Geographia Polonica 2013
Volume 86, Issue 2, pp. 125-135
http://dx.doi.org./10.7163/GPol.2013.13

INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION
POLISH ACADEMY OF SCIENCES
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WHEN TO STOP COLLECTING DATA ON SHIP MOVEMENTS?

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Abstract

Data available from international shipping consultants becomes less reliable in the 60,000–15,000 dwt range and this is where specialized regional consultancies step in. A rational approach to dealing with the problem is sought in three ways. First, the increase in cumulative worldwide vessel count is compared with the corresponding cargo value as smaller size classes are added. At 25,000 dwt the vessel count equals the cargo value, suggesting a cut-off point. Second, cargo values by port are scaled with corresponding port visits (score) and then segments are merged stepwise from the largest to the smallest. Now the expected inflection point fails to emerge. Third, the above score is mapped in a roster of 30 regions. A contrast emerges between large vessel – long distance and small vessel – short distance zones, which explains the existence of regional consultancies.

Key words

cargo value • port visit • regional differentiation • size class • value gap • ship movement

Introduction

Practically all academic shipping research relies on data collected in the 'field', i.e. at ports, at narrows (by telephoto) and on the open sea. Ships calling at ports are required to report their arrival and departure, with cargo to be discharged or having been loaded. Port authorities may or may not make these data available to interested parties. This author's gut feeling is that data confidentiality increases with size of port, apparently connected with its importance to the national economy and the intensity of competition within its limits. At Finnish and Swedish ports an academic is allowed to browse the cards detailing the ship's credentials, its last and next port of call, and the type and volume of cargo discharged and loaded. At ARA[1] ports, aggregated figures are released by type, country and size class on request. In Singapore, by force of law, only the number of visiting vessels is released (Laulajainen 2012a). Singapore's small size and insular location make foreign trade statistics, detailed and reliable, a welcome proxy for maritime traffic. But this reliability only applies to a certain extent because vessel identity is an essential part of the practical equation. In Kuwait, loadings in individual ports are classified information. The country's small size makes this constraint rather irrelevant for this study. Coastal traffic (cabotage) is normally outside international surveys. That means that essential

[1] See explanation of all abbreviations in the Appendix 1

sections of US, Chinese, Russian, Indonesian and Indian traffic fall outside this study.

Port identity matters since a vessel's location, in combination with its peers, gives an idea of the shipping space available in an area. When tankers carry 250-300,000 tonnes of crude oil, visibility appears guaranteed, but need not be so. Vessel 'spotters' follow their 'game' at narrows in the maritime traffic lanes for speedier information and confirmation. With declining vessel size the task becomes progressively more difficult. Veritable cat-and-mouse games are also played. A Suezmax vessel carrying an oil cargo from Syria to Iran in 2012, concealed its identity by changing its name, nominal owner and nationality several times during a three-week long trip (Saigol 2012). Even when a vessel's identity, location and cargo status (loaded/empty) are known, one piece is still lacking – has it been chartered or not. If this information is available it needs to be matched with a cargo, valued at $m 50-100, in the loading port (Laulajainen 2009). This part of the activity, matching ships with cargos, is the task of shipbrokers who habitually charge a 1.25% commission out of the freight total for their service. When the freight cost of a Vlcc in the MEG-North America trade is easily $m 3-8, the incitement is obvious. Beyond that, cargoes already *en route* are subject to being traded when at sea. Plotted on a map, the stream of vessels on a major shipping route resembles pearls on a chain. For the deal to be meaningful a cargo must not have passed the turning point to a possible new destination. Again, market intelligence is called for. Its collection and analysis becomes a profitable business. An academic has no access to the actual dealing. He/she is constrained to analyzing historical, possibly indirect, data and conducting interviews.

It is a well-known problem in current academic shipping research that the availability of reliable data worsens radically when the vessel size declines below 60,000 dwt. One manager responsible for the chartering of 100 dry cargo vessels of all sizes commented to this author that market intelligence often located his handysize (25-45,000 dwt) units to the wrong areas. As there are more vessels in the smaller size classes, the share of old and poorly maintained units probably grows, the duplication of ship names becomes more frequent, IMO hull numbers are not always available, more out-of-the-way small ports and roadsteads are visited, and so on. Small vessels have local markets more often than large ones, which means that there are fewer market actors which take an active interest in them, and there are informal, local information networks that offer keen competition to the well-known global logos. The outsider intelligence effort remains the same but its value declines. There comes a limit at which it becomes irrational to extend a formal intelligence service to smaller size classes. A worldwide consultant in particular is mostly interested in the large units and adds small size classes until the benefits are outweighed by the effort. The exact point, however, has a strong historical aspect. Today's sub-size ships are yesterday's average vessels (Tab. 1). *This report tries to evaluate where to put a rational lower limit today; where do implied costs exceed benefits.* Fixture (charter party) data face the same problem, although in less accentuated form, because there is not the same analytical need to chain fixtures as there is for ship itineraries, which makes a census necessary, or almost.

