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THE ROLE OF PORTS IN THE DEVELOPMENT OF MEDITERRANEAN ISLANDS: THE CASE OF SARDINIA*

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ABSTRACT: This paper examines the role of ports in the economy of Sardinia by means of the employment generated by port and port-related industries. The subject is important since Sardinia and other Mediterranean islands suffer from chronic unemployment and poor economic performance. The increase of the Europe-Asia commercial flows, the European Union enlargement and the renewed centrality of the Mediterranean have induced optimistic expectations on the development opportunities that may be created for the island communities by the maritime and port sectors. The employment generated by the maritime and port industry is an essential, although partial, measurement of the development impact of ports. Therefore its quantification is indispensable in order to correctly estimate the impacts that a more central role of the Mediterranean might have on the local island economies. In the case of Sardinia, ports generate approximately three percent of the total island employment, and over eight percent on average of the employment of the single municipalities. This result adds to the vital role that ports have to play as transportation nodes and in creating value added.

KEYWORDS: ports; employment impacts; Mediterranean; Sardinia; impact studies.

INTRODUCTION

UNTIL recently, the strategic position of the Mediterranean on the route Europe-Far East has not been effectively exploited. Mediterranean ports not only enjoy the advantage of shorter sailing time to Asia than the North European ports but are also situated in the proximity of promisingly devel-

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oping markets (Cazzaniga Francesetti and Foschi, 2002). Whether this new centrality of the Mediterranean will materialise is difficult to say. On the one side, the position of the Northern Range ports is hardly to be eroded as long as they remain connected to a large inland transport network, they continue to provide efficient, reliable services and sufficient excess capacity, and their infrastructure is still able to accommodate and serve large ships. On the other side, the spectacular increases in traffic, the alerting episodes of congestion in some of the north European hubs, in combination with the large capital investments and the very favourable conditions available in some Mediterranean ports, may induce shipping lines if not to transfer fully their operations at least to acquire preventive strategic positions in the Mediterranean (Foschi and Cazzaniga Francesetti, 2001).

In any case, the growth of the traffics passing the Mediterranean is welcomed by its ports and is often generating enthusiasm also at the local community level. The successful examples of ports rediscovered as transhipment hubs, such as Gioia Tauro, Algeciras or Marsaxlokk, have nourished expectations among port authorities and local communities and favoured in some cases large (public) investments in the attempt to gain a better position in the competition for containerized traffics in general and transhipment traffics in particular. Transhipment traffics are in principle desirable for ports that have large excess capacity and fewer alternative uses. It is more controversial to evaluate, at least from a local community point of view, whether transhipment is desirable for ports that do not have excess capacity – thus requiring additional investment – and whose areas could be more profitably used in other activities (Musso, 1996; Musso 1998; Musso and Benacchio, 2000; Musso *et al.*, 2004).

For that matter, the development effects that ports are allegedly able to generate constitute one of the major justifications for (public) port investment. On the one side it is widely recognised that ports may indeed have positive development impacts, on the other side however, it is becoming increasingly more evident that the size of these impacts varies substantially from region to region and depends on the typology of traffics and the size of the port. If these effects are clearly discernible in the ports that have already grown up to a national or even international scale, nothing guarantees that those can be reproduced in the smaller ports, especially given the tendencies taking place in the port industry (Musso, 1998; Musso and Benacchio, 2000; and Musso and Benacchio, 2001).

These changes are nowadays an incontrovertible fact. Large industrial conglomerates have consolidated, heavy industries have started to relocate, port

cities have become increasingly congested, port activities have moved far from the urban centres and the port industry has developed towards a capital intensive industry, especially as a consequence of the increasing usage of the container (Benacchio *et al*, 2000, Notteboom and Winkelmans, 2001). In the end the link between ports and local development has become less important if important at all (Musso, 1998; Benacchio *et al.*, 2000).

This observation leads to another important aspect related to the establishment of a causal link between ports and development that cannot be ignored. The benefits deriving from the existence of the port do not necessarily occur at the same geographical level at which its costs are imposed. While, especially for large ports, the positive effects in terms of reduced transport costs, potential for logistics operations, etc. have an evident international dimension, social and environmental costs or simply the opportunity costs deriving from the allocation of resources to the port sector, are born mostly locally (Marchese, 1980; Musso, 1996; Haralambides, 1996).

Given these considerations, the local communities' enthusiasm towards container traffics and transhipment appears, if not unmotivated at least overstated. The present paper will build upon these considerations through the analysis of the employment generated by ports and port related activities in the economy of Sardinia.

The choice of Sardinia is motivated by a number of reasons. Firstly, the analysis of the employment generation potential of port economic activities is more urgent in those regions that are characterised by high unemployment rates, such as Sardinia or other islands in the Mediterranean.

Secondly, the choice of Sardinia is justified by its increasing tourism vocation (Hospers, 2003; CRENOS, 2003). In Sardinia, in the same way as in many other Mediterranean islands, port land and port areas have the potential of being successfully used for high-value-added activities connected to tourism, such as real estate exploitation, restaurants, hotels and entertainment (Hoyle, Pinder and Husain, 1994). The growing opportunities deriving from tourism in the Island's economy, increase the attractiveness of alternative uses of port land and exacerbate the trade-off between the expansion of the traditional port industry, whose benefits for the port region are diminishing, and those activities that do not conventionally belong to the port business but have a more visible impact on its region.

A third consideration that has been important in the choice of Sardinia, even if not directly addressed in the paper, concerns the comparative high value of accessibility for islands (Eurisles, 2003). It is evident that ports represent an important connection node in transport and economic networks,

especially for islands. Whether the economic importance of these nodes is increasing or decreasing, given the growing role of IT technologies, the developments in logistics, etc. is difficult to say. Nevertheless the issue of accessibility should always be considered when discussing port impacts and it is in the case of islands that the accessibility issue is most relevant.

A final consideration in the choice of Sardinia is related to the fact that hardly any literature has been devoted to the study of the island's port sector, and of Sardinia's transportation systems. This is a missed opportunity not only because a better understanding of the port sector in the island is important to correctly direct policy interventions at a regional, national and European level, but is also interesting for the specificities of Sardinia, namely low population density, high unemployment and tourism vocation.

From a methodological perspective, the paper makes use of a technique previously developed by Musso *et al.* (2001) but until now only applied to the port of Genoa. In this paper the author applies the methodology in the different context of islands. This contribution is valuable as it provides further testing for the methodology and highlights some of the aspects of the methodology that would require further investigation.

