DIVERSIFICATION STRATAGIES IN THE EUROPEAN NATURAL GAS MARKET – OPTIMAL INVESTMENT DECISION IN INFRASTRUCTURE

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Overview

The European natural gas market is facing a number of changes in the mid to long term. Decreasing European production, especially in the Netherlands until 2030, entails a growing level of imports in many non-producer countries. Future demand of natural gas within European countries is subject to a great number of uncertainties emanating from both the power and heat sectors. Additionally, due to ongoing geopolitical tension, e.g. Russia-Ukraine crisis, and the goal of security of supply, the European Union (EU) has put forward plans to pursue the strategy of creating an EU Energy Union in order to diminish its dependence on Russian natural gas supplies. In recent years, many proposals for diversifying the natural gas supply mix have been discussed. From a technical point of view, the options for limiting the power of a single dominant supplier are twofold:
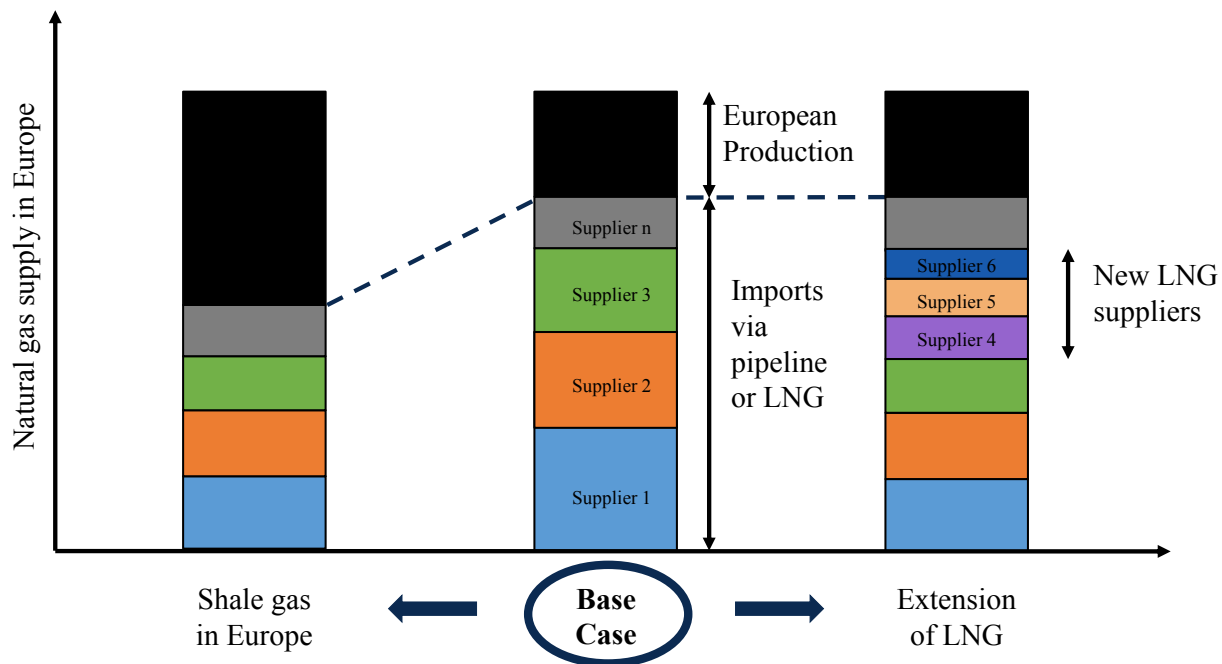

Figure 1 Impact of shale gas and LNG on a diversified supply structure of natural gas in Europe

As depicted in Figure 1, under the assumption of a constant demand, the first option involves expanding domestic production through the permission of shale gas production. All things being equal, rising domestic production would lead to a decreasing share of foreign supply. As there are many public reservations and the economic viability remains questionable, shale gas is not viewed as being a feasible alternative to decreasing the power of dominant non-European suppliers. The second option entails a diversification of the import share. In this context, investment decisions in new natural gas infrastructure are becoming increasingly important. Projects that are currently being discussed include:

- new pipelines to bypass transit countries like Ukraine (South Stream)
- new pipelines to new supply countries, e.g. in Middle East and Caspian region (Nabucco, TANAP)
- pipeline extensions to increase transportation capacities (Nord Stream 2)
- fostering security of supply through installing reverse flows within Europe (esp. to Eastern Europe)
- new LNG import terminals (e.g. in Balic states)

In this context, this paper addresses the two following research questions:

- Which combination of investment decisions would foster security of supply in the European natural gas market most cost efficiently?
- What are the impacts of diversification strategies on gas prices and trading patterns in the European natural gas market?

Methods

For analysing the optimal diversification strategy for European countries the model GAMAMOD is used. The basic version of GAMAMOD involves a bottom-up model devised to determine the optimal supply structure under perfect competition. The model is formulated as a linear problem and is implemented in the General Algebraic Modelling System (GAMS). The objective function minimises total system costs. These include costs for production, transportation via pipeline and LNG shipping as well as costs for storage utilisation. To analyse optimal investments in infrastructure, the extension of GAMAMOD is configured to incorporate multi-period endogenous investment decisions in new pipelines, reverse flow capacities and new LNG import and regasification terminals. This approach computes the optimal mix of investments in infrastructure regarding a given set of investment opportunities (based on proposed projects).

