Investment Options and Bargaining Power in the Eurasian Supply Chain for Natural Gas

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Abstract

In this paper we analyze how the bargaining power of the different players along the supply chain of Russian natural gas depends on the architecture of the transmission system and its possible extensions. By applying the Shapley value as a solution for multilateral bargaining we find that competition between Poland and Ukraine, and bypassing Ukraine is of little strategic importance compared to an option for direct Russian access to its customers in Western Europe.

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1 Introduction

Russia is the major supplier of natural gas to Western Europe providing a quarter of the consumption in the region and more than 40% of its imports. Gazprom, Russia's dominant exporter, plans to increase the supply from almost 100 bcm/a by another 50 bcm/a over the next decade. This would allow Russia to remain the largest single supplier of natural gas to Western Europe, with a share of slightly less than 40% of the 350 bcm/a of imports forecasted for 2010.[1] Such a growth of supply, however, requires heavy investment in transport facilities linking consumers in Western Europe to the main pipelines in Western Russia and further on to fields in permafrost regions of Siberia.[2]

Historically, the Eurasian transmission system was developed under long–term agreements, typically ranging from 15 to 25 years. The importing countries often contributed in–kind to investment cost by providing pipes and compressors. So called 'take–or–pay' contracts regulated prices and quantities to ensure the efficient usage of the capacities and steady revenues. To account for changes in the economic environment gas prices used to be indexed to oil prices. However, over a long period of time the contracted quantities had to be paid for whether used or not, hence, the name 'take–or–pay' (Asche, Osmundsen, Tveteras (2000)). As the gas market developed, prices gained some independence from oil prices and the current drive for liberalization favors short–term contracts and third party access. In spite of these changes, it is still common that producers and importers form consortia to realize new projects under long–term agreements (Stern (2001)).

When the Soviet empire disintegrated, Russia emerged as a central player owning most of the gas fields and essential transport pipelines. At present, even gas–rich Turkmenistan depends on transport through Russian pipelines to reach customers. In this sense, Russia controls critical bottleneck facilities. For the final delivery to the lucrative markets in Western Europe, however, it now depends on transit through independent countries, such as Ukraine, Poland, Belorussia and others.

This paper analyzes how the balance of power along this vertical supply chain depends on the architecture of the transmission network and how it is and or could be altered through strategic investment in pipeline capacity. As the number of players is small and the basic technologies of gas transport are well–known, we assume the members of the Eurasian supply chain to bargain efficiently and make the best use of the existing transmission network. This allows us to use the Shapley value, a well–known solution concept for multilateral bargaining, to calculate the sharing of profits in the supply chain. The relative size of payoffs indicates the strength of the players' positions. Hence, we derive the bargaining power of the parties in a very natural way from the features of the transmission grid and the various options to modify it. In particular, we can calculate the strategic value not only for existing pipelines but also for various options to extend the system through investment

Hitherto, only Grais & Zheng (1996) and Chollet & Meinhart & von Hirschhausen & Opitz (2001b) attempt a rigorous and quantitative analysis of the strategic interaction in

[1]For more information see Europäische Kommission (2001) and Observatoire Mediterraneen de L'Energie (2002).

[2]Throughout this paper we will refer to 'Western Europe' as the market connected through a dense network of pipelines in central Western Europe, basically the EU-countries excluding Greece. For the ease of reference we often use the names of the countries instead of companies, whenever there is no risk of misunderstanding. Hence we speak of Russia rather than Gazprom, Ukraine instead of Naftogaz etc.

transmission systems for gas. None of them derives the bargaining power endogenously from the architecture of the transmission system. Instead, they assume that Russia has all the bargaining power by giving it a first mover advantage. This would allow Russia to extract the whole rent if contracts covered prices and quantities or if it could set non–linear prices. However, in this literature it is assumed that Russia can commit only to simple linear prices. With this restriction, competition among transit countries determines the quantities supplied to the markets in Western Europe and profits are inefficiently low due to double marginalization.[3]

We see two main shortcomings of the paper which are left for further research. First, we ignore the interaction with other suppliers such as Norway and Algeria, whose shares of European imports are 25% and 30%, respectively. In the following we simply assume a given residual demand for Russian gas. Second, most of the investment in new transport capacities is sunk. This raises the question, whether the players can commit to long term agreements or whether they are prone to recontract and haggle over the sharing of quasi–rents at the post investment stage. Here, we assume that long term agreements are possible.[4]

