

MODERN SYSTEMS FOR ASSESSING THE INFORMATIZATION OF COUNTRIES IN THE CONTEXT OF GLOBAL SUSTAINABLE DEVELOPMENT

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Abstract. Information and communication theories became a major driver of the economic development of countries in a global world. Information component plays a key role in the building of competitive potential of countries and the development of international relations. At the national level, the development of innovative technologies enables the countries to take higher ranking positions by the level of progress of information and communication technologies. The assessment is carried out using a number of indicators, calculated with the respective index system and applied for analysis of problem areas in politics, as well as for monitoring of progress in the field of innovative technologies introduction. Although, this methodology does not take into consideration the indicators over time. Therefore, this paper aims to study the dynamics of networked readiness index as a factor of informatization of global economic development. The authors suggested a methodology to determine the level of informatization of global economic development based on cluster analysis of countries according to the indicators, included in NRI, which makes it possible to eliminate this defect. *Methodology.* The methodology of the paper is based on statistical data, forming the analytical database of the research findings and being studied using cluster analysis. The paper reviews a new indicator, which enables considering the informatization of global economic development in a comprehensive manner: in dynamics by a group of countries. *Results.* As a result of the author's study, it has been established that, according to the level of informatization of global economic development, the countries can be divided into three groups: the countries with sustainable level of informatization, the ones with moderate development and the countries, which are the most backward by the level of informatization. Moreover, the paper identifies the countries, which had no data for the period under review, or underwent a transition from one informatization level to another one. *Practical implications.* The presented results make it possible to consider informatization of the global economic development in a comprehensive manner: in dynamics by a group of countries. It enables identification of the countries with a sustainable level of informatization of global economic development. *Value/originality.* As a result of the study, it has been proved that it is more expedient to study the countries, which underwent a transition from one level of informatization to another one during the period under review. The prospects of further studies in the above-stated area are in the search for factors to enable the transition of countries to a higher level of informatization of global economic development.

Key words: networked readiness index, NRI, ICT, cluster analysis.

JEL Classification: C38, F62, M38, O30, R11

1. Introduction

In the modern world, information and communication technologies (ICT) are increasingly being adopted in diverse spheres of social life, changing these spheres and providing social and human development with new features, senses, and values. Information and communication technologies became the major driver

of the economic development of any country in the modern global world, and information component plays the key role in the building of competitive potential of countries and development of international relations.

Science, technology, and innovations (STI) play the predominant role in the implementation of the goals of sustainable development. The European Commission

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monitors and provides consulting support to the “New Agenda 2030” in the implementation of global policy for sustainable development. The paper determines that STI will become the primary tool for the realization of the agenda for global development as far as it is capable of enhancing the efficiency in economic and ecological components of development, and finding new more comfortable conditions to meet human needs, to extend human rights and opportunities for the future. Successful use of the innovative scientific and technological potential will require a shift of the focus to the problem of sustainable development and reorientation from customary transfer of technology towards the formation of innovative space; strengthening of partnership between the countries, having a different level of development, with attraction of all interesting parties, including private sector and individual initiatives; introduction of “walk the talk” – the highest level of coherence between the policies of the participants in order to eliminate defects, provide internal integration, and create opportunities to take advantage from innovative and technological breakthrough (European Commission, 2015).

Multiple studies demonstrate that there is a link between the development of ICT and economic prosperity. Large-scale deployment of high-speed communication and Internet technologies is a catalyst for ICT development. It produces a multiplier effect on other sectors of the national economy, facilitates the acceleration of technological progress and the growth of GDP. Thus, the development of ICT is one of the strategic steps towards modernization of the economy.

2. Importance of ICT

In a highly competitive economy, information and communication technologies determine the speed of response to the variable market environment. Reengineering in the information sphere facilitates the enhancement of overall economic system performance. Information infrastructure of the country has to provide an opportunity for the realization of intellectual potential in the form of innovations. The parameters, characterizing the innovative process, include access to information resources, the formation of information infrastructure, and training of personnel to work in conditions of the global information society. The experience of foreign countries shows that the formation of information infrastructure and access to information resources is one of the key factors that affect the creation and implementation of innovations in the economy. At the national level, the development of innovative technologies enables a country to take higher ranking positions by the level of information and communication technology development. The assessment is carried out using a number of indicators, calculated with the respective index system and applied

for analysis of problem areas in politics, as well as for monitoring of progress in the field of innovative technologies introduction. A selection of the calculation methods primarily depends on priorities of statistical analysis.

3. Indices of ICT assessment

Diverse indices are used to assess the level of ICT, as follows:

1. ICT Development Index (IDI), which has been published annually since 2009, is a composite index that combines 11 indicators into one benchmark measure. It is used to monitor and compare developments in information and communication technology (ICT) between countries and over time (International Telecommunication Union, 2017).

2. The Web Index, which is designed and produced by the World Wide Web Foundation for measurement of the World Wide Web's contribution to social, economic, and political progress in countries across the world (World Wide Web Foundation, 2014).

3. Networked Readiness Index (NRI) – determines the propensity for countries towards harnessing the power of information and communication technologies (ICT). For the time being, NRI is defined for 139 countries based on 53 features (World Economic Forum, 2016).

4. The Knowledge Economy Index (KEI) is an aggregate index that represents the overall level of development of a country or region in the Knowledge Economy (World Bank, 2007).

5. E-Government Development Index (EGDI) presents the state of E-Government Development of the United Nations Member States. The EGDI is a composite measure of three important dimensions of e-government, namely: provision of online services, telecommunication connectivity, and human capacity (United Nations, 2018).

Among the above-stated indexes, IDI considers just 11 indicators, The Web Index is limited by the impact of the Internet, KEI is focused on the knowledge economy, EGDI is calculated once per two years. Therefore, further study is focused on the Networked Readiness Index.

