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Commodity Structure of the Railway Transportation Market: the History of a Century and a Half Transformation

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ABSTRACT

The purpose of the research described in the article is a long-term (from the last quarter of 19th century to the present) assessment, using methods of statistical and historical analysis, of the commodity structure of transportation on the domestic railway network, identifying the main trends in its transformation and drawing conclusions about development prospects of railway cargo transportation.

The analysis made it possible to identify the specifics of the commodity structure of railway transportation in the Russian Empire, the USSR and the Russian Federation and its changes within the corresponding historical periods. General trends in changes in the commodity structure of railway transportation over the entire sesquicentennial period under consideration have also been identified.

It is noted that adaptation of railway transport to transformation of the commodity structure of transportation indicates the high adaptability of the capital goods of the industry, and therefore the prospects of investment in development of railways.

A methodological approach to the typology of the commodity structure of the railway transportation market is proposed, based on which its qualitative changes during the period under review are analysed. It has been established that at the end of 19th – beginning of 20th century the commodity structure of railway transportation was diversified, then mixed and concentrated structures alternated, and at the beginning of 21st century the concentrated structure predominated. This structure makes transport companies dependent on the situation in a small number of industries and vulnerable if it worsens, therefore, it was concluded that it is advisable to diversify the commodity structure of railway transportation based on implementation of both marketing, technical and technological innovations. The key to this is the customer-focused improvement of cargo transportation technology and introduction to the market of new transport products that are attractive to cargo owners and effective for transport companies.

Keywords: railway transport, commodity structure of the railway transportation market, market conditions, trends, economic transformation, adaptability of capital goods, diversification, transport products.

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Текст статьи на русском языке публикуется в первой части данного выпуска.

INTRODUCTION

Railways, which bear over 90 % of commercial cargo turnover in the country (excluding specialised pipeline transport) [1], play a key role in the Russian cargo transportation market, and therefore in meeting transport needs of domestic commodity producers and product buyers. The importance of railways for the Russian economic history is great regarding last two centuries, when the country's economy developed in inextricable unity with the development of railway transport [2, P. 163]. The opinion of M. A. Davydov, a well-known researcher of the economic history of Russia in the second half of 19th – early 20th centuries seems justified: «… Railway transportation is a very important and clear indicator of the level of development of the national economy at any given moment in time, by which one can judge the dynamics of development of industry and trade, …development of the market… Among other things, railway statistics make it possible to capture changes in production and market conditions that are often not traced from other mass sources» [3, P. 753]. This assessment is confirmed by several studies carried out on material dated the second half of 19th – early 21st centuries [4–6].

An important characteristic of macroeconomic development and market conditions is not only the dynamics, but also the structure of railway transportation. It can be considered in various aspects, for example, geographical (by transport corridors, transportation directions) [7] or seasonal – by quarters and months of the year [8]. The commodity structure of railway transportation is of key importance, i. e., structure by type of goods (cargo) transported, which is the basis for segmentation of the railway cargo transportation market [9, P. 77]. It should be recalled that domestic railway science and practices initially widely used the concepts of «transportation of goods», «goods movement», «goods train» (as well as wagon, station, etc.) [10–12]. During the period of a centrally planned economy, the word «goods» in relevant terms gave way to the words «cargo» or «freight»[1] («cargo transportation,» «freight transportation», «cargo train», «freight train», «cargo station», «freight station», etc.). However, even then, in the sphere of relations between the railway, shippers and consignors (which was called *commercial work*), the concepts of «goods office» and «goods cashier» were preserved.

Indeed, from an economic point of view, transport hauls precisely goods that have such economic characteristics as production cost, market price, and utility for the consumer. The demand for transportation depends on these characteristics, as well as the requirements imposed by commodity producers on the timing and cost of transporting their products, with which the technology of the transportation process must be harmonised.

It is based on economic and cost characteristics that cargo on Russian railways is divided into three tariff classes, belonging to which determines the level of transportation tariff [13; 14], and, accordingly, the freight charge (rate) that the goods owner will pay, and which will be included in the carrier's income. Therefore, using modern long-held terminology in this work («cargo», «freight», «cargo transportation», «freight transportation» etc.), we will mean that goods transported by rail are goods produced for sale on the market and having the corresponding economic characteristics, the correct accounting of which by railway companies determines their positioning in the cargo transportation market, operational efficiency and long-term competitiveness.

