

# Price Transmission Among the Participants of the Livestock Products Agrofood Chain in Ukraine

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## Abstract

The article, by the example of livestock products, estimates and analyses the mechanism of price transfer (transmission) among the participants of the agrofood chain (agricultural producers, food processing and trading companies) and discovers abnormalities, imbalances and mismatches of the economic relations development among the stated participants. Straight-line regression with application of least-squares method was built, as well as three linear trend models that allowed to forecast the trends for price change at each administrative and technical stage of the product distribution (production, processing, trade). Quantitative evaluation was held for the price change of the livestock product market, and the time needed for the change. The obtained data confirmed the market “weakness” of agricultural goods producers denying the industrial safety guarantee of the country as a whole.

**Keywords:** price transmission, agrofood chain, livestock products, meat, milk, straight-line regression, consumer price

## 1. Introduction

### 1.1 Articulation of Issue

The agrofood system is complex, multi-component and multi-level reality, uniting the interests of diverse industry economic relations participants regarding food supply to consumers. This is the price that includes all the complexity of economic relations. Thus, participants (entities, operators) of the agrofood price chain are agricultural goods producers (enterprises and households), food processing enterprises and wholesale and retail trade representatives. Market participants also include the state and the end consumer (population).

Given the current situation in Ukraine when, on the one part, agricultural producers of cattle products, being at the very beginning of the price chain, have the least leverage of commercial influence on other participants and therefore are price recipients. The price received does not depend on the amount and changes in costs of goods producers, and therefore often does not allow to receive economically justified profit on investment. On the other part, a consumer (retail) price paid by end consumer – population is too high, which does not allow to bring the consumption of meat and dairy products to scientifically justified standards. It is therefore important to evaluate and analyze, in the current economic environment, how the mechanism of food prices transmission between participants in the agrofood chain, in particular the livestock products market, functions. Evaluation and analysis of the nature of the price transmission mechanism and its role in the development of economic relations between market participants will allow to determine the measures for their (relations) harmonization, on the one part, and support of consumer purchasing power, on the other part.

### 1.2 Analysis of Recent Research and Publications

Ukraine's agricultural sector accounts for 12% of the country's GDP and its output is continuously growing. For six consecutive years (2013-2018), Ukraine harvested over 60 million tons of grain annually, and 2018 export of ag commodities reached \$18.6 billion (Onegina *et al.*, 2020). The issues of pricing in the cattle products market, namely

the price transmission along the agrofood chain main participants, were considered in research as (Bondar *et al.*, 2014), (Ilchuk & Konoval, 2016), (Misyuk, 2012), (Onegina *et al.*, 2018), (Rozhko *et al.*, 2019), Yakubovs'ka & Luk'ianyk, 2017), (Shpychak *et al.*, 2017) et al. According to the authors, in order to effectively manage cash flows when choosing instruments of state support for agricultural producers, in particular livestock products, you can choose those that will give maximum social effect with minimum financial costs, or vice versa, focus on the implementation of projects that combine a high level of both these indicators, while minimizing political risks (Onegina *et al.*, 2019).

In the foreign literature, the following scientists have considered the transmission of prices in the agrofood supply chain: (Aragrande & Canali, 2017), (Barahona & Chulaphan, 2017), (Hassouneh *et al.*, 2010), (Karikallio, 2015), (Liu, 2011) et al.

Despite numerous studies and their scientific importance, the issue of the mechanism of price transmission between the subjects of the cattle dairy market and its impact on the development of economic relations between the main participants in the agrofood chain remains unresolved.

## 2. Methodology

The theoretical and methodological basis of the research is the dialectical method of knowledge of economic processes, the fundamental provisions of modern economic theory, scientific works domestic and foreign scientists on economic relations between participants of the agrofood market for livestock products and price transmission problems. A systematic approach, methods of generalization, induction, deduction, analysis, synthesis and comparison were used to achieve this purpose.

