

I. V. Tiutiunyk<sup>1</sup>,  
orcid.org/0000-0001-5883-2940,  
A. O. Zolkover<sup>2</sup>,  
orcid.org/0000-0002-8176-1850,  
S. V. Lyeonov<sup>1</sup>,  
orcid.org/0000-0001-5639-3008,  
L. B. Ryabushka<sup>1</sup>,  
orcid.org/0000-0001-8597-6819

1 – Sumy State University, Sumy, Ukraine, e-mail: [i.karpenko@finance.sumdu.edu.ua](mailto:i.karpenko@finance.sumdu.edu.ua)  
2 – Kyiv National University of Technologies and Design, Kyiv, Ukraine

## THE IMPACT OF ECONOMIC SHADOWING ON SOCIAL DEVELOPMENT: CHALLENGES FOR MACROECONOMIC STABILITY

**Purpose.** To develop a model of investigating the link between the level of shadow economy and indicators of social development of the country.

**Methodology.** The study of the relationship between the analyzed indicators was conducted using general and special research methods. The established hypotheses were tested using VAR/VEC modeling. Dickey-Fuller test, the Phillips-Perron test, Joansen test are used in the work.

**Findings.** The paper identifies the risks of the shadow economy for social indicators of macroeconomic stability. Based on the analysis of the country's social development indicators, indicators were identified that are most sensitive to changes in the level of the shadow economy which are: Gini coefficient, average income ratio of 10 % of the richest to 10 % of the poorest, average income ratio of 20 % of the richest to 20 % of the poorest sections of the population, Human Development Index, gross average wage. The EU countries and Ukraine are identified as the statistical base of the study and the assessment period is 2005–2020. The results of modeling proved the relationship between the level of shadow economy and indicator of social development.

**Originality.** The approach to assessing the relationship between the level of the shadow economy and indicators of social development of the country by considering the indicators that most fully characterize the level of social protection and material well-being of the population has been improved.

**Practical value.** The scientific contribution of the paper is that existing research on the impact of shadow economy on the level of social development of the countries remains fragmented, as well as studies assessing its effect on the macroeconomic stability. The impulse response function constructed by the authors may provide some insight into better understanding of the indicators of social development, the most sensitive to the shadow economy shocks. The results of estimation can be used for practical or scientific purposes.

**Keywords:** *shadow economy, macroeconomic stability, social development, economic development, cointegration*

**Introduction.** The shadow economy is a threat to the activity of the whole country. The negative consequences of its influence are observed in all spheres of the country's work. Today, in the scientific literature, there is a significant amount of scientific works devoted to studying the shadow economy impact on economic development indicators, including GDP, inflation, tax revenues, exchange rates, foreign direct investment, and so on. At the same time, the issues on the relationship between the shadow economy level and the country's social development indicators, the scale of which quite often corresponds to or even exceeds the impact on economic indicators, have not been entirely studied.

Social security is closely related to macroeconomic stability and prosperity. As a result, the shadow economy is a significant risk factor that has a destructive impact on the country's social development and stability. The level of the shadow economy causes changes in the income of the population and, thanks to the income redistribution mechanism, has a significant impact on the living standard of individual households and the country in particular. These relationships have found theoretical and empirical confirmation in many scientists' research.

Social security at the individual level is perceived as a state-guaranteed condition creating a sense of security and confidence in the availability of compensation and benefits.

This perception largely determines the motives of economic behavior in the domestic labor market, the tolerance degree for possible informal employment and income, and the motives of migration decisions to find an environment with a higher level of economic security.

Thus, tax revenues, particularly the social contributions, are quite sensitive to changes in the level of the shadow econ-

omy. Tax evasion, including personal income tax and social security contributions, accompanied by shadow employment, underestimation of the declared wage leads to underestimating funding for social development programs, financial incentives and support for vulnerable groups, and others. Reduction of tax revenues is one of the main prerequisites for reducing budget funding for the social sphere, including cultural and educational institutions, health care, social protection and others.

**Literature review.** In the scientific literature, there are studies on the relationship between the level of the shadow economy and individual social development indicators. In their work, A. Katrechka and S. Dahlberg analyze the relationship between the level of the shadow economy and individual indicators of social development. The authors suppose that the most closely shaded financial flows affect the life expectancy of the population, the HIV prevalence, enrollment in school, and the mortality rate of the people under five years old [1]. During the research, the authors built four econometric models on the example of 58 countries, among which 31 are highly developed countries and 27 – with an average level of development. The authors concluded a statistically significant negative impact of the shadow economy on these indicators based on empirical calculations. At the same time, life expectancy, school enrollment, and mortality of the population under five years old in low- and middle-income countries are most sensitive to the shadow economy-level changes. For example, an increase in the level of the shadow economy by 1 % will increase the population's mortality rate under five years by 4.66 people per 1,000 newborns, the level of HIV incidence by 0.12 %.

Based on empirical studies on the relationship between the population involved in informal activities and the marginality degree of the lower class.

The impact of the shadow economy on the country's social development indicators has been thoroughly studied by many scientists.

One of the most common indicators that reflects the social component of the national economy stability is the Human Development Index. The advantages of empirical calculations include its international dimension and the ability to compare individual countries. In their work, A. Amendola and R. Del Anno studied some aspects in calculating the relationship between the shadow economy and the index data [2]. Based on the construction of the econometric model, the authors substantiate the U-shaped relationship between these indicators for Latin American countries (Fig. 1).

One of the most relevant problems that attract the world community's attention is high unemployment. This problem is urgent for most countries, regardless of their economic development level. One of the triggers in these processes is the country's low macroeconomic stability. It involves reducing production, increasing the number of bankrupt enterprises, deteriorating performance of small and medium businesses, low official minimum wage, the high tax burden on individuals, etc. These factors lead to an increase in the official unemployment rate in the country and, accordingly, an increase in the share of full or partial informal employment in the country. Most of the population – participants in the shadow activities identify themselves as having a low level of material well-being. Therefore, they consider the shadow sector of the economy to contribute to improving the population welfare, increasing its well-being and income.

Vorontsova, et al. [4] studied the impact of shadow financial flows on income inequality between certain segments of society. Scientists emphasize that income inequality growth causes an increase in the scale of shadow activity. At the same time, the paper substantiates the existence of a two-way link between the shadow economy and income inequality. Considering inequality as one of the shadowing triggers, the authors emphasize that shadowing growth is often a prerequisite for income inequality among the population.

