Analysis of Methods of Estimating the Shadow Economy Level

[1]Dmitry Panursky, [2]Maxim Kaimov and [3]Nataly Podolyakina,
[1,2]Baltic International Academy, 4, Lomonosov str., LV-1019, Latvia
[3] Transport and Telecommunication Institute, 1, Lomonosovstr., LV-1019, Latvia

Abstract: This research presents a theoretical study of such a complex and multifaceted concept in the modern economy as the shadow economy. First, the generalization and classification of the essence of the concept of shadow economy is carried out; it is based on the findings of foreign scientists have been involved in this problem issuessince the middle of the previous century. This generalization allowed identifying the problem of lack of a single interpretation of such economic phenomenon as a shadow economy. The consequence of this problem is the difficulties in assessing the level of the shadow economy. This paper demonstrates the classification of the most famous methods for assessing the level of the shadow economy, as well as a brief description is given. After assessing the applicability of the classified methods of determining the level of the shadow economy, the indirect methods of estimating the shadow economy were chosen for a more specified study. Their detailed description is carried out; the advantages and shortcomings of the described methods are defined, which allowed the authors to draw a conclusion about the necessity of developing a new method of an assessment of the shadow economy level.

Keywords: *Shadow Economy, Modern Globalized World, Direct and Indirect Method So Fassessing The Level Of The Shadow Economy, Analysis.*

1. INTRODUCTION

Being the integral part of the economic system of any state, the shadow economy hinders the process of expanded reproduction, increases income disparities and social tension, weakens the levers of governmental management and prevents economic development.

The shadow economy is one of the most challenging problems of the contemporary world; it occurs in various forms in all countries of the world; it has been accompanying the mankind for centuries. In the beginning of the XXI century the shadow economy is not eradicated, moreover, on the contrary, its role has greatly increased in the modern globalized world.

The goal of this research is generalisation and systematisation of various methods of the shadow economy level assessment.

2. THEORETICAL APPROACHES TO COMPREHENSION AND CLASSIFICATION OF THE SHADOW ECONOMY BY FOREIGN SCIENTISTS

The study of the shadow economy presupposes, first of all, turning to the concept and terminology.

Systemic study of the shadow economy by foreign scientists has begun relatively recently.Economic science of the nineteenth century ignored the research of shadow economic relations in the society, considering it to be not important. Although it should be noted that the first attempts at economic and mathematical modelling of crime were undertaken in the

end of the 18th century, and these attempts did not have any impact on the development of economic science [1].

A great contribution to the study of crime as a socio-economic phenomenon is associated with the name of the famous American economist Garry Becker. In 1968 he published an article entitled "Crime and Punishment: An Economic Approach", which analysed crime as the activity of a rational individual maximizing his own profit [2].

However, the shadow economy became an object of research only by the end of the 20th century. In the sixties K. Hart was the first who paid attention to informal employment in the countries of the third world and came to the conclusion that it had no relation to the official economy and was generated by the accumulation of small unregistered businesses that did not pay taxes [3].

Being an expert in the field of social anthropology, in years 1965-1968 K. Hart conducted the field research in the slums of Accra, the capital of the Central African state of Ghana. His articles, published on the basis of the research results, served as a reason for discussions about the role of the informal sector in the economy of developing countries. K. Hart interpreted the economic system of the developing countries within the framework of the dual concept, contrasting the formal sector with the informal one, distinguishing the directly opposite characteristics for each of them.

American sociologist A. Portes (Johns Hopkins University, Baltimore) in the article, which he wrote in cooperation with S. Sassen-Kub (Columbia University), makes an attempt to comprehend the informal sector as a phenomenon inherent to all modern countries with a market type of economy, which is one of the forms of progressive economic development in the conditions of the scientific and technological revolution; his work is based on the generalisation of the studies of the 1970-1980ies [4].

D. Mead (Michigan State University) and K. Morrisson (University of Paris) devoted their research to the problem of criteria for the phenomenon that is commonly referred to as the "informal sector" [5].

Researchers analyse three commonly used basic criteria of informality:

a) Legality – registration, payment of taxes, regulation of working conditions (payment of the minimum wage, pension and insurance payments, provision of accident prevention, and legislation limiting the activities of producers and sellers (in particular, measures to protect the rights of consumers, such as, for instance, keeping to the quality standards).

b) Dimensions – the researches are focused on small businesses. The main criterion is usually the number of employees – no more than 5 – 10 (rarely 20) employees.

c) Capital intensity – the role of production equipment in the

activities of the informal enterprises (shadow sector).

An interesting approach proposed by Dallago B. [6]; he uses the notion of an unregulated economy to refer to the shadow economic processes, which refer to the activities of economic agents which do not follow the regular rules and laws or are hidden from government control and governance authorities.

A methodological approach to understanding the shadow economy as an economic category was proposed by Pierre Lemieux [7]; this approach is based on the ideas of Adam Smith "An Inquiry into the Nature and Causes of the Wealth of Nations" [8].

Smith considered thedivision of labour and its objective consequence – the relationship of exchange as the basis of the modern society. Pierre Lemieux, developing the idea of Smith, noted that the shadow economy arises in the sphere of exchange as a result of restrictions connected with rules, taxes and prohibitions.

