METHODOLOGICAL BASES OF DEFINITION OF THE INTEGRATED INDICATOR LIQUIDITY OF THE DERIVATIVES MARKET

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Abstract

In this article methodological approach to definition of an integrated indicator liquidity of the derivatives market of Ukraine on the basis of application of the taxonomical analysis. The offered approach to an assessment of liquidity of the derivatives market proves the applied value of taxonomical methods for carrying out its diagnostics on the basis of 17 indicators grounded on three aspects according to the concept of an indicator of a development level of Hellwig (1968) (12 – stimulators and 5 – destimulators). These indicators based on three aspects of the liquidity (depth, density and elasticity) are the main conceptual directions which provide system of transformations, accelerate a level of development of the derivatives market of Ukraine.

Keywords: Liquidity of the Derivatives Market, Taxonomical Analysis, Integrated Indicator of Development, Integrated Indicator of the Liquidity of the Derivatives Market

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1 Introduction

More often liquidity of the market is perceived by its participants as due. However, from time to time, liquidity shows the unstable nature. For example, in October, 1987 crash of stock markets worldwide further turned into Asian and Russian financial crises. Events testified unexpected disappearance of liquidity in many main markets of the whole world, with negative consequences for normal functioning of a financial system and, perhaps, economies of these countries in general.

Research of market liquidity at the level of the G-10 Central Banks was stimulated by the events connected with the announcement in August 17, 1998 of a default on an internal debt of Russia. The problems with liquidity which arose in the Russian market extended on the American market of debt obligations. Consecutive disappearance of liquidity in the markets which aren't connected with each other and growth of volatility caused by it became distinctive feature of this crisis. Still the bigger attention was drawn by crash of Long Term Capital Management hedge fund which took place as a result of these events (LTCM) [8].

Application of difficult financial models with use of derivatives market and the increase in sharing tools caused by them, in emerging markets, in portfolios of investors and instability of data of the markets was resulted in need of research of liquidity, in the derivatives market in particular.

At application of an assessment of liquidity along with others the following statement of G.Gambarov (2005) was made: "There can be a conclusion that there is no effect of liquidity in this market, and that the wrong choice of the measuring instrument of liquidity exists" [7]. Besides, they have limited informational content and don't allow seeing interrelation between separating aspects and indicators of liquidity. However consideration of an integrated indicator or system of indicators of liquidity of the market, in our opinion, will better allow solving a problem of "compatible hypotheses" at an assessment of level and degree of liquidity of the market, than at application of one certain characteristic (aspect). Taxonomical methods have a powerful arsenal of algorithms of systematization and therefore are urged to solve this problem [9].

Research of liquidity of the derivatives market only starts. In recent years there were researches concerning liquidity of basic assets. So, Jones, Kaul and Lipson (1994) investigated the indicators characterizing such aspect of liquidity as depth in equity markets and have proved that there is a

positive correlation between the number of concluded transactions and volatility that exists in many markets. Fleming (1999, 2003) studied and measured U.S. Treasury securities Market Liquidity and also to substantiated the relationship and commonality in liquidity in equity markets and between equity and Treasury markets. The essence of aspect "resilience" was considered by Amikhud, Mendelson (1986). Kyle, A. (1985) was one of the first scientists to turn to a complex assessment of liquidity.

Questions of application of methodology of the multivariate statistical analysis in economic researches are taken up in Hellwig, Z. (1968), Pluta, W. (1980), Ashmanov, S. (2001), Guseva, O. (2014), H. Harman's (1976) works and others. Despite the existing technique of calculations of a taxonomical indicator of growth it wasn't used for carrying out an assessment of liquidity of the derivatives market, the main aspects and indicators of its diagnostics and distribution to stimulators and destimulators aren't defined.

2 Theoretical framework

For existence of the derivatives market, surely the trade mechanism which has to be competitive must be developed. Emergence of new innovative financial instruments and growth of investment opportunities for investors was followed by a problem of determination of liquidity of both separate derivatives instruments, and the market of derivatives in a whole.

