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THE MECHANISM OF THE ENTERPRISE'S ECONOMIC BEHAVIOR: ELEMENTS AND MODELS

МЕХАНІЗМ ЕКОНОМІЧНОЇ ПОВЕДІНКИ ПІДПРИЄМСТВА: ЕЛЕМЕНТИ ТА МОДЕЛІ

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The dynamic development of the external environment of the enterprise forms the prerequisites for the formation of a strategy for managing the economic behavior of the enterprise, which is a complex process that characterizes the external and internal environment of enterprises and is based on the development of enterprises. The purpose of the work is to build a mechanism of economic behavior of an enterprise to improve the efficiency of enterprise management in the long-term and short-term periods. The constructed mechanism of economic behavior of the enterprise is based on a system of principles and includes two main blocks: principles of spatial nature and principles of temporal nature. The developed mechanism has a modern mathematical basis in the form of VAR models and cross-spectral analysis, which allows studying economic behavior in both long-term and short-term business horizons. Each of the management horizons contains its own local mechanism of economic behavior. Within the framework of this work, the local mechanism of managing the economic behavior of the enterprise in the long-term planning horizon was investigated using the Granger causality test, impulse analysis and dispersion decomposition.

Keywords: economic behavior, mechanism, principles, long-term and short term management, VAR models, cross spectral models.

Динамічний розвиток зовнішнього середовища підприємства формує передумови для формування стратегії управління економічною поведінкою підприємства. Важливим елементом стратегії управління є визначення складових управління задля ефективної їх реалізації. Метою даної статті є побудова механізму економічної поведінки підприємства. Цей механізм побудований на системі принципів, яка поділяється на дві основних складові: принципи просторової природи та принципи часової природи. Просторові принципи закладають ієрархічну структуру механізму, його елементів і просторових зв'язків регуляції. Тоді як часові принципи дозволяють ефективно використовувати сучасні математичні інструменти для аналізу часових рядів. Розроблений механізм складається з трьох основних блоків: блок математичного інструментарію, блок короткострокового регулювання та блок довгострокового регулювання. В якості математичного підґрунтя розробленого механізму в статті пропонується використовувати апарат кросс-спектрального аналізу, який використовується для дослідження короткострокових тенденцій в поведінці підприємства та апарат векторних авто регресійних моделей (VAR моделей), задля визначення довгострокової поведінки підприємства. Кожен з горизонтів управління містить свій локальний механізм економічної поведінки. В статті акцент зроблений на аналізі довгострокової поведінки за допомогою складових VAR моделей, таких як тест Гренджера, імпульсний аналіз та дисперсійний аналіз. За допомогою тесту Гренджера побудовано граф взаємного впливу ВВП, внутрішньої доданої вартості (ВДВ) видів економічної діяльності та економічної поведінки підприємства, який показав, що підприємство має вплив на ВДВ і ВВП національної економіки. Такий вплив свідчить, що досліджуване підприємство є великим підприємством галузі. Визначено вплив кожного з факторів на дисперсію показника чистого прибутку підприємства, який відображає його економічну поведінку. Проаналізовано шоки в розвитку показників ВВП та ВДВ та їх вплив на економічну поведінку підприємства в довгостроковому горизонті управління.

Ключові слова: економічна поведінка, механізм, принципи, довгострокове та короткострокове управління, VAR моделі, кросспектральні моделі.

Introduction. In the conditions of a dynamic external environment, the enterprise faces challenges regarding the transformation of its behavior in order to ensure effective functioning and achieve sustainable development in the long term. The openness of economic systems, which include enterprises, requires the systems to establish mechanisms of interaction with the external environment, which can take both active and passive forms. Active interaction consists in the impact of enterprises on the external environment due to the high share of the enterprise in the gross added value of the type of economic activity. In this case, the enterprise acts as an industry-forming, strategic enterprise. Passive interaction is reflected in the influence of external factors on the functioning of the enterprise. Active and passive interaction of the enterprise with the external environment is the basis of its economic behavior.

The economic behavior of the enterprise is a multifunctional phenomenon, which was studied by prominent foreign and national scientists.

It is advisable to consider the economic behavior of the enterprise as a separate system that contains important elements and connections between them.

Literature review. Herbert Simon (1955) was an early critic of the idea that people have unlimited information-processing capabilities. He suggested the term "bounded rationality" to describe a more realistic conception of human problem-solving ability. The failure to incorporate bounded rationality into economic models is just bad economics – the equivalent of presuming the existence of a free lunch. Since we have only so much brainpower and only so much time, we cannot be expected to solve difficult problems optimally. It is eminently rational for people to adopt rules of thumb as a way to economize on cognitive faculties. Yet the standard model ignores these bounds [1, 2].