4. Networked Readiness Index

Networked Readiness Index (NRI) is a composite indicator, characterizing the level of information and communication technologies progress in countries throughout the world. It has been developed in 2001. It has been issued by the World Economic Forum and international business school INSEAD since 2002 within the framework of the annual series of reports on the development of information society in countries throughout the world – The Global

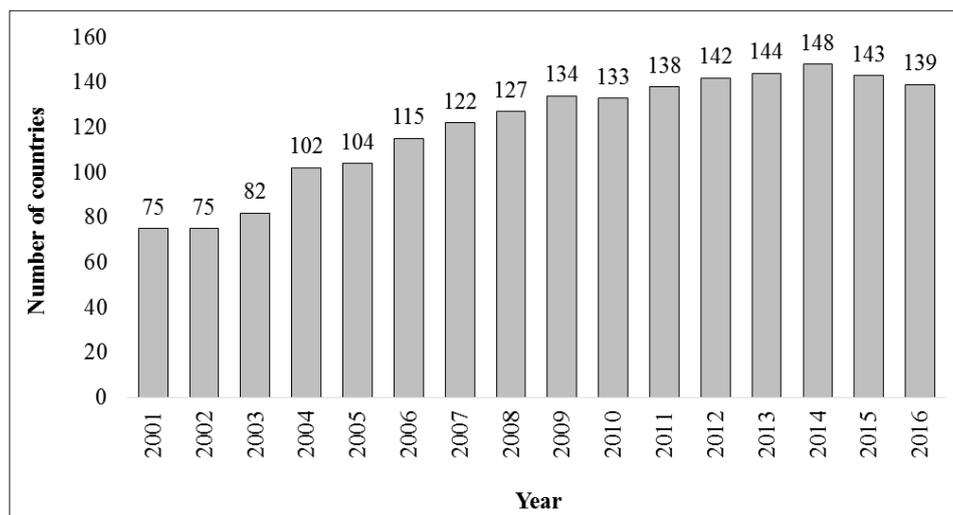


Figure 1. A number of countries, taken into consideration while calculating the Networked Readiness Index in 2001–2016

Source: World Economic Forum, 2002–2016

Information Technology Report. In 2013, Samuel Curtis Johnson Graduate School of Management joined the project. At present, the research is considered one of the most critical indicators of the country's potential and development opportunities. It is assumed that the index should be used by countries to analyse the most critical issues in their policy, as well as to monitor their progress in the area of introducing innovative technologies (WorldEconomicForum, 2002–2013). For the years of the report publication, a number of countries have been continuously changing (Figure 1). The approaches to assessment of NRI have been changing as well.

NRI is a globally accepted measure in determining the influence of ICT on an economy as a whole. Using a scale from one to seven, NRI is a composite indicator, made up of four main categories (subindexes), 10 subcategories (pillars), and 53 individual indicators distributed across the different pillars (Table 1). The four subindexes are (1) environment, (2) readiness, (3) usage, and (4) impact. NRI is included in the annual Global Information Technology Report, being published by INSEAD and the World Economic Forum (WEF) since 2001 (Tugas, 2016).

NRI helped policymakers and relevant stakeholders to track their economies' strengths and weaknesses, as well as their progress over time. However, the equal-weight framework of the NRI methodology has been an issue of controversy. As a possible remedy to the issue, Milenkovic and al. presented the multilevel I-distance methodology. The I-distance approach can synthesize many indicators into one single numerical value that represents rank. With this approach, the entities can not only be ranked, but the differences between them are better explored (Milenkovic, Brajovic, Milenkovic, Vukmirovic, & Jeremic, 2016). However, this

methodology does not take into account the change of the indicators over time. This paper is aimed to study the dynamics of the networked readiness index as a factor of informatization of the world economic development. The authors suggested a methodology to determine the level of informatization of the global economic development based on cluster analysis of countries according to the indicators, included in NRI, which makes it possible to eliminate this defect.

5. Cluster analysis of NRI factors

The paper suggests grouping the countries in clusters by the criterion of similarity of NRI factors, as follows: A.01, A.02, B.03, B.04, B.05, C.06, C.07, C.08, D.09, D.10.

As far as all indicators are assessed on the scale from one to seven, in order to ensure comparability, the data for each indicator from Table 2.10 has been standardized using the following formula (Letser, 2018):

$$\frac{x_i - \bar{x}}{s}, \quad (1)$$

where x_i – the value of the indicator; \bar{x} – mean value of the indicator; n – the number of indicators; s – standard deviation:

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}}. \quad (2)$$

The missing data is defined as zero. Thus, the countries, where no data is submitted, are grouped in a separate cluster. The number of clusters was calculated using the method of k-means. Calculated results are shown in Figure 2.

As you can see in Figure 2, it is expedient to divide the countries into 4 clusters. Table 2 shows the results of cluster analysis across the indicators A.01, A.02, B.03, B.04, B.05, C.06, C.07, C.08, D.09, D.10.

Table 1

The indicators, included in the Networked Readiness Index

Series code	Series	Indicators in series
A	Environment subindex	
A.01	1st pillar: Political and regulatory environment	Effectiveness of law-making bodies, laws relating to ICTs, judicial independence, efficiency of legal system in settling disputes, efficiency of legal system in challenging regs, intellectual property protection, software piracy rate, no. procedures to enforce a contract, no. days to enforce a contract
A.02	2nd pillar: Business and innovation environment	Availability of the latest technologies, venture capital availability, total tax rate, no. days to start a business, no. procedures to start a business, intensity of local competition, tertiary education gross enrolment rate, quality of management schools, government procurement of advanced tech
B	Readiness subindex	
B.03	3rd pillar: Infrastructure	Electricity production, mobile network coverage, int'l Internet bandwidth, secure Internet servers
B.04	4th pillar: Affordability	Prepaid mobile cellular tariffs, fixed broadband Internet tariffs, Internet & telephony competition
B.05	5th pillar: Skills	Quality of educational system, quality of math & science education, secondary education gross enrolment rate, adult literacy rate
C	Usage subindex	
C.06	6th pillar: Individual usage	Mobile phone subscriptions, individuals using Internet, households with personal computer, households with Internet access, fixed broadband Internet, mobile broadband, use of virtual social networks
C.07	7th pillar: Business usage	Firm-level technology absorption, capacity for innovation, PCT patents, ICT use for business-to-business transactions, business-to-consumer Internet use, extent of staff training
C.08	8th pillar: Government usage	Importance of ICTs to gov't vision, government Online Service Index, Government success in ICT promotion
D	Impact subindex	
D.09	9th pillar: Economic impacts	Impact of ICTs on business models, ICT PCT patents, impact of ICTs on new organizational models, knowledge-intensive jobs
D.10	10th pillar: Social impacts	Impact of ICTs on access to basic services, Internet access in schools, ICT use & government efficiency, E-Participation Index