There are three types of ocean going vessels with widely varying sizes to select from: cruising vessels, liners and bulk ships. Cruising vessels and liners follow schedules and are normally not chartered as whole units. There is very little disguised geographical information about the vessels' whereabouts (although there is for cargos) to look for. Bulk carriers are their direct opposite. There are several size classes and the trading patterns are both global and very varied. Tankers (liquid bulkers) are mostly for crude oil and oil prod-

Table 1. Historical bulk carrier sizes (dwt).

	British flag, average				Liberty/T2	St. Lawrence
Year	1914	1929	1933	1936	1941/5	1959
Dry bulk	5,810	7,365	7,546	7,642	10,900	25,000
Tanker	7,153	8,530	9,835	9,889	15,900	25,000

Sources: Isserlis (1938), Tables I, II, III, IV, foreign trade; Wikipedia; LMIU.

ucts with relatively homogeneous cargos implying relatively invariant price tags. This facilitates the estimation of attached information value and makes tankers a suitable object for study.

Ports are the natural fixed points for locating vessels. Globally, one thousand are large enough to warrant attention (Laulajainen 2006, Tab. 2.5; Tab. 3). They are of all sizes with the largest ones covering tens of square kilometers of built-up land facilities with attached industries and as much again in dredged water areas (Wikipedia 2012a, b). These facts matter when data is collected by direct observation, 'in the field', and the agent corps involved full-time is sized accordingly. A manager at a leading intelligence organization estimated two decades ago that the overall headcount was 800-1,000. On top of that there are 50-100 office-based analysts who arrange and classify the raw data.

The major data sources familiar to this author are *Lloyd's Marine Intelligence Unit* (LMIU) and *Fairplay* in London, and *Maritime Research* in New York. Their worldwide vessel movement data are very similar and mutually comparable. This observation can be further extended to other major shipping consultants who may rely more on purchased data, such as *Clarkson Research Services* and *Drewry Shipping Consultants* in London (Laulajainen et al. 2001, Tab. 4.1). This author has mostly used LMIU and Drewry data. The choice was by default rather than a premeditated decision.

The current analysis may be the only one of its kind in the public domain. Evaluations have certainly been made, but have remained within the private distribution network of consultants. This author has benefited from the provision of databases by LMIU and *Neste Oil*, the Finnish oil company on a complimentary basis. The calculations were mostly made before data for vessels below 60,000 dwt became available on a piecemeal basis and this data had already been partly aggregated in any case (Laulajainen 2011, 2012a). It was also impossible to differentiate reliably between oil product and chemical tankers. Omissions have been commented on where appropriate. The rest of the data are all-inclusive. Its use follows two parallel and complementary tracks: ships and ports. The former approach is aggregate and encyclopedic, the latter disaggregate and geographical.

The core assumption in both cases is that the information value attached to a vessel is in direct proportion to the value of the cargo. Unit values are available from the United Nations statistics (UN Comtrade 2004). Average prices in Singapore and the Netherlands, both recognized trading centers, are considered sufficient (Laulajainen 2012a, Tab. 2). Crude oil import prices (SITC 333) are c.i.f. and oil product export prices (SITC 334) are f.o.b. Their use follows geographical logic, because most coastal refineries are located at import ports and most product shipments originate from them.

