment of the population in sports (Eurostat, 2022 (b)), the number of participants in XXXII Summer Olympic Games (Arba, 2021) was carried out using the R programming language, Quantreg, SparseM libraries in the RStudio software. The Quantreg package is used to develop quantile regression models: linear and non-linear, parametric and non-parametric models for conditional quantiles (Koenker, 2020). The SparseM package provides the basic functionality of linear algebra, without which it is impossible to develop testable statistical hypotheses regarding the obtained results quality, for example, the calculation of Student's test values based on a previously calculated covariance matrix (Koenker, 2018). Therefore, the Quantreg package library cannot work without the SparseM package.

The code for developing quantile regressions for quantiles of 0,17 and 0,83 order and classical linear regression, in which the method of least squares is used to estimate the residuals of the model, is:

```
# install.packages("quantreg")
library(quantreg)
mydata<- read.csv("C:/Econometrics/Data/123456.csv")
attach(mydata)
# Define variables
Y <- cbind(k1)
X <- cbind(k2,k3)
# Descriptive statistics
summary(Y)
summary(X)
# OLS regression
olsreg <- lm(Y ~ X, data=mydata)
summary(olsreg)
# Quantile regression
Quantreg17 <- rq(Y ~ X, data=mydata, tau=0.17)
summary(quantreg17)
quantreg83 <- rq(Y ~ X, data=mydata, tau=0.83)
summary(quantreg83)
```

```
# ANOVA test for coefficient differences
anova(quantreg17, quantreg83)
library(ggplot2)
library(tidyverse)
ggplot(data = mydata, aes(K1,K2)) +
geom_point() +
geom_abline(intercept=coef(olsreg)[1], slope=coef(olsreg)[2])+
geom_abline(intercept=coef(quantreg17)[1],color = "red",, slope=coef(quantreg17)[2])+
geom_abline(intercept=coef(quantreg83)[1],color = "blue", slope=coef(quantreg83)[2])
ggplot(data = mydata, aes(K1,K3)) +
geom_point() +
geom_abline(intercept=coef(olsreg)[1], slope=coef(olsreg)[2])+
geom_abline(intercept=coef(quantreg17)[1],color = "red",, slope=coef(quantreg17)[2])+
geom_abline(intercept=coef(quantreg83)[1],color = "blue", slope=coef(quantreg83)[2])
```

The results of code execution are shown in the tables 6-11.

Table 6 shows the results of the numerical features of the normalized data (the 1st stage of the software code implementation), which are necessary for the further development of quantile regressions for evaluating the sports management effectiveness according to the dependent indicator K1 (the number of participants of XXXII Summer Olympic Games) and the independent indicators K2 (employment of population in sports in the country), K3 (state expenses for recreational and sporting services).

Table 6. Descriptive statistics

> summary(Y)		> summary(X)	
K1		K2	K3
Min.	0,3201	0,4264	0,4430
1st Qu.	0,3962	0,4466	0,4537
Median	0,5000	0,5000	0,5000
Mean	0,5449	0,5444	0,5463
3rd Qu.	0,5930	0,5553fe	0,5667
Max.	0,9526	0,9526	0,9526

Source: *built by the authors*

So, for indicator K1 (Table 6), 1st Qu (lower quartile) means that 17% of observations of normalized input data are lower than the number 0,3962. The 3rd Qu (upper quartile) means that 83% of observations take a value less than 0,9526.

The next step of the software code (Table 7, 8) is to develop a multiple linear regression. It describes the impact of independent indicators (employment of the population in sports, K2 and public expenses for recreational and sporting services, K3) on the dependent indicator (the number of participants in XXXII Summer Olympic Games, K1). Table 6 displays the residuals of the observed variables, representing the difference between the change in K1 and the estimated value of K2 and K3.

Table 7 Residuals of linear regression analysis

Min	1Q	Median	3Q	Max
-0,13073	-0,04971	-0,02373	0,05276	0,17051

Source: *built by the authors*

Table 8 shows the obtained coefficients of the regression model and the verification of its statistical significance using the Student’s test and the value of the standard error.

Table 8 Regression model: coefficients of the model and significance testing

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-0,15050	0,06817	-2,208	0,0359
K2	0,69413	0,39316	1,766	0,0888
K3	0,58118	0,44133	1,317	0,1989

Source: *built by the authors*
Notes: Estimate – values of model coefficients; Std. Error – Standard Error; t value – the value of the calculated T-Statistic, Pr – predictor.

The equation of the obtained econometric model, which describes the influence of indicators of population employment in sports and state expenses for recreational and sporting services on the number of participants of XXXII Summer Olympic Games, is given by formula (5):

$$K1 = -0{,}15050 + 0{,}69413K2 + 0{,}58118K3 \quad (5)$$

Table 8 shows that both independent input variables have an insignificant link with the indicator of the athletes' number at the Olympic Games. The Pr(>|t|) column contains the predictor variable related to the value in the t value column. If the p-value is less than a certain significance level (e.g., α = 0,05), the predictor variable has a statistically significant relationship with the variable in the model (Ibn, 2016). In model (5), the p-value for variable K2 and variable K3 exceeds 5%, indicating a statistically insignificant link with the resulting variable K1.

