[*ENERGY STRATEGIES IN NORHT-EAST ASIA: ESPO- AND ALTAY-PIPELINES*]

[Vladislav V. Savin, ERIRAS, +7 499 123 08 11, vsavin@eriras.ru, w11bsavi@mail.ru]
[Tatiana A. Mitrova, ERIRAS, +7 499 137 60 30, mitrovat@rambler.ru]
[Vladimir N. Sidorenko, MSU, +7 495 939 2676, v_sidorenko@mail.ru, vladimir@econ.msu.ru]
[Alexander A. Zaitsev, alex_zaytsev@bk.ru]

Overview

In 1997-1998 Gazprom developed strategical vision of the future expansion to new markets, in first place, to the Asian-Pacific Region. The necessity for this came from strategical necessity to diversify Russian gas exports, estimated growth of gas production in Russia and stability of Gazprom positions on European gas markets where Gazprom served approximately no more than one third of gas demand on the long term contract basis. Because of all that Gazprom continued the work of former Soviet Ministry of Gas Industry and began works on internal valuations of the possibilities for constructing gas pipelines to China that could deliver 30-38 bln m^3 of natural gas yearly during next 20-30 years.

In the former USSR 7 variants of gas export to China were analyzed: from Turkmenistan and or Uzbekistan, from Western Kazakhstan, from Western Siberia (Yamalo-Nenets Autonomous District), from the North of the Krasnoyarskiy Kray, from the North of the Irkutsk Oblast, from Yakutia Republic, and from Sakhalin island. The most profitable variants of gas export identified were: the export routes from Turkmenistan (through Uzbekistan and Kazakhstan) and from Western Siberia (through Krasnoyarskiy Kray and Mongolia). Here we analyze the route from Western Siberia to China[1].

The experience of constructing international gas pipelines shows that the main assumption for such a project to be profitable and affordable is the existence of sufficient gas reserves that could serve pipelines as long as during 35-50 years. Such a gas reserves base could be found in the group of gas fields in Yamalo-Nenetz Autonomous District (Western Siberia), where the proved reserves constitute 1200 bln m^3 and the forecasted reserves constitute 4600 bln m^3. 82% of these reserves are concentrated in 5 gas fields: Nakhodkinskoe, Pyakyakhinskoe, Yuzhno-Messoyakhskoe, Khalmerpayutinskoe and Antipayutinskoe. These gas fields could guarantee the yearly deliveries of 40 bln m^3 to China for 30 years. However, the needs for capital investments in developing these gas fields and constructing the pipeline only on the Russian territory would be about 6 bln USD and 15 bln USD correspondingly.

[1] The route from Turkmenistan should be analized during 2009 in the context of joint Russian-Taiwan research project carried out under the financial grant of Taiwanese National Sciences Council, No. 994, and the Russian Foundation of Humanities, №08-02-95123a/Tau. The research 2009 is designed specifically to understand the main problems of the pipeline game between major regional and global players in Central Asia.

In March 2006 during his visit in China the President of the Russian Federation Vladimir Putin proposed to build the NG pipeline – "Altay"-pipeline – from Russia to China that could transport yearly up to 40 billion m^3 of natural gas and be about 6700 km long (2700 km on Russia's and 4000 km on China's territory). In July 2008 the vice-speaker of Russian Duma, and simultaneously the President of the Russian Gas Society, Valery Yazev told on the video-conference "Moscow-Beijing" about Russian plans to enlarge the Russia's gas export to the "East" and to build new capacities for transporting in 2020 up to 10% of Russian gas exports (~70 billion m^3) to Asian-Pacific Region. So, it seemed that a new vision for a gas pipeline network going from Russia to China emerged.

However this was only the beginning of the story. Afterwards the world economy crisis came to Russia and deteriorated the Gazprom investments capabilities. These developments, together with environmental questions raised by Greenpeace, made the construction of Altay-pipeline highly implausible.

The 2008 developed Gazprom general scheme for development of gas pipelines in Russian Federation till 2030 sees a lot of risks in the so called Western-Siberia route of gas export to China: this route has economic conditions that are obviously "bad" for competitiveness of Russian gas on markets of North-Eastern China (Shanghai), it has to overcome difficulties with passing through mountains regions and consequently to answer perhaps too complex technical-engeneering construction questions, it also has too long distances to overbridge and should go through some ecologically protected areas. As the result, this pipeline is no more the part of the Gazprom general scheme for development of gas pipelines in Russian Federation till 2030[2].

In this paper authors try to show what kind of rationalizing could lead first to the discussing of different possibilities for the gas pipeline network construction to China (also, the Altay-pipeline) and whether, and if yes, what kind of, the influence of some third party could make it possible that the project would be finally given up[3].

