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Analysis of the Problem of Import Substitution in the Chemical Industry and its Impact on Other Sectors of the Economy

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ANNOTATION

In Russia, the issues of import substitution are now more acute than ever. In this article, these problems are examined in relation to various sectors of the economy, and first of all, to the chemical industry, which is the basis for technological progress and whose development makes it possible to create conditions for the emergence and implementation of innovations in other industries. The author of the study set out to analyze the situation with import substitution in the chemical industry, as well as related industries, using Rosstat data, existing research results on similar issues, and also based on her own experience. In the course of the work, the main trends in import substitution and existing opportunities for increasing it were identified. Scientific tools such as analysis, synthesis, statistical method and data visualization method were used as a methodological basis. The research results reflected in this article can be useful both to researchers of the development of high-tech industries, and to representatives of federal and regional executive authorities, and other interested parties.

Keywords: import dependence; high-tech industries; sanctions policy; development problems; R&D; import substitution; chemical industry; financing problems

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INTRODUCTION

Due to the current geopolitical situation, the task of import substitution in all sectors of the Russian economy has become particularly acute. As for the chemical industry, the share of imports here is extremely high and reaches 90% of the total volume of production. However, the real data are often understated: most companies do not have direct supplies from China, but purchase Chinese products from Russian intermediary firms with russified documents.

The first direct references to the problem of import substitution appeared back in 2015. The fact that it still exists is evidenced both by the statistical data analyzed in this article and the results of scientific research; at the same time, about half of the authors openly point out the problem, while the rest cover it in a veiled manner.

Thus, the need to reduce import dependence and increase the share of domestic production is discussed in the article by E. Yu. Shirokova [1]. The issues of import substitution are touched upon by S.V. Kirbitova and N.A. Kozhina [2]. M.A. Kuimova [3] notes that the Russian Federation has an unrealized potential for the development of the chemical industry, and L.A. Suvorova, S.A. Banin, L.L. Zaushitsyna, I.V. Pestova [4] point out some tasks, the solution of which can contribute to its development. O.A. Mironova writes about the creation of some systemic conditions of state support [5].

Failure to solve the problem of import substitution may lead to irreversible technological dependence on foreign suppliers. In this study, the author proposes to analyze the situation in the chemical industry and related industries by studying the Rosstat data of existing research results on similar issues, as well as on the basis of her own experience.

RESEARCH METHODOLOGY

In this study, the author, using Rosstat data, existing research results on similar issues and based on her own experience, conducts a comparative analysis of the situation with import substitution in the chemical industry, as well as its dependent industries: radio-electronic, electronic, aviation, metallurgical, machine-building, agro-industrial, food pharmaceutical, textile, printing and fuel industries.

Rosstat data (selected by the name of the type of activity according to OKVED) are presented by the category "Production indices for certain types of economic activities in the Russian Federation". Three sub-sectors of the chemical industry were considered: production of pesticides and other agrochemical products; production of paints, varnishes and similar coating materials, printing inks and mastics; production of chemical fibers, with maximum peak values for the period from 2014 to 2022 and three peak points for each sub-sector.

RESULTS OF STATISTICAL DATA ANALYSIS

To confirm the relevance of the problem, we study the Rosstat data in terms of average actual import prices for basic goods, as well as physical volume indices of imports of goods and services.

The analysis reveals that the highest peaks of import growth occur in Q3 2010 (135.1%) and Q2 2021 (132.2%), and the highest average actual import prices for major commodities, in July 2020 ($8,165.4 thousand).[1] This indicates that the price of imported products was increasing in value terms, which reflects the direct dependence of the Russian economy on the import policy of foreign suppliers. Based on the values of the Indices of the physical volume of imports of goods and services and average actual import prices for basic goods, we can conclude that urgent measures are needed to reduce the share of imports, as well as the development of

[1] Average actual import prices for basic commodities. URL: https://www.fedstat.ru/indicator/43239?ysclid=le4rjpxz15788192711 (accessed on 15.12.2022).

weak areas. The latter include: lack of financing, low exports and significant imports of chemicals; outdated and obsolete production facilities; shortage of qualified personnel (holders of unique knowledge are usually over 70 years old); poorly organized sales; slow implementation of innovations and the presence of a corruption component.

