



Features and evolution of international crude oil trade relationships: A trading-based network analysis



Haizhong An ^{a, b, c}, Weiqiong Zhong ^{a, b, c, *}, Yurong Chen ^{a, b, c}, Huajiao Li ^{a, b, c}, Xiangyun Gao ^{a, b, c}

^a School of Humanities and Economic Management, China University of Geosciences, Beijing, China

^b Key Laboratory of Carrying Capacity Assessment for Resource and Environment, Ministry of Land and Resources, Beijing, China

^c Lab of Resources and Environmental Management, China University of Geosciences, Beijing, China

ARTICLE INFO

Article history:

Received 28 March 2014

Received in revised form

11 June 2014

Accepted 25 June 2014

Available online 18 July 2014

Keywords:

International crude oil trade

Complex network

Trading-based relationship

ABSTRACT

Traditional international trade theories have some limits in analyzing international crude oil trade as a system with numerous countries and complicated relationships. Complex network theory provides a method to analyze the world-wide trade system entirely and partly. Complex network models on direct relationships are fundamental analysis; we went further and established a new model based on indirect relationships.

This paper established a trading-based network model of international crude oil to study the relationship between countries with common trade partners. There are two types of networks in our model: importing-based network and exporting-based network. We studied their evolution of scales, stability, hierarchy structure and partition over time.

We found that the international crude oil trade is evolving into a stable, ordered and integrated system, and different types of events show different impacts on the importing and exporting countries, thus we provided different policy implications.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

The uneven distribution of crude oil production and consumption shapes the international crude oil trade. As one of the most important commodities for national development and people's living, the international crude oil trade patterns and the relationships between countries are increasingly concerned by researchers and policy makers [1–3].

Traditionally, crude oil trade is studied by international trade theory. Most of the previous studies focus on oil price [4–7], markets [8], risks [9], and policy optimization [3,10]. In recent years, gravity model is also applied to study the global oil trade patterns [11]; the oil import security of China is studied from a perspective of supply chain process [12]; and the political factors affecting the international oil trade patterns and the U.S. firms are also studied by researchers [13]. These studies obtain abundant achievements with practical significance. However, they only analyze a few

countries or the abstract market while the real international trade is a system with numerous countries and complicated trade links.

Recently, some scholars have introduced complex network theory into the study of international trade. Complex network method can analyze the world-wide trade system entirely and partly, so as to reveal many new features of the international trade topologically and dynamically [14–17]. Also, on international crude oil trade, some researchers studied the regional energy security and global oil trade patterns by analyzing the patterns of crude oil trade network [18,19].

So far as we know, most of the previous complex network models for international trade are based on the direct trade relations, i.e., setting countries as nodes and their trade links as edges. Modeling direct relationships is the fundamental step of network analysis. However, we can go further and establish a new model based on indirect relationships.

The network model on indirect relationships has been applied to the study of the stock holdings. If two fund managers invest in the same stock, they are informationally connected with each other. Thus, a holding-based network model can be constructed and be analyzed by complex network method [20–22].

* Corresponding author. No.213, 4th Building, No. 29, Xueyuan Road, Beijing 100083, China. Tel.: +86 01082323783; fax: +86 01082321783.

E-mail address: ahz369@163.com (W. Zhong).

Our study is the first one to introduce the concept of indirect relationships into the study of international crude oil trade. We defined our model as trading-based network model, i.e., if two countries share the same crude oil trade partners, they will have a trading-based relationship between them. According to the flows of the crude oil, the trading-based relationships can be divided into two categories, importing-based relationships and exporting-based relationships. Thus, we can construct two types of network models.

Trading-based network reveals the competition and cooperation between countries. For example, in the importing-based network, the production capacity of an oil-producing country is limited, if this country significantly increases its exporting volume to one country, the share of other countries will be reduced inevitably. This is the competition between importing countries. In other cases, countries importing from the same country can get together to apply trade sanctions to this country. This is the cooperation between importing countries. The traditional network model with direct trade relations cannot reflect the competition and cooperation relationships between countries.

In this paper, Section 2 introduces the data and the process of modeling. Section 3 applies network analysis on features and evolution of the network scale, stability, hierarchy structure and partition. Section 4 is the discussion and conclusion remarks.

2. Data and model

The data on international crude oil trade is downloaded from UN Comtrade, which contains crude oil export and import flows among 181 countries in the world. We selected the annual crude oil trade data of all the countries from 1993 to 2012.

There are two types of trading-based network of the international crude oil trade; one is exporting-based network, and the other is importing-based network. The modeling of the two networks is shown in Fig. 1.