Source: World Economic Forum, 2016

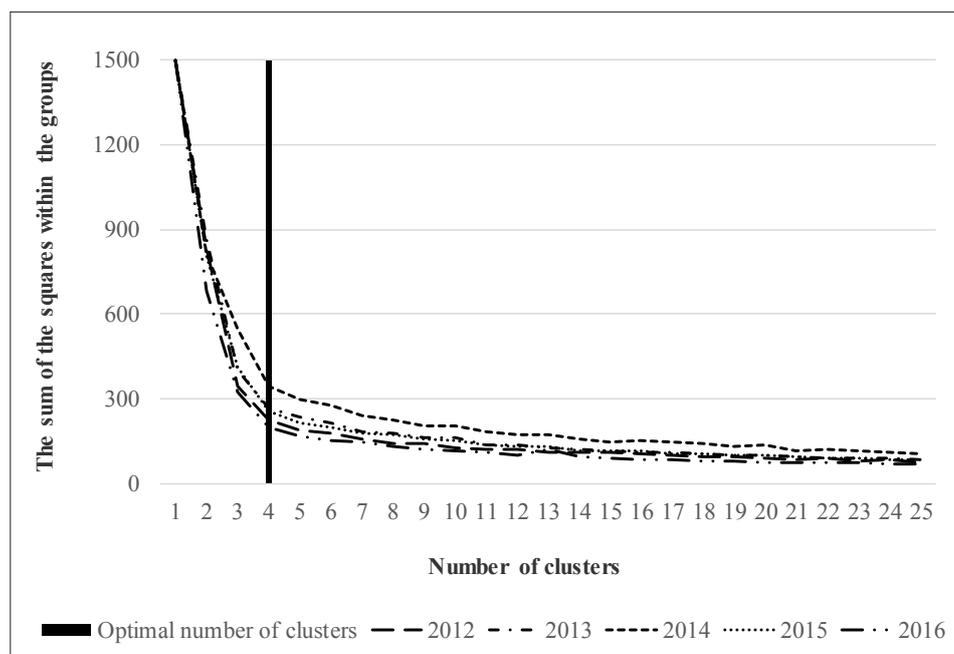


Figure 2. Calculation of the number of clusters for every year

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

Table 2

Results of cluster analysis for 2012–2016

Country	2012	2013	2014	2015	2016
AGO	3	4	3	3	4
ALB	2	2	2	2	3
ARE	2	1	1	1	1
ARG	2	2	3	3	3
ARM	2	2	2	2	2
AUS	1	1	1	1	1
AUT	1	1	1	1	1
AZE	2	2	2	2	2
BDI	3	3	3	3	3
BEL	1	1	1	1	1
BEN	3	3	3	4	3
BFA	3	3	3	3	4
BGD	3	3	3	3	3
BGR	2	2	2	2	2
BHR	2	2	2	2	2
BIH	2	2	2	4	3
BLZ	3	4	4	4	4
BOL	3	3	3	3	3
BRA	2	2	2	2	2
BRB	2	2	2	2	4
BRN	2	3	2	4	4
BTN	4	4	2	2	3
BWA	3	3	3	3	3
CAN	1	1	1	1	1
CHE	1	1	1	1	1
CHL	2	2	2	2	2
CHN	2	2	2	2	2
CIV	3	3	3	3	3
CMR	3	3	3	3	3
COL	2	2	2	2	2
CPV	2	2	2	2	3
CRI	2	2	2	2	2
CYP	2	2	2	2	2
CZE	2	2	2	2	2
DEU	1	1	1	1	1
DNK	1	1	1	1	1
DOM	3	3	2	2	3
DZA	3	3	3	2	3
ECU	3	2	2	4	3
EGY	2	3	2	2	3
ESP	2	2	2	2	2
EST	2	1	1	1	1
ETH	3	3	3	3	3
FIN	1	1	1	1	1
FRA	1	1	1	1	1
GAB	4	3	3	3	3
GBR	1	1	1	1	1
GEO	2	2	2	2	2
GHA	3	3	2	3	3
GIN	4	3	3	3	3
GMB	3	3	3	3	3
GRC	2	2	2	2	2
GTM	3	3	3	3	3
GUY	2	3	2	2	3