2 The Supply Chain for Eurasian Gas

When the Soviet Union collapsed, Russia found itself in the uncomfortable position that its only supply route to Western Europe passed through three newly independent states Ukraine, Slovakia and the Czech Republic.[5] Looking westward towards integration with the EU, Slovakia and the Czech Republic wanted to be seen as reliable partners who honor existing obligations. Emerging from former Czechoslovakia, these countries benefited from old contracts with the Soviet Union, which entitled them to large deliveries of gas at low cost which helped to smooth the transition to market pricing. In the following, both countries privatized their transmission pipelines, the Slovakian section was acquired by the German Utility RWE, the Czech section by a consortium of Gazprom, Ruhrgas and Gaz du France.

Relations between Russia and Ukraine, in contrast, turned sour. In principle, Russia pays for transmission by supplying gas to Ukraine, approximately 26-30 bcm/a (plus an additional 6-7 bcm/a compressor gas). This payment in kind is sometimes translated into a 'transit fee' by assigning a price to the gas, but as these fees are not actually paid, they have little relevance. The conflicts are essentially over the compensation for additional 20 bcm/a, which Ukraine dearly needs but can hardly pay for. While Russia claims average European prices Ukraine concedes only half of that. But even the lower figures have not fully been paid. Ukraine is also blamed for syphoning off gas in excess to what it acknowledges officially, a claim which has some credibility, although it is strongly denied by Ukraine.

[3]While there is a small literature exploring the strategic implication of Shapley bargaining for choice of technology and merger in general models (Inderst & Wey (2001), Jeon (2002)), we are not aware of previous usage of the Shapley value in applied studies of industrial organization. Hence, the paper also pioneers the practical application of a concept, which in theoretical analysis is widely seen as the only convincing solution to the problem of multilateral bargaining.

[4]For an analysis of recontracting see Hubert & Ikonnikova (2003).

[5]For a detailed account of the ensuing conflicts and Russia's strategy see Stern (1999).

As a result of non–payments and alleged 'steeling' debts accumulated. As the dispute about non–payments for gas deliveries and accumulated debt dragged on, threats of disconnections and counter-threats of diversion have been issued. While Ukraine interrupted gas supplies to Western Europe only occasionally and for brief periods, these episodes highlightened Russia's vulnerability and threatened to taint its reputation as a secure supplier of gas. In marked contrast to Turkmenistan, which was quick to stop deliveries when Ukraine failed to pay, Russia has little choice but to supply whatever Ukraine takes or to default on its obligations to western importers. Recently Gazprom and Ukrainian Neftogas reached a tentative agreement according to which Russia in co–operation with German Ruhrgas would attract $ 2.5 bn to upgrade the system. However, Ukraine would have to share ownership and control of its network in exchange and there is little concrete progress on this sensitive issue so far.

Eager to diversify its export channels, Russia turned to Belorussia and Poland. Belorussia' ties with Russia remained very close and its ability to act independently appears to have been quite restricted even after gaining independence. In 1993, the two countries agreed on a long–term solution for sales and transit relationships, including the transfer of the assets of BelTransGaz, the national transmission company, to Gazprom under a 99–year lease. With Poland a joint stock company, EuroPolGaz, was established in which Polish PGNiG and Russian Gazprom hold equal shares. This enabled Gazprom to revive old ambitious plans to develop the huge Yamal field and connect it to internal and external markets with a new massive northern route. However, as demand was weak during the nineties and the cost of developing Yamal turned out to be very high, the project was gradually scaled down. Eventually, attention focussed entirely on the export line, now commonly referred to as *Yamal 1*, which is built 'from the market to the field'.[6] Its current capacity of 18 bcm/a will reach 28 bcm/a when is completed. Provisions have been made for a further doubling of the capacity to up to 56 bcm/a, which would require additional investments in the range of $ 2.5 bn. However, recently Russia's enthusiasm with the project has been dampened by disputes both with Poland and Belorussia.