OVERVIEW OF THE CURRENT SITUATION IN THE CHEMICAL AND RELATED INDUSTRIES

According to Rosstat data, the share of chemical products is 8.6% in the total volume of shipped goods [1]. Based on the information of the Center for Macroeconomic Analysis and Short-Term Forecasting (CMASTF), there is no progress in this production for the last five years [1].

The author, relying on her own experience, knowledge gained by reviewing the literature on similar issues, as well as on the basis of the results of analyzing the activity of one of the leading chemical enterprises, considered the problem in more detail:

– ***Energy-rich materials.***

In 1970–1980, domestic raw materials were used in the USSR for the production of energy-rich materials, but later they were abandoned under the pretext of "environmental danger" and replaced by imports, for example, from Germany, Korea and France, which turned out to be much more expensive. In addition, Russia became dependent on the political situation, as Western countries gradually imposed restrictions on the supply of raw materials, up to a complete ban. As a result, under time pressure, it is necessary to look for another importer and raise the issue of adapting production to the new imported raw materials.

– ***The reagents.***

The USSR had its own production of almost all types of reagents for analyses and/or for use as components in the chemical industry. Due to its cheapness it started to be purchased abroad (mainly from China). Our own production was liquidated, and the quality of Chinese products began to deteriorate, but the price began to rise due to lack of competition. Thus, we invested money in the Chinese economy, which gained not only markets, but also the opportunity to gain significant profits from the large-scale production of reagents; at the same time, the delivery time due to logistical disruptions (as a result of the COVID-19 pandemic) increased, and enterprises were unable to deliver their products on time. This problem requires the immediate development of new domestic technologies for the manufacture of these components.

– ***Materials for the chemical industry (plants for chemical production).***

The requirements for materials that were produced in the USSR were defined in design and technological documentation in accordance with GOSTs (technical specifications of state standards). As part of import substitution, the properties of materials have deteriorated due to the use of various additives that were not used in Soviet times. This negatively affects the quality of manufactured products.

– ***Ozone-depleting substances.***

Ozone-depleting substances are widely used in fire extinguishing systems, refrigeration systems, as solvents, etc. In accordance with the requirements of the Montreal Protocol[2] their production was banned from 1996; only regeneration (recovery) of those in use was allowed. At the same time, the production of ozone-depleting substances was stopped, and regeneration (recovery) required imported raw materials (from Great Britain), the supplies of

[2] Production of highly regulated ozone-depleting substances is prohibited on the basis of the Montreal Protocol (adopted by the Government of the USSR in November 1988) and the Russian legislation acting on its basis (Federal Law of 10.01.2002 No. 7-FL "On Environmental Protection" in the latest version (Art. 69.1), Resolution of the Government of the Russian Federation of 18.02.2022 No. 2 06, etc.). Laws and Statutory Instruments).

which stopped after the introduction of the next package of sanctions. A critical situation arose, and new suppliers had to be found. However, it is impossible to obtain raw materials in the previous volumes in the current period, and therefore it is necessary to find alternative ways to produce analogue substances with a lower ozone-depleting potential (not prohibited by the Montreal Protocol).

– ***Solid chemical sources of oxygen.***

Solid chemical oxygen sources are used to provide first aid to the population in critical conditions (for example, in epidemics, accidents, disasters), emergency transport of seriously ill patients, mountain climbers, etc. However, after the introduction of the next package of sanctions, supplies of sodium chlorate produced in Finland were stopped. Chinese sodium chlorate is comparable in cost to Finnish sodium chlorate. There is no domestic analogue, and, as mentioned above, it is impossible to restore production of both raw materials and subsequent products in the shortest possible time.