[2] It is interesting to mention that the Gazprom general scheme for development of gas pipelines in Russian Federation till 2030 says that in China there is absent the economic understanding of some details concerned gas deliveries from Russia to China that could make them equally profitable with the deliveries of Russian gas to Europe; however, if such the understanding on Chinese side will emerge the construction of the "Altay"-pipeline could again become the reality (with appropriate commercial business agreements and ecologically correct environmental solutions). See p. 2-16 of the Gazprom general scheme.

[3] The question about Russian oil pipelines (ESPO or VSTO-1- and ESPO or VSTO-2-pipelines) going in North-East-Asia from West-Siberia oil fields to Chinese Daqing and/or Russian Nakhodka received a detailed answer in the following paper written by the Russian-Taiwan workgroup in 2008: Savin V. et al. "Russia's global energy strategy - mapping trans-Asian pipelines (Intermediary Report 2008), http://www.eriras.ru/papers/2009/savin_taiwan_09.pdf.

Methods

As a method of the analysis the formal approach of the game theory was used. We have built the extensive form game between 3 players (see Fig. 1): Russia, China and USA[4], who could be interested in fulfilling and/or not fulfilling the project.

Game. The main idea was to analyze whether influence from the third party could make it possible that the pipeline project – which was, as results of the first discussions have shown, estimated as profitable – would be finally given up. For doing this we designed the simple game in the following manner:

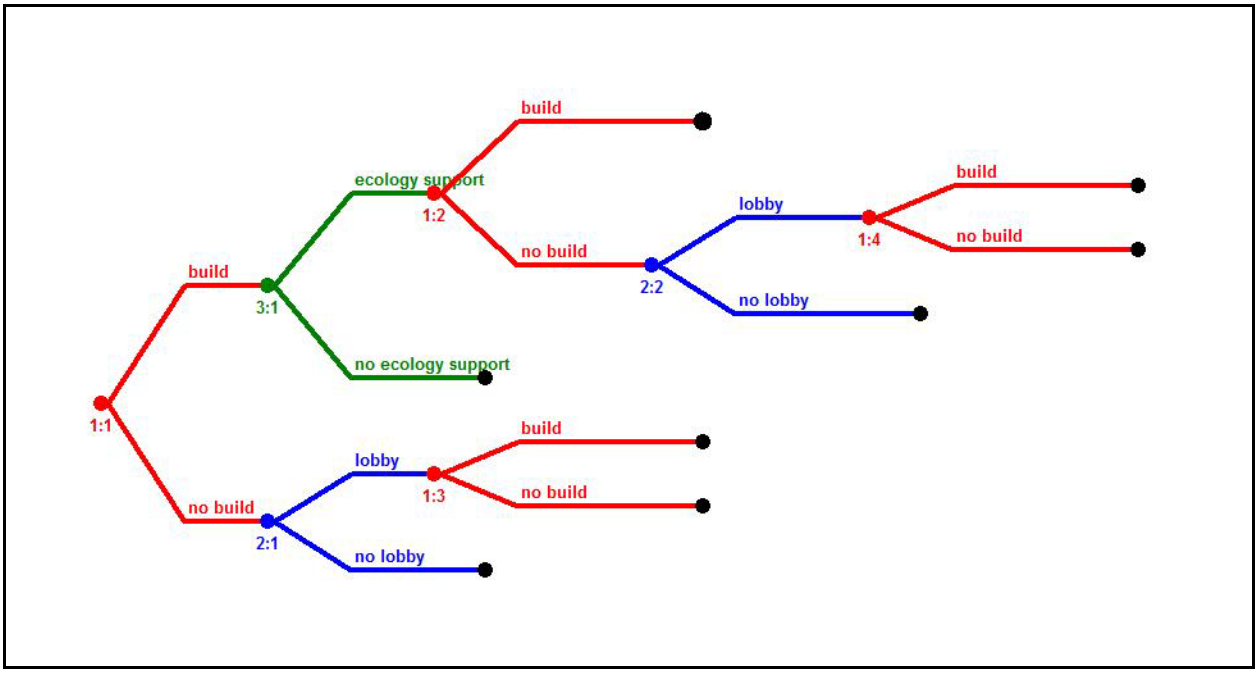

Figure 1: The game tree for the game regarding Altay-gas-pipeline
(Russia could build, China – lobby, USA – support ecology)

In the beginning of the game, Russia moves first and has to decide between two options regarding the "Altay"-pipeline to China: to build or not to build it. If Russia will decide not to build it China could lobby the construction of the pipeline, and if so, Russia has to decide again: to build or not to build. Afterwards the game ends (with or without pipeline constructed); the game ends also (without pipeline constructed) if China will decide not to lobby. If Russia has decided to build the pipeline then USA could support the efforts of environmentalists who could significantly hamper the fulfillment of the project

