Diamond Mining in the Arctic: Influence of Industrial Potential on Social and Economic Systems

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Abstract. In conditions of market, the relations between local authorities and subsoil users are poorly developed. The problem of the reaction of diamond mining companies' activities to the budgetary process of the resource region is investigated insufficiently. A high degree of production costs increase in the industry of the Arctic regions determines the possibility of industrial projects development only for highly liquid productions, one of which is the commercial mining of natural diamonds. The industrial potential of the diamond mining companies of the Arctic was assessed on the base of a set of quantitative indicators. Macroeconomic factors influencing the sale of diamond products on the world diamond market are highlighted. The proposed methodological approach to assessing the industrial potentials of the companies allows conducting a comparative analysis of their influence on social sphere. The sources of the initial data for the quantitative assessment are the annual reports of the companies, i.e. the time series of data based on the period from 2015 to 2016. As a result of the research, it was determined that the industrial potential of diamond mining companies makes a similar contribution to the social and economic development of Anabar, Bulun, Olenek and Zhigansk municipal districts of Yakutia. Analysis of production and financial capacity has shown that there are reserves for increasing the social and environmental costs.

1. Introduction
The social and economic development of the Arctic territories is defined by the features of economic activities of the Arctic population. Complex natural and climatic conditions, poor transport accessibility, poor access to fuel and energy and information and communication networks determine the high degree of production costs increase in the industry of the Arctic regions. Therefore, the establishment and sustainable development of the industrial projects is possible only for highly liquid productions, one of which is the commercial mining of natural diamonds [1]. The best part of natural diamonds reserves is located in the Republic of Sakha (Yakutia), where the economy is focused on mining operations (resource region) [2]. Tax payments of diamond mining companies form a significant part of the revenues of Yakutia state budget. At that, the problem of the reaction of diamond mining companies' activities to the budgetary process of the resource region is investigated insufficiently. In this regard, the proposed research is relevant and in-demand one.

2. Methodology
The information base of the research was the reporting and analytical documents of the diamond mining companies of the Arctic [3, 4]. The documents are publicly available on the companies' official websites. The analysis of the world diamond industry is based on reports of dedicated analytical and
consulting agencies, such as AWDC [5] and Diamond Pipeline [6]. While researching the following economic methods were used: observation, bibliographic analysis of literature and materials of the Internet, obtained data analysis, expert assessment, factor analysis, etc.

The task of the research is to determine the influence of industrial potential on the social and economic development of local areas where the diamond mining is carried out. The subjects of the research are diamond mining companies operating in the Arctic Region of Russia. The algorithm of the research is based on the following stages:

- Diamond industry market analysis: global problems and market development prospects.
- Comprehensive assessment of the companies' industrial potential, namely mineral, production, financial, budgetary and tax potentials.
- Identification of interaction points between the local authorities and industrial company.

3. Challenges posed by the diamond industry

Diamond products mined in the Arctic are mainly sold on the world diamond markets. Thus, macroeconomic problems and threats to the world diamond market significantly affect the demand and sales of the mined rough diamonds.

The diamond industry is experiencing three established problems: the slowing of the long-term demand for diamonds; the active development of the synthetic diamonds market; and the low liquidity and financial stability of the diamond-processing segment of the diamond pipeline [5]. The development of the synthetic diamond industry can be competed by impact diamonds (diamond Ionsdaleite raw material) from the Popigai crater located on the territory of Anabar District of Yakutia and Krasnoyarsk Region [7, 8]. The balance stocks of impact diamonds of A+B+C1+C2 categories are taken into consideration in the unallocated subsoil fund and amount to ca. 267 billion carats [7,8]. According to laboratory tests, a group of scientists from Novosibirsk [8,9] says that the features of physical and mechanical properties of impact diamonds exceed the parameters of natural and synthetic diamonds.