Thus, model (5) is statistically insignificant. However, it does not mean that the quantile regressions will also be statistically insignificant. Quantile regression and classical regression answer different questions.

The logic of choosing the quantile regressions order is based on the division of countries into groups by the level of the sports management system effectiveness . The K1 indicator was selected as an indicator of the effectiveness. The authors suggested dividing all 30 countries into two groups: countries with a below-average sports management system effectiveness, and countries with an above-average sports management system effectiveness. At the same time, to determine whether a country belongs to a certain group, it is necessary to apply the following interval scale with respect to the percentile value (quantile of order τ): $0\% \leq K1 \leq 15\%$ – low effectiveness of the sports management system; $15\% < K1 \leq 50\%$ – the below-average effectiveness of the sports management system; $50\% < K1 \leq 70\%$ – the average effectiveness of the sports management system; $70\% < K1 \leq 85\%$ – the above-average effectiveness of the sports management system; $85\% < K1 \leq 100\%$ – high effectiveness of the sports management system.

The next step is to develop quantile regressions. It is proposed to develop two quantile regressions for the studied countries, corresponding to quantiles of the order of 0,83 and 0,17 The quantile regression of order $\tau = 0{,}83$ describes 83% of countries, which have an above-average level of sports management (Maris, 2022). The quantile regression of order $\tau = 0{,}17$ describe 17% of countries with below-average level of sports industry management (Table 9). This is the difference between quantile and ordinary regressions, which determine the tendency of a change in the resulting feature only in the average value.

Table 9 Quantile regression of the 0,17 order

Indicator	Coefficients	Lower limit	Upper limit
(Intercept)	-0,15224	-0,24177	-0,11682
K2	1,15810	-2,63502	1,16203
K3	-0,01820	-0,01820	3,38122

Source: *built by the authors*

The mathematical model for quantile regression of order 0,17 is:

$$K1 = -0{,}15224 + 1{,}15810K2 - 0{,}01820K3 \qquad (6)$$

Figure 4 shows the quantile regression equations describing the influence of the independent variable of the population employment in sports (K2) on the dependent variable of the participants' number in XXXII Summer Olympic Games (K1). The red line characterizes the quantile regression (6) of order $\tau = 0{,}17$, blue line – quantile regression (7) of order $\tau = 0{,}83$.

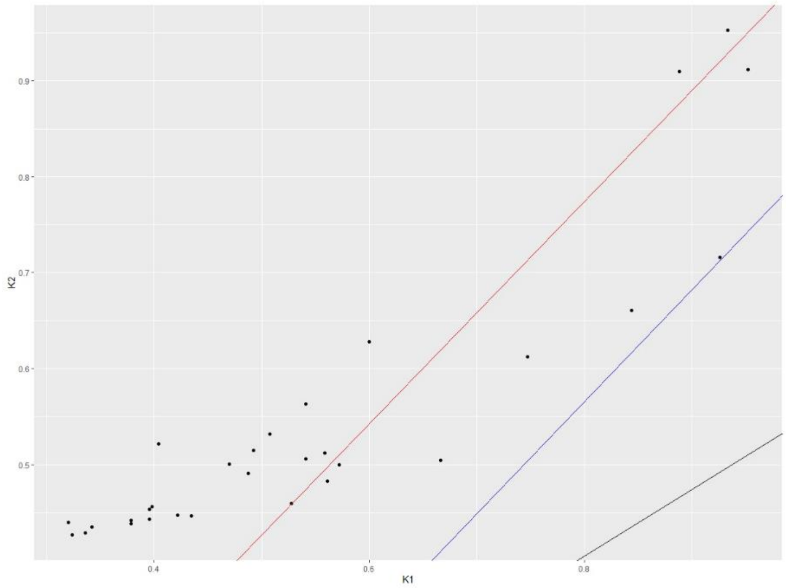

Figure 4. Quantile regressions of the influence made by the indicator of population employment in sports on the participants' number of XXXII Summer Olympic Games
Source: *built by the authors*

The mathematical model for quantile regression of order 0,83 is as follows:

$$K1 = -0{,}36737 + 1{,}16665K2 + 0{,}65090K3 \qquad (7)$$

The free terms in models (6) and (7) are negative both for countries with a below-average level of sports management system effectiveness (Table 9) and for countries with an above-average level of sports management system effectiveness (Table 10). It means that if people in general are not engaged in sports and sport is not invested by the state, for 83% of countries with an above-average level of sports management, the number of participants in the Olympic Games will decrease by 0,36737 for each country represented in the study. For 17% of countries with a low effectiveness of the sports management system, the number of participants in the Olympic Games will decrease by the amount of 0,15224 for each country.

