

## Article

# Impact of Trade Restrictions on the Russian Forest Industry: Evidence from Siberian Timber Producers

Roman V. Gordeev <sup>1,2,\*</sup>  and Anton I. Pyzhev <sup>1,2</sup> 

<sup>1</sup> Laboratory for Economics of Climate Change and Environmental Development, Siberian Federal University, 660041 Krasnoyarsk, Russia; apyzhev@sfu-kras.ru

<sup>2</sup> Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences, 630090 Novosibirsk, Russia

\* Correspondence: rgordeev@sfu-kras.ru

**Abstract:** In 2022, the Russian forest sector was severely affected by the government's ban on the export of unprocessed timber and trade sanctions imposed by several countries. It is generally recognized that the regions of the Russian North-West are the most affected by trade barriers that have emerged. Against this background, the impact of bilateral trade restrictions on timber companies in the Asian part of Russia is not discussed. Nevertheless, the forest industry is an important sector of the Siberian economy that has an economic, social and environmental impact on the life of local communities. This paper analyzes the differences among Siberian timber companies in their response to the crisis depending on three factors: industrial specialization, scale of revenue and regional location. The results show that in 2022 the highest median revenues and net profits were generated by small firms that were focused on the domestic market and benefited from reduced competition due to sanctions. There is also evidence that spatial heterogeneity in the response to the crisis may be due to the different support measures of regional authorities and the proximity of the region to border points. We argue that the current conditions may become a new driver for the timber industry development, aimed at the growth of added value and expansion of domestic demand for wood products.

**Keywords:** forest economics; timber companies; forest industry; Asian Russia; Siberia; Russia; trade sanctions; export ban; corporate financial reporting; Kruskal–Wallis one-way analysis of variance



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## 1. Introduction

The Russian timber industry has experienced several important demand shocks over the past two years. To stimulate the development of high value-added wood processing from 1 January 2022, the export of unprocessed timber was banned by order of the President of the Russian Federation. Consequently, to sell as much timber as possible before the ban comes into effect, Russian timber producers exported USD 17.5 billion worth of forest products in 2021.

Thus, 2022 exports were expected to decline substantially even if many Western countries had not started imposing numerous trade sanctions against Russia in March. The most severe restrictions on trade in forest products with Russia were established as part of the fifth package of the European Union sanctions [1]. Since 10 July 2022, the EU banned imports of all wood products from Russia included in code 44 of Harmonized Commodity Description and Coding System (HS), wood pulp obtained by a combination of mechanical and chemical pulping processes (4705 HS code), uncoated kraft paper and kraft cardboard in rolls or sheets (4804 HS code) and furniture and parts thereof (9403 HS code). The export ban included 77 items of the six-digit HS code in the groups of wood products (44 HS code), cork (45 HS code), wood pulp (47 HS code), paper and paperboard (48 HS code), printed matter (49 HS code) and furniture (94 HS code).

These restrictions were supplemented by the eighth package of EU sanctions [2], which banned imports from Russia of chemical wood pulp (4703 HS code), certain types of paper, cardboard and packaging from them (HS codes: 4801, 4802, 4803, 4805, 4810, 4811, 4818, 4819 and 4823), furniture (9401 HS code) and wooden prefabricated buildings (9406 HS code) since 8 January 2023.

Additionally, personal sanctions were imposed that affected two major Russian timber companies. In June 2022, the world's largest producer of birch plywood, Sveza, as part of Severgroup LLC, was included in the Specially Designated Nationals and Blocked Persons List (SDN List) of the USA. In November 2023, the Sistema Public Joint Stock Financial Corporation, which owns more than 50% of timber producer Segezha Group, joined the list, as well [3].

Even though the share of value added to the final products of the Russian forest industry has been gradually growing in recent years, sawn timber remained the main export product (Table A1). In general, the pattern of foreign trade in forest products in the country can be described by the following two flows: exports of roundwood, sawn timber, plywood, particle and fiberboard to Europe and China and imports of higher added value products such as wooden furniture, kraft paper, printed matter and forest machines. In 2022, the shortcomings of such export-oriented strategy of forest companies became obvious. The closure of the EU market, which was one of the most important for Russia, served as an incentive to diversify exports and develop the domestic market. After 30 years of predominantly export-oriented production, the Russian timber industry has faced a sharp decline in external demand for its products. This hit especially hard the enterprises of the North-West region, which historically had been strongly connected with European customers for their products. Against this background, the most important South Asian market in terms of volumes and development prospects, served by the timber industry in Siberia and the Russian Far East, at first glance did not suffer and even benefited from these restrictions.

Most of the literature on the Russian forest industry is devoted to analysis at the national or regional levels, due to the scarcity of data at the micro level [4–7]. Basically, Russian state forest sector statistics contain only major indicators for a rather short period of observation, some of which are incomplete and inconsistent [8]. In particular, there is a lack of information on forest roads and forest species composition [9,10]. However, there is enough data that is still underemployed. This is especially true for micro-level statistics.

Therefore, rare studies on the Russian timber companies are particularly valuable. In a series of articles devoted to Russian forest companies, a significant difference between the rationality of tax and economic behavior was revealed. In addition, it was shown that the level of collection of value added tax in the Russian timber industry is six times lower than in the Scandinavian countries [11,12]. A number of studies have been devoted to assessing the effectiveness of state support for investment projects in the field of forest development [13,14]. Furthermore, a model has been proposed to assess the probability of the successful completion of such projects [15].

The economic crisis of 2022 has significantly affected the activities of forest companies, which underlines the relevance of research at the micro level. Previously, we assessed the social importance of forest companies in the Asian part of Russia for local labor markets [16]. It has been shown that even during the recession of 2022, companies had incentives to retain employees and even recruit new ones.

In this paper, we focus on how the recently evolved trade barriers affect forest companies of the Asian part of Russia, specifically in Siberia. We consider 10 regions administratively grouped into the Siberian Federal District: Altai Krai, Altai Republic, Irkutsk Oblast, Kemerovo Oblast, Krasnoyarsk Krai, Novosibirsk Oblast, Omsk Oblast, Republic of Tyva, Republic of Khakassia and Tomsk Oblast. We examine the financial performance of Siberian forest companies in 2022. The narrow purpose of the study is to determine how the ban on the export of raw timber and international sanctions have affected the revenue and net income of firms. Many Russian enterprises in 2022 had to change their logistics, contractors,

production structure and reorient to other markets. The main research questions are as follows: (1) how has the structure of production, revenue and net profit of Siberian forest companies changed in 2022 compared to 2021? (2) Are changes in financial performance affected by (a) firm’s manufacturing specialization, (b) firm size, or (c) regional location?

The article is organized as follows. Section 2 contains a description of data sources and analysis methods. Section 3.1. gives an overview of the role Siberian forest firms play in the Russian forest industry. Subsequent subsections of Section 3 are devoted to inquiring how the dynamics of financial indicators of Siberian forest companies depends on their industrial specialization (Section 3.2), firm size in terms of revenue (Section 3.3) and regional location (Section 3.4). Section 4 contains a comparison with the results of other studies and a discussion on how much the changes in institutional rules in 2022 affected the current activities and development strategy of Siberian forest companies. Section 5 contains summary conclusions on the results obtained.

## 2. Materials and Methods

The main data sources of this study are the “Transparent business” system of the Russian Federal Taxation Service [17] and the Kontur.Focus service providing access to company accounts [18]. According to these sources, more than 6000 forest companies were registered in the Siberian Federal District in 2022. However, a significant part of them appear to have no economic activity or are legally closed before the study period or did not submit reports in recent years. After excluding these cases, we dealt with 2052 firms that submitted financial statements to the tax authorities in 2021 and 2022.

We determine the industrial specialization of the company to be the activity type according to the national classifier OKVED2. Upon registration, each company in Russia declares its main activity type for further reporting to the tax authorities and statistical services. Any enterprise may also specify several additional types of activity. For example, a logging company may also produce pellets or firewood. Despite the ambiguity of this classification, it is not possible to take into account all additional activities for further analysis. Analysis covers firms engaged in the following types of activities (OKVED2 code is given in brackets): forestry (02.1), logging (02.2), sawing and planing of wood (16.1), the manufacturing of wood products (16.2), manufacturing of pulp, paper and paper products (17.1 and 17.2) and manufacturing of furniture (31.01, 31.02 and 31.09). To reflect the scale of the company, we use the classification by revenue adopted in Russia [19]. Table 1 shows the classification of Siberian timber enterprises by size and main type of activity.

**Table 1.** Siberian forest companies by type of activity and revenue, 2022.

Activity	Number of Firms by Revenue, Million Rubles				Total Number
	Large (>2000)	Medium (800–2000)	Small (120–800)	Micro (<120)	
Forestry	NA	NA	105	8	113
Logging	3	11	364	80	458
Sawing and planing of wood	9	11	448	63	531
Manufacturing of wood products	3	6	275	31	315
Manufacturing of furniture	NA	3	471	26	500
Manufacturing of pulp, paper and paper products	4	8	93	30	135
All	19	39	1756	238	2052

Data source: Unified Interagency Information and Statistical System. Russian Federation Government Statistics [20]. NA—not applicable.

To find significant changes in the financial performance of forest companies between 2021 and 2022 we use analysis of variance. We calculated the growth rates of firms’ revenue and net income in 2022 compared to previous year. The initial sample is divided into

groups based on firm's regional origin, firm size and manufacturing specialization. Since the companies' revenue and net income are not normally distributed and have outliers, standard methods of analysis of variance, such as ANOVA, cannot be applied [21]. The usual solution in this case is to use non-parametric tests. The Kruskal–Wallis test is a common non-parametric alternative that does not assume a normal distribution of the data and is more robust to outliers [22].

To analyze how strong the differences, if there are any, between groups are, we used the effect size measure. For the Kruskal–Wallis test, effect size was measured using the ordinal epsilon-squared proposed by T. L. Kelley [23]:

$$\varepsilon^2 = \frac{\chi^2}{(n^2 - 1)/(n + 1)}, \quad (1)$$

where  $\chi^2$  is the statistic value of the Kruskal–Wallis test and  $n$  is the number of observations [24]. Theoretically, epsilon-squared takes values from 0 to 1, the closer it is to 1, the stronger the effect of differences between groups [25,26]. However, some sources rely on scales according to which epsilon-squared values  $< 0.08$  can be considered as small effect size, in the range of 0.08–0.26 as medium and more than 0.26 as large [27].

To visualize the results, we used the open-source R packages ggstatsplot version 0.12.1 [28] and ggplot2 version 3.4.4 [29] in the software environment developed by R Core Team (Vienna, Austria) [30].

### 3. Results

#### 3.1. The Role of Siberian Regions in the Russian Forest Industry

Russian forest sector is characterized by high spatial heterogeneity [31–33]. The North-western and Siberian federal districts are the leaders of timber industry. The biggest Russian logging companies such, as the Ilim Group, Segezha Group, Titan Group, Ustyanskiy Timber Industry Complex LLC and Mondi Syktyvkar, operate in these macro regions. The current crisis has affected the Northwestern regions to a greater extent, as there were more companies with foreign owners and their trade ties with the EU were strong. However, Siberian timber companies also faced new difficulties due to the need to compete for railway transport capacity with loads from the west of the country, which were reoriented to Asian markets [34,35].