## 3. Results and Discussion

The term “transmission” literally means “connecting gear”. In economics, it is most widely used in the field of monetary regulation and originates in Keynesian analysis of macroeconomic variables sequences (Alimpiiev, 2015). Based on this, price transmission is a process of sequential transmission of shocks (impulses) of the prices of some goods to the market prices of the other ones.

The transmission approach to price transfer is a practical tool for quantitative evaluation of the size of price changes in the market and the time during which this change occurs. In other words, a price transmission is a change in the market price of one product over time caused by (due to) a change in the market price of another product.

There are several models of price transmission: vertical, horizontal and cross-commodity (Barahona & Chulaphan, 2017). Vertical price transmission is related to the technological features of food supply, namely relatively independent production, processing and trade. An example of a vertical model can be the increase in the price of live weight of animals that are fed by an agricultural producer, which automatically leads to an equivalent change in the cost of producing chilled meat in the food processing industry. This increase transmits into the retail (consumer) price at the end of the price chain.

Horizontal or geographical price transmission occurs during interregional and international trade when the price change of one product in one market is caused by the change of the same product in another market.

Cross-commodity price transmission occurs in the substitutes supply chain. For example, an increase in the domestic price of beef and pork has significantly reduced the consumption of meat of these species, thereby increasing the demand for poultry meat and therefore its price.

A feature of the formation of the end consumer price for meat and dairy cattle products is the mandatory going through several basic organizational and technological processes, such as directly production, processing and end products wholesale and retail trade. These processes are components of the agrofood chain (Fig. 1).

