

*Pavel Pronoza*

Simon Kuznets Kharkiv National University of Economics  
9a Lenina Pr., 61166, Kharkiv, Ukraine

**DETECION OF PATHOLOGICAL CRISIS PROCESSES IN BRANCHES OF ECONOMY  
(ON THE EXAMPLE OF AGRICULTURE OF UKRAINE)**

**Abstract**

The article is devoted to applying the concept of early detection of pathological crisis processes to analyze the dynamics of Ukrainian agriculture development in 2003-2011. The analysis is based on time series of the export, import, production volume, export and import prices for agricultural products, volume of loans and investments. Despite the fact that the only branch that demonstrated the growth of output in 2008-2009 was agriculture, there were observed four years of crisis in agriculture during the period under consideration. The built signal panel and structural and logical model of pathological crisis processes detection in agriculture of Ukraine showed that the leading role was played by the investment balance deficit, reduction of the technological level of exports compared to imports and growth of domestic production credit bubble.

**Key words**

crisis pathological processes, agriculture, signal panel, imbalance, disequilibria, structural and logical model, detection, crisis indicators.

**Introduction**

At present, various aspects of the problem of occurrence and development of crisis phenomena in economy are the subject for the studying and discussion of scientists and practitioners all over the world. At that, a special attention in modern research and developments is paid to the issues of detecting the crisis processes in economy with a view to their prevention.

The financial crisis of 2008-2009 showed the imperfection of the existing methodological approaches to the problem of early detection of crisis processes in economy, which suggests the need for further research in this direction.

The study suggests such interpretations of the basic concepts [1]:

1. *Crisis* is a specific phase of development, which is characterized by deep distress, abrupt turn in the habitual way of the system functioning, dislocation of its equilibrium and balance caused by the dynamic irrevocable transformation of its elements and has negative consequences.
2. *Economic crisis* is an integral phase of the economic cycle and a negative economic phenomenon caused by imbalances arising in the process of production, exchange and consumption, which is manifested in sharp deterioration of the socio-economic situation in the country due to significant decline in production, breakdown of manufacturing relations, bankruptcy of enterprises, rising unemployment and inflation, and as a result — in decrease of the population living standard.

**Review of the modern theory and practice**

In the world theory and practice there used three main approaches to early detection of crisis processes in economy:

- qualitative analysis;
- using logit and probit regression models;
- signals approach.

Most approaches and methods are oriented towards prevention of banking, monetary and exchange crises. A detailed analysis of the approaches to development of systems for early detection of financial instability is presented in [2, 3], of banking crises — in [4, 5, 6] and currency crises — in [7].

*Qualitative analysis* lies in comparing the dynamics of fundamental economic indicators in the period before the crisis and crisis-free state. To identify crisis events two approaches are applied: the fixation of crisis events and exceeding of thresholds by some indicators. The first approach was used by B. Eichengreen, A. Rose, Ch. Wyplosz [8] to identify a currency crisis. The approach to the crisis identification based on threshold values seems more versatile. This approach is applied in most studies on the use of qualitative analysis to determine the parameters — harbingers of currency and banking crises [4, 5].

In a number of works qualitative analysis is supplemented by statistical estimations aimed at confirming the choice of leading indicators [9]. J. Azis, F. Karamazza, R. Salgado [10] conducted a comparison of macroeconomic indicators in calm periods and during the “crisis window” based on comparing the average values and evaluating the significance of their differences by means of the Student’s t-test. The main disadvantage of qualitative analysis is a notable subjectivity in the interpretation of dynamics of the indicators, which can be eliminated by means of statistical criteria only partly.

*Econometric approach* involves the building, as a rule, of a multiple regression model evaluating the relationship of economic indicators with crisis probability in the chosen field. Most frequently there used logit and probit models of binary or multiple choices. In probit models there used the integral function of standard normal distribution [5]. The logistic distribution function estimates the probability of a crisis in logit models [11]. The model with censored data (tobit model) [6] suggests that the dependent variable is connected by the rule of censorship with the latent variable, and for the latent variable, in turn, a linear regression model is built.

