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IMPACT OF NEW TECHNOLOGIES ON SHORTSEA SHIPPING IN GREECE

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Abstract

This paper describes the current situation of shortsea shipping in Greece and discusses the possible role of new technologies within the context of coastal transport in this country in the years ahead. By "new technologies" this paper mainly refers to vessels of new design and operating characteristics (such as "fast" vessels capable of making 30-50 knots). In addition, the term "new technologies" also includes the broader spectrum of technological advances that would increase the efficiency of the present system, such as computerized passenger reservation systems, advanced communications systems, etc.

With respect to ship technology, the coastal shipping system in Greece has already experienced a significant transformation in the last 20-30 years, and is most likely to experience another one in the years ahead. The first such transformation concerns the gradual substitution of ferry vessels for the more traditional passenger-only vessels sailing in the Aegean and Ionian seas. The second transformation concerns the potential role of fast vessels of new design, whose appearance in the system has already started.

If one combines such a development with other technological advances in information systems and telecommunications, as well as the likelihood of increased deregulation of the shortsea market in the near future, it is likely that the picture of shortsea shipping in Greece in the years ahead will be dramatically different from what it has ever been. The paper presents some speculative scenarios as to how this picture might evolve.

This paper also includes a section on policy recommendations so as to improve the efficiency of the system and aim toward a better EC transport integration.

1. Introduction

This paper describes the current state of shortsea shipping in Greece and discusses the possible role of new technologies within the context of coastal transport in this country in the years ahead.

By "new technologies" this paper mainly refers to vessels of new unconventional design and operating characteristics (such as "fast" vessels or AMV's (advanced marine vehicles) capable of making 30-50 knots). In addition, the term "new technologies" also includes the broader spectrum of technological advances that would increase the efficiency of the present system, such as computerized passenger reservation systems, advanced communications systems, etc.

Coastal shipping in Greece has experienced a significant transformation in the last 20-30 years, and is likely to experience another one in the years ahead. The first such transformation concerned the gradual substitution of mixed passenger/ car ferry vessels for the more traditional passenger-only vessels sailing in the Aegean and Ionian seas. The second transformation concerns the potential role of fast vessels of new design, whose appearance in the system has already started.

If one combines such a development in internal Greek maritime transport with other technological advances in information systems and telecommunications, as well as the likelihood of increased deregulation of the shortsea market in the near future (in view of the Single European Market and the Maastricht accords), it is very likely that the picture of shortsea shipping in Greece in the years ahead will be dramatically different from what it has ever been. The paper presents some speculative scenarios as to how this picture might evolve.

This paper also includes a section on policy recommendations so as to improve the efficiency of the system and aim toward a better EC transport integration. As the present national institutional structure is excessively cumbersome and rigid, analysis of policy alternatives is considered a top priority if the present inefficiencies are to be alleviated.

The rest of this paper is organized as follows. Section 2 describes the current situation of coastal shipping in Greece. Section 3 discusses future prospects, and Section 4 presents our conclusions and policy recommendations.

Before we further proceed, a few words are necessary on the data that have been used for this paper. This comes from a computer database compiled by Martedec S.A. in Piraeus for the coastal shipping system

in Greece from 1985 to 1988. Built in the context of a NATO Science for Stability project, this database is far ahead of any other known single source of data on Greek coastal shipping in terms of completeness, quality, and accessibility. However, there are certain categories of data that could be very useful for this paper but which were not readily available. A detailed breakdown of the various commodities of cargo carried is an example; a breakdown of the various classes of passengers (first, second, tourist) is another; a listing of the feeder cargo ships is yet another. Finally, we did not have ready access to such data before 1985 or beyond 1988. We feel that the results of this paper would be stronger and more useful if we had ready access to such additional information.

2. The Greek Coastal Shipping System: Status Quo.

Our discussion covers the following topics: geography, fleet composition, volume of traffic, network design, port infrastructure, and other system features.

2.1 Geography.

Greek coastal shipping involves the movement of passengers and freight within a complex system of mainland-to-island, island-to-island, and mainland-to-mainland connections (see Figure 1). Although the actual number of islands is on the order of several thousand, most of these islands are very small and uninhabited, and only 69 islands are officially considered important from an economic perspective. The islands and the mainland are served by a total of 138 ports (see Psaraftis (1992) for a listing). By convention, "mainland Greece" is considered to also include the Peloponnese and Euvoia (which are islands in the very strict sense of the word, but are linked to the rest of Greece by short bridges). As thus defined, the mainland has 42 ports. The rest of the ports (96) are island ports. Crete is Greece's largest island, with 8 ports.