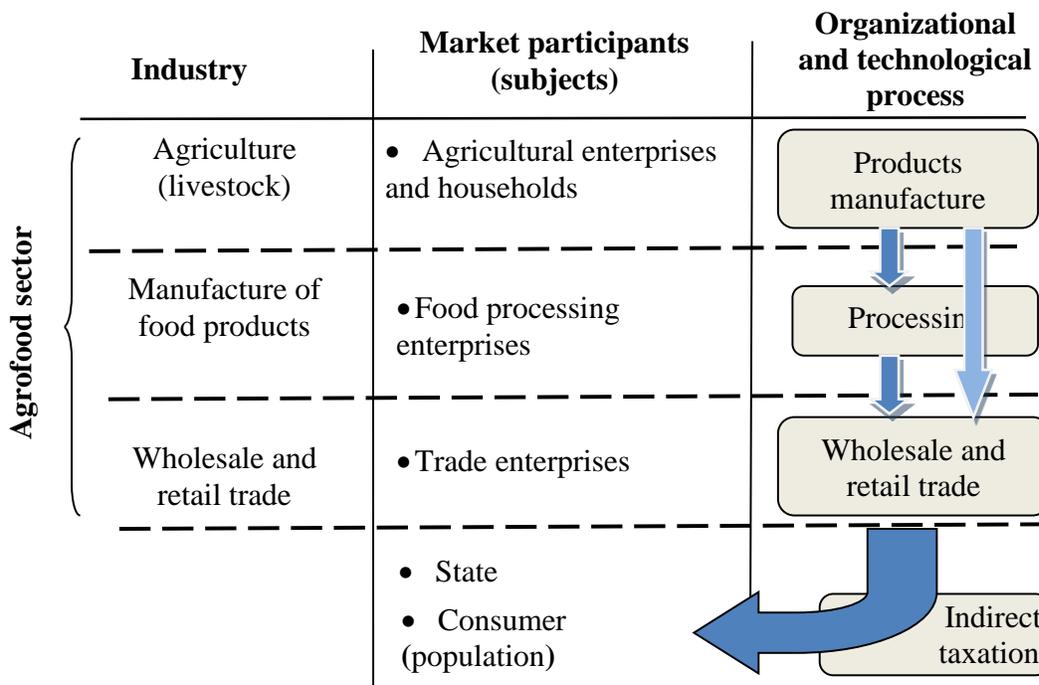


Figure 1. Flow chart of the agrofood cattle products supply chain

Source: developed by the author

During the years of independence, Ukraine has developed a dual structure of livestock production, thus, according to the country’s statistical yearbook, 52.5 % is produced by households and 47.5 % by enterprises in 2018. Regarding the condition and economic efficiency of production and sale of cattle products as a livestock sub-sector, modern studies have shown that cattle breeding is a system-forming sector of the country’s economics, the level of food security of the state and socio-ecological balance in agricultural production depends on its development (Ilchuk *et al.*,2018). The main products are meat (beef and veal) and cattle milk.

As of January 01, 2019, 3,332.9 thousand cattle heads are fed in Ukraine, including 1,919.4 thousand cows, which is 30 % less than in 2010, or 3.2 times less than the number of cattle heads and 2.8 times of cows compared to 2000. The share of the number of animals by category of farms is as follows: 34 % of cattle heads and 24 % of cows are fed at the enterprises, 66 % and 76 % at the households. Production volumes in 2018 in the country are as follows: beef and veal meat – 359 thousand tons (or 84 % and 47.6 % compared to 2010 and 2000, respectively), milk – 10,064 thousand tons (or almost 90 % and 80 % compared to the previous years). The efficiency (level of profitability) of meat and dairy products production by enterprises is shown in Fig. 2.

Therefore, the loss rate of cattle meat production during 2010–2018 (except 2017) ranges from 18 % to 43 % of the losses incurred. Milk production is profitable with a rate of return from 3 % to 27 %; At the same time, the increase in prices of industrial products, the cost of which is embedded in the cost of agricultural production, substantially exceeds the level of profitability of milk production during almost the entire period.

