

The impact of economic crises on the Russian cheese market

Vladimir Plotnikov^{1,*}, Iuliia Ugarova², and Evgeniia Ugarova¹

¹ Saint-Petersburg State University of Economics, Sadovaya str 21, 191023, St. Petersburg, Russia

² Polzunov Altai State Technical University, Lenina av 46, 656038, Barnaul, Russia

Abstract. The market economy is developing cyclically. Periodically, crises arise in it. During the crisis, GDP decreases, unemployment increases, incomes of the population decrease, etc. The consequences of crises for different areas of economic activity are different. The purpose of the article is to study the impact of economic crises on the agro-industrial complex and national food market. The object of study is the Russian cheese market. The article analyses the impact of the crises of 1998, 2008, 2014 and 2020 in Russia on the national agribusiness and cheese market. The authors analysed the economic indicators of production and sale of cheese, revealed the structural and dynamic features of this market. According to the results of the study, causal relationships were found for changes in the Russian cheese market under the influence of economic crises. These results can be used to improve the public policy of regulating the national economy, ensuring food security, stimulation of agro-industrial complex and regulating the Russian cheese market.

1 Introduction

Economic goods have various usefulness. This is determined by the fact that they satisfy the various needs of people. Among these needs, vital needs can be distinguished. (From the Latin “Vita” - Life.) Not only the level and quality of life, but also the fact of human existence depends on their satisfaction. These needs include food needs. Physical food shortages or economic inaccessibility can cause serious crises. In this regard, food security is one of the priorities of public policy, both at the level of individual countries and regions, and at the level of the international community [1, 2, 3, and other].

At the same time, there is a direct and inverse relationship between providing the population with food and the functioning of the economy. These connections are most clearly observed in crises. In the context of the economic crisis, there has been a drop-in output, unemployment is growing, and the level of income of the population is falling. As a result, the availability of food to the population is decreasing. And vice versa. If the population is not provided with enough food (and even more so, hunger is observed [4]), this creates social instability. The result of social unrest is a violation of economic processes [5, 6, 7, and other]. This creates the prerequisites for the economic crisis.

* Corresponding author: plotnikov_2000@mail.ru

The purpose of this article is to study the impact of economic crises on the national food market. This problem is very wide. It has regional, national and industry specifics. In this regard, the study was conducted on the example of the cheese market of the Russian Federation.

2 Materials and Methods

To conduct the study, official materials of the national statistics of the Russian Federation were used: the Federal State Statistics Service (Rosstat) and the Federal Customs Service (FCS). Also, these materials were used by industry enterprises, the results of in-depth interviews with top managers of dairy and cheese-making enterprises. To identify general trends in the cheese market, a content analysis based on materials from printed and electronic specialized industry media was used.

During the study, general scientific methods were used: the dialectical approach, system analysis, formal logical analysis, methods of statistical, economic and comparative analysis, synthesis, comparison, grouping, graphical and tabular methods of information interpretation, as well as special methods of marketing research.

3 Background research (a review of economic crises in modern Russia)

In the recent history of the modern Russian Federation (as a new state that arose after the collapse of the Soviet Union) four crises are known. All of them had a significant impact on the national economy, economic indicators of the development of individual industries and fields of activity, as well as enterprises. These are the crises of 1998, 2008, 2014 and 2020.

Strictly speaking, the first crisis for the economy of modern Russia was the transformational crisis that arose as a result of the collapse of the USSR. The difficult stage of the transition to a market economy in Russia in the early 1990s led to structural imbalance in the economy and incomplete institutional reforms. This caused high inflation, a federal budget deficit and a general imbalance in the financial system. After the intensification of market reforms, September 22, 1992, the ruble against the US dollar fell sharply by 14.73%. This was only the first leap; over the next six years, the steering wheel depreciated 47 times. This crisis should rather be regarded as a crisis of the Soviet, not Russian, economy. This is a crisis of transition. Therefore, we did not study it.

Each Russian economic crisis proper has its own genesis and its consequences. Let's consider them in more detail.

The economic crisis of 1998. In the mid-1990s, a tough monetary policy was introduced in Russia aimed at curbing inflation and the ruble exchange rate volatility. Refusal to issue money, a large domestic debt, to cover which the issuance of State Short-Term Liabilities began, led to the depletion of foreign exchange reserves. This led to a partial default of 1998. The main external causes of the economic crisis in Russia in 1998 were the decline in oil prices, the crisis in Southeast Asia, which was facilitated by the devaluation of the national currencies of Thailand, Vietnam, Laos, Indonesia and other countries [8]. The combination of internal and external factors led to a partial default and simultaneous devaluation of the national currency, as a result of which consumer prices began to rise, real incomes of the population decreased, the number of poor citizens increased, many bank failures took place, gold and foreign exchange reserves decreased, etc.