The growing interest in synthetic diamonds, including from diamond mining companies, provokes one to take some measures to control turnover and identification of synthetic diamonds. Scientific and design works are conducted to develop affordable and efficient equipment for synthetic diamonds identification. Fluctuations in price indices against the background of rising prices for rough diamonds (due to decrease of offers) and decrease of prices for diamonds (due to low demand for luxury goods) lead to a decrease of diamond processing industry's margins. Based on the long-term predictive assessment of Bain & Co [5] experts, the world diamond industry is facing a global problem of depletion of the explored diamond deposits, the inadequacy of reserves of plots prepared for exploration and production, and the lack of new diamond deposits suitable for industrial development.

4. Industrial Potential of the Diamond Mining Companies of the Arctic

4.1. Mineral and resource potential for diamond mining in the Arctic

In the Arctic regions of Russia, the natural diamond reserves are taken into consideration in the Republic of Sakha (Yakutia) only. Deposits with accounted natural diamonds are concentrated in four Arctic municipal districts of Yakutia (according to the assessment dated January 1, 2017 [10]):

- Anabar District: placers of Ebelyakh, Gusiny, Kholomolookh, Istok, Mayat, Morgogor and Billyakh Rivers. The aggregate estimate of the balance reserves of B+C1+C2 categories diamonds accounts to 24,705.90 million carats and the off-balance reserves are of 2,519.40 million carats;
- Bulun District: Molodo placer with balance stocks of C1+C2 categories diamonds are of 1,384.40 million carats and the off-balance reserves are of 390 million carats;
- Olenek District: Verkhne-Munskoye and Bolshaya Kuonamka placers and the basins of Uchakh-Ytyrbty, Khara-Mas and Talakhtakh Rivers. The aggregate estimate of the balance
reserves of B+C1+C2 categories diamonds accounts to 47,846.20 million carats and the off-balance reserves are of 2,864.10 million carats;

- Zhigansk District: there are balance reserves of the undistributed diamond fund of Motorchuna River placer for 106.7 million carats. The remaining reserves of Yakutia are concentrated in the West of Yakutia.

Comparing the mineral and resource reserves of diamonds (including balance and off-balance reserves) of the Arctic and Western zones of Yakutia, one can see a tendency for reserves to decrease over the past thirty years (see Fig.1).

This picture is typical for the world diamond industry [5]. As the retrospective analysis of reserves for the last thirty years (1986-2016) shows, there is a decrease in reserves in Mirny District from 1,265.60 million carats to 672.50 million carats, i.e. by 47%. The decrease of reserves is directly related to the annual growth in industrial opencast and underground mining of diamonds by ALROSA (PJSC). Since 2006, diamond reserves in the Arctic have increased from 6.85% to 8.01% of total diamond reserves in Yakutia due to the increased exploration. In order to solve the problem of natural diamonds reserves replenishment, the academician Nikolay Pokhilenko proposes to strengthen work on the development of new methods of search, exploration and forecasting of deposits [1]. He picks out the prospective plots of possible location of diamond ore in Anabar Region of Yakutia and proposes to start geological exploration with the involvement of public-private financing.

The availability of reserves of diamond mining companies conducting production in the Arctic at the moment can be deemed satisfactory (Table 1).

Figure 1. Change in diamond reserves in Yakutia, according to the assessment of 1986-2016.

| Diamond mining companies | Balance stock (categories A+B+C1) | Est. Production in 2016 (carat) | LOM Years |
|--------------------------|----------------------------------|--------------------------------|-----------|
| JSC Almazy Anabara       | 25486,6                          | 3,400,000                      | 7,50      |
| JSC Nizhne-Lenskoe       | 746,8                            | 1,800,000                      | 0,4       |
| PJSC ALROSA              | 30616,2                          | 1,800,000                      | 17,0      |
Almazy Anabara JSC with current raw material reserves and productivity (2016) are secured for at least 7 years. According to the cumulative assessment of diamond reserves, considering the current level of production, ALROSA Group is provided with the reserves for at least 25 years with a good prospect of increase when carrying out an advanced geological exploration. According to the annual report of the ALROSA Group, the increase in diamond reserves for 2016 amounted to 58.4 million carats.

