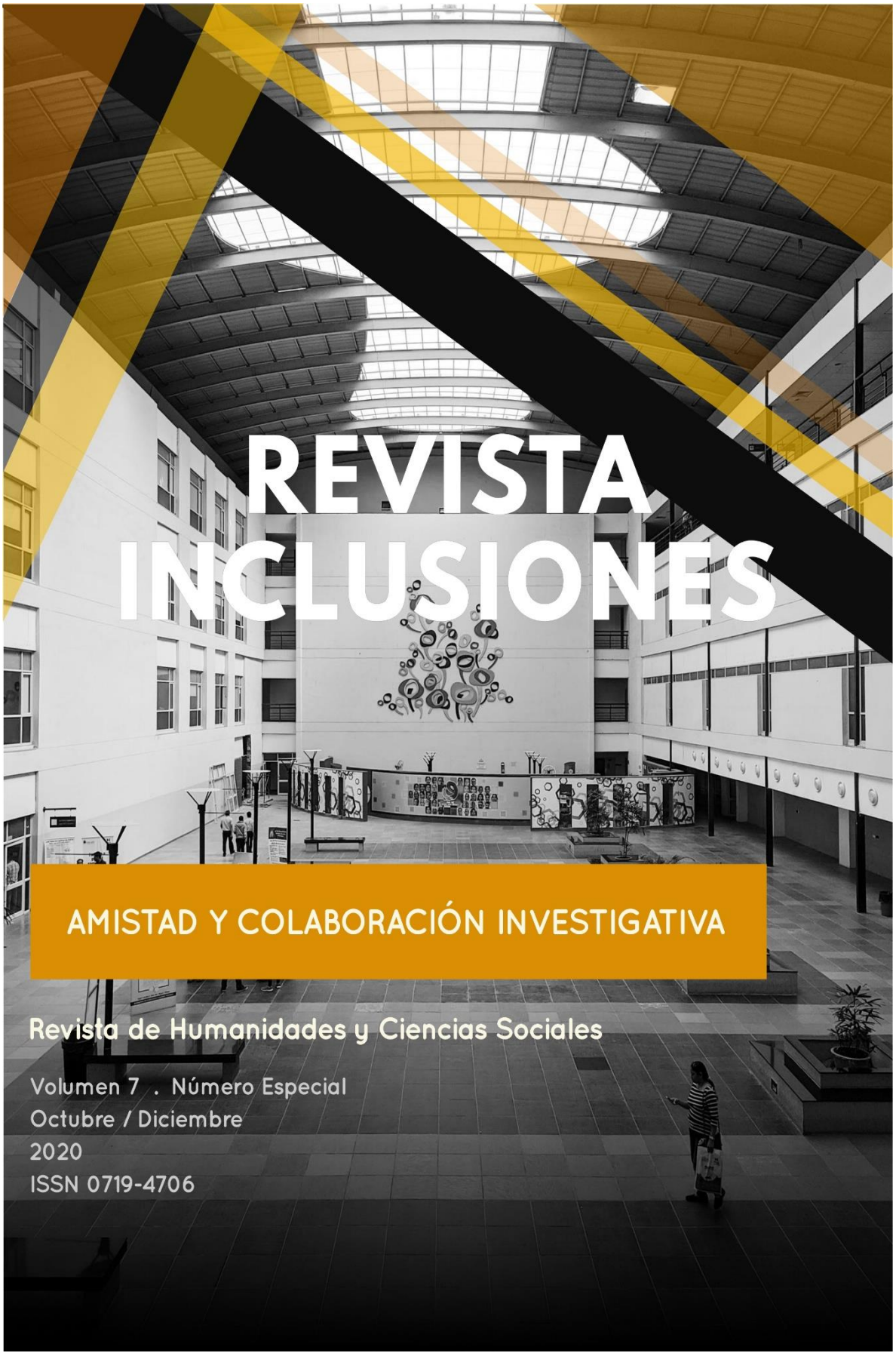

REVISTA INCLUSIONES

AMISTAD Y COLABORACIÓN INVESTIGATIVA

Revista de Humanidades y Ciencias Sociales

Volumen 7 . Número Especial
Octubre / Diciembre
2020
ISSN 0719-4706

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

Editorial Cuadernos de Sofía
Santiago – Chile
OBU – C HILE

Indización, Repositorios y Bases de Datos Académicas

Revista Inclusiones, se encuentra indizada en:

BIBLIOTECA UNIVERSIDAD DE CONCEPCIÓN

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL

ISSN 0719-4706 - Volumen 7 / Número Especial / Octubre – Diciembre 2020 pp. 481-502

MATHEMATICAL MODELING OF SOCIOECONOMIC PROCESSES DURING THE DEVELOPMENT OF COUNTRIES BASED ON THE INDICATIVE EVALUATION SYSTEM

Ph. D. (c) Viktor D. Orekhov
International Institute of Management LINK, Russia
ORCID: 0000-0002-5970-207X
vorehov@yandex.ru
Dr. Olga S. Prichina
Russian State Social University, Russia
ORCID: 0000-0002-3069-3755
olgaprichina@mail.ru
Dr. Peter V. Solodukha
Russian State Social University, Russia
ORCID: 0000-0003-3171-5378
soloduhapv@rgsu.net

Fecha de Recepción: 06 de mayo de 2020 – **Fecha Revisión**: 20 de mayo de 2020

Fecha de Aceptación: 26 de agosto 2020 – **Fecha de Publicación**: 01 de octubre de 2020

Abstract

The goal of the study is to develop mathematical methods for analyzing the dynamics of the economic performance of countries based on a wide range of aggregate indices, which allow to draw conclusions about the state of the socioeconomic development of the country. A generalized algorithm for the causal interpretation of the mutual influence of the aggregate indices on the results of the socioeconomic development of countries has been developed based on the regression and correlation analysis. Optimization of the connection among 14 global indices into optimal Predictors CP_i allowed to secure a low level of the regression error ($\Delta R^2 = 1 - R^2$), which amounted to 5.8 % for forecasting gross domestic product (GDP) per capita (GDP/C) and 11.5 % for the World Happiness Index (WHI) for 24 major economies. The multilevel structure of the system of the global aggregate indices based on GDP/C, the WHI, and the Social Progress Imperative (SPI) has been revealed. It has been proved that the group of the human capital indices (Mean Years of Schooling, Global Human Capital, and the Human Capital Index) has significant impact (~35 %) on GDP per capita, while the Worldwide Governance Indicator and the Index of Economic Freedom have significant impact on the WHI (~29 %).

Keywords

Human Capital – GDP per capita – Forecasting – The Global Index – R&D

Para Citar este Artículo:

Orekhov, Viktor D.; Prichina, Olga S. y Solodukha, Peter V. Mathematical modeling of socioeconomic processes during the development of countries based on the indicative evaluation system. Revista Inclusiones Vol: 7 num Especial (2020): 481-502.

Introduction

The global aggregate indices are widely used to forecast the socioeconomic development of countries; their number exceeds several dozens, and the number of indicators in each can be up to a hundred. At the same time, each such indicator is usually developed independently of the others, although the statistics for some of the indicators are used in various indices. As such, no relationships between these indicators are identified, and they do not constitute a single system.

Another problem of forecasting the socioeconomic development at the level of countries is the availability of alternative indicators of the results of such activities.

GDP and, accordingly, GDP/C were considered to be the main indicators of the society development in the industrial era. However, the situation had changed significantly by the early 21st century, because 80 % of the national wealth of the largest economies was made up of human capital[1] based on people's intelligence[2]. As such, human capital itself can be considered as a result of the socioeconomic development of society, the humanity's highest value.

Recent criticism of GDP has allowed scientists to determine the welfare of the nation by a set of criteria that take subjective assessments of the population into account. For example, the developers of the 2008 System of National Accounts (SNA) indicate that "GDP was never intended to measure welfare"[3]. As a result, a resolution "Happiness: towards a holistic approach to development" was adopted at the 65th UN session in 2011, which stated that international indices of happiness were the key parameters for the success of countries.

As such, there is a change in the mission of the development of modern society. As a result, the development indicators must also change[4]. The WHI[5] and others[6] were

[1] Y. A. Korchagin, Rossiyskiy chelovecheskiy kapital: faktor razvitia ili degradatsii?: Monograph (Voronezh, 2005) y A. V. Koritsky, The Impact of Human Capital on Economic Growth (Novosibirsk: NGASU (Sibstrin), 2013).

[2] G. S. Becker, "Investment in Human Capital: A Theoretical Analysis", Journal of Political Economy Vol: 70 num 5 (1962): 9–49; T. Schultz, "Reflection on Investment in Man", The Journal of Political Economy Vol: LXX (1962); A. Brooking, Intellectual Capital (London: International Thompson Business Press, 1996) y S. Albert y K. Bradley, Intellectual Capital as the Foundation for New Conditions relating to Organizations and Management Practices, Working Paper Series num 15. Milton Keynes: Open University Business School. 1996.

