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Integrated assessment of the corruption level in the world

Abstract. The methodology of assessing the level of corruptibility of the society occupies an important place in the strategic programs of anti-corruption activities. The obtained rating indicators reflect the dynamics of corruption in the country, and the change of the state's position in the ranking show the efficiency of anti-corruption policy. Since the data of obtained ratings differ significantly, the urgent scientific problem is to combine them in a single integral assessment. The authors have developed a methodology of integral assessment of the level of corruption in the country and evaluated the influence of different social and economic factors on it. Integral assessment was carried out on the basis of initial indicators Corruption Perception Index, Index of Economic Freedom, World Government Indicator, Doing Business, Political Risk Services International Country Risk Guide. We have used the method of modified principal component to determine gross coefficients of the above indicators in the integral assessment. The following indicators were found to have a significant impact on the level of corruption: human development index, education index, GDP per capita, coefficient of human inequality, employment to population ratio, unemployment. A multi-factor model has been developed that makes it possible to evaluate the efficiency of anti-corruption measures taken.
Keywords: Integrated Assessment; Integrated Assessment of The Corruption Level; Rating Indices; Multicollinearity; Regression Equations
JEL Classification: C82; F29; K22

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Інтегральне оцінювання рівня корупції в світі

Анотація. Важливе місце в стратегічних програмах антикорупційної діяльності займає науково обґрунтована методика оцінювання рівня корумпованості суспільства. Одержані рейтингові показники відображають динаміку корупції в країні, а зміна позиції держави в рейтингу показує ефективність проведення антикорупційної політики. Оскільки дані одержаних рейтингів суттєво відрізняються, актуальною науковою проблемою є поєднання їх в єдиній інтегральній оцінці. Авторами розроблена методологія інтегрального оцінювання рівня корупції в країні та оцінено вплив на нього різних соціально-економічних факторів. Інтегральне оцінювання здійснено на основі початкових показників індексу сприйняття корупції, індексу економічної свободи, індикатору державної влади у різних країнах світу, ведення бізнесу, індексу політичного ризику. Методом модифікованої головної компоненти визначено вагові коефіцієнти вказаних показників в інтегральній оцінці. Виявлено, що істотний вплив на рівень корупції мають такі показники: індекс людського розвитку, індекс освіти, ВВП на душу населення, коефіцієнт людської нерівності, відсоток зайнятого населення, відсоток працездатного населення. Розроблена багатофакторна модель, що дає можливість оцінювати ефективність прийнятих антикорупційних заходів.
Ключові слова: інтегральне оцінювання; інтегральна оцінка рівня корупції; рейтингові показники; мультиколініарність; рівняння регресії.

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Интегральное оценивание уровня коррупции в мире

Аннотация. Важное место в стратегических программах антикоррупционной деятельности занимает научно обоснованная методика оценки уровня коррумпированности общества. Полученные рейтинговые показатели отражают динамику коррупции в стране, а изменение позиции государства в рейтинге показывает эффективность проведения антикоррупционной политики. Поскольку данные полученных рейтингов существенно отличаются, актуальной научной проблемой является сочетание их в единой интегральной оценке. Авторами разработана методология интегральной оценки уровня коррупции в стране и оценено влияние на него различных социально-экономических факторов. Интегральное оценивание осуществлено на основе исходных показателей индекса восприятия коррупции, индекса экономической свободы, индикатора государственной власти в различных странах мира, ведения бизнеса, индекса политического риска. Методом модифицированной главной компоненты определены весовые коэффициенты указанных показателей в интегральной оценке. Обнаружено, что существенное влияние на уровень коррупции имеют следующие показатели: индекс человеческого развития, индекс образования, ВВП на душу населения, коэффициент человеческого неравенства, процент занятого населения, процент трудоспособного населения. Разработана многофакторная модель, дает возможность оценивать эффективность принимаемых антикоррупционных мер.
Ключевые слова: интегральное оценивание; интегральная оценка уровня коррупции; рейтинговые показатели; мультиколиниарность; уравнение регрессии.

1. Introduction

The problems of preventing and combating corruption are relevant for all countries without exception. In order to solve these problems different countries develop systems of anti-corruption measures that take into account national specialties of each country. In Finland, which is one of the most corrupt countries in the world, there is no special anti-corruption structure; the Ministry of Justice, courts and law enforcement agencies are responsible for fighting corruption. The low level of corruption in the country is ensured by an efficient organization of the administrative system, the activity of public institutions and high wages of public servants (Sytnyk, 2016). In the UK, laws have been accepted to regulate the terms of service, remuneration and the principles of conduct of civil servants. A special anti-corruption structure is the Office for Combating Corruption on a Particularly Large Scale. France has established the Central Service for the Prevention of Corruption, which collects centralised information on cases of corruption and provides this information to the judicial and investigative authorities. The French law provides for mainly administrative liability for acts of corruption (Parhomenko-Kutsevil, 2019). A special feature of anti-corruption in Germany is the community support, efficient financial system. An important anti-corruption gear is the creation of a register of corrupt companies, which are no longer

able to obtain public contracts (Petrashko, 2014). In Singapore, a Corruption Investigation Bureau has been set up and its powers have been expanded. Under the country's laws, those found guilty of Habarna riots are liable to up to five years' imprisonment or a USD 100,000 fine. To combat corruption in the state apparatus, harsh methods have been used, including dismissal of employees (Bogomolov et al., 2014).