One should consider that one of the strategic tasks of Nizhne-Lenskoye JSC is the implementation of a plan for the company dissolution in favor of Almazy Anabara JSC under the leadership of ALROSA (PJSC). According to the results of 2016, Nizhne-Lenskoye JSC has completed mining operations on the tributary of the Billyakh River. By a decision of the Board of Directors, in 2016 the Nizhne-Lenskoye JSC has handed over the main exploited deposits to Almazy Anabara JSC by Bolshaya Kuonamka, Talakhkakh and Molodo placers plots.

4.2. The Production Potential of Diamond Mining in the Arctic

Initially, the commercial development of placer deposits of diamonds in the Arctic was established by the model of small-scale so called seasonal enterprises. Almazy Anabara JSC and Nizhne-Lenskoye JSC were the owners of the charter capital. But as practice showed, the financial stability of these enterprises could not overcome the crisis impact of 2008-2009. As a result, the above mentioned companies were included in the ALROSA Group, which allowed equalizing the operational and productive activities of the companies. The share of diamonds mined in the Arctic against the total volume of diamonds mined by the ALROSA Group in value terms over the period from 2006 to 2016 increased from 6.9% to 9.9% (Table 2).

| KPI                                           | FY2006 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 |
|-----------------------------------------------|--------|--------|--------|--------|--------|--------|
| Extraction of diamonds in the Arctic of Yakutia | 171,7  | 279,9  | 313,1  | 392,4  | 361,5  | 331,9  |
| Extraction of diamonds in the west of Yakutia  | 2332,2 | 2495,1 | 2596,9 | 3260,2 | 3477,4 | 3036   |
| Share of the mined diamonds in the Arctic from the total amount of the mined diamonds group of ALROSA | 6,9%   | 10,1%  | 10,8%  | 10,7%  | 9,4%   | 9,9%   |

The decreasing of production indicators during 2015-2016 was carried out purposefully, depending on the strategic objectives of the companies to maintain the growth in the cost of rough diamonds, based on the international market situation [11] (Table 3).

| KPI                                           | JSC Almazy Anabara | JSC Nizhne-Lenskoe |
|-----------------------------------------------|--------------------|--------------------|
| Rock mass (th. m3)                            | FY2015             | FY2016             | YOY change (2016/15) |
|                                              | 14582              | 13657              | -6,3%                  |
| Extraction of rough diamonds (carat mn)      | 3,308              | 3,421              | 3,4%                  |
|                                              | 7,866,0            | 6,743,0            | -4,3%                  |
| Rough diamond sales by producers ($ mn)       | 127,5              | 194,1              | 52,2%                  |
|                                              | 185,3              | 165,5              | -10,7%                 |
| Est. Average Price Per Carat                 | 38,54              | 56,74              | 32,1%                  |
|                                              | 94,35              | 95,94              | 1,7%                   |
The solution of the strategic task led to an increase of the average cost of the sold rough diamonds. One should consider that the cost of rough diamonds depends on the following quality characteristics: crystal shape, mass, color and defectiveness (presence of inclusions and defects).

4.3. The Financial Potential of Diamond Mining in the Arctic

Diamond mining companies in the Arctic are considered as large-scale companies, with the exception of oil and gas companies. Annual revenues of diamond mining companies amount to 16 to 18 billion rubles. The average profitability as per EBITDA was 40-42% (Table 4). In 2016, the ALROSA (PJSC) has achieved the highest profitability as per EBITDA among the participants of the diamond mining market, which amounted to 55%.

