ECONOMICS & Sociology

Vasylieva, T., Vysochyna, A., & Filep, B. (2022). Economic development and income inequality: Role in country resistance to COVID-19. *Economics and Sociology*, *15*(4), 286-302. doi:10.14254/2071-789X.2022/15-4/14

ECONOMIC DEVELOPMENT AND INCOME INEQUALITY: ROLE IN COUNTRY RESISTANCE TO COVID-19

Tetiana Vasylieva
Sumy State University, Ukraine; Silesian University of Technology, Poland; The London Academy of Science and Business, UK
E-mail: tavasilyeva@biem.sumdu.edu.ua
ORCID 0000-0003-0635-7978

Alina Vysochyna
Sumy State University, Ukraine
E-mail: a.vysochyna@uabs.sumdu.edu.ua
ORCID 0000-0001-9490-1026

Bálint Filep*
Széchenyi István University, Győr, Hungary
E-mail: filep.balint@sze.hu
ORCID 0000-0003-3955-6818
**Corresponding author*

Received : December, 2021
1st Revision : August, 2022
Accepted : November, 2022

DOI: 10.14254/2071-789X.2022/15-4/14

ABSTRACT. The pandemic of coronavirus disease (COVID-19) significantly slowed economic development and exacerbated income inequality. However, the scale of this destructive influence varies considerably among countries. Thus, the purpose of this study is to identify changes in causality patterns between economic development and income inequality due to COVID-19. To fulfill the task, an Index of Economic Development (IED) is developed using the multivariate analysis tools, Cronbach's alpha and the Fishburn formula. The Gini index was chosen as a core proxy of social inequality. The research covers a sample of 15 European countries. The period of the analysis is 2000-2021. A set of regression equations are constructed to determine the relationship between economic development and income inequality in the studied countries. A dummy variable is integrated into the equation to determine the impact of the coronavirus disease (COVID-19). Modeling is carried out on the panel data. The most acceptable functional form of the regression model is clarified based on the Hausman test. Modeling results make it possible to identify patterns of changes in the impact of income inequality on economic development, and vice versa. The change in their causality due to COVID-19 is substantiated.

JEL Classification: E24, E31, F32, I18, O47

Keywords: economic development, income inequality, COVID-19, coronavirus disease, country resistance

Introduction

The COVID-19 pandemic has led to one of the most significant crises in the last 100 years, negatively affecting the public health and the socioeconomic situation in almost all countries of the world. In response to the spread of the pandemic, representatives of the public administration sector worldwide jointly developed a system of regulatory interventions aimed at reducing the rate of morbidity and mortality from COVID-19. Strict quarantine restrictions and large-scale vaccination campaigns made it possible to achieve significant success in combating the coronavirus disease during 2020-2022. However, these measures also had a controversial impact on economic engagement in specific sectors because they blocked some activities. Therefore, it is important to determine the patterns of relationships between the level of country economic development and income inequality for the sake of both creating a post-pandemic recovery strategy and developing effective mechanisms of resistance to similar threats in the future. Additionally, changes in these patterns due to the pandemic of the coronavirus disease (COVID-19) should be substantiated with the aim of further formalizing strategies for socioeconomic recovery that are more regionally personalized.

1. Literature review

The literature review block clarifies previous research results concerning economic development and income inequality, its interaction and manifestation in the pandemic period.

The first part of the literature review aims to identify economic development measurement indicators. Most scientists considered economic growth and economic development from a limited perspective and chose only GDP growth (Omran, Bilan (2022); Grenčíková et al. (2022)) or GDP per capita (Simovic (2021)) as a crude proxy of its quantitative assessment. The group of researchers (Lyulyov et al. (2021); Oliinyk et al. (2021); Tiutiunyk et al. (2021); Pimonenko, Lyulyov, Us (2021)) characterized the state of economic development and economic growth through the leading indicators of macroeconomic stability, namely: GDP growth; unemployment rate; consumer price index; state budget deficit, current account balance. In turn, scientists (Brychko et al. (2021)) additionally defined the balance of trade accounts and value-added as the indicators of economic growth measurement. Govdeli (2022) proposed to measure country's economic development with three indicators: gross domestic savings, fixed capital investments and GDP growth. Štreimikienė et al. (2022) characterized the economic perspective of the country's development through the following quantitative parameters: central government debt, total % of GDP; GDP growth, annual %; GDP per capita, PPP constant 2011 international $; gross fixed capital formation, % of GDP; income share held by the lowest 20%; industry value-added, annual % growth; research and development expenditure, % of GDP; unemployment, % of the total labor force; current account balance, % of GDP. Researchers (Yarovenko et al. (2021); Leonov, Frolov, Plastun (2014)) stated that dynamic economic growth is impossible without sufficient investments and their effective allocation (in high-tech projects that will contribute to country innovative development). In the paper (Didenko et al. (2020)), it is mentioned that the financial inclusion of population also determines the sustainability of socio-economic development. The group of researchers (Lopez, Alcaide, Blockchain (2020); Shipko et al. (2021)) noted that sustainable economic growth directly or indirectly depends on public expenditures and the effectiveness of budget funds management. They also pointed out the importance of the quality of state management of enterprises and institutions of critical infrastructure, the efficiency of the system of early response and warning to external shocks, and the quality of anti-crisis management at the national, local and micro levels.

The next section of the literature review aims to summarise the most relevant research results on the assessment of income inequality and its impact on economic development proxies. Thus, (Syahnur et al. (2021)) in the context of a quantitative assessment of the level of socio-economic inequality, relied on indicators of investment volumes, public expenditures, human development index. Tiutiunyk et al. (2022); Fertö, Bojnec, Podruzsik (2022) also argued that the country's social development is closely related to the leveling of the population's income distribution (the Gini index) and the level of human development. Skare et al. (2021) also chose the Gini index as a proxy for income inequality. In turn, Bajra (2021), in the context of identifying the relationship between the level of economic growth and income inequality, found that an increase in GDP per unit leads to a reduction in the share of people living in inequality by 0.05 %. However, Laskienė, Zykiene, Verdnikovaite (2020) investigated the relationship between income inequality and population migration in a sample of EU countries. The researchers found that income inequality has more significant effect on immigration than on emigration. In contrast, emigration processes depend on income inequality only in a group of countries with an average level of income inequality. Laurinavičius et al. (2020) also focused on identifying the impact of income inequality and migration processes. The authors revealed that income inequality plays a crucial role in boosting migration in crisis and early post-crisis periods. In contrast, these causal relationships become weaker in less turbulent economic conditions. Kot, Paradowski (2022) identified that inequality aversion is closely correlated with income inequality but has no statistically significant causality with country's economic development. Wildowicz-Szumarska (2022) researched fiscal preconditions of income inequality in EU countries. The author revealed that social transfers are more effective in combating income inequality than direct taxes. It was also pointed out that income inequality is more likely to develop in liberal than in social-democratic states. However, Gonos et al. (2023) confirmed the existence of a close connection between the social and economic parameters of the country's development. The scientists found that for V4 Region countries growing life expectancy and education enrollment are critical social determinants of national income growth. Popescu (2022) also focused on identifying social determinants' impact on country performance. The author revealed that educational factors significantly influence the country's economic development.