As a direct threat to Ukraine's strategic position, plans have been drawn up for a twin–pipeline with a capacity of 60 bcm/a running north–south through Belorussia, Poland and Slovakia. Since this link can also be seen as part of the larger Yamal project it is sometimes referred to as Yamal 2. However, if realized without additional investment towards customers in the West (and fields in the east) it would mainly serve to bypass Ukraine, hence, we will refer to this project as *Bypass*. Nevertheless, offering an alternative to the route through Ukraine, its strategic value is potentially large. So far, no timetable for investment has been set, and it appears as if the project has been shelved with the recent agreement between Russia and Ukraine.

Increasing frustration with the demands of transit countries led Russia to look also for direct, though much more costly, offshore options. Early plans for a Baltic Ring, connecting Russia through Finland and Sweden to Germany have been abandoned in favor of a direct offshore connection between Vybourg (Russia) and Germany, the *North Trans Gas*. The project is currently shared by Gazprom and Finnish Fortum, but German Ruhrgas and Wintershall may join. Like the *Bypass*, *North Trans Gas* is a project on the blackboard.

[6] Recently, the high cost of developing new fields such as Yamal or Stockman and the availability of low cost alternatives in old Siberian fields and Turkmenistan casted doubt on the economic viability of grand scale projects in the near future (Stern (1995)). Meanwhile, gas for *Yamal 1* is supplied from fields in the Siberian Basin including newly opened Zapolyarnoye.

Commercially, the link would look more attractive if connected to Stockman, a large field which has yet to be developed. As with Yamal, the prospects for the development of Stockman are vague at best. And even if the field is developed, it might be cheaper to liquify the gas, since the cost of an onshore pipeline appear to be very high due to difficult terrain on the Kola peninsula.

The post Soviet developments in the Eurasian transport network for natural gas reflect to a large extent Russia's reactions to the strength of Ukraine's position in the inherited system. Moves such as the diversification of export routes and plans for a bypass, can be understood as a deliberate attempt to gain leverage over the neighbor, perceived to be obstructive and excessively demanding. While the cost of establishing alternative supply routes are known, at least by order of magnitude, the strategic gains are difficult to discern. It requires a formal model of how network architecture and investment options determine the power of the different players and the sharing of profits from gas exports. This framework can then be used to analyze whether building Yamal helped Russia to strengthen its bargaining position. We can assess how important the Bypass is to discipline Ukraine. What is the effect of further, even more costly, options to diversify export routes such as North Trans Gas.

3 Bargaining Power, Network Architecture, and Strategic Investment

Intuitively, the power of a player should increase as he becomes more 'important' for other players, which will depend on his control over gas fields and transport routes. In this section we explain how we can measure exactly the 'importance' of a particular player by looking at the contributions he can make to the various possible coalitions.

Let n denote the total number of players which may form arbitrary coalitions S with $s \leq n$ players. We will represent the strategic interaction along this supply chain by the so called 'value function' $\pi(S)$, that is the payoff which a coalition S can assure for itself. Obviously, any change in demand for gas, network architecture, transportation cost etc. will yield a new function π.[7] The most common solution for games represented in value function form is the Shapley value. It calculates the payoff ϕ_i of player i as his expected contribution to all possible coalitions, assuming that all possibilities are equally likely:

$$\phi_i(\pi) = \sum_{S:i \notin S} \frac{s!(n-s-1)!}{n!} \cdot [\pi(S_{+i}) - \pi(S)],$$

where the first term in the summand gives the probability of a particular coalition S and the second the marginal contribution of the player i. The Shapley value derives the payoffs of the players from the fundamentals of the problem. Any two players contributing the same to all possible coalitions receive equal payoff (symmetry). In this sense the 'bargaining power' is assumed to be equal. Only the differences in the strategic positions of the players yield different shares of profit. However, in this paper we want to compare different networks layouts, i.edifferent value functions, and it is convenient to refer to the relative share of a player, $\sigma_i(\pi) = \phi_i(\pi)/\sum_{-i}\phi_j(\pi)$, as his 'bargaining power'.

[7] A potential problem with the value function approach is that a coalition's payoff may depend on what the excluded players do. Fortunately, this problem does not arise in our case because Russia is an essential player. Whether transit countries act alone or form coalitions, they will not be able to establish a complete supply chain and, therefore, neither receive any income from exporting gas nor compete with the coalition which includes Russia.

