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# CONTENTS

## ECONOMIC SCIENCES

<b>Mulyk Ya.I.</b> USE OF MOBILE APPS FOR BUSINESS, ACCOUNTING AND CONTROL .....	4
<b>Мулик Я.И.</b> ПРИМЕНЕНИЕ МОБИЛЬНЫХ ПРИЛОЖЕНИЙ ДЛЯ БИЗНЕСА, УЧЕТА И КОНТРОЛЯ .....	4
<b>Palamarenko Y.V., Mashevskaya A.A.</b> RESEARCH OF FINANCIAL AND ECONOMIC RISKS IN THE ENTERPRISE MANAGEMENT SYSTEM .....	13
<b>Аушева А.Х.</b> ЗАГРЯЗНЕНИЕ АТМОСФЕРЫ ЗЕМЛИ .....	25
<b>Ausheva A.K.</b> EARTH ATMOSPHERE POLLUTION .....	25
<b>Boltovskaya L.L.</b> INNOVATION AND INVESTMENT ACTIVITY AS A STRATEGIC PRIORITY IN THE DEVELOPMENT OF MEAT PRODUCTS SUBCOMPLEX ENTERPRISES .....	28
<b>Квaterniuk A.O.</b> ОРГАНІЗАЦІЙНО-ЕКОНОМІЧНИЙ МЕХАНІЗМ ІННОВАЦІЙНОЇ ДІЯЛЬНОСТІ В РОСЛИННИЦЬКІЙ ГАЛУЗІ УКРАЇНИ .....	33
<b>Kvaterniuk A.O.</b> ORGANIZATIONAL AND ECONOMIC MECHANISM OF INNOVATIVE ACTIVITY IN THE PLANT INDUSTRY OF UKRAINE .....	33
<b>Коваль Н.І.</b> ФІНАНСОВА ДІЯЛЬНІСТЬ ПІДПРИЄМСТВ: ІСТОРИЧНІ ОПИСИ СТАНОВЛЕННЯ ТА РОЗВИТКУ .....	36
<b>Koval N.I.</b> FINANCIAL ACTIVITY OF ENTERPRISES: HISTORICAL DESCRIPTIONS OF BECOMING AND DEVELOPMENT .....	36
<b>Kovalchuk S.</b> QUALITY OF AGRICULTURAL PRODUCTS IN THE SYSTEM OF EUROPEAN INTEGRATION PRIORITIES OF UKRAINE .....	42
<b>Амонс С.Е., Красняк О.П.</b> УПРАВЛІННЯ КОНКУРЕНТОСПРОМОЖНІСТЮ І ТЕНДЕНЦІЇ РОЗВИТКУ СЕКТОРА ОРГАНІЧНОГО СІЛЬСЬКОГО ГОСПОДАРСТВА .....	52
<b>Amons S., Krasnyak O.</b> COMPETITIVENESS AND TRENDS MANAGEMENT DEVELOPMENT OF THE ORGANIC AGRICULTURE SECTOR .....	52
<b>Potapova N.A.</b> ECONOMETRIC MODEL FOR ESTIMATING THE IMPACT OF SMALL BUSINESS FACTORS ON CHANGES IN THE SECTORAL STRUCTURE OF AGRICULTURE IN UKRAINE .....	59

<b>Ruda O.L.</b>	
CURRENT STATE OF THE BANKING SYSTEM OF UKRAINE IN THE CONTEXT OF BANKING SUPERVISION .....	68
<b>Руда О.Л.</b>	
СУЧАСНИЙ СТАН БАНКІВСЬКОЇ СИСТЕМИ УКРАЇНИ В КОНТЕКСТІ БАНКІВСЬКОГО НАГЛЯДУ .....	68
<b>Yurchuk N.P.</b>	
METHODOLOGICAL APPROACHES TO IT PROJECT MANAGEMENT .....	74

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DOI: [10.24412/2520-6990-2021-16103-59-67](https://doi.org/10.24412/2520-6990-2021-16103-59-67)**ECONOMETRIC MODEL FOR ESTIMATING THE IMPACT OF SMALL BUSINESS FACTORS ON CHANGES IN THE SECTORAL STRUCTURE OF AGRICULTURE IN UKRAINE****Abstract.**

The article covers the processes of forming a system of economic indicators to assess changes in the sectoral structure of agriculture in Ukraine. The findings of development and approbation of econometric model of estimation of influence of factors of small business patterns on changes in the sectoral structure of agriculture of Ukraine for the purpose of its further use in processes of restructuring and state regulation of agriculture sector are specified. The evaluation findings are confirmed by the statistics of Ukraine agriculture, the relevant criteria of regression analysis and the high level of neighboring correlation relationship between the factors.

**Keywords:** small business patterns, agriculture, econometric model, theoretical estimation, level of neighboring correlation relationship.

The main source of food security of the state of any country is the agricultural sector. The completeness and effectiveness of this issue depends on many factors, in particular, the balance of the sectoral structure of agriculture and the balance of commodity markets for agricultural products supported by all their participants. Today, in Ukraine there is an imbalance in the structure of markets for agricultural products, which is manifested in the predominance of medium and large enterprises over small businesses [1].

