The market for ship demolition

Little has been written about the ship demolition market, an essential element in the supply/demand balance for shipping. Either technical or economic obsolescence may be the cause for scrapping a ship, where the latter is strongly influenced not only by anticipated freight market levels, but the rate at which more efficient ships are being introduced. The scrap value of a ship is a function both of the realizable value of the materials within the ship and cost of demolition. Both are strongly influenced by the cost structures prevailing in the likely country of demolition. The paper explores not only the fundamentals of the ship demolition market, but the trends from the 1960s to the present. The shipbreaking market has moved in that time from being West European-centred to Asian-centred, concentrating for some years in Taiwan, but now shifting to the Indian sub-continent.

1. Fundamentals of the ship demolition market

Comparatively little has been published on the market for ship demolition, yet it is a primary element in balancing supply of and demand for ships. Figure 1 indicates the general relationship, although it does not illustrate fully the dynamics of the situation. In a steady state equilibrium situation, i.e. fleet replacement but no expansion, and assuming an average ship life of 25 years, annual scrapping plus losses should amount to 4% of the existing fleet as should newbuilding demand. Since annual losses from all causes are around 0·2–0·6% measured in gross tons (0·3–0·7% in numbers), scrapping should amount to about 3·6% p.a. During the 1980s, the world fleet remained roughly constant (although not fully employed) with merchant ships over 100 GT† (i.e. excluding military and non-propelled vessels) totalling about 75 000 ships of about 410 m GT. This implies a demolition market of around 2600 ships a year of about 15 m GT. Table 1 shows that in practice the annual total of ships broken up between 1980 and 1989 varied widely between 695 and 2360‡ ships, with tonnage between 2·5 and 22·2 m GT, as a result of market fluctuations. Statistics of ship scrapping are not good prior to 1970, when *Lloyd's Register* started publishing more detailed breakdowns by flag and country of demolition [1], later adding ship type, size and age. Previously only aggregated or partial data (e.g. from shipbrokers [2]) were available. Nevertheless there is sufficient information to provide an adequate understanding of the market over the past two to three decades. Demolition of naval vessels is not a major influence on the world shipbreaking

†Gross registered tons (GRT) implies measurement under the old tonnage convention. Gross tons (GT) implies the 1969 convention, including all vessels built since 1982. All vessels will be remeasured by 1994.

‡Since the median scrapping age of all ships is around 22–26 years, this suggests that a number of small vessels disappear without being recorded as 'Scrapped' or 'Lost'.

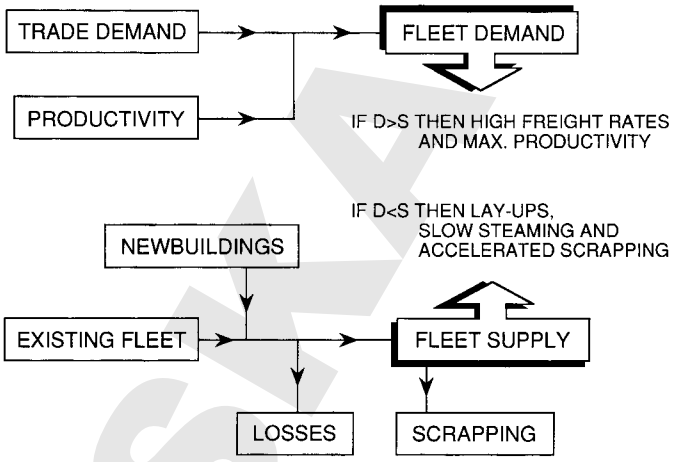


Figure 1. The role of scrapping in the supply/demand balance.

Table 1. Merchant ship demolition.

Year	Number of ships	Gross tonnage $\times 10^{-3}$	Europe %	Taiwan %	Sub-continent %	Other Asia %	Others %
1970	1030	4311	30·7	25·6	—c.19—		24·7
1971	962	4266	34·1	32·1	—c.12—		21·8
1972	917	4994	38·8	34·4	—c.10—		16·8
1973	812	3578	33·2	46·0	—c. 8—		12·8
1974	696	2959	33·3	42·7	—c.15—		9·0
1975	626	5077	35·5	42·2	—c.17—		5·3
1976	734	6615	28·4	52·5	—c.14—		5·1
1977	914	6093	25·5	55·7	6·0	8·0	4·8
1978	1078	10070	15·1	60·0	6·5	15·0	3·4
1979	923	6665	16·7	59·6	5·0	14·6	4·1
1980	903	6022	11·0	73·2	7·2	5·6	3·0
1981	762	7252	5·2	72·6	13·1	5·7	3·4
1982	1113	13624	5·6	57·5	15·7	18·7	2·5
1983	1310	16759	6·3	46·6	15·5	28·9	2·7
1984	1785	17751	6·0	37·7	12·5	41·2	2·6
1985	2360	22229	7·1	35·2	14·7	39·4	3·6
1986	1888	20288	8·3	38·3	8·7	41·5	3·2
1987	1474	12009	4·8	36·8	22·0	33·4	3·0
1988	1452	5015	14·3	30·3	23·0	22·3	10·1
1989	695	2477	9·9	6·6	42·9	30·3	10·3

