Study of value chains for selected foods in the Siberian Federal District

D V Parshukov, Z E Shaporova, N I Pyzhikova and N G Filimonova
Krasnoyarsk State Agrarian University, Mira street, Krasnoyarsk, 660049, Russia

E-mail: Parshukov83@mail.ru

Abstract. The article presents the results of studies of value chains for certain types of food. The Siberian Federal District was selected as the study region. The study is important to identify intercompany relations between economic agents of the food market. To obtain the results, statistical-economic and computational-constructive methods of studying the structure of income and costs in the value chains of products, as well as a graphical interpretation of information are used. The authors determined that agricultural organizations create the highest value of intermediate consumption in the production and sale of products, but only in the value chains of milk and pork have the largest share of total profit. It was also established that the state receives the most taxes from the production and sale of one kilogram of beef. The role of intermediaries in the chains under consideration is insignificant, but retail chains have the strongest positions.

1. Introduction
The state of local food markets determines the level of food security throughout the country. In the existing food supply system at the regional level, there are a number of urgent problems. So, experts in this field note the lack of an organized and regulated wholesale market [1-3]. The result is a redistribution of market forces in favor of retail chains. As a result, agricultural organizations face high barriers to entry into the market, and their share in the value added of the product does not exceed 50%. Another problem is the decline in real incomes of the population, which causes structural changes in the consumption of food products [4, 5]. For the period 2016-2018, there has been an increase in the consumption of products such as potatoes, bakery products, cereals, which can be attributed to “Giffen goods” [6]. Current demand does not stimulate the growth of production of "farm quality", that is, environmentally friendly, high-quality, but more expensive at a price. The premium segment of farm food products is quite small and the demand existing there cannot provide a potential supply for producers [7]. As a result, not being able to sell the goods directly to the mass consumer, organizations have to sell their products either to large processing enterprises or various intermediaries, reducing their own margin.

The development indicators of local food systems depend on the individual effects that economic agents of the market receive. At the same time, it is important to evaluate not only individual performance results, but also the cumulative effects in the areas of production and circulation of products. The study of the structure of the distribution of value added and operating costs between all participants in the chain of movement of goods allows us to determine the specifics of intercompany economic relations. This is what determined the purpose of this work, as a study of the existing
structure in the value chains of food products, to identify the combined effects and benefits of market participants from the existing food supply system.

2. Methods of research

Key types of food selected for the study: chilled lump beef, chilled lump pork, cow’s drinking milk, wheat flour. The study region is the Siberian Federal District. The research methodology is based on the study of the structure of retail prices for selected types of products. Data on the structure of retail prices were obtained from the official website of the Federal State Statistics Service of the Russian Federation.

The research methodology included a number of sequential steps.

Stage 1. Assessment of the aggregate characteristics of value chains for selected products:
Total costs in the value chain (OPEXVC):

\[ OPEX_{VC} = \sum_{i=1}^{4} OPEX_i \]  \hspace{1cm} (1)

OPEX1 – costs of production and sale of basic raw materials in agriculture, rubles;
OPEX2 – costs of production and sales in the food processing industry, rubles;
OPEX3 – distribution costs of intermediary organizations (wholesale, storage, transport services), rubles;
OPEX4 – distribution costs of finished products in retail (retail), rubles.

Total profit on production and sales (Profit):

\[ PROFIT_{VC} = \sum_{i=1}^{4} PROFIT_i \]  \hspace{1cm} (2)

PROFIT1 – net profit of agricultural organizations in the production of the main raw materials (livestock and pigs in live weight, raw milk, food wheat), rubles;
PROFIT2 – net profit in the production of goods in production, rubles;
PROFIT3 – net profit of market intermediaries, rubles;
PROFIT4 – retail net profit on product sales, rubles.

State revenues from the production and sale of products in the value chain:

\[ TAX_{VC} = \sum_{i=1}^{4} TAX_i \]  \hspace{1cm} (3)

TAX1 – single agricultural tax for agricultural organizations, rubles;
TAX2 – value added tax, excise taxes and other types of taxes paid by enterprises of the food processing industry, rubles;
TAX3 - value added tax, excise taxes and other types of taxes paid by intermediary organizations, rubles;
TAX4 – value added tax accrued by a retail organization, rubles.

The total profitability of production and sales (Pr, %):

\[ Pr = \frac{PROFIT_{VC}}{OPEX_{VC}} \times 100 \]  \hspace{1cm} (4)

Stage 2. Analysis of value chains of products. The following chains have been studied:
• gross value chain as an increase in the selling price of each member of the chain;
• chain of formation of costs for the production and sale of products;
• the structure of total profit for organizations involved in the production and sale of products.

Stage 3. Compilation of a matrix of business and government gains from the existing system of intercompany relations in the food market. The authors highlighted as winning the following points:
• state revenues in the form of tax revenues at the stages of production and circulation of products;
• profit from product sales received by a business representative is considering areas of economic activity.