In the structure of small business patterns are: small agricultural enterprises, farms, cooperatives and personal farms (households). They cover the activities of the rural population and are one of the structural elements of a market economy. The advantages of small forms of management include the dynamism of innovative implementations, the speed of response to market changes, the maintenance of lower product prices, accessibility for the final consumer, and others. The main drawback is limited access to resources and government regulation. Taking into account the volume of production and sales, the following commodity and consumer small business patterns have been specified [2]. The first type is involved in the manufacture of products for own consumption, the other implements production for own consumer needs and profit. Households are not accounted as enterprises; however, surplus products can be sold by them in consumer markets. Commodity farms (farming enterprises) are involved in small-scale production of agricultural products and sell it in competitive consumer small wholesale or retail markets. In conditions of pure competition (lack of power and opportunities for direct pressure on the market), delivery and service to the end consumer (sales logistics) is one of the main problems. Its solution will be facilitated by consumer cooperation, which is able to organize stable links between producers, consumers of products and service [3]. Therefore, the question of assessing the impact of the main types of small farms on changes in the sectoral structure of agriculture and the market is relevant.

**The Article Is Devoted** to the form a system of

economic indicators to assess changes in the sectoral structure of agriculture in Ukraine, as well as to develop an econometric model for assessing the impact of small farms on changes in this structure for further use in restructuring and state regulation of agriculture.

**Findings.** The impact of small business patterns on the final result of surplus exchange value of the agricultural sector of Ukraine is quite significant and is reflected in changes in economic conditions of all market participants, the ratio rating of commodity production of live-stock and crop production and agricultural price indices. Small business patterns have a significant share in the live-stock industry of the state. They include about 67% of cattle: 77% of cows, 46.5% of pigs, 93.4% of horses, 85.8% of sheep and goats, 45.5% of poultry of all species, 98.1% of bee colonies. On average, there is a significant disparity in the number of the employed population and the share of small business patterns in the accounting of live-stock and poultry in the regions. Thus, in the Steppe zone the share of small business patterns is high (for example, the Zaporizhzhia region – more than 80%), in the Forest-Steppe zone it is about one third (the Cherkasy region – 35-50%) [2]. According to the State Statistics Service of Ukraine in 2013-2019, the average price indices of sales of agricultural products by households in Ukraine in most regions ranged from 94.0% to 104.6% (17 regions).

Average indices for 2013-2019 of agricultural sales prices by agricultural enterprises (including farms) of Ukraine in most regions ranged from 99.6% to 113.7% (17 regions). The households of the population of Ukraine are characterized by lower growth rates of selling prices in comparison with agricultural enterprises.

According to the assessment of the structural component, the households of the population of Ukraine are focused on the live-stock industry. The distribution of regions of Ukraine in 2013-2019 determined a growing trend of the share of households in live-stock products with a clearly defined asymmetry in the direction of growth: 7 regions – from 51% to 66% (average level), 7 regions – 66% to 81% (above for the middle level), 4

regions – from 81% to 97% (high level).

In the households, the structural share of crop production is low, and the distribution by the regions of Ukraine is characterized by downwards asymmetry: 11 regions – 26% to 38% (low level), 6 regions – 38% to 50% (between low and medium level). According to the Ukrainian Agrarian Exchange [8] in 11 regions with a low share of households there are about 375 elevators (about 50%) out of 761 in Ukraine as a whole, of which 16 elevators are owned by *Kernel*, 16 elevators are owned by *Nibulon*, 35 are state-owned companies (18 elevators belongs to the State Food and Grain Company of Ukraine). The crop industry is focused on large and medium-sized enterprises, which is due to the advantage in the production of export-oriented products and the location of a network of granaries and warehouses to ensure its storage with subsequent accessibility to transport.

In general, in the structure of agricultural output of Ukraine the share of households is in the range from 37% to 50% in 10 regions (taking into account the combined impact of the structure of crop production and animal husbandry). The highest share of households is in the Transcarpathian region (from 76% to 94%), where they are one of the sources of employment of the rural population in the absence of powerful industries and the specific nature of the geographical location. The share of agricultural production in households of 5 regions (ranging from 63% to 73%) is approaching a high level: Volyn, Rivne, Lviv, Ivano-Frankivsk and Chernivtsi

$$\begin{cases} \hat{y}(t) = b_{01} + b_{11} \times \sin(b_{21} \times \hat{x}_{11}(t) + b_{31}) + b_{41} \times \cos(b_{51} \times \hat{x}_{11}(t) + b_{61}) + b_{71} \times d \\ \hat{x}_{11}(t) = \hat{x}_{11\_1}(t) \cup \hat{x}_{11\_2}(t) \\ \hat{x}_{11\_1}(t) = b_{02} + b_{12} \times \hat{sv}_d(t) + b_{22} \times \hat{sv}_f(t) \\ \hat{x}_{11\_2}(t) = b_{03} + b_{13} \times \sin(b_{23} \times \hat{sv}_d(t) + b_{33}) + b_{43} \times \sin(b_{53} \times \hat{sv}_f(t) + b_{63}) \end{cases} \quad (1.1)$$

where

$\hat{y}(t)$  is the theoretical estimate of gross surplus exchange value of the agriculture sector of Ukraine, UAH million;

$\hat{x}_{11\_1}(t)$  is the theoretical estimate of the share of gross crop production, % ( $d=0$ );

$\hat{x}_{11\_2}(t)$  is the theoretical estimate of the share of gross livestock production, % ( $d=1$ );

$\hat{sv}_d(t)$  is the theoretical assessment of the share of crop production in households as a result of total agricultural production of Ukraine, %;

$\hat{sv}_f(t)$  is the theoretical assessment of the share of crop production in farms as a result of total agricultural production of Ukraine, %;

$\hat{sv}_d(t)$  is the theoretical assessment of the share of livestock production in households as a result of total agricultural production of Ukraine, %;

$\hat{sv}_f(t)$  is the theoretical assessment of the share of livestock production in farms as a result of total agricultural production of Ukraine, %.

regions. The growth of households in these areas is a consequence of natural settlement and ways of doing business (Carpathian economic region with a high level of population density and rural isolated farmstead).