Table 10. Quantile regressions of the order 0,83

Indicator	Coefficients	Lower limit	Upper limit
(Intercept)	-0,36737	-0,84444	0,12032
K2	1,16665	0,42855	2,21936
K3	0,65090	-0,05867	2,33644

Source: *built by the authors*

Figure 5 displays quantile regression equations describing the effect of the independent variable of public expenses on recreation and sporting services (K3) on the dependent variable of participants' number in XXXII Summer Olympic Games (K1). The red line corresponds to the quantile regression (6) of order $\tau = 0{,}17$, and blue line – quantile regression (7) of order $\tau = 0{,}83$.

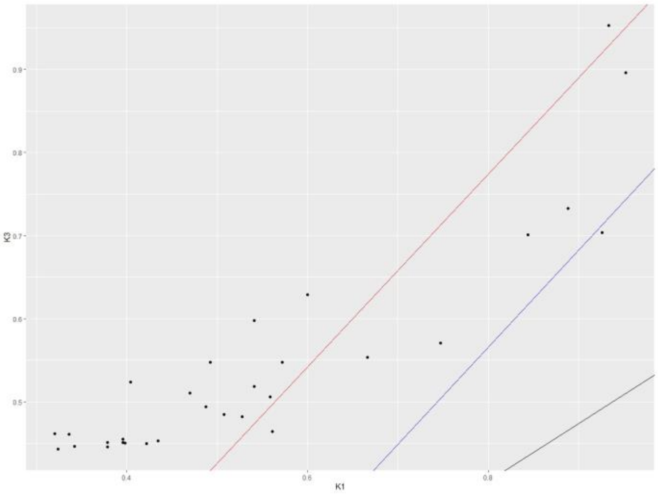

Figure 5. Quantile regressions of the impact of public expenses for recreational and sporting services on the performance indicator of the participants' number in XXXII Summer Olympic Games.
Source: built by the authors

A comparative analysis of the coefficients of models (6) and (7) using ANOVA analysis tested the statistical significance of the calculated quantile regression models (Ibn, 2016) (Table 11).

Table 11. The results of testing the statistical significance of quantile regressions of order 0,17 and 0,83

Df	Resid Df	F value	Pr(>F)
2	58	7,4789	0,001289

Source: *built by the authors*
Notes: Df – the number of freedom degrees, Resid Df – the number of degrees of residues freedom , F value – calculated value of Fisher's test

The last column of Table 11 describes the significance of the difference between models (6) and (7). The value of 0,001289 indicates the statistical significance of the difference between models (6) and (7) at the confidence level of 95% (p-value significance level = 5%) and confirms the statistical significance of the developed quantile regressions (6), (7) (SAS Institute Inc., 2022).

According to the results of the two-factor variance analysis (two-way ANOVA), the F-statistic is 7,4789 (Table 11). It is greater than the F-table (critical) 3,1504 for the significance level of p-value 0.05, indicating a statistical significance of quantile regressions (6) and (7).

Conclusion

The conducted research made it possible to divide the sample of 30 observed countries that are members of the European Union into two groups by the level of sports management effectiveness. These are countries with an above-average sports effectiveness and countries with a below-average sports management effectiveness. The effectiveness of the sports management system is determined by the performance of high-achievements sports. (it is believed that the greater the participants' number in the Olympic Games in various types of competitions and the greater the number of podium finishes, the higher the quality of the sports management system in the country) (Andreas et al., 2020). 83% of countries have an above-average level of sports management system effectiveness, including the following countries: Germany, France, Italy, Spain, Netherlands, Poland, Hungary, Sweden, Belgium, Ireland, Czechia, Denmark, Switzerland, Romania, Portugal, Norway, Greece, Austria, Croatia, Slovenia, Finland, Bulgaria, Lithuania, Slovakia. The list of these countries is ranked from the largest number of participants in the Olympic Games to the smallest for countries that are in the group with an above-average level of effectiveness of the sports management system. For example, the largest number of participants of XXXII Summer Olympic Games was from Germany in 2021 – 425 participants, followed by France – 385 athletes, and Italy – 372 participants. The European countries with a below-average sports management level are Estonia, Latvia, Cyprus, Luxembourg, Malta, and Iceland. For comparison, we note that at XXII Summer Olympic Games, there were only 33 participants from Estonia and Latvia and only 4 from Iceland.

The proposed hypothesis H1, which suggested that the amount of public expenses for recreational and sporting services is a stimulating factor for improving the effectiveness of the sports management system, was refuted for countries with a below-average level of sports effectiveness. Even an increase in state funding of the sports industry by 1 million Euro will not increase the number of participants in the Olympic Games; the coefficient for this variable is negative, although it is quite small (0,01820). Thus, Estonia, Latvia, Cyprus, Luxembourg, Malta, and Iceland should look for other ways to ensure the performance of high-achievements sports and reform the management of the sports industry than increase state funding (Chen et al., 2021; Daubaraite-Radikiene et al., 2022) and reform the sports industry management for improving its quality. For countries with an above-average effectiveness of the sports management system, hypothesis H1 is confirmed: if state expenses increase by 1 million Euro, the total number of participants in the Olympic Games will increase by 0,006509 (i.e., by 0,65%).