The paper is structured in the following way. Section 2 focuses on the general theory of economic impact analysis applied to ports. Section 3 briefly explains the characteristics of the employment impact evaluation technique that has been applied in this paper. Section 4 describes the context of the analysis in terms of general macroeconomic variables and focuses on the employment situation in Sardinia by assessing the importance of the port system for employment creation. Section 5 provides some conclusions, general recommendations and suggestions for further developments of the analysis.

The analysis of the economic impact of a port

The economic impacts of ports

The traditional arguments used to support the positive benefits generated in the economy by ports can be summarised in:

- Impacts deriving from improved accessibility;
- Impacts on the industrial structure of the country or the region of the port;
- Impacts on employment;
- Impacts generated by the development of metropolitan and urban areas.

In the following this categorisation of impacts will be briefly explained.

Impacts deriving from improved accessibility

Among these impacts we can consider all the economic benefits deriving from the existence of the port as a transportation node. The scope and entity of these benefits is related to the definition that is adopted for accessibility: nearness of opportunities, a simple physical measure, some sort of utility, etc. (Martellato *et al*, 1998). They include economic benefits deriving from the reduction in transportation costs, the benefits deriving from the shift of cargo among transportation modes, the gains from the development of logistics operations and distribution centres, etc. Especially in the case of islands, benefits deriving from improved accessibility are substantial as ports may represent the principal (if not the exclusive) way into the island (Eurisles, 1999). Improved accessibility, in the sense of the reduction of the negative effects of geographical borders and barriers, is an essential component for development (Corvers and Giaoutzi, 1998).

Impacts on the industrial structure

Port are recognised to have effects on the industrial and productive structure of their regions and countries. The connection between ports and industrial activities is well documented and ports are accounted for as facilitators in the development of industrial districts (Musso, 1996; Banister and Berechman, 2001).

Impacts on employment

Traditionally, the port industry used to be considered a labour intensive industry. The developments in transportation technologies next to the changes in the social and economic structure of ports, at least in developed countries, make port activities today unimaginable without the use of cranes and containers. These changes have necessarily affected the impact on employment generated by a port both quantitatively and qualitatively. While in the past port employment was characterised by large numbers of unskilled workers, often employed on a precarious and temporary basis, the present evolving port business requires a well trained, reliable workforce that needs to be employed on a regular basis. This shift of port activities from labour intensive to capital intensive next to the abandonment or relocation of heavy industries from developed to developing countries, have in general substantially reduced the growth impacts that ports generate on employment.

Impacts generated by the development of metropolitan and urban areas

The presence of a port has been identified as one of the elements at the basis of the development of large cities and metropolitan areas (Soriani, 2002). The agglomeration effects previously described, the concentration of industrial and financial activities next to the port, the accessibility advantages of port regions, etc. have favoured the development of urban areas stimulating spin-off development effects (Musso, 1996; Marchese, 1980; Zanetto, 1998).

The evaluation of port economic impacts

Port impact studies

The quantitative or qualitative evaluation of the economic effects deriving from the presence, the construction or the expansions of port structures is carried out with a set of analytical methodologies that go under the name of (port) economic impact studies. The appropriate methodology is determined by the characteristics of the activity and the region being analysed, the purpose of the study, data availability, and the time and resources allocated to the study.

The two major methodological problems of the evaluation of port impacts can be summarised in:

- the identification of the activities that are dependent on the port and the evaluation of their degree of dependency, i.e. how much of the impact of the activity taken into consideration (employment, value added, etc.) can be ascribed exclusively to the existence of the port;
- the intensity of the impact of the port, i.e. how much of the consumption activities and multiplier effects can be attributed to the existence of the port.

In the majority of the analyses carried out in practice, the two problems are solved simultaneously by distinguishing among types of impacts. It is generally distinguished between the core activities of the port – the port industry – and those activities dependent on or generated by the port – port-dependent industry (Villaverde-Castro and Coto Millán, 1998). More elaborate subdivisions distinguish between port-required, port-attracted and port-related activities (Yochum and Agarwal, 1988), or port required, port-related and port-induced activities (Musso, 1998). There is however no accordance on the definition of the types of impacts, and the distinction remains somehow arbitrary.

The aims of port impact studies

Port impact studies are carried out for a variety of reasons, but mainly in order to:

- Determine adequate development strategies for the port;
- Determine adequate development strategies for its region;
- Evaluate port expansion projects and investments;
- Justify port expansion projects and investment in the eyes of public opinion;
- Evaluate policy reforms such as privatisation and commercialisation;
- Evaluate the effects of social and environmental policies;
- Raise financial aid for the port.

The aim of an economic impact analysis is to determine and quantify the scale of the direct and indirect effects of a port. The assessment is generally done in terms of a (monetarily) quantifiable variable, such as value added, income, taxes, remunerations, employment, etc

Port economic impact evaluation techniques

The following is a brief description of the most used port economic impact evaluation techniques, and draws on previous studies on the topic (Musso, *et al*. 2000). The primary objective of this section is to provide a methodological context for the technique used in the present paper and explain the existing alternatives in the evaluation of the employment impacts of a port.

Models of port demand

This approach has been developed by De Salvo and Fuller (1994) in the analysis of the port of Tampa in Florida. The method evaluates the impact of a port on basis of the changes in the price elasticities of demand for imports and exports conveyed through the port. The idea is that the presence of the port reduces the price of imports and exports by reducing the cost of transport. The production of the port region is influenced by the port on the side of exports, as the absence of the port would increase export prices and reduce demand, and on the side of imports, as the absence of the port, by increasing the exported raw materials and semi-finite goods would increase the cost of production, the output price and reduce demand. The reduction of demand would generate sooner or later a reduction of economic activity and employment. The main disadvantages of port demand models are ports' aggregate characteristics that make it difficult to distinguish among the direct and indirect impacts.

