Recovery of Information Flows of the Unobserved Regional Economy*

Elena I. Piskun [1][0000–0002–4397–8143], Vladimir V. Khokhlov [2][0000-0002-4027-4714] and Victor P. Nevezhin [3][0000-0002-6928-895X]

[1] Sevastopol State University, 33 Universitetskya, Sevastopol, 299053, Russia
lenapiskun@mail.ru
[2] Sevastopol State University, 33 Universitetskya, Sevastopol, 299053, Russia
khokhlov_vv57@mail.ru
[3]Financial University under the Government of the Russian Federation, 49 Leningradsky Prospekt, Moscow, 125993, Russia
vpnevezhin@fa.ru

Abstract. The existence of an unobservable economy leads to distortion of the financial results of the regional economy, which affects the quality of decisions made by regional authorities. Exploratory factor analysis allows restoring information flows of unobservable economic processes. The method consists of the fact that the factor structure of the regional economy is found based on official statistics. Then, an instrumental exploratory factor is introduced, which is associated with the functioning of the unobserved economy, and an estimate of its values is found based on an expert assumption about the level of the shadow economy and the performance of households that go for their consumption. After that, according to the values of exploratory factors, the values of the main macroeconomic indicators are restored, taking into account the unobservable regional economy. The difference between the data of official statistics and data obtained employing the factor model gives the value of the information flow of the unobserved economy.

Keywords: Unobserved Economy, Gross Regional Product, Exploratory Factor Analysis, Efficiency of Tax Administration.

1 Formulation of the Problem

The problem of the unobserved economy is one of the most pressing financial problems in the world. Shadow income, profit transfer, financial flows hidden from tax authorities lead to a compression of the tax base and, as a result, to an increase in the tax burden for law-abiding taxpayers. The resulting imbalances in the tax burden lead to a loss of

competitiveness of honest taxpayers, encouraging them to go into the shadows. Therefore, the identification and assessment of the volume of the shadow regional sector and the definition of ways to combat it is an important scientific and practical task.

The existence of an unobservable sector of the economy is a complex problem, it has not only economic but also political, economic, and social. World experience and numerous studies show that the identification of the results of the functioning of the non-observed economy, as well as its removal from the shadows, should be carried out simultaneously through many channels. Any bias or concentration of measures in only one direction (for example, concentration on strengthening control) may not only fail but also lead to opposite results - to the growth of the shadow sector of the regional economy [1-4]

Reliable statistical information is an important element of economic research and the development of adequate economic policies. The most important aspect of the quality of economic information is the extent to which it covers all types of economic activity. Comprehensive accounting is difficult to achieve due to a wide range of economic activities, some of which are deliberately hidden from oversight by those responsible for it [5-6].

Incomplete coverage creates problems for users, skewing both levels and trends. Gross regional product (GRP) levels are shifted downward, which creates an inaccurate picture of the economy and makes it difficult to compare economic indicators.

Errors in trend estimates can arise if the growth rate of economic activity not included in GRP differs from the growth rate of those included. For example, it is often hypothesized that the growth of the shadow or informal sector of the economy occurs at a time when the formal economy is in decline.

For economists analyzing regional economies, incomplete coverage violates the internal consistency of indicators, since some economic transactions can be immeasurable. For example, household spending on goods and services produced in the shadow economy can be measured because their buyers have no reason to hide their purchase and producers will not report on related production activities.

Much attention is paid in the media to the possibility of underreporting economic activity, and reports often suggest that GRP data published by statistical agencies do not include a significant part of the economy. These reports call into question the credibility of official records and often contain claims of underestimation. The problem is that many media reports are based on a research methodology that has at least one of two major flaws. First, these methods often do not accurately determine what should be measured, and therefore may go unaccounted for. The lack of accuracy in determining the object of measurement is characterized by a wide variety of terms used in everyday life: hidden economy, shadow economy, parallel economy, shadow economy, informal economy, cash economy, black market. There is no common understanding of whether all these terms mean the same thing, and if not, how they relate to each other. Capital flight, tax evasion, shuttle trading, theft, and extortion all collapse as unwanted or illegal activities that are highly underestimated in official figures.

