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OIL TANKER RATES: A LIFE-LONG CHALLENGE

by

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OIL TANKER RATES:

A LIFE-LONG CHALLENGE

Zenon S. Zannetos

I. How it all began.

It was twenty-eight years ago when I was introduced to the topic of oil transportation by Professor Adelman. I was then a student in his class when at the end of one of the sessions he said to me, "You are the person I have been looking for." He went on to explain that there was a need for someone with a strong background in mathematics and management to carry forward the work of Professor Koopmans (1939) and urged that I look into it.

I still remember the feelings of ambivalence that occupied me. On the one hand I was flattered by the compliment paid me by a professor I immensely respected. But at the same time, I was paralyzed by the fear of failure, for I knew nothing about the subject and was fully aware of the legendary reputation of Professor Koopmans.

The gentle encouragement and the confidence Professor Adelman had shown helped me overcome my fears long enough to look into the subject. And so I immersed myself in an activity that had a profound effect on my professional orientation and is still a fascinating part of my academic life. The road, of course, was not smooth and easy and, in the years that followed, several events made me pause and reflect on the admonition of another famous oil economist, Dr. Walter

Levy. It was during my first visit to his New York office, at the beginning of my research, when he said, "Many people tried to do what you are planning to do but failed. I feel sorry for you because you will probably spend a lot of time on this subject and end up not having a thesis. Take my advice and try something else. It is a very complex and difficult subject. No one can unravel it." Three years and about six months later, I finished my dissertation just in time to save Professor Adelman of an embarrassment. But this does not mean that Dr. Levy was wrong! Here I am twenty eight years after my initiation in this field, possibly a little less naive, and still trying to unravel the mystery of oil tanker rates.

II. What Did We Find Then?

Koopmans (1939) in his classic study of freight rates and before him Tinbergen (1934) identified a cyclical price behavior in the tanker-freight and tankship-building markets without seeing much evidence of any cyclical demand. Koopmans tried to explain the price cyclicality in both the tanker-transportation and shipbuilding markets in terms of the replacement cycle of vessels. He hypothesized that tanker owners, independents as well as oil companies, being in business to provide transportation services, will automatically scrap and reinvest when their vessels become old./1 As a result of this hypothesis, spot freight rates and orders for new vessels become dynamically interdependent, causing price cyclicality because of the replacement cycle, even with demand constant.

The notion that capital investment decisions are made independently of expectations regarding future returns and the implicit assumption that scrapping and automatic replacement will take place irrespective of the then current level of freight rates, provided a challenge for us to provide a more satisfactory explanation to the freight-rate and shipbuilding cycles. And so we put ourselves to the task of penetrating behind the symptom to understand enough about the causes of cyclicality.

What followed was an incredible view of an exciting world. On the theoretical side, the thought that something mysterious, unique and even possibly contrary to traditional economic theory was happening in the tanker markets, led to the developments of the theory of price-elastic expectations and the proof that, within certain well-defined regions of the demand schedule, equilibria were possible. This breakthrough opened up a plethora of corollaries and consequences which together with the theory itself needed empirical testing and validation.

After many attempts and rebuffs to gain access to data and decision makers from oil companies and independent tanker operators, and having come close to doing exactly what Dr. Levy advised - give up - finally, some doors were opened. And as Matthew Arnold described with such vivid imagery in Dover Beach (1897), the world which seemed

> To lie before us like a land of dreams,
> So various, so beautiful, so new,
> Hath really neither joy, nor love, nor light,
> Nor certitude, nor peace, nor help for pain;

It was indeed amazing. "Proprietary information" came to mean tanker brokers reports collecting dust in vaults. "Unique

decision-making models" evaporated in thin air after the conversants got to know each other. We found people protecting "secret weapons" not because there were any but because they were afraid to say they had none. Yet the tanker markets were not normal markets. There was either feast or famine. Some tanker owners were thriving and coexisting with others who could not make ends meet. Then there was the almost unanimous opinion of those oil-comany employees involved in tanker operations that "this is a bad business, an ancillary evil for us." When asked to explain the success of some independents, the answer was "we do not know how they make it ... they must have a lot of money to throw around." The illogicality of the statements did not sink in for they were confused and if I may so so, shell-shocked, for they had made disastrous decisions during the 1956-57 period. In a six-month period they saw rates drop to 14% of their height. One oil company could have saved at least one and a quarter billion dollars had it waited six months to place its orders. The only excuse was "when you get into a stampede you do not stop to ask questions" and the only consolation, "we did not do any worse than our competitors."

The above gives some description of the confusion, turmoil, fear and suspicion that existed at the time we began our research. To borrow again from Matthew Arnold, the world that was unveiled revealed people as on a "darkling plain"

> Swept with confused alarms of struggle and flight,
> Where ignorant armies clash by night.
> (Dover Beach, 1867)

We will present in the paragraphs that follow a brief summary of some of the findings of our research conducted during the late fifties, in order to establish a basis for a comparison with the present state of the markets. The order in which we list the points we wish to stress, does not necessarily imply a ranking in terms of significance. Also some of the findings are interdependent and may be derived from others, but are listed separately for expositional purposes. Finally, we do not claim that others may not have made observations similar to some of those listed here. Readers interested in details and the full rationale may wish to consult the original sources (Zannetos 1959 and 1966), as well as the classic studies of Professors Tinbergen (1934) and Koopmans (1939).

A. Competitive Markets.

One of the most striking aspects of the tanker markets in the late fifties is that these operated in a manner approximating perfect competition. The concentration of ownership of tanker capacity in the relevant market - the spot market - was found to be very low to affect the efficiency of the markets.

Back in January 1959, as Table 1 shows, we had a fleet of 2703 vessels of over 6,000 Dead Weight Tons (DWT) each, for a total of 52.41 million DWT, and an average size of a vessel of 19,390 DWT. Of this total, the oil companies controlled 32.55% and the independents 65.24%, with the rest, 2.21%, belonging to governments but operating commercially. The five largest owners of tankers among the oil companies controlled about 22.17% of the total fleet and the five largest independents 12.31% (Zannetos, 1966: 175). In spite of this, at no time anyone controlled capacity anywhere near even 1%, in

the spot market, to have any impact on freight rates. The tonnage controlled by the oil companies, having been well below their average needs, did not appear in the charter markets, unless under extremely depressed market conditions. And even then, the mathematics and the economics underlying oil-company decisions were such that the odds of any one oil-company vessel appearing in the spot market were found to be insignificant.