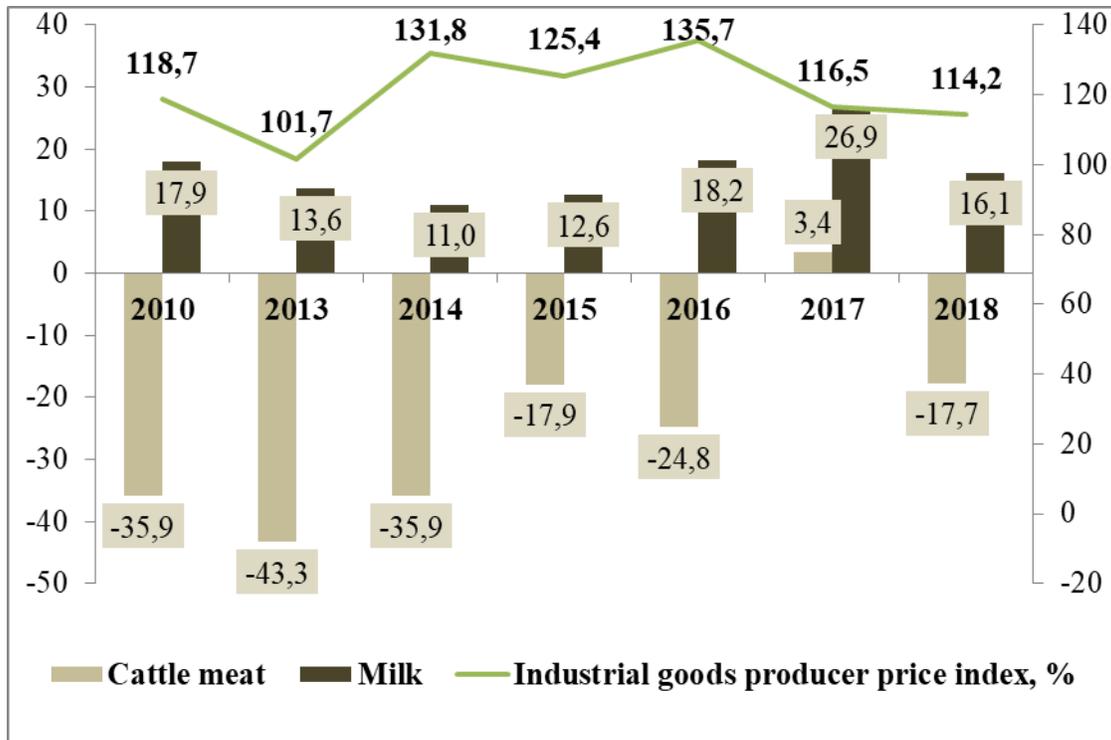


Figure 2. The level of profitability of cattle products production by agricultural enterprises over 2010–2018,%  
 Source: Own research according to the State Statistics Service of Ukraine

Have a look at the price dynamics of the “production-processing-trade” agrofood chain of cattle products (Fig. 3, 4). In this regard, the average selling prices of meat and dairy products by agricultural producers (enterprises and households), the average producer prices of industrial products (by main types of food products) and the average consumer prices of goods (services) in Ukraine for 9 months of 2019 were processed.

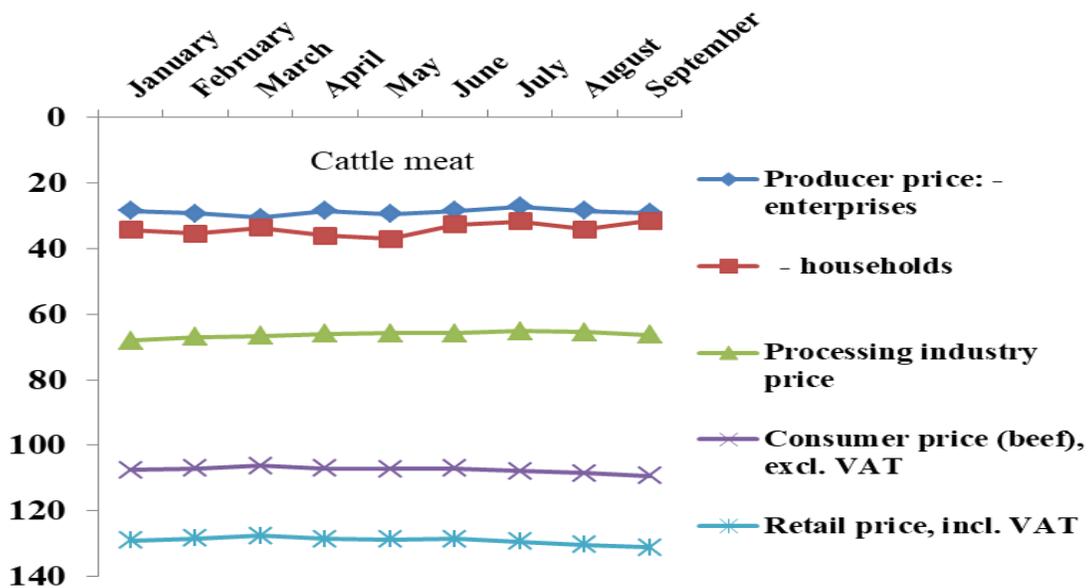


Figure 3. Dynamics of cattle meat prices in the agrofood chain for 9 months of 2019, UAH/kg  
 Source: Own research according to the State Statistics Service of Ukraine

The average purchase price for meat from farmers is from 28 UAH to 34 UAH per 1 kg of live weight (depending on the category of farm); processing industry sells meat at a price of 66.30 UAH; trade entities for 107.50 UAH (excl. VAT); the end consumer pays almost 130 UAH for 1 kg of beef.

Farmers sell milk at 6.60–8.0 UAH per liter; processing enterprises at 15.45 UAH, trade entities already receive more than 20 UAH, respectively, for the population the average price of milk, including VAT, is 24.25 UAH, or at least 3 times more than the cow holders receive.