Aggregate approach

Most vessels of a meaningful size operate over large areas and visit all kinds of ports. But they do not necessarily operate in the same areas and visit the same ports, depending on the quality and size of cargos. Therefore analysis by ship size segment (class) is to be recommended. A classification into oil tankers and chemical tankers does not follow too closely their actual use, which means one is obliged to use an undifferentiated tanker population and aggregate measurements. Since encyclopedic data about ship numbers and characteristics obviate data collection at ports, the shortcut appears permissible. The idea is that ship size segments can be compared by counting the vessels and weighting the count by average cargo value (Tab. 2). Specifically, when a segment comprises both crude oil and oil products, the split is handled by averaging. This idea rests on the concept of an invariant intensity of use and will be challenged later on (Tab. 3). Cumulative ship counts are subtracted from cumulative cargo values (percentages) by segment and the difference is called the 'value gap'. The value gap reaches its highest value of 57 in the Handymax class and nosedives below 25,000 dwt (Fig. 1). The top of the curve is quite flat, however, which leaves room for managerial judgment. For example, the segments from Ulcc to Aframax amass together 71 percent of cargo value. It is not only the large ship size but also the total count of over 1,600 vessels, almost equal to the next three classes of much smaller sizes. This tells most of the story.

Disaggregate approach

The assumption of an invariant effort per ship or port is probably untenable. Key data items such as vessel characteristics, cargo quality and size,

Table 2. Tanker information value, 2004.

Segment	Ships		Avg cap			Avg cargo		Total value			Gap	
	no.	cum.	%	'000 mt	crude%	$/mt	$m	$bn	cum.	%	%	chg
Ulcc	201	201	2	285.0	100	274	78.09	15.70	15.70	16	14	14
Vlcc	353	554	6	250.0	100	274	68.50	24.18	39.88	40	34	20
Suezmax	369	923	10	133.0	100	274	36.44	13.45	53.32	53	43	9
Aframax	706	1,629	17	90.0	95	278	25.01	17.66	70.98	71	54	11
Panamax	305	1,934	20	62.0	80	290	17.96	5.48	76.46	76	56	2
Handymax	684	2,618	27	37.0	50	313	11.58	7.92	84.38	84	**57**	**1**
Handysize	791	3,409	36	27.0	10	344	9.29	7.35	91.73	91	**56**	**-1**
Small	823	4,232	44	13.0	0	352	4.58	3.77	95.66	95	51	-5
Midi	3,007	7,239	76	3.8	0	352	1.34	4.02	99.69	99	24	-27
Mini	2,324	9,563	100	0.9	0	352	0.32	0.74	100.42	100	0	-24

Notes: Capacities based on average dwt and crude/product specific gravities 0.8/0.9. Shares of oil products are quite reliable in Aframax and Panamax segments but are approximations in the Handysize segment. Inflection point in bold. Cf., Table 3, Notes.
Sources: LMIU Vessel Data (2004); LMIU Movement Data (2004); UN Comtrade (2004); Laulajainen (2011, Tab. 6).

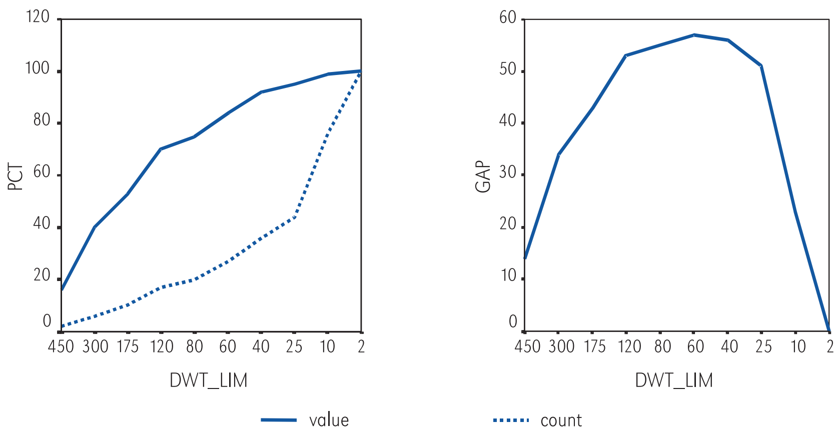

Figure 1. Value gap by dwt.