The commodity[2] structure of the railway transportation market is important and interesting for scientific analysis because it:

– reflects the structure of the economy and the situation in goods and commodity markets;

– largely determines the profitability of the carrier's activities and transportation technology;

– indicates the predominant specialisation or diversification of the activities of railway transport and, to some extent, its long-term prospects under the conditions of economic transformation.

A number of works note such problems in the structure of railway cargo transportation as the dominance of coal («coal-centricity»), which reduces the specific profitability of transportation and does not correlate with the global decarbonisation trend [15; 16], as well as

[1] In original Russian text a single term is used for «cargo» and «freight». – *Translator's note*.

[2] While a terminological difference may exist between «commodity» meaning mainly raw materials or primary agricultural products and «goods» narrowly meaning a tangible physical product, then for the purposes of the article a term «commodity structure» refers in a broader sense as is the case of trade and exports to both goods and commodities if not mentioned otherwise. – *Translator's note.*

a decrease in the share of some goods transported (and, accordingly, their share in the structure of transportation), indicating their outflow to competing modes of transport (primarily road) [17].

All the above indicates the relevance of analysing the evolution of the commodity structure of the railway transportation market.

The objective of this study is to conduct, using *methods* of statistical and historical analysis, a long-term (from the last quarter of 19th century to the present) analysis of the commodity structure of transportation on the domestic railway network, identify the main changes and trends and, based on that, draw some conclusions for the future.

RESULTS

Commodity Structure of Railway Transportation in the Russian Empire

The threshold and beginning of construction of railways in the Russian Empire was accompanied by a very active discourse [18], touching on various aspects of this epoch-making innovation [19]. At the same time, in the Russian discourse of the 1830s – 1860s, railways in terms of their economic importance were considered, first, as a means of transporting agricultural products, primarily grain cargo. However, starting in the 1870s, the paradigm began to change: the government began to view railways as a tool to accelerate the industrialisation of the country through industrial orders for the needs of railway construction [20].

Indeed, orders for large-scale railway construction and for the needs of already operating railways, the length of which was growing dynamically, had a powerful stimulating effect at the end of 19th century on the growth of coal and oil production, the development of oil refining and ferrous metallurgy, mechanical engineering and metalworking and other industries [21–23]. On the other hand, railways contributed to development of industry thanks to high carrying capacity, as well as to regularity, accuracy, acceleration and reduction in cost of transportation [24; 25]. Considering the synergy of these two channels for stimulating industrial development on the part of railways, from 1870 to 1900, coal production in Russia increased by 23,5 times, oil production by 351 times, iron ore mining by 8 times; iron smelting increased by 8,5 times, iron and steel production increased by 9,3 times [26]. This radically changed the commodity structure of railway transportation (Table 1). If in the 1870s it was dominated by grain cargo, then by the end of 19th century coal came into first place, the share of ferrous metals increased significantly, and the share of oil cargo increased by an order of magnitude. It should be noted that the growth of grain transportation in absolute terms during this period was quite dynamic; it approximately doubled. However, coal transportation grew four times faster than grain transportation, and oil transportation almost 20 times faster [26; 27], which caused the noted structural changes.

At the beginning of 20th century, the persistence of accelerated growth in coal transportation (by 3,2 times with a total increase by 2,5 times) and a slower increase in grain transportation (by 2,2 times) [27] led to a continuation of trends in increasing the share of coal and reducing shares of grain cargoes. But the growth of oil cargo transportation slowed down significantly: the volumes there-of increased only by 1,5 times, and their share decreased significantly. This was due to a general decline in oil production in the country. It reached its peak in the Russian Empire in 1901, after which it began to decline due to depletion of fields explored at that time in the main oil-bearing region of the country – Baku – and insufficient compensation due to increased production in other oil-bearing regions [28, pp. 69–70]. In general, during 1900–1913, oil production decreased by 21 % [26, P. 403]. The persistence of impressive growth in rail transportation of oil cargo under these conditions (although it has slowed down significantly) indicates the effective positioning of railways in the cargo transportation market, where their main competitor was water transport. The share of oil transported by rail increased from 13,8 % in 1897–1901 to 47,3 % in 1913 [12, P. 246]. It should be noted that the share of railways in the domestic market for entire mainline cargo transportation also grew steadily: in the second half of the 1870s it was of 55 %, in the first half of the 1890s of 65 %, and in 1913 of about 75 % [21; 29]. At the same time, the share of industrial cargo in the total volume of railway transportation in 1913 accounted for 75,8 % [29, P. 189].

