Quantifying China's oil import risks and the impact on the national economy

Mei Sun [a,*], Cuixia Gao [a], Bo Shen [b]

[a] Center for Energy Development and Environmental Protection, Jiangsu University, Zhenjiang, Jiangsu 212013, PR China
[b] China Energy Group, Energy Analysis and Environmental Impact Assessment Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, One Cyclotron Road, MS 90R4000, Berkeley, CA 94720, United States

HIGHLIGHTS

- Quantifies China's OIR while taking into consideration the risks from oil-exporting countries and the risks from oil transportation routes.
- Explores the relationship between China's OIR and oil import costs using a multiple linear regression approach.
- Analyzes the effects of China's OIR on the investment cost of domestic sectors with an input–output analysis.
- Investigates the impact of China's OIR on the domestic economy.

ARTICLE INFO

ABSTRACT

With an increase in China's oil imports, China's oil supply will also continue to be effected by the socio-economic stability of oil-exporting countries and the safety of oil transport routes. This paper introduces a systematic and quantitative method to evaluate the influence of China's oil import risks (OIR) on the national economy and industrial sectors from a perspective of apply chain process. For this analysis, China's OIR is quantified by integrating oil exporting country risk and the risks from oil transportation routes. Country risk is defined as the oil-exporting country's political risk caused by political changes or internal conflicts. Transport risk is defined as the risk of shipping routes affected by pirate attacks and geopolitics. Second, the relationship between China's OIR and oil import costs is analyzed using a multiple linear approach. Third, an input–output analysis method is used to research the effect of the cost of China's oil imports on the cost of investment within China's domestic sectors. This research finds that the corresponding impact on GDP is 3494.5 million dollars given an increasing by 10% of China's OIR. And the impact on domestic sectors differs from sector to sector. Finally, this paper puts forth recommendations to improve long-term oil supply security in China.

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1. Introduction

In 2003, China was already the world's second-largest oil importer, surpassing Japan, with total oil consumption at 245.7 million tons. Simultaneously, China's oil import dependency has been increasing and reached 56.3% in 2012. As China is actively engaging itself in the world oil market, volatile international markets have had ever-increasing impacts on the Chinese economy. Hence, it is imperative to analyze and understand China's OIR and its impact on the domestic sectors' costs as well as China's overall economic development.

Due to this topic's growing importance, there have already been a number of studies focusing on China's OIR. Cao and Hu (2008) thought that China's OIR was composed of three parts—political and economic risk, transport risk, and the risk of variability in oil import prices. Lesbirel (2004) quantitatively measured both systematic and specific risks associated with Japanese energy imports using Sharpe's One-way Analysis of Variance. Wu et al. (2007, 2009) used an improved portfolio approach to quantify the diversification index of China's crude oil imports, compared and analyzed the supply, price and transport risks of crude oil and petroleum product imports. The results showed that the average rate of return of China's petroleum product imports was lower than that of crude oil imports, and that China should increase petroleum product imports to decrease its oil import risk. He et al. (2009) proposed an OICR Index that included country risk to evaluate oil-importing risk. Li et al. (2011) focused on oil-importing decision optimization based on a multi-objective

* Corresponding author. Tel.: +86 13775366657; fax: +86 51188791467.
E-mail address: sunm@ujs.edu.cn (M. Sun).

programming approach with considering country risk as the main objective to minimize risk exposure of importing disruption. Zhou and Zhang (2012) designed a risk index of China's crude oil imports from the main oil-exporting countries based on ITIRI and the transport security of crude oil. Zhang et al. (2013) constructed an evaluation framework for oil import security using a supply chain process and built a two-phase DEA-like model to evaluate oil import security.

In addition, the input–output model became an important method used in the investigation of the connection between oil import risk and national economics. Tang et al. (2011) analyzed the direct, indirect, and induced impacts of China's petroleum industry by using the input–output approach. Tang et al. (2012) established an input–output model to calculate oil embodied in the international trade of China. Ilkin et al. (2012) provided empirical research to identify the linkages between final demand and total output, final demand and total supply, value-added ratios and prices, and also analyzed total factor productivity growth using the input–output framework for 25 sectors. Kengo and Yohji (2010) proposed an analytical framework combining the input–output model and the portfolio approach, and estimated a risk of an increase in the producer price in Japanese non-energy sectors during the period 1970–2000.