The economic crisis of 2008. In 2008, the economic crisis affected almost all countries of the world, including Russia (it appeared in Russia a little later - in 2009, when the GDP, calculated in rubles, fell by 7.8%). The cause of the crisis was the "blowing bubbles" in the

US mortgage market. The consequence of this was the numerous bankruptcies in the financial sector, which turned out to be oversaturated with derivatives. A significant part of the securities circulating in the US stock market turned out to be junk bonds. Uncontrolled development of fictitious capital has occurred. And this “bubble” had to be eliminated. Compared to 1998, the Russian economy has entered a better prepared state in this crisis. Manageability was significantly higher. It was possible to accumulate significant foreign exchange reserves. Business economic performance was higher. The country was more prepared for economic shocks. But they could not be completely avoided, since oil prices (an important export commodity of Russia) fell and there was a serious external debt [8]. The consequences of the economic crisis of 2008-2009 in Russia were a decrease in GDP, mass layoffs of workers, a decrease in public confidence in the government, a reduction in state projects in the field of construction and infrastructure, etc. There was an increase in food prices [9].

The economic crisis of 2014. The general deterioration of the Russian economy, which began in 2014 (the fall intensified in 2016), was triggered by economic sanctions by the United States and several countries that supported them (EU, Norway, etc.). The military coup in Ukraine, the state adjacent to Russia, led to a change of government in that country and its partial disintegration. As a result of political upheaval, an armed conflict arose in the East of the country (Donetsk and Lugansk regions). In this conflict, Russia provided moral and humanitarian support to the newly formed People’s Republics. In addition, based on a democratically held popular plebiscite, the population of the Crimean Peninsula decided to secede from Ukraine and reunite with Russia. (Earlier for several centuries, Crimea was Russian territory and legally became a part of the sovereign state of Ukraine only after the collapse of the USSR, due to the internal administrative borders that had prevailed at that time.) Trying to change these political realities, the EU, the USA and some states that joined them introduced economic sanctions against Russia, which affected the gas, financial and banking, defense industry, food and other areas. The response was the introduction of a food embargo by Russia. Rising oil prices, falling GDP and the ruble, reducing gold and foreign exchange reserves, reducing exports and imports, lower real incomes and capital outflows are consequences of the 2014 economic crisis for Russia [10, 11, 12, and other].

The economic crisis of 2020. In 2019, the economic situation in Russia worsened somewhat due to lower investments, weak retail growth, oil price volatility, etc. The situation was significantly aggravated by the Covid-19 pandemic. At the end of 2019, the first case of infection was detected in China. After this, the infection spread rapidly around the world [13]. This negatively affected economic activity. To counteract the infectious disease, the governments of the world, in addition to the medical measures themselves, have introduced measures to reduce the number of social contacts. As a result, the work of retailers, transport, industry, and other sectors of the economy is limited. Most countries of the world have temporarily banned the crossing of state borders for private citizens, the number of business trips has also been drastically reduced. Similar measures have been taken in Russia. According to the Decree of the President of the Russian Federation of March 25, 2020 No. 206 "On the announcement of non-working days in the Russian Federation", the activities of many organizations were suspended. Economic losses for Russia and other countries from the Covid-19 pandemic have not yet been determined. But it is obvious that due to the slowdown in economic activity, there will be a decrease in GDP, income and purchasing power of the population. There is a risk of increased unemployment. This, of course, will negatively affect the provision of food to the population.

Figure 1 shows the dynamics of the Russian GDP, calculated in rubles at the base prices of 2008 (1995 was taken as 100%). This figure clearly shows the impact of the economic crises on the Russian economy. For 2020, for obvious reasons, there are no statistics yet.

However, according to a cautious assessment by the UN (April 1, 2020): “The global economy could shrink by almost one percent this year - 0.9 percent - due to the Covid-19 pandemic ... instead of growing a projected 2.5 percent. World output could contract further if imposed restrictions on economic activities extend to the third quarter of the year and if fiscal responses fail to support income and consumer spending”. Author's estimates of the fall in GDP in Russia are more significant - up to 5%.