Siberian regions play a crucial role in Russian timber industry. This federal district unites about 28 billion Cubic Meters (cbm) timber stock which is comparable to all EU volumes (28.3 billion cbm) [36]. Krasnoyarsk Krai accounts for about 40% of this volume. A significant part of its forests is located in a remote area. In this regard, they are not suitable for economic activity, but play an important role in the country's carbon balance [37]. Irkutsk Oblast is the second most forested area in Russia and it is the national leader in terms of timber harvesting (Table 2).

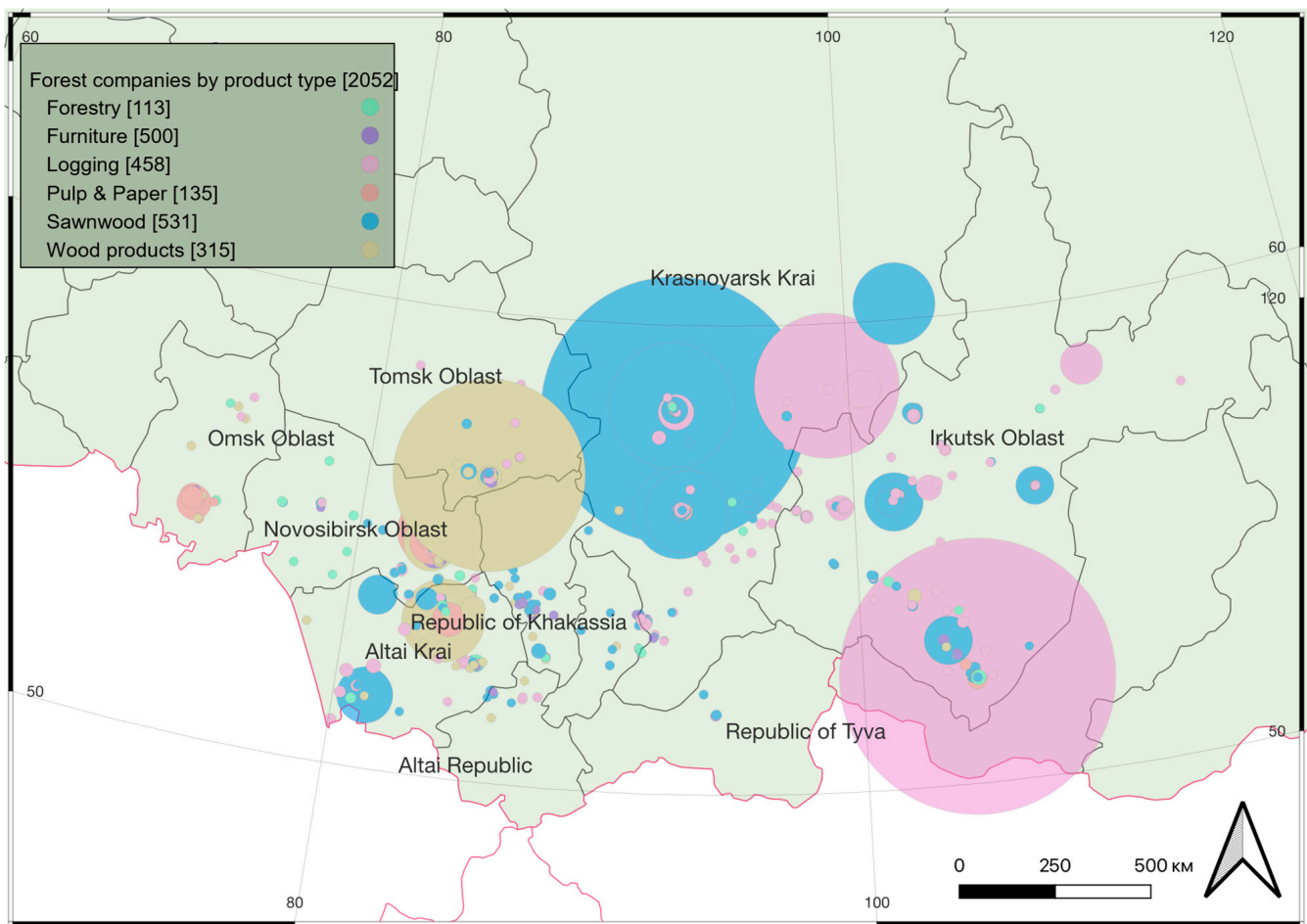
Figure 1 shows the location of the timber companies in Siberian regions.

Due to the large resource potential, these regions are also attractive for investors in the woodworking industry. Priority Investment Projects (PIPs) have been the main instrument of public-private partnership in Russian forest industry since 2007. The investor undertakes to create or modernize a wood processing enterprise in exchange for preferential conditions from the state for the lease of forest plots [15]. The largest projects in terms of investment are also located in these two Siberian regions. Since 2008, Kraslesinvest has been implementing a project for the production of saw wood, pellets and pulp on the Krasnoyarsk Krai with a total investment of more than 150 billion rubles. The largest project in the Irkutsk region for the modernization of pulp and paper production in the amount of more than 100 billion rubles belongs to the Ilim Group.

**Table 2.** Growing stock of forests, cuts and investment projects in the Siberian Federal District, 2022.

Region	Number of Priority Investment Projects	Growing Stock		Cuts	
		Volume, Million cbm	Share, %	Volume, Million cbm	Share, %
Siberian federal district	41	27,957.1	33.9	61.0	31.4
Krasnoyarsk Krai	21	11,512.5	13.9	19.6	10.1
Irkutsk Oblast	14	8704.7	10.5	27.9	14.4
Tomsk Oblast	3	2802.9	3.4	5.8	3.0
Republic of Tyva	NA	1164.1	1.4	0.2	0.1
Altai Republic	NA	765.2	0.9	0.4	0.2
Kemerovo Oblast	NA	748.0	0.9	1.6	0.8
Omsk Oblast	1	639.8	0.8	1.4	0.7
Novosibirsk Oblast	NA	584.4	0.7	1.2	0.6
Altai Krai	2	562.5	0.7	2.5	1.3
Republic of Khakassia	NA	472.9	0.6	0.3	0.2

Note: Data on Priority Investment Projects, as of October 2023. The shares are calculated in comparison with the all-Russian indicators. Data sources: Unified Interagency Information and Statistical System. Russian Federation Government Statistics [20]; Ministry of Industry and Trade of Russia [38]. NA—not applicable.



**Figure 1.** Location of Siberian forest companies by size and industrial specialization. The size of the circle reflects the firm's revenue in 2022. Made using QGIS version 3.34.1.

### 3.2. Differences by Type of Activity

Descriptive statistics in Table 3 show that all variables in our dataset are not normally distributed, as the Shapiro–Wilk test  $p$ -values are less than 0.001. The mean values are skewed and exceed both the median and 3rd quartile values indicating major outliers in

the sample. These features of the data require the use of non-parametric tests such as Kruskal–Wallis test.

**Table 3.** Descriptive statistics for financial performance of Siberian timber companies, 2021–2022.

Descriptive Statistics	Revenue, Million Rubles		Net Income, Million Rubles	
	2021	2022	2021	2022
Minimum	0.006	0.001	−981.6	−1646.0
1st quartile	3.2	3.4	0.02	0.01
Median	14.0	13.4	0.4	0.3
Mean	126.2	121.5	13.9	2.6
3rd quartile	55.7	54.4	2.9	2.2
Maximum	14,088.5	15,158.5	3955.3	813.5
Std.dev	616.0	656.9	131.4	58.3
Skewness	12.2	15.4	18.5	−11.8
Kurtosis	196.3	295.7	463.7	376.4
Shapiro–Wilk test	0.2	0.1	0.1	0.2
<i>p</i> -value (SW)	0.000	0.000	0.000	0.000

The median and mean for both financial indicators decreased in 2022 from the previous year. However, the median and mean revenue growth rates are positive, while net profit growth rates turn negative. This suggests that the costs of forestry companies have increased significantly. Sharp changes in the ruble–dollar exchange rate in 2022 had a strong impact on the decline in exporters’ profits. From stable values of about 75 rubles per 1 USD in 2021, the ruble weakened to 104 rubles per USD in March 2022, and then strengthened to less than 60 rubles per USD in summer 2022. After the ban on exports to Europe, timber prices dropped significantly. China’s purchase prices for Russian timber decreased 3 times from 19 to 20 thousand rubles in the beginning of 2022 to 7 thousand rubles in June [39]. As a result, the profitability of timber exports has significantly decreased, as transportation costs, wages, fuel, and spare parts are paid in rubles. Still, most of the forest companies have continued to operate. The number of vacancies in forestry companies in the labor market in 2022 exceeded the values for previous year [40] and continued to grow in 2023 [41].

Figure 2 shows the difference between revenue and net profit growth rates depending on the production specialization of the timber company. Given that the *p*-values of the Kruskal–Wallis test are significant in both cases, there is evidence that firms with different production specialization responded differently to the institutional changes in 2022. However, the effect size can be characterized as small for both revenue and net profit growth rates.

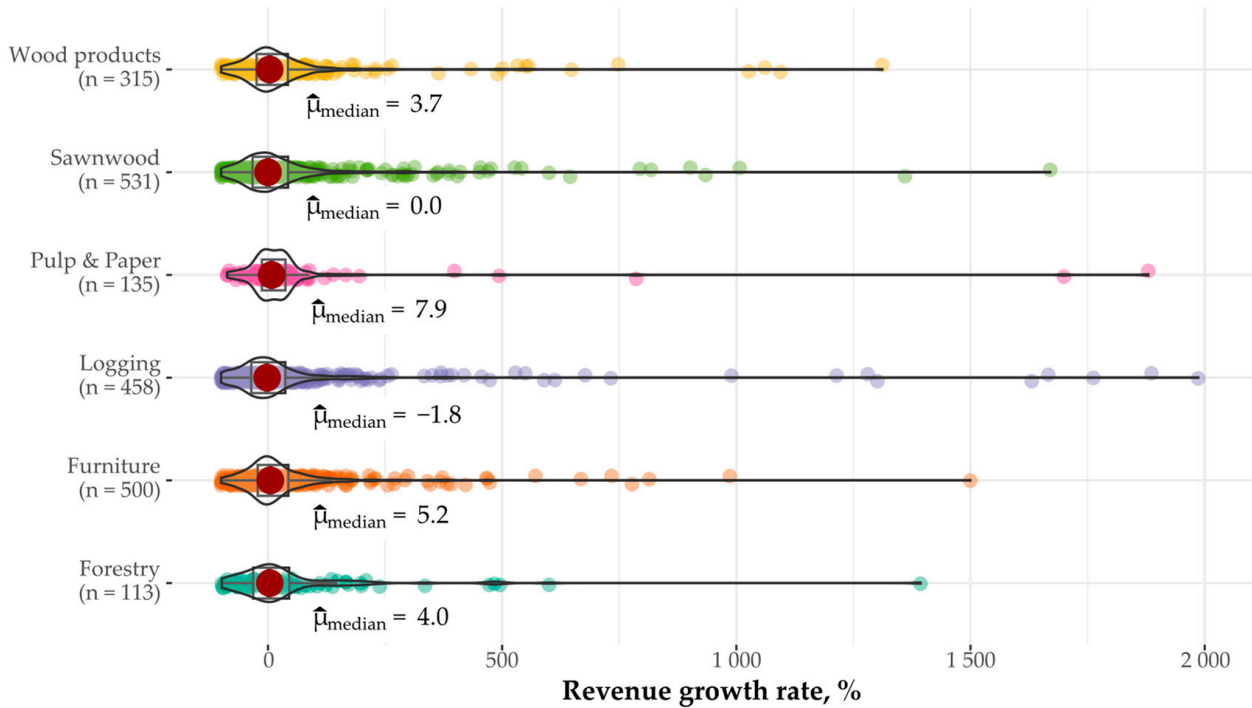
The best performance is shown by the pulp and paper industry, furniture manufacturing and forestry. For a meaningful interpretation, it is useful to compare these results with the macroeconomic statistics of the production of particular types of timber products in Siberia (Table 4).