B. Economies of Scale.

Extensive economies of scale were found to accrue with an increase in the size of the vessel. However, because of (1) the large number of vessels needed to satisfy the demand, and even if these vessels were of the largest size, (2) the constraints imposed by geography, canals, channels, harbors, refinery locations, storage capacities and the size of markets and (3) the risks associated with investment decisions, disruption of schedules, satisfaction of contracts, and unemployment as well as underemployment of vessels, the market forces encouraged efficiency and equalization of average rates of return by vessel class and market segment, both in terms of geography and by type of charter.

The realization of extensive economies of scale was found to be surplus producing and mitigating the risk of unemployment for large vessels as these could effectively bypass some of the constraints described above, by being able to effectively operate at less than full capacity and/or unload offshore to shuttles. Because of these reasons, we concluded that innovation leading to the construction of larger tankers would continue and coexist with the more-or-less perfect competitive operations of the tanker markets.

C. Freight Rates and Oil Prices.

The imbalance between crude oil production and refining capacity at consuming and producing centers, placed transportation in a critical role. In order to equalize the price of a homogeneous good, such as oil, at the market place no matter where it originated, the oil companies sold oil on a delivered basis. This almost perfect complementarity between producer plans and transportation needs, and the fact that the demand for oil in the short run was very inelastic, caused negative covariations in the demand for transportation capacity facing the oil companies. As a result, the operations of the independent tankship markets were found necessary for the long-run minimization of transportation costs.

D. Mobility of Capital.

Unlike most capital investments, the purchase of tankers does not fix the capital in a specific geographic location. This mobility of capital facilitates the entry and exit of vessels into and from the various geographic markets, serves toward a faster global equalization of supply and demand for transportation services and even reduces the cost of exit from the industry. The ex ante risk, therefore, facing potential tanker owners is mitigated because of the mobility of capital, encourages entry into the industry, and enhances competition.

E. The Vessel is the Firm.

Given that (1) the economics of scale accruing with the incease in the size of the vessel are far more significant than those

realized by increasing the size of a fleet, (2) capital investment in tankers is mobile, (3) entry into and exit from markets and the industry are rather easy and (4) effective managerial control from a distance is not feasible, the vessel for all practical purposes becomes the firm.

There are many implications associated with the notion that the vessel is the firm, all of which explain the more-or-less perfectly competitive nature of the tanker markets. Rather than repeat arguments made elsewhere (Zannetos 1959, 1966: 182-183), I will only mention here the consequences on the financing of the vessel if it is viewed as a firm.

The normal way of financing vessels built by independents during the late fifties, was to mortgage a charter given by an oil company. As a result, many banks loaned as much as 90% of the cost of the vessel over a five-year period. The risk associated with most of such loans was minimal, as the charters were so remunerative as to amply guarantee the repayment of the loan out of the net hire. In effect, the oil companies assumed the risk, by providing the loan guarantee, i.e., the time charter. The net result for the independent was a lower cost of capital, a high debt-equity ratio, a lower cost function, and higher returns, if prices were to reflect the long-term average cost of vessels owned by the oil companies.

If the oil companies were to invest funds in tankers and followed the normal method of financing their normal activities, their cost of capital would be dominated by the high risk associated with exploration and production. Related to this risk was a debt-equity ratio far lower than that allowed the independents by the banks. All in all, a higher risk and cost of capital imposed on a

low-risk and low-return operation. Hence, an investment in tankers by oil companies well below the optimum level. /2

The above findings encouraged us to identify the normal risks facing the industry, to distinguish these from those facing the firm, and those facing the vessel,/3 and measure the effects of shifting the risks of unemployment and underemployment from the owner to the charterer. In this respect, the methodology we developed and used in the late fifties, was not unlike what later came to be called the capital-asset pricing model (CAPM), but more complex because of the presence of vessel economies of scale and the various dimensions of risk.

F. Price-Elastic Expectations.

One of the most exciting results of our research of the late fifties was the development of the theory of price-elastic expectations and the proof of the hypothesis that the behavior of those operating in the tanker markets was governed by such expectations.

The opinion of the experts at the time was that price-elastic expectations do not exist, because we do not observe continuously exploding prices upward or downward. Only in the case where expectations were assumed to be "extrapolative" (Anthoven and Arrow, 1956; Arrow and McManus, 1958) or "adaptive" (Arrow and Nerlove, 1958) they were found not to destabilize an otherwise stable system.

By assuming that price-elastic expectations cause interperiod substitutions and through an analysis of the consequences on demand of these substitutions and of the income effects, we found that stable equilibria can be obtained. As a result, it was shown that:

1. The demand for tanker transportation was composed of five segments, as shown in Exhibit I, alternating between negative and positive slope.

2. Interperiod substitution effects were causing an increase in the number of transactions as freight rates increased and reducing the quantity demanded as the rates decreased.

3. Opposing the interperiod-substitution effect was the income effect. So the slope of the demand schedule was determined by the net effect of the two.

4. The interperiod-substitution effect (income-compensated) was far more significant than the income effect up until the high freight rates caused all the budgets to be exhausted (close to "bankruptcy" for buyers) or the rates fell to such precipitously low levels (close to bankruptcy for sellers) as to encourage the oil companies to "slow steam", use chartered vessels and tie-up or scrap some of their own vessels, or use tankers for floating storage.

5. Freight rates were bounded on the upper side by the "opportunity value" of the cargo, the latter being the short-run contribution margin plus the opportunity cost of losing long-term contracts, and on the low side by the withdrawal rate of vessels reduced by the opportunity cost of tie-up. The above resulted in freight rates on the upper

side where the total value of the cargo "plus something" was paid for transportation, and on the low side rates below the out-of-pocket cost of vessels.

6. "Feast or famine" conditions were the norm in the tanker markets and not the expception. Price equilibria would rarely be observed in the range of the long-run break-even cost of the marginal vessel. It was more likely to observe equilibria at very high and very low rate levels, because of the shape of the demand schedule and the short-term supply schedule.

7. The price range above the hypothetical long-run cost of tanker services was up to twenty times greater than the range below for good economic reasons mostly implied in item 5 above.

8. Price-elastic expectations in the tanker transportation markets caused orders for vessels to be placed with a manifested time-lag of six months, bringing about a lumpiness in investment and deliveries of vessels during depressed market conditions, further prolonging the recovery.