Originally, the Shapley solution was obtained from axiomatic reasoning, leaving open the question which particular (non–cooperative) bargaining process would be able to achieve the efficient outcome and the Shapley–profit sharing.[8] Meanwhile, the theoretical literature has proposed a number of solutions to this problem (e.g. Gul (1989), Inderst & Wey (2001)). Among these, the model of Stole & Zwiebel (1996a) and Stole & Zwiebel (1996b) appears to fit real world bargaining in the gas market particularly well. They look at bilateral negotiations with a central player without whom nothing can be achieved, assuming that all agreements can be renegotiated before any plans are executed and show that only the Shapley–sharing of profits is renegotiation–proof. In the Eurasian gas market Russia, is a central player in the sense of Stole and Zwiebel and negotiations with transit countries are usually bilateral. As a rule, there are many rounds of negotiations, resulting in letters of intent, preliminary agreements etc. which will be renegotiated several times before any investment is undertaken.

4 The Value Function

The payoff which a particular coalition can achieve depends on demand for Russian natural gas, on production cost and on the cost of transport routes which are available for this coalition. The latter depends on the geographical location of its members, on past investment in transport facilities, and on options to extend the system.

Demand & Production Cost We assume that demand and production cost are independent of transport routes to the west. This will be true to the extend that the capacity of pipelines running from north to south in Germany are large enough to avoid large discrepancies in prices between the different regions. On the supply side it requires low variable transportation cost between Torzhok and the Ukrainian border or the possibility to substitute gas from Siberia by gas from Turkmenistan and vice versa.

The demand for Russian natural gas is determined by preferences for natural gas, the prices of substitutes such as oil and gas from competitors, preferences for diversifying energy supply, the cost of transporting gas within Western Europe etc. The bulk of the deliveries is under a small number of long–term contracts, the details of which are not made public. The annual figures for average gas prices given in the statistics largely reflect oil–price movements. They are of little relevance for the buyers tied up in these agreements. Moreover, many of the important structural determinants of demand for Russian gas, such as environmental concerns, preferences for diversity of supplies, turbine technology etc., are changing fast. Therefore, we have to resort to 'plausible' assumptions and then consider a range of possible parameters to assess the robustness of our analysis.

For simplicity, we take a linear specification of the demand function and assume that marginal production cost are constant.[9] From figures on current and future marginal cost

[8] As Shapley (1953) has shown, it is the only rule for sharing the profits from multilateral cooperation which fulfills some reasonable criteria which are (i) that players who do not contribute anything to any of the possible coalitions should receive nothing, (ii) payoffs should only depend on the players role in the game not an assumed differences in personal bargaining power etc. and (iii) we can take expected payoffs under uncertainty (which makes sense if players are risk neutral). Myerson (1980) added further appeal to the Shapley value by showing that it is the unique rule for dividing the gains from cooperation which obeys simple rules of fairness and balanced contributions.

[9] In this paper, production cost include the cost of transporting gas to the major link connecting Torzhok

of non–Russian suppliers provided in Observatoire Mediterraneen de L'Energie (2002) we estimate residual demands for Russian gas with intercepts in the range of 130 to 140 and slopes 0.45 to 0.63, yielding prices in the range of 75 to 85 \$/tcm.[10] The cost of Russian gas tends to increase as production from old low cost fields declines and new, more expensive fields have to be developed. The cost of current production from recently developed fields such as Zapolyarnoye may be in the range of 11 to 15 \$/tcm.[11]

Transportation Cost The total cost of transporting gas can be decomposed into capacity cost c and operating cost, the latter consisting of management and maintenance cost m and energy cost. For pipeline technology, the cost of providing transport capacity is roughly proportional to distance and the same is true for maintenance. As the fraction of gas used over a given distance is roughly constant, transport cost t can be calculated according to

$$t(y) = \left(\frac{c+m}{g} + p_0\right)\left(e^{g\cdot y} - 1\right)$$

where y denotes the distance, p_0 the price of gas at the source, and g the fraction of gas per distance which is needed for pressurizing.[12] As we express all figures on an annual basis, we obtain the annualized cost of capacity from the initial investment cost I as $c = r \cdot I/(1-(1+r)^{-T})$, where T denotes the expected lifetime of the facilities and r the interest rate for real investment.

We assume that operating cost are proportional to quantity. However, there are several types of economics of scale in providing transport capacity. Some are related to the pipeline itself, others are gains obtained from laying pipelines along the same track. Capacity economics of scale appears to fade out at a capacity of 20 bcm/year, though this effect is somewhat weaker with offshore pipelines than with onshore pipes.[13] There are several reasons to install additional pipes parallel to existing ones (track economics of scale). To account for these we use specific cost estimations for the different routes and inflate cost of entirely new pipelines by 15%.