Juarez-Garcia M. holds a similar opinion. She proved the existence of a positive correlation between the levels of the shadow economy and the material well-being of the population based on the results of building econometric models. At the same time, the author emphasized that these trends persist under the condition of an individual in shadow operations. As the number of participants grows, the nature of the relationship changes from positive to negative. Given the fact that most shadow schemes of income concealment involve more than one person, increasing the level of shadow economy only exacerbates income inequality [5].

No less significant influence on the shadow economy level is exerted by the volume of wages in the official and shadow

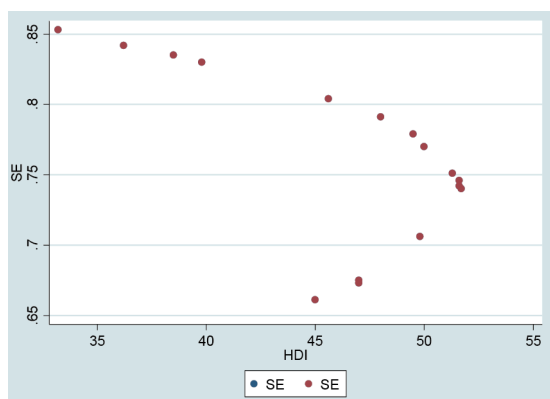


Fig. 1. The quadratic relationship between HDI and the shadow economy on the example of Latin America for the period 2005–2020 [3]

sectors of the economy [6, 7]. A considerable excess of wages in the shadow sector of the economy over the official is seen as a driving force in making decisions in favor of informal employment [8–10].

The obtained conclusions correlate with the results of comparing the shadow economy level and the number of people at the poverty level (Fig. 2).

At the same time, employment in the informal sector is seen as a threat to social protection [11]. As a rule, these workers are deprived of the guarantees provided by the state and the employer within the official sector of the economy, including benefits in case of disability [12] or certain insured events [13], violation of labor laws by the employer, late payment of wages [14], and so on.

The results of comparing the level of the shadow economy with the population in a difficult financial situation shown in Fig. 3 confirm the existence of a direct correlation between them. The population growth in a difficult financial position is accompanied by an increase in the shadow economy sector, as such, which they see as a guarantee of improving material well-being.

In addition, given the informal nature of this employment in the future, such persons receive a much smaller amount of pension benefits.

No less important generalizing indicator that characterizes the country's social development level is the Gini coefficient, which determines the disparities in the level of material well-being of different population segments. The shadow economy growth and the decline in the level of material protection of the population leads to a deterioration of social standards that dominate in society and, accordingly, an increase in poverty in the country.

The comparative analysis results of the shadow economy levels and the Gini coefficient of the countries we mentioned for the period 2004–2020 in Fig. 4, show that there is a direct

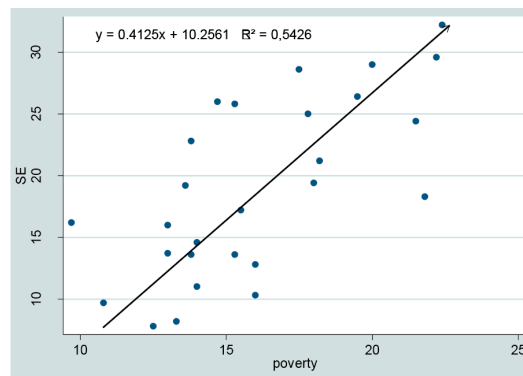


Fig. 2. Relationship between the level of the shadow economy and the number of people at the poverty level [3]

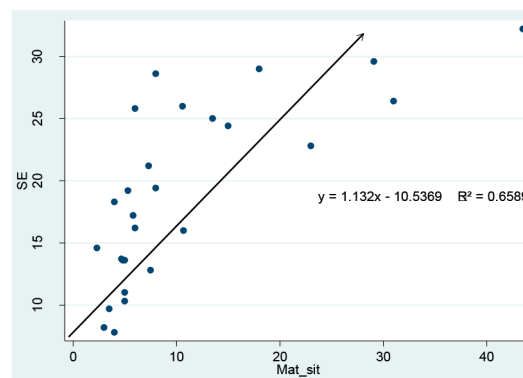


Fig. 3. Relationship between the shadow economy level and the number of people in a difficult financial situation [3]

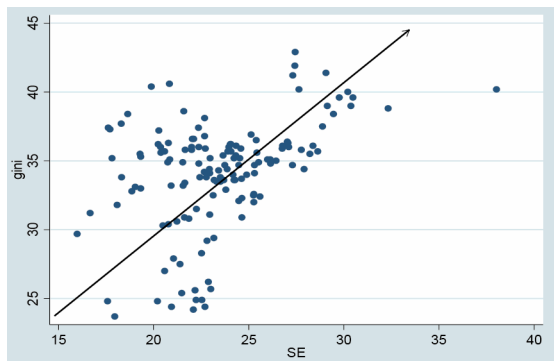


Fig. 4. The relationship between the shadow economy level and the Gini coefficient of the analyzed countries for the period 2004–2020 [3]

relationship between them. The growth of the shadow economy level occurs with a simultaneous increase in income inequality of certain segments of the analyzed countries' population.

Vasylieva, et al. [15], Brychko, et al. [16], Poliakh & Alikariyev [17], Bouchetara [18] emphasize the positive role of shadow economy in the country's social development. According to the authors, the active development of shadow processes contributes to the creation of new jobs, improving the financial situation of the population, the money supply growth, which is formed in the shadow economy sector and then rotates in the official sector.

**Unsolved aspects of the problem.** Despite numerous studies on the impact of the shadow economy on the macroeconomic stability of the country, the analysis of the relationship of shadow operations with indicators of material well-being of the population and their social protection remain poorly studied.

**Purpose of the article:** to develop a model of investigating the link between the level of shadow economy and indicators of social development the country.

**Methods.** The results of the above analysis form the following hypotheses about the relationship of shadow economy with social development indicators:

1) the shadow economy causes a reduction in poverty in the country by improving the material well-being of the population, which is reflected in the reduction of the Gini coefficient;

2) a prerequisite for the development of the shadow economic sector is the low average wages in the country. The low material well-being of the population reduces the trust in state institutions and creates preconditions for finding additional earnings from both legal and illegal sources;

3) the shadow economy level is higher in countries with a significant gap in the income of the richest and poorest sections of the population. Thus, income inequality leads to the search for low-income groups of sources of additional income, including shadow ones;

4) the lower the shadow economy level is, the better the living conditions of the population are along with easier access to knowledge and longer life of the population, which is reflected in the values of the Human Development Index.

