Impact of Seasonal Production on the Dynamics of Prices for Meat and Dairy Products in Ukraine

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Abstract – **There are seasonal deficits during the year in the meat and dairy product markets that lead to an increase in consumer prices.**

The calculated coefficient of elasticity showed that prices increase by 0.05%, with a decrease in the monthly supply volumes of meat by 1%.

The calculated coefficients of elasticity indicate that the consumer price index for drinking milk, cheese and butter increases by 0.24, 0.12 and 0.13%, respectively, and with a decrease in the production of milk raw materials by 1%.

Keywords **- meat, milk, prices, seasonality, deficit.**

1. Introduction

The European integration vector of Ukraine's development implies, first of all, the formation of a modern model of the economy in which the high standard of living of its citizens is one of the key strategic goals. Internal policy of the government should be aimed at ensuring sustainable growth of real incomes regarding the population in order to achieve such a goal. Among other things, this can be achieved under the condition of a significant

slowdown in prices increase, first of all consumer ones. Galloping growth of the consumer price index is a topical social-and-economic problem of the Ukrainian economy - its value was 110.9% in 2018, and in the last five years (2014-2018) it grew 2.4 times substantially damaging the government's efforts to increase the incomes of the country's population.

In our opinion, taking measures to stabilize prices in the food segment of the consumer market is the most actual vector of anti-inflationary policy of the government based on the fact that at present the population of Ukraine use more than 50% of their expenses for buying of foodstuffs.

The object of our study is the dynamics of consumer prices for meat and dairy products. This is dictated by the following considerations: 1) one of the most reliable indicators of the standard regarding person's living is the volume of his consumption of valuable food products, to which, first of all, belong the products of animal origin - meat and dairy; 2) meat and dairy products are among the leaders of the basic foodstuffs by the rates of consumer prices growth for the last 19 years (2000-2018); 3) more than 34% of the impact on the formation of the consumer price index for food and non-alcoholic beverages is for meat and dairy products.

2. Literature review

Prices have always been and will be the subject of a careful attention from the scientific community, state authorities, and the public. This is dictated by many reasons by which the social-and-economic context and the changing character of the nature are the most important among them. The category "price" is the most complex and widespread among all economic categories. It is the most used by persons in everyday life, and it is the bearing frame of the entire economic mechanism of the national economy [1].

Despite the scientific development of this topic, principles of the formation and methods of prognosis for food prices in the Ukrainian economy are a newly studied problem. Some aspects of their formation are studied by domestic expert environment, [3]. However, the comprehensive concept of price formation, based on general and specific features of the Ukrainian economy is still absent. It has to be admitted that its formation in the short-term future is objectively problematic task because of the incomplete reform and uncertainty of the place of the Ukrainian economy in the global economic environment. In our opinion, the most important part of the uncertainty is caused by the last factor. Internal transformation processes in the Ukrainian economy coincided in time with the rapid liberalization of its foreign trade relations, which was marked by entering of Ukraine to the WTO and signing of the EU-Ukraine Association Agreement. As a result, Ukraine got one of the most open economies in the world, with the incompleteness of the process of institutions formation of pricing and price control.

The significant growth of the role of the external sector in the macro-system of Ukraine, among other things, complicates the mechanism of price formation, prediction of prices and control over them. According to the international classification, Ukraine belongs to the group of developing countries, and its economy is small open. The global financial crisis of 2008-2009, which led to a 15% drop in Ukraine's GDP, demonstrated the excessive dependence of the Ukrainian economy on the market condition of external sector as a result of the immaturity of its market and government institutions. Risks of the deep and prolonged crisis recurrence increase significantly under these conditions. Macroeconomic instability in the part of galloping inflation is evidence of the difficult predictability of price dynamics in the Ukrainian economy. First and foremost, it is caused in its food segment. Difficult predictability of food prices in Ukraine's domestic market is provoked by the excessive volatility of prices on the global food market. Their rapid growth led to an increase in social-and-economic tensions in developing countries [6] and growth of redistributive processes in the national markets up to a ban on food exports [7]. Particular concern is caused by the fact that world food prices, and therefore, domestic prices are largely determined by speculative operations that do not have anything in common with the objective principles of market price formation [8].

The effect of a ratchet, which explains the inflexibility of prices to decreasing, is an important factor in the formation and dynamics of market prices in the markets with imperfect competition [9].