An important concept in Greek shortsea shipping is what are known as the "main lines" of the system. Each main line is defined not as a prescribed sequence of port visits, but rather as a set of geographical clusters that are internally linked by a network of ship routes (e.g., Piraeus- Crete, Piraeus- Cyclades- Dodecanese- Crete, etc.). There are a total of 31 main lines, spanning the entire system (see Psaraftis (1992) for a complete listing). There can be more than one main line serving a specific geographical area (e.g. for the Cyclades there are 10 different main lines). Within a specific main line, a variety of individual routes can serve the ports that belong to that main line.

2.2 Fleet composition.

If one excludes deepsea cargo vessels that make direct calls to the mainland or the Greek islands from

overseas destinations, as well as cruise ships that exclusively cater to the tourist industry, there are several major categories of ships that operate in the Greek coastal shipping system on a regular basis.

The first category concerns only the movement of *freight* and is classified under the general rubric of "feeder ships." These carry cargo either in bulk or as general cargo between the islands and the mainland. These ships load typically from Piraeus or a similar major mainland port and distribute cargo to the islands (the reverse operation also takes place). This category of ships operates on a charter basis and is not constrained by specific "main lines," routes, or schedules. It has constituted the predominant mode of freight transport to and from the islands in the past.

A second major category of ships that has become increasingly important in recent years is the fleet of ferries for the transport of passengers, private cars, buses, motorcycles, and freight-carrying trucks. These ships operate on the "main line" system described earlier. They have virtually displaced the traditional passenger-only coastal ships that provided service to the islands in the 50's and 60's. Such ships still exist (this is the third ship category), but their numbers are steadily declining. They also operate on the "main line" system described earlier. Having lost a significant share of their market to ferries on long-haul routes, these ships seem to be losing the battle on shorter routes too (their main theater of operation today), this time to high-speed vessels, such as hydrofoils, catamarans, etc. (see also later in this section).

This evolution from traditional passenger-only ships to (mixed passenger/ car) ferries is the first significant transformation of the nature of shortsea shipping in Greece in recent years. This transformation has developed over the course of the last 20-30 years and has been spurred to a significant extent by rapid island economic growth and by significant infrastructure improvements in island ports in the late 60's and early 70's. This allowed for the first time ferry service to these islands.

It should be mentioned here that up until that time it was impossible for passenger ships even to dock at most of the islands, people having to embark and disembark by using small boats that approached the ship while the latter was anchored in the middle of the harbor. The construction of docks and piers in most islands ended this mode of operation and opened the door to ferry services.

The ferry mode of operation, practically nonexistent in Greek coastal shipping a few decades ago (except for very short distances and for the island of Crete that had adequate port facilities), has steadily grown since the 70's, by extending service to virtually all Aegean and Ionian islands. Due to the introduction of larger and larger ferries, this mode has ballooned to explosive proportions in the last 3-5 years, and constitutes now an integral and the strongest component of the system.

The Martedec database lists 106 ships as of 1988. Of these, 83 are ferry ships (see Psaraftis (1992) for a listing). The remaining 23 ships provide passenger service only but cannot carry vehicles. Two ferries are pure freight carriers (ro/ro's), having a passenger capacity of only 12. All other ships are passenger/freight combination ferries or pure passenger ships. The average tonnage of the ferries is 3,015 GRT, with the largest ship being 11,546 GRT (this is the FAIDRA). The average passenger capacity is about 700, with the maximum capacity being 2,300 passengers (this is the APOLLON EXPRESS). The average (private) car capacity is 231, with the maximum capacity being 490 cars (APTERA). Average speed is about 16 knots, with maximum speed (among displacement ships) being 23 knots (ARIADNE). Ship average age is relatively high: 19 years in 1988 (versus 16 years in 1985)[1].

As all fares are fixed by the Government, ferry operators (as well as all shipping companies) cannot compete on price. Instead, they try to improve the quality of services offered. Indeed, in recent years this quality has been increasing, by the introduction of more comfortable accommodations, air conditioning, etc. In spite of this, one must address the following basic deficiencies of the conventional Greek shortsea shipping fleet:

First, not only are these ships rather old on the average (as mentioned earlier), but also their average operating speed is low, as compared to that of similar services in other European countries (Northern Europe, Italy, Channel, etc).