The relations of exchange were considered as a main reason for the emergence of the shadow economy in all of its best known models, although the modern researchers represent the shadow economy not only within the scope of exchange, but also as uncontrolled production, distribution and consumption of commodity and material valuesand services.

The shadow economy is a phenomenon of economic activity which is inherent in society. Hans F. Sennholz[9]believed that the properties of the shadow economy are derived from the need of human nature to choose the optimal alternative from the prescribed ones: even in the ancient world governors established laws and regulations, introducing them through violence and terror, and the population either obeyed or found ways of resistance, often preferring going into hiding the economic activity from any control.

A review of foreign scientific literature shows that there is no unambiguous comprehension of the phenomenon of the "shadow" economy among the various interpretations of it. Consequently, the absence of a unified term indicates an ambiguous understanding of the subject itself.

3. CLASSIFICATION OF METHODS OF MODELING THE SHADOW ECONOMY, AND ANALYSIS OF INDIRECT ASSESSMENT METHODS
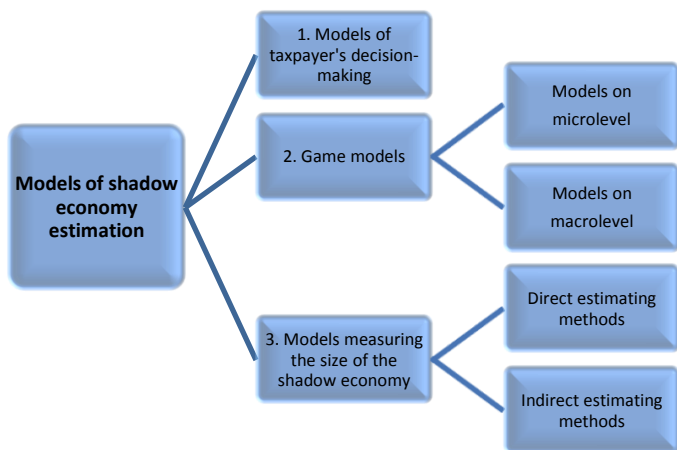

Fig. 1. Models of estimating the size of the shadow economy[autor]

Fig. 1 demonstrates the classification of the principal types of shadow economy estimation methods employed by the world scholars; the classification is generated by the authors.

Simulation of the shadow economy at both micro- and macro-level has become a widespread research method among foreign scholars.

This area of research is characterised by large differences in approaches and uniqueness of the developed models.

The analysis of shadow economy models allowed the author to classify them and to group them into three groups.

Therefore, the models of the first and second groups are aimed at studying the shadow economy as a phenomenon, the causes of its appearance and properties.

The models of the third group are more intended for estimating the size of the shadow economy and determining its place in the national economy.

The objects of research by direct methods, as a rule, are characterized by small size (individual, industry, district).

Indirect methods employ a variety of economic and non-economic indicators, containing the information about the development of the shadow economy. The study analyses the following indirect methods of assessing the level of the shadow economy (Fig. 2):
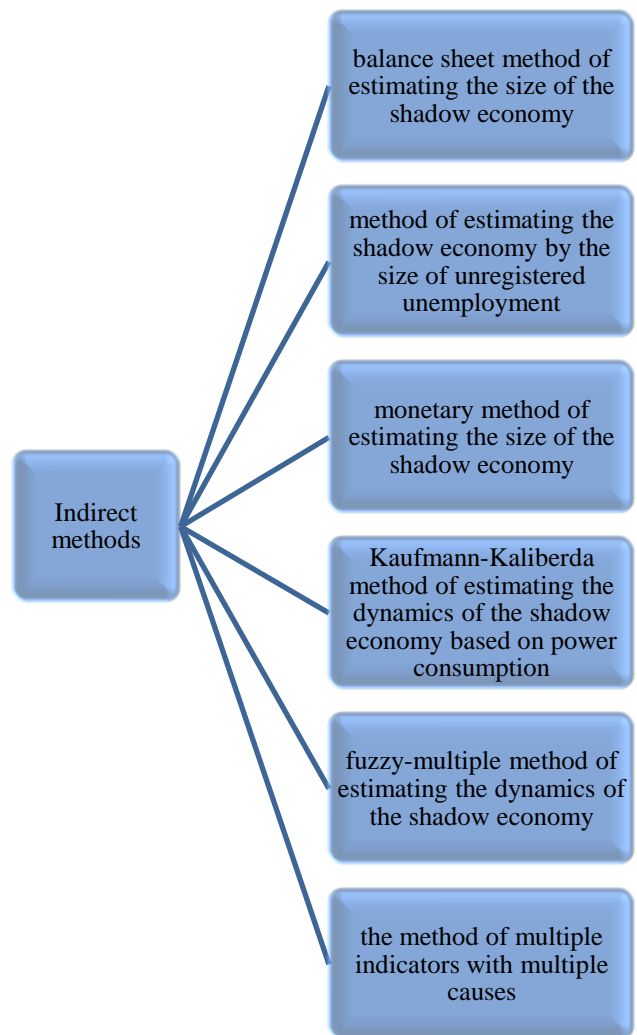

Fig.2. Indirect methods of estimating the size of the shadow economy [autor]

The balance sheet method of estimating the size of the shadow economy has been known for about 30 years. It is based on the discrepancy between the statistics of expenditures and income in the national GDP. Since the income part of the GDP should theoretically be equal to its expenditure part, and in practice they are not equal, the difference between income and expenditures is used by the authors as an indicator showing an increase or decrease in the size of the shadow economy.