Regardless of national peculiarities in the system of anti-corruption measures, a scientifically based methodology of assessing the level of corruptibility of the society should occupy an important place.

An important place in the strategic programmes of anti-corruption activities is occupied by a scientifically based methodology of assessing the level of corruptibility of the society. The results of the assessment can be used to determine the effectiveness of anti-corruption measures. The method of comparative rankings is widely used in different countries around the world to assess the scale of corruption. Data from expert assessments and sociological surveys is used to determine the scope of corruption. The ranking indicators illustrate the annual dynamics of corruption in a certain country; changes in the state's position in the ranking show the success of anti-corruption policy or vice versa. However, the findings of the rankings differ greatly. The world organizations use different methodologies, diverse sources, as well as non-transparent mechanisms during the preparation of the rankings, therefore their validity is subject to the influence of subjective factors, political and ideological conjuncture.

2. Brief Literature Review

Anti-corruption issues were discussed in the works of many authors. Chang (2013) investigated the synergy of factors in the development of corruption relations according to several parameters, including the number of corruptive public authority levels, corruption expansiveness, anti-corruption infrastructure and its quality. A number of works by various authors are devoted to the study of corruption in various spheres of the public life. The phenomena of corruption in international business have been described in Bahoo et al. (2020). The phenomena of corruption in banks have been analyzed in the works of Bahoo (2020). Problems of corruption in the economy were studied in the works of Bahoo et al. (2021). The determinants of corruption at the individual level were investigated in the work of Mangafić and Veselinović (2020). Paunov (2016) has investigated the impact of corruption on the acceptance of quality certificates and patents by smaller and larger firms.

An overview of the discussions on corruption accumulated in scientific research was given in the work of Marani et al. (2018). The relationship between exposure to local corruption and mental health was examined in article of Sharma et al. (2021). Empirical approach to model corruption using the concepts and tools of complexity science and complex networks has been presented by Luna-Pla and Nicolas-Carlock (2020). An interdisciplinary approach to the study of corruption was proposed in work of Pertiwi (2018). Zimelis (2020) suggested using an integrated approach to the study of corruption. The use of a synergetic methodological approach to the understanding of anti-corruption transformations of public law in an open society was studied in the work of Makarenkov (2020).

Kolesnikova and Turuk (2016) claimed that the corruption reasons are a disproportionate «growth» of bureaucratic apparatus of officials, imperfection of the legislation system that regulate the relationship between government and capital in terms of sphere of influence and others.

The main tasks of the authorized departments for prevention and detection of corruption in ministries and central executive bodies were considered in the work of Holovkin (2018). In the work of Melnyk and Koren (2018), the crisis in economy, poor development of small and medium-sized businesses and mass unemployment were named among the main causes of corruption in Ukraine.

Hubin (2019) specifies that the economic de-shadowing can prevent corruption rent, since without the opportunity to earn, hide, accumulate and spend it, sense of corruption is lost. The author suggests to simplify the taxation system, slightly reduce taxes and strengthen control over tax evasion.

The problem of corruption is a key factor in restraining economic reforms in the country. According to a survey of foreign investors conducted by the European Business Association, Dragon Capital and the Center for Economic Strategy in 2019, the main obstacles to foreign investment in Ukraine are (by a 10-point scale): widespread corruption - 8.3; distrust to the judicial system - 8.2; monopolization of markets and seizure of power by oligarchs - 6.5. Ukrainian

citizens have not seen the effective steps of the authorities in order to overcome corruption according to the survey (United States Agency for International Development, 2020). 71% of respondents have not noticed any changes in the promoting anti-corruption reform and only 22% have noticed slow changes.

The problem of corruption in the state, as the main political problem of Ukraine, is recognized by various target audiences, and they do not observe any progress in overcoming it.

The economic reasons for corruption include limited resources such as land and minerals. Thanks to the investigations of detectives of the National Anti-Corruption Bureau of Ukraine (2017) and prosecutors of the Specialized Anti-Corruption Prosecutor's Office in the agro-industrial complex, 32 cases of corruption at state enterprises were sent to the court. PJSC «State Food Grain Corporation» has been reimbursed about UAH 70 million, which amounted to USD 2.68 million at the exchange rate as of May 2017. Corruption in the agro-industrial complex is mainly land fraud (52%) misuse of funds and property of state-owned enterprises (48%). The losses from corruption schemes exposed by the detectives of the National Anti-Corruption Bureau in the agro-industrial complex exceeded UAH 2 billion. The number of cases of corruption identified by NABU detectives in the agro-industrial sector as of 30.06.2017 exceeds UAH 2 billion.

