Macroeconomics of mining of the Far Eastern Federal District

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Annotation. The analysis of macroeconomic indicators of the results of solid mineral extraction (TPI) in 11 subjects of the Far Eastern Federal district (DFO) was performed. The total value of production of all types of minerals (DPI) in terms of money at DFO is about 2.4 trillion rubles (45% of total gross regional product (GRP) of the region is equal to 5 trillion rubles.). More than 63% of the volume of DPI is achieved at the expense of fuel and energy resources of the Sakhalin region and the Republic of Sakha (Yakutia). In the dynamics of the region, there is a significant increase in GRP, production and value added for the DPI in general, and the production of fuel and energy minerals, but slower growth in the production of solid minerals. Ore (metal) raw materials of the region's subjects in its total GRP is about 21%, in value terms-500 billion rubles. The region produces 16-18 types of ore mineral raw materials, including 12 types of raw materials as the main components of production, 4-5 types-as associated components. The main one is gold production (in 2019 more than 170 tons), silver (more than 930 tons). In the Far Eastern Federal district, reserves and resources of the main TPI for the long term have been identified. It is possible to significantly support the mining industry of the region in the case of exploration of new deposits with high-quality ores. Ore mineral raw materials of the leading geological and industrial types are currently insufficiently studied. It is necessary to develop intra-regional use and processing of raw materials to final products, create metallurgical industries, this will give new incentives to the development of the region's resources. The analysis is of practical importance for evaluating and selecting directions in the deposits of subsurface use.

1 Introduction

The key sector of the Far Eastern Federal district's economy is mining (28%). Subsurface use in terms of reproduction, exploration and development of mineral deposits is an integral part of the economy of each of the 11 administrative-territorial subjects of the Far Eastern Federal district, but it does not constitute a single economic space: each entity has its own economy and accounting for its results by type of economic activity "mining" (DPI). The

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region has produced and is producing 16-18 types of ore mineral raw materials, including 12 types of raw materials as the main components of production, 4-5 types — as associated components of production (copper, cobalt, bismuth, titanium, partially silver). Production in recent years has fluctuated, and its average level reflects table 1.

Table 1. Annual metal mining in the subjects of DFO (averaged for the last three years data of the Dal'nedra, websites of companies, information and analytical sites, etc.)

Subjects DFO	Minerals	Mining	Subjects DFO	Minerals	Mining
Resp. Buryatiya	Gold, t	5,5	Kamchatskij kraj	Copper, thous. t	1
	Tungsten (WO ₃), t	928		Nickel, thous. t	7
	Uranium, t	693		Cobalt, thous. t	50
Resp. Sakh (Yakutiya)	Gold, t	30,3		Gold, t	6
	Silver, t	88		Platinum, t	0,39
	Antimony (conc.), thousand. t	20,4	Habarovskij kraj	Tin, t	1900
	Uranium, thous. t	15		Gold, t	24,8
Zabajkalskij kraj	Gold, t	12,1		Silver, t	70
	Silver, t	150		Platinum, t	0,6
	Uranium, t	1720		Copper, thous. t	0,2
	Copper, thous. t	20,9		Tin, thous. t	1,6
	Lead, thous. t	31,4		Tungsten (WO ₃), thous. t	0,14
	Zinc, thous. t	28,5	Amurskaya oblast	Iron ore, million tons	0,53
	Molybdenum, t	19		Gold, t	25
	Bismuth, t	315		Silver, t	9
	Antimony (metal), t	685	Magadanskaya oblast	Gold, t	38,8
	Tungsten (WO ₃), thous. t	1380		Silver, t	710
Primorskij kraj	Lead, thous. t	8,5		Lead, thous. t	6
	Zinc, thous. t	14,2	Sahalinskaya oblast	Zinc, thous. t	5,1
	Tin, thous. t	0,014		Gold, t	1,2
	Tungsten (WO ₃), thous. t	1,84		Silver, t	6
	Gold, t	0,3	Evrejskaya avt. oblast	Iron ore, million tons	5,830
	Silver, t	33		Gold, t	0,2
	Copper, thous. t	0,2	Chukotskij avt. okrug	Gold, t	24,6
	Bismuth, t	16		Silver, t	120
	Cadmium, t	88			
	Indium, t	1,1			
	Germanium, t	3			