Ukrainian food market continues to evolve in the context of the growing openness of the national economy, so all the above problems create significant difficulties for understanding the mechanism of price formation, prediction and, if necessary, justifying a set of the most effective management measures for their correction. Such segments of the food market as the markets for meat and meat products, milk and dairy products have special characteristics - seasonality of the raw materials supply and demand for finished products, organizational structure of the producers of finished products, spontaneous nature of export-and-import operations, etc. It does not create conditions for stable prices and significantly complicates their predictability. At the same time, there is a shortage of scientific researches that show seasonal fluctuations in certain articles of balances of meat and dairy products that generate permanent deficits of products on the domestic market and provoke growth of corresponding consumer prices. That determines the relevance of the research topic.

Aims

To check the hypothesis on the connection between seasonal fluctuations in the production volumes of meat and dairy products and consumer price indices of the corresponding products; to calculate the quantitative parameters of the elasticity of consumer prices for meat and dairy products from changes in their production volumes.

Methods

General scientific methods are: abstract-and-logical - for systematization and classification of available scientific-and-research information; induction and deduction - for deriving of general principles concerning the analysis of facts and justification of causal relationships; synthesis - for combining the components of the phenomenon under research and its complete analysis; comparison - for evaluating of the received results.

Economic-and-statistical methods are: dynamic series, chain indexes and average values - for quantitative estimation of the price increase for meat and meat products, milk and dairy products, seasonality in the production of meat and meat products, milk and dairy products; correlation analysis - for determining of the connection level between seasonality in the production of meat and meat products, milk and dairy products and prices for the corresponding products during a calendar year.

The principal scheme for the analysis of balances of receipt and use of meat and meat products, milk and dairy products is used in the following manner: Resources = Usage; resources = products usable for use + import; use = export + changes in stocks (+ or –; stocks at the end of the year – stocks at the beginning of the year) + domestic use. The presented scheme of the formation concerning the balances of

food resources meets international recommendations is based on the concepts and methodological approaches of their forming by the United Nations Food and Agriculture Organization (FAO), and it is used by the State Statistics Service of Ukraine to calculate and publish relevant statistics. The study uses the indicator "Food self-sufficiency index", which, according to the current methodology of the balances formation of food resources, is calculated under the formula:

$$L_s = \frac{P}{CF + NFE} \cdot 100\%,$$

in which: L_s – level of self-sufficiency;

P – production;

CF – consumption fund;

NFE – expenses for non-food purposes (for feeding, losses, etc.).

Results

Cumulative values of the prices growth for each type of food for each month of the year regarding the period of 2001-2018 (basic indices) were calculated in order to identify stable tendencies in the price dynamics of the studied food products (Fig. 1).

There are three periods when there is a sharp rise in prices in the domestic market of meat and meat products during a calendar year: the first - in January; the second - in April; the third - in July-September.
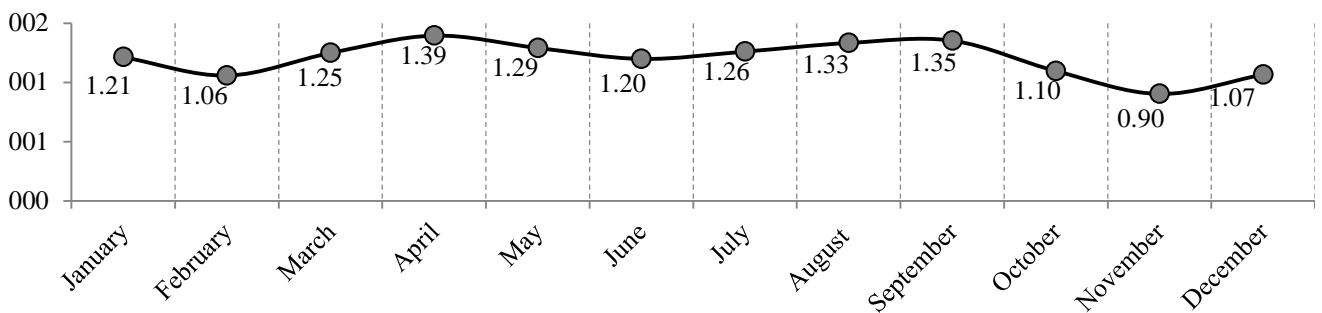

Fig. 1. Cumulative values of the prices growth for meat and meat products for each month of a calendar year for the period of 2001-2018 (basic indices), times [10]

In our opinion, deficit - a temporary or permanent excess of demand over supply is the main thing among all the reasons that cause increase of commodity prices. Calculations of seasonality of the production of meat and meat products during a calendar year were made according to cumulative data of 2001-2018 to verify this suggestion (Fig. 2).

