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## METHODOLOGY OF RESEARCH, EVALUATION AND MODELING OF VEGETABLE MARKET DEVELOPMENT IN UKRAINE

### **Abstract.**

*Management of the economic system, as a rule, aims to achieve a certain desired state, which would be characterized by significantly better parameters. This requires modeling of both the system itself and the change management process as a whole. The object of research in the article was the market of vegetable products in Ukraine. Like any market and economic system, in addition to a static description of its state, it is necessary to determine the dynamics, to reflect the changes in this market over time. To define certain basic concepts in identifying such dynamics, the author of the article proposed a «matrix of market dynamics», which provides an interpretation of the main vectors of change in the state of these objects in terms of quantitative and qualitative transformations. Thus four basic variants of a condition can be defined: development, degradation, growth, decline. Defining such zones of market state is important, first of all, from the point of view of forecasting the movement of the real market to a better state, where, taking into account the dialectical law of interdependence between quantitative and qualitative changes, only two alternatives to the vector of change.*

*In turn, the author's methodology had a feature of direct interpretation of types and models of the market. Determining the ideal, desired state of the market (perfect / effectively functioning) requires a study of market structure, the allocation of different types (models) of the market depending on the market behavior of enterprises and groups of agents, features of market prices, sales, demand and supply of goods or of other quality, etc. Within these tasks, it is important to study, first of all, the factors of institutional nature that lead to the transformation of market processes, as well as methods of their identification by the criterion of the effectiveness of the economic system as a whole.*

*The developed model of vegetable market assessment in Ukraine outlines critical limitations based on the analysis of the existing model of this market, which in general are critical environmental dysfunctions, insufficient level of functionality of almost all market components and minimization of market value due to low industry potential.*

**Keywords:** *methodology, market, model, evaluation, market of vegetable products.*

Any economic theory can be evaluated by its applied value, the ability to provide specific proposals for improving or modifying the management system of the object under study. Based on this, a new management task is formed.

Management of the economic system, as a rule, aims to achieve a certain desired state, which would be characterized by significantly better parameters. This requires modeling of both the system itself and the change management process as a whole. The market of vegetable products, like any market and economic system, in addition to a static description of its state, needs

to determine the dynamics, ie to reflect the changes in this market over time. Comparing the current state of the object with the past and future – predicted – state allows us to answer the following questions: 1) how perfect this state is compared to the past and expected / possible; 2) what is the history of the dynamics of the object and how much its condition improves and deteriorates; 3) what determines the essence of deterioration or improvement in terms of the history of dynamics and how it can be taken into account by the control system [1, p. 6].

The conceptual foundations of the application of dynamic models to the analysis of economic processes and the significant methodological potential of such an approach were substantiated, as is well known, in the 70s of the twentieth century. a number of economists, such as the Nobel laureates in economics J. Tinbergen [2] and R. Frisch [3] and others.

To define certain basic concepts in identifying such dynamics, we proposed a "matrix of market dynamics" (Fig. 1), which provides an interpretation of the main vectors of change in the state of these objects in terms of quantitative and qualitative transformations.

Criteria interpretation of matrix positions:

Development – changes in the structure of the market, which are expected to improve the set of its characteristics in the future in accordance with the global trend relative to more efficient markets;

Degradation – changes in the structure of the market, which are expected to lead to a deterioration in the totality of its characteristics in the future in line with the global trend relative to more efficient markets;

Growth – an increase in market indicators (value in the first place, as well as: sales volumes, the number of market transactions, the number of speculative transactions, the value of speculative transactions, etc.);

Recession – a decrease in market indicators (value in the first place, as well as: sales volumes, the number of market transactions, the number of speculative transactions, the value of speculative transactions, etc.);

Depression is steady trend of lack of positive changes in qualitative and quantitative content during a clear and well-defined period.

<i>Quantitative changes</i>	Growth	<b>II Zone extensive growth</b>	<b>IV Zone progress («Market intensification»)</b>
	<i>Lack of significant quantitative changes</i>	<b>Ia. Depression zone</b>	<b>III Optimization zone</b>
	Recession	<b>I The zone of decline («Market collapse»)</b>	
		Degradation	<i>Lack of significant structural changes</i>
		<i>Structural (qualitative) changes</i>	

Figure 1. Description of possible scenarios of market dynamics

Source: author's research

Thus four basic variants of a condition can be defined, namely: 1) development (changes of structure of the market which can be recognized as positive); 2) degradation (changes in market structure that are recognized as negative); 3) growth (increase in quantitative indicators and market dynamics – value in the first place, etc.); 4) recession (decrease in market indicators) and depression (steady state of the system/facility in an inefficient state). In general, this approach to classification can now be considered generally accepted, the basis of which was at one time – in the 70-80's of the twentieth century. research and work of such Nobel Prize winners in the field of economics as S. Koval [4], A. Lewis [5], T. Schultz [6], R. Solow [7] and others.

The importance of this scheme is as follows: the combinatorial matrix mapping of possible market positions in the author's interpretation provides an idea of possible scenarios of dynamics. In this case, each of the sectors of the matrix is realistic, because it is confirmed by the history of the domestic market of vegetable products (which is presented later in the paper). In order to

reflect the most general proportions of these alternatives, some characteristic indicators of market conditions in different periods are given in table. 1. Such positions should be defined as «zones» of market dynamics, the content of which is designed to reflect, above all, the characteristics of the market in certain time periods of its own evolution.

In the scheme in fig. 1 the ideal state is position IV or so-called. «Progress zone». In the table 1, this was associated with positive qualitative changes in the market structure, which were considered as the main impetus for change and at the same time, its growth, the classical model of intensification; for Ukraine, this situation is considered desirable in the long run a priori.

The author's approach assumed that a positive assessment of the existing qualitative changes in the market should be associated with the effect of a multiplicative nature, which naturally determines the growth of perfection, efficiency and effectiveness of the system in the future.

