The geopolitical impact of Nord Stream 2

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European gas market overview

- Natural gas plays an important role in Europe’s energy mix.
- Nearly three-quarters of the EU’s natural gas consumption is imported and 40% of the total import comes from Russia.
- Experts predict constant demand and shrinking local production.
- Asia diverts LNG production surplus, US shale gas is not yet price competitive.
- Security of supply is a critical issue.
- Network development is very costly and involves a lot of geopolitics.
Third Energy Package

EU legislators established a strategic plan for secure, affordable and environmentally-friendly energy – the so-called Third Energy Package. The law stipulates

- the establishment of national regulatory authorities,
- third-party access to pipelines,
- separation of energy production and transmission,
- setting non-discriminatory tariffs,
- overall more transparent operations.
Solidarity, Security, Trust

Solidarity in energy matters is a key point in the Treaty on the Functioning of the European Union as well as in the Energy Union.

“Government interventions that affect this market framework, such as national decisions on renewable energy or efficiency targets, decisions to support investment in (or decommissioning of) nuclear generation, or decisions to support key infrastructure projects (such as Nord Stream, South Stream, TAP or a Baltic LNG terminal) need to be discussed at European and/or regional level to ensure that decisions in one member state do not undermine security of supply in another member state.” (European Commission, 2014)
European gas pipeline network
Nord Stream 1 and 2

- Nord Stream 1 connects Russia and Germany, respectively the largest supplier and consumer in Europe. It became operational in 2011.
- Nord Stream 1 already led to political tensions within the EU.
- The EU introduced restrictions allowing the pipeline to be utilized at only half of its capacity, 27.5 from 55 billion cubic metres (bcm).
- Recently the limitations were lifted, and negotiations started over doubling Nord Stream yearly transmission capacity to 110 bcm.
- In March 2018, the Nord Stream 2 project received all the required permits to begin construction, and Gazprom expects the pipeline to be operational by the end of 2019.
Propagators of Nord Stream 2 argue that the project has sound commercial reasons.

- The EU’s production capacities are declining, while demand is on the rise.
- Nord Stream 2 helps to lower gas prices in the EU.
- Key pipelines in Ukraine are reaching the end of their service life and lack viable alternatives.
- Ends the uncertainty of the Ukrainian transit route.
Contra Nord Stream 2

What are the main arguments *against* the project?

- Incompatible with the Energy Union’s strategic goals and with the Third Energy Package.
- Does not diversify the EU’s energy supply.
- Adds to an infrastructure overcapacity in the EU.
- Undermines the economic sanctions towards Russia.
Research questions

- How much bargaining power does a country hold?
- Which network development project will be supported?
- How to increase supply security?

We formulate a cooperative game theoretical framework to answer these questions. We are particularly interested in the implications of the Nord Stream 2 project. We focus on the change of influence of the players in three different scenarios. We investigate how the power of the agents shift when the Nord Stream pipeline is expanded, when the Ukrainian pipeline is shut down and finally when both of these happen.
Short literature overview

Cooperative approach

- Hubert and Ikonnikova (2011) The Journal of Industrial Economics
- Cobanli (2014) Energy Policy

Oligopolistic modelling

- Abada, Gabriel, Briat, and Massol (2013) Networks and Spatial Economics

Policy reports

- Fischer (2016) Policy Perspectives
- European Political Strategy Centre (2016), EPSC Strategic note
- Barnes (2017) Centre for European Policy Studies, CEPS Special Report
Cooperative TU-games

In cooperative transferable utility games

- players individual strategy choices are not visible;
- players can cooperate and form coalitions;
- each coalition has a value, this number represents the worth the coalition, that is how much profit they can obtain on their own without help from outside the coalition;
- we assume that eventually all the players cooperate, that is the grand coalition will form;
- the question is how to distribute the benefits created by the grand coalition among the players.
Cooperative TU-games

Formally,

- there is a set of player \( N = \{1, 2, \ldots, n\} \);
- a coalition \( S \) is just a subset of the player set, \( S \subseteq N \);
- we assign a value \( \nu : 2^N \to \mathbb{R} \) for each coalition, by convention \( \nu(\emptyset) = 0 \);
- \( \nu \) represents the worth of the coalition, in particular \( \nu(N) \) shows how much value the players can create if they all decide to cooperate.
Model setup

- We sort the regions in scope (27 in all) into two groups: net producers and net consumers.