Notes: Cumulative percentage of cargo value and ship count. Value gap = cargo value – ship count.
Source: Table 1.

handling equipment at loading and discharging ports, departure and arrival dates, origins and destinations may be available from port or customs authorities. But they may also be confidential information and the only alternative is field observation, perhaps clandestinely or from an onshore observation post or at the discharging port. Physical presence is necessary and the effort in a large port can be considerable (Verlaque 1974; Vigarié 1979). Worldwide, the number of ports easily approaches 1,000 (Tab. 3). The intensity of action required (visits/ship x average nm x 10^{-3}), declines with ship size. Explanations such as variation in the visits/trip ratio (2.1–2.6), time spent in port, and idleness are possible. Cargos may also have escaped the LMIU net or may not be able to be allocated to a port but only to a territory and therefore are not suitable for use in this study. Really small territories, such as Kuwait, Qatar, Bahrain and Sri Lanka, or those with one dominant port, are treated as single ports, however. This undefined, territorial share grows when vessels get smaller, a familiar feature in tributary seas such as the Baltic, Caribbean, Mediterranean and MEG, in large archipelagos such as Indonesia, and in product trades. The usual percentage is 9 percent of movements, which rises to 23% in the Handysize segment and becomes still larger in the small sizes (Laulajainen 2011, Tab. 6). No difference is made between loading and discharging ports since visits to both are of equal relevance. Of course, a tanker leaving a destination port is in ballast but since it is probably chartered for a new cargo leg it is very much part of the ongoing game.

There is a fixed cost associated with any port in the census: personnel must be found and communication channels opened. Thereafter, the cost is related to the number of ships visiting the port, the number of visits and possibly their density per port sq-km. Many cost items are functions rather than constants. The main input is labor and its cost varies widely between ports.

The basic equation is apparently

$$\text{cost} = \int (\text{ports, ships, visits}).$$

Lacking empirical data for parameter estimation, the equation becomes:

$$\text{score} = \text{cargo value}/\mathit{ln}(\text{visits} + 1)$$

Economies of scale suggest the use of a logarithmic transformation: *ln*(visits +1). A negative score is impossible and a sharp change of direction in the score curve indicates a breakeven point. A fictional example based on the Ulcc and Vlcc segments will clarify the details.

Example:

Port	Value, $ million			Visits			*ln*	Score	
	U	V	UV	U	V	UV	UV+1	Port	Cumul.
Juaymah	28,671	25,643	54,314	341	409	750	6.62	8,203	8,203
Valdez	0	8,833	8,833	0	126	126	4.84	1,823	10,026
Philadelphia	2,181	0	2,181	29	0	29	3.40	641	10,667

The merging effect is seen in Tables 4 to 6. The pull exerted by ports investigated in earlier merger rounds on a new vessel segment can be considerable. Suffice it to highlight the role played by the Suezmax segment in new ports with attached visits. The Aframax segment also enters many new ports but with less visits attached. These two segments compare very well with the much larger vessels of the Ulcc and Vlcc segments. The number of segment combinations naturally complicates analytical effort. This study registers 42 combinations of which 12, with at least 1,000 visits each, are listed in Table 5. The lower part of Table 3, displaying the 5.4 million export tonnes by Neste

Table 3. Tanker operational basics, 2004.

Class	Ships	Average ('000 dwt)	Ports	Visits	Ships/ port	Visit/ ship	Visit/ port	Avg (nm)	Inten- sity
Ulcc	201	316.2	147	2,791	1.37	13.9	19.0	below	below
						15.5		6,130	95
Vlcc	353	274.3	189	5,820	1.87	16.5	30.8	above	above
Suez	369	147.9	381	8,371	0.97	22.8	22.0	2,617	60
Afra	706	100.2	599	19,129	1.18	27.1	31.9	1,730	47
Pana	305	69.0	456	5,645	0.67	18.5	12.4	1,970	36
Handy	1,475	34.4	276	28,365	5.34	19.2	102.8	1,591	31
Total	3,409	n.a.	821	70,119	4.15	20.6	85.4	n.a.	n.a.

Notes: Handysize includes Handymax. Clean Handy 15-60,000 dwt. Dirty Handy (10-60,000 dwt) 1,029 legs is a vanishing segment and overlooked. Territories cannot be allocated between ports and are excluded. The average number of visits per trip grows with increasing vessel size. Average nm is per cargo leg. Intensity = visit/ship * avg nm/1,000.
Sources: LMIU Movement Data (2004); LMIU Vessel Data (2004); Laulajainen (2012b, Tab. 1).

Oil, gives an indication of the invisible element in the oil product tanker market.

There are three variables: value, visits and score to be accounted for. Since score is a function of value and visits, it contributes little to the analysis. Port scores plotted against visits would be a compact rising band of observations. It is better to focus on value and visits. They will be tabulated and plotted by port, ship segment or their combination. The aim is to find discontinuities (gaps, inflection points). As previously noted, it is rational to start with the largest units, which contribute most to the analyst's resources. Thus Ulccs will be displayed first and Handysizes last (Tab. 3). Alternatively, Ulccs will be merged with Vlccs first and so on, in declining order (Tab. 4 and 5). Figure 2 displays the effect graphically.

