Price Parity of Reconstructing Technological Supply Chain Capacity in the Agricultural Sector of Ukraine

O. Varchenko[#1], I. Svynous[#2], V. Skotsyk[#3], Y. Grynchuk[#4], L. Khakhula[#5], Larysa Khakhula[#6]
[#]*Bila Tserkva National Agrarian University*
[*]*Candidate of Pedagogic Sciences, Associate Professor, Department of management, Bila Tserkva National Agrarian University, Sq. Soborna, 8/1, m. Bila Tserkva, Kyiv region, 09117, Ukraine.*
grynchuk1979@icloud.com

Abstract- **The main form of equivalence of professional trade in the agricultural sector remains the parity of agricultural producers and the prices of goods and services of industrial origin that they buy. The price of equality for the supply chain capacity of agricultural products is equal to the product of the price level for the base period and the industrial product price index for the current year. The efficient functioning of agriculture depends on the equivalence of relations with other sectors of the national economy, mainly with industry, as a supplier of material and technical resources.**
The main reason for the appearance of price disparity is a significant reduction in the production of agricultural machinery by agricultural machinery companies compared to the pre-reform period. Now in economic theory two methodical approaches are used to calculate the index of equality between agriculture. The price of equality for the supply chain capacity of agricultural products is equal to the product of the price level for the reference period and the index of prices produced in current year products and input resources. The first (concept of income) presupposes that the price ratio between agricultural and industrial products must influence the evolution of production volumes. The calculation of the parity index using the concept of exchange provides for the determination of the correlation of the price indices for agriculture. The price of equality for the capacity of the agricultural technology supply chain is equal to the product of the price level for the base period and the price index of industrial products in agricultural products and machinery of the current year. This approach truly reflects the role of agriculture in the system of market-money relations.

Keywords- *price parity, technological supply chain capacity, parity index, agricultural products, modernization.*

1. Introduction

Equivalence of economic relations in the agrarian sector is a specific form of implementing the general principle of the conditions of agro-industrial production. The equivalence of interbranch exchange, in this case, means that a certain amount of social labor embodied in the consumer value of agricultural products is exchanged for an equal amount of social labor invested in the consumer value of products and services of industrial origin. Equivalence and the creation of equal economic conditions for all participants in the exchange can theoretically be achieved through the functioning of the totality of price and financial relations. This is because even in a market economy, the formation of equilibrium prices manifests itself only in a tendency and in agriculture, the effect of rent factors and low elasticity of demand narrows the sphere of action of equilibrium prices.

2. Analysis of the latest research and publications

The study of the peculiarities of formation of parity relations between producers of agricultural products and technical means is constantly in the field of view of domestic and foreign scientists. Among them, the study of the peculiarities of price formation and pricing processes in the agrarian sector was carried out by V. Andreychuk, YU.P. Voskoboynyk, V.A. Esypov, YU.F. Mel′nyk, B.Y. Paskhaver, V.V.

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Pynyshko and P.T. Sabluk, the problem of the disparity of prices for agricultural products, as well as the development of ways to achieve parity in economic relations, agricultural scientists such as Lukinov I.I., Oliynyk O.V., Shpychak O.M. and others. In the works of E. Sagaidak, A. Shutkov, A. Rybak, N. Zimin and Yu. Konkin, the reasons for the violation of price parity are revealed. However, the volatility of the agricultural products market and the market of material and technical resources necessitates research on establishing an equivalent exchange between agriculture and the production of the means of production. The aim of the study is to develop practical recommendations on the formation of equivalence between agricultural enterprises and manufacturers of technical equipment.

3. Materials and Methods

To implement the tasks set in the article, such methods and techniques were used: abstract-logical, computational-constructive - in substantiating the equivalent exchange between producers of agricultural machinery and agricultural enterprises.