The next block of theoretical research is focused on clarifying the channels of influence of the coronavirus disease (COVID-19) on proxies of socioeconomic development. Researchers (Smiianov et al. (2020)) in the context of identifying the impact of the pandemic lockdown on economic growth, noted the presence of several logical chains. The authors declared that GDP growth affects the population's well-being and the level of employment, which, in turn, has a positive effect on economic dynamics. Moreover, GDP growth contributes to investments accumulating and allocating in medical infrastructure. Modernization of the healthcare system's infrastructure positively affects public health and stimulates economic growth due to the improvement of the quality and productivity of the workforce. Lyeonov et al. (2021a); Lyeonov et al. (2021b); Vasylieva et al. (2020); Ziabina, Kwilinski, Belik (2021) also highlighted channels of public health care system influence on the country's economic development. Finally, GDP growth stimulates investing in the development of the green economy, and the improvement of the environment allows for the allocation of investments in fixed assets and accelerates economic growth (Tomchuk et al. (2018). The authors (Keliuotytė-Staniulėnienė & Daunaravičiūtė, 2021) also support the idea of a positive impact of green investments on the country's economic growth. The researchers (Fadel et al., 2021; Uslu, Alagöz & Güneş, 2020) also devoted special attention to the empirical analysis of the prospects for ensuring economic growth through the channel of environmental transformations caused by the coronavirus pandemic. Many scientists (Zhang et al., 2022; Sardak et al., 2018) also researched employment and labor migration consequences of COVID-19 for socio-economic

development. Privara (2022) revealed that the number of cases of COVID-19 did not significantly damage the country's socioeconomic parameters, while mortality from the coronavirus disease dramatically negatively affected the country's economic development. Numerous researchers (Castro, 2022; Kuzior, Mańka-Szulik, Krawczyk, 2021; Alabdullah, Asmar, 2022; Dvorský et al., 2021; Capolupo, Palumbo, Adinolfi, 2022) identified the changes in the organizational and functional patterns of business models due to COVID-19 pandemic. Rahmanov, Mursalov, Rosokhata (2021); Zhu, Li, Shang (2022); Basuki et al. (2022); Androniceanu, Kinnunen, Georgescu (2020); Sawangchai et al. (2020); Jurczuk, Florea (2022); Beno (2022; Boronos et al. (2020); Karácsony et al. (2021); Hasan et al. (2022); Ray (2021); Grebosz-Krawczyk, Siuda (2022); Hinrichs, Bundtzen (2021); Jurek, Korjonen-Kuusipuro, Olech (2021) researched perspectives of implementing remote business management, e-governance and digital technologies as a possible pathway for survival in a competitive business environment during the pandemic period. Lulaj (2022) researched the pandemic crisis through the public spending optimization perspective.

Summarizing the results of the theoretical analysis, it is worth noting that the pandemic, on the one hand, led to large-scale socio-economic losses but, on the other hand, contributed to the active implementation of innovative technologies. However, the strength and scale of such an impact of COVID-19 are not identical in all countries of the world, which requires further research in this direction. It is also worth noting that scientists dominantly use the Gini index as a proxy of income inequality, while they are not so unanimous in determining the measurement indicators of economic development.

2. Methodological approach

The purpose of this study is to determine the patterns of the relationships between the level of country economic development and income inequality, as well as to justify the changes in these patterns due to the coronavirus disease (COVID-19) pandemic. This study will be realized on a sample of 15 European countries: Albania, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Serbia, Slovakia, Slovenia, and Ukraine. Period of observation – 2000-2021.

The hypotheses of this study are as follows: (1) the increase in the level of economic development of the country leads to a decrease in income inequality; (2) the growth of income inequality negatively affects the dynamics of the country's economic development; (3) during the COVID-19 pandemic, the positive impact of the increase in the level of economic development of the country on the reduction of income inequality became weaker; (4) during the COVID-19 pandemic, the negative impact of the growth of income inequality on the economic development of the country became stronger.

To test hypotheses (1) and (2), simple linear regression models will be built on the panel data using the Stata/SE 14.2 software product, covering the entire time range of observations (2000-2021). Instead, to test hypotheses (3) and (4), similar simple linear regression models will be constructed but covering only the pre-pandemic period. Confirmation or refutation of hypotheses (3) and (4) involves comparing the values of the regression coefficients in the model for 2000-2021 and the model for 2000-2019. An additional stage of testing hypotheses (3) and (4) also involved the construction of simple linear regression models on the panel data with a dummy variable characterizing the pandemic as an independent variable (COVID). The dummy variable takes the value of "0" in the pre-pandemic period and "1" - during the outbreak of the pandemic (2020-2021).

The Gini index was chosen as a measure of income inequality without hesitation considering the literature review results. At the same time, the multifaceted nature of the country's economic development does not allow choosing the only proxy of the country’s

economic development. Thus, the Index of Economic Development (IED) is developed based on the following indicators:

- Unemployment, total (% of total labor force) (*Unempl*);
- School enrollment, secondary (% gross) (*School*);
- Electric power consumption (kWh per capita) (*El_cons*);
- GDP growth (annual %) (*GDPg*);
- Foreign direct investment, net inflows (% of GDP) (*FDI*);
- Gross capital formation (% of GDP) (*GCF*);
- General government final consumption expenditure (% of GDP) (*GGFCE*);
- Current account balance (% of GDP) (*CAB*);
- Inflation, consumer prices (annual %) (*CPI*);
- New business density (new registrations per 1,000 people ages 15-64) (*Bus*);
- Tax revenue (% of GDP) (*Tax_rev*);
- Trade (% of GDP) (*Trade*);
- Government Effectiveness: Estimate (*GE*);
- Regulatory Quality: Estimate (*RQ*).