This approach was used by A. Franz for Austria [10]; Kerrick MacAfee, Michael O'Higgins and James D. Smith employed it for the United Kingdom [11, 12, 13]; Hans-Georg Petersen; Daniela Del Boca applied it for Germany [14, 15], and Tea Park did it for the United States[16].

An international comparison of the shadow economies of a number of countries with this method employmentwas done byTihoYooand Hyun Jin K (Yoo, Tiho and Jin K.Hyun, 1998)[17]. They calculated the size of the shadow economy of Korea (in 1996 – 20.3%), Taiwan (in 1995 – 16.5%), Italy (in 1995 – 19.2%), Spain (in 1990 – 50.5%), Russia (in 1995 – 74.9%) and Hungary (in 1994 – 56.9%). Nevertheless, these results differ from many other international studies. So, Ceyhun Elgin and OguzOztunali[18] and Feld and Schneider [19] obtained the results showing that the shadow economies of Spain and of Italy in 1995 were 25% and 29% of their GDP correspondingly.

These results can be explained by the fact that this method, despite its simplicity, has a number of drawbacks.It does not take into account shadow incomes that are transferred to abroad, or hidden expenditures that are not taken into account by state statistics, as well as shadow elements that remain hidden in the calculation of both the income and expenditure part of GDP.

The comparison of the formal and the actual labour force is even more interesting. The method of estimating the size of the shadow economy according to the unregistered unemployment is based on the assumption that the unregistered unemployed are the main labour force used by the shadow economy. This method assesses both hidden and criminal economic activity. The main indicator within this method is calculated as follows [19]:

$$X_{employment} = \frac{U_{ilo} - U_{fsz}}{L - U_{fzs}} \qquad (1)$$

Where U_{ilo} is the number of unemployed according to the Employment Service;

U_{fsz} is the number of oficiallyregistered unemployed;

L isatotalnumberofeconomically active population.

It is assumed that labour productivity in the shadow sphere is the same as in the official sector, which leads to the conclusion that the share of the shadow economy in GDP is equal to the calculated indicator. Productivity in this case is calculated as a ratio of GDP to total number of employed.

Estimates of the shadow economy by this method were obtained for Italy (Contini, 1981)(Contini, 1982) [20; 21;15] and the United States(O'Neill, 1983) [22].

This method is easy to apply, but it estimates only the part of the shadow economy associated with the labourforce, and has a number of drawbacks. It does not consider illegal wages paid at the official work, hidden profits, etc. This method has

the unrealistic assumption of equal labour productivity in the official and in the shadow economy, which leads to understatement of the share of shadow economy. However, application of some modifications of this method are possible. Thus, the weakening of the assumptions of this approach can improve the accuracy of the estimates and give interesting results in the process of employment together with other estimation methods.

The general idea of the monetary method of estimating the size of the shadow economy is to assume that all shadow transactions are made in cash, and tax fees are the main reason for going into the shadow economy. It follows that the money supply **(M0)** has a positive dependence on the amount of tax levies. The shadow economy increases with an increase in the size of tax fees, while the amount of cash circulating in the shadow, increases **M0**. Using the econometric methods it is possible to estimate the part of **M0**, which is described by the taxes. The obtained result is the amount of cash involved in the calculation of shadow transactions.

This approach was first used in the work of Cagan, 1958 [23] to calculate the correlation between the demand for currency and a tax pressure (load) as one of the causes of the shadow economy occurrence for the United States over the period 1919-1955. 20 years later this method was modified in Gutmann's, Feige's and Tanzi's works(Gutmann, 1977; Feige, 1979; Tanzi, 1982,1983) [24, 25, 26, 27]. Using the econometric methods, Tanzi estimated the demand function for the US currency for the period 1929-1980 to calculate the share of the shadow economy. The most popular regression equation for the demand for currency (M0/M2) was the equation proposed by Tanzi [27]:

$$\ln\left(\frac{C}{M_2}\right)_t = \beta_0 + \beta_1 \ln(1 + TW)_t + \beta_2 \ln(WS/Y)_t + \beta_3 \ln R_t + \beta_4 \ln Y/N_t + u_t, \qquad (2)$$

where:

C/M_2 is aratioofcashvolumetothe deposit accounts

TW is the average weighted tax rate;

WS/Y is a ratio of wages volume to the National Income;

R is an interest paid on saving deposits;

Y/N is a National Income per capita. It is assumed that:

$$\beta_1 > 0; \beta_2 > 0; \beta_3 < 0; \beta_4 > 0.$$

To determine the share of the shadow money supply in the resulting equation, the elements that stimulate the shadow economy are equated to zero. Thus, the share of money supply M0 in M2, which is serving the official economy, is calculated, and the "net" money supply is determined. Subtracting the found share of "net" money supply M0 in M2from a share of money supply M0 in M2, it is possible to find a share of the cash serving the shadow market in money supply M2. Using this indicator, the size of the shadow economy is calculated.