9. The more-or-less predetermined physical life of tankers and the huge lumpiness in investment set the conditions for a lumpiness in withdrawal and the beginning of another freight rate and shipbuilding cycle. Thus, price-elastic expectations were found to cause cyclical price behavior without the necessity of cyclical demand./4

10. Cobweb-like behavior at very low levels of freight rates caused fluctuations in the rates as vessels came in and went out of markets.

11. Price-elastic expectations also affected the shipbuilding markets with the quantity of orders placed determined by two interperiod substitution effects (both positive) and two income effects which opposed each other. The income effect associated with the change in freight rates and the size of the tonnage in one's control was found to be positive, while that associated with the orders budgeted for the period and the change in shipbuilding cost was negative. So feast and famine patterns were also observed in the shipbuilding markets and the cyclicality explained in terms of the developed theory of price-elastic expectations.

12. The orders placed at the peak of the rate cycle were about equal to the total fleet at the time. This, and the speed with which price-elastic expectations take hold, led us to infer that the "famine" part of the rate cycle would be much longer than that of "feast"./5

III. Beyond the Late Fifties.

A. Crude Oil

A lot of significant events took place in the field of oil economics during the last 25 years, but their impact in the

fundamental determinants of freight rates and on the general tanker-market behavior has been negligible. OPEC, which was established in 1960 ostensibly to bring some stability in the flow of oil revenues to the oil-producing countries and thus facilitate economic development, has tried to maximize revenues and in the process unleashed expenditure patterns that destabilized the economies of a lot of its member nations and plunged the world into an economic disarray.

In the early seventies, oil consumption was projected to increase at a compounded rate of 5% per year in the United States, 7% in the rest of the Western World and 8 1/2% in the developing countries. This was at a time when the posted price of oil was still at $1.80 per barrel and the net revenue going to the producing countries was $1.025 per barrel. Then came the events of 1973, with the early spring demands by the Shah for $7.00 per barrel for Iran, which, according to the formula used at the time, necessitated a posted price of $11.65 per barrel. The latter became the official OPEC price in October 1973, and the price for participation oil was set between 93 and 94% of posted prices./6

For about five years, the posted prices remained relatively under control, rising by about $2.00 per barrel on the average. More significantly, however, and something which many people ignored, the inflow of funds to the OPEC countries increased, between 1970 and 1978, by 1350% and on a per barrel basis by 1281% (see Table 2)./7 This flow of money and the stupor of the newly discovered power of riches, changed the expenditure patterns and even the nature of most of the OPEC countries irrevocably. As Table 3 indicates the imports

alone of the OPEC countries increased by 2633% between 1972 and 1978, and 424% in one year, between 1977 and 1978, reducing their current account surpluses to an estimated $18 billion in 1978 and strongly foretelling the magnitude of the deficits that were sure to follow.

The insatiable appetite of the oil-producing countries for more revenues - often approaching the vengeful - and the unwitting encouragement by those who claimed that oil was underpriced and that we would run out of it in a decade, combined to bring about the 1979 -1981 price increases of over twenty three dollars per barrel and the onset of another major economic crisis./8 Of course, some may claim that it was the Iranian oil field strikes and the subsequent political problems in that country which caused the price increases by reducing the available supply of oil. No doubt, the Iranian situation had its psychological impact, but the objective evidence vindicates Professor Adelman and very few others, who have been claiming all along that there was a surplus of oil./9 To us it looked from the very beginning, as if this were not a crisis that was brought about by a scarcity of a natural resource, but a financial crisis brought about by the avarice of the OPEC cartel. Furthermore, we predicted that those price increases, which in late 1980 and early 1981 briefly brought the spot price of oil at over $47 per barrel, would make oil economically obsolete, drive many countries to bankruptcy, accentuate the oil surplus, and eventually be rescinded. Needless to say, these beliefs were not very popular and did not receive much attention at the time.

By the end of 1980, the new round of price increases by Lybia, Indonesia and Venezuela, all effective January 1, 1981, raised the OPEC ceiling price from $37 per barrel to $41, although the

official benchmark price for marker crude was still set at $34. However, with the possible exception of Saudi Arabia which held to a price of $32/b, no one paid attention to official prices and the game was who would succeed in charging more, by adding surcharges. All in all, it was a chaotic situation, with prices floating all over.

In the meantime the law of supply and demand, even under these strained conditions, was working amazingly well, admittedly with the help of some political muscle flexing by Saudi Arabia. Inventories were piling up and by early May the oil glut was such as to encourage talks within OPEC aimed at unity at $34 per barrel. The efforts failed, because Saudi Arabia insisted on a price of $32 per barrel and a clear delineation of price differentials, while the "hawks" demanded price increases and control of output.

On May 29, 1981 in an unprecedented move, the oil companies demanded a cut of $6 per barrel. On June 4, 1981, Mexico cut its prices by $4 per barrel, to be followed ten days later by Great Britain with a $4.25 per barrel reduction. By this time spot prices for crude dropped to as low as $32.15 per barrel and one could get the products of a barrel of crude at even lower prices.

For about a year, several attempts were made behind the scenes for a unification, but resulted in no viable plans. Then on April 28, 1982 it was announced that Iran, in order to increase its sales above the ceiling of 1.2 million barrels per day "allowed" by OPEC (they wanted to produce 2.1 million barrels), cut its price to $28 per barrel.

Attempts to control output and prop up prices were not very successful. In January and February of 1983, further cuts were announced, so at the quarterly meeting of OPEC, held on March 14,

1983, an historical step was taken to reduce the OPEC official benchmark price by $5 per barrel, to $29. The spot price of crude at this time was around $27.50 per barrel.

The significance of the price reductions must not be underestimated for it shows a weakening of the fiber of OPEC. In fact, it could be that the signing of the agreement effecting the price reduction does not indicate "strength in unity", but an evidence of its lack of importance. If the OPEC members have no intent of obeying it and there are no sanctions if it is violated, why fuss about it? It did not, for example, keep Iran from cutting its prices reportedly to $27 per barrel to Japan, and to $25 per barrel to Syria less than two months later (Wall Street Journal, May 5, 1983: 38). On the other hand, we have had a lot of evidence of the flexibility of the OPEC countries when it comes to serving their own interests. So OPEC, although extensively weakened, should not be counted out, at least not as yet.