[3] P. van de Ven, The Implementation of the 2008 SNA and the Main Challenges. 2014. Retrieved from:
http://www.cisstat.com/sna/Peter%20van%20de%20Ven%20The%20Implementation%20of%20the%202008%20SNA%20and%20the%20Main%20Challenges_rus.pdf

[4] S. Dusenko; A. Oleynik; V. Sharikov; V. Polyakov; E. Kryukova y A. Melnichuk, "Current state of innovative activities in education: the use of e-learning in Russian universities", Research Journal of Pharmaceutical, Biological and Chemical Sciences Vol: 7 num 4 (2016): 1629-1637; I. Ilina; A. Zotova; E. Kuznetsova; E. Nakhratova y E. Kryukova, "Teachers of Russian higher educational institutions in the professional labor market", Rupkatha Journal on Interdisciplinary Studies in Humanities Vol: 8 num 2 (2016): 128-136; E. Kryukova, Institutional structure and infrastructure of the tourism services market of Russia. 2017 in international relations 2017: current issues of world economy and politics. 2017; E. Kryukova; O. Kaurova; V. Khetagurova y D. Makeeva, Peculiarities of socioally responsible tourism in Russia and prospects of its development. Economic and Social Development Book of Proceedings, 2018; V. S. Khetagurova; E. M. Kryukova; A. N. Maloletko; I. V.

proposed as some of them. However, it has not been quite clear what "levers" of controlling "happiness" have existed until recently. For example, the relationship between the index of happiness and GDP/C has been the subject of economic debate for decades[7]. Some believe that the growth of GDP/C leads to an increase in the level of happiness only within certain limits, while others insist on a monotonous relationship between these indices.

It was proved in the study[8] that the Worldwide Governance Indicators (WGI) and the Index of Economic Freedom (IEF) were also the main Predictors for the Happiness Index besides GDP/C. However, the six Predictors considered in the study are far from exhaustive of all possible indices of "subjective welfare," thus, the issue of expanding the number of factors taken into account to maximize the economic benefits of a particular person and, therefore, the economic growth for society, remains relevant.

The authors conduct a comparative study of the socioeconomic development of the countries in terms of two performance indicators: GDP/C and the WHI. The data for 15 global indices were used to identify systemic connections at the macro and micro level. As the global economy develops as a single system with a single capital of technology and knowledge[9], it is of fundamental importance to rely on information both for individual countries and for the world economy in developing such a systemic model.

The solution to this problem does not have the only correct variant, but it is sufficient for understanding the complex of Predictors that determine economic dynamics, since the approximation of the countries moving along the growth path of these Predictors is supposedly equivalent to the growth of GDP/C and the WHI, accurate to cyclical and nonstationary effects.

Mukhomorova y E. N. Egorova, Volunteer tourism as a variety of responsible. Tourism. IOP Conference Series: Earth and Environmental Science num 204 (2018); A. I. Mosalev; E. M. Kryukova; I. V. Mukhomorova; E. N. Egorova y V. S. Khetagurova, Experience of Socially Responsible Tourism Projects in Russia. IOP Conference Series: Earth and Environmental Science num 204 (2018) y I. Ilina; A. Zotova; E. Kuznetsova; E. Nakhratova y E. Kryukova, "Teachers of Russian…

[5] J. Helliwell; R. Layard y J. Sachs, World Happiness Report 2019 (New York: Sustainable Development Solutions Network, 2019). Retrieved from: http://worldhappiness.report/

[6] R. A. Easterlin, Does Economic Growth Improve the Human Lot? Some Empirical Evidence (Philadelphia: University of Pennsylvania, 1974); R. Veenhoven, "Social conditions for human happiness: A review of research", International Journal of Psychology Vol: 50 num 5 (2015): 379-391; M. Argyle, Psikhologiya schast'ya (Saint Petersburg: Piter, 2003); R. Layard, Schaste: uroki novoi nauki (Moscow: Izd-vo In-ta Gaidara, 2011); Yu. E. Shmatova y M. V. Morev, "Assessing the Level of Happiness: a Review of Russian and Foreign Research Economic and Social Changes: Facts, Trends", Forecast Vol: 3 num 39 (2015): 141 – 162 y Economic development of the Eurasian Economic Union and member states in 2019: International ratings (Analytical report) (Moscow: Eurasian Economic Commission, 2019).

[7] R. A. Easterlin, Does Economic Growth Improve the Human Lot… y E. Diener, "Rising income and the subjective well-being of nations", Journal of Personality and Social Psychology Vol: 104 num 2 (2013): 267–276.

[8] V. D. Orekhov; O. S. Prichina; U. N. Loktionova; O. N. Yanina y N. B. Gusareva, "Scientific analysis of the Happiness Index in regard to the human capital development", Journal of Advanced Research in Dynamical and Control Systems Vol: 12 num Special (2020): 467–478.

[9] S. P. Kapitsa, Growth Paradoxes: The Laws of the Global Development of Humanity (Moscow: Alpina non-fiction, 2012).

Methods

This study is aimed at developing quantitative methods for analyzing the dynamics of the socioeconomic development of countries using a systematic database of aggregate indices.

The regression and correlation analysis served as a methodological basis of the study. The GDP/C and the WHI were used as the indicators of the binary system of the socioeconomic performance.

The main methodological idea is to use two resulting and 13 factor indices to form two lines of the complex Predictors that are optimal from the standpoint of the minimum regression error. Further, it is required to identify the systemic characteristics of the used set of global factors by comparing the factors weights in the Predictors. It is assumed that the factor weights of the optimized Predictor reflect their influence on the development.

The most famous global indices, the characteristics of which are presented in Table 1, were mainly used in the study. The sequence of indices in the table corresponds to how the number of indices included in the study has changed from stage to stage.

#	Abbreviation	Full name	Indicators
1.	GDP/C	GDP per capita at PPP	Gross domestic product at purchasing power parity in 2018, USD, according to the data from the World Bank
2.	IEF	Index of Economic Freedom	Freedom: of business, trade, finance, money, investment, labor relations – from corruption and the government, and protection of property rights[10]
3.	EDB	Ease of Doing Business Ranking, World Bank	Ease: of starting a business, registering real estate, construction, access to electricity, protecting investment, taxing, international trade, applying for a loan, managing contracts, and ending a business[11]
4.	WGI	Worldwide Governance Indicators	Accountability of the authorities and freedom of speech, stability and lack of violence, quality and rule of law, efficiency of the authorities, and control of corruption[12]
5.	GCI	Global Competitiveness Index, WEF	Macroeconomics, infrastructure, institutions, education, health; markets for goods, services, labor, and finance; business competitiveness, technological and innovative development[13]
6.	MYS	Mean Years of Schooling, UNDP	Mean duration of schooling for the working-age population[14]
7.	GHC	Global Human Capital, WEF	Productivity (employees' education), implementation (accumulation of skills), development (qualifications and education), and know-how (skills used at work)[15]

[10] T. Miller; A. B. Kim; J. M. Roberts y P. Tyrrel, Index of Economic Freedom. Washington: Heritage Foundation. 2019. Retrieved from: http://www.heritage.org/index

[11] Doing Business 2020 (Washington: The World Bank) Retrieved from: www.worldbank.org

[12] D. Kaufmann; A. Kraay y M. Mastruzzi, The Worldwide Governance Indicators: Methodology and Analytical Issues World Bank Policy Research Working Paper # 5430 (2010).

[13] K. Schwab, The Global Competitiveness Index 4.0 2019 Rankings. World Economic Forum. 2019. Retrieved from: https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth

[14] Human Development Indices and Indicators: 2018 Statistical Update. United Nations Development Programme. 2018.

8.	HCI	Human Capital Index, World Bank Group	Probability of a child surviving until turning five, the expected number of years of schooling until turning 18, taking the quality of education into account, the survival rate of adults under 60, and the proportion of children without arrested development[16]
9.	RDE	R&D Expenditure	Research and development (R&D) expenditure. R&D cover basic research, applied research, and experimental development[17]
10.	WHI	World Happiness Index	Healthy life expectancy, freedom of life choice, support from other people and social support, low corruption, and feeling positive or negative emotions[18]
11.	LPI	The Legatum Prosperity Index, Legatum Institute	Economics, management, entrepreneurship, education, healthcare, social capital, personal freedoms, security, and environmental protection[19]
12.	CPI	Corruption Perception Index	The index of perceiving corruption based on the expert opinions – the prevalence of corruption in the public sector[20]
13.	SPI	The Social Progress Imperative	Food, healthcare, housing, water and electricity supply, security, knowledge and literacy, information and communications, environmental protection, human rights and freedoms, the ability to make decisions and realize oneself[21,22]
14.	LEI	Life Expectancy Index	Life expectancy at birth in years[23]
15.	KIG	KOF Index of Globalization	Economic (36 %), social (39 %), and political globalization[24,25]

Table 1
Indices used as factors

There are several arguments under study that are not the global aggregate indices formally – in particular, Mean Years of Schooling (MYS). This indicator is a subindex of the