Another problem is that many valuation methods are based on oversimplified assumptions. For example, so-called “monetary models” assume that changes like the demand for money can be fully explained by changes in unrecorded economic activity

and accurately reflects them. Another known model is based on a change in electricity consumption. Some methods make inadequate use of the variety of available economic data, and it is unclear how their findings can be reconciled with others to provide more reliable measurements.

One of the reasons these macro models are getting so much attention is that the statistical authorities do not explain in detail their methods. Consequently, users of statistical information believe that other methods should be used.

Comparing data from different sources is the main method for identifying the problem of hidden economic information. It can also be used to identify the remaining errors and gaps in this data. Comparison of data to check statistical information and improve its quality is carried out using the following types of data: data from business surveys compared with data on taxation; wages paid against collected taxes, sales of goods and services subject to VAT, against collected VAT; production versus production-related taxes; business survey data on food production versus business survey data on food procurement; resources of goods and services versus their use; expenditure survey data versus retail sales survey data; household spending versus retail sales; etc.

However, the results of comparisons of these data allow only to reveal the very problem of inconsistency and indicate the presence of an unobservable regional economy. The degree of discrepancy between data from different sources gives an approximate estimate of the amount of hidden economic information. There are various methods to restore information flows of unmeasured economic indicators. Specifically, production method, end-use method, tabular resource use, and use method [7-11].

2 Results

To reveal information hidden from official reporting, it is proposed to use exploratory factor analysis, which allows one to explain the nature of the interdependencies of economic indicators.

It is proposed to use the gross regional product (GRP) as the main macroeconomic indicator for which statistical reporting data are available, as well as the presence of unobservable information is assumed. It is influenced by many other indicators, namely: investments in fixed assets, regional money supply, lending volumes, household expenditures, tax collection, the level of development of targeted government programs, household income, as well as indicators directly included in the GRP. These indicators are naturally interconnected, and an exploratory factor structure is introduced to explain the correlations between them:

$$\boldsymbol{X} = \boldsymbol{F}\boldsymbol{A}^T + \boldsymbol{U}; \quad (1)$$

where $\boldsymbol{X}$ –a matrix of values of indicators that have a direct impact on the gross regional product, obtained according to official data;

$\boldsymbol{F}$ – matrix of values of exploratory factors;

$\boldsymbol{A}^T$ – transposed factor loading matrix;

$\boldsymbol{U}$ – factor residual matrix.

Exploratory factors are mutually independent values, and the transition to them when explaining the dynamics of GRP allows you to eliminate the effect of multicollinearity

and compose a regression dependence of the gross regional product on orthogonal exogenous variables:

$$\boldsymbol{y} = \boldsymbol{Fb} + \boldsymbol{e}; \tag{2}$$

where $\boldsymbol{y}$ – vector of GRP values according to official statistics;

$\boldsymbol{b}$ – vector of regression coefficients of factors on GRP;

$\boldsymbol{e}$ – vector of random deviations.

All parameters of equations (1) and (2) are estimated by known procedures, including the matrix of values of exploratory factors. In particular, the least-squares method can be used to obtain estimates of the regression coefficients, since regressors are independent variables:

$$\boldsymbol{F}^T\boldsymbol{F} = \boldsymbol{I}.$$

In model (2), exploratory factors set and explain the values of the gross regional product according to the data of the state committee on statistics.

Suppose that experts argue that the GRP, taking into account the non-observed economy, should be adjusted upward by a certain percentage. Then this increase is achieved due to an additional exploratory factor and (2) is transformed to the form:

$$\tilde{\boldsymbol{y}} = (\boldsymbol{F} \quad \boldsymbol{f}_0)\begin{pmatrix}\boldsymbol{b}\\ b_0\end{pmatrix} + \boldsymbol{e}_0; \tag{3}$$

where $\tilde{\boldsymbol{y}}$ – real value of GRP taking into account the non-observed economy;

$\boldsymbol{f}_0$ – exploitative factor of the non-observed economy;

b_0 – exploitative factor of the non-observed economy;

$\boldsymbol{e}_0$ – corrected vector of random deviations.