All the variables described above (except the dummy one) are chosen as proxies of the country's economic development based on literature review results. They are collected from the World Bank Group's "World Development Indicators" and "Worldwide Governance Indicators" collections (World Bank DataBank, 2022).

The formation of an IED involves the implementation of several stages.

Stage 1. Bringing individual indicators to a comparable value using natural normalization and Savage normalization approaches. Before using normalization approaches, all variables are transformed to eliminate negative value indicators. This transformation refers to such variables GDP growth (annual %) (GDPg); Foreign direct investment, net inflows (% of GDP) (FDI); Current account balance (% of GDP) (CAB); Government Effectiveness: Estimate (GE); Regulatory Quality: Estimate (RQ). To eliminate negative values, all the the values are increased by the absolute value of the minimal extremum identified separately for each indicator.

In the next step, all indicators are brought to the comparable form considering their impact on the integral indicator. Indicators, which growth has a positive effect on IED (School, GDPg, FDI, GCF, CAB, Bus, Tax_rev, Trade, GE, RQ), are brought to a comparable form using natural normalization approach according to the formula:

$$x_n = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

where x_n – the normalized value of the corresponding indicator;
x_i– the current value of the normalized indicator;
x_{min}– the minimum value of the normalized indicator for the entire set of observations;
x_{max}– the maximum value of the normalized indicator for the entire set of observations.

In turn, indicators, which growth led to the decrease of the integral indicator, are brought to the comparative view using Savage normalization approach according to the formula:

$$x_n = \frac{x_{max} - x_i}{x_{max} - x_{min}} \quad (2)$$

where x_n– the normalized value of the corresponding indicator;

x_i– the current value of the normalized indicator;
x_{min}– the minimum value of the normalized indicator for the entire set of observations;
x_{max}– the maximum value of the normalized indicator for the entire set of observations.

After completion of normalization procedures, values of all individual indicators belong to the range [0; 1].

Stage 2. Conducting a test for internal consistency of indicators. Cronbach's alpha test in Stata/SE 14.2 software will be used for this purpose. Cronbach's alpha computes the interitem correlations or covariances for all pairs of variables in the varlist and Cronbach's alpha statistic for the scale formed from them (Stata, 2022). If the level of indicators' internal consistency is high, then they will all be used to form the Index of Economic Development. If the Cronbach's alpha test results are low, it will be necessary to repeat all previous iterations to obtain a satisfactory test result.

Stage 3. Identification of weighting coefficients of individual indicators of economic development. For this purpose, one of the multivariate analysis tools built into Stata / SE 14.2 – principal components analysis is used. Application of the principal components analysis approach for indices construction described by Brody, Smith (2022); Vyas, Kumaranayake (2006); Nardo et al. (2005). In the first step, covariance matrix is constructed. Considering the cumulative correlation value, the critical quantity of principal components is determined. Their eigenvalues will be used at further stages of the research. Selection of the principal components is based on the assumption that principal components must explain at least 60-70% of the total signs' variation (Nardo et al. (2005)). In the following stage, eigenvectors of all those principal components are taken, the cumulative variation of which is ≤0.7. After selecting an appropriate quantity of principal component, we might analyze indicators' loading within each principal component to clarify weighting coefficients. The more straightforward approach considers using loadings from the first principal component as a weighting coefficient. However, such an approach has some limitations (another principal component might reflect considerably different loading for the same indicators). Therefore, it is proposed based on (Vyas, Kumaranayake (2006); Nardo et al. (2005)) to identify the vector-averaged eigenvalues (loadings) for each indicator of the country's economic development within all selected principal components. Averaged eigenvalues cannot be used as weighting coefficients because they characterise the indicator's relativity in uncorrelated vectors (principal components). That is why averaged eigenvalues are used only at a preliminary stage to clarify factors' relativity. Considering indicators' loading values, the ranking approach is used to sort all variables by growth. In the next step, weighting coefficients are identified as a curtain indicator rank to total ranks sum ratio (based on the Fishburne approach). After that, the IED is formed according to the formula:

$$IED = w_1 \cdot Unempl + w_2 \cdot School + w_3 \cdot El_{cons} + w_4 \cdot GDPg + w_5 \cdot FDI + w_6 \cdot \cdot GCF + w_7 \cdot GGFCE + w_8 \cdot CAB + w_9 \cdot CPI + w_{10} \cdot Bus + w_{11} \cdot \cdot Tax_{rev} + w_{12} \cdot Trade + w_{13} \cdot GE + w_{14} \cdot RQ \quad (3)$$

where $w_n$is the weighting coefficient of the corresponding individual indicator of the characteristics of economic development;

IED– Index of Economic Development of the Country.

Thus, IED will be the second primary variable in addition to the Gini index.

Stage 4. Direct testing of the research hypotheses using regression modeling on panel data in the Stata/SE 14.2 software product. Determination of the functional form of regression

models will be implemented using the Hausman test. The test helps to choose a regression model with fixed or random effects.

3. Conducting research and results

3.1. Construction of the Index of Economic Development (IED)

Before moving on to regression modeling and testing the hypotheses of the study, it is necessary to develop IED.

Thus, at the first stage of this process, all 14 individual indicators were transformed to a comparable form using natural normalization and Savage normalization. According to normalisation results, all individual indicators now belong to the range [0; 1].

The next stage of this process involves conducting an internal consistency test - Cronbach's alpha test. According to the test results, "Scale reliability coefficient: 0.7978" was established, which is a satisfactory indicator, and therefore all 14 individual indicators will be used to develop the IED.

The next stage of IED formation involves building a covariation matrix using principal component analysis. *Table 1* presents the results of this stage.

Table 1. Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
PC1	4.339	2.340	0.310	0.310
PC2	1.999	0.660	0.143	0.453
PC3	1.339	0.197	0.096	0.548
PC4	1.142	0.178	0.082	0.630
PC5	0.964	0.094	0.069	0.699
PC6	0.870	0.131	0.062	0.761
PC7	0.739	0.139	0.053	0.814
PC8	0.600	0.019	0.043	0.857
PC9	0.581	0.146	0.042	0.898
PC10	0.435	0.055	0.031	0.929
PC11	0.380	0.045	0.027	0.956
PC12	0.334	0.115	0.024	0.980
PC13	0.220	0.162	0.016	0.996
PC14	0.057	.	0.004	1.000

Note: PC – Principal Component
Source: *own calculation in Stata/SE 14.2*

The results conclude that for future calculations, it is necessary to choose six principal components as cumulative variation of the sixth principal component exceeds the critical threshold of 0.7. Namely, these six principal components allow explaining more than 70% of variables variation

In the next step, the weighting coefficients of the individual indicators of economic development in the composite indicator were determined (*Table 2*).