When the analysis proceeds by port the rational order is less clear because of the numerous vessel combinations (Tab. 6). Analysis by separate segment will, however, establish relative profitability at a glance (Fig. 3). Graphics follow a premeditated order. There are two sets of graphs, both with $m on the vertical axis and visits on the horizontal axis. One set displays a 10% sample taken at even intervals from data arranged by cargo value and its logarithmic version. Logarithms were the recommended measure because of the economies of scale. The total data covers a 12-fold range in

Table 4. Merging the tanker segments by visit, 2004.

LMIU	Ports	of which new ones					Visits	of which in new ports					New%
Crude Prod.		V	S	A	P	H		V	S	A	P	H	
Ulcc	147						29,339						100.0
plus Vlcc	207	60					34,068	4,729					13.9
plus Suez	433		226				59,880		25,812				43.1
plus Afra	694			261			67,747			7,867			11.6
plus Pana	791				97		69,027				1,280		1.9
plus Handy	821					30	70,119					1,092	1.6

Neste Oil	Ports	of which new ones			Visits	of which in new ports			Visits/port	
Products		H	S	M		H	S	M	New	Total
Pana	5				13				0.0	2.6
plus Handy	16	11			75	19			1.7	2.6
plus Small	18		2		271		2		1.0	8.0
plus Mini	29			11	442			61	5.5	8.0

Notes: Neste figures give an indication of the invisible element of the oil tanker market, the oil product market in particular. Total shipments from the Sköldvik and Naantali refineries were 5.394 mmt on 442 visits. Of these 2.868 mmt and 279 visits, 53% and 63% respectively, were not in the LMIU data.
Sources: LMIU Movement Data (2004); Neste Oil Export Shipments (2004).

Table 5. Merging the tanker segments by value, 2004.

Segment	$bn in new ports					Total	$m/visit in new ones					Total
	V	S	A	P	H		V	S	A	P	H	
Ulcc						1,007						34.3
plus Vlcc	121					1,128	25.6					33.1
plus Suez		515				1,643		19.9				27.4
plus Afra			127			1,770			16.1			26.1
plus Pana				17		1,787				13.0		25.9
plus Handy					11	1,798					10.4	25.6

Sources: LMIU Movement Data (2004); UN Comtrade (2004).

Table 6. Tanker combinations by size segment, 2004.

Combination		Ports						Visits						
		H	P	A	S	V	U	H	P	A	S	V	U	Total
1-digit														2,422
	H	30	0	0	0	0	0	1,092	0	0	0	0	0	1,092
	P	0	83	0	0	0	0	0	339	0	0	0	0	339
	A	0	0	129	0	0	0	0	0	0	538	0	0	538
	S	0	0	0	35	0	0	0	0	0	0	429	0	429
	V					10	0	0	0	0	0	0	19	19
	U	0	0	0	0	0	5	0	0	0	0	0	5	5
2-digit														4,852
	HA	16	0	16	0	0	0	785	0	222	0	0	0	1,007
	PA	0	73	73	0	0	0	0	676	862	0	0	0	1,538
	SA	0	0	57	57	0	0	0	0	769	303	0	0	1,072
3-digit														4,391
	PAS	0	55	55	55	0	0	0	437	2,148	1,041	0	0	3,626
4-digit														23,563
	HPAS	70	70	70	70	0	0	10,121	1,405	5,893	1,680	0	0	19,099
	HASV	7	0	7	7	7	0	105	0	258	490	161	0	1,041
	ASVU	0	0	24	24	24	24	0	0	298	374	1,085	750	2,507
5-digit														11,736
	HPASV	13	13	13	13	13	0	1,353	385	467	207	94	0	2,506
	HPAVU	11	11	11	0	11	11	736	80	365	0	525	149	1,855
	HASVU	5	0	5	5	5	5	521	0	219	271	40	52	1,103
	PASVU	0	27	27	27	27	27	0	393	2,017	1,126	1,308	734	5,578
6-digit	HPASVU	35	35	35	35	35	35	7,705	1,138	3,178	1,282	2,177	867	16,347
All combinations		276	456	599	381	189	147	28,365	5,645	19,129	8,371	5,820	2,792	70,119

Source: LMIU Movement Data (2004).

