



**Market Structure Analysis of the container terminals in  
the Red Sea and Gulf of Aden  
(Case study of Aden Container Terminal & its  
neighboring competing terminals)**

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**Abstract:**

Measuring the competitiveness of container terminals is considered extremely vital in the world of logistics and maritime transport as it would make container terminals a crucial point in the supply chain where containers are loaded, unloaded and transferred between different modes of transport. It is known that measurement of the competitiveness of such terminals requires careful and thorough in-depth analysis. The current study aims at measuring the competitiveness of the Aden Container Terminal in its capacity as the main terminal handling containers in Yemen. The analytical method is applied in this study as it is a method that is compatible with the study objectives and hypotheses. The following indicators have been used to measure the competitiveness of ports. Concentration Ratio (CR), Hirschman-Herfindahl Index (HHI) Boston Consulting Group (BCG) matrix.

Through the (CR) analysis, the researcher has found that the largest productivity of the four ports - under study - was (83%) on average throughout the study period from 2017, until 2023. In addition, he has found that the ports of “Aden Container Company” and “Port Sudan Port” have obtained the position of the lowest productivity of containers in the Red Sea and the Gulf of Aden throughout the study period which extended from 2017 to 2023. On the other hand, it has been found through the concentration ratio (HHI) that it is a high percentage for the ports under study during the years from 2017 to 2023. The most important results of the BCG matrix were that: Doraleh Port, Port Sudan Port, and Aden Container Terminal are all located in the (Dogs) area due to their lower market share compared to other competitors. Furthermore, it has been found that they operate in a slow-growing market, unlike Jeddah Islamic Port, Salalah Port, and King Abdullah Port, which are lie in the (Cash Cows) area because they are among the most profitable ports among the ports under study during the year 2023.

**Keywords:** Market Structure, Container Terminals, Red Sea, Aden Container Terminal, CR, HHI, BCG, Yamen.

## تحليل هيكل السوق لمحطات الحاويات بالبحر الأحمر وخليج عدن (دراسة حالة محطة عدن للحاويات، والمحطات المنافسة المجاورة لها)

### المستخلص:

يعد قياس القدرة التنافسية لمحطات الحاويات أمرًا حيويًا في عالم اللوجستيات، والنقل البحري؛ وهو أمر من شأنه أن يجعل محطات الحاويات نقطة حيوية في سلسلة التوريد؛ حيث يتم تحميل الحاويات، وتفريغها، ونقلها بين وسائل النقل المختلفة. ومن المعروف أن قياس القدرة التنافسية لمثل هذه المحطات يتطلب تحليلًا مُدقَّقًا، ومتعمِّقًا. وتهدف الدراسة الحالية لقياس القدرة التنافسية لمحطة عدن للحاويات؛ بوصفها المحطة الرئيسية لتداول الحاويات باليمن. وقد تم استخدام المنهج التحليلي فيها؛ كونه منهجًا يتوافق مع أهداف الدراسة، وفرضياتها. وقد استُخدمت المؤشرات التالية لقياس القدرة التنافسية للموانئ، والمتمثلة في:

Concentration Ratio (CR), Hirschman-Herfindahl index (HHI) Boston Consulting Group (BCG) matrix.

ومن خلال تحليل (CR) وجد الباحث أن أكبر إنتاجية لأربعة موانئ- قيد الدراسة- كانت بنسبة (٨٣%) كمتوسط طوال فترة الدراسة من عام ٢٠١٧م، وحتى عام ٢٠٢٣م، كما حصل ميناء: "عدن للحاويات"، و"السودان" علي المركز الأقل إنتاجية للحاويات بالبحر الأحمر، وخليج عدن طوال فترة الدراسة، والتي امتدت من عام ٢٠١٧م، وحتى عام ٢٠٢٣م؛ في حين وُجد؛ من خلال نسبة التركيز (HHI) أنها نسبة عالية للموانئ قيد الدراسة خلال العام ٢٠١٧م وحتى العام ٢٠٢٣م. وقد جاءت أهم نتائج مصفوفة (BCG) أن كل من: ميناء "دوراليه"، وميناء "السودان"، و "محطة عدن للحاويات" جميعها تقع في منطقة (Dogs)؛ نظرًا لما تتمتع به من حصة سوقية أقل مقارنة بالمنافسين الآخرين. كما وجد أنها تعمل في سوق بطيء النمو، على عكس ميناء "جدة الإسلامي"، وميناء "صلالة"، وميناء "الملك عبدالله" يقعان في منطقة (Cash Cows) لأنهما من أكثر الموانئ ربحية بين الموانئ قيد الدراسة خلال العام ٢٠٢٣م.

**الكلمات الدالة:** هيكل السوق، محطات الحاويات، البحر الأحمر، محطة عدن للحاويات، CR، HHI، BCG، اليمن.

## 1. INTRODUCTION:

The world economy globalization has led to the increase in the role and importance of the maritime transport industry, particularly the container transportation industry as it plays a major role in the maritime transport industry. Maritime transport is deemed as the backbone of international trade and global economy as more than 80 percent of the global trade volume is transported by sea all over the world. The United Nations Conference on Trade and Development has estimated that the total volume of maritime trade in 2019 was (1.108) billion tons (UNCTAD, 2023).

Ports are also considered as a fundamental pillar and a vital support for the economic development all over the world. They play a prominent role in the enhancement of trade exchange at both levels: "National and international". Ports have started to focus on improving efficiency and promoting the quality of the provided services to meet the needs of current and prospective customers. Hence, numerous countries have made significant efforts to improve their maritime performance through applying the technology of information and communications. This effort seeks to boost and improve the effectiveness of ports which would lead to an increase in the overall trade volume, and a reduction of the overall costs and the presence period of ships in the port (Qardash, 2021)

Moreover, this improvement results in enhancing the port's competitive capabilities. Among the prominent developments in the maritime transport sector appears the concept of smart ports, whose application considerably contributes to the reduction of time waste and the improvement of the quality of the provided services at the port. Due to the fact that this approach improves the flow of logistics operations and increases efficiency in managing the movement of ships and goods, and the use of modern technology, it becomes possible to achieve a better integration among the various aspects of maritime work. Definitely, this would ultimately augment the achievement of economic growth goals in a greater and more effective way (Amzarbeh, 2022).

