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Assessment of Transshipment Port Market StructureanApplication toSino-MoroccanMaritime Routing

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Abstract: *The purpose of this paper is to evaluate the advantage and the competiveness of the major port in the routing relating the kingdom of Morocco with the People's Republic of China. In doing so the structural conduct performance approach is employed to examine the advantage level as well as the inequality levels of the eleven major transshipment ports located in the Strait of Gibraltar, the Canal Suez and the Straits of Malacca over the period between 2013 and 2016.*

This paper presents the results from different perceptions by providing an analysis of the dynamic characteristics of the transshipment port market, and using four methods namely K-Firm concentration ratio, Hirschman-Herfindahl index, Entropy index and Gini coefficient.

The results reveal that the market is moderately concentrated during the recent years but moving towards de-concentration in the near future and the competition level will be increased which can be explained by an increased number of market players due the rise of port development in the sector over the study period. Nevertheless the study also shows that the market is less competitive between the whole eleven ports but when it comes to a detailed comparative study it reflects the opposite.

Keywords*: K-Firm concentration ratio, Hirschman-Herfindahl index, Entropy index, Gini coefficient*

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I. Introduction

The study on transshipment port structure mostly focused on the degree of market concentration, which consists of a combination of firms resulting in a long-term change in the market structure, a loss of independence of the various firms combined and a strengthening of the economic power of the whole. It is assessed mainly according to the number of present operators, their respective effective dynamism and their individual shares held in the total market.This characteristic, often called simply concentration, which can theoretically be appreciated on both sides "supply and demand". The term also applies to the study of the distribution of production within industrial sub-sectors (The study of the industrial concentration). In other word measures of concentration illustrate characteristics of the firm size distribution at a point in the time. (Flora, 2017) and the distribution dimensions varies gradually over time, thus the associated elements of concentration (Baldwin and Gorecki, 1998).

Transshipment ports structure is assessed in this study by employing concentration indices from 2013 to 2016 in order to figure out the competition level as well as the future market trend of each engaged hub that shipping liners use to plan their routing. In this regard the number and size distribution of rivalry ports will be described through a single-parameter index. Nevertheless the most questionable topics in a maritime industrial organization referred to the proper dimension of the size distribution of firms in a maritime industry. There is no consent on the model that can relate performance, structure and behavior from which, n index can be derived. With the lack of such a model, some researchers suggest altered measures to the various dimensions of market structure.

For the analysis of market concentration and competition as well as port advantages, statistical measures of market concentration such as HHI and concentration ratios are commonly used (Notteboom, 2010, Liu et al., 2011). Moreover the lack of consensus as to which transshipment ports structure index is preferred, there is a large arrangement that the index should reflect at least two elements of the size distribution of organization; the number of organization and the organization sizes variance. Thus they rise if either the number of organization decreases or the degree of difference in organization size increases (Flora, 2017).

The indices of market structures can be characterized in two main clusters. First, the discrete measures using records on market shares of a small number of the largest firms such as k-concentration ratio related to the chief four or eight organizations. Second, collective estimates employing all the data points in

the size distribution such the collective measures include the HHI that measures market share of firms and the Shannon index described as the log of share as the weight.

II. The dynamic analysis of the transshipment port market

The following research is limited to eleven major transshipment ports that are respectively, Singapore, Hong Kong, Ningbo, Guangzhou, Tanjung-Pelepas, Valencia, Algeciras, Tangier Med, Piraeus, Barcelona and Las Palmas terminal, those portsare currently deployed by common shipping lines for vessels departing from People Republic of China and serving several destination ports of the kingdom of Morocco.

The following chart shows the traffic volume of the chosen eleven ports for our research,

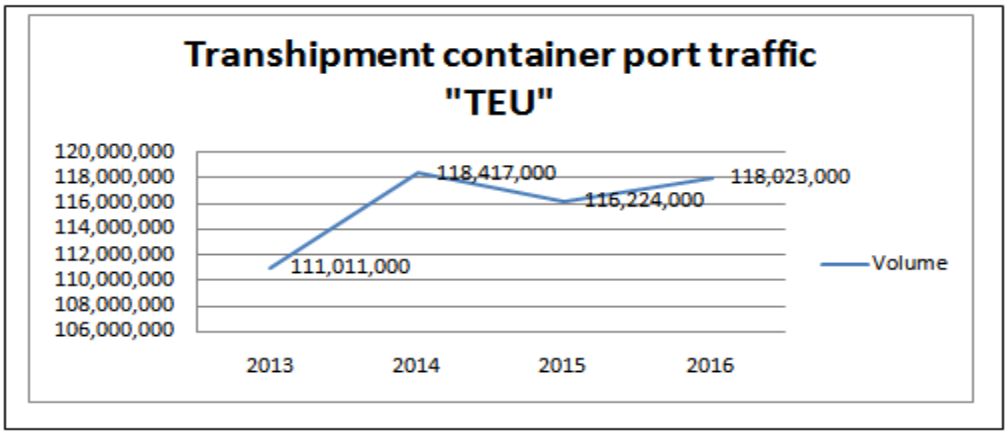


Figure 1: Transhipment ports container volume from 2013 to 2016
**Source: Drewry Maritime Advisors (2017)*

As it is indicated in figure 1, 2014 was the most prosperous year in terms of traffic volume reaching 111,8417,000 TEU, succeeding an increase of around 7% compared to 2013. The year 2015 witnessed a slow decline which can be explained by the decline of some major transshipment hub that are respectively Singapore terminal and Hong Kong terminal, finally the curve concluded its year 2016 with a slight rebound steading at a total container throughput of 118,023,000 TEU