[15] K. Schwab, The Global Human Capital Report. World Economic Forum. 2019. Retrieved from: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf
[16] The changing nature of work. World development report. Washington: World Bank Group. 2019. Retrieved from: https://www.worldbank.org/en/publication/wdr2019
[17] R&D Expenditure, % of GDP. World Data Atlas. Knoema Enterprise. 2017. Retrieved from: https://knoema.ru/
[18] J. Helliwell; R. Layard y J. Sachs, World Happiness Report 2019…
[19] The Legatum Prosperity Index (London: Legatum Institute, 2019). Retrieved from: https://www.prosperity.com/download_file/view_inline/3690
[20] Corruption perception index. Transparency international. 2020. Retrieved from: https://www.transparency.org/en/cpi
[21] M. E. Porter, Competitive Advantage of Nations: Creating and Sustaining Superior Performance (New York: Simon and Schuster, 2011).
[22] S. Stern y T. Epner, Social Progress Index Methodology Report. The Social Progress Imperative. 2018. Retrieved from: https://www.socialprogress.org/assets/downloads/resources/2019/2019-Social-Progress-Index-Methodology-Report.pdf
[23] Human Development Indices and Indicators: 2018…
[24] G. Savina; F. Haelg; N. Potrafke y J. E. Sturm, "The KOF Globalisation Index – Revisited", Review of International Organizations Vol: 14 num 3 (2019): 543-57. Retrieved from: https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html
[25] Index of globalization of the countries of the world according to KOF. Humanitarian encyclopedia: Research. Center for Humanitarian Technologies, 2006–2020. Retrieved from: https://gtmarket.ru/ratings/kof-globalization-index/info

Human Development Index, HDI[26]. The full HDI is not applicable, because GDP/C is one of its components. Therefore, using it as a predictor for GDP/C is not correct. The MYS indicator is convenient, because it is not a composition of other indicators and is therefore easily controlled. For ease of comparison with other indicators, the MYS index is assigned to the conditional duration of tertiary education, which was considered equal to 16 years. Similarly, predictors include R&D Expenditure (RDE) in shares of GDP and the Life Expectancy Index (LEI) in years, which are important components of the socioeconomic development.

Since the countries represented in the study vary significantly in terms of GDP/C and the number of residents, it is difficult to consider them correctly in the same row without taking the relative weight into account, although most ratings do just that. The situation is complicated by the fact that small countries are more susceptible to various external influences. Therefore, it would be more correct to make forecasts separately for groups of countries of various sizes. The authors used a number of samples in this study that varied in the number of countries included in them as GDP/C at PPP decreased. The corresponding samples were indicated by letter G and the number of countries represented. For example, the G6 sample includes China, the US, India, Japan, Germany, and Russia. Samples G12, G24, G48, and G72 were also used. The fuel producing countries of Qatar, Kuwait, and Saudi Arabia, which significantly deviate in general GDP/C trends from various predictors, were not included in the samples. The economies for which there were no data for some Indices were not included in the samples either: Uzbekistan, Taiwan, Azerbaijan, Belarus, Oman, Iraq, Libya, Lebanon, Turkmenistan, Puerto Rico, and Sudan. Instead of these countries, those with the following values of GDP at PPP were included in the samples.

The regression dependences and the reliability of approximation (R^2) were determined for some samples presented above, and the arithmetic mean (mid) value of the determination coefficient R^2_m was determined for 4 – 5 samples. The value $\Delta R^2_m = 1 - R^2_m$, which described the error of the regression model, was found for the convenience of analysis in those cases when R^2_m was close to unity.

Both the indices presented in Table 1 and the complex Predictors, which were formed as a linear combination of the above indices in accordance with formula (1), where k_i were the weight coefficients, were used as the predictors influencing the socioeconomic performance. The k_i coefficients are positive, and their sum is unity:

$$CP = k_1 \cdot IEF + k_2 \cdot EDB + k_3 \cdot WGI + k_4 \cdot GCI + k_5 \cdot MYS + k_6 \cdot GCI + k_7 \cdot HCI + k_8 \cdot RDE + k_9 \cdot WHI + k_{10} \cdot LPI + k_{11} \cdot CPI + k_{12} \cdot SPI + k_{13} \cdot LEI + k_{14} \cdot KIG \quad (1)$$

First, k_i was varied, then the regression model of the resulting parameter (GDP/C or the WHI) from CP was determined, and R^2 values were calculated for 4 – 5 samples to find the weights of the optimal complex predictor CP. Further, the optimal values of k_i were found, at which the maximum value of R_m^2 was reached. The optimization was carried out by the gradient descent method with the cyclic change of variables.

[26] Human Development Indices and Indicators: 2018…

Results

Dependence of GDP/C on various global Indices

Almost all global indices are formed independently of each other, although some indicators are included in different aggregate indices with different weights. The objective of this study is to understand the system of all these indices. The first step in this understanding is to determine the potential of the indices in forecasting the resulting value. First, GDP/C at PPP is considered as the resulting parameter. The values of the determination coefficients between GDP/C and each of the indices under study are provided in Table 2.

	Trend: power						Exponent
	G6	**G12**	**G 24**	**G48**	**G 72**	**mid**	mid
Index of Economic Freedom, Her. Foun.	0.853	0.543	0.561	0.602	0.546	0.621	0.624
Ease of Doing Business, WB	0.831	0.433	0.597	0.568	0.485	0.583	0.600
Worldwide Governance Indicators, WB	0.480	0.575	0.703	0.703	0.639	0.620	0.674
Global Competitiveness Index, WEF	0.809	0.770	0.776	0.767	0.787	0.782	0.777
Mean Years of Schooling, UNDP	0.915	0.883	0.864	0.708		0.843	0.776
Global Human Capital, WEF	0.887	0.814	0.814	0.665	0.664	0.769	0.768
Human Capital Index, WBG	0.834	0.886	0.911	0.717	0.780	**0.826**	**0.832**
R&D – Expenditure, WB	0.743	0.558				0.651	0.527
World Happiness Index, SDSN	0.964	0.674	0.474	0.602	0.621	0.667	0.668
Legatum Prosperity Index, Legatum Inst.	0.841	0.828	0.834	0.805	0.827	**0.827**	**0.814**
Corruption Perceptions Index, Transp. Int.	0.338	0.459	0.588	0.71	0.669	0.553	0.573
Social Progress Imperative, SPI	0.876	0.867	0.909	0.793	0.84	**0.857**	**0.846**
Life Expectancy Index, UNDP	0.647	0.723	0.739	0.609	0.681	0.68	0.694
KOF Index of Globalization, KOF SEI	0.886	0.843	0.791	0.707	0.791	0.804	0.796

Table 2
R^2 values for the dependence of GDP/C on the global indices

The power and exponential trends indicate a slight difference in the R^2 value for GDP/C, where R^2 is usually slightly higher for the power trend. However, the power trend is not always determined, as can be seen from Table 2. The data from Table 2 are presented in Figure 1 for better visual perception.

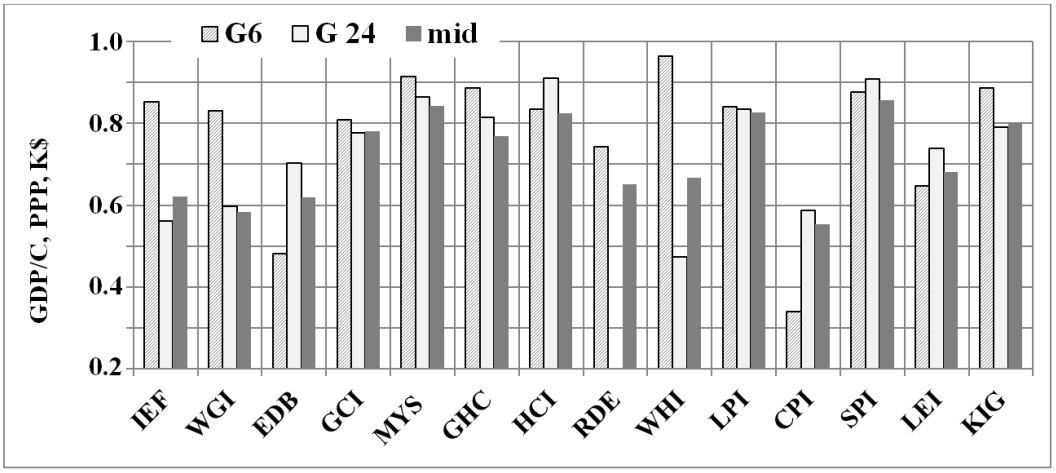

Figure 1
R^2 values for the power regression of GDP/C from 14 global Indices

It can be seen that the highest average value $R_m^2 = 0.857$ is secured by the SPI, where $R^2 = 0.896$ for the G24 sample is with an exponential trend, and $R^2 = 0.909$ – with a power trend. The LPI ranks second in terms of R_m^2: $R_m^2 = 0.827$, and the HCI ranks third: $R_m^2 = 0.826$ (power trend). It must be noted that the R^2 values for G6 and G24, as well as the average value for five samples (R_m^2) do not differ much for these indices. However, the WHI predictor has $R^2 = 0.964$ for the G6 sample and $R^2 = 0.474$ for G24. Half of the indices (IEF, WGI, EDB, RDE WHI, CPI, LEI) are described by a low value of $R_m^2 < 0.7$.

The indices describing human capital (MYS, GHC, and HCI) have relatively high determination coefficients. As the sample size increases, the R^2 value usually decreases. The Corruption Perceptions Index is described with the least prognostic ability, which may indicate either its weak influence on GDP growth or the incorrectness of its formation.