Country	2012	2013	2014	2015	2016
HKG	1	1	1	1	1
HND	3	3	3	2	3
HRV	2	2	2	2	2
HTI	3	3	3	3	3
HUN	2	2	2	2	2
IDN	2	2	2	2	3
IND	2	2	2	2	3
IRL	1	1	1	1	1
IRN	3	3	3	2	3
ISL	1	1	1	1	1
ISR	1	1	1	1	1
ITA	2	2	2	2	2
JAM	2	2	2	2	3
JOR	2	2	2	2	2
JPN	1	1	1	1	1
KAZ	2	2	2	2	2
KEN	3	3	2	2	3
KGZ	3	3	3	2	3
KHM	3	3	3	3	3
KOR	1	1	1	1	1
KWT	2	2	2	2	2
LAO	4	4	3	2	3
LBN	2	2	3	2	2
LBR	4	3	3	4	3
LBY	4	3	3	2	4
LKA	2	2	2	2	2
LSO	3	3	3	3	3
LTU	2	2	2	2	2
LUX	1	1	1	1	1
LVA	2	2	2	2	2
MAR	3	3	2	2	3
MDA	2	2	2	2	2
MDG	3	3	3	3	3
MEX	2	2	2	2	3
MKD	2	2	2	2	2
MLI	3	3	3	3	3
MLT	2	1	1	2	2
MMR	4	4	3	3	3
MNE	2	2	2	2	2
MNG	2	2	2	2	2
MOZ	3	3	3	3	3
MRT	3	3	3	3	3
MUS	2	2	2	2	2
MWI	3	3	3	3	3
MYS	2	2	2	2	2
NAM	3	3	3	3	3
NGA	3	3	3	3	3
NIC	3	3	3	3	3
NLD	1	1	1	1	1
NOR	1	1	1	1	1
NPL	3	3	3	3	3
NZL	1	1	1	1	1
OMN	2	2	2	2	2
PAK	3	3	3	3	3

(End of Table 2)

Country	2012	2013	2014	2015	2016
PAN	2	2	2	2	2
PER	3	3	2	2	3
PHL	2	2	2	2	3
POL	2	2	2	2	2
PRI	2	3	2	2	4
PRT	2	2	2	2	2
PRY	3	3	3	2	3
QAT	2	1	1	1	1
ROU	2	2	2	2	2
RUS	2	2	2	2	2
RWA	3	3	3	3	3
SAU	2	2	2	2	2
SEN	3	3	3	3	3
SGP	1	1	1	1	1
SLE	4	3	3	4	4
SLV	3	3	2	2	3
SRB	2	2	2	2	2
SUR	3	3	3	2	4
SVK	2	2	2	2	2
SVN	2	2	2	2	2
SWE	1	1	1	1	1
SWZ	3	3	3	3	3
SYC	4	3	2	2	2
SYR	3	4	4	4	4
TCD	3	3	3	3	3
THA	2	2	2	2	2
TJK	3	3	4	3	3
TLS	3	3	3	3	4
TTO	2	2	2	2	2
TUN	2	4	2	2	3
TUR	2	2	2	2	2
TWN	1	1	1	1	1
TZA	3	3	3	3	3
UGA	3	3	3	3	3
UKR	2	2	2	2	2
URY	2	2	2	2	2
USA	1	1	1	1	1
VEN	3	3	3	2	3
VNM	2	2	2	2	3
YEM	3	3	3	3	4
ZAF	3	3	3	2	2
ZMB	3	3	3	3	3
ZWE	3	3	3	3	3

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

Thus, according to the results of cluster analysis, for the period of 2012–2016 we can single out 4 clusters among 151 countries on the NRI factors: 1) countries with sustainable development; 2) countries with moderate development of informatization; 3) countries, which are the most backward by the level of informatization; 4) countries with no data for the period under review. Table 3 shows the distribution of countries by clusters.

Table 3

Distribution of countries by clusters for the period of 2012–2016

Year	Cluster			No data
	1	2	3	
2012	24	65	53	9
2013	28	57	59	7
2014	28	68	52	3
2015	27	76	40	8
2016	27	48	64	12

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

Accordingly, Figure 3 shows the structure of informatization of the world economic development for the period of 2012–2016.

The analysis of countries' distribution by clusters for the period from 2012 to 2016 makes it possible to identify the following trends.

The first cluster includes the countries with sustainable development (24 countries): Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Finland, France, the United Kingdom, Hong Kong SAR, Ireland, Iceland, Israel, Japan, Rep. Korea, Luxembourg, Netherlands, Norway, New Zealand, Singapore, Sweden, Taiwan (China), and the United States.

The second cluster – the countries with moderate development of informatization (45 countries): Armenia, Azerbaijan, Bulgaria, Bahrain, Brazil, Barbados, Chile, China, Colombia, Costa Rica, Cyprus, Czech Republic, Georgia, Greece, Croatia, Hungary, Italy, Jordan, Kazakhstan, Kuwait, Spain, Sri Lanka, Lithuania, Latvia, Moldova, Macedonia FYR, Montenegro, Mongolia, Mauritius, Malaysia, Oman, Panama, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Serbia, Slovak Republic, Slovenia, Thailand, Trinidad and Tobago, Turkey, Ukraine, and Uruguay.

The third cluster is represented by the countries, which are the most backward by the level of informatization (43 countries): Angola, Burundi, Benin, Burkina Faso, Bangladesh, Belize, Bolivia, Botswana, Côte d'Ivoire, Cameroon, Chad, Ethiopia, Gabon, Guinea, The Gambia, Guatemala, Haiti, Cambodia, Liberia, Lesotho, Madagascar, Mali, Myanmar, Mozambique, Mauritania, Malawi, Namibia, Nigeria, Nicaragua, Nepal, Pakistan, Rwanda, Senegal, Sierra Leone, Swaziland, Syria, Tajikistan, Timor-Leste, Tanzania, Uganda, Yemen, Zambia, and Zimbabwe.

Besides the countries, which have been steadily related to a certain cluster for the period of 2012–2016, there are 39 countries, which had no data for the period under review, or underwent transition from one level of informatization to another one, i.e., moved from one cluster to another one (Table 4).

