Energy and Value Letter

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- John Simpson introduces the 4th Energy and Value Letter
- André Dorsman reports from the CEVI board
- Mehmet Baha Karan and Özgür Arslan share the success of the first energy school
- Call for papers 3rd Multinational Energy and Value Issues Conference, 7-10 July 2011
- Helen Cabalu: Indicators of Security of Natural Gas Supply in Asia
- Timothy Boon von Ochssée and Tom Smeenk: Russia's optimal gas export strategy: competition or cooperation?

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Energy and Value Letter

Editorial Board

Editorial Policy

The Energy and Value Letter brings together academics and practitioners worldwide to discuss timely valuation issues in the energy sector. It publishes news from the Centre for Energy and Value Issues (CEVI), its linked organisations and others (including calls for papers), practitioners' papers: short articles from institutions, firms, consultants, etcetera, as well as peer-reviewed academic papers: short articles on theoretical, qualitative or modelling issues, empirical results and the like. Specific topics will refer to energy finance in a broad sense. Most of the publications are on invitation, but the journal welcomes unsolicited contributions. Please e-mail to **energyandvalue@gmail.com**, c/o Özgür Arslan, a copy of a news item or a completed paper. Include the affiliation, address, phone, and e-mail of each author together with appropriate JEL classifications with your contribution. A news item should not have more than 400 words and a paper should not exceed 3.000 words.

Energy and Value Letter

INTRODUCING THE FOURTH ENERGY AND VALUE LETTER

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The articles provided in this issue raise several very important issues in the ebb and flow of the financial economics of the global energy sector. Helen Cabalu, from Curtin University in Australia, discusses the security of natural gas supply. Political risk impacts energy security and it must be a major consideration for importers of natural gas.

The application of portfolio theory in sources of energy supply for security of supply becomes just as important as its application for risk and return optimisation in domestic and foreign direct investment in natural gas infrastructure. Exporters of natural gas also need to diversify their markets. This is an area of increasing importance as the use of cleaner burning natural gas as an energy source, increases at the expense of oil and coal.

Importers of natural gas, for security of supply, need to hold a portfolio of exporters from high, medium and low risk countries in their sources and this is particularly important as the relative proportions of cross-country pipeline gas and marine shipped gas change as well as the proportions of spot and long-term contract gas sales change. A case is put here for an acceptance of Australian marine shipped gas to Europe.

Australia has abundant supplies of natural gas and steadily increasing production and export infrastructure and Australia is of course an OECD country with lower levels of risk in its relatively stable economic, financial and political environment. Low risk of course sometimes comes with additional costs of transportation.

Helen's article leads in quite well into that by Timothy Boon von Ochssee and Tom Smeek as the latter discuss Russia's optimal gas export strategy. This is definitely a case in point as Russia's abundant gas to Europe is pipelined across countries and political risk and its diversification needs to come into the equation.

I hope to meet many of you at the forthcoming 2011 CEVI conference in Groningen (refer to the call for papers in this issue).

Energy and Value Letter

A SHORT NOTE FROM THE CEVI BOARD

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This year's CEVI board meeting was held in Barcelona, during the MFS (Multinational Finance Society) conference. The board meeting concentrated on the CEVI activities: publications of scientific books and articles on Energy, organizing conferences and educational programs.

CEVI is a society existing of active participants. We are preparing our first book Financial Aspects in Energy (FAIE), to be published by Springer Verlag. This book will be the first one in a series of CEVI –Springer Energy books. FAIE exists of four topics, namely markets, prices, regulations and firms. Note that one topic, covering three chapters, is regulation. Although the juridical part is prevalent here, it is most relevant from the financial perspective. The fast developing energy markets lack a common development in legislation and regulation. Learning by doing is the way of operating of the legislator here. Inevitably, this attitude creates leaks in legislation and therefore also in regulation.

We are planning to present the book FAIE on the third CEVI Energy and Value conference that will be held on July 7-10 2011 in Groningen (The Netherlands). Local organizer is Wim Westerman, University of Groningen. Separately you will find in this EVL a call for papers.

The preliminary title of the second book in the CEVI-Springer series is Macro Economics and Financial Markets (MEFM). This book exists of four parts namely, 1. Energy consumption, supply and demand and pricing; 2 Volatility and energy derivatives markets; 3 Environmental and legal issues and renewables; 4 Finance and energy. We try to present MEFM on the fourth CEVI Energy and Value conference that is to be held in 2013 in Chicago. Local organizer will be Paul Prabhaker.