The growth in the share of railway transportation and the qualitative change in their commodity structure in the last quarter of 19th – early 20th centuries are a very clear and important characteristic of the modernisation transformation

Table 1

Changes in the commodity structure of railway transportation in the Russian Empire, %

Cargo name	Years			
	1876–1878 (on average)	1895–1897 (on average)	1899	1913
Coal	9,2	15,9	17,5	22,1
Oil cargo	0,7	7,1	6,3	3,7
Ferrous metals	2,4	3,5	3,1	3,0
Forest building materials	6,9	7,2	7,6	9,4
Firewood	…	…	5,2	6,2
Main grain cargoes	31,9	20,4	14,5	12,9
Other cargo	48,9	45,9	45,8	42,7
Total	100,0	100,0	100,0	100,0

Sources: [26; 27].

of the economy of the Russian Empire, the prologue of which was associated with the reforms of the 1860s – 1870s, and the crown of which was the «great economic breakthrough» of 1885–1914, supported by new institutional reforms [23].

Commodity Structure of Railway Transportation in the USSR

It is advisable to begin consideration of the structure of railway transportation in the USSR from 1928, located «at the junction» of the reconstruction period (after the First World War and the Civil War) and the period of the «first five-year plans», when forced industrialisation began within the framework of a centrally planned economy [30]. Although production and transportation of products were now carried out not to satisfy market demand, but to fulfil directive plan targets [29; 30], signs of commodity relations between product manufacturers, consignees and railways remained: they carried out monetary settlements, generated income and profit, etc. Therefore, and also to maintain a single approach to the stated topic throughout the entire sesquicentennial period under review, we retain the term «commodity structure of railway transportation» in relation to a centrally planned economy, without forgetting that these transportations referred to commodity rather in form than in content.

It should be noted that the structure of transportation in 1928 was not too different from the structure in 1913 (Table 2). Moreover, the share of coal decreased by 2,6 percentage points, and the share of firewood increased by a comparable amount (by 2 percentage points).

During the centrally planned industrialisation, in which priority was given to development of heavy industry [31, pp. 782–784], the structure of railway transportation had undergone significant changes by 1950: the share of coal increased dramatically, of ore – significantly, and the share of grain cargo decreased by more than twofold. However, these significant changes seemed to continue the trends of the late 19th – early 20th centuries. A fundamentally new trend has been associated with the dynamic growth of the share of mineral construction materials (previously, such a group was not identified at all in railway statistics) with a decrease in the share of forest construction materials. These interrelated trends continued until the end of the Soviet period.

In the structure of transportation of fuel and energy cargo in the 1950s – 1960s, dramatic changes began, associated with transformation of the country's energy balance – a decrease in the share of coal in it, an increase in the share of oil and gas, as well as development of nuclear and hydropower. Apropos, a significant role in this transformation was played by the accelerated transition of the railways themselves from predominantly steam to predominantly electric and diesel traction, which began in 1956 and had been largely completed by the early 1970s [32]. In the initial year of this transition, 1956, when steam traction dominated railway transport, railways consumed about 100 million tons of coal, over 22 % of all coal production in the country, and steam locomotives in real operating conditions could use only 4–5 % of the energy of burned fuel [33, P. 224]. The transition of railways to progressive types of traction freed up this coal for alternative, and more efficient, use, thereby reducing the required scale of increasing coal mining and coal transportation. Accordingly, the railways' carrying capacity was freed up for

Table 2

Change in the commodity structure of railway transportation in the USSR, %

Cargo name	Years						
	1928	1940	1950	1960	1970	1980	1990
Coal	19,5	24,5	30,6	24,8	21,2	19,6	19,2
Oil cargo	5,6	5,0	5,2	8,0	10,5	11,3	10,1
Ferrous metals	3,6	3,7	3,8	4,2	4,9	5,1	5,0
Forest building materials *	11,1	7,2	8,6	8,8	6,2	3,9	3,7
Firewood	8,2	4,0	2,3	…	…	…	…
Grain cargo	9,9	7,8	4,7	4,3	3,7	3,6	3,9
All kinds of ore	4,5	5,9	5,8	6,7	8,5	8,5	8,2
Mineral building materials (including cement)	12,9	18,8	18,9	22,9	23,9	25,7	29,4
Chemical and mineral fertilizers	0,3	0,7	0,7	1,1	2,4	3,1	3,6
Other cargo	24,4	22,3	19,5	19,2	18,8	19,2	16,9
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0