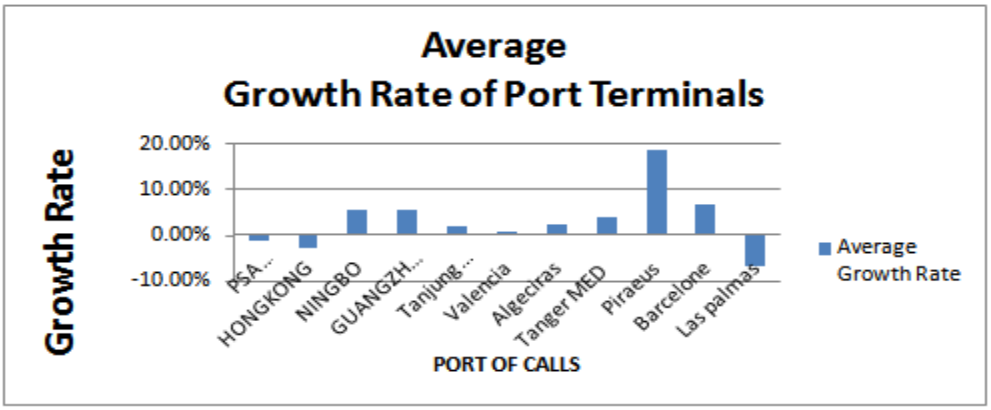


Figure 2: Transhipment ports average growth rates (2013 – 2016)
**Source: Author*

The average growth of the studied transshipment ports is not steady for most of the above ports. It's taking several forms since some container terminal are performing perfectly well as the case for Piraeus which has an average growth of almost 18% during the recent 4 years. Thanks to the bold management pursued by the Chinese

liner COSCO this result was achieved. In fact it must be said that the Chinese strategy is to make Piraeus, able to accommodate large ships, an international hub as well as a transfer center of goods. In other word a gateway to the rest of the continent. (Demenopoulos, 2016). In this regard, Piraeus is the armed arm of the strategy deployed by President Xi Jinping in 2013 to create a new Silk Road. The port of Piraeus is the "dragonhead" of this strategy as far as the seaway is concerned.(Tzogopoulos, 2016)

In the other hand according to figure 2, Guangzhou, Ningbo and Barcelona terminals have almost same pace of growth concluding the year of 2016 with satisfying results, but still the Chinese ports are much greater in terms of total throughput. Singapore, Hong Kong and Las Palmas ports have a negative growth rate respectively of -1.31%, -2.97% and -6.78%.

III. K-Firm Concentration Ratio Analysis

After applying the K-firm concentration analysis to our research on the competing transshipment ports, we figure that CR4 is much greater than 40%, which mean the market is oligopoly. The four container terminals that are sharing around 78% during the 4 recent years are respectively Singapore PSA, Ningbo, Hong Kong and Guangzhou terminals. In 2013 the concentration ratio of these top four biggest ports was exactly 78.9% then declined slowly during the following two years steading respectively at 77.95% and 76.76%, finally CR4 has rebounded slightly by 0.52% steading at 77.22% demonstrating that the market is still highly concentrated.

The first analysis shows that the market is less competitive between the whole eleven ports but when it comes to a detailed comparative study of only those four biggest ports, the below table (Table 1) reflects the opposite , in other word a stiff competition with equitable proportion especially for Hong Kong, Ningbo and Guangzhou terminal ports.

In 2013 Hong Kong made a total throughput of 22,352,000 TEU allowing it to rank in the 2nd position, buts starting from the year 2015 that's no longer the case, Ningbo port overcame its direct rival and wining the 2nd position of the podium with a total throughput of 20,630,000 TEU and 21,560,000 TEU in 2016. Guangzhou port is also performing well since its cargo volume is taking an increased pathway starting from 15,309,000 TEU in 2013 and completing the year of 2016 with a total throughput of 18,858,000 TEU very close to Hong Kong port volume which mean in the coming year Guangzhou port will take the 3rd position of the rank unless Hong Kong port authorities moves in an efficient way to circumvent the situation. Nevertheless Singapore PSA total throughput has witnessed in the recent four year inappropriate downward continuously moving from 32,579,000 TEU in 2013 and ending the year of 2016 with 30,904,000 TEU.In particular, the Southeast Asian transshipment hub lost market share to regional rivals as alliance arrangements saw a shift in cargo patterns.

Port Kelang handled 11.9m TEU in 2015, an 8.6% increase on 2014 while fellow Malaysian port Tanjung-Pelepas saw container volumes increase 7.1% to 9.1m TEU in 2015.

These are difficult, uncertain times, but also challenging and exciting. In the last few years, we have witnessed the massive impact of rapidly changing mega liner alliances; the arrival of mega ships and port congestion around the globe due to the inadequacy of some berth facilities; protracted dips in crude oil prices; and a global economy that has lost much of its growth momentum resulting in anemic trade flows. (Meng, 2015).

The second category of the K-firm concentration ration analysis has shown that the left seven transshipment port reflects three segments of competitors:

The first segment has only Tanjung-Pelepas terminal port standing in the 5th position with no other rival having its dimension since the total throughput of PTP is nearly the double of Valencia port which is ranked in the 6th position. Tanjung-Pelepas terminal total volume has known an increased pace during the first 3 years followed by a slight decline in 2016, that are correspondingly , 7,628,000 TEU , 8,500,000 TEU, 9,130,000 TEU, and 8,281,000 TEU.

The second segment includes Valencia and Algeciras port with a total volume ranging from 4,114,000 TEU to 4,616,000 TEU. These two terminals are performing in a similar manner.

In 2013 Valencia port ranked in the 6th position with a total throughput of 4,470,000 TEU, in the following two years the terminal port lost its market share in favor of Algeciras port, before standing back in the initial position in 2016 with a total throughput of 4,616,000 TEU.

