CONCENTRATION OF GOODS TRAFFIC IN SPANISH PORTS DURING THE PERIOD 2000-2009

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Abstract:
This paper has as object analyze the concentration of the big groups of goods dealt in the different Spanish ports during the period 2000 2009, indicating the most relevant economic aspects that have provoked that certain ports have increased or diminished the above mentioned concentration. The vulnerability that great number of ports present before the crisis, is intimately related to the lack of specialization in his facilities, for what a determinant factor to observing in order an improvement of the maritime and port traffic, is the need of specialization of the systems of maritime transport.
JEL: P25, P35, R11, R12, R13.
Keywords: Transport economics, Port traffic, Gini index, Concentration of goods.

1. Introduction.

A true reflection of economic activity in a country with access to the sea, it is the traffic recorded by all its ports. In Spain, the Ministry of Development is in charge of the execution of the Government's ports policy. The Spanish port system of state ownership includes 46 ports of general interest, managed by 28 Port Authorities, whose coordination and efficiency control corresponds to Public Organization of the State Ports.

Current Data published by that Organization (2013) *"The importance of ports as links in the logistics and transport chains is supported by the following figures: for they pass nearly 60% of exports and 85% of imports, this represents 53% of foreign trade with the European Union and 96% with third countries. In addition, the state port system activity contributes 20% of GDP in the transport sector, which represents 1.1% Spanish. It also generates direct employment for more than 35,000 jobs and about 110,000 of indirect form"*.

The objective of this work is the study of Spanish port concentration, using Lorenz curves and Gini index as a methodological tool, for this we have obtained a Lorenz curve for each type of merchandise for the 27 Port Authority of Spain, (Ferrol and S. Cibrao are located within walking distance, so we will consider 27 ports and not 28), it will produce, hence, a Gini index per year of study and type of merchandise, being the time period of study, from 2000 to 2009, In order to find the vulnerability that port number appear before the economic crisis began in 2007.

The database used for the development of this work has been built from the Statistical Yearbook of the State Ports Public Organization. With this work, we will establish

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empirically, which are the Spanish coastal ports, where is the highest degree of concentration of merchandises, and we will explain the reason for such concentration.

For the better development of the proposed objectives, this work is structured into five sections, in which after the Introduction, then in section 2 classification of the types of merchandise that are being studied. In section 3 is a small reference is made to theoretical foundations (Lorenz relative curves and Gini index), and methodology used. Empirical results are obtained in section 4, while the main conclusions are summarized in the last section.

2. Merchandises in Spanish ports.

The largest volume of sea port merchandises, in this work, are classified into four groups (LIQUID BULKS, SOLID BULKS, CONTAINERS AND CONVENTIONAL MERCHANDISES), against other clearly lower volumes as fresh fishery, provisioning, etc... Next, we turn to the description:

Liquid bulks constitute the largest volume of the Spanish ports. In contrast to the other traded products, their handling require forcibly the necessity of special systems, that will be more or less complex depending on the product to be handled. Certainly, the highest tonnages move in those ports with nearby refineries or that have a strong industrial and demographic influence area, Tarragona, Algeciras, Sta. Cruz of Tenerife, Cartagena, they would be the most important, followed by Barcelona, Málaga, Huelva and La Coruña.

These ports have a dual function: they are receptors and distributors at the same time. They receive crude oils, transform them into their refineries and they are shipped to other peninsular and insular ports in more or less degree. Crudes from outside are downloaded and transformed products are loaded for back to proceed to unloading operations in reception centers.

Solid bulks constitute the second volume of port activity globally. As is logical exist a general tendency to place attached ports to large factory complexes, processors or producers of susceptible materials of transport in bulk, on specialized ships.This type of ports are highly mechanized and they assure rapidity, safety and economy in the process. We are referring to ports such as Almería (Central Térmica de Carboneras), Barcelona, Bilbao, Cartagena, Castellón, Ferrol, Gijón, Huelva, Melilla, Palma, Santander, Sevilla, Valencia, Vigo and others less important.

In the last few years traffic of goods through has grown a lot, especially for the specialization of certain Spanish ports that rival in this type of merchandises traffic of goods. This transport system requires an adaptation of port systems in order to get effective performances, with good connections to land Example this type of ports are: Bahía de Algeciras, Valencia and Barcelona.

Conventional merchandise: here is a large number of products of the most heterogeneous conditions: scrap, live animals, coaches, aircraft parts, all kinds of machinery, and in general merchandises not usually transported in containers.