* Since 1960 – Timber cargo (including firewood)

Sources: [29]; Transport and communications of the USSR. Statistical collection. Moscow, Statistika publ., 1972, 320 p.; Railways of the USSR in numbers. Compiled by A. Jacobi; edited by Z. L. Mindlin. Moscow, TsUNKHU Gosplana USSR, 1935, 189 p.; Operator's Handbook. Ed. by N. A. Gundobin. Moscow, Transport publ., 1971, 704 p.; National Economy of the USSR in 1990: Statistical Yearbook. State Statistics Committee of the USSR. Moscow, Finansy i statistika publ., 1991, 752 p.; Dynamics of development of railway transport and prospects for formation of market infrastructure: reference book. Compiled by N. P. Tereshina, A. V. Ushkov. Moscow, MIIT Printing House, 1992, 88 p.; Transport and communications of the USSR. Statistical collection. Moscow, State Statistical Publishing House, 1957, 260 p.

transportation of other goods. Moreover, a significant increase in train performance, achieved due to the introduction of electric and diesel traction and other significant innovations on railways [34], significantly increased the carrying capacity that could be used to transport various goods. The influence of this transformation on the structure of railway transportation became evident already in 1960, when the share of coal decreased significantly, and the share of oil cargo, quite stable in 1928–1950, increased sharply. This was the beginning of a new trend, during which by 1970 coal had conceded primacy in the structure of transportation to mineral and construction cargo (its share fell below the level of 1913), and oil cargo took third place, ahead of timber.

Cross-cutting structural trends throughout the existence of a centrally planned economy were a gradual increase in the share of ferrous metals and a very dynamic increase in the share of chemical and mineral fertilisers, which, being insignificant in the period 1928–1950, by 1990 had become comparable to the share of timber and grain cargoes.

Thus, during the Soviet period, there was a significant transformation in the structure of railway transportation, which clearly reflected structural changes in the country's economy.

Commodity Structure of Railway Transportation in the Russian Federation

The assessment of the commodity structure of railway transportation in the Russian Federation (Table 3) was made based on data on the departure (loading) of goods, as in Table 2. It should be noted that since the beginning of the 1990s, the indicators of «shipped» and «transported» goods ceased to be identical, because transportation of imported and transit cargo began to be considered in a special way[3].

However, the difference between the departure and transportation of goods is not so great and, more importantly, the structure of the departure of goods characterises both the structure of domestic production and the success of attracting products from certain sectors of the Russian economy to railway transport. Therefore, the use of this indicator remains methodologically correct for the purposes of the study.

Under the conditions of a centrally planned economy, the structure of railway cargo transportation in the Russian Federation was somewhat different from the entire railway network of the USSR, in particular, the share of coal and ore was slightly lower, and that of oil and timber cargo was higher (see data for 1990

[3] See in detail: [35, P. 50].

Table 3

Changes in the commodity structure of railway transportation in the Russian Federation, %

Cargo name	Years							
	1990	1995	2000	2005	2010	2015	2020	2022
Coal	18,1	23,9	23,2	21,9	22,3	26,7	28,4	28,7
Oil cargo	11,5	14,6	14,8	17,2	21,0	20,6	16,8	17,5
Metal ores	6,6	10,2	10,8	10,0	10,6	10,7	11,2	10,8
Ferrous metals	5,1	5,2	6,0	5,8	6,0	5,9	5,3	5,4
Chemical and mineral fertilizers	3,6	3,1	3,4	3,4	3,8	4,2	5,0	4,9
Mineral building materials (including cement)	28,8	23,5	22,0	25,4	14,6	13,1	12,6	12,8
Timber cargo	6,2	4,7	4,6	5,1	3,4	3,2	3,3	2,5
Grain and grinding products	3,8	2,7	2,0	1,8	1,5	1,7	2,4	2,2
Other cargo	16,3	12,1	13,2	9,4	16,8	13,9	15,0	15,2
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Sources: [35]; Transport in Russia: Stat. collection. Goskomstat of Russia. Moscow, 2003, 182 p.; Transport in Russia. 2018: Stat. collection. Rosstat. Moscow, 2018, 101 p.; Transport in Russia. 2022: Stat. collection. Rosstat. Moscow, 2022, 101 p.; Review of the work of cargo railway transport for 12 months of 2022. URL: //railsovet.ru/analytics/obzor.