The second hypothesis in the research, H2, suggested that the total number of the population that regularly engages in sports is a positive factor in increasing the number of participants in the Olympic Games, was confirmed for both groups of countries. Thus, for countries with an above-average sports effectiveness , if the population increases by 1,000 people engaged in sports, the number of athletes participating in the Olympic Games will increase by 1,166%. And for Estonia, Latvia, Cyprus, Luxembourg, Malta, and Iceland, the number of people who do sports permanently will increase the number of participants of the Olympic Games by 1,158. The coefficients for the variables characterizing the number of people engaged in sports for both groups are very close. Thus, general conclusions can be drawn that the main stimulating factor for the development and improvement of the sports management system effectiveness for each country is the increase in the number of the population engaged in sports and lead a healthy lifestyle (Kuzior et al., 2022 (a), (b)); Letunovska et al., 2021).

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References

Abada, F., Manasseh, Ch., Nwakoby, I., Obidike, P., Okonkwo, O., & Alio, F. (2021). An assessment of inclusive growth policy as a determinant of unemployment reduction in Nigeria: An application of autoregressive distributed (ARDL) bound test approach. *Montenegrin Journal of Economics*, 17(4), 85-97. http://doi.org/10.14254/1800-5845/2021.17-4.8

Abafe, E., Oduniyi S., & Tekana, S. (2022). Beyond Least Squares Assumptions: Quantile Regression Estimates of the Heterogeneity in Commercialization–The Case of Sunflower-Producing Households in North West Province, South Africa. *Frontiers in Sustainable Food Systems*, (5), 10.3389/fsufs.2021.758399

Abdullah, S. (2022). Earnings management in small listed firms in malaysia using quantile regression. *International Journal of Business and Society*, 3(1), 326-341. 10.33736/ijbs.4615.2022

Adebayo, T., Akadiri, S., Akpan, U., & Aladenika, B. (2022). Asymmetric effect of financial globalization on carbon emissions in G7 countries: Fresh insight from quantile-on-quantile regression. *Energy & Environment*, 0(0). Retrieved from https://doi.org/10.1177/0958305X221084290

Afrifa, Jnr., Amoah, N., Fianko, S., & Dzogbewu T. (2021). Supply chain integration and operational performance in health institutions: A structural model for mediation effects. *Polish Journal of Management Studies*, 24(1), 9-29. http://doi.org/10.17512/pjms.2021.24.1.01

Agarwal, R., Ankit M. Dheeraj M. (2022). Customer happiness as a function of perceived loyalty program benefits - A quantile regression approach. *Journal of Retailing and Consumer Services*, 64. 10.1016/j.jretconser.2021.102770

Aghamohammadi A., Dadashi H., Sojoudi, M., Sojoudi, M., & Tavoosi M. (2022). Optimal portfolio selection using quantile and composite quantile regression models. *Communications in Statistics: Simulation and Computation*. 10.1080/03610918.2022.2094961

Ahmed, K. (2021). Vaccination Management Process and Challenges: Case of Bangladesh. *Health Economics and Management Review,* 2(3), 65-78. https://doi.org/10.21272/hem.2021.3-06

Ahmed, R., & Rodeen, W. (2021). Sparse minimum average variance estimation via quantile regression group variable selection penalties (glqmave). *International Journal of Agricultural and Statistical Sciences*. 17. 2395-2401

Ahmed, S., & Doukas, J. (2021). Revisiting disposition effect and momentum: quantile regression perspective. *Review of Quantitative Finance and Accounting*, 56(3). 1087-1128. 10.1007/s11156-020-00919-4

Aliyeva, Z. (2022). Innovation in healthcare management: drug decriminalization for reducing the health damage from crime. *Marketing and Management of Innovations*, 1, 37-57. https://doi.org/10.21272/mmi.2022.1-03

American Sports Medicine Institute. (2022). *Student Researcher Program*. Retrieved from https://asmi.org/about-us/student-researcher-program/

Andreas, A., Tatang,A., Nurjannah, U., Nurul, I.(2020). The effect of announcement as the host of XVIII Asian Games on the Indonesian stock market. *Investment Management and Financial Innovations*, 17(1), 109-118. doi:10.21511/imfi.17(1).2020.10

Araba. A (2021). Topic: Tokyo 2020 Olympics and Paralympics in Japan. Retrieved May 31, 2022, from https://www.statista.com/topics/6142/tokyo-olympics-and-paralympics-n-japan/

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975.