4. Results and Discussion

However, the main form of ensuring the equivalence of inter-sectoral exchange in the agrarian sector remains the parity of agricultural producers and prices for goods and services of industrial origin that they acquire. The immediate indicators that reflect the state and dynamics of price parity are the price indices and their ratios for agricultural and industrial output in the current (accounting) period relative to the time period adopted as the base period. On the basis of this approach, the level of the parity price for agricultural products is determined, equal to the product of the price level for it in the base period and the index of prices for industrial products in the current year. The criterion of parity is the opportunity for agricultural producers at these price levels to purchase in the current period the quantity of industrial goods and services that they could acquire in the base [1].

If the equivalence of exchange in agriculture is significantly violated, then it manifests itself in a whole series of indicators, and vice versa, if the parity ratio has a positive dynamic, this is manifested by an increase in the level of profitability, wage level, rate of accumulation of resources, etc. Therefore, the effective functioning of agriculture depends on the equivalence of relations with other branches of the national economy, primarily with industry, as a supplier of incoming material and technical resources.

In recent years, in the conditions of the monopoly of processing and marketing enterprises, as well as suppliers of material and technical resources for the industrial production of equivalent exchange between the I and II spheres, the agro-industrial complex has sharply escalated. The nonequivalent exchange between the branches of agriculture and industry because of the violation of price parity leads to a deterioration in the conditions of reproduction in agriculture [2]. The main reason for the emergence of price disparity is a significant reduction in the output of agricultural machinery by agricultural machinery enterprises in comparison with the pre-reform period. In the pre-reform period, the enterprises of the machine-building industry focused on minimizing costs in the production of agricultural machines (due to economies of scale). In this case, a cost-based pricing method was used. At a price level equal to P_0, the price of the consumer $P_n$exceeded the manufacturer's price or is equal to it, that is, the consumer, in this case the agricultural producer, was profitable to purchase the machine. In case the manufacturer's price exceeded the consumer's price, the state compensated the consumer's losses. After the implementation of pricing reforms, in the conditions of inflation, the number of cars produced was reduced (Q_1). Accordingly, the cost of producing one machine increased, and the price increased (to P_1). The producer's price became higher than the consumer's price; a disparity of prices was formed. Thus, the disparity of prices between agricultural machinery products and agricultural products is the difference between the manufacturer's price and the price of the consumer. In this case, the task of finding parity is reduced to determining the price of a consumer, that is, some maximum price that a rural commodity producer can offer for the purchase of equipment.

Now in economic theory, two methodical approaches are used to calculate the parity index between agricultural products and input material resources. The first (income concept) - assumes that the price ratio between agricultural and industrial products should influence the change in production volumes [3]. In part, this does not agree with these methodological approaches to determining the parity index according to the income concept. It should be noted that the volume of production of agricultural products, in particular, plant growing, is significantly affected by the natural and climatic conditions prevailing in the reporting year. In this case, the natural yield of agricultural crops can neutralize or deniveluvat value of the parity index. As the data in Fig. 1, observed a significant difference between the calculated parity values in 2004, 2008, 2011 - 2013. To some extent, the use of this indicator gives grounds to assert that elimination of the disparity of prices for agricultural and industrial products is possible not only with the use of state regulation methods but also at the expense of internal reserves of agribusiness entities. In the world practice, there are positive examples of the successful functioning of agriculture in conditions of a decline in parity of prices, in particular in Germany. Between 1992 and 1999, parity of prices has significantly decreased, but at the same time, labor productivity has increased: 18% reduction in relative prices for agricultural products was accompanied by a 54% increase in labor productivity [4].

The calculation of the parity index by the exchange concept provides for the determination of the ratio of price indices for agricultural products and agricultural machinery [5]. In our opinion, it really reflects the role and place of agriculture in the system of commodity-money relations. In general, as the results of the conducted studies show, the parity index between prices for agricultural products and agricultural machinery is characterized by instability, does not form the preconditions for effective economic activity and because of technical re-equipment.