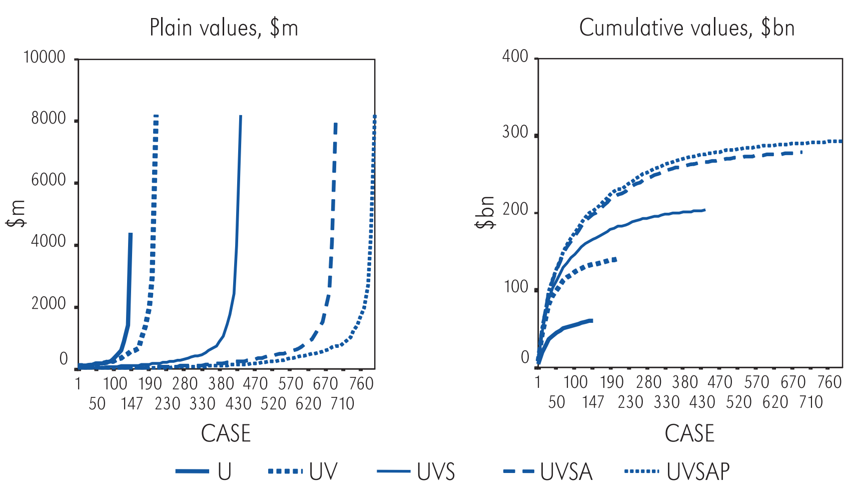

Figure 2. Cargo values by ship segment combination.

Note: A 10% even interval sample. Handysizes omitted for clarity. Plain values plotted from smallest to largest, cumulative values from largest to smallest.

Sources: LMIU Movement Data (2004); UN Comtrade (2004).

the vertical and a 20-fold range in the horizontal dimension compared with the 10% sample. Both the remaining two graphs display three ship segments to upgrade legibility. The Ulccs and Vlccs are then handled as a single segment. Aframax plots are 'in-between' in both displays in order to establish a scale. The markers of larger ships locate above those of smaller ones. When 'plain' visits are used as the input data, the plots are linear or almost so, but if logarithms are taken they become convex curves. Horizontal ranges in the single-segment graphs may be narrower than in the 10% sample.

The plots suggest no cutoff points. Small, simple ports are the natural domain of small ships whereas large ships tend to pull a string of smaller sizes with them to large ports. It is important to have a presence where this happens. How rapidly the score value declines with ship size is apparently a function of the size mix. There is no simple answer.

Geographical approach

No disaggregate discontinuities have been identified which would suggest the pruning of ship segments or ports. The context was non-geographical since the mutual location of ports was ignored. Rather the idea that port size and advanced specialization would somehow differentiate between them was implicitly advocated. From the consultant's angle this idea is acceptable. If the field can be disaggregated into the more and less profitable parts, the underlying criterion is of secondary