Table 2. Results of identification of weighting coefficients

Variable	PCE_1	PCE_2	PCE_3	PCE_4	PCE_5	PCE_6	PCE_av	Rank	Weight
Unempl	0.177	0.092	0.351	0.573	0.231	0.352	0.2848	11	0.1058
School	0.321	0.105	0.169	0.087	0.09	0.461	0.1544	3	0.0288
El_cons	0.37	0.012	0.067	0.169	0.071	0.349	0.1378	1	0.0096
GDPg	0.083	0.399	0.256	0.085	0.316	0.094	0.2278	9	0.0865
FDI	0.006	0.294	0.347	0.194	0.698	0.064	0.3078	13	0.1250
GCF	0.02	0.61	0.187	0.025	0.016	0.097	0.1716	5	0.0481
GGFCE	0.234	0.151	0.446	0.278	0.168	0.235	0.2554	10	0.0962
CAB	0.251	0.451	0.169	0.077	0.174	0.089	0.2244	8	0.0769
CPI	0.187	0.03	0.265	0.619	0.373	0.016	0.2948	12	0.1154
Bus	0.293	0.239	0.107	0.059	0.303	0.337	0.2002	6	0.0577
Tax_rev	0.111	0.206	0.552	0.242	0.001	0.496	0.2224	7	0.0673
Trade	0.362	0.058	0.079	0.138	0.208	0.134	0.169	4	0.0385
GE	0.425	0.076	0.031	0.138	0.088	0.237	0.1516	2	0.0192
RQ	0.398	0.163	0.053	0.155	0.076	0.15	0.3078	13	0.1250

Note: PCE – Principal Component Eigenvalues; PCE_av – average value of all eigenvalues
Source: *own calculation in Stata/SE 14.2*

The results presented in *Table 2* prove that the most relevant factors for ensuring the country's economic development are high-quality state regulation, foreign investments, and weak inflationary processes. In contrast, the least important determinants of economic development in the selected countries are reductions in electricity consumption, government efficiency, and secondary school enrollment.

Taking into account weighting coefficients from *Table 2*, IDE is calculated by the formula:

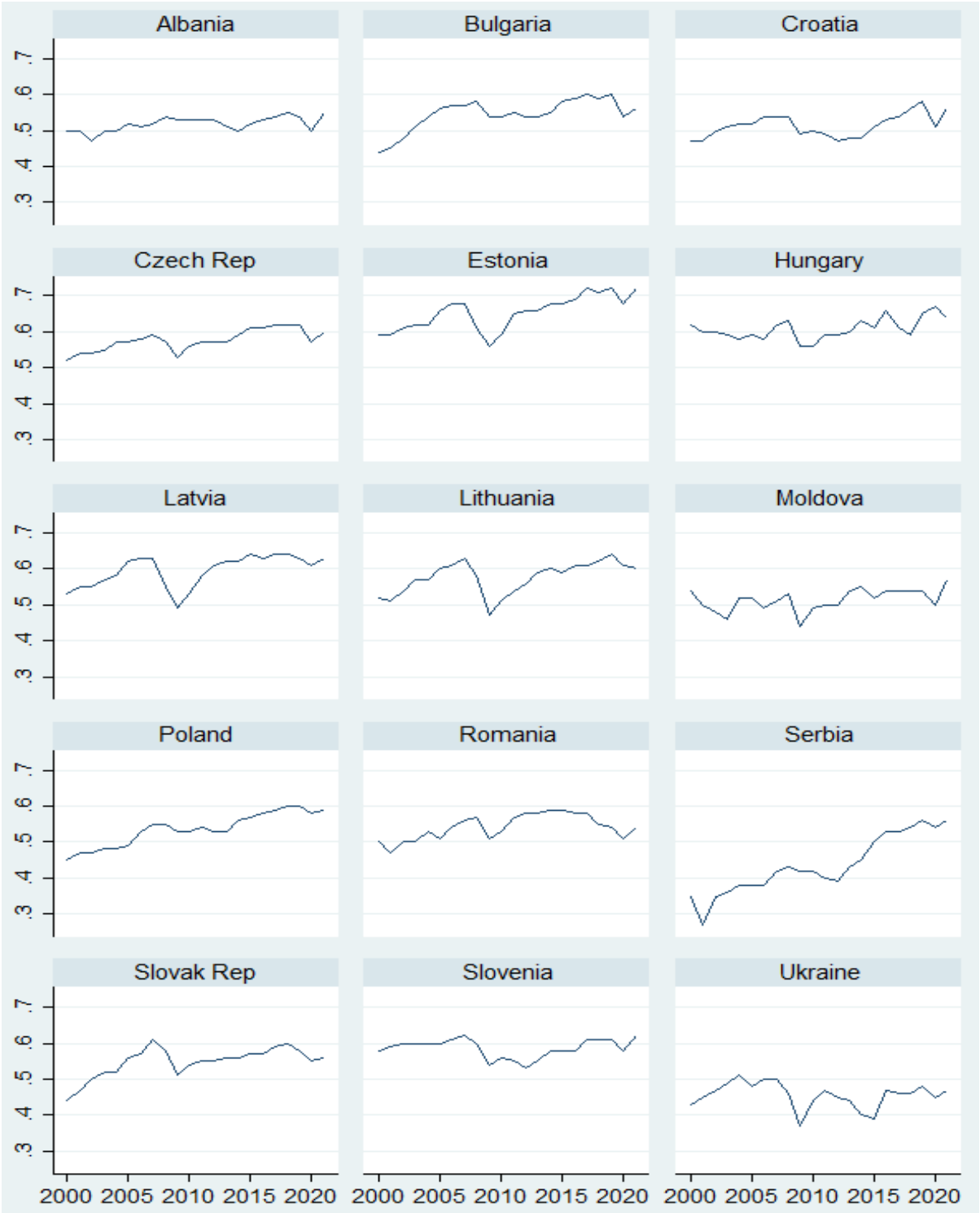
$$IED = 0.1058 \cdot Unempl + 0.0288 \cdot School + 0.0096 \cdot El_{cons} + 0.0865 \cdot GDPg + 0.125 \cdot FDI + 0.0481 \cdot GCF + 0.0962 \cdot GGFCE + 0.0769 \cdot CAB + 0.1154 \cdot CPI + 0.0577 \cdot Bus + 0.0673 \cdot Tax_{rev} + 0.0385 \cdot Trade + 0.0192 \cdot GE + 0.125 \cdot RQ \quad (4)$$

where IED is the Index of Economic Development of the Country.