Table 1

**Interpretation of the state of the vegetable market in Ukraine according to the matrix of market dynamics**

Indexes	Growth	Degradation	Optimization	Growth and optimization trends	Strategic perspective
	1990 y.	1995 y.	2000 y.	2019 y.	2025 y.
Temporal interpretation	The other half 80-x yy.	The first half 90-x yy.	The other half 90-x yy. - beginning 2000-x yy.	With 2010-x yy.	Prognosis
Volume of vegetable production, million dollars USA*	765,0	199,2	56,8	1136,3	1300,0-1500,0
Consumption of vegetables per 1 person, kg	128,0	114,0	101,7	164,9	185,5
The share of fire in production, %	27,0	73,0	83,0	85,0	65,0
Application of mineral fertilizers, kg / ha	164,0	73,5	23,0	205,0	300,0
Exports of vegetable products, million dollars USA **	106,0	85,7	14,7	299,3	550,0

Notes: \* - 1990 - the course of nat. currency up to 1 dollar USA - 0.60 rubles; 1995 - exchange rate UAH 1.76; 2000 - course UAH 5.75; 2019 - exchange rate UAH 27.0; prognosis - UAH 25.0;

\*\* - according to FAO [8].

Source: author's research, interpretation of the content of fig. 1.

Accordingly, the «zone of decline» (I) means the deterioration of both quantitative and qualitative characteristics at the same time. That is, it is a recession in terms of quantitative changes and degradation of the structure at the same time; as an example – for the domestic market of vegetable products this is typical primarily for the 90's. A special case is the lack of clearly defined significant quantitative and qualitative changes in the market – the so-called. «Zone of depression», which in practice, obviously, can not take place for a long time, but is transformed into zones of optimization, growth or decline.

In essence, intermediate positions II and III reflect the state of the market, respectively:

- for the «zone of extensification» (II) as such, where, for example, the volume of intensive vegetable growing is minimized, but this is compensated by the outstripping growth of quantitative parameters (sown areas) due to technologically and organizationally primitive systems; At the same time, modified market exchange systems became widespread: for example, due to little or no uncontrolled natural markets, and so on. Thus, this is typical for Ukraine from the second half of the 90s and the beginning of the 2000 s;

- for the «optimization zone» (III) is characterized by stagnation or even a decrease in quantitative indicators (or some of such – sown areas, for example) market against the background of positive structural changes and improved economic indicators (production, profitability, profitability, etc.) – for the domestic market of vegetable products, this is typical for some time periods since the 2000s.

We would like to note that in practice it is quite problematic to clearly define the state of the market for the current period, because it is often possible to argue about trends or / and change of a group of indicators against the background of the stability of others. It is

more correct to state the predominance of the characteristics of a zone for a particular market at the moment (a detailed analysis of the domestic market of vegetable products for these characteristics and typology of zones is given in [1]). In other words, as already mentioned, the industry and the market will never have unambiguous characteristics of a zone, instead there will be a combination of features of different zones with the predominance of one of them.

Nevertheless, in our opinion, the state of zones I and II is, in turn, the plane of the so-called. «Marginalization» of this market as a regional in the structure of international markets. The term «marginalization» used by F. Brodel in [9, p. 244], applied as synonymous with «operation» in terms of individual economic territories and regional markets. Hence, the marginalization of a market means a state of subordination to the existing international division of labor and the world market, when the marginalized market is in conditions of unequal, non-equivalent exchange. Arguments that the Ukrainian market of vegetable products falls under the signs of marginalized, are given in the article [10, p. 62], which indicates the economic cost of losses from these effects.

Defining such zones of market state is important, first of all, from the point of view of forecasting the movement of the real market to a better state, where, taking into account the dialectical law of interdependence between quantitative and qualitative changes, there are only two alternatives to the vector of change. I - III – IV. Hence, the movement to a better state along these trajectories is proposed to be defined as «normal», while the degradation vectors – «abnormal». In this case, the hypothesis may be the statement about the impossibility of direct transformation by the vector I - IV. Conceptually normal changes are expected to be realized in the economic system of the capitalist type

with a high level of economic liberalism and minimization of regulations; anomalous changes are associated with an inefficiently functioning economic system, which has the characteristics of a capitalist-market, but which is characterized by unreasonably high levels of inefficient regulation, dysfunction of the competitive environment and other market elements.

In turn, the author's methodology had a feature of direct interpretation of types and models of the market.

An important condition for the successful development of any state is the effective development of a market economy, as it will allow the state to strengthen its position in the foreign market, improve the investment climate, increase production, better meet people's needs, etc. In the study of theoretical and methodological foundations building in Ukraine a market model of management is important not only an adequate understanding of the processes of economic transformation in market conditions, but also the formation of full-fledged markets in order to adapt to the requirements of the world economic environment [11, p. 43].

It should be emphasized that determining the ideal, desired state of the market: according to the author's version – perfect / effectively functioning - requires a study of market structure, selection of different types (models) of the market depending on market behavior of enterprises and groups of agents. , supply and demand for goods of one quality or another, etc. The market structure also includes internal connections between parts of a single whole – the market: the relationship of sellers and buyers with each other and with each other, as well as the relationship of potential sellers with potential buyers and competitors.

In an organized market environment, market relations, which are formed between buyers and sellers, create opportunities for the free exchange of material goods in different competitive markets, provided that the principle of equivalence of exchange is observed. It is well known that market competition is characterized by economic struggle between producers, suppliers and consumers of goods under the most favorable conditions of production, sale, consumption. At the same time, it is a method of choosing the optimal business solution. The economic feasibility of choosing the right solution is confirmed by the state of market equilibrium between supply and demand in a particular product market and the achievement of optimal parameters of indicators that characterize this market.

Based on the conditions where competitive advantages are the basis, the following most typical models of market structures are traditionally distinguished: «pure (perfect) competition», «monopolistic competition», «oligopoly», and «pure monopoly». Analysis of the domestic market of vegetable products for these four positions suggests that this belongs to the model of monopolistic competition. In this statement there are key points that can be considered as the basis for further optimization of the market.