The net effect of the escalation of crude oil prices was the reduction in world-wide oil consumption, from 55.674 million barrels per day (mbd) in 1973 to 52.855 mbd in 1983./10 Although this reduction may appear insignificant it must be contrasted with a level of over 110 mbd had the expected 6 1/2% average growth in world oil consumption materialized. This discrepancy proved to be very critical for the tanker markets, as we will now show.

B. Tankers

The reduction in oil consumption left its unmistakeable imprint on the demand for transportation. However, unlike the case of oil, where excess capacity can be shut in without any significant

cost, the burden of idle tonnage on the tanker owners is very heavy. The out-of-pocket costs associated with tie-up, temporary idleness, and the readiness of the owners to enter into the market with slight improvements in rates, keeps the latter during periods of surplus tonnage at levels which do not even cover the out-of-pocket cost of operation for most vessels. Furthermore, idle tanker capacity is capacity lost forever, while shut in oil can be extracted later, and in the hope of some even appreciate in value.

If the overall demand for oil were to have continued to increase at 6 1/2% per year and assuming a transportation intensity for oil of the late fifties, we would have needed a tanker fleet of over 450 million DWT by 1980 to transport it, and over 600 million by 1985. And this because of the projected dependence of he United States on Middle-Eastern oil./11 On a straight proportionality basis, the requirements appeared more modest, indicating a fleet of over 280 million DWT by mid-1979 and 383 million DWT by mid 1984. But all this was before OPEC spoke.

The oil production data, previously mentioned, do not reveal the total impact on oil transportation because they do not indicate seaborne trade and the transportation intensity of such. According to Fearnleys (1983:24) the seaborne trade of crude oil and products in 1972 was 1446 million metric tons, reached a peak of 1817 tons in 1979 and dropped to 1292 in 1983 registering an 11% drop for the eleven-year period. More significantly, the total ton-miles of oil delivered decreased from 8650 billion in 1972 to 6250 billion in 1983, or by 28%, and from the peak of 1977 by 45.5% (see Table 4)./12

Taking the above statistics and applying them to the average fleet of 1973, we arrive at a requirement of only 122 million DWT for

the 1983 seaborne trade./13 This figure is almost identical to what one may derive by looking at the supply side from data provided by Jacobs (1983:42). As can be seen in Table 5, the total surplus under all categories as of December 31, 1983, was estimated at 149 million DWT out of a fleet of 272 million DWT, indicating a requirement of only 123 million DWT.

The price increases by OPEC, as a result, extracted a heavy toll on the value of the capital invested in oil transportation. For the vessels that are in lay up, in particular, in addition to the permanent loss of capacity, extensive investment is required to bring them back to the operating stage, the size of the expenditure depending on the length of idleness and the care taken of the vessel while in lay up.

To the extent that tanker rates influence orders for vessels, it is not surprising to find that shipyards are begging for business and that the prices quoted for the very large vessels are in nominal dollars what these were back in 1976 (Fearnleys 1983:32).

We will now examine the various characteristics of the tanker markets in order to identify if any significant changes have occurred since the late fifties.

1. Market Structure:

We have found no evidence to suggest that the structure of the industry has changed during the last twenty five years. The distribution of ownership between oil companies and independents followed the pattern of old, fluctuating between 30 and 40 percent of total, with the independents controlling the rest. As we found in the late fifties, the oil company percentage ownership reaches the low point during periods of high tanker rates and the high point

during the bottom of the depression. In 1974 the relevant figures were 32% for the oil companies and 68% for the independents, but by the end of December 1983 were close to 40% and 60% respectively.

The ownership of the five largest oil companies dropped significantly from 22.17% of the total fleet on January 1, 1959 to 14.97%, twenty five years later, and that of the five largest independents remained almost unchanged at 12.31% on January 1, 1959 versus 12.4% on January 1, 1984. During this period only one change occurred in the ranks of the top five oil companies, with Mobil replacing Gulf, but in the case of the independents a complete transformation occurred. In 1959 there were four Greek companies and one American among the top five, but by 1984 all were replaced by Far-Eastern corporations and one Norwegian.

So the nature of the tanker markets still remains the same, close to perfect competition. The oil-producing countries have attempted to move into transportation "in order to control the delivered price of oil", but as we predicted (Zannetos 1973:108-114), they failed on both counts./14 Chartering "on private terms" so as to hide freight absorption does occur, as always did, and will occur. But this does not appear to threaten the competitive nature of the tanker markets because of the low concentration of ownership and the other characteristic factors of the markets to which we will soon turn. In fact, there are still over 1100 owners of vessels, and with the reduction in the degree of concentration in the oil industry, brought about to a great extent by the birth of the national oil companies, the nature of the independent tanker markets is more or less guaranteed.

2. Economies of Scale:

The drive toward larger vessels continued in the sixties and seventies because of compelling economic reasons. The largest vessel in operation increased from 104,500 DWT in 1959 to 546,210 DWT in 1979, and no one should be surprised to see this tendency continued. As we have pointed out elsewhere (Zannetos 1973:44), however, ancillary technologies must be developed to allow for these economies of scale to be realized and mitigate the risk of unemployment and underemployment of large vessels. The size of markets served is also critical, that is why one would not expect to find a preponderant number of these huge vessels in the world fleet.

If we look at the scale curves of the industry, we find that in 1958, the economic long-run average cost of tankers "flattened" at 75,000 DWT, in 1966 at 250,000 DWT, and in 1979 at 475,000 DWT (Zannetos: 1973(a): 44; 1982: 43)./15 This is mostly due to progress in the ancillary technologies of welding, propulsion, loading and unloading, navigation and safety, as well as the size of refineries, markets served, storage facilities, canals, channels and harbors. As a reesult the long-run cost of transporting oil today in a 475,000 DWT vessel is only 41% of the "optimal" vessel of 1958, and only 23% of the cost of a 30,000 DWT vessel.

Given the extensive economies of scale which accrue with the size of the vessel and the reduction in the transportation intensity of crude oil we would expect some reduction in the number of vessels in the world fleet, especially in the years to come.