Among the shortcomings of econometric modeling to build early warning systems for crises P. Trunin and M. Kamenskikh [8] emphasize that the main obstacle to the creation of effective system for early detection based on the econometric approach is the need for a large number of crisis episodes observed in one country and realization of statistical assumptions about the distributions of the indicators, which is difficult to achieve if synthetic indices are used as indicators.

*Signals approach* became widespread owing to the work dated 1998 by G. Kaminsky, S. Lizondo, S. Reinhart devoted to the analysis of currency crises in 25 countries from 1970 to 1995 [7]. The methodology of the signals approach is described in detail by the authors in [9]. The method is based on the assumption that the economy in the period before the crisis behaves abnormally. The idea of the signals approach is to test the main hypothesis that the economy is in a normal state, against the alternative one that within the following three to six months the occurrence of instability is possible. As with testing of any statistical hypothesis, it is required to choose a limit (critical value), which divides the indicator distribution into two zones. If the indicator value gets into the critical zone, that is, beyond the threshold value, it is considered that the indicator issues a signal. If the indicator issues a large number of “good” signals (i.e., has a high capacity for work), we can expect that the probability of instability, provided the signal is issued, will be greater than the absolute probability.

Among the shortcomings of the signals approach A. Gaytan, Ch. Johnson [5] indicate a lack of information, conditioned by using for prediction the macroeconomic information, which is available at a lower frequency than necessary; rather arbitrary choice of variables; the approach does not allow investigating the crisis severity; it is not possible to use standardized tests of statistical reliability and take into account regional differences.

Thus, the analysis of the developments for the past 15 years has shown that to detect and predict forthcoming of crises different methods are used, but the scope of their application is limited to the financial sector of the economy. To the real sector there devoted critically low number of works [11] concerning the crisis in the industry, and agriculture proper is not considered at all.

**The purpose of the research** is to assess the degree of development of pathological crisis processes in agriculture of Ukraine and their manifestations during the global crisis of 2007-2009.

#### **Main results.**

The study is based on the concept of the origin and development of pathological crisis processes in the real sector of the country economy suggesting analysis of the fundamental threats to development of a full-scale crisis on the basis of evaluating imbalances, disequilibria and growth of bubbles in individual industries of the real sector, presented in [12]. In accordance with this concept there proposed a methodical approach to early detection of origin and development of pathological crisis processes in the real sector of the country economy (Table 1).

Table 1. The methodical approach to early detection of the origin and development of pathological crisis processes in the real sector of the country economy

The stage and its purpose	Sequence of operations	Tools
I. Monitoring (detecting the origin of pathological processes and estimating the health of economic activity)	I. Estimation of the health of economic activity	Estimation scale
	1.1. Calculation of signal indicators	
	1.2. Comparing the indicators of signals with their threshold values	Static signal panel Dynamic signal panel Estimation scale
	1.3. Detecting the pathological processes and identifying the stage of their development	
	1.4. Analyzing the dynamics of development of pathological processes	
1.5. Estimating the health state of the type of economic activity		
II. Analysis (diagnosing the relationship and causes of the formation and development of pathological processes in individual types of economic activity)	II. Diagnosing the causes of diseases of a certain type of economic activity	Structural and logical model Cognitive model Casual and logical analysis
	2.1. Diagnosing the state and development of pathological processes	
	2.2. Identifying the relations between the pathological processes	
	2.3. Revealing the reasons of formation and development of pathological processes	

It should be noted that the global financial crisis that began in 2007 affected all sectors of the world economy and the economy of Ukraine as well. Agriculture is practically the only industry of the real sector of Ukrainian economy, which was able to maintain a positive growth of output in the crisis period. The high share of agriculture in the country GDP (7.8% in 2012) and its socio-economic significance [2, 4] suggests the need to focus on early detection and prevention of development of crisis processes in the industries in connection with the potential threat to the entire economy.

This study is based on the data on the volume of output, exports, imports, GDP, cost-output tables for 2003-2011 [13]. To determine the periods of crises there was used the industrial output index and the index of agricultural output as the main indicators for the real economy [14].

The analysis of the dynamics of the rates of change in output of the leading industries in the real sector of Ukrainian economy in 2003-2011 showed that the greatest number of crisis years in Ukraine was observed in the production of petroleum derivatives — 6 years; agriculture — 4 years, food production and metallurgical production — 3 years each.