Ports face intense competition for their market share and their ability to achieve a more efficient and safe flow of goods all over the world. Therefore, ports apply smart technologies for a better management of operations that would enable them

to confront new challenges whenever they emerge so as to maintain safe, secure, and efficient facilities in their use of energy that would subsequently reduce environmental impacts (Molavi et al., 2020).

## 2. LITERATURE REVIEW:

There are several indicators to measure market structure (Pavic et al., 2016); however, the easiest and the most widely traded, and commonly used is the Concentration Ratio (CR) indicator. The concentration ratio (CR) indicator is used to understand the extent of market concentration and measure the extent of the power distribution among major companies. Therefore, if the concentration rate is high, this indicates that there is a large concentration in the market, which means that a few companies control the market sector - to a large extent. Consequently, this can lead to the possibility of market monopoly or minimizing competition.

The Concentration Ratio (CR) is a common measure of market power whose spread is attributed to its simplicity, both in terms of calculation and ease of use. The concentration ratio is calculated by summing the percentages of market share for a number given by the largest institutions in the relevant industry. If there is a large number of companies with small market shares that operates in industry, and offers homogeneous products, the concentration ratio for the four major companies will be close to zero, or very low. The equation for calculating the Concentration Ratio index is as shown in the following equation, No. (1):

$$CR_n = \sum_{i=1}^n S_i$$

Source: (Naldi, and Flamini, 2014).

Where (n) in (CR<sub>n</sub>) represents a company in a given industry, and (i) represents the market share of company in the observed industry. The value of the concentration ratio (CR) ranges from approximately (0%) to (100%) and based on this ratio conclusion can be drawn about market concentration, market power, and market structure type affiliation.

The study of Yaşar and Kiracı (2017), has examined the market structure and competition level in the aviation market in the world. The study aims at determining the market structure and competition level through the market shares of specific airlines in the world. The market structure and competition level were examined during the period from 2006 to 2015. Both the market concentration ratio (CRn) and the index (HHI) were applied as they are the most widely used market concentration ratios in the studies measuring market concentration. The study results have revealed that the market structure in the mentioned markets in general acquires the same manner of competitiveness though market structure has witnessed major changes over the years.

The study of Elbayoumi et al., (2023) has used four indicators to analyze the competition level for the main container terminals in the Middle East region. The study aims at examining whether the specific market behavior tends towards monopoly, or strong and complete competition through applying 4 analyses on (12) selected container terminals in the Middle East. The concentration ratio K (KCR), the (HHI) index, the (BCG) matrix, and (Shift-Share) analysis were used to analyze the market behavior and its movement over a period of 15 years which was determined from 2004 to 2018. The results of the study revealed that the Index (HHI) has decreased by 2018; which indicates the increase in competition between market participants. This shows that the competition - between the terminals under study - has improved, and that the market is moving steadily towards pure competition. Real evidence provided by container productivity data from the main container ports in the Middle East region have also indicated that “Jebel Ali,” the “Suez Canal Container Terminal” and “King Abdullah” have been at the forefront of the ports benefiting from competition in the region.

The Hirschman-Herfindahl index is a widely used method to measure the degree of concentration in a market or industry, and it is used as an indicator of the occurrence of monopoly (Brezina et al., 2016; Johan, and Vania, 2022). It provides a numerical value that reflects the market share distribution among companies operating in the market. HHI is calculated by normalizing each company's market share in the market and summing these squared values. A higher HHI indicates a higher level of concentration, with fewer companies dominating the market. On the other hand, a low HHI index indicates a more

competitive market with a more balanced distribution of market share among companies. The indicator HHI is commonly used by researchers, policy makers, and regulators to assess the competition level and concentration in various industries, including the banking sector (Bukvic, 2022). It is noteworthy to state that the indicator HHI is used to measure competitive balance because it is more accurate than other indicators (Kvålseth, 2018).

In this context, the study of Bukvic (2022) has aimed at measuring concentration in the banking sector of Serbia using the Herfindahl-Hirschman Index (HHI). Moreover, the study of Veselinović and Radukić (2021) has focused on measuring and analyzing the level of oil market concentration in Serbia, applying specifically the HHI index, as an indicator of concentration. The study did not provide a comprehensive overview of the different interpretations of economic categories related to market concentration. Moreover, the paper does not discuss the specific limitations of using the HHI as an indicator of concentration. Furthermore, the paper does not address the potential challenges or criticisms associated with the above indicator. In addition, it has not explored alternative concentration indices, nor has it discussed their advantages and disadvantages.

The study of Talpur (2023) has investigated the competitiveness of banking companies and its impact on performance through market testing. The researcher has conducted a comparative study of Singapore and Pakistan in the period from 2005 to 2020, the Herfindahl Hirschman index has been used. The study results have revealed that the Singapore market is highly concentrated; which indicates the existence of a monopolistic competitive environment.

The equation for calculating the Herfindahl-Hirschman Index is shown as follows:

$$HHI = \sum_{i=1}^n s_i^2$$

Source: (Naldi, and Flamini, 2018).

A higher (HHI) value indicates that fewer companies dominate the market; therefore, this signifies a higher level of concentration. In contrast, a lower HHI value indicates a more competitive market, with a more balanced distribution of market share among companies. In other words, every increase in the HHI index means a decrease in competitive balance (Ausloos, 2023). It is calculated by the sum of the squared market shares of the competing companies in the market (Crozet, 2017), as shown in Equation (2).