Despite the growing share of households in some regions of Ukraine, in most areas they account for at least a third of production, which makes them an important factor in the efficient functioning of agricultural markets. Along with this, the development of farms, the activities of which determine the basic concept of small business development in rural areas is significant in many countries around the world. In this regard, it is advisable to outline the limits of the impact of the main types of small businesses on changes in the sectoral structure of agriculture and the market.

The basis of the methodology of this study are the methods of economic and mathematical modeling, in particular, econometric modeling. The analysis justifies the development of an econometric complex model with the definition of the criterion – gross surplus exchange value of the agricultural sector of Ukraine. The econometric model includes 5 blocks (Fig. 1). Block 1 reflects the impact of small farms on changes in the sectoral structure of agriculture in the absence of other factors. The analysis of the block is based on the definition of the goal criterion – gross surplus exchange value of the agricultural sector of Ukraine. Block 1 (definition of the goal criterion) is described by the system of equations 1.1:

The main hypothesis of the modeling will be the change in the share of crop production depending on the changes of prices for the main types of crops. Price changes are characterized by price indices, the constancy of which in relation to the previous year is determined by 100%. When prices increase, the index will exceed 100%, with a decrease it will be less than 100%. In accordance with the maintenance of market equilibrium with the growth of price indices for products, the share of supply in the commodity market should narrow, resulting in the effect of replacement by other products, and consequently increase its share.

With the narrowing of the share of crop production in households, its structure should be replaced by agricultural enterprises (farms), or products with more stable prices (reorientation to the production of livestock products). Block 2 characterizes the assessment of the share of crop production of households in Ukraine based on the impact of the price index of major crops: cereals, oilseeds, sugar beets, potatoes, vegetables, fruits and berries. Block 2 is described by a system of equations 1.2:

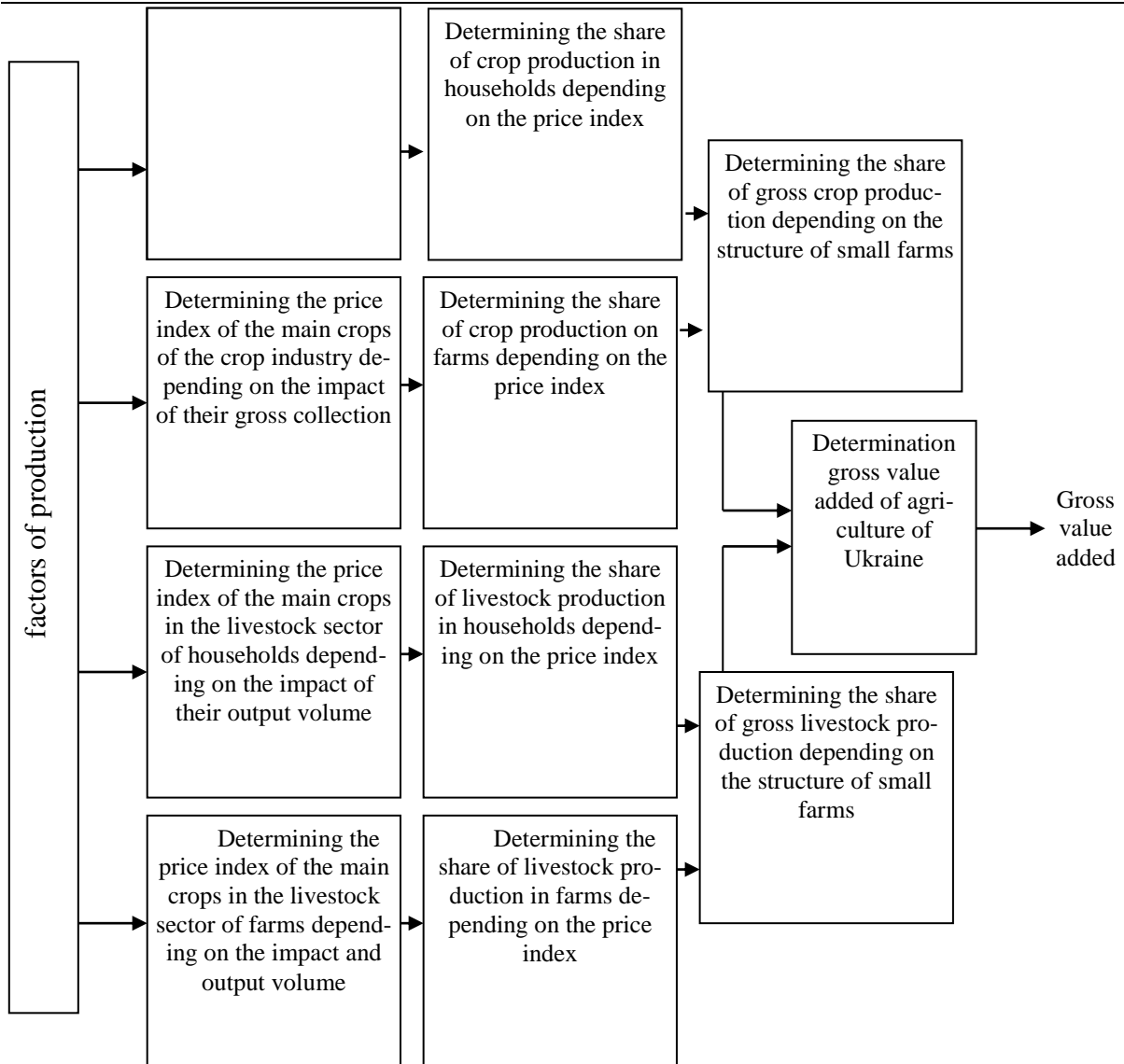


Fig. 1 Model for assessing the impact of the main types of small farms on changes in the sectoral structure of agriculture in Ukraine \*