An other activity is the CEVI Energy School. The School started her activities in September this year in Ankara. Local organizer was Mehmet Baha Karan, who did a great job by making this first education activity a success. Separately, in this EVL issue, he informs you about this activity. In February 2011, CEVI will organize an educational program in Istanbul.

Lastly, our website has been renewed. The website's address is www.centerforenergyandvalue.org or www.centerforenergyandvalue.com. Mr. Mustafa Kaya coordinates creating, development and management of the website. Of course comments and suggestions to improve the website are welcome.

Energy and Value Letter

THE STORY OF THE FIRST CEVI ENERGY SCHOOL: A New Step to Success

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As it is stated in an old phrase; starting is half of completing a task. Starting is always onerous, however once a work ends up to be a success it not only becomes unforgettable but also motivates for the second step. Just like CEVI's first success, which is the Energy and Value conference in Amsterdam in 2007, we are enthusiastic for the second and the third and hence the first energy school taking place in Ankara on 20-24 September 2010 has given us a fair hope and by now it is already a candidate to be one of the unforgettable events of the CEVI. This activity has significance for being taking place in Turkey, which has annual electricity consumption over its GDP growth, is located in geography between energy resources and energy consumers despite owning no traditional energy resource and targets to be an international energy hub through participating important projects like Nabucco.

The CEVI Energy School is realized through keen team work, just like all the CEVI activities, given that André Dorsman provided corporate support from APX-ENDEX and meticulously organized the lecturers from The Netherlands and Mehmet Baha Karan has spent his considerable effort for the web site, promotion, marketing and accessing institutions. Moreover, Hasan Kazdağlı has both secured the support of Hacettepe University and assisted in solving bureaucratic issues. Consequently, very intensive 5-day training has taken place through the participation of around 35 experts from important private and public entities. Specifically, 12 experts from The Turkish Regulatory Authority, 5 from the Electric Stock Exchange, 4 from the Derivative Exchange and a large number of energy experts from private entities have participated. The event has been realized in high standards with a considerably quality environment in a five star hotel, the Bilkent Hotel. During the courses; applications in Turkey, The Netherlands and the European Union have been discussed and participants have actively joined the discussions. Undisputedly, the most interesting part of the trainings is that participants are enabled to see the applications in Turkey on the one hand, and how the markets would evolve in the future on the other. We are grateful to Mr. Matthijs Nijpels (APX-ENDEX), Mr. Paul Pottuijt (Gen) and Andre Koch (Stachanov) who have come from The Netherlands and lent their strength on behalf of their institutions. We are assured that their contribution to us will not be limited by this training. We believe that we will cooperate in trainings and projects in the future.

The best side of the educational programs is that education is twofold. On the one hand students acquire the latest information; on the other hand we have the opportunity to closely follow the problems of the Turkish market and requirements of the experts. Undoubtedly, this information will guide us to the second and the following energy schools. Last but not the least, this experience has whispered us that our vision should not be limited to Turkey. A phrase from André Dorsman on the last day of the program still remains in our ears: "Why should CEVI not organize similar educational programs in Eastern European countries and emerging markets?"

Energy and Value Letter

1st CALL FOR PAPERS 3rd MULTINATIONAL ENERGY AND VALUE ISSUES CONFERENCE

Sponsored by:

University of Groningen, The Netherlands

(Other sponsors to be announced)

July 7 – 10, 2011

Groningen, The Netherlands

The objective of the conference is to bring together academics and practitioners from all over the world to focus on timely valuation issues in the energy sector. Papers dealing with developed as well as developing countries are welcome. *Specific topics* must refer to energy issues and include, but are not limited to:

Financial Regulation; Financial Markets; Financial Risks; Asset Pricing; Value at Risk; Capital Structure; Sourcing Capital; Corporate (Re-) Structuring; Corporate Governance; Behavioural Finance; Financial Performance; Cost Control; Financial Accounting; Fiscal and Legal Issues.

