

# THE INFORMAL SECTOR IN THE STRUCTURE OF THE NATIONAL ECONOMY: SIMULATION AND EVALUATION

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## ABSTRACT

Research into the shadow economy of a country has scientific and practical value. Any state is interested in evaluating the size of its shadow economy, as it affects the goals and priorities of the country's development. This study presents a model for evaluating the shadow economy in the Russian Federation. The authors developed and analyzed an approach to measuring the shadow economy based on factor analysis and a MIMIC model. The study features factor analysis of official statistics for Russia over the period 1992 to 2019, with more than 150 indicators characterizing different spheres of the life of the country. The authors determined the factors affected by Russia's shadow economy, built a MIMIC model on this basis, and estimated its size. Assessing the size of shadow activity is important for analyzing economic development and the impact of government regulations on it.

**Keywords:** shadow economy, Russia, economic security, MIMIC model, measurement

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## INTRODUCTION

The shadow economy in Russia is becoming one of the significant factors in the destabilization of the economic, social, and

political life of the country. It is closely connected with the legal activities of society and covers a significant share of it (Vasiljeva, 2009).

Many researchers in various fields (Dell'Anno & Davidescu, 2019; Schneider, 2016) have explored the shadow economy. Some researchers examined the issues of its formation, functioning, and development (Goel & Nelson, 2016). Describing this phenomenon, though, is a challenging task due to the vague definitions of its constituent elements and numerous approaches to choosing the criteria for its categorization (Gaspareniene et al., 2016; Restrepo-Echavarria, 2015).

In any economic system, the informal sector causes various socio-economic deformations: lower budget revenues, structural crises, an increasing tax burden (Mazhar & Méon, 2017), ineffective macroeconomic regulation (Gonzalez-Fernandez & Gonzalez-Velasco, 2015), a worsening investment climate, higher inflation, undermined social values, or substitution of social institutions. To eliminate these consequences and to develop priority development areas, the State must estimate the shadow economy's scale (Ponkratov et al., 2019).

While researchers have attempted to assess the size of the shadow economy in certain regions, it still requires further study at the country level.

Schneider (2017) is one of the leading experts in the evaluation of the shadow economy. When examining the shadow economy in 36 developed and developing countries of the European Union, he applied a complex approach based on an econometric analysis of extensive statistical data and the analysis of survey results.

The share of the shadow economy in the European Union (hereinafter referred to as the EU) is currently estimated at more than EUR 2.1 trillion (18% of GDP). According to various estimates, this figure in Russia ranges from 20 to 40% of GDP, and because the growing risks of the shadow economy seriously undermine the country's economic security, it is an extremely relevant problem for the Russian state (Osipov et al., 2020).

The purpose of the study was to develop a model of the shadow economy and to evaluate it in the Russian Federation. To achieve this research goal, we set the following objectives:

1. Study scientific publications and research papers that consider various methods of evaluating the shadow economy.
2. Use factor analysis to examine the indicators describing different areas of social life and to identify indicators that are affected by the shadow economy
3. Build a model for estimating the size of the shadow component in the Russian economy.

### LITERATURE REVIEW

Researchers have proposed various approaches to defining the concept and content of the shadow economy. According to the most commonly used definition, the shadow economy refers to unregistered economic activities that contribute to the officially calculated gross national product (Hoa, 2019; Morris & Polese, 2015; Tanzi, 2017). In contrast, Schneider (2017) gives a narrow definition of the shadow economy. According to him, it is the goods and services, the income from which is deliberately hidden from the authorities to evade paying income tax, VAT, or other taxes, social insurance contributions, or not to comply with certain legal norms of the labor market, such as minimum wages, maximum working hours, and safety standards.

In our opinion, the shadow economy is a system of certain economic relations that emerges among individuals, groups of individuals, or institutional units, refers to production, distribution, redistribution, exchange, and consumption of material goods and services, and depends on the general economic situation, the standard of living, and the restrictions imposed by the state.

