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## ECONOMIC INSECURITY AS SYSTEMIC RISK

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### Abstract

*Difficulties related to the problem of evaluating the economic security / insecurity, including the threshold of economic security / insecurity, namely the impossibility of giving an analytical description of a criterion entirely made up of a set of indicators describing the degree of economic security / insecurity, makes more and more researchers, including the authors, to seek indirect ways of finding solutions, for example considering systemic risk., as a measure of evaluation. Thus, starting from a new approach, and given the specific components of systemic risk to financial stability: the banking sector, corporate sector, public sector, volume of credits, economic activity index the threshold vector of economic security / insecurity can be developed. The study shows that systemic risk can be used to measure the threshold of economic security /insecurity.*

**Keywords:** security, food security, inflation, inflation rates, financial stability, econometric models, stochastic models, optimization models

**JEL classification:** C02, C63, E27, E32

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### 1. INTRODUCTION

An economy or a stable economic system can be considered stable if they are able to functionally dissipate shocks without affecting radically their characteristics. This situation implies the existence of a stable development period, with financial security, appropriate structural policies, ongoing government programs, lasting macroeconomic projections, etc., a period which is meant to prevent disturbances and malfunctions. It should be noted that, in the era of globalization of the economic environment, in addition to traditional, domestic factors, the development dynamics and fierce competitiveness of economic openness may cause additional instability of the system and make risks become systemic. At the same time the economic system is a living organism, so, the man along with his doubts is the main disturbance factor. The term „economic security” is not recent in the economic literature, from the very beginning having an interdisciplinary character (Gârlă, 2015, p. 123; Blanchard and Quah, 1989, p. 656). In terms of macroeconomics, economic security refers to ensuring market integrity, the state’s capacity to generate economic growth and welfare.

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But permanent economic disturbances reshape the global content of security concept. For example, fundamental changes in the energy sector, characterized by technological progresses and scientific discoveries come up with new views regarding the ways how energy is consumed. This is when international markets become increasingly affected by structural changes in the global energy supply and demand. Regarding the set of statistical indicators used to measure the economic security, it should be noted that an indicator is a quantitative characterization of an object's properties and of a socio-economic process (omitted). Economic category, consisting of one or more indicators reflects one of the basic components of economic relations. Formalizing the notion is even more complicated with defining the structures connecting these economic categories and simple indicators, often together with other terms related to them, i.e. having defined the structures, hierarchies of structures, aggregation of structures, distance between structures, and measurement of the data distance structure of a pre-established standard. From another point of view, we have an economic system, with its own interactive descriptive elements – structure. Thus, the structure of an economic system confers its fundamental characteristics, and each element of this structure participates in evaluating the state of the socio-economic system, so, the structure is an invariant of the economic system and the characterized indicators constitute a subset of all possible indicators logically related among them in order to describe as accurately as possible the structural properties. On the other hand, it is desirable for indicators to be subject to mathematical operations without completing any aggregation stage. Or, it is known that any aggregation approximates the initial data and, never, even theoretically, can express the primary essence of their source. Direct evaluation of economic security / insecurity, including the threshold of economic security / insecurity also faces other difficulties, primarily the inability to give an analytical description of an integral criterion consisting of a set of indicators characterizing the measurement of economic security / insecurity. This impediment makes many researchers, including the authors, to look for indirect ways of solving the problem by considering, for example, systemic risk as an assessing measure.

## 2. DESCRIPTION OF EXISTING METHODS

Even though some indicators could be a subset quite suitable for measuring economic security of an entity, formally it is impossible to propose a characteristic set, therefore, we support more the indirect way (Gârlă, 2014, p. 142; Gârlă and Pârțachi, 2015, p. 60): here, a new approach based on systemic risk assessment. So, further we will consider that systemic risk can be used to measure the threshold of economic security / insecurity. If we do a review of research in the field, we should note that there is a unanimous or quasi-unanimously accepted theory, and the overwhelming majority of researchers refer to diversification and elucidation of the notions of economic security / insecurity, threshold, as well as of economic measures, anticipating possible imbalances. In terms of methodology, we should point out that the evaluation of economic security / insecurity can not be based on a single indicator because it covers a range of issues, including resources, risks, shocks; therefore it is needed, to build some integrated, synthetic indicators, composite from case to case, that could measure this extremely complicated phenomenon. Some studies referring to economic security (direct approach) are based on stochastic models, i.e. non-deterministic (Hough, 2008, p. 15; Păun and Topan, 2013, p. 6), with random parameters, models that respond to specific price shocks, exchange rates fluctuations, unemployment rates, level of