Economic Base models

The Economic base approach has been used in the Sixties by Krafft and Erbguth in the analysis of the Rhine ports of Hamm and Neuss, near Düsseldorf (as cited in Musso, 1996: 78; Villaverde-Castro and Coto Millán, 1998). They divided the economy in a local sector and a basic sector. The local sector produces for regional consumption, while the basic sector produces for the markets outside the region. The basic sector, that includes also transport services, is the main determinant of regional economic growth. If we indicate with Y the total regional income, with B the income deriving from the basic sector and with L the income deriving from the local sector we have

$$[1] \qquad Y = B + L \qquad \text{and} \qquad L = sY, \quad \text{with } s > 0 \text{ (that can be obtained econometrically)}$$

Rearranging we have: $Y = [1/(1\text{-}s)]\ B$ where $[1/(1\text{-}s)]$ is the economic base multiplier that indicates the variation in income deriving from an autonomous variation in exports. Also these models are aggregated and the distinction between basic and non basic sector does not seem appropriate to the port sector, as it does not allow a complete evaluation of the induced effects.

Control group models

The approach based on the control groups has been developed by Isserman in the United States (Isserman and Merrifield, 1982). The fundamental idea is to identify with statistical techniques, regions that are equal or as likely as possible to the region under analysis in terms of a selected set of variables. Once the most likely regions have been identified, they are used as benchmark and compared with the region under examination. The differences between the two regions are attributed to the specific infrastructure under analysis and eventually corrected for other factors. Control groups theory has never been applied to the evaluation of port impacts. The main pitfall is related to the satisfactory determination of the control group or control region.

Keynesian Income-Expenditure approach models

The Keynesian Income-Expenditure approach model is based on the econometric determination of the income multiplier under the usual hypothesis:

$$
\begin{aligned}
&Y = C + I + G + X + M \\
&C = C_A + c\, Y_d \\
&M = M_A + m\, Y_d \\
&Y_d = Y - t\, Y \\
&I = I_A;\ G = G_A;\ X = X_A
\end{aligned}
\qquad [2]
$$

where Y, Y_d, C, I, G, X and M are respectively income, disposable income, consumption, investment, public expenditure, exports and imports, "A" indicates that the variable is determined exogenously, and c, m and t are respectively the consumption propensity, the import propensity and the tax rate. From the model we can obtain the aggregated income-expenditure multiplier, $k = [(1 - t)(c - m)] - 1$. The most important element is (c-m) that represents the marginal propensity to consume outputs produced internally. The drawback of the model is that the multiplier is aggregated and the model does not provide any insight in the relations among sectors.

Input-Output Models

The input-output technique (I/O) has been widely employed in the port sector with different variants. In general the I/O models offer a description of the functioning of the regional economic system in a disaggregated perspective, and they comprise a system of linear equations, each of which describes a certain economic branch or sector. A detailed analysis of the I/O methodology goes far beyond the scope of this paper. Nevertheless it is relevant to provide a brief review of some of the studies that made use of I/O tables in the attempt to evaluate port economic impacts.[1]

The methodology has been used by Warf and Cox (1989) in the assessment of the economic impact of the changes in cargo volumes and commodity mixes in the port of New York/New Jersey on its metropolitan region. In addition they performed a traffic flows analysis with the aim of revealing the types of commodity that had a strategic role in the development of the port. Villaverde Castro and Coto Millán (1998) have used the methodology in the assessment of the economic impact of the port of Santander in the Galician economy, and also Martinez Budría (1995) in the economic impact assessment of the ports of Tenerife.

Regional I/O tables are also at the basis of the approach used by the Bureau of Transport Economics of Australia (BTRE) in the evaluation of the

[1] A detailed analysis of the scientific aspects of the use of I/O analysis in the evaluation of maritime activities impacts and a discussion of its policy implications in the context of shipping is presented by Haralambides (1996).

port impacts of the Australian ports of Mackay and Gladstone (BTRE, 2001*a* and BTRE, 2001*b*) and in the preparation of the general framework for port impact studies developed by the BTRE in 1999 to analyse the economic impact of the port of Freemantle. I/O analysis is also the methodology used by the National Bureau of Transportation Statistics (NBTS) in the US for the preparation of the *MARAD* Port Economic Impact Kit used in the estimation of the economic impact of US ports.

Survey Approach

The survey approach has been used in the port sector by Yochum and Agarwal (1988) in the evaluation of the port of Hampton Roads, by Villaverde-Castro and Coto Millán (1998) in conjunction with input-outputs techniques, and by Gripaios and Gripaios (1995) in the evaluation of the impact of the port of Plymouth. The survey approach consists of the interview with representatives of different port activities and port-dependent activities. The survey articulates as usual in the formulation of a questionnaire, tailored to identify the most important port impacts and possibly quantify them. Given the high dependency of the successful outcomes of the economic impact study on the accurateness and completeness of the survey, the application of the method requires a beforehand knowledge of the port and the benevolent disposition of those surveyed to disclose information on their business and beliefs. The valuable aspect of the survey method is the possible combination with the other impact assessment procedures and the port-specific tailored character of the research. The major disadvantage is related to the high degree of subjectivity in the approach design and in the interpretation of the results, as well as the high costs and the time requirements.

Models based on the location coefficients

Musso *et al.* (2000) have proposed the estimation of port employment impact with a technique based on location quotients and control regions. The methodology attempts evaluating the employment impact of ports on a region in terms of the probability that a specific economic activity is totally or partially port oriented. This probability is calculated on the basis of how relevant is the economic activity in the port local economies (PLEs) with respect to non-port economies (NPEs). In other words if the share of employment ascribed to an economic activity is significantly higher in a PLEs with respect to the NPEs, it is assumed that the difference is (at least partially) due to the presence of the port. The author also provides the application of the technique to the port of Genoa. The technique has been chosen for

evaluating the role of the ports in the employment of the Island of Sardinia, and will be described in more detail in section 3.

The economy of Sardinia

Demography

Sardinia has a total surface of 24,089 km^2 and a total population of 1,631,880[2] inhabitants. These figures characterise Sardinia as the largest and mostly populated island in the Mediterranean, after Sicily. With 69 inhabitants per km^2, Sardinia has the lowest population density in Italy and among the lowest densities in the insular regions of the Mediterranean (Table 1). More than half of the population is concentrated in one fourth of the territory, where the major urban areas and developed agricultural activities are located, with a population density of 147 inhabitants per km^2. The population density increases to 70 inhabitants per km^2 in the countryside and drops to 37 inhabitants per km^2 in the inner parts of the island. More than a third of the population lives in economically depressed areas (65% of the territory).