IED dynamics within countries of the samples for 2000-2021 is presented in *Graph 1*.

The data presented in Graph 1 shows that the cluster of countries with the highest level of economic development for the period is formed by the Czech Republic, Estonia and Hungary. In contrast, the countries with the lowest level of IED are Ukraine, Moldova and Serbia. However, Serbia demonstrated a relatively rapid pace of economic development over the past 7-8 years. It is also worth noting that in most countries, there was a drop in economic dynamics in the first year of the spread of the COVID-19 pandemic (2020). However, the pre-pandemic economic dynamics are gradually recovering in 2021, which is clearly illustrated in the graph. Also interesting is that the selected countries' economic systems reacted differently to the shocks of the pandemic. In particular, for Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Romania, Slovakia and Slovenia, the destructive impact of the COVID-19 pandemic was equivalent to or slightly less than the negative impact of the global financial crisis of 2007-2008. In contrast, the financial crisis had more devastating economic consequences for Latvia, Lithuania, Estonia, Moldova, Serbia, and Ukraine).. In addition, the graph for Ukraine quite revealingly reflects the negative economic effect of the annexation of Crimea and the beginning

of the military conflict in the East of Ukraine. The scale of the destructive impact of these events is almost the same as that of the global financial crisis.



Graph 1. Dynamics of IDE during 2000-2021
Source: *own calculation in Stata/SE 14.2*

Before the regression analysis, the descriptive statistics of all variables might be performed *(Table 3).*

Table 3. Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Unempl	330	.644	.208	0	1
School	330	.53	.168	0	1
El_cons	330	.576	.22	0	1
GDPg	330	.633	.145	0	1
FDI	330	.306	.062	0	1
GCF	330	.479	.16	0	1
GGFCE	330	.41	.186	0	1
CAB	330	.602	.157	0	1
CPI	330	.945	.089	0	1
Bus	330	.154	.155	0	1
Tax_rev	330	.55	.203	0	1
Trade	330	.527	.196	0	1
GE	330	.551	.267	0	1
RQ	330	.563	.227	0	1
IED	330	.547	.068	.27	.72
GINI	330	32.215	5.428	23.2	51.93

Source: *own calculation in Stata/SE 14.2*

Thus, according to descriptive statistics, it can be noted that the sample is strongly balanced since there are no missing observations. The average IED for the countries is 0.547 so the economic potential in the studied countries is used by 50-60%, while the flagship country reached a value of 72%. There is almost a two-fold gap between countries in the context of income inequality.

3.2. Regression modeling results

The initial stage in the block of regression modeling on panel data is determining the most appropriate form of regression dependence for a defined data set using the Hausman test. The test application made it possible to obtain the following results: "Prob>chi2 = 0.2659", that is, to use the random effects regression model more effectively in this case. All modeling results illustrate causal relationship significance with a 99% confidence probability.

So, in order to test hypothesis (1), which suggests that an increase in the level of economic development of the country leads to a decrease in income inequality, and hypothesis (2), which suggests that an increase in income inequality harms the dynamics of the country's economic development, we will analyze the results of regression modeling according for 2000-2021 (*Table 4*).

Table 4. Regression results on identifying the relationships between economic development and income inequality in 15 countries in 2000-2021

	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
				Gini→ IED			
Ginny	-.0061	.0008	-7.97	0	-.0076	-.0046	***
Constant	.7442	.0287	25.92	0	.6879	.8004	***
				Gini →IED			
IED	-26.6056	3.3024	-8.06	0	-33.0781	-20.1331	***
Constant	46.7729	2.21	21.16	0	42.4415	51.1043	***

Source: *own calculation in Stata/SE 14.2*

So, based on the panel data regression modeling results, the following conclusions can be drawn:

– for the formed sample of 15 countries, hypothesis (1) was confirmed, as the modeling results showed that an increase in the country's Economic Development Index by 1 unit leads to a decrease in the Gini index by 0.006% with a confidence probability of 99%, that is, there is a decrease in the income inequality;

– hypothesis (2) was also confirmed: an increase in the Gini index by 1% leads to a decrease in the country's Economic Development Index by 26.6 units with a confidence probability of 99%, i.e., an increase in the income inequality in the studied countries leads to a significant decrease in the dynamics of economic development.

To test hypothesis (3) that during COVID-19 pandemic, the positive impact of the increase in the level of economic development of the country on the reduction of income inequality became weaker, and hypothesis (4) that during COVID-19 pandemic, the negative impact of the growth of income inequality on the economic development of the country became stronger, we will analyze the results of regression modeling presented in *Table 5* and *Table 6* .

Table 5. Regression results on identifying the relationships between economic development and income inequality in 15 countries in 2000-2019

	Coef.	St. Err .	t-value	p-value	[95% Conf	Interval]	Sig
			Gini→ IED				
Ginny	-.0059	.0009	-6.80	0	-.0076	-.0042	***
Constant	.735	.0315	23.30	0	.6732	.7968	***
			Gini →IED				
IED	-22.7829	3.3236	-6.85	0	-29.2971	-16.2687	***
Constant	44.8436	2.2147	20.25	0	40.503	49.1843	***

Source: *own calculation in Stata/SE 14.2*

Table 6. Regression results on identifying the relationships between economic development, income inequality and COVID-19 in 15 countries

	Coef.	St. Err .	t-value	p-value	[95% Conf	Interval]	Sig
			COVID-19 →Gini				
Ginny	-2.4176	.4978	-4.86	0	-3.3933	-1.4419	***
Constant	32.4346	1.2675	25.59	0	29.9504	34.9187	***
			COVID-19 →IED				
IED	.0277	.0078	3.55	.0004	.0124	.0429	***
Constant	.5447	.0145	37.51	0	.5162	.5731	***

Source: *own calculation in Stata/SE 14.2*

So, based on the modeling results, the following conclusions can be drawn:

– for the entire observation period (2000-2021), the value of the coefficient for the regressor in the model for determining the impact of economic growth on income inequality is -0.0061, while in the model characterizing these causal relationships only in the pre-pandemic period (2000-2019) it is -0.0059, which allows us to conclude the weakening of the relationship between the parameters due to the exclusion from the array of observations of two years of the outbreak of the pandemic; in particular, the elimination from the calculations of 2020-2021 led to a weakening of the influence by 3.28% (growth rate), i.e., during the pandemic years, there was an increase in the impact of economic development on the reduction of income inequality, which refutes hypothesis 3;

– the results of determining the impact of the pandemic on the Gini index proved that its existence leads to a decrease in income inequality by 2.42% with a 99% confidence

probability, while the impact on the economic development of the pandemic in the selected countries is positive – the existence of the pandemic determines the growth of the country's Economic Development Index by 0.0277;

– elimination of the 2020-2021 years led to a decrease in the absolute value of the coefficient in the model for detecting the impact of the growth of the Gini index on the country economic development; the exclusion of pandemic years led to a reduction in the influence of the parameters by 14.37% (growth rate), i.e., hypothesis 4 that the negative impact of the growth of income inequality on the economic development of the country increased during the COVID-19 pandemic was also refuted.