\* Developed by the author

$$\begin{cases}
 \hat{sv}_d(t) = b04 + b14 \times \sin(b24 \times \hat{qr}1_d(t)) + b34 \times \sin(b44 \times \hat{qr}2_d(t)) + \\
 + b54 \times \sin(b64 \times \hat{qr}3_d(t)) + b74 \times \sin(b84 \times \hat{qr}4_d(t)) + b94 \times \sin(b104 \times \hat{qr}5_d(t)) + \\
 + b114 \times \sin(b124 \times \hat{qr}6_d(t)) \\
 \hat{qr}1_d(t) = b05 + b15 \times \sin(b25 \times vz1_d(t) + b35) + \\
 + b45 \times \cos(b55 \times vz1_d(t) + b65) \\
 \hat{qr}2_d(t) = b06 + b16 \times \sin(b26 \times vz2_d(t) + b36) + \\
 + b46 \times \cos(b56 \times vz2_d(t) + b66) \\
 \hat{qr}3_d(t) = b07 + b17 \times \sin(b27 \times vz3_d(t) + b37) + \\
 + b47 \times \cos(b57 \times vz3_d(t) + b67) \\
 \hat{qr}4_d(t) = b08 + b18 \times \sin(b28 \times vz4_d(t) + b38) + \\
 + b48 \times \cos(b58 \times vz4_d(t) + b68) \\
 \hat{qr}5_d(t) = b09 + b19 \times \sin(b29 \times vz5_d(t) + b39) + \\
 + b49 \times \cos(b59 \times vz5_d(t) + b69) \\
 \hat{qr}6_d(t) = b010 + b110 \times \sin(b210 \times vz6_d(t) + b310) + \\
 + b410 \times \cos(b510 \times vz6_d(t) + b610)
 \end{cases} \tag{1.2}$$

where

$\hat{q}r1\_d(t)$  is the theoretical index of sales prices of cereals and legumes of households in Ukraine;

$\hat{q}r2\_d(t)$  is the theoretical index of sales prices of oilseeds of households in Ukraine;

$\hat{q}r3\_d(t)$  is the theoretical index of sales prices of sugar beets of households of Ukraine;

$\hat{q}r4\_d(t)$  is the theoretical index of sales prices of potatoes in Ukrainian households;

$\hat{q}r5\_d(t)$  is the theoretical index of selling prices of vegetables in Ukrainian households;

$\hat{q}r6\_d(t)$  is the theoretical index of selling prices of fruits and berries of households of Ukraine;

$vz1\_d(t)$  is the gross harvest of cereals and legumes of households of Ukraine, thousand tons;

$vz2\_d(t)$  is the gross harvest of oilseeds of households in Ukraine, thousand tons;

$vz3\_d(t)$  is the gross harvest of sugar beets of households of Ukraine, thousand tons;

$vz4\_d(t)$  is the gross harvest of potatoes of households of Ukraine, thousand tons;

$vz5\_d(t)$  is the gross harvest of vegetables of households of Ukraine, thousand tons

$vz6\_d(t)$  is the gross harvest of fruits and berries of households of Ukraine, thousand tons

Block 3 characterizes the assessment of the share of crop production of Ukrainian farms based on the impact of the price index of major crops: cereals, oilseeds, sugar beets, potatoes, vegetables, fruits and berries. Block 3 is described by the system of equations 1.3:

$$\left\{ \begin{aligned} \hat{s}v\_f(t) &= b011 + b111 \times \sin(b211 \times \hat{q}r1\_f(t)) + b311 \times \sin(b411 \times \hat{q}r2\_f(t)) + \\ &+ b511 \times \sin(b611 \times \hat{q}r3\_f(t)) + b711 \times \sin(b811 \times \hat{q}r4\_f(t)) + \\ &+ b911 \times \sin(pr1011 \times \hat{q}r5\_f(t)) + b1111 \times \sin(b1211 \times \hat{q}r6\_f(t)) \\ \hat{q}r1\_f(t) &= b012 + b112 \times \sin(b212 \times vz1\_f(t) + b312) + \\ &+ b412 \times \cos(b512 \times vz1\_f(t) + b612) \\ \hat{q}r2\_f(t) &= b013 + b113 \times \sin(b213 \times vz2\_f(t) + b313) + \\ &+ b413 \times \cos(b513 \times vz2\_f(t) + b613) \\ \hat{q}r3\_f(t) &= b014 + b114 \times \sin(b214 \times vz3\_f(t) + b314) + \\ &+ b414 \times \cos(b514 \times vz3\_f(t) + b614) \\ \hat{q}r4\_f(t) &= b015 + b115 \times \sin(b215 \times vz4\_f(t) + b315) + \\ &+ b415 \times \cos(b515 \times vz4\_f(t) + b615) \\ \hat{q}r5\_f(t) &= b016 + b116 \times \sin(b216 \times vz5\_f(t) + b316) + \\ &+ b416 \times \cos(b516 \times vz5\_f(t) + b616) \\ \hat{q}r6\_f(t) &= b017 + b117 \times \sin(b217 \times vz6\_f(t) + b317) + \\ &+ b417 \times \cos(b517 \times vz6\_f(t) + b617) \end{aligned} \right. \quad (1.3)$$

where

$\hat{q}r1\_f(t)$  is the theoretical index of sales prices of grain and legumes of agricultural enterprises of Ukraine;