3. Merchandise traffic evolution.

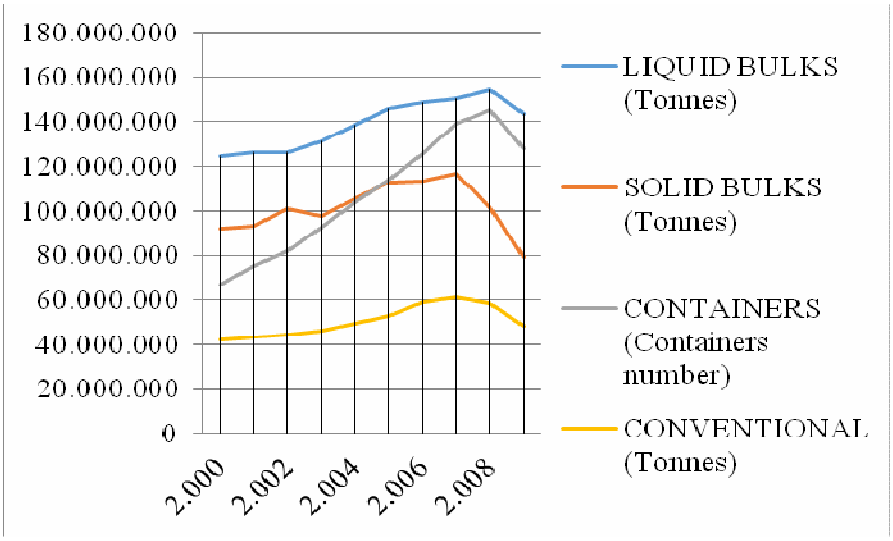
In chronological space of the last decade, Spanish ports have experienced a strong development in the overall traffic of merchandises, without hide clear regressions, that come to coincide with periods of economic recession or manifest crisis as we are suffering today. Following, TABLE 1 shows a summary of the activity of maritime traffic along the study period and according to type of merchandise.

TABLE 1: Total of merchandises per year and typologies of merchandises.

YEARS	LIQUIDS BULKS (Tonnes)	SOLID BULKS (Tonnes)	CONTAINERS (Containers number)	CONVENTIONAL (Tonnes)
2.000	124.845.122	92.303.918	66.859.785	42.326.550
2.001	126322152	93.052.631	75.252.551	43.076.877
2.002	126436850	100.985.785	82.014.847	44.347.716
2.003	131327728	97.875.763	92.652.841	46.377.244
2.004	138434057	105.499.245	103.810.835	49.428.145
2.005	145.672.585	112.853.362	113.836.795	53.074.359
2.006	148805108	113.450.097	125.784.323	59.224.089
2.007	150411087	116.860.976	139.349.701	61.357.446
2.008	154004100	101.352.706	145.403.075	58.333.296
2.009	143529909	79.133.115	127.927.516	48.652.266
TOTAL	1.389.788.698	1.013.367.598	1.072.892.269	506.197.988

Source: Annual directory of State Ports.

GRAPH 1: Evolution of the total merchandises traffic per year and product typology.



Source: Annual directory of State Ports, own development.

We can also see in the GRAPH 1, that since the beginning of 2000,there was a positive increase until 2007 to solid bulks and conventional merchandises. We provide data as apparent cement consumption, that decreased by 1.8% in the month of November. For liquid bulks and containers this increase continued until 2008. In general, after that year, begins a clear decrease with negative slopes for all merchandises.

Placing ourselves schematically in the globalization of the Spanish trade port structure, we can say that 47'77% of the total tonnage of our ports, is constituted by liquid bulks, true key piece of port activity and energy dependence of our country. We believe that the effect of economic growth in our country brought to an increase of the concentration of this type of merchandise and this implied that ports as Bahía of Algeciras, Tarragona, Cartagena, etc. (each with its particular infrastructure), also grow until 2007.

But the economic crisis became clear in 2008, was already announced as we will see later, in the deconcentration that occurred in 2005, due to a decline in demand for petroleum. The second type of product that compose the structure of the global port traffic, is constituted by solid bulks. As we know, closely linked to industry and that suppose 34'83% of total. It is noteworthy here its strong decrease from the beginning of the current economic crisis, inevitably linked to a loss of the industrial fabric of the country. It comes to ports such as Gijón, Tarragona, Bilbao or Valencia, where we can see, deconcentration occurs until 2005 due to times of little economic boom, beginning to recover until 2006, coinciding with a time of significant economic growth due to construction.

Since 2008 the current crisis, due to loss of industries, do decrease the traffic of this type of merchandises. The third group in terms of tonnage is constituted by conventional merchandises with a 17'39%. We refer here to ports such as Barcelona, Baleares, Valencia, Sta. Cruz of Tenerife and Bilbao; as we will see, concentration is clear to Barcelona, Valencia and Bilbao, with important receptions of capital goods due to their iron and steel and industrial activities, decreasing this activity towards the end of 2009, due to global economic crisis. Apart group and of great significance, are the merchandises transported in containers; is very significant rapid growth and growing importance of this modality. As we will see, it grew rapidly until 2008. We refer here to the ports of Bahía of Algeciras compete with Valencia and followed by Barcelona. Container traffic appears as an element replacement of solid bulks, caused by decreasing demand for this last.