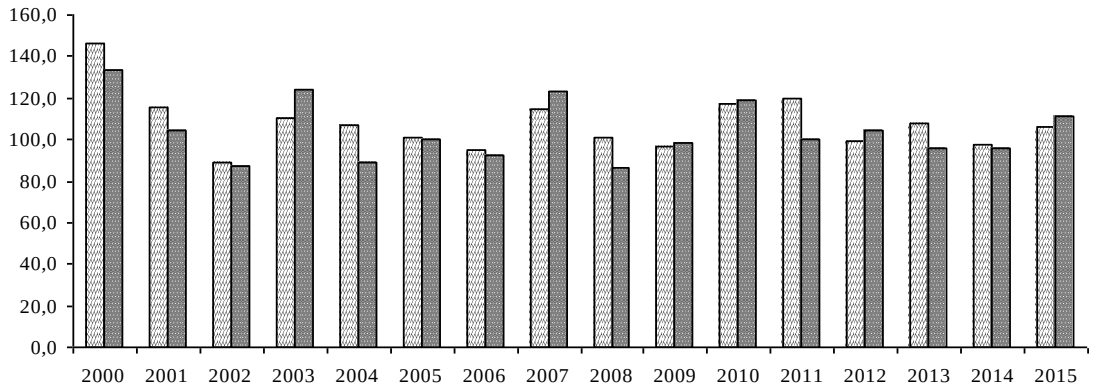

Fig 1. Dynamics of parity indexes between prices for agricultural products and agricultural machinery

Source: developed by the author.

One of the varieties of parity indicators is the index of the expediency of replacing living labor with technical means. It is calculated as the ratio between the index of changes in wages in agricultural enterprises and the cost of technical means. In our opinion, its importance should be one of the indicators for agricultural engineering enterprises - in order to create an adequate price for technical means, state authorities - to ensure effective support of business entities in the field of engineering and agriculture, corporate farms of the agrarian economy - to determine the expediency of acquisition. During the period 2000 - 2003 and 2005-2013, the rate of change in labor remuneration exceeded the index of changes in the value of agricultural products ensured the value of the technical

re-equipment index is more than 100% (Figure 2).

In such conditions, agricultural enterprises are advisable to carry out the process of modernization of the technical base, which will ensure a reduction in the costs of living labor and improving the efficiency of production. In the context of manifestations of destructive phenomena in the economy of the country, the rate of change in labor remuneration is much lower compared to the growth in the cost of technical means; conditions for the acquisition of agricultural machinery are not created.

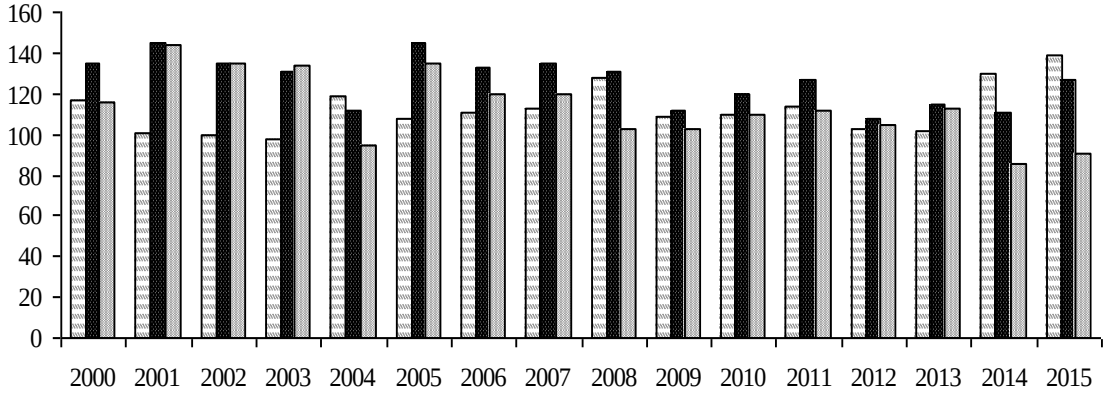

Fig 2. Dynamics of indices of the value of agricultural machinery, changes in labor remuneration and the appropriateness of technical re-equipment %

Source: developed by the author.