Table 1. *Total area[a], number of islands[b], resident population and average population densities – Balearic Islands, Corsica, Ionian Islands, Northern Aegean, Southern Aegean, Crete, Sicily, Sardinia, Malta and Cyprus – 1996.*

Mediterranean Insular regions	Total Area (Km^2)	Number of islands	Population (1996)	Density (hab/Km^2)
Balearic Islands	4,974	4	776,526	165
Corsica	8,681	1	256,879	30
Ionian Islands	2,307	13	199,351	91
Northern Aegean	3,836	10	184,280	115
Southern Aegean	5,286	42	267,866	51
Crete	8,336	2	559,274	67
Sicily	25,708	15	5,094,700	198
Sardinia	24,089	5	1,662,955	69
Malta	316	1	373,958	1197
Cyprus	9,150	1	741,000	81

[a] Land surface of the zone.
[b] An island is a territory surrounded by water, inhabited by more than 50 permanent people, not linked to the mainland by a permanent device (bridge, tunnel), distant by at least 1 Km from the mainland and with no capital of an EU member state (with the exception of Malta and Cyprus).
Source: Eurisles

[2] National Population Census of 2001.

The principal urban conglomerates are those of Cagliari/Quartu Sant'Elena in the province of Cagliari and of Sassari in the North. Table 2 shows that, with the exception of Cagliari which is the principal city on the Island, all urban areas have experienced a slight decrease in population in accordance to the general trends in Italy.

Table 2. *Resident population for the 5 principal cities as of the 1st of January 1991 and 2001 – Sardinia (municipality detail) – Census 2001.*

City or Town	*1991*	*2001*
Cagliari	162,993	164,249
Sassari	120,874	120,729
Quartu Sant'Elena	69,404	68,040
Nuoro	37,615	36,678
Oristano	32,980	31,169
Sardinia	**1,648,248**	**1,631,880**

Source: ISTAT, Population and Housing Census, 2001.

An outline of the economy of Sardinia

The regional annual income of the island is about 16 billion Euros, equal to 9,503 Euros per capita, which is significantly lower than the national average of approximately 12,000 Euros per capita. As shown in Table 3 and Table 4, Sardinia's position with respect to other European regions is somehow ambivalent. With 84% of average European income, Sardinians are still relatively poor, but only slightly above the 75% threshold of Objective 1 region, and above the 62% average of Objective 1 regions. The comparison with the other European insular regions of the Mediterranean, place Sardinia among those with the highest income per capita.

Table 5 confirms the peculiarity of the development of the island. Tertiary industry and public administration contribute the most to the regional income (73.5%), agriculture contributes with 5%, whereas the industrial activity is 21.4%.

As far as the use of the territory is concerned, tertiary activities are located in the urban areas and at the coast. Agricultural activities make use of a large portion of the territory, almost 10% of which consists of farms with the average extension twice as big as the Italian average. Sheep breeding is the main activity as well as vine and citrus fruit production. Fisheries and fishing activities are not extensively exploited.

Due to the unsuccessful development policies of the 70's, Sardinia specialized in heavy industrial activities such as oil refineries, petrochemical indus-

tries and metallurgy. This industrial policy has demonstrated to be sustainable only until the 80's thanks to the strategic position of the island along the Mediterranean oil route. The change in the policy of the large companies in the heavy industry sectors and the relocation of large industrial complexes out of Italy have reduced the role of these activities in the economy of the Island, not without social tensions (Hospers, 2003). The same can be said for the extractive sector. In addition, the Island hosts a number of thermoelectric stations that together with hydroelectric plants, account for 3.6% of the national electric generation power.

TABLE 3. *Per capita income* in Sardinia compared with other EU-regions, 1996 and 2004.*

Regions	*1996*	*2004*
Richest 15 regions in the EU	143	157
Total regions in the EU	100	100
Sardinia	73	84
Total Objective 1 regions	68	62
Objective 1 regions in Italy	67	68
Poorest 25 regions in the EU	59	36

* GDP per capita in PPS (EUR15=100).
Note: as of 2007 Romania and Bulgaria joined the EU, which impacted the year 2004 figures.
Source: European Commission, 1999.

TABLE 4. *Per capita income* in Sardinia compared with other Italian regions and other Mediterranean insular regions, 1970-2005.*

Region	*1980*	*1990*	*2000*	*2005*
Balearic Islands	118	132	132	124
Corsica	-	105	101	117
Ionian Islands	75	73	74	75
Northern Aegean	61	62	80	66
Southern Aegean	82	81	101	95
Crete	72	75	88	82
Sicily	94	92	86	84
Sardinia	100	100	100	100
Southern Italy (Mezzogiorno)	90	91	88	n/a
Italy	128	132	130	131
Northern Italy	150	155	153	n/a

*GDP per capite in PPS (Sardinia = 100).
Source: Table compiled by the author on CRENOS, Eurisles, Eurostat data.

Table 5. *Sardinia's economic structure compared with other Italian regions - Sector shares in percentage of total value added, 1970-1999.*

Region	*1970*	*1980*	*1990*	*1999*
(A) Sardinia				
Industry	33.4	28.7	24.3	21.4
Agriculture	9.3	5.7	3.9	5.0
Services	57.3	65.6	71.8	73.5
(B) Southern Italy (Mezzogiorno)				
Industry	28.8	25.5	23.2	21.3
Agriculture	10.0	7.6	4.9	5.5
Services	61.2	66.9	72.0	73.2
(C) Centre-north				
Industry	37.4	35.6	33.1	31.7
Agriculture	4.3	3.4	2.7	2.7
Services	58.3	61.0	64.2	65.6

Source: CRENOS, 2002 (as reported by Hospers, 2002).

The port system

The past specialisation of Sardinia in the heavy industry sectors has determined the size and the structure of its port system. Industrial ports such as Porto Scuso and Arbatax were built in the 70's and the 80's, while older harbours were redeveloped to accommodate the cargo from the newly built neighbouring industrial activities, such as in Porto Torres and Cagliari. When the industrial activity eventually started to decline, some of the port areas were abandoned.

In the last decades the growth of tourism has favoured the redevelopment of some of the port areas to accommodate the increasing passenger traffics. Representative examples are the ports of Olbia and Golfo Aranci. The increase of international tourism, supported by sound port policy has favoured the rapid growth of the port. New investment (Isola Bianca pier) and the creation of a port authority in 2001 that joins the two harbours have helped to keep pace with the increase in demand.