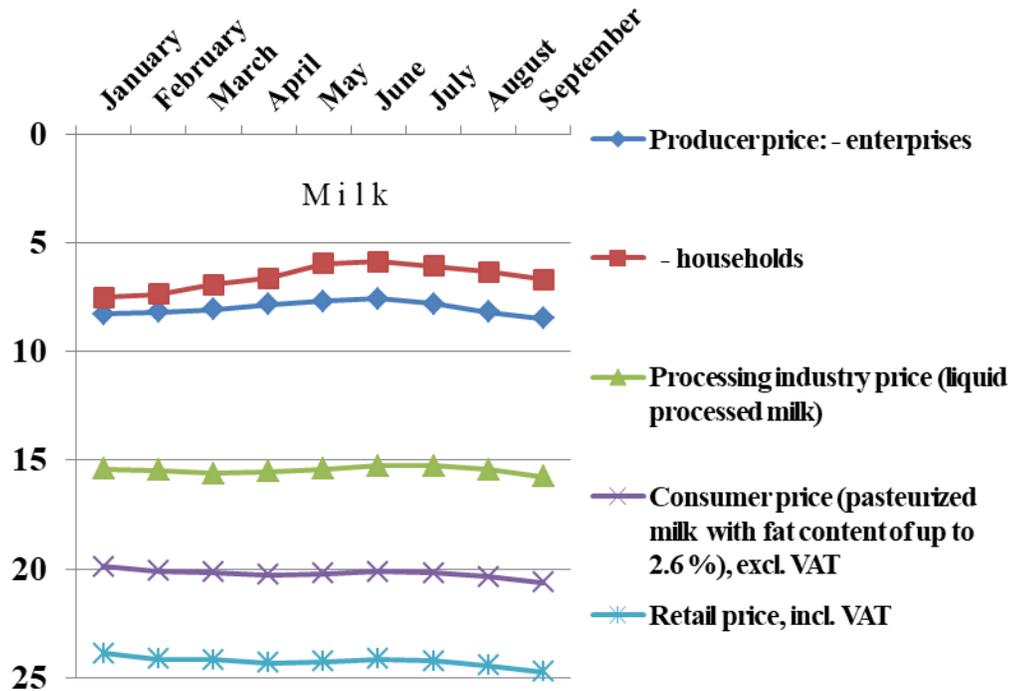


Figure 4. Dynamics of milk prices in the agrofood chain for 9 months of 2019, UAH/kg

Source: Own research according to the State Statistics Service of Ukraine

We did not consider the quality of milk in terms of fat and protein content. As raw milk with much higher quality parameters is used for the industrial production of milk with fat content of 2.5 % and protein of 2.8 %.

Depending on the farm category, the difference in the cost of selling cattle meat and milk as raw material is due to the quality and quantity of products. Thus, meat in live weight is sold by households by 10–25 % more expensive than enterprises, taking into account the end product is “organic”. At the same time, the average price of milk from households is, on the contrary, 10–25 % lower than the price received by enterprises. The reason is that the population sells raw milk in relatively small batches and with much greater bactericidal and bacterial contamination. The researches of M. Ilchuk revealed the highest level of milk production efficiency at the enterprises that kept from 1000 to 1500 heads of cows. They also had the highest parameters of animal productivity, profit per unit of production, and highest selling prices. All because of the scale of production and cost savings for feed through the use of by-products of the crop industry and products from its processing (Ilchuk *et al.*, 2018).

The share of each of the participants in the agrofood price chain is shown in Figure 5. Therefore, the classic mechanisms of market pricing do not work in the formation of the end consumer price, in which only up to 25 % are obtained by direct meat producers and up to 35 % by milk producers. The main factor in pricing is the monopoly status of certain entities in the market, which set the “rules of the game”. It is a paradox that the prices of meat and dairy products in the retail network have long ago reached the level of the leading countries in the world, and the main commodity producers – owners of livestock, continue to reduce livestock. In our view, it is trading networks that are the main player in the livestock market and the undisputed dictator of the rules of the game in the food chains.