Thus, first of all, we should proceed from the idealism (the absence in real life, as a rule) of the model of pure competition, which was proved in the early 30's of the twentieth century. J. Robinson [12] and E. Chamberlin [13]. In turn, for this market due to its features is

virtually impossible model of pure competition. Hence, the market for vegetable products can actually vary from a state of oligopoly to monopolistic competition. In this case, the state of monopolistic competition seems the most acceptable, and this state, as already noted, is present.

This statement has the following arguments: 1) only such a market acquires the maximum socialization (ie the largest possible number of beneficiaries); 2) only such a market can to the greatest extent realize the potential factors of competitiveness of monopolistic content, and this will be manifested in all types of economic activity, at all levels; 3) only in such markets can be realized the most stimulating effect of market pricing mechanisms; 4) in such a market there is a high competitiveness of the economic environment by minimizing barriers to entry into the industry, the actual impossibility of cartels, as well as minimizing the possibility of opportunistic behavior of certain groups of agents on rent [14, p. 126].

We consider it expedient to separately note the need to clarify the methodology of research on the development of different types and models of the market of goods and services in Ukraine in the context of transformational global change. Specific approaches to combining the interests of the subjects of this market in the context of the functioning of Ukraine in the WTO and multifaceted integration into the EU should be promising.

Within these tasks, it is important to study, first of all, the factors of institutional nature that lead to the transformation of market processes, as well as methods of their identification by the criterion of the effectiveness of the economic system as a whole. Thus, according to T. Ostashko, «the difference between the methods of the theory of sectoral market structures from the methods of microeconomic theory is, on the one hand, greater coverage of market processes, and on the other – greater specification of institutional details» (final citation) [15, with. 130]. In this case, we agree that such a methodological approach provides significant advantages in the analysis of a representative market, especially in terms of its active institutional formation, where market imperfections (insufficient efficiency) may be associated with unregulated and unpredictable interaction of formal and informal market institutions.

The institutional approach is considered productive for assessing the effectiveness of markets, their structural elements and structural changes. After all, guided by this theory, in general, the market can be reflected as a system of institutions, both formal and informal, which provides a certain level of transaction costs, usually at the level of individual contracts. Accordingly, the efficiency of the market is due to the development of institutions, which is expressed in low transaction costs.

Domestic scientists believe that the high cost of market transactions in transition in Ukraine was significantly influenced by informal factors, among which the largest was the contribution of uncertainty of the future, which distorted the motives and behavior of market participants [16, p. 12]. On the other hand, it is emphasized that the primary reason for the high cost of

market transactions is that market transformations in Ukraine began and took place without a comprehensive government program, uncertainty of a consistent state policy to reform economic sectors and a transparent national market.

As you know, at the stage of formation of market institutions, the factors of transaction costs themselves are in the process of formation and can not as a functional factor to influence and thus ensure the efficiency of markets. That is, the instability of the institutional environment causes the inefficiency of markets. In particular, the high cost of transaction costs in the domestic market of Ukraine determines the orientation of market agents to short-term goals and adaptation to an inefficient institutional system instead of a long-term balanced development strategy, as well as the formation of new effective institutions and organizations. The latest trend in the growth of transaction costs of participants in national markets has been the process of integration into the WTO, the EU, namely – the growth of transaction costs, which are associated with the adaptation of goods to the requirements of international standards. That is, as we see, the theoretical schemes of institutionalism have a direct applied manifestation.

An important argument in favor of the application of the methodology of analysis of sectoral market structures in the study of market formation and development is a comprehensive approach that provides an analysis of the relationship between the structure and patterns of development of these markets. For this analysis of market structures it was advisable to use already tested approaches, for example in the works of O. Ostashko [15, p. 130–138]. Thus, the scheme of analysis of structural changes and market performance, which specifies the paradigm "structure → behavior → performance", can be implemented through a systematic approach, which is presented in Fig. 3. The above scheme shows that the functional impact on market performance has three hierarchical tiers. Thus, structural-institutional and behavioral characteristics are influenced by factors of two orders [14, p. 132]:

1) the so-called basic conditions (author's term), which determine the peculiarities of the formation of the relationship «supply and demand» in specific historical conditions;

2) the so-called background conditions (author's term) – government regulation, market infrastructure, the functionality of the monetary system and the place of the studied national market in the world system on the criterion of exchange equivalence, which, in turn, determine the marginal ratio of supply and demand. The term «basic conditions» in relation to factors influencing the market means the determinant role of the ratio of «supply and demand» in the functioning of any market, while the aspect of «background» conditions – that the market will exist under any, even very unfavorable conditions. inefficient – according to social criteria of perfection – state.

This logical reflection of causal relationships in the model of market functionality allows us to conclude that it is appropriate to carry out a systematic analysis of the market according to a certain algorithm.

The first stage of such analysis is the assessment of the basic structural conditions of the market, which characterize, on the one hand, the peculiarities of production and consumption of goods and services, and on the other - the specifics of the situation in Ukraine. It is under the influence of basic market conditions on the part of supply and demand are formed features of the structure of this market, the ratio of which is the main component of the market mechanism, which, in turn, is adjusted by the functional influence of other elements [17, p. 44].

The most influential system-forming element of the market is effective demand, absolute and relative indicators of its characteristics: the absolute size of household incomes and their dynamics, the value per capita, territorial and group differentiation. Regarding the proposal, the most influential basic market conditions determine the peculiarities of production of goods and services, which cause instability and lower than potential profitability of market participants in the case of institutional incomplete market formation, inefficient production, low technical and technological armament, as in Ukraine.

With regard to demand, the basic conditions of domestic markets include the specific dynamics of elasticity of demand for goods and services, which causes special price elasticity, linking demand to the physiological needs of the population (for example – in the case of vegetable market), limiting demand due to low purchasing power. unstable conditions of world markets, etc.