The hypotheses established in the paper are based on the country's social development indicators, which according to the above analysis, are most affected by the shadow economy, in particular: the Gini coefficient (ID), average income ratio of 10 % of the richest to 10 % of the poorest (I10), average income ratio of 20 % of the richest to 20 % of the poorest sections of the population (I20), the Human Development Index (HDI), gross average wage (OS).

We will check the validity of the hypotheses put forward in the works using VAR- or VEC-model, the choice of which depends on the stationarity/non-stationarity, cointegration/non-integration of time series.

1. A vector error correlation model (VEC model) will be used for the non-stationary statistical spatial data panel

$$\Delta y_t = a_0 + A y_{t-1} + \sum_{m=1}^p A_m \Delta y_{t-m} + \sum_{n=0}^q B_n \Delta x_{t-n} + \varepsilon_t,$$

where  $\Delta y_t = y_t - y_{t-1}$  is differentiated operator;  $A$  is matrix of coefficients for the first lag;  $A_m, B_n$  are matrices for each lag.

2. For stationary indicators the VAR model will be used

$$y_t = a_0 + \sum_{m=1}^p A_m y_{t-m} + \sum_{n=0}^q B_n x_{t-n} + \varepsilon_t,$$

where  $a_0$  is vector average value of the series  $A_m$ , coefficient matrix for each time lag;  $\varepsilon_t$  is multidimensional Gauss indicator function with mean zero.

3. For a non-stationary statistical spatial panel of non-integrated data, the VAR model in differences will be used.

**Results.** At the first initial stage of testing the hypothesis about the relationship between the shadow economy level with the country's social development indicators, we conduct a comparative analysis of the data series stability, the results of which are shown in Table 1.

The obtained results indicate a significant variability of the analyzed data series. The coefficients of the ratio between average income of 10/20 % of the richest to 10/20 % of the poorest sections of the population are the most variable for all analyzed countries.

The standard deviation of the country's social development indicators is of a significant scale. The ratios of the average income of 10/20 % of the richest to 10/20 % of the poorest sections of the population and the gross average wage size are the most variable for Ukraine and other analyzed countries. At the same time, for countries with higher economic development and a lower shadow level, these values are much lower than in Ukraine. If the variation coefficient of the ratio between the average income of 10 % of the richest and 10 % of the poorest sections of the population is 0.063 for the Czech Republic, this indicator is almost three times higher for Ukraine, as a country with a higher shadow economy. The results shown in Table 1 demonstrate the similarity of trends for other social development indicators of the country.

The correlation analysis results, conducted using the multiple regression method, show a significant impact made by the shadow economy on social development indicators in terms of all countries. Most results are statistically significant at 0.1 and 0.05 %.

The use of the multiple regression method is to build an econometric model as follows

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + u_i, \quad i = 1, \dots, n.$$

The formation of the OLS model is based on the following assumptions:

1. Regressors ( $X_{1i}, X_{2i}, \dots, X_{ki}, Y_i$ ),  $i = 1, \dots, n$ , are modelled in such a way that i.i.d. assumption is executed.

2.  $u_i$  – the error term with a conditional mean zero considering the regressors, i. e.  $E(u_i | X_{1i}, X_{2i}, \dots, X_{ki}) = 0$ .

3. Significant deviations are unlikely.

4. Perfect multicollinearity is absent.

The calculation results, listed in Table 2 show no correlation between the shadow economy level and the Gini index, the Human Development Index. For all analyzed countries, the impact of the shadow economy on the Human Development Index, the level of average wages, and the ratio of the average income of the richest to the poorest sections of the population was confirmed.

We check the all-time series for stationarity using the Dickey-Fuller test to build a model of the social development indicators dependence on the shadow economy level.

The paper will use the extended Dickey-Fuller test (1981), taking into account the difference of the n-th order for five variables to test the hypothesis about the stationarity of variables and determine their integration order

Table 1

Stability indicators of the analyzed data series for the period 2005–2020 [3]

Country	Indicator	Value	Stand. deviation	Maximum value	Minimum value
Ukraine	ID	26.1745	1.7677	24.0	24.9
	I10	9.9555	0.2258	9.6	10.3
	I20	6.2766	0.6258	5.4	7.3
	HDI	0.6865	0.0113	0.7	0.7
	OS	227.2270	63.0363	123.0	363.0
Poland	ID	33.0638	0.5475	29.7	35.8
	I10	3.9697	0.2184	3.6	4.5
	I20	4.7884	0.3048	4.3	5.5
	HDI	0.7745	0.0978	0.7	0.8
	OS	837.4795	135.7780	591.0	1076.0
Czech Republic	ID	26.2430	0.5440	24.9	27.1
	I10	3.0429	0.0630	2.9	3.1
	I20	3.6531	0.062494	3.5	3.7
	HDI	0.8331	0.0115	0.9	0.9
	OS	936.3735	163.4788	616.0	1243.0
Slovakia	ID	26.6729	1.2601	24.7	29.3
	I10	2.9348	0.8852	0.0	3.3
	I20	3.8231	0.1859	3.6	4.4
	HDI	0.7945	0.0079	0.8	0.8
	OS	811.1603	110.3864	614.0	1013.0
Slovenia	ID	24.9919	0.6837	23.7	26.2
	I10	3.1433	0.1109	3.0	3.3
	I20	3.6065	0.1141	3.3	3.8
	HDI	0.8403	0.0109	0.8	0.9
	OS	1473.2264	154.4084	1157.0	1682.0
Romania	ID	36.4954	1.2774	34.4	39.6
	I10	5.8927	0.3794	5.2	6.4
	I20	7.0918	0.6148	6.0	8.1
	HDI	0.7142	0.0099	0.7	0.7
	OS	516.1995	169.9556	275.0	965.0
Hungary	ID	30.0042	2.0367	27.0	34.7
	I10	3.2746	0.2142	2.9	3.6
	I20	4.0160	0.3317	3.4	4.4
	HDI	0.7727	0.0065	0.8	0.8
	OS	787.6380	107.0311	638.0	1035.0
Croatia	ID	31.9383	0.8007	30.4	32.6
	I10	8.5510	0.1855	8.2	9.0
	I20	7.7478	0.2028	7.5	8.2
	HDI	0.7359	0.0304	0.7	0.8
	OS	1022.2869	72.8710	844.0	1139.0
Lithuania	ID	35.8891	1.7510	32.5	38.4
	I10	5.3521	0.3750	4.9	6.0
	I20	6.4873	0.3302	5.3	7.5
	HDI	0.7602	0.0138	0.7	0.8
	OS	682.6530	222.1224	370.0	1296.0