Please e-mail to **w.westerman@rug.nl**, c/o Prof. Wim Westerman, by the *17th February 2011*, a copy of a completed or nearly completed paper. The title page should include the affiliation, address, phone, and e-mail of each author together with appropriate JEL classifications. Each participant agrees to serve as a discussant of a paper of his/her own area of interest, if needed.

Further information regarding conference organisation and accommodation, travel arrangements, fees and activities will be published on the conference website in due course. The conference also includes a "practice day", at no extra costs for workshop presenters and discussants.

PROGRAMME COMMITTEE (to be augmented)

André Dorsman – VU University Amsterdam, The Netherlands

John Simpson – Curtin University, Perth, Australia

Jennifer Westaway – Curtin University, Perth, Australia

Wim Westerman – University of Groningen, The Netherlands

Energy and Value Letter

Indicators of Security of Natural Gas Supply in Asia[1]

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Abstract
Many factors determine gas vulnerability of an economy. Domestic production, gas efficiency usage, volume and sources of gas imports are very crucial in determining an economy's vulnerability. This in this paper highlights inter-country differences in individual and overall indicators of gas security. The analysis implies that country differences exist with respect to vulnerability to natural gas supply disruptions.

1. Background

The growing demand for gas, supply interruptions, increasing gas prices, transportation and distribution bottlenecks, and a growing reliance on imports over longer distances have rekindled a debate on gas security of supply. Natural gas has become an increasingly valuable resource. Its consumption is expected to increase into the future because of its low environmental impact, ease of use and an increase in the number of natural gas-fired power plants. It is one of the fuels that drive the economy. The demand for it, as a replacement for more expensive, less environmentally-friendly and less efficient resources, has already significantly increased (Cabalu and Manhutu, 2009).

The world is dependent on natural gas for power generation. In 2008, it fulfilled more than 24 per cent of the total global primary energy demand (BP, 2009). OECD countries accounted for 50 per cent of gas use, transition economies, especially Russia, used about 20 per cent with developing countries accounting for the rest. Natural gas is forecast to be the fastest growing energy source by 2025, with global consumption rising by almost 60 per cent from 99 trillion cubic feet to 156 trillion cubic feet. The emerging markets of Asia will be the centre of this growth where gas consumption is projected to triple by 2025 (EIA, 2005).

The imbalances between supply and demand drive international trade in natural gas. On the one hand are northeast Asian countries (i.e. Japan, Korea, Taiwan and China), which hold just over 1 per cent of world's reserves but account for almost 8 per cent of the demand. On the other hand, the Middle East (particularly Iran and Qatar) and Russia have two-thirds of the world's reserves and account for around 25 per cent of the demand in 2008 (BP, 2009).

[1] This paper is partly based on a conference paper 'Vulnerability of Natural Gas Supply in the Asian Gas Market' presented at the 37th Australian Conference of Economists in Queensland, Australia. The author thanks Ms Chassty Manuhutu for her valuable contribution to an early version of this paper.

Natural gas is also becoming an increasingly global commodity. In the past, gas has tended to be used in the region where it is produced because of the relatively high transport costs. However, technical developments have led to a drastic reduction in gas liquefaction and transport costs making liquefied natural gas (LNG) competitive with traditional pipeline gas. The rapid growth in LNG use and its greater flexibility has started to create a global market for gas. In 2008, approximately 27 per cent of the global natural gas supply was internationally traded with LNG shipments showing strong growth, well above the ten-year average and making up more than 28 per cent of total export volume (BP, 2009). The remaining share of gas sold on the world energy market is distributed via gas pipelines.

In 2008, about 11 per cent of the Asia-Pacific primary energy consumption was based on natural gas. Gas market requirements are mostly met through imports, 90 per cent of which is LNG from Malaysia, Brunei, Indonesia, Australia and the Middle East. Japan and Korea are almost entirely dependent on LNG imports for their gas supplies. In Japan and Korea, imported gas exchanges are based on long term contracts of 20 to 25 years and indexation clauses where the gas price is directly linked to the price of crude oil, including relatively strict clauses such as take-or-pay clauses which require importers to pay for the gas even if their deliveries are interrupted. In Australia and New Zealand, prices are set by gas-on-gas or gas-on-coal competition (IAEE, 2007; IEA, 2007; BP 2009).