4. Theoretical foundations and used methodology.

Even when dispersion and concentration have opposite meanings, the statistical significance of both concepts don't coincide with what is commonly given to both words. From statistical point of view dispersion makes reference to variability of the data and, therefore, the degree of representation of averages. However, concentration measures try to highlight varying degrees of equality in distribution of all values of variable. They are indicators of the degree of equal distribution of the variable.

The theoretical tools that we will use in our work, will be relative Lorenz curves and Gini coefficient. To determine the degree of inequality, we'll compare Lorenz curves. The reason for choosing this index has been because it is the measure of inequality coefficient most commonly used as well as be easy to interpret.

Gini Index = R = Lorenz area / maximum area of Lorenz

Reference works of this type can be found in SHORROCKS, A. F. (1970), even though the Gini coefficient is the most widely used measure of inequality (for its ease of interpretation), presents some problems:

– It is insensitive to changes in the distribution of entries of ports merchandises that keep unaltered the area under the line of 45°.

– It doesn't meet with the axiom "strong" of transfers; that is, transfers are not weighted by its position in port input scaling.

– Its interpretation may give ambiguous results when Lorenz curves intersect.

– It doesn't satisfy the additive decomposition property; that is, inequality in a country can not be obtained from the Gini coefficients for each region. The working variables of our study to determine the Lorenz curves will be:

Axis x = Ni/N will be percentage of ports, where N= 27 and i=1, 2, 3,…,27.

Axis y = Ti/T will be percentage of accumulated merchandises, where T will be total value of merchandise per type and year of study (study period 2000-2009).

So, for LIQUID BULKS, SOLID BULKS AND CONVENTIONAL MERCHANDISES, T will be measured in tonnes and forCONTAINERS will be measured in container units.

On the other hand, here too i = 1, 2, 3…,27

To obtain the concentration curves thrown by the Gini index, will be:

Axis x = years (from 2000 to 2009).

Axis y = Gini index per year and type of merchandise.

In the methodology used, the procedure has been the following:

1º) Obtaining input vectors box Xi ordered per years and total tonnes (in the case of containers are ordered by number of units) for each of the 27 ports that includes the Annual directory of State Ports.

2º) Getting the table will give us the coordinates of the relative Lorenz function for each year of study and typology of merchandise that was being considered at each moment, obtaining a Lorenz curve for each year, and a single value for the Gini index (identified by letter ”R”).

3º) Are obtained the relative Lorenz curves per type of transport and year of study.

4º) Finally are calculated for each type of sea transportation, the concentration curve for each year of study and Gini coefficients obtained.

5. Empirical results.

5.1. Concentration Study per type of merchandise.

LIQUID BULKS

Below in TABLE 2, and GRAPH 2, we have selected those ports that assemble over than 50% of the overall merchandise and in the GRAPH 3, we obtain concentration curve for the study period. In them we can observe:

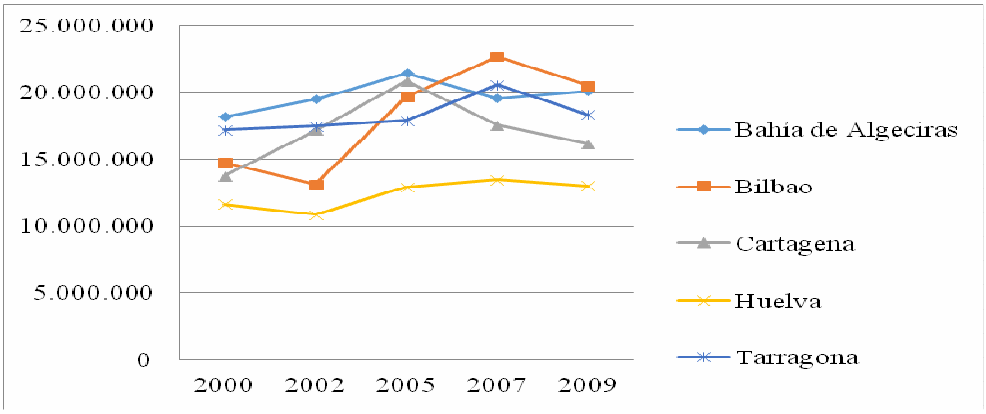
TABLE 2. Principal Spanish ports: number of tonnes of liquid bulk per year (2000-2009).