Second, many of the existing ferries are *conversions* of ships originally built for other purposes. For various reasons (one of which is surely the lack of serious economic incentives to invest in newbuildings when one operates in a rigid price- controlled environment), converting an old ship is often a more attractive alternative to a shipowner than purchasing a new (or even a second- hand) ferry. This is so especially if the conversion is made in a Greek yard. However, and even though these conversions are done successfully, it is clear that the performance of a converted ship (speed/ propulsion, seakeeping, etc.) often cannot match that of an equivalent newbuilding.

Two additional remarks are important with respect to ships: One, we were unable to identify a database similar to Martedec's for the variety of *feeder* ships in the system. Two, and perhaps more important, a

[1] It is intriguing to note that the 1988 database includes MIAOULIS, the last of four sister passenger ships (the other three being KANARIS, KARAISKAKIS, and KOLOKOTRONIS) built in Italy in the late 40's and given brand-new to Greece as part of Italy's reparation payment for World War II. These twin-screw ships (all named after heroes of the Greek revolution against Turkey) were the workhorses of Greece's shortsea transport in the 50's and 60's, offering really superior service (all of them are now decommissioned or scrapped).

second transformation may be slowly taking place in the composition of the fleet. This transformation concerns the emergence of "fast" (30-50 knots) vessels. This category of ships is worthy of investigation because it has the potential to radically transform the nature of the shortsea shipping industry in Greece in the years ahead.

It should be mentioned at the outset that the existence of "fast" ships in Greek coastal waters is not new: a number of Soviet-made hydrofoils (of type KOMETA, the so-called "flying dolphins") have been operating in short-distance routes for the last 10-15 years. These routes mainly serve the islands in the Argosaronikos Bay near Piraeus, although in recent years the operational range of these vessels has been getting longer, with service to several islands in the Aegean, weather permitting (up to about Beaufort 6). As a result of their high speed (on the order of 30 knots) and reasonably reliable service, these vessels have won a significant share of the passenger traffic on these short-distance routes over the traditional displacement ships that were serving these routes in the past. It is estimated that more than 30 hydrofoils are operating today in Greek waters, still increasing their market share against conventional pure passenger ships (Trillo, 1991).

What has however spurred serious discussion on the potential of this general class of vessels for Greece has been recent interest for other, newer types of fast vessels. These other "new technology" types include SES (surface-effect ships), catamarans, and SWATH (small waterplane area twin hull) vessels. Of these types, two SES ships have already begun passenger-only service to some islands in the Central Aegean, reducing traditional 5-7 hour trip times to 2-3 hours. Also a 35-knot catamaran has begun service in the Argosaronikos Bay in parallel with hydrofoils. Such short travel times may put marine transport on a comparable basis with air transport (particularly over shorter distances), and give for the first time a flavor of what may be a revolution in the entire picture of shortsea services in Greek coastal waters.

The growing interest in the potential of these vessels has induced a heated debate on their technical, service, and economic merits for shortsea routes in Greece. Adversaries in this debate are the owners of and prospective investors in such vessels and the owners of the conventional shortsea services (ferry and pure passenger), who are afraid of losing market share to the fast vessels. Arbitrator to the debate is the Ministry of Merchant Marine, tasked by national law to issue permits for the operation of vessels, to approve routes, and to set fares for every type of service rendered. However, owners of fast vessels often complain that the current excessive rigidity in regulation is an obstacle to the issuance of permits, and many times suspect that lobbying by the owners of conventional ships is the real reason for such difficulties.

With few exceptions (see work by Papanikolaou and his colleagues cited in Section 3), there has been little or no serious effort to assess the real potential of all these new types of vessels for Greece on a scientific basis. There is also little operational experience with these new types of fast vessels in Greece (by contrast to hydrofoils), especially on the longer routes that have been planned. Thus, as things stand today, it is fair to say that one can only offer some speculative scenarios on their economic viability and future. Such scenarios will be discussed in Section 3.

2.3 Volume of traffic.

In addition to the above information on transport "supply," from the Martedec database one can also obtain some insights on the "demand" side of the equation, as well as on the growth of that demand for the period 1985-1988. The following statistics are important in that respect:

1) In 1988, total passengers carried by coastal shipping in Greece amounted to about 9.86 million, compared to 8.17 million for 1985. This corresponds to an average annual growth of about 6.9%. By contrast, the Martedec database estimates that for the same period the total passengers carried *by air* to and from the Greek islands fell from about 3.67 million in 1985 to about 3.18 million in 1988 (an average annual drop of about 4.5%).