The above articles analyzed oil import risks with a wide assortment of methods, and provided a large number of ideas and methods for us. Some preliminary quantitative analysis on either OIR or economic influence based on input–output model has been done. This paper attempts to quantify the total of China's OIR with considering country risk of oil-exporting countries and transport risk from the overall perspective of China's oil supply-demand, explore the relationship between China's OIR and oil import costs using multi-linear regression approach. The influence of China's oil import costs on the investment cost of domestic sectors is analyzed using input–output analysis. Finally, this paper puts forth recommendations to improve long-term oil supply security in China.

The outline of this paper is as follows. In Section 2, we introduce the present situation of China's oil supply-demand. In Section 3, we quantify China's OIR based on the information in Section 2. In Section 4 and Section 5, we analyze the impact of China's OIR on oil import costs and the costs of domestic sectors. In Section 6, we draw some conclusions based on previous analysis.

2. The situation of China's oil supply–demand

2.1. China's oil import sources

China's international oil market can be separated into five main regions: Middle East, North Africa, West & Southern Africa, Eurasia, South America and Asia Pacific. In these regions, 16 countries are determined by the proportion of oil exports to China above 1% in the past 10 years (Tian, 2006, 2012), detailed in Table 1.

2.2. Transportation routes of China's oil imports

Tankers and pipelines are the main modes of transport used to import oil into China. China's five shipping routes are Middle East Route, North Africa Route, West & Southern Africa Route, South America Route and Asia Pacific Route. Risk nodes for each shipping route are shown in Table 2.

Oil pipeline transport channels in China include the China–Kazakhstan pipeline, China–Russia crude oil pipeline and China–Myanmar crude oil pipeline which alleviate China's dependence on shipping transport. But it also brings some uncertainties such as Myanmar unrest or the event of Diaoyu islands in South China Sea.

2.3. Sectors of China's oil consumption

In China's economic system, industries can be grouped into 42 sectors according to China's 2007 input–output table which was published in 2009 (National Bureau of Statistics of China (NBSC), 2012). Based on the analysis above, China's oil supply–demand system can be represented in Fig. 1.

3. China's oil import risks

The growing risks of oil-exporting country's political instability and international politics are many, including the unstable of political and economy of oil-exporting countries, intrastate conflict in oil producing states, volatility of oil price, pirate attacks, and natural climate, resulting in China's increasing risks of oil imports. Combining factors from country risk and transportation risk, this paper quantifies China's OIR. Due to the limited availability of date, this paper considers shipping risk only and neglecting the risk of China's pipeline transportation. The impact of China's crude oil pipeline is discussed in Section 5.3. The quantitative formula of China's OIR can be computed as follows:

$$R = \omega_1 \overline{R_1} + \omega_2 \overline{R_2} \tag{1}$$

where $\overline{R_1}$ measures the total country risk of exporting regions. $\overline{R_2}$ is the total transport risk of China's oil imports. ω_1 and ω_2 are the weights of country risk and transport risk respectively.

Table 2
The risk weights of major source countries of China's crude oil import.

Countries	Weights (%)	Countries	Weights (%)
Saudi Arabia	19.45	Sudan	3.7
Iran	9.31	Libya	1.96
Oman	7	Angola	14.52
Yemen	1.41	Congo	2.2
Kuwait	3.91	Russia	7.71
United Arab Emirates	2.7	Kazakhstan	4.19
Venezuela	4.45	Brazil	2.89
Iraq	5.3	Australia	1.61

Table 1
Regions and countries of China's oil import sources.

Region	Country
Middle East	Saudi Arabia, Iran, Oman, Yemen, Kuwait, Iraq, United Arab Emirates
North Africa	Sudan, Libya
West & Southern Africa	Angola, Congo
Eurasia	Russia, Kazakhstan
South America	Venezuela, Brazil
Asia Pacific	Australia