Technical re-equipment of farms in the corporate sector of the agrarian economy contributed to the growth of labor productivity and a decrease in the number of people employed in agriculture (Figure 3).

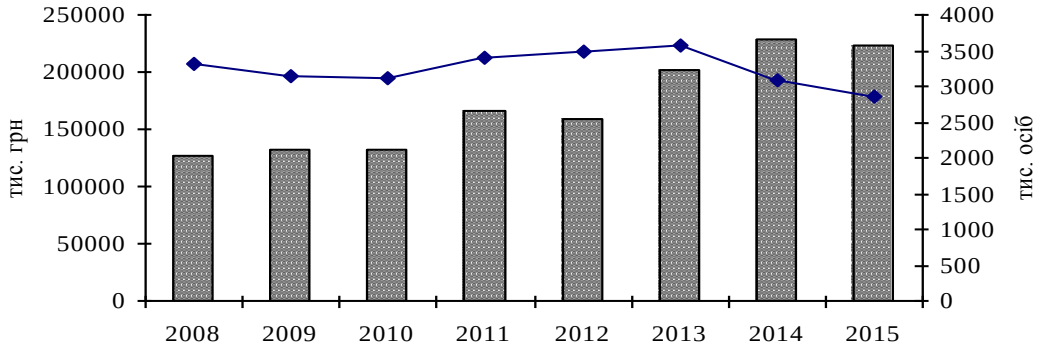

Fig 3. Dynamics of labor productivity in the economy of the corporate sector of the agrarian economy and the number of employed in agriculture

Source*:* compiled according to the State Statistics Service of Ukraine.

During 2008 - 2015, there is a significant increase in labor productivity (by more than 75%, including in plant growing - by more than 53%, livestock production - by 2.5 times), with a decrease in the number of employed in agriculture by almost 13% 6%. This situation is possible only if there is a significant modernization of the technical base of agricultural enterprises.

Chain indices were used to determine the parity indices in the calculations. This circumstance is caused by manifestations of inflationary processes in the economy of the country and the absence of the prerequisites for determining the base year for calculating indices of changes in the value of agricultural products and "incoming" material resources.

In order to establish price parity, we will consider the process of generating losses that occurred if the rural commodity producer does not have the necessary equipment, or the additional economic benefit that he receives in the event of its acquisition.

To determine the real calculation of the parity between agricultural products and agricultural machinery, the prices of cereals and grain harvesters are used. First, this condition is dictated primarily by technological supply chain capacity dependence. Secondly, the main factor that influenced the choice of cereal crops is the masivism of their growing and domination in the structure of production and Sale of farms in the corporate sector of the agrarian economy [6].

In actual production conditions, the actual yield of grain crops can be determined by the formula:

$$У_{max} = У_0 - \sum_{j=1}^{m} В_{jклім} - \sum_{i=1}^{n} В_i$$

(1)

Where $У_0$ is the biological yield, the highest possible under favorable climatic conditions;

$B_{клім}$- losses associated with natural and climatic risks;

B_i- losses on i-th First, this condition is dictated primarily by technological supply chain capacity dependence operation, caused by the untimely and lengthy performance of works, as well as violation of technology of agricultural operations.

The duration of First, this condition is dictated primarily by technological supply chain capacity dependence operations has a great influence on the yield of cultivated crops, and for the different climatic conditions and different crops, the nature of this effect is different. The analysis of literary sources [7] showed that in the course of such operations as harvesting, the current harvest losses for the main cereals could be determined by linear dependence:

$$В_{тi} = \frac{1}{2} k_{ni} \cdot n_i,$$

(2)

Where k_{ni}- loss factor for the i-th operation, tons per hectare per · day;

n_i-total duration of the First, this condition is dictated primarily by technological supply chain capacity dependence operation, days. In value terms, the projected losses of the future crop in a particular process operation are alternative costs that can be determined by the formula:

$$В_{Aj} = Ц \cdot П_j, \text{ UAH / ha} \quad (3)$$

or taking into account formula (5.3):

$$В_{Aj} = Ц \frac{k_{nj} \cdot n_i}{2}, \text{грн/га,} \quad (4)$$

where *Ц* - the price of one ton of grain, UAH / t.