2) Passenger cars carried by ferries grew from about 571,000 in 1985 to about 762,000 in 1988 (an average annual growth of about 11.2%, or nearly double that of passenger traffic). This figure alone testifies to the explosive growth in the ferry business in recent years.

3) The number of trucks carried by ferries also grew, but more slowly, from about 355,000 in 1985 to 385,000 in 1988 (an average annual growth of about 2.82%). The slower growth can be explained because truck traffic depends more on the overall economic/industrial growth of a region and less on tourism, which is more linked to passenger car traffic.

4) The breakdown of passenger traffic among ship classes during the same period (1985-1988) is as follows. Carried by ferries *and* pure conventional passenger ships: from 6.95 million to 8.38 million (a 6.86% annual growth). Carried by "fast" ships (hydrofoils only in that period): from 1.22 million to 1.48 million (a 7.1% annual growth).

5) Passenger traffic generally exhibits a strong *seasonality.* Figure 2 shows passenger traffic originating from the island of Paros (a typical island in the Cyclades) in 1986, for both the air and sea modes. Seasonality is less pronounced for truck traffic, which is more steady because of its dependence on general economic activity rather than on tourism.

6) In general, there is a strong correlation between passenger and car traffic. In Fig. 3 the X- axis measures passenger traffic and the Y-axis measures car traffic, again for the island of Paros in 1986. It can be seen that most of the points (each corresponding to a specific month in 1986) lie close to the diagonal of the box diagram.

7) Unfortunately, statistics on people carried by only pure *conventional* passenger ships were not readily available, but from the previous numbers one can speculate that the growth in that category must be very small, or even negative for that period.

8) Also unfortunately, comprehensive traffic statistics before 1985 or after 1988 were not readily available either. These would have allowed us to compare the growth of air transport to and from the islands in the 70's (period of opening of many island airports) vis-a-vis the growth of coastal shipping in the same period. Air service to the islands is being provided by the national carrier Olympic Airways (major islands like Crete, Rhodos, etc.) and its subsidiary Olympic Aviation (smaller islands). It is speculated that during the above period air travel shifted a share of the passenger traffic away from conventional (pure) passenger ships, rather than generating new demand. Of course, the same period saw the strong penetration of the (mixed passenger/car) ferry into the market, instantly carving a new niche exclusively for itself: people traveling with their private cars, who had no alternative means of transport.

Based on the Martedec data, Psaraftis (1992) carried out a focused investigation of *freight* flows to the Cyclades islands and to the island of Crete. Specifically, he compared freight carried by feeder ships to freight carried by trucks onboard ferries. Some of his observations are summarized below.

a) In general, freight traffic carried by ferry is reasonably well balanced in volume as far as direction is concerned (imports to/ exports from an island). This is not the case with feeder freight, which can exhibit great imbalances in direction. Some islands are net importers of feeder freight, whereas some others are net exporters. In either case, feeder ships may sail virtually empty in one direction but full in the other. Figures 4 and 5 illustrate these points for freight traffic in and out the island of Milos, carried either by ferry or by feeder ship. One can observe that whereas freight by ferry is relatively balanced (Figure 4), feeder freight is much heavier in the export direction than in the import direction (Figure 5).

b) In many islands, freight traffic carried by trucks onboard ferries is today of a comparable (same order of magnitude) volume with freight carried by feeder ships. This is a radical change from the modus operandi of the past (when freight carried by ferries was virtually nonexistent). This is so in spite of the fact that the bulk of truck freight is carried as a *service byproduct* by ships that are predominantly in the *passenger* business (either for passengers alone, or for passengers with their private cars).

This last observation raises the following natural question: Why should a significant portion of the freight to and from the Greek islands be carried by ships that have been designed mainly for the passenger business? Or, could the efficiency of the system be increased by redirecting truck freight to dedicated freight carriers (ro/ro ships) and freeing valuable ferry space for passengers and their cars?

A more daring question is: If a new design of "fast" (30-50 knots) ferry enters the market in the future and attracts a large portion of the passenger *and passenger car* business, and, if truck freight eventually goes to dedicated ro/ro ships, will conventional ferries, as we know them today, gradually disappear from the Greek market?

We shall attempt to answer these questions in Section 3.