Economists have developed various methods for measuring the level and scale of the shadow economy, which can be defined as direct and indirect methods. Direct methods are based on the information obtained through immediate observation of the actors in shadow relations. This group includes surveys, polls, and inspections of state bodies. Indirect methods, however, are more common (Bhattacharyya, 2018; Rocha et al., 2018; Tanzi, 2017). This group includes methods based on the analysis of the indicators of official statistics, ministries,

departments, and special services (monetary, balance sheet, resource, expert, and other indirect methods).

According to the level of research, all methods can be divided into macro and micro ones. A researcher should apply each method under certain conditions and in certain areas of social relations (Mazhar & Méon, 2017; Restrepo-Echavarría, 2015). All research methods are actively used in various sciences according to the subject of research. In sociology and criminology, these methods enable one to study the informal sector at the micro level. To study the macro processes of the hidden economy, one can use the methods of econometrics, often in combination with expert surveys.

To assess the shadow economy, experts apply various models that can simulate the development of economic processes. Based on the analysis of the data set describing the phenomena connected with the shadow processes, researchers can calculate the values of the studied indicators. The functional relationship of economic indicators with the size of the shadow economy is described in a system of equations that make up a mathematical model. The Multiple Indicators Multiple Cause (MIMIC) model is the most popular one, and researchers have been actively applying this model to assess the shadow economy in many countries (Chaudhuri et al., 2016; Herwartz et al., 2015; Schneider, 2015, 2016, 2017).

There is no ideal method for evaluating the shadow economy. To evaluate the hidden economy at the regional level, one should take into account geographical location, historical characteristics, socio-economic structure, political structure, demographics, the level and quality of life of the population, as well as the development of infrastructure and particular social institutions (Rakhimova, 2014).

Since one has to consider all these factors, many theoretical approaches and methods for estimating the shadow component developed

by international researchers are hardly applicable to Russia.

## METHODS AND MATERIALS

The most accurate method for evaluating the shadow economy is the MIMIC approach, which uses many factors and indicators and allows for the theoretical study of the whole shadow economy. In this model, the size of the hidden economy is a latent variable connected with a certain number of observable indicators (that reflect changes in the size of the shadow economy). Also, this model includes a set of observable causal variables which are considered as the influential determinants of the hidden economic activities.

We applied the principal component method in this research, which implied determining the minimum number of orthogonal factors that make the most outstanding contribution to the data variance and analyzed more than 150 factors. We assumed that there was a linear relationship between the latent factors and the observed variables. The sequential selection of the most common factors allowed us to consider the largest share of the feature variance. Each subsequent factor determines the share of the remaining variance and is orthogonal to all previous ones. Thus, all factors are independent among themselves.

For our analysis, we considered the data obtained in the course of statistical observations, censuses, sample surveys, data from ministries and departments of the Russian Federation, as well as information received from organizations that conduct surveys to collect information of an economic and social nature, and material - international organizations. Out of 156 indicators, strongly correlated indicators such as seen, for example, in Figure 1: x15 - the number of economically active population - total (thousand people); x16 - employed in the economy - total (thousand people); and x17 - unemployed - total (thousand people). As a result, only one indicator was left, - x15.

