

# A Comparative Analysis of Military Forces *vis-à-vis* Nation's Resources Using DEA

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## 1. Introduction

Since the dismantle of the Soviet Union, the world stretching from the east to west has witnessed a significant change in the security environments of many nations. Though this has led to give birth a plethora of (general) studies by a number of international political scientists, the research studies based on the real-life data are almost nil.

This paper makes an humble attempt to critically analyze the changes in the security environment of nations from the Cold-war period to post Cold-war period by quantitatively measuring the nation's performance index, which is equivalently interpreted as the nation's dependency on the military resources. We use here a new variant of data envelopment analysis (DEA) models, called Slacks-Based Measure of Super-Efficiency (Super SBM) of Tone [1], which is considered superior index for total factor productivity growth in the presence of slacks, to measure the performance index.

## 2. Frame of analysis

### 2.1 Designing the performance index

Referring to the description in "Basic Policy on National Defense" adopted by Japanese National Defense Council and Cabinet in 1957, we newly design this performance index: the amount of the military forces compared to nation's resources. In our DEA model we treat each nation as a distinct decision making unit (DMU), various nation's resources as outputs, and finally military forces as inputs. In DEA setting, the concept of efficiency is described as follows: A nation is efficient if it has less military forces compared to its resources, *e.g.*, a nation's efficiency score being less than one indicates that it has more military forces compared to its resources, thus yielding the interpretation that the nation's dependance on the military instrument is high.

### 2.2 Input and output (I-O) data

The panel I-O data of 19 nations over 14 years (from 1984 to 1997) are considered. And, we deal with 20 DMUs because we create a new reference DMU (Japan B), which includes the U.S. Forces

stationed in Japan.

We consider three inputs: Ground forces, Naval tonnage and Combat aircraft, which represent respectively the ground, naval and air force [2, 3]. And concerning the selection of the output items, we historically investigate the Japanese security policy, and conduct the statistical hypothesis test using real-life panel data of 158 countries. We determine three output items: Gross national product (GNP), Territory area and Population.

## 3 Analysis

We here address the main evolved results.

### 3.1 Verification of the inference

We attempt here to verify the inference drawn from Dr. Kissinger's description. Dr. Kissinger, known to public in many way *viz.*, as a scholar, a politician, a strategist, and so on, wrote in [4] that the various elements of nations' power were quite distinct in the Cold War period, and they were likely to grow more congruent and more symmetrical in the post-Cold War period. The inference from his description is the following:

**Inference** The efficiency variation among nations gets smaller and smaller over time stretching from Cold-war to post Cold-war period.

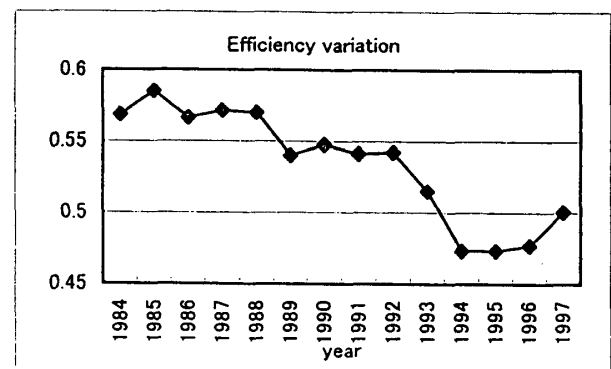


Figure 1: Efficiency variation among the nations

The efficiency variation as shown in Figure 1 confirms the validity of our inference. The variation is

highest in the year 1985 when there was extreme tension between the east and the west. And it is least in 1994 after which the trend is seen to be slightly upward. We thus observed a distinct change, measured quantitatively, at the end of the Cold War.

### 3.2 Clustering nations

We here classify the nations based on the Malmquist Index (MI) values, which help us accurately know the productivity changes of each of these nations over time. MI is computed as the product of *catch-up* and *frontier shift*, and this decomposition gives us deeper insights concerning whether productivity change is due to *catch-up* or *frontier shift*. We compute this index using Super SBM model of Tone [5].

We compute MI values of 20 DMUs over 14 years for the maximum of 91 (=1+2+...+13) time periods. These computed 91 MI values show the change in the nation's productivity over 14 years. If we make cluster analysis with 1820 indexes (20 DMUs × 91 periods), we can then classify the nations based on the productivity change scores. The results are not only shown in Figure 2 but also reported in Table 1. Based on these values, we cluster 20 DMUs into three broad groups.

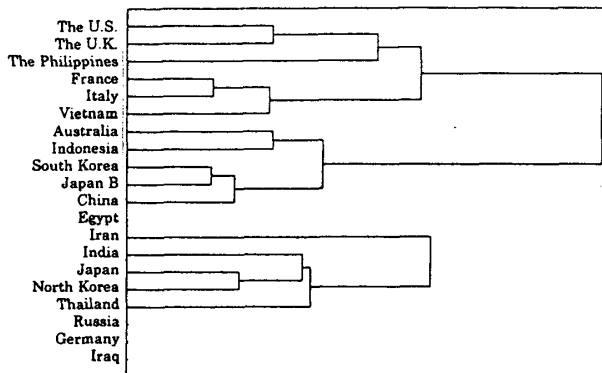


Figure 2: Results of cluster analysis

Table 1: Cluster analysis - classified group

Group1	Group2	Group3	Others
The U.S.	Australia	Iran	Egypt
The U.K.	Indonesia	India	Russia
The Philippines	South Korea	Japan	Germany
France	Japan B	North Korea	Iraq
Italy	China	Thailand	
Vietnam			

Plotting each group's average MI values, we notice that the nations in Group 1 show improvement in their productivity, indicating that there is a remarkable decrease in their dependency on the military instruments in the post Cold-war period. However,

the nations in Group 3 have increased their dependency on the military instruments. But, there is little change visible in Group 2.

We here critically examine to see whether a particular nation's association in each group fits in historically. Based on our analyses, we develop an understanding concerning the security environmental changes of Japan in response to such changes made in the world level.

### 4 Accomplishments

Our study shows that DEA has been proved particularly adept at uncovering the efficiency potentials of nations in the field of international relations. This is accomplished in terms of three major directions.

#### (1) Newly designed index

We design this new index keeping in mind that it should ideally be capable of evaluating the nation's dependency on the military instruments. This index is computed by the ratio of the weighted sum of a nation's resources to the weighted sum of its military forces.

#### (2) Verification using real-life data

Based on the real-life data, we verify with greater precision the inference drawn from the historical description of Dr. Kissinger. It is therefore very important for every future study to verify the inference drawn from historical prospects based on the real-life data.

#### (3) New analytical technique in computing MI

Using a new analytical technique we make cluster analysis based on MI, which measures quantitatively the productivity changes of nations over time. This technique has been most useful in giving a lot of novel insights usually camouflaged in other methods, and will prove useful for future studies as well.

## References

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- [5] Tone, K., "A Slacks-based Malmquist Productivity Index," *GRIPS Research Report Series 1-2001-0002*, (2000).