2.4 Network Design

In spite of the radical changes that have occurred in the system over the past 20-30 years (at least in terms of kinds of ships that operate in it, and in terms of passenger and freight traffic), there has been little change in the design of the network that serves the system. "Main lines" are still more or less the same, many still emanating radially from Piraeus, with little connectivity among islands that do not belong to the same main line.

This situation renders island-to-island movement of freight and passengers cumbersome if both the origin and the destination of the movement are located on different main lines. In such a case, the movement has to go through Piraeus, even if the two islands are adjacent. As an example, the distance between the islands of Paros and Sifnos in the Cyclades is less than 20 nautical miles, yet until recently the only service between these two islands was by a 20-meter boat (passenger only) that only sailed when the weather was good, and whose speed was less than 10 knots. [In the summer of 1992 this situation was alleviated by the introduction of a larger ship, the PAROS EXPRESS, which now links the two islands, but still not yet on a daily basis].

Up until recently, such a shortcoming was judged to be of lesser importance for movements of freight by truck/ferry (this occurs typically to and from the mainland) than it is for passenger travel during the summer tourist months. However, the rigid design of the network is certainly an obstacle for the development of inter-island freight, and there will be increased pressures to move to a more flexible system in the future.

As alluded to earlier, the rigidity of the network can be attributed to the Byzantine institutional structure that still exists in almost all aspects of coastal shipping in Greece. Deregulation is a word that is considered a curse in many circles, and the Government has announced that it will resist the proposed removal of cabotage restrictions proposed by the European Community. Still, there is some hope that at least internally, the system will eventually be forced to adapt to the evolution of traffic, and to the

emerging ship technologies.

2.5 Port infrastructure.

The explosive growth in traffic that was spurred by general economic growth and by the modernization of island port facilities in the last 20-30 years has in turn rendered many of these facilities obsolete and in urgent need of upgrading.

As far as ferry traffic is concerned, the most pressing need seems to be the gross inadequacy of ports, not so much in terms of docks or piers, but rather in terms of road access and parking facilities. Such inadequacy makes loading and unloading of vehicles onto ferries a very painful operation, involving traffic jams at the streets in and around the port, and gridlocks and confusion at quay side. This phenomenon is observed not only at busy ports such as Piraeus, but also at island ports. The latter are frequently overwhelmed by vehicle traffic, especially if two or more ships want to use the port facilities at about the same time, something that is very common during the summer.

2.6 Other system features

For all the significant change that has taken place in the picture of *freight* transport, the logistics of the transport operation that involves the shipment of freight via truck on board ferries is particularly cumbersome and run on an "ad hoc" basis. Most trucking companies are a one-truck concern, serving a specific island. Many trucks (the so-called "private use" trucks) belong to merchants who operate businesses on the islands (e.g., a grocery store) and purchase their supplies from the mainland. Other trucks are "public use" trucks, providing service to customers who want to ship goods to or from the islands. Such customers typically bring the shipment themselves to a loading depot, and the recipient of the shipment picks it up when it arrives at the island (or vice versa). The loading depot can be anywhere in the greater metropolitan area from which the shipment originates, and quite often is the home of the truck owner. There is no published schedule, but delivery usually takes place within a few days. There is also no established tariff for shipments, and truck owners are essentially free to charge what they wish. Since bills of lading or other written receipts are practically nonexistent for small scale shippers, a significant part of the income of most truck owners is tax free. In a sense, most of these transactions are carried out in a "black market" that bypasses the official system. Under these circumstances, the transport of goods is dictated mainly by individual factors, cannot be planned in advance, and may in fact become very expensive for the shipper.

Needless to say, there is no use of any EDI (electronic data interchange) scheme for the shipment of

cargo or passengers. For instance, it is still impossible to purchase a ticket at a place other than the port of origin of a trip. This means that one cannot buy a return ticket, and cannot even reserve space onboard a ship for the return leg, unless that reservation is physically made by somebody at the destination port. This situation, although palatable in the past when everything moved extremely slowly, has now been recognized to be completely unacceptable, and there is recent talk of setting up a computerized passenger reservation system similar to what is used by the airline industry. Almost everybody agrees that the time for such a system is long overdue.

3. Future Prospects

The above description has hopefully given an accurate flavor of the current situation of coastal shipping in Greece, with some emphasis on areas of concern. The question then becomes what are the prospects for the future. This section attempts to answer this question. The topics that are covered are: new institutional environment, new ship technologies, and new transport network design and infrastructure.

Before we proceed, we observe that making predictions for the future of coastal shipping in Greece is certainly not an easy thing to do, given the uncertainties that surround many of the important issues. Nevertheless, it is important to realize that some of the underlying parameters that will be critical determinants of the future state of the system are known in advance, and this renders the formulation of possible scenarios less difficult (although by no means trivial).

3.1 New institutional environment

One of the parameters that is known in advance fairly well is surely the target of an effective European economic integration, expressed by the implementation of the Single European Market as of January 1, 1993, and further reinforced by the Maastricht accords. It is not the scope of this paper to analyze in depth the impact of these institutional changes on the future of coastal shipping in Greece. However, one can name a few key factors that are likely to be of importance.

The first such factor is the considerable pressure on Greece so that the transport deregulation implied by the European economic integration is also applied to Greek internal sea transport. If this happens, services could be offered by ships not flying the Greek flag, and/or not employing Greek seamen (a situation completely different from the current picture). Needless to say, such a prospect is not looked upon very favorably by Greek shipowners or Greek seafarer unions, and the Greek Government has traditionally supported their position vis-a-vis the EC, on the ground of excessive threat to "strategic national interests." As things stand today, it seems that the EC has granted Greece a reprieve until year

2004 for this deregulation to take effect.

It is fair to say that whereas the general sentiment is that the removal of cabotage privileges will be bad for Greek shipowners and seafarers, no one has seriously studied the problem so as to be able to fully assess the economic implications of such a development on the broad spectrum of players involved (passengers, shippers, shipping companies, tourism, regional economies, national economy, or Greek society as a whole). However, it is clear that should this deregulation take effect (even partially), there will be a strong need to find ways to increase the efficiency and the quality of service of the present system.

A second factor that will be important in the future comes from the Maastricht accords. Barring non-ratification (or substantial renegotiation) of the Maastricht treaty, Greece (along with Spain, Portugal, and Ireland) is likely to benefit from the so-called "cohesion funds." One of the uses of these funds is to enhance the economic development of regions located at the EC "periphery," by (among other means) strengthening their links to regions closer to the center. If this happens, shortsea shipping in Greece, along with the vital sea transport link to and from Italy, will benefit considerably by drawing funding for necessary infrastructure improvements.

A third factor that is not directly related to maritime transport but will certainly have ramifications for coastal shipping in Greece is the increasing deregulation of *air travel* in Europe. If foreign airlines are allowed to serve Greek islands (either from Athens, or directly from European cities), some of the passenger traffic that now prefers or is forced to take the boat may shift to air transport. As mentioned earlier, competition from air transport already exists in Greece. However, a deregulation of the airline industry is expected to further increase such competition, irrespective of whether or not the coastal shipping market is still internally regulated. This "external factor" will put even more pressure for the system to become more efficient in the future.

3.1 New ship technologies: advanced marine vehicles.

As said earlier, and similar to international practice, there has been a steady evolution in the types of ships that sail the Greek seas, in terms of size, speed, and technology. It was also mentioned that a ship class that is not yet thoroughly tested, but for which there exists considerable interest is the category of "fast" marine craft, such as hydrofoil, SWATH, catamaran, wave-piercer, SES, air-cushion-vehicle (ACV), etc. According to Trillo (1991), the class of "fast" ships is defined as having length over 20 m and speed over 20 knots. However, in the context of this paper, by "fast" we shall mean advanced marine vehicles on unconventional design that can make 30-50 knots. The basic question is what is the future of

these new ship technologies.

As argued in Section 2, the answer to this question could very well be critical for the future of the entire shortsea shipping industry in Greece, because depending on how the answer goes, the picture of the system in the future could be dramatically different from what it is today (much in the same way the current picture is very different from what it was in the past).

Of these types of ships, the most widely tested in Greek waters is the *hydrofoil* class, which has managed to carve a special niche in the market. Perhaps its greatest advantage is speed (about 30 knots) and reasonably reliable and comfortable service. A basic limitation of this class is its inability to carry vehicles. This effectively limits its clientele to people traveling without cars, the same people who might consider taking the airplane, if this were available and attractive. Of course, the hydrofoil- airplane competition is less serious than it might seem, because hydrofoils typically serve islands very near Piraeus that are not connected by air transport. Another limitation of hydrofoils is that they cannot function properly in heavy sea states. This essentially precludes their effective operation in areas such as the Central and Southern Aegean, where sea states of Beaufort 7 to 9 are not uncommon during the summer tourist season. Based on this, we think it is unlikely that this class will be able to further change the picture of shortsea shipping in Greece in the future.