Short-term security of gas supply is the availability of gas supply despite exceptional demand and difficult supply conditions including disruptions to supply due to physical or economic factors. Physical disruptions can occur when gas supply is exhausted or gas production is stopped. Economic disruptions can be caused by dramatic gas price fluctuations which in turn, are due to physical disruptions or unanticipated price changes associated with speculative reaction to potential disruption.

Long-term security of gas supply on the other hand, is the ability to ensure that future gas demand can be met by a combination of domestic and imported gas supplies. Disruptions to long term security of supply are caused by inadequate investments in production and transmission infrastructure, lack of supply diversity and risks associated with import dependency which are geopolitical in nature. Gas-importing countries have started to examine available responses to disruptions to ensure security of gas supply (Dolader, 2003; Costantini, *et al*., 2007).

The objective of this paper is to evaluate a set of gas supply security indicators including gas intensity, net gas import dependency, and ratio of domestic gas production to total domestic gas consumption and geopolitical risk for seven gas-importing countries in Asia for the year 2008. It proposes a composite gas supply security index (GSSI) that is derived as the root mean square of the scaled values of four security of gas supply indicators (Gnansounou, 2008). The four security of gas supply indicators are interrelated and that the GSSI derived provides a composite quantitative measure of gas security by taking into account the interactions and interdependence between the identified set of indicators.

The GSSI captures the sensitivity of the Asian economies to developments in the international gas market, with a higher index indicating higher gas supply insecurity or vulnerability. The existing literature does not identify a unique methodology to assess and quantify energy security that is factual, objective, unbiased, transparent and accessible. This paper, however, is important in terms of providing metrics by evaluating a set of parameters and indicators to assess overall natural gas supply security in seven Asian economies. It is important for future policy making to benchmark countries against quantified indicators and assess their gas security of supply weakness.

The seven net gas-importing countries included in this study are Japan, Korea, Taiwan, China, India, Singapore and Thailand, which together account for more than 75 per cent of the total gas consumption in the Asia–Pacific in 2008 (BP, 2009).

2. Constructing the GSSI for the Asian gas market

The oil shocks in the 1970s demonstrated how vulnerable the world's economy was to supply interruptions and price volatility. Any energy infrastructure, oil, coal or natural gas, is often vulnerable to disruption by insufficient supply, accident or malice. Terrorism, technical mishap, or natural disasters that damage the energy system could be nearly as devastating as a sizeable war. Inadequate financial resources also increase vulnerability or insecurity by limiting supply, transmission, and reliability while increasing prices of energy imports adversely affect the macroeconomic balance of payments, contribute inflationary pressures, and displace other consumption and investment because short-term demand is inelastic.

In the past, long term contracts between exporters and importers are an important element of security of supply (Czernie, 2002). However, in the last several years long terms contracts are not adequate assurance of uninterrupted deliveries. There has been a strong trend towards shorter contract terms or a considerable decrease in the length of natural gas contracts caused by either market-related or regulatory-related changes. Market changes due to federal regulatory initiatives and the creation of competitive markets in natural gas and transmission have led to this trend (Petrash, 2006).

In line with the analyses made in previous literature, four distinct security of supply indicators were selected for this study: gas intensity (G_1), net gas import dependency (G_2), ratio of domestic gas production to total domestic gas consumption (G_3) and geopolitical risk (G_4). G_1 is measured as the ratio of gas consumed in an economy to gross domestic product (GDP). It is the amount of natural gas needed to produce a dollar's worth of goods and services and provides an indication of efficient use of gas to produce the economy's output. G_2 is expressed as the ratio of net imported gas consumption to total primary energy consumption. G_3 is measured as the ratio of domestic gas production to total domestic gas consumption.

Domestic production is a better indicator of the country's capacity to cope with short–term supply disruption than domestic reserves as production excludes gas from stranded reserves which cannot be tapped immediately. G_4 represents the exposure of an economy to political risk and is measured on the basis of two factors: diversification of gas import sources and political stability in gas-exporting countries.

High gas intensity of GDP results in larger adjustments costs and impacts on gas supply security in the event of natural gas supply shocks. In addition, the higher the share of imported gas in total energy demand the more vulnerable an economy is to international gas developments. Diversification of supply sources, particularly politically stable supply sources also reduces the risk and vulnerability to disruption. Dependence on domestically-sourced gas supply is preferred over imported gas, as it avoids geopolitical uncertainties. In addition, the larger domestic gas reserves relative to consumption or the larger domestic production capabilities a country has, the lesser are the likely impacts on gas security.