Table 4. Key financial highlights of diamond mining companies.

| Key financial highlights | JSC Almazy Anabara | JSC Nizhne-Lenskoe |
|--------------------------|--------------------|--------------------|
| FY2015  | FY2016  | FY2015  | FY2016  |
| Revenue (RUB mn)  | 13583  | 18253  | 34,4%  | 7955  | 15952  | 100,5% |
| Production costs (RUB mn)  | 8465  | 10883  | 28,6%  | 2532  | 9206  | 263,6% |
| EBITDA (RUB mn)  | 5117  | 7369  | 44%  | 5423  | 6745  | 24,4% |
| Net profit for the year (RUB mn)  | 1698  | 2871  | 69,1%  | 3454  | 4315  | 24,9% |
| EBITDA margin (%)  | 37,7%  | 40,4%  | 2,7%  | 68,2%  | 42,3%  | -25,9% |
| net profit margin (%)  | 12,5%  | 15,7%  | 3,2%  | 43,4%  | 27,0%  | -16,4% |

Based on the results of the assessment of companies against the financial risks based on the consolidated indicator of financial reliability of companies, it is determined that Almazy Anabara JSC has a low level of financial risk, with an average assessment of the company's insolvency probability (30 out of 99). Nizhne-Lenskoye JSC is assessed with a high level of risk of financial reliability, as it is at the stage of liquidation.

One of the most promising ways of development of Almazy Anabara JSC seasonal enterprise is a diversification of its activities, which has been restoring and rearranging the timber industry complex in Yakutia since 2004. In 2016, the degree of diversification determined as a percentage of revenue from other activities (timber, milk processing, trading activities, etc.) to revenue from core activities in Almazy Anabara JSC was 26% that is 4.9 billion rubles.

4.4. Social Obligations of Diamond Mining Companies in the Arctic

Significant impact on the social and economic development of the Arctic territories has the involvement and participation of local population in work at industrial enterprises. The stuff of the attracted specialists is 1% from outside the region, 16% from industrial areas, 29% from the Arctic regions and 54% from rural areas of Yakutia. During the period of Almazy Anabara JSC activity in the Arctic, there were created about 2,000 jobs (Table 5).
The rotational working method for mining operations is justified by the seasonality of mining operations due to the harsh climatic conditions of the Arctic and stimulates the intraregional movement of the population. As of January 1, 2016, the population of the Arctic regions of Yakutia is 69 thousand people that is 7.3% of the total population of Yakutia with a share of the rural population of 60.8%. Since 1990, the population of the Arctic regions of Yakutia has decreased by 2 times, and the migration loss has increased by 1.5 times [12, 13].

Table 5. Sustainable development in mining companies.

| KPI                                      | JSC Almazy Anabara FY2015 | JSC Almazy Anabara FY2016 | YOY change (2016/15) | JSC Nizhne-Lenskoe FY2015 | JSC Nizhne-Lenskoe FY2016 | YOY change (2016/15) |
|------------------------------------------|---------------------------|---------------------------|-----------------------|---------------------------|---------------------------|-----------------------|
| Number of employed persons (th people)   | 1814                      | 1645                      | -9.3%                 | 156                       | 148                       | -5.2%                 |
| Social program (RUB mn)                  | 262,9                     | 234,5                     | -10.8%                | 96,4                      | 100,6                     | 4,3%                  |
| Social program/EBITDA (%)                | 5,1%                      | 3,2%                      | -2.0%                 | 1,8%                      | 1,5%                      | -0.3%                 |
| Environmental Protection Program (RUB mn)| 66,7                      | 22,7                      | -34%                  | 174                       | 192,1                     | 10%                   |

The main factor of migration loss is determined by low life quality of the population and poor transport accessibility. Yakutia is characterized by vast and unevenly developed territories with localization near the industrial mining facilities.