Table No. (1) Market classification; According to the level of concentration

	Hirschman-Herfindahl index HHI	Concentration Ratio CR3
Low concentration market	$HHI \leq 1000$	$CR3 \leq 45$
Moderately concentrated market	$1000 < HHI < 2000$	$45 < CR3 < 70$
Highly concentrated market	$HHI > 2000$	$CR3 > 70$

Source: (Bukvic, 2022)

In the above table No. (1), it is found that if the value of the (HHI) index is less than (1000), this shows that the market is low in concentration, and if the value of) HHI) is between (1000) and (2000), this indicates that The market is concentrated, but moderately. However, if the value of the) HHI) index is greater than (2000), this indicates that the market is highly concentrated, and heading towards oligopoly or monopoly (Bukvic, 2022).

The (BCG) Matrix was developed by Boston Consulting Group (Dang and Yeo, 2017). It is used to visualize the dynamics between ports in specific markets, and to evaluate the competitive position of ports. It consists of four allocated categories to define four positions in the market, which are “ Stars”, “Question Mark”, and “Dog”, and finally, the “Cash Cow”, (Wanis et al., 2021). The (BCG) matrix is an effective tool for strategic planning of product performance at both the industry and company levels. It conducts the analysis process to determine which strategic business units should be invested in, sold, and closed.

The BCG matrix helps the company distribute its available resources through effective business management. It is among the most popular and useful



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consulting companies (Mohajan, 2017). This matrix could help in analyzing seaports if data related to the port is provided to determine the average annual growth rate and average share of ports in the market. In addition, the matrix can also represent traffic categories, such as: roll-on/dry bulk, liquid bulk, conventional cargo, and containers, (Birafane, et al., 2020).

Firstly, “Stars” means that the port operates in a highly growing industry. It plays a major role in the international market share. The “Stars” are the generators and users of cash. Secondly, the “Cash Cow” is among the most profitable trademarks and must be “milked” to generate as much cash as possible. To support their further growth, the money earned from the "cow" must be invested in the "stars". Thirdly, the “Question Mark” comes in the third place, because it is a trademark that requires a more accurate study as it has a low market share in fast-growing markets, that consume a large amount of money and incur losses, Fourthly, the “Dogs” come in the fourth place, which have a lower market share compared to other competitors and operate in a slow-growing market. Dogs are not worth investing in because they achieve low or negative cash returns (Wanis et al., 202). As shown in Figure No. (1).

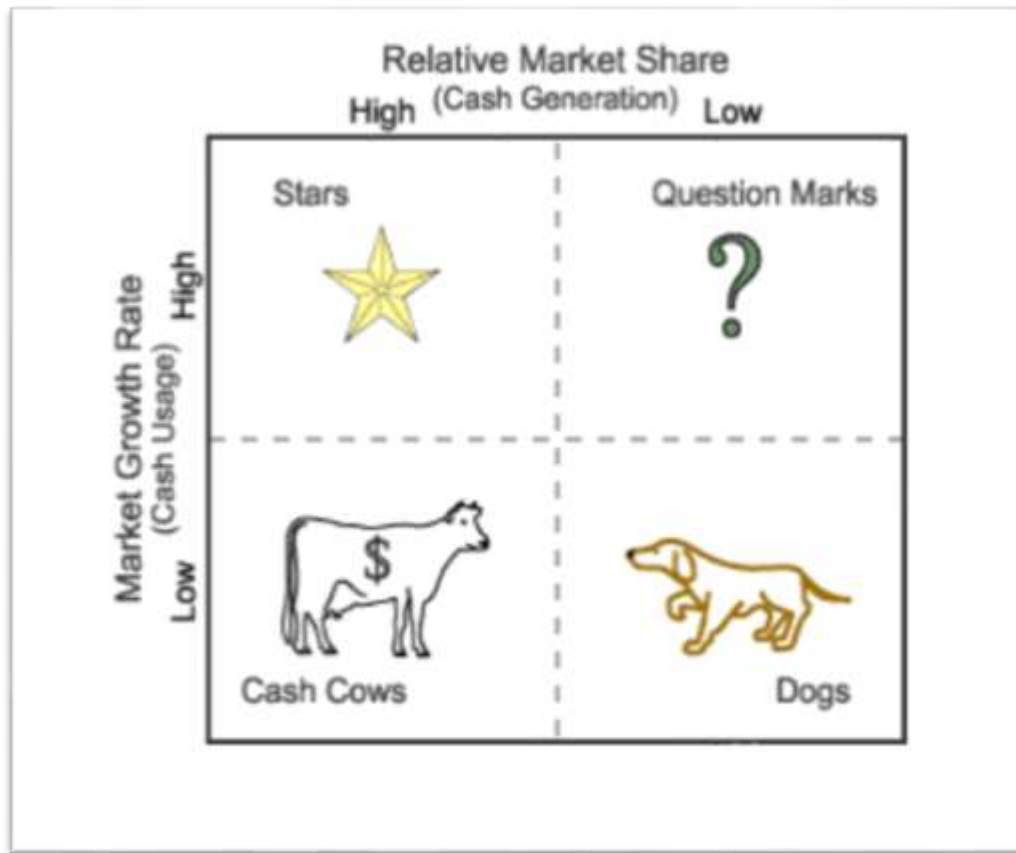


Figure No. (1) Boston Consulting Group Matrix (BCG)

Source :(Hossain and Kader, 2020).

The study of Lorenčić et al. (2020) used the BCG matrix to evaluate the group of cruise regions in the Mediterranean. In this matrix, the four regions were placed according to their market share and their annual growth rate for two consecutive periods. Each period lasted for four years: 2010 -2013 and 2014 - 2017. The figure shows that all regions have maintained their average market shares, but their average annual growth rates have decreased, indicating the possibility of steady development of the market in the future.

