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**ECONOMETRIC MODELING IN
FORMATION OF OPTIMAL PRICE FOR
IMPLEMENTATION OF
AGRICULTURAL PRODUCTS[©]**

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The relevance of the research topic is due to the fact that recently prices for agricultural products and in particular fish, meat and especially vegetables in Ukraine, show considerable instability and variability, and predicting the price on the basis of such data is difficult enough.

It is well known that in market conditions the price level is determined by the ratio of the demand and supply. At the same time, in conditions of the modern agricultural market, imperfect and not efficient enough, the price of agricultural products is significantly influenced by farm factors, which prevent agricultural commodity producers from developing the maximum possible selling prices for finished products. Recently, the situation on the vegetable market has changed: the demand and supply sharply reduced, rates of decline in demand become prevailing, and in particular due to a significant increase in prices. At the same time, many types of scarce vegetable products have become over-saturated. The decrease in the demand for vegetable products is primarily due to the decrease in household incomes, as

well as the increase in taxes and other payments, with a limited ability to export products. The article substantiates that the AGMEMOD Model allows to simulate and predict the diversity of political scenarios for both Ukraine and the EU; dependence of demand and supply of vegetable production on the prices of their sale is investigated; on the basis of econometric modeling the point of equilibrium of supply and demand is determined; based on the obtained dependencies, determined the optimal price of selling vegetables in Ukraine; the optimal cost per hectare of vegetable production in Ukraine is substantiated.

Keywords: demand, price, supply, econometric modeling, market, agricultural products, approximation, equilibrium, costs

Tabl.: 4. Fig.: 2. Lit. 15.

ЕКОНОМЕТРИЧНЕ МОДЕЛЮВАННЯ В ФОРМУВАННІ ОПТИМАЛЬНОЇ ЦІНИ РЕАЛІЗАЦІЇ ПРОДУКЦІЇ СІЛЬСЬКОГО ГОСПОДАРСТВА

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Актуальність тематики дослідження зумовлена тим, що останнім часом ціни на сільськогосподарську продукцію, і зокрема рибу, м'ясо і особливо овочі в Україні демонструють значну нестабільність і варіативність, і спрогнозувати ціну на основі таких даних досить складно.

Загальновідомо, що у ринкових умовах рівень ціни визначається співвідношенням попиту і пропозиції. Разом з тим, в умовах сучасного аграрного ринку, недосконалого і недостатньо ефективного, на ціну сільськогосподарської продукції значно впливають внутрішньогосподарські фактори, які не дають змоги сільськогосподарським товаровиробникам формувати максимально можливі ціни реалізації на вироблену готову продукцію. Останнім часом на ринку овочевої продукції змінилася ситуація: різко скоротилися попит і пропозиція, переважаючими стали темпи зниження попиту, і зокрема за рахунок значного зростання цін. Одночасно по багатьох видах овочевої продукції із дефіцитного ринок перетворився у перенасичений. Зменшення попиту на продукцію овочівництва зумовлено передусім зниженням доходів населення, а також зростанням розмірів податків та інших платежів, обмеженою можливістю експорту продукції. Метою дослідження є розвиток науково-методичних засад, розроблення практичних рекомендацій щодо прогнозування оптимальних цін на овочі та витрат на їх вирощування на основі статистичної інформації та використання економетричних методів та моделей.

Ключові слова: ціна, попит, пропозиція, економетричне моделювання, ринок, сільськогосподарська продукція, апроксимація, рівновага, витрати.

Tabl.: 4. Рис.: 2. Літ.: 15.

ЕКОНОМЕТРИЧЕСКОГО МОДЕЛИРОВАНИЯ В ФОРМИРОВАНИИ ОПТИМАЛЬНОЙ ЦЕНЫ РЕАЛИЗАЦИИ ПРОДУКЦИИ СЕЛЬСКОГО ХОЗЯЙСТВА

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Актуальность тематики исследования обоснована тем, что последнее время цены на сельскохозяйственную продукцию, в частности на рыбу, мясо и особенно на овощи в Украине демонстрируют ощутимую нестабильность и вариативность, и спрогнозировать цену на основе таких данных очень сложно.