The third segment includes the last four transshipment hub ports of the list that are respectively, Tangier Med, Piraeus, Barcelona and Las Palmas.

As the table 1 indicates Piraeus Port has the highest performance output in the research list growing sharply in a significant way from 1,680,000 TEU (9th position) in 2013 to 3,330,000 TEU in 2016 (8th position), surpassing Tangier MED port by almost 400,000 TEU, and approaching the biggest Spanish ports that are respectively Algeciras and Valencia port.

People's Republic of China has been investing strongly in Greece in recent years. COSCO acquired a 51 percent stake in Piraeus Port for $314 million in 2016 under its strategy for supporting Greece to be a transhipment hub for rapidly increasing trade between Asia and Eastern Europe. It has the choice to purchase additional 16 percent after five years once it finishes compulsory investments of around 300 million euros to develop infrastructure.(Koutantou and Mahlich, 2017)

COSCO has been supervising two of the port's cargo berths since 2009 and has aided Piraeus to appear in the world rankings of container terminal ports from 93rd in 2010 to 44th biggest in 2015 .(Koutantou and Mahlich, 2017)

Morocco's Tangier Med transhipment hub is also performing well and has been a huge success since it opened in 2007, balanced growth in the recent four years of nearly 7% per year. In 2013 the total throughput was 2,550,000 TEU which has been followed by a further growth in 2014, with volumes breaking the 3 million TEU mark for the first time in Moroccan port reaching the maximum capacity of the first two terminal of Tangier Med, and steading finally at a total of throughput of 2,964,000 TEU. Another terminal expansion of Tangier Med is under construction in order to achieve the Moroccan insight to make Tangier Med one of the biggest transshipment hub in the region.

Barcelona port has a moderate growth same with other Spanish regional port moving from 1,722,000 TEU in 2013 to 2,236,000 TEU in 2016. However Las Palmas has the worst competitive position in the list ranking in the 11th position reflecting a significant downturn along the four year shifting its total containerized volume from 1,256,000 TEU in 2016 to 945,000 TEU in 2016

Table 1: Measurement of Transshipment Port Market Structure using K-firm Concentration Ratio (CR4)

2013			2014			2015			2016		
PORT	**Throughput**	**Market Share**	**PORT**	**Throughput**	**Market Share**	**PORT**	**Throughput**	**Market Share**	**PORT**	**Throughput**	**Market Share**
PSA SINGAPORE	32,579,000	29.35%	PSA SINGAPORE	33,869,000	28.60%	PSA SINGAPORE	30,922,000	26.61%	PSA SINGAPORE	30,904,000	26.18%
HONGKONG	22,352,000	20.13%	HONGKONG	22,374,000	18.89%	NINGBO	20,630,000	17.75%	NINGBO	21,560,000	18.27%
NINGBO	17,351,000	15.63%	NINGBO	19,450,000	16.43%	HONGKONG	20,073,000	17.27%	HONGKONG	19,813,000	16.79%
GUANGZHOU	15,309,000	13.79%	GUANGZHOU	16,610,000	14.03%	GUANGZHOU	17,590,000	15.13%	GUANGZHOU	18,858,000	15.98%
CR4		**78.90%**	**CR4**		**77.95%**	**CR4**		**76.76%**	**CR4**		77.22%
Tantung Pelepas	7,628,000	6.87%	Tantung Pelepas	8,500,000	7.18%	Tantung Pelepas	9,130,000	7.86%	Tantung Pelepas	8,281,000	7.02%
Valencia	4,470,000	4.03%	Algeciras	4,501,000	3.80%	Algeciras	4,457,000	3.83%	Valencia	4,616,000	3.91%
Algeciras	4,114,000	3.71%	Valencia	4,328,000	3.65%	Valencia	4,442,000	3.82%	Algeciras	4,516,000	3.83%
Tangier MED	2,550,000	2.30%	Tangier MED	3,080,000	2.60%	Piraeus	3,164,000	2.72%	Piraeus	3,330,000	2.82%
Piraeus	1,680,000	1.51%	Piraeus	2,745,000	2.32%	Tangier MED	2,961,000	2.55%	Tangier MED	2964000	2.51%
Barcelona	1,722,000	1.55%	Barcelona	1,893,000	1.60%	Barcelona	1,954,000	1.68%	Barcelona	2,236,000	1.89%
Las Palmas	1,256,000	1.13%	Las Palmas	1,067,000	0.90%	Las Palmas	901,000	0.78%	Las Palmas	945,000	0.80%
TOTAL	111,011,000	100.00 %		118,417,000	100.00 %		116,224,000	100.00 %		118,023,000	100.00 %

Source, Author, UNICTAD (2017)

IV. Hirschman-Herfindahl Index Analysis

The Hirschman-Herfindahl Index Analysis is used to calculate the degree of concentration in the eleven transhipment ports market by squaring the market share of each port, and then summing the resulting numbers. The more a market is to being a monopoly, the greater the market's concentration (and the lower its competition).

A market with an HH index below 1,500 is considered by The U.S. Department of Justice to be a competitive marketplace, an HHI of 1,500 to 2,500 is considered to be a moderately concentrated market, and an HHI of 2,500 or above is considered to be a highly concentrated market.

If we consider a market, where **N** terminal ports operate, and indicate the market share of the ***i***-th port by S_i (***i*** = 1, 2,..., N and $0 < S_i \leq 1$), the Hirschman-Herfindahl Index is:

$$HHI = \sum_{i=1}^{n} S_i^2 \frac{10000}{n} \leq HHI \leq 10000$$

Where S_i is the market share (throughput of port***i***divided by the total throughput of the selected transshipment port and major port of calls) and ***n*** is the total number of the defined ports in the market.