- △ - seasonality in the production of meat and meat products, %
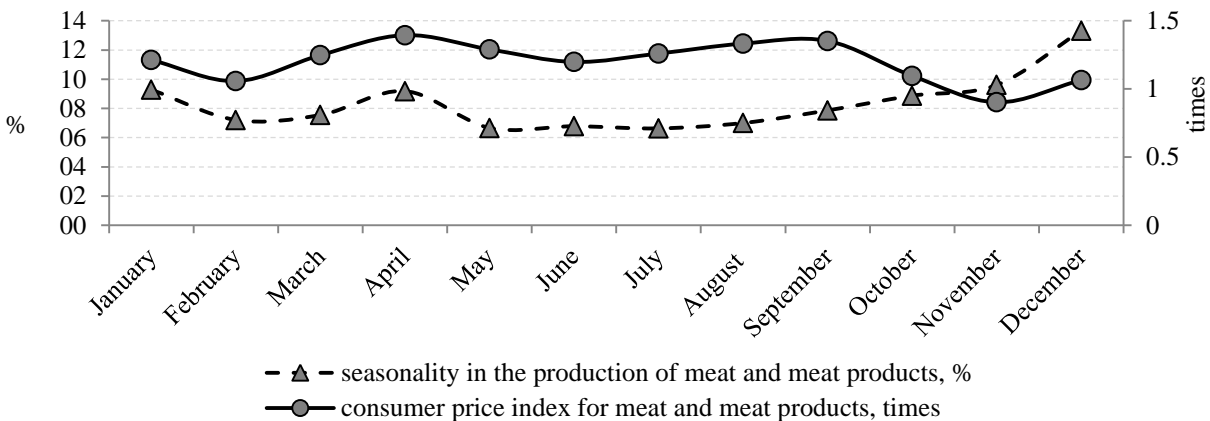- ○ - consumer price index for meat and meat products, times

Fig. 2. Seasonality in the production of meat and meat products, calculated on the basis of cumulative data for the period of 2001-2018; cumulative values of prices growth for meat and meat products for each month of the year for the period of 2001-2018 (basic indices), times [10], [11]

At first glance, the nature of graphs does not give grounds to talk about the presence of the expected synchronization - prices should increase with a decrease in seasonal production. However, according to the logic of the formation of the market condition - there should be a time lag of about 1 month by length, due to the presence of unused commodity stocks, between the feeling of a deficit in the result of a decrease in production volumes and a corresponding increase in market prices. A correlation analysis was conducted in which the functional feature *(Y)* was the increase in prices with forward displacement

of 1 month, and the factor feature *(x)* – seasonal fluctuations in the production of meat and meat products to test this supposition. The results of the analysis showed a high level of connection: *r = 0.69.*

Regression equation: *Y = 1.629 – 0.05x.*

Thus, the nature of the connection is not only tight, but also inverse – as it was supposed. The coefficient of elasticity *(E)* shows that prices increase by 0.05% with a decrease in the monthly production of meat and meat products by 1%.

Starting since 2014, the level of self-sufficiency exceeds 100% in the domestic market of meat and meat products (Fig. 3).
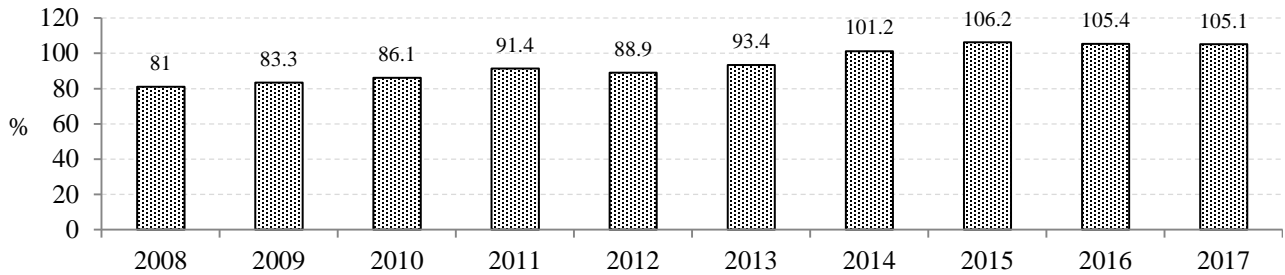

Fig. 3. The level of self-sufficiency of meat and meat products in the domestic market of Ukraine, % [12]

Consequently, the deficit is absent in the scale of a calendar year. However, if we look at the detailed balance of this type of food, one can see that export of meat and meat products in combination with the consumption fund and non-food expenses exceeds production volumes in total (Table 1).