It is difficult to quantify a country's overall gas supply security using individual indicators and it is even more difficult to synthesise different indicators. To facilitate comparison or aggregation of several indicators, it may be better for these to be expressed in the same units. To do this, for each of the four security indicators, a relative indicator φ_i, was estimated which was used to compute a composite index — gas supply security index (GSSI). The relative indicators were estimated by using a scaling technique where the minimum value is set to 0 and the maximum to 1. The value of 0 is assigned to the country with the least vulnerability or insecurity to supply disruptions and the value 1 is assigned to the country with the most vulnerability to supply shocks. Table 1 presents calculations for the relative indicators which are scaled values of the four security of supply indicators.

Table 1. Relative indicators of security of supply in selected net gas importing countries in Asia, 2008 (arranged in ascending order of vulnerability/insecurity)

φ_1	φ_2	φ_3	φ_4
China	China	China	Japan
0.000	0.000	0.000	0.000
Japan	India	Thailand	Korea
0.008	0.126	0.181	0.200
Taiwan	Thailand	India	India
0.126	0.533	0.213	0.535
India	Taiwan	Japan	Taiwan
0.134	0.589	0.970	0.626
Korea	Korea	Korea	China
0.202	0.836	1.000	0.788
Singapore	Singapore	Singapore	Singapore
0.277	0.780	1.000	0.848
Thailand	Japan	Taiwan	Thailand
1.000	1.000	1.000	1.000
AVERAGE	AVERAGE	AVERAGE	AVERAGE
0.249	0.552	0.628	0.571

Source: Author's calculations

Note: φ_1 is the relative indicator or scaled value for G_1 (gas intensity); φ_2 is the relative indicator or scaled value for G_2 (net gas import dependency); φ_3 is the relative indicator or scaled value for G_3 (ratio of domestic gas production to total domestic gas consumption); φ_4 is the relative indicator or scaled value for G_4 (geopolitical risk).

Following Gnansounou (2008), the gas supply security index (GSSI) is derived as the root mean square of the four relative indicators or scaled values of the four security of supply indicators.

$$GSSI_{j\cdots} = \cdots \sqrt{\frac{\sum_{i=1}^{4} \varphi_{ij}^2}{4}}$$

The various relative indicators of gas security are interrelated and that the GSSI derived provides a composite quantitative measure of gas security by taking into account the interactions and interdependence between the identified set of indicators. The GSSI captures the sensitivity of the Asian economies to developments in the international gas market, with a higher index indicating higher gas supply insecurity or vulnerability.

3. Summarised Findings and Conclusion

Many factors determine gas vulnerability of an economy. Domestic production, gas efficiency usage, volume and sources of gas imports are very crucial in determining an economy's vulnerability. The analysis in this paper highlights inter-country differences in individual and overall indicators of gas security which means that country differences exist with respect to vulnerability to natural gas supply disruptions. This implies that governments need to develop policy responses that directly address individual countries' weaknesses to enable them to handle natural gas supply disruptions. Policy measures should reduce the probability of supply disruptions occurring and the costs of disruptions. For instance, India and China are relatively less vulnerable to supply disruptions compared to other countries in the sample because of their significant domestic gas production and small share of gas in its energy mix. These meant that the two countries did not have to rely on gas imports for energy generation.

Governments could implement various measures to better cope with supply disruptions and significantly mitigate their effects. For instance, gas import dependence has risks associated with price volatility, natural disaster, political blackmail and terrorism. Imported gas supplies are either pipeline

bound or sea bound LNG. These transit options are both exposed to risks but it is the degree of having viable alternative options that defines security of supply.

When gas imports depend dangerously on too few sources, it raises a concern whether this is compatible with a sensible policy goal of gas supply security. This concern is exacerbated when taking geopolitical considerations into account. Hence, diversification of gas import sources is encouraged. Other diversification measures include fuel-switching and diversifying energy mix. Diversification in fuel types and sources would reduce the costs of supply disruptions by spreading the risks across different import and energy sources. As Percebois (2006) and Reymond (2007) summed it, a country which imports the majority of its gas at a sustainable cost and ensures the security of supply by well-diversified and politically-stable sources will not be vulnerable.