Conclusion

The theoretical part of this study summarizes currentscientists' existing work in three research blocks: identification of the determinants of the country's economic development, identification of the parameters of income inequality, determining the impact of the pandemic on the parameters of socioeconomic development. According to the research results, it was established that most researchers define the Gini index as the primary measure of the level of income inequality. Instead, the most common parameter for quantifying the country's economic development in scientific studies is GDP growth or GDP per capita. However, in parallel with this, other determinants of economic development are found in scientific works, which necessitated their aggregation in the Index of Economic Development of the country. The IED is formed by combining 14 economic development determinants using multivariate analysis tools, Savage normalization and natural normalization, the Fishburn formula and additive convolution. Based on the convolution results, IED was obtained. Its dynamics adequately reflect the trends of economic development in the selected countries. Thus, among the 15 studied countries, the best value of the indicator is in the Czech Republic, Estonia, and Hungary. In contrast, the countries with the lowest level of IED are Ukraine, Moldova, and Serbia.

Identificationof the impact of the COVID-19 pandemic on the socio-economic development of the country reflects that the pandemic led to the aggravation of problems in the labor market, deterioration of the population's well-being, reduction of business profitability. In addition, there was a qualitative transformation of business models focused on remote technologies and digitalization. Intensification of e-governance implementation processes took place in the system of state and municipal administrative bodies. Thus, the pandemic, on the one hand, led to large-scale losses of socioeconomic origin but, on the other hand, contributed to the introduction of innovative technologies. However, the impact of COVID-19 is not unidirectional and similar in scale across countries.

The empirical part of this study involves testing four hypotheses, namely: (1) an increase in the level of economic development of the country leads to a decrease in income inequality; (2) the growth of income inequality negatively affects the dynamics of the country's economic development; (3) during the COVID-19 pandemic, the positive impact of the increase in the level of economic development of the country on the reduction of income inequality became weaker; (4) during the COVID-19 pandemic, the negative impact of the growth of income inequality on the economic development of the country became stronger. . Hypotheses testing was carried out using panel data regression modeling (random effects model, the appropriateness of which was confirmed by the Hausman test).

According to the research results, hypotheses (1) and (2) were confirmed, and hypotheses (3) and (4) were refuted. At the same time, it should be noted that for this sample of 15 countries, an increase in the country's Economic Development Index leads to a slight decrease in the Gini index (-0.0061% at the maximum value of the indicator at 100%). In

contrast, the increase in income inequality causes an abnormal decrease in the IED (-26.6056 units at the maximum value of 1). Thus, the influence of the social parameter on the economic one has a much higher effect than vice versa.

Also interesting are the results that made it possible to refute hypotheses (3) and (4). In particular, according to the simulation results, it was found that with elimination of pandemic years from modeling the strength of the connection between the parameters in both models decreases, which allows us to conclude about the significant contribution of the pandemic years to the interdependence between income inequality and economic development. At the same time, it was established that the elimination of 2020-2021 led to a weakening of the influence of IED on the Gini index by 3.28%, while in the opposite direction, the strength of the connection lost as much as 14.37%. In the pandemic period, the influence of the social parameter on the economic one is more significant than vice versa. In addition, it is established with a 99% confidence probability that the pandemic leads to a decrease in the Gini index by 2.42% and an increase in the country's Economic Development Index by 0.0277.

Such a positive impact of the pandemic on the socioeconomic dynamics in the selected countries can be explained by their pre-pandemic development and the general elasticity of these parameters. The sample includes countries with an average and above-average level of economic development, for which income inequality varies from 23.2% to 51.93 %. Therefore the destructive impact was not so catastrophic because the system did not function so perfectly in pre-pandemic period.

Acknowledgment

This research was funded by the Ministry of Education and Science of Ukraine, grant number 0122U000778 (“Socio-economic recovery after COVID-19: modeling the implications for macroeconomic stability, national security and local community resilience”) and grant number 0122U000781 (“The impact of COVID-19 on the transformation of the system of medical and social security of population: economic, financial-budgetary, institutional-political determinants").

References

Acemoglu, D., Johnson, S., Robinson. I., & Thaicharoen, Y. (2004). Institutional causes. Macroeconomic symptoms: Volatility, crises and growth. *Journal of Monetary Economics, 50* (1), 49-123.

Alabdullah, T.T.Y., & Asmar, M. (2022). Under COVID-19 Pandemic Impact: Do Internal Mechanisms Play a Fundamental Role in Corporations' Outcomes. *Business Ethics and Leadership, 6* (1), 83-91. https://doi.org/10.21272/bel.6(1).83-91.2022

Androniceanu, A., Kinnunen, J., Georgescu, I. (2020). E-Government clusters in the EU based on the Gaussian Mixture Models. *Public Administration and Management*, 35, 6-20. https://doi.org/10.24818/amp/2020.35-01

Bajra, UQ (2021). The interactive effects of remittances on economic growth and inequality in Western Balkan countries. *Journal of Business Economics and Management, 22* (3), 757-775. https://doi.org/10.3846/jbem.2021.14587

Basuki, B., Szczepańska-Woszczyna, K., Rajiani, I., Widyanti, R., & Kot, S. (2022). Working from home arrangement in delivering public service during the COVID-19 pandemic: innovation or irritation?. *Public Administration and Management*, 39, 26-39. https://doi.org/10.24818/amp/2022.39-02

Beňo, M. (2022). Estimating e-workability components across Central European countries. *AGRIS on-line Papers in Economics and Informatics*, 14(3), 3-16. https://doi.org/10.7160/aol.2022.140301.