From the information in table 1 we calculate the total transport cost along the various routes. First we annualize investment cost, then we add cost of maintenance ($m = 0.1\$/tcm/100km$ for onshore pipelines, and double this amount for offshore pipes) and energy cost (0.25% of gas /100km, and double for the old system in Ukraine and for offshore pipelines).

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with eastern Ukraine.

[10] For more details see Hubert & Ikonnikova (2003).

[11] Since we are assessing the bargaining power, for an architecture of the grid shaped during the nineties, we take rather low figures for demand and cost. For long-term perspectives of Russian gas production and its cost see Stern (1995) and Observatoire Mediterraneen de L'Energie (2002).

[12] The transportation cost per unit gas can be obtained by asking how much its price has to be increase along Δy in order to cover the cost: $p(y+\Delta y) - p(y) = [(c+m) + g \cdot p(y)] \cdot \Delta y$. Dividing by Δy and taking the limit and solving the differentiation equation gives the price of gas at any location y as:

$$p(y) = p_0 e^{g\cdot y} + (e^{g\cdot y} - 1)\frac{c+m}{g}$$

[13] For further information see Oil, Gas and Coal Supply Outlook (1994) and International Energy Agency (1994).

Table 1: Description of Transport Links for Russian Gas

	capacity [bcm/a]	investment [bn$][c]	capital cost [$/tcm/100km]	total cost [$/tcm]	length[a] [km]	players[b]
Ukraine existing	70[d]	sunk	sunk	14.26	2000	Russia, Ukraine
A system of parallel pipelines, gas storages, compressors, mostly depreciated and in poor state of repair.						
Ukraine upgrade I	15	0.75	0.39	21.54	2000	Russia, Ukraine
Mostly repairs and replacement of compressor power.						
Ukraine upgrade II	35	3.1	0.69	33.88	2700	Russia, Ukraine
Additional pipes on the Slovakian territory parallel to old system						
Yamal A	28	3.4	1.35	35.12	1600	Russia, Poland
Frankfurt/O — Torzhok. As the pipeline is already finished, this is an ex–ante perspective of the project.						
Yamal Aa	18	sunk	sunk	13.258	1600	Russia, Poland
Present state of Yamal project.						
Yamal Ab	10	0.4	0.38	19.39	1600	Russia, Poland
Completion of Yamal A by adding compressor stations.						
Yamal B	28	2.4	0.95	28.63	1600	Russia, Poland
Parallel to Yamal A.						
North Trans Gas	30	4.2	1.80	49.82	1600	Russia
Greifswald (Germany) — Vyborg (Russia) 1200 km offshore, 400 km onshore to Torzhok. Originally planned for 18 bcm/a.						
Bypass	60	3.6	0.76	27.38	1400	Rus., Pol., Slov.
Velke Kapuzany — Torzhok. Assumed to use capacities in Slovakia and Tzech Republik which are only available if the network in Ukraine is not used.						

[a]From point of delivery in Western Europe to the main Russian export node of the grid.

[b]Players needed to use or establish the connection.

[c]Estimated investment cost obtained from various sources.

[d]Only capacity used for export to Western Europe.

5 Strategic Value and Investment in Pipelines

In table 2 we present the Shapley values for various assumptions over the availability of pipeline connections. The first figure in each pair of columns gives the absolute payoff in million dollars per year. The second gives the player's share of total profits, which can be interpreted as his relative bargaining power. Demand for gas and production cost have been chosen to be compatible with current transport capacities. Hence, there would be no commercial interest to increase capacity and the available options for investment would not be used.[14]

The first two columns in the upper part of the table give the result for the hypothetical case that the currently existing network could not be changed, i.e., no new pipelines or capacity increases would be possible. As capacities through Ukraine and Poland are both restricted, competition between the two players remains very limited. Russia would obtain 55% of the profits — only slightly more than 50% which it would get if all pipelines would run through Ukraine, though it benefits Poland at the cost of Ukraine. However, as the figures below show, the picture completely changes if we take into account the various possibilities

[14]In Hubert & Ikonnikova (2003) we show that our results are fairly robust with respect to changes in the parameters of demand and supply.