	2000	2002	2005	2007	2009
PORTS	S. BULKS	S. BULKS	S. BULKS	S. BULKS	S. BULKS
Bahía de Algeciras	18.204.702	19.497.624	21.447.071	19.588.784	20.142.781
Bilbao	14.764.325	13.125.429	19.684.508	22.682.180	20.497.399
Cartagena	13.750.893	17.160.962	20.847.754	17.532.087	16.168.779
Huelva	11.665.246	10.867.027	12.927.243	13.463.433	13.042.241
Tarragona	17.190.390	17.492.297	17.906.990	20.594.590	18.349.276
subtotal	75.575.556	78.143.339	92.813.566	93.861.074	88.200.476
TOTALS	124.845.122	126.436.850	145.672.585	150.411.087	143.529.909
PERCENTAGE	60	61	63	62	61

Source: Annual directory of State Ports, own development.

In this TABLE 2, we can see that the most important ports that absorb around 60% of liquid bulks traffic, this ports are in Bahía of Algeciras, Bilbao, Cartagena, Huelva and Tarragona. In this GRAPH 2, we can see, how the ports mentioned above grow significantly until 2005, with spectacular growth in Cartagena and Bilbao, and slower growth in Tarragona and Huelva.

GRAPH 2. Principal Spanish ports: number of tonnes of liquid bulk per year (2000-2009).

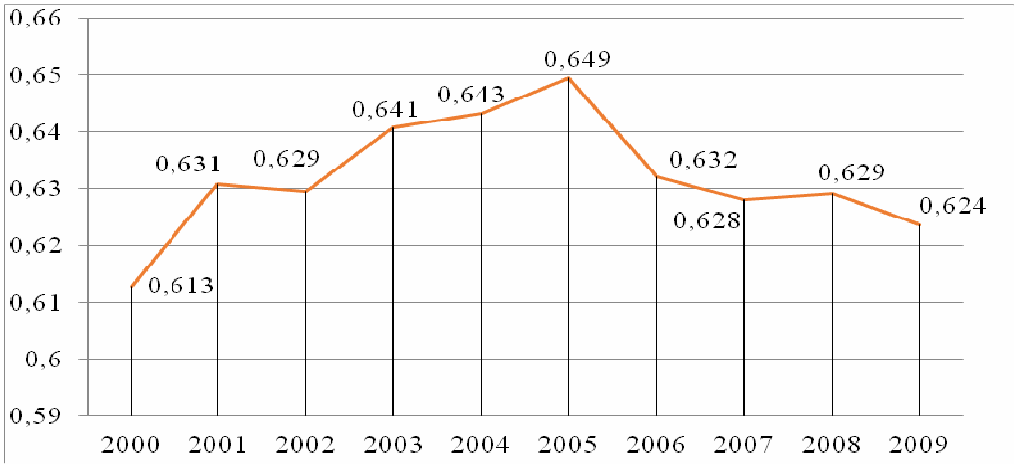


Source: Annual directory of State Ports, own development.

"The most significant is the port of Bilbao, that since 1978 appears as the first Spanish port by the level of the traffic of merchandises; Its structure, appears unbalanced in favor of discharges, 11,7 versus 6 millions of tonnes, in which takes a prominent role landing of foreign origin crude destined for the refinery of Petronor in Somorrostro (6,5 millions of tonnes)".

Indeed, in the graph below, GRAPH 3, where we reflect liquid bulk concentration during the study period, we can confirm the situation described above.

GRAPH 3. Gini Index for Liquid Bulks per year. (2000-2009).



Source: Annual directory of State Ports, own development.

Here we can see how the concentration of this type of good increases considerably since 2000, until 2005, for immediately decentralize until 2009. We think that the effect of economic growth in our country brought to an increase in the concentration of this type of merchandise and this implied that these ports (each one with its particular infrastructure) also grow until 2005, but the economic crisis was evident in 2007, it was already announced in the decentralization observed in 2005, due to a decrease in demand for petroleum.

The port of Bilbao as we have seen before continued growing until 2007, we think that this is because this port, is subjected to strong intermodal investments began in 1992, with a large construction project on the outer cove, that supposed the creation of a new port with capacity several times higher. These infrastructure projects such as road equipments, railways, etc., allowed it to has a few fast access that connected effectively its docks with the origin and destination of merchandises, hence since 2005, decentralization benefitted him until 2007 where the crisis became imminent. The port of Bilbao has a hinterland (zone of influence) ample, which extends almost the entire peninsular north, covering the Autonomous Community of País Vasco, Navarra, Castilla and León, La Rioja, Aragón, Madrid, Cantabria and Asturias. However, in ports that even with refineries, the opportune constructions weren't done as in Cartagena or Bahía of Algeciras (that does not have yet a ferrous communication to facilitate intermodality), caused that since 2005 decentralization affected it so much.

