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Article

Innovative approaches to the assessment of the impact of the shadow economy on social development : an analysis of causation

Reference: Tiutiunyk, Inna/Kuznetsova, Angela et. al. (2021). Innovative approaches to the assessment of the impact of the shadow economy on social development : an analysis of causation. In: Marketing i menedžment inovacij (3), S. 165 - 174.
https://mmi.fem.sumdu.edu.ua/sites/default/files/A544-2021-14_Tiutiunuk%20et%20al_0.pdf.
doi:10.21272/mmi.2021.3-14.

This Version is available at:
<http://hdl.handle.net/11159/6871>

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<https://doi.org/10.21272/mmi.2021.3-14>

JEL Classification H20, H71, F49, K34

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INNOVATIVE APPROACHES TO THE ASSESSMENT OF THE IMPACT OF THE SHADOW ECONOMY ON SOCIAL DEVELOPMENT: AN ANALYSIS OF CAUSATION

Abstract. *The article investigates the causal links between the level of the shadow economy and indicators of social development of 13 European countries. Based on the analysis of research results of scientists, three hypotheses concerning relationship between the analyzed indicators: there is a one-way link between social development indicators and the level of the shadow economy; there is a one-way causal link between the level of the shadow economy and the country's social development; there is a bilateral relationship between the analyzed indicators were tested. Based on the causal analysis the main hypothesis that the increase in the level of the shadow economy is accompanied by a decrease in the level of social development of the country is proved. The purpose of the paper is to analyze the correlation between the level of the shadow economy and the indicators of social development of the country using methods of causal analysis and panel data from 2010 to 2019. Based on comparative analysis of the levels of the shadow economy, share of the population at the level of poverty and share of the population in a difficult financial situation the statistically significant indirect relationship between indicators has been proved. The analysis of the relationship between the level of the shadow economy and the share of personal income tax and social contribution to GDP was made using the Granger test. Reliability established hypotheses and the nature of the relationship between the indicators on the basis of the construction of end-to-end regression (Nald test), regression with fixed individual effects (Brush-Pegan test) and regression with random individual effects (Hausman test) was carried out. Empirical calculations show that it is appropriate to describe the relationships between the level of the shadow economy and the amount of single social contribution, personal income tax and Index of Social Development by using a model with fixed individual effects. All indices are statistically at 5% significant level.*

Keywords: *shadow economy, social development, personal income tax, macroeconomic stability, causality analysis.*

Introduction. The shadow economy is a synthetic phenomenon whose consequences are observed in many areas of society. However, most scholars study the shadow economy through the prism of its impact on the country's economic development, while ignoring its social component, which is affected by shadow operations on a scale no less than economic (Tiutiunyk et al., 2020; 2021; Singh, 2019; Mukherjee, 2018; Palienko et al., 2017).

The impact of the informal economy on various aspects of a country's social development is mainly through its economic environment. Thus, one of the consequences of the shadow economy is a decrease (due to tax evasion) in the amount of tax revenues to the budget of the appropriate level. The greatest negative impact of the shadow economy on the level of social development include evasion of social

Cite as: Tiutiunyk, I., Kuznetsova, A. & Spankova, J. (2021). Innovative approaches to the assessment of the impact of the shadow economy on social development: an analysis of causation. *Marketing and Management of Innovations*, 3, 165-174. <http://doi.org/10.21272/mmi.2021.3-14>

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Received: 20 March 2021

Accepted: 03 August 2021

Published: 13 September 2021



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security contributions, which leads to a reduction in funding for social programs, ineffective pension system, high level of unemployment and low level of health insurance etc. (Ray, 2021; Salé et al., 2021; Miller, 2019).

Literature Review. In estimating the link between the shadow economy and social development, the majority of authors as indicators of the most affected by shadow operations use indicators of quality of life and material well-being of the population (Minchenko & Demchuk, 2011; Palienko & Lyulyov, 2018; Zolkover & Renkas, 2020). However, in our opinion, such indicators characterize only the general level the social development and do not do not take into account the change in its level by the influence of shadow operations. For example, the density of hospital beds cannot fully characterize the level of social security, because in countries with low levels of material development, imperfection of the medical system, sufficient provision of hospital beds may occur in conditions of low population access to health care facilities due to lack of financial capacity, etc.

