Does globalization matter in container port efficiency?

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Abstract— the containerization participates in the globalization process because it plays an important role in the international trade, as consequence, this paper, try to study the real influence of globalization in the container ports efficiency, so it proposes the stochastic frontier analysis "SFA" to evaluate the efficiency scores of 36 global container ports throughout the period 2012-2016. The results suggest that the ports with the best average efficiency scores do not necessarily have high globalization index.

Keywords— container ports, efficiency, globalization.

I. INTRODUCTION

The effect of the efficiency port reflected on its countries economic developments. Port efficiency varied from region to another according to the specific characteristics. It is known that the major container ports are the most efficient in the world. It means that there are different factors permitted this ports topped the first ranks. Several authors have investigated the relationship between efficiency and various variables using several approaches. However, the popular approaches used are two: the first, is to compute correlation coefficients to conduct other with simple non-parametric analysis. The second, usually referred to a two-step procedure, that to measure farm level efficiency and then to estimate a regression model where efficiency is expressed as a function of socioeconomic attributes.

The effects of globalization on the port sector are not facts wait during the last decade. The world's ports were affected by significant institutional and organizational reforms, mainly, through the adoption of privatization public policies, the deregulation and the decentralization of transport infrastructure. These reforms in the port governance were associated with more goals general improvement of port efficiency and the desire to reduce the state intervention in the planning and management of infrastructure Maritime. According to Cullinane et al. [1] containerization facilitated the globalization of maritime services.

In literature review there are many studies used DEA method to estimate port efficiency using several variables as [2], [3], [4], [5], [1], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18] and [19], the DEA is popular then other methods in efficiency measuring because it technique makes it possible to evaluate the differences between the points representing the input values and the observed outputs with respect to a point on the production frontier. The efficiency frontier is estimated using an envelope curve, so it is easier to apply in seaports sector. Conversely, the SFA method, there are only some of studies that used SFA to estimate port efficiency as [20], [21], [22], [23], [24], [25] and [26].

The earlier studies used container throughput (TEUs) as an output variable and a different variables that characterized the port infrastructure and superstructure as inputs variables. Even so, the variations in crane and handling technology are hardly captured in the literature [5]. The focusing on these kinds of samples, founded that is composed of the huge container ports. These views are expressed by several studies such as [19] and [27].

The main objective of this work is to estimate the efficiency parameters of the container ports, evaluate the efficiency scores obtained and identify the explanatory factors of the efficiency scores. To achieve these objectives it makes the following assumptions:
• a Cobb-Douglas production frontier estimate as a technical efficiency analysis tool.
• Container ports located high globalization countries are more efficient.

This paper first proposes a review of the literature on port efficiency. Second, it represents the methodology which describes the econometric methods, the variables and the source of data. Third, discusses the empirical results of the estimate model. Fourth, it represents the conclusion.

II. METHODOLOGIE

A. Stochastic frontier model

This study used stochastic frontier model to estimate the technical efficiency of 36 container ports in the world. The Battese and Coelli (1995) [28] model can be expressed as follows:

\[ Y_{it} = x_i \beta + (V_{it} - U_{it}) \]

\[ i = 1, ..., N; t = 1, ..., T. \]

With:

- \( Y_{it} \): is the output obtained by the i-th port at the t-th time period;
- \( x_{it} \): is the vector of input quantities of the i-th port at the t-th time;
- \( \beta \): is the vector of parameters;
- \( V_{it} \): are random variables which are assumed to be iid. N (0, \sigma^2);
- \( U_{it} \): is (U \exp (-\eta (t-T)))

Where:
\( U_\text{it} \) are assumed to be i.i.d. as truncations at zero the of \( N(\mu_{\text{it}}, \sigma_{\text{it}}^2) \)
\[
\sigma^2 = \sigma^2_v + \sigma^2_u \quad \text{and} \quad \gamma = \sigma_u / (\sigma^2_v + \sigma^2_u)
\]
\( V_\text{it} \) and \( U_\text{it} \) are independent
\( m_{\text{it}} = z_{\text{it}} \delta. \)

With \( z_{\text{it}} \) is the vector of exogenous variables which may influence the efficiency of a port; \( \delta \) is the vector of parameters

**B. Data and variables**

For the reason of the complexity port system and their connectivity, this paper used several variables such as:

- **Containerization throughput (TEU)**: this variable presents the traffic of containers in each port; we chose this variable for reason that containerization is used in all world with the same standardization.
- **The Urban area**: include the following variables:
  - **Population city**: a population city designed the number of all the organisms (peoples) living in the same region (area).
  - **Land area**: the land area is the surface of the area (region) measured in square kilometers.
- **International trade**: international trade is the exchange of goods and services between countries. We chose export and import factors for each country for the reason that international trade affect port efficiency. Whenever, the international trade increase port will be more efficient.
- **Port infrastructure**: the infrastructure depends on the development of seaports to move domestic and international commerce. Transport infrastructures are high and are one of the reasons for the country’s low competitiveness.
- **Globalization**: the globalization index variable includes economic globalization, social globalization and political globalization. The data are collected from the (KOF) Globalization Index, which measuring the three main dimensions of globalization. This variable is introduced for the reason that globalization affects port efficiency. It is supposed that more cities have globalization more they have higher efficient ports.