[4] It is necessary to mention that we used the USA as the most prominent third party in this game. However, the result would be the same if any other third party (for example, European Union) having similar interests and using same strategies would intervene in the game.

and/or stop its realization (if USA will not support the efforts of the environmentalists after Russian decision to build the game will end with pipeline constructed). After the decision of USA Russia has to decide again whether the pipeline should be built: if yes – the game ends (with pipeline built), if no – the game continues with China's choice between not-lobbying and lobbying the construction of the pipeline (now Chinese lobbying is part of the situation where environmentalists know about US decision to support them if the pipeline will not be constructed). If China will decide not to lobby the construction of the pipeline in this situation then the game will end (without pipeline constructed). Otherwise, if China will decide to lobby, Russia will have third chance to re-think the construction of the pipeline weighting the Chinese lobbying against the costs associated with environmentalists' efforts; afterwards the game ultimately ends (with or without pipeline constructed according to the last decision of Russian authorities). In all, this simple game has eight possible outcomes.

Payoffs. For understanding what will be the path of the game (the actual sequence of events that will occur when the game will be played) we had to define payoffs for each outcome and each player: for example, how much will Russia, China, and USA gain as a payoff if the game will end without constructing the "Altay"-pipeline after USA has supported environmental efforts and China has decided not to lobby it.

The basic formulas according to which the yearly payoffs for each year *t* were calculated are:

$$U_{Ru} = P_{Ch} \cdot Q_{Ch} - C_{Ru} + L_{Ch} + \alpha_{Ru} EcSp_{Us} \quad (1)$$

$$U_{Ch} = EnEf_{Ch} \cdot Q_{Ch} - P_{Ch} \cdot Q_{Ch} - C_{Ch} - L_{Ch} \quad (2)$$

$$U_{Us} = -EcSp_{Us} + k_{Us} \cdot (-\Delta_{Q_{Ch}}) \quad (3)$$

, – where U_{Ru}, U_{Ch}, and U_{Us} – are Russia's, China's, and USA's yearly payoffs correspondingly, P_{Ch} is the price for natural gas delivered to China, Q_{Ch} is the quantity of natural gas delivered to China (in billion m^3), $EnEf_{Ch}$ is energy efficiency (in terms of billions GDP dollars for one billion cubic metres of natural gas), C_{Ru}, and C_{Ch} are construction costs for the pipeline going on Russian and Chinese territory, L_{Ch} is lobbying "fees" that China transfers to Russia, $EcSp_{Us}$ is the support that environmental movements enjoy from USA, Δ_{QCh} is the reduction of Russia's gas deliveries to China because of ecological protests ("supported" by USA), k_{Us} is a the "gloating"-coefficient (in billions of GDP dollars per one billion cubic metres of China's natural gas consumption reduction), α_{Ru} is assumed to equal 1, and $-\Delta_{QCh}$ equals 40 bln m^3.

The formulas are self-explaining: it is obvious that the Russia's final payoff equals to quantity of natural gas sold to China multiplied by the selling price plus all incomes received from China and/or USA before beginning the project minus costs for construction of the pipeline; the China's final payoff equals to the energy efficiency (in terms of GDP units) of each tsd m^3 of natural gas buyed in Russia multiplied by the quantity of gas bought minus moneys paid to Russia for gas and as lobbying "fees", and minus the construction costs of the pipeline; the USA's final payoff equals to the GDP increase due to reduction of China's gas consumption minus the costs for supporting the environmental movements in Russia (and in China).

These basic formulas are used for calculation of the final payoffs for each player for the period of T years (through our analysis we assumed T = 20, that is, we calculated final payoffs beginning in the period "0" and ending in the period "19"), then they sum up to build the final payoff using the formula of net present value with certain interest rate *i* (we assumed *i* = 10%):

$$Payoff_{Ru} = \sum_{t=0}^{T-1} \frac{U_{Ru,t}}{(1+i)^t} \quad (4)$$

$$Payoff_{Ch} = \sum_{t=0}^{T-1} \frac{U_{Ch,t}}{(1+i)^t} \quad (5)$$

$$Payoff_{Us} = \sum_{t=0}^{T-1} \frac{U_{Us,t}}{(1+i)^t} \quad (6)$$

, – where $Payoff_{Ru}$, $Payoff_{Ch}$, and $Payoff_{Us}$ – are Russia's, China's, and USA's final payoffs correspondingly[5], T is the period of pipeline functioning, and *i* is the interest rate.

Prices. We assumed that the price for gas will stay constant during all the period of consideration[6] and be 400 USD per tsd m^3.

Quantities. We assumed that the quantity of natural gas sold every year will also stay constant across the whole period of consideration and be 40 bln m^3 NG (natural gas) each year. In this case the selling of

[5] All final payoffs are measured in billion current GDP units.