Where also the following obvious constraint holds N i=1 $S_i = 1$

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

HHI considers the entire size distribution of ports on the market by allocating a mass to both the number of ports in the market and the inequality of market shares. The highest value of the HHI is 10,000 where there is a perfect monopoly with a single port having 100 per cent of the market. (Flora, 2017)

According to Figure 3 and Table 2 indicates that HHI index of overall transshipment port is decreasing from 1,789 in 2013 to 1,654 in 2016 indicating that the studied market is considered to be moderately concentrated during the four years.

It must be seeing that the curve is taking a downward regarding the ongoing years which means the market is moving towards de-concentration in the near future and the competition level will certainly be increased. The following finding is backing our detailed interpretation of decomposed segment of K-firm Concentration Ratio which shown in previous section

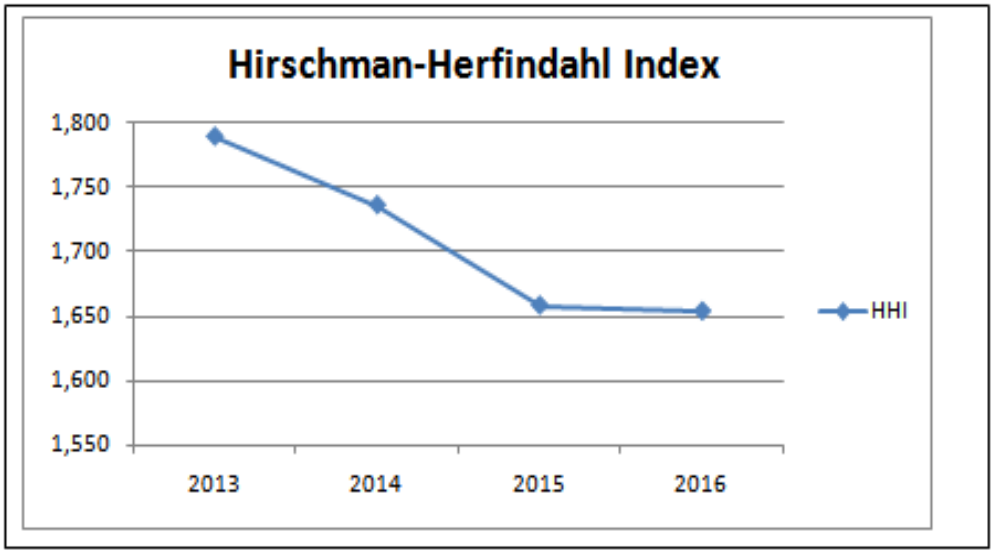


Figure 3: Transshipment Port Market Concentration (2013-2016).
**Source : Author*

Table 2: Hirshman-Herfindahl Index for Trans-shipment Ports Market (2013-2016)

	2013			2016			
PORT	**Throughput**	**Market Share**	**HHI**	**Throughput**	**Market Share**	**HHI**	**Average Growth Rate**
PSA SINGAPORE	32,579,000	29.35%	861.278	30,904,000	26.18%	685.640	-1.31%
HONGKONG	22,352,000	20.13%	405.416	19,813,000	16.79%	281.817	-2.97%
NINGBO	17,351,000	15.63%	244.296	21,560,000	18.27%	333.706	5.58%
GUANGZHOU	15,309,000	13.79%	190.179	18,858,000	15.98%	255.304	5.35%
Tanjung Pelepas	7,628,000	6.87%	47.216	8,281,000	7.02%	49.230	2.07%
Valencia	4,470,000	4.03%	16.214	4,616,000	3.91%	15.297	0.81%
Algeciras	4,114,000	3.71%	13.734	4,516,000	3.83%	14.641	2.36%
Tangier MED	2,550,000	2.30%	5.277	2,964,000	2.51%	6.307	3.83%
Piraeus	1,680,000	1.51%	2.290	3,330,000	2.82%	7.961	18.65%
Barcelona	1,722,000	1.55%	2.406	2,236,000	1.89%	3.589	6.75%
Las Palmas	1,256,000	1.13%	1.280	945,000	0.80%	0.641	-6.87%
TOTAL	111,011,000		1,789.586	118,023,000		1654.134	1.54%

**Source :Author, UNICTAD(2017)*

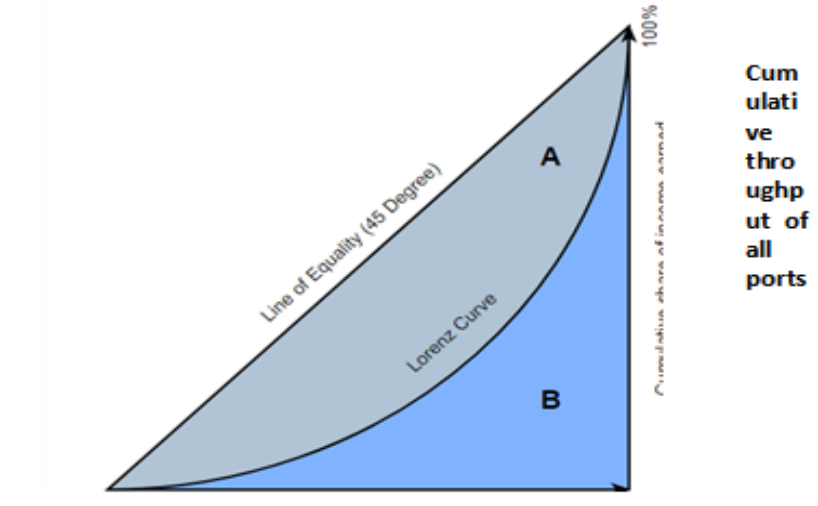
V. Gina Coefficient and Entropy Index Analysis

The Gini coefficient is a widely used index that measures the deviancy from a perfectly uniform distribution of container throughput between ports (Alix, Slack &Comtois 1999, Notteboom, 1997, 2010).

