BENCHMARKING THE EFFICIENCY OF THE EGYPTIAN AND LIBYAN CONTAINER PORTS

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ABSTRACT

The aim of this paper is to evaluate, assess and benchmark the relative efficiency of the Egyptian and Libyan container ports "major ten container ports in Egypt and Libya", in order to define the strengths and weaknesses and to determine the causes of inefficiency of the stated ports, as well as to clarify the drawbacks as it can compete with the same other container ports in the region. The systematic literature review based on the theoretical perspectives, methodologies and scope of research. In addition, the outcomes strongly support both port managers and decision makers by suggesting viable options for exploiting innovation from new technologies for pursuing investment in infrastructure/superstructure resources.

This paper is considered as an attempt to provide a satisfactory understanding of the technical efficiency level of container ports and terminals in Egypt and Libya. This research, however, proposed procedures to measure the technical efficiency of container ports and terminals which can be applied to other container ports in the region using the DEA-CCR model. Panel data for five years were collected from 2012 to 2016 from the Egyptian Maritime Data Bank, the Libyan Ports Company and certified websites, in order to rank the stated ports based on the achieved results.

The main outcome of this study shows that, among six Egyptian ports and four Libyans container ports only ports of Tripoli and Tobruck were inefficient and were scored the least value over the period of study. Based on the fact that the bottleneck in Libyan port performance began with the issue of seaside accessibility (Almadani, 2015) with lack of specialized quay cranes, the top managers of the in-efficient ports have to utilize their resources in terms of terminals infra/superstructure in order to increase their market share, to enhance port's efficiency, and accordingly to improve competitive position and enable to meet their customers' requirements as well. The other outcome of this study was the railway connectivity is essential to enhance cargo flow efficiency and connect the stated ports with their hinterland, including neighboring/land-locked countries. Further, in order to accommodate with large container ships in the Egyptian and Libyan container ports and terminals, large investments in their drafts and resources (infrastructure/superstructure) are needed.

Keywords: **Container port, Technical efficiency, Data Envelopment Analysis (DEA) and TEU.**

1. INTRODUCTION

The advantage of maritime transport is the speed, comfort, safety, and the possibility and ability to handle heavy traffic of goods and passengers at relatively low prices. Compared with traditional port operations, containerization has greatly improved port production performance. To reap economies of scale and of scope, liner shipping companies and container ports are respectively willing to deploy dedicated containerships and efficient container handling systems. As a consequence, port productivity has been greatly enhanced (Hajizadehet al., 2016).

In the recent years, rapid developments of international container and intermodal transport have drastically changed the market structure from one of monopoly to one where fierce competition is prevalent in many parts of the world (Cullinane et al., 2006). They claimed that container ports had to invest heavily in sophisticated equipment or in dredging channels to accommodate the most advanced and largest container ships in order to facilitate cost reductions for the container shipping industry. Many container ports have to compete for cargo with their neighboring ports (Elsayeh, 2015; Wanis and Ismail, 2018).

Efficiency is defined as a level of performance that uses the lowest amount of inputs to create the greatest amount of outputs, and if container ports conduct effective evaluation of their productivity performance to enhance the efficiency of productivity, it will provide more valuable information/data for port managements in their attempts to establish competitive strategies for the future and to improve their resource utilization for ongoing improvements in operational efficiency (Lu and Park, 2010). From this perspective, Data Envelopment Analysis (DEA) method has proved itself as appropriate tool for benchmarking technical efficiency of the container ports since 1993. Thus, it is of great importance for port managers to know whether they have fully used their existing infrastructures and that output has been maximized given the amount of input.

Regarding the structure of this paper and in order to achieve study aims and objectives, this paper is organized as the following: after this introductory section, Section Two is devoted to review the literature on the container port efficiency using DEA which is related to the Egyptian, Libyan and MENA container ports. Section Three and Four describe methodology and data collection that used in this study. Section Five provides DEA analysis and results, while, Section Six as the final section presents the study conclusion.