Additionally, the study of Wanis et al. (2021) concluded that the analysis of BCG Matrix has revealed that the ports of “Damietta”, “West Port Said”, and “Algiers” are the market pioneers, while the ports of “Khoms”, “Sfax”, “Annaba”

and “Sousse” have a low market share in a fast-growing market and require more care. Furthermore, the port of Algiers is considered the most profitable port. The other remaining ports in this study have the lowest market share and operate in a slowly growing environment.

### **3. Importance of Study:**

The importance of the study is determined in measuring the competitiveness of container terminals, which is a crucial matter in the world of logistics and maritime transport. Container terminals are considered also a vital point in the supply chain where containers are loaded, unloaded, and transferred between different modes of transport. To measure the competitiveness of such terminals, it was necessary to conduct an accurate and in-depth analysis.

### **4. Problem of the Study:**

The recent remarkable development in the use of technology in ports has led to the development in most of the ports adjacent to: “Aden Container Terminal”, which has subsequently contributed to the increase in its competitive ability. Despite the unique location that “Aden Container Terminal” enjoys; however, due to the failure to take any necessary measures to develop the terminal, it has had a negative impact on its performance and a decrease in its operational capacity and efficiency. This has caused it to become unable to keep pace with the current developments while all neighboring ports are seeking to increase their competitiveness.

### **5. Objectives of the Study:**

The study has aimed to investigate how to increase the competitiveness of the Aden Container Terminal in its capacity as the principal and main terminal for handling containers in Yemen.

### **6. Methodology of the Study:**

The study uses the descriptive analytical method which is compatible with the objectives and hypotheses of the study. Tools that measure the competitiveness of ports used in this study: K -firm concentration ratio (K-CR), Hirschman-Herfindahl index (HHI), Boston Consulting Group (BCG) matrix.

### **7. Analytical study of the market structure of the ports, neighboring terminals, and competition for the “Aden Container Terminal:**

Studying the productivity of the Aden Container Terminal and comparing it to ports and neighboring terminals in the Red Sea and Gulf of Aden is of great importance for several reason: Firstly and most importantly, this study contributes to a better understanding of the performance of the Aden Container Terminal, which enables it to improve its operations and increase its efficiency by analyzing production and efficiency rates in the use of resources, and costs associated with operations. In addition, the study can identify strengths and weaknesses in the terminal’s performance compared to local competitors.

Furthermore, this study provides a comprehensive comparison between the “Aden” terminal, the ports and its neighboring terminals in the Red Sea, which helps determine the terminal’s position in relation to the market and analyze competitive opportunities and challenges. Subsequently, this contributes to making strategic improvements to increase the competitiveness of the “Aden” terminal and achieving excellence in the provided services. Likewise, this study can also contribute to attracting investments and enhancing international cooperation in the field of maritime transport. Data and accurate analyses can provide convincing evidence to investors and potential partners concerning the attractiveness of the region and its investment opportunities. The following table No. (2) illustrates the productivity of the Aden Container Terminal, comparing it to its neighboring ports and terminals in the Red Sea and the Gulf of Aden.

Table No. (2) Productivity of container terminals/ports in the Red Sea

<b>Container terminal/port</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
Aden Container Terminal	334,893	398,999	464,952	424,000	418,711	370,000	282,652
Salalah Port	3,946,424	3,385,000	4,028,150	4,340,000	4,513,521	4,503,863	3,900,000
Doraleh Port	865,497	815,093	873,648	812,569	646,647	583,253	829,672
Jeddah Islamic Port"	4,154,041	4,116,935	4,405,368	4,740,000	4,739,470	4,500,000	4,100,000

King Abdullah Port	1,705,000	2,301,595	2,020,681	2,150,000	2,813,920	2,912,407	2,600,000
Port of Aqaba "	796,087	815,345	798,160	857,283	765,662	852,554	898,736
Port of Sudan	487,336	451,712	422,597	396,267	320,274	355,000	250,000
Sokhna Port	629,200	666,750	720,000	780,000	887,000	929,353	904,000

Source: Certified reports from the commercial administration of the Aden Ports Development Company (2024)