Table 1. Balance of meat and meat products in the domestic market of Ukraine, thousand tons [12]

Balance sheet item	Year								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	1917	2059	2144	2210	2389	2360	2323	2324	2318
Change of stocks at the end of the year	16	-3	-37	23	-20	-18	-1	-2	-5
Import	439	378	244	423	332	201	158	182	233
Total resources	2340	2440	2425	2610	2741	2579	2482	2508	2556
Export	40	48	79	125	182	218	245	303	351
Spent on non-food purposes	10	8	7	7	9	8	8	10	10
Consumption fund	2290	2384	2339	2478	2550	2325	2179	2195	2195

Deficits that appear can only be covered by import. This problem becomes particularly apparent considering the balance in the context of certain types of meat and meat products (Table 2). So, for example, the level of self-sufficiency in pork was 89.9% in 2017, decreasing compared to the previous year by 1.9 p.p. and its export in the amount of 6 thousand tons enhanced the deficit in the domestic market.

Negative balance was managed to balance only by import of 95 thousand tons of products.

Self-sufficiency rate was 114.5% in the market of poultry meat in 2017. However, the consumption fund together with export and non-food expenses, created a deficit of 122 thousand tons. Inconsiderable final stocks in the amount of 2 thousand tons could not cover a deficit that was only eliminated through import.

Table 2. Balance of meat by the main types in the domestic market of Ukraine in 2016 and 2017 years, thousand tons [12]

Balance sheet item	Beef and veal		Pork		Poultry meat		Other meat	
	2016	2017	2016	2017	2016	2017	2016	2017
Production	376	364	748	736	1167	1185	33	33
Change of stocks at the end of the year	-1	-1	0	-2	-1	-2	0	0
Import	16	13	80	95	85	120	1	5
Total resources	393	378	828	833	1253	1307	34	38
Export	46	14	13	14	241	272	3	6
Spent on non-food purposes	1	1	4	5	4	3	1	1
Consumption fund	346	318	811	814	1008	1032	30	31

Import is a tool for eliminating permanent deficits of products in the domestic market. However, in the case of meat import, the problem lies in the fact that it is mainly deep frozen products. For example, in 2017, 80.7% of import of cattle meat and 90.4% of import of poultry meat were frozen. Such products are not able to cover the deficit of fresh meat (products of primary processing), and they are directed to industrial processing. Therefore, there is a deficit in the market in fresh meat segment, which cannot be covered in the short term, which leads to rise in prices. Consequently, there is no deficit of meat and meat products within a calendar year, but there are seasonal deficits during the year that cause rising of consumer prices for this kind of food, in particular in fresh meat segment (Table 3). The weakness in proposed balance sheet is monthly distribution of the annual consumption fund and non-food expenses. It is explained by the lack of data concerning monthly volumes of food resources use on these balance sheet

items in the official statistical base of Ukraine. It is highly probable that there is seasonality in domestic consumption of meat and meat products. This is evidenced by the nature of the connection between the studied values in Fig. 2 taking into account the monthly lag of the prices reaction for changes in production volumes:

- the first period of rising in prices is due to a deficit of products in January, when production volumes decrease and consumption volumes increase because of New Year's and Christmas holidays;
- the second period of rising in prices is connected to a deficit due to the excess of growth rates of consumption over the growth rates of production, because of Easter holidays;
- the third period of rising in prices is connected to a deficit due to a decrease in production volumes and increase in consumption volumes due to the growth of seasonal demand (period of tourist trips, summer picnics, etc.).

Table 3. Balance of meat and meat products by months of 2017, thousand tons [11], [2].