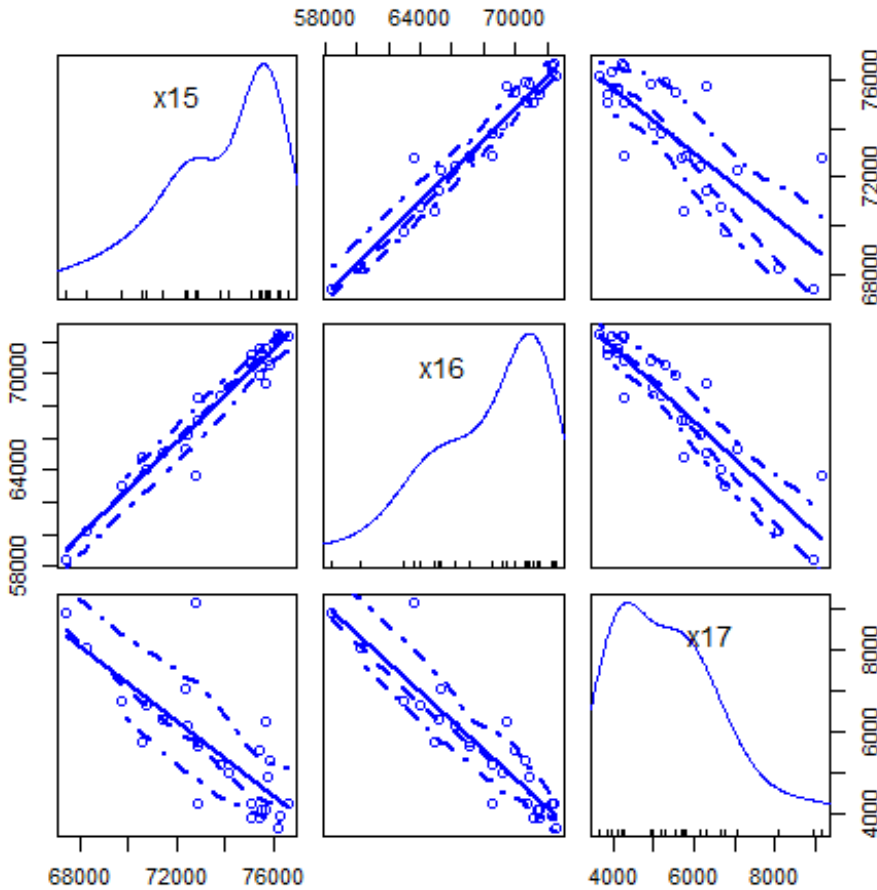


Figure 1. Scatter chart of indicators x15, x16 and x17

The Pearson correlation coefficient for the x15 and x16 indicators is 0.9694103, and the p-value is less than  $2.2e-16$ , which is significantly less than 0.05, therefore, at the 5% significance level, there is reason to reject the null hypothesis that the correlation coefficient is zero. Consequently, there is indeed a direct connection between these indicators.

As a result of the analysis, 19 out of 156 indicators remained. Then, to determine the factors included in the MIMIC model, the principal component method was used, which is based on determining the minimum number of orthogonal factors that make the greatest

contribution to the data variance. It is assumed that there is a linear relationship between the hidden factors and the observed variables. Sequential selection of the most common factors allows you to take into account the largest share of the variance of features. Each subsequent factor determines the share of the remaining variance and is orthogonal to all the previous ones. It turns out that all factors are independent among themselves.

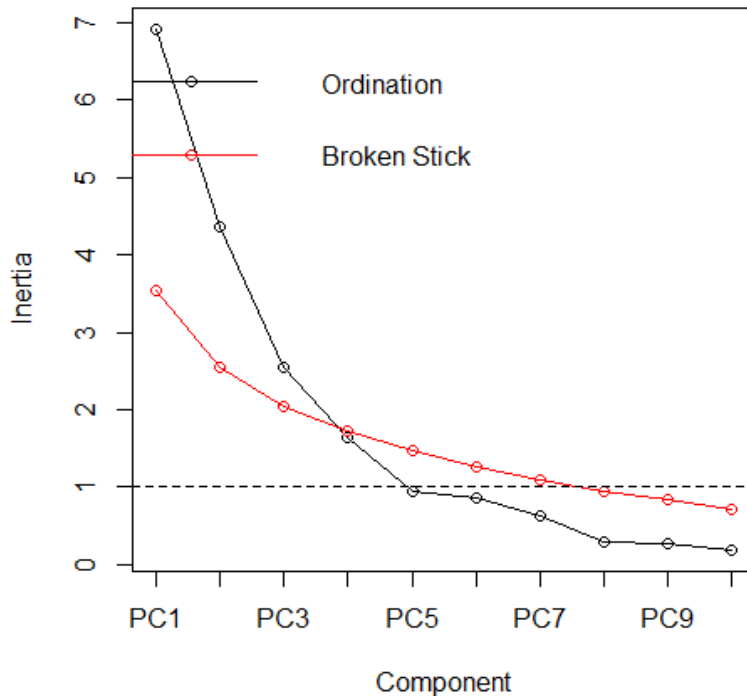
To determine the number of factors included in the model, we used two criteria: the scree test and the Kaiser rule (Table 1).