At application for an assessment of one of liquidity aspects the statement "there is no effect of liquidity in this market, there is the wrong choice of the measuring instrument of liquidity" was made [7], it can be a conclusion. In this case, as noted by Kotysh, E. N. (2009), Melnik, L.G., Hens, L. (2008), Tarasenko,O.N. (2004), not all data but only the key aggregated (generalizing) indicators which most brightly reflect a condition of system and, the most important, tendencies of their change [13, 14, 19] are controlled.

The analysis of liquidity of the derivatives market on its separate aspects (depth, tightness, resilience, immediateness) is the most suitable fundamentals of methodology which can be applied to its assessment. However they also have limited informational content and don't allow seeing interrelation between separate aspects and indicators of liquidity.

Therefore approach of convolution (compression, generalization) of the selected key indicators in one integrated indicator or their integration into uniform system (Nadtoka, T. B.,Vinogradov, A. G. (2013) [15] are even more often practiced. We consider what exactly consideration of an integrated indicator or system of indicators of liquidity of the market will better allow to solve a problem of "compatible hypotheses" at an assessment of level and degree of liquidity of the market, than the application of one certain characteristic (aspect).

Under an integrated assessment we understand the generalizing indicator which pays off on the basis of values of measuring instruments and allows receiving information on liquidity of the derivatives market (interval) in time and dynamics of its change at present. However the derivatives market has the multi-vector of its indicators (quantity of open positions, perfect transactions and the signed contracts, a trading volume, volume of contracts, etc.) which are characterised therefore by the necessity of integrated indicator of liquidity.

One more important methodological question is the compliance of basic data to specifics of a generalization method. Distribution was gained by many methods: from multidimensional one to comparison: use of system of points; rating method; dynamic standard (not metric parcel); taxonomical indicator, calculation of averages (metric convolution); index method; method of a multicriteria integrated assessment; matrix method; uses of the device of the theory of indistinct sets Nadtoka, T. B.,Vinogradov, A. G. (2013) [15].

For calculation of the general indicator of liquidity of the options market we chose a method of the taxonomical analysis. As was noted by Egupov, Y. A. (2009) application of the taxonomical analysis (unlike methods of the cluster, discriminant and factorial analysis) not only simplifies economic interpretation of the received estimates, but also considerably facilitates their transformation in the indicator characterizing [3] liquidity of the derivatives market.

The most important advantage of a taxonomical indicator is the synthetic size which shows the direction and scales of changes in the processes described by set of any number of initial signs (Sablina, N. V. (2009)) [18].

In classical algorithm the object is designed artificially, called a standard, and all studied objects (or conditions of one object) are ordered on distance to this standard of development. Such approach to formation of the generalizing indicator gives the chance to avoid value judgment of weight or the importance of separate indicators (Tishchenko, A. M. (2009)) [20]. The analysis of uniformity of objects points can be deepened considerably by having entered the corresponding indicators of an assessment of degree of separability of the received relative uniform subsets.

3 Data

As characteristics of liquidity we choose value of measuring instruments (aspects) of liquidity and their indicators. The respondent of research is JSC Ukrainian Exchange. In our research for an initial matrix of supervision 17 indicators of liquidity for the market of options (Appendix A) were chosen.

4 Definition of the integrated indicator liquidity

The first stage of definition of a taxonomical indicator of development is creation of a matrix of supervision of the X dimension (m × n) values of characteristics (signs) of multidimensional units:

$$X_{mn} = \begin{pmatrix} X_{11} & X_{12}\cdots & X_{ij}\cdots & X_{1n} \\ X_{21} & X_{22}\cdots & X_{ij}\cdots & X_{2n} \\ X_{i1} & X_{i2}\cdots & X_{ij}\cdots & X_{in} \\ X_{m1} & X_{m2}\cdots & X_{mj}\cdots & X_{mn} \end{pmatrix}, \quad (1)$$

where m – the number of units of *n*-dimensional space, equal to number of lines of a matrix;

n – the number of signs of each unit, equal to number of columns of a matrix;

Xij - value of a sign according to number *j* for unit numbered *i*.