Общезвестно, что в рыночных условиях цены определяются соотношением спроса и предложения. вместе с тем, в условиях современного аграрного рынка, несовершенного и неэффективного, на цену сельскохозяйственной продукции значительно влияют внутренне

производственные факторы, которые не дают возможности сельскохозяйственным товаропроизводителям формировать максимально возможные цены на произведенную готовую продукцию. В последнее время на рынке овощной продукции изменилась ситуация: резко уменьшились спрос и предложение, преобладает темп уменьшения спроса, и обосновывается это значительным увеличением цены. Одновременно по многим видам овощной продукции из дефицитного рынок превратился в избыточный. Снижение спроса на продукцию овощеводства обусловлено прежде всего снижением доходов населения, а также увеличением размера налогов и других платежей, ограниченной возможностью экспорта продукции. целью исследования является развитие научно-методических приёмов и практических рекомендаций относительно прогнозирования оптимальных цен на овощи и затрат на их производство на основе статистической информации и использования эконометрических методов и моделей.

Ключевые слова: цена, спрос, предложение, эконометрическое моделирование, рынок, сельскохозяйственная продукция, аппроксимация, равновесие, затраты.

Табл.: 4. Рис.: 2. Лит.: 15.

Problem statement. Ukraine is predominantly an agrarian country, and the industry has been showing high efficiency in recent times. The level of profitability of enterprises of agriculture, forestry and fisheries in 2017 amounted to 22.7 percent against 8.9 percent of the total economy of Ukraine. Enterprises of the industry received almost 79.1 billion UAH of net profit, which is the highest indicator among all types of economic activity and almost 25 billion USD more than the profit of industry.

Agriculture provided 43.5% of the net profit of all Ukrainian enterprises. In this case, 86.1% of the enterprises of agriculture, forestry and fishery received profits against 72.5% of the total economy.

According to the experts of the agrarian market, under the appropriate climatic conditions, humidity and soil condition, the growing of vegetables is initiated by itself. In addition, the geographical location literally "shouts" about the need to create a competitive local market with an export orientation. This is the neighborhood with the huge European market and Poland, which was able to become a regional leader in growing fruit crops, and access to the sea for long-haul supplies (especially to the Middle East and North Africa). National and international experts call Ukraine one of the world's foremost food producers, along with the United States, Canada, Russia and Belarus. However, for almost 28 years of independence, at least close to this potential is still not possible.

There are several reasons why we still cannot reach the leaders and they can be divided into two groups. The first group - the reasons of the general nature, which affect not only vegetable growing, but also other segments of the agro-industrial complex. Vegetable production is a specific branch of plant growing, which includes a large selection of vegetable crops grown under different technologies, with different shelf life of vegetable products, with different cost and efficiency of its production.

The analysis of the situation on the vegetable market of Ukraine has shown that there is a certain correlation between the volumes of production, sales and the price of products sales. The price situation of the vegetable market in recent years is largely determined by the ratio of the demand and supply in the market. Thus, sales volumes grow when the supply in the market is highest and the level of prices in the market is set to the lowest.

Lack of constantly operating wholesale sales channels also leads to an increase in the shadow market of vegetable products. According to experts from the Ukrainian Agrarian Confederation, the shadow market for vegetables and fruits is about \$ 14 billion, or about 60% of the total turnover of vegetable products in Ukraine.

Lack of land market. Because of the moratorium on the sale of agricultural land, enterprises are not able to independently buy land and develop business in the long run. The fact that Ukraine remains a country without a land market, along with Cuba, Venezuela, Tajikistan and the Congo, speaks for itself. Without settling land ownership rights in Ukraine, we cannot talk about any prospects in agriculture at all.

Economic crisis in the country. Of course, the crisis is a complex concept, but if we talk directly about the development of enterprises, then the main aspect of it is the lack of affordable lending. Today, the NBU is forced to keep the rate high in terms of inflation targeting, and therefore any factor that can lead to price increases will automatically affect the potential for attracting credit resources.