As you can see in Table 4, after 2012 the United Arab Emirates, Estonia, and Qatar moved to the first

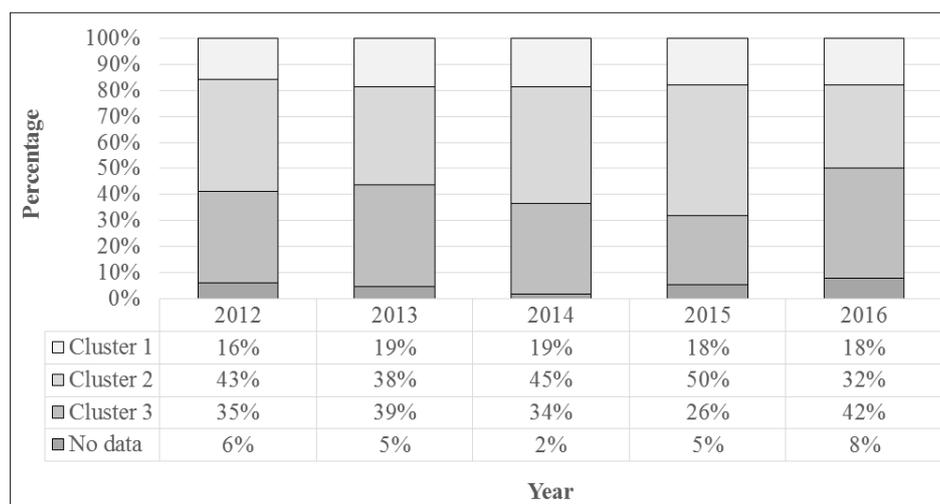


Figure 3. Structure of informatization of the world economic development for the period of 2012–2016

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

Table 4

Clustering of the countries, which have an unstable level of informatization

Country	Year					Average
	2012	2013	2014	2015	2016	
Albania	2	2	2	2	3	2.2
Algeria	3	3	3	2	3	2.8
Argentina	2	2	3	3	3	2.6
Bhutan	–	–	2	2	3	2.3
Bosnia and Herzegovina	2	2	2	–	3	2.3
Brunei Darussalam	2	3	2	–	–	2.3
Cape Verde	2	2	2	2	3	2.2
Dominican Republic	3	3	2	2	3	2.6
Ecuador	3	2	2	–	3	2.5
Egypt	2	3	2	2	3	2.4
El Salvador	3	3	2	2	3	2.6
Estonia	2	1	1	1	1	1.2
Ghana	3	3	2	3	3	2.8
Guyana	2	3	2	2	3	2.4
Honduras	3	3	3	2	3	2.8
India	2	2	2	2	3	2.2
Indonesia	2	2	2	2	3	2.2
Islamic Rep. Iran	3	3	3	2	3	2.8
Jamaica	2	2	2	2	3	2.2
Kenya	3	3	2	2	3	2.6
Kyrgyz Republic	3	3	3	2	3	2.8
Lao PDR	–	–	3	2	3	2.7
Lebanon	2	2	3	2	2	2.2
Libya	–	3	3	2	–	2.7
Malta	2	1	1	2	2	1.6
Mexico	2	2	2	2	3	2.2
Morocco	3	3	2	2	3	2.6
Paraguay	3	3	3	2	3	2.8
Peru	3	3	2	2	3	2.6
Philippines	2	2	2	2	3	2.2
Puerto Rico	2	3	2	2	–	2.3
Qatar	2	1	1	1	1	1.2
Seychelles	–	3	2	2	2	2.3

(End of Table 4)

Country	Year					Average
	2012	2013	2014	2015	2016	
South Africa	3	3	3	2	2	2.6
Suriname	3	3	3	2	–	2.8
Tunisia	2	–	2	2	3	2.3
United Arab Emirates	2	1	1	1	1	1.2
Venezuela	3	3	3	2	3	2.8
Vietnam	2	2	2	2	3	2.2

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

cluster. Malta also underwent such transition, but in 2015 this country returned to the second cluster. In 2014, Lebanon moved to the third cluster, but the next year this country returned to the second cluster. Ghana, on the contrary, in 2014 moved to the second cluster, but the next year this country returned to the third cluster. Four countries, namely, Dominican Republic, Kenya, Morocco, Peru and El Salvador, moved to the second cluster in 2014, where in 2015 six more countries joined them, as follows: Algeria, Honduras, Islamic Rep. Iran, Kyrgyz Republic, Paraguay, and Venezuela. However, in 2016, all ten countries returned to the third cluster. In 2016 eight countries moved to the third cluster, as follows: Albania, Cape Verde, Indonesia, India, Jamaica, Mexico, Philippines, and Vietnam, which were in the second cluster for the period of 2012–2015. Three countries, which in 2012 started from the second

cluster, stayed in the third cluster at the end of the period under review: Argentina, Egypt, and Guyana. Only South Africa managed to move from the third cluster to the second one (in 2015) and not to return back. The following countries moved from one cluster to another one but, according to the latest available data, these countries are related to the third cluster: Bosnia and Herzegovina, Bhutan, Ecuador, Lao PDR, and Tunisia.

A calculation of the mean value by clusters for every country (Table 4) makes it possible to determine the average level of the country’s informatization for the given period, as well as to provide visual results (Figure 4).

As you can see in Figure 4, the countries’ distribution by the level of informatization makes it possible visually to assess the world economic development. Table 5 shows a change in the countries’ rating for the whole period of NRI calculation.