Forestry in Russia is usually considered less profitable than wood production, despite this sector has overcome the crisis period better than other industries. Generally, companies with specialization in forestry provide services for ecological thinning, fire prevention and reforestation. The customer of these services, as a rule, is the state. This ensures the independence of financial results of such companies from the situation on the world market.

The logging industry faced major challenges in 2022. The ban on the export of unprocessed timber and the fifth package of EU sanctions naturally reduced demand. Harvest volumes in Russia hit record levels in 2021, as producers attempted to sell large volumes before the ban on exports of raw timber was implemented. This is the reason why logging is the only one of the six sectors with a consistently negative median revenue growth rate (Figure 2). In 2022, logging volumes amounted to 194.6 million cbm, which is 13.5% less than in the previous year [42]. Siberia’s largest regions reduced volumes even harder: the

Irkutsk Oblast harvested 27.9 million cbm of timber (−14.5%), and the Krasnoyarsk Krai harvested 19.6 million cbm (−20.6%) [42].

$$\chi^2_{\text{Kruskal-Wallis}}(5) = 9.8, p = 8.0 \times 10^{-2}, \hat{\epsilon}^2_{\text{ordinal}} = 4.8 \times 10^{-3}, \text{CI}_{95\%} [2.0 \times 10^{-3}, 1.0], n_{\text{obs}} = 2052$$



$$\chi^2_{\text{Kruskal-Wallis}}(5) = 21.9, p = 5.6 \times 10^{-4}, \hat{\epsilon}^2_{\text{ordinal}} = 1.1 \times 10^{-2}, \text{CI}_{95\%} [5.6 \times 10^{-3}, 1.0], n_{\text{obs}} = 2052$$

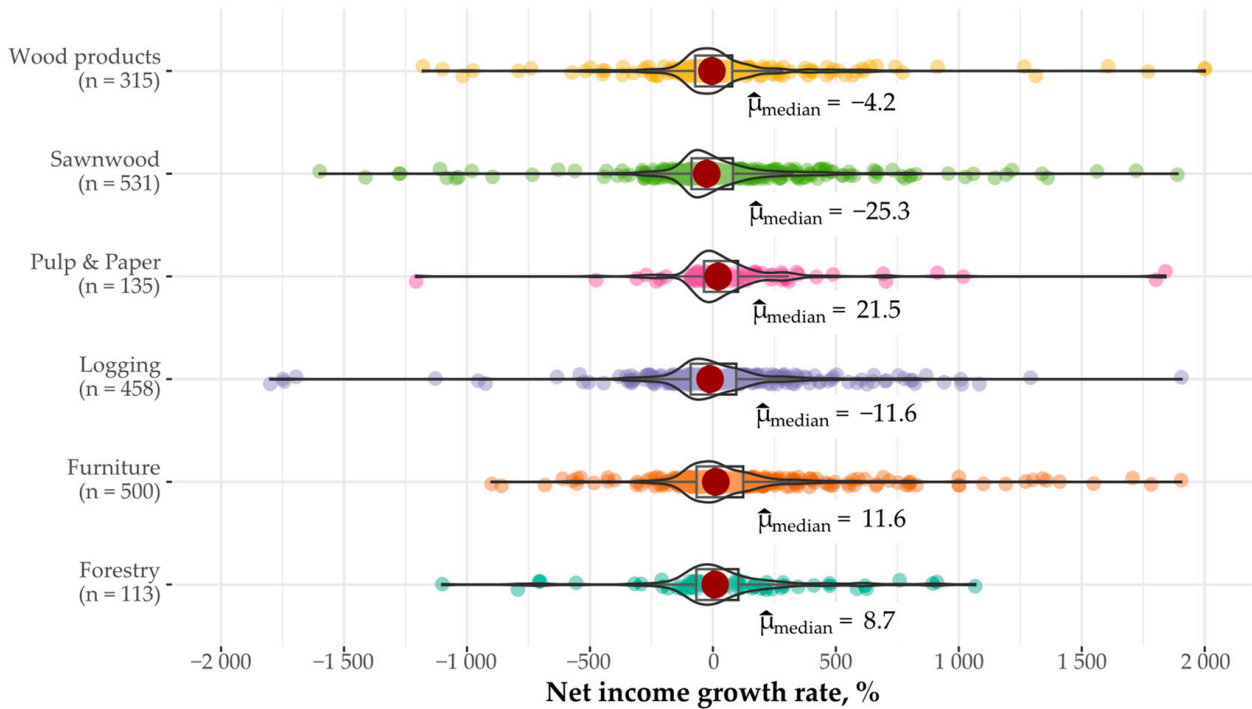


Figure 2. Distribution of financial indicators in Siberian timber companies by economic activity type.

**Table 4.** Production volumes of wood commodities in Siberian Federal District, 2021–2022.

Product	Measurement Units	Production Volumes		Growth Rate, %	Share, 2021, %	Share, 2022, %
		2021	2022			
Coniferous timber	million cbm	40.9	40.0	−2.0	37.0	36.9
Hardwood timber	million cbm	15.1	13.9	−8.1	25.0	24.0
Fuel wood	million cbm	2.0	1.6	−17.9	12.5	10.7
Pulp	thousands of metric tons	2325.0	2377.9	2.3	26.3	27.1
Paper and paperboard	thousands of metric tons	420.5	433.2	3.0	4.1	4.3
Sawnwood	million cbm	12.4	10.6	−14.4	41.1	36.6
Pellets	thousands of metric tons	649.6	607.5	−6.5	27.3	29.3
Plywood	thousands of cbm	285.8	153.8	−46.2	6.4	4.7
Particle board	thousands of cbm	720.6	726.4	0.8	6.3	7.0
Fibreboard	million squared meters	107.3	97.6	−9.0	14.5	15.0
Furniture	billions rubles	23.2	28.0	20.6	7.5	7.9
Prefabricated wooden buildings	million rubles	381.1	1075.3	182.2	6.8	7.1
Wooden houses	thousands of squared meters	1.5	2.9	94.7	0.7	1.4
Garden houses and buildings	units	297.0	1420.0	378.1	4.1	14.9

Note: The shares are calculated in comparison with the all-Russian indicators. Data source: Unified Interagency Information and Statistical System. Russian Federation Government Statistics [20].

Production of sawn wood is strongly dependent on logging volumes. Figure 2 shows that this sector experienced the largest drop in net income. Sawn timber remained the main Russian export item among forest products for a long time. The Russian government's first measures to restrict roundwood exports were introduced back in the 2000s. From 2007 to 2009, customs duties on exports of unprocessed timber were gradually raised. However, this had little effect on the increase of added value in the production chain. Loggers began building sawmills and exporting rough-sawn timber. According to Rosstat, the volume of sawn timber production in 2022 decreased by 3.8%. The similar indicator of Siberian regions fell much stronger, by 14.4% (Table 4), which is due to the exports structure in the Asian part of Russia. A combination of many factors, including proximity to Asian markets, low domestic demand, etc., lead to the fact that it was much more profitable for producers to sell sawn timber instead of producing highly processed forest products [33]. The share of the Siberian Federal District in the national volume of sawn timber production decreased by 4.5% (Table 4). Since European countries did not account for the largest share in the Siberian trade structure, the more important reason for this is the ban on the export of unprocessed timber.

The manufacturing of wood products is a highly heterogeneous sector. It includes companies that produce fiberboard, particle board, plywood, building structures and wooden houses. It is quite difficult to divide them into subsamples, as a company may produce a wide range of products despite formal specialization in a single activity. Median revenue of wood products manufacturers increased slightly (3.7%) while median net income decreased 4.2% (Figure 2). Producers were affected by the sanctions in different ways, according to how much they depended on export or domestic markets.

Plywood production decreased the most, as about 70% of the all-Russian volume was shipped to foreign markets [43,44]. Due to the insufficient capacity of the domestic plywood market, its production in Russia fell by 27.7% on average, while Siberian enterprises suffered more severely, reducing volumes almost twice (46.2%). Implementation of new projects was also jeopardized as risks and costs became higher and expected demand reduced. For example, the planned production capacity for the Anzhersk Plywood Mill in the Kemerovo Oblast was reduced by 17% to 50,000 cbm per year [45].

Production volumes of fiberboard and particleboard decreased to a lesser extent. An additional negative factor was the simultaneous closure of the EU markets and a



drop in demand on the domestic market. As a result, board producers were forced to cut prices by 14% between April and June 2022 [46]. Siberian manufactures of fiberboard and particleboard were less dependent on European and US markets, so their losses were lower than the Russian average, and their share in the national volumes even increased.

In terms of pellet production, Russia ranked 5th in the world in 2021, with more than 85% of the total volume exported abroad. Until 2022, pellet production in Russia had a strong dependence on the EU market. Therefore, companies in Northwest Russia were most affected by the sanctions, as for them transportation costs of entering Asian markets exceeded pellet prices. The largest pellet producer in Russia is Segezha Group with a volume of 360 thousand tons in 2021 at plants in Krasnoyarsk Krai, Irkutsk Oblast and Vologda Oblast. Another major player in Siberia is DOK Enisei with a volume of 120 thousand tons in 2021 [47]. In 2022, Japan and South Korea became the main buyers of Russian pellets, so Siberian regions reduced production by only 6.5%, increasing their share in the national volume by 2%. At the same time, the Far-East regions even increased their output by 60% due to their proximity to Asian markets. An additional support for the industry may be the growth of domestic demand through the conversion of household heating from coal to pellets. However, this remains a more expensive choice for households and the domestic market will not be able to develop without government subsidies [48].

Thus, the production of low and medium processed goods stagnated in 2022 as it was strongly export-oriented. On the contrary, trade sanctions created successful incentives to produce highly processed forest products for the domestic market. Production of prefabricated wooden buildings in monetary terms grew more than 2.5 times on average in Russia and 2.8 times in Siberia. The number of garden buildings expanded by 30% in Russia and more than 4.5 times in Siberia.