After transfer of the beginning of coordinates a matrix of supervision was created.

4.1 Second stage

The research of aspects of the liquidity of the derivatives market and their indicators allow claiming about their diversity that complicates process of creation of an integrated indicator. Therefore, considering their features and heterogeneity as describe various aspects of liquidity and differ from units of measurements, it is necessary to carry out their standardization by transition to their aligned dimensionless values. That is it means that all indicators have to be given to one numerical dimensionless integrated indicator in range [0; 1]. Standardization allows avoiding disagreements with units of measure. At the same time there is a dispersion alignment (each dispersion is equal to unit), and also values of signs (all arithmetic averages are equal to zero) that is undesirable as each sign equally influences results of the analysis [9, 17].

4.2 Third stage

A basis of creation of a vector standard is distribution of signs to stimulators and destimulators Stimulators are indicators increase of which improves the general assessment of liquidity, and destimulators - on the contrary cause deterioration of an assessment. In our research we have both stimulators and destimulators (Appendix 2).

Such distribution of the signs acts as a basis for creation of a standard of development P_0. Elements of this vector have coordinates Z_{0j} and form values of indicators as follows:

$$Z_{0j} = \begin{cases} \max\limits_i, if \ \ j \in I\,(stimulator); \\ \min\limits_i, if \ \ j \notin I\,(destimulator). \end{cases} \quad (2)$$

where I - a set of stimulators;

Z_{0j} - the standardized value of an indicator of j for the temporary period of i.

For descriptive reasons coordinates of a vector standard can be placed under columns of a matrix of the standardized signs:

$$Ze = \begin{pmatrix} z_{11} & z_{12} & \cdots & z_{1n} \\ z_{21} & z_{22} & \cdots & z_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ z_{m1} & z_{m2} & \cdots & z_{mn} \end{pmatrix} \quad (3)$$

In this case the conditional point (unit of population) of Z_e with n coordinates will be a standard:

$$Z_e = (z_{01}, z_{02}, \ldots, z_{0n}) \ldots \quad (4)$$

Z_e = (3,32; 5,41; 4,86; 2,78; 3,21; 3,82; 3,72; 3,55; 3,15; 2,42; 3,33; -0,56; -0,98; -0,3; -0,48; 9,34; -0,12)

4.3 Fourth stage

The following stage of calculation of a taxonomical indicator of development is determination of distance between separate supervision and a benchmark vector by means of such functions of distance $d\left(x_{ie}x_j\right)$ of the comparative analysis.

Using a function of Euclidean distances we will calculate distance of C_{i0} of each of a multidimensional point unit of the studied set (indicators) during the different periods of time (t) to its maximum standard point (tab. 1), and an average value of a distance to a point standard ($\overline{C_0}$):

$$C_{i0} = \sqrt{\sum_{j=1}^{n}\left(z_{ij} - z_{0j}\right)^2}, \quad (5)$$

$$\overline{C_0} = \frac{1}{m}\sum_{i=1}^{m} C_{i0}. \quad (6)$$

And also we will carry out an assessment of a mean square deviation of this distance (σ_0):

$$\sigma_0 = \sqrt{\frac{1}{m}\sum_{i=1}^{m}\left(C_{i0} - \overline{C_0}\right)^2} \quad (7)$$

On condition of a normal distribution of a random variable of distance of C_{i0} of each multidimensional unit to a standard point:

$$C_0 = \overline{C_0} + 2\sigma_0, \quad (8)$$

That allows using the size C_0 for rationing of distances (removal) of each indicator of the liquidity from the maximum (reference) value.

