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Evaluating Chokepoints Ratio in Maritime Transport

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Keywords

maritime transport, chokepoints, energy and natural resources, commercial maritime data, sea lane network

Overview

For countries, which have relatively low self-sufficiency of energy supply, strengthening energy security is a crucial issue in Energy Policy. Especially, in Japan almost energy and natural resources imports are imported by the maritime transport. It is, therefore, necessary to consider safety of the sea lanes for energy security. One of policies to ensure the safety of the sea lanes is a decrease in a frequency of passing through the global chokepoints, that is, a dependence on chokepoints. The previous work with respect to an analysis for the chokepoints includes METI/ANRE [1]. METI/ANRE [1] evaluates the dependence on chokepoints by means of an import data for energy and natural resources. Since in METI/ANRE [1] the chokepoints ratio is estimated by a route from importing country to exporting one, this evaluation approach is a static one. In order to obtain dynamic chokepoints ratio, it is necessary to consider a more sophisticated approach.

In this paper, we calculate the chokepoints ratio with respect to the transport of oil for each country by a dynamic model. We show the difference of the approach between this work and previous work. In addition, we also show how the dependence on the Middle Eastern oil affects the chokepoints ratio.

Methods

In this work, we calculate the chokepoints ratio by means of a commercial maritime data (Lloyd's List Intelligence) and a sea lanes network data. The sea lanes network data is composed of nodes such as port, canal and way point, and links between the nodes [2,3]. We assume that the route from a departure point to a destination is the shortest pass on the sea lanes network. As a result, the passage volume of sea lanes in one degree increment of longitude and latitude is shown in Fig. 1.

We define the Bosphorus Straits, the Suez Canal, the Bab el Mandeb Straits (the Coast of Somalia), the Hormuz Straits, the Malacca Straits and the Panama Canal as the chokepoints in this work (Fig. 2). Additionally, we assume that the chokepoints ratio is one of a total amount of maximum weight of a sip passing through the chokepoints to a total amount of maximum weight of a sip to importing country.

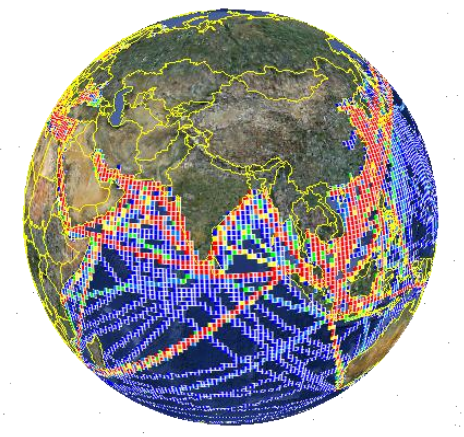

Figure 1. Sea-lanes network

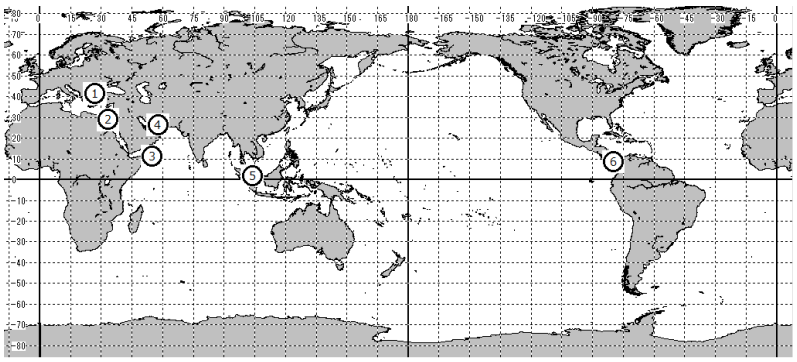

Figure 2. Main chokepoints

Results

In the previous section, we present a model that enables an analysis of the chokepoints ratio with respect to oil import. In this section, we present the numerical analysis that shows the chokepoints ratios for each country and an effect of the import decreasing ratio on the chokepoints ratio.

Fig. 3 shows the chokepoints ratios for France, Germany, UK, US, China, Japan, and South Korea compared to METI/ANRE [1]. The blue and red bars represent numerical results of this work and METI/ANRE [1], respectively. As shown in this figure, although the approach for calculating the chokepoints ratio in this work is different from that in METI/ANRE [1], both results are similar to each other. The chokepoints ratios of Asian countries such as China, Japan, and South Korea are large values compared with other countries. It is, especially, found that in Asian countries, the chokepoints ratios of Japan is the largest value. This is because that the dependence on the Middle East oil is relatively high.

In order to investigate the effect of the oil import from the Middle East in Japan, the relationship between the chokepoints ratio and the import deceasing ratio is shown in Fig. 4. The import decreasing ratios represent the decreases in oil import from the Middle East countries by 5%, 10%, 15%, and 20%, respectively. It can be seen from this figure that the chokepoints ratio decreases as the import decreasing ratio becomes large.

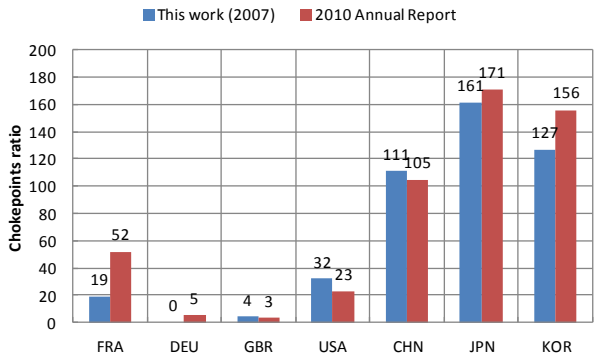

Figure 3. Chokepoints ratios for individual countries

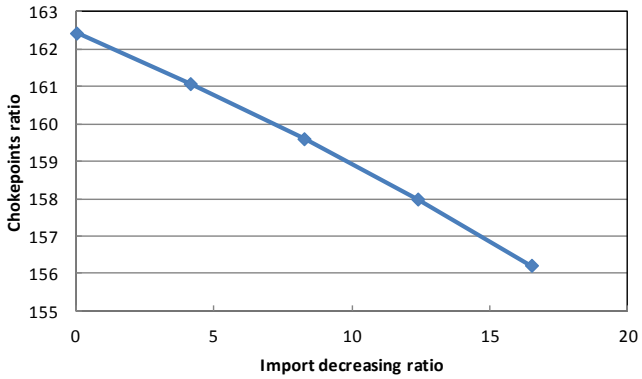

Figure 4. Effect of the import decreasing ratio (2010)

Conclusions

In this study we evaluate the chokepoints ratio for the maritime transport by means of the commercial maritime data and the sea lane network. We show that the approach in this work is similar to the result of previous work by different approach. Furthermore, we show the effect of decrease in oil imports on the chokepoints ratio. Although this paper analyzes the chokepoints for dependence on the Middle Eastern oil, it is also necessary to consider scenarios taking into account economics and diversity. In the future, we will extend the evaluation model in this paper to introduce transport cost and diversity index for each scenario.

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