in Tables 2 and 3). However, these differences were not large – about 1–2 percentage points, and the largest share in the structure of shipments was accounted for by the same cargo: mineral construction, coal and oil.

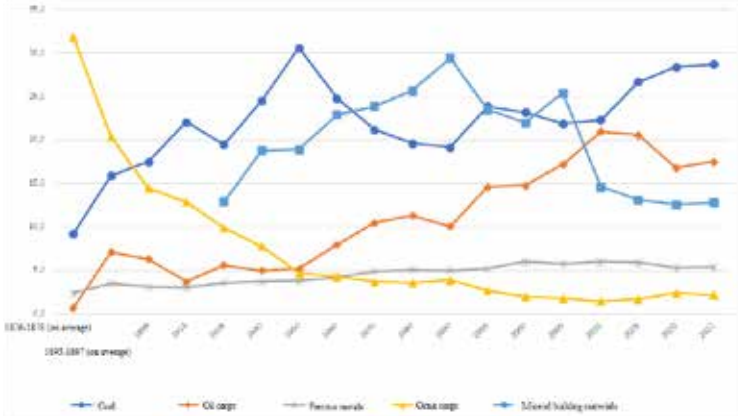
In market conditions, the commodity structure of railway transportation began to change significantly under the influence of two main factors. The first factor is the active entry of Russian manufacturers into global commodity markets, due to which the demand for export transportation of bulk cargo by rail has increased and corresponding changes in the loading structure have occurred. Thus, in 2022, the share of exports in the loading of ferrous metals was of 36 %, of oil cargo exceeded 40 %, of grain was of 58 %, and of coal was of 55 % [35]. It is noteworthy that in 2000, less than 16 % of loaded coal was exported [36]. The organisation of technologically efficient export transportation of coal, also stimulated by tariff policy [37], contributed to an increase in its production [38] and, accordingly, an increase in the share of coal in the commodity structure of transportation, where it again came out on top. The growth of export traffic also contributed to an increase in the share of oil cargo, ore, ferrous metals, fertilisers and, in the last decade, grain.

The second factor is increased competition in the transport market [39], because of which significant volumes of transportation of some goods have left the railways for other modes of transport. Thus, the almost halving after 2005 of the share of mineral construction materials, the average transportation distance of which is small, is associated with their shift to road transport, which is competitive in this market segment [17]. In connection with the active development of pipeline transport [40; 41], which is practically non-competitive in those segments of the transportation market in which it specialises in servicing [9, p. 19], the share of oil cargo by rail, which amounted to 21 % in 2010, then decreased significantly.

It is worth noting another important trend in the change in the commodity structure of railway transportation – an increase in the share of containerised cargo loading. If in 2010 it was of only 1,6 % [42, P. 45], then in 2022 it exceeded 3,6 % [35]. Considering that a wide range of finished products are transported in containers (chemicals, consumer goods, machinery, automobiles and components, etc. [35, P. 59]), an increase in the share of container transportation is important for mitigating the raw material orientation of the existing commodity structure of railway transportation.

Long-term Trends and Qualitative Characteristics of Transformation of the Commodity Structure of Railway Transportation

Along with the analysis of the commodity structure of railway transportation in certain periods of the history of our country, it is of interest to identify general trends in its change



Pic. 1. Change in the share of some cargo in the structure of railway transportation (1876–2022), % [compiled by the authors].*
** Until 1913 – data on the railway network of the Russian Empire, 1928–1990 – USSR, since 1995 – the Russian Federation.*

over the entire sesquicentennial period under consideration. To do this, it is possible to use time series covering this entire period, consisting of data from the corresponding years on the railway network of the Russian Empire, the USSR and the Russian Federation (Pic. 1). As indicated in [43, P. 27], this «principle of «gluing together» statistical indicators (especially relative ones) within different territorial boundaries (Russian Empire, USSR, Russian Federation) relating to periods of the country's history» is methodologically justified.

