Comparative analysis of country approaches towards the development of oil and gas resources of the Arctic shelf and identification of opportunities of foreign experience application in Russia

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Abstract. For the Russian economy, which is so heavily dependent on energy production, the issue of Arctic development is very important. Practice shows that some countries are successfully producing oil and gas in the northern seas. However, only one field has been put into industrial operation on the Arctic continental shelf in Russia at the moment. Therefore, the analysis of approaches to the development of the Arctic shelf of other countries and the study of foreign experience of state stimulation of investments in the development of Arctic resources are now extremely relevant. At the same time, Norway is most interested, so successfully developing its hydrocarbon-based economy. In addition, Norway has access to the same Arctic sea as Russia and is actively engaged in industrial production in it.

1. Introduction

Global changes in the world economy have led to a sharp increase in competition in global and regional energy markets. At the same time, the struggle for possession and control over the economic turnover of hydrocarbon raw materials increasingly goes beyond classical competition and is transferred from the geo-economic to the political and military plane. The Russian Arctic shelf is the object of close attention from the participants of the world market due to the high natural and resource potential and insufficient level of exploration of its oil and gas fields.

The Arctic is rich in almost all types of natural resources. According to the United States Geological Survey, the potential reserves of oil in this region amount to 90 billion barrels, gas – 47.3 trillion m³, gas condensate – 44 billion barrels. Among the Arctic countries, Russia has the largest hydrocarbon reserves explored in the Arctic region.

The increased interest in the development of the hard-to-recover resources of the Arctic shelf is currently due to the following key factors:

- Expectation of positive changes in global energy market conditions and, first of all, hydrocarbon raw materials;
- Global warming of the climate, allowing year-round navigation along the Northern Sea Route;
- Stability of Russian economy development ensuring fulfillment of social obligations of the state.
2. Materials and methods

2.1. Development of the Russian Arctic shelf: potential, prospects, risks

The analysis of hydrocarbon reserves on the Arctic shelf of the Russian Federation and their study carried out by the Institute of Economic Problems named after G.P. Luzin of the Kola Scientific Center of the Russian Academy of Sciences gives the basis for optimistic forecasts of development of shelf deposits. Summary characteristics of continental shelf hydrocarbon dilution and reserves are given in Table 1.

The increasing activity of development of the Russian continental shelf fields is the main incentive for the development of the innovative economy of Russia. The Arctic is the subject of fundamental and applied scientific research in various fields of knowledge, including for international cooperation to acquire new knowledge about the Earth's global natural and climatic processes and the causes of their change, as well as about the sustainability of Arctic ecosystems. The most important areas of scientific research in the Arctic are:

- Study of the natural potential of the entire Arctic region and the continental shelf in particular, including geological and seismic exploration, monitoring of hydrometeorological and geophysical processes using mobile data collection points, including drifting stations, through remote transmission of scientific information and geographic information systems;
- Creation of innovative environmentally safe technologies for exploitation of mineral raw materials, water, biological and other types of natural resources adapted to severe Arctic climatic conditions, reducing high production costs and minimizing risks of man-made disasters, etc.

Table 1. Summary characteristics of the resource base of the Arctic shelf of the Russian Federation.

| №  | Characteristic of resource base                                      | Value indicator |
|----|---------------------------------------------------------------------|-----------------|
| 1  | Initial total recoverable hydrocarbon resources, billions of tons of oil equivalent | about 80        |
| 2  | In addition in the area of disputed jurisdiction of the Russian Federation and Norway, billion tons of oil equivalent | 6.5             |
| 3  | Recoverable oil reserves, million tons                              | more than 400   |
| 4  | Gas reserves, trillion m³                                          | more than 8     |
| 5  | Dilution of initial total extracted hydrocarbon resources, %        | 6.3             |
| 6  | Fields of hydrocarbons                                             | 25              |
| 7  | Local objects (identified and prepared)                             | 524             |
| 8  | Deep drilling efficiency, thousands of tons of oil equivalent per meter of running length | 27              |

At present, Russian applied science faces the task of developing domestic standards of technical regulation that meet international requirements, primarily in the design, construction and operation of facilities on the Arctic shelf.