The indicators of a level of development calculated thus describe dynamics of changes of the studied groups of indicators and generally characterize the scale and the directions of strategic changes (Guseva, O. Y. (2014)) [8] of liquidities of the derivatives market.

Table 1. The distances between separate indicators and a benchmark vector

Period	07-08.04. 2011	11-15.04. 2011	18-22.04. 2011	26-29.04. 2011	04-06.05. 2011	…	03-07.12. 2012	10-14.12. 2012	17-21.12. 2012	24-28.12. 2012
Ci_0	13,62379	12,49809	11,86294	5,94022	4,22752	…	7,65925	8,81559	0,21424	2,28497

$\overline{C_0} = 19{,}56;\ \sigma_0 = 1{,}56;\ C_0 = 15{,}84$

As the Table 1 testifies, for the studied periods the distance to a benchmark vector decreases, indicating a slow but growing level of the liquidity of derivatives market.

4.4 The fifth stage

The fifth stage is characterized directly by calculation of a taxonomical coefficient of a level of development (d_i).

The received distances serve as initial sizes which are used at calculation of an integrated indicator of a level of development. The taxonomical indicator of a level of development is a synthetic size; it accumulates the signs characterizing the studied economic event or process (Ashmanov, C. A. (2001)) [2] and pays off on a formula (9):

$$d_i = 1 - \frac{C_{i0}}{C_0} \quad (9)$$

The value of an integrated indicator of a level of development can fluctuate ranging from 0 to 1. Integrated indicator of a level of development serves for the statistical characteristic of several objects. With its help it is possible to estimate the average level of value of the signs characterizing the phenomenon reached in a certain period or for some period under investigation (Emelyanov, A. S. (2002)) [4].

The integrated indicator of a level of development d_i (tab. 2 and Fig.1) must be treated as follows – its value is more important than closeness of its value to unit, that allows comparing sets of all signs and also characterizes the level of the liquidity of the derivatives market.

