ISF Institute of Research and Education (IIRE)

IIRE JOURNAL
of
MARITIME RESEARCH & DEVELOPMENT (IJMRD)

OCTOBER 2017
The IIRE Journal of Maritime Research and Development (IJMRD) provides a forum for critical reviews and research findings that underpin scientific foundations of all decisions. Selection of articles for publication in the IJMRD is completely merit based and articles are published only if favorable review and approval is received from a referee.

The concepts, views, expressions and examples in the published articles of IJMRD are those of the authors and not necessarily of the journal. The responsibility for the content of the articles remains exclusively with the author(s) concerned.

The Publishing team of IIRE does not necessarily subscribe to views expressed in the articles published under its banner. IIRE as the publisher disclaims any liability to any party for any loss, damage, or disruption caused by errors or omissions, whether such errors or omissions result from negligence, accident, or any other cause.

The copyright of the articles published under IIRE in its Journal of Maritime Research and Development (IJMRD) rests with the author(s) concerned, who may be contacted for any clarifications and/or reproduction rights.

**ISSN: 2456-7035**

**Published By:**

**ISF INSTITUTE OF RESEARCH AND EDUCATION (IIRE)**
410, Gemstar Commercial Complex, Ramchandra Lane Ext, Kachpada, Off Link Road, Malad (W), Mumbai 400 064, INDIA.
Website: www.iire.in, www.isfgroup.in

**Link of Publication:** - [http://iire.in/ojs/index.php/IJMRD](http://iire.in/ojs/index.php/IJMRD)

**Place of Publication:** - Mumbai
Maritime sector has always been influencing the global economy. Shipping facilitates the bulk transportation of raw material, oil and gas products, food and manufactured goods across international borders. Shipping is truly global in nature and it can easily be said that without shipping, the intercontinental trade of commodities would come to a standstill.

Recognizing the importance of research in various aspects of maritime and logistic sector, IIRE through its Journal of Maritime Research and Development (IJMRD) encourages research work and provides a platform for publication of articles, manuscripts, technical notes, papers, etc. on a wide range of relevant topics listed below:

- Development in Shipping
- Ship Operations and Management
- Risk Assessment and Risk Management in Maritime Sector
- Maritime Safety and Environmental Protection
- Technological Developments
- Maritime Education
- Human Resource in Maritime Sector
- Trade Liberalization and Shipping
- Freight Rates Fluctuations and Forecasting
- Commodity Markets and Shipping
- Shipping Investment and Finance
- Maritime Logistics
- Multimodal Transport
- Inland Waterways Transport
- Maritime Statistics
- Port Management, Port Pricing and Privatization
- Economic and Environmental Impact of Shipping and Ports
- Other Current Topics of Interest in Shipping
BENCHMARKING OF MALAYSIAN SHIPPING COMPANIES USING STOCHASTIC FRONTIER ANALYSIS APPROACHES

Saravanan Venkadasalam

Abstract

The purpose of this study is to benchmark selected shipping companies in Malaysia by evaluating their technical efficiency particularly for the financial year 2015-2016. The secondary data of the selected companies were retrieved from the database of Kuala Lumpur Stock Exchange. Based on a Stochastic Frontier Analysis model, the data was analyzed using Frontier 4.1 and STATA 13.0 software. It was found that Malaysian Shipping Companies were operating at average of 92 percent. The hypothesis testing reveals both Cobb-Douglas production frontier and Translog production frontier models are significant at 1%. There is a strong relationship between the variables.

Key words: Company Efficiency, Benchmarking, Shipping Company, Stochastic Frontier Analysis.