Currently, 256 indigenous deposits and 1264 placer gold deposits are being developed, prepared for development and explored, while only 123 deposits of other metals are being developed. Gold production in the Far Eastern Federal district increases from year to year: in 2014, the district's enterprises produced 126 tons of gold, and in 2019 – more than 170 tons, silver – more than 930 tons. Gold resources are sufficient to maintain the achieved level of production in the near future. The indicators of platinum, diamond, lead and tungsten concentrates production, and borate ores production are relatively stable during the observed period. Copper, nickel, and cobalt concentrates are extracted in small amounts and vary from year to year. Kimkan-Sutarsky GOK develops iron ore raw materials (ZHRS). The mining of tin, tungsten, antimony, lead, zinc, copper, fluorite, boron has been in an unstable state for the past 10-15 years: they have noticeably lost their significance for domestic consumption. Tin production resumed: a GOK with a capacity of up to 4-5 thousand tons of tin concentrate per year is being built at the Pravourmiyskoye deposit. The identified and estimated reserves and resources of zinc, nickel, titanium, manganese, mercury, antimony, molybdenum, beryllium, tantalum, niobium, lithium, zirconium and

some of her metals are small in volume or economically unprofitable and unprofitable; production of fluor spar is stopped, production of associated useful components (bismuth, beryllium, lithium, etc.) depends on the extraction of base metals. For the sustainable operation of the mining industry in the region, there are reserves and resources for five types of ore minerals: precious metals (gold and silver), iron ore, copper, and uranium. The most reliable raw material base for the industrial development of the region is the ZHRS [1].

In the article analyzes the current state and feasibility of developing types of mineral raw materials on the basis of Goskomstat indicators that reflect various aspects of the type of activity "mining" in the region in comparative terms (tables 2-4). The gross regional product (GRP) of the Far Eastern Federal district is more than 5.2 trillion rubles, about 5.5% of the national total. The total volume of production of all types of minerals in monetary terms in 2018 was about 2.4 trillion rubles (about 45% of the total GRP). More than 63% of Mining is achieved at the expense of fuel and energy resources of the Sakhalin region and the Republic of Sakha (Yakutia), including oil, gas, gas condensate more than 53% (1.26 trillion rubles), coal – 9% (21.8 billion rubles), and other minerals, including diamonds, boron, magnesite, and so on. ore – more than 12% (282 billion rubles). Ore (metal) raw materials of the region's subjects in its total GRP in recent years is about 21%, which in value terms in 2018 was equal to 500 billion rubles (table 2). In the dynamics of the region, there is a significant increase in GRP, production and value added for Mining in general, and the production of fuel and energy minerals, but slower growth in the production of solid minerals.

Most subjects of the Far Eastern Federal district, having a significant potential for mineral resources, cannot independently maintain the budget balance in a satisfactory state and receive an annual gratuitous budget revenues (grants). The amount of subsidies for subjects in 2018 was 14–63% of the regional budget (the average for the Far Eastern Federal district is 47%). The Sahalinskaya oblast received the smallest relative subsidies to the budget (about 14%), the Chukotka autonomous okrug (63%) and the Zabaikalskij kraj (61%) received the largest.

In 2018, total investments in fixed assets of the subjects of the Far Eastern Federal district amounted to about 1.4 trillion rubles (33% of the GRP), and in Mining – 457 billion rubles (about 30% of the total investment). The highest investment in Mining is in the Sahalinskaya oblast (180 billion rubles), in Yakutia (158 billion rubles), the lowest in the Evrejskaya autonomous oblast, Primorskij kraj and Kamchatskij kraj from 1.1 to 2.7 billion rubles, in other subjects of the Far Eastern Federal district – from 6 to 39 billion rubles. About 90% of the total investment of organizations with foreign capital in the Mining is received, but in general, all branches of the district's economy receive less than 4 times domestic ones. In the Sahalinskaya oblast, domestic and foreign investments are approximately equal (table 3).

Macroeconomic indicators of organizations by kind of activity Mining in the subjects of DFO in 2018, reflects the table 4. The total number working enterprises and organizations of mining at DFO is almost 143 thousand people, equivalent to 3.5% of all people employed in economy employees. The largest number of them work in the Republic of Sakha (Yakutia) – 48.6 thousand people (10% of all working in the Republic), in the other regions work from 1.9 to 17.6 thousand people. The largest share of employees in the field of Mining is observed in Chukotka autonomous okrug (18% of all employees in the district) and the Magadanskaya oblast (13.5%).