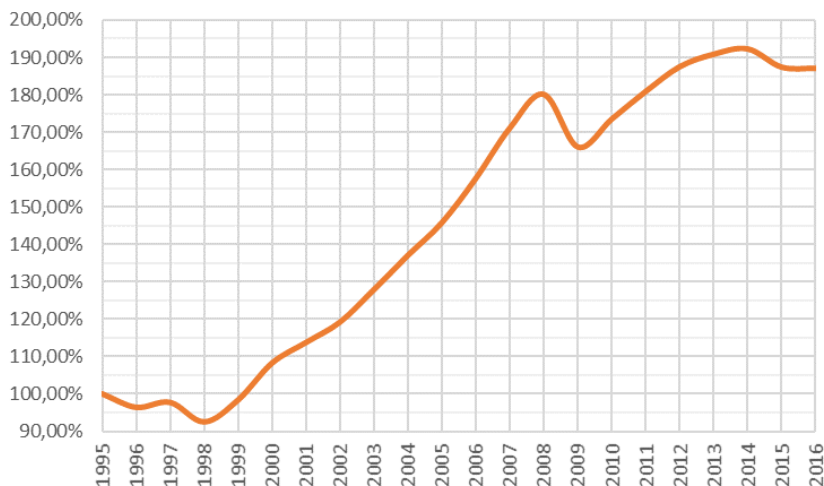


Fig. 1. The dynamics of Russia's GDP. Source: calculated by V. Plotnikov according to Rosstat.

Economic crises affect individual industries and organizations to varying degrees. Based on the purpose of our study, in the future we will consider the impact of crises on the food market. This is a strategically important area ensuring food independence and food security. The analysis will be carried out on the example of the cheese market.

4 Results

Cheese is an important human food product, since it contains a balanced amount of proteins, fats, carbohydrates, mineral salts, trace elements and vitamins [15, 16]. Being a highly nutritious, biologically complete and easily digestible product, cheese has been included in the recommended range of consumption of basic food products by the Ministry of Health (and Social Development of) the Russian Federation for a healthy diet (Order of the Ministry of Health and Social Development of the Russian Federation of August 2, 2010 No. 593n and Order of the Ministry of Health of the Russian Federation of August 19, 2016 No. 614 "On approval of recommendations on rational food consumption standards that meet modern requirements for healthy eating").

According to the Internet portal Statista.com, the highest level of cheese consumption per capita is observed in Denmark, Iceland and Finland (28.1, 27.7 and 27.3 kg in 2016, respectively). According to this indicator, Russia was in 36th place in the world in 2016 (there are no more relevant data yet).

The dynamics of average per capita cheese consumption in Russia has been growing annually in recent decades (Figure 2). The largest volume of cheese consumption by Russians was observed in 2012 and 2013, just before the 2014 crisis. During this period, it almost corresponded to the recommended rational food consumption standards that meet the requirements of a healthy diet, enshrined in the order of the Russian Ministry of Health. Subsequently, the average per capita consumption of cheese in Russia decreased and in

2016 amounted to 77% of the new cheese consumption recommended by the Russian Ministry of Health.



Fig. 2. Retail sale of cheese and per capita consumption of cheese in Russia. *Source:* compiled by Iu. Ugarova and E. Ugarova according to Rosstat.

The main reason for the observed long-term dynamics, as well as Russia's lag the leading countries in cheese consumption, is the unformed cheese consumption culture. The absence of this consumer culture is determined by the inertia of the socio-cultural processes. There was a shortage of this product in the Soviet period, in the national cuisine there are practically no dishes with cheese. During the study period (from 1990 to the present), changes were observed in the overall growth trend of average per capita cheese consumption. By 1995, there was a decrease in the indicator to 1.3 kg / person per year compared to 2.7 kg / person per year in 1990. In 2014, there was a decrease to 5.4, and by 2015 to 5.2 kg / person per year compared from 6.0 in 2013. During the 2008 crisis, there was a less significant decrease in per capita consumption of cheese - by 0.1 kg / person per year compared to the previous period.

The volume of consumption of cheese, like any other product, is largely determined by its price. Since cheese is not perceived by the population as a basic food product in the national consumption culture, the elasticity of demand for cheese prices is quite high. In the early 1990s there was a significant jump in cheese prices (Figure 3). In 1992, prices rose more than 31 times. Due to the devaluation of the ruble against the US dollar and other reserve currencies, in 1998 there was a jump in inflation. As a result, in comparable prices, cheese went up by 108%. The next most significant increase in the price of this product was observed in 2007 (162%). It should be noted that in the study period, the Russian ruble was denominated. The reason for this was the high inflation rate in the 1990s. From January 1, 1998, there was an exchange of "old" rubles for "new" with a ratio of 1000 : 1. In this regard, the indicators in Figure 3 are given on a logarithmic scale.