Principal countries of demolition:
Europe: Spain, Italy, Yugoslavia, Greece, Turkey, UK
Sub-Continent: India, Pakistan, Bangladesh
Other Asia: PR China, Japan, Hong Kong, S. Korea
Others: US, USSR
Source: *Lloyd's Register Casualty Returns.*

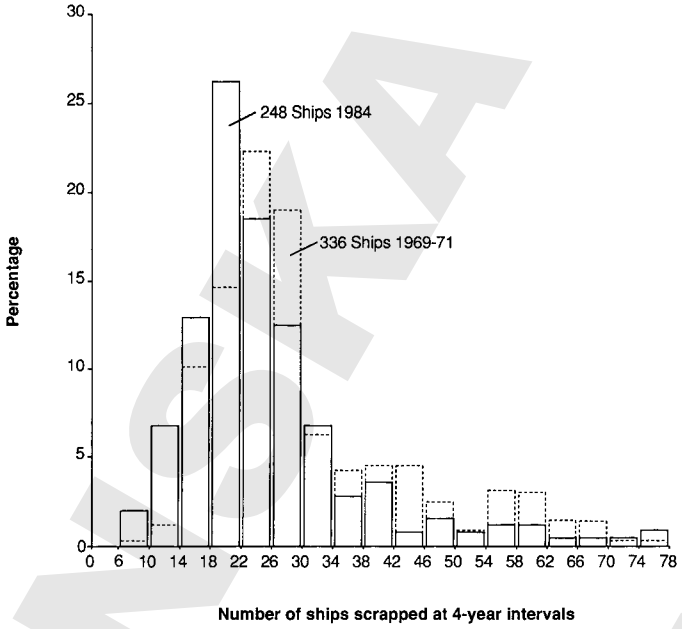
market, except to specific countries at specific periods, e.g. disposal of surplus warships in the UK in the late 1950s, or Soviet warships in Europe during 1989–90.

In addition to wide fluctuations in the total of ships scrapped each year, there are also wide variations in the median age at which different ships are scrapped. Median age is a better measure than average age (which can be distorted by a few ships of great longevity) representing the time by which 50% of ships have been scrapped, with 50% remaining. Table 2 shows for a sample of 248 ships scrapped in 1984 a variation in median age from 12 to 24 years for trading ships, but an astonishing range from 8 to 80 years from the youngest to the oldest individual ship. Figure 2 displays the underlying data as percentages both for 1984, and for 1969–71 when market levels were relatively much higher, increasing median age from 22 to 26 years.

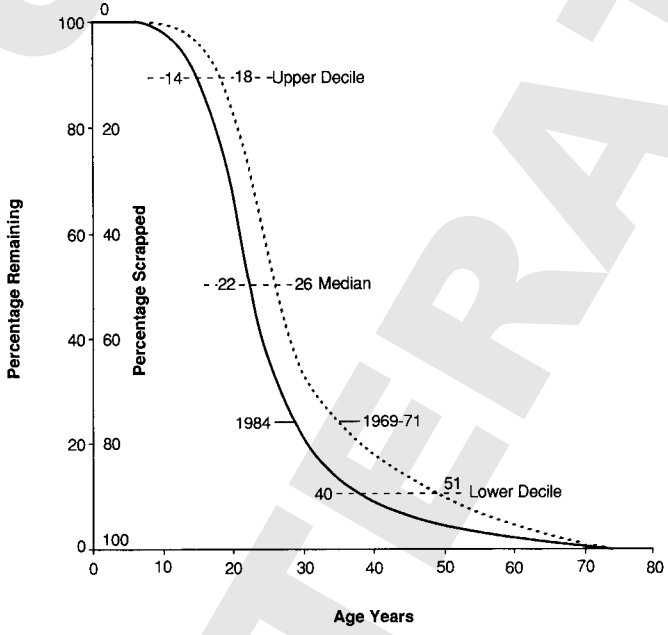
There are sound reasons for this variation in disposal age. Evans [3] discusses the elements influencing the theoretical age at which ships should be replaced. While the factors are fundamentally economic, in practice it is useful to distinguish physical from economic obsolescence, while some commentators have introduced the concept of political obsolescence, where ships are unable to trade owing to flag discrimination, or inability to meet special regulatory requirements. Physical obsolescence is characterized by a ship so worn out in hull and/or machinery as to be not worth repairing. Economic obsolescence is characterized by ships which are still physically sound, but have been rendered uneconomic by the introduction of more efficient ships. The classic example is the wholesale scrapping of medium size steam turbine tankers in the late 1970s, unable to compete with lower fuel consumption diesel tankers in the very low post-1973 freight markets. By the 1980s, this sector of the tanker market, together with smaller tankers, had reverted to a more normal physical obsolescence scrapping age (20–24 years) as the supply/demand balance had improved. VLCCs were, however, still facing gross oversupply, and had an 11-year median scrapping age. Most notable were three laid-up French-built 550 000 dwt tankers (*Batillus* class) which were broken up in Korea and Taiwan in 1984–86 at only 7–10 years old. These VLCCs lacked the route and trade flexibility of smaller vessels, while fragmentation of crude oil supplies reduced parcel sizes well below their potential capability.