Governments also have the option of reducing overall gas dependence by improving gas efficiency through research and development and adoption of technologies that reduce gas consumption or increase the efficiency of gas use, technologies that facilitate gas exploration and production, and alternative processing technologies such as gas to liquids plant. To enhance natural gas supply security, it is also important that investments in domestic gas exploration and production activities are encouraged though joint venture projects and that gas trade routes and sea lanes remain open and secure.

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Russia's optimal gas export strategy: competition or cooperation?

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Abstract

Russia, the world's largest gas exporter, has temporarily lost its muscle. Together with its national champion, Gazprom, Russia has arrived at a crossroads: either aim for competition or deeper cooperation with other gas-exporting countries. It appears to choose for competition for market share with the support of European energy companies, even as cooperation with other gas-exporting countries would be in Russia's interest.

Introduction

A revolution in the gas market is unfolding with the advent of unconventional gas production and a 'tsunami' of liquefied natural gas (LNG), from Qatar, for example. At the same time, future gas demand is under pressure due to the growing importance of alternative energy sources, among other aspects. The result of this revolution is that there will be enough gas for the coming years and possibly lower gas prices.

Time for a Gas-Opec?

In order to avoid lower gas prices, Russia could choose to make agreements with other gas-exporting countries, for example, on further capacity expansions. The Gas Exporting Countries Forum (GECF) and the Gas Troika – comprised of the world's largest gas reserve-holding countries – offer Russia a platform for such coordination. In addition, Gazprom increasingly forms consortia with other gas-exporting companies that are often controlled by the state. However, cooperation between gas-exporting countries is still in its infancy, by and large because markets are still developing and gas-exporting countries each pursue an independent course and are at diverging levels of development in their gas export strategies. For example, one of the largest gas reserve-holding countries Qatar has invested heavily in its LNG export projects, and it now appears set for a pause in making more investments. Meanwhile, Iran has yet to embark on a gas export campaign, despite the fact that it is the second-largest gas reserve holder in the world.

Therefore cooperation among gas-exporting countries is not comparable to the OPEC oil market cartel, as is often suggested. Furthermore, the quota-driven cartel mechanism that OPEC uses to regulate a large share of oil supply in the oil market can hardly be applied to the gas market. Long-term oil-indexed contracts, the lack of a truly global and liquid market for gas and the capital intensity of the gas value chain form considerable obstacles to an OPEC type of production restriction mechanism.

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* Dr. Timothy Boon von Ochssée and Dr. Tom Smeenk recently attained their PhDs with a focus on Russia's gas export strategy. Boon von Ochssée's dissertation The Dynamics of Gas Supply Coordination in a New World (ISBN: 978-90-367-4445-7) and Smeenk's dissertation Russian Gas for Europe: Creating Access and Choice (ISBN: 978-90-367-4445-4) are published by CIEP and are available for download in PDF format on CIEP's website, at <www.clingendael.nl/ciep/publications>.

A more tacit form of collusion[2] is likely to suit the nature of the gas market and Russia's independent posture with regard to other gas-exporting countries, where coordinated capacity expansions and shared investments could ultimately help avoid price competition.

Nord and South Stream pipelines: Knights in a wider gambit

Russia appears bent on pursuing a course that aims at developing its own gas export strategy. With gas market share yet to be captured in Europe, Russia is ostensibly seizing the initiative ahead of its potential rivals in a bid to strengthen its own market position. Indeed, considerable Russian investment projects are planned, often with the support of Western energy giants. Together with the French and Norwegians, for example, Russia will develop the large Shtokman gas field in the Barents Sea, and there are plans for the development of new gas fields on the Yamal Peninsula in Northwest Siberia. For this megaproject, Western energy companies have meanwhile made available their resources and their know-how.

The newly planned pipelines serve as an important instrument to strengthen Gazprom's market position, see also Box 1 for the theoretical underpinning. In this regard, the Nord Stream pipeline is to clear the way for new Russian gas in North-western Europe while the South Stream pipeline follows suit in Southern- and Central Europe. Russia cooperates with German, French and Dutch energy companies in the Nord Stream project, which is already under construction. Among others, the French and Italians are contributing to the realisation of the South Stream project.