Table 2: Availability of Pipelines and Bargaining Power

Shapley values in mln$/a and percent

	status quo[a]		adding one option at a time							
			Yamal		Bypass		NTG		Upgrade	
Russia	2928	55%	3353	63%	3139	59%	3998	75%	2955	55%
Ukraine	1978	37%	1129	21%	1346	25%	1116	21%	2005	38%
Poland	422	8%	846	16%	632	12%	214	4%	368	7%
Slovakia	0	0%	0	0%	211	4%	0	0%	0	0%
	all options		excluding one option at a time							
			Yamal		Bypass		NTG		Upgrade	
Russia	4236	80%	4126	77%	4231	79%	3386	64%	4209	79%
Ukraine	714	13%	839	16%	730	14%	1139	21%	687	13%
Poland	372	7%	262	5%	366	7%	797	15%	426	8%
Slovakia	6	0%	101	2%	0	0%	6	0%	6	0%

[a]Demand has intercept 130 and slope 0.63, production cost are 11 $/tcm, yielding a total profit of 5.328 bn$/year at current capacities, which are optimal.

to change the transmission grid. With 80% of the profits Russia now obtains the lion's share, while Ukraine and Poland are down to 13% and 7%, respectively. Although given our assumption on demand none of the additional links or capacities would be used, the mere possibilities of delivering gas through the Baltic Sea, increasing capacities on Yamal and the Ukrainian system strengthens Russia's bargaining power.

To single out the strategic value of particular options, we may look at them in isolation, adding one link at a time to the status quo (upper part of table 2). Alternatively, we can see them in the context of the other options, withdrawing one link at a time from the benchmark case 'all options' (lower part). For small additions to the capacity, Yamal is currently the cheapest, hence, commercially the most interesting option. If Yamal would be the only possibility to increase capacity, its strategic impact would also be substantial. It would cut Ukraine's share of profit by 16 percentage points, dividing the gains equally between Russia and Poland. If seen in the context of other options, however, its strategic value is fairly modest. Comparison of the second and the first pair of columns in the lower part shows that Russia and Poland gain 3 and 2 percentage points, respectively, while Ukraine and Slovakia loose out.

The Bypass looks relevant only in isolation. Ukraine would be weakened by 12 percentage points, or 632 mln$, annually, which are distributed evenly among the other players. Assessed in the context of other options, however, its impact on Russia is negligible and there is only a minor amount of redistribution between Poland and Ukraine. Even Slovakia gains very little. The option to upgrade the Ukrainian system provides an opportunity to add substantial capacity at low cost. Its impact on the relative bargaining power, however, is small in both perspectives. This stands in marked contrast to the strategic role of the North Trans Gas project. In isolation, it would raise Russia's profits by 1070 mln$, a fifth of total profits. And even when accounting for the other options, North Trans Gas increases Russia's share of profits by 850 mln$/year, raising its bargaining power from 64% to 80%. In our view, this explains Russia's interest in a project, which from a naive point of view, i.e. without accounting for strategic interaction, makes pretty little economic sense due to its high cost.

In order to interpret these results it is useful to consider briefly how geography and cost interact to determine the Shapley Values. Suppose that all pipelines would have equal unit–cost, so that total profits were the same for all possible connections. If the only possible transmission route was through Ukraine, then Russia and Ukraine would share the profits equally. Both are indispensable and there is no reason why any one should have a strategic advantage. If we introduce an equally efficient route through Poland, Russia would obtain two thirds of the profits and Ukraine and Poland would share the rest equally. However, if Russia can establish a direct offshore link on its own, it obtains the whole profit, as there is no need to share with anyone. Now, assume that pipelines differ in their cost, either because of different conditions (NTG vs. Yamal) or because investment costs are already sunk (Ukrainian system, Yamal Aa). Loosely speaking, Russia would start with the profits which it would obtain if the direct link were the only connection to Western Europe. While North Trans Gas looks inefficient in comparison to the other options, standing alone it would still be highly profitable. In addition, Russia will obtain 2/3 of the increase in profits obtained from switching from the offshore to the next best onshore option and 1/2 of the difference of profits between the two onshore options. The North Trans Gas strengthens Russia with respect to all possible coalitions and has therefore a strong impact on its bargaining power. In contrast, all coalitions which can realize the Bypass can also realize Yamal, which is just marginally less profitable. Hence, its strategic impact is negligible.