The production costs for the reduced First, this condition is dictated primarily by technological supply chain capacity dependence operation can be determined by the formula:

$$З_n = ЗП + ПММ + Р + А, \text{грн/га,}$$

(5)

where, *ЗП*- labor costs, UAH / ha;

ПММ- costs for fuel and lubricants, UAH / ha;

Р - expenses for repairs and technological services, UAH / ha;

А - amortisation charge, UAH / ha;

When carrying out a First, this condition is dictated primarily by technological supply chain capacity dependence operation (in this case harvesting cereals) for a combine harvester of this brand, it is possible

$$З_n = \mu_i \cdot С_i, \text{ грн/га,} \quad (6)$$

where, *С* - the price of combine, UAH;

μ- factor of proportionality.

Required number of harvesters for harvesting work can be defined as

$$N = \frac{S}{W \cdot n_{ji}},$$

(7)

where *W* - the daily capacity of the unit, ha / day;

S - the area, ha.

Studies show that the productivity of new combines is usually higher than that of combines that are in operation for a long time.

Thus, the total cost of harvesting crops can be expressed as

$$З_{ni} = \frac{\mu_i \cdot C \cdot S_i}{1.36 \cdot W \cdot n_j},$$

(8)

The most acceptable criterion for the efficiency of this condition is dictated primarily by technological supply chain capacity dependence operation, in particular, the harvesting of cereals, is the aggregate level of expenditure, which is the sum of crop losses (grains) in this operation and the production costs for it

$$З_i = \frac{S}{2} \cdot Ц \cdot k_j \cdot n_j + \frac{\mu \cdot C \cdot S}{1.36 \cdot W \cdot n_j} \to min,$$

(9)

Or the level of aggregate unit costs

$$З_i = \frac{Ц \cdot k_j \cdot n_j}{2} + \frac{\mu \cdot C}{1.36 \cdot W \cdot n_j} \to min,$$

(10)

Expressions (9) and (10) are production functions. In order to find the optimal value (the extremum of the function) of the parameters of the production function, it is necessary to find the derivative and equate it to zero. The numerical value of the optimal duration of a First, this condition is dictated primarily by technological supply chain capacity dependence operation can be determined by searching for the extremum of the function of aggregate (total) costs (11) relative to the duration of the operation n_j:

$$\frac{dЗ_j}{dn} = 0$$

(11)

Or

$$\frac{dЗ_j}{dn} = \frac{Ц \cdot k_{nj}}{2} + \frac{\mu \cdot C}{1.36 \cdot W \cdot n_j{}^2} = 0,$$

12

(12)

Hence

$$n_{opt} = \sqrt{\frac{2 \cdot \mu \cdot C}{1.36 \cdot W \cdot Ц \cdot kn_j}},$$

(13)

To carry out further analysis, we introduce the notation $q = \frac{C}{Ц}$, which is a "grain equivalent", the meaning of which means what volume of production can be paid for one combine harvester, is involved in the technological supply chain capacity operation. In this case, expression (13) takes the form:

$$n_{opt} = \sqrt{\frac{\mu \cdot q}{0.68 \cdot W \cdot k_{nj}}},$$

(14)

In view of the foregoing, the actual yield with the optimal duration of a process operation can be defined as

$$У_{max} = У_0 - \sum_{j=1}^{m} В_{jклім} - \sqrt{\frac{\mu \cdot q}{0.68 \cdot W \cdot k_{nj}}}$$

(15)

The rural commodity producer, on the basis of considerations of profitability of purchase, will purchase the means of mechanization in the event that the total loss of harvest (for the whole life of the machine) without the use of these machines will be greater than their price:

$$q \le \frac{0.68 \cdot W \cdot k_{nj} \cdot n_{opt}{}^2}{\mu},$$

(16)

Thus, the cost of a combine harvester in grain equivalent depends on compliance with the agrotechnical terms of harvesting, the productivity of this combination for crop losses in a given technological supply chain capacity operation and the production costs for its carrying out. In order to find the maximum ratio of the prices for grain and combine harvester, it is necessary to determine the optimum duration of the technological supply chain capacity operation, the productivity of the combine and the costs of carrying out the technological operation [8].