- We assume the presence of an alternative source. That is, consumers may always satisfy their own demand without gas from the producers, although at a much higher price.

- A coalition of players may utilize only the part of the network, that their own, and trade on it. We focus on cost saving: we observe how much cost a coalition can save by cooperation.

- Cost saving is due to three effect: producers supply gas, consumers create demand, and transit countries link the former two.
Coalitions and cost saving

Coalition (GER+UA) is not connected $\rightarrow$ no cost saving
Coalition (GER+UA+POL) is connected, but there is no supplier $\rightarrow$ no cost saving
Coalitions and cost saving

Cost saving is due to the presence of consumers (GER, POL, UA), supplier (RU) and transit countries (POL, UA).
The cost of a coalition is calculated with an iterative LP.

Instead of optimizing the network flows of a coalition in one step, we do it iteratively country-after-country according to a certain order. We do this in order to obtain a more fitting model of the gas market, where long term bilateral contracts are still dominant.

One advantage of this approach is that flows corresponding to the consumption of individual countries can be distinguished in this way.

We compute the Shapley-value of the corresponding game (the average marginal contribution of each player with respect to each possible coalition).
Shapley-value

- When a coalition forms, members join one-by-one, and each member contributes a non-negative amount to the cost saving.
- Existing members are not harmed if (almost all) of this saving is kept by the new entrant.
- Considering all possible orders we can calculate the average marginal contribution to cost saving for each of the members of the coalition.
Simplifying assumptions – Regions
Further simplifying assumptions

- Producers’ prices are fixed.
- Transmission cost is proportional to the length of the pipeline.
- Gas quality is homogeneous.
- Uniform replacement cost among consumers (i.e. the price of the alternative source is the same everywhere).
- We include LNG as a new player with zero consumption, a production corresponding to current LNG imports to Europe and links to every player with a significant LNG terminal.
Data and calculations

Calculations were carried out with Matlab using the OPTI toolbox, and the linear programming task was solved by the CLP solver, using the Dual simplex method.

<table>
<thead>
<tr>
<th>Data type</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission capacities</td>
<td>ENTSOG</td>
</tr>
<tr>
<td>Pipeline length</td>
<td>Wikipedia, Google Maps</td>
</tr>
<tr>
<td>Production/Consumption</td>
<td>BP, IndexMundi</td>
</tr>
<tr>
<td>Data Verification</td>
<td>EIA, HEA</td>
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</tbody>
</table>
## Benefits compared to the baseline scenario

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ukraine</th>
<th>Nord Stream 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (+Belarus), Central Asia, Finland, Balticum</td>
<td>-38.8 %</td>
<td>+16.6 %</td>
<td>-2.0 %</td>
</tr>
<tr>
<td>Norway, Denmark</td>
<td>+26.5 %</td>
<td>-19.4 %</td>
<td>-1.0 %</td>
</tr>
<tr>
<td>Algeria (+Lybia)</td>
<td>+34.8 %</td>
<td>-9.1 %</td>
<td>9.9 %</td>
</tr>
<tr>
<td>LNG</td>
<td>+32.5 %</td>
<td>-10.6 %</td>
<td>2.1 %</td>
</tr>
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</table>