The use of concentration methods, particularly the Gini coefficient, is prevalent in port researches, although the coefficient is a methodical measure that does not reveal the processes behind the changes in the level of concentration (Notteboom, 2006). Given the dependence of Hirschman index to port number and the restriction of Gini coefficient in producing unfair results in case of examining industry with small firms, Fageda (2005) suggested using both indexes in the analysis of port concentration.

In the current study the Gini index is represented graphically through the Lorenz curve, which shows port throughput distribution by plotting the Cumulative percentage of number of Port by increased order of throughputs on the horizontal axis and cumulative throughput of all ports on the vertical axis. The Gini coefficient is equal to the range below the line of absolute equality (0.5 by definition) minus the area below the Lorenz curve, divided by the area below the line of absolute equality. In other words, it is double the area between the Lorenz curve and the line of perfect equality.

Figure 3.4 - Graphical representation of the Gini coefficient



**Source: World Institute for Development Economics Research,*

As the above graphical representation shows the Gini coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve (marked A in the diagram) over the total area under the line of equality (marked A and B in the diagram); that is to say $GC = \frac{A}{(A+B)}$

In case only one port control total throughput, the Gini index will be 1 and Lorenz curve will equal to area under diagonal line, however if all ports are equal in terms of size , the Gini index will be 0 and Lorenz curve will be subsequently equal to diagonal line. (Notteboom, 2006).

In our research the Lorenz curve is approximated on each interval as a line between consecutive points, then the area B can be approximated with trapezoids and the GC can be expressed more simply as follow:

$$GC = \left| 1 - \sum_{i=1}^{n} (x_i - x_{i-1})(y_i - y_{i-1}) \right|$$

- X_i is the cumulated number of ports variable, for $X = 0,...,n$, with $X_1 = 0$, $X_n = 1$.
- Y_i is the cumulated throughput of all ports variable, for $i = 1,...,n$, with $Y_1 = 0$, $Y_n = 1$.
- Y_i should be indexed in non-decreasing order ($Y_i > Y_{i-1}$)

As The table below (Table 3) presents the estimated cumulative port throughput Gini coefficients over the last 4 years, as calculated by the descripted formula here above, the transhipment port throughput inequality has been constantly decreasing since 2013. There was a steady decrease in the global cumulative throughput inequality, Gini index scored from 2013 to 2016 respectively 0.516, 0.503, 0.484, and 0.481. This trend appears increasing constantly with rapid market share growth of emerging transshipment ports. The trend is moving from moderate concentrated market toward de-concentration that is to say to low inequality market.

In order to make our study more relevant the Gini index will be represented graphically through the Lorenz curve, thus if all ports in a port system are equals in size, the index will be 0 and Lorenz Curve will be equal to diagonal line. In case only one port accounts for total throughput, Gini Coefficient will be 1 and Lorenz Curve equal to area under diagonal line (Fageda, 2005).

Figures 4 and 5 shows the transshipment port market trend concentration as the area ratio between the curves of inequality in relation to the diagonal line which characterizes the total equality of port population distribution, The Gini coefficient represented in figure 4 and 5 illustrate a moderate concentration shifting slightly toward deconcentration trend between 2013 and 2016. On the other hand, the Lorenz Curve described as the cumulative proportion of volume represented different proportions of the ports distribution, illustrating subsequently the inequality of market share which is slightly shrinking along the 4 years.

The closer the Lorenz curve is to the diagonal, the more equal the income distribution and the lower the Gini coefficient. Drawn below is a Lorenz curve representing the income distribution for the cumulative volume, which displays moderate inequality for the 4 years

The Lorenz curve in figure 4 explains the size of inequality of the overall ports of transhipment by showing that the first 50% of the total ports account approximately only 11% of total throughput, however the remaining 50% of total ports account the left balance of total throughput, that is to say 89% (100% - 11%) as it was confirmed by the k firm concentration ratio analysis. The Lorenz curve in figure 4 explains almost the same size of inequality of the overall transhipment ports illustrating that the first 50% of total ports account around 14% of total throughput, a small improvement of 3 points compared to the year 2013. Nevertheless the remaining 50% of total ports account 86% of total throughput. These results can be related to the rise of port development in the region which flattened cargo throughput in the sub-region involving a tendency toward a decrease of inequality of traffic distribution. However, the port in the earlier phase of development is expected to grow and thus this growth will likely involve a shift toward concentration of throughput (Noteboom, 2011) in the sub-region