The results of calculating the actual price level in "grain equivalent" for grain harvesters are given in Table 1. For calculations, two combines: domestic KSS-9-1 "Славутич"(Slavutich) and the imported Claas Lexion 560.

When calculating the value of the loss factor during harvesting (k_{nj}), it was assumed to be

0.03. According to the scientific literature, the recommended duration of harvesting (n_{opt}) is 10-12 days. According to technological cards, the share of expenses for direct collection of winter crops in the structure of variable costs is 20%. Correspondingly, the proportionality factor (μ) is - 0.2. Productivity of the combine KSS-9-1 "Славутич" (Slavutich) - 11 tons / h or 40 hectares / day (with a base yield of 40 dt/ha); The Claas Lexion 560 combine is 20.34 tons / hour or 61.2 hectares per day.

Table 1. Determination of the actual "grain equivalent" for grain harvesters

Year	Cost of 1 ton of wheat, UAH	The cost of a combine "Славутич" (Slavutych), thousand UAH	The cost of the combine Claas Lexion 560 thousand UAH	"Grain equivalent" of "Славутич" (Slavutych)combine, tons	"Grain equivalent" of the combineClaas Lexion 560, tons
2006	492,8	567,3	2079,3	1151,18	4219,36
2007	415,2	651,6	2469,2	1569,36	5947,01
2008	527	687,6	2815,1	1304,74	5341,75
2009	796,7	728,8	2084,6	914,77	2616,54
2010	753	969,5	2559,8	1287,52	3399,47
2011	791,6	1099	3130,8	1388,33	3955,03
2012	1085,8	917,3	2540,4	844,81	2339,66
2013	1333,1	861,4	2088,2	646,16	1566,42
2014	1550,3	851,1	3378,9	548,99	2179,51
2015	1368,1	686,4	4132,4	501,72	3020,54

Source: developed by the author.

We substitute the obtained initial data into the right part of the ratio. For the Combine KSS-9-1 "Славутич" (Slavutych) the "grain equivalent" is:

$$q = \frac{0{,}68 \cdot 40 \cdot 0{,}03 \cdot 10^2}{0{,}2} = 408\ (\text{тонн})$$

.

Accordingly, for the combine Claas Lexion 560:

$$q = \frac{0{,}68 \cdot 61{,}2 \cdot 0{,}03 \cdot 10^2}{0{,}2} = 624{,}24\ (\text{тонн})$$

.

The comparison results for the absolute and relative disparity of prices for combine harvesters are presented in Table 2.

As can be seen from the results of calculations (Table 2), the discrepancy is observed in the prices of grain and grain harvesting equipment. In addition, if for domestic combine KZS-9-1 "Славутич" (Slavutych) for the last 3 years of the analyzed period parity tended to equalize: so in 2015 the difference between the actual cost and the calculated was 93.72 tons or 22.97%. The average level of disparity for the imported combine harvester, Claas Lexion 560, was 454% and in particular for 2015 383.87%. That is, the actual level of the price of a combine harvester exceeded 3.8 times the price, which the agricultural producer can pay based on reasons of profitability.