The following works can serve as examples of using this method: Guissarri(Guissarri, 1986) [28] calculated the share of the shadow economy for Argentina (56% of GDP in 1983), Schneider and Bajada, 2003 [29] – for Australia (14.3% of GDP in 2000), Isachsen and Strom (Isachsen, etc., 1985) [30] – for Norway (4-6% of GDP), Schneider and Enste(Schneider, etc., 2000) [36] – for Austria (13% in 1993), Bagachwa and Naho (Bagachwa et al., 1995) [40]– for Tanzania (31% in 1990). It was also applied to the calculation of the shares of

shadow economies of many countries OECD by Schneider, Johnson, Kaufmann, and Zoido-Lobatón[42, 43] and Williams and Jan Windebank [32, 39, 41], Schneider, 1998 [32]; Johnson et al. [42], 1998; (Williams et al., 1995) [41].

This method has a number of advantages. First, it covers the cash-related part of the shadow economy. Secondly, it allows assessing the impact of various factors on the size of the shadow economy. Third, it not only measures the dynamics of the shadow economy, but also allows determining the size of the shadow economy at a certain point in time.

Criticism of this method is presented in researches of Thomas [45], Feige[46] and Pozo [47]. These authors noted that not all the shadow economy uses cash. There are also barter and non-cash payments (the role of non-cash payments in the shadow economy, in our opinion, is constantly growing); the results of the method depend on the selected set of factors in the main equation, which brings additional uncertainty in the obtained results; the method evaluates only hidden economic activity.

The monetary method makes it possible to estimate the size of the shadow economy at the starting point and is often used to calibrate the methods measuring only the dynamics of the shadow economy growth as a percentage.

If the monetary method measures the size of the shadow economy from the point of view of the money supply, the method of Kaufman-Kaliberdadoes it from the part of production. The main assumption of this method is based on the empirical observation that in the short term the elasticity of electricity consumption to GDP (industrial electricity consumption to industrial output, when industrial production is considered separately) is constant and approximately equals to 1. The dynamics of GDP according to the dynamics of electricity consumption is calculated and compared with official statistics on the basis of this assumption. The deviation between the growth in electricity consumption in % and the increase in official GDP in % is the result of changes in the shadow economy.

For the first time this approach was used in the work of Kaufmann and Kaliberda [48]; the research presented the estimations of the the shadow economy for countries with transition economy. The criticism of this study was stated in the work of M. Alexeev and W. Pyle [Alexeev et al., 2001] and is related to the fact that Kaufmann and Kaliberda in their study took the size of the shadow economy equal to 12% in 1989 for all the republics of the USSR as the starting point of the reporting period. M. Alexeev and W. Pyle showed that these estimates are underestimated. They also showed the heterogeneity of the shares of the shadow economy between different USSR republics.

In subsequent studies, the method ofWestinP. [49] and T. Komarova was used to measure the shadow economy of Russia. Komarova, basing on the study of Westin P., used this approach to estimate the size of the shadow economy in the regions of the Russian Federation and gave the following description of the method.

Assume,αis an elasticity of electricity consumption relative to GDP. Then, according to the assumption, the dynamics of the total GDP can be estimated by the dynamics of electricity consumption according to the following formula:

$$\Delta Total_{GDP} = \frac{1}{\alpha} \times \Delta ElectricityConsumption , \qquad (3)$$

where

$\Delta Total_{GDP}$is the growth of total GDP (in %);

$\Delta ElectricityConsumption$ is the growth of electricity consumption (in %).

Johnson S., Kaufmann D., Shleifer A. [44] notedon the basis of the Republics of the USSR, that the elasticity of electricity consumption relative to GDP is different during economic growth and recession. As a result, two elasticity measures were introduced: 1.15 during GDP growth and 0.87 during the recession:

$$\Delta Total_{GDP}$$
$$= \begin{cases} \frac{1}{1.15} \times \Delta ElectricityConsumption, incase\ of\ economy\ growth \\ \frac{1}{0.87} \times \Delta ElectricityConsumption, in\ case\ of\ recession \end{cases}$$

Assume,$Official_{GDP}$is the official volume of GDP, and $Total_{GDP}$ is the volume of total GDP.$Total_{GDP}$value for the whole period under review is calculated on the basis of $\Delta Total_{GDP}$ for all analysis periods, and externally given point estimates of$Total_{GDP}$. The size of the shadow economy in this case is the difference between the total GDP and the official ($Total_{GDP} - Official_{GDP}$). This method estimates the share of the shadow economy from the production part rather than consumption, as most methods do. Its drawbacks are that it does not fix grey wages, shadow services and criminal economic activities. Rigid assumptions about the constancy of elasticity are controversial. Nevertheless, if to combine the method of Kaufman-Kaliberda with methods considering grey shadow wages and services, this will significantly increase the reliability of the results.

Giles and Draeseke [Giles et al., 1999] [50] described a fuzzy-set method for estimating the dynamics of the shadow economy, based on expert estimates, which allows estimation of the dynamics of the shadow economy using a small statistical base. This method involves the use of two indicators (I_1 and I_2) dependent on the size of the shadow economy. To measure the shadow economy of Russia A. Kostin, 2008used data on total real (I_1) and regulatory (I_2) VAT payments and tax on income of natural persons (Natural Persons Income Tax) (NPIT).

The main assumption of this method is that the two selected indicators have the opposite effect on the share of the shadow economy in GDP.