salaries, production volume, etc., but, in reality, economic shocks are not of one type, but combined and, simultaneously, there arises the need to take into account as many factors as possible. The approach assumes that all the variables are endogenous, so they follow to be modelled together, systemically, using simultaneous equations. These models require dividing the variable in the deterministic and stochastic part, i.e. which can not be explained by the history of past values and is evaluated in equations as an error. Often in such models, the demand-offer relationship, price and wage development constitute the main variable, and with other sets of indicators and combined with various econometric techniques allow the assessment of the output. But, on the one hand, the real economy shocks are not as single type but in combination, on the other hand there exists the need in taking into account as many factors as possible, which strongly affect the model, which led to new approaches and new problems as well, namely methodological ones. Particularly, should be noted the concept of systemic risk which estimates the risk itself and indicates ways of avoiding it. Risk estimation involves simulating economic process as such and socio-economic situations of crisis anticipation. Here are used various direct methods; the optimization ones, for example, contribute adequately to describing the overall picture; analyse from many points of view the economic status; allow the synthesis of a specific evaluation criterion; suggest how security / insecurity numeric threshold can be determined, while the set of primary indicators, in most cases, include: domestic macro indicators, external macro indicators, indicators characterizing the interaction between entities and regional disparities, critical values of the indicators, monitoring indicators, etc. Multidimensional statistical analysis methods refer here to the transition from the initial economic indicators to other unrelated factors, whose number is much lower, but their variability exhausts all initial indicators. To be more exact, a set of indicators, quite close to the real situation in the economy of an entity could be: total GDP, GDP per capita, production volume, industrial production volume, agricultural production volume, investments volume, fixed assets, number of enterprises with innovations absorption, increasing reserves of natural resources, the structure of GDP, the share of SMEs, number of farming households, profitability, material intensity, energy intensity, total population, structure of citizens income, minimum consumer basket, average wage, number of pensioners, Consumer Price Index, labour, budget share to GDP, budget deficit, money in circulation, the structure of export / import, and each indicator in this group would be unambiguously determined others, given by numerical values. Thus, one of the basic components of economic security – energy security is characterized by energy intensiveness, given the energy intensity, the price of a litre of gasoline, the price of a litre of diesel, export / import of energy resources, quality of energy power, energy consumption per capita, and environmental pollution with fuels. In conclusion to this chapter we would like to emphasise that most direct methods require the existence of thresholds (limits of variation), but only for certain indicators, unlike the indirect ones, which assess the security / insecurity in general.

### 3. METHODOLOGY AND NUMERICAL METHOD

Summing up the above mentioned, economic security is defined simply as the totality of conditions and factors whose action has a negative and destabilizing effect on the functioning and effective development of the economic system, but the main problem of economic research is that until now there is no unique concept (ascertainment) that clearly assess the level of economic security, likewise, there is no effective quantifiable criterion,

which generates permanent debate and various approaches, sometimes diametrically opposed. The economic security of a country means first of all competitiveness, sustainable economic development, guaranteed access to resources and markets, integration, risk minimization and depends on the supply of energy resources, mineral resources, food, etc., and permanent synthesization of data related to disturbances on the domestic market and identifying system states, setting the threshold of security / insecurity - the critical threshold can estimate the level of security / insecurity. Crossing the security threshold disturbs the entire economic system sooner or later, goods and services become uncompetitive, risks visibly increase, economic and financial stability is jeopardized, the complexity of the phenomenon is major, and the criterion of the security indicator is purely linear and may worsen exponentially. In the present study optimization will form the implementation basis in defining and calculating security / insecurity and the threshold of economic security / insecurity. The optimization problems unequivocally determine the values of variables and then options become available, choosing those values, which correspond to the optimum alternative. This is reflected in the form of objective functions, organic links, variation limits, which describe the economic efficiency. The objective function that determines the goal in mathematical terms is given by a Euclidean norm, and organic ties and variation limits are given in different functions and constitute the restrictions of optimization problem. For example, the optimality of inflation factors requires, first, developing a set of impact indicators: coinage, interest rate, securities, exchange rate / purchasing power parity, budgetary transfer, tax rates, social contributions rates, state policies, remittances. The most general form of limits for  $x_i$  parameters is

$$a_i \leq x_i \leq b_i, i = \overline{1, n} \quad (1)$$

organic links between indicators are nonlinear / linear functions, e.g.

$$C = \exp(c_1x_1 + c_2x_2 + \dots + c_nx_n)$$

i.e. bonds set by an exponential function,  $c_i$  - coefficients, or combinations of such features and the linear case

$$C = c_1x_1 + c_2x_2 + \dots + c_nx_n \quad (2)$$

finally, the objective function of the optimization procedure can take the form

$$\min \text{ESI} = \sum_{i=1}^n (x_i - x_i^0)^2, \quad (3)$$

$x_i^0$  - is a given vector, called standard ESI - Economic Security Index.