Table 1. The first eight eigenvalues obtained in the principal component analysis

PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
6.910876	4.366121	2.537091	1.641576	0.950327	0.857862	0.631716	0.296820

The scree test is a graphical method in which one identifies the point on the graph where the decrease of eigenvalues from left to right slows

down as much as possible. In our case, the appropriate number of factors was 10 (Figure 2).



**Figure 2.** The scree test for determining the number of indicator factors

According to the Kaiser criterion, only factors with eigenvalues greater than 1 are selected. In essence, this means that if a factor does not distinguish a variance equivalent to at least the variance of one variable, then it is omitted. In the above problem, based on this criterion, four factors (the first four principal components) should be retained, but because the eigenvalue of the fifth component was 0.950327 it was not considered in further studies.

The first four components explain 81.35% of the total variability.

The Kaiser rule sometimes retains too many factors, while the scree test sometimes suggests too few. Both criteria, however, are effective under normal conditions when there are relatively few factors and many variables. The

practical application of the constructed models always requires a meaningful interpretation of the results. Therefore, in this study, we analyzed the models with a larger and smaller number of factors and selected the most suitable one on this basis.

The rotation method ensures better interpretability of factor loadings without changing the number of factors. The new factors resulting from the rotation of the axes are defined as a linear combination of the available factors that maximize the variance of the squares of the factor loadings for the variables. This allows for a more accurate interpretation. The results of using the method are presented in Table 2.

**Table 2.** Factor loadings of indicators left after the first phase of the analysis

Value	Designation	Factor			
		PC1	PC2	PC3	PC4
Urban population, thousand people	x7	-0.03708	0.046314	-0.09559	0.05077
The number of deaths, people	x12	0.41533	-0.432931	-0.18043	0.06204
Employment rate of the population aged 15-72 years total, in percent	x20	-0.45981	-0.164477	0.34197	-0.03530
Employment rate of the population, of working age - total, in percent	x21	-0.46194	0.374538	0.23268	0.28369
Number of Internet users, as a percentage of the previous year	x34	-0.09467	-0.529885	-0.33214	-0.03168
Funds ratio (income differentiation coefficient), in times	x40	-0.68627	-0.086215	-0.46201	0.03910
The number of state and municipal educational institutions of secondary and higher education	x51	0.39548	0.408634	-0.50631	-0.58399
The number of persons with higher, incomplete higher, secondary specialized and secondary (complete and incomplete) education, per 1000 people	x58	0.32159	0.255369	-0.17354	0.67005
Number of computers per capita, pcs	x69	0.28993	0.591569	0.15038	0.11919
The number of persons accommodated in sanatorium and resort organizations and recreation organizations	x71	0.55603	-0.001211	0.22146	0.46801
Number of registered crimes, thousand	x72	0.41443	-0.333889	0.59359	0.13712
Gross domestic product, billion rubles	x75	-0.56066	0.055798	0.02471	-0.23821
Number of road traffic accidents, thousand	x96	-0.12529	-0.220144	-0.59835	0.19905
Production and import taxes	x97	-0.96909	-0.026598	-0.31097	0.23869
Production and import subsidies	x128	-0.6006	-0.364849	0.26490	0.15360
Written correspondence sent, million	x129	-0.24557	0.239725	0.27497	-0.13983
Money transfers sent by post, million	x130	-0.27570	-0.741625	0.01558	-0.20786
Revenues from cellular services rendered to the population, mln rubles	x137	-0.18885	-0.690023	0.06897	0.37049
Index of physical volume of retail trade turnover, as a percentage of the previous year	x147	0.40858	-0.389581	0.18629	-0.38646

The analysis of factor loadings showed that the following seven indicators have a fairly large factor load relative to the first four factors:

- The number of state and municipal educational institutions of secondary and higher education (x51);
- The number of registered crimes, thousand (x72);

- The number of road accidents, thousand (x96);
- Taxes on production and imports (x97);
- Subsidies for production and imports (x128);
- Sent by postal money transfers, million. (x130);
- Income from cellular services rendered to the population, million rubles. (x137).