3. Freight Rates and Oil prices

Because of the escalation in the price of crude oil and the fact that shipbuilding costs have not increased proportionately to the oil prices, transportation in a relative sense is not now as important in the delivered price of oil as it was in the past As Table 6 shows, at the present levels of freight rates for VLCCs, the cost of transporting oil from the Persian Gulf to the United States is less than 4% of posted prices, or about 24.4% of what it was in December of 1972./16

There is another consequence, however, of this relative diminution of transportation cost in oil pricing which relates to the market structure and the fluctuations of the spot rates. The oil companies as well as the oil producing countries, will now pay even less attention to tankers, which in the long run will reduce concentration even further. Finally, in times of "crises" the charterers and particularly the national oil companies will, in all likelihood, be willing to pay rates which, in terms of world scale, will be even higher than what they paid in the past for the marginal capacity required.

4. Mobility of Capital

The technology of transporting oil and its products has not changed over the years to challenge the workings of the tanker markets. The invested capital in tankers is still mobile and with the increase in the number of relevant markets, the importance of this factor in bringing about an equilibrium between markets has been increasing over the years.

5. The Vessel is the Firm

Under economies of scale we discussed the significance of the size of the vessel, and pointed out that over the years the realizable economies of large vessels have increased. Also in the area of financing vessels, we have observed shipyards, as well as countries, provide 80 to 90% of the capital and charter the vessel back to the owner, bareboat, over twelve years at 8 1/2%. As a result the emphasis placed on "the vessel as the firm" back in the late fifties, continued and even increased.

There are not many economies that accrue with the size of the fleet and even those of which we can find evidence, are insignificant as compared to the economies of size realized by the vessel. Discussions with independent tanker owners indicate that the function is not monotone. As one increases the size of the fleet he/she realizes diseconomies before any economies start to manifest themselves. The overhead of small tanker operators is not greater than $100 - $150 per day per vessel, but for larger fleets, say twenty vessels, the cost rises to over $250. And this mostly because of the information and control systems.

6. Price Elastic Expectations

In the years following our initial study, in which we developed the theory of price elastic expectations, we had two opportunities to test our theory, in 1970 and 1973. In both cases, the evidence fully supports the existence of price elastic expectations and a cyclicality in freight rates and shipbuilding

prices which is not caused by a cyclical demand. Table 7 presents a comparison of the impact of tanker rates on shipbuilding activity for the period of 1956-59 and 1973-83.

Tanker rates reached their peak in November 1956 and generated orders which by 10/1/57 stood at 106% of the total fleet in operation at the time. What ensued was a prolonged period of depression in the tanker markets, up until the growth in transportation requirements and more importantly, the retirement of the vessels built as a result of the World War II effort, absorbed the surplus tonnage. The lumpiness in investment in 1957-59 caused the lumpiness in the retirements of 1978-79 and the mini-surge in rates during the latter period. However, tanker rates did not go beyond the full cost of the marginal vessel to cause the avalanche of orders we normally get when rates reach World Scale 450.

In 1973 and before the October events, retirements of vessels built during the 1950-52 freight-rate peaks started causing tightness in the supply of transportation capacity. Then October came and rates reached World Scale 450, causing orders of over 200 million DWT, and as in the case of 1956-57 the orders placed were almost equal to the total tonnage in operation. So history again repeated itself and set the foundation for the next cycle, as did the rate cycles before that.

To conclude, then, price-elastic expectations have continued to influence the behavior of those who operate in the tanker markets in the way we observed back in the late fifties.

7. Structure versus Level of Rates

The extensive economies of scale that are realized with the size of vessels and the risk of unemployment and underemployment, which also increase with size, determine a structure of rates.

For spot rates, the "normal rate" is the short run cost of the then marginal capacity. A vessel which is smaller or less efficient than the then marginal capacity, in order to be drawn into the market, must obtain a rate which is higher than the "normal" rate. Larger and more efficient vessels exchange part of their economies of scale for mitigating the risk of short-run unemployment and mainly underemployment. Thus a structure of rates is formed.

In the case of period or time-charter rates, in addition to the structure that we observe around the normal long-term rate for the then marginal vessels, we have another structure, spread around the long-run economic cost of the vessel itself. This range of rates is a function of the spot rate and the duration of the time charter. Again these two factors, spot rates and time-charter duration, affect the ex ante probability of underemployment and unemployment of the vessel.

All the above factors were analyzed and an attempt was made to measure the part of the economies of scale which remains with the owners versus the part which goes to the charterers under various market conditions and given the size of the relevant marginal vessel. In the case of spot rates the most recent results of our research are included in Serghiou and Zannetos (1982). As for time-charter rates, the basic theoretical details of the model used may be found in Zannetos (1965) and for the most recent application

of the model the interested reader may wish to refer to Zannetos et al (1981).

IV. What Will the Future Hold?

To summarize, our analysis has shown that the precipitous events which saw the OPEC cartel rise from obscurity to a position of world dominance caused a change in the consuming patterns of oil, changed its transportation intensity, accentuated the surplus of tankers, but did little to affect, thus far, the basic nature of the tanker markets. That much is clear, but would it continue? We will now try to say a few words about the future, fully realizing the vagaries of such an effort.

As we have already mentioned, the oil-producing countries have attempted to move downstream by obtaining tankers/17, building refineries on their own soil and in some cases entering into the distribution network of some consuming countries. Although these involvements have not been significant to effect meaningful changes in the market structure for tankers, the building of more refineries at the producing centers will require, other things being equal, the seaborne movement of more products and less crude oil. As a result, we expect that the average size of tankers will continue to decrease. According to Jacobs (July-December 1983:7), the average size of the fleet on December 31, 1983 was 91,006 DWT, and of the vessels on order 50,463 DWT. More significantly, however, on 12/31/83, the average size of vessels on order to be delivered in 1984 was 53,160 DWT, for the 1985 deliveries it was 48,886 DWT, for 1986 40,068 DWT, and for 1987 30,900 DWT./18 Also for the same

reasons, we do not expect to see a push for more and larger ULCCs because of the high expected cost (risk) of unemployment and underemployment for these vessels.

Given that the oil companies are now producing a lower percentage of the oil they are distributing as compared to the pre-expropriation era, they will, in all likelihood, reduce their share of ownership of tankers in the future. This will increase the importance of the independent tanker owners and of the free markets. As for the oil producing countries, we expect that they will make further investments in tankers, but their efforts will not completely offset the impact of the oil-company actions, in our estimation. Therefore, the separation of the ownership of the oil-producing assets from the control of the distribution network for a significant percentage of the total oil consumption, especially of the oil which is most transportation intensive will make the oil industry, and in particular, the international oil companies, more dependent on the spot segment of the tanker markets./19 Furthermore, and even with the reduction in oil prices that we foresee, the significance of tanker rates in the delivered price of oil will never be what it used to be. Any rational oil-producer and/or distributor, as a result, should not devote as many financial and planning resources on tanker transportation as in days past.