Cheese production is material intensive. For the manufacture of 1 kg of the finished product, about 10 kg of raw milk is needed. Therefore, the price of cheese is largely determined by the price of raw materials, and the volume of national production depends on the resource potential of dairy farming. At the same time, to produce quality cheeses, as a

rule, milk from domestic producers is used. Powdered milk can be used to produce low quality cheeses and cheese products (products that mimic real cheese).

In 2007, a rise in cheese prices in Russia was associated precisely with a rise in raw material prices. The main reasons for the increase in the price of raw milk include: an increase in the cost of its production due to an increase in the price of feed (internal, production factor, see: (https://www.dairynews.ru/news/rynok_moloka_i_molokoproductov_v_2007_godu.html)); a short-term increase in the demand of processing enterprises for raw milk for the production of milk powder due to an increase in its price on the world market in the context of a decrease in the volume of raw milk production (external, market factor, see: <https://www.agroinvestor.ru/markets/article/10554-tselnoe-gore>). In 2008, due to the reduction of duties on milk imports from 15% to 5% and the saturation of the raw materials market, there was a decrease in purchase prices for raw milk. As a result, the price of cheese decreased by 9% compared to 2007 (Figure 3).

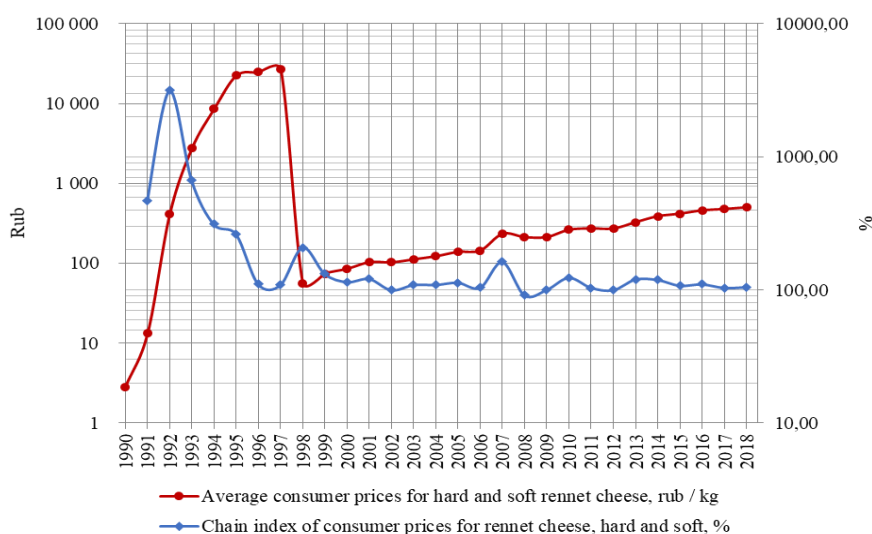


Fig. 3. Dynamics of chain indices and consumer prices for rennet hard and soft cheeses in Russia.
 Source: compiled by Iu. Ugarova and E. Ugarova according to Rosstat.

The dynamics of the resources and use of milk in Russia are presented in Figure 4.

A shortage of raw materials (raw milk) is characteristic of cheese production in Russia during the entire period of the study. According to Rosstat, in 1990 the production capacities of milk processing enterprises were 86% loaded. This is the highest level of capacity utilization. The start of radical market reforms since 1992 negatively affected production. Capacity utilization ratio decreased to 50%. Since 2000, the production capacities of enterprises have begun to grow due to the modernization of existing enterprises and the opening of new production sites. In addition, the growth in the number of small enterprises in this area has begun. Since 2015, growth has been observed due to the opening of mini-cheese factories, the organization of cheese production in peasant farms. Along with the development of dairy farming and an increase in cattle productivity, the level of utilization of production capacity increased slightly. This contributed to the growth of physical volumes of cheese production in Russia (Figure 5).