6 Conclusions

In this paper we derive the bargaining power of the different players along the supply chain of Eurasian gas endogenously from the architecture of the transmission system and its possible extensions by applying cooperative game theory for multilateral negotiations. As the number of players is small and the cost parameters of gas transport are well–known, we assume that the members of the Eurasian supply chain bargain efficiently and make the best use of the existing transmission network. This allows us to use the Shapley value to calculate the sharing of profits along the vertical supply chain. We quantify the strategic importance of each single option to extend the grid, by calculating how it changes the distribution of the profit.

The 'Bypass' is a pipeline explicitly designed to shortcut Ukraine through Poland and Slovakia. What at first glance may look as a powerful threat to Ukraine's strong position in the current network turns out to have very limited strategic relevance. This is particular true if seen in the context of other options. Of more importance is the option to extend the capacities on the Yamal line, which is also commercially attractive. However, by far the strongest impact on the bargaining power is exerted by North Trans Gas, the option through the Baltic Sea. Although this project cannot compete commercially with the other options to increase transport capacity, it strengthens the Russian position more than all other options together. It is also the only link which maintains its influence even when all other options are taken into account. In a nutshell: competition between Poland and Ukraine is of little strategic importance compared to an option for direct Russian access to customers.

7 References

Asche, Frank & Osmundsen, Petter & Tveteras, Regnar (2000), European market integration for gas? Volume flexibility and political risk, Energy Economics (forthcoming)

Chollet, Andreas & Meinhart, Berit & von Hirschhausen, Christian & Opitz, Petra (2001a), Analysis of the Russian gas export to Western Europe, Discussion Paper.

Chollet, Andreas & Meinhart, Berit & von Hirschhausen, Christian & Opitz, Petra (2001b), Options for transporting Russian gas to Western Europe a game-theoretic simulation, Discussion Papers of DIW Berlin.

Europäische Kommission, Grünbuch: Hin zu einer europäischen Strategie für Energieversorgungssicherheit, (2001).

Golombek, Rolf & Gjelsvik, Eystein & Rosendahl, Knut Einar (1995), Effect of liberalizing the natural gas markets in Western Europe, The Energy Journal Vol. 16(1).

Grais, Wafik & Zheng, Kangbin (1996), Strategic interdependence in European east-west gas trade: a hierarchical Stackelberg game approach, The Energy Journal Vol. 17(3).

Gul, Faruk (1989), Bargaining foundations of Shapley value, Econometrica, Vol. 57, 81-95

Hubert, Franz & Ikonnikova Svetlana (2003), Strategic investment and bargaining power in supply chains: A Shapley value analysis of the Eurasian gas market, Humboldt University, Discussion paper

Inderst, Roman & Wey, Christian (2001), Bargaining mergers, and technology choice in bilaterally oligopolistic industries, Discussion paper, London School of Economics, CEPR

Jeon, Seonghoon (2002), Shapley bargaining and merger incentives in network industries with essential facilities, Sogang University, Discussion Paper.

Myerson, R.B. (1980), Conference structures and fair allocation rules, Int. Journal of Game Theory, Vol. 9, Issue 3, pp.169-182

International Energy Agency (1994), Natural gas transportation. Organization and regulation

Stern, Jonathan P (2001), Traditionalists versus the new economy: competing agendas for European gas markets to 2020, The Royal Institute of International Affairs

Stern, Jonathan P (1995), The Russian gas bubble, The Royal Institute of International Affairs.

Stern, Jonathan P (1999), Soviet and Russian gas: The origins and evolution of Gazprom's export strategy, in: Mabro, Robert & Wybrew-Bond, Ian (ed.), Gas to Europe. The strategies of four major suppliers, Oxford University Press

Stole, Lars & Zwiebel, Jeff (1996a), Intra-firm bargaining under non-binding contracts, Review of Economic Studies, Vol. 63(3).

Stole, Lars & Zwiebel, Jeff (1996b), Organizational design and technology choice under intra-firm bargaining, American Economic Review 86, 195-222.

British Petroleum (2002), Statistical Review of World Energy.

Observatoire Mediterraneen de L'Energie (2002), Assessment of internal and external gas supply options for the EU, Executive Summary.

Oil, gas and coal supply outlook (1995), edition of the World Energy Outlook.