### III. EMPIRICAL RESULTS

As shown in table 1, the estimate of \( \gamma \) is 0.379, which indicates that the vast majority of error variation is the inefficiency error \( u_i \) (and not due to random error \( v_i \)).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>OLS</th>
<th>ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>( \beta_0 )</td>
<td>-0.169 (-2.00)</td>
<td>0.466 (0.610)</td>
</tr>
<tr>
<td>X1</td>
<td>( \beta_1 )</td>
<td>0.251 (0.289)</td>
<td>0.208 (0.239)</td>
</tr>
<tr>
<td>X2</td>
<td>( \beta_2 )</td>
<td>-0.512 (-1.46)</td>
<td>-0.454 (-1.43)</td>
</tr>
<tr>
<td>X3</td>
<td>( \beta_3 )</td>
<td>0.108 (0.625)</td>
<td>0.105 (0.635)</td>
</tr>
<tr>
<td>X4</td>
<td>( \beta_4 )</td>
<td>-0.105 (-0.553)</td>
<td>-0.109 (-0.585)</td>
</tr>
<tr>
<td>X5</td>
<td>( \beta_5 )</td>
<td>0.115 (0.679)</td>
<td>0.137 (0.673)</td>
</tr>
<tr>
<td>X6</td>
<td>( \beta_6 )</td>
<td>0.168 (0.327)</td>
<td>0.100 (0.212)</td>
</tr>
<tr>
<td>X7</td>
<td>( \beta_7 )</td>
<td>-0.200 (-0.928)</td>
<td>-0.210 (-1.011)</td>
</tr>
<tr>
<td>X8</td>
<td>( \beta_8 )</td>
<td>-0.496 (-1.24)</td>
<td>-0.184 (-0.444)</td>
</tr>
<tr>
<td>Constant</td>
<td>( c )</td>
<td>0.772 (0.111)</td>
<td></td>
</tr>
<tr>
<td>Sigma-squared (( \sigma^2 ))</td>
<td>0.280</td>
<td>0.376 (0.540)</td>
<td></td>
</tr>
<tr>
<td>Gamma (( \gamma ))</td>
<td>0.379 (0.158)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-0.799</td>
<td>-0.785</td>
<td></td>
</tr>
</tbody>
</table>

\( Y \): Throughput (TEU). \( x_i \): population city. \( X \): Land area (km²)
\( X_1 \): Import (billions of dollars). \( X_2 \): Export (billions of dollars). \( x_3 \): Total quay length.
\( X_4 \): Maximum alongside depth. \( x_5 \): Total terminal area (km²).
\( X_6 \): Total container storage capacity. \( X_7 \): Globalization index.

The estimated ML coefficient of extent of import showed a positive value of 0.208 which was significant. Therefore, the increase of import extent by one percent will increase output by a larger proportion (20.8 percent). The estimated ML coefficients for population city, import, total quay length, maximum alongside depth showed positive values of 0.208, 0.105, 0.137 and 0.100 respectively. All these values were significant. This indicates that augmentation of the inputs; population city, import, total quay length and maximum alongside depth by one per cent will increase output by 0.208 per cent 0.105 percent 0.137 percent and 0.100 percent respectively. However, contrary to expectation, the coefficient for; land area, export, total terminal area, total container storage capacity showed a negative value of 0.454, 0.109, 0.210, 0.184 respectively which was not significant.

The analysis of the results presented in table 2 show that all the container ports achieved score efficiency more than 0.5. The most efficient container ports in this study is Shanghai affected a level efficiency equal to 0.861 and the less efficient is Antwerp affected the last rank with a level efficiency more than 0.501. The difference between the score efficiency is caused by the selected variables used for this estimation.
The mean technical efficiency of the container port was found to be 77.33 percent, which indicates that the output could be increased by 22.67 percent if all container ports achieved the technical efficiency level of the best container port. Figure 1 represents the variation of the mean efficiency and the mean index globalization matches to each country.

Figure 1. The variation of the mean efficiency and the mean index globalization

The variation lines are not similar, it’s independent when one increases the other decrease, which improved that there is no influence on the container efficient caused by globalization index.

IV. CONCLUSION

The technical efficiency gives the possibility to container ports to avoid in the process of production. For this purpose, the technical efficiency of container ports can be improved. Several factors can explain variations in technical efficiency, this study considers containerization, urban area, international trade, port infrastructure and globalization index as mainly variable to evaluate efficiency.

The finding results showed that the efficiency scores are reasonably high for the sample of container ports, in addition, the variables Import, total quay length, maximum alongside depth improved efficiency. The variables land area, export, total terminal area, total container storage capacity has no implication in the model. This study proved, a major synthesis, that there is no affect on the container efficient caused by globalization.

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REFERENCES