The regression dependences of GDP/C on SPI for the G24 sample at exponential and power (dashed) trends are provided in Figure 2.

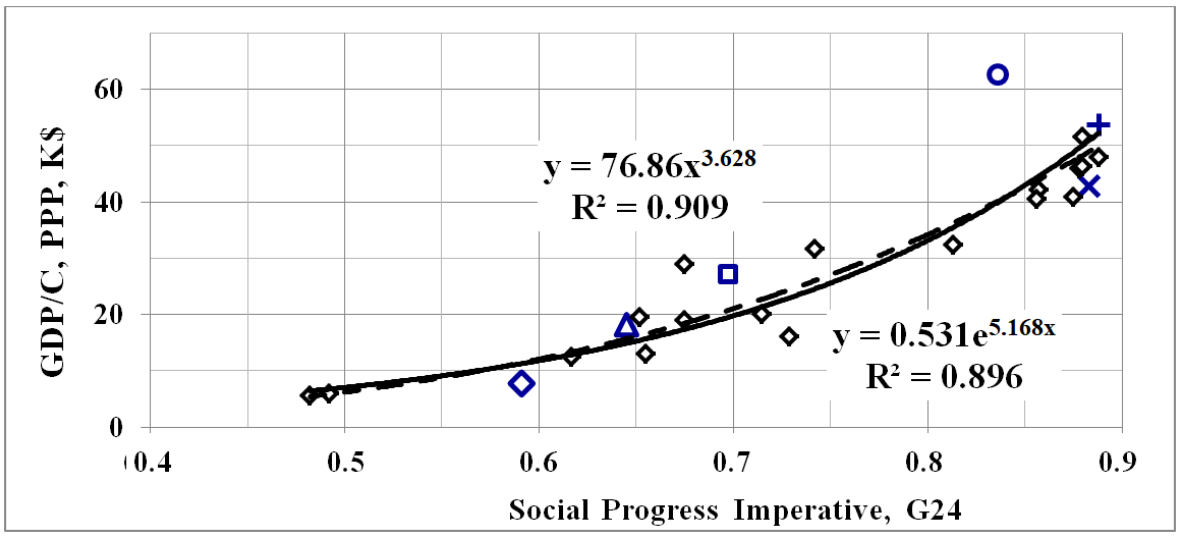

Figure 2
Regression dependencies of GDP/C on the SPI

It can be seen that the power and exponential trends are close to each other in this range of values. The G6 countries are represented by special icons in Figure 2: China as △, the US as ○, India as ◇, Japan as ×, Germany as **+**, and Russia as □. It can be seen that the deviation of the G6 points from the trend is fairly significant, especially for the US.

Dependence of GDP/C on the paired optimal Predictors

As part of the second step in understanding the prognostic ability of the system of 14 global indices, their potential for cooperative prediction of GDP/C is evaluated. To this end, the Predictors are formed from a pair of indices, where those with the highest results individually are taken as one of them (Figure 1) – in particular, the SPI and the HCI, while all the others are taken as another one in the pair. Moreover, the optimal share of the leading index for each pair is determined – k_i. Since the values of the determination coefficients in this case are close to unity, the results are presented as a regression error $\Delta R^2 = 1 - R^2$. The corresponding results for the leading HCI and SPI indices are provided in Tables 3 and 4.

It can be seen that for the leading HCI (Table 3), the smallest regression error is provided in the pair with the SPI Predictor – $\Delta R_m^2 = 10.1$ % at $k_7 = 0.35$, $k_{12} = 0.65$. All paired Predictors provide less regression error than a single HCI. The EDB, GHC, ERD, LEI, and KIG indices are described by the relatively high regression error ($\Delta R_m^2 > 15$ %) in the optimal paired Predictors with the HCI.

HCI	**k_7**	G6	G12	G24	G48	G72	mid	**HCI**	**k_7**	G6	G12	G24	G48	G72	mid
IEF	0.6	**6.1**	9.1	7.5	20.5	18.1	12.3	ERD	0.8	15.1	11.2	9.4	25.9	21.3	16.6
EDB	0.8	14.7	11.5	9.0	25.2	21.7	16.4	WHI	0.6	7.8	8.0	10.2	21.0	16.7	12.7
WGI	0.8	8.0	5.5	7.0	19.4	17.7	11.5	LPI	0.5	**6.9**	5.3	7.8	19.0	15.5	**10.9**
GCI	0.5	10.4	9.7	10.2	20.0	15.8	13.2	CPI	0.77	14.1	11.5	8.7	19.5	17.2	14.2
MYS	0.7	9.1	7.4	6.6	22.9	23.2	13.8	SPI	0.35	**7.5**	6.2	6.4	17.3	13.2	**10.1**
GHC	0.5	13.4	10.1	8.7	26.4	22.2	16.2	LEI	0.75	15.9	10.7	9.6	27.7	21.1	17.0
HCI	1.0	16.6	11.4	8.9	28.3	22.0	17.4	KIG	0.7	15.8	10.7	9.8	27.7	20.9	17.0

Table 3
Regression error for the optimal Predictors paired with the HCI, %

SPI	**k_{12}**	G6	G12	G24	G48	G72	mid	**SPI**	**k_{12}**	G6	G12	G24	G48	G72	mid
IEF	0.62	11.5	11.8	8.6	15.4	12.9	12.0	ERD	0.9	12.1	10.8	9.1	19.3	15.3	13.3
EDB	0.75	**6.8**	6.0	8.2	15.0	15.2	**10.2**	WHI	0.8	7.8	12.6	9.6	18.2	13.8	12.4
WGI	1.0	12.4	13.3	9.1	20.7	16.0	14.3	LPI	0.7	12.7	11.8	9.7	17.9	14.1	13.2
GCI	0.6	10.7	8.1	9.7	15.7	11.6	11.2	CPI	0.9	14.5	12.9	9.3	15.0	14.6	13.3

MYS	0.65	**6.9**	5.9	6.5	17.8	12.6	**9.9**	SPI	1.0	12.4	13.3	9.1	20.7	16.0	14.3
GHC	0.58	**4.5**	4.1	7.4	18.9	14.6	**9.9**	LEI	0.9	12.7	13.3	9.1	20.3	15.7	14.2
HCI	0.65	**7.5**	6.2	6.4	17.3	13.2	**10.1**	KIG	0.7	10.7	10.1	8.4	19.2	13.7	12.4

Table 4
Regression error for the optimal Predictors paired with the SPI, %

For the leading SPI, the smallest regression error – ΔR_m^2 = 9.9 – 10.1 % – corresponds to three indices describing human capital (MYS, GHC, and HCI). The SPI – EDB pair also secures a low value (ΔR_m^2 = 10.2 %), although individually the EDB showed a high regression error. It is significant that, when paired with the SPI, all indices provide a regression error of no more than a single SPI – 14.3 %. The WGI do not reduce the regression error when paired with the SPI.

The dependence of GDP/C on the best paired Predictor for G24 is provided in Figure 3 for power (dashed) and exponential trends. From the G6 sample, the US point deviates significantly from the trend.

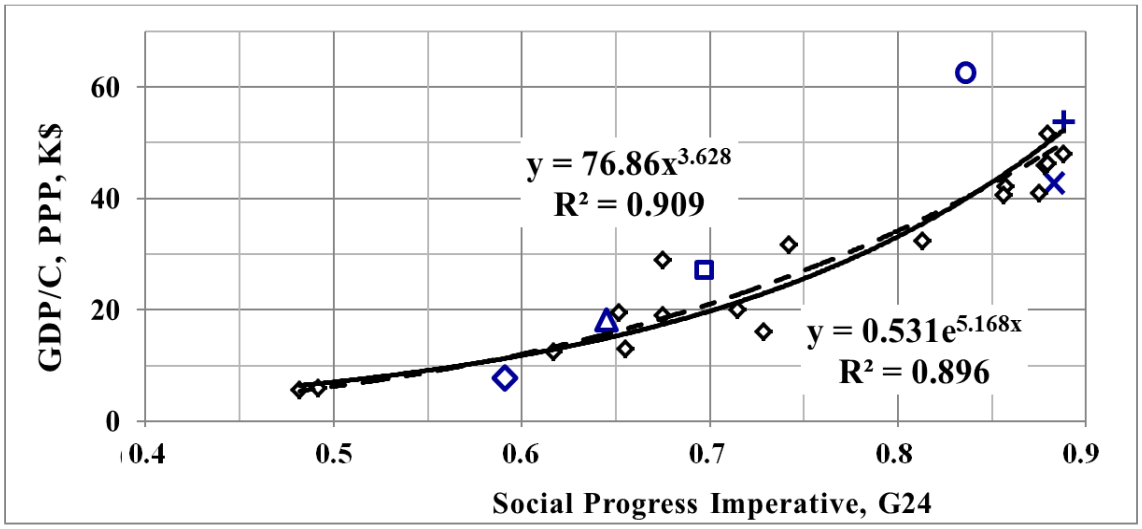

Figure 3
Dependence of GDP/C on the best Predictor paired with the SPI

Summarizing the study of the paired predictors, it must be noted that the composition of two indices with the best individual SPI and one of the human capital indices can further reduce the regression error by almost 1.5 times.