The period of the most severe crisis for all the considered types of economic activity was during 2008-2009. At that time, the largest decline in production was observed in mechanical engineering — 55.3%; metallurgical production — 64.3%; chemical and petrochemical industry — 70.4% and production of non-energy minerals — 74.6%. The only economic activity, which preserved the growth rate of output in 2008-2009, is agriculture — 115.0% (calculated according to [13]).

In general in the period of 2008-2009 in agriculture there was observed an increase in production by 115.0% with insignificant decline in 2009 — 98.2% (Fig. 1). This decline was the lowest in the industry as compared with other major economic activities of the real sector of economy of Ukraine in 2009.

The growth rate of the production output, %

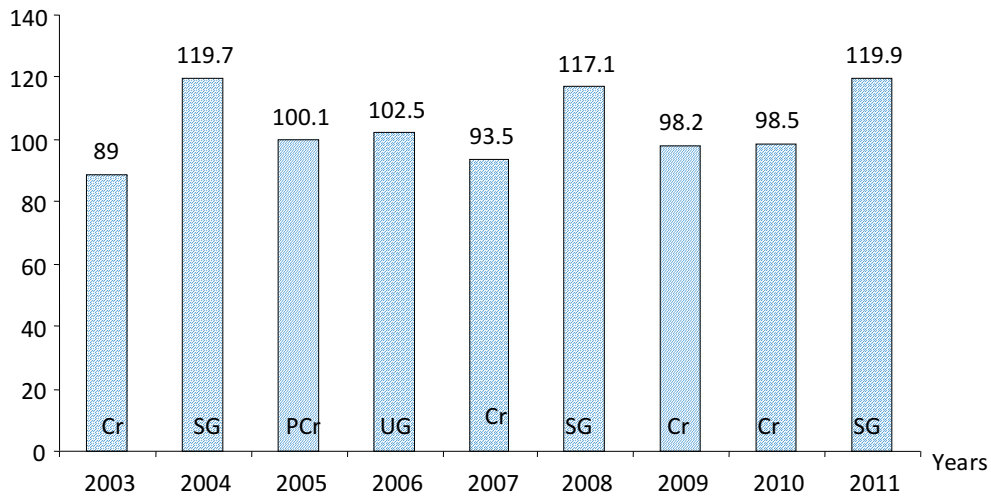


Fig. 1. Dynamics of production output in agriculture of Ukraine in 2003-2011. [13]:  
 SG – steady growth, UG – unsteady growth, PCr – pre-crisis state, Cr – crisis state.  
 (the same abbreviations are used in Fig. 2, Tab. 1)

At the same time it should be noted that agriculture is a specific type of economic activity of the real sector of economy, development of which depends largely on weather conditions in a given year, as can be seen from Fig. 2. During the period that preceded the global financial crisis of 2008-2009 in agriculture of Ukraine in 2003-2007 there was observed a decline or unsteady output growth.