Month	Production	Stocks at the beginning of the year	Consumption fund	Spent on non-food purposes	Export	Import	Profit (+) / Deficit (-)
January	187.4	5.0	182.9	0.83	21.0	19.0	6.7
February	165.3	x	182.9	0.83	26.5	14.7	-30.3
March	186.3	x	182.9	0.83	31.6	17.6	-11.4
April	183.9	x	182.9	0.83	25.3	16.1	-9.0
May	197.0	x	182.9	0.83	27.9	17.4	2.7
June	173.2	x	182.9	0.83	29.8	19.2	-21.1
July	177.8	x	182.9	0.83	32.9	22.6	-16.1
August	185.5	x	182.9	0.83	32.2	22.3	-8.2
September	182.4	x	182.9	0.83	31.0	24.2	-8.1
October	197.5	x	182.9	0.83	30.1	22.9	6.5
November	186.6	x	182.9	0.83	35.8	20.2	-12.7
December	295.1	x	182.9	0.83	27.0	16.7	101.1

In all cases, export of products increased its deficit in the domestic market. The seasonal dynamics of price volatility is also observed in the dairy market - peak rise in prices is observed in October, November and December (Figure 4-6).
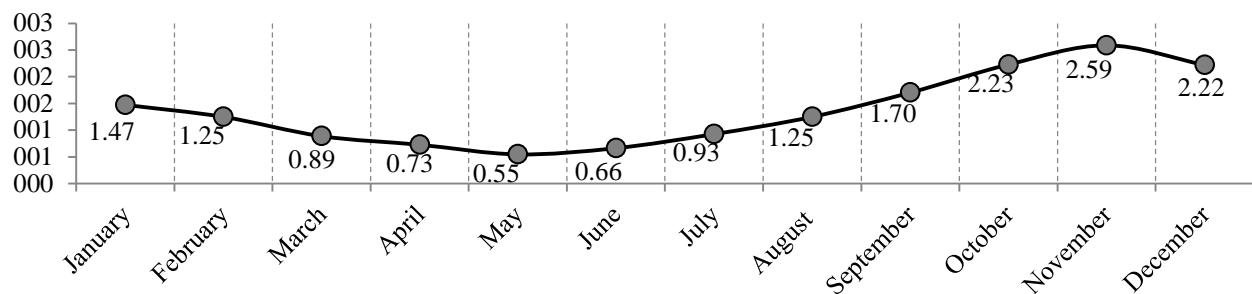

Fig. 4. Cumulative values of rising in prices for drinking milk for each month of the year for the period of 2001-2018 (basic indices), times [10]
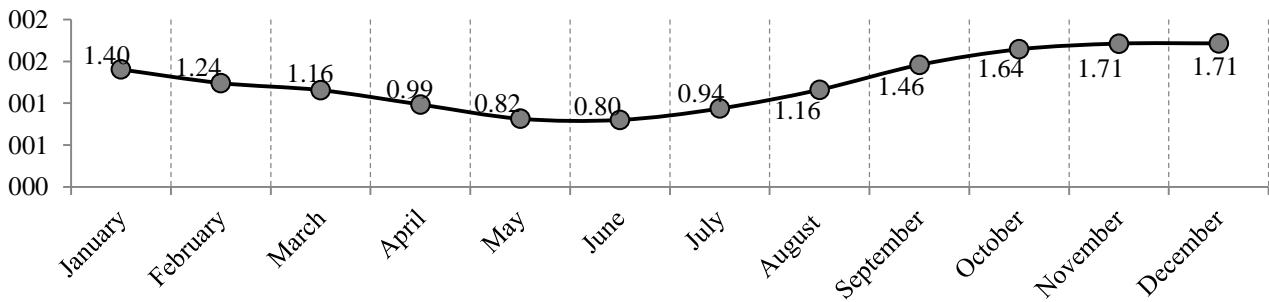
Fig. 5. Cumulative values of rising in prices for butter for each month of the year for the period of 2001-2018 (basic indices), times [10]
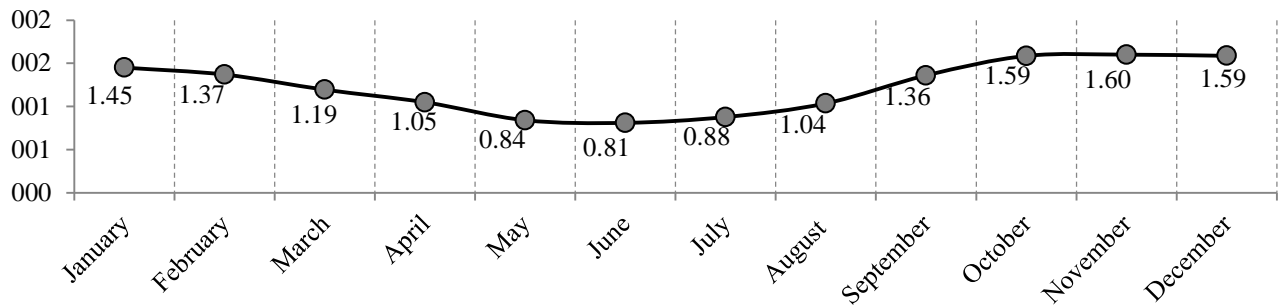

Fig. 6. Cumulative values of rising in prices for cheese and cottage cheese for each month of the year for the period of 2001-2018 (basic indices), times [10]

Prices for drinking milk, butter and cheese show synchronous dynamics (Table 4). As we see, the density of the connection between the changing in prices for various types of dairy products is tight in all cases. That indicates the same character of conditions and factors influencing price formation of basic types of dairy products in the domestic market.