Dependence of GDP/C on the multi-index Predictors

The third stage of the study was devoted to the search for the optimal complex Predictor securing the smallest regression error with GDP/C. The function of 14 variables – R^2_m – was optimized using the method of coordinate descent with a cyclic change of variables (indices). The optimization was completed if the change in the function ΔR^2_m did not exceed 0.02 %. The ΔR^2_m values for the optimal complex Predictors (CP_i) and the corresponding coefficients k_i are provided in Table 5. It also contains the characteristics of the best ΔR^2_m relative to GDP/C global Indices (SPI and HCI), as well as the best pair of the complex Predictors (0.58SPI + 0.42GHC and 0.65SPI + 0.35HCI) for comparison.

	ΔR^2, %. Trend – polynomial			IEF	EDB	WGI	GCI	MYS	GHC	HCI	ERD	WHI	LPI	CPI	SPI	LEI	KIG
Predictor	G6	G24	mid	k_1	k_2	k_3	k_4	k_5	k_6	k_7	k_8	k_9	k_{10}	k_{11}	k_{12}	k_{13}	k_{14}
HCI	16.6	8.9	17.4							1.0							
SPI	12.4	9.1	14.3												1.0		
HCI, LPI	6.9	7.8	10.9							0.5			0.5				
SPI, GHC	4.5	7.4	9.9						0.42						0.58		
SPI, HCI	7.5	6.4	10.2							0.35					0.65		
CP_1	2.1	7.8	8.06		0.03	0.04	0.06	0.16		0.28		0.24	0.19				
CP_2	2.4	5.8	6.84	0.03	0.06		0.02	0.12	0.08	0.15	0.01	0.15	0.04	0.01	0.26		0.07

Table 5
Regression error for the complex Predictors, %

The complex Predictor CP_1 was formed earlier without using the last four indices and secured ΔR^2_m = 8.06 %.

The Predictor CP_2 is based on 14 indices, including the SPI, and secures ΔR^2_m = 6.84 %. Compared to the best paired Predictor, a complex one containing the SPI has about 1.5 times less regression error, and is 2.1 times smaller compared to the individual SPI. The regression error for CP_2 reaches record low values for G6 and G12 samples (65 % of global GDP at PPP): 2.2 – 2.6 % (2.1 – 2.8 % for CP_1).

The human capital indices (MYS, GHC, and HCI) had a share of 44 % in CP_1 and 35 % in CP_2 due to the inclusion of the SPI index in the Predictor. The share of the human capital indices in the part of CP_2 that differed from the SPI even increased to 47 % (35 %/(1 - 0.26) = 47 %), which indicated the cooperative interaction between the SPI and the human capital indices.

The WHI makes a significant contribution to the Predictor CP_2 (k_9 = 0.15). The share of Ease of Doing Business is k_{10} = 0.06, which indicates a good complementarity of the SPI and the EDB, because the EDB alone has a high regression error (Table 2). The WGI and the LEI are not included in the optimal Predictor at all, while the Global Competitiveness Index, R&D Expenditure and the Corruption Perceptions Index contribute about 0.01 – 0.02.

The obtained weight fractions of various indices in the optimal complex Predictor indirectly indicate the contribution of various global Indices to the growth of GDP/C. However, the system of indices under review is a complex, interdependent system. Therefore, it should not be assumed that there is a mechanistic addition of contributions.

The dependence of GDP/C on the complex Predictor CP_2 is provided in Figure 4. It can be seen that the points corresponding to China and Russia are in good agreement with the trend. The US point lies slightly above the trend line.

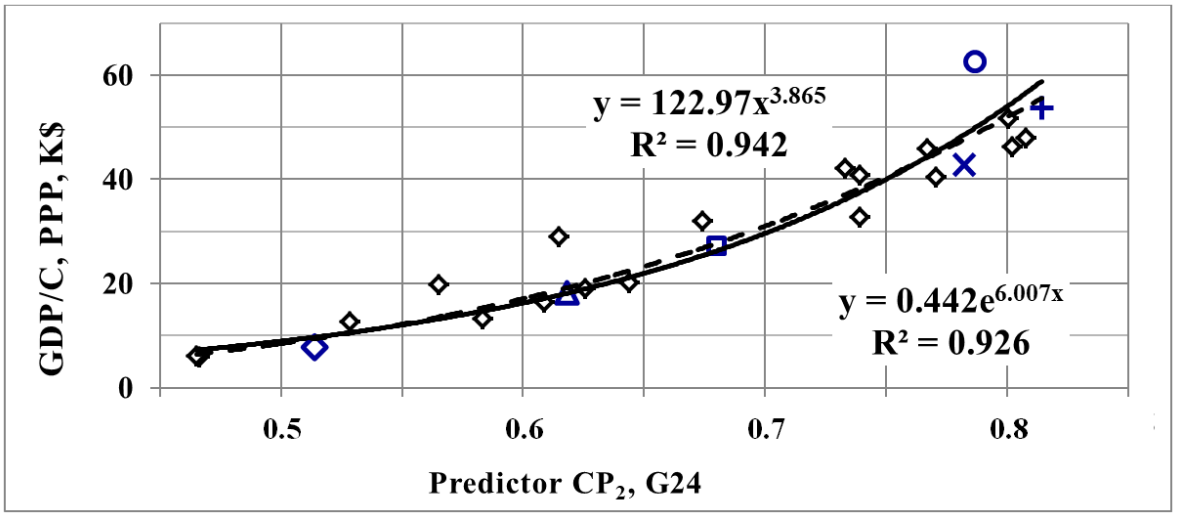

Figure 4
Dependence of GDP/C on the complex Predictor CP_2

Dependence of the WHI on various global Indices

Similar to how the dependence of GDP/C on various indices was studied, the relationship between the WHI and the same indices was analyzed. However, the GDP/C at PPP indicator in hundreds of thousands of dollars was used in the ninth place, instead of the WHI. Only samples G6 – G48 were considered because the regression error for the WHI was higher than for GDP/C, especially for large samples. The values of the determination coefficients for the WHI regression with 14 global indices for samples G6 – G48 are provided in Table 6. The trends in the form of a polynomial of the sixth degree (of the fourth degree for G6) were used for this.

	G6	G12	G24	G48	mid		G6	G12	G24	G48	mid
IEF	0.97	**0.85**	0.60	0.64	0.76	**ERD**	1.00	0.36	0.46	0.46	0.57
EDB	0.97	0.45	0.34	0.42	0.55	**GDP/C**	0.99	0.84	0.74	0.71	**0.82**
WGI	0.80	0.56	0.63	0.68	0.67	**LPI**	0.87	0.79	0.77	0.78	0.80
GCI	0.85	0.38	0.57	0.60	0.60	**CPI**	0.86	0.59	0.56	0.62	0.65
MYS	0.96	0.73	0.60	0.61	0.72	**SPI**	0.88	**0.88**	0.80	0.75	**0.82**
GHC	0.98	0.72	0.68	0.65	0.76	**LEI**	0.73	**0.89**	0.56	0.64	0.70
HCI	0.91	**0.92**	0.79	0.58	0.80	**KIG**	0.92	0.82	0.57	0.60	0.73

Table 6
R^2 values for the dependence of the WHI on global indices, %

The SPI (R^2_m = 0.818, GDP/C – R^2_m = 0.825), the LPI (R^2_m = 0.801), and the human capital indices (R^2_m = 0.72 – 0.80) are described by the maximum values of the determination coefficient. The regression dependence of the WHI on GDP/C for the G12 sample is provided in Figure 5 with a linear trend (dashed) and a polynomial of the sixth degree (P6). It can be seen that the trend is bimodal. The G6 points lie close to the trend line since R^2 = 0.99.

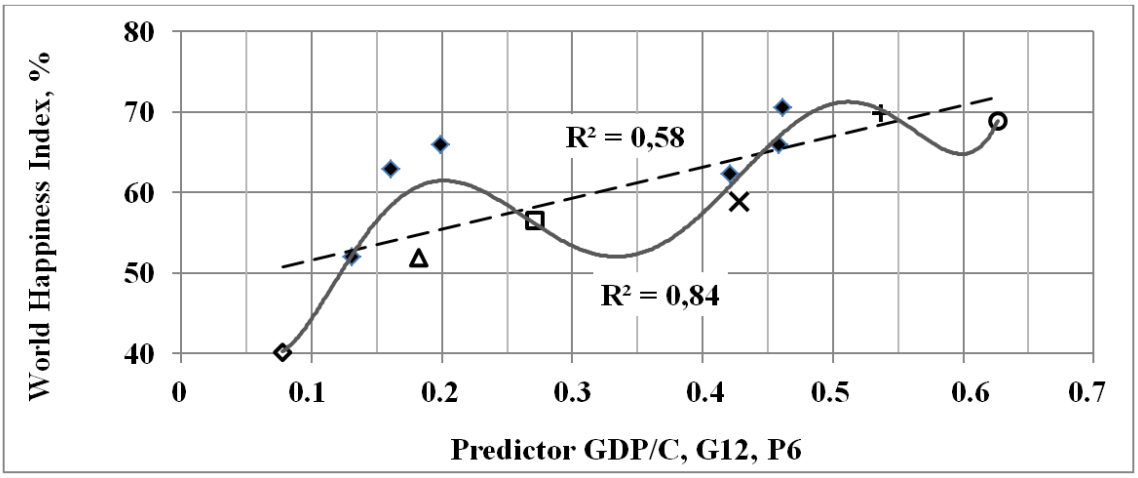

Figure 5
Dependence of the WHI on GDP/C, G12

Dependence of the WHI on the paired optimal Predictors

Let us further evaluate the possibilities of the cooperative influence of the paired Predictors on forecasting the WHI, similar to how it has been done with GDP/C before. From a pair of indices, those with the highest determination coefficient for the regression dependence with the WHI (Table 6), namely GDP/C and the SPI, are selected as the leading ones. All the other 12 indices from Table 1 are used as the second index, and the optimal share of the leading index, k_i of the pair, is found. In contrast to the GDP/C case studied before, not all indices in the pair secure an increase in R^2 in relation to the WHI. Tables 7 and 8 contain the values of the regression error (ΔR^2 in %) relative to the WHI for the indices that when paired with GDP/C or the SPI, respectively, secure a decrease in ΔR^2_m. The Δ symbol indicates the amount of decrease in ΔR^2_m relative to the leading index individually.