$\hat{q}r2\_f(t)$  is the theoretical index of sales prices of oilseeds of agricultural enterprises of Ukraine;

$\hat{q}r3\_f(t)$  is the theoretical index of sales prices of sugar beets of agricultural enterprises of Ukraine;

$\hat{q}r4\_f(t)$  is the theoretical index of sales prices of potatoes of agricultural enterprises of Ukraine;

$\hat{q}r5\_f(t)$  is the theoretical index of selling prices of vegetables of agricultural enterprises of Ukraine;

$\hat{q}r6\_f(t)$  is the theoretical index of sales prices of fruits and berries of agricultural enterprises of

Ukraine;

$vz1\_f(t)$  is the gross harvest of grain and legumes of farms of Ukraine, thousand tons;

$vz2\_f(t)$  is the gross harvest of oilseeds of farms of Ukraine, thousand tons;

$vz3\_f(t)$  is the gross harvest of sugar beets of farms of Ukraine, thousand tons;

$vz4\_f(t)$  is the gross harvest of potatoes of farms of Ukraine, thousand tons;

$vz5\_f(t)$  is the gross harvest of vegetables of farms of Ukraine, thousand tons;

$vz6\_f(t)$  is the gross harvest of fruits and berries of farms of Ukraine, thousand tons.

Block 4 characterizes the assessment of the share of livestock production in households of Ukraine depending on the impact of price indices of the main types of livestock products: live animals, eggs and milk. Block 4 is described by the system of equations 1.4:



$$\begin{cases}
 \hat{sv}_d(t) = b_{018} + b_{118} \times \sin(b_{218} \times \hat{qt}_1_d(t)) + b_{318} \times \sin(b_{418} \times \hat{qt}_2_d(t)) + \\
 + b_{518} \times \sin(b_{618} \times \hat{qt}_3_d(t)) \\
 \hat{qt}_1_d(t) = b_{019} + b_{119} \times \sin(b_{219} \times vt_{1_d}(t) + b_{319}) + \\
 + b_{419} \times \cos(b_{519} \times vt_{1_d}(t) + b_{619}) \\
 \hat{qt}_2_d(t) = b_{020} + b_{120} \times \sin(b_{220} \times vt_{2_d}(t) + b_{320}) + \\
 + b_{420} \times \cos(b_{520} \times vt_{2_d}(t) + b_{620}) \\
 \hat{qt}_3_d(t) = b_{021} + b_{121} \times \sin(b_{221} \times vt_{3_d}(t) + b_{321}) + \\
 + b_{421} \times \cos(b_{521} \times vt_{3_d}(t) + b_{621})
 \end{cases} \quad (1.4)$$

where

$\hat{qt}_1_d(t)$  is the theoretical index of sales prices of farm animals (live weight) of households in Ukraine;

$\hat{qt}_2_d(t)$  is the theoretical index of milk sales prices of Ukrainian households;

$\hat{qt}_3_d(t)$  is the theoretical index of egg sales prices of Ukrainian households.

$vt_{1_d}(t)$  is the volume of production of farm animals (live weight) of households of Ukraine, thousand

$$\begin{cases}
 \hat{sv}_f(t) = b_{022} + b_{122} \times \sin(b_{222} \times \hat{qt}_1_f(t)) + b_{322} \times \sin(b_{422} \times \hat{qt}_2_f(t)) + \\
 + b_{522} \times \sin(b_{622} \times \hat{qt}_3_f(t)) \\
 \hat{qt}_1_f(t) = b_{023} + b_{123} \times \sin(b_{223} \times vt_{1_f}(t) + b_{323}) + b_{423} \times \cos(b_{523} \times vt_{1_f}(t) + b_{623}) \\
 \hat{qt}_2_f(t) = b_{024} + b_{124} \times \sin(b_{224} \times vt_{2_f}(t) + b_{324}) + b_{424} \times \cos(b_{524} \times vt_{2_f}(t) + b_{624}) \\
 \hat{qt}_3_f(t) = b_{025} + b_{125} \times \sin(b_{225} \times vt_{3_f}(t) + b_{325}) + b_{425} \times \cos(b_{525} \times vt_{3_f}(t) + b_{625})
 \end{cases} \quad (1.5)$$

where

$\hat{qt}_1_f(t)$  is the theoretical index of sales prices of farm animals (live weight) of agricultural enterprises of Ukraine;

$\hat{qt}_2_f(t)$  is the theoretical index of milk sales prices of agricultural enterprises of Ukraine;

$\hat{qt}_3_f(t)$  is the theoretical index of selling prices of eggs of agricultural enterprises of Ukraine;

$vt_{1_f}(t)$  is the volume of production of farm animals (live weight) of farms in Ukraine, thousand tons;

$vt_{2_f}(t)$  is the volume of milk production of farms of Ukraine, thousand tons;

$vt_{3_f}(t)$  is the volume of egg production on farms of Ukraine, mln. pc.