In recent years, wooden house-building in Russia has been developing rapidly. However, its share in the volume of new housing does not exceed 10% and the potential for further growth is still high [49]. In 2019, the Russian government allowed the construction of residential buildings with wooden structures up to a height of 28 m. This is still less than, for example, 85 m in Norway [50]. By 2024, regulations for 12-story buildings will be developed [51]. The production of wooden multi-story buildings can also have an important social function. For example, the Arkhangelsk region became the first region in Russia to relocate people from emergency housing to wooden high-rise buildings [49]. The leader in the Russian market is the Segezha Group, whose Sokol CLT plant in the Vologda region has a production capacity of 50,000 cbm of cross-laminated timber (CLT) per year. Table 4 shows that it was building structures and wooden houses that showed the most impressive year-on-year growth in 2022.

The share of imported furniture in Russia halved in 2022 compared to 2019. This fact created new opportunities for domestic manufacturers. One of the best-known international brands in the mass market of furniture in Russia was IKEA. In Russia, three IKEA factories are in operation, 75% of whose production was exported abroad. According to experts' estimates, in 2023 they were sold for 75% of their one total annual revenue (about 15 billion rubles) to Russian timber processing company Luzales and furniture manufacturer Slotex. IKEA products accounted for about 5%–6% of sales in the Russian furniture market [52]. These volumes were replaced by local producers, as many IKEA suppliers from Russia started selling the same products under their own brands. At the same time, it has created an incentive for marketplaces to replace offline commerce. In the first six months of 2022, the revenue of the largest Russian marketplaces, Ozon and Wildberries, increased by 87% and 61%, respectively [53].

In 2022, the volume of furniture production in Russia remained at the same level in physical terms, with a 15% growth in monetary terms. Demand for furniture was supported by growth in housing construction. In 2022, 102.7 million square meters of housing was built in Russia, which is 11% more than last year and an absolute record for

the last decades [54]. Thus, furniture producers increased revenue even in the face of rising costs for the purchase of imported fittings [55]. Siberian furniture manufacturers increased production volume by 20% in monetary terms (Table 4), resulting in a net profit growth rate of over 11%, even for the median company (Figure 2). Nevertheless, the share of Siberian furniture manufacturers on a national scale still does not exceed 8% (Table 4). Further growth is limited by the small population of Siberia compared to the European part of Russia and high logistics costs within the country.

The best results in terms of revenue and net profit among Siberian companies were shown by producers of packaging, paper and cardboard (Figure 2), despite a slight increase in production of only 3%. Until 2022, the pulp and paper industry in Russia was mainly represented by companies with foreign shareholders (Mondi, International Paper) located in the northwestern part of the country. Of the large enterprises only the Ilim Group (Irkutsk Region) and the Selenginsky Pulp and Cardboard Mill (Selenginsk, Republic of Buryatia) operated in the Asian part of Russia, accounting for merely 4% of the total Russian paper and paperboard output [56]. Mondi and International Paper have now sold their assets in Russia with a substantial discount. Mondi estimates that losses due to leaving the market amounted to 70–80 million euros [57].

At the beginning of 2022 there was a shortage of bleached office paper in Russia, the price increase was up to three times. Local wood was used in production, but pulp bleach (sodium chlorate) was supplied by the Finnish Kemira Oyj. The suspension of imports from Finland created a deficit, which was replaced by the end of the year by increasing the production volume of Russian companies such as Arkhangel'sk Pulp and Paper Mill, Ilimkhimprom and reorienting to imports from China, India and Turkey [58].

Major foreign producers Elopak (Norway) and Tetra Pak (Sweden and Switzerland), which sold 12 billion pieces of carton packs, have also exited Russian market [59]. The Elopak plant in St. Petersburg was bought out by local management and continued to operate. At the same time, the Russian manufacturer Molopak, which has been on the market since 2012, is increasing production volumes in the Moscow region [60].

Despite local deficits, demand for pulp and paper products in Russia is gradually growing but is still significantly below the global average. Compared to the per capita consumption of paper, cardboard and packaging, Russia is three times more behind countries such as Canada, the USA, Germany and Finland. Thus, Siberian pulp and paper companies have significant potential for future growth [56].

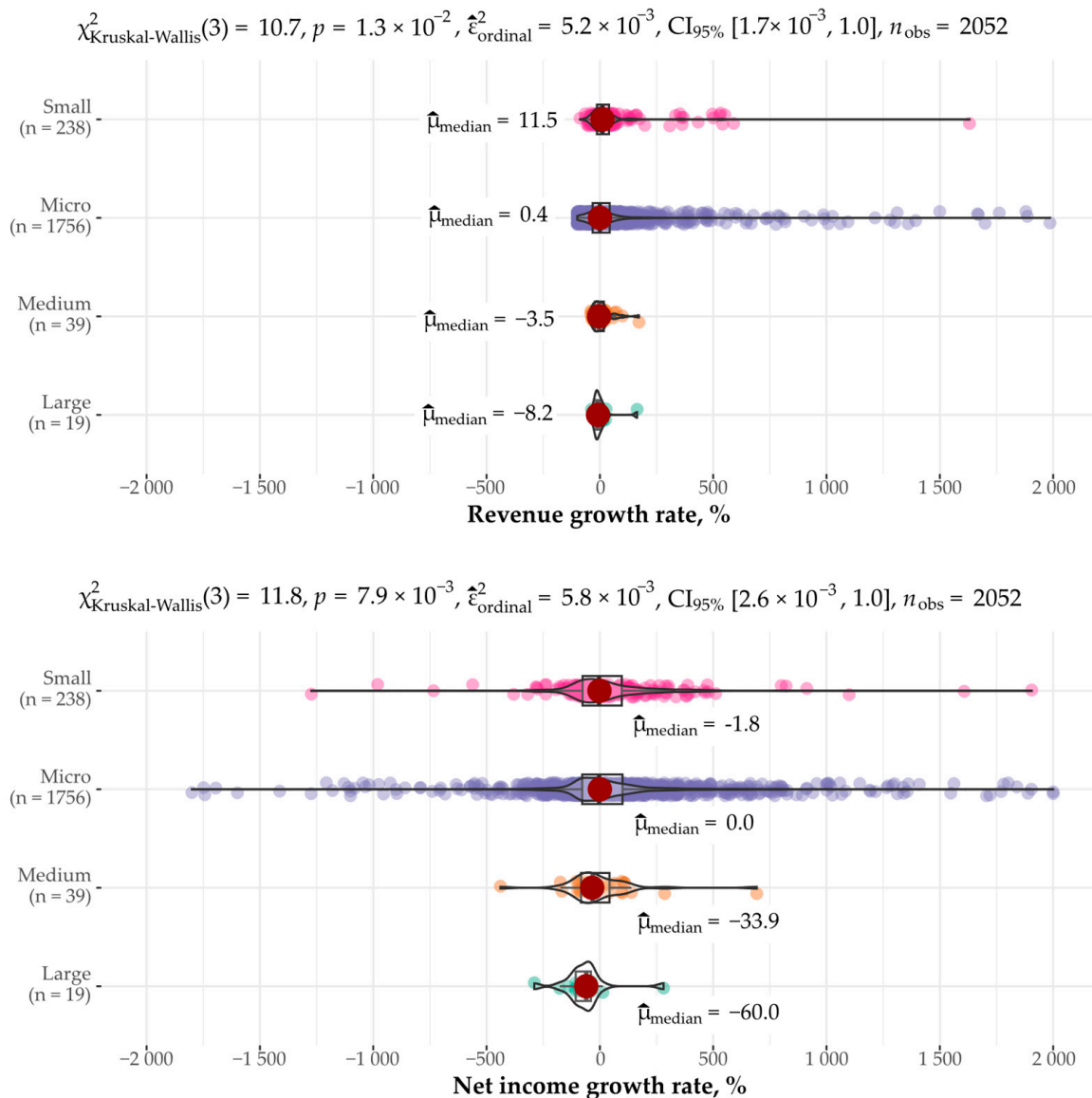
### 3.3. Differences by Scale of Activity

The forest industry in Russia is an imperfectly competitive market with multiple players. The twenty largest forest companies in Russia harvest only 37.1% of all logging volumes. The trend towards monopolization has intensified with the departure of Western companies, as in 2021 the same indicator was 33.7%. Ilim Group (12.6 million cubic meters) and Segezha Group (12.1 million cubic meters), which own facilities in Siberia and Northwest Russia, rank first and second in terms of logging volumes. Each of these companies accounts for about 6% of the total harvest volume in Russia. At the same time, the fourth place in terms of logging volume (11.2 million cubic meters) is occupied by harvesting for own needs of construction and residential heating by individuals in Russia [61].

Most forest companies in Russia are micro-enterprises with revenue of less than 120 million rubles (Table 1). Despite the small revenue, they serve an important social function, often being the only employers in small rural communities [16]. The dependence of the dynamics of financial indicators on the scale of the company was found for both net income and revenue growth rates. However, the effect sizes are also weak (Figure 3).

Following these test results, a comparison of the median values shows that large and medium-sized firms were more affected by the change in institutional incentives

