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METHOD OF ESTIMATING THE VOLUME OF THE SHADOW ECONOMY

Abstract. The shadow economy at the transitional stage of development of Ukraine became an integral part of the economy, began to solve a number of macro and microeconomic problems of the state. Today, the shadow economy has a significant impact on all socio-economic processes

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FULLSCREEN

DEVELOPMENT OF INTEGRATED REPORTING FUNCTIONS OF THE ENTERPRISE

PDF (УКРАЇНСЬКА)

M. T. Telovata, K. V. Bezverkhiy

198-205

VALUABLE ASPECTS IN THE ENTERPRISE MANAGEMENT PROCESS

PDF

M. A. Teplyuk, A. V. Liezina, M. V. Zavyalova, N. S. Lysenko, A. F. Yavorska

206-212

IMPROVED METHODS OF EVALUATION OF FINANCIAL SECURITY FOR COMPANIES IN UKRAINE

PDF

T. V. Kharchuk, V. A. Kredisov, V. V. Melnik, O. A. Purdenko

213-222

The models and process technology of the financial informationESTIMATING AND FORECASTING OF FINANCIAL SECURITY OF ENTERPRISES

PDF

G. M. Azarenkova, O. G. Golovko, K. V. Oryekhova, O. V. Salenko, A. V. Maiboroda

224-230

LEGAL REGULATION DEVELOPING REGIONAL INNOVATION CLUSTERS IN THE FINANCIAL SECTOR IN UKRAINE

PDF

L. Velychko, I. Horodetska, O. Moskalenko, L. Shumna

231-243

METHOD OF ESTIMATING THE VOLUME OF THE SHADOW ECONOMY

PDF

V. Yu. Ilin, T. P. Nazarenko, I. V. Suprunova, I. V. Tomashuk, A. A. Shevchenko

244-250

MODELING OF EMPLOYMENT STRUCTURAL TRANSFORMATIONS

PDF

L. M. Ilich, O. M. Hlushak, S. A. Semenyaka

251-259

MODELING THE OPTIMAL DIVIDEND POLICY OF UKRAINIAN COMPANIES

PDF (УКРАЇНСЬКА)

O. M. Ptakhina, T. V. Sych, Ye. V. Ivanov, O. P. Yevsuykov, O. V. Kozyrieva

260-268

METHODICAL APPROACH TO THE QUANTIFICATION OF ENTERPRISE FINANCIAL SECURITY LEVEL

PDF

B. V. Samorodov, O. O. Sosnovska, M. O. Zhytar, J. V. Ananieva

269-277

RULE OF LAW AND ECONOMIC GROWTH

PDF

V. O. Shevchuk, M. M. Blikhar, I. I. Komarnytska, N. M. Tataryn

278-289

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METHOD OF ESTIMATING THE VOLUME OF THE SHADOW ECONOMY

Abstract. The shadow economy at the transitional stage of development of Ukraine became an integral part of the economy, began to solve a number of macro and microeconomic problems of the state. Today, the shadow economy has a significant impact on all socio-economic processes occurring in the country. But the shadow economy's share of gross domestic product today is so large that it poses a threat to national security. A significant level of the shadow economy leads to the criminalization of society, the growth of corruption, the formation of an atmosphere of legal nihilism in the state. Tendency to evade taxes causes significant damage to Ukraine's budget. This, in turn, narrows the transition to a welfare state model, as it reduces resources for infrastructural upgrades, social payments, medical and other social services for the population.

Official estimates of the size of the shadow economy by various government agencies have considerable differences. Inaccurate assessment of the impact of the shadow economy on all spheres of the country's activity leads to irrelevant assessments of socio-economic processes and their tendencies, miscalculations in the formation of domestic and foreign policy of Ukraine. The shadow economy has been researched by many scholars, but in the considerable number of works on this topic there are no even well-grounded data on the shadow economy. Therefore, the urgent task is to develop an algorithm for estimating the shadow economy. To do this, the article analyzes various terminological approaches to defining the shadow economy and its components. The classification of existing methodological approaches to the identification and assessment of the extent of shadow economic activity is carried out. A mathematically correct method of estimating the size of the shadow economy which is suitable for practical use has been proposed and substantiated. The analysis of the obtained mathematical equation showed that it is possible to formulate mathematically precisely the conditions for a stable level of the shadow economy and the growth of the shadow economy. The estimation of the correlation functional of the shadow economy size became mathematically accurate.