In 2007, the ferry berths of the Isola Bianca handled 6.6% more passengers than in 2003 reaching 3.7 million passengers. Golfo Aranci as also grown from a virtually non existing port to the one million passengers handled last year. As far as the other ports are concerned, Porto Foxi, in the province of Cagliari (municipality of Sarroch), has a turnover of over 27 million tonnes and is one of Italy's main industrial ports (ISTAT, 2008). Porto Torres, Olbia and Cagliari have a turnover of approximately 2 to 3 million tonnes an-

nually. Olbia is the principal passenger port with a turnover of 1.3 million passengers compared to 700,000 of both Porto Torres and Cagliari (ISTAT, 2003).

TABLE 6. *Total annual seaborne transport for major Sardinian ports (in 1000 tonnes).*

	2000	*2003*	*2006*	*2007*
Arbatax	27	82	n/a	n/a
Cagliari	4,395	5,378	9,287	9,482
Carloforte	150	143	n/a	n/a
Calasetta	19	28	n/a	n/a
Golfo Aranci	1,007	537	n/a	n/a
La Maddalena	284	97	n/a	n/a
Olbia	4,623	4,772	5,029	5,374
Palau	283	90	n/a	n/a
Porto Foxi (Sarroch)	23,751	26,106	22,760	27,111
Porto Torres	5,278	4,960	5,741	5,805
Portovesme (Porto Scuso)	5,641	5,129	5,778	6,085
Oristano	n/a	1,757	1,711	1,649

Note: Since 2004 ISTAT does not report disaggregate figures for ports below one million tonnes.
Source: ISTAT.

Particularly interesting is the case of the port of Cagliari (Porto Canale). Originally developed as a heavy industry port, traffics never picked up. A new season for the port started when a concession for a new container terminal was awarded to Contship Italia, with the intention to redevelop some of the old industrial areas as transhipment facilities. The port joined the national portfolio of Contship ports, which includes the fast growing port of Gioia Tauro and the container terminal Darsena Toscana of Leghorn, among others. Transhipment demand seemed to grow promisingly, for the port authority of Cagliari included containers as one of the strategic development areas in its port triennial plan. But competition for transhipment cargo in the Mediterranean is fierce and Maersk Line, Cagliari's only large customer, left the terminal at the beginning of 2008. The decision of Maersk to withdraw from Cagliari was taken independently of the participation of Maersk Line in the terminal company. It is interesting to observe that Maersk has acquired also a participation in the port of Tangier Med, recently developed.

The character of insularity of Sardinia, the limited population and population density and the scattered small rural communities signify that large container terminals are unfeasible to be sustainable without transhipment.

Demand within the island itself is fragmented, and the amount of road infrastructure is below the Italian average, making the logistics business in the island expensive and inefficient. The terminal in Cagliari tried to expand the demand captivity region of the port by setting up a regular feeder service with the port of Genoa (Cagliari Sling Shot Project). This strategy seems to have been relatively successful in increasing the port's container throughput.

The increasing competition for transhipment hubs in the Mediterranean, coupled with larger vessels sizes and the eventual reduction of the number of calls, as well as the concentration taking place in the terminal and shipping industry, might signify that those regions more dependent on good connections, such as islands, may inevitably be relegated to periphery. It is not unlikely to foresee scenarios where a container from the Far East directed to Sardinia, might have to travel through Genoa or Gioia Tauro (if not even through Rotterdam or Antwerp), even though Cagliari is virtually at minimum diversion from the Europe-Far East route. Ports still have to play an essential role in providing insular regions the right degree of accessibility.

Another possible source of development for the port industry of Sardinia is the growth in passenger and cruise vessels. Cruise passengers growth in the port of Cagliari has been below expectations, but hopefully the decision of the port authority to proceed with the construction/redevelopment of a cruise terminal, will stimulate this sector, even if competition for cruise calls in the Mediterranean is also increasing. The Island showed in the last decade high increase of (international) air and sea passenger numbers, confirming its tourism potential. But so far only the port of Olbia and Golfo Aranci seems to have been able to capitalise substantially on tourism. In this respect it might be sensible exploring the synergies possible between the port sector and Sardinia's three major airports.

Insularity and unemployment

The National Industrial Census figures for total employment have slightly increased between 1991 and 2001, growing from 409,509 units in 1991 to 430,072 units in 2001 (ISTAT, Industry and Services Censuses data 1991 and 2001).

At a provincial level of detail, the largest number of employed workforce resides in the province of Cagliari. Cagliari also showed the largest increase in employed population. The province of Oristano not only has the smallest percentage of employed workforce but is also the only province in which this percentage has decreased.

TABLE 7. *Unemployment rates in the major Mediterranean insular regions (NUTS level 3) – Annual averages.*

	1999	2000	2001	2002	2003
Balearic Islands (E)	8.1	6.6	n/a	7.3	9.3
Corsica (F)	26	22.8	n/a	n/a	n/a
Sardinia (IT)	21	20.6	18.7	18.5	16.9
Sicily (IT)	24.5	24	21.5	20.1	20.1
Malta (M)	n/a	n/a	n/a	6.9	7.6
Northern Aegean (EL)	10.9	n/a	n/a	9.2	7.4
Southern Aegean (EL)	11.4	11.5	11.9	14.2	10.9
Ionian Islands (EL)	8.6	9.1	10.2	9	11
Crete (EL)	8.2	6.9	6.7	7.7	6.8
Cyprus (CY)	n/a	5	4	3.3	4.1
EU (25 countries)	n/a	n/a	n/a	8.9	9.1
EU (15 countries)	n/a	n/a	7.5	7.8	8.1

Source: EUROSTAT

From the following graph it can be observed that the majority of employment is concentrated in the public administration sector (33%). Manufacturing and industrial activities employ 23% of the workforce, while agriculture, breeding and fisheries activities account for less than 10% (ISTAT, Population and Housing Census data, 2001).

It should be noted that even if hotels and restaurants represent 5% of the total employment and tourism is generally considered to be able to offer large development opportunities for the Island, the turnover for tourism is less than 4% of the national total. The number of foreign tourists to the Island is still below the national average. Even if improvements have been observed in the recent years, tourism is still considered to be an economic activity yet to be developed (CRENOS, 2003). Needless to say ports may play a crucial role in this development.

PORT EMPLOYMENT IMPACT IN SARDINIA

In the following, employment is assumed as a measure of the development generated by a port. As already outlined before, the issue is more complex and focusing only on the employment impacts of a port is a significant restriction of the analysis since other important aspects worth being considered, especially in the case of islands, are left out.