Shleifer, Andrei (2020) said in his book about behavior finance. This approach starts with an observation that the assumptions of investor rationality and perfect arbitrage are overwhelmingly contradicted by both psychological and institutional evidence. In actual financial markets, less than fully rational investors trade against arbitrageurs whose resources are limited by risk aversion, short horizons, and agency problems [3].

R. H. Thaler and S. Benartzi (2004) investigated the problems of behavioural economics as a tool to increase employee pension savings. In their paper, two problems of the behaviour exist. From one hand, the calculation of the correct savings rate is very hard process. And, from the other hand, the employees are reluctant to increase their savings rate because it will reduce their consumption now [4].

O. Rayevnyeva and T. Touzani [5] observe the economic behaviour as interrelation between labour and capital. The article is devoted to the construction of forecasting models of an enterprise's behaviour, namely: 1) a predicting model of the production system's activities that combines the resource capabilities of the enterprise with the state and prospects of branch development; 2) a model of determining the sustainability of the enterprise’s trajectory. The first model contains the production component in the form of the Cobb-Douglas function; financial, labour, innovative and enterprise’s image components, represented by autoregressive functions. The specifically feature of the constructed model is to use capital and labour resources of the enterprise as factors that ensure the transfer and interaction of internal and external fluctuations of the production system. To using factors of the export volume and the gross value added of the branch in the enterprise’s image component allowed to have regard to the development opportunities of the enterprise in the national economy. To determine the stability of the enterprise's development trajectory, the study uses Lyapunov's theory of stability.

Kalycheva N. [6], Kondrateva T. [7], Karachina T [8] and others dealt with the issue of determining the economic behaviour of the enterprise. They believe that the economic behaviour of the enterprise in conditions of uncertainty appears in two forms: adaptation of the enterprise to the environment and influence on the environment in order to change it. Such behaviour covers not only the company reactions to the changes that have taken place, but also all long-term, strategic actions that improve the long-term market position of the company. In this regard, it is necessary to distinguish between short-term and long-term adaptation, which involves the development of the enterprise.

Researchers [9] emphasize that to form an enterprise's active economic behavior, it is necessary to consider trends in the external environment. Thus, a special role is played by studying the main macroeconomic indicator - GDP per capita and the activity of migration processes. It is the latter indicator that reflects changes in the number of the economically active population in the country.

Moroz O.V., Karachyna N.P., Ostryi I.F. change economic behaviour as an ordered set of actions of business entities aimed at achieving economic goals in the conditions of specific economic systems, taking into account value institutions [10].

R. Lucas and N. Wallace, representatives of the "information economy" theory, supplemented the theory with firm-theoretical provisions about the rational expectations of enterprises, which are formed not only under the influence of their previous experience, but also assessments of the prospects for the development of the economy in general, the same enterprise. Researchers believe that it is precisely these rational expectations that determine the economic behaviour of the enterprise both in the short-term and in the long-term perspective [11].

Thus, economic behaviour is the complex process that characterized the external and internal environment of the enterprises and based on the development of enterprises.

Research objective. The purpose of the paper is construction of the mechanism of enterprise's economic behaviour for the increases of efficiency of the management of the enterprises in long-term and short-term periods.

– We have following tasks to support our purpose:

– The investigation of the backgrounds (approaches, principals) of the construction of the mechanism of economic behavior;

– The formation of the blocks of the mechanism by the economical and mathematical senses;

– The choice of the mathematical tools as instrumental part of the mechanism of economic behavior;

– The investigation of influence of the variation decomposition on the analyzing enterprise.

We used time series of the GDP per capita and gross value added (GVA) by the branch of economic activities for our investigation. For our paper we choose following branch of the national economy: agricultural, construction, manufacturing industry, trading industry and transport. Our choice based on the analysis of the GVA of the branch and development of the national economy.

Main researsh.

A. Approaches and principals for the construction of the mechanism of economic behavior

The analysis of the references help us to systematized the principles that to form of the backgrounds of the mechanism of economic behavior. These principles show on the Figure 1.

The principle of openness and diversity.