Thus, the indicators of the causes for the MIMIC model were determined.

$$Shadow_t = Shadow_{index,t} \times Shadow_{base} / Shadow_{index,base} \quad (1)$$

where  $Shadow_{index,t}$  is the value of the MIMIC index calculated according to equation (1) for time period  $t$ ,  $Shadow_{index,base}$  is the base value of the index for the analyzed time period, and  $Shadow_{base}$  is the base value of the shadow economy for the analyzed time period.

## RESULTS

Using the above approach, we performed the factor analysis of the interrelationships of indicators characterizing various aspects of social life for the period from 1992 to 2019. We took the level of employment as a normalization variable. All variables were considered as the average growth rate of the initial statistical data during the period under consideration.

The resulting four components can be interpreted as follows:

- PC1 – economic factors (indicators x97, x128).
- PC2 - factors of information society development (indicators x130, x137)
- PC3 – factors of criminalization (violation of the law) (indicators x72, x96).
- PC4 - factors of education (factors of socialization of society) (indicator x51).

In the course of the factor analysis, we identified seven indicators that can be conditionally divided into the following groups: economic, criminalization (violation of the law), education (socialization), and communication

We chose electricity consumption and the level of employment (Wiseman, 2013) as indicator variables reflecting particular dimensions of the economic activity of the society and connected with the level of the shadow economy.

We converted the values of the indices obtained with the structural equation into the values of the size of the shadow economy according to the base value in the current year:

(the critical factor in the development of the information society).

The economic factor was the most significant one, which explains the variation in tax revenues and production subsidies.

Tax revenues are the primary financial source for the state that is crucial for meeting socially significant and legally established needs (Shtiller et al., 2017). The tax potential of the state determines the provision of public goods and services to the population, which includes welfare, education, health care, environmental protection, and security. This explains the dependence of the shadow economy and the size of tax revenues from production, imports, and the number of state and municipal institutions and organizations. The negative sign of the indicator confirms this pattern.

The third most important factor for the Russian Federation was the crime rate and violation of the law. These indicators include the number of registered crimes and road traffic accidents. One can observe qualitative changes in criminal behavior; for instance, greater sophistication and closer connection with shadow economic relations. Crime is becoming more and more organized, armed, and corrupt. It is becoming more intellectual and global, linking not only separate regions but also continents. Increased traffic intensity and more vehicles on city roads leads to a closer interaction of road users and more traffic accidents. The situation is aggravated by illegal carriers and transport enterprises that seek to

maximize their profits and economize on security, which puts people's lives and health at risk.

According to the results of the factor analysis, we chose variable causes for building the MIMIC model.

We selected the following indicators as indicator variables for evaluating production activity and estimating the level of the shadow economy: electricity consumption (million kWh

/ GRP in current prices) and employment rate (%). The employment rate was used as a normalization variable. All variables were calculated as the growth rate of the initial statistical data during the period under consideration.

We did the calculations in RStudio software using the lavaan package. Table 3 presents the results of evaluating the variables.

**Table 3.** The results of evaluating the variable causes in the MIMIC model

Indicator	Conventional signs	Value
The number of state and municipal educational institutions of secondary and higher education	EDU	-0.01
Number of registered crimes, thousand	crim	0.015
Number of road traffic accidents, thousand	r_acci	0.002
Production and import taxes	tax	1.151
Production and import subsidies	subs	0.527
Money transfers sent by post, million rubles	m_trans	0.129
Revenues from cellular services rendered to the population, million rubles	cell_serV	1.723

MIMIC coefficients characterize the structure of the shadow economy at a certain point in time and allow one to determine its relative size.

**Table 4.** Quality indices of model fitting

Root mean square error of approximation ( <i>RMSEA</i> )	0.000
P-value ( $RMSEA \leq 0.05$ )	0.762
CFI (confirmatory factor index)	1.000
TLI (Tucker-Lewis index)	1.042
Number of degrees of freedom	28

Thus, based on the results of the constructed MIMIC model, we obtained a structural equation

for calculating the index of the shadow economy:

$$SHADOW = -0.01 \times EDU + 0.015 \times CRIM + 1.151 \times TAX + 0.527 \times SUBS + 0.002 \times R\_ACCI + 0.129 \times M\_TRANS + 1.723 \times CELL\_SERV \quad (2)$$

