Gas Transportation, Geopolitics and Future Market Structure

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Abstract

- There is high political role of energy issues with respect to diversification of European gas imports and Russian gas exports.
- We see the core problem in high cost of gas infrastructure. It stresses the spatial component in economic models.
- The goals of this paper is to analyse gas games and there origins. Long run gas game that may emerge in the future involves oligopoly of producers with main reserves and oligopsony of consumers.
- Transit games bring negative externality for EU consumers. We discuss how changes in internal accounting of Gazprom and new gas taxing scheme (royalty, export tax) in Russia can reduce or even eliminate transit games.
Paper Structure

- Gas issues seem to be purely economic, but they emerge as geopolitical issue. Why?
- This paper focus on spatial heterogeneities (in gas reserves, asymmetry of access to market) that put forward geography, which along with scale economies in transport lead to local monopoly, global oligopoly and geopolitical games.
- We consider origins of two types of games: long run game (development of future markets) and short run game (transit).
- But before that it is important to discuss asymmetries between countries and regions in gas production, consumption and reserves.
Table 1. The main world gas reserves holders, their production and consumption. Source: BP data and calculations by authors.

<table>
<thead>
<tr>
<th>N</th>
<th>Country</th>
<th>Reserve</th>
<th>%</th>
<th>R/P years</th>
<th>Production mtoe</th>
<th>YUS</th>
<th>Cons. 2005</th>
<th>Export mtoe</th>
<th>Export %</th>
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<tbody>
<tr>
<td>1</td>
<td>Russia</td>
<td>47,82</td>
<td>26.6</td>
<td>80</td>
<td>538.2</td>
<td>75.52</td>
<td>364.6</td>
<td>173.6</td>
<td>32.3</td>
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<tr>
<td>2</td>
<td>Iran</td>
<td>26,74</td>
<td>14.9</td>
<td>&gt;100</td>
<td>78.3</td>
<td>42.23</td>
<td>79.6</td>
<td>-1.3</td>
<td>-1.7</td>
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<td>3</td>
<td>Qatar</td>
<td>25,78</td>
<td>14.3</td>
<td>&gt;100</td>
<td>39.2</td>
<td>40.72</td>
<td>14.3</td>
<td>24.9</td>
<td>63.5</td>
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<td>4</td>
<td>Saudi Arabia</td>
<td>6.9</td>
<td>3.8</td>
<td>99</td>
<td>62.6</td>
<td>10.87</td>
<td>62.6</td>
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<td>5</td>
<td>OAE</td>
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<td>3.4</td>
<td>&gt;100</td>
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<td>9.54</td>
<td>36.4</td>
<td>5.5</td>
<td>13.1</td>
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<tr>
<td>6</td>
<td>USA</td>
<td>5.45</td>
<td>3</td>
<td>10.4</td>
<td>473</td>
<td>8.63</td>
<td>570.1</td>
<td>-97.1</td>
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<td>8.26</td>
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<td>35.5</td>
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<td>23.1</td>
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<td>31.4</td>
<td>22.6</td>
<td>41.9</td>
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<td>2.41</td>
<td>1.3</td>
<td>28.3</td>
<td>76.5</td>
<td>3.80</td>
<td>4</td>
<td>72.5</td>
<td>94.8</td>
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<tr>
<td>16</td>
<td>China</td>
<td>2.35</td>
<td>1.3</td>
<td>47</td>
<td>45</td>
<td>3.71</td>
<td>42.3</td>
<td>2.7</td>
<td>6.0</td>
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</table>
Comments to Table 1. Gas Resources vs Reserves.

- Russia, Iran and Qatar are the main gas reserves holders (above 55% of world gas)
- The largest gas consumers are USA and Russia. Russia is the largest gas exporter, while USA is growing importer
- USGS has probabilistic estimates of gas resources (expected future discoveries), suggesting the undiscovered gas is about equal to discovered, while for USA undiscovered reserves are 10% contrary to only 3% of proven reserves. This improves otherwise pessimistic forecast that the US import will grow rapidly (given R/P=10 years only) and makes it more uncertain
The dynamics of gas reserves under IAE scenario shows that most of smaller gas producers will use most of reserves till 2030. Among survivors only Nigeria and Venezuela are out of Middle East and Central Asia.

Fig. 2. Dynamics of gas reserves for smaller reserve holders (excl. Russia and Middle East). Source: BP data, IEA scenario. Calculation by authors.
Spatial Aspects

- Spatial aspects are very important for natural gas since costs and transportation modes depend significantly on distance and geography (land or sea). A crucial decision is to deliver natural gas via pipelines or LNG. Both requires huge sunk costs. The choice of transportation makes a partial lock-in for exporters and importers (particularly for pipelines).

- Spatial distribution of gas reserves and their location relative to the consumers is important. Spatial topology of pipelines and other geographical factors play an important role here. Transportation cost of gas represents an important price component, and thus price is regional (no world price).