2. LITERATURE REVIEW

Monitoring a port's performance in an ever-changing environment is crucial for measuring its efficiency and competitiveness levels (Jimenez et al., 2013). Efficiency rather than productivity is the most important concept in measuring performance of container ports. Recently, the efficiency of container ports has become more important since it is one of the key factors of survival in the current competitive business environment in the shipping industry and a way to reduce maritime cost. Moreover, container ports are vital to the efficiency of the whole global logistics chain since they act as the connecting link between different transportation modes in the global logistics chain (Wang et al., 2005; Elsayeh, 2015).

Studying port efficiency is becoming more important than ever before due to increasing reliance on global participation and rapid change in logistics. Container ports efficiency became increasingly important topic as it connecting links between different transport modes in the global logistics chain, and container terminals are vital to the efficiency of the whole chain. Beyond its pivotal role in the global trade network, the efficiency of container ports and terminals is also a key issue for operators due to intensifying port and terminal competition worldwide (Kutin et al., 2017).

To this end, there are different approaches and techniques that used to measure, assess, evaluate and benchmark the port efficiency from different perspectives depending on the aim, objective or the hypotheses of the study. As parametric method, Stochastic Frontier Analysis (SFA) technique was used by (Liu, 1995; Cullinane and Song, 2006 and Sarriera et al., 2013), while Free Disposal Hull (FDH) technique as non-parametric method was used by (Cullinane et al., 2005; Herrera and Pang, 2008), as well as Data Envelopment Analysis (DEA) as another non-parametric technique also was used by (Al-Eraqi et al., 2008; Merk and Dang, 2012; Elsayeh, 2015; Kutin et al., 2017).

In this regard, DEA method is becoming popular for assessing the relative efficiency of business entities and benchmarking. DEA is a technique of mathematical/linear programming that enables the determination of a unit’s efficiency based on its inputs and outputs, and compares it to other units involved in the analysis (Cullinane, 2004). Meanwhile, studies on the efficiency of sea ports sector first appeared in the academic journals was in the year of 1993 by Roll and Hayuth. Since then, there have been a significant number of studies on port efficiency, demonstrating a growing interest in methods to measure their efficiency (Pallis et al., 2011). Petiot et al., (2017), on the other hand, pointed out that the maritime transport industry represents relatively limited volume of academic production among fields of applied research using DEA contributed only with 26% out of 461 articles in the whole transport sector between 1993 when the first study was exposed till year of 2017. Further, Emrouznejad and Yang (2018) found that 2974 DEA articles were published by top 21 international journals over the last 40 years, and were categorized them in five main fields, namely; agriculture, banking, supply chain, transport and public policy.

Using panel data for the year 2008, Polyzos and Niavis (2013) measured the technical efficiency of the major thirty container ports in the Mediterranean basin that handled more than 100,000 TEUs annually. Although the study covers a significant number of container ports in the Mediterranean region, the conclusion drawn from study was that among the thirty ports, only two ports were efficient. Added to this, the DEA analysis result indicated that functional inefficiencies of the ports, since what matters is not only the attraction of large volume of containers but mainly the qualitative, valid and safe transport of containers.

Similarly, Al-Eraqi et al., (2010) measured the operational efficiency of twenty-two container ports in the East Africa and the Middle East regions. They compared ports location that located on the maritime East-West trade route using DEA-CCR and cross section data. The empirical results revealed that the port technical efficiency plays a significant role for waiting time and congestion in the ports, while Almeshwaki et al., (2014) measured the operational efficiency of nineteen container ports in the Middle East region using DEA-CCR and cross section data. The main results of study illustrated that there were a strong effect of the geopolitical conflict, turbulence, and instable environment on both; ships calling and port efficiency.