Awojobi, O. (2022). Cash Transfer Programmes For Reducing Poverty And Vulnerabilities: Effects On Children’s Health In Sub-Saharan Africa And Latin America. *SocioEconomic Challenges*, 6(1), 5-23. https://doi.org/10.21272/sec.6(1).5-23.2022

Awojobi, O. (2022). Health Inequalities and Social Determinants of Indigenous Peoples’ Health in Australia, Canada, and the United States: Causes and Policies Options. *Health Economics and Management Review*, 3(1), 8-18. https://doi.org/10.21272/hem.2022.1-01

Cabinova, V., Gallo, P., Partlova, P., Dobrovic, J., & Stoch, M. (2021). Evaluating Business Performance and Efficiency in the Medical Tourism: A Multi-criteria Approach. *Journal of Tourism and Services*, 12(22), 198-221. http://doi.org/10.29036/jots.v12i22.247

Caratas, M., Trandafir, R., Iftene, C., Spatariu, E., & Cheorghiu, G. (2021). The impact of sustainability disclosure on companies’ performance in healthcare industry. *Transformations in Business and Economics*, 20(2), 593-613.

Carmen, V., Roman, R., & Cervantes, P. (2022). Should risk-averse investors target the portfolios of socially responsible companies? *Oeconomia Copernicana*, 13(2),439-474. http://doi.org/10.24136/oc.2022.014

Celen, A. (2014). Comparative Analysis of Normalization Procedures in TOPSIS Method: With an Application to Turkish Deposit Banking Market. *Informatica*, 25(2), 185-208. http://doi.org/10.15388/Informatica.2014.10

Chen, CY., Chen, RL., & Sheu, MH. (2003). A fast additive normalization method for exponential computation. *Euromicro symposium on digital system design, proceedings*, 286-293. http://doi.org/10.1109/DSD.2003.1231955.

Chen, Y., & Sun, Y. (2021). Determinants of platform ecosystem health: An exploration based on grounded theory. *Journal of Business Economics and Management*, 22(5), 1142-1159. http://doi.org/10.3846/jbem.2021.15047

Cima, E., Rocha-Junior, W., Dalposso, G., Uribe-Opazo, M., & Becker, W. (2021). Forecasting Grain Production and Static Capacity of Warehouses Using the Natural Neighbor and Multiquadric Equations. *Agris On-line Papers in Economics and Informatics*, 13(3), 3-14. http://doi.org/10.7160/aol.2021.130301

College of applied health sciences. (2022). Department of Kinesiology & Community Health. Retrieved from https://ahs.illinois.edu/kch-home

Columbia University. (2022). Sports Medicine Fellowship. Retrieved from https://www.cuimc.columbia.edu/rehab/education/sports-medicine-fellowship

Čingienė, V. (2020). The effect of Lithuanian household income on the choice of non-formal education of children through sports and related costs. *Innovative Marketing* , 16(1), 11-18. doi:10.21511/im.16(1).2020.02

Daubaraite-Radikiene, U., & Startine, G. (2022). Index-Based Measurement of Creative Industries' Impact on National Economy. *Engineering Economics*, 33(1), 13-26. http://doi.org/10.5755/j01.ee.33.1.27869

Dye S. (2020). Quantile Regression. Towards Data Science. Retrieved from https://towardsdatascience.com/quantile-regression-ff2343c4a03

El Amri, A., Boutti, R., Oulfarsi, S., Rodhain, F., Bouzahir, B. (2020). Carbon financial markets underlying climate risk management, pricing and forecasting: Fundamental analysis. *Financial Markets, Institutions and Risks*, 4(4), 31-44. https://doi.org/10.21272/fmir.4(4).31-44.2020

Eurostat. (2020). How much do governments spend on recreation and sport. Retrieved from https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20190923-1

Eurostat. (2022, (b)). Employment in sport by sex: Eurostat. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/SPRT_EMP_SEX/default/table

Eurostat. (2022, (a)). Government expenditure by function – COFOG: Eurostat. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_by_function_%E2%80%93_COFOG#General_overview

Fadilah, S., Rosdiana, Y. Maemunah, M., Hernawati, N., Sukarmanto, E., & Hartanto, R. (2021). Multidimensional scaling (Mds): Sustainability assessment model of community economic empowerment. *Polish Journal of Management Studies*, 24(2), 119-135. http://doi.org/10.17512/pjms.2021.24.2.08

Gavurova, B., Belas, J., & Rowland, Z. (2021). The impact of agreement on government procurement use on the competition in slovak healthcare sector. *Administratie si Management Public*, 36, 102-115. http://doi.org/10.24818/AMP/2021.36-06

Harborview Injury Prevention and Research Center. (2022). Retrieved from https://hiprc.org/

He, L., Tao, J., Meng, P., Chen., D., Yan, M., & Vasa, L. (2021). Analysis of socio-economic spatial structure of urban agglomeration in China based on spatial gradient and clustering. *Oeconomia Copernicana*, 12(3), 789-819. http://doi.org/10.24136/OC.2021.026