One of the areas where corruption can occur is the organization of public procurement. The National Agency for Corruption Prevention (NACP, 2021) has identified 25 of the biggest corruption risks in this area, including: Increase in the estimated value and volume of the procurement, piecemeal division of the subject matter of the procurement to eliminate competitive procedures, discriminatory conditions in the tender documentation and limitation of competition, unwarranted use of the negotiation procedure of the procurement, demanding parens patriae documents in the composition of the tender offer and product samples.

NAPC also developed recommendations for eliminating the identified risks and prepared a checklist of issues to be included in the checklist for identifying the presence of corruption risks and achieving an effective outcome of the procurement procedure. Procurement during quarantine can cause problems for suppliers in obtaining paper certificates. In order not to disqualify the favourable bids, it is necessary to specify in the bidding documents the possibility of providing the relevant notices electronically.

Having analyzed the findings of the International Center for Economic Research «Doing Business» (2019), we observed the absence of competitive conditions in Ukrainian economy. Although the ratings of Ukraine for 2019 have risen by five positions compared to last year, they remain rather low (71st place out of 190 countries). The rating increased due to simplification of cross-border trade, abolition of the requirements for checking for auto parts, amending the rules of civil procedure in order to introduce pre-trial proceedings as part of the methods used in court and the ease of obtaining construction permits, but Ukraine worsened its position in the context of taxes payment ease.

According to the analytical group of the World Economic Forum (WEF), Ukraine ranked 85th in the 2019 global competitiveness rating, having worsened its position by two points (Schwab 2019). Negative factors for doing business in Ukraine are the following: political instability, corruption, inflation, the complexity of tax legislation, high tax rates, difficult access to finance, foreign exchange market regulation, instability of government, ineffective state bureaucracy.

The non-profit organization Transparency International (2019) published the World Corruption Perceptions Index, where Ukraine returned to a level of 2017 and ranked 126th out of 180 countries. The index is based on several independent surveys involving international financial and human rights experts, in particular from the World Bank, the American Organization Freedom House, the Asian and African Development Banks. Ukraine is ahead of Russia among neighbouring countries (28 points, 137th place), Poland is a leader (58 points, 41st place), Belarus added one point and now has 45 points and 66th place.

This index is the subject of scientific research by various authors. The results of the corruption index based on the definition and the Transparency International index were analyzed in work of Zouaoui et al. (2017). A study of the features of the corruption perception index was carried out in the work of Baumann (2020). The role of the media in measuring the perception of corruption has been studied in the work of Noerlina et al. (2017). Gilman (2018) investigated the subindicators used by the Corruption Perceptions Index and noted doubts about the quality of their data. A critique on the Corruption Perceptions Index is given in article of Budsaratragoon and Jitmaneeroj (2020).

Hart (2019) investigates how measuring the level of corruption helps in the design, implementation and monitoring of development programmes. Johnson and Mason (2013) explore the feasibility of using country-specific corruption measurement indicators (proxies) to assess the impact of implemented anti-corruption measures. Johnson (2015) describes in detail the types of data that can be used at different stages of corruption risk assessment. Merry (2016) describes the quantitative limits that are created when investigating complex social phenomena and highlights the tendency to quantify the international development field, which includes the anti-corruption field. Cooley (2015) points out that when ranking the level of corruption, the role of subjective indicators increases, resulting in the perception that countries are more or less corrupt than they really are. According to Sequeira (2012) the sub-indicators of corruption: are influenced by another cognitive bias, resulting in a tendency to associate the level of corruption in the country with the level of economic development.

Malito (2014) divides the large number of indicators that reflect the level of corruption into three groups: indicators based on survey results, indicators based on global governance indices, and capacity indicators. The author points out that it is not possible to measure corruption in one indicator due to the presence of different forms of corruption. Moreover, the efficiency of anti-corruption measures is difficult to assess due to the non-linear nature of the environment and the dynamism of processes.

Cardenas et al. (2018) in investigating the phenomenon of corruption in Latin America, they proposed the use of a synthetic cumulative indicator derived through factor analysis using the principal components methodology to capture significant statistical information. The indicator reflects 86 per cent of all corruption-related information collected.

He (2016) based on an empirical study of corruption indicators, for 20 years, argues that there is no causal link between cultural traditions and the level of corruption in countries. The correlation between these indicators may be due to the subjectivity of assessments caused by the cultural superiority of respondents.

3. Purpose

The purpose is to develop a method for integrated assessment of the corruption level in the country and impact of various socio-economic factors on it.