- European Union has three main sources of gas at present: from Russia (by transcontinental pipelines with length about 4000 km), from Northern Sea (developed by Norway, Netherlands and UK) – by sea pipelines, from Northern Africa – delivery by LNG to Mediterranean ports.
Outlook for the development of regional patterns in gas trade

- **USA-the World.** The USA is the largest world gas consumer and the 2-nd largest producer although its reserves are only modest (3%). Any change in the US demand for imports influences world trade. USA has to rely on increase of LNG imports.

- **Russia-EU.** Europe will be more dependent on Russian gas due to depletion of its own production and gas from Northern Africa after 2030. But Russia may not fulfil all European demand for its gas in future due to several reasons: a) too slow growth of domestic gas extraction due to growing cost of gas extraction development, b) reorientation of export to other markets (Asia).

- **Russia – Asia.** At present, the demand of Japan and S. Korea for gas is satisfied by LNG supplies. The role of China as gas consumer is growing fast, from 23.8 bcm in 2000 to 47 bcm in 2005. There is a technical possibility of gas pipeline from Eastern Siberia to Far East, with Japan, Korea and China as potential consumers.
EU: Supply Security and Scenarios

- The present gas supply to EU depends on too few exporters (with Russia playing the dominant role), depends on pipeline infrastructure, “the system without flexibility”, that involves several types of risks.
- Both new pipelines and LNG infrastructure are very expensive equipment, and both require long run contracts. This contrasts the beliefs of many Europeans about the benefits from gas market liberalization, since security of supply is also needed.
- Huge trans-Eurasian gas pipelines will still be used in the middle run as a bulk supply of Russian gas to EU. Shift to LNG seems the proper economic decision. But who will deliver them after 2030?
Regional dynamics of gas imports reveals increasing import dependence of EU, along with growing shares of USA and Asia.

Fig. 3. Dynamics of gas imports by main regions
Regional dynamics of gas export shows fast growth in Africa (only in the middle term, later deposits will vanish) and Middle East.

Fig. 4. Dynamics of gas export by regions.
Source: BP data, IAE scenario. Calculation by authors.
Regional dynamics of gas reserves till 2030 shows the dominant role of Russia and Middle East after 2030

Fig. 5. Dynamics of gas reserves by regions (no new discoveries)
Future Gas Game

- Consider a game with two periods. The period 1 lasts until 2030. In this period there are 3 main gas importers: EU, USA and Core Asia, which remain main importers also in the 2nd period.
- Gas exporters have broad oligopoly in period 1 and narrow oligopoly in period 2. Future oligopoly depends very much on present policy chosen by EU.
- Narrow oligopoly contains 3 main holders of gas reserves: Russia, Iran, Qatar.
- Players choose intensity of exploitation and shares of investment in different infrastructure.
- The more is competition in period 1 (it also depends on EU policy), the more small players start to deplete their reserves fast, and the quicker will be the period with narrow oligopoly.
LNG-Pipeline Split of Future Gas Demand

- Both pipelines and LNG infrastructure have high fixed costs. Contrary to LNG, commitment to investment in pipeline is location-specific.

- The strategy of USA is high bid for LNG in future, because resources of American continent are limited (4% in N.A. and 4 % in S.A.). Japan is fully dependent on LNG now, while China is indifferent. For EU, the present share of LNG is low (15%), but may increase.

- The problem of EU that is will not be the hardest bidder for LNG in future, since due to geographical properties it is not as fatally dependent on them as Japan or USA.
Strategies of Gas Producers

- Consider investment strategy of main producers in period 1. They will determine market structure in period 2.
- Denote strategy of player $X$ for investment in project $Y_i$ as vector $(XY_1, XY_2, XY_3)$, where $X=R, M$, $Y_i=E, A, L$, where $R$ is Russia, $M$ is Mid.East, $E=\text{Europe}$, $A=\text{Asia}$.
- Russian bulk investment is already into European pipelines. Only extra capacity will split among 3 alternative investments: $E, A, L$. Hence, Russian investment vector will be biased to the first component.
- If Middle East will diversify fully, choosing $(1/3, 1/3, 1/3)$, the long run shares of LNG may be between $1/4$ and $1/3$.
- If LNG development will be low, USA and Japan will present the highest bids, and EU may stay without LNG. Then Russian investment split becomes crucial for EU.
Some Statements

- **Prop.1.** Period 2 will start at some moment.
- **Prop.2.** Russia is indifferent between constructing more pipelines to EU or building LNG plants. Pipelines to EU are slightly preferred to pipelines to Asia.
- **Prop.3.** If LNG becomes scarce, USA will submit higher bid for them.
- **Prop.4.** If Russia builds LNG plants or Asian pipelines in period 1, it is not optimal for it to increase gas sales to EU by building new pipelines in period 2.
- **Prop.5.** EU should invest in pipeline to Russia in period 1, to reduce Russian risk in energy demand and to reduce Russian incentive to invest more in Asian pipelines and LNG. By doing this, EU can secure its gas supply in period 2.
Some Possible Equilibria
(Future Gas Market Structures)

- **Equilibria 1** (monopolistic). Suppose that Qatar fully invest in LNG, Iran in pipeline to Asia, while Russia in pipeline to EU. Then the long run future gas trade will include 3 clusters: Russia - EU, Iran - Asia, Qatar - USA. Each of these 3 couples will be monopolistic-monopsonistic relationship.