Another change that we see in the future relates to the oil/ore carriers. The relative importance of these vessels will increase, because of the flexibility they provide, but again, we do not expect that the role of pure tankers will be threatened.

The behavior of those who will operate in the tanker markets is not expected to change and will continue to be governed by price-elastic expectations. And this because of the absolutely necessary role transportation plays in the oil arena. As in the days of old, when the oil companies were trying to protect their share of the market, the OPEC and other oil-producing countries will try to prevent others from eroding their position. They will, therefore, absorb transportation during periods of high tanker rates and guarantee a delivered price to protect their customer base. If they continue to bypass the oil companies in order to increase their share of the end-user market, and most probably they will, the fluctuations in tanker rates, from peak to trough, will be even greater in the future than these were in the past. And this because for the oil that is sold directly by the oil-producing countries, the difference between the delivered price and the out-of pocket cost of production is so much greater now than before. Ironically, had the oil-producing countries decided to market their oil exclusively through the international oil companies, the rate fluctuations would have been dampened in spite of price-elastic expectations. Thus the oil-producing ccountries would have derived more revenue and on top of that have the oil companies be responsible for the collections of receivables and for absorbing the bad debts.

If we now look at the supply schedule for tankers, the economies of scale will cause certain changes to its slope. As Mr. Hettena, President of Maritime Overseas Corporation, pointed out at a speech before the M.I.T. Shipping Club, about a year ago, the fundamental economies realized by large vessels which allow them to accept part cargo (underemployment) and the economics of slow down

and speed up, create more elasticity in the supply schedule above the effective full-capacity level and inelasticity below. This implies that the cobweb iterations and the range of equilibria during depressed market conditions will widen and become more volatile. For the same reason, the fall in spot rates from their highest level reached will be more precipitous and the feast more short-lived than in the past. Finally, the student of tanker rates in the future must monitor not only tie-ups but also the amount of underemployment, both actual and potential, associated wih part cargo and slow downs, because of its impact on the supply schedule.

V. Epilogue

As we stand at the threshhold of a new era, those of us who have been privileged to be associated with the work of Professor Adelman and whose professional life has been touched by the intense excitement with which he views the world, are happy that the challenges in the field of oil economics and oil transportation are still there for the future generations to carry the torch forward.

He has been a good mentor, a good colleague and a great friend. We hope that we may be able to reach a small measure of his accomplishments and as educators enjoy hearing from our students the words that come naturally to our lips from the depth of our heart. "Thank you for all these years, and for the life-long challenge, but above all many thanks for what you are."

Footnotes

1. Koopman's hypothesis assumed implicitly that the ex ante and ex post investment horizons for vessels are identical, and would have precluded a significant amount of tonnage being traded in the second-hand markets, especially after an equilibrium is reached.

2. Another consequence of this asymmetry between independent tanker owners and oil companies was the encouragement of the treatment of oil-tanker operations as a "loss center" and an ancillary evil.

3. We must stress again that as far as the independents were concerned the vessel was the firm but for the oil companies the total legal entity was the firm. The independent multi-vessel owner would use intuitively portfolio management techniques to achieve an acceptable risk-return balance in his/her operations, viewing the vessels as independent, and truly zero-covariated entities, especially on an ex ante basis. For the oil companies, on the other hand, the concern was the risk of not being able to deliver crude oil and oil products. Their portfolio of vessels was "balanced" between owned, time-chartered and spot chartered vessels with this risk in mind. And this in order to protect the high returns obtained from the contracts associated with the cargo. For the oil industry, the distribution of owned, time-chartered, and spot-chartered vessels was fluctuating around 35-50-15 with a significant variance between oil companies and between the phases of the rate cycle.

4. Professor Koopmans was to a certain extent right in associating the retirement of vessels with a shipbuilding cycle, especially at the symptomatic level. However, we found that there was no "one-to-one correspondence" between retirements and replacement decisions. The investment horizons associated with these decisions were proven to be different and were not necessarily made by the same decision makers.

5. The lead-time to delivery of vessels, which under pressure could be shortened to eight months, guarantees that enough tonnage can be delivered and shift the supply schedule far enough to the right, to bring about a precipitous drop in prices. So, and even if spot rates were not to drop before new orders dry up, the feast could not last more than a few months. The famine period, however, may last for years, up until growth in demand and retirement of vessels combine to bring about a scarcity.

6. The participation, that is to say the oil produced by the oil companies but owned by the nation, was mostly set at 40% in 1973 but Kuwait demanded and received 60%. Soon the producing countries, one after another, expropriated the assets of the oil companies by nationalizing their oil industry. Even before full expropriation, however, in the case of Kuwait the effective participation was close to 100%, because it demanded that its oil be produced first and the quantity be determined by applying the percentage to the maximum capacity rather than the quantity actually produced.

7. The concern of most economists at the time was the size of the increase in the price of oil to the U.S. consumer, which was about 450%. They spent an inordinate amount of time and energy calculating the impact on inflation, in terms of what these prices represented in the total G.N.P. expenditures before and after, ignoring the potential influence of the OPEC countries on the world capital markets, the stability of the international monetary system, and the distorting impact of the expenditure patterns of these countries on the world economy. In fact, they even ignored the "sympathetic pressure" oil prices had on other prices and thus extensively underestimated the inflationary effect of the oil-price increases.

8. The 1979 price increases brought forth the two-tier price for crude oil with Saudi Arabia holding at first to an $18 per barrel price while others charged between $24 and $27 per barrel. Finally, in 1980, in two successive increases, the official lower bounds were set at $32 per barrel for Saudi Arabia and $34 for the majority of OPEC countries.

9. The arguments of those who were claiming that the price of oil was low and that higher prices would discourage us from consuming more, prompted Professor Adelman to say, in jest, that we should thank OPEC for increasing prices since it was for our own good.

10. The data represent production rather than consumption and were obtained from the Energy Information Administration, Monthly Energy Review, March 1984: 108-109. The very high inelasticity of demand is a two-edged sword as the recent price decreases indicate. What is more important, in the case of oil, is the short-term and long-term elasticity of production; especially since we estimate that OPEC is producing only at 48 1/2% of its current capacity and the AOPEC (Arab OPEC) at 43%.