End of Table 1

Latvia	ID	35.9895	1.3408	34.2	39.0
	I10	5.1127	0.4425	4.5	5.8
	I20	6.6493	0.5479	4.7	7.9
	HDI	0.7512	0.0146	0.7	0.8
	OS	701.2223	181.3699	350.0	1033.0
Estonia	ID	32.6686	1.3908	30.4	35.1
	I10	5.1050	0.1951	4.7	5.2
	I20	6.5267	0.6283	5.2	7.1
	HDI	0.7926	0.0142	0.8	0.8
	OS	908.2615	227.7183	516.0	1310.0

Table 2

Values of multiple regression coefficients to link the shadow economy with social development indicators for the period 2005–2020 [3]

Country		HDI	I20	I10	ID	OS
Ukraine	regress	0.0004	-0.0338	-0.0209	0.0316	-13.8139
	cons	0.6693	7.0063	5.9391	24.6589	773.4223
Poland	regress	-0.0058	1.0617	0.5519	0.4504	-36.7736
	cons	0.0896	0.1472	2.8528	24.0463	1552.6011
Czech Republic	regress	-0.0043	0.0249	0.0159	0.3283	-80.7588
	cons	0.8831	3.3477	2.8454	22.2838	1864.1853
Slovakia	regress	-0.0049	0.0913	-0.0383	0.6212	-79.0108
	cons	0.8535	2.7022	3.6000	19.0031	1753.3526
Slovenia	regress	0.0023	0.0373	-0.0282	0.2093	25.4369
	cons	0.7879	2.7972	3.5285	20.4396	908.1814
Romania	regress	-0.0022	0.0289	0.0194	0.3691	-38.6162
	cons	0.7707	6.3426	5.3816	27.2432	1461.2077
Hungary	regress	-0.0003	-0.0059	-0.0720	0.1752	-39.2539
	cons	0.7763	4.1319	4.8208	26.1273	1614.3638
Croatia	regress	0.0105	0.0162	0.0162	0.0408	5.5061
	cons	0.4778	8.1313	7.3305	30.8708	883.8596
Lithuania	regress	-0.0021	-0.1452	-0.0659	-0.3428	-41.0719
	cons	0.8025	9.4196	6.4356	42.7483	1449.0576
Latvia	regress	-0.0037	0.0601	0.0089	0.3091	-54.6650
	cons	0.8172	5.5526	5.1772	30.3438	1652.6680
Estonia	regress	-0.0005	0.0358	0.1328	-0.1478	-42.6433
	cons	0.7972	4.3916	3.9176	35.4528	1705.6820

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$ . Standard errors are indicated in parentheses

$$x_t = D_t \gamma_1 + \gamma_2 x_{t-1} + \sum_{i=1}^n \pi_i \Delta x_{t-i} + \varepsilon_t,$$

where  $D_t$  is deterministic term vector (constant, trend, etc.);  $n$  is time lag differences;  $\Delta x_{t-i}$  is ARMA-structure of the error; but  $\varepsilon_t$  is the error term.

According to the calculation results, most analyzed indicators of the country's social development and the shadow economy level are non-stationary. The absolute calculated value is less than the critical value at the level of 1, 5 and 10 % of weight.

According to the results of the Dickey-Fuller test, the value of t-statistics for the Estonian Human Development Index is  $-2.66$ , for the Gini index is  $-3.12$ , which is less critical for a sample of at least 25 and allows us to conclude that the data series are nonstationary. The similar results were obtained for other indicators of social development. At the same time, the values of t-statistics exceed the critical ones for the average wages and coefficients of the ratio of average income of the richest to the poorest sections of the population.

We analyze the data series using the Phillips-Perron test to verify the validity of the obtained results on the data series stationarity. It assumes of autocorrelation, heteroskedasticity, and optional normal distribution of a random component with zero mathematical expectation  $u_t$ . Thus, the Phillips-Perron test, in contrast to the Dickey-Fuller test, allows us to consider a wider class of time series data.

The values of t-statistics for the Phillips-Perron test in Table 5.3 do not confirm the null hypothesis of a single root about the stationarity of the analyzed data series at a 10 percent level of weight. According to the Dickey-Fuller test, the values of the Human Development Index and the Gini Index are such that they need to be corrected by bringing them to a steady state. We check the stationarity of the first differences of the data series, whose results are shown in Table 4.

The obtained calculation results do not allow rejecting the hypothesis regarding the presence of a single root in the time series. The value of t-statistics in the first differences exceeds the critical one at all levels of weight. Since the p-value values for all data series do not exceed 10 %, the null hypothesis of nonstationarity of the first data series differences can be rejected with an error probability of almost 0 %.

The results obtained in this way enable to conclude about the stationarity of the first differences regarding data series and their order of integration 1.

Table 3

Results of the extended Dickey-Fuller test and the Phillips-Perron test for the shadow economy level and the country's social development indicators for the period 2005–2020 [3]

Countries	Indicator	ADF Test Statistics*			Philips Perron Test Statistics		
		Prob.	lag	Test statistic	Prob.	lag	Test statistic
Ukraine	ID	0.0001	1	-4.774*	0.2604	0	-2.061
	I10	0.0088	1	-3.469**	0.0082	0	-3.491**
	I20	0.0064	0	-3.569**	0.0053	0	-3.624**
	HDI	0.5536	1	-1.459	0.5949	0	-1.374
	OS	0.0816	1	-2.658***	0.2257	0	-2.148
	SE	0.0050	1	-3.645**	0.0125	0	-3.358**
Poland	ID	0.9985	0	1.876	0.9448	0	-0.145
	I10	0.3578	0	-1.846	0.0542	0	-2.829
	I20	0.2050	0	-2.203	0.0122	0	-3.367**
	HDI	0.3459	0	-1.871	0.3398	0	-1.884
	OS	0.8511	0	-0.683	0.8763	0	-0.576
	SE	0.8803	0	-0.557	0.7812	0	-0.920