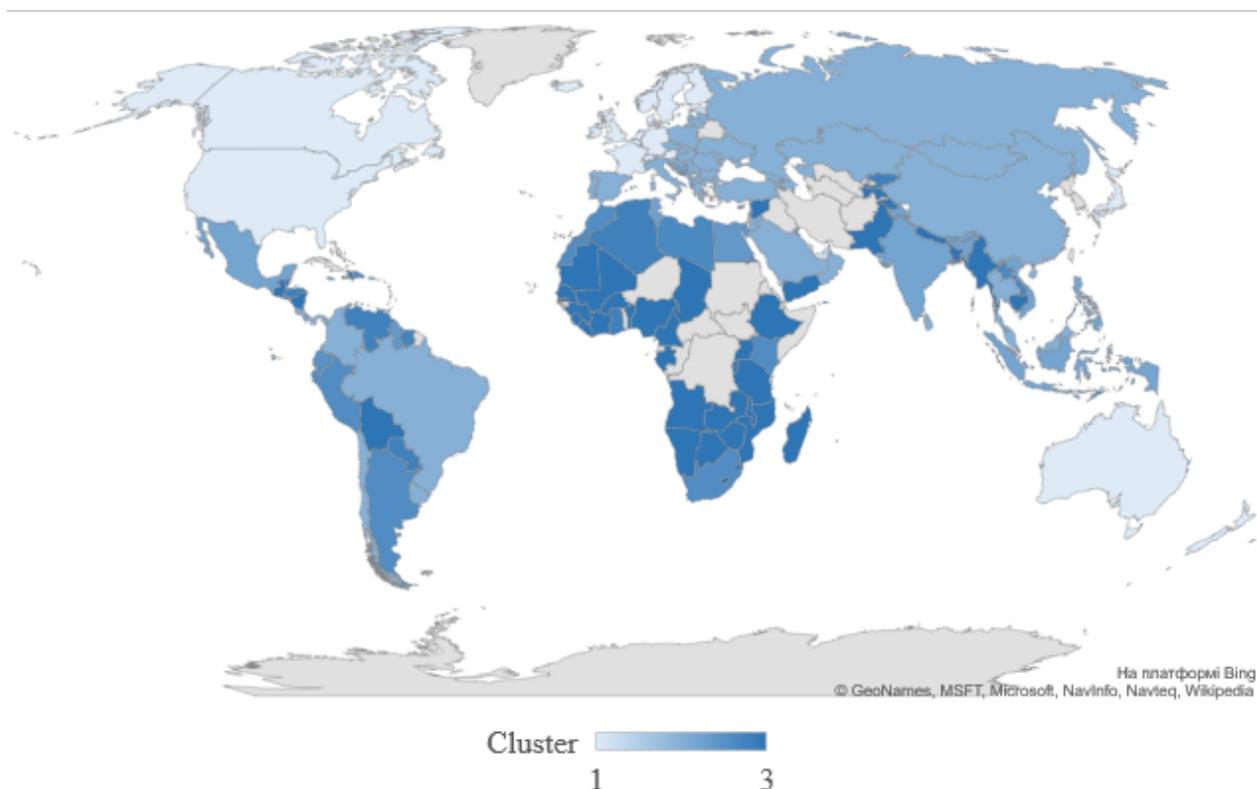


Figure 4. Clustering of the countries by the level of informatization of the world economic development in 2012–2016

Source: calculated by the authors according to the data of (World Economic Forum, 2016)

Table 5

Change of the countries' rating according to NRI for the period of 2001–2016

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Cluster
Singapore	8	8	3	2	1	2	3	5	4	2	2	2	2	2	1	1	1
Finland	3	3	1	3	3	5	4	6	6	6	3	3	1	1	2	2	1
Sweden	4	4	4	4	6	8	2	2	2	1	1	1	3	3	3	3	1
Norway	5	5	17	8	13	13	10	10	8	10	9	7	5	5	5	4	1
United States	1	1	2	1	5	1	7	4	3	5	5	8	9	7	7	5	1
Netherlands	6	6	11	13	16	12	6	7	9	9	11	6	4	4	4	6	1
Switzerland	16	16	13	7	9	9	5	3	5	4	4	5	6	6	6	7	1
United Kingdom	10	10	7	15	12	10	9	12	15	13	15	10	7	9	8	8	1
Luxembourg			27	14	17	26	25	24	21	17	14	21	16	11	9	9	1
Japan	21	21	20	12	8	16	14	19	17	21	19	18	21	16	10	10	1
Denmark	7	7	8	5	4	3	1	1	1	3	7	4	8	13	15	11	1
Hong Kong SAR	13	13	18	18	7	11	12	11	12	8	12	13	14	8	14	12	1
Rep. Korea	20	20	14	20	24	14	19	9	11	15	10	12	11	10	12	13	1
Canada	12	12	6	6	10	6	11	13	10	7	8	9	12	17	11	14	1
Germany	17	17	10	11	14	17	16	16	20	14	13	16	13	12	13	15	1
Iceland	2	2	5	10	2	4	8	8	7	12	16	15	17	19	19	16	1
New Zealand	11	11	23	23	21	21	22	22	22	19	18	14	20	20	17	17	1
Australia	14	14	15	9	11	15	15	14	14	16	17	17	18	18	16	18	1
Taiwan, China	15	15	9	17	15	7	13	17	13	11	6	11	10	14	18	19	1
Austria	9	9	16	21	19	18	17	15	16	20	21	19	19	22	20	20	1
Israel	22	22	12	16	18	19	18	18	25	28	22	20	15	15	21	21	1
Belgium	18	18	22	24	26	25	24	25	24	22	23	22	24	27	24	23	1
France	24	24	19	19	20	22	23	21	19	18	20	23	26	25	26	24	1
Ireland	19	19	21	22	22	20	21	23	23	24	29	25	27	26	25	25	1
Estonia	23	23	24	25	25	23	20	20	18	25	26	24	22	21	22	22	1,2
United Arab Emirates					23	28	29	29	27	23	24	30	25	24	23	26	1,2
Qatar						39	36	32	29	30	25	28	23	23	27	27	1,2
Malta				27	28	30	27	27	26	26	27	26	28	28	29	34	1,6
Bahrain					33	49	50	45	37	29	30	27	29	29	30	28	2
Lithuania	42	42	46	42	43	44	39	33	35	41	42	31	32	31	31	29	2
Portugal	27	27	31	31	30	27	28	28	30	33	32	33	33	33	28	30	2
Malaysia	36	36	32	26	27	24	26	26	28	27	28	29	30	30	32	31	2
Latvia	39	39	38	35	56	51	42	44	48	52	52	41	41	39	33	32	2
Saudi Arabia								48	40	38	33	34	31	32	35	33	2
Spain	26	26	25	29	29	31	32	31	34	34	37	38	38	34	34	35	2
Czech Republic	28	28	28	33	40	32	34	36	32	36	40	42	42	42	43	36	2
Slovenia	29	29	33	30	32	35	30	30	31	31	34	37	37	36	37	37	2
Chile	34	34	35	32	35	29	31	34	39	40	39	39	34	35	38	38	2
Kazakhstan						60	73	71	73	68	67	55	43	38	40	39	2
Cyprus					37	33	43	41	33	32	31	32	35	37	36	40	2
Russian Federation	61	61	69	63	62	72	70	72	74	80	77	56	54	50	41	41	2
Poland	35	35	39	47	72	53	58	62	69	65	62	49	49	54	50	42	2
Uruguay	37	37	55	54	64	65	60	65	65	57	45	44	52	56	46	43	2
Costa Rica	45	45	49	49	61	69	56	60	56	49	46	58	53	53	49	44	2
Italy	25	25	26	28	45	42	38	42	45	48	51	48	50	58	55	45	2
Macedonia, FYR				75	85	82	81	83	79	73	72	66	67	57	47	46	2
Slovak Republic	33	33	40	41	48	41	41	43	43	55	69	64	61	59	59	47	2
Turkey	41	41	50	56	52	48	52	55	61	69	71	52	45	51	48	48	2
Mauritius	51	51	56	43	47	45	51	54	51	53	47	53	55	48	45	49	2
Hungary	30	30	30	36	38	38	33	37	41	46	49	43	44	47	53	50	2
Montenegro					79	80	74		71	42	44	46	48	52	56	51	2
Oman								53	50	50	41	40	40	40	42	52	2
Azerbaijan						73	71	67	60	64	70	61	56	49	57	53	2