– ***Components of monitoring, control, automation, and data acquisition systems.***

These components of monitoring, control, automation, and data collection systems are used for construction and development of chemical production facilities. Due to sanctions, supplies of: pressure sensors (manufactured by the European company Keller), temperature sensors, level gauges manufactured by the companies Vega (Germany) and Endress+Hauser (Switzerland), flow meters of the trade mark (Tm) Krohne (Germany), etc. have been suspended. At the same time, the use of Chinese analogues leads to deterioration of metrological characteristics (measurement error increases and reproducibility of controlled parameters decreases), and, consequently, it leads to a decrease in the accuracy of establishing the modes of technological processes and reliability (devices fail prematurely). In addition, the supply of such equipment as thermostats, high-temperature pumps, quality fittings, laboratory glassware cut-offs [in particular, reactors, Kavalier Glass (Czech Republic) made of Simax glass, glass products of European firms FL medical, Kartell, Nuova Aptaca] has been discontinued. Instead of these brands, nowadays Chinese products are used, for example, Greetmed and others, which leads to deterioration of equipment performance. And it takes time to develop own production facilities.

– ***Organofluorinated compounds.***

Monitoring of scarce and requiring import substitution of materials of low-tonnage chemistry revealed the lack of resources possessing the properties of perfluoropolyethers (PFPE) (chemical inertness, low pour point, resistance to aggressive environments and various oxidising agents, high thermal and radiation stability, non-toxicity), allowing to use PFPE as: hydraulic and pumping liquids in diffusion pumps, compressors; sealing gaskets in contact with aggressive environments (oxidising agents, halogens, gaseous acids); low solidification oils and greases in stop valves, bearings (especially in conditions of northern regions in the oil and gas production industry).

High stability and radiation resistance, chemical inertness of PFPE allows to guarantee their performance in devices for a long time (more than 30 years). Currently, the Russian consumer market for perfluoropolyethers is about 30 tonnes. The main suppliers of PFPE, each of which produces several dozens of types intended for different segments of the world market, are the USA (DuPont, Nye Lubricants, IKV Tribology; TM Demnum, Dow Corning), Belgium (Solvay Industries TM Krytox company); Japan (TM Fomblin, Daikin) Great Britain (M&I Materials Limited company); China (ICAN company) and others. Dupont, Solvay, Daikin together occupy about 90% of the global PFPE market, with Dupont dominating in North America and Solvay dominating in Europe. [6]. At present, supplies from abroad have stopped,

so the Russian Federation needs to create its own production facilities.

– ***Radio-electronic and electronics industries.***

These industries were systematically developing in the USSR, and in some areas our country was even ahead of the West. Import substitution affected only the defence industry, and even partially. In 2020 Rostech State Corporation developed a roadmap for the modernisation of Russian microelectronics, taking into account investments in chip manufacturing enterprises (798 billion roubles until 2024) [7, 8]. This document is based on the measures to stimulate the production of new commodities in the absence of imports, but the indicated growth rates of the industry will not ensure the transition of the Russian economy to the modern level. The lack of enterprises in the country for the production of silicon and its derivatives serves as a vivid example of the interconnection of radioelectronics and electronic industry with the chemical industry: the production of semiconductors directly depends on silicon, without it it is impossible to manufacture computer equipment necessary for the automation of production processes and the creation of new modern production facilities.

– ***Aviation industry.***

The development of this industry was based on partial (minimal) import substitution. At the same time, a significant part of aviation equipment and components for it were purchased from foreign suppliers [7]. Thus, the share of domestically produced aircraft in the fleet of Russian air carriers was annually decreasing. As for the components for the aviation industry, some of them imported by Russia are made of domestic basic polymers. This production is developing quite rapidly in our country, but is exported as cheap raw materials to then return in the form of expensive imported products.

– ***Metallurgical industry.***

Let us consider the defence-industrial complex [7]. A vivid example of the lack of import substitution in this industry is the fact that Russia does not produce sodium sulphide, which is used in metallurgy to produce steel and non-ferrous metals. This element is also used for the production of dyes, sodium hydroxide and soda. Sodium sulphide is also used in chemistry itself, mainly as a reagent for chemical laboratories.