The second consequence of the economic crisis was a sharp devaluation of the national currency and, as a consequence, a rise in the cost of growing vegetables. It is about equipment for planting, collecting and storing, and directly seed and plant protection products, which are mainly imported in Ukraine.

Lack of proper state support. Under normal conditions, a business must develop independently, but the agrarian sector is rather an exception, since it is a key to determining the country's food security. Therefore, state subsidies to agrarians cause hot discussions every year. For today, state support in the vegetable growing

segment is limited to preferential lending and individual financing programs, often in cooperation with international donors. Much of the support of the AIC goes to producers of cereals and legumes, which significantly limits the possibility for the development of producers of crops with higher marginality.

As for directly highly specialized factors, they are largely the result of the actions of the first factors. However, their understanding is necessary to form a coherent picture of the market and steps to bring vegetable growing from a deep stagnation.

The purpose of this study is to analyze the price of vegetable sales in Ukraine and determine the optimal price according to demand and supply, as well as optimal costs for vegetable production.

We used the following methods of research and forecasting prices in the market of vegetables in the process of research: analysis, synthesis and scientific abstraction (in the study of the categorical-conceptual apparatus); comparative analysis (when considering the main theoretical concepts explaining the behavior of prices in the product markets); technical and fundamental analysis (when studying methods of forecasting prices in the product markets); correlation analysis (in the study of the mutual impact of economic indicators); method of expert assessments (when developing scientific and methodological bases of forecasting); statistical analysis (when assessing the response of the food markets to changes in the price of vegetables).

Analysis of recent research and publications. Modern theory of pricing policy at the enterprise is developed under the influence of scientific concepts of different economic schools. Significant influence of pricing of agrarian formations was made by such world scientists as V. Petty, D. Ricardo, A. Smith, but they were more deeply investigated in the works of E. Engel, S. Maxwell, L. Mises, M. Tracy. Among the domestic scientists should note the work of Yu.P. Voskobynika [1], OV Kopystko [2], NM Khizha [3], T.A. Shubotovych [4], S.A. Stasinevich [5], I.I. Red [6], O.G. The pestle [7]. It is determined that the most important component of stimulating agrarian business is price. The price of agricultural products determines the economic interest of producers in the production of products, indirectly determines the financial result of management, encourages social responsibility, stimulates the growth of labor productivity of workers; introduction of innovations.

The conditions in which the agrarian sector operates have a high degree of volatility uncertainty, and this circumstance requires agricultural producers to find ways to obtain reliable information about the state of the agricultural market, organizational and functional links between the subjects of the agricultural market, prices for agricultural products. etc. [9].

Formulation of the problem. The purpose of this study is to:

- price analysis of the sale of vegetables in Ukraine;
- substantiation of the use of the AGMEMOD partial equilibrium model for forecasting vegetable production in Ukraine;
- determining the dependence of the demand and supply of vegetables on the price of their sale;
- determination of the point of equilibrium of supply and demand and calculation of the optimal selling price of vegetables in Ukraine;
- to justify the optimal costs of vegetable production.
- analysis of the price of selling vegetables in Ukraine and determining the optimal price according to supply and demand, as well as the optimal cost of production of vegetables.

We have used the following research and forecasting methods for the vegetable market during the research process: the analysis, synthesis and scientific abstraction (in the study of categorical-conceptual apparatus); the comparative analysis (when considering the basic theoretical concepts that explain the behavior of prices in food markets); the technical and fundamental analysis (in the study of methods for forecasting prices in food markets); the correlation analysis (in the study of the mutual influence of economic indicators); the method of expert assessments (in the development of scientific and methodological principles of forecasting); the statistical analysis (in assessing the reaction of food markets to change the price of vegetables).

Consequently, based on economical modeling, we will determine the optimal price of vegetables in Ukraine and optimal costs for their cultivation, namely: material costs, labor costs and depreciation costs per hectare of vegetable sowing.