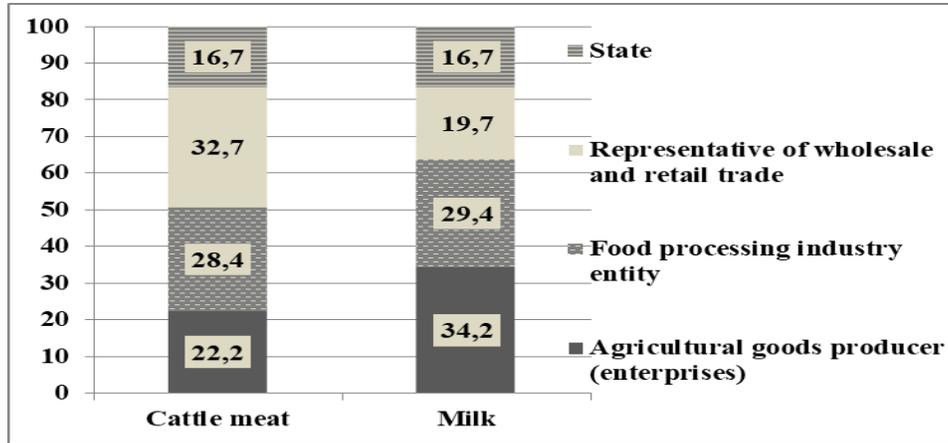


Figure 5. Consumer (retail) price structure of meat and dairy products in September 2019, %

Source: Own research according to the State Statistics Service of Ukraine

The evaluation and analysis of the price vertical transmission mechanism gives an understanding of how much and for how long (time lag) the reaction of processing and trade entities to changes in the price of agricultural raw materials occurs. In this regard, we used linear regression using the least squares method (LSM). This method is one of the most universal and effective ways of aligning empirical rows in correlation and regression analysis. The purpose of the method is to estimate the patterns observed against random fluctuations and to use them for further calculations, in particular, for forecasting.

$$\text{General formula is } y = mx + b \text{ or } y = m_1 x_1 + m_2 x_2 + \dots + b.$$

Figures 6 and 7 show the monthly dynamics of prices for meat and dairy products during 2013–2018 and 9 months of 2019 at all sectors (stages) of the agrofood chain (production, processing and trade). Three linear trend models were built, which made it possible to predict trends in price changes at each organizational and technological stage of product sales.

The adequacy (reliability, confidence) of the trend models is estimated using the calculated correlation coefficients (R) and approximations (R<sup>2</sup>), which are universal.