1. INTRODUCTION:

The concept of measuring an organization’s efficiency has its roots in the fields of education and healthcare, but has been adopted by other industries also. The measurement of technical efficiencies is seen as an effective index in measuring a company’s performance (Sowlati, 2005) as an alternative to financial pointers. This enables companies to benchmark themselves within the industry and enhance their reputation (Brønn and Brønn, 2005). Besides, measuring efficiencies, such indices would assist the managers in stabilizing the company’s finances (Gokgoz and Çandarli, 2011). However, not many studies have been conducted in this field, especially for the shipping industry. Recent global economic downturn has weakened the performance of the shipping companies. The prelude to this was the drop in demand for commodities as an impact of the 2008/09 global crisis (Grama, 2012). Scholars indicated that shipping company continues to operate even though required to be pure technology inefficient (Odeck, 2008) or scale inefficient (Chang and Liao, 2012) in order to sustain in this industry.

Studies on efficiencies of shipping companies are limited and those available have measurements related to smaller companies involved in fishing and management of ferries. Works by Kim et al. (2011), Pascoe et al. (2013), Gutierrez et al. (2014) and Pinello et al. (2016) are few of the studies worthy of mention. Kim et al. (2011) studied

1 Malaysian Maritime Academy: v.saravanan@alam.edu.my
on the cost reduction variables to assist the fishery industry, while Pascoe et al. (2013) stated that the technical and the scale inefficiencies as business exit indicators. However, there are no studies in the region which have measured efficiencies of large shipping companies engaged in international trade. In this study, the efficiencies of few big Malaysian shipping companies have been measured and a benchmarking exercise has also been completed.

2. METHODOLOGY:
The key aspect of this research is the use of the stochastic frontier analysis (SFA) for benchmarking the efficiency of the selected shipping companies. Even though, there are few other methods such as least square econometric production models, total productivity indices and data envelopment analysis to analyze the efficiency, the SFA was considered for this study. SFA uses the maximum likelihood estimation, which encompasses desirable statistical properties like unbiasedness, efficient and consistent in a small sampling (Radam, Yacob, and Muslim, 2010). Also, the pure random noises are excluded in the SFA approach. SFA approaches have been employed in cases where estimations have been affected by unpredictable noises (Martín, Román, and Voltes-Dorta, 2009). Since, the shipping companies vary in operation, size and nature of the business activity, and presence of unpredictable noises are foreseen, SFA would effectively exclude them and measurements would be precise. Hence, SFA was selected as the best tool for the study.

Malaysia is the 3rd largest ship owner country within the ASEAN states. As per the Review of Maritime Transport 2016, Malaysia have 1660 registered vessels with a total carrying capacity of 9,616,000 dead weight tonnage.

In this present study, a total of 17 shipping related companies located in Malaysia were tested. These companies were limited liability companies listed on the Kuala Lumpur Stock Exchange (KLSE). Table 1 displays the list of companies considered in this study. While some are noticeably big in capital and international operations, the others are within the set of related industries such as oil and gas sector and shipping-support service sectors. The audited annual reports of these companies were extracted from the KLSE website for the purpose of gathering the required data. Factors indicating the financial strength and performance were considered primarily. Information on
revenues, paid in capital, general and administration expenses and cost of goods sold for the year 2015-2016 etc., were used as the input and output variables.