#### 4. MODEL RIGOR

The optimization problem is solved using the numerical calculation scheme of model PG [Gârlă, 2015, p. 144]. Namely, starting from the idea of comparing the standard, which here plays the role of the threshold of economic security by using the PG model (proposed by authors), the authors elaborated a calculation scheme which equals more with situations where the admissible limit values of security are obsolete, thus creating opportunities for appreciating the range of security and insecurity. Noteworthy is the fact, that related to the issue of security / insecurity, in essence, even if initially only one element of the economic process is changed, the feed-back analysis, i.e. of security / insecurity will record changes of

all elements involved in this process. It should be also stated that unlike the problems of forecasting, where the trend is very important, in other words the existence of significant past information about variables and economic process, as such, for security problem long series are not relevant, important being the analysis of successive states so as to understand the deviations from the natural course of things in the economic process, where essential are the situational developments of matrices or, for example, of the size of  $2 \times 10$ :

$$\begin{bmatrix} h_{11}h_{12} \\ h_{21}h_{22} \end{bmatrix}, \begin{bmatrix} h_{12}h_{13} \\ h_{22}h_{23} \end{bmatrix}, \dots, \begin{bmatrix} h_{19}h_{1,10} \\ h_{29}h_{2,20} \end{bmatrix}$$

Following to the above mentioned, we shall refer more widely to a concrete matrix  $A$ , this time with the size  $6 \times 4$ , 6 indicators for 4 consecutive quarters with components that measure risks at the level of Moldova's economy – namely the annual rates of inflation (%), exchange rates of MDL against the USD, remittances (billions USD), currency in circulation (%), exports (%), imports (%) – the last indicators being reported to the respective period of the previous quarter. Let us take for  $A$ :

$1^{st}$  row - *Inflation rate*: quart.III, 2014: 5.1; quart.IV, 2014: 6.3; quart.I, 2015: 8.9; quart.II, 2015: 10.6;

$2^{nd}$  row - *Exchange rate*: August 2014: 13.2; October 2014: 14.6; January 2015: 18.3; July 2015 19.3;

$3^{rd}$  row - *Transfers*: quart.III, 2014: 0.49; quart.IV, 2014: 0.36; quart.I, 2015: 0.24; quart.II, 2015: 0.30;

$4^{th}$  row - *Currency in circulation*: quart.III 2014 2; quart.IV 2014 1; quart.I, 2015 1; quart.II 2015 0;

$5^{th}$  row - *Export*: quart.III 2014 1; quart.IV 2014 -1.1; quart.I, 2015 -1.2; quart.II, 2015 -1.4;

$6^{th}$  row - *Import*: quart.III 2014 1; quart.IV 2014 1; quart.I, 2015 -2.1; quart.II, 2015 -2.0.

Thus, the following picture of successive states is outlined (vector of matrix  $A$ , repeating the previous state).

$$\left\{ \begin{array}{l} 5,1 \dots 6,3 \\ 13,2 \dots 14,6 \\ 0,49 \dots 0,36 \\ 2,0 \dots 1,0 \\ 1,0 \dots -1,1 \\ 1,0 \dots -1,0 \end{array} \right\}, \left\{ \begin{array}{l} 6,3 \dots 8,9 \\ 14,6 \dots 18,3 \\ 0,36 \dots 0,24 \\ 1,0 \dots 1,0 \\ -1,1 \dots -1,2 \\ -1,0 \dots -2,1 \end{array} \right\}, \left\{ \begin{array}{l} 8,9 \dots 10,6 \\ 18,3 \dots 19,3 \\ 0,24 \dots 0,30 \\ 1,0 \dots 0,0 \\ -1,2 \dots -1,4 \\ -2,1 \dots -2,0 \end{array} \right\}$$

where we have columns with numerical values of the six indicators in quarters III-IV in 2014 (first matrix), quarters IV 2014-I, 2015 (second matrix) quarters I-II in 2015 (third matrix). It should be noted the immediate shock that occurs in the natural course of things in the economy in the first quarter of 2015: inflation reaches 8.9%, the currency depreciating sharply reaching an exchange rate of MDL / USD 18.3:1, the value of remittances and exports decreasing considerably. It is not difficult to assume that the fall is caused by external shock – significant worsening of Russia's economic situation, as well as by internal one – the liquidation process of three commercial banks in Moldova. Let us see what has been the impact of this shock that occurred in the national economy, for which we will

transform the matrix below. It is known that the front calculation of the inverse matrix to  $A$  does not bring the expected results. Therefore we shall use the  $PG$  model, this time with 6 variables. But beforehand we shall transform matrix  $A$ , into matrix  $A^*$  reporting all indicators in column 1, which represents the economic situation immediately preceding the shock – a natural thing, as in the situation during the third quarter can be considered here as a standard. Then  $A^*$  will be:

$$A^* = \begin{pmatrix} 1, 0 \dots 1, 2 \dots 1, 7 \dots 2, 1 \\ 1, 0 \dots 1, 1 \dots 1, 4 \dots 1, 5 \\ 1, 0 \dots 0, 7 \dots 0, 5 \dots 0, 6 \\ 1, 0 \dots 0, 5 \dots 0, 5 \dots 0, 0 \\ 1, 0 - 1, 1 - 1, 2 - 1, 4 \\ 1, 0 - 1, 0 - 2, 1 - 2, 0 \end{pmatrix} \quad (4)$$