SOLID BULKS

Below in TABLE 3, and GRAPH 4, we have selected those ports that concentrate more than 50% of total merchandise and in GRAPH 5, we obtain concentration curve for the study period. In them we can observe:

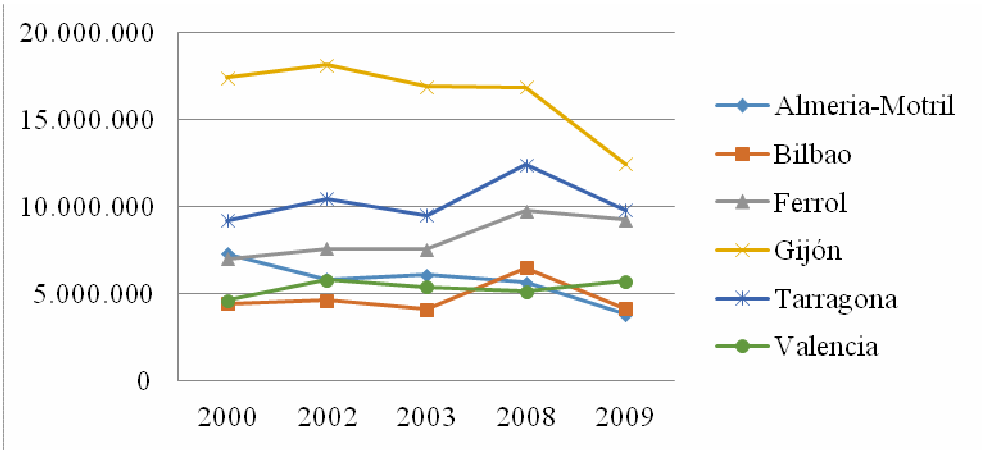
As to GRAPH 4, we must consider, that in regard to foreign and coastwise trade, in this type of transport of merchandises so close to industry, has a negative balance with respect to the first, in the same way is presented unfavorable in loading and unloading operations. So the port of Almeria is one of the first ports of solid bulk emitters. As to Gijón, Tarragona, Bilbao or Valencia, they have a receptor activity; due to their large industrial centers. In the case of Gijón, it is the largest recipient of solid bulks, counting its port with important facilities for discharge of solid bulk. We can observe, as since 2008, it seems that crisis takes its toll on all of them, due to the loss of industries throughout the Levant.

TABLE 3. Principal Spanish ports: number of tonnes for Solid Bulks per year (2000-2009).

	2000	2002	2003	2008	2009
PORTS	S. BULKS	S. BULKS	S. BULKS	S. BULKS	S. BULKS
Almería-Motril	7.337.329	5.868.380	6.118.173	5.663.822	3.827.983
Bilbao	4.452.656	4.625.295	4.142.642	6.525.092	4.180.685
Ferrol	7.045.159	7.626.424	7.595.784	9.781.089	9.268.088
Gijón	17.417.568	18.143.288	16.894.547	16.869.645	12.456.055
Tarragona	9.235.030	10.484.111	9.540.809	12.420.882	9.830.390
Valencia	4.638.486	5.797.755	5.396.239	5.165.374	5.735.361
subtotal	50.126.228	52.545.253	49.688.194	56.425.904	45.298.562
TOTAL	92.303.918	100.985.785	97.875.763	101.352.706	79.133.115
PERCENTAGE	54	52	50	55	57

Source: Annual directory of State Ports, own development.

GRAPH 4. Principal Spanish ports: number of tonnes of Solid Bulk per year (2000-2009).

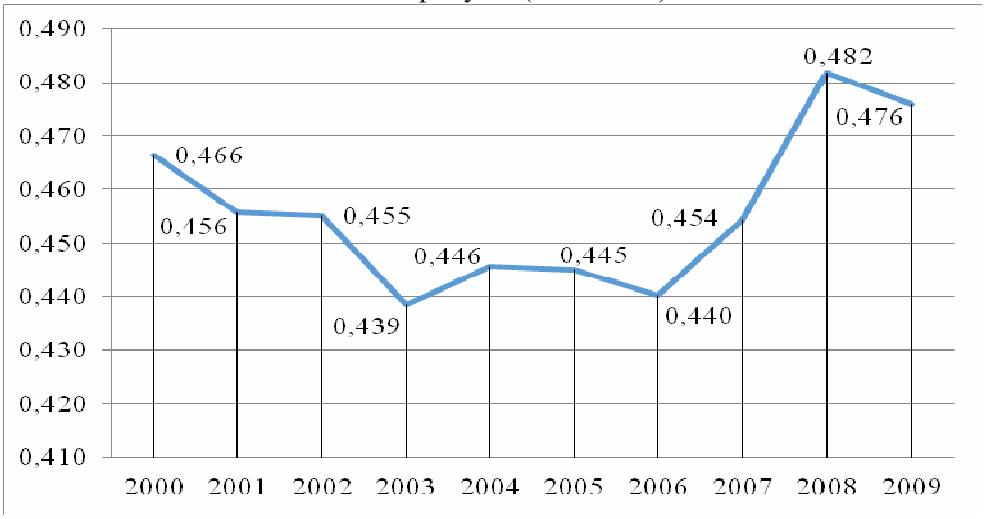


Source: Annual directory of State Ports, own development.