The essence of this principle is the constant interaction of the enterprise with external systems that belong to different levels of the hierarchy. Such constant interaction will ensure the continuous development of the enterprise, which makes it possible to shape its effective behavior. The variety of external elements shows the multidimensionality of modeling processes, which allows taking into account as many factors as possible and thus ensuring the development

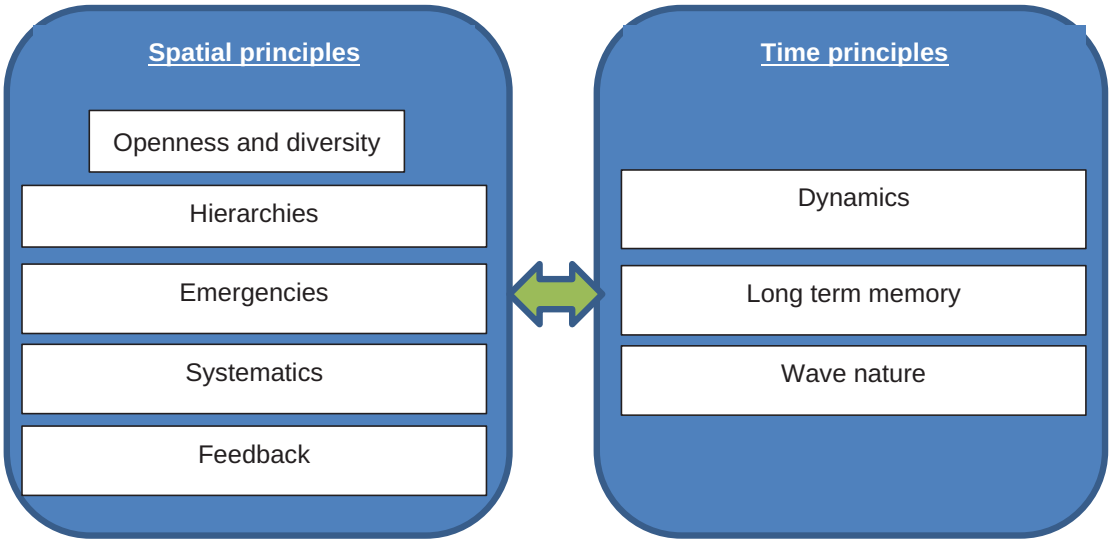

Figure 1. The principles of the mechanism of the economic behavior

Source: compiled by the author

of effective scenarios for managing the economic behavior of the enterprise.

The principle of hierarchy.

Being in constant interaction with the external environment, the enterprise functions within the framework of a hierarchical structure, which is divided into three levels of hierarchy: macro level, meso level, micro level. The macro level characterizes the influence of macroeconomic factors on the activity of the enterprise and on the performance indicators of the meso level. Such factors include GDP, inflation, consumer price index and others. The meso level, on the one hand, is under the constant influence of the indicators of the 1st level of the hierarchy, and on the other hand, since this level is aggregate, it takes into account the specifics of the functioning of objects from one type of economic activity. And according to the principle of similarity, this level affects the activity of the enterprise itself, reflecting the development of the competitive environment.

The principle of emergency.

The functioning of the enterprise is subject to the achievement of economic and social goals. The construction of a mechanism based on the principle of emergency allows us to determine individual elements of the mechanism, the activity of each of which allows us to achieve separate local goals of the mechanism, while combining these elements into a single mechanism we can achieve the global goal of building the mechanism – ensuring the effectiveness of the enterprise's behavior in conditions of non-stationary external environment.

The principle of systematics consists in the fact that the mechanism of economic behavior of the enterprise consists of separate elements and subsystems, which in close interaction with each other allow to achieve the set goal of building the mechanism. Each of the subsystems of the mechanism has its own local tasks and performance criteria.

The principle of feedback. This principle is closely related to the previous principle and takes into account the possibility of adapting the mechanism to external and internal changes. In the context of this work, both structural and parametric adaptation can be considered.

Structural adaptation of the mechanism of behavior consists in changing the structure of the mechanism due to the appearance of new elements that can form new subsystems depending on the new needs of the mechanism and new goals.

Parametric adaptation is aimed at changing the parameters (input data) of building a mechanism for prompt response to changes in the external environment. Structural and parametric adaptation can be considered in the context of short-term and long-term horizons of enterprise behavior management.

The principle of dynamism consists in the constant consideration of the time factor, both indirectly - through the influence of external factors, and directly by including the time factor in the economic-mathematical model.

The principle of long-term memory. Long-term memory indicates the presence of long-term trends, the prerequisite of which are events in the past. The presence of long-term memory allows us to make an assumption about the non-stationarity of processes in time series, which determines the need to study long-term cointegration.

The principle of wave nature. Taking into account this principle provides the possibility of using spectral analysis methods in the analysis of cyclic trends in time series, which in turn allows determining phase shifts and predicting possible fluctuations of the enterprise depending on changes in the external environment.

B. Conceptual scheme of the mechanism of economic behavior of the enterprise

Thus, based on the analyzed of the principles the algorithmic models of the mechanism have following form (Figure 2).

The hierarchical structure of the economic behavior of the enterprise has the following form: 1st level – GDP per capita; 2nd level – GVA of the branch of economic activity; 3rd level is an indicator of the company's profit.