Table 4. Correlation matrix of the density of connection between cumulative values of rising in prices for butter, milk and cheese for each month of the year for the period of 2001-2018, r

Food	Butter	Drinking milk	Cheese and cottage cheese
Butter	1	0.90213857	0.96719883
Drinking milk	0.902138566	1	0.96909397
Cheese and cottage cheese	0.96719883	0.96909397	1

The synchronicity of changes is observed between the graphs of production of raw milk and dairy products - prices for finished dairy products increase with the decrease in the production of raw milk (Fig. 7).
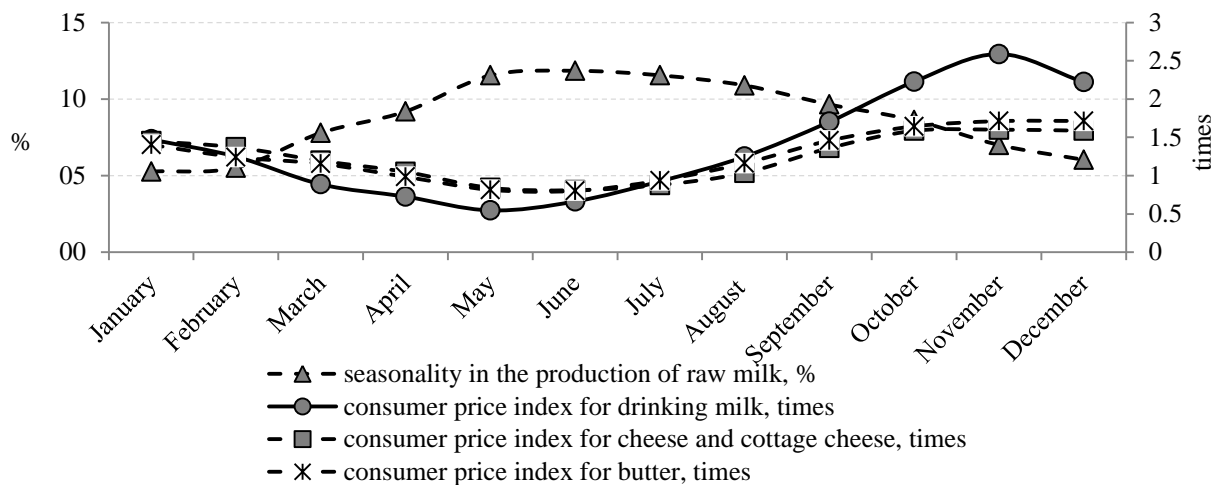

Fig. 7 Seasonality in the production of raw milk, calculated on the basis of cumulative data for the period of 2001-2018; cumulative values of rising in prices for dairy products for each month of the year for the period of 2001-2018 (basic indices), times [10, 11].

Correlation analyses was conducted in which the functional feature *(Y)* was the increase in prices for the corresponding type of dairy products with forward displacement of 1 month, and the factor feature *(x)* – seasonal fluctuations in the production of raw milk to check the regularities found in the result of a graph analysis (Table. 5).

As we can see, the tightness of connection is high in all cases. Obtained coefficients of the elasticity indicate that the consumer price index for drinking milk, cheese and butter increases by 0.24, 0.12 and 0.13%, respectively, under a decrease in the production of raw milk by 1%.