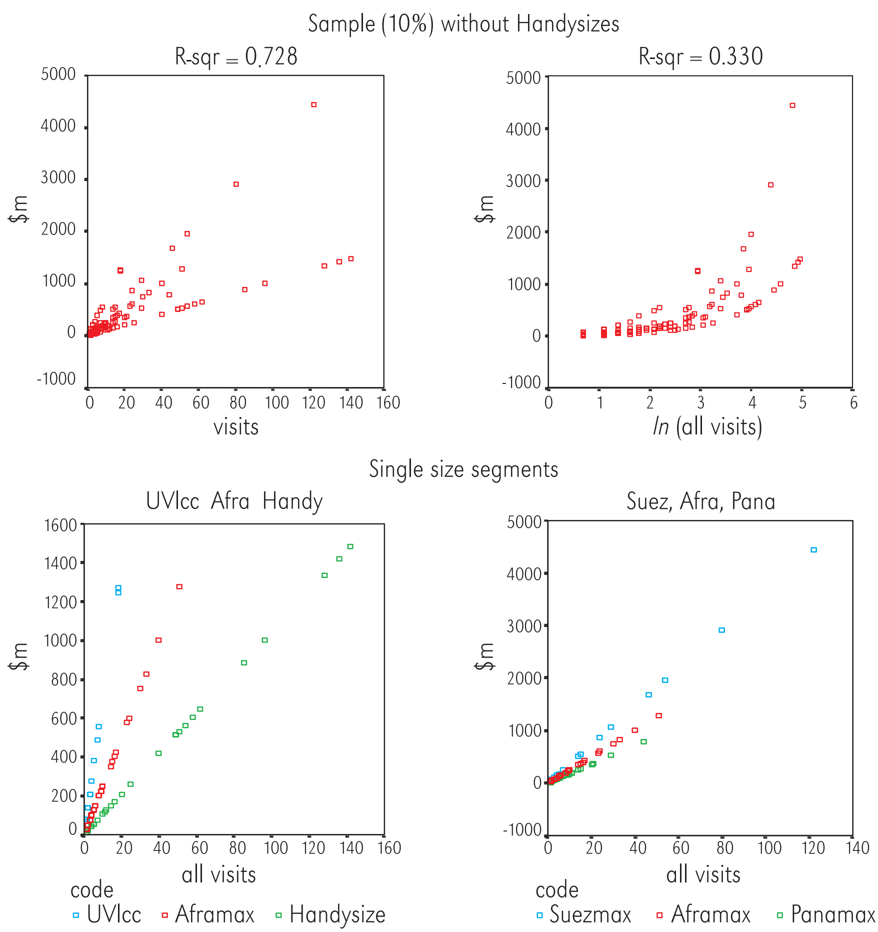

Figure 3. Cargo values reflect the number of visits.

Note: The sample is plotted with even intervals.
Sources: LMIU Movement Data (2004); UN Comtrade (2004).

importance. The main thing is that it will work. But it has not worked particularly well and now plain geography is called upon to rescue the analysis. Why should it have a better chance than the rest? It could possibly have this because the structure of the oil industry varies geographically. It adapts to settlement patterns and reacts to variable demand and substitutes. Small coastal settlements in Chile and Norway do not support the heavy infrastructure typical for industrial areas in NW Europe, Japan and the US Gulf and Atlantic coasts. Countries well supplied with domestic energy carriers are more geared to refining automotive combustibles than viscose heating oils. Will these features reflect in the value/effort scores? If they do this in principle, is the mesh below sufficiently fine to differentiate between regions?

The mapping will be done within a 30-region framework (Fig. 4). Cargo value is used as a reference surface. It originates from ship visits and because one person can handle quite a large number of visits before a larger headcount is needed there are obvious economies of scale. These are accounted for by logarithmic conversion. The outcome reflects the familiar geographical logic: crude oil producing regions with long distances to customers use large ships and make few visits per cargo unit. Where consumption pockets are small and producers are close to customers smaller ships with numerous visits dominate. South America's Pacific coast, the Caribbean, parts of the US Atlantic coast, the Western Mediterranean, the Black Sea and the Baltic belong to this category (Laulajainen 2012a). The Western Mediterranean is of particular note since here crude oil flows from the Algerian ports to Spain, France and the Italian islands nearby. This appears academically plausible, but needs judgment in application. The regional shadings in Figure 4 give some assistance by suggesting, e.g. the integration of the Middle East and African producing areas with the major consumption regions in the northern Asia Pacific, Europe and the US Gulf into one group, South America into another and the Baltic into a third one. Trading matrices by ship segment will undoubtedly be helpful.

Conclusion

The oil tanker assortment of global consultants has been evaluated with several data sets. The first set is aggregate and encyclopedic, consisting of vessels of all size segments with estimated cargo values. The cumulative percentages of vessel counts are subtracted from corresponding cargo values and the change of this 'value gap' is plotted. The trajectory has a flat top, followed by a sharp dive at the 25,000 dwt mark (Handysize lower boundary), a customary limit for data collection by consultants.