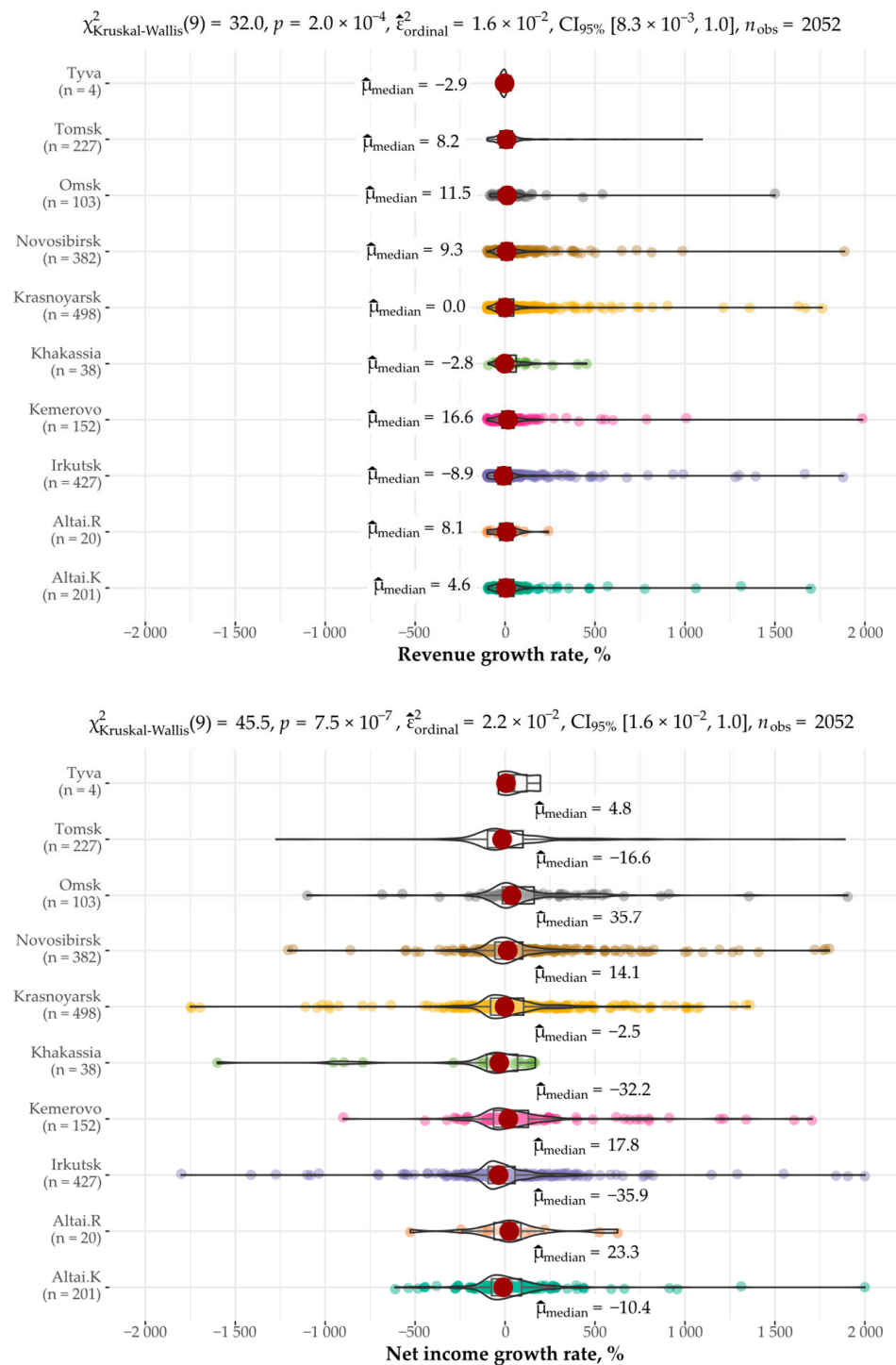
in 2022. Large enterprises may feel more pressure due to sanctions because they have a wider range of products and are more export-oriented. At the same time, micro and small enterprises that produce roundwood could be more affected by the ban on exports of unprocessed timber introduced since January 2022. A survey by Strategy Partners in July 2023 showed that only 50% of forest companies have adjusted their development strategy over the past year and a half [62]. Moreover, 28% are not going to revise their strategy soon, which means they are confident about their market position and further plans.



**Figure 3.** Distribution of financial indicators in Siberian timber companies by size of revenue volumes.

### 3.4. Spatial Heterogeneity

Among the regions of Siberia, two leaders can be distinguished: the Krasnoyarsk Krai and the Irkutsk Oblast. Several regions have an average development level of the forest industry: Novosibirsk Oblast, Tomsk Oblast, Altai Krai, Kemerovo Oblast and Omsk Oblast. The forest sector is hardly developed in the Republic of Khakassia, the Altai Republic, and the Republic of Tyva. The Kruskal–Wallis test showed significant differences between the regions with low effect size (Figure 4).

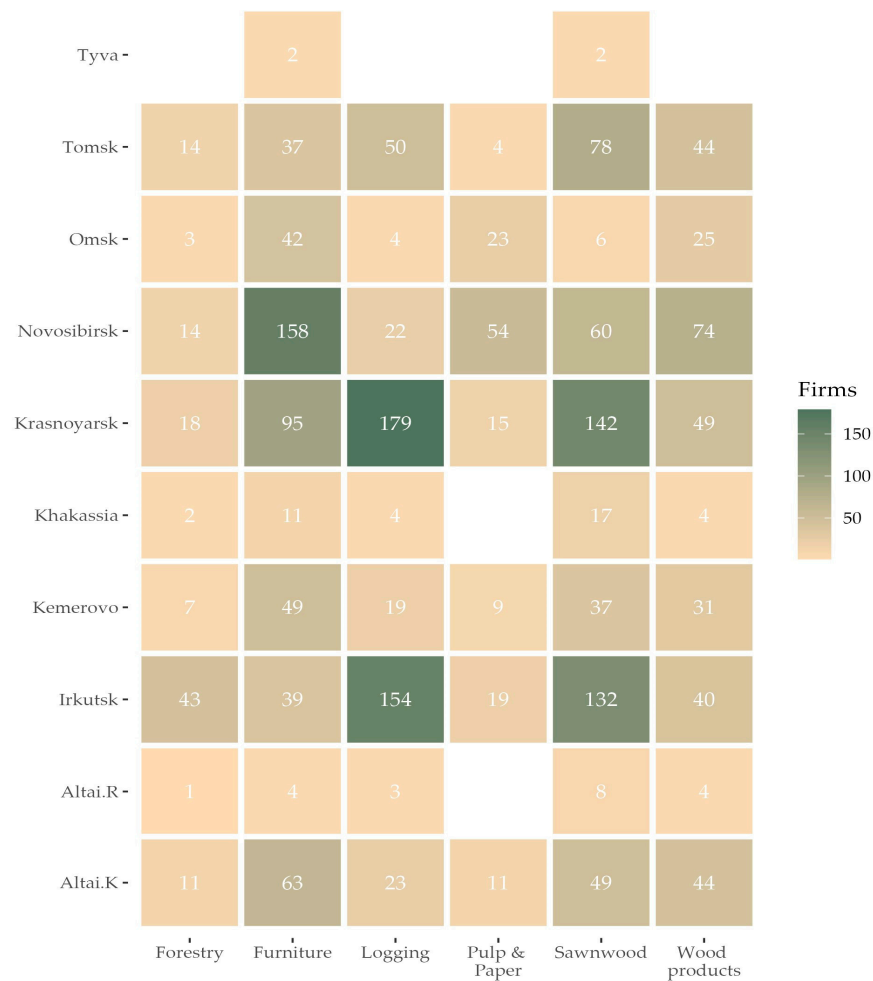


**Figure 4.** Distribution of financial indicators in Siberian timber companies by regional location.

Figure 5 shows that the leading forest regions, Krasnoyarsk Krai, and Irkutsk Oblast, also have a similar structure of timber companies by activity type. However, their financial performance in 2022 was different.

Financial indicators of Irkutsk timber companies declined the most in the Siberian Federal District, as the region’s logging volume decreased by 20% in 2022 [63]. Despite, Irkutsk sawn wood producers Tayriku-Igirma and Timber Trans took the first and third places in the ranking of the largest forest companies in Siberia and the Far East. They are characterized by large revenue gains (164% and 354%) with a fixed net loss by the end of 2022. At the same time, JSC Lesosibirskiy LDK No 1 from Krasnoyarsk Krai held the second

place with only 4% revenue growth rate [64]. It is noteworthy that all three companies are part of the Segezha Group.



**Figure 5.** Distribution of Siberian timber companies by regional location and type of economic activity.

It is hard to identify the reasons for the different financial results between two rather similar regions. One of the options could be the impact of high base effect. Pulp and paper producers became the most profitable forest companies in 2021 [65]. Enterprises from Irkutsk Oblast, in particular the Ilim Group, are traditionally strong in this sector.

Another reason is the differences in regional policy measures. In Russia, all forests belong to the state, which leases forest plots to companies through a system of auctions. Some plots are leased for a long-term lease of up to 49 years, while others are intended for one-stage clear-cutting. Payments for forest lease are small and, as a rule, do not exceed 10%–15% of the final value of round timber on the domestic market. These payments are divided into two parts filling the federal and regional budgets, respectively. Krasnoyarsk Krai became the first region of Russia that allowed the postponement of lease payments for logging companies in 2022 [66]. This helped stabilize the financial performance of small-scale producers. The opportunity to implement such a measure of state support at the federal level began to be considered only in the spring of 2023 [67].

In addition, Krasnoyarsk Krai adopted a law on subsidies for firewood procurement for certain categories of rural population in 2022. This also had a valuable social effect, since the standard for free firewood for heating was increased from 20 to 25 cubic meters and from 30 to 35 cubic meters for the northern territories [68].

Among the regions with an average level of development of the forest industry, the Tomsk region had the worst results. This is mainly due to logistical problems. In particular, the reasons were the ban on the export of sawn wood, except for to Kazakhstan and Kyrgyzstan, and the closure of nearby automobile border posts. By the end of 2022, exporters of the Tomsk Region had 1.2 billion rubles worth of timber leftover [69].

Tomsk Oblast showed an interesting example of how complex the interrelationships of the local consequences of the export ban could be. Until 2022, trucking companies from Kazakhstan imported 95% of onions consumed in Tomsk Oblast. On the way back, they exported raw timber to Kazakhstan, which compensated the transportation costs. As a result, the export ban on the unprocessed timber led to an increase in the price of onions in the Tomsk region [70].

This example shows that the trade restrictions introduced in 2022 had a complex effect that is difficult to assess unequivocally. The consequences of institutional changes in the forest industry had an impact not only on Russian timber companies, but also on several related industries, the transport sector, construction and the purchasing power of the Russian population.

#### 4. Discussion

Previously, we calculated estimates of potential damage to the Russian timber industry based on an analysis of foreign trade volumes [43]. This study supplements the earlier findings with data from companies' financial statements. Since there is limited literature using statistics of the Russian forestry industry at the micro level, it is rather difficult to make comparisons with other studies.

The article [71] assessed the presence of spatial heterogeneity of the effect of sanctions imposed against Russia in 2014. It was found that companies in the eastern and western regions have equally felt the negative effects of the sanctions. On the contrary, the fixed effects panel modelling showed that the impact of sanctions on different regions is influenced by factors such as favoritism of political elites, differences in the level of development and structure of industry and the degree of involvement in international trade flows [72]. These contradictory results were reflected in our study, as we found that the industrial specialization, scale and location of the Siberian forest company in most cases had a statistically significant impact on financial results in 2022. Along with that, the effect size was weak for all cases.

Mostly, we found an increase of revenue with a decrease in net profit, which is consistent with other studies [64]. Pulp and paper manufacturers, furniture manufacturers and forestry companies coped best with the crisis. It should be mentioned that there can be a certain survivorship bias as we explore only companies that remain active and have filed tax reports in both 2021 and 2022. Some forest companies could cease to exist in 2022. However, due to the obvious cyclical nature of the forest business and its risks, it would be difficult to determine the true reason for the closure. To identify the causal relationship between the structural shifts of 2022 and the closure of enterprises, an analysis of the dynamics over several years is necessary. Such study can become a direction for future research.

Two major events occurred in 2022 that impacted companies' financial performance, behavioral incentives, and strategic plans. The first one is related to the ban on the export of unprocessed timber, introduced by the Russian government in January 2022 as part of the fight against illegal logging. This law change was anticipated and became a logical continuation of the prevailing trends. In particular, in the Irkutsk Oblast, exports of roundwood decreased from 5–6 million cbm in the mid-2000s to 2 million cbm by 2020 [73]. The companies increased their logging volumes at the end of 2021, which allowed them to receive record export revenue, and were preparing to change the structure of their production.