4. Methodology and Results

To assess the level of corruption, indicators calculated using different methodologies are used. A comparative analysis shows that the rankings of countries based on different indicators can differ significantly. Therefore, for an overall assessment of the level of corruption it is advisable to develop an integral indicator that combines several well-known indicators.

The development of this integrative indicator involves the following steps:
1. Selecting initial indicators to build a hierarchical system based on them.
2. Determination of integral assessment for each multiplier of the system, which requires normalization of the given set of indicators, i.e., bringing them to the same measurement scale, and determination of gross ratios for each of these indicators.
3. Determining the overall integral assessment of the level of corruption on the basis of the resulting integral assessments of the indicator's multiples.

The set of initial indices includes the following:
1. Corruption Perception Index (CPI). This index is calculated by Transparency International based on the thirteen researches of the international organizations: PERC Asia Risk Guide, World Bank CPIA, World Economic Forum EOS, Global Insight Country Risk Ratings, Bertelsmann Foundation Transformation Index, African Development Bank CPIA, IMD World Competitiveness Yearbook, Bertelsmann Foundation Sustainable Governance Index, World Justice Project Rule of Law Index, PRS International Country Risk Guide, Varieties of Democracy Project, Economist Intelligence Unit Country Ratings, Freedom House Nations in Transit Ratings (Transparency International, 2019). This index takes a value from 0 to 100, a higher value corresponds to a lower level of corruption. This index is often used to assess the corruption level in countries. But it is criticized for inaccuracy and inconsistency (Volianska, 2010, p. 220). Corruption Perception Index assesses the corruption level only in the public sector.
2. Index of Economic Freedom (IEF). This index is calculated on the basis on twelve factors: property rights, efficiency of the judiciary, government integrity, tax burden, government expenditure,

fiscal health, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, financial freedom. The weight of these factors is considered to be the same, the correlation between the factors is not taken into account. The index of Economic Freedom is assessed on a scale from 0 to 100, the closer this index to 100, the higher economic freedom level (Miller et al., 2019).

3. World Government Indicator (WGI). This indicator is calculated on the basis of survey of a large number of enterprises, citizens and experts conducted by analytic center, private firms, international and non-government organizations. To determine this index, we use the integrated assessment based on initial indicators: voice and accountability (VA), political stability and absence of violence (PV), government efficiency (GE), regulatory quality (RQ), rule of law (RL), and corruption control (CC). The assessment of a government control level varies from -2.5 to 2.5 (World bank group, 2019).

4. Ease of Doing Business Index that is reflected in the project «Doing Business» (DB). The World Bank determines this rating according to a study of regulatory rules for starting business, obtaining construction permits, registering property, getting a credit, protecting investors, paying taxes, foreign trade, enforcing contracts, closing a business, access to electricity and employment (The PRS Group, 2019). This index should be included in the integrated assessment of the corruption level because of corruption in these fields of activity.

5. Political Risk Index (PRS) assesses political and business environment in the country (The PRS Group, 2019). The initial data for determining this index are the same indicators used for calculation of the index of government indicator, but their values are calculated by the analytical agency Political Risk Services Group and assessed on a scale from 0 to 1. Based on these data, we determine the value of the PRS index using the integrated assessment.

The described above indices form a hierarchy system, which is shown in Figure 1.

We used the following symbols X_1 - corruption perceptions index, X_2 - index of economic freedom, X_3 - government indicator, X_{3j} - components of indicator WGI (X_{31} - index VA, X_{32} - index PV, X_{33} - index GE, X_{34} - index RQ, X_{35} - index RL, X_{36} - index CC), X_4 - index of ease of doing business, X_5 - political risk index, X_{5j} - components of index PRS (X_{51} - index VA, X_{52} - index PV, X_{53} - index GE, X_{54} - index RQ, X_{55} - index RL, X_{56} - index CC). For the study, we selected data from 36 countries for the period of 2012-2019. The countries were selected on the following principle: Ukraine, neighboring countries (Belarus, Moldova, Poland, the Russian Federation), countries which occupy high places in the rating according to the Corruption Perceptions Index (Denmark, New Zealand, Finland, Singapore, Switzerland, Sweden, Norway, the Netherlands, Luxembourg, Germany, Iceland, Canada, Great Britain, Australia, Austria, Hong Kong, Belgium, Ireland, Spain, Japan, Uruguay, UAE, France, the USA, Post-Soviet countries (Latvia, Lithuania, Estonia, Azerbaijan, Armenia , Kazakhstan) and China.