In order to measure the employment impact of ports the present paper makes use of the methodology developed by Musso *et al.* (2000). In this sec-

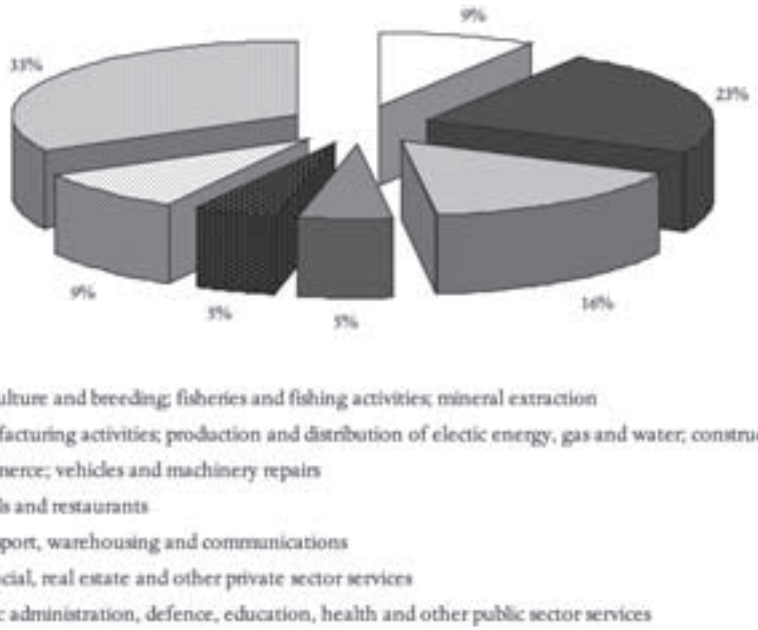

FIGURE 1. Share of employed population by subdivision of economic activities - Sardinia - Census 2001.
Source: Elaboration of the author on ISTAT Population and Housing Census data.

tion only the most relevant aspects of the methodology will be discussed with reference to the case of the ports of Sardinia. Readers interested in a more detailed description of the methodology should refer to the original paper.

Data

The data required by the technique are characterised by a high level of disaggregation, both at a territorial level and at the economic activity detail level. In the previous application (Musso *et al*, 2000), port municipalities were used as proxy of the region affected by the presence of the port. In the present paper this choice is maintained mostly for data availability reasons.

As far as the disaggregation of economic activities is concerned, the level of disaggregation used was the highest available for the statistics provided by the Italian National Bureau of Statistics (ISTAT). The data break-down (ATECO91) subdivides the economic activities in 874 categories, with a coding system up to 5 digits. The data were collected for the industrial censuses of 1991 and 2001 by ISTAT.

Methodological aspects

The technique attempts to evaluate employment impact in terms of the share of employed labour force to be ascribed to a port according to the estimated probability that industries are totally or partially port oriented. The technique distinguishes economic activities into port local economies (PLEs) and non-port economies (NPEs), and by applying probability theory, it determines what share of employed labour force in a predefined region is attributable to the presence of the port.

As pointed out in the original paper (Musso *et al,* 2000) the methodology consists of five different steps:

1. Definition of the PLEs and of the NPEs;
2. Comparison of the PLEs and NPEs;
3. Attribution of the share of the employees to each selected industry;
4. Determining the employment impact for each PLE;
5. Estimating port employment impact for a range of PLE.

In the present analysis only the first step justifies a more detailed description.

Definition of Port Local Economies (PLEs) and of the Non-port Economies (NPEs)

This is done by subdividing the municipalities of the target region, i.e. Sardinia, in port-dependent and non port-dependent municipalities. In other words, the researcher identifies what are the municipalities that are characterised by a port. Given the relatively large number of ports and marinas present in Sardinia, an appropriate methodology for the selection of the PLEs needed to be found. At a preliminary stage of the 377 municipalities of the island, 23 municipalities have been selected on the basis of their geographical position (coastal), the number of port facilities present on their territories and the existence of a maritime administration office.

The first step in the selection of the PLEs consisted of collecting additional information for each of the 23 municipalities identified as potential PLEs. Each municipality has been characterised on the basis of the following criteria:

- industrial vocation of the municipality (tourism, heavy industries, services, agriculture);
- type of port facility (geography and infrastructure);
- annual turnovers (cargo and passengers);
- typology of cargo handled (container, bulk, chemicals, oil, Ro-Ro);
- position in the transport network of the island (node, periphery);

- position in the extra-island transport network;
- relevance as access point;
- importance for local communities.

In the second step of the selection procedure, the information obtained for each municipality has been summarised resulting in the identification of five distinctive features of each PLE (urban areas, industrial conglomerates, tourism, logistics centres and important access node). These features qualified the port municipalities and allow a more thorough assessment of the impact of their ports.

In the course of the process, 14 municipalities have been dropped either because as being considered non-representative of port activities or because the size of the port facilities/throughput was negligible. The procedure resulted in the selection of the nine PLEs listed in Table 8. Table 9 shows the port distinctive features of the municipalities selected. It should be noted that the importance of tourism and accessibility for the island is reflected in the selection procedure and in the resulting PLEs.

Other relatively important ports have been excluded in the attempt to reduce the bias of the tourist dimension on the analysis, since one of the major economic activities of the region is as a matter of fact tourism and it is located mostly in coastal areas. The analysis however is robust and is not affected by the introduction or elimination of a municipality as long as its population is relatively small. The whole of the remaining 368 municipalities of Sardinia has been considered as NPEs.

The port employment impact on the development of Sardinia

From the analysis of the employment impact of ports on the region we can observe that 8% of the entire workforce in the PLEs depends on ports (Table 10). This percentage is slightly smaller than the result found by Musso for the city of Genoa, where almost 10% of the employment of the city is generated by specific port activities, but is still indicative of the importance of ports at a local level. This difference may be caused by the difference in the size of the port system and by the scattered character of the Sardinian port system.