Table 5. Connection of production seasonality of raw milk and dairy products in Ukraine

Food	Correlation coefficient, r	Elasticity coefficient, E
Drinking milk	0.834	-0.235
Cheese and cottage cheese	0.932	-0.12
Butter	0.902	-0.125

The level of self-sufficiency exceeded by 100% in the domestic market of dairy products during the analyzed period (Fig. 8). Consequently, the deficit is absent in the scale of a calendar year. However, it can be seen that exports, in combination with the

consumption fund and non-food expenses exceed production volumes in total as in the meat and meat products market, when considering the detailed balance of this type of food.
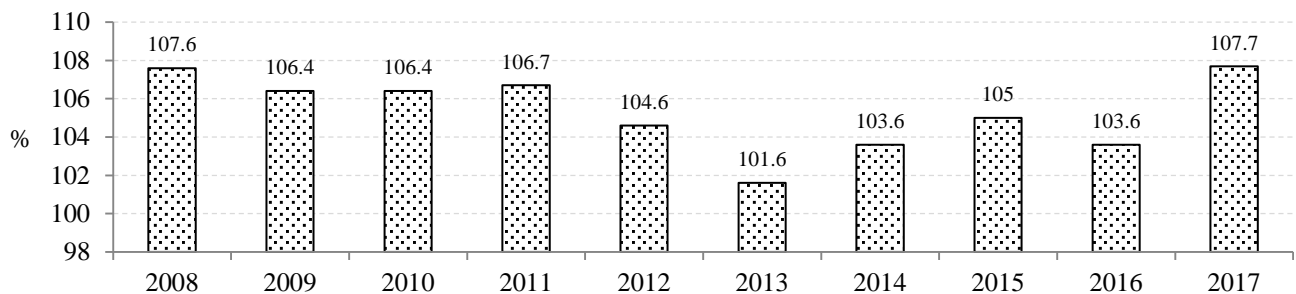

Fig. 8. Level of self-sufficiency in dairy products in the domestic market of Ukraine, % [12]

Deficits that appear can only be covered by the expense of import (Table 6).

However, import cannot eliminate deficits in specific segments of the domestic consumer market – whole and sour milk products, produced in private

peasant farms. And this is a large-capacity market. For example, in 2017, 37.3% (2.3 million tons) were sold by private peasant farms in the form of ready-to-eat products from 6.2 million tons of milk sold by all agricultural producers in all areas.

Table 6. Balance of milk and dairy products in the domestic market of Ukraine, thousand tons [12]

Balance sheet item	Year								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	11610	11249	11086	11378	11488	11133	10615	10382	10281
Change of stocks at the end of the year	230	-11	-9	90	-45	85	-41	28	33
Import	455	273	257	410	548	357	78	105	132
Total resources	11835	11533	11352	11698	12081	11405	10734	10459	10380
Export	919	956	964	820	769	527	464	434	835
Spending on feeding	1126	1099	1020	1072	1252	1153	1097	1069	1036
Losses	10	8	5	9	10	14	15	14	13
Consumption fund	9780	9470	9363	9797	10050	9581	8995	8942	8496

There is a deficit, which cannot be covered in the short term, which leads to rise in prices in the periods of seasonal reduction of raw milk production in the milk market in the segment with demand for products of private peasant farms.

Consequently, there is no deficit in the domestic market of dairy products within a calendar year; however, seasonal deficits occur during a year, which leads to an increase in consumer prices for this type of food (Table 7).

Table 7. Balance of milk and dairy products by months of 2017, thousand tons [11].

Місяць	Production	Stocks at the begin-ning of the year	Consumption fund	Spending on feeding	Losses	Export	Import	Profit (+) / Deficit (-)
January	585.6	33.0	708.0	86.3	1.1	59.5	9.4	-293.0
February	601.4	x	708.0	86.3	1.1	79.1	10.0	-263.2
March	801.3	x	708.0	86.3	1.1	72.2	9.9	-56.4
April	909.6	x	708.0	86.3	1.1	76.9	9.6	46.9
May	1089.5	x	708.0	86.3	1.1	76.6	9.3	226.8
June	1074.5	x	708.0	86.3	1.1	77.6	7.2	208.7
July	1067.6	x	708.0	86.3	1.1	72.5	11.2	210.9
August	1019.8	x	708.0	86.3	1.1	74.0	11.0	161.4
September	929.5	x	708.0	86.3	1.1	58.0	12.5	88.6
October	845.6	x	708.0	86.3	1.1	66.1	13.6	-2.3
November	736.6	x	708.0	86.3	1.1	67.9	13.3	-113.4
December	619.9	x	708.0	86.3	1.1	54.4	14.9	-215.1

The weakness in the proposed balance sheet is the monthly distribution of the annual consumption fund, costs for animal feeding and losses. It is explained by the lack of data on monthly volumes of use of food resources in the data articles of the balance sheet in the official statistical base of Ukraine. In our opinion, consumption of milk and dairy products is more regular throughout the year unlike meat and meat products. However, the use of milk for feeding farm animals is uneven. It is connected with the irregularity of the arrival of the offspring. What is evidenced by the monthly fluctuations in the production of raw milk – the reduction of production is due, first of all, to a dry period during which cows do not milk in the last few weeks of pregnancy, and during the first two months of lactation, when a significant amount of milk is spent on feeding calves.