Suppose there are crude oil trade relationships among five countries named A, B, C, D and E in a certain year. If A exports crude oil to B (the solid line with arrow), and D exports crude oil to B at the same time, we can define that A and D share an exporting-based relationship (the dashed line). Thus, country A and D are defined as nodes in the exporting-based network model. Their exporting-based relationship is defined as the edge between them. The weight of this edge is 1, because A and D have only one common exporting partner (country B).

Country B imports crude oil from A, and C also imports crude oil from A (the solid line with arrow); we can define that B and C share an importing-based relationship (the dashed line). Thus, country B and C are defined as nodes in the importing-based network, and their importing-based relationship is defined as the edge between them. The weight of this edge is 2, because B and C have two common importing partners (country A and E).

The real crude oil trade network is composed of numerous countries and trade links; therefore, there are thousands of exporting-based and importing-based relationships. We took the importing-based network in 1993 as an example to show the nodes and edges. The width of the edge represents the weight: the wider the edge is, the higher the weight will be (see Fig. 2).

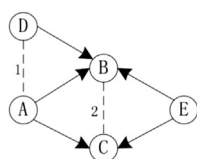


Fig. 1. Modeling of the trading-based network.

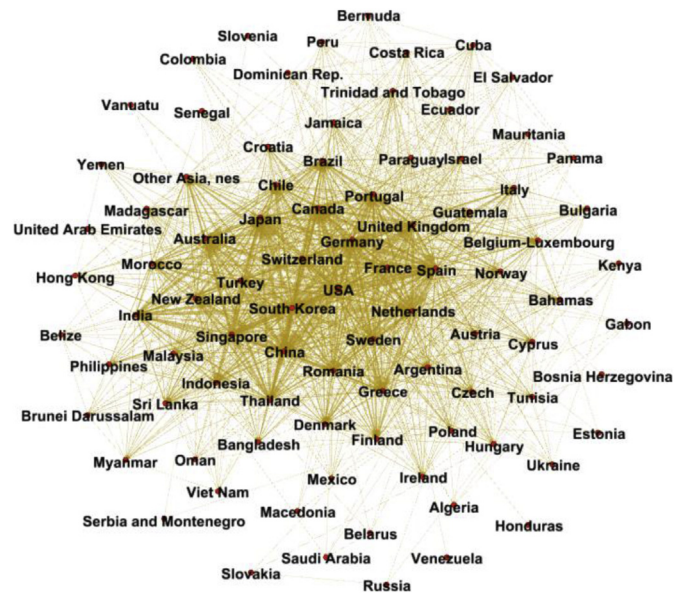


Fig. 2. Importing-based network in 1993.

3. Network analysis

3.1. Descriptive statistics: scales of the networks

The total number of nodes is the scale of the trading-based network that indicates how many countries share the same trade partners with others. It can reflect the whole trade patterns of crude oil. The total number of edges is the total number of trading-based relationships in the international crude oil trade, which reflects the coherence of the trade strategies of the countries. Fig. 3 shows the number of nodes and edges in both types of networks from 1993 to 2012. During the whole period, the importing-based network and exporting-based network have some common characters. Firstly, all the curves show upward tendency from 1993 to 2012. This means that as the world economy is rapidly developing, the total demand of crude oil is also rocketing, thus, more trade relations are built. Countries are expanding their trading ranges to reduce risks and to enhance national energy security. Secondly, there are more nodes and edges in the importing-based network than those in the exporting-based network. This indicates that the crude oil trade strategies of importing countries are relatively more coherent, because same importing sources create trading-based relationships. However, the strategies of the exporting countries are less coherent.

Before 2003 the scale of both the importing-based network and the exporting-based network were increasing, while the scale of the exporting-based network shrank slightly in 1997 and the scale of the importing-based network shrank slightly in 1998 (Fig. 3A). This phenomenon may be due to the Asian financial crisis in 1997. The sharp decrease of crude oil demand of the Asian countries affected the exporting countries at first, and then affected the importing countries. However, this impact was not so significant on the range of the importing-based relationships. In Fig. 3B, only the range of the exporting-based relationships was affected. This is because when some countries reduced their trade relations, they may have no common trade partners, and they disappeared from the network model. However, exporting countries diversified their trade strategies by seeking for new customers in order to maintain their profit. Thus, new trade relations were built. The importing countries remaining in the network obtained more importing-based relationships.

Download English Version:

<https://daneshyari.com/en/article/1732459>

Download Persian Version:

<https://daneshyari.com/article/1732459>

[Daneshyari.com](https://daneshyari.com)