As can be seen from Pic. 1, different cargoes showed different types of long-term trends in their share in the structure of railway transportation.

The share of grain cargo decreased almost exponentially. The share of ferrous metals, which is quite stable within certain periods of time lasting 15–20 years or more, has generally tended to moderate growth over a century and a half.

Noting the general trend towards a dynamic increase in the share of oil cargo, one should pay attention to the periods of its decline, separated by a century and comparable in scale: 1895–1913 and 2010–2020

It is noteworthy that the graph of changes in the share of mineral and construction cargoes is very close to the part of the graph illustrating changes in the share of coal, which covers 1876–2010, including periods of dynamic growth, moderate decline, one absolute and one local maximum and, finally, a period of stabilisation after the decline relative to the local maximum. For hard coal this is 2000–2010, and for mineral building materials – 2010–2022. It should be noted that if the absolute maximum shares of hard coal and mineral building materials are close (and amount to about 30 %), then the decrease from the maximum level of the share of mineral building materials was much more significant than that of hard coal.

At the same time, the change in the shares of coal and mineral construction materials occurred in antiphase: an increase in the share of one cargo was accompanied by a decrease in the share of the other. The decline in the share of coal from the late 1950s to the early 1990s freed up capacity and loading resources to increase railway transportation of mineral building materials. Conversely, the return to the dominance of coal in railway transportation after 2005 appears to have been a factor in the shift of a significant portion of its traffic to other modes of transport (road as well as river transport). Between coal and mineral building cargo, although there are significant economic similarities (relatively low cost of the cargo itself and, accordingly, low profitability of their transportation), there is also an important difference. The transportation distance for coal is significantly higher than the average distance, and the transportation range of mineral and building materials, on the contrary, is small[4].

Accordingly, coal gravitates towards railways. The coefficient of its transportation by rail was already about 70 % at the end of 19th century [12, P. 246], and then became close to 100 % [44]. And mineral building materials, as noted above, are mainly transported within the range where road transport is competitive.

In the long term, decarbonisation of the

[4] N. P. Tereshina, V. G. Galaburda, V. A. Tokarev [*et al*]. Economics of railway transport. Ed. by N. P. Tereshina, B. M. Lapidus. Moscow, TMC for education on railway transport, 2011, P. 226.

Table 4

Long-term transformation of the commodity structure of transportation on domestic railways

Years*	TOP-3 of cargo		Main cargo		Qualitative characteristics of the commodity structure of transportation
	Name	Share, %	Name	Share, %	
1876–1878 (on average)	Grain cargo Coal Forest building materials	48	Grain cargo	31,9	Mixed
1895–1897 (on average)	Grain cargo Coal Forest building materials	43,5	Grain cargo	20,4	Diversified
1899	Coal Grain cargo Forest building materials	39,6	Coal	17,5	Diversified
1913	Coal Grain cargo Forest building materials	44,4	Coal	22,1	Diversified
1928	Coal Mineral building materials Forest building materials	43,5	Coal	19,5	Diversified
1940	Coal Mineral building materials Grain cargo	51,2	Coal	24,5	Mixed
1950	Coal Mineral building materials Forest building materials	58,1	Coal	30,6	Concentrated
1960	Coal Mineral building materials Forest cargo	56,5	Coal	24,8	Mixed
1970	Mineral building materials Coal Oil cargo	55,5	Mineral building materials	23,9	Mixed
1980	Mineral building materials Coal Oil cargo	56,6	Mineral building materials	25,7	Concentrated
1990	Mineral building materials Coal Oil cargo	58,7	Mineral building materials	29,4	Concentrated
1995	Coal Mineral building materials Oil cargo	62,0	Coal	23,9	Mixed
2000	Coal Mineral building materials Oil cargo	60,0	Coal	23,2	Mixed
2005	Mineral building materials Coal Oil cargo	64,5	Mineral building materials	25,4	Concentrated
2010	Coal Oil cargo Mineral building materials	57,9	Coal	22,3	Mixed
2015	Coal Oil cargo Mineral building materials	60,4	Coal	26,7	Concentrated
2020	Coal Oil cargo Mineral building materials	57,8	Coal	28,4	Concentrated
2022	Coal Oil cargo Mineral building materials	59,0	Coal	28,7	Concentrated

* Before 1913 – data on the railway network of the Russian Empire, 1928–1990 – USSR, since 1995 – the Russian Federation
Source: Developed by the authors.

economy may lead to a decrease in the share of coal in railway transportation [16]. Mineral building cargo can be considered as a «candidate» to replace coal transportation, similar to how it was in the 1960s – 1980s. This, of course, will require an appropriate «tuning» of transportation technology and ensuring its high efficiency, allowing one to combine a level of tariffs acceptable for cargo owners with transportation efficiency necessary for transport companies.