Hennepin Healthcare. (2022). Pediatric Brain Injury Program. Retrieved from https://www.hennepinhealthcare.org/specialty/traumatic-brain-injury-center/pediatric-brain-injury-program/

Ibn A. (2016). Tutorial: Quantile Regression using R. Rpubs. Retrieved from https://rpubs.com/ibn_abdullah/rquantile

Jankova, Z., Jana K., & Dostal, P. (2021). Investment decision support based on interval type-2 fuzzy expert system. *Engineering Economics*, 32(2), 118-129. http://doi.org/10.5755/j01.ee.32.2.24884

Jencova, S., Petrushka, I., Lukasova, M. (2021). Relationship between roa and total indebtedness by threshold regression model. *Montenegrin Journal of Economics*, 17(2), 37-46. http://doi.org/10.14254/1800-5845/2021.17-2.3

Jeon, Ji-Hong (2021). The impact of tourism uncertainty on airline stock markets in Korea: A quantile regression approach. *Journal of Business Economics and Management*, 22(4), 923-939. http://doi.org/10.3846/jbem.2021.14668

Kaya, H.D. (2021). The Stability of The Financial System: a Comparison of Developed and Less Developed Countries. *Financial Markets, Institutions and Risks*, 5(2), 5-13. https://doi.org/10.21272/fmir.5(2).5-13.2021

Keliuotytė-Staniulėnienė, G., Daunaravičiūtė, K. (2021). The Global Green Bond Market in the Face of the COVID-19 Pandemic. *Financial Markets, Institutions and Risks*, 5(1), 50-60. https://doi.org/10.21272/fmir.5(1).50-60.2021

Koenker R. (2018). SparseM. Cran.r-project. Retrieved from https://cran.r-project.org/web/packages/SparseM/index.html

Koenker R. (2020). Quantreg. Cran.r-project. Retrieved from https://cran.r-project.org/web/packages/quantreg/index.html

Koenker R., & Kevin F. Hallock (2001). Quantile Regression. *Journal of Economic Perspectives*, 15(4), 143–156.

Kolková, A., Rozehnal, P., Gaži, F. & Fajmon, L. (2022). The Use of Quantitative Methods in Business Practice: Study of Czech Republic. *International Journal of Entrepreneurial Knowledge*, 10(1), 80-99. http://doi.org/10.37335/ijek.v10i1.159

Kollmann, J. & Dobrovič, J. (2022). Key factors of organizational and management structures in the formation of competitive strategy. *Journal of International Studies*, 15(3), 130-144. http://doi.org/10.14254/2071-8330.2022/15-3/9

Kraft, M. (2021). The Role of Health Promotion in Management Development. A Systematic Review of Training Concepts in an Organizational Context. *Business Ethics and Leadership*, 5(1), 89-97. https://doi.org/10.21272/bel.5(1).89-97.2021

Kumar, V., Nayak, K., & Bhinder, H. (2021). The Technology Acceptance Model and Learning Management System: A Study on Undergraduate Tourism and Hospitality Students. *European Journal of Interdisciplinary Studies*, 13(2), 65-89. http://doi.org/10.24818/ejis.2021.13

Kuzior, A., Kashcha, M., Kuzmenko, O., Lyeonov, S., & Brożek, P. (2022 (a)). Public health system economic efficiency and COVID-19 resilience: Frontier DEA analysis. *International Journal of Environmental Research and Public Health*, 19(22) doi:10.3390/ijerph192214727

Kuzior, A., Zhuchenko, S., Samoilikova, A., Vasylieva, T., & Brożek, P. (2022 (b)). Changes in the system of country's population health care depending on the level of providing affordable housing. *Problems and Perspectives in Management*, 20(3), 215-232. doi:10.21511/ppm.20(3).2022.18

Kuzmenko, O., Vasylieva, T., Vojtovič, S., Chygryn, O., & Snieška, V. (2020). Why do regions differ in vulnerability to covid-19? spatial nonlinear modeling of social and economic patterns. *Economics and Sociology*, 13(4), 318-340. doi:10.14254/2071-789X.2020/13-4/20

Letunovska, N., Saher, L., Vasylieva, T., & Lieonov, S. (2021). Dependence of public health on energy consumption: A cross-regional analysis. Paper presented at the E3S Web of Conferences, , 250 doi:10.1051/e3sconf/202125004014

Lewicki, A., Pancerz, K., & Puzio, L. (2021). The temporal inference with the use of ant-based clustering algorithm and flow graphs in the problem of prognosing complications of medical surgical procedures. *Human Technology*, 17(3), 213-234. http://doi.org/10.14254/1795-6889.2021.17-3.3

Lyeonov, S., Bilan, S., Yarovenko, H., Ostasz, G., & Kolotilina, O. (2021 (a)). Country's health profile: Social, economic, behavioral and healthcare determinants. *Economics and Sociology*, 14(3), 322-340. doi:10.14254/2071-789X.2021/14-3/17

