Price Indices for Ocean Charter Contracts

A study of freight rate developments in marine transportation, 1997-2007

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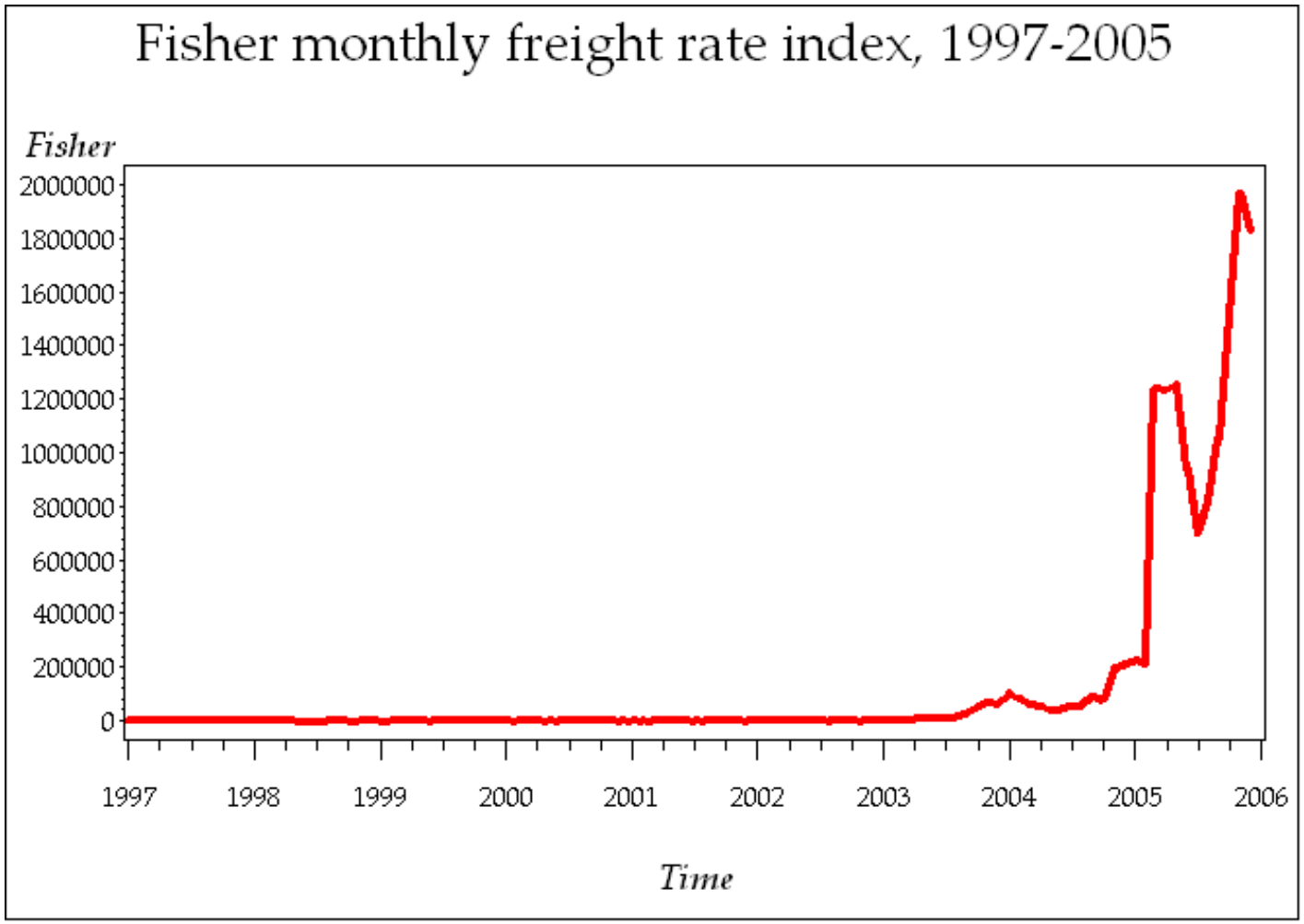
Rotterdam, May 9, 2008