### Table 1: Malaysian shipping companies (all listed in KLSE)

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
<th>Stock Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alam Maritime Resources Berhad</td>
<td>ALAM</td>
</tr>
<tr>
<td>2</td>
<td>Bumi Armada Berhad</td>
<td>ARMADA</td>
</tr>
<tr>
<td>3</td>
<td>Complete Logistics Services Berhad</td>
<td>COMPLET</td>
</tr>
<tr>
<td>4</td>
<td>Harbour- Link Group Berhad</td>
<td>HARBOUR</td>
</tr>
<tr>
<td>5</td>
<td>6 Imn off;stoe-</td>
<td>HUBLINE</td>
</tr>
<tr>
<td>6</td>
<td>Hubline Berhad</td>
<td>ICON</td>
</tr>
<tr>
<td>7</td>
<td>Icon Offshore Berhad</td>
<td>MAYBULK</td>
</tr>
<tr>
<td>8</td>
<td>Misc Berhad</td>
<td>MISC</td>
</tr>
<tr>
<td>9</td>
<td>PDZ Holdings Bhd</td>
<td>PDZ</td>
</tr>
<tr>
<td>10</td>
<td>Petra Energy Berhad</td>
<td>PENERGY</td>
</tr>
<tr>
<td>11</td>
<td>Sapura Energy Berhad</td>
<td>SKPETRO</td>
</tr>
<tr>
<td>12</td>
<td>Scomi Energy Services Berhad</td>
<td>SCOMIES</td>
</tr>
<tr>
<td>13</td>
<td>Sealink International Berhad</td>
<td>SEALINK</td>
</tr>
<tr>
<td>14</td>
<td>Shin Yang Shipping Corporation Berhad</td>
<td>SYSCORP</td>
</tr>
<tr>
<td>15</td>
<td>T7 Global Berhad</td>
<td>T7GLOBAL</td>
</tr>
<tr>
<td>16</td>
<td>TAS Offshore Berhad</td>
<td>TAS</td>
</tr>
<tr>
<td>17</td>
<td>Yinson Holdings Berhad</td>
<td>YINSON</td>
</tr>
</tbody>
</table>

All these variables were tested on the stochastic frontier production function. The basic SFA for panel data was developed by Battese and Coelli in (1995; 1992) as expressed in the equation (1). This model has two components, one estimating the random effect and another estimating the inefficiency. The Frontier 4.1 and Stata 14.0 software were utilized for this analysis.

\[
Y_{it} = X_{it}(\beta) + V_{it} - U_{it} \quad \text{Eq. (1)}
\]

Where, \(Y_{it}\) is the logarithm of the production of the \(i^{th}\) firm in \(t^{th}\) time period, \(X_{it}\) is the vector of the input quantities of \(i^{th}\) firm in \(t^{th}\) time period, \(\beta\) is vector of the unknown parameter to be estimated, \(V_{it}\) represents the random errors \(N(0, \sigma_v^2)\), which were independently distributed of the \(U_{it}\), while \(U_{it}\) represents the non-negative random variables \((z_{it}\delta + W_{it})\) associated with the production technical inefficiency.

Two models were tested in this study. The first model is the Cobb-Douglas production frontier using panel data and assuming a half normal distribution as shown in equation...
(2). The second model was the Translog production frontier using panel data and assuming a truncated normal distribution as shown in equation (3). The model specifications are expressed below:

\[
\ln(RV_{it}) = \beta_0 + \beta_1 \ln(VC_{it}) + \beta_2 \ln(FC_{it}) + \beta_3 \ln(TE_{it}) + (V_{it} - U_{it})
\]

Eq. (2)

\[
\ln(RV_{it}) = \beta_0 + \beta_1 \ln(VC_{it}) + \beta_2 \ln(FC_{it}) + \beta_3 \ln(TE_{it}) + \beta_4 \ln(VC_{it}^2) + \beta_5 \ln(FC_{it}^2) + \beta_6 \ln(TE_{it}^2) + \beta_7 \ln(VC_{it}) \ln(FC_{it}) + 8 \ln(FC_{it}) \ln(TE_{it}) + \beta_9 \ln(VC_{it}) \ln(TE_{it}) + (V_{it} - U_{it})
\]

Eq. (3)

\[i = 1, 2, 3, \ldots, n\]

Where,

RV = Revenue
VC = Variable costs (sales of goods sold)
FC = Fixed costs (administrative and general)
TE = Total equity

Two hypothesis is developed. The first proposition with test the relationship between the variables under the Cobb Douglas production frontier model. The first null hypothesis as stated;

\[H_0 = \text{There is no relationship between the variables in Cobb Douglas production frontier model}\]

\[\beta_0 \neq \beta_2\]

Eq (4)

The second hypothesis is testing the relation between variables under the Translog production frontier model. The second null hypothesis to be tested will be;

\[H_0 = \text{There is no relationship between the variables in Translog production frontier model}\]

\[\beta_0 \neq \beta_2\]

Eq (5)

3. RESULTS AND DISCUSSION:

Table 2 presents the ordinary least squares (OLS) estimates of the stochastic frontier analysis for both models. Based on the results, both models are significant at 1%. Thus, both nulls are rejected. There is a strong relationship between the variables. For the model 1, there is a strong positive relationship within the revenue and the variable costs
and the equity. This was further proven in the model 2 where similar variables show a significant relationship. High $R^2$ and increased adjusted $R^2$ in this test shows that this model is reliable and perfectly fit. In this estimation, over 99% of the fractions between the variables can be explained and only less than 1% were uncounted as the error term. The Wald Chi2 indicates that the dependent variable is attributed by the change in the independent variables. For example, in the model 1, any changes in the variable cost leading to change in the revenue by 85%. Meanwhile, the changes in the total equity affect the revenue by 14%. The outcome from the second part of this study is shown in the Table 3 where the efficiencies of selected shipping companies for the year 2015-2016 were measured. In the Cobb-Douglas production frontier model, all shipping companies appear efficient. This has resulted from the assumption that all firms have similar or same production elasticity. This drawback of the Cobb-Douglas model being simplistic indicates the positive normalization of all companies being equally efficient. Hence this outcome was not considered for final analysis.

### Table 2: Ordinary Least Square estimations

<table>
<thead>
<tr>
<th>Ln(RV)</th>
<th>Model 1⁺</th>
<th>Model 2⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.9353 (0.63)</td>
<td>16.7681⁺⁺ (2.22)</td>
</tr>
<tr>
<td>Ln(FC)</td>
<td>-0.0086 (-0.16)</td>
<td>-0.8612 (-0.88)</td>
</tr>
<tr>
<td>Ln(VC)</td>
<td>0.8515⁺ (13.7)</td>
<td>-2.2433 (-1.63)</td>
</tr>
<tr>
<td>Ln(TE)</td>
<td>0.1423⁺ (2.87)</td>
<td>2.2883⁺ (3.34)</td>
</tr>
<tr>
<td>Ln(FC)²</td>
<td>-0.0419 (-1.21)</td>
<td></td>
</tr>
<tr>
<td>Ln(VC)²</td>
<td>0.2305⁺⁺ (2.53)</td>
<td></td>
</tr>
<tr>
<td>Ln(TE)²</td>
<td>0.0878⁺ (3.25)</td>
<td></td>
</tr>
<tr>
<td>Ln(FC)*Ln(VC)</td>
<td>0.0593 (0.85)</td>
<td></td>
</tr>
<tr>
<td>Ln(VC)*Ln(TE)</td>
<td>-0.3459⁺ (-4.31)</td>
<td></td>
</tr>
<tr>
<td>Ln(FC)*Ln(TE)</td>
<td>0.0586</td>
<td>0.85</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.9909</td>
<td>0.9937</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.99806</td>
<td>0.9914</td>
</tr>
<tr>
<td>Wald chi²</td>
<td>1012.92</td>
<td>1709.69</td>
</tr>
</tbody>
</table>

*Note:* *and ** represent the significance level at 1% and 5% respectively.
### Table.3: Malaysian shipping companies: Technical Efficiencies

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALAM</td>
<td>0.9999</td>
<td>0.8934</td>
<td>15</td>
</tr>
<tr>
<td>ARMADA</td>
<td>0.9999</td>
<td>0.9309</td>
<td>10</td>
</tr>
<tr>
<td>COMPLET</td>
<td>0.9999</td>
<td>0.9672</td>
<td>2</td>
</tr>
<tr>
<td>HARBOUR</td>
<td>0.9999</td>
<td>0.9744</td>
<td>1</td>
</tr>
<tr>
<td>HUBLINE</td>
<td>0.9999</td>
<td>0.9397</td>
<td>9</td>
</tr>
<tr>
<td>ICON</td>
<td>0.9999</td>
<td>0.9658</td>
<td>3</td>
</tr>
<tr>
<td>MAYBULK</td>
<td>0.9999</td>
<td>0.9099</td>
<td>12</td>
</tr>
<tr>
<td>MISC</td>
<td>0.9999</td>
<td>0.9590</td>
<td>4</td>
</tr>
<tr>
<td>PDZ</td>
<td>0.9999</td>
<td>0.8954</td>
<td>13</td>
</tr>
<tr>
<td>PENERGY</td>
<td>0.9999</td>
<td>0.8943</td>
<td>14</td>
</tr>
<tr>
<td>SCOMIES</td>
<td>0.9999</td>
<td>0.8917</td>
<td>16</td>
</tr>
<tr>
<td>SEALINK</td>
<td>0.9999</td>
<td>0.9498</td>
<td>7</td>
</tr>
<tr>
<td>SKPETRO</td>
<td>0.9999</td>
<td>0.7613</td>
<td>17</td>
</tr>
<tr>
<td>SYSCORP</td>
<td>0.9999</td>
<td>0.9518</td>
<td>5</td>
</tr>
<tr>
<td>T7GLOBAL</td>
<td>0.9999</td>
<td>0.9503</td>
<td>6</td>
</tr>
<tr>
<td>TAS</td>
<td>0.9999</td>
<td>0.9258</td>
<td>11</td>
</tr>
<tr>
<td>YINSON</td>
<td>0.9999</td>
<td>0.9433</td>
<td>8</td>
</tr>
<tr>
<td>Mean</td>
<td>0.9999</td>
<td>0.9238</td>
<td></td>
</tr>
</tbody>
</table>

This drawback of Cobb-Douglas model is overcome by the generalization using the Translog Frontier function. The Translog production frontier generalizes the Cobb-Douglas function. The flexible functional form provides a second order estimation. From the study, the most three efficient firms were ‘HARBOUR’, ‘COMPLET’ and ‘ICON’ with an efficiency level of 97.44%, 96.72% and 96.58%, respectively. The least three efficient firms identified were ‘ALAM’, ‘SCOMIES’ and ‘SKPETRO’ with operating efficiencies at 89.34%, 89.17% and 76.13%, respectively.

The mean represents the shipping industry’s efficiency as a whole in Malaysia, which worked to 92.39% for 2015-2016. Previous studies by Gutierrez (2014) to measure the efficiency of international container shipping lines in 2009 indicated that the shipping companies’ efficiency at 74%. The results from this study indicates the performance of the companies have improved as compared to the earlier study by Gutierrez (2014).
Further, the results show that all shipping companies in Malaysia were operating above 89%, with the exception of ‘SKPETRO’ with an efficiency of 76.13%. This results are a good index and reason to investigate into the performance of the company.

Figure 1 exhibits the breakdown of the pure technical efficiency (PTE), cost efficiency (CE) and the overall efficiency (OE).

**Figure 1:** Malaysian shipping companies: Comparison of Efficiencies

From Figure 1, it is seen that all the companies are operating at the same level of cost efficiency, which is about 11%. The cost efficiency can be taken as an indication of the optimization of the inputs by the management (Iliyasu and Mohamed, 2016) while a low score of pure technical efficiency would indicate failure of maximizing resource utilization (Sufian, 2007). Considering pure efficiencies, it is seen that all companies except ‘SKPETRO’ are equally efficient. The pure technical efficiency is the deciding factor for the overall efficiency. Fail in maximizing the use of the resources (equity) will lead to pure technical inefficiency. This is supported further by the hypothesis testing. The revenue is strongly dependent to the equity.