- **Equilibria 2** (oligopolistic). This equilibrium can be symmetric. For example, 3 producers produce mix $(1/3,1/3,1/3)$, and 3 consumers import this mix. It is quasi-competition, and despite small number of players, prices can be not much different from fully competitive.
Russian Strategies and Scenarios

- Scenario 1: Fast development of gas production and pipeline capacity.
- Scenario 2: Fast development of gas production and LNG.
- Scenario 3: Slow expansion of production; growth of export due to re-export of Central Asian gas and domestic consumption decline.
- Scenario 4: Keeping present steady state in gas production and export to preserve reserves until they become more scarce.

The first two scenarios correspond to high discount rate in Russian preferences, the last two – to low.
Pricing of Russian Gas

- Spatial differences in gas pricing (especially for Russian gas) also became a question of political debates. It is often claimed that low internal gas prices in Russia and some intermediate level for post-communist countries is a result of political game by Gazprom and that it can be eliminated through market liberalization.

- The first important question is about gas price formation. Here not only standard arguments from IO, but also arguments from spatial economics and resource economics play the role. H. Hotelling did arguments first.

- There are high share of transport costs in total cost of gas and thus gas pricing should be spatial (no world price).

- The question of deposit owner also emerges. Before 1991 it was the population of the USSR, by consitution. Natural rent should be paid, and this changes price patterns.
Hypothetical Example

- Suppose that at some moment the EU gas price (per 1000 cum) is $300, Russian internal price is $50, cost of extraction is $10, cost of domestic transportation varies between $30 and $50 depending on region, and cost of export infrastructure is $100. If there is no natural rent, producer of gas makes before tax profit of 300-100-10 =190 ($ per 1000 cum) on exported gas and almost zero profit on domestic sales.

- Consider the effect of natural rent. Suppose that it is $50 (per th.cum). Then the cost of gas at the point of extraction becomes not $10, but $60. The cost of delivered gas will vary domestically between $90 and $110, and pre-tax cost to export gas becomes 10+50+100=160. If consumers get rent, there is little difference. Introduction of two laws (natural rent and tax on gas export) can also replicate present price pattern and establish market equilibrium for regulated monopoly.
About Strategic Role of Internal Accounting in Gazprom

- The final gas price for EU consumer has several components: a) rent (royalty) for using exhaustible natural resource, R; b) extraction cost, E; c) direct competitive transit cost, TC; d) tax on extraction, transit and export, T1; e) transit surplus (rent of intermediary), TS; f) delivery and distribution cost inside EU, DC; g) profit of local EU distributors, PEU; h) EU taxes on gas and distribution, TEU.

- Introducing royalties and correct export tax can do more for efficient equilibrium. Under efficient regulated monopoly transportation sector should operate at zero profit. Price for transit should be equal to transit cost, giving spatial pricing of gas: \( P(x) - P(y) = T \left| x - y \right| \).

- The main problem is to measure \( T \). We need audit.
About Gas Transit Games

- The recent gas game between Russia and Ukraine (February-March 2008) has revealed clearly that “transit price” has little to do with transit cost, but represents rent seeking. Ukraine suggested 5-fold increase of transit price, from $1.70 to $9.32 for 1000 cum per 100 km. Russian replies in raising gas price in this hard bargain are also often above reasonable level; for example, it wants to charge from Ukraine price above $300, which does not correspond to correct spatial pricing. That is why Gazprom is so eager to pursue with Nord Stream and South Stream projects.

- It is important to make some legal changes to eliminate such games in future. There exists several possibilities for that (they may work apart, but can be complementary): a) setting royalty and export tax for Gazprom monopoly at such level that transit brings zero profit (this reduces or eliminates bargaining pie with transit countries), b) building alternative pipelines; c) setting international law about reasonable interval of transit prices based on audit of different firms.
Conclusions. Policy Implications

- This study looks beyond the year 2030. Long term analysis trends show that the demand for gas imports will grow very fast in the USA and Pacific Asia, putting EU into fierce competition for gas supplies. By the middle of the 21st century most of the gas reserves on American and African continents will be depleted. Russia and Middle East would become the main gas suppliers. There will be oligopoly-oligopsony relationship, with 3 main producers (Russia, Iran, Qatar) and 3 large consumers (USA, EU, Pacific Asia). Therefore, Europe will, whether it likes it or not, depend on Russian gas. The emergence of an Asian market with China up front, and the possibility of LNG exports frees Russia from its dependence on gas exports to Western Europe. In the long run, the only viable alternative for gas supply in EU other than Russia is the Middle East. Therefore, EU should either invest in pipelines to Iran, or be prepared to pay higher prices for LNG imports from Middle East.

- The paper also addresses the issue of spatial pricing of gas, in particular for Russia. It is recommended to observe real transport price of gas using accounting data, and set spatial price variation in according to that. The question of natural rent for gas is also discussed. Setting this rent at appropriate level along with tax on export allows for support of the present price pattern (spatial differentiation) as regulated monopoly. Gas transit games and the conditions for their elimination are also discussed.