Presenting main material. The vast majority of Ukrainian vegetables are grown by households and are bought up by traders and processors. According to the State Statistics Service, enterprises grow less than 4% of vegetables in Ukraine. On the one hand, this is explained by the fact that a full-fledged farm that grows and stores vegetables has a high entrance threshold. To buy the same finished product from the population easier, removing the costs of maintaining employees and directly land lease. However, on the other hand, it does not increase the productivity of production, and large enterprises simply will not appear.

Low seed market development. According to profile associations, 96.7% of vegetable seeds certified in Ukraine are of Dutch origin. The share of Ukrainian hardly exceeds 3%. It is clear that in households not all seeds are certified, which is reflected in the shadow of the market. At the same time, the development of the local market of seeds remains critical for the domestic needs of the vegetable sector of the agro-industrial complex, and the fact that the vast majority of seeds are imported confirms the weak technological development of the market.

Lack of modern storage, packaging and transportation technologies. This problem rests on the problems caused by the economic crisis in Ukraine. The continued lack of incentives for the development of the industry has led to the fact that the equipment for vegetable growing is not produced in Ukraine and it should be imported. Absence of long-term planning on the market and devaluation of the hryvnia also plays a role. In addition, since vegetables are perishable, they cannot be transported over long distances, not to mention exports.

The result of the influence of these factors was the lack of market leaders - large enterprises with a complete complex of vegetables and products processing. However, such companies should set the tone for the entire market and create competition, which is the engine of the market development.

If we talk about indicators of the market development for vegetables in Ukraine, then it has developed - not so much thanks just contrary to all these factors. To date, in Ukraine there are 12 key vegetable crops. These are potatoes, cucumbers, tomatoes, cabbage, beets, carrots, onions, garlic, peppers, zucchini, eggplant and pumpkin. Of these 12 cultures, 9 showed growth in the period 2010-2016. Even without taking into consideration uncontrolled Crimea and Donbass. This growth was secured by two key factors:

- increase in yield. This was made possible by improving the quality of seed material and natural technological progress in the processing and application of plants protecting tools.
- increase in export demand for products. Demand, for example, in Ukrainian carrots and onions grew, and therefore the opportunities for cultivation became more [8].

Price is a complex economic category, practically the only element of marketing, which enables the company to get real income. Without a proper economic justification of the price level, the normal functioning of economic entities and entire branches of the economy is impossible, which in turn has a significant impact on the material well-being of the population. At the same time, the level of the market price depends on the value of other elements of marketing, as well as the level of competition in the market and the general state of the economy. Typically, other marketing elements also change (for example, with increasing product differentiation in order to maximize the price or, at a minimum, the difference between price and cost).

The conditions in which the agricultural sector is functioning have a high level of variability and uncertainty, and this circumstance requires producers of agricultural products to find ways to obtain reliable information about the condition of the agricultural products market, organizational-functional connections between the economic market entities, prices of agricultural products, etc [2].

The main goal of the pricing strategy in a market economy is to obtain maximum returns for the planned sales volume. The pricing strategy should ensure long-term satisfaction of the needs of consumers by optimally combining the internal strategy of enterprise development and the parameters of the environment.

Consequently, when forming a pricing strategy, each business must determine its main goals for itself. This can be a maximum of revenue, sales volumes or a certain level of competitiveness while ensuring relative profitability.

The price strategy consists of a pricing strategy and the strategy of prices management.

The pricing strategy allows you to determine the price level and marginal prices for individual product groups. Pricing should always be made taking into consideration the nomenclature and quality of products, its usefulness, significance and purchasing power of consumers and competitors' prices.

The strategy of price management is a set of measures to support the conditional prices in their actual regulation in accordance with the diversity and characteristics of demand, competition in the market.

The price method of regression is found in determining the empirical formulas of price dependence on the value of certain quality parameters. At the same time, the price P acts as a function of several parameters.

This method allows to model the price changes depending on the set of parameters and use the regression equation to calculate the prices of goods included in this parametric series. As a result, the interconnected system of commodity prices is formed.

The choice of a model for the agrarian sector depends on the purpose and tasks of the modeling.