Let us denote through x_{ikt} index value X_i, and through x_{ijkt} index value X_{ij} for the k-th country per year t where t - numerical order of the year during the studied period.
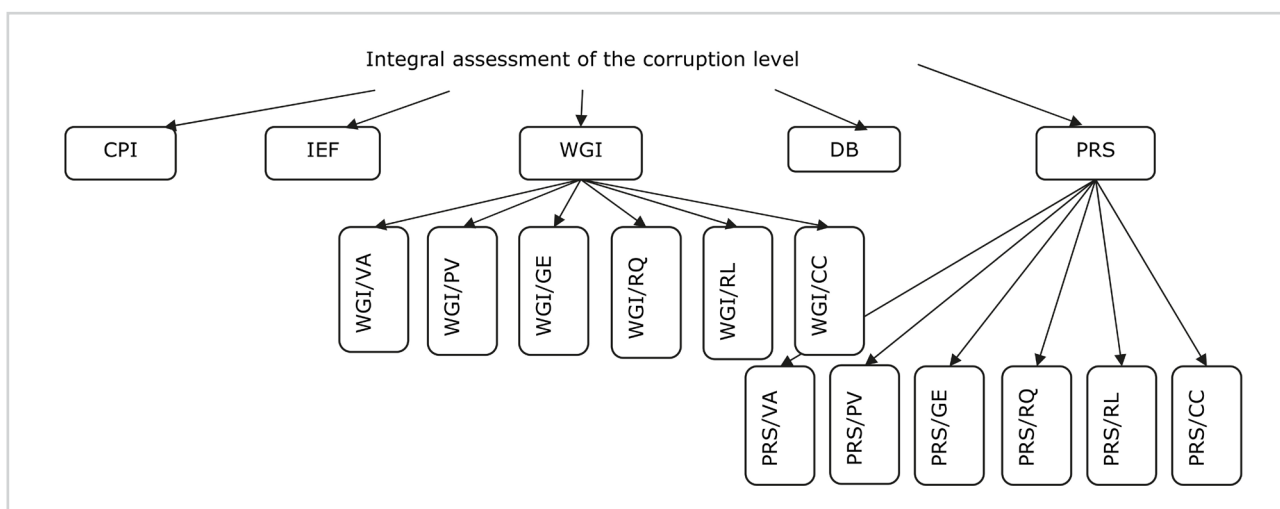

Figure 1:
Hierarchy system of corruption indices
Source: Compiled by the authors according to the results of the study

We determine normalized indices Y_i and Y_{ij}, value of which belong to the interval [0.1]. Since the corruption perception index X_1 takes value from 0 to 100, the corresponding normalized index is determined by the equation $y_{1kt} = x_{1kt} / 100$. The normalized index of economic freedom is calculated in the same way $y_{2kt} = x_{2kt} / 100$. Since the indices X_{3j}, on the basis of which the government indicator is calculated, take values from $x_{3j}^{min} = -2.5$ to $x_{3j}^{max} = 2.5$, normalization is carried out by the formula:

$$y_{3jkt} = \frac{x_{3jkt} - x_{3j}^{min}}{x_{3j}^{max} - x_{3j}^{min}} = \frac{x_{3jkt} + 2.5}{5}.$$ (1)

Index X_4 represents a country's place in the ease of doing business rating. This index takes value from 1 to 189 since 189 countries have been considered. Therefore, normalization is carried out according to the formula $y_{4kt} = (189 - x_{4kt}) / (189 - 1)$. Indices X_{5j}, on the basis of which the political risk index is calculated, take values from $x_{5j}^{min} = 0$ to $x_{5j}^{max} = 1$, then values of the normalized indices are equal to the corresponding values of the initial ones $y_{5jkt} = x_{5jkt}$.

The integral assessment of the corruption level in the k-th country in the t-th year is determined as follows:

$$W_{kt} = \alpha_1 y_{1kt} + \alpha_2 y_{2kt} + \alpha_3 \sum_{j=1}^{6} \beta_{3j} y_{3jkt} + \alpha_4 y_{4kt} + \alpha_5 \sum_{j=1}^{6} \beta_{5j} y_{5jkt}.$$ (2)

Where α_i is a weight coefficient of i-th index in the integral assessment, β_{ij} is a weight coefficient of j-th index in the integral assessment X_i.

The weight coefficients β_{ij} are chosen to be proportional to the squares of the component eigenvector of covariance matrix of the normalized indices that corresponds to maximum eigenvalue of this matrix. The weight coefficients α_i are determined similarly.

The integrated assessments of the corruption level for 2019 obtained with the help of the developed method are given in Table 1, Figure 2 and Figure 3.

The integral indicator of the level of corruption is influenced by a large number of socio-economic factors, among which the following were selected for the study: educational level, employment rate, population income, and income inequality. To assess the impact of these factors, a link between the integral assessment of the level of corruption and the following indicators was made: human development index (a composite index measuring average achievement in three basic dimensions of human development - a long and healthy life, knowledge and a decent standard of living), education index (education index is an average of mean years of schooling (of adults) and expected years of schooling (of children), both expressed as an index obtained by scaling with the corresponding maxima), GDP per capita, coefficient of human inequality (calculated as the arithmetic mean of the values in inequality in life expectancy, inequality in education and inequality in income), percentage of the labor force population ages 15 and older that is not in paid employment or self-employed but is available for work and has taken steps to seek paid employment or self-employment. The statistics were taken from the report on human development published by the United nations development programme (2020).