A. Kireenko and K. Nevzorova (2015) studied the impact of shadow economy on the quality of life of society in terms of 5 groups of countries (with a minimum level of shadow economy, above average, average, below average and maximum) and for four resulting indicators: GDP per capita, population growth, unemployment rate, life expectancy of newborns, level of out - of - school education. According to the results, the life expectancy of newborns is significantly affected for each cluster and the whole population in general. In addition, the analysis showed that with increasing the level of shadow economy, the regression coefficient also increases. Today, the vast majority of countries with medium and low levels of economic development face the problem of high unemployment. This leads to a reduction in production and bankruptcy of companies, production automation, low wages, and so on. However, the shadow economy plays a rather important role in this situation.

M. Chrenekova et al. (2016) established a relatively unfavorable link between the informal employment, subjective and objective indicators of quality of life on the example of the regions of Ukraine. The authors conclude that in the regions with the highest share of informal employment, most households tend to identify themselves as poor or deprived of material well-being. With declining incomes, measured as the average monthly wage, the level of informal employment in the regions increased. The authors emphasize that informal employment creates the conditions for reducing unemployment, especially in rural areas, which indicates the potential of the informal sector to create employment opportunities.

R. Galli and D. Kuchera (2003) proved that the stronger the "civil rights" in society, the greater the share of formal employment in the country compared to informal. For many sociologists, stable employment in official jobs is associated with life satisfaction and high quality. W. Kachere (2011) based on the assessment of the impact of informal trade on poverty reduction in Zimbabwe, shows that informal cross-border trade positive effects on poverty reduction.

At the same time, studies of the link between informal trade and poverty in India show that increasing informal wages can reduce poverty in urban areas. The study argues that real informal wages have risen as a result of trade reform and have had a positive effect on urban poverty reduction.

The informal sector also plays a role in reducing household poverty, but does not reduce its overall level in the country. The poverty rate would be much higher in the absence of the informal sector of the economy for the population that does not have the opportunity to work in the formal sector. As a rule, for both employees and employers, informal employment has its advantages and risks.

Informal employment can be defined as one that does not provide legal and social protection to the population. Shadow employment negatively effects on the social protection of the populations. One of the reasons is that shadow employees do not have the formal labor relations and, as a result - are socially vulnerable. (Tiutiunyk, 2018; Antonyuk et al., 2021; Eddassi, 2020). Generally, the connection between the formal and shadow economy in the context of employment shown in the figure 1.

The level of social protection of workers				
	Low social protection	Partial social protection	Full social protection	
Official employment			←	Quadrant I
Partially declared employment		←		Quadrant II
Informal employment	←			Quadrant III

Figure 1. Matrix with the ratio of formal and shadow labor market

Source: developed by the author

There are three models of employee behavior:

- 1) The country has an official labor market, whose representatives fully declare their income and pay taxes. This scheme provides maximum economic and social protection of economic entities.
- 2) A combination of the formal and shadow labor markets, which consists in the partial declaration of income by receiving part of the salary outside the formal sector.
- 3) shadow employment in both official and unofficial companies. Employment in the informal labor market leads to the loss of workers' right to social protection and social benefits.

Methodology and research methods. In order to test hypotheses about the impact of the shadow economy on the country's social development, we will use the Granger test, which is based on the construction of time series and involves the construction of regression equations that have the following form:

$$SD_t = \alpha + \sum_{j=1}^m \beta_j SD_{t-j} + \sum_{j=1}^n \rho_j SE_{t-j} + e_t \quad (1)$$

$$SE_t = \delta + \sum_{j=1}^p \theta_j SE_{t-j} + \sum_{j=1}^q \tau_j SD_{t-j} + \mu_t, \quad (2)$$

where SE_t – the level of shadow economy in the t-th period; SD_t – is an indicator of the country's social development in the t-th period.