The AGMEMOD model is an example of partial equilibrium (PE) models used in agriculture. Main advantages of partial equilibrium models are simplicity of implemented algorithms, which work is easy to

trace; relative availability of necessary data; calculations are subjected to adequate economic interpretation, provide an opportunity to quickly analyze consequences of a decision adoption in the agrarian sector. However, models of partial equilibrium have some disadvantages. In particular, they do not make it possible to assess macroeconomic effects, such as changes in national income or employment rates, the effects that can be derived from the redistribution of resources (labor, capital, etc.) into more efficient sectors. Application of the models of partial equilibrium allows us to investigate the processes of the agricultural sector functioning, neglecting the influence of other sectors of the economy [3]. Accordingly, the use of such tools is possible if the sectorial changes are weakly influenced by other sectors of the economy. AGMEMOD models can be very useful for a detailed study of many specific factors affecting the behavior in a specific market, especially when the influence of these factors does not affect other sectors. These models include diversified political variables and serve to study the effects of their change.

For domestic researchers, it is expedient to use these models, because they have a Ukrainian module [8], but it is necessary to supplement the program's filling with vegetable statistics.

The economic system, which can be formalized based on at least one nonlinear element, is called a linear dynamic system.

Nonlinearity of dynamical systems is characterized by uneven dynamics processes. At the same time, the process at some stage can be uniformly increasing, and in the future go into a state of uniformly decreasing quantities.

Let's consider the process of forming demand and supply for a specific type of product.

We will assume that a number of actual prices per 1 ton of vegetables (UAH) has been observed over the past 15 years and is shown in Table 1.

Table 1

A number of actual prices for 1 ton of vegetables, UAH.

No. of time period	1	2	3	4	5	6	7	8
actual price	1012,7	1225	1462,1	1547,4	1995,4	2059,9	1790	2551,6
No. of time period	9	10	11	12	13	14	15	
actual price	2139,1	1956,6	2354	2514,3	3903,4	3924,2	4136,1	

Source: own research

Theoretical formalization of price dynamics can be obtained based on approximation methods.

The chart describes the function of the form:

$$P(t) = f(t),$$

$$\text{or } f(t) = 197,68 \cdot X + 723,32$$

$$R^2 = 0,821$$

The model was obtained in Excel spreadsheets for the "Data Analysis" add-on.

Analysis of results. The correlation ratio is calculated as 0.91 - the connection between the indicators on the Chaddock scale is very strong, the determination coefficient is 82.1%, which indicates a variation in the selling price by 82.1% determined by the change in the year, and the rest by other factor. Testing the model for F-criterion adequacy by Fischer showed that the calculated value of the 59.6 criterion is much larger than the table one and is therefore adequate. The influence of unaccounted factors is estimated at 723.3 UAH and each year the price increases by an average of 197.68 UAH per ton.

By the received polynomial of the first degree, we find the theoretical distribution of prices for vegetables (table 2).

Table 2

Theoretical and actual prices for vegetables, UAH per ton

No. of time period t	1	2	3	4	5	6	7	8
Actual price $P(t)$	1012,7	1225	1462,1	1547,4	1995,4	2059,9	1790	2551,6
Theoretical price $P^*(t)$	921	1118,68	1316,36	1514,04	1711,72	1909,4	2107,08	2304,76
No. of time period t	9	10	11	12	13	14	15	
Actual price $P(t)$	2139,1	1956,6	2354	2514,3	3903,4	3924,2	4136,1	
Theoretical price $P^*(t)$	2502,44	2700,12	2897,8	3095,48	3293,16	3490,84	3688,52	

Source: own research

The graph of actual and theoretical prices is shown in Figure 1.