### Western Europe

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ukraine</th>
<th>Nord Stream 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany (+Switzerland)</td>
<td>-1.8 %</td>
<td>+25.9 %</td>
<td>+55.4 %</td>
</tr>
<tr>
<td>UK (+Ireland), Benelux</td>
<td>-3.1 %</td>
<td>+7.2 %</td>
<td>+3.0 %</td>
</tr>
<tr>
<td>France</td>
<td>-29.6 %</td>
<td>+11.4 %</td>
<td>+6.6 %</td>
</tr>
<tr>
<td>Spain + Portugal</td>
<td>-0.3 %</td>
<td>+0.5 %</td>
<td>-0.3 %</td>
</tr>
<tr>
<td>Italy</td>
<td>-15.9 %</td>
<td>+7.3 %</td>
<td>+0.8 %</td>
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</table>

### Central- Eastern- and Southern Europe

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Ukraine</th>
<th>Nord Stream 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ukraine</td>
<td>-98.9 %</td>
<td>-32.6 %</td>
<td>-80.0 %</td>
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<tr>
<td>Poland</td>
<td>+46.0 %</td>
<td>-29.4 %</td>
<td>-4.5 %</td>
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<tr>
<td>Czech Republic, Slovakia</td>
<td>-94.1 %</td>
<td>-33.1 %</td>
<td>-3.0 %</td>
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<tr>
<td>Austria, Hungary, Croatia, Slovenia, Serbia</td>
<td>-96.2 %</td>
<td>+3.1 %</td>
<td>-41.5 %</td>
</tr>
<tr>
<td>Turkey, Greece, Bulgaria, Romania (+Moldova)</td>
<td>-51.1 %</td>
<td>-2.2 %</td>
<td>-29.5 %</td>
</tr>
</tbody>
</table>
Conclusion

- Both the supporters and adversaries of Nord Stream 2 are governed by self-interest and solidarity and trust, the values proclaimed by the EU and the Energy Union, remain but a slogan.

- Network flows show, that even if Nord Stream 2 would provide significantly cheaper gas, the benefits would never reach the Eastern part of Europe.

- The EU has to decide on what should drive its natural gas policy: the market approach or the geopolitical approach. A way to maintain solidarity would be to introduce a compensation scheme.
The substantial investment costs, the interstate nature of pipeline projects and rapidly changing geopolitical interests make the gas network development very volatile.

<table>
<thead>
<tr>
<th>Name</th>
<th>Source</th>
<th>Destination</th>
<th>Integrate with</th>
<th>Capacity (bcm)</th>
<th>To be Commissioned</th>
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</thead>
<tbody>
<tr>
<td>TANAP</td>
<td>Georgia/Turkey</td>
<td>Turkey/Greece</td>
<td>SCP, TAP, ?Tesla?</td>
<td>16</td>
<td>2018</td>
</tr>
<tr>
<td>TAP</td>
<td>Turkey/Greece</td>
<td>Italy</td>
<td>TANAP, ?Turkstream?</td>
<td>10-20</td>
<td>2020</td>
</tr>
<tr>
<td>Turkstream</td>
<td>Russia</td>
<td>Turkey</td>
<td>Tesla, ?TAP?</td>
<td>31.5</td>
<td>2019</td>
</tr>
<tr>
<td>IAP</td>
<td>Albania</td>
<td>Croatia</td>
<td>TAP</td>
<td>5</td>
<td>n.a.</td>
</tr>
<tr>
<td>Tesla</td>
<td>Turkey</td>
<td>Austria</td>
<td>Turkstream, ?TANAP?</td>
<td>27</td>
<td>n.a.</td>
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<tr>
<td>TCP</td>
<td>Turkmenistan</td>
<td>Azerbaijan</td>
<td>SCP</td>
<td>30</td>
<td>n.a.</td>
</tr>
<tr>
<td>Persian Pipeline</td>
<td>Iran</td>
<td>Turkey</td>
<td>?TANAP?</td>
<td>37-40</td>
<td>n.a.</td>
</tr>
<tr>
<td>East Med</td>
<td>Israel</td>
<td>Greece, Italy</td>
<td>Cyprian gas fields</td>
<td>9-12</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Game theoretic analysis of the different scenarios can help us deciding which projects will be realized in the future.
Thank you for your attention!