Table 2. Age of ships at scrapping 1984.

	Median	Lowest	Highest
Large tankers (over 80 000 dwt)	12	8	20
Medium tankers (20–80 000 dwt)	24	15	35
Small tankers (under 20 000 dwt)	20	10	50
Combination carriers	15	10	25
Ore and bulk carriers	20	14	30
Liquefied gas/chemical tankers	18	12	30
Multi-deck general cargo	23	10	40
Container and RoRo	19	13	30
Passenger vessels and ferries	24	14	50
Service craft, tugs, dredgers	25	10	80
Fishing vessels (over 100 GT)	18	10	35
Overall	22	8	80



(a)



(b)

Figure 2. Ship scrapping ages.

The higher median age of the passenger and service vessels is explained by the generally less severe competition they face (e.g local ferries, harbour craft, etc.), generally better maintenance and often a greater adaptability for alternative owners or local trades, usually after conversion. North European ferries converted for local passenger trades in Greek waters are a prime example. Great Lakes vessels with a median scrapping age of 60 years are an outstanding example of longevity, partly due to lack of hull deterioration (operating in fresh water) although mostly having been re-engined from steam to diesel, and partly due to lack of low cost foreign competition, i.e. all operators have similar cost structures. The latter reason also accounts for the survival of steam tankers over 30 years old in the protected US coastal trades.

It is thus in the most competitive sectors of the market where lower cost and/or more productive tonnage appear the quickest, that scrapping age is lowest, i.e. economic obsolescence. In this context, the rate of technological progress is a primary determinant. Benford [4] has shown that a change in the rate of technological progress has a larger influence on optimal life than changes in operating cost levels or rates of deterioration of performance. More fuel efficient hulls and machinery are an example. In effect new, more efficient tonnage initially achieves a better rate of return at prevailing freight rates, but once such ships are present in any quantity, they drive freight rates down to lower real levels, thus accelerating the scrapping of older tonnage of marginal profitability.

2. The decision to scrap

Faced with declining profitability in existing trades, an owner has a number of choices after cost-cutting measures have been exhausted:

(i) Continue trading in the hope of improved markets

(ii) Lay-up the ship, again in the hope of better times

(iii) Convert, either to alternative trades, or modernize, e.g. re-engine

(iv) Sell second-hand

(v) Scrap.

A further possibility is not talked about in polite circles, namely scuttling for the insurance value! Options (iv) and (v) offer the prospect of a quick return, i.e. cash now, so can be compared in present worth terms with the projected discounted cash flows from options (i), (ii) or (iii). In poor markets, these three are likely to generate negative cash flows for the next few years, especially if newbuilding loans have yet to be fully paid off, thus putting a strain on liquid resources. The owner must make his own judgement as to when future markets are likely to improve, and if so to what sort of level, to judge whether these options are 'better' than disposal now—assuming he has the cash flow from other activities to carry him through the trough to an anticipated more profitable future.

Figure 3 shows for the tanker market how not only is the quantity of laid-up tonnage related inversely to freight rates, but also how tonnage sold for demolition relates. VLCCs only started being scrapped in quantity from 1978–1979, but then formed a major element of the aggregate tonnage scrapped (particularly when measured by deadweight rather than gross tonnage, as deadweight overstates the importance of large bulk-type vessels). VLCC freight rate trends however were similar to those of medium sized tankers.