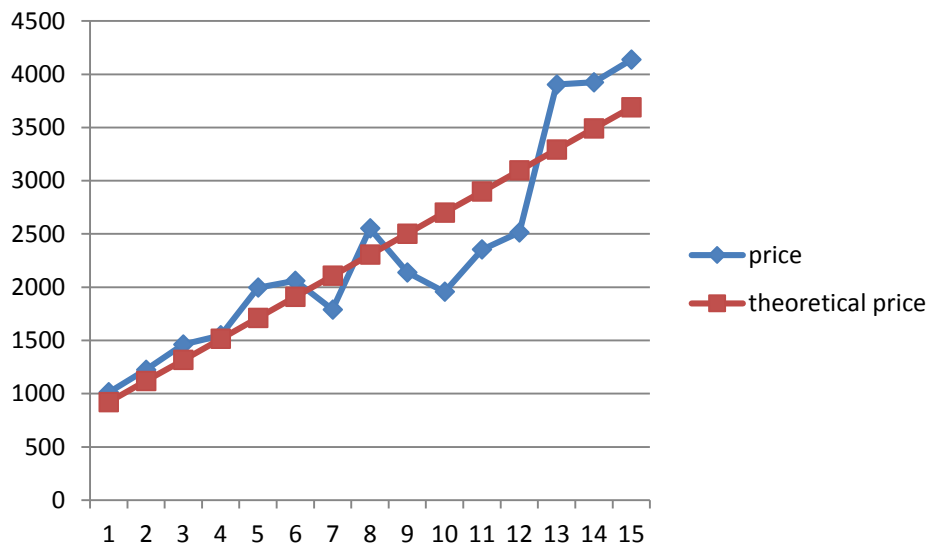


Fig. 1. Distribution of actual and theoretical prices for vegetables

Source: own research

To estimate the offer and demand, we use the theoretical model of the demand and the supply [2]. For such a model, the demand $D(t)$ and the supply $S(t)$ are values that depend on price dynamics (P). The theoretical model has the form:

$$\begin{cases} D(t) = f(p, t) \\ S(t) = f(p, t) \end{cases}$$

To linearize the model, we represent the dependence based on the linear dependencies of the form:

$$\begin{cases} D(t) = a_0 + b_0 P^*(t) \\ S(t) = a_1 + b_1 P^*(t-1) \end{cases}$$

Where $D(t)$ – demand for vegetables, million tons;

$S(t)$ – supply for vegetables, million tons;

$P^*(t)$ – theoretical price for vegetables in the period t , UAH;

$P^*(t-1)$ – theoretical price for vegetables in the previous period $t-1$, UAH.

Thus, to calculate the model, we determine that the demand is a function of changes in the prices of the current period, and the supply is a function that depends on price changes in previous periods.

To obtain the equations of demand and offer, we use the "add a trend line" procedure. In this case, we pre-build the graphs of the actual demand (statistical sample data) from the theoretical price of the current period and the dependence of the actual supply (statistical sample data) on the price of previous periods. The table of initial data will look like Table 3.

Table 3

Initial data to research the dependence of the demand and supply on the price

No. of time period t	1	2	3	4	5	6	7	8
Actual price $P(t)$	1012,7	1225	1462,1	1547,4	1995,4	2059,9	1790	2551,6
Theoretical price $P^*(t)$	723,32	921	1118,68	1316,36	1514,04	1711,72	1909,4	2107,08
Demand	5430	5478	5663	5927	5509	5975	6312	6581
Supply	6921	7333	7606	8745	7317	8489	8976	8873
No. of time period t	9	10	11	12	13	14	15	
Actual price $P(t)$	2139,1	1956,6	2354	2514,3	3903,4	3924,2	4136,1	
Theoretical price $P^*(t)$	2304,76	2502,44	2700,12	2897,8	3095,48	3293,16	3490,84	
Demand	7440	7452	7431	7019	6890	7030	6539	
Supply	10562	10815	10668	10323	9792	9998	9286	

Source: own research

Let us approximate the nonlinear model using the least squares method based on a linear function. To do this, we will use the "Add Trend Line" procedure in Fig. 2.