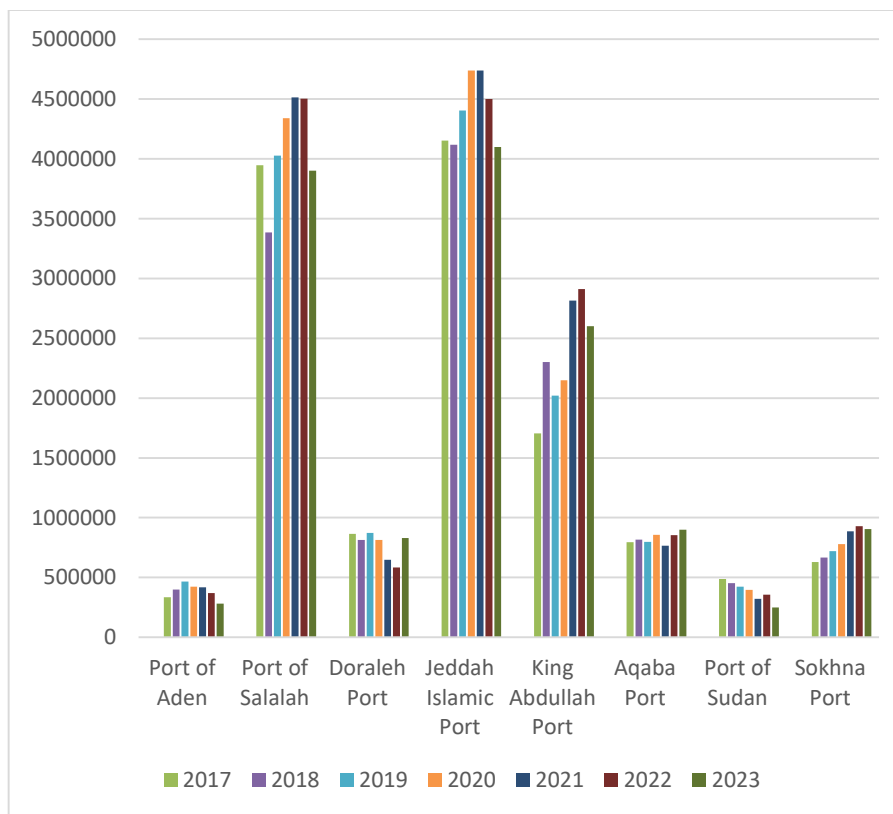


Figure No. (2): Productivity of container terminals/ports in the Red Sea.

Source: Author.

It is clear from the above figure (2) that the lowest container productivity throughout the study period was at the “Aden Container Terminal”. This is due to the political turmoil and instability in the region, such as wars or armed conflicts, and the political tensions, which caused the disruption of logistical and

commercial operations at the Aden Container Terminal. Hence, it has led to a decrease in the productivity of the port.

### **7.1 Analysis of the market structure using the Concentration Ratio Indicator**

As the study has previously reported, the (CR) Concentration Ratio is an important indicator for market analysis. Using the concentration rate (CR) indicator represents an important tool that helps in understanding the degree of market concentration and the distribution of the market among the participating companies. The concentration rate is calculated by summing the percentage of market shares of ports in the study area, as shown in the following table No. (3):

It is clear from Table No. (3) that both: "Jeddah Islamic Port" in the Kingdom of Saudi Arabia, and "Salalah" Port in the Sultanate of Oman maintain an average rate of (60%) throughout the study period from 2018 to 2023. This is out of the total container handling in the Red Sea and Gulf of Aden regions. The "Jeddah Islamic Port" maintained the first place, while the "Salalah port" ranked the second in container productivity - among the ports under study - during the period from 2017 to 2023, followed by "King Abdullah Port" in the Kingdom of Saudi Arabia, which ranked the third undisputed throughout the study period. On the other hand, the port of Aqaba in Jordan and the port of Doraleh in Djibouti competed for the fourth place in container productivity among the ports under study.

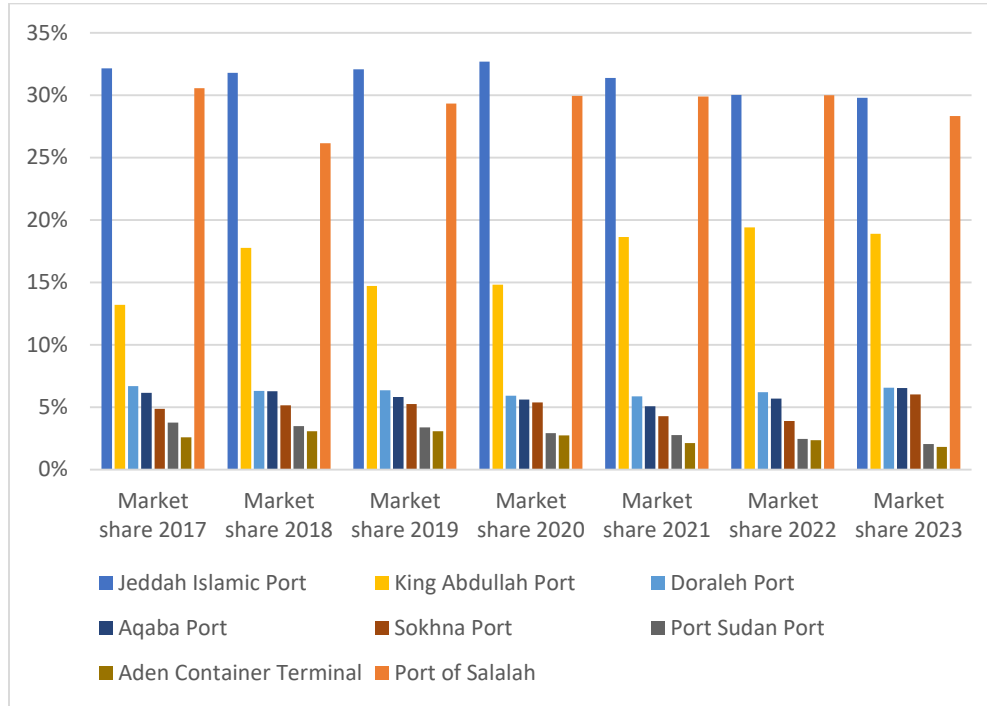


Figure No. (3) Aden's container throughput ratio to its neighboring Red Sea container terminals/ports

Source: Author.

The (CR) analysis has revealed that the largest productivity of the four ports - under study - has been (83%) on average throughout the study period from 2017 to 2023, and "Aden Container Port" and "Port Sudan Port" have been ranked among the least productive ports for containers at the Red Sea and the Gulf of Aden throughout the study period from 2017 to 2023.

Nevertheless, it should be considered that the concentration rate (CR) represents only one indicator and cannot be relied upon solely. Therefore, to evaluate the market health, other factors must also be considered, such as: competition between ports, regulatory restrictions therein, as well as supply and demand factors, and other economic and political factors.

From the following table No. (3), both "Jeddah Islamic" and "Salalah" ports are listed among the most productive ports - among the ports under study - during

the period from 2017 to 2023. Jeddah Islamic Port has continued to occupy the first place throughout the study period, except for the year 2022, in which Salalah Port topped first place, once only throughout the study period.