Table 2. The integrated coefficient of the development

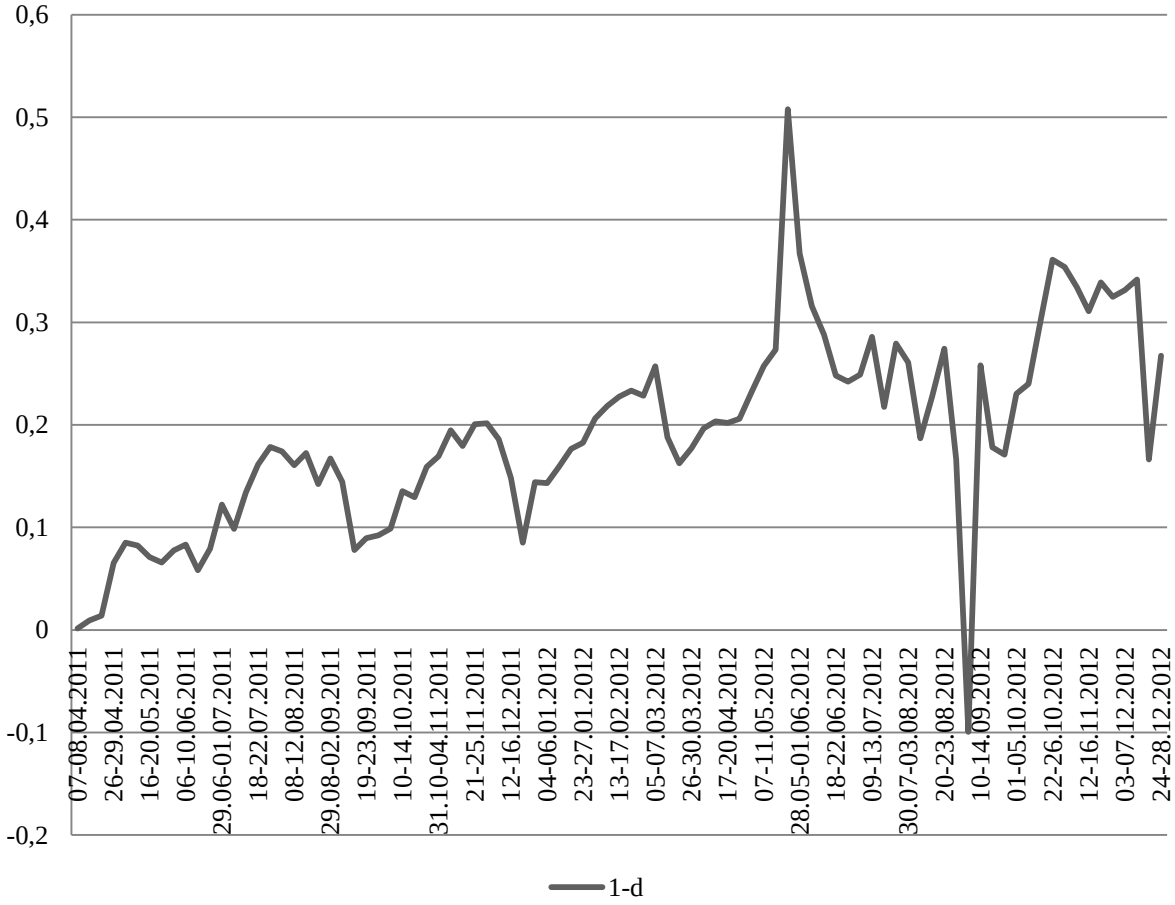
Period	07-08.04. 2011	11-15.04. 2011	18-22.04. 2011	26-29.04. 2011	04-06.05. 2011	…	03-07.12. 2012	10-14.12. 2012	17-21.12. 2012	24-28.12 2012
d_i	0,001	0,009	0,014	0,066	0,085	…	0,332	0,342	0,166	0,267

The interpretation of an integrated indicator of a level of development allows drawing a conclusion on the low level of the liquidity of the derivatives market as value of integrated coefficient of development is closer to zero than to unit. However it is necessary to notice the insignificant but positive dynamics of growth of integrated coefficient of development (Fig. 1) that testifies to growth of level of the liquidity of the derivatives market in domestic market observed.

5Conclusions

Considering instability of emerging markets, growth of financial models with use of derivatives market methodological approach to determination of the derivatives market liquidity of Ukraine and an assessment of its level on the basis of aspects and indicators which allow to consider all its qualitative characteristics: volume (depth), price deviation (tightness) and influence on the price (resilience) gets special development. For this purpose it is offered to use an integrated indicator of liquidity on the basis of methods of the taxonomical analysis, which allows both quantitatively and qualitatively to estimate liquidity of the derivatives market of Ukraine by means of integrated coefficient of development on the basis of 17 indicators in three aspects according to the concept of an indicator of a level of development of Hellwig, Z. (1968) (12 – stimulators and 5 – destimulators).

Figure 1. An integrated indicator of the development of options market liquidity on "Ukrainian Exchange" from 07 April, 2011 to 24 December, 2012



The developed approach allows: 1) to formalize the level of liquidity of the derivatives market for its proximity (distance) to a benchmark vector; 2) to define determinants of development and dynamics of changes of the studied groups of aspects and indicators of the liquidity; 3) to prove the directions of strategic changes within separate aspects of the derivatives market liquidity. By the results of this research the following conclusions are received:

1) the value of an integrated indicator of the liquidity testifies to the low level of the derivatives market liquidity. However, it is necessary to notice that insignificant but positive dynamics of growth of integrated coefficient of development is observed, which testifies to growth of level of the liquidity of the domestic derivatives market;

2) it is revealed that the greatest group of indicators which influence the level of the liquidity are the indicators of depth and price influence (elasticity), and indicators of density have the return influence and are indicators-destimulators;

3) values of indicators allows to define the main directions of development of the derivatives market of Ukraine which have to be directed on stimulation of growth of its volume through realization of multi-vector actions which in total provide optimization of demand for derivatives market.