The second component of the mechanism of economic behavior of the enterprise is the economic and mathematical tools supporting the implementation of this mechanism.

The economic behavior of the enterprise is considered in both tactical and strategic horizons of management.

In this regard, an important task in the study of these management horizons is the decomposition of time series and short-term and long-term trends.

Long-term trends characterize the main development of economic behavior. This type of trends depends on the general trends of the development of the national economy both in the macroeconomic section and at the level of types of economic activity.

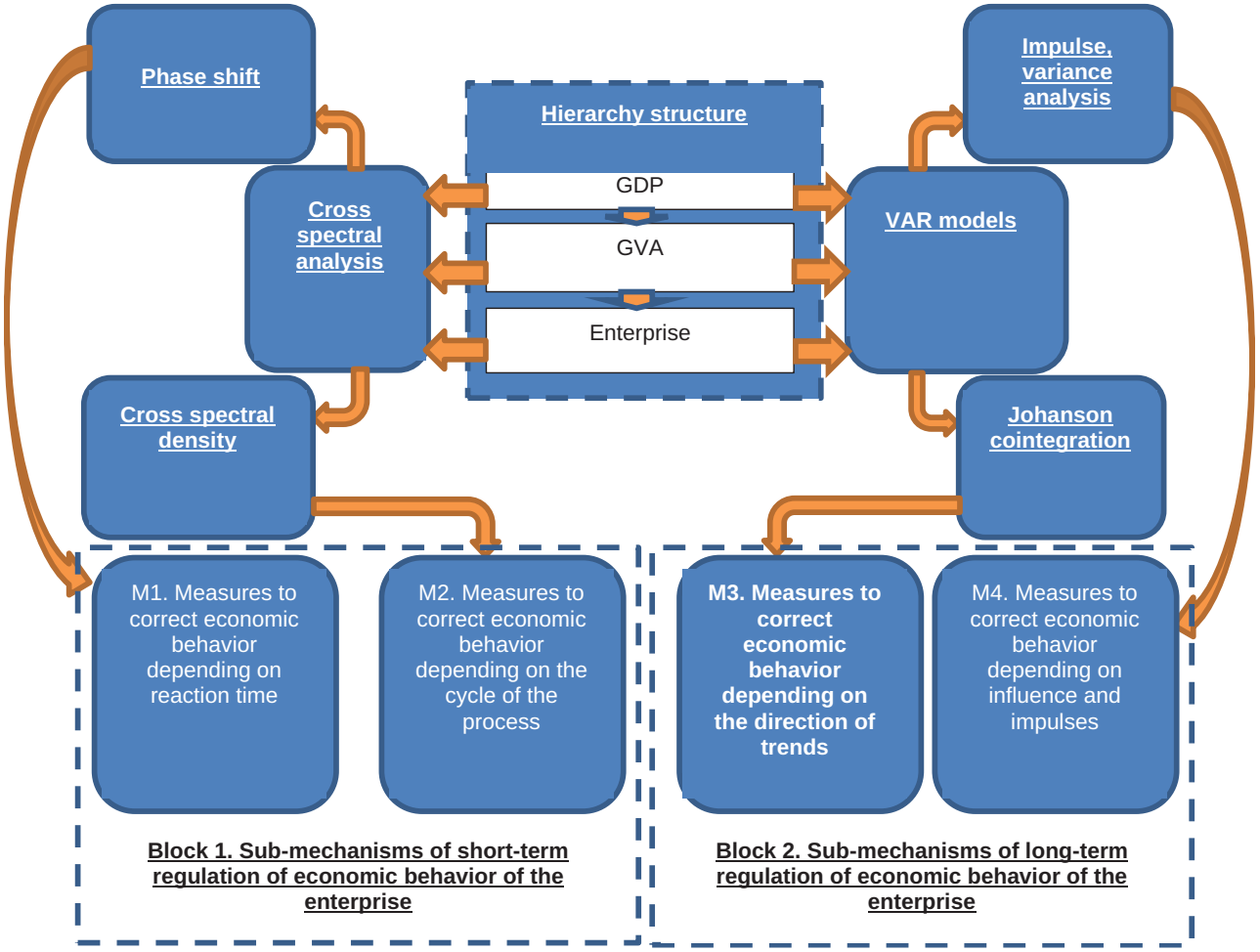

Figure 2. Conceptual scheme of the mechanism of economic behavior of the enterprise

Source: compiled by the author

To study such trends, it is appropriate to isolate the trend component in the dynamics of the time series of all indicators of the hierarchical structure of economic behavior In the tactical horizon of management, the economic behavior of the enterprise is considered from the standpoint of wave theory, that is, as a set of waves of different lengths and amplitudes.