Recently, Almadani (2015) benchmarked technical efficiency of four Libyan container terminals namely: Tripoli, Khoms, Misurata and Benghazi against eighteen international container ports for the year of 2010 using DEA-CCR and panel data. He proved that there were lack of efficient ports in Libya, consequently shipping lines avoid them and use European ports instead. However, the lack of efficient and sufficient handling equipment in Libyan container ports also had a negative impact on the number of ships calling Libyan ports, and ports throughput rate as well. He added, the largest container ships that can visit Libyan ports are from the third generation or old Panamax class, due to water depth restrictions, thus, the Libyan ports cannot accommodate with larger ships than this class.

On the other hand, Ghashat (2012) examined the Libyan port system ownership structure and how can reform them. By the end of his study, he found that the technical performance of Libya's ports needs to be improved. Reforming of the Libyan ports is the key for enhancing port effectiveness, he added. Also, he proposed a governance framework for the whole Libyan port system.

Elsayeh, (2015) studied the effect of technical efficiency on port competition using DEA-CCR and DEA-BCC and data from top twenty-two container ports and terminals in the Mediterranean Sea basin in terms of port throughput between 1998 and 2012. Among a significant number of results and conclusions, he found that the total technical efficiency of investigated ports was below 50%, although the study covers a limited number of container ports in North Africa. Hence, there is a necessity to implement suitable strategies to prompt efficiency level and competitive position for inefficient ports and terminals.

Most recently, Ismail and Elgazzar (2018) used Fuzzy Analytics Hierocracy Process (FAHP) to measure, assess, evaluate and benchmark the port efficiency of six container ports in Egypt. The study results clearly showed that East Port Said port has the highest score of the efficiency index at (0.736), while El-Sokhna port comes second, while Damietta port, Port Said and El-Dekheila come at the third, fourth and fifth places respectively. Alexandria port comes at the sixth and last position with the lowest efficiency score at (0.287). This index, however, can be disaggregated in order to identify any criteria that need to improve Egyptian container port system.

In short, and in order to achieve research objective, an express review for the previous researches related to the Libyan, Egyptian and major MENA container ports efficiency using DEA has been conducted. Although, most studies were centered on the advanced and emerging markets in the North America, Europe and North East Asia, measuring of container port efficiency in the South Mediterranean and North Africa using DEA is limited/seldom through global academic research network due to data availability and market share of the region which is very low. North African ports, on the other hand, always considered as a part of MENA ports, and were never benchmarked individually before(Almeshwaki, 2015).

3. METHODOLOGY

DEA is non-parametric technique that used for measuring the relative efficiencies on Decision Making units (DMUs) with multiple inputs/outputs and has immediately been recognized as a modern tool for performance measurement. DEA is intended as a technique for evaluate and benchmark the efficiency against best-practice despite it ignores the statistical noise (Cook et al., 2014). Since then, a large and considerable amount of articles has been appeared, including significant breakthroughs in theory and a great portion of works on DEA applications, both public and private sectors, to assess the efficiency and productivity of their activities (Emrouznejad et al., 2018).

Among the DEA models, DEA-CCR model is applied in this study, because it is the most common used model of DEA. As well as, in order to evaluate and benchmark the relative efficiency of the major ten container ports in Egypt and Libya for the first time, also, to define the strengths and weaknesses and to determine the causes of inefficiency of the stated ports.

In this regard, DEA itself as a model was proposed for the first time by Charnes et al., (1978) and was referred to as a CCR model. It classified as a radial model, because it has radial projection construct. It can calculate the relative efficiency of DMUs under the assumption that constant returns to scale (CRS) prevail. More, there are two orientations which relate to radial models; input-oriented, where inputs are proportionally decreased while outputs are held constant, and output-oriented, where outputs are proportionally increased while inputs are held constant. It should be noted that any CCR-efficient DMU will also be BCC-efficient as well (Cook, 2004). However, it provided a new way of obtaining empirical estimates of relations, such as; the production functions and/or efficient production possibility surfaces that cornerstones of modern economics.