We observe in TABLE 3, the main ports that concentrate the type of traffic solid bulks are Almería-Motril, Bilbao, Ferrol, Gijón, Tarragona and Valencia.

How we know, solid bulks are very close to construction and industry (cements, coal, phosphates, etc.). Seems to be observed in GRAPH 5, that decentralization occurs since 2000 to practically, 2005 where coincide with little economic movement moments, but begins to recover in 2006, with a high concentration, due to the strong impulse of construction and good economic expectations that derived of it, until 2008, where starts again to decentralize until 2009, due to global crisis we are living today.

GRAPH 5. Gini Index for Solid Bulks per year (2000-2009).



Source: Annual directory of State Ports, own development.

CONTAINERS.

Below in TABLE 4, and GRAPH 6, we have selected those ports that concentrate more than 75% of the total merchandise and in GRAPH 7, we obtain the concentration curve for the study period.

TABLE 4. Principal Spanish ports: number of containers per year (2000-2009).

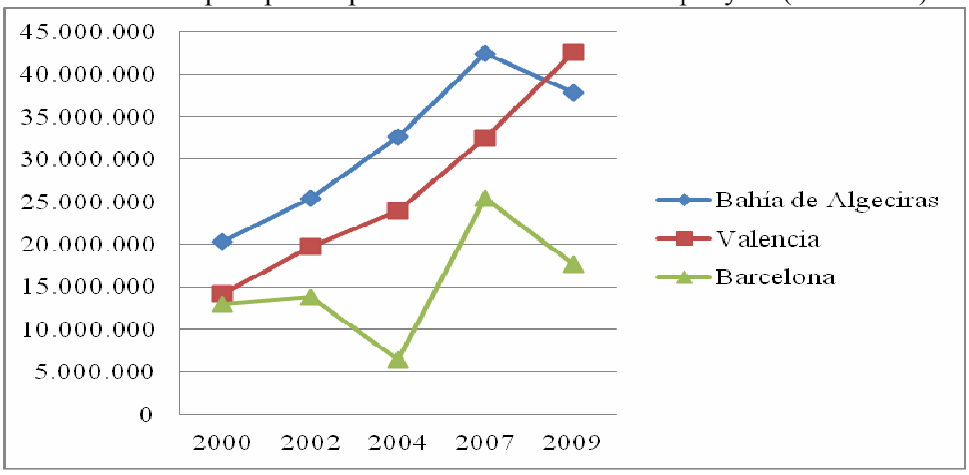
	2000	2002	2004	2007	2009
Ports	Containers	Containers	Containers	Containers	Containers
Bahía de Algeciras	20.334.067	25.403.551	32.666.193	42.468.177	37.879.934
Barcelona	12.988.638	13.842.168	6.463.989	25.417.260	17.625.493
Valencia	14.135.559	19.758.225	23.981.249	32.526.654	42.481.666
subtotal	59.003.944	59.003.944	100.412.091	100.412.091	97.987.093
TOTAL	66.859.785	82.014.847	103.810.835	139.349.701	127.927.516
Percentage	88	72	97	72	75

Source: Annual directory of State Ports, own development.

We observe in TABLE 4, that principal ports that concentrate traffic type of Containers, are Bahía of Algeciras, Barcelona and Valencia.

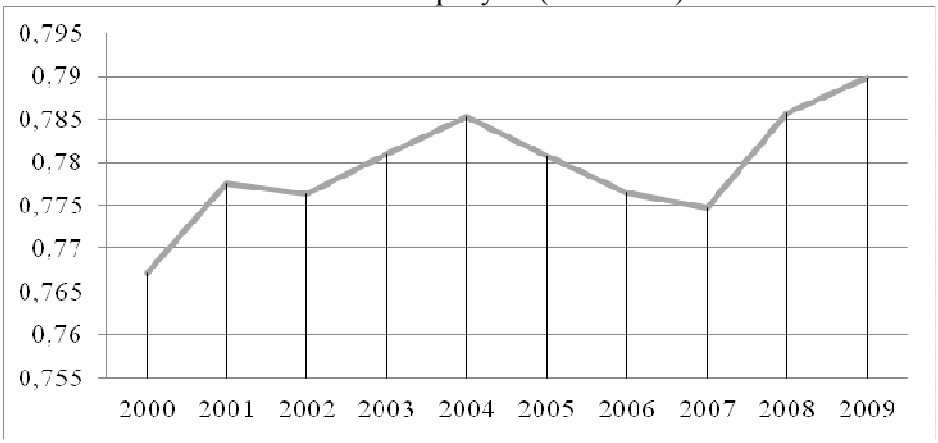
If we observe GRAPH 6 we clearly see that Bahía of Algeciras compete with Valencia's port, followed by Barcelona. Considering only the last decade, Valencian port traffic has been multiplied by almost 2.5, being the most significant the geographic expansion of the same, faithful exponent of the globalization process of which maritime networks is integrated. Valencia has opted for container traffic with significant infrastructure investments specializing in this type of merchandises transport, that as we mentioned previously, they imply connections to the land transport networks, as highways or rail, getting better efficiency than Bahía of Algeciras and being today the first port specialized in containers, knowing face in this way the overall economic crisis in that we are involved, since to decrease demand and also concentration of solid bulks, containers traffic appears as a replacement of the same.