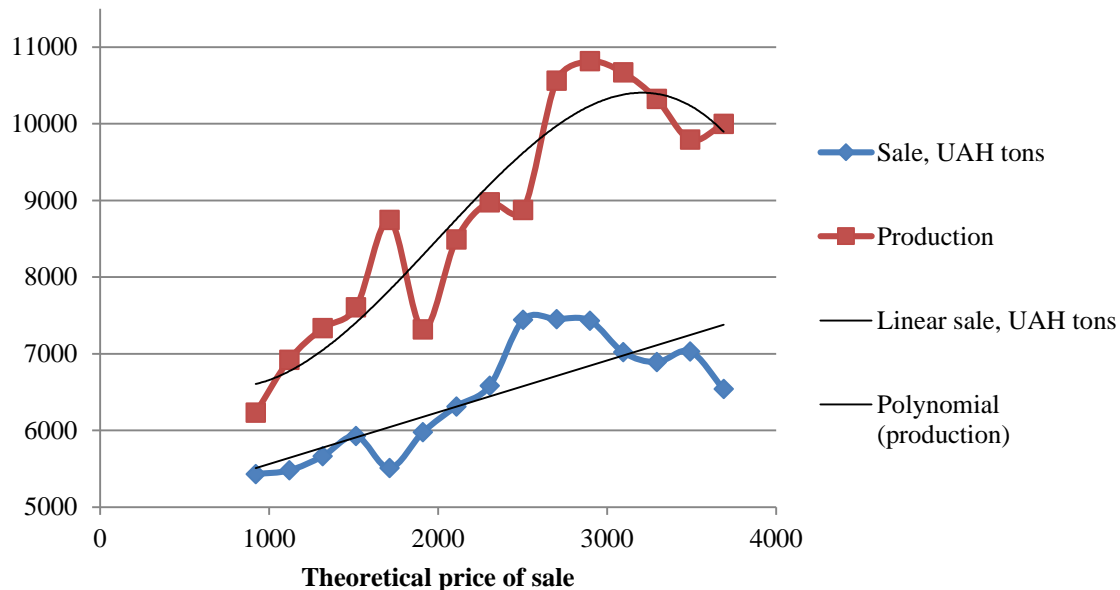


Fig. 2. Dependence of production (supply) and consumption (demand) of vegetables on sales price and their approximation

Source: own research

It was found that for the approximation of vegetable production, the first grade polynomial is best suited

$$S(t) = 0,6762 \cdot p(t) + 4886,7;$$

and for the demand – of the third grade :

$$D(t) = -5E-07 \cdot p(t)^3 + 0,0032 \cdot p(t)^2 - 4,0288 \cdot p(t) + 8014,4.$$

Based on the obtained equations, we determine the state of equilibrium of the system.

Thus, equating the right-hand side of the obtained equations, one can find that the equilibrium of this system is observed at a price of 6558 UAH for 1 ton of vegetables at given conditions of consumption, while the demand is equal to the supply and is 9321 thousand tons.

In order to determine the optimal material costs, labor costs and depreciation costs per hectare of vegetable sowing, we will build on the statistical data one-factor econometric models:

$$Y = a_0 + a_1 \cdot X$$

Let us determine the specification of the models: Y - the price of sales of vegetables, UAH / t, X - costs per 1 hectare of vegetable sowing.

There are a number of methods for testing the hypothesis of the significance of the correlation coefficient and the reliability of the regression parameters. We will work out this test using the Student's criterion.

In this scheme, the hypothesis of the equality of the linear correlation coefficient to zero is adopted as a null hypothesis: H0: the correlation coefficient is equal to zero; accordingly, the alternative hypothesis for a two-way alternative (two tail critical region) is: the correlation coefficient is different from zero [6].

According to the empirical value of the correlation coefficient r, we build statistics:

$$t = \frac{R}{\sqrt{1 - R^2}} \sqrt{n - 2}$$

where R – the empirical value of the correlation coefficient, the number of pairwise observations, on which this value was estimated.

This statistic has the Student's distribution of the degrees of freedom $f = n - 2$. To test the hypothesis, we choose the level of significance of the criterion α , which is characteristic for a given field of science, and by its value and the degree of freedom of statistics, we choose the quantization of the distribution of

the Student's criterion t_{kp} . Zero hypothesis is fair if inequality is true: $|t| < t_{kp}$.

In this case, it can be argued that there is no linear correlation between the random variable X and Y.

In that case, if inequality does not come true, then the null hypothesis is considered unfair, but the alternative is considered an alternative hypothesis, then the linear correlation coefficient is different from zero. Such a result of the statistical analysis suggests that random variables are interconnected by a stochastic bond of linear nature.