	k_9	G6	G12	G24	G48	mid	Δ, %;
GDP/C		1.4	15.8	26.3	29.5	18.3	
IEF	0.05	1.5	16.4	25.7	28.9	18.1	0.1
WGI	0.60	0.5	7.9	17.9	23.9	12.6	**5.7**
LPI	0.30	1.5	20.9	18.1	17.5	14.5	3.8
SPI	0.35	0	11.5	17.6	20.2	12.3	**6.0**
KIG	0.80	1.2	16.0	23.2	29.3	17.4	0.8

Table 7
The WHI regression errors for the Predictors paired with GDP/C, %

	k_{12}	G6	G12	G24	G48	mid	Δ, %;
SPI	1.00	11.6	12.5	20.2	25.5	17.5	
IEF	0.85	11.9	9.5	15.6	20.0	14.3	3.2
EDB	0.90	11.9	14.6	17.7	24.6	17.2	0.2
WGI	0.80	9.4	13.8	15.9	22.4	15.4	2.1
GCI	0.85	10.8	14.9	18.0	22.5	16.5	0.9

GDP/C	0.65	0.1	11.5	17.7	20.2	12.3	**5.1**
LPI	0.55	5.6	10.0	15.6	19.3	12.6	**4.8**
CPI	0.90	3.4	13.3	17.8	22.4	14.2	3.2
LEI	0.70	4.4	10.6	24.2	26.1	16.3	1.1
KIG	0.85	12.9	3.7	17.9	24.4	14.7	2.7

Table 8
The WHI regression errors for the Predictors paired with the SPI, %

It follows from Table 7 that pairs with GDP/C have the smallest regression error when paired with the WGI (ΔR^2_m = 12.6 %) and the SPI (ΔR^2_m = 12.3 %). A significant gain is also secured by the pair of GDP/C and the LPI. Most indices do not provide a decrease in ΔR^2_m when paired with GDP/C.

The paired Predictors with the SPI have less regression error relative to just the SPI in most cases. There is no cooperative effect with the indices describing human capital (MYS, GHC and HCI) and RDE.

It is characteristic that the indices included in the paired Predictors with a low regression error for the WHI and GDP/C (Table 9) vary significantly, although the SPI is involved in the best Predictors in both cases.

Regression with GDP/C	SPI+ MYS	SPI+ GHC	SPI+ HCI	SPI+ EDB	HCI+ LPI	SPI+ GHC	HCI+ WGI	HCI+ IEF	SPI+ WHI
ΔR^2_m, %	9.9	9.9	10.1	10.2	10.9	11.2	11.5	12.3	12.4
Regression with the WHI	GDP/C +SPI	GDP/C+ WGI	SPI+ LPI	SPI+ CPI	SPI+ IEF	SPI+ KIG			
ΔR^2_m, %	12.3	12.6	12.6	14.2	14.3	14.7			

Table 9
Paired Predictors with a reduced regression error

The regression dependence of the WHI on the best paired Predictor (0.35 GDP/C + 0.65 SPI) for the G12 sample is provided in Figure 6 with a polynomial trend of the fifth degree (a trend of the sixth degree with the same ΔR^2 had too much waviness).

Compared to the GDP/C Predictor (Figure 5), the trend in Figure 6 is shifted towards large values of the abscissa axis and has a much narrower range on this axis. This is due to the fact that GDP/C for the countries under study has a much larger spread of values than the SPI.

The pronounced bimodality of the trend can also be noted, with Russia located in the zone of decline in the level of happiness in Figures 5 and 6. According to Figure 6, the level of happiness for Russia is approximately 5 % below the trend for the WHI range for G12: 40 – 70 %.

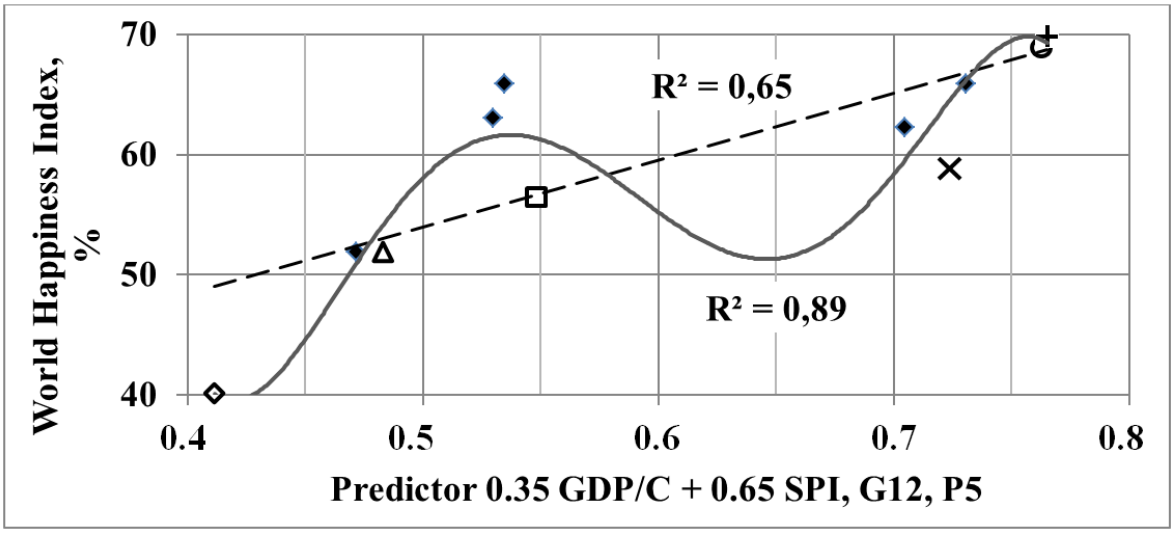

Figure 6
Dependence of the WHI from the Predictor – 0.35 GDP/C + 0.65 SPI, G12

Dependence of the WHI on the optimal complex Predictor

The above analysis of the cooperative abilities of indices in the paired Predictors allows to understand which indices are appropriate to include in the complex Predictor, based on all 14 indices under study, first of all. An optimal Predictor was found in terms of the regression error with the WHI, similar to how it was done before for the regression with GDP/C. The found Predictor CP_5 is presented in Table 10. The best regression errors of the global indices and the paired Predictors are also provided there for comparison. The optimal complex Predictors CP_3 and CP_4 are also presented there, found in the previous works[27,28], which reviewed smaller global index bases. Indices with zero coefficients k_i are omitted in Table 10.

	ΔR^2, Trend – polynomial				%.	IEF	WGI	GCI	MYS	GHC	GDP/C	LPI	SPI	LEI	KIG
Predictor	G6	G12	G24	G48	mid.	k_1	k_3	k_4	k_5	k_6	k_9	k_{10}	k_{12}	k_{13}	k_{14}
GDP/C	1.4	15.8	26.3	29.5	18.3						1.0				
SPI	12	12.5	20.2	25.5	17.6								1.0		
GDP/C +SPI	0	11.5	17.6	20.2	12.3						0.35		0.65		
GDP/C +WGI	0.5	7.9	17.9	23.9	12.6						0.60		0.40		
SPI+LPI	5.6	10.0	15.6	19.3	12.6							0.45	0.55		

[27] V. D. Orekhov; O. S. Prichina; U. N. Loktionova; O. N. Yanina y N. B. Gusareva, “Scientific analysis of the Happiness...

[28] O. S. Prichina y V. D. Orekhov, “Development of the indicative system for assessing the “happiness” level using global indexes, including human capital”, Problems of economics and legal practice num 2 (2020): 148–153.