On the contrary, the introduction of unprecedented trade restrictions against Russia was impossible to predict in advance, which simultaneously created stressful conditions for forest companies. Despite the extensive experience of imposing sanctions in the history of mankind, the question of their impact on the economy remains debatable [74,75]. Empirical studies show that the vast majority of sanctions are not effective, including due to the high costs for the initiator of sanctions [76,77]. This is also true for the global forest industry [78]. The absence of Russian wood has indeed created a high level of employment for European producers and strengthened the position of local companies [79]. At the same time, the sanctions have created local shortages in Europe of such types of forest products as kraft paper, sanitary products, newsprint, which was previously exported from Russia [80,81].

Definitely, the sanctions had a significant negative impact on the financial performance of the timber companies in the short term. Many export-oriented producers lost their traditional sales markets and experienced difficulties with the sale of product stocks. Some forest companies were forced to reduce production or shut down for a while. Foreign owners of companies have sold their assets in Russia. Some factories like Mondi, Elopak continued their operations after being bought out by local management and investors. Others, like IKEA, laid off a significant amount of the workers and withdrew from the Russian market. This created additional social risks, due to the difficulties with finding another job in single-industry towns and remote rural settlements.

The transport system of Russia has experienced a huge load. Trans-Siberian Railway and Far-Eastern ports were overloaded due to the need to redirect products to Asian and Middle Eastern countries. The domestic market was not ready for the consumption of surplus products, which can no longer be exported to Western countries. This is especially true for such goods as sawn wood, plywood and pellets.

The scarcity of forest products was avoided. There were local shortages in the production process, as happened with bleach to produce office paper. The main problem was the supply of machines for woodworking, paper production and forestry. Most of them were previously purchased in countries that imposed sanctions against Russia.

However, every crisis could be considered an opportunity [82,83]. For a long time, the Russian government attempted to create incentives for the timber industry to increase the degree of wood processing, develop the domestic market, invest in forest machinery and machine tool building and reduce the withdrawal of profits to various offshores. Previously, such measures could have been criticized as having too much state control over the economy and being too restrictive of the free market. Currently, all of these incentives were created because of sanctions, since changing the strategy for forest companies is now a necessity for survival.

The importance of Russian wood products for the world market leads to the emergence of new logistic routes to countries that have imposed sanctions against Russia [84–86]. This allows Russian companies to keep up production volumes. However, analysis of the production structure showed that Russian forest companies are not just changing the geographical directions of exports but are looking for opportunities to increase domestic consumption. This is in line with the results of a survey conducted by the Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS), which showed that about two-thirds of Russian enterprises have suffered from sanctions but are demonstrate high adaptive capacity. In particular, they modernize production, release new types of products, look for new sales markets and establish contacts with new suppliers in Russia and abroad [87]. One of the key drivers of forest industry development in the coming years will be wooden house construction [88]. This sector has a positive impact in several areas: (a) it creates an opportunity to load excess capacities to produce fiberboard, chipboard and plywood, which previously worked mainly for export; (b) supports the demand for furniture production; and (c) performs a social function, creating jobs, increasing the availability of housing for the population and can be used to relocate people from emergency housing.

Companies in Siberia have competitive advantages compared to other regions. Large timber reserves, less dependence on the European market and geographical proximity to Asian countries allowed them to cope with the crisis of 2022 better than companies from the north-west and central part of Russia. The obtained results demonstrate that in the high value-added industries such as pulp and paper production and furniture manufacturing, the revenue and net profit of companies increased even compared to the record figures of 2021. In a few sectors, such as the production of wooden houses and building structures, the regions of Siberia have managed to increase their share in the Russian market.

Nevertheless, the traditional limitations of the development of Siberian forest companies remain. Low density and population limit the potential demand for wood products. Attempts to attract additional staff to the Far East with preferential mortgages for real estate and land plots have not yet been successful.

Competition for transportation capacity has intensified due to the fact that forest companies from the Russian Northwest are also trying to gain access to the Asian and the Middle East markets. The Russian government plans to further expand the capacity of Baikal–Amur Mainline and Trans-Siberian Railway in order to reduce the time of cargo delivery by rail. The current stage of infrastructure modernization implies an increase in the capacity of the Russian Far East to 180 million tons per year, and by 2032 it is planned to reach 255 million tons per year [89].

The increased load on railroad and truck infrastructure has encouraged the development of the Northern Sea Route. This is a promising route for Siberian regions due to the Yenisei River, which is almost 3.5 thousand kilometers long. It flows from the south of Siberia through the territory of the Republic of Tyva, the Republic of Khakassia and the Krasnoyarsk Territory to the Kara Sea in the Arctic Ocean. Timber has been transported along the Yenisei through the northern ports of Igarka and Dudinka since 1928. In 1989, 1.2 million cubic meters of lumber passed through the port of Igarka [90]. After the collapse of the USSR, much of the port infrastructure degraded and now requires investment for reconstruction. The northwestern regions of Russia have also started to use this opportunity more intensively. This route is convenient for delivery of cargoes to the countries of southeast Asia. Compared to the Southern Sea Route through the Suez Canal, it is 30% shorter and the delivery time is only 22 days. The export flow of timber products from the Russian Northeast to Asian countries via the Northern Sea Route may reach more than 1.5 million tons per year [91,92].

Climate change processes are occurring faster in the northern territories. Although global warming increases the length of the shipping season, it also poses a threat of increased frequency and severity of forest fires [93–95], increased pest infestations [96,97] and shortened logging season [98].

Thus, it can be concluded that a turning point is coming for Siberian forest companies. New institutional rules under the influence of internal and external effects forces managers to build a new development strategy for the coming decades. The exploration of new foreign markets and the development of domestic demand will be key drivers of further growth. However, successful development requires government measures aimed at increasing the purchasing power of the population, stimulating wooden housing construction, developing logistics infrastructure in Siberia and Far East, removing trade barriers with Asian, African and Middle Eastern countries.

## 5. Conclusions

This paper aims to understand how the production structure and financial results of Siberian forest companies have changed in response to the crisis conditions of 2022. The main results can be summarized as follows:



1. The analysis of the financial performance of Siberian forest companies showed that in 2022 the industry experienced a strong impact of internal and external effects. The ban on the export of raw wood combined with trade sanctions has created fundamentally new conditions and incentives for the development of timber companies in Siberia. These effects reflected both the structure of production and the financial results of forest companies.
2. The Kruskal–Wallis testing showed a significant difference in the response to the crisis for different sectors of the forest industry. The best financial performance were shown by sectors that are focused on the domestic market (forestry) and have gained new opportunities due to the departure of Western competitors (pulp and paper, furniture manufacturing). The biggest drop in revenue and net profit occurred among companies whose main activity was logging and sawn wood manufacturing, as well as companies focused on the markets of Europe and the USA (plywood, fiberboard, particle board).
3. The results demonstrate that the firm scale also had an impact on the financial results of Siberian timber companies in 2022. Large and medium-sized companies suffered more due to the large volumes of forest products that previously went to the world market, as well as due to the high base for comparison, since record export revenue was received in 2021. At the same time, this result may be a consequence of selection bias, since the sample did not include companies that ceased operations in 2022. Among such companies, naturally, there is a large proportion of microenterprises with small revenues. Therefore, this issue requires careful further research.
4. We confirmed the presence of spatial heterogeneity both in the level of development of the forest industry [33] and in the regions' resistance to sanctions pressure [72]. Even regions with a similar structure of companies by type of activity such as Krasnoyarsk Krai and Irkutsk Oblast endured the crisis in different ways. It was shown that the financial results of forest companies located in different regions were influenced by their proximity to customs checkpoints and regulatory measures of regional authorities.
5. In the short term, Siberian forest companies suffered losses due to the closure of a significant part of the global market, lack of transportation capacity, logistical problems and the inability to export unprocessed timber. However, the new conditions and incentives that have developed in 2022 for Russian forest companies have opened up opportunities for the reindustrialization of the forest sector aimed at increasing added value in the production structure and the development of the domestic market. The drivers of future growth will be wooden housing construction, the transfer of residential heating systems from coal to pellets and the intensification of the transition to paper packaging instead of plastic.

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## Appendix A

**Table A1.** Volumes, values and volumes growth rates of key exported wood products for Russia and Siberian Federal District in 2021 compared to 2016.

Wood Product	HS Code	Siberian Federal District			Russian Federation		
		Export Volumes in 2021, Thousand Tons	Export Values in 2021, million US Dollars	Growth Rates of Export Volumes (2016–2021), %	Export Volumes in 2021, Thousand Tons	Export Values in 2021, million US Dollars	Growth Rates of Export Volumes (2016–2021), %
Fuel wood	4401	697.2	84.6	224	6034.9	487.1	95
Wood in the rough	4403	2231.5	291.2	−49	11,882.8	1021.7	−25
Sawnwood	4407	8039.0	2561.8	−9	16,979.1	6048.5	5
Particle board	4410	249.7	90.2	151	1671.0	676.3	58
Fibreboard	4411	129.9	59.2	124	1028.8	480.1	66
Plywood	4412	86.7	76.1	21	2032.0	1932.8	22
Pulp	47	1538.9	1016.9	−4	2279.0	1404.0	−9
Paper & paperboard	48	289.7	197.5	105	4090.2	3149.1	34

Data source: Research Data Infrastructure (INID). Center for Advanced Management Decisions [99].