The second stage in the analysis of market structures is to determine the scale and methods of their state regulation, because it largely depends on the effectiveness of the market. It is well known that the influence of state policy on market structures can be due to investments, prices, production volumes through taxes, subsidies, tariffs, import quotas, antitrust policy and so on. Experience shows that the state can be quite an influential market player. In the realities of the market of the XXI century, declaring the goal of supporting producers and regulating markets, the state most often uses such tools as pricing policy, tax policy, budget support, soft loans. For Ukraine, the problem of creating sufficiently functional (effective) background conditions for the market is, as argued, primarily the difficulty of transforming public policy from administrative to market-oriented type.

The third stage of the analysis of market structures is the study of structural characteristics of the market, namely: quantitative characteristics of sellers and buyers; market differentiation; barriers to market entry; cost structures; level of vertical integration, from production to retail; diversification of production, etc. It should be noted that the analysis of market differentiation has a specificity, which is that along with product differentiation, market competitiveness, an important role is played by institutional differentiation, including market infrastructure, spatial differentiation of regional, national and foreign markets, as well as temporal differentiation, the development of market structures over time.



The next stage of the analysis is to determine the functionality of the legal field in which market participants operate, business environment, marketing strategies, investment in production and behavior of other market participants – intermediaries, consumers, the state.

In the general context of the issue, the behavior of market agents largely depends on the pricing strategy, which directly or indirectly relates to prices and pricing of goods and services. When studying the issues of market pricing, it is important to analyze fluctuations and price ratios, the main directions of which are: assessment of different prices for one type of product or product group; price variation over time; price variation in regions, zones; price discrepancy in individual sub-markets (public, cooperative, private); price variation in the case of purchase of goods by different socio-economic categories (income groups). The analysis of fluctuations and the ratio of prices is based on the scope of variation, which characterizes the gaps between the minimum and maximum prices for goods and indicates the differentiation of consumption.

In a market economy, market participants have the right to independently determine the price of their own products, as well as the right to determine it on the basis of agreement with consumers (buyers) when concluding sales agreements between them. This is what leads to price competition between manufacturers. Therefore, each of them seeks to sell their product, as well as

not only to preserve but also to expand their niche in the market to strengthen their position in it. By determining the level of price increase, it is possible to make predictions about the possibility of production and sale of better products based on the analysis of market conditions. Given the reality of this sale, you can decide to incur additional costs to improve product quality, leading to an increase in its cost. Interest in high-quality products is directly related to the growing demand in world markets in recent times.

The final stage examines the effectiveness of the market, which is based on an assessment not only in terms of production efficiency and resource allocation, but also in terms of employment and social justice, fair distribution of income among market participants. At this stage, the price parameters and the level of demand satisfaction in the domestic market are also studied.

In general, market conditions, the economic situation that has developed in the market at a particular time, can be assessed using a system of indicators that characterize certain aspects of its manifestation. For this purpose, a refined one by T. Dudar was proposed [18, p. 42] the author lists the criteria and indicators (Table 2). The latter are a logical reflection of the criteria for evaluating the market according to the author's methodology, which provides for the complexity of market requirements, which is a feature of the post-industrial market.

Table 2

**Market situation assessment system**

<i>Criteria</i>	<i>Indicators</i>
Offer	Dynamics, volume, structure, cost. Production and raw material potential. Elasticity.
Demand	According to the degree of satisfaction of needs, forms of origin, the state of the market and place of purchase. Concomitant consumption potential: market capacity of means of production, resources, services.
Structural and institutional characteristics of the market	The ratio of supply and demand. The ratio of markets for means of production and consumption parameters. Commodity structure of trade. The structure of sellers by forms of ownership and organizational forms. The structure of purchases: wholesale, retail. Regional market structure. Market distribution by small, medium and large businesses.
Market dynamics	Growth / decrease rates of sales, prices, inventories, profits.
Trends of oscillations, cyclicity	Coefficients of variation of sales, prices, inventories. Seasonal fluctuations, fluctuations in production volumes.
Regional features	Regional variation of supply and demand. Regional variation of the level of demand (per 1 person). Regional variation of the dynamics of the main parameters of the market.
Business activity	Portfolio of orders. Size and dynamics of transactions. Degree of capacity utilization.
Risks	Commercial, investment, credit risks. The risk of making production, logistics, sales, marketing decisions.
Market scale	Total sales of products (goods).

Source: author's interpretation of [18].

It is necessary to emphasize the role given by scientists and practitioners in the process of integration of Ukrainian markets into world ones. Recently, this has been manifested through Ukraine's accession to the

WTO, large-scale association programs with the EU, as well as other integrative processes. First of all, the issues of adaptation of national quality standards and marketing institutions to Western requirements of the

international market for product quality, access of foreign goods to the domestic market, as well as the possibility of gaining access to international product markets with competitive products are relevant. We believe that the economic content of this complex and lengthy process involves minimizing the negative effect of non-equivalent exchange, which has traditionally functioned domestic markets.

We envisage increasing the level of equivalence of market exchange through integration into world markets.

The process of building a predictive analytical model of the market under study should begin with a description of the already known model of its operation for 1990-2017. This was developed on the basis of the dynamics of a set of indicators, [1, p. 7].

The process of building the model includes a number of stages, the sequence of which is given in Fig. 2.

Such an econometric model describes the actual average for the "prehistory" trend of the process. It is assumed that through the time factor (t), it is possible to express the influence of all major factors, over time the accumulated action of major factors and their expression in the trend equation as a reflection of both the mechanism of patterns and trends. The real mechanism of influence on the value of the time series in the existing form is not taken into account.

Analytical trend equalization is a fairly common method of forecasting. Trend extrapolation can be applied only if the development of the phenomenon is well enough described by the constructed equation and the conditions that determine the development trend in the past do not undergo significant changes in the future. Under these conditions, extrapolation is performed by substituting in the trend equation the value of the independent variable t, which corresponds to the value of the forecast horizon.