CP_3	0.1	8.9	16.4	23.3	12.2	0.16	0.40	0.08	0.14		0.22				
CP_4	0.2	7.4	15.6	22.4	11.4	0.14	0.35		0.10	0.02	0.30	0.1			
CP_5	0.4	7.3	11.5	17.1	9.07	0.16	0.13				0.23		0.45	0.01	0.02

Table 10
Regression error for the optimal Predictors of the WHI

It can be seen that the optimal Predictor CP_5 for the WHI has ΔR^2_m = 9.07 %, which is approximately half the regression error for the global indices with the lowest regression error and about a quarter less than with the best paired indices. The SPI is the largest contributor to the optimal Predictor of the WHI (45 %). GDP/C ranks second (23 %), and the IEF ranks third (16 %), followed by the WGI (13 %). Compared with the results of the analysis of the best paired indices, the LPI is not represented in the optimal complex Predictor, and the contribution of the IEF is increased. It is also seen that the introduction of the SPI into some indices used allowed to reduce ΔR^2_m by more than 2 %.

The regression dependences of the WHI on CP_5 for the G12 and G48 samples are provided in Figures 7 and 8. It can be seen that the bimodal nature can be traced in both samples, although it is less pronounced on G48. Unlike dependencies on the Predictors with a smaller number of indices (Figures 5 and 6), Russia is in the zone of growth in the level of happiness in this case, and the point corresponding to Russia (square) is located close to the trend line.

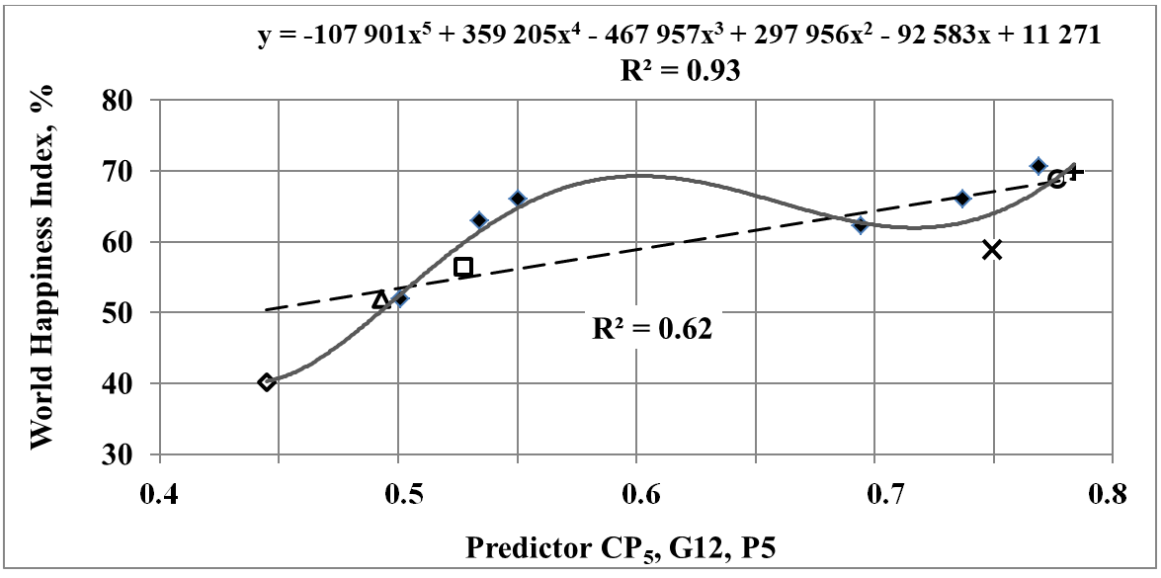

Figure 7
Dependence of the WHI on the optimal Predictor CP_5, G12

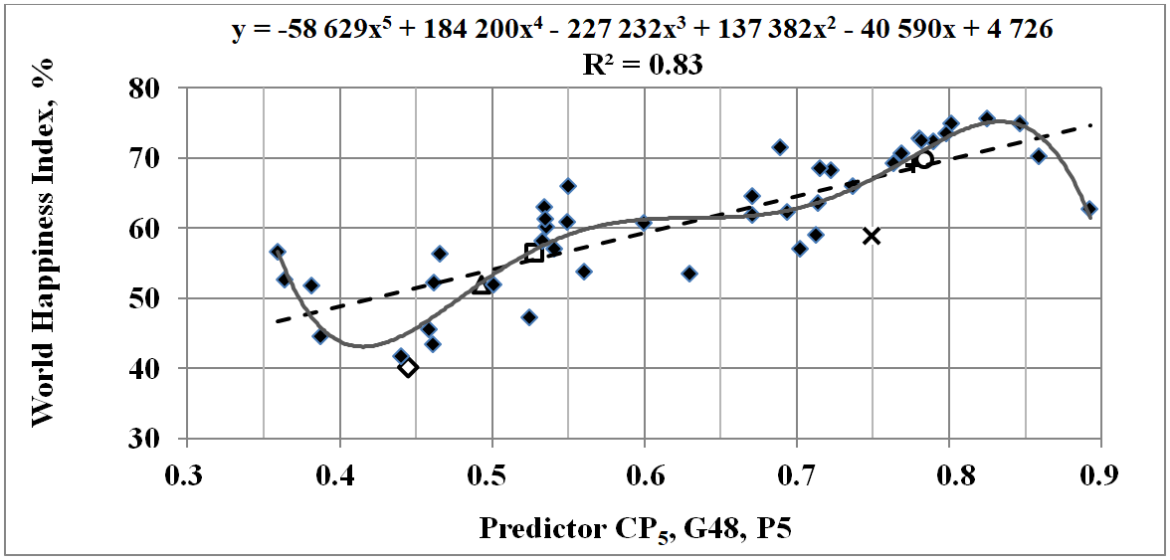

Figure 8
Dependence of the WHI on the optimal Predictor CP_5, G48

Analysis of the system of Predictors for various indicators of the socioeconomic development

The paired Predictors that reduce the regression error for the two types of the resulting parameters (GDP/C and the WHI) are compared in Table 9, and it is indicated that the SPI plays an important role in both cases. In addition to the SPI, both types of the socioeconomic performance (GDP/C and WHI) are significantly influenced by the WGI, the LPI, and the IEF.

According to the results of the formation of the complex Predictor for GDP/C, it is clear that 13 indices (except for the LEI) contribute to it. The largest contributors are the SPI, the WHI, and the human capital indices (MYS, GHC, and YCI). The R&D Expenditure and the Corruption Perception Index have very low weights.

The complex Predictor for the WHI based on 14 indices includes only six indices, two of which are with low weight (LEI and KIG). The main contributors are GDP/C and the SPI, while IEF and WGI contribute noticeably less. As such, the systemic chart of the mutual influence of major indices under study from the standpoint of two development results can be represented as shown in Figure 9.

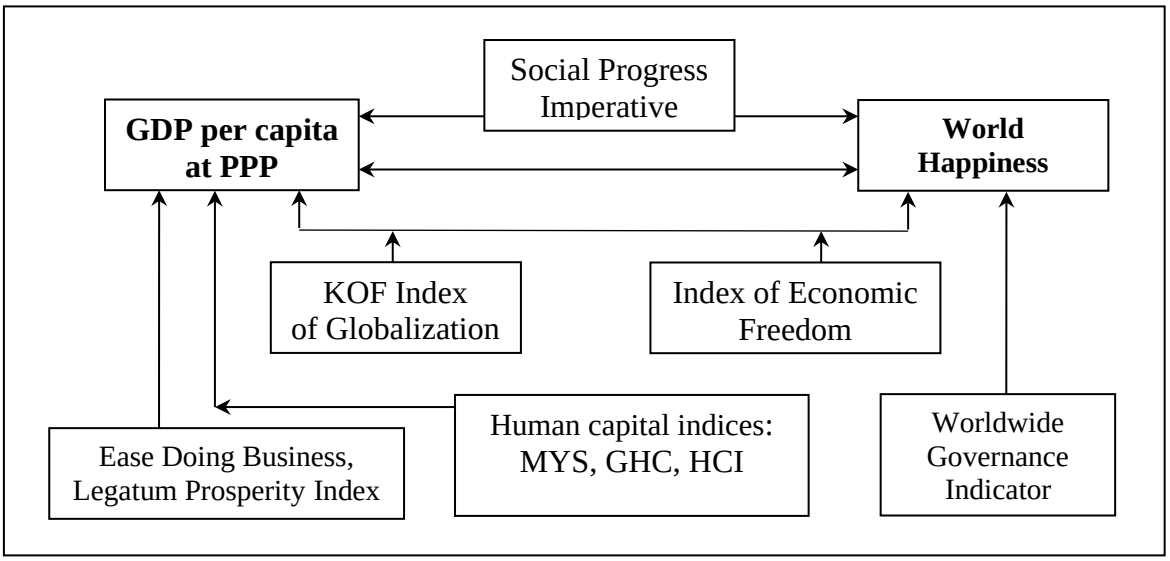

Figure 9
Chart of the mutual influence of major global indices

Two indices (GDP/C and the WHI) are the key parameters of this system and can play the role of an integral result of the socioeconomic development or the role of a factor that significantly influences another result. The SPI index strongly influences the first two results and can also be considered as an integral indicator of the development results. These three indices serve as the basis for the structure of the index system.

The IEF and the KOF Index of Globalization influence both results (virtually the entire system), although to a lesser extent than the three integral indicators noted above. They represent the second level of the structure of the index system.