Czech Republic	ID	0.8865	0	-0.528	0.9157	0	-0.366
	I10	0.0790	0	-2.672***	0.0900	0	-2.615
	I20	0.0413	0	-2.936***	6.056	0	1.0000
	HDI	0.2400	0	-2.111	0.2109	0	-2.187
	OS	0.8328	0	-0.752	0.8056	0	-0.845
	SE	0.2241	0	-2.152	0.2258	0	-2.148
Slovakia	ID	0.0004	0	-4.345*	0.0006	0	-4.230
	I10	0.2042	0	-2.206	0.5647	0	-1.436
	I20	0.0001	0	-4.671*	0.0002	0	-4.501
	HDI	0.0024	0	-3.857*	0.0002	0	-4.452
	OS	0.9482	0	-0.112	0.9452	0	-0.141
	SE	0.2042	0	-2.206	0.1963	0	-2.228
Slovenia	ID	0.0258	3	-3.111	0.5741	0	-1.417
	I10	0.9804	0	0.371	0.9961	0	1.216
	I20	0.6196	1	-1.321	0.7228	0	-1.081
	HDI	0.2364	1	-2.120	0.2368	0	-2.119
	OS	0.1019	0	-2.558	0.2036	0	-2.207
	SE	0.0745	1	-2.698***	0.2336	0	-2.127
Romania	ID	0.0030	1	-3.787	0.1858	0	-2.258
	I10	0.0413	1	-2.936	0.2704	0	-2.038
	I20	0.0415	1	-2.935	0.1709	0	-2.303
	HDI	0.0231	2	-3.149	0.5032	0	-1.561
	OS	0.9983	1	1.790	0.9975	0	1.500
	SE	0.6381	0	-1.280	0.6506	0	-1.253
Hungary	ID	0.0059	0	-3.594	0.0127	0	-3.353
	I10	0.5704	0	-1.425	0.5801	0	-1.404
	I20	0.6643	1	-1.221	0.6519	0	-1.250
	HDI	-3.450	0	0.0094	0.0001	0	-4.661
	OS	0.9619	0	0.042	0.9880	0	0.618
	SE	0.1006	0	-2.564	0.0892	0	-2.619
Croatia	ID	0.7329	2	-1.054	0.9174	0	-0.355
	I10	0.0194	0	-3.211**	0.0082	0	-3.491
	I20	0.0194	0	-3.211**	0.0082	0	-3.491
	HDI	0.0000	3	-6.414*	0.4295	0	-1.703
	OS	0.0871	0	-2.629	0.0903	0	-2.613
	SE	0.1066		-2.537	0.1564	0	-2.350
Lithuania	ID	0.4793	0	-1.609	0.4633	0	-1.638
	I10	0.5838	0	-1.397	0.5381	0	-1.491
	I20	0.2784	0	-2.019	0.3143	0	-1.938
	HDI	0.0702	0	-2.723	0.0344	0	-3.006
	OS	0.9441	0	-0.151	0.9177	0	-0.353
	SE	0.6185	0	-1.323	0.6145	0	-1.332
Latvia	ID	0.0077	0	-3.512**	0.0087	0	-3.474**
	I10	0.1354	2	-2.423	0.1838	0	-2.264
	I20	0.0026	0	-3.830*	0.0033	0	-3.764*
	HDI	0.5250	0	-1.517	0.4764	0	-1.613
	OS	0.7401	0	-1.035	0.7354	2	-1.048
	SE	0.3749	1	-1.811	0.4507	0	-1.662
Estonia	ID	0.0865	2	-2.632***	0.4827	0	-1.602
	I10	0.4595	2	-1.645	0.9885	0	0.637
	I20	0.6468	1	-1.261	0.9673	0	0.118
	HDI	0.0207	0	-3.189**	0.0179	0	-3.238**
	OS	0.9485	0	-0.110	0.9394	0	-0.193
	SE	0.1148	1	-2.503	0.3160	0	-1.934

\*  $p < 0.01$  \*\*  $p < 0.05$  \*\*\*  $p < 0.001$ . Standard errors are indicated in parentheses

1 % Critical Value =  $-3.750$ ; 5 % Critical Value =  $-3.000$ ; 10% Critical Value =  $-2.630$

Table 4

Results of the extended Dikey-Fuller test for the first increase in the number of tributes for the level of improvement and the country's social development indicators for the period 2005–2020 [3]

Country	Indicator	ADF Test Statistics*			Country	Indicator	ADF Test Statistics*			
		Prob.	lag	Test statistic			Prob.	lag	Test statistic	
Poland	ID	0.8222	1	-0.789	Slovakia	I10	0.0738	1	-2.701	
	I10	0.0004	0	-4.339*		OS	0.0913	0	-2.638	
	I20	0.0774	1	-2.681***			SE	0.0005	1	-4.255
	HDI	0.0108	1	-3.404**				Slovenia	ID	0.5346
	OS	0.0138**	0	-3.325**		I10	0.8948		0	-0.486
	SE	0.0052**	0	-3.631**		I20	0.0004		0	-4.348
Czech Republic	ID	0.0009	0	-4.124	HDI	0.0003	0		-4.360	
	I10	0.0004	1	-4.327	OS	0.0357	2		-2.991	
	I20	0.1160	1	-2.498	SE	0.0014	1		-3.997	
	HDI	0.0236	2	-3.143	Hungary	ID	0.0000	0	-6.439	
	OS	0.1640	0	-2.325		I10	0.0005	0	-4.251	
	SE	0.0000	0	-4.830		I20	0.0685	0	-2.733	
Romania	ID	0.0132	2	-3.341		HDI	0.0633	0	-2.766	
	I10	0.1402	1	-2.405		OS	0.1045	0	-2.547	
	I20	0.0861	1	-2.634		SE	0.0002	0	-4.452	
	HDI	0.1025	1	-2.556	Latvia	I10	0.0007	0	-4.167	
	OS	0.9473	0	-0.121		HDI	0.0000	0	-7.013	
	SE	0.0050	1	-3.640		OS	0.0050	1	-3.640	
Croatia	ID	0.0858	0	-2.636		SE	0.0112	1	-3.394	
	HDI	0.6925	0	-1.155	Estonia	ID	0.0629	0	-2.769	
	OS	0.2375	0	-2.118		I10	0.1697	0	-2.307	
	SE	0.0149	0	-3.300		I20	0.3700	0	-1.821	
Lithuania	ID	0.0083	0	-3.488		OS	0.0376	0	-2.972	
	I10	0.0138	0	-3.326		SE	0.0118	0	-3.376	
	I20	0.0074	0	-3.522		Ukraine	HDI	0.4199	0	-1.722
	HDI	0.0003	0	-4.389						
	OS	0.171	2	-2.301						
	SE	0.0472	0	-2.885						

The next step in choosing a model that describes the relationship between the shadow economy level and social development indicators of the analyzed countries is to check the data series for cointegration, which will be carried out using the Johansen test, which is calculated as follows.