If we analyse the ratios of directly port related employment on the total employment of the PLEs, we observe that there is a rather high degree of variability among the results. In general the municipalities of Golfo Aranci, Sarroch, Palau, Porto Torres, Port Scuso, and La Maddalena seem to be the most dependent on their ports. This result may be related to the dimension of the municipalities. It is particularly striking in the case of Golfo Aranci,

TABLE 8. *PLEs selected for Sardinia and brief description.*

Port Municipality	*Brief description and reasons for selection*
Cagliari	The port of Cagliari is the only port in Sardinia that has remarkable international flows. It serves the metropolitan and industrial conglomerates of Cagliari.
Port Scuso	Port Scuso is the industrial port associated with the power plant of Portovesme and its industrial conglomerate. The port has among the highest throughputs in Italy due to its electric power stations.
Sarroch	In the municipality of Sarroch there is the industrial port of Porto Foxi that serves the industrial conglomerate of Sarroch and Cagliari Elmas.
Olbia	It is the biggest passenger port in Sardinia. Together with the port of Golfo Aranci it serves the tourist basin of Emerald Coast and the urban area of Olbia.
Golfo Aranci	The port of Golfo Aranci, mainly dedicated to passengers is growing rapidly. Together with the port of Olbia they form the most relevant passenger gateway of the island.
Palau	The port of Palau is a small port relevant for the connections with Corsica and La Maddalena.
La Maddalena	The port of La Maddalena, situated on the Island of La Maddalena, is a small port, predominantly with tourism characteristics. It has been included because of the high throughput due to the insularity condition of the island.
Porto Torres	Together with Cagliari and Olbia/Golfo Aranci is the largest port of the island. The major traffic of the port is related to the petrochemical industry. Porto Torres is also the natural gateway of the second largest city in Sardinia, Sassari, and its gravitating urban communities.
Oristano	Oristano, capital city of the homonymous province, is a small port mostly exporting sands, silicates and granites.

Source: constructed by the author on various sources.

where port related employment amounts to more than 40%, almost double with respect to 1991. It should be noted that the importance of the port sector in occupational terms on the PLEs is overall decreasing even if slightly (from 8.77% to 8.17%).

The ratio between the whole of the PLEs in Italy and the total firm employment is not provided in the article of Musso. The figure of 2.68% found in the present study (TABLE 11), is though somehow consistent with the employment split provided by ISTAT of 5% of employment dedicated to

transport (figure 1). This percentage has been slightly decreasing in the last 10 years.

TABLE 9. *Selected port municipalities (PLEs).*

Port Municipality	Port municipality distinctive features				
	Urban areas	*Industrial conglomerates*	*Tourism*	*Logistics centres*	*Important access node*
Cagliari	X	X	X	X	X
Port Scuso	-	X	-	-	-
Sarroch	-	X	-	-	-
Olbia	X	-	X	X	X
Golfo Aranci	-	-	X	X	X
Palau	-	-	X	-	X
La Maddalena	-	-	X	-	X
Porto Torres	X	X	X	-	X
Oristano	X	X	-	-	-

Source: constructed by the author on various sources.

As far as the relative importance of the direct port employment on the total employment, we can observe that Cagliari contributes the most, followed by Olbia, Porto Torres and Oristano. This result suggests that those municipalities that have a higher percentage of direct port employment on the total employment of the municipality are somehow less influential on the overall. In other words, the port sector tends to be important for the small municipalities, that have a limited impact on the entire region, while, for the large ones, it seems that the port generated employment, even if in absolute terms contributes more to the total regional employment, is less important. These findings support in general the conclusion that as the size of the port municipality increases, its impact is spread on a larger region, and becomes somehow less relevant as the importance of the other activities increases.

The analysis at a provincial level (TABLE 11 and TABLE 12) supports the findings even if it is less significant. Only the province of Sassari has become more dependent on port employment. Nevertheless it should be noticed that the province of Nuoro, for which no PLE has been selected, gravitates partially on the ports of Olbia/Golfo Aranci and of Cagliari. In other words the demand impact of the province of Nuoro is accounted for in our analysis as being served by ports outside of it. While this assumption does not affect the results at a regional level, it overstates the role of the PLEs at a provincial level, and especially for those ports that are for geographic reasons more likely to be serving the transportation demand of the province of Nuoro (Golfo Aranci/Olbia, Oristano and Cagliari). Oristano and Cagliari have re-

duced their dependence on the port with respect to employment. However, we can still observe that the province of Cagliari is the one with the highest share of PLE-generated employment.

TABLE 10. *Port generated employment and percentage on total employment, 1991 and 2001 – Absolute values and percentages.*

PLE	Port Employed Units		Total PLE Employed Units		% Port on PLE	
	1991	*2001*	*1991*	*2001*	*1991*	*2001*
Golfo Aranci	157	367	691	853	22.71%	43.07%
Sarroch	567	743	4,334	3,730	13.08%	19.93%
Palau	214	153	1,305	1,071	16.42%	14.29%
Porto Torres	986	876	8,918	8,058	11.05%	10.87%
Port Scuso	771	598	6,997	5,621	11.02%	10.63%
La Maddalena	310	299	2,978	3,050	10.40%	9.79%
Olbia	1,218	1,276	15,279	17,285	7.97%	7.38%
Cagliari	6,735	6,375	82,148	86,910	8.20%	7.34%
Oristano	949	820	13,112	14,334	7.24%	5.72%
Total PLEs	11,907	11,507	135,762	140,912	8.77%	8.17%

Source: Elaboration of the author on ISTAT data.

TABLE 11. *Percentage incidence of direct port employment on total Sardinian employment and on provincial employment (ordered on % incidence on the total employment in 2001).*

Municipality (PLE)	Port Employment on Total Sardinia		Port Employment on Province	
	1991	*2001*	*1991*	*2001*
Province of Cagliari				
Cagliari	1.64%	1.48%	3.45%	3.03%
Port Scuso	0.19%	0.14%	0.39%	0.28%
Sarroch	0.14%	0.17%	0.29%	0.35%
Province of Sassari				
Olbia	0.30%	0.30%	1.03%	1.03%
Golfo Aranci	0.04%	0.09%	0.13%	0.30%
Palau	0.05%	0.04%	0.18%	0.12%
La Maddalena	0.08%	0.07%	0.26%	0.24%
Porto Torres	0.24%	0.20%	0.83%	0.71%
Province of Oristano				
Oristano	0.23%	0.19%	2.77%	2.43%
All PLEs	2.91%	2.68%		

Source: Elaboration of the author on ISTAT data.