GRAPH 6. Principal Spanish ports: number of containers per year (2000-2009).



Source: Annual directory of State Ports, own development.

GRAPH 7. Gini index for containers per year (2000-2009).



Source: Annual directory of State Ports, own development.

In GRAPH 7 we can see an increase in concentration from 2000 to 2004 with a slight decentralization from 2004 to 2007, but again the concentration increases until the end of our study period, in 2009. In 2007, crisis begins and container traffic appears, as a replacement of solid bulks, due to decrease in demand for these.

CONVENTIONAL MERCHANDISE

Then in TABLE 5, and GRAPH 8, we have selected those ports that concentrate more than 50% of total merchandise and in GRAPH 9 we obtain the concentration curve for the study period.

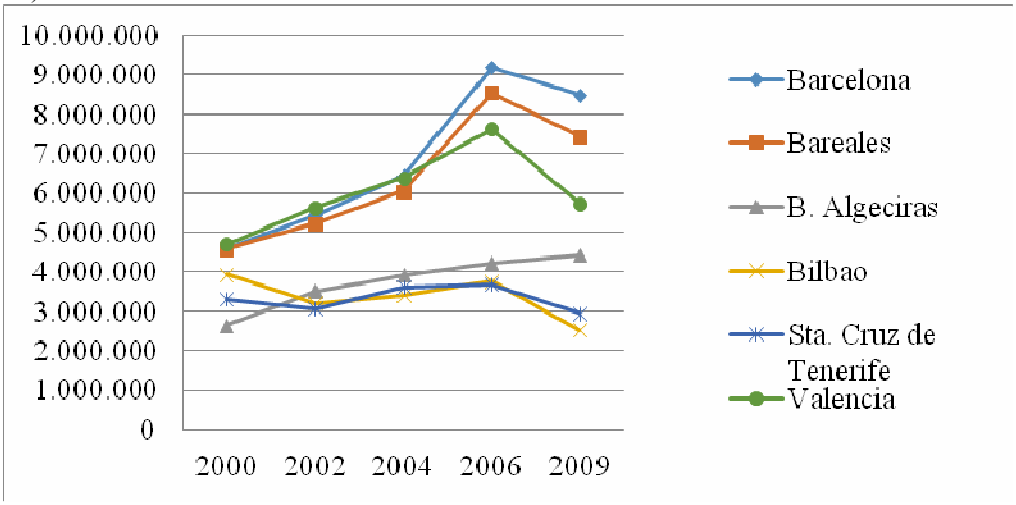
TABLE 5. Principal Spanish ports: number of tonnes of conventional merchandise per year (2000-2009).

Ports	2000	2002	2004	2006	2009
Barcelona	4.596.342	5.452.576	6.436.989	9.189.575	8.491.319
Baleares	4.582.794	5.226.891	6.050.423	8.555.466	7.439.187
B. Algeciras	2.649.959	3.510.394	3.918.109	4.231.443	4.437.062
Bilbao	3.943.249	3.212.703	3.407.322	3.765.238	2.522.389
Sta. Cruz de Tenerife	3.307.725	3.065.567	3.621.374	3.679.006	2.954.557
Valencia	4.703.767	5.635.147	6.387.120	7.624.309	5.735.361
subtotal	23.783.836	26.103.278	29.821.337	37.045.037	31.579.875
TOTAL	42.326.550	44.347.716	49.428.145	59.224.089	48.652.266
Percentage	54	59	59	62	64

Source: Annual directory of State Ports, own development.

Can be seen in TABLE 5, that principal ports that concentrate traffic type of conventional merchandises are, Barcelona, Baleares, Bahía of Algeciras, Bilbao, Sta. Cruz of Tenerife and Valencia.