The calculation of the model developed was carried out on the basis of statistical information on agriculture of Ukraine for the period 2009 – 2019. The parameters of the model are calculated on the basis of the two-step least square method.

Evaluation of the reliability of the modeling re-

sons;

$vt_{2_d}(t)$  is the volume of milk production of households of Ukraine, thousand tons;

$vt_{3_d}(t)$  is the volume of egg production on farms of Ukraine, mln. pc.

Block 5 characterizes the assessment of the share of livestock production in farms of Ukraine depending on the impact of price indices of the main types of livestock products. Block 5 is described by the system of equations 1.5:

sults of the dependence of the factors of sales price indices of the main types of livestock products of agricultural enterprises on the output of livestock products by farms (block 5) showed that the correlation ratio between the factors is rather close. The reliability of the coefficient of determination that characterizes the influence of selected factors ranges from 71% to 89%, and the influence of factors not included in the model is estimated from 11% to 29%. The obtained calculations showed that the amplitude of the sales price index of farm animals (live weight) of agricultural enterprises tends to decrease due to the production volumes of farms from 17.6 to 20.8.

The amplitude of the milk sales price index of agricultural enterprises tends to decrease by 29.3 to an increase by 17.6. The amplitude of the egg sales price index of agricultural enterprises tends to increase from 16.3 to 26.9. The results of estimating the change in the sales price index of farm animals (live weight) of agricultural enterprises from the impact of the volume of production of farm animals (live weight) of farms in Ukraine are shown in Table 1.

**Estimation of changes in the index of agricultural sales prices  
animals (live weight) of agricultural enterprises**

t	Sales price index of live-stock animals (live weight) of agricultural enterprises of Ukraine	Live-stock animals production volume (in live weight) of farms of Ukraine, thousand tons	Theoretical estimation of the sales price index of live-stock animals (live weight) of agricultural enterprises of Ukraine	Deviation of the actual price index of sales of live-stock animals (live weight) of agricultural enterprises of Ukraine according to the theoretical assessment
	qt1_f(t)	vt1_f(t)	qt1_f(t)	e8_1 = qt1_f(t) - qt1_f(t)
1	134.8	26.2	132.1	2.7
2	91.3	40.8	93.7	-2.4
3	102.5	55.9	110.0	-7.5
4	146.0	65.7	124.8	21.2
5	101.8	65.6	115.3	-13.5
6	104.2	73.1	95.5	8.7
7	110.8	76.4	104.1	6.7
8	111.6	80.5	122.6	-11.0
9	95.4	89.9	99.4	-4.0
10	122.9	81.3	119.3	3.6
11	138.6	78.6	142.0	-3.4
Average:	114.5	66.7	114.4	0.1

Source: calculated by the author based on data [4, 5, 6, 7]

The change in the price indices of sales of basic livestock products will be reflected in the structure of agricultural production, in particular in the size of the share of farms (Table 2). According to calculations, it is established that the decrease in the share of farm production in livestock is due to fluctuations in prices for meat products (amplitude will decrease by 1.06%) and eggs (amplitude will decrease by 0.26%), growth is possible due to prices and milk production (amplitude will increase by 0.42%).

The obtained calculations for households showed

that: the amplitude of the sales price index of cereals and legumes has a tendency to change growth in the range from 28 to 29; the amplitude of the sales price index of oilseeds tends to change in the range from -62 to -24; the amplitude of the price index of sugar beet sales tends to change in the range from -33 to 25; the amplitude of the potato sales price index tends to change by 39; the amplitude of the vegetable sales price index tends to change in the range from -23 to 39; the amplitude of the price index of sales of fruit and berries tends to change in the range from -33 to -19.

Table 2

**Estimation of changes in the share of livestock production in farms from the impact of price indices of sales of basic agricultural products in the livestock industry of the agricultural enterprises of Ukraine**

No.	Share of live-stock production in farms as a result of total agricultural production of Ukraine, %	Theoretical index of sales prices of live-stock animals (live weight) of agricultural enterprises of Ukraine	Theoretical index of milk sales prices of agricultural enterprises of Ukraine	Theoretical index of egg sales prices of agricultural enterprises of Ukraine	Theoretical estimate of the share of livestock production in farms as a result of total agricultural production of Ukraine, %	Deviation of the actual share of livestock production in farms as a result of the total agricultural production of Ukraine from the theoretical estimate, %
	svt_f(t)	qt1_f(t)	qt2_f(t)	qt3_f(t)	stvt_f(t)	e7 = svt_f(t) - stvt_f(t)
1	0.8	132.1	137.2	106.3	0.9	-0.1
2	1.1	93.7	111.3	65.5	1.1	0.0
3	1.5	110.0	140.7	142.6	1.6	-0.1
4	1.7	124.8	146.5	97.0	1.6	0.1
5	1.7	115.3	97.1	116.0	1.8	-0.1
6	1.6	95.5	164.7	121.8	1.4	0.2
7	1.7	104.1	97.6	108.8	1.7	0.0
8	1.7	122.6	81.7	126.2	1.8	-0.1
9	1.8	99.4	123.8	109.7	1.9	-0.1
10	1.8	119.3	106.8	118.0	1.6	0.2
11	1.9	142.0	120.6	148.9	1.8	0.1
Average:	1.6	114.4	120.7	114.6	1.6	0.0