4. CONCLUSION
This study has analyzed the efficiency of the shipping companies in Malaysia using the stochastic frontier analysis approach. From the exercise, it is seen that the Malaysian shipping industry is performing well. The study had relied on inputs from the reports
provided in public domain by the companies and reliability of the data was assumed. The scope for validation of the data was as such limited. Further, the reporting format of the companies being non-uniform, some of the fixed cost elements (e.g., labour costs) could not be ascertained. Withstanding these limitations, the study has provided an index to assess a shipping company’s performance for identifying areas requiring improvements. Further studies are recommended wherein other factors such as fixed costs (e.g., insurance), unexpected costs (e.g., port fines, pollution damages etc.) can be considered. Future studies may be undertaken which can enhance this study by analyzing the actual labour cost as the fixed cost.

REFERENCES:


About the Author

**Saravanan Venkadasalam**

Head, Pre Sea Marine Engineering Department/ Training and Education at Malaysian Maritime Academy (ALAM).
ISF Institute of Research and Education (IIRE)

Developing and Delivering Integrated Educational and Research Programs

- Benchmarking surveys
- Industry research
- Peer reviewed journal
- Working paper series
- Compensation and Benefits Surveys
- White papers
- Application notes
- Training material distribution
- Book publishing

Compensation and Benefits Surveys

IIRE has been conducting a ‘Compensation and Benefits Survey’ since 2009 for the sailing officers in various ranks of all types of merchant vessels of foreign shipping companies. The report of the survey has become necessary for the industry players helping them in positioning themselves with regards to wages of seafarers.

IIRE Journal of Maritime Research and Development (IJMRD)

IIRE Journal of Maritime Research and Development (IJMRD) is a platform for publication of articles, manuscripts, technical notes, etc. on a wide range of Maritime related topics. The academic works are reviewed by a panel of experienced academicians prior to publication.

ISF Working Paper Series (ISFIRE)

ISFIRE is a platform for authors in Economics to publish their research/book chapters, academic articles, reviews/notes which are under submission, or forthcoming elsewhere. The papers are reviewed by experts and eminent academicians.

Publishing of Books

IIRE is a one stop solution for publications with designing, proof reading and copy editing support. IIRE also has an ISBN number for its publications and supports distribution through online book stores.
Management & Consultancy
- Management of Institutes
- Design, Development and Delivery of Courses
- Quality Assurance
- Human Resource Management and Organizational Development

E - Solutions:
- E Learning and E Assessment,
- Competence, Aptitude, Psychometric Profiling
- Cadet Selection and Recruitment
- Learning Management Systems
- Audit and Inspections Reporting System
- Career Guidance Platform

Research:
- Surveys;
  - Salary Surveys
  - Compensations and Benefits Exercises,
- Publication of Journals and Research Work

Training:
- Value Addition Programs for Officers & Ratings
- Electrical, Electronics, Automation
- Electronic Engines
- Soft Skills
- Safety Briefings
- Safety Officers Training
- Distance Learning Programmes

We Serve ... We Care...

ISF Institute of Research and Education (IRE)
www.iire.in

ISF Maritime and Offshore Institute

ISF Software and Publications
www.isplearning.net

ISF Management and Consultancy Services

ISF Surveys, Testing, Audits Research & Rating Services

ISF HR Services

ISF Institute of Research and Education (IRE)
ISF Maritime Services Pvt. Ltd.
ISF Group International Pte. Ltd.
Singapore - www.isfgi.com

Inner Search Foundation

NGO - Equality, Dignity and Safety

ISF Maritime Services Pvt. Ltd.

ISF Group International Pte. Ltd.
Singapore - www.isfgi.com

ISF Institute of Research and Education (IRE)
www.iire.in

ISF Maritime and Offshore Institute

ISF Software and Publications
www.isplearning.net

ISF Management and Consultancy Services

ISF Surveys, Testing, Audits Research & Rating Services

ISF HR Services