The number of enterprises and organizations in Mining in the region is more than 3,100, the largest number in Yakutia is almost 600, the smallest in the Evrejskaya avt. oblast, Chukotskij avt. okrug – 43 and Kamchatskij kraj – 63. The Total turnover of enterprises and organizations in the Mining is more than 2 trillion rubles, the largest turnover in the

Sahalinskaya oblast – more than 1 trillion rubles (50% of regional turnover) and in Yakutia – 561 billion rubles, in other subjects the turnover is in the range of 21-115 billion rubles, that is 5-10 times less than in the first two. Yakutia has the best financial result (58% of the regional result), while the Evrejskaya avt. oblast, Kamchatskij kraj and Primorskij kraj have negative results. Approximately also distributed on the subjects of general damages DFO (they in the district around 48 billion rubles) and profitability of sales organizations (for DFO 44.6%) and return on assets of organizations (DFO, at 10.4%). The share of unprofitable organizations from their total number in the Mining is large: from 40 to 100% (in the Evrejskaya avt. oblast), the smallest number of such organizations in the Sahalinskaya oblast is 19%.

The number of medium and small enterprises (MP) to Mining on subjects within 23-394 (total for DFO enterprises, 1980), and the number of employees – more than 9 thousand people (just over 6% of workers in large companies). The total turnover of MP in the Mining in the region is 50 billion rubles (2.4% of the regional turnover of large companies). Yakutia, the Amurskaya oblast and Magadanskaya oblast are the leaders in all three indicators. It is obvious that the results of mining are not enough to eliminate or reduce the subsidized budgets of subjects and that a new strategic approach to the goals and objectives of their development in the region is needed [1].

The Far Eastern Federal district has a developed mining industry with a very weak development of the processing industry. It is generally assumed that the needs and demand of the region are still low due to the small share of the Far Eastern economy in the country's economy and that small needs are met by imports from the Western regions or from abroad. There is no unified program framework for long-term development of subsurface use in the region, and there is no coordination between program documents on directions, sources of funding and deadlines. In the list of Federal target program (FTP) activities, this part represents a set of point projects. Five investment projects of the first group (the most developed and meeting the goals of the Program) are listed. Among them, three projects – 1) construction of the Bystrinsky GOK, 2) development of the Natalka gold deposit, 3) construction of the Tazhnyj GOK – belong to the mining industry (the first two were completed). Of the eleven projects of the second group, seven projects relate to this area: 1) development of the Udokan copper deposit, 2) construction of the Garinsky GOK, 3) construction of the Ametistovyj GOK, 4) construction of the GOK at the Baran'yevsky deposit, 5) increasing the design capacity of company "Urgalugol" to 7.1 million tons/year, 6) development of the Apsatskoe coal Deposit, 7) complex processing of man-made coal waste. The content of three of these projects is gold mining (Bystrinsky GOK, along with the production of iron ore and copper concentrates, which will be exported, also aims to extract gold). These projects are part of a fragmented, but successfully functioning gold mining industry in the Far Eastern Federal district. Three FTP projects are related to the coal industry for intraregional needs, one is focused on the development of copper resources for export. Two projects of the iron ore industry (Tazhnoye and Garinskoye deposits) without a metallurgical complex have an unfinished look.

Table 2. The structure of mining in 2018 (in current prices) by the subjects of the DFO (source: data of the State Statistics Committee, 2019)

Far Eastern Federal District and Subjects	Mining - a to tal of billion rubles	Metal ore mining		Mining of other minerals		Coal mining		Crude oil and natural gas production		Mining service	
		billion rubles	% of all mining	billion rubles	% of a ll mining	billion rubles	% of all mining	billion rubles	% of all mining	billion rubles	% of all mining
DFO 2355,933		500,588	21,2	282,331	12,0	217,6 9,2		1258,104	53,5	97,31	4,1
Resp. Buryatiya	27,974	16,196	57,9 1,904		6,8	9,873	35,3 0	0	0	0	0
Resp. Sakha (Yakutiya)	804,388	78,792	NA	266,745 33,2		78,216	9,7	343,699 42,7		36,936	NA
Zabajkalskij kraj	108,4	55,822	51,5	0,611 0,6		50,859	46,9	0	0	1,108	1
Kamchatskij kraj	21,518	19,647	91,3	0,458 2,	1	NA	NA	NA	NA	NA	NA
Primorskij kraj	22,557	7,599	33,7 3,206		14,2	11,753	52,1 0	0	0	0	0
Habarovskij kraj	91,358	69,806	76,4	2,63 2,9		18,833	20,6	0	0	0,0892	0,1
Amurskaya oblast	60,169	52,335	86,9	3 5,0		3,053	5,1	0	0	1,782	3,0
Magadanskaya oblast	124,937	NA	NA NA		NA	NA	NA 0	0	0	NA	NA
Sahalskaya oblast	1016,799	3,617	0,4	2,981 0,3		40,895	4,0	913,086	89,8	56,221	5,5
Evrejskaya avt. oblast	10,33	NA	NA	NA NA		0	0	0	0	0	0
Chukotskij avt. okrug	67,502	63,537	94,1	NA NA		3,045	4,5	NA 0		0,748	1,1