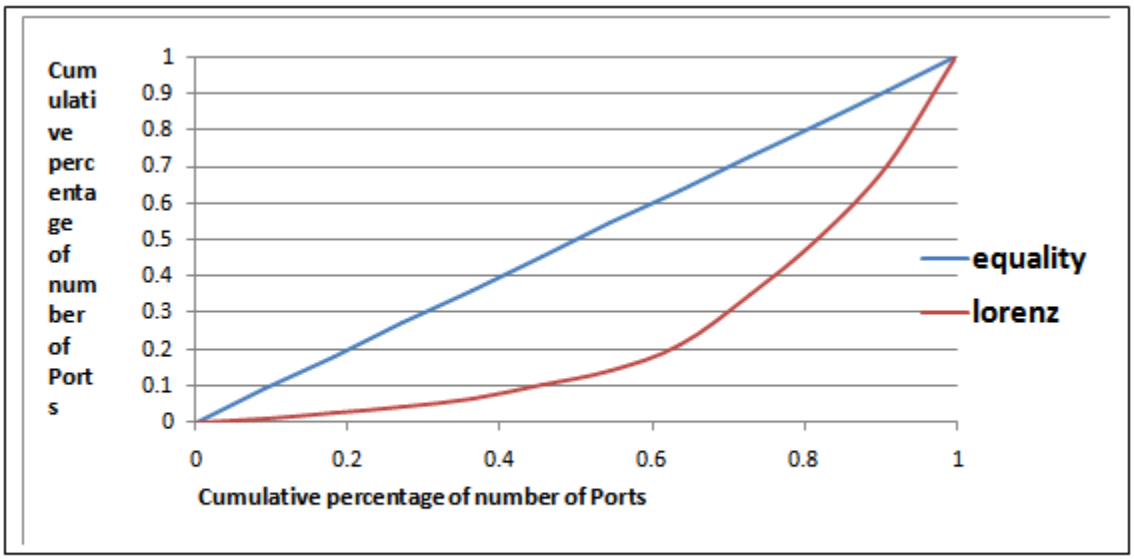


Figure 4: Lorenz Concentration curve for transshipment Port Market (2013)

**Source: Author*

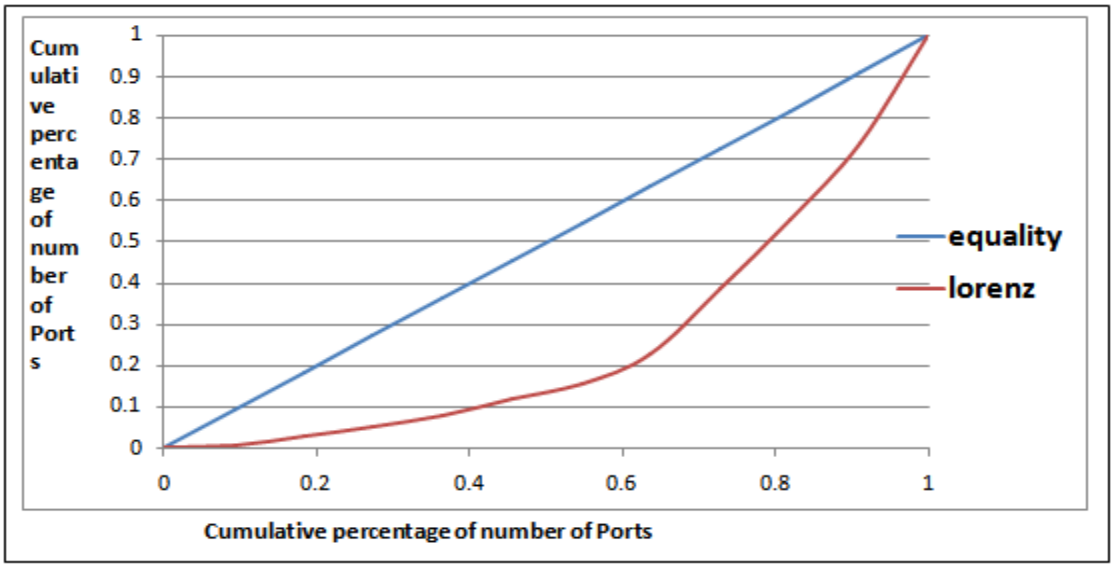


Figure 5`: Lorenz Concentration curve for transshipment Port Market (2016)

**Source: Author*

The Gini coefficient has a number of other drawbacks, such as small sample bias (Deltas, 2003), sensitivity to ordering (Cowell, 1988) and sensitivity to ordering and sensitivity to data errors (Noteboom, 1997). To overcome some of these problems, we will conduct additionally an integrated method for the Ginicoefficient consist of an entropy-based indices, that is Shannon index analysis.

The Entropy index gives in fact an idea of the specific diversity of an environment. That is to say the number of species of this environment (species richness) and the distribution of individuals within these species (specific equitability), it is represented by a positive real number often between 0 and 5, but has theoretically no maximum.it is described as a negative measure of concentration, the higher its value, the lower the level of concentration (Masisi, 2008).

The below tables indicates that the Shannon index measured is increasing slightly year after year. In 2013 the index registered 1.947, then increased respectively in the following 3 years, 1.970, 1.996, and 1.999 in the last year, which explain the that market is moving toward de concentration. To avoid any misinterpretation of the result the normalized Shannon index is calculated and as it is indicated in the below table its value is decreasing slowly from 0.188 in 2013 to 0.166 in 2016 which make the current finding creditable and confirming that the transshipment ports are moving toward competition in the near future .

Table 3: Summary of transshipment port advantages indexes

Index	2013	2014	2015	2016
CR4(%)	78.90	77.95	76.76	77.22
HHI	1790	1736	1659	1654
Normalized HHI	0.0969	0.0910	0.0825	0.0819
Gini coefficient	0.516	0.503	0.484	0.481
Entropy Index (H')	1.947	1.970	1.996	1.999
Normalized H'	0.188	0.178	0.168	0.166
Number of ports	11	11	11	11

**Source: Author*

VI. Conclusion

The assessment of transshipment port market has shown through the application of K-firm concentration that the market was oligopoly. The four port terminals that are sharing around 78% during the 4 recent years are respectively Singapore PSA, Ningbo, Hong Kong and Guangzhou terminals. In 2013 the concentration ratio during the four recent years demonstrated that the market is still highly concentrated. The study shows also that the market is less competitive between the whole eleven ports but when it comes to a detailed comparative study of only those four biggest ports, it reflects the opposite, in other word a stiff competition with equitable proportion especially for Hong Kong, Ningbo and Guangzhou terminal ports. This is also confirmed by the Gini coefficient study which demonstrated through the Lorenz curve analysis that the size of inequality of the eleven transhipment ports showing that the first 50% of the total ports account approximately only 11% of total throughput, however the remaining 50% of total ports account for 89%.