Their market share has reached an average of (61%) during the study period. The average market concentration (CR) for the two largest ports during the study period has been (61%), while the average market concentration (CR) for the four largest ports (CR4) during the period of the study rate was (84%), during the period from 2017 to 2023.

It is also noted that “King Abdullah Port” has maintained the third place throughout the study period from 2017 to 2023 AD, while “Aqaba Port” has ranked the fourth in 2018, and in 2020 only.

From the following table No. (3), it is clear that the concentrations of the four ports mentioned in the previous table are found in (Jeddah Islamic Port ‘Salalah Port, King Abdullah Port and Doraleh Port) at the expense of the other four ports with less concentration rates, namely: Aqaba Port which reached the fourth place only in 2018 and 2020, but fell to the fifth place, and the port of Djibouti, which ranked the fourth in only two years: (2017 and 2019) before falling to the sixth place. The port of Aden ranked seventh, ahead of the port of Sudan, which ended up in the eighth and last place among the container ports in the research area.

The security situation in Sudan played a major role in the decline of imports through the port of Sudan. In this context, the Aden Container Terminal suffers from poor security conditions which caused its market share to be only about 3% in the region.



Port	TEUs	Market Share	Port	TEUs	Market Share	Port	TEUs	Market Share	Port	TEUs	Market Share
	2017			2018			2019			2020	
Jeddah Islamic Port	4,154,041	32%	Jeddah Port Islamic	4,116,935	32%	Jeddah Islamic Port	4,405,368	32%	Jeddah Islamic Port	4,740,000	33%
Salalah Port	3,946,424	31%	Salalah Port	3,385,000	26%	Salalah Port	4,028,150	29%	Salalah Port	4,340,000	30%
<b>CR2</b>		<b>63%</b>	<b>CR2</b>		<b>58%</b>	<b>CR2</b>		<b>61%</b>	<b>CR2</b>		<b>63%</b>
King Abdullah Port	1,705,000	13%	King Abdullah Port	2,301,595	18%	King Abdullah Port	2,020,681	15%	King Abdullah Port	2,150,000	15%
Doraleh Port	865,497	7%	Aqaba Port	815,345	6%	Doraleh Port	873,648	6%	Aqaba Port	857,283	6%
<b>CR4</b>		<b>83%</b>	<b>CR4</b>		<b>82%</b>	<b>CR4</b>		<b>82%</b>	<b>CR4</b>		<b>83%</b>
Aqaba Port	796,087	6%	Doraleh Port	815,093	6%	Aqaba Port	798,160	6%	ميناء دوراليه	812,569	6%
Sokhna Port	629,200	5%	Sokhna Port	666,750	5%	Sokhna Port	720,000	5%	Sokhna Port	780,000	5%
Port of Sudan	487,336	4%	Port of Sudan	451,712	3%	Aden Container Terminal	464,952	3%	Aden Container Terminal	424,000	3%
Aden Container Terminal	334,893	3%	Aden Container Terminal	398,999	3%	Port of Sudan	422,597	3%	Port of Sudan	396,267	3%
<b>Total</b>	<b>12,918,478</b>	<b>100%</b>	<b>Total</b>	<b>12,951,429</b>	<b>100%</b>	<b>Total</b>	<b>13,733,556</b>	<b>100%</b>	<b>Total</b>	<b>14,500,119</b>	<b>100%</b>

Source : Author.

Table No. (3) Market structure using the Concentration Ratio indicator.

Port	TEUs	Market Share	Port	TEUs	Market Share	Port	TEUs	Market Share
	2021			2022			2023	
Jeddah Port Islamic	4,739,470	31%	Salalah Port	4,503,863	30%	Jeddah Islamic Port	4,100,000	30%
Salalah Port	4,513,521	30%	Jeddah Islamic Port	4,500,000	30%	Salalah Port	3,900,000	28%
<b>CR2</b>		<b>61%</b>	<b>CR2</b>		<b>60%</b>	<b>CR2</b>		<b>58%</b>
King Abdullah Port	2,813,920	19%	King Abdullah Port	2,912,407	19%	King Abdullah Port	2,600,000	19%
Sokhna Port	887,000	6%	Sokhna Port	929,353	6%	Sokhna Port	904,000	7%
<b>CR4</b>		<b>86%</b>	<b>CR4</b>		<b>86%</b>	<b>CR4</b>		<b>84%</b>
Aqaba Port	765,662	5%	Aqaba Port	852,554	6%	Aqaba Port	898,736	7%
Doraleh Port	646,647	4%	Doraleh Port	583,253	4%	Doraleh Port	829,672	6%
Aden Container Terminal	418,711	3%	Aden Container Terminal	370,000	2%	Aden Container Terminal	282,652	2%
ميناء السودان	320,274	2%	Port of Sudan	355,000	2%	Port of Sudan	250,000	2%
<b>Total</b>	<b>15,105,205</b>	<b>100%</b>	<b>Total</b>	<b>15,006,430</b>	<b>100%</b>	<b>Total</b>	<b>13,765,060</b>	<b>100%</b>

Source : Author.

## 7.2 Analysis of market structure using the Herfindahl-Hirschman Index (HHI)

The following table No. (4) shows the analysis of concentration ratios using the (HHI) index in the container terminal market exceeds (2000), which indicates a highly concentrated market. This means that the market is undoubtedly controlled, and the reason for concentration is basically attributed to the two most important ports in the region: “Jeddah Islamic Port” and “Salalah” Port in Oman, which together constitute more than (60%) of the total container activity in the Red Sea region and the Gulf of Aden during the study period from 2017 to 2023.