## References

- European Union. *Council Regulation (EU) 2022/576 of 8 April 2022 Amending Regulation (EU) No 833/2014 Concerning Restrictive Measures in View of Russia's Actions Destabilising the Situation in Ukraine*; European Union: Brussels, Belgium, 2022; Volume 111.
- European Union. *Council Regulation (EU) 2022/1904 of 6 October 2022 Amending Regulation (EU) No 833/2014 Concerning Restrictive Measures in View of Russia's Actions Destabilising the Situation in Ukraine*; European Union: Brussels, Belgium, 2022; Volume 259I.
- US Office of Foreign Assets Control. *Specially Designated Nationals and Blocked Persons List*; US Office of Foreign Assets Control: Washington, DC, USA, 2022.
- Bukina, T.V.; Bukin, E.K.; Tretiakova, E.A. The Transport Framework of Logging as a Key Factor in the Development of the Timber Industry of the Perm Region. *ECO* **2023**, *53*, 25–43. [[CrossRef](#)]
- Pyzhev, A.I. The Forest Industry of the Regions of Siberia and the Far East: Prospects for the Development of the Forest-Climate Sector. *Stud. Russ. Econ. Dev.* **2022**, *33*, 402–408. [[CrossRef](#)]
- Antonova, N.E. Forestry Complex of Khabarovsk Krai in Search of Development Paths. *ECO* **2023**, *53*, 64–85. [[CrossRef](#)]
- Shvarts, E.A.; Shmatkov, N.M.; Karpachevsky, M.L.; Baibar, A.S. Challenges and problems of reforming the forestry sector in Russia. *Izv. St.-Peterbg. Lesotekh. Akad.* **2022**, 157–172. [[CrossRef](#)]
- Pyzhev, A.I.; Gordeev, R.V.; Vaganov, E.A. Reliability and Integrity of Forest Sector Statistics—A Major Constraint to Effective Forest Policy in Russia. *Sustain. Sci. Pract. Policy* **2020**, *13*, 86. [[CrossRef](#)]
- Shvidenko, A.; Mukhortova, L.; Kapitsa, E.; Kraxner, F.; See, L.; Pyzhev, A.; Gordeev, R.; Fedorov, S.; Korotkov, V.; Bartalev, S.; et al. A Modelling System for Dead Wood Assessment in the Forests of Northern Eurasia. *Forests* **2023**, *14*, 45. [[CrossRef](#)]
- Smirnov, M.; Andrianov, Y.; Chernyakevich, V. Technological Modernization of Forest Roads Construction in Russia. *J. Appl. Eng. Sci.* **2018**, *16*, 328–332. [[CrossRef](#)]
- Labunets, I.E.; Mayburov, I.A. Rationality of the Tax and Economic Behavior of Enterprises in the Russian Forestry Sector. *J. Tax Reform* **2023**, *9*, 110–127. [[CrossRef](#)]
- Labunets, I.E.; Mayburov, I.A. The Impact of the Size of Enterprises on Tax Evasion in the Forestry Industry of Russia. *J. Tax Reform* **2022**, *8*, 88–101. [[CrossRef](#)]
- Lapo, V.F. Regions' Competition for Investment Projects in Forest Development. *Spat. Econ.* **2014**, *2*, 75–92. (In Russian) [[CrossRef](#)]
- Lapo, V.F. Efficiency of Investment Stimulation Methods in a Timber Industry Complex: An Econometric Research. *Appl. Econom.* **2014**, *1*, 30–50. (In Russian)
- Ivantsova, E.D.; Pyzhev, A.I. Factors of success of priority investment projects in the sphere of forest exploitation in Russia: Econometric analysis. *Russ. J. Econ. Law* **2022**, *16*, 315–330. [[CrossRef](#)]
- Gordeev, R.V.; Pyzhev, A.I. Social and Economic Importance of Forest Companies in Asian Russia: Evidence from Corporate Financial Reporting. *Forests* **2022**, *13*, 2151. [[CrossRef](#)]
- Transparent Business. Available online: <https://pb.nalog.ru/index.html> (accessed on 3 November 2023).
- Kontur.Focus Database. Available online: <https://focus.kontur.ru/> (accessed on 3 November 2023).
- The Federal Law No 209-FZ On the Development of Small and Medium Entrepreneurship in the Russian Federation. Available online: <http://kremlin.ru/acts/bank/25971> (accessed on 12 November 2023).
- Federal State Statistics Service of Russia Unified Interagency Information and Statistical System (EMISS). Available online: <https://www.fedstat.ru/> (accessed on 23 September 2021).
- Snedecor, G.W.; Cochran, W.G. *Statistical Methods*; Iowa State University Press: Ames, IA, USA, 1980; ISBN 978-0-8138-1560-2.
- Kruskal, W.H.; Wallis, W.A. Use of Ranks in One-Criterion Variance Analysis. *J. Am. Stat. Assoc.* **1952**, *47*, 583–621. [[CrossRef](#)]
- Kelley, T.L. An Unbiased Correlation Ratio Measure. *Proc. Natl. Acad. Sci. USA* **1935**, *21*, 554–559. [[CrossRef](#)]
- Tomczak, M.; Tomczak, E. The Need to Report Effect Size Estimates Revisited. An Overview of Some Recommended Measures of Effect Size. *Trends Sports Sci.* **2014**, *21*, 19–25.

25. Carroll, R.M.; Nordholm, L.A. Sampling Characteristics of Kelley's  $\epsilon$  and Hays'  $\omega$ . *Educ. Psychol. Meas.* **1975**, *35*, 541–554. [CrossRef]
26. Frieman, J.; Saucier, D.A.; Miller, S.S. *Principles & Methods of Statistical Analysis*, 1st ed.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2017; ISBN 978-1-4833-5859-8.
27. Mangiafico, S.S. Kruskal–Wallis Test. Available online: [https://rcompanion.org/handbook/F\\_08.html](https://rcompanion.org/handbook/F_08.html) (accessed on 18 November 2023).
28. Patil, I. Visualizations with Statistical Details: The “ggstatsplot” Approach. *J. Open Source Softw.* **2021**, *6*, 3167. [CrossRef]
29. Wickham, H. Ggplot2. Available online: <https://ggplot2.tidyverse.org/index.html> (accessed on 20 November 2023).
30. R Core Team. R: A Language and Environment for Statistical Computing. Available online: <https://www.r-project.org/> (accessed on 23 September 2021).
31. Lomakina, N.V.; Antonova, N.E. Institutional Innovations for the Development of the East of Russia: Effects of Implementation in the Resource Region. *J. Sib. Fed. Univ. Humanit. Soc. Sci.* **2020**, 442–452. [CrossRef]
32. Dobrynin, D.; Jarlebring, N.Y.; Mustalahti, I.; Sotirov, M.; Kulikova, E.; Lopatin, E. The Forest Environmental Frontier in Russia: Between Sustainable Forest Management Discourses and ‘Wood Mining’ Practice. *Ambio* **2021**, *50*, 2138–2152. [CrossRef]
33. Gordeev, R.; Pyzhev, A.; Yagolnitsr, M. Drivers of Spatial Heterogeneity in the Russian Forest Sector: A Multiple Factor Analysis. *Forests* **2021**, *12*, 1635. [CrossRef]
34. Gordeev, R.V.; Pyzhev, A.I. The Russian timber industry at a crossroads. *ECO* **2023**, *53*, 169–191. [CrossRef]
35. Lukin, E.V.; Shirokova, E.Y. Manufacturing sector of the economy of North-West Russia: A year of functioning under the conditions of strengthening sanctions. *Econ. Manag.* **2023**, *29*, 927–937. [CrossRef]
36. Forests, Forestry and Logging. Available online: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Forests,\\_forestry\\_and\\_logging](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Forests,_forestry_and_logging) (accessed on 3 November 2023).
37. Vaganov, E.A.; Porfiriyev, B.N.; Shirov, A.A.; Kolpakov, A.Y.; Pyzhev, A.I. Assessment of the Contribution of Russian Forests to Climate Change Mitigation. *Ekon. Reg.* **2021**, *17*, 1096–1109. [CrossRef]
38. List of Priority Investment Projects for the Development of the Forest Sector. Available online: <https://minpromtorg.gov.ru/docs/list/?pdfModalID=b9eabff7-f735-4241-80ab-8b670ac10589&fileModalID=252c0719-1ced-4b14-8674-9d2385c2e24a> (accessed on 20 November 2023).
39. The Strength Is Not in the Ruble: How a Strengthening Currency Hinders Timber Exports. Available online: <https://forestcomplex.ru/finasy-2/kak-ukreplenie-rublya-meshaet-eksportu-drevesiny/> (accessed on 3 December 2023).
40. Results of the 3rd Quarter in the Timber and Wood Processing Industry of the Country. Available online: <https://krasnoyarsk.kh.ru/article/30930> (accessed on 3 December 2023).
41. The Number of Vacancies in the Forestry and Woodworking Industry Increased by 34%. Available online: <https://lpk-sibiri.ru/news/kolichestvo-vakansiy-v-sfere-lesnoy-promyshlennosti-i-derevoobrabotki-vyroslo-na-34/> (accessed on 3 December 2023).
42. In Russia, Timber Harvesting in 2022 Decreased by 13.5%. Available online: <https://tass.ru/ekonomika/17146669> (accessed on 14 November 2023).
43. Gordeev, R.V.; Pyzhev, A.I. The timber industry in Russia under sanctions: Losses and opportunities. *Vopr. Ekon.* **2023**, *4*, 45–66. [CrossRef]
44. Thurner, T.; Kuzminov, I.; Lobanova, P. The Russian Forest Industry: Declining Wood Production and Emerging Opportunities in Bioenergy. *Balt. For.* **2022**, *28*, 623. [CrossRef]
45. The Plant Was Pushed Back in Terms of Deadlines. Available online: <https://www.kommersant.ru/doc/6321918> (accessed on 15 November 2023).
46. Production of Wood-Based Panels and Plywood in Russia in 2022 Reduced by a Third. Available online: <https://proderevo.net/news/indst/amdpr-proizvodstvo-drevesnykh-plit-i-fanery-v-rossii-v-2022-godu-sokratilos-na-tret.html> (accessed on 15 November 2023).
47. Pellets Are Caught in a Bind. Available online: <https://www.rbc.ru/newspaper/2022/06/24/62b1c1519a7947bfefea7dc6> (accessed on 16 November 2023).
48. Syrtova, E.; Pyzhev, A.; Zander, E. Social, Economic, and Environmental Effects of Electricity and Heat Generation in Yenisei Siberia: Is There an Alternative to Coal? *Energies* **2023**, *16*, 212. [CrossRef]
49. Pomorye Became the First Region Where People from Emergency Housing Will Be Relocated to Wooden High-Rise Buildings. Available online: <https://rg.ru/2023/09/04/svai-v-dosku.html> (accessed on 16 November 2023).
50. Segezha Group Announced the Construction of Wooden High-Rise Buildings in Sokol. Available online: <https://lpk-sibiri.ru/news/segezha-group-anonsirovala-stroitelstvo-derevyannyh-mnogoetazhek-v-sokole/> (accessed on 16 November 2023).
51. Perevoshchikova, M. Chips Will Take off: Russia Will Start Developing Wooden High-Rise Buildings. Available online: <https://iz.ru/1513687/mariia-perevoshchikova/shchepki-vzletiat-v-rossii-nachnut-stroit-dereviannye-mnogoetazhki> (accessed on 16 November 2023).
52. IKEA Said Goodbye to the Factories. Available online: <https://www.kommersant.ru/doc/5899090> (accessed on 17 November 2023).
53. Nemtseva, M. I'd like Furniture: IKEA's Departure Has Lifted Revenue for Marketplaces. Available online: <https://iz.ru/1405434/mariia-nemtseva/mne-mebel-ukhod-ikea-podnial-vyruchku-marketpleisam> (accessed on 17 November 2023).
54. Housing Development. Available online: <https://rosstat.gov.ru/folder/14458> (accessed on 17 November 2023).