The formation of the modern energy sector, the creation of high-tech, raw materials-producing enterprises is becoming the main direction of development of the Russian economy. The exploitation of the richest natural resources of the Arctic shelf plays a leading role in the economic and political life of the country. It will increase the economic potential of the Russian Federation, bring the development of our country to a qualitatively new level.

The intensification of competition for access to Arctic shelf resources determines the need to immediately develop clear state positions in the implementation of regional investment policy in the Arctic as determining the comprehensive development of Russian northern territories.

Realization of effective investment activities is defined by a state and availability of sources of investment resources, including the state investments, investments of the commercial organizations, foreign investments.
One of the economic characteristics of the development of the Arctic shelf is the high level of investment risk, which includes the following components: technological, economic, managerial, financial, environmental, socio-political and criminal risks.

The analysis of the main investment risks of the development of oil and gas fields of the Arctic Russian shelf shows a high degree of connection between the successful implementation of investment projects, the formation of consortium with international participation, the attraction of private domestic capital with the improvement of the mechanisms of state regulation of the development of the region.

2.2. Analysis of the economic efficiency of the Arctic project. Conditional oil field development model

Currently, the bulk of the Arctic continental shelf deposits are not yet ready for industrial development. The reason for the slow development of the Arctic shelf is the low profitability due to the huge amount of investments required for the development of offshore deposits in severe natural and climatic conditions. The purpose of this analysis is to find out under what conditions (tax system of Russia or Norway) the economic efficiency of development of a conditional deposit in the Barents Sea is higher, what factors most influence the profitability of the project.

The conditional deposit is located in Russia, on the continental shelf of the Barents Sea, in its southern part. It is a new offshore field, as oil production falls after 2016. The basic assumption of the model is that the probability of finding oil is 1, and the production of gas, whose reserves can be opened during the development of the deposit, is not taken into account.

Natural factors such as climate, ice, depth of the sea and distance from the shore have a strong impact on capital and operating costs and transport costs. It is these conditions that determine the choice of platform type, the period of exploration and the cost of drilling.

The type of mining platform is marine ice-resistant stationary (MLSP) with a service life of 30 years. On the central technological platform (CTP) the produced oil is prepared before its transportation to shore via underwater pipelines.

This project uses a linear depreciation calculation scheme. The standard term of use of amortized property is 10 years.

The construction of MLSP and CTP, underwater communications and pipelines and the implementation of environmental measures that are essential in such a human-sensitive Arctic environment are the most important in the costs of field development.

In the structure of operating costs (OPEX) the largest share (42.3%) is taxes and payments included in the cost price, about 20% of all OPEX is for both current costs and depreciation charges, slightly less (15.9%) – for transportation costs in oil export.

The project as a whole lasts 35 years (from 2020 to 2054). The first 6 years of geological exploration of the deposit is carried out, for 7 years (2026) the field development is completed and oil production is started. Maximum oil extraction is achieved for the 4 year of industrial production (in 2029) and is equal to 5927 thousand tons. The accumulated volume of production for the design term will amount to 98226 thousand tons.

The model assumes that part of the oil produced (2.5%) is used for its own needs. The total quantity of commercial oil is 96262 thousand tons.

3. Results and discussion

3.1. Project cost effectiveness assessment methodology

For the company, the traditional method of assessing the economic efficiency of oil and gas production projects is to calculate net discounted income NPV (Net Present Value). This indicator is equal to the difference in the present value of cash inflows and outflows.

\[ NPV = \sum_{t=1}^{35} DCF_t, \]

where \( DCF_t \) is net discounted cash flow in year \( t \):
\[ DCF_t = \frac{NCF_t}{(1+i)^t}, \]

where \( NCF_t \) is net cash flow in year \( t \); \( i \) is the discount rate.

\[ NCF_t = \text{INFLOW}_t - \text{OUTFLOW}_t, \]

where \( \text{INFLOW}_t \) is a measure of cash inflows in year \( t \) and \( \text{OUTFLOW}_t \) is a measure of cash outflows in year \( t \).