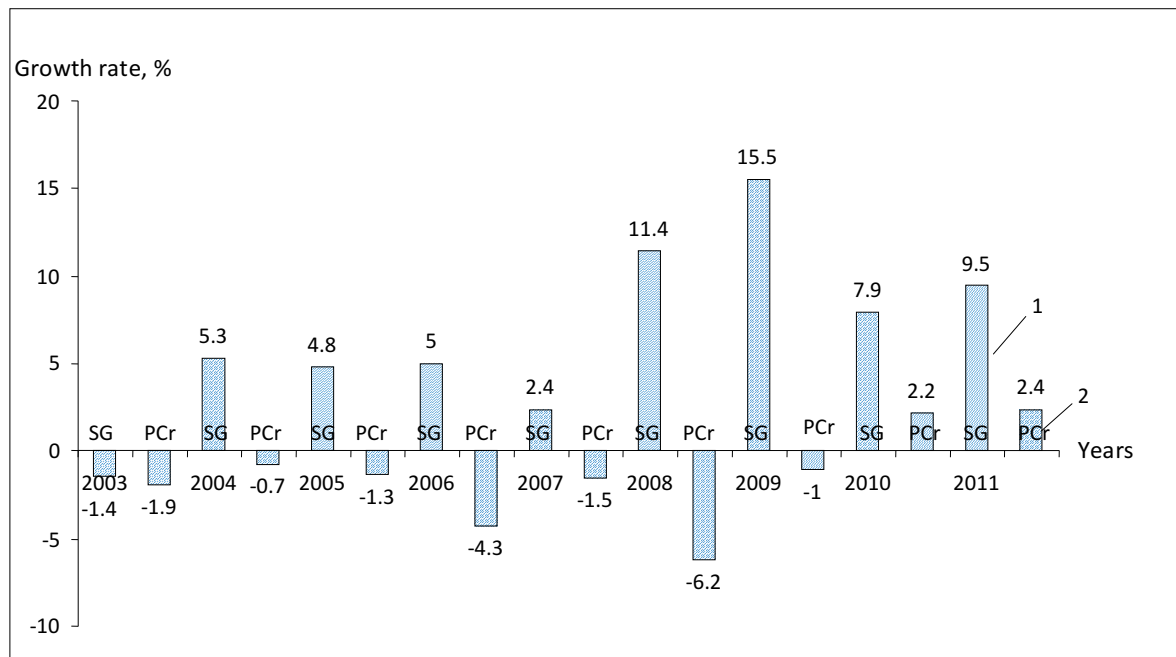


Fig. 2. Dynamics of development of imbalances in agriculture of Ukraine in 2003-2011:  
 1 – trade imbalance; 2 – investment imbalance (calculated by the authors)

As seen from Fig. 2, in 2003-2007 in agriculture of Ukraine there was observed a steady development of trade imbalance and development of pre-crisis investment imbalance. At the same time, by the end of the analyzed periods there decreased both the surplus of the trade imbalance and deficiency of the investment balance.

In the study there was used the structural and logical model for diagnostic of pathological processes in leading indus-

tries of the real sector of the economy presented in [12]. This model is based on calculation of the trade imbalance ( $Im_1$ ) and investment imbalance ( $Im_2$ ), forming them disequilibria and growth rate of external and internal bubbles.

The results of calculations based on the methodological approach presented in Table 1 are summarized in the signal panel of indicators for early detection of pathological processes in the agricultural sector of Ukraine in 2003-2011 (Table. 1) and the structural and logical model for diagnostic of pathological crisis phenomena (Fig. 3).

As can be seen from Table 1 the disequilibria in the ratio of external and internal demand ( $De_1$ ) and the external and domestic supply ( $De_2$ ) in 2003-2007 did not go beyond steady development (less than 15 and 10% respectively), and by the end of the analyzed period fell slightly.

At the same time the disequilibrium in the ratio of export and import prices for agricultural products ( $De_3$ ) in 2003-2007 was practically all the time in the pre-crisis state (greater than 70%), either reducing or rising. However, the effect of this disequilibrium did not have a significant impact on the trade imbalance in agriculture of Ukraine.

The formation of the investment imbalances in agriculture of Ukraine in 2003-2011 was significantly affected by the considerable disequilibrium in investment adequacy ( $De_4$ ) and debt load ( $De_5$ ) with a slight influence of the disequilibrium in the solvency ( $De_6$ ).

By the beginning of the financial crisis of 2008-2009 external and internal price bubbles in agriculture of Ukraine practically did not start. At the same time by this period the tendency to the starting of the domestic production credit bubble, the growth rate of which reached 631.7% of the level in 2003.

#### **Summary**

The main pathological processes that developed in agriculture of Ukraine in 2003-2007 were:

- investment imbalance ( $De_2$ );
- decrease in the technological level of exports compared to that of imports ( $De_3$ );
- growth of domestic production credit bubble ( $B_4$ ).

The export bubble is mostly determined by credit growth. This can be explained by the need for crediting agricultural producers during spring and autumn field works. Import bubble is triggered by the rise in world prices, which is reflected in the export bubble as well. The import bubble itself stimulates the growth of the credit bubble, because an increase in import prices brings about the increase in the need for loans.

Table 1. The signal panel of indicators for early detection of pathological processes in agriculture of Ukraine in 2003-2011.