– ***Mechanical engineering (Machine building).***

When analysing the regulatory documents on the strategic development of the industry, it was revealed that the existing tools to support it are insufficient [7]. Considering the structure of production, it can be seen that the share of the chemical industry is 9.8%, and in the structure of the domestic market — 14%.[3] The observed imbalance points to Russia's import dependence — for example, the lack of various types of domestic fuel can lead to irreversible consequences, including disruption of launches of civil and military satellites, spacecraft for geological reconnaissance, problems in navigation, provision of cellular communications, etc. This may cause a multiplier effect and disruption of the state's vital activity, as well as a threat to its defence capability.

– ***Agro-industrial complex.***

The analysis has shown that this industry is also import-dependent, as well as those mentioned above [9]. Due to the geopolitical situation and sanctions imposed against Russia on the supply of various types of equipment and components, there is no possibility to organise the production of calcium carbonate, which is widely used in animal husbandry, agriculture, construction, food industry and cosmetics industry.

– ***Food processing industry.***

The data analysis revealed the following trend: 98% of food ingredients, as well as nutri-

[3] The Russian Government Order No. 2816-o dated 06.10.2021 approved the List of initiatives for socio-economic development of the Russian Federation until 2030. Section 10.5 Chemical Complex. URL: https://www.consultant.ru/document/cons_doc_LAW_144190/4125ee61cb16b4e5fb24f676bb90038570b89c4e/?ysclid=lgs6pc3d9v898868479 (accessed on 22.11.2022).

tion of various types (medical, children's, sports, and preventive) remain import-dependent [10]. The consequence of import substitution at the end of 2020 is a decrease in imports: by 65% — of pork; by 20% — of dairy products; by 11% — of fruits and vegetables. As an example, let us demonstrate the level of support per 1 hectare of arable land abroad (in thousand roubles): in Norway — 146.2; in the European Union — 29.1; in China — 25.9; in the USA — 23.87. In the Russian Federation its value is only 1.9 thousand roubles. [11]. The author [12] notes that full import substitution on the example of the food market has not occurred, including for some reasons: geographical and climatic features of our country and others.

– ***Pharmaceutical industry.***

In the production of pharmaceuticals, the raw materials are substances, about 800 items of which were imported in 2019. [13]. In value terms, insulin ranks first; perindopril ranks second; dolutegravir ranks third. In quantity terms, metformin leads; followed by acetylsalicylic acid and paracetamol. The leading countries in the production of substances are: China (49.7% of the total volumes); India (22.1%) and France (11.1%). The author [14] notes that currently there are 570 pharmaceutical production facilities operating in the Russian Federation, including 60 new ones, 16 of which belong to foreign companies. Based on the above, we can conclude that in this industry it is necessary to develop not only individual enterprises, but also full-cycle production — "from raw materials to the final product".

– ***Textile industry.***

The textile industry is closely related to the chemical industry — the complex technology of textile production is based on physical and chemical processes.

Rosstat recorded positive dynamics of the national light industry growth rate in 2021 in relation to 2020 — the volume of manufactured products in the first two months of 2021 was 14.6% higher than the previous year's level (clothing showed a 5% increase in production, while leather goods showed a 10% decrease in volumes). In February 2021, the textile industry was one of the eight sectors with the highest growth compared to the same period in 2020: the production of textile products increased by 16.2% and clothing by 3.8%. Workwear remains the leading category — the growth against February 2020 was 33.7%, and against January — 22.8% (for comparison, the output of knitted goods increased by 8.5%). The production of knitted raw materials also shows growth. In the first two months of 2021, Russian factories produced 6 thousand tonnes of products, which is 22% more than in the same period of 2020. Companies producing sewing synthetic threads (+11.6%) and fabrics (+8%) started the year on the plus side. The industry increased production volumes despite an increase in the textile price index — the cost of production rose by 1.8% from January 2021, and by 7.1% in relation to January-February 2020.[4]

The sphere of light industry is very dependent on imported raw materials, government orders, as well as the wear and tear and lack of production of Russian equipment. According to the Higher School of Economics, there are up to 600 workers from competing countries in Asia per one worker in this industry in Russia [15]. Another problem is that up to 33% of synthetic fabrics are manufactured in the country, and the share of imports of raw materials (synthetic fibre) is still high. The factors constraining import substitution include the shortage of domestic sewing equipment, lack of raw material base, lack of qualified personnel, and low wages in the industry.