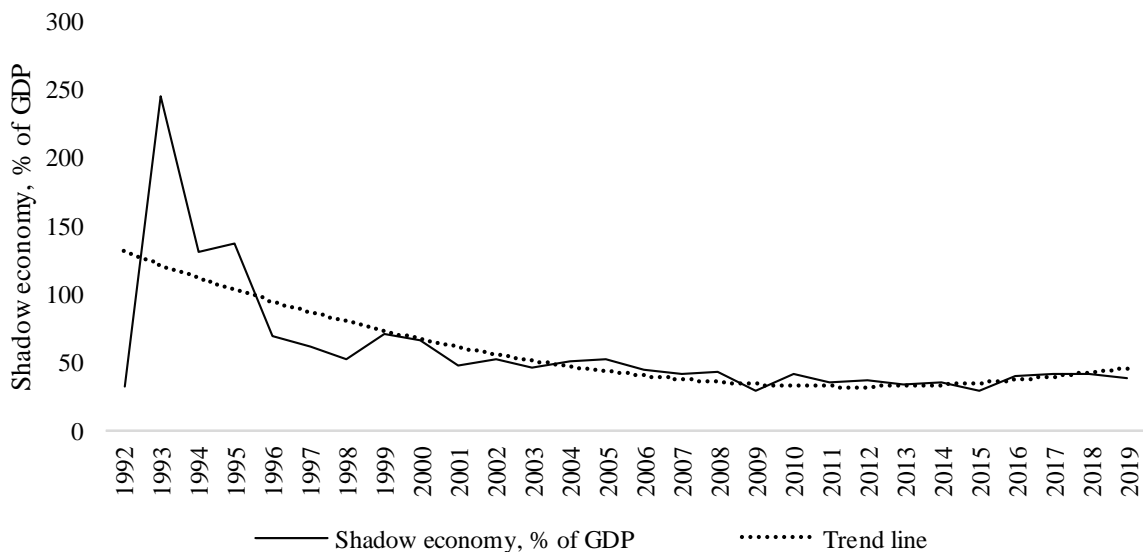


The RMSEA (root mean square error of the estimate), -0.000, is less than 0.05, and the relative indicators of the fit of the model are  $TLI > 0.95$  and  $CFI > 0.95$ , which indicates good agreement between the model and actual data. In the future, it is planned to study MIMIC models in which factors obtained in the method of principal components act as variable causes. The resulting model makes it possible to determine the relative volume of the shadow

economy during the period under consideration. The transformation of the relative estimates of the size of the shadow economy into absolute ones was carried out according to the formula (1), where the data obtained from the official statistics were used as the base values for the shadow economy. This allowed us to estimate the size of the shadow economy (Table 5 and Figure 3).

**Table 5.** Results of calculating the volume of the shadow economy in the Russian Federation for 1992 – 2019

<b>Year</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>
Shadow economy, % of GDP	31.49000	244.18221	130.63947	136.15905	68.11923	60.51090	51.65733
In billion rubles	5,98	418,67	797,46	1944,79	1367,5	1417,16	1357,9
<b>Year</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
Shadow economy, % of GDP	70.05061	65.64142	46.40896	51.72561	46.07877	49.51288	51.24211
In billion rubles	3380,03	4796,42	4149,11	5600,5	6082,18	8431,55	11079,21
<b>Year</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Shadow economy, % of GDP	44.26578	41.05402	41.97649	29.39523	41.70468	34.44731	35.66538
In billion rubles	11918,94	13650,88	17334,92	11419,56	19314,68	20707,51	24290,14
<b>Year</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
Shadow economy, % of GDP	32.82150	34.41563	28.85617	39.04481	41.46589	40.78871	37.3039
In billion rubles	11918,94	13650,88	17334,92	11419,56	19314,68	20707,51	24290,14