Boronos, V., Zakharkin, O., Zakharkina, L., & Bilous, Y. (2020). The impact of the COVID-19 pandemic on business activities in Ukraine. *Health Economics and Management Review,* 1(1), 76-83. https://doi.org/10.21272/hem.2020.1-07

Brody, D., & Smith, W. (2022). On the use of principal components analysis in index construction. *The Journal of Finance & Data Science*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4294718

Brychko, M., Bilan, Y., Lyeonov, S., & Mentel, G. (2021). Trust crisis in the financial sector and macroeconomic stability: A structural equation modeling approach. *Economic Research-Ekonomska Istrazivanja*, 34(1), 828-855. https://doi.org/10.1080/1331677X.2020.1804970

Brychko, M., Bilan, Y., Lyeonov, S., & Streimikiene, D. (2022). Do changes in the business environment and sustainable development really matter for enhancing enterprise development? Sustainable Development, https://doi.org/10.1002/sd.2410

Capolupo, N., Palumbo, R., Adinolfi, P. (2022). All that Glitters is not Gold. Exploring Virtual Team Adoption in the Covid-19 Era. *International Journal of Entrepreneurial Knowledge,* 10(1), 46-64. https://doi.org/10.37335/ijek.v10i1.148

Castro, FAO (2022). The Asian entrepreneurship core in the COVID-19 period: value chains, specialized education, massive participation of women and strategic accompaniment. *SocioEconomic Challenges*, 6(3), 132-147. https://doi.org/10.21272/sec.6(3).132-147.2022

Didenko, I., Paucz-Olszewska, J., Lyeonov, S., Ostrowska-Dankiewicz, A., & Ciekanowski, Z. (2020). Social security and behavioral aspects of population financial inclusion: A multicountry analysis. *Journal of International Studies*, 13(2), 347-359. https://doi.org/10.14254/2071-8330.2020/13-2/23

Dvorský, J., Čepel, M., Kotásková, A., & Bugánová, K. (2021). Differences in business risk effects on the future of SMEs due to the Covid-19 pandemic . *International Journal of Entrepreneurial Knowledge,* 9(2), 14-31. https://doi.org/10.37335/ijek.v9i2.144

Fadel, S., Rouaski, K., Zakane, A., & Djerboua, A. (2021). Estimating Climate Influence Of The Potential Covid-19 Pandemic Spreading In Algeria. *SocioEconomic Challenges*, 6(1), 24-40. https://doi.org/10.21272/sec.6(1).24-40.2022

Fertö, I., Bojnec, Š., & Podruzsik, S. (2022). Do Subsidies Decrease the Farm Income Inequality in Hungary? *AGRIS on-line Papers in Economics and Informatics,* 14 (2), 49-56. https://doi.org/10.7160/aol.2022.140204 .

Gonos, J., Tomkova, A., Culkova, K., & Lisuch, J. (2023). Influence of Human Development Index to the State Economy in V4 Region. *Montenegrin Journal of Economics*, 19 (1), 69-82.

Govdeli, T. (2022). Economic Growth, Domestic Savings and Fixed Capital Investments: Analysis for Caucasus and Central Asian Countries. *Montenegrin Journal of Economics* 18(3), 145-153.

Grebosz- Krawczyk, M., & Siuda, D. (2022). The COVID-19 Pandemic Impact on the TV Commercials Content in European Countries. *Marketing and Management of Innovations*, 2, 76-85. https://doi.org/10.21272/mmi.2022.2-07

Grenčíková, A., Habánik, J., Španková, J., Húževka, M., & Šrámka, M. (2022). Current Labor Market Challenges in the Light of Future Economic and Demographic Developments. *European Journal of Interdisciplinary Studies*, 14(1), 100-112.

Hasan, F., Islam, M.R., & Ishrat, F. (2022). COVID-19 Pandemic Impact on the Supply Chains of UK-Based Multinational Manufacturing Companies. *Business Ethics and Leadership, 6* (2), 44-67. https://doi.org/10.21272/bel.6(2).44-67.2022

Hinrichs, G., & Bundtzen, H. (2021). Impact of COVID-19 on personal insurance sales – Evidence from Germany. *Financial Markets, Institutions and Risks*, 5(1), 80-86. https://doi.org/10.21272/fmir.5(1).80-86.2021

Jurczuk, A., & Florea, A. (2022). Future-Oriented Digital Skills for Process Design and Automation. *Human Technology*, *18* (2), 122–142. https://doi.org/10.14254/1795-6889.2022.18-2.3

Jurek, P., Korjonen-Kuusipuro, K., & Olech, M. (2021). When technology use causes stress: Challenges for contemporary research. *Human Technology, 17* (3), 190–196. https://doi.org/10.14254/1795-6889.2021.17-3.1

Karácsony, P., Vasa, L., Bilan, Y., & Lipták, K. (2021). Hungarian Experiences of the Transition from Traditional Work to Telework. *Transformations in Business & Economics* 20(3), 168-182.

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

Kot, S.M., & Paradowski, P.R. (2022). The atlas of inequality aversion: theory and empirical evidence on 55 countries from the Luxembourg Income Study database. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *17* (2), 261–316. https://doi.org/10.24136/eq.2022.010

Kuzior, A., Mańka-Szulik, M., & Krawczyk, D. (2021). Changes in the management of electronic public services in the metropolis during the COVID-19 pandemic. *Polish Journal of Management Studies*, 24(2), 261-275. https://doi.org/10.17512/pjms.2021.24.2.16

Laskienė, D., Zykiene, I., & Verdnikovaite, P. (2020). Assessment of the Impact of Income Inequality on Population's Migration. *The Engineering Economics, 31,* 547-557.

Laurinavičius, A., Laurinavičius, A., & Laurinavičius, A. (2020). Impact of income inequality on emigration: Case of Lithuania and other new EU member states. *Business, Management and Economics Engineering*, *18* (2), 265-281. https://doi.org/10.3846/bme.2020.12683

Lopez, B.S., & Alcaide, A.V. (2020). Blockchain, AI and IoT to improve governance, financial management and control of crisis: case study of COVID-19. *SocioEconomic Challenges*, 4(2), 78-89. https://doi.org/10.21272/sec.4(2).78-89.2020 .