Keywords: shadow economy, shadow economy indicators, economic category, and the manifestations of the shadow economy.

JEL Classification E26, O17

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МЕТОДИКА ОЦІНКИ ОБСЯГУ ТІНЬОВОЇ ЕКОНОМІКИ

Анотація. Тіньова економіка на перехідному етапі розвитку України стала невід’ємною частиною економіки, почала вирішувати низку макро- та мікроекономічних завдань держави. Сьогодні тіньовий сектор економіки має значний вплив на всі соціально-економічні процеси, які відбуваються в державі. Але частка тіньової економіки у валовому внутрішньому продукті сьогодні є такою великою, що становить загрозу національній безпеці. Значний рівень тіньової економіки призводить до криміналізації суспільства, зростання корупції, формування в державі атмосфери правового нігілізму. Намагання ухилитися від сплати податків наносить суттєвий збиток бюджету України. Це, у свою чергу, звужує можливості переходу до моделі соціальної держави, бо зменшує ресурси на оновлення інфраструктури, соціальні виплати, медичні та інші соціальні послуги для населення.

Офіційні оцінки обсягу тіньової економіки різними державними установами мають значні розбіжності. Некоректна оцінка впливу тіньової економіки на всі сфери діяльності країни призводить до нерелевантних оцінок соціально-економічних процесів та їхніх тенденцій, прорахунків у формуванні внутрішньої і зовнішньої політики України. Тіньову економіку досліджували багато вчених, але у значній кількості праць за цією темою навіть відсутні обґрунтовані дані про тіньову економіку. Тому нагальним завданням стає розроблення алгоритму оцінки тіньової економіки. Для цього проаналізовано різні термінологічні підходи до визначення тіньової економіки та її складових. Проведено класифікацію наявних методологічних підходів до виявлення та оцінки масштабів тіньової економічної діяльності. Запропоновано і обґрунтовано математично коректний метод оцінки обсягу тіньової економіки, придатний для використання на практиці. Аналіз отриманого математичного рівняння показав, що можливо математично точно сформулювати умови сталого рівня тіньової економіки та зростання обсягу тіньової економіки. Математично точним стала оцінка корелювального функціоналу обсягу тіньової економіки.

Ключові слова: тіньова економіка, показники тіньової економіки, економічна категорія, прояви тіньової економіки, економічні відносини, економічні інтереси.

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МЕТОДИКА ОЦЕНКИ ОБЪЕМА ТЕНЕВОЙ ЭКОНОМИКИ

Аннотация. Теневая экономика на переходном этапе развития Украины стала неотъемлемой частью экономики, начала решать ряд макро- и микроэкономических задач государства. Сегодня теневой сектор экономики имеет значительное влияние на все социально-экономические процессы, происходящие в государстве. Но доля теневой экономики в валовом внутреннем продукте сегодня такая большая, что представляет угрозу национальной безопасности. Предложено и обосновано математически корректный метод оценки объема теневой экономики, пригодный для использования на практике. Анализ полученного математического уравнения показал, что возможно математически точно сформулировать условия устойчивого уровня теневой экономики и рост объема теневой экономики. Математически точной стала оценка коррелирующие функционала объема теневой экономики.

Ключевые слова: теневая экономика, показатели теневой экономики, экономическая категория, проявления теневой экономики, экономические отношения, экономические интересы.