The DEA-CCR input-oriented model aims to minimizing inputs while producing at least the given output levels. However, the output-oriented model attempts to maximize outputs, while using no more than the observed amount on any inputs (Cooper et al., 2007). Any DMU is considered to be inefficient if it obtains a score of less than the unity where a score of unity implies that it is efficient (Cullinane et al., 2004; Elsayeh 2015; Wanis and Ismail, 2018). Infante and Gutiérrez (2013) explained that the use of the DEA-CCR has been emphasized on the arena of production for the efficiency evaluation. Consequently, overall efficiency using DEA-CCR can be described as:

$$E = \frac{Outputs}{Inputs} \text{ Or formally; } E = \frac{\sum_{i=0}^{N} v_i y_i}{\sum_{i=0}^{N} u_i x_i}$$ (Infante and Gutiérrez (2013)

where *E* represents efficiency, *xi* and *yi* are inputs and outputs respectively, whereas *ui* and *vi* signify factors that explain the relative significance of every one of the factors. If the relative significance of each one of the inputs and outputs were known a priori, the focal problem of efficiency evaluation would be ended; however, this data is usually unknown, as well as, the assessment of efficiency usually includes multiple inputs and outputs. Consequently, this study is limited to DEA-CCR model for measuring efficiency level of the Egyptian and Libyan container ports.

4. DATA COLLECTION

This study used panel data of five years between 2012 and 2016. Further, ten Egyptian and Libyan container ports were studied, namely: Alexandria, El-Dekheila, Damietta, Port Said, East Port Said and El-Sokhna were from Egypt, while Tobruck, Misurata, Khoms and Tripoli were from Libya. Data were obtained from the Egyptian Maritime Data Bank, Libyan Ports Company and certified websites, in order to rank stated ports based on the achieved results. Panel data itself, however, contain observations on multiple ports observed over multiple time periods. However, the main advantage of this approach is to study technical efficiency changes and the impact of regulation, and management changes are analyzed by comparing pre and post change efficiency using panel data (Al-Eraqi, 2014).

So far, the selection of variables is the primary step in any efficiency analysis, because it weighs on the accuracy of the analysis (Cooper et al., 2007). However, the input and output variables should reflect the actual objectives and process of the container terminal production as accurately as possible (Cullinane et al., 2004). This paper used criteria as follows: storage capacity, terminal area, berth length, draught and handling equipment, which are the most common used variable to assess, evaluate or rank the efficiency of the Egyptian container port. Figure (1) shows study variable and specifications.

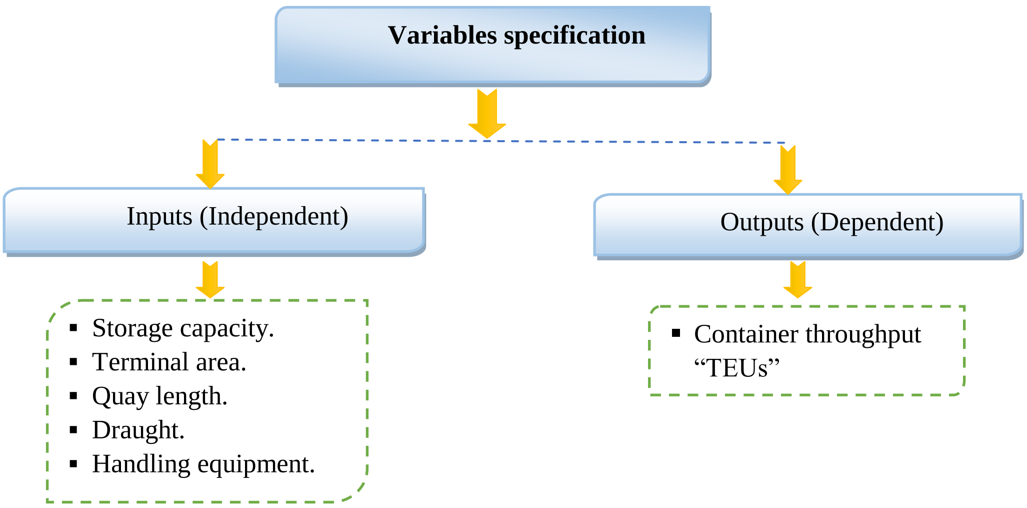

Figure (1) Study variables
Source: Authors own elaboration.