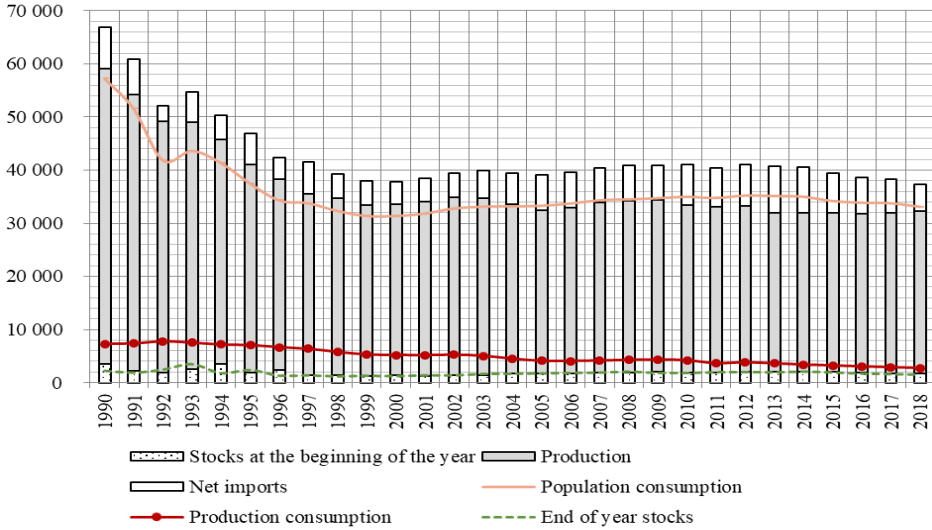


Fig. 4. Dynamics of resources and use of milk in Russia, thousand tons. *Source:* compiled by Iu. Ugarova and E. Ugarova according to Rosstat.

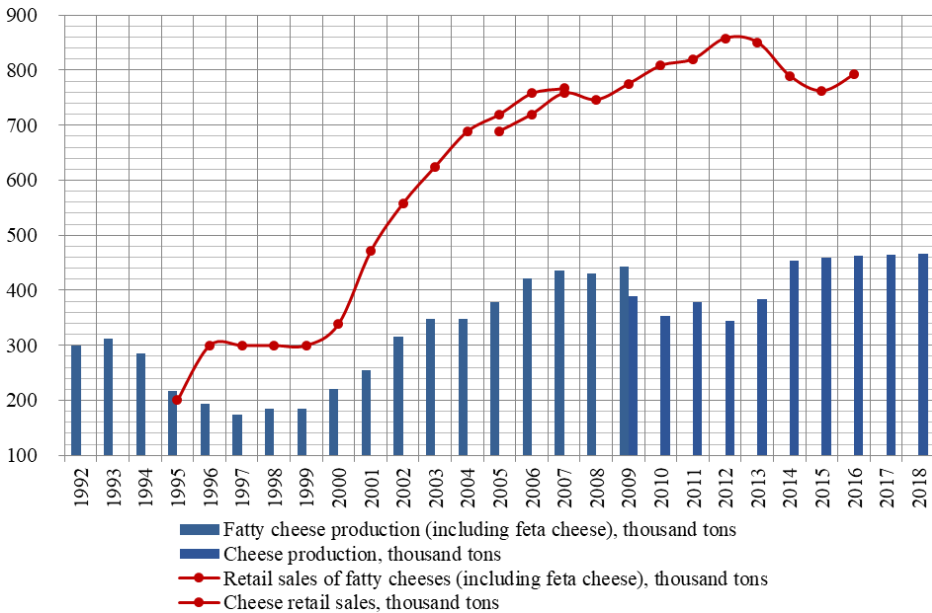


Fig. 5. Dynamics of production and retail sales of cheese in Russia. *Source:* compiled by Iu. Ugarova and E. Ugarova according to Rosstat.

Moreover, since the mid-1990s, the consumption of cheese in Russia has only partially been ensured by its own production (Figure 5). The Russian consumer cheese market is heavily dependent on imports. According to the portal Customsonline.ru, cheeses are delivered to the Russian Federation at different periods of the study from more than 30 countries of the world. The main importers of cheese and cottage cheese in different years were Belarus, Germany, Ukraine, Lithuania, Finland, and the Netherlands. A significant reduction in imports occurred in 1998, which continued until the end of 2001 (Figure 6).

The increase in the supply of imported cheese on the Russian market, which began in 2002, continued until 2014. In the future, due to the food embargo, imports decreased significantly. At the same time, large foreign producers (for example, the brands *Svalya* Lithuania, *Valio* Finland), in order to maintain their positions in the Russian market, organized import-substituting (from the positions of Russian economic interests) production in Russia.

5 Discussion

The authors highlight a number of stages in the development of the national (Russian) cheese market. Moreover, the economic crises that occurred in the Russian economy served as reference points in the development of this market.