Seasonal production is a distinctive feature of the domestic livestock sector, which is not inherent in agrarian production in highly developed countries. For example, let's compare the distribution of pro- duction of raw milk and meat (in slaughter weight) between the quarters of a calendar year in Ukraine and Germany (Table 8). Seasonality in the production of meat and milk is a consequence of the organizational features of supply in the relevant markets. First of all, this is a structure of livestock production by categories of households. As of the beginning of 2017, 36% of meat (in slaughter weight) and 74% of milk were produced in households. It should be noted that cows are kept in 1.2 million rural households, cattle for growing and fattening – in 1.3 million rural households, and pigs – in 1.5 million rural households. This contributes to the spontaneity in the functioning and development of the relevant markets, because in the vast majority of cases, peasants do not coordinate their production plans to each other, nor with industrial enterprises, which buy the corresponding primary products from them. That does not allow them to plan and ensure regular supply of livestock products for the market throughout the year.

Table 8. Distribution of production of raw milk and meat (in slaughter weight) between the quarters of a calendar year (2016),% [11], [5], [4]

Country	I quarter	II quarter	III quarter	IV quarter
Raw milk				
Ukraine	17.6	31.1	30.6	20.6
Germany	24.6	25.7	25.0	24.6
Meat (in slaughter weight)				
Ukraine	24	22.6	21.5	31.9
Germany	25	24.4	25.1	25.6

Another drawback of small-scale production is relatively high fixed expenses per unit of commodity production and prevalence of low-yield manual labor. This increases the price barrier of entry to the market for such producers and increases the dependence of their pricing policy on the increase in the cost of input resources (electricity, fuel and lub- ricants, veterinary preparations and zoo technical services, etc.).

Unlike rural households, agricultural enterprises have the opportunity not only to plan regular supply of livestock products throughout the year, but also to coordinate the calendar of product sales with industrial enterprises. This allows the latter to plan monthly balances of primary products receipt for

processing, to predict its probable deficits and sources of their coverage. This makes predictability in the functioning of the relevant markets and allows smooth seasonal fluctuations in supply.

Confirmation of our assumption is the connection between seasonal fluctuations in the production of meat and milk and the share of agricultural enterprises in the production of the corresponding products (Table 9). Thus, as we can see, the density of connection is high in both cases. And coefficients of elasticity indicate that an increase by 1% of the share of agricultural enterprises in the production of meat (in slaughter weight) reduces seasonal fluctuations (coefficient of variation) in the production of this product by 0.4%, in the production of raw milk – by 0.792%. Based on this, it can be concluded that one of the ways to slow down the growth of consumer prices for meat and dairy products is to promote the development of large-scale production of livestock products based on agricultural enterprises, and to promote the idea of creating community-based cooperatives on the basis of rural households engaged in livestock products.

Table 9. *Connection between seasonal fluctuations in the production of meat (in slaughter weight) and raw milk, and the share of agricultural enterprises in the production of the corresponding products*

Indicator	Correlation coefficient, r	Elasticity coefficient, E
In the production of meat (in slaughter weight)	0.978	-0.4
In the production of raw milk	0.802	-0.792

In the context of our study, the important advantage of such cooperatives is the provision of planning in the economic activity of rural households, aimed at equalizing the seasonal fluctuations in their production of livestock products.

3. Conclusion

The conducted study allowed confirming the hypothesis on the existence of a connection between seasonal fluctuations in the production volumes of meat and dairy products and indices of consumer prices of the corresponding products. The scientific novelty of the conducted research is calculated quantitative parameters of elasticity of consumer prices for meat and dairy products from changes in their production volumes.

During the study, it was found that there was a close connection between the decline in production seasonality of meat and dairy primary products and the growth of the share of agricultural enterprises in the structure of production of these types of livestock products.

Prospective directions of further research on this topic are: the development of proposals to substantiate the mechanism of the formation for regional food reserves and their use for commodity interventions in order to adjust the retail prices in the relevant markets; the development of proposals for substantiation of the national strategy for the development of meat and dairy farming; the calculation of the quantitative estimation of the export contribution to the growth of the consumer price index of the corresponding products.

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