Lyeonov, S., Vasilyeva, T., Bilan, Y., & Bagmet, K. (2021 (b)). Convergence of the institutional quality of the social sector: The path to inclusive growth. *International Journal of Trade and Global Markets*, 14(3), 272-291. doi:10.1504/IJTGM.2021.115712

Lyeonov, S., Kuzmenko, O., Koibichuk, V., Rubanov, P., & Smiianov, V. (2021 (c)). Behavioral, social, economic and legal dimension of the public health system of Ukraine: descriptive, canonical and factor analysis. *Wiadomosci Lekarskie* (Warsaw, Poland : 1960), 74(12), 3126-3134. doi:10.36740/wlek202112102

Lopushniak, H., Mylyanyk, R., Lopushniak, L., Shandar, A., Leontenko, O. (2022). Managerial competencies in the training of specialists in public and corporate management in Ukraine. *Problems and Perspectives in Management*, 20(4), 88-110. doi:10.21511/ppm.20(4).2022.08

Louis, R. (2022). The Global Socioeconomic Impact of Mental Health. SocioEconomic Challenges, 6(2), 50-56. https://doi.org/10.21272/sec.6(2).50-56.2022

Maris, M. (2022). Management of Competitiveness in the EU Member States: The Main Strengths and Weaknesses. *Marketing and Management of Innovations*, 2, 110-120. https://doi.org/10.21272/mmi.2022.2-10

Marsova, E., Lichnerova, I., & Machyniak, J. (2021). Efficiency of the functioning of public administration: Regional empirical study. *Administratie si Management Public*, 36, 165-180. http://doi.org/10.24818/AMP/2021.36-10

Millia, H., Adam, P., Muthalib, Abd A., Tajuddin, P., Yuwanda, P. (2022). The Effect of Inward Foreign Direct Investment and Information and Communication Technology on Economic. Growth in Indonesia. *Agris On-line Papers in Economics and Informatics*, 14(1), 69-79, http://doi.org/10.7160/aol.2022.140106

Moskalenko, B., Lyulyov, O., & Pimonenko, T. (2022). The investment attractiveness of countries: Coupling between core dimensions. *Forum Scientiae Oeconomia*, 10(2), 153-172. doi:10.23762/FSO_VOL10_NO2_8

Musetescu, R.-C., Grigore, G.-E., & Nicolae, S., (2022). The Use of GARCH Autoregressive Models in Estimating and Forecasting the Crude Oil Volatility. *European Journal of Interdisciplinary Studies*, 14(1-6), 13-38. http://doi.org/10.24818/ejis.2022.02

Nastisin, L., Gavurova, B., Bacik, R., Svetozarovova, N. & Fedorko, R. (2021). Sustainable performance of players in the global aviation industry in the light of multi-factor analysis of online reputation. *International Journal of Entrepreneurial Knowledge*, 9(1), 1-9. http://doi.org/10.37335/ijek.v9i1.130

Nguyen P., Nguyen L., Van Doan, Khan N., & Tran, H. (2021). Enhancing emotional engagement through relational contracts, management receptiveness, and employee commitment as a stimulus for job satisfaction and job performance in the public sector. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 16(1), 203-224. http://doi.org/10.24136/eq.2021.008

Nikonenko, U., Khalina, O., Kazyuk, T., Paliukh, V., & Shevchenko, S. (2021). Influence of internal and external factors on the structural changes of national economy: An example of Ukraine. Business, *Management and Economics Engineering*, 19(2), 244-271. http://doi.org/10.3846/bmee.2021.14472

Nufer, G. (2019). "Say hello to Halo": the halo effect in sports. *Innovative Marketing* , 15(3), 116-129. doi:10.21511/im.15(3).2019.09

Oklahoma State University. (2022). Center for health sciences. Retrieved from https://go.okstate.edu/

Oteh, O. U., Oloveze, A. O., Obasi, R. O., & Opara, J. O. (2021). Consumer health knowledge: cultural norms and marketing of healthcare products. *Health Economics and Management Review*, 2(1), 8-22. https://doi.org/10.21272/hem.2021.1-01

Pozeriene, J., Macenaite, O., Reklaitiene, D., & Ostasevicience, V. (2021). The importance of sporting activity for men (As advanced consumers) self-esteem and reduction of social exclusion. *Transformations in Business and Economics*, 20(2), 264-275.