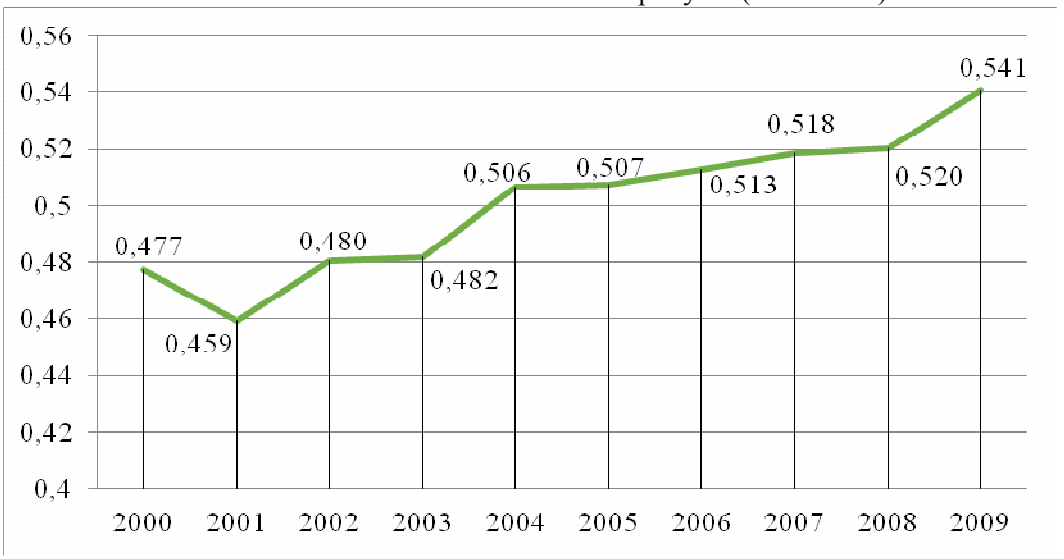
GRAPH 8. Principal Spanish ports: number of tonnes of conventional merchandise per year (2000-2009).



Source: Annual directory of State Ports, own development.

With respect to GRAPH 8 we have to indicate that in this type of transport, external balance is more favourable to merchandises loaded that the unloaded. Most of the ports of the peninsula logically produce a favorable balance, while insular port such as Baleares or Sta. Cruz of Tenerife produce a negative balance. Here, the most important dispensers ports are Barcelona, Valencia and Bilbao. It is important to highlight the iron and steel and industrial activities of Barcelona and Bilbao with an important reception of equipment and machinery.

GRAPH 9. Gini index for conventional merchandises per year (2000-2009).



Source: Annual directory of State Ports, own development.

As we could see in GRAPH 9, concentration is clear in this type of merchandise, from 2008, tends to concentrate toward ports of Barcelona, Valencia and Baleares although to a lesser extent by the end of 2009, probably due to global economic crisis that we are living in.

5. Conclusions.

In light of the study, we can conclude the following per types of merchandises:

FOR LIQUID BULKS: The five ports that we obtain, Bahía of Algeciras, Tarragona, Cartagena, Bilbao and Huelva, grow considerably, until 2005. There is particular concentration growth in Cartagena and slight growths in Tarragona and Huelva. The effect of economic growth in our country led to an increase in the concentration of this type of merchandiseand this implied that these ports also grow until 2005, but the economic crisis was evident in 2007, was already announced in the concentration observed in 2005, due to a decrease in demand for petroleum. The Port of Bilbao is subdued to strong intermodal investments initiated in 1992. These infrastructure works, allowed it greater effectiveness docks, hence from 2005, decentralization benefited it until 2007, where the crisis became inevitable. However in ports that even with refineries, appropriate works were not made as in Cartagena or Bahía of Algeciras, This caused that from 2005 decentralization became apparent.

FOR SOLID BULKS:The principal ports that concentrate this type of traffic are Gijón, Almería, Ferrol, Tarragona and Valencia. Decentralization until 2005 coincides with the moments of little economic movement, but begins to recover in 2006, with a high concentration, coincidental with few moments of significant growth due to the strong impulse of construction and good economic expectations that derived from them. Since 2008, it seems that crisis takes its toll in all of them, due to the loss of industries throughout the east.

FOR CONTAINERS:We can see an overall increase in concentration along the entire study period and if we observe that Bahía of Algeciras competes with the port of Valencia, followed by Barcelona. Valencia has backed container traffic with significant infrastructure investments specialized in this type of merchandise transports, getting better performances than Bahía of Algeciras and being nowadays the first port specialized in containers, that know face in this way general economic crisis where we are involved. So, decrease in demand and solid bulk concentration, causes the appearance of container traffic as a replacement part.

FOR CONVENTIONAL MERCHANDISES:The principal ports that stand out are Barcelona, Baleares, Valencia, Sta. Cruz of Tenerife and Bilbao. Concentration is clear in this type of merchandises, so, since 2008, tends to concentrate toward ports of Barcelona, Valencia and Baleares although in smaller quantity in the end of 2009 probably due to the global economic crisis which we live today. Port installations are a key factor in improving port maritime traffic. Along the study, is proved that vulnerability of a large number of our ports. they give face of economic crisis an unfavorable behavior, due to low specialization in suitable systems for handling each type of merchandises, compared to other large port sets, that due to its intermodality at its port facilities allow adapt better to the current economic crisis.

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