While GAMAMOD provides an optimal solution for the entire natural gas system, the market equilibrium model accounts for the strategic behaviour of individual market players. Hence, high resolution data of individual infrastructure facilities is aggregated into market areas. Taking the investment decisions in infrastructure from GAMAMOD into account, the market equilibrium model determines price levels in European natural gas market areas. Three scenarios reflect different policies on diversification and security of supply for European countries. With respect to market prices, the results of each scenario are compared and optimal investments in infrastructure under different diversification policies are assessed.

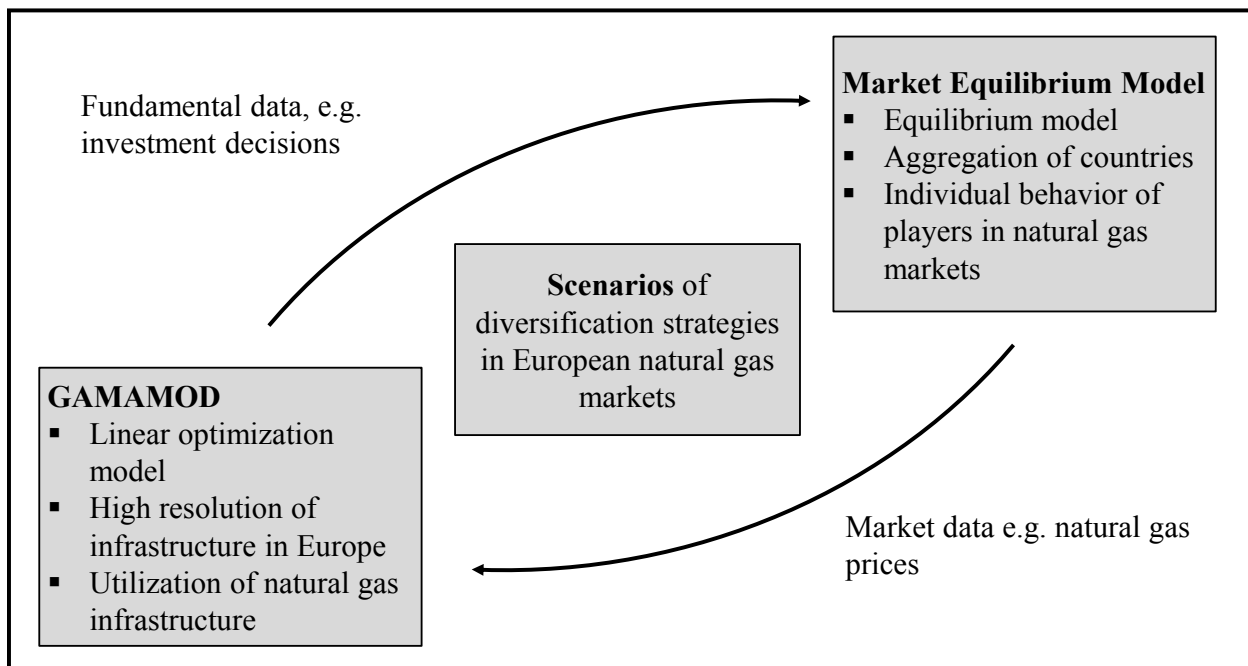Figure 2 shows the coupling of GAMAMOD and the market equilibrium model.

Figure 2 Structure and interfaces of coupling GAMAMOD and the market equilibrium model

Expected Results

Although research is still ongoing, it is anticipated that different diversification strategies for European countries gas supply will be identified. While Eastern European countries could profit from new supply lines from the Middle East and Caspian Region, Central and Northwest European countries could foster efforts to increase capacities in regasification facilities for LNG. At this stage, it is difficult to estimate to what extent new pipelines can substitute for LNG supplies and vice versa. Additionally, the results of the market equilibrium model will provide insights into the reaction of established suppliers, e.g. Russia, to the development of new infrastructure projects. As long as transmission capacities from Russia to Europe prove to be sufficient (realisation of Nord Stream II and South Stream), it is unlikely that the model results will entail the completion of a large number of proposed projects. If further constraints are incorporated into the model, e.g. a requirement that European countries (esp. Baltic states) diversify their supply mix, the need for alternatives and the willingness to invest are sure to increase.

Conclusions

The European natural gas market is characterised by decreasing domestic production and a growing dependence on non-European imports. Due to current political tensions, a diversification away from Russian natural gas in gaining in importance. This paper focuses on expanding import capacities. On the basis of different scenarios, an optimal investment in new pipelines, reverse-flow facilities and LNG import terminals is computed. Taking these investments into account, market prices and trading flows are analysed. Diversification and security of supply require new investments which entail future costs. To guarantee the security of supply in the European natural gas market, legislators need policy recommendations including the value of the respective diversification strategies. The results of this work can contribute to these issues.

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