Net cash flow \( NV \) is:

\[ NV = \sum_{t=1}^{35} NCF_t. \]

The company’s cash inflow is equal to the revenue it receives from the sale of produced oil in the foreign and domestic markets. The formula for cash outflows varies by country depending on the taxation system used.

In the context of the Russian tax system:

\[ \text{INFLOW}_t = \text{TR}_t; \]

\[ \text{OUTFLOW}_t = \text{CAPEX}_t + \text{OPEX}_t + \text{NDPI}_t + \text{N}_{PR} + \text{EXP}_t + \text{TRANS}_t + \text{RESERV}_t, \]

where \( \text{TR}_t \) – total oil sales revenue; \( \text{CAPEX}_t \) – capital expenditures; \( \text{OPEX}_t \) – operating costs; \( \text{NDPI}_t \) – value added tax; \( \text{N}_{PR} \) – income tax; \( \text{EXP}_t \) – export duty; \( \text{TRANS}_t \) – transportation costs related to oil exports; \( \text{RESERV}_t \) – contributions to the reserve of forthcoming expenses in the year \( t \).

In the context of Norway’s tax system:

\[ \text{INFLOW}_t = \text{TR}_t; \]

\[ \text{OUTFLOW}_t = \text{CAPEX}_t + \text{OPEX}_t + \text{NDPI}_t + \text{N}_{PR} + \text{EXP}_t + \text{TRANS}_t + \text{LIQUID}_t, \]

where \( \text{TR}_t \) – total oil sales revenue; \( \text{CAPEX}_t \) – capital expenditures; \( \text{OPEX}_t \) – operating costs; \( \text{NDPI}_t \) – value added tax; \( \text{N}_{PR} \) is a tax on carbon dioxide emissions; \( \text{AREA} \) – territory fee; \( \text{CORPN}_{PR} \) – corporate income tax; \( \text{SPECIAL}_{PR} \) – special income tax; \( \text{TRANS}_t \) – transportation costs related to oil exports; \( \text{LIQUID}_t \) – contributions to the liquidation fund in year \( t \).

Contributions to the reserve of forthcoming expenses in Russia and contributions to the liquidation fund in Norway represent the company’s costs to eliminate fishing after the completion of production at the field, so they are taken into account in the outflow of funds. Contributions to the depreciation fund are not deducted from the cash flow, as the outflows take into account the capital costs themselves.

Internal rate of return (IRR), payback period, cost return index (ID) and investment (PI) are also indicators of the project’s economic efficiency.

\( IRR \) is the interest rate at which \( NPV = 0 \).

The payback period is the time period after which the \( NPV \) takes only a positive value.

The formulas used by «LUKOIL» were used to calculate the company’s Cost Return Index (ID) and Investment Index (PI):

\[ ID = \frac{\sum_{t=1}^{35} \text{TR}_t}{\sum_{t=1}^{35} \text{CAPEX}_t + \text{OPEX}_t + \text{NDPI}_t + \text{N}_{PR} + \text{EXP}_t + \text{TRANS}_t + \text{RESERV}_t (\text{LIQUID}_t)} + 1; \]

\[ PI = \frac{NPV}{\sum_{t=1}^{35} \text{CAPEX}_t (1+i)^t} + 1, \]

where \( \text{TR}_t \) – total oil sales revenue; \( \text{CAPEX}_t \) – capital expenditures; \( \text{OPEX}_t \) – operating costs; \( \text{NDPI}_t \) – project tax expense; \( \text{TRANS}_t \) – transportation expenses related to oil export; \( \text{RESERV}_t (\text{LIQUID}_t) \) – contributions to the reserve of forthcoming expenses (to the liquidation fund) in year \( t \); \( i \) is the discount rate.