The group of the human capital indices and, to a lesser extent, the Ease Doing Business and the LPI significantly influence only GDP/C, while the WGI only influences the WHI. In sum, they represent the third level of the structure of the index system.

The remaining indicators are included in the fourth level of the structure. They relatively weakly influence the indicators of the society development, but can replace them with a decrease in the number of indicators used, although with a larger regression error.

Discussion

This study continued a series of works studying the influence of the global factors on the integral indicators of the socioeconomic performance of countries, where the number of used indices increased significantly at each subsequent stage. It turned out that there were indices that very significantly influenced the regression error among the newly added indices. In this regard, the task of searching for additional indicators that can further enhance the predictive performance of the indicator system remains relevant.

The averaging of the regression error for different sized samples of the largest economies was used in this study to correct the errors arising in the statistical analysis of the characteristics of countries that significantly varied in economic weight. This allowed to combine the tasks of searching for regression dependencies adequate for a large number of countries and focusing on the characteristics of the largest economies. As a result, the

entire system is relatively correctly analyzed. However, from the standpoint of the forecasting practice, it is logical to separate these tasks and search for the regression dependencies separately for economies of different sizes, which should reduce the regression error in each group of countries. It will also reveal indices that work better in large and smaller economies.

The dependence of two integral indicators of the economic performance on various parameters was studied in this work. In addition, it was indicated that the SPI index was also close in its systemic properties to these two integral parameter results. Similar studies in relation to this indicator should be conducted in the future.

Conclusion

The following conclusions can be drawn, based on the studies performed.

1. The analysis of the mutual influence of 15 aggregate global indices has revealed the multilevel structure of this group of indicators as a single system. Three of these indices – GDP/C, the WHI, and the SPI indices – form the “skeleton” of this system. They most strongly influence each other (41 – 68 % of influence) and other indices and can serve as integral indicators of the success of the society development.

2. The second level of the system includes the indices that influence the entire system, although to a lesser extent (9 – 18 %). These are the IEF and the KOF Index of Globalization. The third level of the index system is formed by the indices that influence only one of the integral indicators of the society development under study. The group of the human capital indices (MYS, GHC, and HCI), as well as EDB and LPI mainly influence GDP/C (~45 % influence), while the Worldwide Governance Indicator (~13 %) influences the WHI. The remaining indicators are included in the fourth level of the system structure and influence the results weakly.

3. The complex optimal Predictors developed in the course of the study secure about a two-fold reduction in the regression error compared to the best single indicators: up to 5.8 % for GDP/C (sample of 24 largest economies), and up to 11.5 % for the WHI.

Acknowledgments

The reported study was funded by RFBR, project number 19-29-07328.

References

Albert, S. y Bradley, K. Intellectual Capital as the Foundation for New Conditions relating to Organizations and Management Practices, Working Paper Series num 15. Milton Keynes: Open University Business School. 1996.

Argyle, M. Psikhologiya schast’ya. Saint Petersburg: Piter. 2003.

Becker, G. S. “Investment in Human Capital: A Theoretical Analysis”. Journal of Political Economy Vol: 70 num 5 (1962): 9–49.

Brooking, A. Intellectual Capital. London: International Thompson Business Press. 1996.

Corruption perception index. Transparency international. 2020. Retrieved from: https://www.transparency.org/en/cpi

Diener, E. “Rising income and the subjective well-being of nations”. Journal of Personality and Social Psychology Vol: 104 num 2 (2013): 267–276.

Doing Business 2020. Washington: The World Bank. Retrieved from: www.worldbank.org

Dusenko, S.; Oleynik, A.; Sharikov, V.; Polyakov, V.; Kryukova, E. y Melnichuk, A. “Current state of innovative activities in education: the use of e-learning in Russian universities”. Research Journal of Pharmaceutical, Biological and Chemical Sciences Vol: 7 num 4 (2016): 1629-1637.

Easterlin, R. A. Does Economic Growth Improve the Human Lot? Some Empirical Evidence. Philadelphia: University of Pennsylvania. 1974.

Economic development of the Eurasian Economic Union and member states in 2019: International ratings (Analytical report). Moscow: Eurasian Economic Commission. 2019.

Helliwell, J.; Layard, R. y Sachs, J. World Happiness Report 2019, New York: Sustainable Development Solutions Network. 2019. Retrieved from: http://worldhappiness.report/

Human Development Indices and Indicators: 2018 Statistical Update. United Nations Development Programme. 2018.

Ilina, I.; Zotova, A.; Kuznetsova, E.; Nakhratova, E. y Kryukova, E. “Teachers of Russian higher educational institutions in the professional labor market”. Rupkatha Journal on Interdisciplinary Studies in Humanities Vol: 8 num 2 (2016): 128-136.

Index of globalization of the countries of the world according to KOF. Humanitarian encyclopedia: Research. Center for Humanitarian Technologies, 2006–2020. Retrieved from: https://gtmarket.ru/ratings/kof-globalization-index/info

Kapitsa, S. P. Growth Paradoxes: The Laws of the Global Development of Humanity. Moscow: Alpina non-fiction. 2012.

Kaufmann, D.; Kraay, A. y Mastruzzi, M. The Worldwide Governance Indicators: Methodology and Analytical Issues World Bank Policy Research Working Paper # 5430. 2010.

Khetagurova, V. S.; Kryukova, E. M.; Maloletko, A. N.; Mukhomorova, I. V. y Egorova, E. N. “Volunteer tourism as a variety of responsible”. Tourism. IOP Conference Series: Earth and Environmental Science num 204 (2018).

Korchagin, Y. A. Rossiyskiy chelovecheskiy kapital: faktor razvitia ili degradatsii?: Monograph. Voronezh. 2005.

Koritsky, A. V. The Impact of Human Capital on Economic Growth. Novosibirsk: NGASU (Sibstrin). 2013.

Kryukova, E. Institutional structure and infrastructure of the tourism services market of Russia. 2017 in international relations 2017: current issues of world economy and politics. 2017.

Kryukova, E.; Kaurova, O.; Khetagurova, V. y Makeeva, D. Peculiarities of socioally responsible tourism in Russia and prospects of its development. Economic and Social Development Book of Proceedings. 2018.

Layard, R. Schaste: uroki novoi nauki. Moscow: Izd-vo In-ta Gaidara. 2011.

Miller, T.; Kim, A. B.; Roberts, J. M. y Tyrrel, P. Index of Economic Freedom. Washington: Heritage Foundation. 2019. Retrieved from: http://www.heritage.org/index

Mosalev, A. I.; Kryukova, E. M.; Mukhomorova I. V.; Egorova E. N. y Khetagurova V. S. Experience of Socially Responsible Tourism Projects in Russia. IOP Conference Series: Earth and Environmental Science num 204 (2018).

Orekhov, V. D.; Prichina, O. S.; Loktionova, U. N.; Yanina, O. N. y Gusareva, N. B. “Scientific analysis of the Happiness Index in regard to the human capital development”. Journal of Advanced Research in Dynamical and Control Systems Vol: 12 num Special (2020): 467–478.

Porter, M. E. Competitive Advantage of Nations: Creating and Sustaining Superior Performance. New York: Simon and Schuster. 2011.

Prichina, O. S. y Orekhov, V. D. “Development of the indicative system for assessing the “happiness” level using global indexes, including human capital”. Problems of economics and legal practice num 2 (2020): 148–153.

R&D Expenditure, % of GDP. World Data Atlas. Knoema Enterprise. 2017. Retrieved from: https://knoema.ru/

Savina, G.; Haelg, F.; Potrafke, N. y Sturm, J. E. “The KOF Globalisation Index – Revisited”. Review of International Organizations Vol: 14 num 3 (2019): 543-57. Retrieved from: https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

Schultz, T. “Reflection on Investment in Man”. The Journal of Political Economy Vol: LXX (1962).

Schwab, K. The Global Competitiveness Index 4.0 2019 Rankings. World Economic Forum. 2019. Retrieved from: https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth

Schwab, K. The Global Human Capital Report. World Economic Forum. 2019. Retrieved from: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

Shmatova, Yu. E. y Morev, M. V. “Assessing the Level of Happiness: a Review of Russian and Foreign Research Economic and Social Changes: Facts, Trends”. Forecast Vol: 3 num 39 (2015): 141 – 162.

Stern, S. y Epner, T. Social Progress Index Methodology Report. The Social Progress Imperative. 2018. Retrieved from: https://www.socialprogress.org/assets/downloads/resources/2019/2019-Social-Progress-Index-Methodology-Report.pdf

The changing nature of work. World development report. Washington: World Bank Group. 2019. Retrieved from: https://www.worldbank.org/en/publication/wdr2019

The Legatum Prosperity Index. London: Legatum Institute. 2019. Retrieved from: https://www.prosperity.com/download_file/view_inline/3690

Van de Ven, P. The Implementation of the 2008 SNA and the Main Challenges. 2014. Retrieved from: http://www.cisstat.com/sna/Peter%20van%20de%20Ven%20The%20Implementation%20of%20the%202008%20SNA%20and%20the%20Main%20Challenges_rus.pdf

Veenhoven, R. “Social conditions for human happiness: A review of research”. International Journal of Psychology Vol: 50 num 5 (2015): 379-391.

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL