



Network-based study on the relationship between arms exports and foreign policies



Xing Chen^a, Ru-lan Zhao^a, Zi-ke Zhang^b, Jing Zhao^{a,*}

^a Department of Fundamental Studies, Logistical Engineering University, Chongqing, 401311, China

^b Alibaba Research Center for Complexity Sciences, Hangzhou Normal University, Hangzhou, 311121, China

HIGHLIGHTS

- We measure correlations of arms exports between the top 20 arms export countries.
- We construct an arms export network to weigh the importance and influence of the exporters with the change of time.
- The interactions between exporters are revealed by clustering with time lag.

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ABSTRACT

According to the data of arms exports of the top 20 largest arms exports countries in 1993–2012, an arms exports network is constructed to study the relationship of the exporters. Then the topological properties of the network and its minimal spanning tree are calculated to weigh the influence and importance of a country in all exporters, and the time evolution of the properties. It turns out that the properties fluctuate with the time. Consequently, the correlations of the arms exporters are discussed with the recipients during and after the wars. Besides, a time delayed network is constructed. The correlations of the exporters with time lag are discussed by filtering the time delayed network in different ways. The interactions between the exporters are visualized after filtering. This study may shed new light on how arms exports reflect foreign policies.

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1. Introduction

Arms export is a good business when nations are at war, or when they fear it, in case that the weapons manufacturers strictly adhere to market principles [1]. But most of governments have established controls over private arms sales [2], thus the arms export becomes an instrument of foreign policy for the government. That means the arms exports reflect the foreign policies in some extent.

Nowadays there is no secret in global arms exporters. Most of the exporters are developed countries. In 1993–2012, the top 5 exporters are the USA, Russia, Germany, France, and UK [3]. They occupy larger shares of market than the other countries, which are in proportion to their international influence. The developing countries are the largest importers, though the import has a negative impact on developing nations. The developing countries undertake more pressure of security from arms race, domestic security, and the conflict in geographically proximate even though there is no conflict. They prioritize arms to development, which means that the exporters face a big market of demand even in peace time. Consequently, the arms exports are more and more important as an instrument of foreign policy for the government.

* Corresponding author. Tel.: +86 18623032819.
E-mail address: zhaojanne@gmail.com (J. Zhao).

After the Cold War era, the western political leaders have placed ethical and moral considerations at their foreign policy discourse [4–6], meanwhile, humanitarian principles began to play a growing role in arms exports. Most of western exporters advocate promoting and advancing the respect for human rights in recipient countries of arms [7]. Actually, their talks were inconsistent with actions, due to contradictory interests, obligations and incentives [8,9]. Some exporters may consider more about the politics and prices than moral concerns [10], when they sell weapons. In another word, they inclined to export the arms in terms of the self-interest, economic and geopolitically-important relational ties. Although the foreign policy of a country might be decorated with great rhetorical skill, the figures of arms exports could not be. Therefore, we can explore the foreign policies of the countries and its influences through the exports of the arms and its time evolutions.

In this paper, we study the relationship between arms exports and foreign policies based on network analysis. At first, we use the arms exports data of the top 20 arms exporters during 1993–2012 to calculate a distance matrix with an initial time t_0 , and time window T . Then an arms export network is constructed based on it. Second, we discuss the properties of networks and its time evolutions. At last, we discussed the time-delayed network and the correlations between the exporters.

To analyze the influence of a country's foreign policies systematically, we create a minimal spanning tree (MST) of the network. We apply network topological properties such as node strength and betweenness to study the importance and influence of a country's exports in the whole arms export network. For visualizing the trend of properties of arms exporters, we divide the whole spanning time into three parts, 1995–2000, 2001–2006, and 2007–2012, respectively to construct networks. Then, we calculate the topological properties of these networks. We discuss the influence of exporters with the evolving of time. Besides, to get more information about the influence of a country with the change of time in arms export network, we calculate the node strength by a moving time window as well. Accordingly, we compare the change patterns of the node strength with moving time windows about the USA, Russia, and France during 1993–2009. Then the wars or conflicts during the period are discussed to analyze the correlations of those countries.

To further analyze the correlation of arms exporters during wars, we calculate a mean distance matrix and its variance with time window $T = 4$ and initial time t_0 . We discuss the relationship between exporters and wars at different initial time t_0 .

To explore whether one exporter followed the exports policies of another exporter, we consider the time lag in the arms exports, and define a time delayed distance. Through filtering the time delayed matrix in different ways, we obtain networks of opposite and similar patterns corresponding to a special time t in the arms exports. The nodes linked in the structure of opposite exports patterns have more different export patterns, which might illustrate the competition in the markets. Meanwhile, the nodes linked in the network of similar exports patterns have more similarities in their exports patterns, which might be accounted for the cooperation of the exporters in arming their alliance or opposition of the exporters in supporting opposite arms recipients.

2. Materials and methods

2.1. Data collection

The data we investigate are downloaded from the web of Stockholm International Peace Research Institute (SIPRI) (<http://portal.sipri.org/publications/pages/transfer/tiv-data>), which is generated on 20 March 2015 [3]. This database only includes conventional weapons, which have been widely used by governments/combatants to maintain their grip on power [11]. In this database, the SIPRI Trend Indicator Values (TIVs) are used to indicate the volume of arms exports rather than the actual money paid, which is closer to the real value of the arms exports [12]. The TIVs are expressed in US\$m. at constant (1990) prices, which cover major conventional arms transfers based on reports of licensed transfers from particular countries.

We choose the data of the top 20 largest countries from 1993 to 2013, the period marks the beginning of a new wave after the disbanding of Soviet Union and the unification of Germany, and the exports of these counties account for more than 90% of total exports in the world. A '0' in the data indicates that the value of deliveries is less than US\$0.5 m, which means we lose some values as well. Besides, for the black spaces in the values we treat as zeros as well in the paper. See Table 1 for details of these countries, as well as their ranks of total figures of TIVs during the period.

We also use the Arms Transfer Database provided by SIPRI (<http://portal.sipri.org/publications/pages/transfer>), which includes detailed arms transfer information during a spanning time, such as exporters, recipients, the weapons and so on.

2.2. Arms export network and its properties

We first use radian distance to measure the similarity of arms export between countries. Let $P_i(t)$ be the export TIV of a country i at time t . We standardize $P_i(t)$ to reduce the influence of dimension as follows:

$$r_i(t) = (P_i(t) - \overline{P_i(t)}) / \sqrt{\frac{1}{19} \sum_{t=1}^{20} (P_i(t) - \overline{P_i(t)})^2}, \quad (1)$$

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