At the first stage, the hypothesis of the analyzed data series cointegration is tested. In the case of the hypothesis confirmation for the rank, it is concluded that there is no common integration. The hypothesis is tested for all ranks using successive iterations. If the hypothesis is not confirmed, a conclusion is made about the lack of data series cointegration.

The calculation results in Table 5 show that obtained values for all data series are higher than critical and finally cointegrated ones. At the same time, the obtained results indicate the presence of different time lags for the analyzed data series. For gross average wages, statistics exceed 5 % (for Ukraine, the Czech Republic, Hungary, Croatia, and Latvia) and 1 % (Poland, Slovakia, Slovenia, Romania, Lithuania, Estonia) of critical values.

At the same time, the analyzed data series are cointegrated on different time lags. The data series on the ratio of the average income of 10 % of the richest to 10 % of the poorest sec-

tions of the population are cointegrated with a lag in 1 year (Romania, Hungary, Croatia) and 2 years (Ukraine, Slovenia, Estonia) and 3 (Poland, Slovakia).

Values for rank 1 are less than 5 and 1 % critical for Lithuania's gross average wage, the average income ratio of 10/20 % of the richest to 10/20 % of the poorest sections of the population and the Gini coefficient of Estonia

Thus, the results enable to conclude about reasonability to model the relationship between the shadow economy level and the social development of the analyzed countries by building a VAR model. It is the dependence of the shadow economy on lag differences in values of social development indicators and shadow economy and can be represented as the following equation

$$A(SE) = f(A(DHI(L)), A(IN20(L)), A(IN10(L)), A(DG(L)), A(OS(L)), A(SE(L))),$$

where  $A(CD(L))$  is the value of lag differences in a number of data of the  $i$  – indicator of the country's social development ( $CD$ );  $A(SE)$  is the value of lag differences in a number of indicators of the Human Development Index.

Only endogenous changes will be considered when building the model.

Table 5

Results of checking data series for cointegration (Joansen test) for the period 2005–2020 [3]

	Lag	Rank	5% of critical value	1% of critical value	Trace statistic				
					HDI	IN20	IN10	DG	OS
Ukraine	1	0	15.41	20.04	–	21.221	–	–	–
	2	0	15.41	20.04	19.567	–	19.206	33.161	17.982
Poland	3	0	15.41	20.04	479.72	46.800	35.143	20.540	54.309
Czech Republic	2	0	15.41	20.04	19.104	17.707	18.734	–	–
	3	0	3.76	6.65	–	–	–	31.891	19.127
Slovakia	1	0	15.41	20.04	19.313	19.842	–	18.883	–
	2		15.41	20.04	–	–	–	–	20.931
	3		15.41	20.04	–	–	14.569	–	–
Slovenia	1	0	15.41	20.04	16.997	–	–	–	–
	2	0	15.41	20.04	–	22.060	15.823	16.810	22.682
Romania	1	0	15.41	20.04	23.285	17.084	16.971	18.351	–
	2	0	15.41	20.04	–	–	–	–	20.559
Hungary	1	0	15.41	20.04	20.037	17.220	33.624	38.447	16.835
Croatia	1	0	15.41	20.04	19.777	16.997	33.187	37.947	16.616
Lithuania	0	0	15.41	20.04	27.164	29.990	33.196	36.446	–
	1	1	3.76	6.65	–	–	–	–	29.425
Latvia	0	0	15.41	20.04	63.832	26.127	24.670	–	17.524
	1	0	3.76	6.65	–	–	–	16.053	–
Estonia	0	0	15.41	20.04	28.891	–	–	–	–
	1	0	15.41	20.04	–	–	–	–	35.833
		1	1	3.76	6.65	–	3.838	–	–
2	1	3.76	6.65	–	–	15.844	20.153	–	

Table 6

The maximum time lag through which the impact of the shadow economy level on social development in Ukraine for the period 2005–2020 [3]

lag	LL	LR	df	p	FPE	AIC	HQOC	SBIC
HDI SE								
0	8.79723	–	–	–	0.000229	–2.71889	–3.13818	–2.87512
1	15.1568	12.719	4	0.013	0.000128	–3.66272	–4.9206	–4.13139
2	17.0514	14.30888	4	0.014	0.00014	–4.12056	–5.53568	–4.64781
3	19.18283	16.09748*	4	0.016	0.00016*	–4.63563*	–6.22763*	–5.22879*
IN20 SE								
0	–8.81638	–	–	–	0.03799*	2.40364	2.30906	2.44747
1	–6.67831	4.2761	4	0.370	0.06048	2.8174	2.53366	2.94889
2	568.761	1131.9*	4	0.000	–	122.391*	–123.243*	–121.997*
IN10 SE								
0	–7.36951	–	–	–	0.02754*	2.08211	1.98753	2.12594
1	–6.48384	1.7713	4	0.778	0.05792	2.77419	2.49045	2.90567
2	571.006	1132.7*	4	0.000	–	–122.89*	–123.742*	–122.496*
DG SE								
0	–21.8535	–	–	–	0.68857*	5.30078	5.2062	5.34461
1	–20.574	2.5591	4	0.634	1.32649	5.90533	5.62159	6.03681
2	–551.703	1117.8*	4	0.000	–	–118.601*	–119.452*	–118.206*
OS SE								
0	–60.0519	–	–	–	3345.61	13.7893	13.6947	13.8331
1	–29.8608	34.654	4	0.000	167.145*	9.74685	9.08479	10.0536
2	521.234	1102.2*	4	0.000	–	–111.83*	–112.681*	–111.435*

The time lag through which the impact of the shadow economy on social development indicators is maximum is to identify the time guidelines to implement the state policy of de-shadowing of the economy in the framework of leveling the negative impact on social development indicators in work using the maximum lag test. The results, confirmed by Akaike, Hannan-Quinn and Schwartz Bayes criteria, showed that for Poland, the Czech Republic, Romania, Lithuania and Estonia they have the maximum lag of 4 years, for Hungary and Croatia – 2 years. For the rest of the country, the maximum impact is in 5 years.