In line with the research methodology requirements, and as shown in Figure (1) above, that this study identified a total of six variables, including five inputs and one output performance indicators. Infrastructure measures, however, including: total quay lengths in meters, average water depth (draft) in meters, total terminal area in square meters, total storage capacity in square meters and equipment measures include total number of handling machinery. While the only output variable is the total number of containers handled in that port/terminal per annum in terms of TEUs. Logically, it is always adopted as the output measure. Total throughput is arguably the most important and widely accepted indicator of port/terminal output because it considered a primary basis on which container port are compared and benchmarked, and adding another variable in the model will reduce the quality of the result (Nwanosike, 2014).

5. RESULTS

With respect to the efficiency value analysis of the terminals, when the efficiency score of the terminal is less than 1, then the terminal is technically inefficient, and the implication is that the operational input to produce the output being used is not appropriate. Table (2) below provides the technical efficiency levels (scores) of each port under this study using DEA-CCR model, within the observed period of five years extended between 2012 and 2016. The scores raised from using the MAX DEA software program.

Further, ports of Alexandria and East Port Said port have efficiency score equal to the unity. Alexandria port has an efficiency score equal to unity only in years of 2014 and 2016. East Port Said port, on the other hand, had an efficiency score equal to unity in year of 2013 only. The average efficiency levels of all the Egyptian container ports were increased between 2012 and 2016.While, the average efficiency score of Tripoli and Tobruck ports during period of study was remained under 0.5. This means, these container ports were suffering from inefficiency, while the efficiency of these container ports doesn't increase over the entire period that extended between 2012 and 2016. Moreover, technical inefficiencies score of the inefficient ports were mainly due to pure technical inefficiencies rather than inefficiencies of scale. The low pure technical efficiency compared to the efficiency of scale suggested that inefficiencies were mostly because of inefficient management practices.

Further, the analysis demonstrated that most Egyptian and Libyan container ports were suffered from inefficiency due to the geopolitical conflict, turbulence, and instable environment, especially during the movement of the Arab Spring since year of 2011 which affect their national security, economy and direct investment, and reflected negatively on the shipping lines and port activities. Added to this, the negative impact was stretched to their maritime transport system including the related logistics services and activities in Egypt which already suffered from a number of regulatory and policy pitfalls including; overlapping jurisdictions between different authorities in ports, absence of separating ownership and regulation, heavy governmental control over pricing, domination of the public sector in logistics services and lack of clear regulations (Ghoneim and Helmy, 2007).

Table (2) Efficiency scores for the Egyptian and Libyan container ports using DEA-CCR.

Container port	**2012**	**2013**	**2014**	**2015**	**2016**
Alexandria	0.788	0.850	1.000	0.971	1.000
El-Dekheila	0.630	0.750	0.880	0.766	0.788
Damietta	0.653	0.594	0.613	0.624	0.706
East Port Said	0.882	1.000	0.994	0.935	0.765
Port Said	0.663	0.517	0.659	0.493	0.374
El-Sokhna	0.667	0.580	0.708	0.919	0.818
Khoms	0.740	0.830	0.680	0.738	0.559
Tripoli	0.303	0.320	0.230	0.210	0.136
Misurata	0.724	0.809	0.535	0.273	0.264
Tobruck	0.180	0.130	0.050	0.332	0.309
Mean	***0.623***	***0.638***	***0.635***	***0.626***	***0572***

Source: Authors own calculation.