Second-hand prices fluctuate substantially, influenced partly by current (and

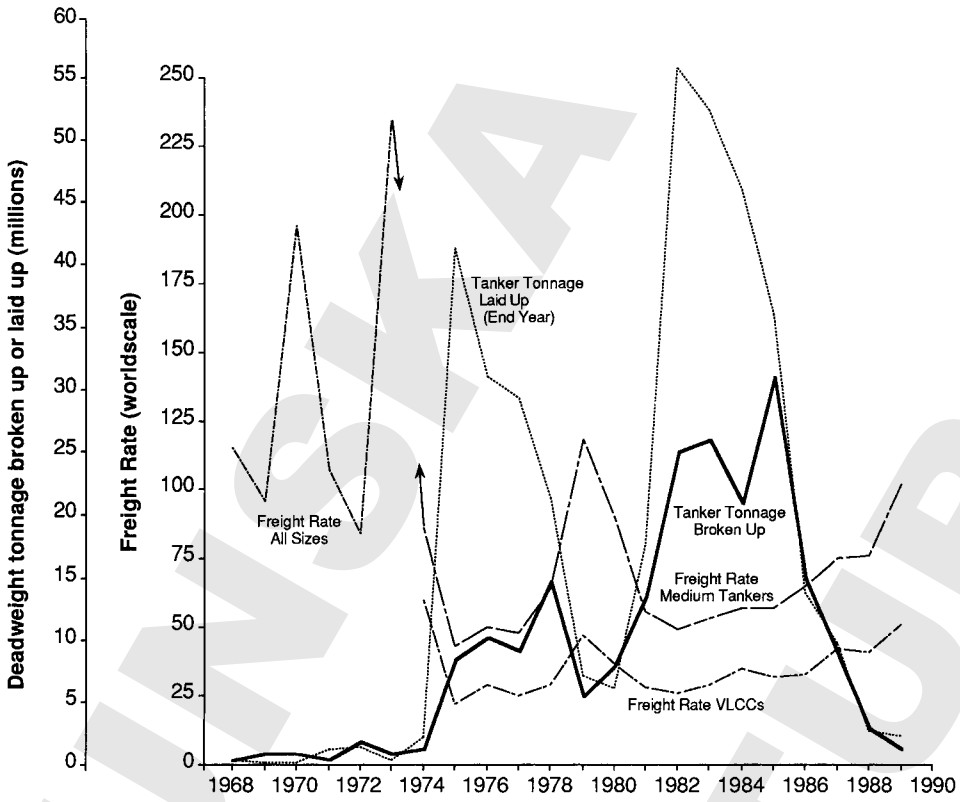


Figure 3. Tanker freight rates, lay-ups and scrapping.

anticipated) freight markets, by current newbuilding prices, and of course by type, age and condition of the particular ship. The theoretical price is the present worth of the projected future cash flows, about which prospective buyer and seller may well have different views. While there is no formal second-hand price index as such, it is possible from the year end values reported by Fearnleys [2] to show that second-hand values can fluctuate from a low of about half an average long-term age-related price, to about double. The long term trends correspond to a real decline of 8–10% per annum compound. Such a rate is related to the current replacement cost of a newbuilding rather than historic cost. For example, a 5-year old ship would on average be worth about 60% of a similar new ship $[(1-0{\cdot}097)^5=0{\cdot}600.]$

Sale for scrap, as opposed to further use, will of course normally only occur once second-hand values fall close to demolition levels—typically around 10% of current newbuilding price. Depending on the rate of inflation since delivery, scrap price may, however, be a much higher percentage of historic cost than of newbuilding price. It is not, however, unknown for owners such as liner operators with tonnage that to them is obsolete but not physically worn out, to sell only for demolition, to prevent possible competitors buying the ships and operating them in similar trades.

3. Demolition value

Demolition prices do not fluctuate as much as second-hand prices in absolute or relative terms. That is, even when scrap prices are high as a result of high demand

from steelworks, a typical vessel may only fetch a few hundred thousand dollars more than in a low market, while the second-hand value for trading could vary by millions. VLCCs in the late 1980s are the prime example, where the second-hand price of ships built in the mid-1970s rose from $5m to over $30m, while scrap value only fluctuated between $4m and $8m. Demolition prices are set more by the cost structures in the likely countries of demolition than by the supply of ships, which only constitute a small proportion of the scrap required by the steel industry. The scrapping business is highly competitive, so the price offered by shipbreakers will be close to their estimate of:

Value of realizable materials
less *delivery costs to scrapyard*
less *cost of demolition*

The value of the realizable materials depends partly on the breaker's estimate of the tonnage outturn of the various material categories, based partly on their unit value. Most ships can be separated into:

(i) Scrap steel for furnaces
(ii) Re-rollable steel
(iii) Non-ferrous metals
(iv) Reusable items
(v) Unsaleable and rubbish.