Surface effect ships (SES) have been very recently introduced in Greece, and now serve some islands in the Cyclades as pure passenger carriers. Another SES is now operating between Brindisi (Italy) and the island of Corfu in the Ionian Sea. Operating at close to 40 knots, and with an "acceptable" (but still not ideal) seakeeping performance, this type of vessel seems promising in the future, especially if new designs of larger size, higher speed, improved seakeeping, and an ability to also carry private cars or other cargo are introduced.

Another potential category of advanced marine vehicles for Greek coastal shipping is that of *catamarans*. There are many known alternatives or hybrids: displacement, semi-displacement, planing catamaran, foil-CAT, wave-piercer, super slender CAT, etc. To some extent, SWATHs and Fast Displacement CATs (FDCs) belong to this category too, but they will be considered separately.

The catamaran class has had in the past a chance to demonstrate its merits in practice in Greek seas. Besides an unsuccessful attempt in the past to operate a semi-submerged catamaran between Piraeus and Crete (severe seakeeping problems), there are today several cases of successful operation of high-speed catamarans in Greece, mainly in protected waters (Argosaronikos Bay). Also, some lower-speed catamarans have been introduced in the Dodecanese. Plans exist for larger passenger/car ferry

catamarans from the mainland to Aegean Sea islands, and for wave-piercers on the route from Patras to Italy.

Thus, experience from catamarans is still limited, and mixed. Some people like their speed, while some other people dislike their "bumpy ride" in rough weather. It seems that if their service continues to be limited to passengers only, then catamarans will be more of a threat to hydrofoils (and to airplanes) than to conventional ferries. If on the other hand designs that are able to also carry private cars are introduced, then the entire shortsea "game" will certainly be played by completely different rules.

A scenario therefore that might conceivably be threatening for the future of conventional ferries in Greece is the possible emergence of ship designs that combine high speed and superior seakeeping performance, with an ability to carry vehicles. If such a design proves economically viable in practice, it may attract a significant share of passengers traveling with their private cars, away from the conventional ferry market. If, in addition to that, truck freight is diverted from passenger ferries to specialized freight (ro/ro) ships (only two of such ships currently exist), then the conventional passenger ferry fleet will be on a shaky ground in the future.

Of course, the two "ifs" of the previous paragraph are really "big ifs." Although the two are not directly related to one another, it is perfectly possible that developments in one of them will facilitate developments in the other. We briefly discuss each of them below.

Coming to the second "if" first, the development of a ro/ro fleet exclusively carrying freight to and from the Greek islands has never been systematically investigated in theory or tested in practice. However, it is conceivable that such a system, particularly if it is properly logistically integrated, be viable economically. If so, a considerable portion of truck freight may prefer to travel on these specialized ro/ro ships instead of the passenger ferries on which it travels today.

With respect now to the first "if," the question is this: how serious is the possibility of developing a viable "fast" design *that can also carry passenger cars?* This is perhaps the most critical (and certainly not easy) question to answer.

Several attempts to answer this question are currently under way worldwide (e.g., Techno-Superliner project in Japan, SES and SWATH designs in Trillo (1991), etc). In addition, the work of Papanikolaou et al (1989,1991) has obtained some insights into that question. They have proposed the design of a SWATH passenger/car ferry, to operate between Piraeus and Crete, and have optimized this design with respect to size, hull form, horsepower, and seakeeping behavior. They have also carried out an economic

analysis of this vessel. The main results of this study are summarized below.

One of the prototype vessels considered (named AEGEAN QUEEN) measures 51.7 m in deck length, 31.7 m in breadth, and its draft is 5 m. It can carry 752 passengers and 84 private cars at 30 knots. Its deadweight is 226 tons and its gross tonnage is 2,544 GRT. Propulsion is provided by four 5,000 HP diesel engines, placed in the lower hulls and driving two 5-bladed, controllable pitch propellers. Seakeeping analysis and model experiments showed very good seakeeping performance for typical Greek seas, at least for head seas.

The economic analysis of this type of vessel assumed a basic 80% capacity utilization year-round and several other cost and operational parameters. Results showed a Required Freight Rate of USD 11.5/passenger, and USD 50.1/car. According to the authors, these compare to USD 8.6/passenger (B-class ticket) and USD 37.5/car for a conventional ferry running at about half the speed on the same route.