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Introduction. Transitional stage of economic structure of Ukraine by objective factors is impossible without the formation of a shadow economy. The shadow economy at this stage of development became an integral part of the economy of the country, began to solve a number of system tasks, such as employment of a certain part of unemployed workers, providing the necessary level of income of the population, accumulation of private financial resources, etc. That is, the shadow economy objectively plays the role of socio-economic compensator for unregulated legal social relations and is competitive in rivalry with the legal economy [1]. But it is impossible to build an efficient, modern economy, shape a human society, create an economy modeled on developed countries without significantly reducing the shadow economy's share in gross domestic product. It is the significant level of the shadow economy that leads to the criminalization of society, the growth of corruption, the formation of an atmosphere of legal nihilism in the state. Neglecting the influence of the shadow economy on all spheres of the state will lead to irrelevant assessments of socio-economic processes and their tendencies, miscalculations in the formation of domestic and foreign policy of the country. While in the developed countries of the world the level

of the shadow economy is 10—15% of GDP, in Ukraine this share is 30—50% the critical level being 40—50% [2].

Analysis of research and problem statement. The shadow sector of the economy has a significant impact on all socio-economic processes in society. The problems of the shadow economy were studied in the works of eminent national scientists, namely, Pirnykoza P.V. [2], Mazur I.I. [3], Morozova D.V. [6], Yatsenko O., Nitsenko V., Karasova N. [7], Zos-Kior M., Nitsenko V., Ilin V. [8], Mukoviz V., Sharapa O. [9], Kolyada Y.V., Semashko K.A. [10], and others. As the shadow economy exists not only in Ukraine, scientists from other countries of the world have also researched these problems, including Polese A., Williams C., Horodnic I.A., Bejakovic P. [1], William H.M., Parcell J.L. [7], Bilan Y., Sinelnikau U. [8], and others.

The shadow economy is considered by some researchers in the narrow sense of the term - as criminal activity and illegal influence on politics. Indeed, for developed economies of the world, with moderate tax pressure, low costs of legal registration of manufacturing activities, on the one hand, and significant risks of conducting illegal business, on the other hand, the notion of «criminal business» is identical to «shadow business» and is limited to gambling, drug trafficking, weapons, prostitution control and so like. Other researchers define the shadow economy as an economy that tries to reduce fiscal pressure in one way or another [3]. The work of II Mazur [3] gives the following definition of the concept of «shadow economy»: «shadow economy is a system of relations between economic entities which is self-organizing and involves all stages of the process of social production in order to obtain economic benefits, the results of which or the means of achievement are for different reasons either replaced, reduced or completely hidden from direct participants and from the law» [3]. And further, — «the shadow economy exists as a component in the economy of any country, which does not fit into the legitimate idea of the normal interaction of economic entities, which unites qualitatively heterogeneous activities and are completely or partially not subject to formal rules of management or contracts and are not recorded by statistical accounting» [3]. This definition of the shadow economy became essential for this study.

Unsolved aspect of the problem. The shadow economy has been researched by many scholars, but in the considerable number of works on this topic there are no even well-grounded data on the shadow economy. Despite the existence of developed methods for assessing the shadow economy (even the definition of NonObserved economy is characteristic) and methods for estimating the extent of shadow economic activity, little attention was paid to algorithms and mathematically grounded approaches to the assessment of the shadow economy.

The purpose of the article. The purpose of the work is to classify the available methods of estimating the shadow economic activity and to propose and substantiate a mathematically correct method of estimating the size of the shadow economy, suitable for practical use.

Research results. Hiding profits from fiscal and regulatory bodies for producers of goods and services is a tool to offset excessive fiscal pressure and establish a certain level of profitability. Further increase in the share of the shadow economy in GDP will lead to macroeconomic imbalances, which in turn will increase the level of risk to the country's economic security. Trying to evade taxes is a significant detriment to the budgets of transition economies. This narrows the possibilities for the transition to a «welfare state» model, as it reduces resources for infrastructural upgrades, social payments, medical and other social services for the population. Relevant assessment of the shadow economy, on the one hand, gives an opportunity to assess the real potential of the country, to carry out macroeconomic planning and forecasting and, on the other hand, allows to conduct a well-balanced policy of unshadowing, assessing both the required efforts and the degree of effectiveness of the instruments used for this purpose. Methods for estimating the shadow economy [4—9] are used. Unfortunately, the use of these recommendations by different public institutions leads to results that have significant differences. Methods for identifying and assessing the range of shadow economic activity are shown in *Fig.*

These methods allow for a more or less accurate result, but in most cases require considerable effort, large budgets and a considerable amount of time.