Therefore, it is important to highlight the cyclical component in the hierarchical structure of economic behavior with further analysis of the dependencies between the levels of the hierarchy. Thus, the article proposes to use modern methods of time series analysis, such as: vector auto regression models (VAR models) for the study of long-term trends and cross spectral analysis – for the study of short-term trends of the economic activity of the enterprise. The last component of the mechanism of economic behavior of the enterprise is a regulatory component, which includes two blocks (Figure 2).

Block 1 – a block of analysis of short-term components of economic behavior, which includes two sub-mechanisms:

M1 – measures to correct economic behavior depending on reaction time. The development of these measures is based on the study of the phase shift between the cyclical components of the hierarchical system of economic behavior. The phase shift allows you to determine the period of bias from the moment of the crisis in the macroeconomic environment to the implementation of this crisis at the enterprise level. The greater the phase shift, the greater the time to develop effective measures to adapt the economic behavior of the enterprise to fluctuations in the external environment.

M2 – measures to correct economic behavior depending on the cyclicality of the process. If the local mechanism M1 allows you to determine the period of bias, then with the help of M2 there is an opportunity to study the cointegration between individual cyclical components of the short-term

development of the enterprise, types of economic activity and macroeconomic development. The finding of such cointegration allows you to determine the prevailing, most influential periods of the influence of cyclical components on each other. The first two local mechanisms refer to the block of tactical management.

Block 2 – a block of analysis of long-term components, including two sub-mechanisms, that characterize the strategic management of the economic behavior of the enterprise:

M3 – measures to correct economic behavior depending on the direction of trends. With the help of this local mechanism, a study of the co-integration of trends that characterize long-term sustainable development is carried out. The presence of co-integration ties determines the possibility of detecting the autonomy of the enterprise depending on changes in the external environment. If the long-term trends are co-integrated, then the enterprise strongly depends on the macroeconomic environment and it needs to develop its strategy of economic behavior based on the analysis of macro and meso economic processes. In the case of weak co-integration, the company's strategy should be built taking into account the internal factors of the company's development.

M4 – measures to correct economic behavior depending on long-term impact and impulses. In the presence of long-term co-integration between the enterprise and its macroeconomic environment, it is important to study how changes in the dispersion of some factors affect changes in other factors. For this purpose, the dissertation study proposes to use the method of variance decomposition and the method of impulse analysis.

With the help of these methods, it is possible to investigate what share of the change in the dispersion of the resulting indicator of the enterprise's activity – profit depends on the change in the dispersion in the country's GDP and GVA of economic activities. The presence of such a local mechanism makes it possible to predict the long-term behavior of the enterprise and develop strategic measures to improve its efficiency.

C. Mathematical tools

In this paper we will use VAR-models for the investigation of the long-term economic behaviour of the enterprise (block 2 – Sub-mechanisms of long-term regulation of economic behaviour of the enterprise) for the analysis following things:

General VAR model and determination of the behaviour impact lag structure

General VAR (p) model with *n* variables is

$$X_{1,t}=a_{10}+a_{11}X_{1,t-1}+...+ a_{1p}X_{1,t-p}+...+ b_{1p}X_{n,t-p}$$
$$X_{2,t=}a_{20}+a_{21}X_{1,t-1}+...+ a_{2p}X_{1,t-p}+...+ b_{2p}X_{n,t-p}$$
$$...$$
$$X_{n,t=}a_{n0}+a_{n1}X_{1,t-1}+...+ a_{np}X_{1,t-p}+...+ b_{np}X_{n,t-p}$$

where n – the number of variables; p – optimal lag of the VAR model.

Estimation of lag's influences in the VAR model. Generally, two main criteria exist for the determination of the lag's influence. There are Akaike criteria and Schwarz criteria;

Impact impulse analysis. We used momentum analysis to determine the percentage impact of each factor on behavior.

Results. Firstly, we used Dickey-Fuller test for the determination of the order of stationarity of the time series. The results are present in the Table 1.

Table 1

Results of ADF Test

Series	t-Stat	Prob.
Agricultural	2.2315	0.9998
Construction	-1.4386	0.5448
GDP	3.8150	1.0000
Manufacturing	1.1901	0.9969
Enterprise	-0.7624	0.8056
Trading	2.9232	1.0000
Trandport	-2.0345	0.2709

Source: compiled by the author

The dates in the table show us that all time series are non stationarity. In this case we must to calculate first different. The recalculations are in the Table 2.

Table 2

Results of adf test of first different

Series	t-Stat	Prob.
Agricultural	-3.7632	0.0867
Construction	-3.3316	0.0295
GDP	-5.9656	0.0001
Manufacturing	-3.8194	0.0891
ENTERPRISE	-4.0866	0.0052
Trading	-3.4629	0.0140
Trandport	-3.9633	0.0745

Source: compiled by the author

As we look, the time series of the first different are stationarity. Therefore we can to use VAR models for our calculations.