For each of these indicators we determine the correlation coefficient of this indicator with the integral assessment of the corruption level and form a linear regression equation $W = \alpha g + b$, where g is a factor indicator. For checking adequacy of the distribution we use Fisher criterion. The results of the study are shown in Table 2.

Thus, close relationship between the integrated assessment of the corruption level and the human development index, the education index and GDP per capita has been established. There are also significant links with the human inequality coefficient, the percentage of the employed population and the percentage of the working-age population that is not working and looking for work.

To study the simultaneous impact of several factors on the integrated assessment of the corruption level, we use a linear multiple regression model. The information foundation of this model is value of the integrated assessment of the corruption level and affecting factors in 35 countries in 2019. The following conditions must be fulfilled in order to use the model:

Table 1:
Indices of the corruption level (2019)

k	Country	Components of integrated assessment					Integrated assessment
		CPI	IEF	WGI	DB	PRS	
1	Australia	0.77	0.81	0.82	0.91	0.93	0.85
2	Austria	0.77	0.72	0.80	0.87	0.92	0.83
3	Azerbaijan	0.30	0.65	0.36	0.87	0.35	0.40
4	Belgium	0.75	0.67	0.76	0.77	0.90	0.80
5	Belarus	0.45	0.58	0.40	0.81	0.41	0.46
6	Armenia	0.42	0.68	0.48	0.79	0.39	0.47
7	Hong Kong SAR, China	0.76	0.90	0.75	0.98	0.73	0.78
8	Denmark	0.87	0.77	0.85	0.99	0.96	0.90
9	Estonia	0.62	0.77	0.76	0.90	0.69	0.71
10	Ireland	0.74	0.81	0.78	0.88	0.94	0.83
11	Iceland	0.78	0.77	0.81	0.89	0.92	0.85
12	Spain	0.74	0.66	0.68	0.85	0.76	0.74
13	Kazakhstan	0.34	0.65	0.43	0.86	0.66	0.53
14	Canada	0.77	0.78	0.83	0.89	0.95	0.85
15	China	0.41	0.58	0.42	0.76	0.46	0.47
16	Latvia	0.56	0.70	0.67	0.90	0.65	0.66
17	Lithuania	0.60	0.74	0.69	0.93	0.66	0.68
18	Luxembourg	0.80	0.76	0.85	0.65	0.95	0.85
19	Moldova..	0.32	0.59	0.43	0.76	0.42	0.43
20	Netherlands	0.82	0.77	0.85	0.81	0.95	0.87
21	Germany	0.80	0.74	0.81	0.88	0.93	0.85
22	New Zealand	0.87	0.84	0.87	1.00	0.97	0.91
23	Norway	0.84	0.73	0.87	0.97	0.96	0.89
24	United Kingdom	0.77	0.79	0.79	0.96	0.93	0.85
25	United Arab Emirates	0.71	0.78	0.62	0.95	0.71	0.71
26	Poland	0.58	0.68	0.63	0.83	0.71	0.66
27	Russian Federation	0.29	0.59	0.37	0.84	0.46	0.43
28	Singapore	0.85	0.89	0.82	0.99	0.87	0.87
29	United States	0.69	0.77	0.74	0.96	0.89	0.80
30	Ukraine	0.30	0.52	0.40	0.63	0.47	0.42
31	Uruguay	0.71	0.69	0.68	0.50	0.62	0.65
32	Finland	0.86	0.75	0.87	0.91	0.97	0.90
33	France	0.69	0.64	0.75	0.84	0.78	0.75
34	Switzerland	0.85	0.82	0.86	0.80	0.94	0.87
35	Sweden	0.85	0.75	0.86	0.94	0.96	0.89
36	Japan	0.73	0.72	0.77	0.80	0.87	0.79