Fig. Methods of estimation of shadow economic activity

Source: Compiled by the author according to [3—10].

Therefore, the mathematization of the methods of estimating the extent of the shadow economic activity will allow to solve these problems and to develop the necessary tool, suitable for practical use.

To estimate the size of the shadow economy, we use the mathematical approach of nonlinear dynamics [10]. Then we make a system of equations.

$$\left\{ \frac{dx}{d\theta} = ax + cdx + cex^2 \right. \quad \left. \frac{dy}{d\theta} = by + fexy + fdy^2 \right. \quad (1)$$

where x, y describe the volumes of the legal and shadow economy sectors.

Changing the characters of the coefficients in the system of equations (1) allows us to describe correctly the different modes of interaction between the legal and the shadow economy thus achieving its relevance. To form a mathematical model suitable for practical use and analysis, we present the first equation in the system of equations (1) as follows:

$$\frac{dx}{d\theta} / x = a + c(dy + ex) \quad (2)$$

Then:

$$x(\theta) = x(0) \exp\left\{\int_0^\theta [a + c(dy + ex)]d\theta\right\} \quad (3)$$

Similarly, for the second equation of system (1):

$$y(\theta) = y(0) \exp\left\{\int_0^\theta [b + f(ex + dy)]d\theta\right\} \quad (4)$$

Having finally transformed equations (5) and (6) and divided them into one another, we obtain:

$$\frac{x(\theta)^{\frac{1}{c}}}{y(\theta)^{\frac{1}{f}}} = \frac{x(0)^{\frac{1}{c}}}{y(0)^{\frac{1}{f}}} * \exp\left(\frac{(fa - cb)\theta}{cf}\right) \quad (5)$$

Then the size of the shadow economy can be calculated by the formula:

$$y = x^{\frac{f}{c}} \left(\frac{x(0)^{\frac{1}{c}}}{y(0)^{\frac{1}{f}}}\right)^{-f} \exp\left\{\left(b - \frac{f}{c}a\right)\theta\right\} \quad (6)$$

The analysis of the obtained mathematical expression (6) shows that a stable level of the shadow economy will be subject to the condition $b = \frac{fa}{c}$, and its growth condition is $b > \frac{fa}{c}$. The complex $\frac{x(0)^{\frac{1}{c}}}{y(0)^{\frac{1}{f}}}$, as seen from the analysis of equation (5), plays the role of the correlation functional.

Conclusions. The paper states that today the shadow economy has become an integral part of the country's economy. This, on the one hand, is a positive factor because it helps to solve a number of complex socio-economic problems of the state, but on the other hand, the size of the shadow economy in the country's GDP is so large that it even threatens national security. Estimates of the size of the shadow economy by various state institutions today have considerable differences. An accurate assessment of the size of the shadow economy requires relevant macroeconomic analysis and socio-economic forecasting. Therefore, it is an urgent task to classify methods of estimating the volume of shadow economic activity and to offer a valid mathematical method of estimating the range of the shadow economy, suitable for practical use, and this task is solved in this paper. The classification of methods is given, in particular, the methods of estimating the shadow economy. It is stated that the implementation of these techniques requires considerable time and resources. Therefore, an urgent task to solve the identified problems was to develop an algorithm for estimating the shadow economy. The mathematical apparatus of nonlinear dynamics is used for this purpose. This contrasts in some ways with the common practice of using linear modeling of economic processes. Linear modeling seems to be more suitable to calculate economic systems that tend to equilibrium, but not to the present economic state of Ukraine, which is characterized by rapid dynamic changes. The analysis of the resulting equation showed that it is possible to formulate mathematically precisely the condition of both a sustainable level of development of the shadow economy and the condition of increasing the share of the shadow economy in the country's GDP. It was also possible to formulate mathematically precisely the functional for correlating the size of the shadow economy. This will allow practitioners to find the size of the shadow economy without significant expenditure of resources, to analyze its development trends and impact on socio-economic processes.

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