Indicator	Year								
	2003	2004	2005	2006	2007	2008	2009	2010	2011
$Im_1=(Ex-Imp)/V$	-1.4	5.3 ↑	4.8 ↓	5 ↑	2.4 ↓	11.4 ↑	15.5 ↑	7.9 ↓	9.5 ↑
	SG	SG	SG	SG	SG	SG	SG	SG	SG
$De_1=Exp/Cap$	5,6	9.4 ↑	8.9 ↓	9.5 ↑	6.8 ↓	18.4 ↑	25.8 ↑	15.3 ↓	16.5 ↑
	SG	SG	SG	SG	SG	UG	UG	UG	UG
$De_2=Imp/V$	7,1	3.6 ↓	3.7 ↑	4.1 ↑	4.3 ↑	4.9 ↑	6.2 ↑	6.2 ↓	5.4 ↓
	SG	SG	SG	SG	SG	SG	SG	SG	SG
$De_3 = Exp_1/Imp_1$	78,0	36.3 ↓	27 ↓	30.6 ↑	47.8 ↑	30.6 ↓	18.5 ↓	22.1 ↑	27.0 ↑
	UG	PCr	PCr	PCr	PCr	PCr	PCr	PCr	PCr
$Im_2=(NP-I)/V$	-1,9	-0.7 ↑	-1.3 ↓	-4.3 ↓	-1.5 ↑	-6.2 ↓	-1 ↑	2.2 ↑	2.4 ↑
	PCr	PCr	PCr	PCr	PCr	PCr	PCr	PCr	PCr
$De_4=I/V$	3,0	3.7 ↑	4.9 ↑	6.9 ↑	7.6 ↑	9.4 ↑	5.1 ↓	5.5 ↑	6.1 ↑
	PCr	PCr	PCr	UG	UG	UG	UG	UG	UG
$De_5=C/V$	6,4	5.6 ↓	8.1 ↑	11.2 ↑	13.1 ↑	16.1 ↑	14.2 ↓	11.8 ↓	11.4 ↓
	SG	SG	SG	SG	UG	UG	UG	UG	UG
$De_6=NP/C$	16,9	53.0 ↑	45.2 ↓	22.9 ↓	46.7 ↑	20.1 ↓	29.1 ↑	65.1 ↑	74.3 ↑
	UG	SG	SG	UG	SG	UG	UG	SG	SG
$B_1 = \Delta Exp_{val} - \Delta Exp_{ph}$		-17.1 ↓	-7.7 ↑	21.3 ↑	38.1 ↑	15.6 ↓	-61.9 ↓	21.2 ↑	37.1 ↑
		SIB	SIB	FG	FG	SIG	Col (FB)	FG	FG
$\Sigma B_1 = \Sigma \Delta Exp_{val} - \Sigma \Delta Exp_{ph}$		-17.1 ↓	-38.4 ↓	12.4 ↑	106 ↑	361.9 ↑	87.8 ↓	193.9 ↑	395.9 ↑
		SIB	SIB	S	FG	FG	FG	FG	FG
$B_2 = \Delta Imp_{val} - \Delta Imp_{ph}$		27.3 ↑	26.1 ↓	9.7 ↓	14.1 ↑	66.5 ↑	774 ↑	15.9 ↓	11.7 ↓
		FG	FG	SIG	SIG	FG	FG	SIG	SIG

Table 1 (Continued)

Indicator	Year								
	2003	2004	2005	2006	2007	2008	2009	2010	2011
$\Sigma B_2 = \Sigma \Delta Imp_{val} - \Sigma \Delta Imp_{ph}$		27.3 ↑	40.3 ↑	54.1 ↑	73.9 ↑	150.2 ↑	128.8 ↓	165.3 ↑	196.1 ↑
			FG	FG	SIG	SIG	FG	FG	FG
$B_3 = \Delta V - \Delta V_{ph}$		-14.0 ↓	8.0 ↑	-0.1 ↓	44.5 ↑	-6.8 ↓	8.2 ↑	31.5 ↑	-6.3 ↓
			SIB	SIG	S	FG	SIB	SIG	FG
$\Sigma B_3 = \Sigma \Delta V_{val} - \Sigma \Delta V_{ph}$		-14.0 ↓	-5.6 ↑	-5.8 ↓	46.6 ↑	43.6 ↓	57.4 ↑	116.3 ↑	123.9 ↑
			SIB	S	S	FG	FG	SIG	FG
$B_4 = \Delta C$		14.4 ↑	57.0 ↑	45.8 ↓	36.8 ↓	76.3 ↑	-9.7 ↓	2.0 ↑	28.6 ↑
			SIG	FG	FG	FG	FG	SIB	S
$\Sigma B_4 = \Sigma \Delta C$		114.4 ↑	179.0 ↑	261.0 ↑	357.0 ↑	629.4 ↑	568.3 ↓	579.7 ↑	745.5 ↑
			SIG	FG	FG	FG	FG	FG	FG
$\Delta V$		89.0	119.7 ↑	100.1 ↓	102.5 ↑	93.5 ↓	117.1 ↑	98.2 ↓	98.5 ↑
			Cr	SG	PCr	UG	Cr	SG	Cr