(Continuation of Table 5)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Cluster
Croatia			48	48	58	57	46	49	49	51	54	45	51	46	54	54	2
Panama	48	48	61	58	69	66	65	64	66	58	60	57	46	43	51	55	2
Armenia						86	96	106	114	101	109	94	82	65	58	56	2
Mongolia						92	90	87	93	94	85	63	59	61	61	57	2
Georgia					91	96	93	91	88	93	98	88	65	60	60	58	2
China	64	64	43	51	41	50	59	57	46	37	36	51	58	62	62	59	2
Jordan	49	49	51	46	44	47	57	47	44	44	50	47	47	44	52	60	2
Kuwait						46	54	52	57	76	75	62	62	72	72	61	2
Thailand	43	43	41	38	36	34	37	40	47	47	59	77	74	67	67	62	2
Sri Lanka	62	62	54	66	71	83	86	79	72	72	66	71	69	76	65	63	2
Ukraine	66	66	70	78	82	76	75	70	62	82	90	75	73	81	71	64	2
Romania	65	65	72	61	53	58	55	61	58	59	65	67	75	75	63	66	2
Trinidad and Tobago	46	46	58	52	59	74	68	82	81	79	63	60	72	71	70	67	2
Colombia	57	57	59	60	66	62	64	69	64	60	58	73	66	63	64	68	2
Bulgaria	53	53	68	67	73	64	72	68	68	71	68	70	71	73	73	69	2
Greece	31	31	42	34	42	43	48	56	55	56	64	59	64	74	66	70	2
Moldova						94	92	96	99		97	78	77	77	68	71	2
Brazil	38	38	29	39	46	52	53	59	59	61	56	65	60	69	84	72	2
Serbia				77	79	80	74		84	84	93	85	87	80	77	75	2
Barbados							40	38	36	35	38	35	39	55	39		2
Indonesia	59	59	64	73	51	68	62	76	83	67	53	80	76	64	79	73	2,2
Mexico	44	44	47	44	60	55	49	58	67	78	78	76	63	79	69	76	2,2
Philippines	58	58	62	69	67	70	69	81	85	85	86	86	86	78	76	77	2,2
Vietnam	74	74	71	68	68	75	82	73	70	54	55	83	84	84	85	79	2,2
Jamaica	56	56	60	53	49	54	45	46	53	66	73	74	85	86	82	83	2,2
Albania						106	107	108	105	95	87	68	83	95	92	84	2,2
Cape Verde											84	81	81	89	87	85	2,2
Lebanon											95	95	94	97	99	88	2,2
India	54	54	37	45	39	40	44	50	54	43	48	69	68	83	89	91	2,2
Seychelles													79	66	74	74	2,3
Tunisia			34	40	31	36	35	35	38	39	35	50		87	81	81	2,3
Bhutan														94	88	87	2,3
Bosnia and Herzegovina					89	97	89	95	106	110	110	84	78	68		97	2,3
Puerto Rico								39	42	45	43	36	36	41	44		2,3
Brunei Darussalam									63	63	57	54	57	45			2,3
Egypt	60	60	65	65	57	63	77	63	76	70	74	79	80	91	94	96	2,4
Guyana						111	98	102	100	100	100	90	100	88	93	100	2,4
Ecuador	71	71	75	89	95	107	97	107	116	114	108	96	91	82		82	2,5
South Africa	40	40	36	37	34	37	47	51	52	62	61	72	70	70	75	65	2,6
Morocco			52	64	54	77	76	74	86	88	83	91	89	99	78	78	2,6
Kenya				84	75	91	95	92	97	90	81	93	92	92	86	86	2,6
Argentina	32	32	45	50	76	71	63	77	87	91	96	92	99	100	91	89	2,6
Peru	52	52	67	70	90	85	78	84	89	92	89	106	103	90	90	90	2,6
El Salvador	55	55	63	62	70	59	61	66	78	81	92	103	93	98	80	93	2,6
Dominican Republic	47	47	57	57	78	89	66	75	75	74	79	87	90	93	95	98	2,6
Lao PDR														109	97	104	2,7
Libya								105	101	103	126		132	138	131		2,7
Islamic Rep. Iran											101	104	101	104	96	92	2,8
Honduras	72	72	81	98	97	100	94	90	95	106	103	99	109	116	100	94	2,8
Kyrgyz Republic						103	105	114	115	123	116	115	118	118	98	95	2,8
Ghana				74	65	61			103	98	99	97	95	96	101	102	2,8
Paraguay	63	63	76	91	98	113	114	120	122	127	127	111	104	102	105	105	2,8
Venezuela	50	50	66	72	84	81	83	86	96	112	119	107	108	106	103	108	2,8