Table 2. The definition of the absolute and relative disparity of prices in the "grain equivalent"

Year	Actual"grain equivalent", tons		Parity"grain equivalent", tons		Absolute disparity		Relative disparity,%	
	КЗС-9-1	Claas Lexion 560	КЗС-9-1	Claas Lexion 560	КЗС-9-1	Claas Lexion 560	КЗС-9-1	Claas Lexion 560
2006	1151,18	4219,36	408,00	624,24	743,18	3595	182,15	575,92
2007	1569,36	5947,01			1161,36	5323	284,65	852,68
2008	1304,74	5341,75			896,74	4718	219,79	755,72

2009	914,77	2616,54			506,77	1992	124,21	319,16
2010	1287,52	3399,47			879,52	2775	215,57	444,58
2011	1388,33	3955,03			980,33	3331	240,28	533,58
2012	844,81	2339,66			436,81	1715	107,06	274,80
2013	646,16	1566,42			238,16	942,2	58,37	150,93
2014	548,99	2179,51			140,99	1555	34,56	249,15
2015	501,72	3020,54			93,72	2396	22,97	383,87

Source: developed by the author.

The calculation was carried out in the statistical package Minitab 16. The result of the autocorrelation analysis is shown in Table 3 and in Figure 4. As can be seen from the result, in particular, the form of the autocorrelation function, in the time series of the dollar, there is no statistical relationship. Since the coefficients of autocorrelation for any lag are close to zero. Therefore, building a forecast based on statistical methods is impossible.

Table 3. Autocorrelation analysis of the time series of the US dollar. *Source*: developed by the author.

Lag	ACF1	TSTA1	LBQ1
1	0,313367	1,085535	1,499764
2	0,110697	0,350581	1,705628
3	0,080792	0,253291	1,827472
4	0,048907	0,152514	1,877702
5	-0,01392	-0,04331	1,88235
6	-0,1693	-0,52685	2,684886
7	-0,18418	-0,56035	3,824712
8	-0,18589	-0,55129	5,275962
9	-0,18243	-0,52783	7,139596
10	-0,17454	-0,49368	9,698565

Therefore, for the forecast of the course we use the expert method. To do this, based on the views of analysts, we will adopt three options for the development of the situation: the immutable rate of the dollar, growth, decrease.

The optimistic scenario of the course includes a dollar at the level of 18 UAH, pessimistic - 35 UAH. Most financiers converge on a course within the limits of 22.5-23.5 UAH (for calculations we will accept 23 UAH per dollar).

On the basis of this information, we will determine the possible costs of combine harvesters. At the beginning of the year, the price of Claas Lexion 560 is 4620 thousand UAH, KSS-9-1 "Славутич" (Slavutych) - 1250 thousand UAH. Assuming that the Claas combine harvester is imported and the price change is 100% dependent on the rate, three possible variants of the price will be: 3615,7 thousand UAH; 4620 thousand UAH; 7030.4 thousand UAH.

Taking into account the share of imported units and aggregates, of which the combine harvester "Славутич" (Slavutych) is composed, we assume the dependence of the price on the exchange rate on 80%, and, consequently, the variants of prices are: 978.2 thousand UAH; 1250 thousand UAH; 1902.2 thousand UAH.