The normalized Shannon index makes the current finding creditable and confirming that the transshipment ports are moving toward competition in the near future, this uncovered fact was hard to find without the aid of our present research it's considered as a primordial guide for shipping line seeking a pioneering routing between China and Morocco. This forms a useful contribution to the literature of port economics. The research also demonstrates that the dynamic characteristics of transshipment port market have a substantial effect in explaining not only market concentration extent but also the competitiveness level of ports in the market

References

[1]. **Baldwin, J. R., &Gorecki, P. (1998).** The dynamics of industrial competition: A North American perspective. Cambridge University Press.

[2]. **Cowell, (1988).** Inequality decomposition: Three bad measures, bulletin of economic research, p309.

[3]. **Kitsos, (2014),**Changes of concentration patterns in European container ports during and after the crisis, Erasmus Universiteit of Rotterdam, p09.

[4]. **RODRIGUE, J.P. & NOTTEBOOM, T. (2010)** Foreland-based regionalization: integrating intermediate hubs with port hinterlands, Research in Transportation Economics, 27: 19-29.

[5]. **Demenopoulos, 2016,** Head-Corporate Communications & Investor Relations at Piraeus Port Authority SA

[6]. **Meng, (2015),** Network Design and Capacity Exchange for Liner Alliances with Fixed and Variable Container Demands, Transportation sciences journal, Volume 49, Issue 4, p886 – 899.

[7]. **Fageda, X. (2005).** Load centres in the Mediterranean port range: Ports hub and ports gateway. Public Policies and Economic Regulation Research Unit, University of Barcelona.

[8]. **Notteboom, T. (2011).**An application of multi-criteria analysis to the location of a container hub port in South Africa.Maritime Policy & Management, 38(1), 51–79.

[9]. **Deltas G (2003)**The Small-Sample Bias of the Gini Coefficient: Results and Implications for Empirical Research. Review of Economics and Statistics. Volume 85, Issue 1, p.226-234.

[10]. **Notteboom, T.E. (1997).**Concentration and load centre development in the European container port system. Journal of Transport Geography. 5 (2), 99-115.
[11]. **Notteboom, T.E. (2006)** 'Port regionalization in Antwerp. In: Notteboom, T. (Ed.), Ports are more than Piers. de Lloyd, Antwerp, pp. 307–328.
[12]. **Alix, Slack &Comtois (1999)** Alliance or acquisition? Strategies for growth in the container shipping industry, the case of CP ships,Journal of Transport Geography, Volume 7, Issue 3, Pages 203-208
[13]. **Wilmsmeier and Notteboom, 2010**, Regional hub port development, the case of Montevideo, Uruguay, Transport Research Institute, Edinburgh Napier University, p09-p19.
[14]. **FLORA (2017),**Analysis of Port efficiency and Competitiveness in West and Central Africa , Shanghai Maritime university, p19-p120.

Other Reference Materials
(1) Drewry Maritime Advisors (2017)
(2) United Nations Conference on Trade and Development 2017 (UNCTD 2017)
(3) WORLD SHIPPING COUNCIL (WSC)
(4) World Institute for Development Economics Research

Appendix 1- Gini coefficient 2013

PORT	Port throughput	Cum % of port	Share market	Cum % of port throughput	Area under lorenz
0	0	0	0.0000	0	
1	1256000	0.090909091	0.0113	0.0113	0.000514282
2	1722000	0.181818182	0.0155	0.0268	0.001733653
3	1680000	0.272727273	0.0151	0.0420	0.003126635
4	2550000	0.363636364	0.0230	0.064930502	0.00485865
5	4114000	0.454545455	0.0371	0.101989893	0.007587291
6	4470000	0.545454545	0.0403	0.142256173	0.011102094
7	7628000	0.636363636	0.0687	0.210970084	0.016055739
8	15309000	0.727272727	0.1379	0.348875337	0.025447519
9	17351000	0.818181818	0.1563	0.505175163	0.038820477
10	22352000	0.909090909	0.2013	0.706524579	0.055077261
11	32579000	1	0.2935	1.0000	0.077569299
TOTAL	111011000		1		0.2418929
Area A	0.2581071				
Gini 2013	0.5162142				

Appendix 2 – Gini coefficient 2014

PORT	Port throughput	Cum % of port	Share market	Cum % of port throughput	Area under lorenz
0	0	0	0.0000	0	
1	1067000	0.090909091	0.0090	0.0090	0.00040957
2	1893000	0.181818182	0.0160	0.0250	0.00154577
3	2745000	0.272727273	0.0232	0.0482	0.003326073
4	3080000	0.363636364	0.0260	0.074186983	0.005562009
5	4328000	0.454545455	0.0365	0.11073579	0.008405581
6	4501000	0.545454545	0.0380	0.148745535	0.011794606
7	8500000	0.636363636	0.0718	0.220525769	0.016785059
8	16610000	0.727272727	0.1403	0.360792792	0.026423571
9	19450000	0.818181818	0.1643	0.525042857	0.040265257
10	22374000	0.909090909	0.1889	0.713985323	0.056319463
11	33869000	1	0.2860	1.0000	0.077908424
Total	118417000		1		0.248745381
Area A	0.251254619				
Gini 2014	0.502509237				