As revenues of the state will be considered tax payments of companies (Russia, Norway) and net income from participation as an investor (Norway with \( SDFI = 30\% \)).
In the context of the Russian tax system:
The state has an inflow of money from payment of taxes by the extractive company:

\[ \text{INFLOW}_t = \text{VAT}_t + \text{EXP}_t + \text{NDPI}_t + N_{PR} \]

In the context of Norway's tax system:
All taxes and fees paid by the company are state income. In addition, the State has an inflow and outflow of funds due to its direct participation in the project as an investor (proportional to the share of SDFI). Its cash flow consists of the following elements:

\[ \text{INFLOW}_t = \text{TR}_t + \text{VAT}_t + N(\text{CO}_2)_t + \text{AREAFEE}_t + \text{CORPN}_{PR} + \text{SPECIALN}_{PR} \]
\[ \text{OUTFLOW}_t = \text{CAPEX}_t + \text{OPEX}_t + \text{TRANS}_t + \text{LIQUID}_t \]

Net income of the state is equal to the difference \( \text{INFLOW}_t \) and \( \text{OUTFLOW}_t \).

3.2. Cost-efficiency of the project in the conditions of the tax system of Russia
In Russia, state regulation leads to the following tax conditions under which the project will be implemented.

- **VAT**
  It is paid when oil is sold to the domestic market. The rate is 18%.

- **MET**
  According to the new legislative changes, tax holidays for the new offshore field are not provided. Within 10 years from the moment of the beginning of commercial production the rate is equal to 10% of cost of the extracted oil in the world prices, after (since 2031) – MET is raised in the standard way and is equal \( 559 \times K_p \times K_d \), where \( K_p \) – oil price factor, \( K_d \) – coefficient of depletion of the field (559 rubles – NDPI rate since 2016).

- **Property Tax**
  It is not paid.

- **Export duty**
  Not payable until 2042. Then according to the standard scheme: \( 29.2 + 0.6 \times (P - 182.5) \) dollars/tonn, where \( P \) – the oil price in foreign market (provided that the price is more than 25 dollars/barrel).

- **Income tax**
  The rate is 20%.

Contributions to the reserve of forthcoming expenses for the completion of mining activities begin after reaching 70% of the field production and cannot exceed 1% of annual income. The model assumes that the annual cost of such a reserve is a 10% of capital expenditure.

The project is characterized by sufficiently long payback times, which is not surprising in Arctic shelf conditions.

So, the development of a conditional Russian deposit in the southern part of the Barents Sea brings the company a positive NPV even at a discount rate of 15%. The value of the cost return and investment indices is respectively greater than 1. This suggests that under Russia's current tax system, which provides significant benefits, the project is cost-effective for the company. Benefits under NDPI and export duty allow the subsoil user to pay back high costs and get positive NPV. The project pays off in 11 years at a discount of 10% and in 12 years at a discount of 15%.

The undiscounted income of the state from the payment of taxes by the company during the implementation of the project is 777,225 million rubles and consists of mineral extraction tax, value added tax, income tax and export duty. Half of the total income from the project, which comes to the budget of the Russian Federation, comes from NDPI.

Taking into account the discount of 10%, the income of the state is 169,065 million rubles, and 15% – 93,242 million rubles.

By creating favorable conditions for companies, the state, it can be said, takes risks, losing a significant part of tax revenues to the budget. However, this approach contributes to the advancement of the Arctic shelf. The introduction of benefits opens up access to oil and gas reserves, the extraction of which was previously economically inefficient. The development of Arctic deposits will lead to an increase
in the level of hydrocarbon production in Russia, the development of infrastructure in the northern territories, the creation of new jobs and the growth of profits of mining companies.

In addition to the economic efficiency of Arctic development, the issue of the impact on the ecology of a region so sensitive to anthropogenic effects is extremely important. According to experts, in case of an accident, only up to 15% of spilled oil that can spread outside the Arctic can be eliminated in Arctic conditions. Therefore, Russia needs serious technological solutions that will ensure not only the profitability of production on the continental shelf of the Arctic, but also its safety for the environment.

3.3. Economic efficiency of the project in the Norwegian tax system

Norway's government regulation creates the following tax conditions for the project.

- **VAT**
  It is paid when oil is sold to the domestic market. The rate is 25%.

- **Corporate income tax**
  The rate is 27%. The standard oil prices in the model are $788.4/ton on the foreign market and $473/ton on the domestic market.

- **Special income tax**
  The rate is 51%. The base of this tax is equal to the base of corporate income tax less uplift (5.5% of capital investments for 4 years).

- **Property Tax**
  It is not paid.

- **Export duty**
  It is not paid.