Source: calculated by the author based on data [4, 5, 6, 7]

Evaluation of the reliability of the simulation results of the dependence of the factors of the indices of sales prices of the main types of household livestock products on their output (block 4) showed a high level of closeness of the relationship between the factors. The reliability of the coefficient of determination that characterizes the influence of selected factors ranges from 77% to 98%, and the influence of factors not included in the model is estimated from 2% to 23%. The obtained calculations showed that the amplitude of the

selling price index of farm animals (live weight) of households has a tendency to change from a decrease of 36 to an increase of 34. The amplitude of the selling price index of household milk has a tendency to change from 26 to an increase of 24. Amplitude of the egg sales price index of household tend to increase from 17 to 19. The results of estimating the change in the sales price index of live-stock animals (live weight) of households from the impact of live-stock animal production (live weight) of households in Ukraine are shown in Table 3.

Table 3

**Estimation of change in the sales price index of live-stock animals (live weight) sale of households from the impact of production volume of live-stock animals (live weight) of the households in Ukraine**

t	Sales price index of live-stock animals (live weight) of Ukrainian households	Volume of production of live-stock animals (live weight) of households of Ukraine, thousand tons	Theoretical estimation of the sales price index of live-stock animals (live weight) of households of Ukraine	Deviation of the actual price index of sales of live-stock animals (live weight) of households of Ukraine from the theoretical assessment
	qt1_d(t)	vt1_d(t)	$\hat{q}t1_d(t)$	$e9_1 = qt1_d(t) - \hat{q}t1_d(t)$
1	184,9	1426,5	181,9	3,1
2	90,2	1435,9	88,9	1,3
3	124,4	1311,3	126,8	-2,4
4	151,1	1251,6	140,4	10,7
5	123,4	1277,7	136,4	-13,1
6	127,1	1298,2	120,3	6,8
7	107,5	1258,3	99,4	8,1
8	104,5	1310,9	104,6	-0,1
9	108,2	1238,6	108,7	-0,5
10	106,2	1168,9	116,8	-10,6
11	120,3	1161,9	123,7	-3,4
Average:	122,5	1285,4	122,5	0,0

Source: calculated by the author based on data [4, 5, 6, 7]

It has been established that the decrease in the share of household production in livestock is possible due to fluctuations in prices for meat products (amplitude will decrease by 6.6%) and milk (amplitude will decrease by 4.8%), increase is possible due to prices for egg products (the amplitude will increase by 6.9%).

Evaluation of the reliability of the results of modeling the dependence of the factors of sales price indices of the main types of crops in the crop sector of farms on their gross harvest (block 3) confirmed the high level

of closeness of the relationship between the factors. The reliability of the coefficient of determination that characterizes the influence of selected factors ranges from 90% to 99%, and the influence of factors not included in the model is estimated in the range from 1% to 10%. The results of estimating the change in the price indices of sales of cereals and legumes of agricultural enterprises from the impact of the gross harvest of farms in Ukraine are shown in Table 4.

Table 4

**Estimation of changes in price indices of sales of grain and legumes of agricultural enterprises from the impact of gross harvest of the farms in Ukraine**

No.	Price index of sales of grain and legumes of the agricultural enterprises of Ukraine	Gross harvest of grain and legumes of the farms of Ukraine, thousand tons	Theoretical index of sales prices of grain and legumes of the agricultural enterprises of Ukraine	Deviation of the actual index of sales prices of grain and legumes of the agricultural enterprises of Ukraine from the theoretical assessment
	qr1_f(t)	vz1_f(t)	$\hat{q}r1_f(t)$	$e11_1 = qr1_f(t) - \hat{q}r1_f(t)$
1	91.8	4082.7	90.8	1.0
2	123.3	4226.6	132.1	-8.8
3	161.8	3249.5	149.2	12.6
4	81.6	6857.3	86.8	-5.1
5	102.6	5555.8	104.1	-1.5
6	140.3	4702.5	142.1	-1.8
7	121.4	6734.6	124.0	-2.6
8	109.1	5046	106.8	2.3
9	90.8	7439.1	88.5	2.3

10	132.8	7693.3	140.6	-7.8
11	156.6	7650.2	159.2	-2.6
Average:	119.3	5748.9	120.4	-1.1

Source: calculated by the author based on data [4, 5, 6, 7]

The obtained calculations for farms showed that: the amplitude of the sales price index of cereals and legumes has a tendency to change in the range from 18 to 22; the amplitude of the sales price index of oilseeds tends to change in the range from -27 to 39; the amplitude of the sugar beet sales price index tends to change in the range from -38 to 25; the amplitude of the potato sales price index tends to change in the range from -53 to 60; the amplitude of the vegetable price index tends to change in the range from -15 to -26; the amplitude of the fruit and berry sales price index tends to change in the range from -12 to 29.

It is established that the decrease in the share of crop production in the production of farms is due to: fluctuations in prices for sugar beets (amplitude will decrease by 9.0%), vegetables (amplitude will decrease by 1%) and fruit and berries (amplitude will decrease by 0.4%). The growth of the share of crop production of farms is due to: fluctuations in prices for cereals and legumes (amplitude will increase by 0.4%), oilseeds (amplitude will increase by 1.4%) and potatoes (amplitude will increase by 1.3%).