Table No. (4) Productivity Ratio of container terminals/ports in the Red Sea to the other neighboring ports

Container terminal/port	TEUs 2017	TEUs 2018	TEUs 2019	TEUs 2020	TEUs 2021	TEUs 2022	TEUs 2023
Jeddah Islamic Port	32.16	31.76	32.08	32.71	31.46	30.27	29.97
Port of Salalah	30.55	26.12	29.33	29.95	29.96	30.24	28.50
King Abdullah Port	13.20	17.76	14.71	14.84	18.68	19.57	19.00
Doraleh Port	6.70	6.37	6.36	5.92	5.89	6.25	6.61
Aqaba Port	6.16	6.29	5.81	5.53	4.82	4.87	6.06
Sokhna Port	4.87	5.14	5.24	5.38	4.29	3.92	5.96
Port of Sudan	3.77	3.48	3.39	2.93	2.78	2.49	2.07
Aden Container Terminal	2.59	3.08	3.08	2.73	2.13	2.39	1.83
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
<b>HHI</b>	<b>2269</b>	<b>2134</b>	<b>2228</b>	<b>2298</b>	<b>2325</b>	<b>2304</b>	<b>2195</b>

Source: Author.

The following figure, No. (4), shows the concentration rate for all ports - under study - during the years 2017 to 2023 as the (HHI) ratio reached 2269 in 2017, and it decreased to 2134 in 2018. However, it rose in 2019 and reached 2228 and continued to rise in 2020 and 2021 to amount to 2298 in 2020. The percentage was (2325) in 2021, and it decreased in 2022 to (2304), and continued to decrease in 2023 to reach (2195).

The reason for this is the low productivity of most dealers in the container market in the study area, namely Jeddah Islamic Port and Salalah Port, as a result of the Corona pandemic and the subsequent political tensions due to the Russian-Ukrainian war.

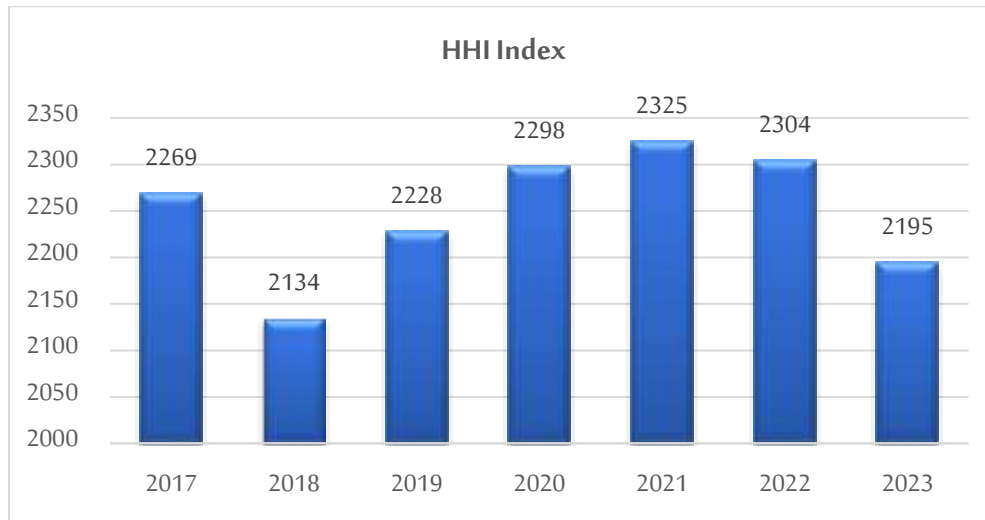


Figure No. (4): (HHI) Index for the container terminals under study  
Source: Author.

### **7.3 Market structure analysis using the Boston Consulting Group (BCG) index:**

To make the BCG matrix, the average relative market share of the ports under study should be calculated first, as well as the annual market share growth rate for all ports under study

(Birafane, et al., 2020, through the following equations:

$$\text{Relative Market Share} = (\alpha/\theta) \quad (1)$$

Where  $\alpha$  is SBU Throughput in the given year, and  $\theta$  is the largest competitor port throughput this year.

$$\text{Market growth rate} = \{(z_1/z_0) - 1\} \quad (2)$$

Where  $z_1$  is the market's total throughput in the given year, and  $z$  is the market's total throughput of the previous year.

Equation No. (3) Average relative market share of ports & the annual market share growth rate.

Source: Birafane et al., 2020.

The following table No. (5) shows the calculation of the average relative market share of the ports under study and that of the annual market share growth rate for all ports under study. The average market share has been calculated Average Market Share (%) is calculated according to the following equation:

The port's productivity was calculated divided by the highest productivity among the ports under study. For example, to calculate the average market share of "Jeddah Islamic Port" (4,100,000 /3,900,000), it was multiplied by (100%) to extract the required percentage.

In the previous year (2022), it was calculated divided by the port's productivity for the current year, 2023. Then the result was divided by the port's productivity for the previous year, 2022. For example, to calculate the Average Annual Market Growth share (%) for Jeddah Islamic Port (4,503,863 - 4,100,000 /4,503,863), it was multiplied by (100%) to extract the required percentage. When the percentage is negative, this means that the port's productivity has decreased from the current year, 2023 to the previous year, 2022.

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Table No. (5): Average relative market share of ports & the annual market share growth rate

Port/container terminal	TEUs 2022	TEUs 2023	Average market share Market Share (%)	Average Annual Market Share Market Growth (%)
Jeddah Islamic Port	4,503,863	4,100,000	105.13%	-8.97%
Salalah Port	4,500,000	3,900,000	95.12%	-13.33%
King Abdullah Port	2,912,407	2,600,000	63.41%	-10.73%
Port of Doraleh	929,353	904,000	22.05%	-2.73%
Port of Aqaba	724,619	829,672	20.24%	14.50%
Sokhna Port	583,253	816,153	19.91%	39.93%
Port Sudan Port	370,000	282,652	6.89%	-23.61%
Aden Container Terminal	355,000	250,000	6.10%	-29.58%

Source :Author.