The constructed equations of dependences allow to check the existence of a connection between the shadow economy and the indicators of social development of the country in terms of the following hypothesis:

1. There is a one-way link between social development indicators and shadow economy.
2. There is a one-way causal link between the shadow economy and country's social development.
3. Bilateral link between the indicators.
4. No link between the shadow economy and social development.

The link between the level of shadow economy and indicators of social development will be conducted in terms of its two components:

- 1) financial indicators that reflect the functioning of the social sector of the country – the amount of income from personal income tax and social contributions as indicators of the functioning of the employment market, the level of average wages – as a characteristic of the labor market in the country;

2) the index of social development as an indicator that reflects the non-economic component of the quality of life of society.

In order to assess the impact of the shadow sector of the economy on the indicators of social development of the country, we will check the relationship between the volume of shadowing of income and indicators of social development of the country: the personal income tax and SSC revenues; the level of average wages; ISR.

The main hypotheses in the process of studying the impact of the shadow economy on the indicators of social development of the country are:

1) the shadowing of the national economy determines the shadow employment, which is reflected in the dynamics of PIT and SSC revenues;

2) the level of shadowing of the economy is lower in countries with a higher level of average wages. Thus, citizens' dissatisfaction with the level of payment for their work leads to the search for additional earnings and tax evasion. Quite often these workers are both participants in the official and shadow labor markets;

3) the level of shadowing of the economy is lower in countries with a higher level of meeting the basic needs of the population, welfare and opportunities for development.

The hypothesis about the link between indicators will be tested on the example of countries that according to the World Economic Forum have the highest (China, USA, India, Japan, Germany), average (Romania, Bulgaria, Serbia, Ukraine) and the lowest (Georgia, Macedonia, Armenia, Moldova) GDP.

Results. At the first stage, a comparative analysis of the levels of the shadow economy and social development of the country was conducted. According to the results (Figures 2-3), the shadow economy has a negative impact on the material well-being of the population.

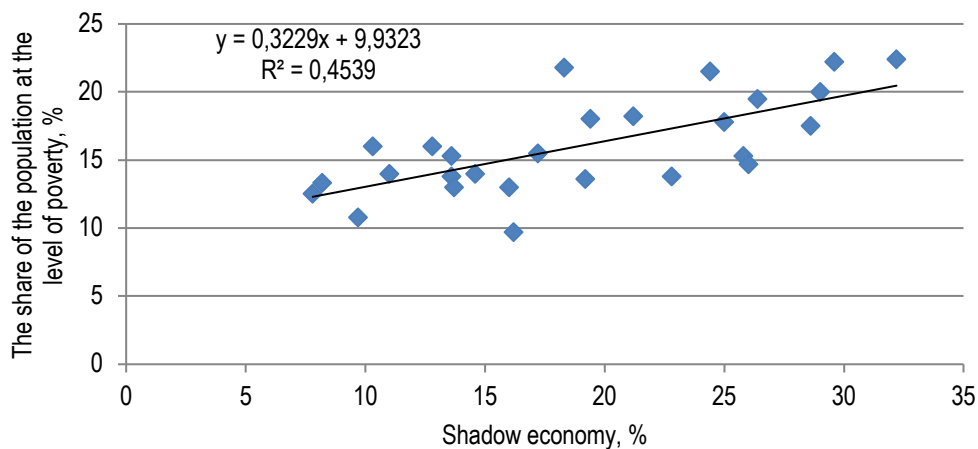


Figure 2. The link between the share of the population at the level of poverty and the level of the shadow economy

Source: Gicuku (2017).

Participants in the shadow sector of the economy are deprived of the right to social guarantees and benefits, protection of their rights. In addition, working in the shadow labor market, such individuals do not fully comply with their tax obligations, thereby posing a threat to the economic security of the country.

In the second stage, we will analyze the static indicators that characterize the stability of the analyzed indicators, in particular: standard deviation, coefficient of variation, their maximum and minimum values.