- **CO₂ Tax**
  Payable in proportion to the amount of oil burned at NOK 0.98 ($0.157) per litre.

- **Territory Fee**
  It is charged from the beginning of production in proportion to the area of the deposit: in the first year – 34,000 Norwegian kroner ($5.440) for 1 km², the second for 68,000 Norwegian kroner ($10.880) per 1 km², followed by 137,000 Norwegian kroner ($21.920) per 1 km².

When applied in the model of the tax system of Norway, let contributions to the liquidation fund be formed as well as reserves of forthcoming expenses in Russia, i.e. start after reaching 70% of the field production and account for 10% of capital expenditures, but do not exceed 1% of annual income.

Suppose that a company with a share of 70% and a state with a share of 30% (through the SDFI mechanism) is involved in the project for the development of a conditional oil field in the south of the Barents Sea. The state pays 30% of the costs and receives 30% of the total revenue.

Despite such a high total income tax rate (78%), the project is nevertheless profitable for the company and has the following economic efficiency indicators.

It should be noted that such high revenues are mainly related not to direct participation of the State, but to the tax system itself. If the state did not invest in the project, i.e. the share of SDFI would be 0%, the economic efficiency indicators for the company would be slightly higher, and the income of the state remained at the same high level.

With a discount of 10% of the company’s NPV more than 1.5 times in the absence of a state share in the project, the payback period and rates of return on costs and investments remain at the same level. With a discount of 15%, the company's NPV is more than 1.7 times, the payback period is less by a year, and the rates of return on costs and investments hardly change.

In the case of a zero share of SDFI, the cash flow of the state consists only of cash inflows, as it does not bear any costs related to the implementation of the project. The net income of the state in the absence of its direct participation is less than in the case of SDFI = 30%, by only 3.9% at the discount rate of 10% and by 0.5% at the discount rate of 15%.

Thus, for the company, the project to develop an Arctic deposit in the southern part of the Barents Sea in the context of Norway's tax system is profitable.
The Norwegian approach is based on taxing the financial result, so the company's high costs contribute to reducing its taxable base. The high total rate of income tax brings the state a large net income from the implementation of the project regardless of whether it invests in the project or not. However, the direct participation of the state through the SDFI mechanism allows the company to reduce the risks taken, which are extremely high in the Arctic.

3.4. Analysis of approaches by Russia and Norway. Assessment of the possibility of applying Norwegian experience in Russia

The comparison of the project economic efficiency indicators under the conditions of the tax system of Russia and Norway is presented in Table 2.

The economic efficiency of the project for the company in the conditions of the tax system of Russia is higher than Norway (higher indicators NV, IRR, NPV, ID, PI and less payback period). This result is not surprising at the extremely high rate of income tax in Norway (78%) versus the rate in Russia (20%), which takes away most of the profits from oil production. Russia's preferential tax system creates extremely favorable economic conditions for investors.

On the contrary, the income of the state from the implementation of the project is higher in the conditions of the tax system of Norway. If private companies are allowed to mine on the Arctic continental shelf in Russia, the country's budget will receive significantly less funds than in Norway. When the project is implemented by a private company (at SDFI = 0%), the tax income of the state in Norway (at a discount of 15%) is 1.7 times more than in Russia.

| Company | Indicators | units measurements | value in Russia | value in Norway (SDFI = 30%) | value in Norway (SDFI = 0%) |
|---------|------------|--------------------|----------------|-------------------------------|-----------------------------|
|         | NV         | million dollars     | 21.111         | 6.067                         | 8.741                       |
|         | IRR        | %                  | 24.8           | 15.3                          | 15.4                        |
|         | Payback period | years          | 10             | 10                            | 10                          |
|         | NPV (10% discount) | million dollars | 4.382          | 748.5                         | 1.086                       |
|         | Payback period | years          | 11             | 13                            | 13                          |
|         | (discount of 10%) | piece         | 1.4            | 1.1                           | 1.1                         |
|         | ID (10% discount) | piece         | 2.2            | 1.3                           | 1.3                         |
|         | PI (10% discount) | million dollars | 1.907          | 29.5                          | 51.5                        |
|         | NPV (15% discount) | years         | 12             | 25                            | 24                          |
|         | Payback period | piece         | 1.3            | 1.005                         | 1.006                       |
|         | (discount of 15%) | piece         | 1.7            | 1.01                          | 1.02                        |
| State   | Net income | million dollars     | 22.860         | 37.903                        | 35.229                      |
|         | Net discounted income (10% discount) | million dollars | 4.973          | 8.606                         | 8.269                       |
|         | Net discounted income (15% discount) | million dollars | 2.742          | 4.620                         | 4.598                       |