Second step is the determination of the quantity of lags and determination of the endogenous variables. We used Granger Causality test for it. This test shows us that the optimal lag is equal and all variables are endogenous.

Third step is the analysis of the causality between variables. The results of the analysis are in the Table 3.

– The interrelation between time series is present on Figure 3. The results of the Table 3 and Figure 3 show us:

– The enterprise has influence onto the GVA and GDP of the national economy which indicates that the enterprise is a large enterprise of the industry;

Construction industry is an industry that is influenced by many other industries. That is, the development of such industries provokes an increase in the development of construction.

In most cases, VAR models are used to investigate impulse and variation. The results of the impulse analysis are show on a Figure 4.

Table 3

Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.
Agricultural does not Granger Cause Construction	7.48238	0.0056
Enterprise does not Granger Cause Agricultural	39.6734	1.E-06
Transport does not Granger Cause Agricultural	3.17251	0.0710
Manufacturing does not Granger Cause Construction	11.3132	0.0010
Enterprise does not Granger Cause Construction	24.6958	2.E-05
Trading does not Granger Cause Construction	3.73674	0.0482
Transport does not Granger Cause Construction	7.40060	0.0058
GDP does not Granger Cause Construction	11.7691	0.0008
Enterprise does not Granger Cause Manufacturing	31.4067	4.E-06
Manufacturing does not Granger Cause Trading	3.15854	0.0717
Enterprise does not Granger Cause Trading	96.2652	3.E-09
Enterprise does not Granger Cause Transport	8.89522	0.0028
Enterprise does not Granger Cause GDP	49.9903	2.E-07
Transport does not Granger Cause Trading	10.2075	0.0016
GDP does not Granger Cause Trading	11.0331	0.0011
GDP does not Granger Cause Transport	3.52503	0.0556

Source: compiled by the author

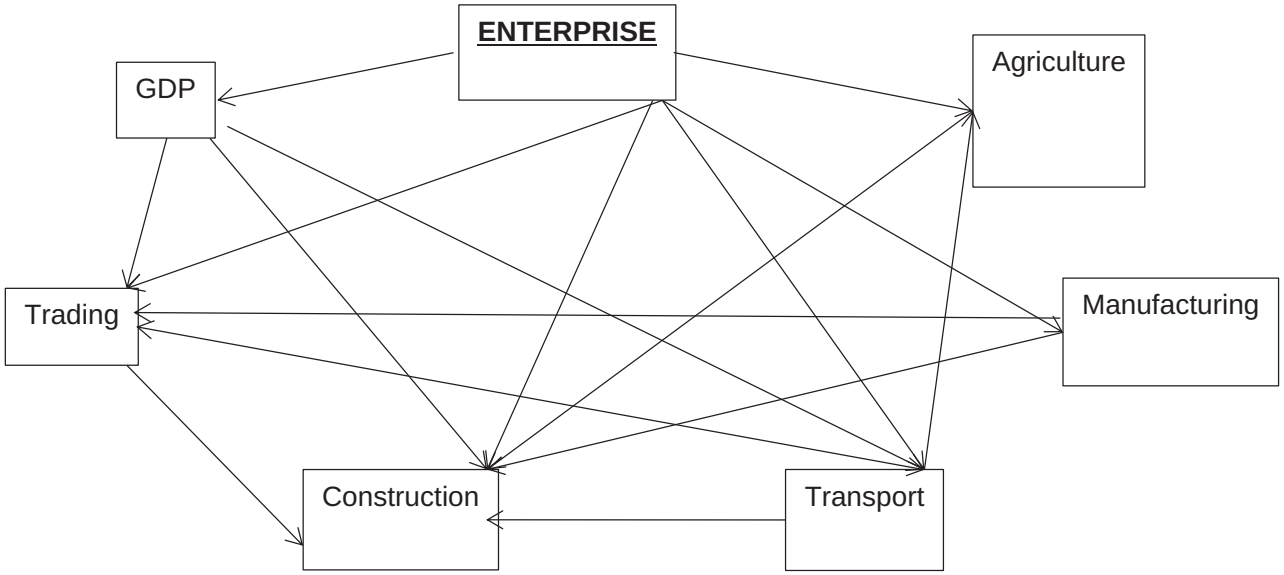

Figure 3. Graph of the interrelation between GDP, braches of economic activities and enterprise