The results of calculations indicate a significant variability of the analyzed indicators over the years and a significant degree of their deviation.

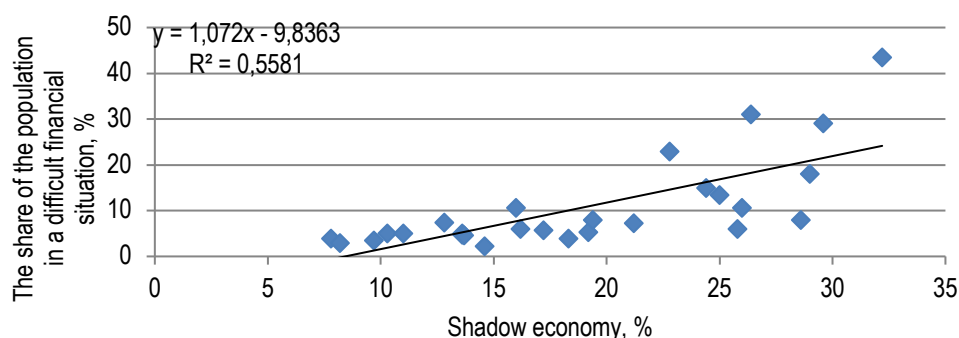


Figure 3. The link between the share of the population in a difficult financial situation and the level of the shadow economy

Source: Gicuku (2017).

The standard deviation of the analyzed countries is characterized by a significant scale. Thus, if the standard deviation of social contribution revenues for Georgia is 145, then for some countries this value is much higher: Armenia – 42459.35, Germany – 47054.28, Japan – 52585.49, Romania – 14373.6. A similar situation is followed by other indicators of social development.

In addition to economic factors that determine the impact of individual indicators of the country's development on the share of the shadow economy, an important role in these processes is played by the effectiveness of social protection. The level of material security of vulnerable segments of society, the regulation of unemployment in the country, the income of the population are key factors in the decision of individuals to carry out activities in the shadow sector of the economy.

One of the preconditions for the existence of the shadow labor market is the desire of economic entities to reduce the amount of their tax liabilities. Full or partial non-registration of employees allows to significantly reduce or avoid the occurrence of liabilities for both personal income tax and the single social contribution. To test this hypothesis, we will analyze the relationship between the level of the shadow economy and the share of personal income tax and social contribution revenues to GDP.

Based on the results, it can be concluded that the shadowing of the economy has a negative impact on the personal income tax revenues for all analyzed countries, but with different time lags.

Table 1. The impact of the level of the shadow economy on PIT revenues

Countries	Correlation coefficient	Lag		
		1	2	3
1	2	3	4	5
Armenia	-0.6364	-0.6676	-0.3761	-0.1495
Bulgaria	-0.6701	-0.0767	-0.0736	-0.0665
China	-0.6477	-0.3638	-0.0478	-0.0719
Georgia	-0.6828	-0.5444	-0.6087	-0.5130
Germany	0.3324	0.3251	0.6371	0.2583
India	0.3163	0.6378	0.1506	0.0869
Japan	-0.7050	-0.5903	-0.1420	-0.0488

Continued Table 1

1	2	3	4	5
Macedonia	-0.7195	-0.1265	-0.5899	-0.3289
Moldova	-0.5981	-0.6302	-0.2853	-0.1820
Romania	0.6554	0.6307	0.1933	0.1422
Serbia	0.2684	-0.5940	0.1929	0.1739
Ukraine	-0.2405	-0.6582	-0.1529	-0.0296
USA	-0.5627	-0.5129	-0.6773	-0.3791

Source: author's calculations based on World Bank data.

Thus, for 7 countries (Bulgaria, China, Georgia, Japan, Macedonia, Moldova, Romania) the change in the level of shadowing leads to a change in PIT revenues without time lag, for Armenia, India, Serbia and Ukraine it is manifested with a lag of 1 year, and for Germany and the USA - with a lag of 2 years. The relationship between the analyzed indicators with a lag of 3 years has not been confirmed for any country.