Radical market reforms carried out immediately after the collapse of the USSR and the formation of a new sovereign state - the Russian Federation (1992-1994) led to an uncontrolled increase in prices for consumer goods and services. Cheese has also risen in price significantly, which has led to a reduction in cheese sales and per capita consumption. During this period, the level of utilization of production capacities was significantly reduced at their approximately constant value. The productivity of the dairy herd (this process continued until 1996) and the number of dairy cattle (this process continues to this day) began to decrease. Cheese production volumes were maintained. Due to the increase in imports of raw milk, it was possible to maintain production volumes. Since 1997, there have been changes in the organization of animal husbandry. Work was done to increase the productivity of dairy herds (cows). This over time allowed to partially compensate for the shortage of raw materials to produce cheese.

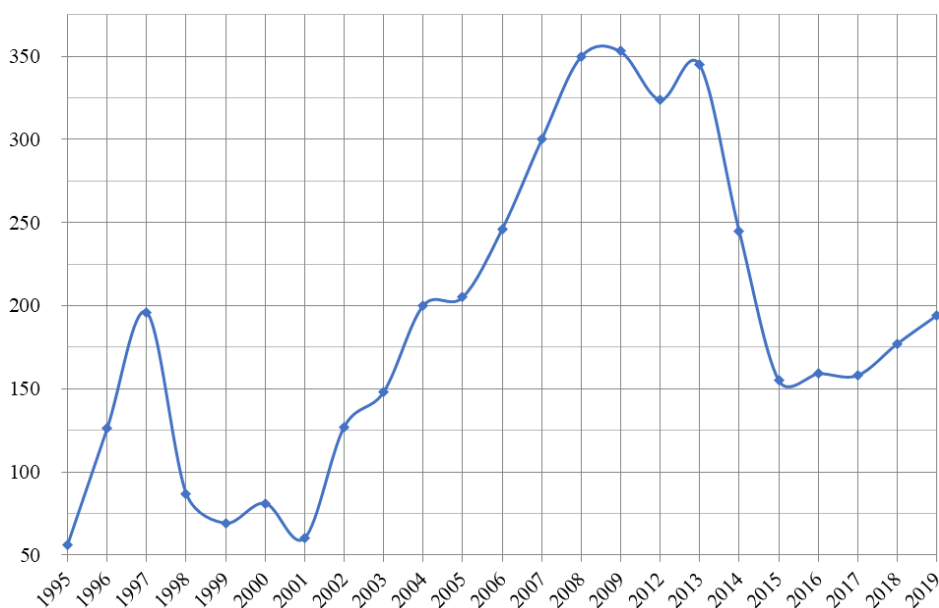


Fig. 6. Dynamics of cheese imports to Russia, thousand tons. *Source:* compiled by Iu. Ugarova and E. Ugarova according to FCS and FAO (fao.org/3/a-at654r.pdf)

As a result of the devaluation of the ruble during the 1998 economic crisis, domestic (ruble) prices for imported food increased significantly. Food imports declined significantly. The cheese market has undergone strong structural changes. These changes

served as an incentive to improve the performance of industry enterprises. There was a technical modernization of production (mainly due to the purchase and commissioning of new imported equipment), the product range was expanded, technological processes were improved, enterprises mastered the production of cheeses with an accelerated ripening time to quickly meet the ever-growing demand.

The crisis of 2008 and the devaluation of the ruble caused a rise in prices for food products, including cheese. Imported cheeses in Russia have risen in price again. In conditions of insufficient domestic production, the structure of imports has changed. The import of cheaper cheeses has increased (due to the use of cheap raw materials, low quality products and the effect of agreements on the Free Trade Zone) from Belarus and Ukraine to Russia. These imports began to threaten domestic production. Therefore, in 2009, due to the threat of bankruptcy of domestic cheese-making enterprises, import duties were introduced.

In addition, regulators have begun to pay more attention to improving the quality of cheese. One of the barriers to the development of the cheese market was the increasing requirements for the quality and safety of raw materials, especially milk. This is reflected in the new technical regulations of the Customs Union (Decision of the Council of the Eurasian Economic Commission of October 9, 2013 No. 67 "On technical regulations of the Customs Union "On the safety of milk and dairy products" (together with TC CU 033/2013. Technical regulations of the Customs Union)").

After the introduction of economic sanctions and countersanctions (food embargo) in 2014, the volume of cheese imports to Russia sharply decreased. The introduction of the embargo favorably affected the development of domestic production of cheese and cheese products. Commodity producers began to increase production volumes, modernize and technically re-equip existing production capacities, and introduce new ones. Thus, competition between domestic producers increased, which contributed to the development of technology and the expansion of the range of domestic cheeses. But, despite the introduction of the embargo, the domestic cheese market remained import dependent. Cheese production in Russia depends on foreign technological and packaging equipment, supplies of bacterial starter cultures, concentrates, milk-clotting enzymes, etc. Also, the development of cheese production in Russia was limited by rising prices for basic raw materials [17].