[6] It is obvious that the prices will fluctuate following the long term and short term distrubances. Nevertheless, it was interesting enough to understand what will happen in the simplest possible case, so we tried to keep our analysis as simple as possible.

40 billion m^3 NG could bring to Russia revenues as high as 16 billion USD every year[7]. The net present value of such a cash flow during twenty years (T=20) with interest rate of 10% (i=10%) will be as high as 149.8 bln USD (approximately 150 bln USD).

Energy efficiencies. In our previous work we derived that every additional 1 toe consumed will bring to China 1.7 tsd current USD[8]. In this case the delivering of 40 bln m^3 of natural gas from Russia to China could bring to China additional GDP increase of approximately 61 bln USD every year during the period of consideration[9]. The net present value of such energy efficiency gains during twenty years (T=20) with interest rate of 10% (i=10%) will be as high as 573.1 bln USD (~573 bln USD).

Construction costs. We assumed that both: China, and Russia, – will pay for the construction of the pipeline up to 30 bln USD[10].

Lobbying. We assumed that China will be ready to pay for lobbying the construction of the pipeline up to 5% of the gains received from bying Russian natural gas[11]. That means that if China's GDP increase would be 100 bln USD because of natural gas deliveries then it would be ready to pay 5 bln USD as "lobbying fees" beginning different lobbying activities (consulting, conferences, financing of smaller affiliate projects etc.). Because in our calculations (with interest rate of 10%) we came to the GDP increase of 573 bln USD because of Russian natural gas deliveries, we could assume that China could be ready to invest in some lobbying activities in Russia approximately 30 bln USD (this should be regarded as an additional lobbying payment; it is not the construction cost of the pipeline in China).

[7] We simplify our analysis assuming that there is no constructing, build-up, decline and clean-up phases in pipeline functioning, and that the only phase of the pipeline is the plateau-phase. So, in our artificial world the pipeline would immediately begin to work on full operational capacity.

[8] Actually in our previous study on VSTO pipelines we derived the energy efficiency for the year 2007 in 1990 USD (Table 4.3 in Savin V. et al. "Russia's global energy strategy - mapping trans-Asian pipelines (Intermediary Report 2008), http://www.eriras.ru/papers/2009/savin_taiwan_09.pdf.). The energy efficiency of GDP for China was 700 USD for 1 toe of average consumption. However, if we will use the current data for 2007 without adjusting for 1990 we will find that in average the consumption of 1 toe will be linked with a 1700 USD of GDP (= 3280 bln USD / 1863 Mtoe).

[9] 1 tsd m^3 of natural gas equals to approximately 0.9 toe. So, we have to multiply the 40 mln of 1000 m^3 of natural gas to the conversion factor of 0.9, and then to 1700 USD for having an estimate of how much GDP increase could 40 bln m^3 of natural gas be.

[10] This is a quite natural assumption, because in Russia and other FSU-coutnires construction costs often could be doubled or tripled during the realization of the project. The construction companies (often privatized monopolies or oligopolies) are interested in enlarging their revenues, that is, the costs of construction (so they could try to build pipeline preferably during winter times, at nights, and to choose ecologically and economically questionable routes). Because of all that, construction costs for both China and Russia were assumed to be equal (though the pipeline has different length on China's and Russia's territory: 2.7 tsd km in Russia and 4.0 tsd km in China).

[11] The usual agio in international business agreements varies between 0.5% and 10%. We used in our analysis the medium agio percentage of 5%.

Ecology support. So, we proposed that USA could use "negative" lobbying, that is support ecological efforts in Russia (and/or China) that could make the "Altay"-pipeline construction impossible. We assumed that this environmental support could be up to 150 bln USD and that it will completely go to Russian ecological organizations ($\alpha_{Ru} = 1$), if the pipeline will not be constructed.

We tried to materialize the US interest in making the natural gas pipeline cooperation between Russian and China not happen and did it in the following way: we assumed that diminishment of the gas supplies to China could increase the GDP of USA.

The logic behind it depends on the fact that after the collapse of the Soviet Union and the serious weakening of the geostrategic and geoeconomic position of its follower, Russian Federation, the winner of the cold war USA sees in China its mayor geostrategic and geoeconomic competitor in the sense of producing and/or distributing the world GDP. Many experts (from the IMF, World Bank, UNO etc., to name just a few) suggest that China could become the biggest economy of the world no later than 2050 if it will have among other things enough raw materials supplied. So, if USA could interrupt to some degree the raw material deliveries to China they would slow down China's GDP growth and this way increase opportunities for own economic development (we assumed this with certainty for simplicity reasons, that means with a probability that equals to one).