Note. "0" - not produced; "NA" - no data (for commercial and other reasons)

Table 3. The volume and share of mining by the subjects of DFO in the formation of their own gross regional product in 2018 (according to the State Statistics Committee and the Federal Treasury, etc.)

Far Eastern Federal District and Subjects	GRP		Volume of goods shipped by mining			Investment in fixed capital			Finance		
	Total, billion rubles	Per capita, ruble	Billion rubles	Share in GRP, %	Mining in industrial production, %	Total, billion rubles	among them on mining, billion rubles	Foreigner, million dol.	Budget (revenues), billion rubles	Professional/deficit (-) budget, billion rubles	Donated income, billion rubles
DFO	5204,117	634214,3	2355,933	45		1394,467	456,606	5590			
Resp. Buryatiya	226,135	229836,9	27,974	12	24	48,754	6,347	26	64,778	-0,379	30,709
Resp. Sakha (Yakutiya)	1084,556	1123113,8	804,388	74	85	403,427	180,310	129	248,329	12,538	80,978
Zabajkalskij kraj	326,866	305683,1	108,4	33	NA 90,058		38,899	351	70,791	0,367	26,617
Kamchatskij kraj	236,484	750407,7	21,518	9	12 39,279		2,772	1	87,792	1,583	53,549

Primorskij kraj	834,023	437147,4	22,557	3	6 141,859		2,032	488	142,373	16,683	30,676
Habarovskij kraj	710,640	536377,5	91,358	13	20 129,646		9,343	200	122,245	-10,264	27,260
Amurskaya oblast	301,069	378318,7	60,169	20	52 239,705		14,256	288	65,283	0,511	14,081
Magadanskaya oblast	170,723	1196690,1	124,937	73 81		51,512	36,514	5	37,789	-1,106	13,549
Sahalinskaya oblast	1179,669	2407929,4	1016,799	86	93 218,339		157,863	3535	156,810	-8,505	22,689
Evrejskaya avt. oblast	55,809	346715,8	10,33	19 NA		16,821	1,106	162	11,678	-0,530	4,029
Chukotskij avt. okrug	78,143	1578496,1	67,502	86	80 15,068		7,165	250	36,269	0,434	22,725

Table 4. Macroeconomic indicators of organizations by type of "mining" activities in DFO entities in 2018 (source: data of the State Statistics Committee, 2019)

Far Eastern Federal District and Subjects	Number of businesses and organizations in mining	Number of workers in mining, thous. Man	Number of employees in mining, % of the total number of employed	Turnover of organizations on mining, billion rubles	Financial result, billion rubles	Loss, billion rubles	Share of loss-making organizations as a percentage of the total number of organizations	The return on assets of mining organizations, %	Profitability of mining organizations, %	Number of small enterprises (MP) mining	Number of MP mining workers	Turnover of MP mining, billion rubles
DFO 3141		142,6	3,5	2077,7	272,564	43,907 47,6		10,4	44,6	1980	9116	49,750
Resp. Buryatiya	338	6,9	1,8	66,6	12,812 0,623		50,0	15,2	28,6	244	594	2,012
Resp. Sakha (Yakutiya)	599	48,6	9,8	561,4 158,848		7,083	42,1	13,3	88,5	340	2111	8,856
Zabajkalskij kraj	401	17,6	3,8	52,1	2,272 4,337		52,6	2,2	24,6	223	981	3,641
Kamchatskij kraj	62	3,4	2,1	21,1	-3,255 4,396		70,0	-5,8	29,4	30	142	0,692
Primorskij kraj	232	9,9	1,0	25,3	-0,237 1,856		65,0	-0,7	4,8	158	581	1,434
Habarovskij kraj	258	10,8	1,6	85,1	10,232 6,825		50,0	7,6	24,8	172	392	2,072
Amurskaya oblast	574	14,4	3,7	55,3	10,364 1,302		51,4	6,7	28,4	394	1620	10,896
Magadanskaya oblast	428	12,4	13,5	115,3 9,445		13,056	40,0	3	22,5	298	1598	13,465
Sahalinskaya oblast	163	10,7	3,8	1024,3	58,044 0,112		19,0	14,3	7,3	74	653	4,531
Evrejskaya avt. oblast	43	1,9	2,8	NA	-3,516 3,516		100	-10,9	14,7	23	157	0,587
Chukotskij avt. okrug	43	6,0	18,1	61,7	17,555 0,801		42,9	17,3	44,3	24	287	1,563