The consequences of the economic crisis of 2020 will manifest themselves in full sometimes later. Now, it is impossible to accurately predict them quantitatively. At the same time, the negative impact of the Covid-19 pandemic and related restrictions imposed by the authorities on the national cheese market is already evident. The restrictions imposed by the authorities did not directly affect food industry enterprises (including cheese producers). These industries are life supporting. The volume of output, in this regard, has not changed significantly. Volumes of supplies of raw materials having a pronounced seasonality are comparable with the previous period.

At the same time, one of the problems faced by cheese-making enterprises is the lack of components and packaging material, which are mainly supplied from abroad. Due to the closure of borders, there was a problem with their supply. An insignificant shortage of packaging material is observed, since alcohol-based paints are used for its production. Due to the spread of coronavirus infection, most of the alcohol is redistributed to the production of antiseptic drugs, the demand for which has increased significantly in a pandemic. The volatility of the national currency caused an increase in prices for imported raw materials and packaging material. The rising costs of cheese producers have already led to higher prices for the final product. In the first 19 weeks, average retail cheese prices in Russia rose 2.77% (Figure 7).

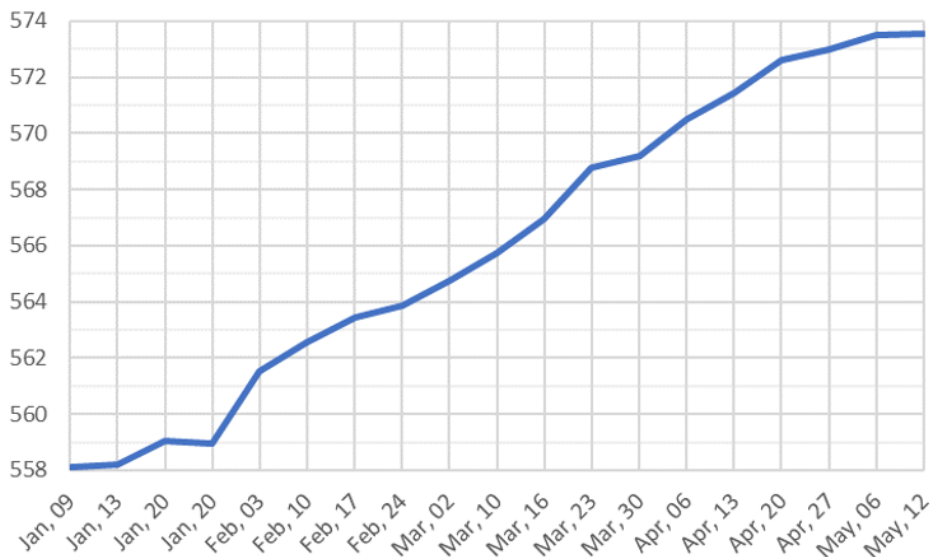


Fig. 7. Weekly dynamics of average retail cheese prices in Russia, 2020, rubles / kg. *Source:* compiled by V. Plotnikov according to Rosstat.

At the same time, demand constraints began to appear. The decline in population incomes, the increase in the number of unemployed leads to a decrease in demand for all consumer goods, including food not of prime necessity. As noted above, in the Russian culture of consumption, cheeses do not occupy significant positions. In this regard, the demand for them, especially for expensive varieties, may decrease. This will require manufacturing enterprises to change the range and structure of output. Also, the introduction of the Federal State Information System "Mercury", which is designed to improve the quality of food, will make a certain contribution to the development of the national cheese market. But the costs of introducing this system are very substantial, their reimbursement may be a problem for the subjects of the Russian cheese market.

6 Conclusion

As a result of the study, general trends in the development of the Russian cheese market under the influence of the economic crises of 1998, 2008, 2014 and 2020 were identified:

- A shortage of raw milk restrains the development of cheese production, forcing cheese-making enterprises to find alternative sources of satisfying needs, including using poor quality resources of personal subsidiary plots of the population and small farmers and the inclusion of milk fat substitutes in the recipe. This reduces the production efficiency and negatively affects the consumer characteristics of the finished product.
- High resource consumption, rising prices for basic raw materials contribute to higher prices for the finished product - cheese, which reduces its attractiveness and accessibility for consumers amid falling incomes and purchasing power of the population. This trend is reinforced by the lack of formation of a national cheese consumption culture.
- The presence on the market of cheese products with low consumer characteristics, low-quality products and counterfeit helps to reduce consumer loyalty and reduce consumption. In this regard, the introduction by the authorities of the Federal State Information System "Mercury" can be assessed as an effective measure.