The crucial fact here is our assumption that US will support ecology efforts in Russia (and/or in China) depending on the final "success" (no pipeline construction). That is, if Russian (and/or Chinese) ecologists would achieve the "no build" variant, then they would receive some payments, if the "no build" variant wouldn't be achieved then the ecologists wouldn't receive anything (the ecology supporting money would then go to US environmental organizations).

Also important is the "gloating"-coefficient k_{Us} which shows how much payoff the diminishment of China's gas consumption could bring to USA. If we assume that this "gloating"-coefficient could be up to 200 USD per tsd m^3 of natural gas consumption reduction in China, then the total gain from ecology support could be 160 bln USD (reduction of China's gas consumption is 800 bln m^3 (= 20 times 40 bln m^3), and 800 bln m^3 multiplied by 0.2 USD/m^3 equal 160 bln USD). This satisfy the non-negativity condition of the payoffs for USA

$$EcSp_{Us} < k_{Us} \cdot (-\Delta_{Q_{Ch}}), \quad -\Delta_{Q_{Ch}} > 0 \tag{7}$$

, – where $Payoff_{Ru}$, $Payoff_{Ch}$, and $Payoff_{Us}$ – are Russia's, China's, and USA's final payoffs correspondingly, T is the period of pipeline functioning, and *i* is the interest rate.

Branches. Now we we have all the necessary data to calculate the payoffs for all three players in every outcome of the game.

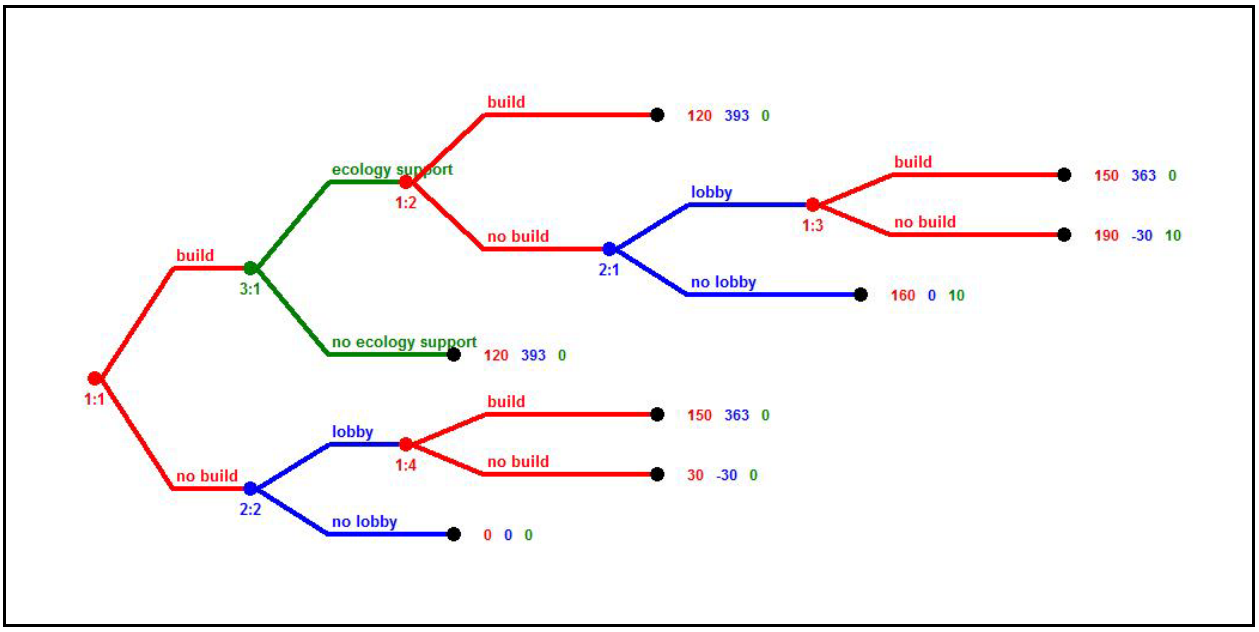

Figure 2: The game tree for the game regarding Altay-gas-pipeline with payoffs[12]

1. If no pipelines were built, and China did not lobby construction, then payoffs would be: for Russia → 0, for China → 0, for USA → 0.

2. If Russia decided not to build, then China lobbied and Russia stayd with its decision not to build, then payoffs were: Russia's → +30, China's → –30, USA → 0 (actually the participation of USA at the game in the 6 from 8 outcomes is purely nominal).

3. If Russia decided not to build, then China lobbied and Russia re-decided to build, then the payoffs could be: for Russia → 150 – 30 + 30 = 150, for China → 573 – 150 – 30 – 30 = 363, for USA → 0.