For Moldova and Romania there is a significant relationship without time lag and with a lag of 1 year, which may indicate a constant relationship between the analyzed indicators.

Correlation coefficients for all countries exceed 0.7 with a high level of statistical significance. Thus, the analysis confirmed the hypothesis of a significant share of shadow employment in these countries, accompanied by significant amounts of tax evasion.

According to the results, there is no direct relationship between PIT revenues and the level of the shadow economy (Table 2). In general, the correlation coefficient does not exceed 20% regardless of the selected time horizon.

Table 2. The coefficient between the of PIT revenues on the level of the shadow economy

Countries	Correlation coefficient	Lag		
		1	2	3
Armenia	-0.6364	-0.1802	-0.1015	-0.0404
Bulgaria	-0.6701	-0.0206	-0.0199	-0.0179
China	-0.6477	-0.0982	-0.0128	-0.0194
Georgia	-0.6828	-0.1470	-0.1644	-0.1385
Germany	0.3324	0.0878	0.1720	0.0698
India	0.3163	0.1722	0.0407	0.0235
Japan	-0.7050	-0.1594	-0.0383	-0.0131
Macedonia	-0.7195	-0.0342	-0.1593	-0.0888
Moldova	-0.5981	-0.1701	-0.0770	-0.0492
Romania	0.6554	0.1703	0.0522	0.0384
Serbia	0.2684	-0.1603	0.0521	0.0469
Ukraine	-0.2405	-0.1776	-0.0413	-0.0080
USA	-0.5627	-0.1385	-0.1829	-0.1024

Source: author's calculations.

The results of the analysis of the causal links between the share of PIT in GDP and the shadow economy according to the Granger test are summarized in Table 3.

According to the result, there is a significant impact of the shadow economy on the amount of revenues to the personal income tax.

Table 3. Causal links between the share of PIT in GDP and the shadow economy according to the Granger test

Countries	Lag			
	0	1	2	3
Armenia	SE → PIT	SE → PIT	-	-
Bulgaria	SE → PIT	-	-	-
China	SE → PIT	-	-	-
Georgia	SE → PIT	-	SE → PIT	-
Germany	-	-	SE → PIT	-
India	-	SE → PIT	-	-
Japan	SE → PIT	SE → PIT	-	-
Macedonia	SE → PIT	-	SE → PIT	-
Moldova	SE → PIT	SE → PIT	-	-
Romania	SE → PIT	SE → PIT	-	-
Serbia	-	SE → PIT	-	-
Ukraine	-	SE → PIT	-	-
USA	-	-	SE → PIT	-

Source: author's calculations.

The validity of the established hypotheses and determination of the relationship between the indicators was carried out on the basis of the construction of end-to-end regression, regression with fixed individual effects and regression with random individual effects. The results of investigations of the parameters of the regression model based on the Wald test are shown in table 4.

Table 4. Wald test

Countries	F test	Prob > F	Countries	F test	Prob > F
Armenia	29.439	0.0000	Macedonia	44.802	0.0000
Bulgaria	42.729	0.0000	Moldova	31.004	0.0000
China	38.083	0.0000	Romania	46.875	0.0000
Georgia	32.430	0.0000	Serbia	29.988	0.0000
Germany	51.578	0.0000	Ukraine	41.107	0.0000
India	29.439	0.0000	USA	44.802	0.0000
Japan	42.729	0.0000			

Source: author's calculations.

The critical value (p-level) for all analyzed indicators is less than 0.01, which allows the rejection of the hypothesis. This allows us to conclude that the regression model with fixed effects is better suited for describing the data than a simple model.

At the next stage, we compare the parameters of the regression model with random effects with the results of end-to-end regression (Broysch-Pagan test).

As shown by the results shown in Table 5, for all countries the p-level is greater than 0.01, which allows us to assert the validity of the hypothesis. Thus, the combined regression model describes our data better than the random effect model.

c) at the last stage we will calculate the regression coefficients using a regression model with fixed effects (Hausman test). The results of the calculations are shown in Table 6.