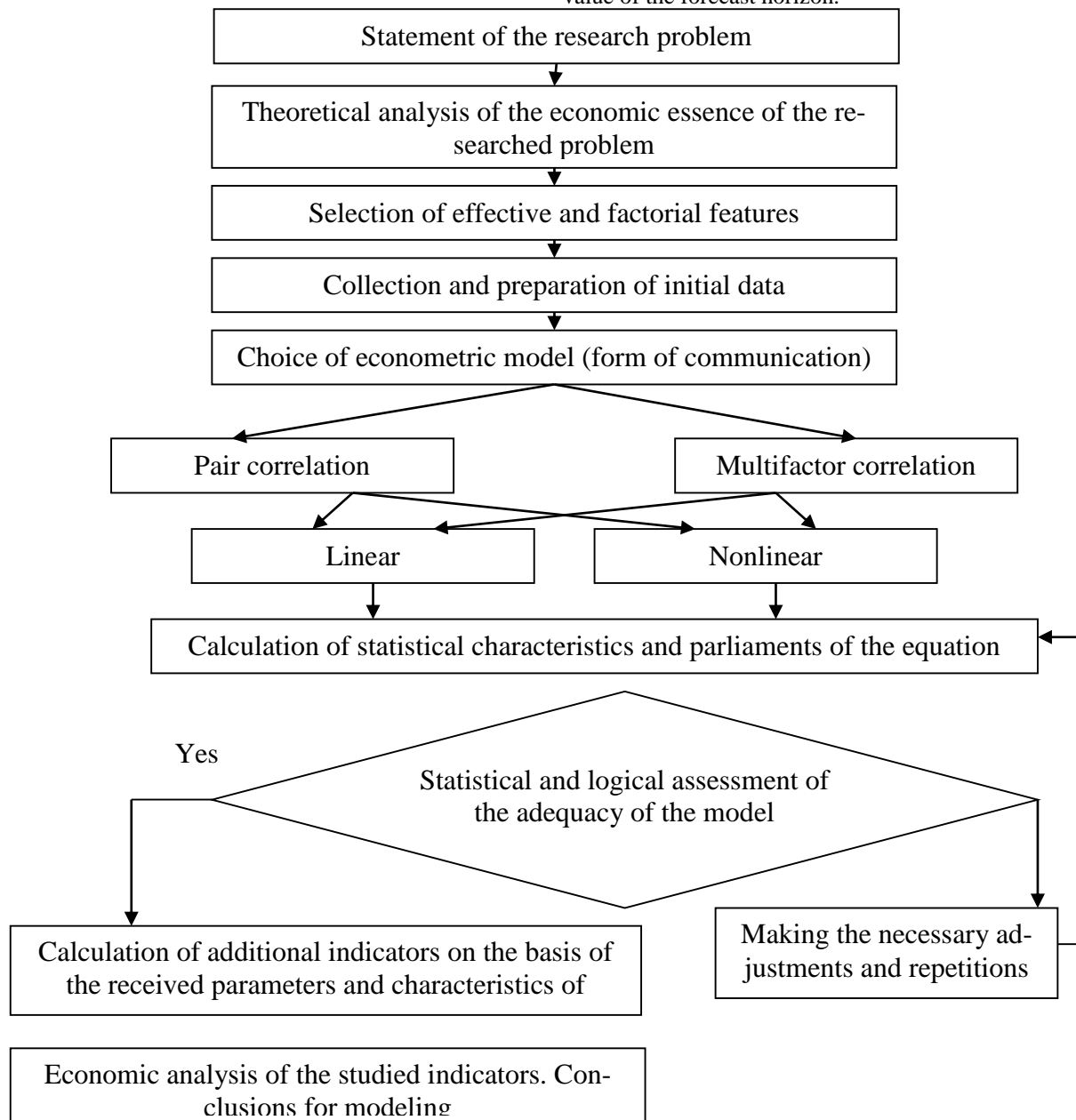


Fig. 2. Algorithm for building an econometric model

Source: author's research

$$\hat{y}_{t+p} = f(t_{n+p}), \quad (1)$$

where,  $p$  – is the value of the forecast horizon, ie the periods for which the forecast is made.

*Methods and models for assessing the quality of forecasts.* An important stage of forecasting is the verification of forecasts, assessing their accuracy and validity. At the stage of verification use a set of criteria, methods and procedures that make it possible to assess the quality of the forecast. The most common retrospective estimation of the forecast, estimation of the forecast for the past time.

To do this, the source information is divided into two parts, one of which covers earlier data and the other – later. With the help of the data of the first group (retrospection) the parameters of the forecast model are estimated, and the data of the second group are considered as actual data of the forecasted indicator. The retrospective forecast error obtained to some extent characterizes the accuracy of the applied forecasting technique.

All indicators used to analyze the quality of the forecast can be divided into three groups: absolute, comparative and qualitative. Absolutes are indicators that allow you to quantify the magnitude of the forecast error in units of the predicted object or as a percentage. These are the standard error  $\sigma$ , the absolute error  $Apr$ , the mean absolute error  $Dlf$ , the relative error  $epr$  and the mean relative error of the forecast  $epr$ .

Absolute forecast error can be defined as the difference between the actual value ( $y$ ) and the forecast ( $y^*$ ):

$$\Delta_{np} = y_t - y^*. \quad (2)$$

The average absolute value of the error will be:

$$\bar{\Delta}_{np} = \sqrt{\frac{\sum_{t=1}^n (y_t - y_t^*)^2}{n}}. \quad (3)$$

The standard error of the forecast is calculated by the formula:

$$\sigma_t = \sqrt{\frac{\sum_{t=1}^n (y_t - y_t^*)^2}{n}}. \quad (4)$$

It should be noted that for a large class of statistical distributions there is a relationship between the mean absolute deviation and the standard deviation, which can be represented as:  $\sigma_e = 1,25 \cdot \bar{\Delta}_{np}$ .

The disadvantage of these indicators is that the value of these characteristics significantly depends on the scale of measuring the levels of the studied phenomena.

Absolute forecast error  $\varepsilon_{np}$  can be expressed as a percentage of the actual values of the indicator as follows:

$$\varepsilon_{np} = \frac{y_t - y_t^*}{y_t} \cdot 100, \quad (5)$$

and the average relative error (approximation error) is calculated as:

$$\bar{\varepsilon}_{np} = \frac{\sum_{t=1}^n |y_t y_t^*|}{n} \cdot 100. \quad (6)$$

This metric is typically used to compare the accuracy of forecasts of disparate forecasting objects. Typical values for medium-term forecasts and their interpretation are given in table 3.