3. Results and discussion
Retail prices for selected products on average in the Siberian Federal District and in its regions are presented in table 1.

Table 1. Retail prices for products in the regions of the Siberian Federal District.

| Region                        | Beef, kg | Pork, kg | Drinking milk, l | Wheat flour, kg |
|-------------------------------|----------|----------|-------------------|-----------------|
| Siberian Federal District     | 298.0    | 273.5    | 52.3              | 28.2            |
| Altai Republic                | 313.4    | 278.4    | 63.7              | 28.1            |
| Tyva Republic                 | 247.7    | 287.6    | 69.3              | 30.4            |
| The Republic of Khakassia     | 271.9    | 261.2    | 58.7              | 30.7            |
| Altai region                  | 274.8    | 250.6    | 46.3              | 23.4            |
| Krasnoyarsk region            | 318.7    | 296.9    | 55.9              | 31.9            |
| Irkutsk region                | 315.5    | 307.4    | 53.6              | 28.1            |
| Kemerovo Region - Kuzbass     | 297.5    | 258.6    | 45.1              | 26.5            |
| Novosibirsk region            | 317.6    | 278.6    | 54.7              | 28.2            |
| Omsk region                   | 272.9    | 247.6    | 44.6              | 27.5            |
| Tomsk region                  | 326.1    | 289.8    | 54.1              | 28.4            |

The highest prices for beef were recorded in the Tomsk region, the lowest in the Republic of Tuva. Pork is most expensive in the Irkutsk region, cheaper than the Omsk region. The highest price for milk is recorded in the Republic of Tuva, the lowest prices can be observed in the Altai Territory. Also, in the Altai Territory, 1 kg of flour is the cheapest; in the Krasnoyarsk Territory, this product has the highest prices in the Siberian Federal District.

Summary characteristics for each product according to the analysis of the structure of retail prices are presented in table 2.

Table 2. Summary characteristics of the production and sale of certain types of food products in the Siberian Federal District for 2018.

| Production type   | OPEX       | Profit | Renta  | R    |
|-------------------|------------|--------|--------|------|
| Chilled beef      | 237.6      | -7.8   | 28.5   | -3.3 |
| Chilled pork      | 229.6      | 62.4   | 23     | 27.2 |
| Drinking milk     | 42.9       | 14.0   | 5.48   | 32.7 |
| Wheat flour       | 23.0       | 4.4    | 2.01   | 19.1 |

According to the data obtained, the largest business expenses are observed in the production and sale of beef - 237.6 rubles per 1 kg of product. Also in the cumulative effect of the business on this product is negative (-7.8 rubles per 1 kg). At the same time, this product brings the state the most taxes - 28.5 rubles per 1 kg. The most profitable is the production and sale of milk: profitability is 32.7%. The largest total profit is generated in the chain of production and sale of pork - 62.4 rubles per 1 kg.

Data on the gross value chain of the product are presented in table 3.

Table 3. Gross value chains of products in the Siberian Federal District in 2018.

| Price types                                         | Beef       | Pork       | Drinking milk | Wheat flour |
|-----------------------------------------------------|------------|------------|----------------|-------------|
|                                                     | Value, rubles | Share, %  | Value, rubles | Share, %  | Value, rubles | Share, %  | Value, rubles | Share, %  |
| The price of raw materials from the manufacturer    | 182.8 | 61.34 | 147.3 | 53.9 | 21.7 | 41.6 | 8.7 | 30.7 |
| Price after processing (without)                     | 236.8 | 79.46 | 176.4 | 64.5 | 37.2 | 71.1 | 11.9 | 42.3 |
According to table 79.5% of the gross value of beef is created in the production sphere and 20.5% of the value in the circulation sphere. The share of wholesale intermediaries in this value chain is the smallest of the products under consideration - 1.8%. The gross cost of milk is created by 71.13% in the production sector and by 28.87% in the circulation sector. The share of the wholesale intermediary for this product is 5.56%. The pork production sector forms 64.5% of the cost of the product, another 35.4% of the cost falls on the circulation. The share of the wholesale intermediary in this product is higher than for beef and milk and amounts to 6.6%. In the cost of flour, only 42.3% falls to the production sphere, and 57.68% to the circulation sphere. For this product, the highest share of intermediaries in gross value is observed (19.34%).

Then, the value chains shown in figure 1 were investigated.

In accordance with the data presented, most of the costs for all types of products are formed in agriculture. The largest contribution to the cost of production and sale of basic raw materials is in the cost of beef (79.6%), followed by pork (64.14%), milk (55.3%). Only in the production and sale of flour the costs of agricultural production are comparable with the sphere of intermediary link (37.3% versus 36.1%).