11. The present author is as guilty of miscalculation as any, if not more. Even as late as February 1973 most of us did not foresee the events that were to follow a few months later, and the consequences that derived therefrom. (Zannetos, 1973: 115-117).

12. The reason for this reduction in the transportation intensity of oil was mainly the increase in production of oil in areas closer to the main consumption centers, such as Alaska, Mexico and the North Sea.

13. The average 1973 fleet we estimate at 200 million DWT. The decrease in the ton-miles of oil delivered between 1973 and 1983 was 39% according to Fearnleys. We chose mid-1973 as the base period because there was a semblance of a balance between supply and demand for transportation at the time.

14. Furthermore, with the deficits and the many demands on the budgets of the OPEC countries, it is inconceivable how any one country (and "doubly inconceivable" as a cartel) can allocate the necessary funds to change the structure of the tanker markets.

15. The ordinate scale in the graph depicting the 1979 scale curve (Zannetos 1982: 43) is mislabeled, starting at -10% instead of 0%. What is, therefore, 90% should be 100% for the 30,000 DWT vessel. Apologies to the readers.

16. The world scale calculations do not permit such exactness in comparisons. Ever since the cost of bunkers became the most significant factor in the short-run cost of transportation, yearly adjustments in the scale reflect changes in the short-run operating costs only.

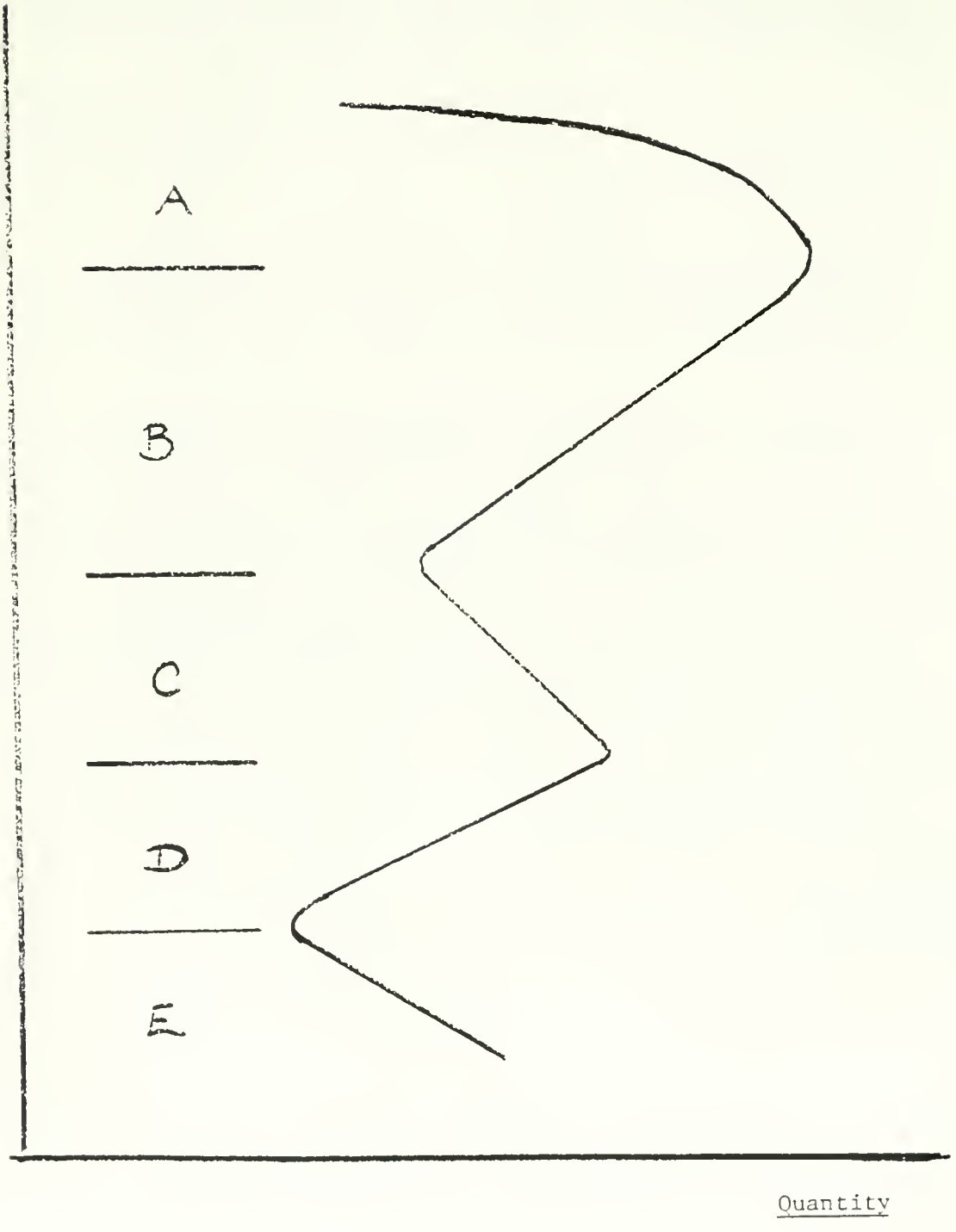
17. In the top thirty flags of registry there are five OPEC countries represented as of December 31, 1983, Saudi Arabia, Kuwait, Iraw, Iran, and Lybia. Their combined ownership was 4.41% of total (Jacobs, July-December 1983:52). We realize that the data refer to the flag of registry, but for the OPEC countries the tonnage owned is more or less identical to that registered under their flag.

18. It should be realized of course that under depressed market conditions the backlog is very small and does not fully represent the size composition of the future fleet. Special purpose or handy size vessels may be influencing the average size but the trend, in our estimation, is clear.

19. We believe that the international oil companies will also depend relatively more on the spot market for oil and oil products.

EXHIBIT I

Demand Schedule for
Oil Tanker Services



Note: Areas A, C, and E contain stable equilibria.