Source: compiled by the author

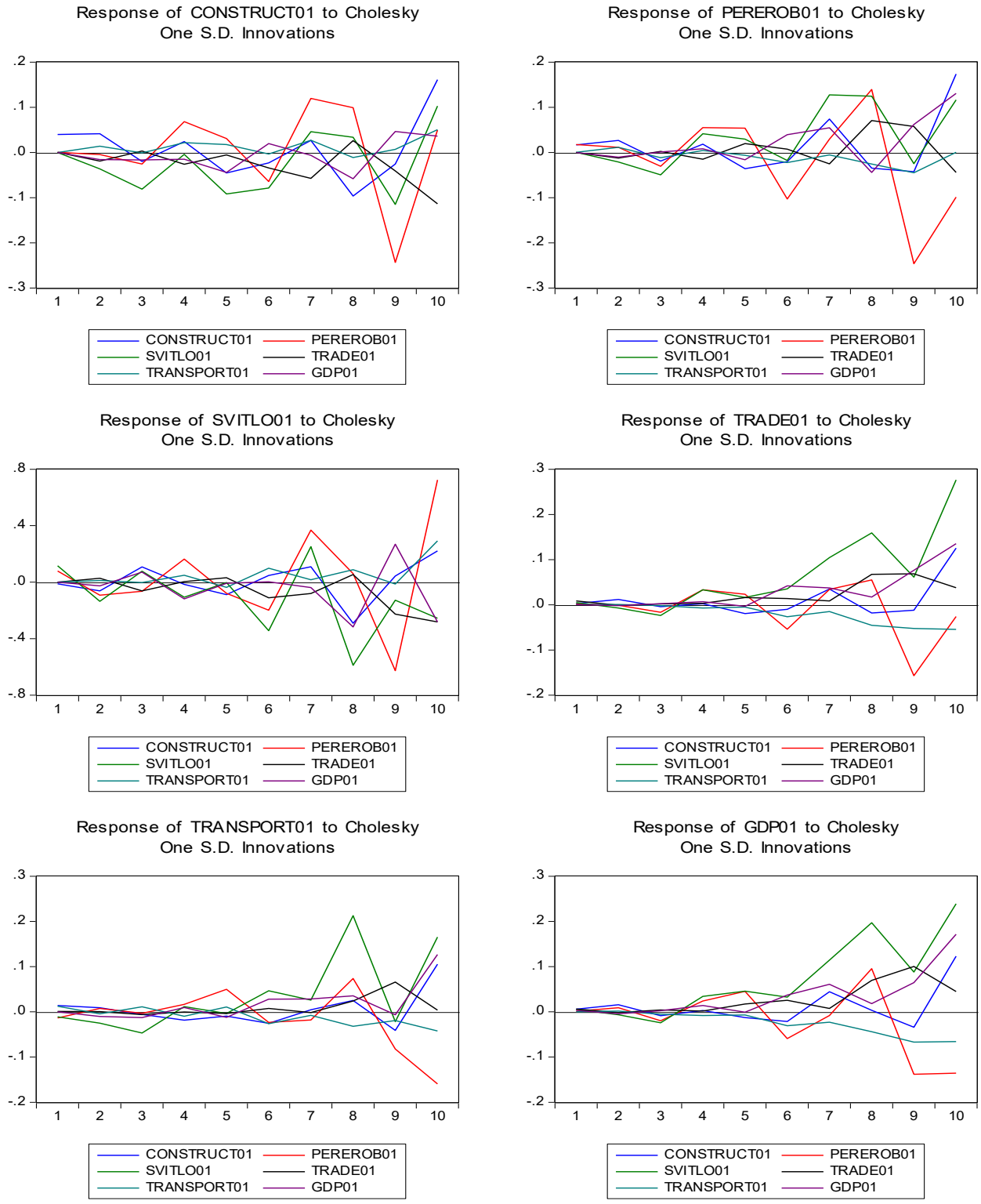

Figure 4. Impulse analysis and shock response of the factors depend from the influenced factors

Source: compiled by the author

The date of the Figure 4 shows us following results:

– The construction industry has a big impact of manufacturing industry during all lags and biggest impact we can see in 9th period; The manufacturing industry depends on itself and enterprise influences to manufacturing industry in 7th-9th periods;

– The biggest shock of the reaction of behavior of enterprise observed for the manufacturing industry in 6th-10th periods

– The trading industry has biggest impact from all industry since 7th period. Also we can look big shock reaction in transport industry and GDP (national economy).

Long term analysis is very important in combination between impulse analysis and variance analysis. The results of variance analysis (decomposition of the variance) are given in the Table 4.