The unit value of (ii)–(iv) is higher than that of scrap steel, but only if a worthwhile local market exists and the labour cost of extraction is not too high. In Asian countries, there is a large market for re-rolled steel particularly for reinforcing bars for concrete construction. In the Indian sub-continent re-rolled steel plates originating in scrapped ships are even used in new construction of river craft. In this case, stiffeners must be carefully separated from plates, which should preferably be large and flat. There is also a large market for reusable equipment—pumps, generators, winches, galley equipment, boats, furniture—which when refurbished are in greater demand in poorer countries than they are in Europe, where such items are little more than scrap metal and firewood.

The realizable value of the scrap materials can be 50% higher in Asia than in Europe which, after lower demolition costs, translates into a ship purchase-price offer double that in Europe. For example, during the peak years in the mid 1980s, and also during 1975–78, Far Eastern prices per light displacement ton† (LDT) varied from $90 to $130, while Southern European prices were $45 to $75.

Not surprisingly, the Asian share of the world shipbreaking market rose from around 40% in the early 1960s to 60% in the mid 1970s and around 90% in the 1980s as illustrated in figure 4. Despite the higher productivity in shipbreaking in Europe from greater mechanization, the very low level of wages, particularly in the Indian sub-continent, has induced an irreversible shift eastwards, where much higher demolition prices can be offered, justifying high towage cost, even for medium sized ships.

Indeed such shifts have occurred within Asian countries as the realizable value minus labour cost equation deteriorated with increasing wages and prosperity. Japan was the first to move that way, while both Korea and Taiwan have followed. Taiwan dominated the shipbreaking market from the late 1960s until 1988, with around half the market. Work was concentrated in some 50 breaking sites in close proximity in

†Ships are sold for scrap on a light displacement ton basis, i.e. empty weight. Actual tonnage realized is around 10% less, because of liquids in systems, corrosion losses, etc.

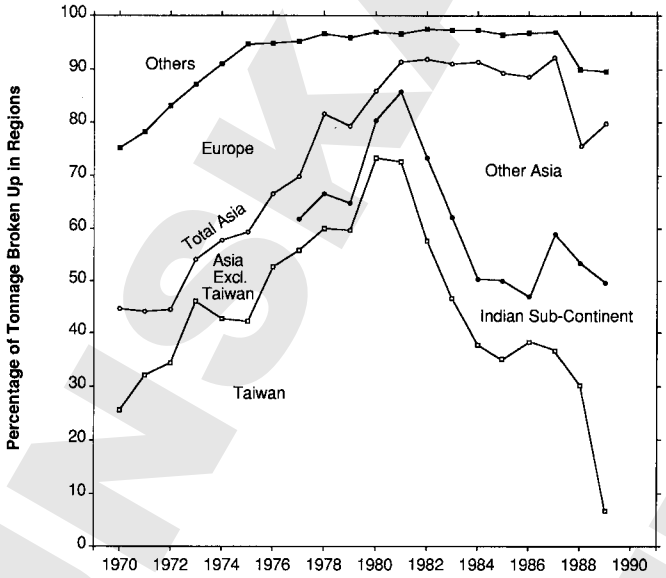


Figure 4. Ship scrapping regions.

Kaohsiung. Despite high import taxes, Taiwan regularly bought 200 or more large ships a year through much of the 1980s totalling 5–8m GT at a cost of around $M300–400, equivalent to about 3–4 millions LDT. Partly as a result of redevelopment of Kaohsiung harbour, and partly due to the sharp drop in ships offered for sale with improved freight markets, shipbreaking in Taiwan declined very rapidly in the late 1980s, with only 164 000 GT being broken up in 1989.

The People's Republic of China was expected to take over as the dominant force in world shipbreaking, but in the event it has been the better market for steel scrap in the Indian sub-continent, coupled with its low wages, that has enabled India and Bangladesh to constitute the largest centre of shipbreaking at the start of the 1990s, despite their modest facilities. With few VLCCs going for scrap recently, their lack of deepwater berths and large cranage has been no handicap in offering prices of over $200 per LDT.

In conclusion, it does not seem likely that there will be any changes in the economic forces dominating the demolition of ships. The basic decision on disposal will be taken on the technical and economic factors influencing the anticipated profitability of the ship. When these prospects are poor, and second-hand prices are correspondingly low, the scrapping option is likely to prove the least unattractive. The owner's shipbroker can then be invited to get the best price from prospective shipbreakers. These are likely to remain the low labour-cost Asian countries, except for small or damaged vessels too far away to be worth the delivery costs.