Table 3

#### Forecasting and interpretation data

$\varepsilon_{np}$	Interpretation
<10	High accuracy
10-20	Good accuracy
20-50	Satisfactory accuracy
>50	Unsatisfactory accuracy

Source: author's research

The mean absolute and root mean square errors record the mean value of the error at each forecast state without taking into account this error. The average error allows you to determine which type of error is the most common – underestimation or overestimation of the forecast. It should be borne in mind that  $\varepsilon_{np}$  equal to zero only when  $y_t = y^*$  for each  $t$ , in the case of a perfect prediction. A similar statement is unfair to an absolute error, because there can be mutual compensation of errors. Both absolute values of variables and their increments can be used to calculate these indicators.

Comparative indicators of forecast accuracy are based on the comparison of the error of the considered forecast with the reference forecasts of a certain type.

One of the types of such indicators ( $K$ ) can be generally presented as follows:

$$K = \sqrt{\frac{\sum_{t=1}^n (p_t - y_t)^2}{\sum_{t=1}^n (p_t^* - y_t)^2}}, \quad (7)$$

where,  $p^*$  – the predicted value of the reference forecast.

Simple extrapolation, simple growth rate, etc. can be chosen as a reference forecast.

A special case of indicators of this type is the mismatch coefficient, in which  $p^* = 0$  for all types:

$$KH = \sqrt{\frac{\sum_{t=1}^n (y_t^* - y_t)^2}{\sum_{t=1}^n y_t^2}} \quad (8)$$

You can build various modifications of the mismatch coefficient, namely: 1. The mismatch coefficient (KH1) is calculated as the ratio of the standard error of the forecast to the same error that would occur if we take as a forecast for each year the average value of the variable for the whole period:

$$KH_1 = \sqrt{\frac{\sum_{t=1}^n (y_t^* - y_t)^2}{\sum_{t=1}^n (\bar{y} - y_t)^2}} \quad (9)$$

If  $KH_1 > 1$ , then the forecast at the level of the average value would give a better result than the obtained forecast.

2. The discrepancy factor V is the ratio of the standard error of the forecast to the same error that would occur if we take as a forecast for each year the value aligned with the analytical trend

$$V = \sqrt{\frac{\sum_{t=1}^n (y_t^* - y_t)^2}{\sum_{t=1}^n (y_t - \bar{y}_t)^2}} \quad (10)$$

where  $\bar{y}_t$  – extrapolating the value of the studied value at the time t.

If  $V > 1$ , then the prediction by simple extrapolation gives the best result.

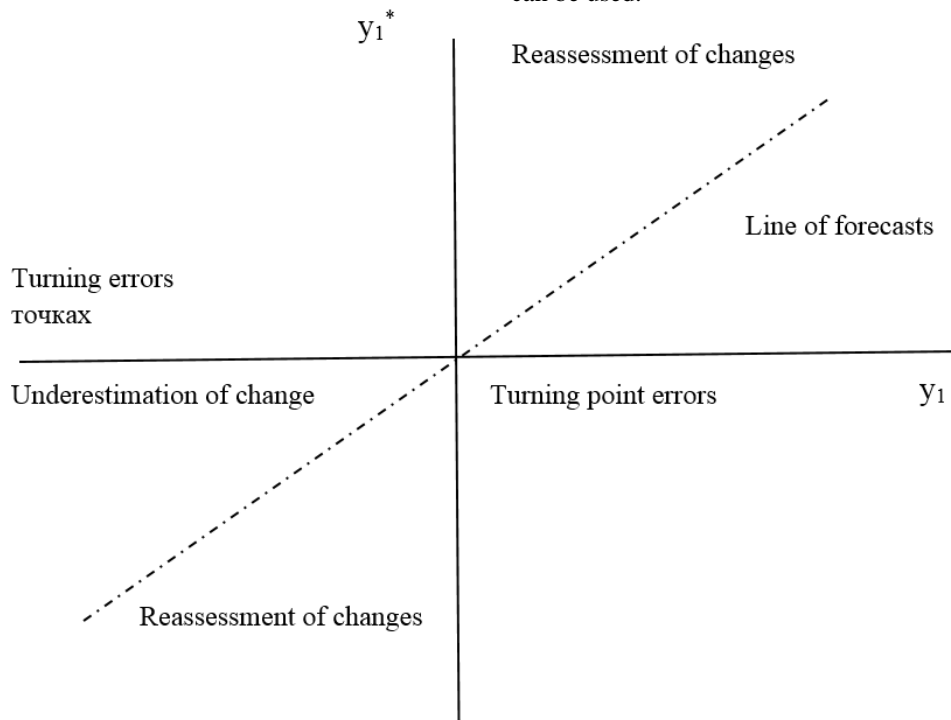
The comparative indicators include the correlation coefficient between the predicted and actual values of the variable R:

$$R = \frac{\frac{1}{n} \sum_{t=1}^n (y_t^* - \bar{y}_t^*) (y_t - \bar{y})}{\sqrt{\frac{1}{n} \sum_{t=1}^n (y_t^* - \bar{y}_t^*)^2 \cdot \frac{1}{n} \sum_{t=1}^n (y_t - \bar{y})^2}} \quad (11)$$

One of the disadvantages of using a correlation coefficient as a measure of the accuracy of predictions is that a complete positive correlation only indicates the presence of a linear relationship between a number of predictive and actual values. As a result, the correlation coefficient is most suitable for analyzing the predictions of cyclically evolving variables.

Qualitative indicators of forecast accuracy allow to analyze the types of forecast errors, to divide them into components. Such an analysis is especially important for cyclically variable variables, when it is necessary to predict not only the general direction of development, but also the turning points of the cycle.