- A high share of imported raw materials in the production of Russian cheese, high import dependence on the used production equipment makes the industry sensitive to changes in the foreign exchange market, dependent on political factors.
- The limited Russian technological and recipe base explains the low competitiveness of domestic cheeses, limits the ability of manufacturing enterprises to expand the range of domestic cheeses, import substitution and satisfy consumer preferences.
- A long production cycle and a long payback period make the industry less attractive for investment. Apparently, this should be considered by state institutions when implementing measures to support entrepreneurship in this industry (tax holidays, subsidizing production and technical re-equipment, soft loans, etc. [18]).
- Economic crises have a dual effect on the cheese market. On the one hand, barriers to the use of imported resources appear, the purchasing power of the population decreases (crises in Russia are usually accompanied by a depreciation of the national currency). On the other hand, the penetration of imported cheese on the market is limited, the competitiveness at the price of domestic products is growing, and the opportunities for developing own cheese production, related and supporting industries and economic activities are expanding. The prerequisites for the development of the industry through import substitution are being formed. Formed consumer behavior and selectivity forces manufacturers to improve in order to meet the needs of the population and produce goods that meet expectations.

References

1. J. Brooks, *Food Security and the Sustainable Development Goals*, <http://wp.me/p2v6oD-2rM> (accessed 12 February 2020)
2. FAO, *The State of Food Security and Nutrition in the World 2019. Safeguarding Against Economic Slowdowns and Downturns*, Rome (2019)
3. G.V. Fedotova, A.A. Gontar, N.N. Kulikova, A.K. Kurbanov, *Advances in Intelligent Systems and Computing*, **622**, 542-548 (2018)
4. S. McGuire, *Advances in Nutrition*, **6(5)**, 623-624 (2015), DOI: 10.3945/an.115.009936
5. FAO, *Sustainable Development Goals. Indicator 2.1.1 - Prevalence of undernourishment*, <http://www.fao.org/sustainable-development-goals/indicators/211/en> (accessed 09 January 2020)
6. V. Plotnikov, M. Golovko, G. Fedotova, M. Rukinov, *Lecture Notes in Networks and Systems*, **87**, 342-351 (2020) DOI: 10.1007/978-3-030-29586-8_40
7. Y.V. Vertakova, A.V. Polyaniin, T.A. Golovina, *European Research Studies Journal*, **21**, 1001-1012 (2018)
8. V.K. Senchagov, S.N. Mityakov, *Finance: Theory and Practice*, **6**, 71-88 (2013)
9. RIA Novosti, *The global financial crisis of 2008 and the consequences for Russia*, <https://ria.ru/20130816/956672411.html> (accessed 22 January 2020)
10. E.Y. Charochkina, O.V. Mikhailov, *Indian Journal of Science and Technology*, **9(16)**, 89865 (2016)
11. A.A. Gromyko, V.P. Fyodorov, *Sovremennaya Evropa* **68(2)**, 22-27 (2016)
12. L. Tyll, K. Pernica, M. Arltová, *Journal of International Studies*, **11(1)**, 21-33 (2018)
13. A.A. Al-Qahtani, *Saudi Journal of Biological Sciences*, (2020) DOI: 10.1016/j.sjbs.2020.04.033

14. UN, COVID-19 likely to shrink global GDP by almost one per cent in 2020, <https://www.un.org/sustainabledevelopment/blog/2020/04/covid-19-likely-to-shrink-global-gdp-by-almost-one-per-cent-in-2020> (accessed 15 May 2020)
15. A. Ash, A. Wilbey, *International Journal of Dairy Technology*, **63(3)**, 305-319 (2010)
16. D. Bjerklie, *Time*, **161(16)**, 80 (2003)
17. Iu. Ugarova, O.P. Pavlusenko, N.I. Davydenko, *IOP Conference Series: Earth and Environmental Science*, **395**, 012106 (2019), DOI: 10.1088/1755-1315/395/1/012106
18. O. Kryzhanovskaya, L. Sevriukova, V. Plotnikov, Y. Vertakova, *Proceedings of the 27th International Business Information Management Association Conference*, 845-856 (2016)