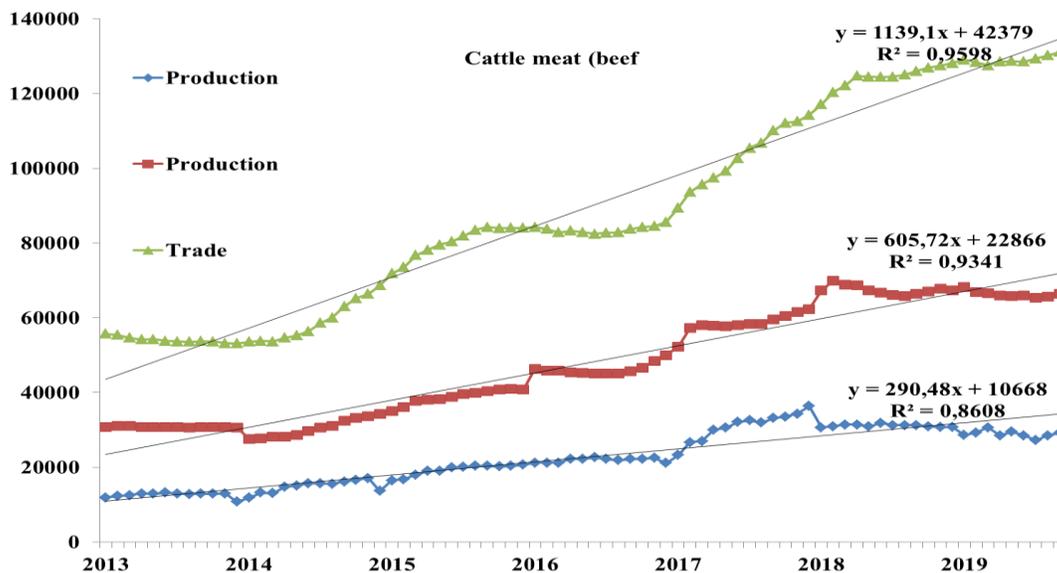


Figure 6. Linear trend model of prices (UAH/t) for cattle meat of agrofood chain participants

Source: Own research according to the State Statistics Service of Ukraine

Correlation coefficient is an indicator used to measure the density of relationship between performance and factor attributes in the correlation-regression model according to a linear relationship. In absolute value, R ranges from -1 to +1. The closer this indicator is to 0, the weaker the connection, the closer it is to  $\pm 1$  the closer the connection. The “+” sign near the correlation coefficient means a direct relationship between the signs of x and y, the “-” sign – the opposite.

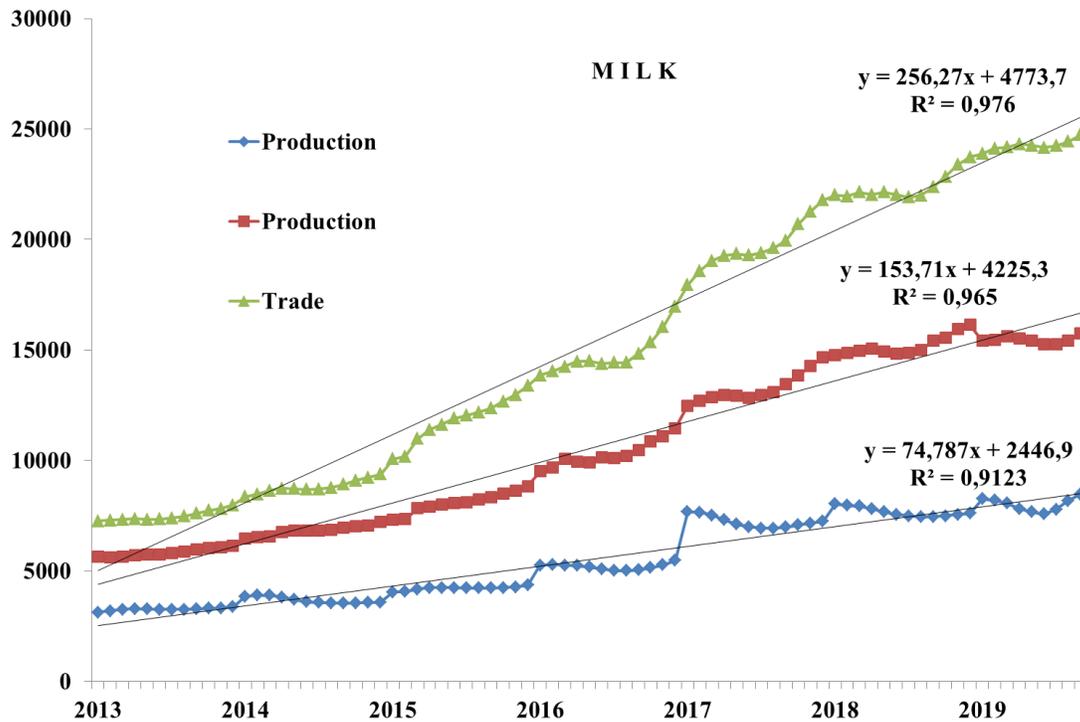


Figure 7. Linear trend model of prices (UAH/t) for milk of agrofood chain participants

Source: Own research according to the State Statistics Service of Ukraine

Thus, the calculation results show that an increase in the price of meat in live weight and raw milk from an agricultural producer automatically, instantly leads to an increase in the price of chilled and liquid processed milk in the food processing industry and the consumer price of beef and milk in trade paid by end consumer (population).