55. Trubilina, M. Furniture Production Grew by 15 Percent over the Year. Available online: <https://rg.ru/2023/01/20/proizvodstvo-mebeli-vyroslo-za-god-na-15-procentov.html> (accessed on 16 November 2023).
56. Pyzhev, A.I. Russian pulp and paper industry: In search of new points of growth. *Econ. Manag.* **2023**, *29*, 917–926. [CrossRef]
57. Western Investors Have Withdrawn from the Woodworking Industry. Available online: <https://www.kommersant.ru/doc/6223711> (accessed on 17 November 2023).
58. Birch Bark Is Canceled: How Russia Is Looking for a Replacement for Bleached Office Paper. Available online: <https://forestcomplex.ru/cbp/kak-v-rossii-ishhut-zamenu-beloj-ofisnoj-bumage/> (accessed on 17 November 2023).
59. The Reply to Tetra Pak: How Does the Russian Packaging Market Live under Sanctions? Available online: <https://forestcomplex.ru/cbp/chem-zhivjot-rossijskij-rynok-upakovki-v-usloviyah-sankcij/> (accessed on 17 November 2023).
60. Packaging Production near Moscow Continues to Develop with Regional Support. Available online: [https://www.vedomosti.ru/press\\_releases/2023/01/13/podmoskovnoe-proizvodstvo-upakovki-prodolzhaet-razvivatsya-pri-podderzhke-regiona](https://www.vedomosti.ru/press_releases/2023/01/13/podmoskovnoe-proizvodstvo-upakovki-prodolzhaet-razvivatsya-pri-podderzhke-regiona) (accessed on 17 November 2023).
61. ILIM Group Regained Its Leadership among Timber Loggers. Available online: <https://roslesinforg.ru/news/all/gruppa-ilim-vernula-sebe-liderstvo-sredi-zagotoviteley-drevesiny-/> (accessed on 3 December 2023).
62. Strategy Partners. Expectations of Forest Companies in 2023. 2023. Available online: <https://strategy.ru/research/research/43> (accessed on 3 December 2023).
63. In the Irkutsk Region in 2022, Timber Harvesting Decreased by 20%. Available online: <https://tass.ru/ekonomika/16823225> (accessed on 18 November 2023).
64. Zabolina, A. Expert Siberia Top-400: Rating of Companies in the Real Sector of the Economy of Siberia and the Far East. Available online: <https://expertsibdv.com/ekonomika/top-400-rejting-kompaniy-realnogo-sektora-ekonomiki-sibiri-i-dalnego-vostoka/> (accessed on 19 November 2023).
65. Sidorova, M. A Record for Memory. Available online: [https://www.lesindustry.ru/issues/li\\_164/%D0%A0%D0%B5%D0%BA%D0%BE%D1%80%D0%B4\\_%D0%BD%D0%B0\\_%D0%BF%D0%B0%D0%BC%D1%8F%D1%82%D1%8C\\_2260/](https://www.lesindustry.ru/issues/li_164/%D0%A0%D0%B5%D0%BA%D0%BE%D1%80%D0%B4_%D0%BD%D0%B0_%D0%BF%D0%B0%D0%BC%D1%8F%D1%82%D1%8C_2260/) (accessed on 19 November 2023).
66. Pavlovskiy, V.E.; Panteleev, V.I. The Krasnoyarsk Timber Industry Is Crying out for Help. Available online: <https://krasrab.ru/news/ekonomika/27058> (accessed on 19 November 2023).
67. List of Instructions Based on the Results of the Meeting on the Development of the Timber Industry Complex. Available online: <http://www.kremlin.ru/acts/assignments/orders/70764> (accessed on 3 December 2023).
68. Panteleev, V. How to Save the Forest Industry. Available online: <https://krasrab.ru/news/davayte-obsudim/25905> (accessed on 19 November 2023).
69. Tomsk Forestry Enterprises Began to Withdraw Capacity from Inactivity after Solving Problems with Exports. Available online: <https://obzor.city/news/666036---tomskie-predpriyatija-lpk-nachali-vyvodit-moshchnosti-iz-prostoja-posle-reshenija-problem-s-eksporto> (accessed on 20 November 2023).
70. Expert: Onions in Tomsk Have Risen in Price Due to the Ban on the Export of Timber to Kazakhstan. Available online: <https://www.riatomsk.ru/article/20230110/ekspert-luk-v-tomskoj-oblasti-podorozhal-iz-za-pilomaterialov/> (accessed on 20 November 2023).
71. Shida, Y. Russian Business under Economic Sanctions: Is There Evidence of Regional Heterogeneity? *Post-Communist Econ.* **2019**, *1*–21. [CrossRef]
72. Li, Z.; Li, T. Economic Sanctions and Regional Differences: Evidence from Sanctions on Russia. *Sustainability* **2022**, *14*, 6112. [CrossRef]
73. Dementieva, E. Irkutsk Forest Industry Is Ready to Ban the Export of Roundwood. Available online: <https://rg.ru/2022/02/17/reg-sibfo/irkutskij-lpk-gotov-k-zapretu-na-eksport-krugloj-drevesiny.html> (accessed on 19 November 2023).
74. Knobel, A.Y.; Proka, K.A.; Bagdasaryan, K.M. The Theory and Practice of International Economic Sanctions. *JNEA* **2019**, *43*, 152–162. [CrossRef]
75. Bapat, N.A.; Heinrich, T.; Kobayashi, Y.; Morgan, T.C. Determinants of Sanctions Effectiveness: Sensitivity Analysis Using New Data. *Int. Interact.* **2013**, *39*, 79–98. [CrossRef]
76. Hufbauer, G.C.; Schott, J.J.; Elliott, K.A.; Oegg, B. *Economic Sanctions Reconsidered*, 3rd ed.; Peterson Institute for International Economics: Washington, DC, USA, 2007; ISBN 978-0-88132-407-5.
77. Ata, N.K.; Ismailov, N.; Volkova, I. Sanctions and the Russian Federation’s Economy: A Systematic Literature Review and Analysis of Global Energy Sector. *Ege Acad. Rev.* **2023**, *23*, 377–392. [CrossRef]
78. Liu, Q.; Ning, Z. Impact of Global Supply Chain Crisis on Chinese Forest Product Enterprises: Trade Trends and Literature Review. *Forests* **2023**, *14*, 1247. [CrossRef]
79. Ponsse’s Interim Report for 1 January–30 September 2022—Ponsse. Available online: [https://www.ponsse.com/company/investors/releases/-/asset\\_publisher/XbANRjhQNz7o/content/ponsse-s-interim-report-for-1-january-30-september-2022#/](https://www.ponsse.com/company/investors/releases/-/asset_publisher/XbANRjhQNz7o/content/ponsse-s-interim-report-for-1-january-30-september-2022#/) (accessed on 19 November 2023).
80. Worldwide Pulp Shortage Raises Risk of Higher Tissue Prices. Available online: <https://www.bloomberg.com/news/articles/2022-05-06/worldwide-pulp-shortage-raises-risk-of-higher-tissue-prices> (accessed on 19 November 2023).

81. Fastmarkets. How an EU Ban on Russian-Made Paper Could Transform the European Sack Kraft Market. 2022. Available online: <https://www.fastmarkets.com/insights/how-an-eu-ban-on-russian-made-paper-could-transform-the-european-sack-kraft-market/> (accessed on 3 December 2023).
82. Galbraith, J.K. *The Gift of Sanctions: An Analysis of Assessments of the Russian Economy, 2022–2023*; Institute for New Economic Thinking: New York City, NY, USA, 2023.
83. Horak, J. Sanctions as a Catalyst for Russia’s and China’s Balance of Trade: Business Opportunity. *J. Risk Financ. Manag.* **2021**, *14*, 36. [CrossRef]
84. Six Months into War, Russian Goods Still Flowing to US. Available online: <https://apnews.com/article/russia-ukraine-putin-biden-baltimore-only-on-ap-81a34ce2eecebe491f52ace380ce87fb> (accessed on 25 October 2022).
85. How Russian Timber Bypasses U.S. Sanctions by Way of Vietnam. Available online: <https://www.washingtonpost.com/world/2022/10/01/russia-sanctions-birch-wood-vietnam-china/> (accessed on 25 October 2022).
86. Lehren, A.W. The U.S. Put Punishing Tariffs on Russian Plywood after the Ukraine Invasion. Did It Actually Cut Imports? Available online: <https://www.nbcnews.com/news/world/us-tariffs-russian-plywood-ukraine-invasion-cut-imports-rcna71914> (accessed on 2 December 2023).
87. Kuvalin, D.B.; Zinchenko, Y.V.; Lavrinenko, P.A.; Ibragimov, S.S. Russian Enterprises at the End of 2022: Countering Sanctions, Relations with Banks and Reaction to the Climate Agenda. *Stud. Russ. Econ. Dev.* **2023**, *3*, 200–216. [CrossRef]
88. Bezrukikh, O.A. Formation of a Highly Efficient Wooden Housing Construction Sector in Russia. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, *751*, 012088. [CrossRef]
89. Skorlygina, N. The Third Went. Available online: <https://www.kommersant.ru/doc/6197185> (accessed on 19 November 2023).
90. Mishechkina, M. Facts Passed through the Heart. Available online: <https://krasrab.ru/news/stati/6640> (accessed on 3 December 2023).
91. 1.5 Million Tons via the Northern Sea Route. Available online: <http://lesregion.ru/slider/6048-15-mln-tonn-produkcii-cherez-sevmorput.html> (accessed on 3 December 2023).
92. In August, a Test Delivery of Timber along the Northern Sea Route from Pomorie to China Will Take Place. Available online: <https://nationalforest.ru/en/news/v-avguste-sostoitsya-testovaya-dostavka-lesa-po-sevmorputi-iz-pomorya-v-kitaj> (accessed on 3 December 2023).
93. Shvidenko, A.Z.; Schepaschenko, D.G. Climate Change and Wildfires in Russia. *Contemp. Probl. Ecol.* **2013**, *6*, 683–692. [CrossRef]
94. Loupian, E.; Balashov, I.V.; Bartalev, S.A.; Burtsev, M.A.; Dmitriev, V.V.; Senko, K.S.; Krashenninnikova, Y.S. Forest Fires in Russia: Specifics of the 2019 Fire Season. *Sovrem. Probl. Distantionnogo Zondirovaniya Zemli Iz Kosmosa* **2019**, *16*, 356–363. (In Russian) [CrossRef]
95. Korená Hillayová, M.; Holécy, J.; Korísteková, K.; Bakšová, M.; Ostrihoň, M.; Škvarenina, J. Ongoing Climatic Change Increases the Risk of Wildfires. Case Study: Carpathian Spruce Forests. *J. Environ. Manag.* **2023**, *337*, 117620. [CrossRef]
96. Ivantsova, E.D.; Pyzhev, A.I.; Zander, E.V. Economic Consequences of Insect Pests Outbreaks in Boreal Forests: A Literature Review. *J. Sib. Fed. Univ. Humanit. Soc. Sci.* **2019**, *12*, 627–642. [CrossRef]
97. Mezei, P.; Potterf, M.; Škvarenina, J.; Rasmussen, J.G.; Jakuš, R. Potential Solar Radiation as a Driver for Bark Beetle Infestation on a Landscape Scale. *Forests* **2019**, *10*, 604. [CrossRef]
98. Chugunkova, A.V. Modeling of Logging Industry Dynamics Under the Global Climate Change: The Evidence from Siberian Regions. *J. Sib. Fed. Univ. Humanit. Soc. Sci.* **2020**, *13*, 1870–1879. [CrossRef]
99. Exports and Imports of Russian Regions: Customs Statistics for 2016–2021. Available online: <https://data.rcsi.science/data-catalog/datasets/201/> (accessed on 3 December 2023).

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