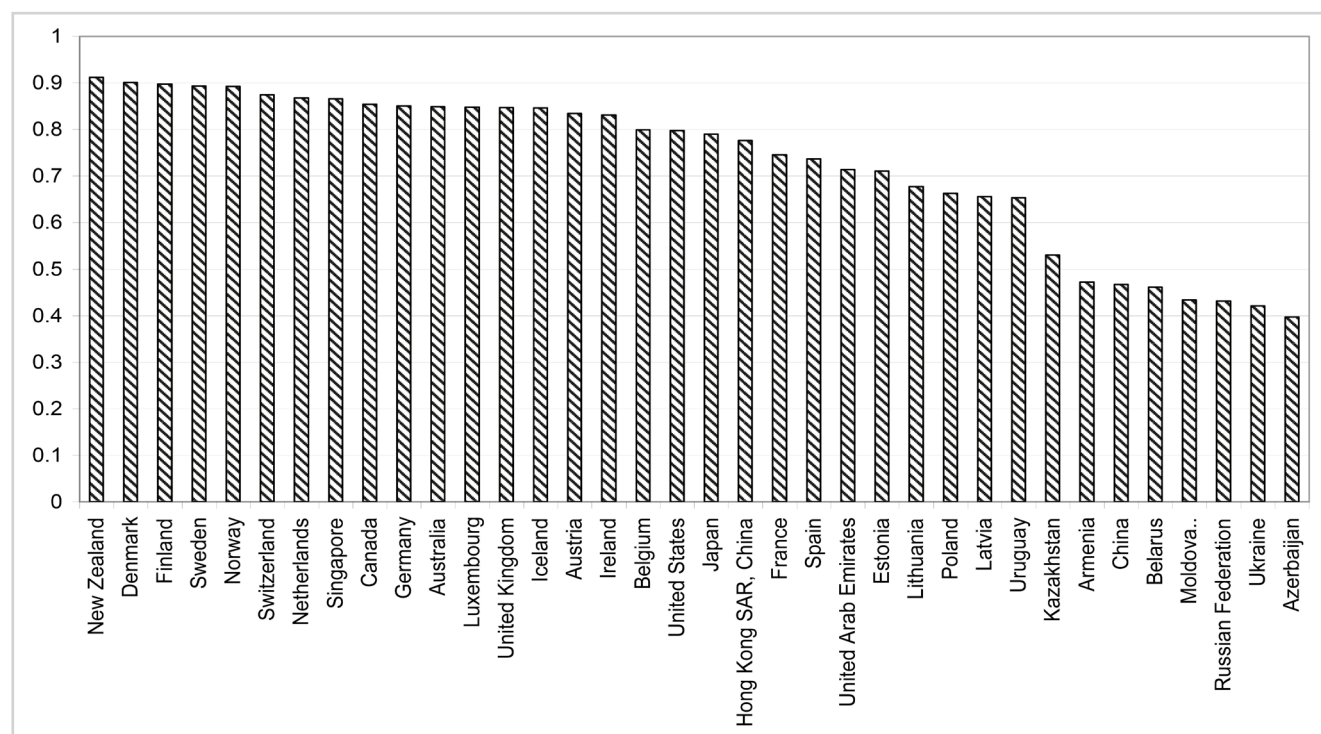Source: Compiled by the authors according to the results of the study

Figure 2:
Integrated assessment of the corruption level in 2019
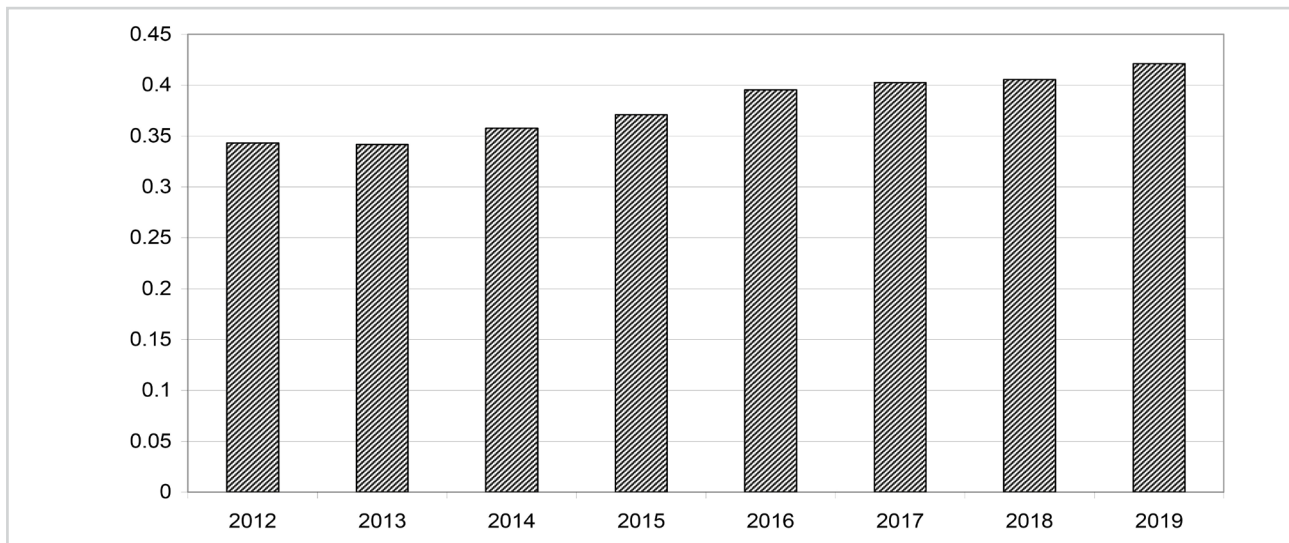Source: Compiled by the authors according to the results of the study