Data on the total profit from production and sales of products, as well as its distribution between the participants in the value chain, are presented in figure 2.
The largest profit of organizations at all stages of the movement of raw materials and products is formed during the production and sale of pork 62.4 rubles, with a total cost of 229.6 rubles in 2018. Most of the profits came from agricultural organizations 34.2 rubles (54.8%). Retail from 1 kg of pork receives 19.3 rubles (30.8%) of the total profit for the product. Processing enterprises and intermediaries accounted for 9.2% and 5.08%, respectively. In the total profit from milk production, agricultural organizations also have the largest share - 62.3% or 8.7 rubles per 1 liter. This is followed by retail with 23.6% or 3.3 rubles from 1 liter. In the field of milk processing, 23.3% or 1.9 ruble of profit is formed, intermediaries work at the margin of profitability - 0.6% of the total profit in the chain. In the production and sale of beef collectively creates a loss of 8 rubles per 1 kg. The entire loss is due to agricultural organizations (- 44.4 rubles per 1 kg). The remaining participants in the chain make a profit. In retail and processing industries, 23.7 rubles and 12.7 rubles per 1 kg, respectively. Intermediary organizations are on the edge of profitability. Finally, in the value chain of flour, 57.12% of total profit is received by retail, 21.7% are received by agricultural organizations, 13.6% are processed enterprises and 7.5% are intermediaries.

The matrix of the distribution of winnings between the participants in the chain and the state is presented in table 4.

**Table 4.** Matrix of gains in the value chain of food products in the Siberian Federal District in 2018.

| Taxes / Profit                  | Beef       | Pork       | Drinking milk | Wheat flour |
|-------------------------------|------------|------------|---------------|-------------|
| Total for 1 kg of product      | (28.52; -7.8) | (23; 62.4) | (5.48; 14)    | (1.92; 4.19) |
| State / Agricultural Organization | (3.1; -44.4) | (2.1; 34.2) | (1.42; 8.7)   | (0.06; 1)   |
| State / Processing Plant       | (17.9; 12.7) | (14; 5.8)  | (3.37; 1.9)   | (1.12; 0.6) |
| State / Organization of circulation | (0.11; 0.21) | (0.48; 3.2) | (0.02; 0.09)  | (0.05; 0.33) |
| State / Retail                 | (7.51; 23.7) | (6.4; 19.3) | (0.67; 3.3)   | (0.79; 2.5) |
The state receives the largest amount of taxes from the production and sale of beef - 28.52 rubles per 1 kg. The largest share of tax deductions is generated in the processing industry: about 62.7% of the total taxes for beef processing, about 61% for pork and milk, and about 55.5% for flour production.

According to the total gain (the sum of taxes and profits) of the participants, the most attractive product is pork. The production and sale of this product creates an effect in the form of 85.4 rubles per 1 kg. At the same time, the effectiveness of this product is 37.17%. This is followed by the production and sale of beef, for which the cumulative effect is 20.7 rubles per 1 kg. But production efficiency is at the level of 8.71%. A slightly smaller cumulative effect is observed in the production and sale of milk (19.8 rubles), with the highest efficiency (45.43%). In the production of flour, the amount of taxes is 6.8 rubles per 1 kg, and the efficiency is 27.73%.

Summing up, the authors will formulate the main findings of the study:
- agricultural organizations create the largest percentage of the final cost of the products in question, but only in the cost of pork and milk have the largest margin share;
- the main tax revenues to the state are provided by the processing of agricultural products;
- intermediaries in the food market of the products in question do not have market power, and the retail organizations of the products in question have the strongest positions;
- production and sale of the types of products under consideration (with the exception of beef) is a highly profitable business, but high margins are unevenly distributed among participants in the food system.

4. Conclusion
Thus, the authors determined the general trends and the specifics of the distribution of costs, revenues and effectiveness between participants in the food system in the Siberian Federal District. Each of these areas requires further detailed study in order to develop accurate ways to create additional competitive advantages for agribusiness, taking into account the specifics of the food market.

References
[1] Sergienko E G, Korshikova M V and Chernobay N B 2017 Polyclithematic network electronic scientific journal of the Kuban State Agrarian University 127 308317
[2] Shelamova N A and Cherkasova O B 2017 Agro-food policy of Russia 5 35-44
[3] Reshetnikova E G 2017 Economics and Management 3 3442
[4] Pyzhikova N I, Parshukov D V, Vlasova E Y and Pyhanova E V 2018 European Research Studies Journal 21(2) 362377
[5] Parshukov D V, Shaporova Z E and Hodos D V 2019 IOP Conference Series: Earth and Environmental Science 315 (2) 002279
[6] Reshetnikova E G 2019 Economic and mathematical methods of analysis of the activities of agricultural enterprises 4952
[7] Chernysheva N M, Kotov R M, Altynbaeva E S and Khristoforova Yu A 2017 Food Engineering and Technology 4 (47) 145151