The total real (I_1) and regulatory (I_2) revenues of VAT and personal income tax were used by the authors of this study as an example of indicators. It is assumed that if there is an increase in the tax burden on the population and simultaneously a decrease in real taxes collected, the shadow economy increases. To estimate the size of the shadow economy, Giles and Draeseke used fuzzy methods (for theoretical facts and the basics of fuzzy logic, see V. G. Rubanov, A. G. Filatov, I. A. Rybin [Rubanovet al, Chapter 2] and Pavlov A.V., Pavlov V. N. [Pavlov et al., 2012, Chapters 1-9]. In their works, the authors transform two selected indicators into qualitative indicators: very low, low, normal, high, very high (VL, L, N, H, VH).

There are several ways to define the boundaries of a fuzzy set.

The boundary of the fuzzy set A defined on the universal set X is a clear set front A whose elements satisfy the condition A = $\{x \in X | 0 < \mu_A(x) < 1\}$. In this case, as in Giles and Draeseke [Giles et al., 1999] research, a non-centered moving average is used. A 12-month moving average is taken for each factor and a one-step forecast is made. Each predicted value is calculated by the formula:

$$F_{t+1} = (1/N) \times \sum_{j=1}^{12} A_{t-j+1}, \qquad (4)$$

where

N is the number of previous periods included in the moving average;

Aj is the actual value at time j;

Fj is the predicted value at time j.

The value "normal" (N) is assigned to each forecasted value. To determine other qualitative values, one and two standard deviations (SD) around the "normal" value for each period are used. To describe fuzzy sets "Low", "Normal" and "High" the triangular fuzzy numbers with a single kernel (the point where the membership function is equal to one) are used. Z and S - linear functions are used to describe fuzzy sets "Very high" and "Very low" (Table 1 and Fig. 3).

Table 1 - Kernels of fuzzy indicator sets (I_1 and I_2)

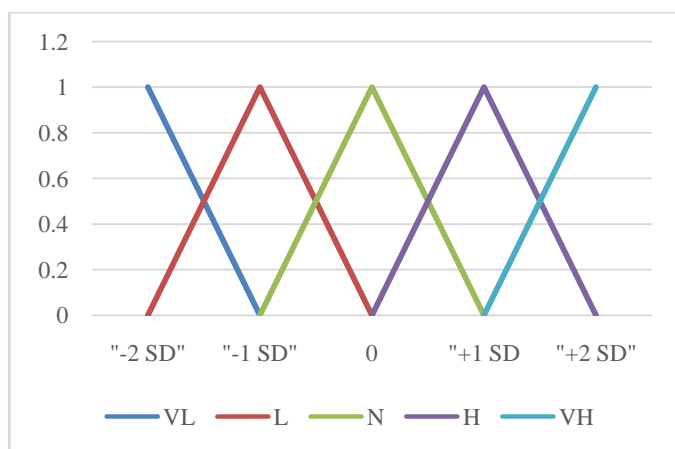| Very low	Low	Normal	High	Very high
VL	L	N	H	VH
-2 SD	-1 SD	F	+1 SD	+2 SD

Fig3. Indicators membership functions (I_1 and I_2)

Strengths of this method:

- the use of logic;
- ease of use;
- small size of the required statistical base.

Weaknesses of this method:

- only two factors affecting the shadow economy are considered;
- although the logical relationships look plausible, the process of their transformation is controversial;
- the results of this method depend on the selected indicators, the given values of the expectation and the standard deviation of the size of the shadow economy, which brings uncertainty to the final results;
- the process of transition from a fuzzy set of the size of the shadow economy to a clear equivalent is complicated by the definition of fuzzy sets.

The proposed algorithm has limitations on the measurement of the shadow economy by a maximum of ±2 standard deviations from the mathematical expectation.

According to the authors of this study, the method requires improvement in the following areas:

1. increasing the number of indicators;
2. statistical substantiation of the method of transformation of fuzzy sets of indicators into fuzzy sets of the shadow economy;
3. development of a more reasonable method of transition from fuzzy sets to clear equivalents.

The solution of the tasks on the development of this method is a separate research work and is beyond the scope of this study.

The first mentions of the method of multiple indicators with multiple causes (MIMIC) are found in the works of Weck [Weck, 1983] [52], Frey and Weck [Frey et al., 1983,1984] [53, 54, 55]. The authors have applied this approach to panel data from 24 OECD member countries for several years. Recently, this method is actively used by Schneider and Bühn [A. Bühn et al., 2012; Schneider, 2012] [56].

The MIMIC method (multiple indicators with multiple reasons) assumes that the size of the hidden economy is a latent variable. It is associated, on the one hand, with a certain number of observed indicators (reflecting changes in the volume of the shadow economy), and on the other – with a set of observed causal variables, which are considered as the most important determinants of hidden economic activity. If to know these indicators and variables, it is possible to use econometric methods to estimate the size of the shadow economy. The appropriate selection of indicators and variables allows estimating not only the hidden, but also the criminal shadow economy by this method.
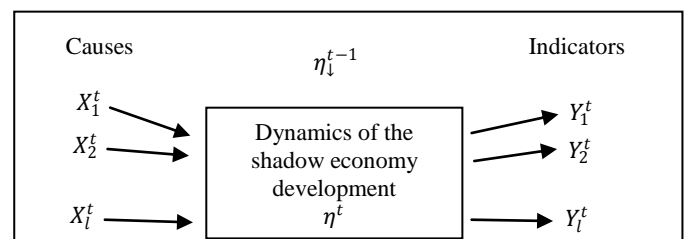