4. If Russia decided to build, and USA didn't support ecology, then payoffs were: for Russia → 150 – 30 = 120, for China → 573 – 150 – 30 = 393, for USA → 0.

5. If Russia decided to build the pipeline, and then USA supported ecology, Russia changed its mind, China lobbied, and Russia re-decided to build, then payoffs would be: for Russia → 150 – 30 + 30 = 150, for China → 573 – 150 – 30 – 30 = 363, for USA → –150+150=0.

[12] As it is possible to see in the Figure 4, if Russia would decide to build the "Altay"-pipeline to China and no third party would intervene, then project would be realized because of its profitability for both: Russia and China.

6. If Russia decided to build, and then USA decided to support ecology, Russia changed its mind, China lobbied, and Russia nevertheless did not build the pipeline, then payoffs were: for Russia $\rightarrow$ 160 + 30 = 190, for China $\rightarrow$ –30, for USA $\rightarrow$ –150 + 160 = 10.

7. If Russia decided to build, and then USA decided to support ecology, Russia re-decided not to build the pipeline, China didn't lobby, then payoffs were: for Russia $\rightarrow$ 160, for China $\rightarrow$ 0, for USA $\rightarrow$ –150 + 160 = 10.

8. If Russia decided to build, and USA – to support ecology, and Russia then builded, then payoffs were: for Russia $\rightarrow$ 150 – 30 = 120, for China $\rightarrow$ 573 – 150 – 30 = 393, and for USA $\rightarrow$ 80.

Remarks on methods: It is interesting enough to mention that, as the history often shows, the final payoffs actually received by the players after the game is finished could in reality be totally different from the players imaginated payoffs before they begin to play the game. Important for the finding the optimal path of the game is however, what the perception of the payoffs is before the game is actually started, not the real payoffs coming out at the end of game (perceived reality defines what will happen).

The game also could be expanded in multiple ways. For example, USA could try to reduce its support of environmental movements abroad, or Russia could try to renegotiate payoffs again and again, or China would try to expand the time horizont and explore some new strategies in the game. Such an expansion however would make the game necessarily more complex and lead us away from the simple answer on a simple question whether intelligent and rational decision-maker in Russian government could say "yes" to the pipeline after the first exploration of the game, and say "no" to the same pipeline after the second exploration of the game[13].

Results

Solving the game for equilibrium in pure strategies using Zermelo-Kuhn-algorythm for subgame perfect equilibria we have shown that if the payoffs were calculated according to the assumptions regarding time period, interest rates, prices, quantities, construction costs, energy efficiency, lobbying, and ecological support described above, then it could be seen that USA have well understood interest of supporting Russian ecological movements and making the "Altay"-pipeline not to be build.

[13] The numbers presented here are in some sense very unrealistical, because it is really not imaginable that such financing could be unobserved and tolerated by Russian and Chinese authorities. Neverteless, because we want to explore opportunities that make certain game scenario happen we could afford it for a moment.