TABLE 1

Commercial Fleet as of Jan. 1. 1959

Vessels of 6,000 DWT & over

	No. of Vessels	T.2s	DWT in 1000	% of Total
Oil Companies	906	1,037.7	17,060	32.55
Independents	1713	1,065.8	34,191	65.24
Government Commercial	84	63.7	1,158	2.21
TOTAL	2703	3,167.2	52,409	100.00

Average Size of Vessel:	Oil Companies	18,830 DWT
	Independents	19,960 "
	World Fleet	19,390 "

Source: Zannetos (1966), p. 66-67

TABLE 2

SOME COMPARISONS OF CASH INFLOW TO OIL PRODUCING COUNTRIES

ESTIMATED ANNUALIZED DATA IN BILLION $

	1970	10/73	10/75	7/77	10/78	1980
Arab OPEC	4.5	8.3	52	90	100	268
Arab OPEC plus Iran	5.8	10.6	65	111	127 *	
All OPEC	10	16.4	96.5	148	135	379
Average Revenue $/Barrel	1.025	1.65	11.62	12.50	13.13	37
Inflow per Barrel as Percentage of 1970 Flow	100	161	1133	1220	1281	3610

* Iran data prior to the oilfield strikes

Source: Monthly Energy Review, Energy Information Administration, Washington, D.C., various issues;
also:
Middle East Information Service and miscellaneous sources.

TABLE 3

OPEC CURRENT ACCOUNT AND MERCHANDISE

IMPORT TRENDS: 1972 - 1978

(Billions of U.S. Dollars)

	SURPLUS CURRENT ACCOUNT	IMPORTS MERCHANDISE
1972	2.0	14.4
1973	9.0	20.2
1974	61.8	33.2
1975	30.8	55.0
1976	42.3	67.9
1977	37.0	89.5
1978 est	18.0	379.2
	$ 200.9	

Source: Tilford Gaines, Senior Vice President
Manufacturer's Hanover Trust
"Petrodollars Revisited", Economic Report September 1978

TABLE 4

WORLD SEABORNE TRADE 1972-83

	In Million Metric Tons		In Billion Ton-Miles	
	Crude Oil	Oil Products	Crude Oil	Oil Products
1972	1185	261	7,720	930
1973	1366	274	9,207	1,010
1974	1361	264	9,661	960
1975	1263	233	8,885	845
1976	1422	260	10,233	950
1977	1475	273	10,472	995
1978	1457	270	9,661	985
1979	1538	279	9,614	1,045
1980	1362	276	8,385	1,020
1981	1215	267	7,731	1,000
1982	1043	285	5,412	1,070
1983 est.	1020	272	5,200	1,050

Notes: Estimates for 1983 are based on statistics for the first nine-eleven months of the year for the most important countries as regards the specified commodities, supplemented with data from international associations.

Source: Fearnleys Review 1983, Norway.

TABLE 5

IDLE OIL TANKER CAPACITY

December 31, 1983

	DWT IN MILLIONS	
Laid-up tankers and combined carriers (proportion)	55.9	
Slow steaming VLCC tonnage	29.5	
Slow steaming smaller tonnage (40-160,000 tons)	28.5	
Excess port time	10.8	
Delays waiting cargo, etc.	4.0	
Part cargo incidence	17.6	
Tonnage acting as temporary storage	2.7	
Overall gross surplus as of December 31, 1983	149.0	million tons

Source: John I. Jacobs, World Tanker Fleet Review, July - December 1983, p. 42.

TABLE 6

TANKER RATES AND POSTED PRICES FOR CRUDE

Persian Gulf-USA Basis

December 1972			June 1984		
World Scale		% of Posted Prices	World Scale		% of Posted Prices
%	$/b		%	$/b	
30	.384	15.57	30	1.11	3.8
100	1.28	51.88	100	3.70	12.76
250	3.20	129.71	250	9.25	31.89
450	5.76	233.48	450	16.65	57.41

Assumptions:

1. Crude Prices: Iranian Light $2.467 for December 1972 and $29.00 for June 1984.

2. For 34° API we assume 7.5 b/ton.

TABLE 7

TANKER FLEET & BACKLOG

DATE	FLEET				BACKLOG			
	No.	DWT (000)	T-2EQ	Ave. Size	No.	DWT	T-2	Ave. Size
1/1/57	2,094	39,642	2,397	18,931	966		1,898	
10/1/57	2,278	42,979	2,538	28,927	1,211		2,693	
1/1/59	2,703	52,411	3,167	19,390	810	28,836	1,935	35,600
1/1/74	3,458	215,593	14,801	62,346	1,171	197,631	13,668	168,771
7/1/74	3,550	234,180	16,039	65,966	1,202	194,637		161,928
1/1/77	3,636	320,728	22,144	88,209	293	35,214		120,184
1/1/78	3,564	332,476	22,929	93,287	188	19,604		104,277
6/30/78	3,438	329,800	22,719	97,660	173	15,562	1,078	89,952
1/1/79	3,370	328,481	22,243	97,472	156	12,363	859	79,250
6/30/79	3,325	327,405	22,158	98,468	197	13,432	N.A.	68,183
1/1/80	3,320	327,882	22,187	98,760	270	16,457	798	60,952
7/1/80	3,205	317,444	22,014	99,047	380	20,218	1,368	53,205
6/30/81	3,190	106,928	21,224	96,210	351	17,151	1,157	48,860
7/1/82	3,142	295,371	20,384	94,007	260	11,637	784	44,757
7/1/83	3,048	298,544	19,202	91,386	184	8,759	595	47,603
1/1/84	2,989	272,018	18,742	91,006	206	10,395	711	50,461

NOTES:

1. Largest size on order in 1958 was 106,000 DWT.
2. Largest size on order in 1974 was 477,000 DWT
3. Before 1966 vessels of 6,000 DWT and over were included in the fleet. From 1966 and on the vessels are 10,000 DWT and over.
4. On 1/7/74, there was also a fleet of combined carriers of 39,463,575 DWT and 8,926,700 on order.
5. Largest vessel in backlog on 1/1/78 was 541,000 DWT scheduled for 1979 delivery. It was delivered in 1979 as a 546,210 DWT vessel and as of 1984 it is the largest vessel afloat.
6. A vessel of 230,000 DWT sold in February 1978 for $22 per DWT. It was six years old. A similar vessel in the first half of 1974 was sold for $187 per DWT, and a smaller vessel (85,000) went for $259 per DWT in 1974.
7. Backlog as % of fleet - 106% as of 10/1/57; 92% as of 1/1/74. On April 1, 1974, the backlog was 97% of the total fleet. The fleet figures for 7/1/83 and 1/1/84 exclude 11.758 and 9.537 million DWT respectively which represent vessels committed to "permanent" storage.

Data Source: John I. Jacobs, World Tanker Fleet Review (Semi-annual issues)

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