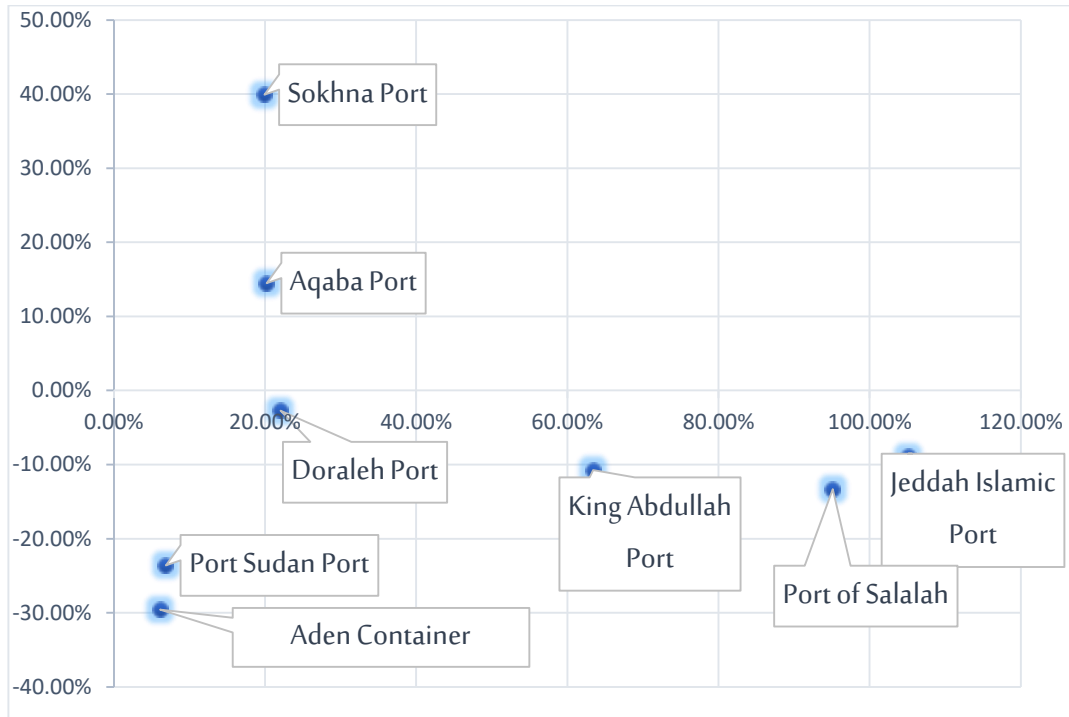


Figure No. (5): BCG matrix for the ports under study.

Source: Author.

It is clear from the above figure that Doraleh Port, Sudan Port, and Aden Container Terminal are all located in the Dogs area because they have a lower market share compared to other competitors, and they operate in a slow-growing market. In contrast, it was found that each of the following ports: “Jeddah Islamic Port”, “Salalah Port,” and “King Abdullah Port” are all located in the Cash Cow’s area because they are one of the most profitable ports - among the ports under study - during the year 2023.

It is noted from the above figure and based on the analysis of the (BCG) matrix of the ports under study, that there is no presence in the (Question Mark) area. This is because none of the ports identified in the study have a low market share considering the rapidly growing market. However, the ports of “Sokhna” and the port of “Aqaba” are in the (Stars) region. This is because these ports enjoyed a positive annual market share during the year 2023 among the ports under study.

## 8. CONCLUSION:

The study aimed at measuring the competitiveness of the Aden Container Terminal in its capacity as the main terminal for handling to and from containers. The study applied the analytical approach as it is the most compatible method with its objectives and hypotheses. A set of indicators were used to measure the competitiveness of ports, namely : (CR), (HHI) and (BCG). The study has found that the analysis of (CR) has revealed that the greatest productivity rate of the four ports under study was determined at (83%), on average throughout the study period from 2017 to 2023. Aden Container and Sudan Port were also ranked among the least productive ports for containers in the Red Sea and the Gulf of Aden throughout the study period from 2017 to 2023. The concentration ratio (HHI) indicated that the concentration rate of the ports under study is high during the years 2017 to 2023. Among the most important results of the (BCG) matrix was that the port of Doraleh, the port of Sudan, and the Aden Container Terminal are in the (Dogs) area. Because they were characterized by a lower market share in comparison with other competitors. In addition, they also operate in a slow-growing market; unlike Jeddah Islamic Port, Salalah Port, and King Abdullah Port, which are in the Cash Cows area. This is because they are among the most profitable ports among the ports under study during the year 2023.

The study recommends investing in technology development in the Aden terminal, namely smart port management systems, automation techniques , and artificial intelligence applications to improve the efficiency of operations, provide distinguished services to customers, and develop the skills and capabilities of workers at the Aden Terminal. This can be achieved by training and developing human cadres and providing motivational programs to increase effectiveness and efficiency at work. Furthermore, the study recommends enhancing and strengthening the security and safety procedures at the “ Aden ” terminal to ensure the safety of workers, shipments and equipment which contributes to the construction of a positive reputation and increasing customer confidence. It also recommends adopting sustainable environmental practices in port operations, such as applying clean technology and effective waste management which would contribute to attracting more customers, who care about sustainability. Finally, it is recommended to develop effective marketing



strategies to market the “ Aden ” terminal, attract more shipments and ships, and expand the customer base.

For future studies, the current study recommends using appropriate analytical tools, such as the (SWOT) matrix to understand the strengths and weaknesses of the “Aden” terminal and the competing terminals. It is also necessary to conduct a comparative analysis of the competing terminals adjacent to the “Aden” terminal, including the overall structure of your business. service level, pricing strategies, etc. This would help in understanding the strengths and weaknesses of each terminal.

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