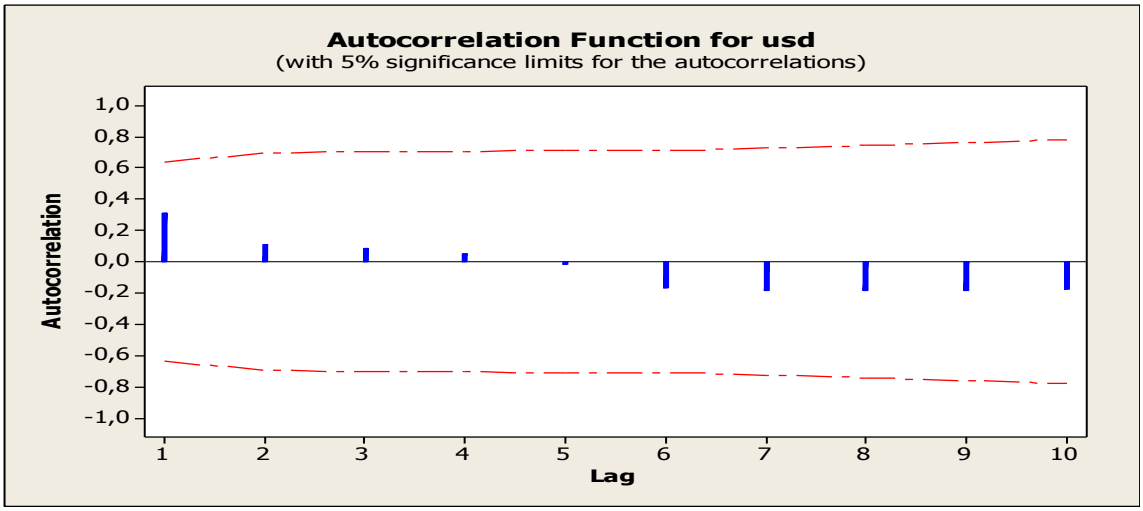

Fig 4. Graph of the autocorrelation function of the dollar exchange rate, *Source*: developed by the author

Similarly, we will define three possible prices for winter wheat. But here the approach with the price at the beginning of the year is inapplicable. We use the hypothesis about the simultaneous dependence of the price on yield and the exchange rate. In addition, we will construct a multiple regression.

According to the grain price model, we need to know the forecast yield of winter wheat for 2017. To do this, we use the forecast of the National Academy of Agrarian Sciences of Ukraine. According to their program "Grain of Ukraine", the forecast yield of wheat in the winter of 2017 will be 45.2 dt/ha. We substitute the obtained values in the price formula and determine the "grain" equivalents for the selected grain harvesting equipment under different course scenarios (Table 4). As can be seen from Table 4, the choice of the scenario for the development of the dollar's exchange rate has a special effect on the "grain" equivalent. Since the exchange rate changes equally affect the price of wheat and machinery. According to the parity of prices, the disparity on the combine of the firm Claas, though it will decrease, will however remain (relative disparity will be 67.5%).

As for the domestic combine "Славутич" (Slavutich), the projected "grain equivalent" will be less by 27% of parity. That is, the disparity of prices for grain and grain harvesters will disappear. Among representatives who lobby the interests of large agribusiness, the widespread belief is that raising the prices of agricultural products will help to solve the problem of disparity of prices. Many governments used this tactic, and then found that such measures were extremely expensive and ineffective in the end. The support of prices will bring temporary relief to producers, however, as the terms of trade for agriculture in the world continue to worsen, the state will require more and more financial resources to support even the existing parity of prices. State regulation and price subsidies also lead to conflicts with trading partners and organizations such as the World Trade Organization.

Table 4. Determination of the forecast value of combine harvesters in the "grain" equivalent in 2017

"what if" scenario	Rate, UAH / USD	Yield, dt/ha	The price of winter wheat, UAH / tons	The cost of a combine thousand UAH		"Grain equivalent", tons	
				КЗС-9-1 "Славутич" (Slavutich)	Claas Lexion 560	КЗС-9-1 "Славутич" (Slavutich)	Claas Lexion 560
Optimistic	18	45,2	3299,84	978,2	3615,7	296,44	1095,72
"Realistic"	23	45,2	4414,84	1250	4620	283,12	1046,47
Pessimistic	35	45,2	7090,84	1902,2	7030,4	268,26	991,48

Source: developed by the author.

5. Conclusion

Estimating the level of parity between agricultural and agricultural machinery, it should be noted that during 2014 – 2015. There is a disparity of prices, does not ensure the modernization of the technical base of agriculture. In our opinion, the establishment of appropriate proportions between agricultural products and an industry that would satisfy all subjects of relations is possible not only with the use of state support methods, but also with the search for domestic reserves of agricultural producers, mainly through the introduction of innovations in production activities. Determination of the price ratio between the cost of grain and agricultural machinery should be an indicator for the adoption of appropriate management decisions at the level of business entities in the field of agribusiness and agricultural machinery and government authorities to formulate and regulate prices for agricultural products and equipment.

The proposed methodical approach will contribute to the development of rational management decisions at the level of the subjects of the agricultural machinery industry to reasonably determine prices for technical resources, to increase the effectiveness of state economic regulation and economic justification for agricultural producers.

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