– ***Printing industry.***

The printing market in Russia started to experience difficulties during the pandemic,

[4] Textile industry grew by 15 per cent in 2021. URL: https://profashion.ru/business/finance/tekstilnaya-promyshlennost-prirosla-na-15-v-2021-godu/ (accessed on 06.03.2023).

but since February 2022 they have worsened. The constant imposition of new sanctions is causing significant damage to production and reflects its imperfections. For example, after the introduction of the fifth set of sanctions in April 2022, it became impossible to import certain types of equipment and components, special paints and varnishes, pulp, preparations for paper processing, etc. into Russia. The industry's problems, such as the availability of its own capacity for the production of only some types of paper and cardboard, which is certainly not enough for the full functioning of the industry, have been clearly identified. In addition, during the pandemic there was a tendency to move away from paper media to the online space, and the new crisis is only accelerating this process. As a result, the market for printing services is shrinking. Sanctions prevent the realisation of traditional logistic schemes, and hence problems with the delivery of necessary materials. The output of printing inks is decreasing (over the last four years it has decreased by more than 2 times). Overall, the number of publishing and printing enterprises in 2021 decreased by 12% in each of the segments. This is also accompanied by a drop in the index of entrepreneurial confidence (down by 8% in the industry).[5]

– ***Fuel industry.***

During the sanctions period, the market has shrunk. Since the beginning of 2023, oil is getting cheaper, and the previous production volumes do not bring the same profits as before, so they have to be increased [16]. However, new directions of development are emerging in the industry. For example, over the last decade the number of cars and water transport units with internal combustion engines running on alternative fuels has increased significantly.

[5] State of the printing industry according to Rosstat data. URL: https://blog.pagbac.ru/sostoyanie-poligraficheskoj-i-izdatelskoj-otrasli-na-2021-god-po-dannym-rosstat/?ysclid=lfh4xkpriv236996820 (accessed on 06.03.2023).

– ***Conclusions***

It is clear from the data presented in the review that the lack of domestically produced chemicals of all kinds has a negative impact on various industries. At the same time, the fact that there is no domestic capacity for the development of the chemical industry has a negative impact on the latter. There is a common problem for the chemical (and not only) industry of seeking immediate benefits from the use of imported materials, resulting in significant losses both in terms of finances and possible sales markets. It should also be noted that during the time when production did not exist, many domestic (Soviet) technologies were lost (or sold), plants and research and production complexes were destroyed or repurposed, and experienced specialists — both scientists and practitioners, after losing their jobs, moved to other spheres of activity, and some opted for early retirement.

ANALYSIS OF PRODUCTION VOLUMES IN VARIOUS SUB-SECTORS OF THE CHEMICAL INDUSTRY IN THE INTERVAL 2014–2022 AND CONCLUSIONS BASED ON THE RESULTS OF THE ANALYSIS

Let us consider and analyse the production volumes at the enterprises of the chemical industry for 7 years (from 2014 to 2022) in the context of its sub-sectors.

Analysing the data in *Fig. 1*, we can conclude that the peak growth rates are in January 2018 (173.6% compared to December 2017); December 2018 (145.3% compared to November 2018) and December 2019 (138.9% compared to November 2019). Due to the imposition of sanctions against the Russian Federation, manufacturers are striving to produce and manufacture competitive and import-substituting products, modernise plants and increase capacity.