Appendix 3 – Gini coefficient 2015

PORT	Port throughput	Cum % of port	Share market	Cum % of port throughput	Area under lorenz
0	0	0	0.0000	0	
1	901000	0.090909091	0.0078	0.0078	0.000352376
2	1954000	0.181818182	0.0168	0.0246	0.00146895
3	2961000	0.272727273	0.0255	0.0500	0.003391179
4	3164000	0.363636364	0.0272	0.077264593	0.005786631
5	4442000	0.454545455	0.0382	0.115483893	0.008761295
6	4457000	0.545454545	0.0383	0.153832255	0.012241643
7	9130000	0.636363636	0.0786	0.232387459	0.017555442
8	17590000	0.727272727	0.1513	0.383733136	0.028005482

9	20073000	0.818181818	0.1727	0.556442731	0.042735267
10	20630000	0.909090909	0.1775	0.733944796	0.058653979
11	30922000	1	0.2661	1.0000	0.078815673
Total	116224000		1		0.257767915
Area A	0.242232085				
Gini 2015	0.48446417				

Appendix 4 – Gini coefficient 2016

PORT	Port throughput	Cum % of port	Share market	Cum % of port throughput	Area under lorenz
0	0	0	0.0000	0	
1	945000	0.090909091	0.0080	0.0080	0.000363951
2	2236000	0.181818182	0.0189	0.0270	0.001589059
3	2964000	0.272727273	0.0251	0.0521	0.00359175
4	3330000	0.363636364	0.0282	0.080280962	0.006015777
5	4516000	0.454545455	0.0383	0.11854469	0.00903753
6	4616000	0.545454545	0.0391	0.157655711	0.012554564
7	8281000	0.636363636	0.0702	0.227820001	0.017521623
8	18858000	0.727272727	0.1598	0.387602416	0.027973746
9	19813000	0.818181818	0.1679	0.555476475	0.042867222
10	21560000	0.909090909	0.1827	0.738152733	0.058801328
11	30904000	1	0.2618	1.0000	0.079006942
Total	118023000		1		0.259323491
Area A	0.240676509				
Gini 2016	0.481353018				

Appendix 5 – Shannon Index 2013

PORT	Port Throughput	Share market	Lnpi	pi*lnpi
0	0	0.0000		
1	1256000	0.0113	-4.481697227	-0.050706792
2	1722000	0.0155	-4.166142889	-0.06462511
3	1680000	0.0151	-4.190835502	-0.063422577
4	2550000	0.0230	-3.773535936	-0.086680749
5	4114000	0.0371	-3.295233504	-0.122119345
6	4470000	0.0403	-3.212240887	-0.129344991
7	7628000	0.0687	-2.677803608	-0.184002359
8	15309000	0.1379	-1.981188405	-0.273216287
9	17351000	0.1563	-1.855979154	-0.290089219
10	22352000	0.2013	-1.602713493	-0.322705426
11	32579000	0.2935	-1.225961386	-0.359789534
H	**Hmax**	**Equitability**	**Normalized EI**	
1.946702	2.397895273	0.811837953	0.188162047	

Appendix 6 – Shannon Index 2014

PORT	Port Throughput	Share market	Lnpi	pi*lnpi
0	0	0.0000		
1	1067000	0.0090	-4.709361321	-0.042433844
2	1893000	0.0160	-4.136049421	-0.066118391
3	2745000	0.0232	-3.764431218	-0.087262502
4	3080000	0.0260	-3.649282696	-0.094917036
5	4328000	0.0365	-3.309106752	-0.120943902
6	4501000	0.0380	-3.269912699	-0.124288549
7	8500000	0.0718	-2.63414613	-0.189079626
8	16610000	0.1403	-1.96420737	-0.275513519
9	19450000	0.1643	-1.806365223	-0.296695606
10	22374000	0.1889	-1.666312723	-0.314837235
11	33869000	0.2860	-1.251712151	-0.358008047
H	**Hmax**	**Equitability**	**Normlized EI**	
1.970098	2.397895273	0.821594788	0.178405212	

Appendix 7 – Shannon Index 2015

PORT	**port throughput**	**Share market**	**Lnpi**	**pi*lnpi**
0	0	0.0000		
1	901000	0.0078	-4.859769385	-0.037674252
2	1954000	0.0168	-4.08564081	-0.068689274
3	2961000	0.0255	-3.669992314	-0.093499167
4	3164000	0.0272	-3.603682314	-0.098104099
5	4442000	0.0382	-3.264414638	-0.124763645
6	4457000	0.0383	-3.26104347	-0.125055675
7	9130000	0.0786	-2.543953669	-0.199840799
8	17590000	0.1513	-1.888188805	-0.285769214
9	20073000	0.1727	-1.756143735	-0.303302874
10	20630000	0.1775	-1.728773036	-0.306860784
11	30922000	0.2661	-1.324051459	-0.352270781
H	**Hmax**	**Equitability**	**Normalized EI**	
1.995831	2.397895273	0.832325992	0.167674008	

Appendix 8 – Shannon Index 2016

PORT	**port Throughput**	**Share market**	**Lnpi**	**pi*lnpi**
0	0	0.0000		
1	945000	0.0080	-4.827449872	-0.038652976
2	2236000	0.0189	-3.966190965	-0.075141311
3	2964000	0.0251	-3.684339813	-0.092527585
4	3330000	0.0282	-3.567907217	-0.100667929
5	4516000	0.0383	-3.263252874	-0.124864221
6	4616000	0.0391	-3.241350992	-0.126772546
7	8281000	0.0702	-2.656915787	-0.18642061
8	18858000	0.1598	-1.833942294	-0.293031729
9	19813000	0.1679	-1.784541233	-0.299578179
10	21560000	0.1827	-1.700039775	-0.310556905
11	30904000	0.2618	-1.339993895	-0.350873739
total	118023000	1.0000		
H	**Hmax**	**Equitability**	**Normalized EI**	
1.999087731	2.397895273	0.833684337	0.166315663	

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