**Figure 3.** Shadow economy in Russia, % of GDP

## DISCUSSION

Often in research (Schneider, 2015, 2016, 2017), multiple indicators and multiple causes (MIMIC) models are applied to time series data estimating the size and development of the shadow economy for a particular country. This type of model derives information about the relationship between cause and indicator variables and a latent variable (here the shadow economy) from covariance structures. The MIMIC model is based on the assumption that the level of the hidden economy is a latent variable associated with both a certain number of observable indicators (reflecting changes in the volume of the shadow economy) and a set of observable causal variables, which are considered as some of the most important determinants. The research results demonstrated that economic factors have the most significant influence on the size of the shadow economy. Tax evasion and concealment of economic activity from control lead to an increase in the tax burden on legal entities, contributing to further concealment of income. Startienė and Trimonis (2011), Amoh and Adafula (2019) assume that the tax burden has a massive impact on the size of the shadow economy. The model presented in this study proves that this factor is one of the leading ones for Russia. Inconsistent application of the law, combined with excessive regulation of economic activity by the state, creates a breeding ground for corruption and shadow activities in general.

Informal economic relations in Russia emerge due to the symbiotic interconnections of dominant market institutions and the preserved logic of distribution in which property and the opportunity to do business are distributed in exchange for bribes to officials and their participation in market projects. In this regard, the authorities are interested in big business, and big business seeks positions in the state bodies. For big business, the shadow economic relations mean strong chances for abnormal prosperity, which is associated with financial flows connecting business structures and the state authorities and often not only in the form of banal corruption. The merger of business and government is becoming not only a desirable

but also a necessary condition since it enables entrepreneurs to receive some privileges (Orlova et al., 2015). The latter include government orders, subsidies, winning tenders in violation of competitive conditions, impunity or minimal punishment for violating economic legislation, elimination of competitors by the forces of repressive authorities, and priority consideration of the company's interests when a new law is developed. This explains why we included such an indicator as subsidies for production and imports in the model.

Functionally, the shadow economy adds to the official one in many aspects: income, employment, etc. It brings the legal economy up to the scale and level that is required for maintaining the life of society. Shadow economic relations attract a larger share of the population and become an organic part of modern society. This entails severe economic and social consequences: the manageability of the economy decreases, the population differentiation increases, moral norms are destroyed, many social institutions are replaced, and the political consciousness, cultural level, and intellectual development are transformed. The results of this study are consistent with the conclusions of international researchers who explored the impact of the shadow economy on education and the level of the intellectual development of the population.

As researchers (Juraev, 2018; Meyer, 2019) suggest, one should not directly associate the increase in the volume of the shadow economy and corruption only with the ineffectiveness of law enforcement agencies and the imperfection of the legal framework. We should trace the origin of this phenomenon to the causes and conditions of its occurrence, namely to the socio-economic policy of the state.

## CONCLUSIONS

The problem of the shadow economy is a most pressing one for Russia. Having completed this research, we obtained the following results:

1. According to the experts, the optimal research method is the MIMIC model. It assumes that the size of the shadow economy is a latent variable associated, on the one hand,

with a certain number of observable indicators (reflecting changes in shadow practices), and, on the other hand, with a set of observable causal variables that are taken as the most important determinants of hidden economic relations.

2. Having analyzed research publications, we identified the main factors in the formation of shadow relations in modern society. Among them, one can name general ones which include economic, managerial, political, legal, social, and demographic factors, as well as specific (narrow) ones – the development of computer technologies, the level of digitalization of the economy, or tax morality.

3. We performed factor analysis for the period from 1992 to 2019 and identified the indicators that determine the informal sector in the Russian economy. There are four main groups of factors in the shadow economy: economic, criminalization (violation of the law), education (socialization), and communication (the critical factor in the development of the information society).

4. The determinants of the shadow economy have a multidirectional influence, positive and negative. Of the identified factors of the shadow economy, all factors, with the exception of education, have a positive impact on the performance indicator. The value of this indicator is negative, which once again emphasizes the negative impact of shadow economic activities on the provision of socially necessary goods by the state (education, health care, and defense).

5. Having estimated the size of the shadow economy in Russia, we concluded that over the past decades, the value of the level of shadow economy had been decreasing and fluctuated in the range from 30 to 50%. Despite this positive trend, the level of the shadow economy in the country remains high. This necessitates the development of state regulation measures aimed at reducing the informal sector since only rational and adequate state policy can resist the growth and development of hidden economic processes.

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