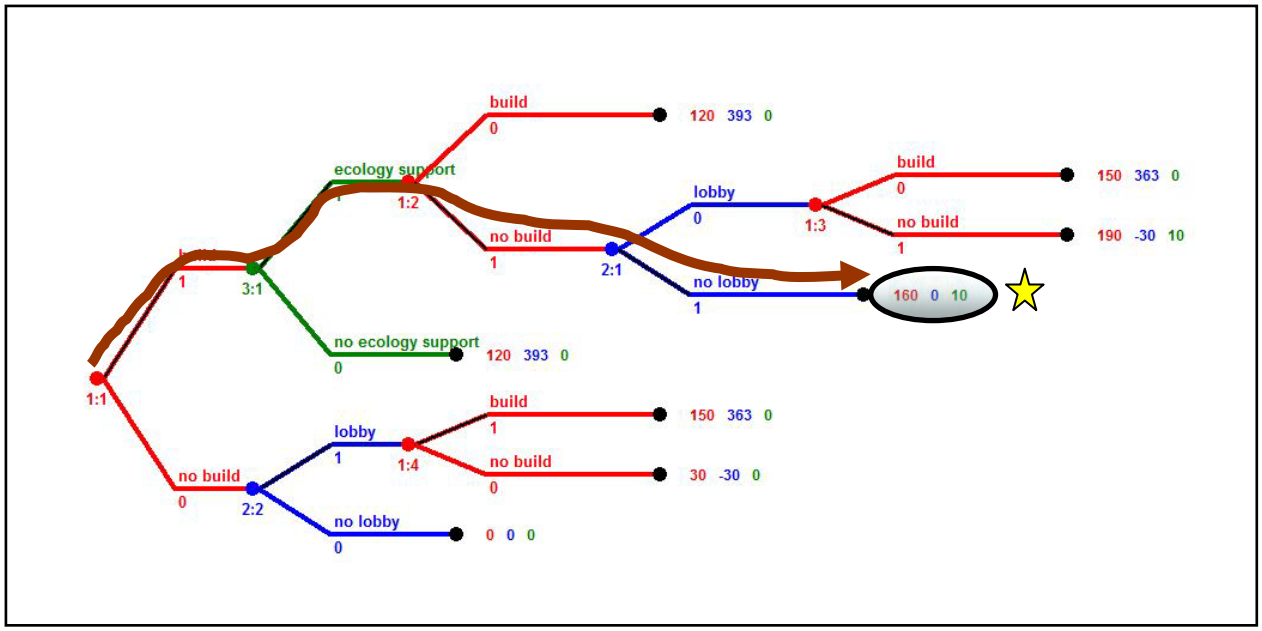

Figure 3: The Zermelo-Kuhn-solution of the game

Only if USA supports the environmentalists it will have a chance to come to positive payoffs in this game. If Russia decided first to build the pipeline and USA promised to support the environmental organizations if the pipeline will not be constructed then the most profitable (in the sense of payoffs) option for Russia will be to decide not to build the pipeline (with or withoug lobbying from China).

However, how could it be explained that Russia and China waited for so long before beginning the real talks about “Altay”-pipeline, that USA had the time to use its chance with ecology support? One possible explanation is the difference in perceiving perspectives in the game between Russia and China.

If we assume that without intervention of USA, the “only” game that as Russia perceived could be played between Russia and China regarding the “Altay”-pipeline would be the game with four possible outcomes (see Figure 4), then we will come to the necessity of Chinese lobbying. In this game there is also only one subgame perfect equilibrium: for Russia, first, to decide not to build the pipeline, then to wait till China will lobby the construction of the pipeline, and then finally build it (the resulting payoffs will be: for Russia $\rightarrow$ +150, for China $\rightarrow$ +363). For China the only choice is between to lobby and not to lobby: with no lobbying China would receive nothing, with some lobbying China would receive the gas deliveries from Russia and significant GDP increase.

However, if we assume that China think strategically and perceives that after some sufficiently long period of time Russia would confront itself with the necessity of infrastructure development in Western Siberia and so would have to perceive the game as the game with only one possible outcome (see Figure

5), then we would come to the necessity for China to wait till no lobbying for the construction of the pipeline will be necessary. Such a “game” would have only one branch sequence: for Russia to build the pipeline without hoping on China’s lobby and/or USA’s ecology support (the resulting payoffs will be: for Russia → +120, for China → +393).