Fig. 4. The MIMIC diagram of the method [38]

Method MIMIC (Fig. 4) represents the ratio between the vector $y \epsilon R^p$ of indicator variables and the vector $x \epsilon R^q$ of causal variables (Trevor Breusch, 2005) [57]. They are interconnected by an unobservable hidden variable of the shadow economy η (scalar) using the following equations:

$$\begin{cases} y_t = \lambda \eta_t + \varepsilon_t \\ \eta_t = \gamma' x_t + \xi_t \end{cases} \qquad (5)$$

where

$\gamma' \epsilon R^q$ and $\lambda \epsilon R^p$ are coefficient vectors,

$\xi \epsilon R^q$ and $\varepsilon \epsilon R^p$ are uncorrelated error vectors with zero mean $\Theta = diag(\theta_1, \dots, \theta_p)$ and dispersion ψ.

After the transformation, the system of equations is as follows:

$$y_t = \Pi x_t + v_t, \tag{6}$$

where

$$\Pi = \lambda \gamma' \text{ and } v_t \sim N(0, \Omega) \ (\Omega = \lambda \lambda' \psi + \Theta).$$

To search for these coefficients, the coefficients are normalized. Different authors do this in different ways, for example, Giles and Tedds(Giles et al., 2002) [58] make the normalization by equaling λ_1 to 1.

The system of equations is obtained (on the example of two indicators in the system):

$$\lambda = \begin{bmatrix} 1 \\ \lambda_2 \end{bmatrix}, \Pi = \begin{bmatrix} \gamma' \\ \lambda_2 \gamma' \end{bmatrix} u\theta = \begin{bmatrix} \theta_1 & 0 \\ 0 & \theta_2 \end{bmatrix}, \tag{7}$$

$$\begin{cases} y_{1t} = \gamma' x_t + v_{1t} \\ y_{2t} = \lambda_2 \gamma' x_t + v_{2t} \end{cases} \tag{8}$$

where

$$var \begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix} = \begin{bmatrix} \psi + \theta_1 & \lambda_2 \psi \\ \lambda_2 \psi & \lambda_2^2 \psi + \theta_2 \end{bmatrix} \tag{9}$$

The linear transformation is performed:

$$y_{2t} - \lambda_2 y_{1t} = v_{2t} - \lambda_2 v_{1t} = u_t. \tag{10}$$

This transformation allows considering the following system of equations:

$$\begin{cases} y_{1t} = \gamma' x_t + v_{1t} \\ y_{2t} = \lambda_2 y_{1t} + u_t \end{cases} \tag{11}$$

where

$$var \begin{bmatrix} u_t \\ v_{1t} \end{bmatrix} = \begin{bmatrix} \lambda_2^2 \theta_1 + \theta_2 & -\lambda_2 \theta_1 \\ -\lambda_2 \theta_1 & \psi + \theta_1 \end{bmatrix} \tag{12}$$

This system allows estimating the values of λ_2 and γ'. The required variance parameters are found from the following equations:

$$\theta_1 = -cov(u_t, v_{1t})/\lambda_2 \tag{13}$$

$$\theta_2 = var(u_t) - \lambda_2^2 \theta_1 \tag{14}$$

$$\psi = var(v_{1t}) - \theta_1 \tag{15}$$

The advantage of this method is that it uses a variety of factors and indicators, which, in general, allows covering most of the shadow economy. Employment of this method estimates only changes in the shadow economy; therefore, it is often used in conjunction with the monetary method.

The weaknesses of the MIMIC method:

1. instability of the estimated coefficients with respect to changes in the sample size;
2. difficulty in obtaining reliable data on all causal variables except tax rates;
3. the ambiguity of the impact of "causes" and "indicators" on the change of the shadow economy.

Trevor Breusch (Trevor Breusch, 2005) [57] also criticized this approach. He noted that the normalization when using the method is often built incorrectly and leads to the fact that the method becomes sensitive to the units of data measurement.

Despite the criticism, the MIMIC method with the correct selection of indicators allows assessing the dynamics of the share of the shadow economy, taking into account various aspects of its manifestation, which is not allowed by previous methods. The MIMIC method is the most often used for panel data, and its results are used to compare countries by share of the shadow economy.

CONCLUSIONS

Summarizing the theoretical and economic analysis of the shadow economy, it should be noted that shadow economic relations accompany humanity throughout the entire history of its existence. For a long time, due to the domination of subsistence economy and largely personalised social control, the shadow economy manifested itself in rather primitive forms of economic crimes.

The official economic relations of economic entities in inadequate economic, legal and institutional conditions inevitably transform into the shadow ones, which have specific forms of manifestation; it is manifested in their economic functions identical to those of small enterprises in the official sector of the economy, but having their own specific features.

The global economic crisis required strengthening the role of the state in the economy of the country. The insecurity of private property, the manifestation of imperfect competition, the decline in the effectiveness of traditional business mechanisms, the escalation of the contradictions between liberalised private enterprise and the state lead to a systemic growth of shadow economic relations.