Figure 3:
Dynamics of the integrated assessment of the corruption level in Ukraine
Source: Compiled by the authors according to the results of the study

Table 2:
The impact of human development indices on the integrated assessment of corruption

Sign	Indices	Correlation coefficient	Regression equation	Fisher's test
g_1	Human development index	0.92	W= 25.3g_1-1.51	1618.64
g_2	Education index	0.69	W= 1.711g_2-0.725	263.04
g_3	GDP per capita	0.77	W= 6.36E-06g_3+0.44	414
g_4	Coefficient of human inequality	0.36	W=-0.025g_4+0.94	37.75
g_5	Employment to population ratio	0.25	W=0.0056g_5+0.39	18.77
g_6	Unemployment, total	0.21	W=-0.008g_6+0.776	8.63

Source: Compiled by the authors according to the results of the study

1) There should be no multicollinearity between factors. If multicollinearity is present, these factors cannot be used in the same multiple linear regression model, some factors must not be included in the model.
2) The model must be adequate to the initial data.
3) The coefficients of the model must be significant.
   The multiple linear regression model is constructed in several stages.
   Stage 1. To test the factors for multicollinearity, we normalize the initial values of these factors. Let g_{ik} be the value for i-th factor for k-th country. The normalized values are determined by the formula:

$$g_{ik}^{norm} = \frac{g_{ik} - \bar{g}_i}{\sigma_i \sqrt{m-1}}, (k = \overline{1,m}), (i = \overline{1,n}) , \tag{3}$$

where:
n - number of factors,
m - amount of initial data for each factor (for our research $m = 35$),
$\bar{g}_i$ - mean value of the factor $\bar{g}_i$ by all studied countries,
σ_i - mean-square deviation of the factor g_i.

   Let G_{norm} - matrix of dimension $m \times n$, the elements of which are normalized values of the factors, and G_{norm}^T is a matrix transposed to it. Determine the correlation matrix $Kor = G_{norm}^T G_{norm}$, the elements of which show dependencies between factors: the closer the element in absolute value to 1, the stronger relationship between the relevant factors. To check the presence of multicollinearity between factors, we determine the calculated and tabular value of the criterion χ^2. If the calculated value in absolute value is higher than the tabular value, then there is multicollinearity between the variables, therefore, at least one of the factors must be discarded.
   Stage 2. We calculate the coefficients of the multiple regression equation. In order to do this we determine the matrix $A = (G^T G)^{-1} G^T Q$, where G is a matrix, the first column of which consists

of units and other columns contain values of the factors g_i, G^T is a matrix, transposed to G, Q is a column vector of integrated estimates. The elements of matrix A are the coefficients of the regression equations.

Stage 3. We check the adequacy of the obtained model to initial data and significance of its coefficients.

With six factors, it is possible to have 15 two-factorial, 20 tri-factorial, 15 four-factorial, 6 five-factorial and 1 six-factorial linear multiple regression model. The study of all these models showed that only two-factorial model meets the requirements of multicollinearity absence, adequacy to initial data and significance of all coefficients. It reflects the dependence of integrated assessment of corruption on GDP per capita and human inequality coefficient. The equation of this model has the following form $W = 0.0000054g_3 - 0.015g_4 + 0.615$.

We determine the coefficients of elasticity of the integrated assessment of the corruption level in relation to value of GDP per capita and in relation to the coefficient of human inequality coefficient. For Ukraine, these coefficients are equal to 0.119 and -0.178, respectively. This means that an increase in GDP per capita by 1% with a constant human inequality coefficient will improve the expected value of the integrated corruption index by 0.119% and a decrease of the human inequality coefficient by 1% with a constant GDP per capita - by 0.178%.

5. Conclusions

The integrated assessment should be used in order to assess the corruption level in different countries. It combines Corruption Perception Index, Index of Economic Freedom, World Government Indicator in different countries worldwide, Index of Doing Business, Political Risk Services International Country Risk Guide.

Such factors as human development index, education index, GDP per capita, human inequality coefficient, percentage of employed population, percentage of able-bodied population not working and looking for work have a significant impact on the integrated assessment of corruption. A study of two-factorial model of the dependence of the integrated assessment of the corruption level on GDP per capita and the human inequality coefficient showed that increasing GDP per capita and reducing human inequality coefficient results in a corruption decrease in the country.

To increase the effectiveness of anti-corruption activities, along with improving the general system for preventing and combating corruption and implementing anti-corruption measures in the priority areas, it is necessary to provide measures in order to increase an education level, overcome unemployment and income inequality and increase population income.

It is important to prevent corruption in the area of public procurement where the cost and volume of procurement may increase, competition may be curtailed and other corruption risks may arise. The potential for such risks increases during quarantine when there are problems in obtaining pesticide certificates. One of the measures to mitigate these risks should be the use of electronic documentation in procurement process.

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