Table 1 shows how much, or to what extent, or for how long the price shock (impulse) of the increase in the price of raw meat and dairy products is transmitted to the end consumer.

Thus, the economic content of the results obtained for the change in the price of cattle meat is as follows: with each period (in our calculations, a month) the price of a ton of meat is increased at producer by 290.5 UAH, or at a rate of +0.996 %, at processing representative – by 605.7 UAH (+0.912 %), at trade entity – by 1,139.1 UAH (+0.869 %). Due to increasing the price of selling meat (as raw material) for farmers by 1 UAH in the processing industry, the price increases by 1.91 and the consumer price in trade by 3.48 UAH.

Thus, the economic content of the results obtained for the change in the price of cattle meat is as follows: with each analysis of the milk price transmission, it is established that with each period the rate of increase of the price of 1 ton of production is: +0.883 % (or 74.8 UAH) at agricultural goods producer; +0.976 % (or UAH 153.7) at processing; +1,036 % (or 256.3 UAH) at retail trade. With the increase in the price of raw milk at agricultural goods producer by 1 UAH, the price of processed milk in processing increases by 1.96, and the retail price for end consumer, by 3.25 UAH respectively.

Table 1. Analysis of the meat and milk price transmission

Analysis Element	Price Change:					
	At Agricultural Producers (Price of Meat and Dairy Raw Materials)		At Food Industry Enterprises (Price of Producers of Industrial Products)		At Trade Representatives (Consumer Price)	
	+, - UAH	R1	+, - UAH	R	+, - UAH	R
1. Forecast of price change for the next period (month)						
- Cattle meat	+290.48 (+0.996 %)	0.93	+605.72 (+0.912 %)	0.97	+1139.13 (+0.869 %)	0.98
- Milk	+74.79 (+0.883 %)	0.96	+153.71 (+0.976 %)	0.98	+256.27 (+1.036 %)	0.99
2. Price change due to agricultural producer price increase:						
- Cattle meat	+1.00	x	+1.91	0.96	+3.48	0.94
- Milk	+1.00	x	+1.96	0.98	+3.25	0.98

<sup>1</sup>R – correlation coefficient

Source: developed and calculated by the author

The correlation coefficient (R) value is a confirmation of the relationship between price changes. According to our calculations, the R values are approaching 1, so there is a direct correlation between price changes.

#### 4. Conclusion

Summarizing the results of the study on the transmission of prices along participants in the agrofood chain of livestock products, we should note: the main problem of our time is the imperfection of the process of price transmission from agricultural producer (farms of all categories) to consumer (population). Meat and dairy farmers, being at the very beginning of the price chain and having a share in the final price formation of 22 to 34 %, are not able to make extended production reproduction.

It is determined that the price transmission is a process of sequential transmission of shocks (impulses) from the prices of some goods to the market prices of the other ones. Thus, using the example of meat and dairy cattle products, by determining linear regression using the least squares method (LSM), three linear trend models were built to predict the trend of price changes at each organizational and technological stage of product sales. Thus, an increase in the price of meat and dairy products from a farmer per unit consistently transforms the processing price by a factor of 1.9, and is automatically reflected in the retail price paid by end consumer by a factor of more than 3. The data obtained confirm the market “weakness” of agriculture producers, which makes it impossible to guarantee the food security of the entire country.

Evaluation and analysis of the mechanism of price transmission and its role in the development of economic relations between market participants will allow to determine the measures for their (relations) harmonization, on the one part, and support of consumers purchasing power, on the other part. The next research will be devoted to the search for effective mechanisms for harmonizing the economic relations of the agrofood chain participants.

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