Notes. Exp – export, Imp – import, NP – net profit, Cap – home market capacity, V – production volume,  $Exp_1$ ,  $Imp_1$  – the price for 1 ton of export, import correspondingly, C – loans, I – investments,  $\Delta Exp_{val}$  u  $\Delta Exp_{ph}$  – growth rate of products export correspondingly in value and physical terms,  $\Delta Imp_{val}$  u  $\Delta Imp_{ph}$  – growth rate of products import correspondingly in value and physical terms,  $B_1$  – external export bubble,  $B_2$  – external import bubble,  $B_3$  – internal price bubble,  $B_4$  – internal credit bubble,  $\Sigma B_4$  – the bubble in relation to 2003,  $\Delta V$  – index of production of agricultural products, PCr – pre-crisis state, Cr – crisis state, FG – fast growth (of the bubble), S – steady state, SIG – slow growth (of the bubble), SIB – slow burst/blow-off (of the bubble), Col (FB) – collapse (Col) or fast burst/blow-off (FB) (of the bubble). (calculated by the authors)

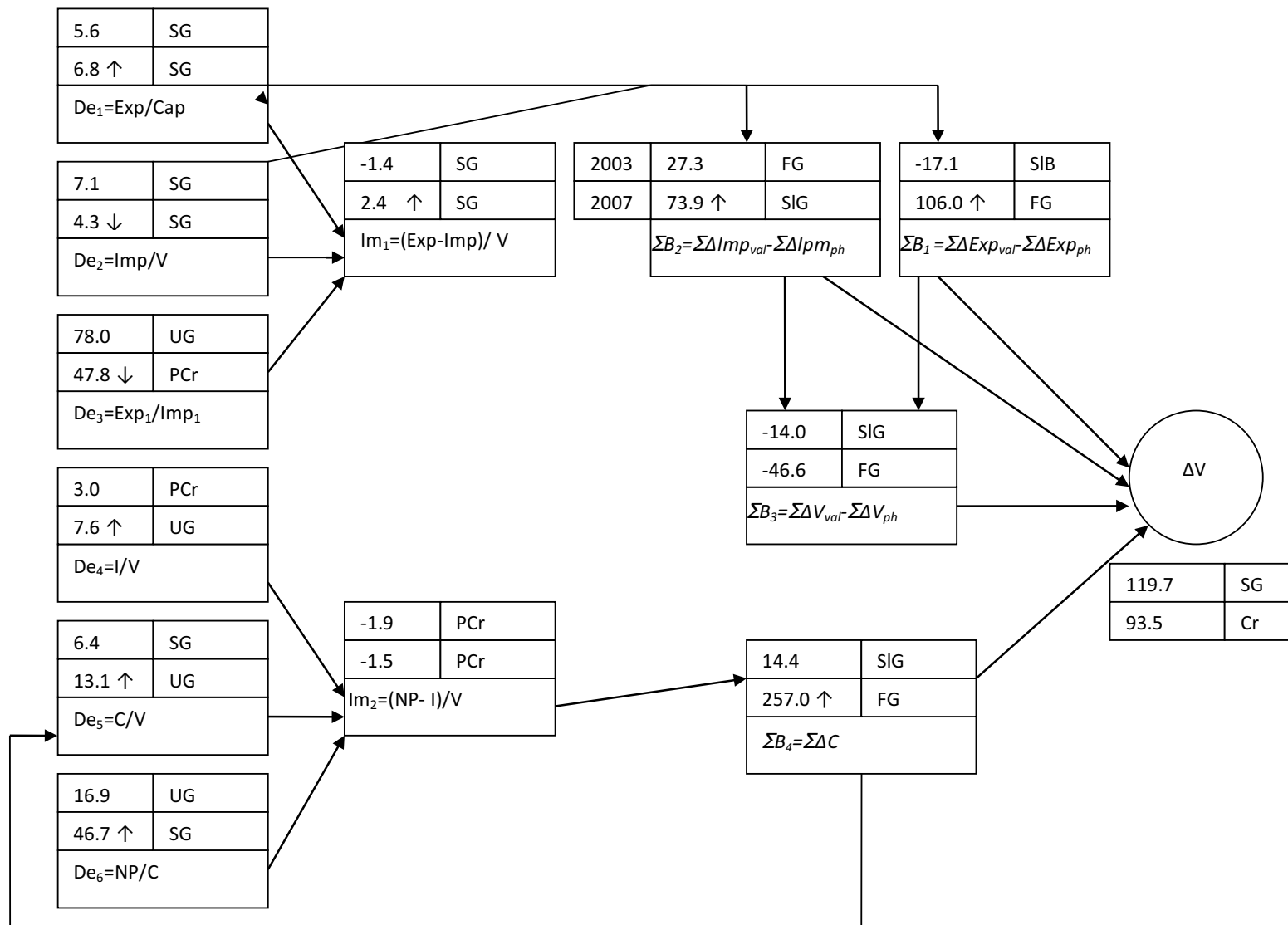


Fig. 3. Structural and logical model for diagnostic of the state and development of pathological processes in agriculture of Ukraine in 2003-2007 (developed by the authors)



## References

- [1] V. Khaustova, P. Pronoza, Theoretical aspects of emergence and development of the crisis phenomena in economy, *Problems of Economy*, 4 (2011) 13-23.
- [2] P. Trunin, Monitoring financial stability in emerging economies (for example Russia), IEPP, Moscow, (2007).
- [3] A. Ulyukayev V, P. Trunin, Application signaling approach to the development of indicators-precursors of financial instability in Russia, *Problems of Forecasting*, 5 (2008) 100-109.
- [4] E. Davis P., D. Karim, Comparing early warning systems for banking crises, *Journal of Financial Stability*, 4 (2) (2008) 89–120.