We can to make following conclusion on the date in the Table 4:

Table 4

Variance Decomposition Of Factors

Variance Decomposition of Construction:						
Period	**1**	**2**	**3**	**4**	**5**	**6**
1	100.0	0.000	0.000	0.00	0.00	0.00
2	60.29	0.39	24.40	6.80	3.54	4.57
3	27.47	5.11	***59.23***	2.82	1.44	3.89
4	21.29	26.56	39.79	5.33	3.27	3.74
Variance Decomposition of Manufacturing:						
Period	1	2	3	4	5	6
1	***47.34***	52.65	0.00	0.00	0.00	0.00
2	43.24	19.07	19.83	7.23	5.65	4.95
3	21.71	22.25	***47.11***	2.72	4.37	1.81
4	14.42	38.21	39.94	3.38	2.49	1.52
Variance Decomposition of **Enterprise**:						
Period	1	2	3	4	5	6
1	0.68	**31.63**	67.67	0.00	0.00	0.00
2	7.64	**28.26**	60.95	1.53	0.26	1.34
3	18.94	**22.76**	45.52	5.56	0.17	7.03
4	11.59	**33.01**	35.66	3.36	1.87	14.48
Variance Decomposition of Trading:						
Period	1	2	3	4	5	6
1	6.81	3.63	20.44	69.10	0.00	0.00
2	***47.71***	1.64	24.96	24.62	0.12	0.93
3	13.82	24.09	***54.37***	6.69	0.33	0.65
4	4.79	39.96	***49.60***	2.52	1.53	1.57
Variance Decomposition of Transport:						
Period	1	2	3	4	5	6
1	29.63	27.67	19.04	0.11	23.52	0.00
2	17.92	15.32	***48.70***	0.06	11.38	6.59
3	7.55	6.01	***71.82***	0.91	7.22	6.45
4	13.02	10.36	***61.09***	0.74	7.73	7.03
Variance Decomposition of GDP:						
Period	1	2	3	4	5	6
1	28.38	1.41	26.56	34.27	0.03	9.31
2	***54.59***	16.37	14.54	8.25	0.50	5.73
3	22.00	29.29	40.74	3.77	2.03	2.14
4	10.02	28.95	***50.11***	1.75	2.84	6.31

Note: 1 – Construction industry; 2 – Manufacturing industry; 3 – Enterprise; 4 – Trading industry; 5 – Transport industry; 6 – GDP

Source: compiled by the author

Enterprise has most impact on the variation in all factors. In construction industry – 59%, in manufacturing industry – 47%, in trading industry – 54%, in transport industry – 71% and in national economy (GDP) – 50%

The construction industry is the second most influential factor on the economy (54% in GDP, 24% in transport, 47% in trading, 47% in manufacturing);

The most significant lag for enterprise is 3. The variance of the time series of enterprise more depending from manufacturing industry. Average influence is 29.6%

Thus, the calculated dependence of the variation of the dynamics of the time series of the enterprise allows to determine the most influential factors, which in turn provides an opportunity to increase the effectiveness of management decisions

In this paper, a mechanism of economic behavior of the enterprise was constructed, which consists of a number of blocks and contains modern mathematical tools. Within the framework of this mechanism, the second environmental mechanism was analyzed, which is aimed at investigating the long-term dependence of the economic behavior of the enterprise on external factors calculated dependence of the variation of the dynamics of the time series of the enterprise allows to determine the most influential factors, which in turn provides an opportunity to increase the effectiveness of management decisions.

Conclusion. The following results were obtained during the research:

The system of mechanism building principles was formed, the basis of which expansion was the division of all principles into two main groups: spatial principles and time principles. Spatial principles lay down the hierarchical structure of the mechanism, its elements, and spatial connections of regulation. While time principles allow effective implementation of modern mathematical tools for time series analysis.

On the basis of a systemic approach, a conceptual diagram of the mechanism of economic behavior of the enterprise is proposed, which combines both regulatory objects and research methods and local mechanisms that ensure effective regulation of economic behavior in the short-term (tactical) and long-term (strategic) management horizons;

The conceptual scheme of the mechanism of economic behavior of the enterprise was constructed. This scheme consists of hierarchical structure of the factors, mathematical tools (VAR models and cross spectrum analysis) and two sub local mechanism for the management in long-term and short-term period.

Based on the Granger Causality test, the enterprise has influence onto the GVA and GDP of the national economy which indicates that the enterprise is a large enterprise of the industry. This is confirmed by both the impulse analysis and the decomposition of time series variances. Time series of the profit of enterprise is most influenced series in investigated sets of indicators. Enterprise has most impact on the variation with the 3rd period on construction industry – 59%, in manufacturing industry – 47%, in trading industry – 54%, in transport industry – 71% and in national economy (GDP) – 50%

This paper gives background for future investigation in the following directions. Firstly, we have two sub local mechanisms in general mechanism of the economic behavior and need more research in the area of the short – term management. Secondary is a debatable issue regarding the co-integration of the investigated series in the short-term and long-term horizons of management.

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