Prokopchuk, O., Nepochatenko, O., Malyovanyi,M., Ulyanych,Y., Bilan, Y. (2022). Trends in the functioning of the Ukrainian insurance services market. *Insurance Markets and Companies*, 13(1), 47-65. doi:10.21511/ins.13(1).2022.05

Ramli, M., Boutayeba, F., Nezai, A. (2022). Public Investment in Human Capital and Economic Growth in Algeria: An empirical study using ARDL approach. *SocioEconomic Challenges*, 6(2), 55-66. https://doi.org/10.21272/sec.6(2).55-66.2022

Sarihasan I., Dajnoki, K., Olah, J., & Al-Dalahmeh, M. (2022). The importance of the leadership functions of a high-reliability health care organization in managing the COVID-19 pandemic in Turkey. *Economics and Sociology*, 15(1), 78-93. http://doi.org/10.14254/2071-789X.2022/15-1/5

SAS Institute Inc. (2022). Quantreg procedure (chapter): SAS. 2022. Retrieved from https://support.sas.com/documentation/onlinedoc/stat/121/qreg.pdf

Seattle Children's Hospital. (2022). Seattle Children's Research Division. Retrieved from https://www.seattlechildrens.org/research/

Seguer, Z., & Hasna, A. (2022). Business Intelligence as a Challenge for the Managerial Function: Case Study on Managerial Decision Making in Algerian Companies. *Business Ethics and Leadership*, 6(3), 35-46. https://doi.org/10.21272/bel.6(3).35-46.2022

Sylwestrzak, M. (2022). Using a hybrid model to detect earnings management for Polish public companies. *Journal of International Studies*, 15(3), 158-172. http://doi.org/10.14254/2071-8330.2022/15-3/11

Smiianov, V. A., Vasilyeva, T. A., Chygryn, O. Y., Rubanov, P. M., & Mayboroda, T. M. (2020 (a)). socio-economic patterns of labor market functioning in the public health: challenges connected with Covid-19. *Wiadomosci Lekarskie* (Warsaw, Poland : 1960), 73(10), 2181-2187. Retrieved from https://wiadlek.pl/wp-content/uploads/archive/2020/WLek202010114.pdf

Smiianov, V., Lyulyov, O., Pimonenko, T., Andrushchenko, T., Sova, S, & Grechkovskaya, N. (2020 (b)). The impact of the pandemic lockdown on air pollution, health and economic growth: system dynamics analysis. *Wiadomosci Lekarskie* (Warsaw, Poland : 1960), 73(11), 2332-2338. Retrieved from https://wiadlek.pl/wp-content/uploads/archive/2020/WLek202011102.pdf

SuperDataScience Team. (2021). Quantile Regression Explained in 5 Minutes. Retrieved from https://sdsclub.com/quantile-regression-explained-5-minutes/

Szostek, D. (2021). Innovations in human resource management: impact of demographic characteristics, quality of interpersonal relationships on counterproductive work behaviours. *Marketing and Management of Innovations*, 1, 11-20. https://doi.org/10.21272/mmi.2021.1-01

The Micheli Center for Sports Injury Prevention. (2022). Retrieved from https://www.themichelicenter.com/

The university of Iowa. Health and Human Physiology. (2022). Retrieved from https://clas.uiowa.edu/hhp/

Tovmasyan, G. (2022). The Impact of Skills, Personality and Psychology on Management and Decision Making: Empirical Study Among Managers and Employees. *Business Ethics and Leadership*, 6(3), 5-13. https://doi.org/10.21272/bel.6(3).5-13.2022

University of Witwatersrand. Wits Sport and Health. (2022). Retrieved from https://www.wits.ac.za/wish/about-us/

Us, H., Malyarets, L., Chudaieva, I., & Martynova, O. (2018). Multi-Criteria Optimization of the Balanced Scorecard for the Enterprise's Activity Evaluation: Management Tool for Business-Innovations. *Marketing and Management of Innovations*, 3, 48-58. Retrieved from http://doi.org/10.21272/mmi.2018.3-04

Valdes, R., & Garsia-Fernandes, F. (2022). The distribution of wage inequality across municipalities in Mexico: a spatial quantile regression approach. *Equilibrium. Quarterly*

Journal of Economics and Economic Policy, 17(3), 669-697. http://doi.org/10.24136/eq.2022.023

Vasanicova, P., Jencova, S., Gavurova, B., Bacik, R. (2022). Coopetition of European Union Countries within Destination Management. *Journal of Tourism and Services*, 13(24), 71-89. http://doi.org/10.29036/jots.v13i24.368

Vasilyeva, T., Kuzmenko, O., Kuryłowicz, M., & Letunovska, N. (2021). Neural network modeling of the economic and social development trajectory transformation due to quarantine restrictions during covid-19. *Economics and Sociology*, 14(2), 313-330. doi:10.14254/2071-789X.2021/14-2/17

Vinska, O., & Tokar, V. (2021). Cluster analysis of the european union gender equality and economic development. Business, *Management and Economics Engineering*, 19(2), 373-388. http://doi.org/10.3846/bmee.2021.15382

Winiarski, S., Chomatowska, B., Molek-Winiarska, D., Sipko, T., & Dyvak, M. (2021). Added value of motion capture technology for occupational health and safety innovations. *Human Technology*, 17(3), 235-260. http://doi.org/10.14254/1795-6889.2021.17-3.4