Based on the data in *Fig. 2*, it can be noted that the peak values are in March 2016 (141.8% compared to February 2016); March 2017 (132.4% compared to February 2017) and Feb-

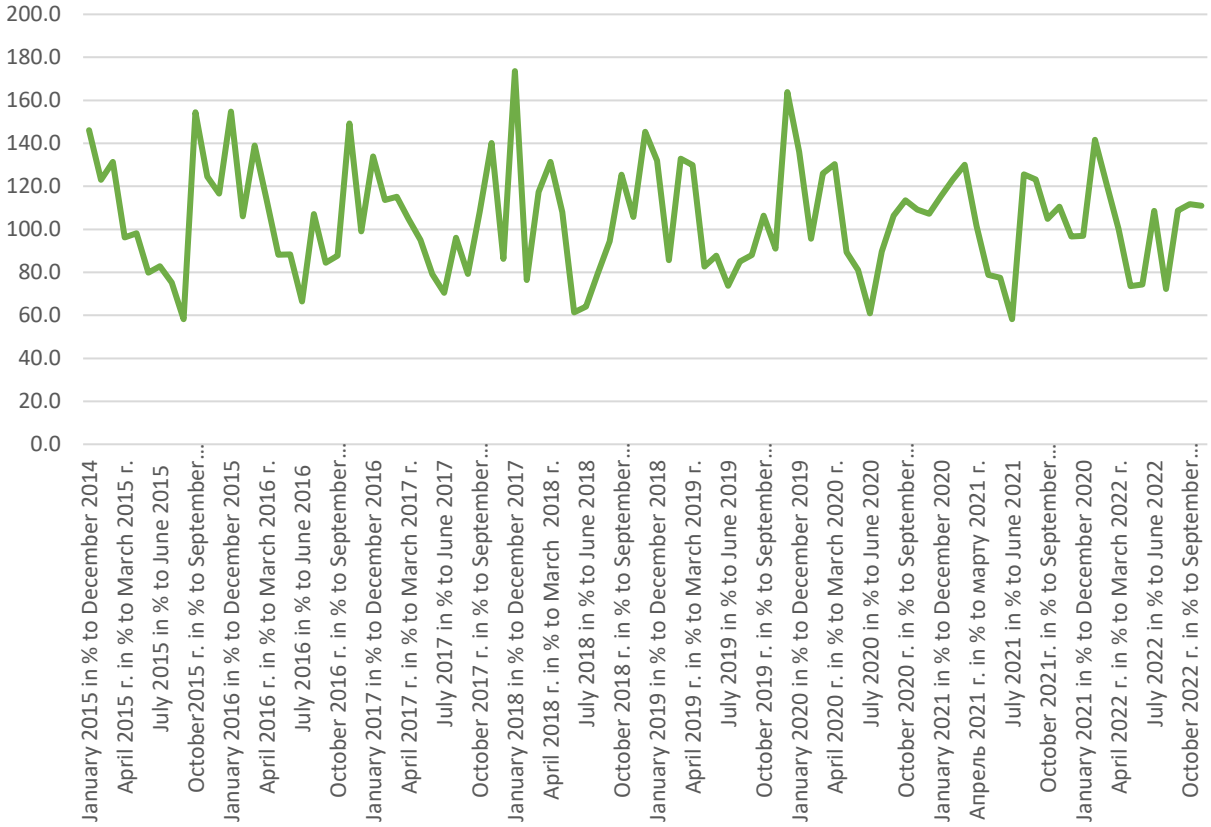

Fig. 1. **The growth rate of production of pesticides and other agrochemical products in the period 2015–2022, %**

Source: Developed by the author on the basis of Rosstat data. URL: https://rosstat.gov.ru/enterprise_industrial.