TABLE 12. *PLE-generated employment impact on the province, 1991 and 2001, including percentage change from 1991 to 2001 and share of PLE-generated employment on the total employment of the province.*

PLE	PLE employment impact on the provinces of Sardinia			% of PLE employment on total employment of the province	
	1991	*2001*	*% change 91-01*	*1991*	*2001*
Sassari	2,885	2,971	2.97%	2.43%	2.40%
Nuoro[a]	-	-	-	-	-
Oristano	949	820	-13.59%	2.77%	2.43%
Cagliari	8,073	7,716	-4.42%	4.13%	3.66%

[a] *In the province of Nuoro no PLE has been considered.*
Source: Elaboration of the author on ISTAT data.

From the comparison of TABLES 11 and 12 with TABLE 9, it can be observed that the ports with a higher employment impact on the entire island are those with urban areas, followed by those connected to industrial activities and finally the tourist ones. There does not seem to be any connection between the accessibility dimension and the employment impact.

TABLE 13 provides a brief overview of the economic activities that result strictly connected to the port from the present analysis. The results support the consistency of the methodology as in general the activities selected are those commonly associated with ports. What is interesting in the analysis is that between 1991 and 2001 the number of specific port activities has increased, showing somehow the diversification of the PLEs. Another interesting observation is that activities traditionally connected to tourism such as hotels and restaurants appear as port related activities. This is connected to the prominent tourism vocation of the Island.

CONCLUSIONS

The employment directly generated by the port sector in Sardinia accounts for approximately three percent of the total employment on the Island. This number has slightly decreased, even if cargo volumes have steadily increased. The situation presents a more diversified picture at municipal and provincial levels. In particular in the province of Cagliari, ports generate approximately four percent of total employment. The percentages for the other provinces are above two percent.

The municipalities where ports generate the largest impact are Golfo Aranci, Sarroch and Palau, with 43%, 20% and 14% respectively. It is interesting to observe that both Golfo Aranci and Palau have substantial passenger flows. In general we can say that the analysis suggests that ports defi-

TABLE 13. *List of activities characteristic of PLEs, depending on the number of PLEs in which they are present and year.*

2001	1991	Number of PLEs in which the activity is present and % contribution	
Description	*Description*		
Activities in support of water transport		9	100
Freight forwarding agencies and customs offices	Activities in support of water transport	8	99.6
Coastal water transport	Freight forwarding agencies and customs offices	7	96.5
Activities of travel agencies and tour operators	Refuse disposal	7	96.5
Activities of transport intermediaries		7	96.5
Ship repairs	Ship repairs	6	85.5
Retail sale of cakes, flour confectionery and sugar confectionery	Installation of electrical wiring and fittings	6	85.5
Hotels (without restaurants)	Building and repairing of pleasure and sporting boats	6	85.5
Contribution to more efficient operation business (limited to transport and communication)	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines (excluding road transport and airplanes)	6	85.5
Cargo Handling Activities connected with maritime transport	Architectural activities and related technical consultancy	6	85.5
Real estate agencies	Coastal water transport	6	85.5
Renting of personal and household goods	Taxi operation	6	85.5
Integrated engineering activities	Industrial cleaning	6	85.5
Canteens and self service restaurants		6	85.5

Source: Elaboration of the author on ISTAT data.

nitely play a role at the municipal level, but their employment impact for the large ones, even if bigger in absolute terms, is reduced relatively to the size of that of non port activities.

The employment impact has increased from 1991 to 2001 only in the municipalities of Golfo Aranci and Sarroch. With reference to the port of Golfo Aranci, this increase might be ascribed to the substantial passenger growth that has taken place in the port. It is interesting in this respect to observe that the ports of Olbia and Golfo Aranci have become in 2001 a joint Port Authority. The Port Authority has been extended to include also the port of Porto Torres in 2008. The port of Porto Foxi (Sarroch) on the other hand is an oil port. The increase in the employment impact cannot be justified in this case with changes in port activities, but might be related to other developments in the municipality.

In the case of Cagliari cargo volumes have almost doubled. Port employment impact has though been reduced both at a municipal and provincial level, although it remains substantial. This might indicate that the activities in the port of Cagliari have become less labour intensive. This is in line with the general trend observed in ports elsewhere in Europe.

On the whole the analysis seems to suggest that ports play an important role in the employment of the Island. The employment impact generated by industrial and commercial port activities seems to have become less relevant, while passengers and tourism appear to offer the highest potential for a fast growth of workplaces. The employment impact of logistics activities connected to the port is difficult to assess.

In this respect it should be noted that the present methodology only considers port employment impact and not the impact measured by other indicators, such as value added and accessibility. A complete assessment of the port impact in Sardinia or elsewhere would require the investigation of other variables as well. Although the employment impact of the port sector in some areas of the Island may be limited and decreasing, ports and port related activities may still be important for the value added they generate, without considering the crucial role ports may play in granting access to these areas and allowing for the local people to travel, export and import goods and raw materials.

Furthermore the analysis suggests that port economies in Sardinia have undergone a sort of diversification. This is consistent with the general observation that many port municipalities in Sardinia are trying to develop alternative uses of port areas, such as tourism and real estate.

The technique can be improved in a number of ways. First of all, the exclusive focus of the technique on employment reduces its applicability to those ports where the employment impact is not a major determinant of development. In the case of Sardinia it could be argued that gains in accessibility offset limited gains in employment. The role of accessibility has been consid-

ered in the selection procedure, but less heuristic methods for the inclusion of other important determinants of development should be explored.

A further weak point of the analysis is the difficulty in selecting an adequate control region. Nevertheless, a careful assessment of the characteristics of PLEs and NPEs may be sufficient in reducing the biases deriving from control regions not fully consistent. Yet, it is evident that a certain degree of discretionality affects the selection procedure of the municipalities to be considered as PLEs and consequently the whole analysis. The robustness of the methodology however has been tested for small changes in the PLEs (namely the addition of one or more coastal municipalities with small employed population). Only in some circumstances the size and geographical definition of the municipality may affect the reliability of the results.

The analysis can be extended in several directions. A first obvious extension is that of including other measures of port impact. Accessibility and value added are two important variables that should be taken into consideration. This analysis would be interesting in evaluating whether the estimation of the impact with respect to other indicators would give substantially different results. This extension may result in the development of an integrated methodology that encompasses the employment impact, accessibility, value added, etc. The additional complexity would raise the issue of the attribution of relative weights to the various measures.

Finally with reference to the condition of insularity it would be interesting to compare the employment impact in other Mediterranean islands and assess whether this differs from island region to island region and how.

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