- [5] A. Gaytan, Ch. Johnson, A review of the literature on early warning systems for banking crises, Central Bank of Chile, 183 (2002). <http://www.bcentral.cl/Estudios/DTBC/doctrab.htm>.
- [6] S. Percic, C.-M. Apostoiaie, V. Cocri, Early warning systems for financial crises - a critical approach, *CES Working Papers*, 1 (2013) 78-88. [http://ceswp.uaic.ro/articles/CESWP2013\\_V1\\_PER.pdf](http://ceswp.uaic.ro/articles/CESWP2013_V1_PER.pdf)
- [7] G. Kaminsky, S. Lizondo, C. Reinhart, Leading Indicators of Currency Crises, *IMF Staff Papers*, 45 (1998) 1-48.
- [8] B. Eichengreen, A. Rose, C. Wyplosz Contagious Currency Crises: First Tests, *Scandinavian J. of Econ.*, 98 (1996) 463–484.
- [9] G. Kaminsky, M. Goldstain, C. Reinhart, Methodology for an early warning system: the signals approach, *Assessing Financial Vulnerability: An Early Warning System for Emerging Markets*. Chapter 2, DC: Institute for International Economics, Washington, (2000). <http://mpra.ub.uni-muenchen.de/24576>
- [10] J. Aziz, F. Caramazza, R. Salgado Currency crises: in search of common elements, *IMF working paper*, 00/67 (2000).
- [11] A. Tabolov, System of leading indicators for the Republic of Belarus, *Banking Herald*, November (2007) 30-36.
- [12] M. Kyzym, P. Pronoza, O. Polyakova, An early detection of pathological processes in the real economy // *News ISEA*, 1 (93) (2014) 110-120.
- [13] State Statistics Service of Ukraine. <http://www.ukrstat.gov.ua>.
- [14] T. Knedlik, The European Commission's Scoreboard of Macroeconomic Imbalances – The impact of preferences on an early warning system, *IWH Discussion Papers*, 10 (2012). <http://www.iwh-halle.de/d/publik/disc/10-12.pdf>.