Approaches to modeling the shadow economy can be divided into qualitative and quantitative. None of the methods covers all the sectors of the shadow economy. This led to the idea of constructing an integral indicator that includes a number of estimates obtained by modeling certain aspects of the shadow economy by various methods, as well as to the development of a new model describing the unexplored aspects of the shadow economy.

References

[1] Beccaria, C. (2002) Analytical experience of smuggling. *Economics and Mathematical Methods*, Vol.38 Issue 4.

[2] Becker, G. (2000) Crime and Punishment: An Economic Approach. *The origins*, 28-90.

[3] Hart, K. (1973) Informal urban income opportunities and urban employment in Ghana. *Journal of Modern African Studies.*

[4] Portes, A., Sassen-Koob, S. (1987) Making It Underground: Comparative Material on the Informal Sector in Western Market Economies. *American Journal of Sociology*, 30-58.

[5] Mead, DC, Morrisson, C. (1996) The Informal Sector Elepfant. *World Development*, 1611-1619.

[6] Dallago.B. (1990). The Irregular Economy in Transition: Features, Measurement, and Scope. *International Studies in Economicsand Econometrics*, 31-63.

[7] Lemieux., P. (2007) The Underground Economy. Causes, Extent, Approaches. *Montreal Economic Institute Research Paper.*

[8] Smith, A. (2007). *An Inquiry into the Nature and Causes of the Wealth of Nations.* Edited by S. M. Soares. MetaLibri Digital.

[9] Hans, F. (1982). *Death and Taxes.* Washington: DC.

[10] Franz, Anton. "Wie gro. ist die "schwarze" Wirtschaft?" Mitteilungsblatt der Osterreichischen

Statistischen Gesellschaft, 1983, 49:1, pp. 1-6.

[11] MacAfee, Kerric. "A Glimpse of the Hidden Economy in the National Ac- counts," Economic Trends, 136, 1980, pp. 81-87.

[12] O'Higgins, Michael. "Assessing the Underground Economy in the United Kingdom," in Edgar L. Feige (ed.): The Underground Economies: Tax Evasion and Information Distortion. Cambridge: Cambridge University Press, 1989, pp. 175- 195.

[13] Smith, James D. "Market Motives in the Informal Economy," in Wulf Gaertner and Alois Wenig (eds.): The Economics of the Shadow economy. Berlin: Springer, 1985, pp. 161-177.

[14] Petersen, Hans-Georg. "Size of the Public Sector, Economic Growth and the Informal Economy: Development Trends in the Federal Republic of Germany," Re- view of Income and Wealth, 28:2, 1982, pp. 191-215.

[15] Del Boca, Daniela. "Parallel Economy and Allocation of Time," Micros- Quarterly Journal of Microeconomics, 4:2, 1981, pp. 13-18.

[16] Park, Tea. "Reconciliation Between Personal Income and Taxable Income", Washington D.C.: Bureau of Economic Analysis; 1979, pp. 1947-1977.

[17] Yoo, Tiho, and Jin K. Hyun. "International Comparison of the Black Economy: Empirical", 1998

[18] Elgin, Ceyhun and Oztunali, Oguz "Shadow Economies around the World: Model Based Estimates," Working Papers 2012/05, Bogazici University, Department of Economics, 2012.

[19] Feld, L., Schneider, F. Survey on the Shadow Economy and Undeclared Earnings in OECD Countries, Invited Paper written for publication in the German Economic Review, Department of Economics, University of Linz, Linz, Austria, 2010.

[20] Contini, Bruno. "Labor Market Segmentation and the Development of the Parallel Economy – the Italian Experience," Oxford Economic Papers, 33:4, 1981, pp. 401-412.

[21] Contini, Bruno. "The Second Economy of Italy," in Vito Tanzi (ed.): The Underground Economy in the United States and Abroad. Lexington: D.C. Heath, 1982, pp. 131-159.

[22] O'Neill, David M. "Growth of the Underground Economy 1950-81: Some Evidence from the Current Population Survey," Study for the Joint Economic Committee, 98:122; Washington: U.S. Congress, Joint Committee Print, U.S. Gov. Printing Office. 1983.

[23] Cagan, Phillip. "The Demand for Currency Relative to the Total Money Sup- ply," Journal of Political Economy, 66:3, 1958, pp. 302-328.

[24] Gutmann, Pierre M. "The Subterranean Economy," Financial Analysts Journal, 34:1, 1977, pp. 24-27.

[25] Feige, Edgar L. "How Big is the Irregular Economy?" Challenge 22:1, 1979, pp. 5-13.

[26] Tanzi, Vito. "The Underground Economy in the United States and Abroad." Lexington: D.C. Heath. 1982.

[27] Tanzi, Vito. "The Underground Economy in the United States: Annual Estimates, 1930-1980, "IMF-Staff Papers, 30:2, 1983, pp. 283-305.

[28] Guissarri, A. "La Demanda de Circulante y la Informalidaden la Argentina: 1930 – 1983", Seminarios ITDT. 1986.

[29] Schneider F., Bajada C. "The Size and Development of the Shadow Economies in the Asia-Pacific." Working Paper No. 0301, Department of Economics, Johannes

[30] Kepler University Linz, 2003.

[30] Isachsen, A. and Strom, S. "The Size of the Hidden Economy in Norway", Review of Income and Wealth, vol. 31, issue 1, pages 21-38. 1985.