6. CONCLUSION

The paper proposed a framework to measure the efficiency level for ten container ports located in Egypt and Libyan. An empirical study was conducted on theses container ports for the period between 2012 and 2016. This paper, however, is considered as the first ever empirical study that assessed, evaluated and benchmarked the Egyptian and Libyan container ports together using DEA-CCR model which never compared together before. As illustrated above, the results proved that Alexandria container port had an efficiency score equal to unity in 2014 and 2016, also the East Port Said container port has an efficiency score equal to unity in 2013.

Also, there was a great decrease in the efficiency score/level of the stated Libyan container ports which operated by a public company (LPC). In fact, inefficiency was derived basically by the movement of the Arab Spring since February 2011, which affected the Libyan economy, investments, security, shipping lines and internal policy. However, in the context of all Libyans container ports, the performance of seaside operations in Libyan ports is low, because of the lack of efficient and specialised cranes at these ports. Added to this, Libyan ports use insufficient equipment such as; external trucks for container transport, with some port tractors and trailers.

Although, Ultra Large Container Ship (ULCC) as the biggest container ship these days, it can be handled only in one container port in Egypt. It has a length of 400m, 59m beam with draft of 15.5m (Maersk, 2013). So, in order to make the other container ports in Egypt and Libya handle these types of ships, investment in their drafts and resources are needed.

In fact, although most efficient ports and terminals used more sophisticated transport equipment, such as AGVs, straddle carriers and tractors and trailers, Libyan ports suffer of lack of sufficient and efficient handling equipment. Added to this, the structure and layers of control and management of Libyan ports are highly complex, involving a multiplicity of ministries, government departments and agencies. This means, no any Libyan port that operated by LPC have a free hand to invest and develop its individual strategies. So, specialized quay cranes are urgently needed and railway connectivity is essential to enhance cargo flow efficiency and connect stated ports with their hinterland, including neighbouring/land-locked countries.

REFERENCES

1. Almadani, (2015) "Examination of port performance in a developing economy: Libya ports case study". *RMIT.* Melbourne.
2. Almashwaki, et al., (2014). "Efficiency analysis of container port: A review". *The Asian Journal of shipping and logistics*, (4), pp. 477-486.
3. Al-Eraqi, et al., (2008) "An extended DEA windows analysis: Middle East and East African seaports". *JES*, 37 (2), pp. 208-218.
4. Al-Eraqi, A. S., Mustafa, A., Khader, A. T. and Barros, C.P. (2008) "Efficiency of Middle Eastern and East African Seaports: Application of DEA Using Window Analysis", *European Journal of Scientific Research*, *23*, pp. 597-612.