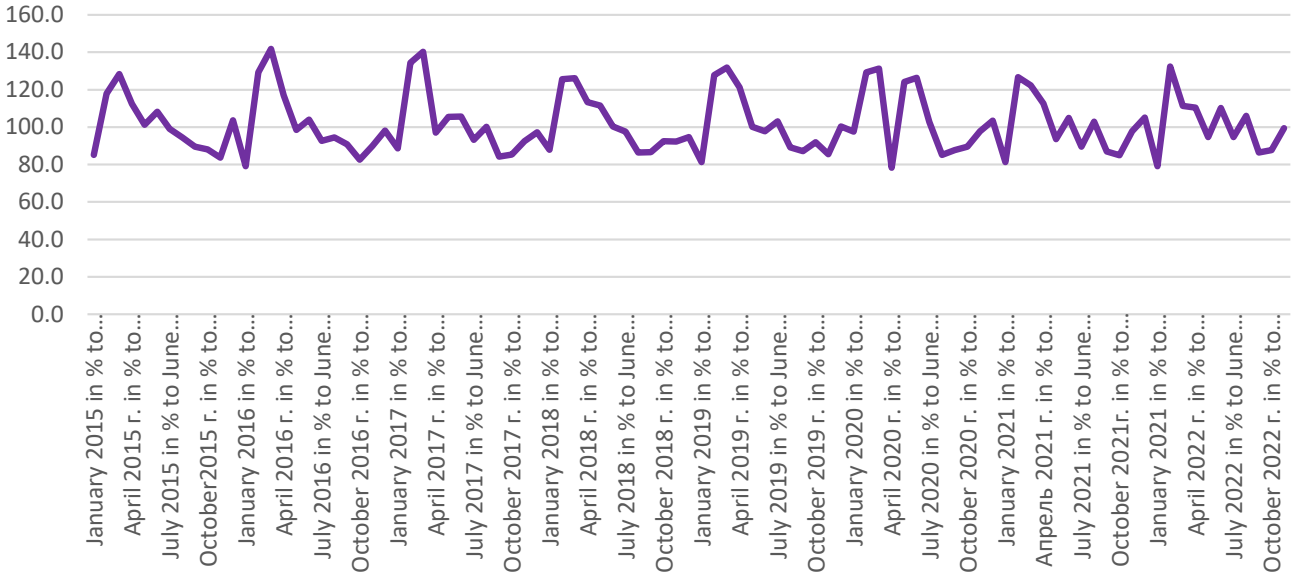

Fig. 2. **The growth rate of the production of paints, varnishes and similar materials for coating, printing inks and mastics, %**

Source: Developed by the author on the basis of Rosstat data. URL: https://rosstat.gov.ru/enterprise_industrial.