Thus, Norway's experience confirms the effectiveness of public-private partnerships in the oil and gas sector of the economy. Norway's tax system allows the state to receive large tax revenues from oil and gas production by private companies. The SDFI mechanism strengthens state control over the industry and promotes risk sharing among project participants.
In Russia, private companies cannot participate independently in the development of the Arctic continental shelf. And the slow pace of development of the region is due to a number of legislative restrictions, which involve the work of only two companies.

To date, industrial exploitation of only one deposit has begun in Russia on the continental shelf of the Arctic. The introduction of tax incentives should lead to more projects, but it takes a long time to carry out work on distributed licensed areas. The question of the need for technologies to work in the extremely difficult natural conditions of the Russian Arctic remains relevant.

The Russian model of the oil and gas sector is very different from the Norwegian insufficient participation of the state in the development of the industry. The state, in addition to performing supervisory and fiscal functions, should promote fundamental and applied research that will allow Russia to develop its own production technologies at Arctic fields.

4. Summary
On the basis of the analyzed material, the following aspects of early development of the Arctic shelf of Russia can be distinguished.

1. Development of research and development.
In order to develop the Arctic, Russia needs to give priority to the development of its own scientific and technical potential, which will become the main source of new technologies. The state should actively finance R & D in the oil and gas sector of the economy, set tasks for industry science and stimulate innovation of mining companies.

2. Licensing to private companies.
In addition to the obvious result (faster development of the Arctic), the creation of a competitive environment will lead to the technological development of Russian companies and, consequently, to the reduction of the cost of their production in the Arctic. Obtaining individual search and exploration licenses by private companies could have a significant impact in opening up new cost-effective oil and gas reserves.

3. Active involvement of foreign partners.
The partnership with foreign companies on favorable terms will allow Russia to gain access to the world advanced technologies of geological exploration and production of hydrocarbons. It is worth noting that the activities of foreign partners should contribute to the development of the national economy. The State must maintain its control and benefit from the development of Arctic deposits. And an example of how this can be done is Norway's approach.

Russia could allow foreign participants to the continental shelf of the Arctic, subject to mandatory training of local personnel, investment in Russian scientific research, purchase of equipment of domestic production. Liberalization of companies' access should not be a distribution of Russia's Arctic shelf reserves, and the state should also benefit significantly from mining activities.

4. Changing the tax system in liberalizing access.
The calculations showed that under the current system of taxation of Russia based on gross income, the project is profitable for the company only if there are benefits that significantly reduce tax payments. But the state is taking such measures, as taxes are not the only potential source of its income from the development of Arctic reserves. As the main shareholder of mining companies, the state also owns part of their net profit.

From the activities of private companies the state will receive income only in the form of tax payments. But current tax incentives significantly reduce possible cash flows to the country's budget. Therefore, access to the continental shelf of private companies is likely to involve changes in Russian tax legislation. In such a case, the role of income tax (rate increase) may increase, which will not allow the state to lose income, and companies will allow to take into account high costs in the taxable base.

5. Strict state control.
If new participants, including foreign companies, are involved in the development of oil and gas reserves of the continental shelf, the State must define clear rules of their work (unambiguous and predictable) and ensure the stability of the proposed conditions.
One way to maintain state control in Russia may be to allow private companies to enter into contracts such as product sharing agreements (SPRs), according to which the state will own a fixed share of produced hydrocarbons. Russia could also develop its direct state involvement mechanism, like SDFI in Norway. The state could act as an investor in Arctic projects, financing part of the costs and receiving the corresponding part of the revenues from the sale of oil and gas. This approach will allow companies to reduce their extremely high risks in the Arctic and allow the state to generate additional net income.

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