5. Banker, et al., (1984) "Some models for estimating technical and scale inefficiencies in data envelopment analysis". *MSJ*, 30 (9), pp.1078-1092.
6. Cook et al., (2014) "Data envelopment analysis: Prior to choosing a model", Omega, (44), pp.1-4.
7. Charnes et al., (2009) "Data envelopment analysis –Thirty years on". EJOR, 192 (1), pp.1-17.
8. Cullinane, K. and Song, D-W. (2006) "Estimating the relative efficiency of European container ports: a stochastic frontier analysis", *Research in Transportation Economics.* 16, pp. 85-115.
9. Cooper et al., (2007) "Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software", Springer.
10. Cullinane, K., Wang, T-F., Song, D-W., and Ji, P. (2006 b) "The technical efficiency of container ports: comparing data envelopment analysis and stochastic frontier analysis", *Transportation Research*, *Part A* 40, pp. 354-374.
11. Cullinane et al., (2004). "*Quantitative models for performance evaluation and benchmarking DEA* with spread sheet". Palgrave.
12. Cullinane, K., Song, D-W and Wang. T-F. (2005) "The application of mathematical programming approaches to estimating container port production efficiency", *Journal of Productivity Analysis.* 24. pp. 73-92.
13. Charnes et al., (1978) "Measuring the efficiency of decision making units". *EJOR*, 2 (6), pp.429-444.
14. Emrouznejad and Yang (2018) "survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2017". *Socio-Economic Planning Sciences*, (61), pp. 4-8.
15. Elsayeh, M. (2015) "The impact of port technical efficiency on Mediterranean container port competitiveness", *PhD Thesis.* University of Huddersfield.
16. EMDB, 2015. "Maritime Ports Guide (commercial and specialized)". EMDB management & operation project. Arab Republic of Egypt. Ministry of transport. Maritime transport sector.
17. Ghashat (2012) "Identifying the right 'fit': What can Libya learn from port devolution in Malaysia". Napier University. Edinburgh.
18. Ismail, A. and Elgazzar, S. (2018) "Measuring the Egyptian container ports' efficiency: A FUZZY AHP framework", *paper presented to 23rd Annual Conference of The Chartered Institute of Logistics and Transport, Logistics Research Network (LRN).* Plymouth, UK. 5-7 September 2018.
19. Infante and Gutiérrez (2013) "Port Efficiency in APEC. Conference: Enhancing APEC Reciliency: more Integrative, Connected, Sustained and Inclusive Development At: Vol. 1, Indonesia, Jakarta. 26-27 June 2013.
20. Jimenez, Z. I., Gutiérrez, A. and Ortiz, C. (2013) "Port Efficiency in APEC", *México y la Cuenca del Pacífico,* 3, pp. 41-74.
21. Kutin, N., Nguyen, T., H. and Vallée, T. (2017) "Relative Efficiencies of ASEAN Container Ports based on Data Envelopment Analysis", *Asian Journal of Shipping and Logistics.* 33 (2), pp. 67-77.
22. Lu, B., Park, N.K. (2010) "Operational performance evaluation of Korean major container terminals". Journal of Korean Navigation and Port Research, 9, pp. 719-726.
23. Lin, et al., (2007) "Operational performance evaluation of major container ports in the Asia-Pacific region", *MPM,* (34), pp.535-551.
24. Liu, Z. (1995) "The comparative performance of public and private enterprises". *Journal of Transportation Economics and Policy.* September. pp. 263-274.
25. Petiot et al., (2017) "A quarter century of Data Envelopment Analysis applied to the transport sector: A bibliometric analysis". SEPSJ, (57), pp.84-96.

26. Polyzos, S. and Niavis, S. (2013) 'Evaluating port efficiency in the Mediterranean', *Int. J. Data Analysis Techniques and Strategies*, 5 (1), pp.84-100.
27. Nwanosike, F. O. (2014) "*Evaluation of Nigerian Ports Post-concession Performance"*, PhD Thesis. University of Huddersfield.
28. Merk, O. and Dang, T. T. (2012) "Efficiency of world ports in container and bulk cargo (oil, coal, ores and grain)". *OECD Regional Development Working Papers. 2012/09.*
29. Maersk (2013) Maersk Home Page, 1 January 2013, Available from: http://www.maersk.com/en/hardware/triple-e.
30. Roll and Hayuth (1993) "Port performance comparison applying data envelopment analysis". *The flagship journal of international shipping and port research*, 20 (2), pp. 153-161.
31. Sarriera, J. M., Araya, G., Serebrisky, T., Briceñogarmendía, C. and Schwartz, J. (2013) "Benchmarking Container Port Technical Efficiency in Latin America and the Caribbean", *The World Bank Latin America and the Caribbean Region Sustainable Development Department*. Policy Research Working Paper 6680.
32. Herrera, S. and Pang, G. (2008) "Efficiency of Infrastructure: The Case of Container Ports", *EconomiA*. 9 (1), pp. 165-194
33. Kutin, N., Nguyen, T., H. and Vallée, T. (2017) "Relative Efficiencies of ASEAN Container Ports based on Data Envelopment Analysis", *Asian Journal of Shipping and Logistics*. 33 (2), pp. 67-77.
34. Wanis, A. and Ismail, A. (2018) "Role of the global container shipping in a changing economic world (recent trends and future perspectives)", *paper presented to The International Maritime Transport & Logistics Conference (MARLOG 7) Innovation in Ports "The Gateway to the Future".* Egypt, Alexandria. 18-20 March 2018.
35. Wang, T. F., Cullinane, K. and Song, D. W. (2005) "*Container Port Production and Economic Efficiency".* Palgrave Macmillan, Basingstoke, Hampshire; New York.