Table 6 shows the calculation results in Ukraine, the impact of shadow economy on the Human Development Index occurs with a time lag of 3 years, while for other social development indicators, the time lag does not exceed 2 years.

Graphs of responses of VAR model parameters to single and accumulated shocks of the shadow economy were constructed to visualize the results of modeling the impact of the shadow economy on the countries' social development indicators. The staticity of other model parameters was taken into account during the construction. The impulse function of the response of the gross average wage to the shocks of the shadow economy in Ukraine is shown in Fig. 5.

According to the modeling results, the coefficients of the ratio between average income of 10/20 % of the richest and 10/20 % of the poorest sections of the population, and the human development index are the most sensitive indicators to changes in the level of shadow economy in Ukraine. At the same time, the impact of changes in the shadow economy level is more noticeable in the short term than over a certain time horizon. The impulse response function to the level of the average wage in Ukraine and the shadow economy shocks showed a slight dependence between them.

We will analyze the parameters of its stability using a test for conditional stability of the eigenvalues of the models to verify the constructed model reliability. This test enables the assessment of the normality and stability of the model values.

Since the eigenvalues of the model shown in Fig. 6 are within a single circle of the model, it allows us to conclude the reliability of the established dependencies and the stability of the constructed model. Similar results were obtained for other indicators of the country's social development.

**Conclusions.** Thus, the analysis results indicate the sensitivity of the analyzed indicators of the country's social development to changes in the shadow economy level. The implementation of shadow schemes of income concealment has a negative impact on the social component of the country's development, worsening living conditions, in particular deepening income disparities of certain groups, reducing the financial

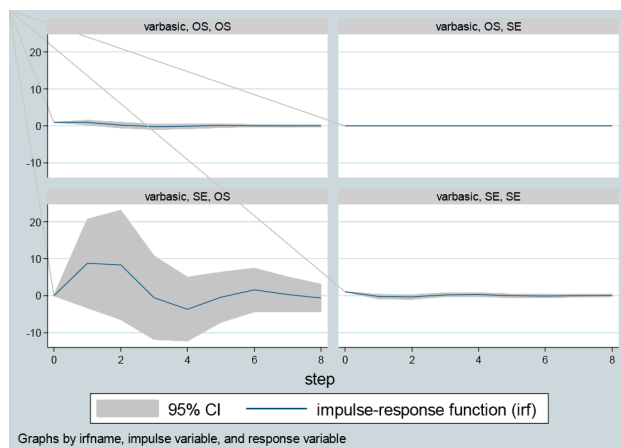


Fig. 5. Impulse response function of the gross average wage to the shadow economy shocks of Ukraine for the period 2005–2020 [3]

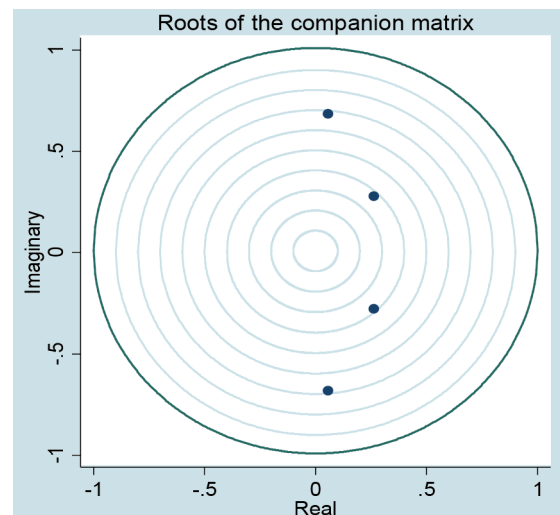


Fig. 6. The results of testing the VAR model for the stability of eigenvalues for the period 2005–2020 [3]

capacity of territories to finance programs and social activities, which negatively affects the satisfaction of public life.

In this context, it is necessary to consider the country's social development indicators in establishing partnerships with representatives of other states. The social development level is one of the indicators taken into account by international investors, organizations, representatives of other countries when making decisions on establishing partnerships with this country.

Given the statistically significant impact of the shadow economy on social development indicators of Ukraine, the de-shadowing of the economy can be considered as one of the tools to improve the material well-being of the population, raise living standards, etc.

**Acknowledgements.** This research was funded by the grant “Quadrocentric recursive model of de-shadowing of Ukraine's economy for growth of its macroeconomic stability” (0120U104798, funding – National Research Foundation, 2020–2021).

#### References.

- Katrechka, A., & Dahlberg, S. (2014). *The effect of the shadow economy on social development. A comparative study on advanced and least developed countries.* (Master's Thesis, University of Gothenburg).
- Amendola, A., & Dell'Anno, R. (2010). Institutions and Human development in the Latin America shadow economy. *Estudios En Derecho Y Gobierno*, 9-24.
- World Development Indicators* (n.d.). Retrieved from <https://data.worldbank.org/indicator?tab=all>.
- Vorontsova, A., Vasylieva, T., Bilan, Y., Ostasz, G., & Mayboroda, T. (2020). The influence of state regulation of education for achieving the sustainable development goals: Case study of central and eastern european countries. *Administratie Si Management Public*, 2020(34), 6-26. <https://doi.org/10.24818/amp/2020.34-01>.
- Juarez-Garcia, M.I. (2020). Personal Corruption & Corrupting Laws: Montesquieu's Twofold Theory of Corruption. *Business Ethics and Leadership*, 4(4), 76-83. [https://doi.org/10.21272/bel.4\(4\).76-83.2020](https://doi.org/10.21272/bel.4(4).76-83.2020).
- Vasileva, T.A., & Lasukova, A.S. (2013). Empirical study on the correlation of corporate social responsibility with the banks efficiency and stability. *Corporate Ownership and Control*, 10(4A), 86-93. <https://doi.org/10.22495/cocv10i4art7>.
- Smiianov, V.A., Vasilyeva, T.A., Chygryn, O.Y., Rubanov, P.M., & Mayboroda, T.M. (2020). Socio-economic patterns of labor market functioning in the public health: challenges connected with COVID-19. *Wiadomosci Lekarskie (Warsaw, Poland: 1960)*, 73(10), 2181-2187. <https://doi.org/10.36740/WLEk202010114>.
- Kobushko, I., Tiutiunyk, I., Kobushko, I., Starinskyi, M., & Zavalna, Z. (2021). The triadic approach to cash management: Communication, advocacy, and legal aspects. *Estudios De Economia Aplicada*, 39(7). <https://doi.org/10.25115/eea.v39i7.5071>.