Then we transform the 6 indicators into variables analogue to (1), subjecting them to restrictions

$$a_i \leq x_i \leq b_i, i = 1, 6 \quad (5)$$

in order to avoid slipping too much towards definitions. According to the  $PG$  model, organic connections between indicators are established (in total 4) in the form of equation (2)

$$C = c_1x_1 + c_2x_2 + c_3x_3 + c_4x_4 + c_5x_5 + c_6x_6. \quad (6)$$

Here, 2 of the 4 organic links should be noted: the second (vector 2 from matrix (4)) and the third (vector 3 from matrix (4)), which correspond to the pre-shock and post-shock situation. Assuming that the 6 indicators impact equally the economic security of the state, i.e.

$$c_1 = c_2 = c_3 = c_4 = c_5 = c_6 = 1$$

with appropriate units of measurement we can write

$$abs(1,2) + abs(1,1) + abs(0,7) + abs(0,5) + abs(-1,1) + abs(-1,0) = 5,6 \quad (6^1)$$

$$abs(1,7) + abs(1,4) + abs(0,5) + abs(0,5) + abs(-1,2) + abs(-2,1) = 7,4 \quad (6^2)$$

Note the enormous difference in scores from 5.6 to 7.4 set in only 2 months, which, once again, confirms the disastrous impact of the shock in the winter of 2015. Let us now define the goal function. We shall do it in form (3), but more specific

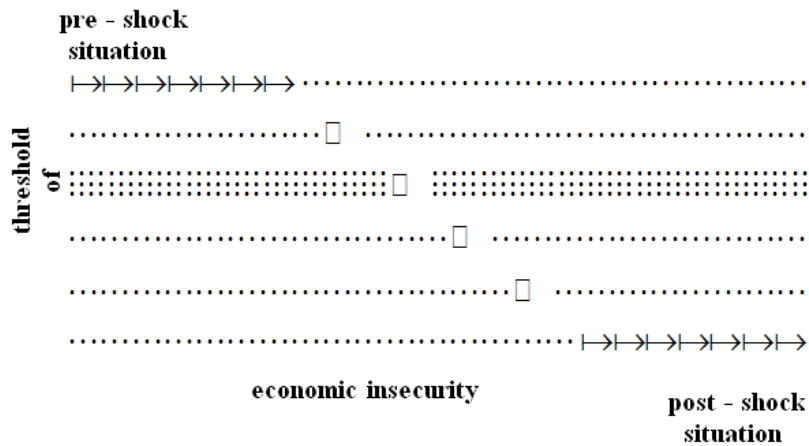
$$ESI = \sum_1^6 (x_i - x_i^0)^2, \quad (7)$$

stating that in the sum of squared differences of numerical values of the 6 indicators will be taken from case to case the distance from the standard, i.e. of parameters of the third quarter 2014 or the distance between two quarters, and  $ESI$  (Economic Security Index) will point

this integrated indicator, measured in points. Note that criterion (7) in economy is based on a new formula proposed by Yager (1996, p. 50) based on the weighted average of economic indicators, which introduced many other concepts. Now when we know post-factum the shock nature – exclusively financial-monetary, using the *PG* model similar results are obtained by optimizing only the first 4 variables, the other two export / import having a greater lag. Indeed, the first 4 optimal variables from (6<sup>2</sup>) will have values

**2.263087                      1.463741                      0.184035                      0.189137**

whereof it can be concluded that a non-monetary inflation increase (component 1) compared to the original data, from 1.7 to 2.26 would have minimized the impact of the shock, because the distance from the standard values before the shock would have been minimal. The authors propose that the optimal value of the solution vector to be called the **threshold of economic insecurity** (Figure 1).



**Figure no. 1 – The threshold of economic insecurity**

### 5. CONCLUSIONS

The issue of assessing the economic security / insecurity, economic interpretation and measure of threshold is a particular problem, which is not completely solved. The authors consider that systemic risk can serve directly as a measure to assess the economic threshold of security / insecurity. Building the threshold vector of components such as: banking sector, corporate sector, public sector, volume of credits and economic activity index sufficiently define the risks, and therefore the threshold of security / insecurity. Specifically, shocks, their magnitude within the mentioned sectors significantly diminish the entity's economy and overall economy – multiplies, causing the decline, which in its turn leads to higher risks, culminating with a massive economic insecurity.

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