Appendixes

Appendix (1) statistics of Egyptian and Libyan container ports (2012-2016)

Egyptian and Libyan container ports	*Storage capacity*	*Terminal area*	*Berth length*	*Depth*	*Handling Equipment*	*TEUs*	
Alexandria	211810	163000	914.4	12.8	15	548213	2012
El-Dekheila	288831	380000	1520	12	23	647749	
Damietta port	255950	587631	1050	14.5	15	743551	
East Port Said	1200000	1200000	2400	15	19	2624728	
Port Said port	243253	405000	350	13.2	14	691263	
El-Sokhna	200000	410000	750	17	10	540477	
Khoms	15000	450000	1720	11	18	97523	
Tripoli	81000	450000	2800	9	43	94122	
Misurata	67000	105000	2658	11	26	172632	
Tobruck	11000	100000	1080	8	13	8751	
Alexandria	211810	163000	914.4	12.8	15	591656	2013
El-Dekheila	288831	380000	1520	12	23	771571	

Damietta port	255950	587631	1050	14.5	15	676036	
East Port Said	1200000	1200000	2400	15	19	2974665	
Port Said port	243253	405000	350	13.2	14	538772	
El-Sokhna	200000	410000	750	17	10	470109	
Khoms	15000	450000	1720	11	18	80954	
Tripoli	81000	450000	2800	9	43	99328	
Misurata	67000	105000	2658	11	26	192839	
Tobruck	11000	100000	1080	8	13	6334	
Alexandria	211810	163000	914.4	12.8	15	696018	
El-Dekheila	288831	409972	1520	12	23	936686	
Damietta port	255950	587631	1050	14.5	15	698493	
East Port Said	1200000	1200000	2400	15	19	2955890	
Port Said	243253	435000	350	13.2	14	687539	**2014**
El-Sokhna	200000	410000	750	17	10	573782	
Khoms	15000	450000	1720	11	18	66319	
Tripoli	81000	450000	2800	9	43	71622	
Misurata	67000	105000	2658	11	26	127547	
Tobruck	11000	100000	1080	8	13	2445	
Alexandria	298459	163000	914.4	12.8	15	775784	
El-Dekheila	409416	409972	1520	12	23	905687	
Damietta	255950	587631	1050	14.5	15	713966	
East Port Said	1200000	1200000	2400	15	19	2780071	
Port Said	243253	435000	350	13.2	14	514465	**2015**
El-Sokhna	200000	410000	750	17	10	744921	
Khoms	15000	450000	1720	11	18	72008	
Tripoli	81000	450000	2800	9	43	65330	
Misurata	67000	105000	2658	11	26	65079	
Tobruck	11000	100000	1080	8	13	16156	
Alexandria	298459	163000	914.4	12.8	15	798994	
El-Dekheila	409416	409972	1520	12	23	920765	
Damietta	255950	587631	1050	14.5	15	804089	
East Port Said	1200000	1200000	2400	15	19	2274268	
Port Said	243253	435000	350	13.2	14	390284	**2016**
El-Sokhna	200000	410000	750	17	10	662965	
Khoms	15000	450000	1720	11	18	54533	
Tripoli	81000	450000	2800	9	43	42244	
Misurata	67000	105000	2658	11	26	63000	
Tobruck	11000	100000	1080	8	13	15025	

Source: Authors own calculation.