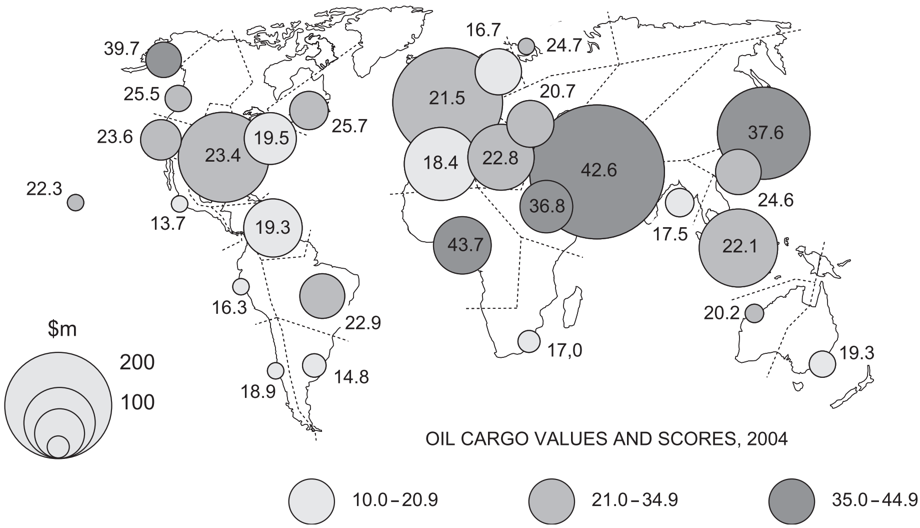

Figure 4. Regional cargo values ($m) and scores [($m)$^{-2}$/*ln* (visits)], 2004.

Note: Division by 100 is for scaling only.

Sources: LMIU Movement Data (2004); UN Comtrade (2004).

The second set consists of ship visits to loading and discharging ports. The attached cargo values by port are divided by the logarithm of visit counts, mimicking the labor input of data collection. Some ports are visited by only one size segment and some by all six, from Ulcc to Handysize. On an axis of coordination (value – *ln* [visits]), single-segment ports display six smoothly rising curves, with smaller ship curves below larger ones. When all segments are aggregated there is corresponding scatter without an inflection point or gap. That suggests a dead end for this study – there is no logical cutoff point. There is a compensating side effect, however. When smaller ships are integrated with the giants there is an influx of new ports with attached cargo value and ship visits. The Suezmax segment in particular plays an important role. In other words, if the data collection needs drastic pruning the Handysize and Panamax segments can well go whereas the Aframax segment ends in a grey zone.

The third, unconventional approach is geographical. The knee jerk way is to rank ports by cargo value, or score, ignore their internal structure, put them on a map and focus on port clusters. This approach truncates many vessel itineraries, which, nevertheless, have information value of their own. An alternative is to follow trading patterns, i.e., operate within maritime regions (Laulajainen 2012b). This is exactly what regional consultancies are doing.

Acknowledgments

Special appreciation is due to Wally Mandryk (Lloyd's Marine Intelligence Unit) and Mauri Harki (Neste Oil, Helsinki) for the provision of data on a complimentary basis and for advice

Editors' note:
Unless otherwise stated, the sources of tables and figures are the author(s), on the basis of their own research.

Endnote:
Reader unfamiliar with shipping at large will find the following titles useful (introductory/ specialized/ advanced): Stopford, 2009; Verlaque 1975; Grammenos 2010; Coulson 1991; Sargent 1930; Nossum 1996; Laulajainen 2006; 2010; Talley 2009.

Appendix 1. Abbreviations and terms.

ARA	=	Amsterdam–Rotterdam–Antwerp
MEG	=	Middle East Gulf
IMO	=	International Maritime Organization
SITC	=	Standardized International Trade Classification
UN Comtrade	=	United Nations Commodity Trade Statistics
Ulcc	=	Ultra large crude carrier
Vlcc	=	Very large crude carrier
Suezmax, Panamax	=	(largest) vessel able to pass the Suez or Panama Canal in full cargo
Aframax	=	stands for Average Freight Rate Assessment and was adopted during the 1939/45 War to facilitate government chartering. The original tanker size of 19,500 dwt was raised to 75,000 dwt in 1989 to better correspond to the then standard vessel plying between Africa and NW Europe. The current upper limit today is 90-100,000 dwt
f.o.b.	=	free on board – includes all logistics costs to the loading port and getting the cargo on the board there
c.i.f.	=	cost, insurance, freight – includes stowage, insurance & sea freight from the loading port to the destination and discharging costs there
dirty cargos	=	crude oil, fuel oil, lubricant base oils, bitumen – spec. weight abt 0.9
clean cargos	=	naphta, kerosene, jet fuel, gasoline, diesel oil – spec. weight abt 0.8
dwt	=	dead weight tonnes – the total weight of cargo, fuel (bunkers), stores and crew which sink the vessel down to the loading (Plimsoll) mark on the vessel's hull; the mark's location varies by sea area and season
nm	=	nautical mile, 1,852 m
tonne, mt	=	metric (1,000 kg) ton

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Article first received • May 2012
Article accepted • December 2012