[31] Schneider F. The Increase of the Size of the Shadow Economy of 18 OECD- Countries: Some Preliminary Explanations. Paper presented at the Annual Public Choice Meeting, March 10–12, 2000b, Charleston, S.C.

[32] Schneider F. The Shadow Economies of Western Europe. Journal of the Institute of Economic Affairs, 17(3): 42–48, 1997.

[33] Schneider F., Bajada C. "The Size and Development of the Shadow Economies in the Asia-Pacific." Working Paper No. 0301, Department Of Economics, Johannes Kepler University Linz, 2003.

[34] Schneider F., Buehn A., Montenegro Claudio E. "Shadow Economies All over the World: New Estimates for 162 Countries from 1999 to 2007" Working Pa- pers wp322, University of Chile, Department of Economics, 2010a.

[35] Schneider F., The Size of the Shadow Economy for 25 Transition Countries over 1999/00 to 2006/07: What do we know", September 2009.

[36] Schneider, F. and Enste, D. "Shadow Economies: Size, Causes, and Consequences", Journal of Economic Literature. 38:1. 2000a.

[37] Schneider, F. and Enste, D. The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications. Cambridge (UK): Cambridge University Press, 2002.

[38] Schneider, Friedrich "The Shadow Economy and Work in the Shadow: What Do We (Not) Know?" IZA Discussion Papers 6423, Institute for the Study of Labor (IZA), 2012.

[39] Schneider, Friedrich. "Further Empirical Results of the Size of the Shadow Economy of 17 OECD-Countries Over Time," Paper presented at the 54. Congress of the IIPF Cordoba, Argentina and Discussion Paper, Department of Economics, University of Linz, Linz, Austria. 1998a.

[40] Bagachwa, M., Naho, A. "Estimating the second economy in Tanzania", World Development, 23:8., pp. 1387-1399. 1995.

[41] Williams, Colin C. and Jan Windebank. "Black Market Work in the European Community: Peripheral Work for Peripheral Localities?", International Journal of Urban and Regional Research, 19:1, 1995, pp. 23-39.

[42] Johnson, S., Kaufmann, D. and Zoido -Lobatón, P. Corruption, Public Finances and the Unofficial Economy. Washington, D.C.: The World Bank, Discussion Paper, 1998a.

[43] Johnson, S., Kaufmann, D. and Zoido -Lobatón, P. Regulatory Discretion and the Unofficial Economy. The American Economic Review, 88(2): 387–392, 1998b.

[44] Johnson S., Kaufmann D., Shleifer A. Politics and Entrepreneurships in Transition Economies // The William Davidson Institute, University of Michigan. Working Paper Series. No 57, 1997.

[45] Thomas, Jim J. "Quantifying the Black Economy: 'Measurement without Theory' Yet Again?" The Economic Journal, 109:456, 1999, pp. 381-389.

[46] Feige, Edgar L. "A Re-examination of the 'Underground Economy' in the United States," IMF Staff Papers, 33:4, 1986, pp. 768-781.

[47]   Pozo, Susan. "Exploring the Underground Economy: Studies of Illegal and Unreported Activity. Michigan": W.E. Upjohn, Institute for Employment Research. - 1996.

[48]   Kaufmann, Daniel and Kaliberda. "Integrating the Unofficial Economy into the Dynamics of Post Socialist Economies: A Framework of Analyses and Evidence," Policy research working paper 1691. Washington, D.C.: The World bank. 1996.

[49]   Westin, P. "Emerging from the shadow: Special Topics in Russian Economy", Aton Capital Group, 2002.

[50]   Giles, David E.A. "Measuring the Hidden Economy: Implications for Econometric Modeling," The Economic Journal, 109:456, 1999a, pp.370-380.

[51]   Giles, David E.A. "Modeling the Hidden Economy in the Tax-Gap in New Zealand," Working paper, Department of Economics, University of Victoria, Canada. 1999b

[52]   Weck, Hannelore. "Schattenwirt schaft: Eine Moglichkeitzur Einschrankung der offentlichen Verwaltung?" Eineokonomische Analyse. Frankfurt/Main: Lang. 1983.

[53]   Frey, Bruno S. and Hannelore Weck "The Hidden Economy as an 'Unobserved' Variable," European Economic Review, 26/1, 1984 pp. 33-53.

[54]   Frey, Bruno S. and Hannelore Weck. "Bureaucracy and the Shadow Economy: A Macro- Approach", in Horst Hanusch (ed.): Anatomy of Government Deficiencies. Berlin: Springer, 1983a, pp. 89-109.

[55]   Frey, Bruno S. and Hannelore Weck. "Estimating the Shadow Economy: A 'Naive' Approach," Oxford Economic Papers, 35, 1983b, pp. 23-44.

[56]   Bühn A., Schneider F. "Size and Development of Tax Evasion in 38 OECD Countries: What do we (not) know?" CESifo Working Paper Series4004, CESifo Group Munich, 2012.

[57]   Trevor Breusch "Estimating the Underground Economy using MIMIC Models" 2005 http://128.118.178.162/eps/em/papers/0507/0507003.pdf

[58]   Giles, David, E.A., Tedds, Lindsay, M. and Werkneh, Gugsa. "The Canadian underground and measured economies", Applied Economics, 34/4, 2002, pp.2347-2352.