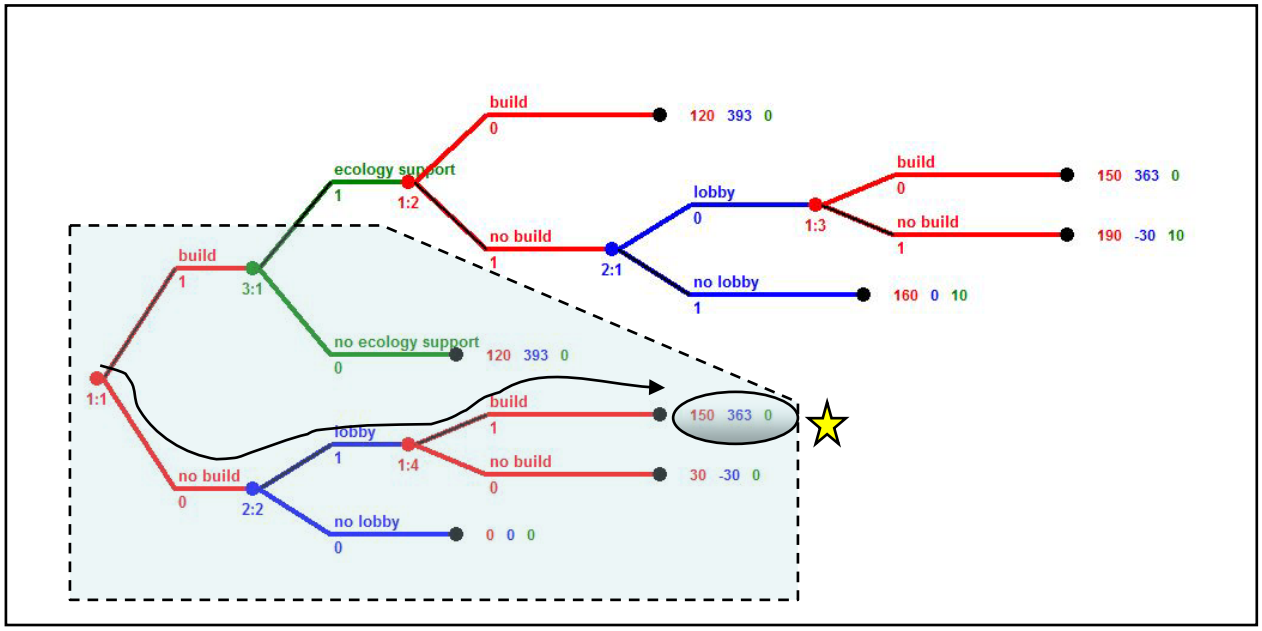

Figure 4: The game as it could be seen by Russia

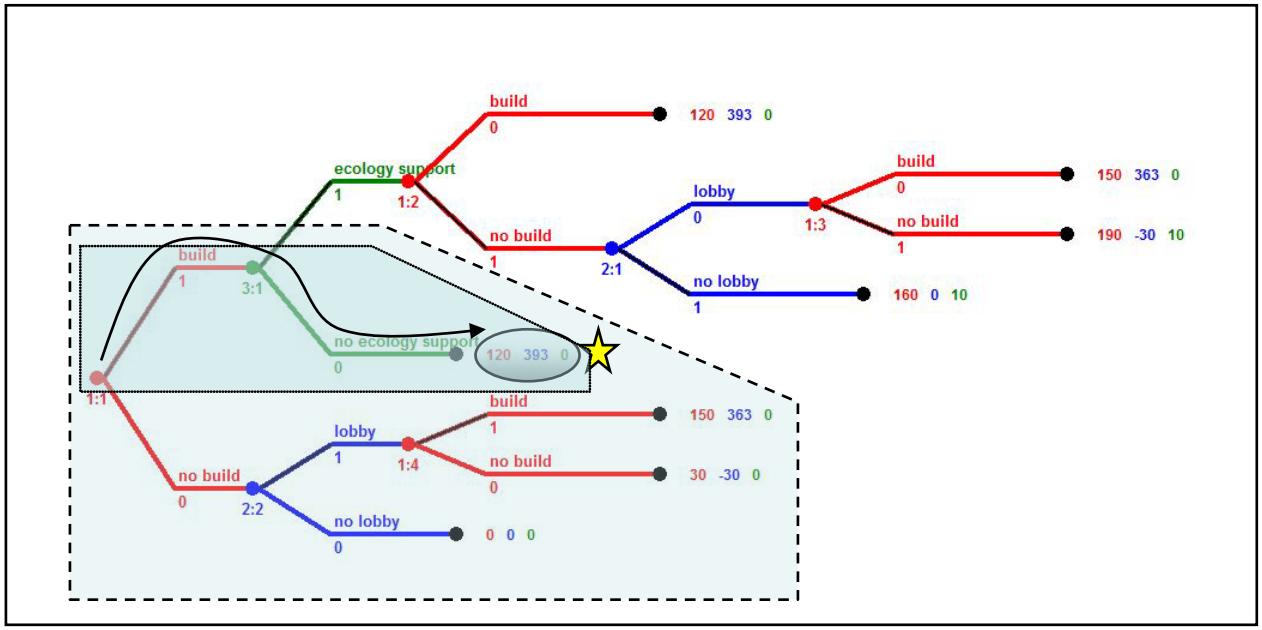

Figure 5: The game as it could be seen by China

So, both countries: Russia and China waited for each other to move and finally losed the opportunity for constructing the “Altay”-pipeline as soon as USA has developed the sufficiently serious arguments to

environmental organizations in Russia (and/or China) that now "prohibit", perhaps forever, the construction of the pipeline[14].

It is also interesting enough to mention that in the last two perspectives of the game the summed payoff of all three players were the same: 513 bln USD (=150+363 or = 120+393). In the case where USA (or any other third party) comes into the game with environmental arguments the summed payoffs of all three players were much more lower: 170 bln USD (=160+10), and it was China who suffered a loss of quite 400 bln USD potentially possible GDP increase.

Conclusions

In this paper we have shown what kind of reasoning besides the world economy crisis could lie behind the facts that the "Altay"-pipeline could first be proposed and then later given up by the Russian government.

We showed also that if not the bilateral relationships only, but the trilateral (and perhaps the multilateral) relationships are accounted for, the result of the game could change substantially.

So, through our analysis we have shown that quite any serious third party not interested in the construction of the pipeline could with success intervene in the situation and through using of certain kind of ecology supporting strategies quasi "prohibit" the building of the "Altay"-pipeline.

References

1. Generalscheme of gas industry development till 2030. Gazprom. 2008. [Генеральная схема развития газовой отрасли на период до 2030 года. Газпром. 2008].
2. Osborne M. An introduction to game theory. Oxford University Press, 2004.

[14] It could been seen that Russia waited so long for the lobbying from China's side that the third party emerged who destroyd the whole agreement.