9. Tsalikis, J. (2018). Can We Act Ethically? Implications of Determinism, Chaos Theory and Unintended Consequences. *Business Ethics and Leadership*, 2(2), 6-13. [https://doi.org/10.21272/bel.2\(2\).6-13.2018](https://doi.org/10.21272/bel.2(2).6-13.2018).
10. Yoshimori, M. (2019). Shadow Exchange Rates – Changing the Winds with Headwinds and Tailwinds. *SocioEconomic Challenges*, 3(2), 78-88. [https://doi.org/10.21272/sec.3\(2\).78-88.2019](https://doi.org/10.21272/sec.3(2).78-88.2019).
11. Vasilyeva, T., Kryklii, O., & Shilimbetova, G. (2019). The creative industry as a factor in the development of the economy: Dissemination of European experience in the countries with economies in transition. *Creativity Studies*, 12(1), 75-101. <https://doi.org/10.3846/cs.2019.7453>.
12. Kuzmenko, O., Vasilyeva, T., Vojtovič, S., Chygryn, O., & Snieška, V. (2020). Why do regions differ in vulnerability to covid-19? Spatial non-linear modeling of social and economic patterns. *Economics and Sociology*, 13(4), 318-340. <https://doi.org/10.14254/2071-789X.2020/13-4/20>.
13. Vasilyeva, T., Machová, V., Vysochyna, A., Podgórska, J., & Samusevych, Y. (2020). Setting up architecture for environmental tax system under certain socioeconomic conditions. *Journal of International Studies*, 13(4), 273-285. <https://doi.org/10.14254/2071-8330.2020/13-4/19>.
14. Trifu, A. (2018). Defending and Modelling Europe: The Visegrad Group Experience. *SocioEconomic Challenges*, 2(2), 13-18. [https://doi.org/10.21272/sec.2\(2\).13-18.2018](https://doi.org/10.21272/sec.2(2).13-18.2018).
15. Vasilyeva, T., Jurgilewicz, O., Poliak, S., Tvaronavičienė, M., & Hydzik, P. (2020). Problems of measuring country's financial security. *Journal of International Studies*, 13(2), 329-346. <https://doi.org/10.14254/2071-8330.2020/13-2/22>.
16. Brychko, M., Savchenko, T., Vasilyeva, T., & Piotrowski, P. (2021). Illegal activities of financial intermediaries: A burden of trust crisis. *Journal of International Studies*, 14(1), 172-189. <https://doi.org/10.14254/2071-8330.2021/14-1/12>.
17. Poliak, S., & Alikariyev, N. (2017). Evaluation Quality of Consumer Protection by Financial Markets Services. *Financial Markets, Institutions and Risks*, 1(3), 75-81. [https://doi.org/10.21272/fmir.1\(3\).75-81.2017](https://doi.org/10.21272/fmir.1(3).75-81.2017).
18. Bouchetara, M., Nassour, A., & Eyih, S. (2020). Macroprudential policy and financial stability, role and tools. *Financial Markets, Institutions and Risks*, 4(4), 45-54. [https://doi.org/10.21272/fmir.4\(4\).45-54.2020](https://doi.org/10.21272/fmir.4(4).45-54.2020).

## Вплив тінзації економіки на соціальний розвиток: виклики для макроекономічної стабільності

I. В. Тютюник<sup>1</sup>, А. О. Золковер<sup>2</sup>, С. В. Леонов<sup>1</sup>,  
Л. Б. Рябушка<sup>1</sup>

1 – Сумський державний університет, м. Суми, Україна,  
e-mail: [i.karpenko@finance.sumdu.edu.ua](mailto:i.karpenko@finance.sumdu.edu.ua)

2 – Київський національний університет технологій і дизайну, м. Київ, Україна

**Мета.** Розробити модель оцінювання зв'язку між рівнем тіньової економіки та показниками соціального розвитку країни.

**Методика.** Вивчення взаємозв'язку між аналізованими показниками проводилося за допомогою загальних і спеціальних методів дослідження. Встановлені гіпотези перевіряли за допомогою VAR/VEC моделювання. У роботі використовуються тести Дікі-Фуллера, Філіпса-Перрона та Йоансена.

**Результати.** У роботі визначені ризики тінзації економіки для соціальної складової макроекономічної стабільності. На основі аналізу показників соціального розвитку були визначені найбільш чутливі до зміни рівня тіньової економіки показники: коефіцієнт Джині, середній коефіцієнт нерівномірності доходу 10 % найбагатших та 10 % найбідніших верств населення, співвідношення середнього доходу 20 % найбагатших та 20 % найбідніших верств населення, індекс людського розвитку, середня заробітна плата. Статистичною базою дослідження є країни ЄС та Україна, часовим горизонтом дослідження обрано 2005–2020 роки. Результати моделювання довели зв'язок між рівнем тіньової економіки та індикаторами суспільного розвитку.

**Наукова новизна.** Удосконалено підхід до оцінювання взаємозв'язку між рівнем тіньової економіки й показниками соціального розвитку країни з урахуванням показників, що найбільш повно та всесторонньо характеризують рівень соціального захисту й матеріального добробуту населення.

**Практична значимість.** Існуючі дослідження впливу тіньової економіки на рівень суспільного розвитку країни носять фрагментований характер, а оцінювання її впливу на макроекономічну стабільність є несистемними та некомплексними. Побудована авторами функція імпульсного реагування соціального розвитку на шоки тінзації економіки може дати краще розуміння найбільш чутливих до потрясінь тіньової економіки показників. Результати оцінювання можуть бути використані у практичних або наукових цілях.

**Ключові слова:** тіньова економіка, макроекономічна стабільність, соціальний розвиток, економічний розвиток, коінтеграція

*The manuscript was submitted 24.06.21.*