To assess the long-term transformation of the commodity structure of railway transportation, it is of interest to analyse the changes in the leading cargo shipments in terms of shipment volume and their share in the total shipment volume (Table 4).

Changes in the composition of three leading cargoes, as can be seen from Table 4, occurred gradually, and the role of the main cargo for the entire century and a half belonged alternately to grain cargo, coal and mineral building materials. Moreover, the last two cargoes have replaced each other in the first position several times over the period from 1970 to the present.

It should be noted that there are significant fluctuations in both the total share of the three main cargoes (from 39,6 % to 64,5 %) and the main cargo (from 17,5 % to 30,6 %) – in both cases the differences are more than by one and a half times.

Transport (as well as commodity) markets are usually assessed based on distribution of shares between market players (sellers of transport services) [45, pp. 57–62]. However, for the railway cargo transportation market, its characteristics in terms of distribution of shares between the serviced industries, the demand of which is met by transport companies, are of no less interest. This distribution is manifested precisely in the commodity structure of the transportation market. If the total share of three main cargoes exceeds 50 % and, at the same time, the share of the main cargo exceeds 25 %, the product structure can be characterised as concentrated. Otherwise (the share of TOP-3 is less than 50 % and the share of the main cargo is less than 25 %) – as diversified. In other cases, the product structure can be characterised as mixed.

As can be seen from Table 4, if at the end of 19th – beginning of 20th century the commodity structure of railway transportation was diversified, and then mixed and concentrated structures alternated, then in 21st century the concentrated structure prevails. Although a high concentration in transportation of certain goods gives railway transport some advantages in terms of customising transportation technology and ensuring its efficiency, it also makes transport companies dependent on the conditions of a small number of industries and vulnerable if they deteriorate. Therefore, in the future, it is advisable to diversify the commodity structure of railway transportation.

CONCLUSION

The sesquicentennial transformation of the commodity structure of the railway transportation market reflects the industrialisation of the economy and the energy transition to the predominant use of fossil fuels (first coal, then, increasingly, oil) [46], and since the mid-20th century, a large-scale redistribution of traffic between modes of transport associated with the dynamic construction of roads and pipelines [40; 41; 44]. The analysis shows that, despite the gradual change in this structure, in the long term the share of cargo that occupied leading positions in it may decrease to a low level (grain, timber cargo) or even practically to zero (firewood), and vice versa, cargo that accounted for a small share of transportation, can significantly increase their importance for the transport market (oil cargo, chemical and mineral fertilisers).

The adaptation of railway transport to significant changes in the commodity structure of transportation (which entail both changes in the directions of cargo flows and changes in requirements for transportation technology) indicates the high adaptability of the capital goods of the industry, and therefore the prospects of investment in its development.

Noteworthy is the consistently high share of ferrous metals in the transportation structure and the confident return to the role of the main cargo of coal, which first occupied this position at the end of 19th century. This is due not only to the significant share in the country's economy of industries producing relevant products, but also to the high degree of compliance of the technological features of railway transport with the needs of the shippers of these goods.

The concentrated commodity structure of railway transportation that emerged at the beginning of 21st century with the dominance of coal, considering the low profitability of coal transportation for railways [36; 37], and the unfolding, albeit gradual, decarbonisation of the

economy [16; 46], is not effective and promising. Its long-term diversification is necessary based on implementation of both marketing and technical and technological innovations [19; 47]. At the same time, customer-oriented improvement of cargo transportation technology is of key importance [48; 49]. An important role in the long-term diversification of railway cargo transportation can be played by the creation, based on a synthesis of marketing and technical and technological innovations, focused on the most promising market segments, of new transport products that are attractive to cargo owners and effective for transport companies.

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