Let us summarize the information about the calculated models and their estimation characteristics to the following table (Table 4).

Table 4

Results of the dependence simulation of the selling price type on expenditures

Indicator	Model 1	Model 2	Model 3
Dependence of the price on:	Material expense	Labor cost	Depreciation cost
Econometric model	$Y=99,82+0,9*X$	$Y =-359,47+10,03*X$	$Y =-192,32+12,42*X$
Correlation coefficient	0,82	0,33	0,67
Determination coefficient	67%	11%	44%
Value of the F – criteria (F=4,6)	26,7	1,6	10,3
Value of t – statistics for correlation coefficient ($t_{kp(0,05;13)}=2,16$)	5,169	1,263069	3,220962
Value of t – statistics for the parameter a_0 ($t_{kp(0,05;13)}=2,16$)	0,221	-0,169	-0,241
Value of t – statistics for the parameter a_0 ($t_{kp(0,05;13)}=2,16$)	5,169	1,263	3,221

Source: own research

For the first model - the dependence of the price on material costs, the content of unaccounted factors is estimated at 99.82 UAH per hectare; with an increase in material costs of 1 hectare per 1 UAH, the selling price is increased by UAH 0.9. per ton. Based on F - Fisher's criterion, the model is adequate, the relationship between the indicators is tight. The value of the linear correlation coefficient is statistically significantly different from zero.

Accordingly, the second model can be noted that the connection is weak, the calculated correlation coefficient can be trusted, but in general, the conclusion about the adequacy of the model cannot be made. The model shows that with an increase in labor costs by 1 UAH per hectare, the price increases by 10.03 UAH per ton.

The third model based on F - Fisher's criterion is adequate; the relationship between the indicators is mean. With an increase in depreciation costs per 1 hectare per 1 UAH the selling price will increase by 12.42 UA. per ton. The value of the linear correlation coefficient is statistically significantly different from zero.

Based on the calculated models, we will determine the optimal expenses per 1 hectare: material - 7144.2 UAH, labor costs - 689.4 UAH, depreciation costs - 543.4 UAH.

Conclusin. The demand is a function of changes in the prices of the current period, and the supply is a function that depends on price changes in previous periods. Econometric models of the dependence of the demand and supply of vegetable production on the price of their sale are constructed. The system equilibrium is observed at a price of 6558 UAH per 1 ton of vegetables at given conditions of consumption, while the demand is equal to the supply and is 9321 thousand tons.

Econometric models of price dependence on material costs, labor costs and depreciation are constructed. According to the first model, it is possible to determine that the content of unaccounted factors is estimated at UAH 99.82. per hectare; with an increase in material costs of 1 hectare per 1 UAH, the selling price is increased by UAH 0.9. per ton. Based on F - Fisher's criterion, the model is adequate; the relationship between the indicators is tight. The relationship between the indicators of the second model is weak, the calculated correlation coefficient can be trusted, but in general, it is impossible to make a conclusion on the adequacy of the model. The model shows that with an increase in labor costs by 1 UAH per hectare, the price increases by 10.03 UAH per ton. The third F-criterion based on Fischer's criterion is adequate, the link between the indices is average. With an increase in depreciation costs per 1 hectare per 1 UAH, the selling price will increase by 12.42 UAH per ton. The value of the linear correlation coefficient is statistically significantly different from zero.

Based on the calculated models, we will determine the optimal expenses per 1 hectare: material - 7144.2 UAH, labor costs - 689.4 UAH, depreciation costs - 543.4 UAH.

Highlights.

1. The AGMEMOD model allows you to model and predict the diversity of political scenarios for both Ukraine and the EU as a whole. The further development of the model should seek to endogenize world prices.
2. Dependence of the demand and supply of vegetables production on the prices of their sale is investigated.
3. The point of equilibrium of the demand and supply and based on this optimum price of the sale of vegetables in Ukraine is determined.
4. Optimal costs per hectare for the production of vegetable crops in Ukraine are substantiated.

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