By using the real-option game model, when Gazprom decides to build the South Stream pipeline early on, it has a deterrence effect, owing partially to larger economies of scale and great upward demand potential. Depending on the upward demand potential in North-western Europe, the Nord Stream pipeline may also have a deterrence effect on LNG flows for example. Yet, the real-option game model is of a highly stylised nature. Therefore, other aspects should be taken into account in assessing gas infrastructure investments (see also Box 1). Besides the goal of possibly expanding Gazprom's market share, infrastructure investments could serve to mitigate overall transit risks, especially in Ukraine. However, Gazprom's organisational constraints in realising gas infrastructures could put into question the rationale of such investments. In addition, Gazprom's position as well as that of Russian gas may be pressured by European (regulatory) policy in favour of alternative gas and other energy sources.

These hurdles may stall a pro-active strategy on Gazprom's part. Signing long-term contracts with European buyers enables Gazprom to ensure its market position in volume terms in the European market.[3] Nevertheless, from the perspective of a vertically integrated gas supplier, gas transport projects can be seen as integral part of their overall business. Because of this, these types of firms may be better able to bear the cost of making strategic investments by requiring a lower rate of return.

Thus, these gas pipelines can be employed by Gazprom to protect and/or expand market share by making early strategic investments. Regional gas market structures can thus be influenced by individual projects, which is inherent to an industry characterised by an oligopolistic market structure and a capital-intensive value chain. Simultaneously, the application and use of the real-option game model highlights the importance of a wait-and-see approach, i.e., a postponement strategy where large lumpy investments are mothballed until they may appear to be necessary to compete with other suppliers after all.

[2] Collusion in this particular context should be seen against the backdrop of actions taken by countries outside liberalised markets such as the EU and the US, for example (c.f., OPEC).

[3] For example, Gazprom has already ensured some 30 percent of the Nord Stream's capacity through long-term supply contracts.

Box 1 Theoretical underpinning of gas infrastructural investments

Along the product life cycle, firms compete in the first instance on capacity extension in order to deliver new volumes to the market, and thereby potentially capturing additional market share. In a later stage, price competition becomes more important. In the case of long-distance transport in general, the largest part of the total costs in the value chain is related to the transport component. Therefore, both in relative and absolute terms, the economies of scale in this component, at a project level and in general, help to decrease the average cost of gas vis-à-vis competition.

Because the infrastructural investment opportunities do not exist in a vacuum, they must be considered in their strategic and competitive context. We therefore argue that in order to ascertain the overall value of gas transport infrastructure investments, account must be taken of both demand uncertainty and possible competition through a strategic-economic approach. The real-option game model, developed by Smit and Trigeorgis (2001), captures both components via the discounted cash flow approach, real-option approach (as a means of factoring demand uncertainty), and the game theoretic underpinnings of entry deterrence.

Based on these value components, we can distinguish between the value of having a strategic option to compete (strategic 'option-game' value, i.e. construct a pipeline) and foregoing this option to compete now (the value of the option to postpone strategically, i.e., postponing to construct a pipeline). These values collectively are an addition to the traditional direct (static) net present value (NPV), which is equal to the future expected cash flows from investing immediately.

The model's added value lies in its mathematical underpinning for a more intuitive understanding of strategic investments. Yet, the model is of a highly stylised nature. The so-called conceptual toolbox is designed to take into account those factors which cannot be taken into account quantitatively when assessing whether or not to invest strategically. These include the general investment climate, geo-economic and geopolitical relationships, difficulties involved in transit countries as well as organisational and financial feasibility of investments.

The right balance?

The drive to compete mirrors Russia's ambitions to position itself as a great power in international relations. The question remains whether Russia and Gazprom choose the right balance between cooperation and competition with gas-exporting countries, in such a way that it secures Russia's own interests. For Russia, the income stream from gas exports is a vital economic interest. This stream of income could be jeopardised if too much gas is supplied to markets because of competition for market share. Furthermore, it remains to be seen whether Gazprom can realise its investment projects even as the call in Europe for additional Russian gas is sounding fainter. This is the case because Europe aims to become less dependent on Russian gas for geopolitical reasons.

Despite the independent strategies of the various gas-exporting countries, cooperation with other gas-exporting countries is desirable for Russia, even if this cooperation were to be informal. In any case, through cooperation with European energy companies, Russia must strive to manifest itself as a reliable gas supplier in the European energy transition in order to prevent that its new pipelines remain empty.