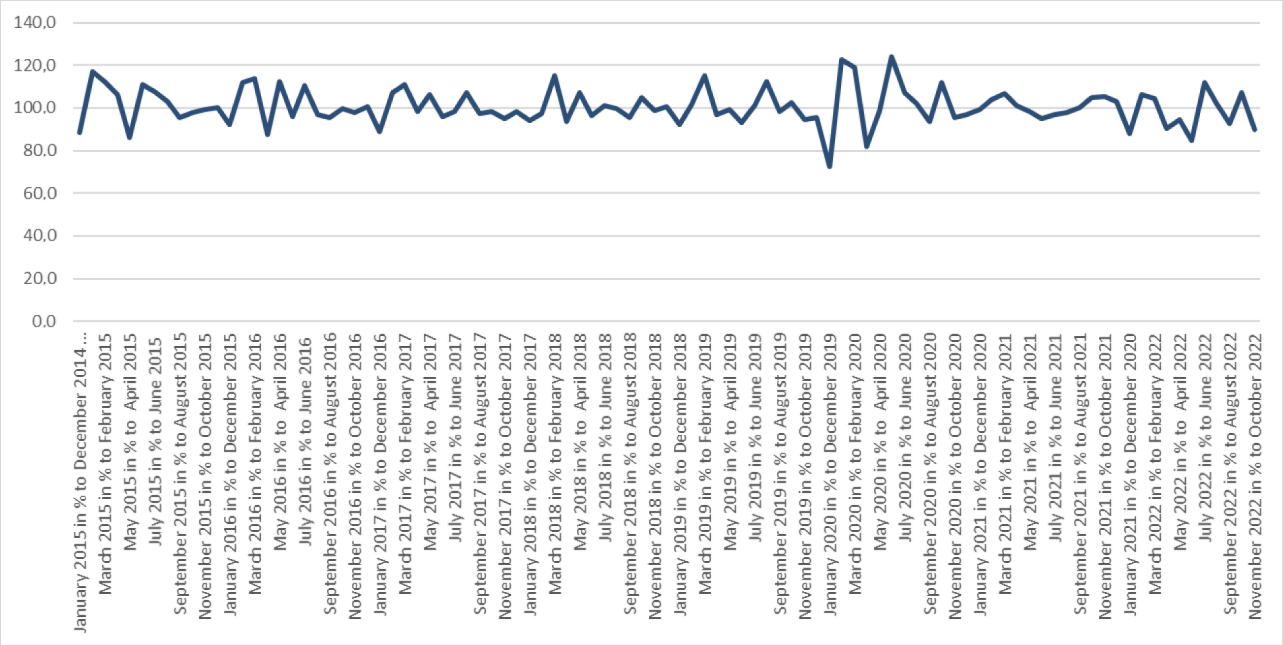

Fig. 3. **Growth rates of chemical fiber production, %**

Source: Developed by the author on the basis of Rosstat data URL: https://rosstat.gov.ru/enterprise_industrial.

ruary 2017 (134.4% compared to January 2017). According to a study conducted by marketing agency ROIF EXPERT[6] in 2022, "the volume of the domestic paint and varnish market showed an absolute maximisation" and increased by RUB 67 billion in terms of value indicators.

From the data of *Fig. 3* it can be evidenced that chemical fiber production reached its first peak in September 2017 (131.8% compared to August 2017); second peak — was reached in March 2015 (127.5% compared to February 2015) and third peak — was reached in June 2020 (117.4% compared to May 2020).

Based on the presented analysis, it can be concluded that the peak of activity in the production of pesticides and other agrochemical products was in 2018, paints, varnishes and similar coating materials, printing inks and mastics — in 2017. Thus, it can be said that in these sub-sectors, the production is developing along the import substitution path.

In general, there are peaks and downturns and not systematic development of the chemical industry, which negatively affects other industries. Sub-sectors of the chemical industry are highly specialized, and more comprehensive changes, such as a state plan for the production and marketing of certain types of chemical products, are needed for the products to be developed systematically [17–22].

RESEARCH RESULTS

In the current geopolitical situation, the import dependence of the Russian Federation economy becomes obvious. Domestic production and technological capacities cannot ensure the production of goods in such quantities that they can replace foreign products [23]. At this

[6] Paint and varnish market in Russia (with types), impact of sanctions of 2022: study and forecast up to 2026. URL: https://vc.ru/u/406653-roif-expert/385506-analiz-rynka-lakokrasochnyh-materialov-v-rossii-vliyanie-sankciy-2022-maksimalnoe-67-mlrd-uvelichenie-obema-rynka?ysclid=le4s88cul0779364284 (accessed on 07.02.2023).

stage, imports are necessary, since the adaptation, introduction of new and/or similar technologies requires a certain amount of time and significant investments. As for the chemical industry, due to its highly specialized nature and lack of permanent markets and plans for development, it develops one-step rather than systematically.

It is worth taking into account that the level of development of the chemical industry in a number of high-tech foreign countries allows the creation of materials with fundamentally new properties, which, in turn, contribute to the development of other areas of the economy.

In addition, it is important to emphasize that in order to develop the chemical industry, it is necessary to use the Soviet experience, adapt the experience of developing countries, especially the People's Republic of China. It is necessary to allocate funds for the restoration, maintenance and development of research and production complexes, guided by the historical and geographical features of the regions.

Based on the results of the study, we can conclude that the problem of import substitution remains open. It should be addressed more comprehensively: to develop the system of product sales and systematize production plans. Also, the process of import substitution should be combined with increasing exports, otherwise the slowdown of economic growth is inevitable.

The creation of specialized ministries will help to optimize the processes of ensuring technological sovereignty, since this method of management will provide better visibility of the problems of each sector, and their solution will be in the hands of qualified specialists. In addition, it will increase the personal responsibility of each ministry for solving problems in a specific sector accountable to it. Interaction between ministries should help regulate the import substitution process in order to maximize the effect of its comprehensive implementation on a national scale.

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