Promising as these results might be, it is fair to say that additional research and/or a real-life test of such a vessel (or of other "fast" types) will probably be necessary in order to fully ascertain their practical merits for Greek waters.

3.3 New transport network design and infrastructure.

With the various kinds of pressure on the system toward a better efficiency and improved levels of service, it is only natural that this will ultimately translate into an improved design of the shortsea transport network and into improved infrastructures.

Regarding the network, even a partial deregulation of the market (that is, with no removal of cabotage privileges) will result in the establishment of new routes, with minimal interference from the Government. The concept of "main lines," as it is known today, may become meaningless for the overall fleet, although each individual company may very well establish its own main lines (which will not necessarily be the same with those of its competitors).

It is still premature to predict what a deregulated shortsea shipping network will look like, but it is very likely that it will be very different from the one currently in place. In the United States, airline deregulation in the 80's radically transformed the air transport network from one with predominantly long-haul routes to a "hub-and-spoke" system involving passenger transfers. This does not necessarily mean that the same will happen in Greek shortsea shipping (transfers are much more cumbersome when traveling by ship). However, one could very well envision a system where main destinations ("hubs") are

served directly from Piraeus, and remote destinations are served by boats that originate from these hubs.

In addition, a "mixed-mode" system may also evolve, where passengers could fly to the hubs, and continue their journey to their final destination using a high-speed boat. Then they could rent a car instead of bringing along their own. Some people already use such a method when going to remote islands in the Dodecanese (by plane to Rhodos and then by boat or hydrofoil to the islands nearby). Deregulation of air and sea transport will increase this mode of travel some more, particularly if the combination airplane-ship-car rental (and maybe hotel) is attractively packaged.

As finally regards infrastructure improvement, this is considered absolutely essential for enhancing the efficiency and the service quality of the system. Not only ports, but also basic services such as passenger/car reservations, ticketing, communications, and all related logistical services should be completely overhauled. Establishment of "integrated" services, either for passengers or for freight could take place. For instance, door-to-door shipment of packages maybe offered by a company that has integrated truck distribution with ro/ro ship operation. We predict that the combination of a deregulated environment, the new ship technologies, and EC financial assistance (cohesion and other funds) will bring about such changes sooner rather than later.

4. Conclusions and Policy Recommendations.

4.1 Conclusions

Based on the previous analysis, we believe that a number of conclusions can be made. These can be summarized as follows:

(1) There has been a drastic change in the pattern of sea transport to and from the Greek islands over the past 20-30 years. This change involved the establishment of the (mixed passenger/car) ferry as the workhorse of the fleet and the gradual reduction of the role of the traditional pure passenger ships.

(2) Transport of freight by ferry to and from the Greek islands, virtually non-existent in the past, is now comparable in volume with that carried by conventional feeder cargo ships. This is so despite the fact that ferries are designed for and cater to mainly the passenger business.

(3) In spite of significant changes in ship technology and pattern of trade, there has been little change in the structure of the network that serves the islands.

(4) The infrastructure of ports in both mainland Greece and the islands is in urgent need of improvement to cope with the volume of passenger and freight traffic.

(5) The regulatory structure under which the system operates is excessively rigid and is a cause of many of the problems. Deregulation of European Community maritime (as well as air) transport will bring about changes in the shortsea transport network design and operation.

(6) New technology ships (such as high-speed craft) that have begun service to the islands may dramatically alter the pattern of both passenger and freight trades in the future, even if their main role is currently only in the passenger business.

4.2 Policy recommendations.

Based on the above, the following policy recommendations can be offered to improve the efficiency of the system:

(a) The present system of Government regulations on main lines, fares, route approval, and other aspects of the system should be made more liberal and flexible, without necessarily leading to the removal of cabotage privileges. This would necessitate the complete overhaul (or even possibly the scrapping) of certain parts of the present regulatory structure.

(b) Computerized ticketing and reservation systems (or other EDI systems) that could book space for passengers and cargo onboard ferries and other ships should be installed and implemented as soon as possible.

(c) A massive port infrastructure improvement plan should be put in place for all ports in the system.

(d) The possibility of using a greater number of dedicated freight ferries (ro/ro's) should be examined.

(e) The concept of "main lines," as it stands today, should be radically changed, and a thorough investigation of alternative routes and connections should be undertaken.

(f) Continued research into emerging new ship technologies should be undertaken, including their viability for carrying vehicles.

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