Equation (3) after multiplying the block matrices is reduced to the form

$$\tilde{\boldsymbol{y}} = \boldsymbol{Fb} + \boldsymbol{f}_0 b_0 + \boldsymbol{e}_0. \tag{4}$$

Taking into account the fact that the mathematical expectation of the vector of random deviations is equal to zero, based on expression (4), an estimate of the exploratory factor of the non-observed economy can be found:

$$\boldsymbol{f}_0 = \frac{1}{b_0}(\tilde{\boldsymbol{y}} - \boldsymbol{Fb}).$$

The value of the regression coefficient b_0 of the non-observed economy-factor can be obtained based on an expert assessment of the level of shadow business in the region.

If the exploratory factor of the non-observed economy is introduced into the model (1), then the real indicators affecting GRP can be recalculated and the real information flow of economic indicators can be restored using the formula

$$\tilde{\boldsymbol{X}} = (\boldsymbol{F} \quad \boldsymbol{f}_0)\begin{pmatrix}\boldsymbol{A}^T\\ \boldsymbol{a}_0^T\end{pmatrix} + \boldsymbol{U};$$

where $\boldsymbol{a}_0^T$ – transposed vector of loads of the exploratory factor of the non-observed economy. Its estimate can be obtained by analogy with the property of parameters of orthogonal exploratory analysis:

$$\boldsymbol{F}^T\boldsymbol{X} = \boldsymbol{A}^T,$$

namely:

$$\boldsymbol{a}_0^T = \boldsymbol{f}_0^T\boldsymbol{X}.$$

Then the estimate of the volume of the shadow sector of the economy is determined by the expression

$$\boldsymbol{X}_0 = \tilde{\boldsymbol{X}} - \boldsymbol{X}, \tag{5}$$

which makes it possible to identify those sectors of the regional economy where the volumes of concealment of economic information are the most significant.

3 Conclusions

Overcoming the consequences of the existence of an unobservable regional economy should be carried out not so much for individual economic entities of economic activity, as with the reasons that generate, push them to hide their income, evade taxes and conduct unofficial, illegal activities. This requires a reform of state regulation of economic activity, a fundamental change in the existing realities of managing business entities, a revision of the conditions for doing business and economic activity in the whole country, and not only in a separate region.

Bringing an unobservable economy into one that willingly submits real reports on its activities is impossible without developing and creating favorable conditions for small and medium-sized businesses. Here it is necessary to reconsider the issue of the tax burden, which is unbearable for start-up entrepreneurs. It is also necessary to simplify the maintenance of tax and accounting documents, which requires the creation of a stable and effective tax system based on the interests of not only the state but also taxpayers.

In addition to creating liberal conditions for economic activity, it is also necessary to develop and create an effective financial, control, and law enforcement system. It is also necessary to tighten operational control in terms of compliance with the implementation of tax legislation. The solution to this issue will help to suppress the "shadow" economic transactions that create an unfavorable climate, both within the regional economy and within the Russian economy.

Significant changes in these issues will make it possible to reduce each of the segments of the non-observed economy separately and the share of the shadow sector as a whole.

Thus, effective administration of taxation should create conditions under which taxpayers do not have the opportunity to secretly evade the obligation to pay legally established taxes and fees.

The reduction in the scale of the non-observed economy largely depends on the solution of Russian institutional problems, among which the low level of citizens' trust in the government's actions, the insufficient level of protection of rights and freedoms are the most significant. The increase in the level of financial and tax literacy of the population, the formation in the public consciousness of the connection between the concepts of "payment of taxes" and "quality of public services" should become the basis for creating a "society of taxpayers" in the state as a basic element of civil society. A real fight against corruption can also significantly increase the level of public confidence in the actions of the government and establish a productive dialogue between society and the authorities, which, in turn, would form the right basis for the successful implementation of specific measures to reduce the consequences of the unobserved economy.

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