

STRATEGIC PIPELINES IN THE EURASIAN GAS NETWORK

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Overview

We measure the strategic value of a new pipeline in a given network by the impact which it has on the power structure of the associated cooperative network game. The game is defined on a calibrated model of the Eurasian gas network. We compare two power indexes (solution concepts): the Shapley value and the nucleolus, which is a unique point in the core, and consider three projects in detail: 'Nord Stream' and 'South Stream', allow Russian gas to bypass transit countries, Ukraine and Belarus. The third project, 'Nabucco', aims at diversifying Europe's gas imports by accessing producers in Middle East and Central Asia.

Methods

We define and calibrate a pipeline network with 35 nodes and 40 links and 20 players, each of whom controls only some parts of the network. For each possible combination of players we determine the accessible sub-network and solve the associated quadratic gas flow optimization problem to obtain the so called value (or characteristic) function of the cooperative game. For this value function we then calculate the Shapley Value and the nucleolus as alternative power indexes. Then we add a new pipeline or section of pipeline obtaining a new network and repeat the process. The differences in the power indexes before and after the investment yield the strategic impact of the project on the different players. Finally, we assess whether the gains of the involved players (the members of the pipeline consortium) exceed the project cost. In this case the pipeline is strategically viable.

Results

For the Shapley Value we obtain a clear ranking of the projects which corresponds to the observed investment patterns. Nord Stream's strategic value is huge, easily justifying the high investment cost for Germany and Russia. The additional leverage obtained through South Stream is much smaller and it can be shown, that Russia would not invest, if the section in the Balkans is not exempted from EU regulations on open third party access. Nabucco is not viable. For the nucleolus in contrast, none of the pipelines has any strategic relevance at all, which contradicts the empirical evidence on investment. All the results are robust with respect to reasonable variations in the parameters.

Conclusions

We show that the Shapley Value has a high predictive power in explaining strategic pipeline investments in the Eurasian pipeline network for natural gas. The nucleolus in contrast, appears to be poor indicator of changes in the power structure. We also find that pipelines which have very little value in narrow economic terms, i.e. add little value to the network as a whole, may nevertheless be of large strategic importance for some players.