One of the methods of such analysis is the «forecast – implementation» diagram. The essence of the method is to construct point predictions in coordinates in which on one axis the real value of the variable is plotted, on the other its predicted value (Fig. 3). The use of the diagram allows to evaluate the quality of different forecasts, to calculate the coefficients that analyze the quality of turning point forecasting, to identify the most common errors (underestimation or overestimation of changes). To analyze more general types of forecast errors, their classification by sources of origin can be used.



$y_1$  – actual values of variables;  
 $y_1^*$  – prognosis.

Fig. 3. Diagram «forecast – implementation»

Source: author 's research using approaches to estimating forecast error by [19]

G. Tale divided the forecast error into fractions of discrepancy: the fraction of the shift ( $V^\mu$ ), the proportion of variance ( $V^s$ ) and the share of covariance ( $V^k$ ) [19].

$$V^\mu = \frac{(\bar{y}_t^* - \bar{y})^2}{\frac{1}{n} \sum_{i=1}^n (y_t^* - y_i)^2}; \quad (12)$$

$$V^s = \frac{(\sigma_y^* - \sigma_y)^2}{\frac{1}{n} \sum_{i=1}^n (y_t^* - y_i)^2}; \quad (13)$$

$$V^k = \frac{2(1-R)\sigma_y^*\sigma_y}{\frac{1}{n} \sum_{i=1}^n (y_t^* - y_i)^2}. \quad (14)$$

The share of the shift indicates the presence of an error in the assessment of the central trend,  $V^\mu > 0$ , when the arithmetic mean of the forecasts differs from the arithmetic mean of the actual data. In the «forecast – implementation» diagram, the absence of this error means that the center of gravity of point forecasts lies on the line of forecasts.

The part of the variance reflects the degree of coincidence of the standard deviations of the forecast and the actual values.  $V^s = 0$  in the event, that  $a = 0$ . Thus, this indicator reflects the correspondence, the degree of instability of the predicted values of the degree of instability of the actual dynamics.

The share of covariance  $V^k$  is zero when the correlation coefficient is equal to one between the predicted and actual values. On the «forecast – implementation» diagram, this corresponds to the case when all points lie on one line.

All of the above indicators of forecast accuracy are used to verify the accuracy of the forecast obtained in the form of point estimates. If the forecast is an internal forecast, the measure of accuracy of the forecast can be considered the relative number of cases to the total number of cases (15): if  $\eta = 1$ , then all predictions are confirmed;  $\eta = 0$  they are not confirmed.

$$\eta = \frac{p}{p+q}, \quad (15)$$

where,  $p$  – is the number of forecasts confirmed by actual data;

$q$  – is the number of forecasts that are not confirmed by actual data.

The above indicators of forecast accuracy can be used only if there is information about the actual values of the studied indicator. All of them are of great value when comparing different forecasting techniques.

If such data are not available, then the problem of accuracy can be considered as a comparison of a priori qualities and properties with the inherent alternative prognostic models. Thus, when forecasting by statistical methods, the concept of a priori accuracy of the forecast can be related to the size of the confidence interval. In this case, the forecast model is considered more accurate if at the same confidence level it has a narrow confidence interval.

The choice of indicators of forecast accuracy depends on the plans set by the researcher in the analysis of forecast accuracy. The quality of forecasts obtained by different methods and models can be judged only by a set of comparisons of forecasts and their implementation.

The implementation of the above intellectual complex was carried out through a mathematical interpretation of the efficiency of the vegetable market in Ukraine for 1990–2019 on the basis of the author's methodological approach to describe such efficiency according to the «market formula». Accordingly, the efficiency of the market ( $Y$ ) was evaluated in relative units (from 0.0 to 1.0 units), as well as all components ( $x_1 \dots x_5$ ). The expression of this was the following regression equation (16):

$$Y = -0,328 + 0,083x_1 + 0,204x_2 + 0,118x_3 + 0,122x_4 + 0,169x_5 \quad (16)$$

де,  $x_1$  – the ratio of supply to demand;

$x_2$  – state regulation;

$x_3$  – the state of the competitive environment;

$x_4$  – market infrastructure;

$x_5$  – monetary system;

$Y$  – general state of the market.

The correlation coefficient was 0.98 in. from (ie the connection was very tight), the model is adequate (F criterion was 145 and its significance was 6.84E-14). For the last three years, the forecast was determined by the model and compared with the calculated data (Table 4).

Table 4

**Forecast indicators based on the representative market model**

Calculated values	Forecast	Absolute forecast error	The average absolute value of the error	Total absolute forecast error
0,0464	0,05028	-0,0039275	2,1382E-05	-8,473226905
0,0452	0,04582	-0,000664	1,8511E-06	-1,470457968
0,0346	0,02791	0,0066812	3,5816E-05	19,31473901
			5,9049E-05	
Average		0,00069655	0,00443657	3,123684712

Source: author's research

Thus, the model can be recognized as suitable for predicting and predicting values in assessing the effectiveness of a representative market.

Graphical representation of the model is shown in Fig. 4.