4.5. The Budgetary and Tax Potential of Diamond Mining Companies in the Arctic

The local points of so called budget mining enterprises interaction are formed and accounted for by the following:

- tax revenues (mineral extraction tax, personal income tax, and profit tax) distributed to regional and local budgets;
- increase in the fixed assets of the municipal districts (co-financing of the kindergartens and schools construction [14]);
- job growth of the local population (training of local labor resources, workflow management of local organizations, and reduction of the unemployment rate);
- life quality improvement of the local population (increase in the average monthly salary, application of social support measures for employees, namely, travel, sanatorium and medical expenses at the expense of the enterprise, as well as charity);
- living conditions quality of the population (construction of blocks of flats and infrastructure development).

At the same time, the company makes the bulk of the company's tax deductions to the regional budget (about 90%); 6% are directed to the federal budget. An amount of 3% is deducted to non-budgetary funds for providing medical and pension insurance. An amount of less than 1% is deducted to local budgets. According to the results of 2016, Nizhne-Lenskoye JSC has transferred taxes for the amount of as little as 14.9 million rubles to the local budget.

5. Discussion

Large industrial projects allow forming a production infrastructure. The production infrastructure refers to the involvement of small-scale and medium-scale businesses to provide services, including
catering, repairs, transport, and medical services. Establishment of a stable social and economic and engineering infrastructure for the local population will have a synergetic effect on the own profitability of the administrative territories, attraction of investments and improvement of the local population life quality [14, 15].

A characteristic feature of the resource region is that tax revenues and payments for the use of natural resources in the form of minerals are immediately directed to the regional budget [16], while revenues to municipal budgets are formed through the production of common mineral resources only (sand, limestone, etc.). Tax revenues and payments for the use of natural resources are not received by the budgets of urban and rural settlements. Consequently, the settlements do not receive any effect of the presence of mining enterprise on the territory of the municipal entity. The reference points for interaction between executive authorities and industrial enterprises operating in the region are regulated only on the basis of contractual agreements for the measures implementation [17, 18]. Legislative acts regulating the activities of the mining enterprises and aimed at the local population social support have not been adopted yet.

The development program of corporate and social responsibility of the company includes the activities aiming at the environment protection, social protection of indigenous people's traditional ways of life, strengthening of labor capacity through the attracting of local organizations and training of labor resources from the local population [19]. The group of diamond mining enterprises has a high sustainability level of the coefficient of corporate and social responsibility of the enterprise [20], which is characterized by high growth rates of social expenses exceeding the net profit growth rates. The sector of corporate and social responsibility is integrated to the maximum into the main enterprise management system.

6. Conclusion
As a result of the research, it was determined that the industrial potential of diamond mining companies makes a similar contribution to the social and economic development of Anabar, Bulun, Olenek and Zhigansk municipal districts of Yakutia. The influence of enterprises on the social sphere of the municipal region is of a contractual nature and is broadly defined by the management of the enterprise only. Analysis of production and financial capacity has shown that there are reserves for increasing the social and environmental costs. In order to further develop the social and economic situation of the Arctic, it is suggested to consider the following conclusions and recommendations:

(a) In conditions of market, the relations between local authorities and subsoil users are poorly developed. There is no systematic approach for the comprehensive infrastructure establishment and development. Limited energy resources inhibit the industrial development of the Arctic territories, but also contribute to the preservation of the ecological situation in the Arctic.

(b) The application of the rotational method of resource development is most effective, but at the same time it brings a catastrophic threat to the ecological and ethnological situation in the Arctic.

(c) The availability of mining industry facilities on the territory affects positively the tax potential and budget provision of the municipal district.

(d) With regard to the development of settlements, it is necessary to enable local self-government bodies to make independent decisions on the execution of budgetary powers aimed at their sustainable development.

(e) It is necessary to develop a set of measures to improve the mechanisms for the financial support of local budgets and to strengthen their own revenue base through the effective work on the social and economic development of the territories, including the creation of new types of industries according to the market demand.

Acknowledgment
The article was prepared within the framework of the project on the state task of the Ministry of education and science of the Russian Federation «Development of the theory and methodology of spatial organization of socio-economical systems of the Northern region» (No 26.8327.2017/8.9).

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