Lulaj, E. (2022). An unstoppable and navigating journey towards development reform in complex financial-economic systems: an interval analysis of government expenses (past, present, future). *Business, Management and Economics Engineering*, *20*(2), 329–357. https://doi.org/10.3846/bmee.2022.17389

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

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

Nardo, M.; Saisana, M.; Saltelli, A.; Tarantola, S. (2005). Tools for Composite Indicators Building. Retrieved from http://publications.jrc.ec.europa.eu/repository/bitstream/JRC31473/EUR%2021682%20EN.pdf

Oliinyk, O., Bilan, Y., Mishchuk, H., Akimov, O., & Vasa, L. (2021). The Impact of Migration of Highly Skilled Workers on The Country's Competitiveness and Economic Growth. *Montenegrin Journal of Economics,* 17(3), 7-19. https://doi.org/10.14254/1800-5845/2021.17-3.1

Omran, E.A.N., & Bilan, Y. (2022). Female Labor Force Participation and the Economic Development in Egypt. *European Journal of Interdisciplinary Studies*, 14(1), 1-12.

Pimonenko, T., Lyulyov, O., Us, Y. (2021). Cointegration between Economic, Ecological and Tourism Development. *Journal of Tourism and Services*, 23(12), 169-180. https://doi.org/10.29036/jots.v12i23.293

Popescu, C.R.G. (2022). Human capital impact on the global performance of the European Union in the period 2007-2019. *Transformations in Business & Economics*, 21, 1(55), 169-208.

Privara, A. (2022). Economic growth and labor market in the European Union: lessons from COVID-19. *Oeconomia Copernicana*, *13*(2), 355–377. https://doi.org/10.24136/oc.2022.011

Rahmanov, F., Mursalov. M., & Rosokhata, A. (2021). Consumer behavior in the digital era: impact of COVID 19. *Marketing and Management of Innovations*, 2, 243-251. https://doi.org/10.21272/mmi.2021.2-20

Ray, A. (2021). Containing airborne transmission of COVID-19 and its implications for global economic recovery. *Business Ethics and Leadership, 5*(1), 81-88. https://doi.org/10.21272/bel.5(1).81-88.2021

Sardak, S., Korneyev, M., Dzhyndzhoian, V., Fedotova, T., & Tryfonova, O. (2018). Current trends in global demographic processes. *Problems and Perspectives in Management*, 16(1), 48-57. https://doi.org/10.21511/ppm.16(1).2018.05

Sawangchai, A., Prasarnkarn, H., Kasuma, J., Polyakova, A.G., Qasim, S. (2020). Effects of COVID-19 on digital learning of entrepreneurs. *Polish Journal of Management Studies*, 24(2), 261-275. https://doi.org/10.17512/pjms.2021.24.2.16

Shipko, A., Demikhova, N., Pajak, K., & Motrechko, V. (2021). Health management at the regional level: multivariable performance assessment. *Health Economics and Management Review*, 2, 8-16. http://doi.org/10.21272/hem.2020.2-01

Simovic, M. (2021). The impact of corruption on economic growth in the countries of southeast europe. *Transformations in Business & Economics*, 20, 1(52), 298-308.

Skare, M., Gil-Alana, L.A., Claudio-Quiroga, G., & Pržiklas Drujeta, R. (2021). Income inequality in China 1952-2017: persistence and main determinants. *Oeconomia Copernicana*, *12* (4), 863–888. https://doi.org/10.24136/oc.2021.028

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

Stata (2022). *Manual for Cronbach's alpha* . Retrieved from https://www.stata.com/manuals/mvalpha.pdf

Syahnur, S., Frohberg, K.K., Ryu, D., & Diantimala, Y. (2021). Enriching the socio-economic inequality model by using alternative indices. *Economics and Sociology*, 14(4), 47-72. https://doi.org/10.14254/2071-789X.2021/14-4/3

Tiutiunyk, I., Drabek, J., Antoniuk, N., Navickas, V., & Rubanov, P. (2021). The impact of digital transformation on macroeconomic stability: Evidence from EU countries. *Journal of International Studies*, 14(3), 220-234. https://doi.org/10.14254/2071-8330.2021/14-3/14

Tiutiunyk, I.V., Zolkover, A.O., Lyeonov, S.V., & Ryabushka, L.B. (2022). The impact of economic shadowing on social development: challenges for macroeconomic stability. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*, (1), 183-191. https://doi.org/10.33271/nvngu/2022-1/183

Tomchuk, O., Lepetan, I., Zdyrko, N., & Vasa, L. (2018). Environmental activities of agricultural enterprises: accounting and analytical support. *Economic Annals-XXI*, 169(1-2), 77-83. https://doi.org/10.21003/ea.V169-15

Tommaso, F. D. (2020). The New Italian Legislation on Corporate Governance and Business Crisis. The Impact of Covid-19 on SMEs and the Recent Rules to Mitigate the Effects. *Financial Markets, Institutions and Risks, 4*(4), 91-108. https://doi.org/10.21272/fmir.4(4).91-108.2020

Uslu, A., Alagöz, G., Güneş, E. (2020). Socio-cultural, Economic, and Environmental Effects of Tourism from the Point of View of the Local Community. *Journal of Tourism and Services, 21*(11), 1-21. https://doi.org/10.29036/jots.v11i21.147

Vasylieva, T., Kuzmenko, O., Rashid, M.N., Vojtovic, S., Kascha, M., & Lieonov, H. (2020). Innovations in government management of the healthcare system: forecasting of covid-19 consequences in social, investment and business development. *Marketing and Management of Innovations*, 4, 11-25. https://doi.org/10.21272/mmi.2020.4-01

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health Policy and Planning, 21*(6), 459–468. https://doi.org/10.1093/heapol/czl029

Wildowicz-Szumarska, A. (2022). Is the redistributive policy of the EU welfare state effective in tackling income inequality? A panel data analysis. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *17* (1), 81–101. https://doi.org/10.24136/eq.2022.004

World Bank DataBank. (2022). Retrieved from https://databank.worldbank.org/home.aspx

Yarovenko, H., Bilan, Y., Lyeonov, S., & Mentel, G. (2021). Methodology for assessing the risk associated with information and knowledge loss management. *Journal of Business Economics and Management*, 22(2), 369-387. https://doi.org/10.3846/jbem.2021.13925

Zhang, L., Chen, Y., Lyulyov, O., & Pimonenko, T. (2022). Forecasting the effect of migrants' remittances on household expenditure: COVID-19 impact. *Sustainability (Switzerland)*, 14(7). https://doi.org/10.3390/su14074361

Zhu, X., Li, T., & Shang, H. (2022). The Impact of Online Sales on Recovery from COVID-19. *Engineering Economics*, 33(4), 444–457

Ziabina, Ye., Kwilinski, A., & Belik, T. (2021). HR management in private medical institutions. *Health Economics and Management Review*, 2(1), 30-36. https://doi.org/10.21272/hem.2021.1-03