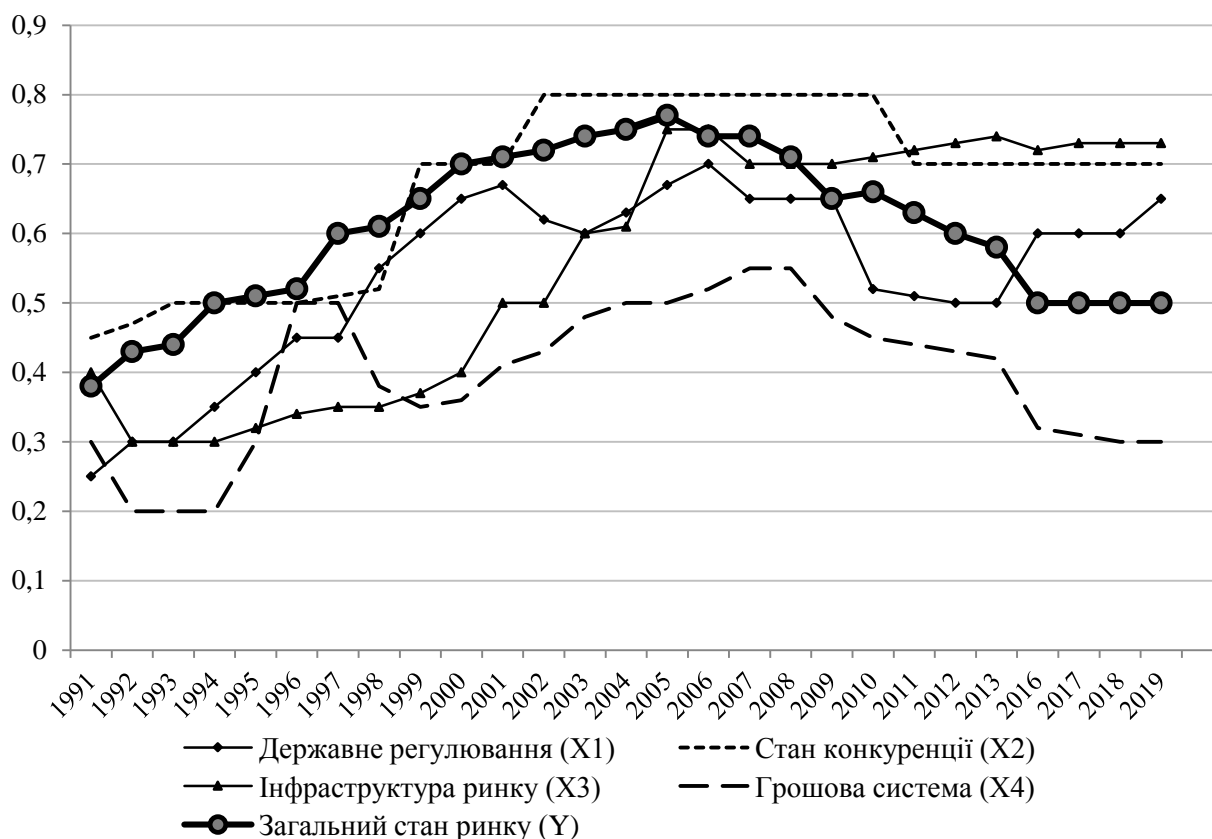


Fig. 4. Evaluation of the efficiency of the vegetable market in Ukraine for 1990-2019, relative units

Source: author's research according to the methodology, methodology and mathematical apparatus of evaluation proposed by the author

According to most trends (see Fig. 2), both the market and its functional components can be characterized by a fairly bright positive dynamics during the 90's and in general the achievement of the most favorable situation by 2010; In the future, the state of the market did not improve dramatically, and in some positions even worsened after the political events of 2014.

At the same time, the most destabilizing effect, obviously, historically in this period of time was demonstrated by the factor of national monetary policy. In our opinion, the positive trends in the market were almost primarily due to the strengthening of the monetary system in 1995-1996 and 2000-2008; in turn, with a diametrical orientation, the market has suffered serious shocks due to financial crises and the inability of the domestic monetary system to perform the necessary functions.

The special role of such components as infrastructure and competitive environment for the studied market should be emphasized. In the first case, the market for a relatively short period has formed a sufficient functional infrastructure as a whole; it should be added that since the times of the former USSR, a significant part of the infrastructure of production and sale of vegetable products has been quite effectively implanted in new market mechanisms. On the other hand, the dissertation has already emphasized the positive historical role of the fact that since the early 90's the Ukrainian vegetable market has been influenced by the highly competitive and generally functional economic environment against the background of high socialization

and – on the contrary – very low role of oligarchic monopolization. in all its aspects [20-21].

A similar general graphic orientation of the trend of the functionality of regulatory policy in the industry, however, has its own specification, which at the same time may have conflicting interpretations. Thus, as already noted, this market (unlike other markets for agricultural products) has again historically been formed since the early 1990s under the influence of very limited regulations. This factor obviously had critical limitations only at the beginning of market reforms. Later in the industry there was a global effect of the actual leveling of any state support on the one hand and the refusal of the government to control (including significant tax pressure) – on the other. Obviously, this example can be considered as confirming the profitability of such a model of development and regulation, including (unlike others in Ukraine). According to our estimates, the regulations lost some functionality after 2010 and further after 2014 due to purely political processes.

If we summarize the above information, we can say that this model outlines the critical limitations of the existing model of the market, which in generalized form are as follows:

1) critical environmental dysfunctions due to the lack of economic interpretation of soil fertility losses in Ukrainian vegetable growing;

2) insufficient level of functionality of almost all components of the market, especially infrastructure, monetary policy, supply and demand (low purchasing power of the population, insufficient supply efficiency,

low wages and incomes of recipients, etc.), regulatory policy, etc.;

3) minimization of market value due to the low level of realization of the industry's potential, insufficient domestic demand, lack of access to foreign markets.

Hence, the directions of modernization must somehow start from certain market imbalances.

**Conclusions.** The author's position was based on the assumption of the possibility of developing a methodology for studying the dynamics, individual types, market models and market structures, which should be taken into account in order to achieve targeted and effective management of market development.

To determine the dynamics of the market, a "matrix of market dynamics" has been developed, which provides an interpretation of the main vectors of change in the state of these objects in terms of quantitative and qualitative transformations. Determining the state of the market is important, first of all, in terms of forecasting the movement of the real market to a better state, where, given the dialectical law of interdependence between quantitative and qualitative changes, only two alternatives to the vector of change.

The intellectual elements of the methodology used in the research process, such as the systems approach, provide a fairly complete picture of the direction and geometry of possible market dynamics, which in turn is a well-argued methodology for predicting favorable development models. This logical reflection of causal relationships in the model of market functionality allows us to conclude that it is appropriate to carry out a systematic analysis of the market according to a certain algorithm.

The proposed model of assessing the market of vegetable products in Ukraine outlines the critical limitations of the existing model of the market, which in general are critical environmental dysfunctions, insufficient functionality of almost all market components and minimization of market value due to low industry potential, insufficient domestic demand, lack of access to foreign markets.

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