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Appendix A

Table A.1. The descriptive theoretical and methodical model of a matrix of supervision of the market liquidity of derivatives (options) for the taxonomical analysis

Liquidity measures	Indicators	Factor	Characteristic of indicators
Depth. This measuring instrument shows how many papers it is possible to buy (to sell) without an influence on the quoted price (growth or decrease)	Number of transactions	X1	Characterizes the activity in the derivatives market, and also derivatives supply and demand until the conclusion of the transaction.
	Trading volume, contracts	X2	
	Turnover, UAH	X3	
	Open positions, UAH	X4	
	Open positions, contracts	X5	
	Share of the open positions of options in a trading volume of derivatives, %	X6	
	Share of the open positions of options in the total amount of the auction of the derivatives market, %	X7	
	Share of options contracts in the total amount of contracts derivatives, %	X8	
	Share of transactions with options in a total amount of securities market, %	X9	
	Share of the transactions with options in a total amount of transactions the securities market, %	X10	
	Share of the transactions with options in a total amount of the derivatives market, %	X11	
Tightness. Characterizes transaction losses which are a payment for urgent implementation of the agreement and the mechanism of establishment of the prices of derivatives	Absolute spread (quoted spread)	X12	this spread reflects the size of the minimum transaction expenses at the conclusion of the transaction
	Relative spread	X13	the spread expressed as a percentage is used for testing of the importance of connection between the price and level of the liquidity of an asset
	Effective spread	X14	this spread considers the change in price that occurs in the period of time between the quotation and implementation of the real transaction that allows to claim that the effective spread characterizes the direction of the movement of prices
	Relative effective spread	X15	the spread expressed as a percentage is used for testing of the importance of communication of the price and level of liquidity of an asset
Resilience (indicators of potential depth of the market). Characterizes influence of volume on the price of derivatives and speed with which the prices reach a new equilibrium level after any fluctuation in prices due to large volume of transactions, market shocks and information influence	Amivest liquidity ratio	X16	this coefficient shows what there has to be a trading volume of an asset in terms of money so that it corresponded the change in price of an asset for 1%. With a growth of coefficient - liquidity grows
	Amihud liquidity ratio	X17	the movement of the price of an asset expressed in percents as a response to trade in an asset of 1 monetary unit. With a growth of coefficient - liquidity decreases

Appendix B

Table B.1. Stimulators and destimulators of liquidity of the derivatives market and coordinates of the benchmark vector

Factor	Liquidity measures	Indicator	Stimulator / destimulator	Coordinates of standart vector
X1	Depth	Number of transactions	stimulator	3,32
X2		Trading volume, contracts	stimulator	5,41
X3		Turnover, UAH	stimulator	4,86
X4		Open positions, UAH	stimulator	2,78
X5		Open positions, contracts	stimulator	3,21
X6		Share of the open positions of options in a trading volume of derivatives, %	stimulator	3,82
X7		Share of the open positions of options in the total amount of the auction of the derivatives market, %	stimulator	3,72
X8		Share of options contracts in the total amount of contracts derivatives, %	stimulator	3,55
X9		Share of transactions with options in a total amount of securities market, %	stimulator	3,15
X10		Share of the transactions with options in a total amount of transactions the securities market, %	stimulator	2,42
X11		Share of the transactions with options in a total amount of the derivatives market, %	stimulator	3,33
X12	Tightness	Absolute spread	destimulator	-0,56
X13		Relative spread	destimulator	-0,98
X14		Effective spread	destimulator	-0,3
X15		Relative effective spread	destimulator	-0,48
X16	Resilience	Amivest liquidity ratio	stimulator	9,34
X17		Amihud liquidity ratio	destimulator	-0,12