Evaluation of the reliability of the results of modeling the dependence of the factors of sales price indices of the main types of crops in the crop sector of households on their gross harvest (block 2) showed a high level of closeness of the relationship between the

factors. The reliability of the coefficient of determination, which characterizes the influence of selected factors, ranges from 91% to 99%, and the influence of factors not included in the model is estimated in the range from 1% to 9%. The evaluation results are shown in Table 5. The calculations obtained by households showed that: the amplitude of the sales price index of cereals and legumes tends to change in the range from 28 to 29; the amplitude of the sales price index of oilseeds tends to change in the range from -62 to -24; the amplitude of the price index of sugar beet sales tends to change in the range from -33 to 25; the amplitude of the potato sales price index tends to change by 39; the amplitude of the vegetable sales price index tends to change in the range from -23 to 39; the amplitude of the price index of sales of fruits and berries tends to change in the range from -33 to -19.

It is established that the decrease in the share of crop production in household production is due to: fluctuations in prices for cereals and legumes (amplitude will decrease by 14.4%), oilseeds (amplitude will decrease by 10.8%), sugar beets (amplitude will decrease by 24.0%) and fruit and berries (amplitude will decrease by 15.2%). The growth of the share of crop production in households is due to: fluctuations in sales prices of potatoes (amplitude will increase by 14.8%) and vegetables (amplitude will increase by 22.6%).

Table 5

**Estimation of change in price indices of sales of grain and legumes of the households from the impact of gross harvest of the households in Ukraine**

No.	Price index of sales of grain and legumes of the households of Ukraine	Gross harvest of cereals and legumes of the households in Ukraine, thousand tons	Theoretical estimation of the sales price index of grain and legumes of the households of Ukraine	Deviation of the actual price index of sales of grain and legumes of the households of Ukraine from the theoretical assessment
	$qr1\_d(t)$	$vz1\_d(t)$	$\hat{qr}1\_d(t)$	$e10\_1 = qr1\_d(t) - \hat{qr}1\_d(t)$
1	91.8	9225.1	89.9	1.9
2	123.3	8559.7	135.7	-12.4
3	161.8	6446.8	152.7	9.0
4	81.6	11195.9	80.4	1.2
5	102.6	10186.4	99.7	2.9
6	140.3	9491.6	138.3	2.0
7	121.4	12527.5	125.9	-4.5
8	109.1	10141.2	112.6	-3.5
9	90.8	13227.2	90.0	0.8
10	132.8	13956.7	131.3	1.5
11	156.6	13619.2	155.6	1.0
Average:	119.3	10779.8	119.3	0.0

Source: calculated by the author based on data [4, 5, 6, 7]

The assessment of the factor of gross surplus exchange value of agriculture of Ukraine under the influence of shares of live-stock and crop production, estimated on the basis of factors of selling prices and production of households and farms confirmed the high level of correlation ratio between the factors. The reli-

ability of the coefficient of determination, which characterizes the influence of selected factors, ranges from 81% to 98%, and the influence of factors not included in the model is estimated in the range from 2% to 19%. The assessment of the share of gross live-stock production showed that due to the activity of households the amplitude of the share of gross live-stock production

will increase by 9.4%, and due to the activity of farms by 68%. However, the overall change of the live-stock industry is a downward one and has a low initial level of 14.8% excluding the impact of the shares of these business patterns.

The assessment of the share of gross crop production showed that due to the activity of households the amplitude of the share of gross crop production will decrease by 0.35%, and due to the activity of farms will increase by 1.7%. The general change of the crop industry is an upward one and has a high initial level of 67% without taking into account the impact of the shares of these business patterns.

The resulting estimate is gross surplus exchange value. Estimation of gross surplus exchange value based on estimates of shares of crop and live-stock of functioning of farms and households showed that it is determined by fluctuations and periodicity of changes in crop production (changes in the amplitude of gross surplus exchange value range from -154689 million UAH to 204080 million UAH) and direct proportionality of changes in the share of gross output of the live-stock industry (decrease in gross surplus exchange value by UAH 241787.4 million with an increase in the share of the live-stock industry by 1%).

**Conclusion.** According to the results of econometric modeling of the assessment of the impact of certain types of small business patterns on the gross surplus exchange value of agriculture in Ukraine as a whole, we can note:

1. The stability of the changes of agricultural product sales prices significantly depends on the share of households (low level compared to agricultural enterprises) in the agricultural sector of Ukraine, which is an incentive to increase supply in commodity markets.

2. The extension of household activities in the field of crop production for the market of agricultural products is due to the cultivation of potatoes and vegetables. In general, due to lower sales prices in households, the share of gross crop production in the agricultural sector can be expected to decrease by 0.35%. Farms have the potential to grow grain and oilseeds, under the implementation of which the expected share of gross crop production will increase by 1.7%. In general, the crop sector is weakly dependent on small business patterns and its surplus exchange value in the structure without their influence is about 67%, for the account of large and medium enterprises.

3. Live-stock husbandry is focused on the development of small farms despite the reduction of production. The share of gross livestock production may increase by 9.4% for the account of households and by 68% for the account of farms. There is a potential for farm growth in meat and milk production and household growth in egg production.

4. Gross surplus exchange value of agricultural products is due to the periodicity of downward and upward trends of price fluctuations in the commodity markets of the main types of crop products, one of the players of which are farms and households. The share of live-stock production reduces gross surplus exchange value by increasing price indices for its main types and insufficient production volumes. The inability to form sufficiently large batches of products that can put pressure on the market complicates the system of sales and logistics and confirms the need to combine small businesses into sales consumer cooperatives.

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