A business can perform such spot and market-oriented tasks within the framework of achieving its own corporate goals aimed at ensuring profitability (or break-even) of its shareholders funds, but it cannot (and this is not its task) form a meaningful framework of the economy and organize the creation and development of new directions in it, especially with a view to the future and embedded in the national economy system. This is clearly visible in the part of the started development of the ZhRS base and can be further manifested in the part of the development of copper ore raw materials [2, 3]. Public-private partnership tools are needed. «Fond razvitiya Dal'nego Vostoka i Bajkal'skogo regiona» (Vnesheconombank group) promising economic specialization and eight regions of the Far East (except for Primorskiy kraj and Kamchatskiy kraj and Evrejskaya avt. oblast) identified the development of mineral resources, but there are no tasks on creation of processing industries, which can only be done by the state system, one of the documents which is a Federal program. On the territory of the Far Eastern Federal district, deposits of almost all types of minerals accounted for by the balance of the Russian Federation, including the main strategic ones, have been identified. The typology of their significance for regional (regional and national) needs is as follows: 1) mineral resources are playing a decisive role in the economy of the Far Eastern Federal district: oil and gas of Sakhalin, coal, diamonds, oil and gas Yakutia, gold and silver of the majority of subjects DFO, iron ores in Evrejskaya avt. oblast and Amurskaya oblast and Yakutia; 2) mineral resources that play a significant but not yet decisive role in the economy of subjects DFO: tin, tungsten, lead, zinc, copper, nickel, cobalt, fluorspar, boron, platinum, titanium; 3) mineral resources whose reserves are estimated and partially extracted: antimony and metals extracted along the way – bismuth, cadmium, indium, etc.; 4) mineral resources whose reserves are estimated in advance: their involvement in economic turnover in the current state of study and lack of necessary technologies in the medium term is problematic: rare earth metals, zirconium, molybdenum, etc.

The creation of processing industries in the Far Eastern Federal district can smooth out the imbalances in the previously established structure of the national economy based on mineral resources: in the geographical location of deposits, infrastructure facilities, processing enterprises and consumers of mineral raw materials. Program-target planning principles should be based on an industry approach, that is, set the goal of creating an appropriate industry in the region based on its own mineral resources or participation in a specific segment of the national economy. For the Far Eastern region, these are the creation of its own ferrous and non-ferrous metallurgy. For ferrous metallurgy, the final stage of the technological chain is required – the construction of a metallurgical plant, for non-ferrous – the middle link – copper smelting. Current prices for mineral raw materials should not play a decisive role: the design and operating time of enterprises of this type are many decades and go through several favorable and crisis periods. The determining criterion should be the feasibility of the final goal.

2 Conclusion

The resources of gold, silver, platinum, and diamonds, which are only partially of industrial significance, are primarily important as a social factor. At the current high price level, they provide jobs for a certain part of the population. In DFO there is no industrial processing of the extracted minerals except ore-processing plants, near mines (quarries, mines), there are only three companies (Amur hydrometallurgical plant of the company "Polymetal", the autoclave hydrometallurgical complex "Petropavlovsk", the lead plant of the company "Dal'polimetal").

Prospects for the development of the mining industry in the Far Eastern Federal district depend on the adopted concept development of mineral base. The Far East now needs not

an export concept for the development of ore and mineral resources, but a concept of self-sufficiency in the main industrial sectors based on its own raw materials, primarily metallurgical ones.

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