Table 5. Brush-Pegan test

Countries	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]		Cons
Armenia	-0.44335	0.00037	0.82	0.20214	0.00111	0.00208	-3.52522
Bulgaria	-0.54483	0.01372	-0.39	0.00027	-0.06763	0.05043	-1.92455
China	-1.89536	0.02877	0.12	0.05361	-0.26898	0.29572	-5.76814
Georgia	-0.18692	0.04035	-0.50	0.00080	-0.20582	0.14177	-1.75818
Germany	3.98963	0.01034	-0.43	0.35790	-0.51289	0.35066	-2.23225
India	0.84773	0.01144	0.43	0.03552	0.00004	0.00006	4.03804
Japan	-2.21940	0.85678	-0.54	0.03049	-0.66628	1.07208	-3.55946
Macedonia	-0.28366	0.04866	-0.24	0.00070	-0.22773	0.19102	-2.75288
Moldova	-4.33418	0.00004	0.07	0.57481	-0.00017	0.00018	-3.86288
Romania	6.90027	0.50600	0.28	0.43812	1.23285	0.99203	1.12445
Serbia	3.71591	0.24805	2.99	0.02272	0.64373	0.91021	-5.78249
Ukraine	-6.51379	0.03922	2.63	0.00930	-0.00001	0.00022	3.54101
USA	-1.92984	0.12202	-5.19	0.04801	-2.56229	0.53858	-2.67837

Source: author's calculations.

Table 6. Hausman test (example of Armenia)

Countries	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Armenia	0.000458	0.0003507	0.7701859	0.0019099	0.0010512	0.0019648
Bulgaria	-0.0081279	0.0129645	-0.368706	5.645E-05	-0.063909	0.0476565
China	0.0976891	0.0273506	0.1147085	5.08E-05	-0.2541859	0.2794521
Georgia	-0.0302667	0.0381701	-0.4752211	3.015E-05	-0.1944965	0.1339747
Germany	-0.4608825	0.0097756	-0.3932864	0.0033823	-0.4846928	0.3313709
India	0.0076609	0.011053	0.4014799	3.327E-05	3.982E-05	5.522E-05
Japan	-0.6974198	0.8108632	-0.5161885	2.819E-05	-0.6296352	1.0131165
Macedonia	-0.0173456	0.045985	-0.2212236	0.0044015	-0.2152014	0.1805136
Moldova	0.4559927	3.843E-05	0.0737412	0.0054323	-0.0001639	0.0001696
Romania	0.478986	0.4781708	0.262191	0.0041402	1.1650464	0.9374679
Serbia	0.525434	0.2344315	2.4695111	0.0002147	0.6083215	0.8601486
Ukraine	0.5350154	0.0370525	2.6751671	8.767E-06	-9.832E-06	0.0002089
USA	0.000458	0.0003507	0.7701859	0.0019099	0.0010512	0.0019648

Source: author's calculations.

Since p for all analyzed countries <0.01, it is appropriate to use a Brush-Pegan test to describe the relationships between the level of the shadow economy and the amount of single social contribution. Based on the calculations, we construct the dependence equation for the analyzed countries.

The regression equations for the analyzed countries are as follows:

$$PIT_{ARM} = -3.52522 - 0.44335 SE_{t-1} \quad (3)$$

$$PIT_{CHN} = -5.76814 - 1.89536 SE_{t-2} \quad (4)$$

$$PIT_{GEM} = -2.23225 + 3.98963 SE_{t-2} \quad (5)$$

$$PIT_{IND} = 4.03804 + 0.84773 SE_{t-2} \quad (6)$$

$$PIT_{JPN} = -3.55946 - 2.21940 SE_{t-2} \quad (7)$$

$$PIT_{MLD} = -4.33418 - 3.86288 SE_{t-1} \quad (8)$$

$$PIT_{ROM} = 1.12445 + 6.90027 SE_{t-1} \quad (9)$$

$$PIT_{SRB} = -5.78249 + 3.71591 SE_{t-1} \quad (10)$$

$$PIT_{UKR} = 3.54101 - 6.51379 SE_{t-1} \quad (11)$$

$$PIT_{USA} = -2.27837 - 1.92984 SE_{t-1} \quad (12)$$

Based on the constructed econometric equations of the dependence of the amount of personal income tax revenues on the level of the shadow economy, we can conclude that in general the shadow economy has a negative impact on the revenues from this tax. Thus, an increase in the level of shadowing by 1% leads to a decrease in revenues in Ukraine by 6,51%, in Japan by 2.54%, the United States - 2.15%. The smallest impact of the shadow economy has in Japan - an increase in the level of shadowing by 1% leads to a decrease in tax revenues by 0.5%. At the same time, for 4 countries (Germany, Romania, India, Serbia) there is a positive correlation between the analyzed indicators - the increase of the level of shadow economy is accompanied by growth of the personal income tax revenues. These results, in our opinion, need more detailed research, as they may be due to a number of objective and subjective factors that do not directly depend on the shadow component of economic development. The obtained results allow us to determine the most priority directions of state intervention and to forecast the results of their implementation.

Author Contributions: conceptualization, I. T., A. K. and J. S.; methodology, I. T., A. K.; validation, I. T., A. K.; formal analysis, I. T.; investigation, I. T., A. K. and J. S.; draft preparation, I. T.

Funding: The paper was executed in the framework of scientific research work "Quadrocentric recursive model of Ukrainian unshadow economy to increase its macroeconomic stability" (funding - National Research Foundation, Application ID: 2020.02/0238)

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Інноваційні підходи до оцінювання впливу тінізації економіки на соціальний розвиток країни: аналіз причинно-наслідкових зв'язків

Стаття присвячена дослідженню причинно-наслідкового зв'язку між рівнем тіньової економіки та показниками її соціального розвитку на прикладі 13 європейських країн. У роботі на основі аналізу результатів емпіричних досліджень науковців висунуто та здійснено перевірку трьох гіпотез щодо зв'язку між аналізованими показниками: наявність одностороннього впливу показників соціального розвитку країни на рівень тінізації економіки; наявність одностороннього впливу рівня тінізації економіки на показники соціального розвитку країни; наявність двостороннього зв'язку між аналізованими показниками. На основі причинно-наслідкового аналізу обгрунтована та підтверджена гіпотеза про те, що зростання рівня тіньової економіки супроводжується зниженням рівня соціального розвитку країни. Метою статті є аналіз кореляції між рівнями тінізації економіки та показниками суспільного розвитку країни з використанням методів причинно-наслідкового аналізу та панельних даних з 2010 по 2019 роки. На основі порівняльного аналізу рівнів тіньової економіки, частки населення, що знаходиться на рівні бідності та частки населення, що перебуває у скрутному фінансовому становищі доведено статистично значущу непряму залежність між показниками. Аналіз взаємозв'язку між рівнем тіньової економіки та часткою надходжень податку на доходи фізичних осіб та соціального внеску у ВВП країни проводився за допомогою критерію Грейнджера. Надійність отриманих результатів, достовірність підтвердженої гіпотези та характер взаємозв'язку між показниками перевірено шляхом побудови рівняння наскрізної регресії (тест Вальда), регресії з фіксованими індивідуальними ефектами (тест Бруша-Пегана) та регресії з випадковими індивідуальними ефектами (тест Хаусмана). Емпіричні розрахунки засвідчують доцільність використання моделі з фіксованими індивідуальними ефектами для формалізації взаємозв'язку між рівнем тіньової економіки та обсягами єдиного соціального внеску, податку на доходи фізичних осіб та індексу соціального розвитку. Більшість індексів є статистично значущими на рівні 5%.

Ключові слова: тіньова економіка, соціальний розвиток, податок на доходи фізичних осіб, макроекономічна стабільність, причинно-наслідковий зв'язок.