ASSESSMENT OF KOREA'S LNG IMPORT PORTFOLIO USING A COMPLEX PORTFOLIO MODEL

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Overview

The stable supply of energy, an essential factor in economic growth, is a major political issue in many countries (Winzer, 2012). However, since the 2000s, the threat of terrorism to energy infrastructure and transportation has increased, as have the incidence and ripple effect of natural disasters such as hurricanes(Yergin, 2006). As a consequence, the view of energy security has extended beyond the stable securing and diversifying of energy sources to embrace all energy supply infrastructures related to transportation and utilization(Yergin, 2006).

South Korea cannot import natural gas in any form other than LNG because of the division of South and North Korea. Further, the high proportion of natural gas in the national energy mix makes this resource crucial for energy security in Korea. Against this background, in this study, we review the LNG import portfolio model by considering the uniqueness of the Korean context in general and its natural gas market in particular. In order to account for the natural gas value chain, the presented model includes both intangible weight factors such as national risks, natural disaster risks, and transportation risks and tangible weight factors such as supply capabilities and import prices.

To analyze these weight factors more effectively, our model applies a Fuzzy AHP(Analytic Hierarchy Process). Applying AHP enables this research to reflect the tangible and intangible costs more accurately by using weights based on importance instead of applying the same weight to all costs. The pre-existing natural gas import model(Biresselioglu et al., 2012) does not consider trading through long-term and spot contracts individually when determining country-level import volume. However, since demand for natural gas differs markedly between winter and summer, spot trading is used in winter to cope with natural gas shortages. Accordingly, to consider the use of spot contracts in this way, the present study composes and presents a complex two-step model: the first step consists of the portfolio model to which the mean-variance model and linear programming model are applied in the second step. Finally, this study evaluates the LNG portfolio results obtained from these models by using Lefèvre's (2011) energy security index. Based on these results, we assess the portfolio for LNG import to Korea from the perspective of energy security and present some relevant policy proposals.

Methods

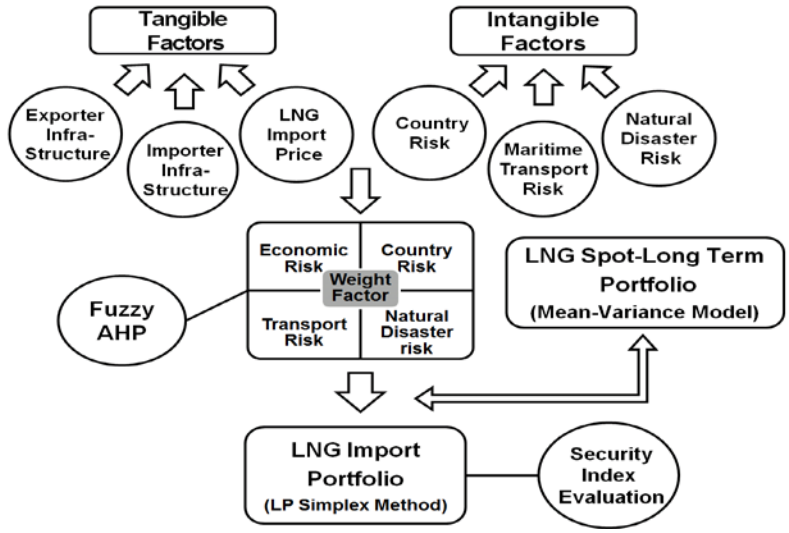

Figure 1. The framework of this study

Figure 1 shows the framework of this study. The model comprises two steps. First, to obtain the optimal purchase ratio, the study examines the price level and the correlation between long-term and spot contracts by using the mean variance portfolio model. The purchase ratio follows the efficient frontier of the cost/risk level related to this price

level and degree of correlation. Second, by applying the obtained long-term contract purchase ratio as the constraint equation in the linear programming portfolio model, we determine the LNG import portfolio that minimizes total tangible and intangible costs

Results

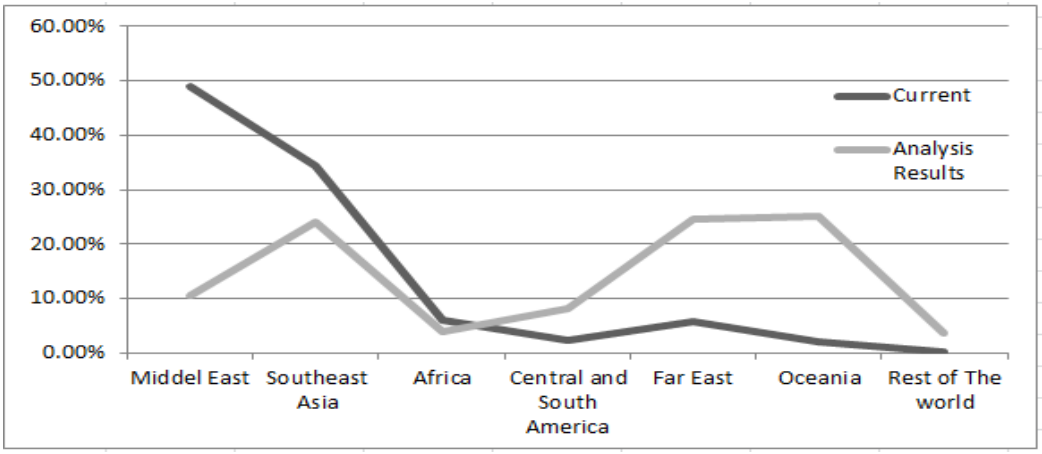

Figure 2. Comparison for current and analysed results of each continental region

First, the optimal ratio between long-term and spot contracts was 94.45% and 5.55% with respect to the cost/risk level. We obtained the economic risks, national risks, maritime transportation risks, and natural disaster risks by analyzing the tangible and intangible factors using the AHP survey results. Then, by applying the AHP results and optimal purchase ratio, we deduced the country-level and continental region-level LNG portfolios.

The analytical results of this study show that the supply ratio in the Middle East and in Southeast Asia decreased, while that in the Far East and Oceania greatly increased, as shown in Figure 2. Moreover, at the continental region scale, the natural gas security index of Korea, measured by using actual data on Korea for 2012, was 3.93. On the contrary, the adjusted natural gas security index of Korea, measured by using the supply ratios adjusted by the new portfolio, was only 1.87, indicating that Korea's natural gas security index greatly improved compared with the security index based on actual supply

Conclusions

In this study, given the nature of the value chain in the LNG industry, we constructed and assessed an LNG supply portfolio model considering tangible and intangible costs in order to improve supply stability from the perspective of energy security. We developed a complex portfolio model that reflects the price level, correlation between long-term and spot contracts, and tangible and intangible costs based on the LNG value chain. The optimal LNG import portfolio calculated in this study has significant policy implications. However, because long-term contracts dominate the natural gas market in Korea, it is not possible to control the LNG import portfolio in the short run. Nevertheless, the findings of this study can be applied to formulate LNG supply policy in the long run, which would significantly improve security policies and reduce the tangible and intangible costs incurred.

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