(End of Table 5)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Cluster
Algeria				87	80	87	80	88	108	113	117	118	131	129	120	117	2,8
Suriname							110	117	117	126		121	117	113	113		2,8
Rwanda												82	88	85	83	80	3
Namibia			53	59	55	78	85	93	92	89	82	105	111	105	102	99	3
Botswana			44	55	50	56	67	78	77	86	91	89	96	103	104	101	3
Guatemala	68	68	73	86	88	98	79	80	82	83	94	98	102	101	107	103	3
Côte d'Ivoire									111	104	113	122	120	122	115	106	3
Senegal				81				85	80	75	80	100	107	114	106	107	3
Cambodia						104	106	115	126	117	111	108	106	108	110	109	3
Pakistan				76	63	67	84	89	98	87	88	102	105	111	112	110	3
Bolivia	67	67	78	90	99	109	104	111	128	131	135	127	119	120	111	111	3
Bangladesh	73	73	77	93	100	110	118	124	130	118	115	113	114	119	109	112	3
The Gambia				82	74	88		101	91	77	76	101	98	107	108	113	3
Tajikistan						93		98	104	109	112	114	112		117	114	3
Lesotho							116	122	118	107	121	133	138	133	124	115	3
Zambia				85	81		112	112	102	97	102	109	115	110	114	116	3
Nepal							108	119	127	124	131	128	126	123	118	118	3
Nigeria	75	75	74	79	86	90	88	94	90	99	104	112	113	112	119	119	3
Ethiopia				101	102	115	119	123	129	122	123	130	128	130	130	120	3
Uganda				80	77	79	100	109	120	115	107	110	110	115	116	121	3
Zimbabwe	70	70	80	95	94	105	117	125	132	132	132	124	116	117	121	122	3
Mozambique				97	96	101	115	121	124	116	106	120	133	137	129	123	3
Cameroon				83		99	113	118	123	128	125	125	124	131	126	124	3
Gabon													121	128	122	125	3
Tanzania				71	83	84	91	100	119	120	118	123	127	125	123	126	3
Mali				96	92	95	101	99	107	96	120	126	122	127	127	127	3
Benin						108	109	113	121	111	114	117	123	135		128	3
Swaziland											134	136	136	126	125	129	3
Liberia													97	121		130	3
Nicaragua	69	69	79	94	103	112	103	116	125	125	128	131	125	124	128	131	3
Malawi				88	93		111		110	119	105	116	129	132	133	132	3
Myanmar														146	139	133	3
Guinea													140	145	142	134	3
Madagascar				92	87	102	102	104	112	121	129	134	137	139	135	135	3
Mauritania							87	97	109	102	130	139	135	142	138	136	3
Haiti			82	100								142	141	143	137	137	3
Burundi							121	126	131	129	137	137	144	147	141	138	3
Chad				102	104	114	122	127	134	133	138	138	142	148	143	139	3
Burkina Faso							99	103	113	108	122	135	130	136	132		3
Timor-Leste									133	130	136	132	134	141	134		3
Yemen												141	139	140	136		3
Angola				99	101		120				133	140		144	140		3
Sierra Leone													143	134			3
Belize												119					3
Syria								110	94	105	124	129					3

Source: calculated by the authors according to the data of (World Economic Forum, 2002-2016) (World Economic Forum, 2002) (World Economic Forum, 2003) (World Economic Forum, 2004) (World Economic Forum, 2005) (World Economic Forum, 2006) (World Economic Forum, 2007) (World Economic Forum, 2008) (World Economic Forum, 2009) (World Economic Forum, 2010) (World Economic Forum, 2011) (World Economic Forum, 2012) (World Economic Forum, 2013) (World Economic Forum, 2014) (World Economic Forum, 2015) (World Economic Forum, 2016)

As you can see in Table 5, the average level of the country's informatization to a certain extent corresponds to the dynamics of rating according to NRI.

Thus, clustering of countries according to the indicators, being the basis of NRI, enables us to take dynamics into consideration and single out similar groups of countries.

6. Conclusions

Therefore, based on the analysis of publicly available data, it has been established that the countries can be divided into three groups by the level of informatization of the world economic development. The first level – the countries with sustainable development. For the period of 2012–2016, 24 countries were steadily related to this cluster, plus the United Arab Emirates, Estonia, and Qatar, which joined them in 2013. These are the first 27 countries of NRI rating. The second level – the countries with moderate informatization development. For the period of 2012–2016, it steadily included 45 countries. Besides, still in 2014 Malta moved to the first level but it's already in 2015 that this country returned to the second level. There also were 17 countries, which left the group during the period of 2012–2016 and thereafter returned to it or moved to the third level. Now 63 countries are related to the second level of informatization. The third level – the countries, which are the most backward by the level of informatization. It is 43 countries, which are steadily related to the third level, and 18 countries, which were

related to the second level in the period of 2012–2016. Totally we have reviewed 151 countries.

Before 2012, the countries' rating by NRI covers the period from 2001 to 2011. However, due to the advancement of the methodology for calculation of the Networked Readiness Index over the above-stated period and larger dispersion of countries' coverage than for the last years, it is not expedient to determine the level of informatization of the world economic development in such a way.

The results presented enable us to approach informatization of the world economic development comprehensively: in dynamics by groups of countries. It allows singling out the countries with the sustainable level of informatization of the world economic development. Although, it is more expedient to study the countries, which moved from one level to another one during the period under review. Perspectives of further studies in the above-stated direction consist in search of the factors, which enable the countries' transition to the higher level of informatization of the world economic development.

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