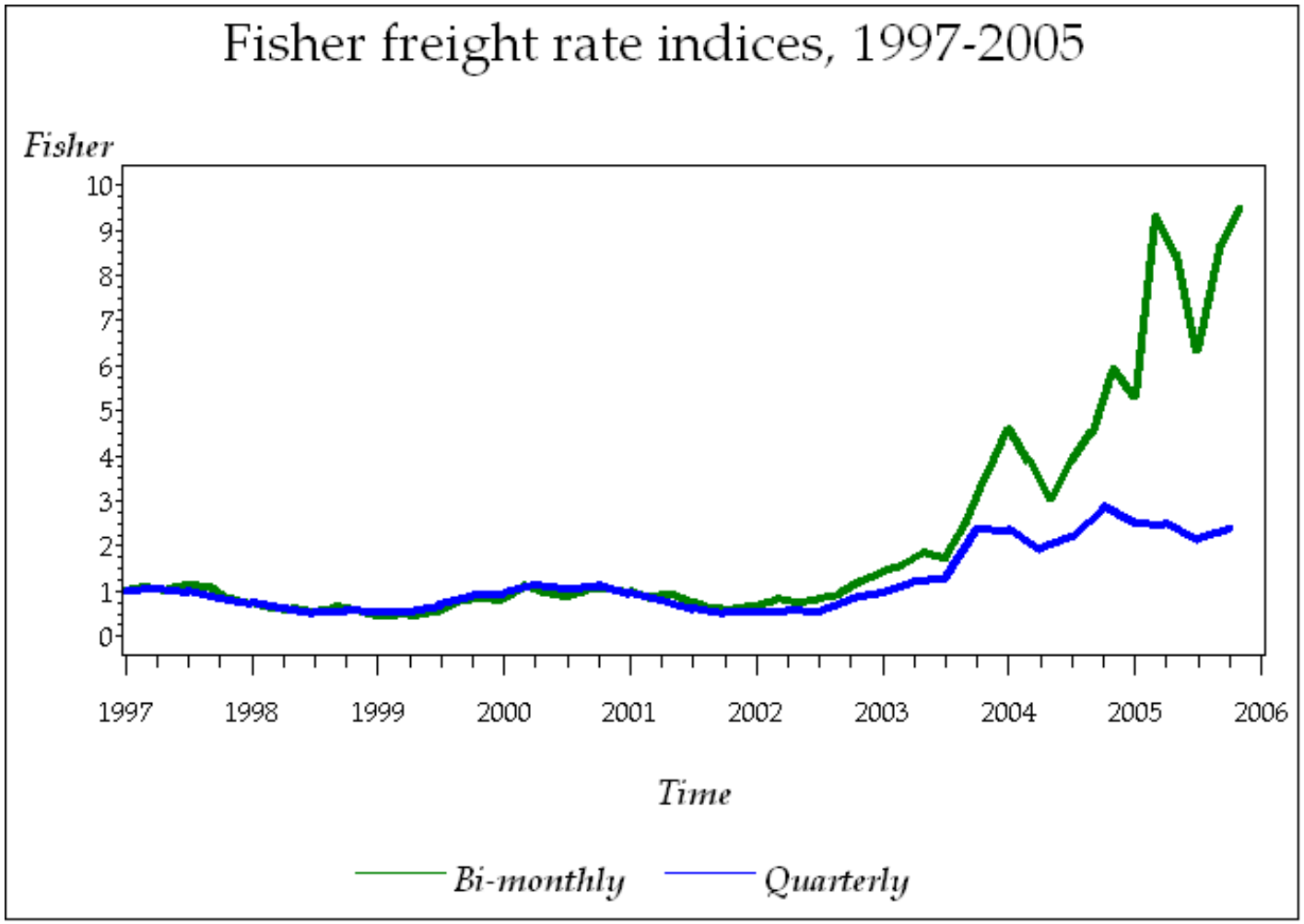
Introduction

- Part of a larger project of dynamic cross section analyses of marine charter contracts (excess statements of speed and fuel consumption, inter contracting times)
- Highly relevant industry: shipping carries 90% of international trade volume, all kinds of cargoes are shipped in various loading units, activities guided by an international legal framework (international law, regulation, registration)
- Cargoes are typically low valued, transportation costs have a large share in commodity prices. Marine transportation is moreover characterized by large economies of scale, and is highly capital intensive. Information about freight rate (developments) are important for decision making in the industry
- Beginning this year we rather naively used matched model indices to measure freight rate developments for bulk carriers in spot markets with somewhat surprising results

Introduction: monthly matched model freight rate index



Introduction: bi-monthly and quarterly indices



Introduction: some observations

- The unusual pattern of the index series has been noted before in Feenstra and Shapiro (2003) in the context of scanner data, and has led to Diewert et al. (2007, p.9)'s comment that 'normal index number theory will break down using weekly data with severe price bouncing data embedded in it'.
- In our example other things go wrong as well: (i) 'ship' may not be a proper definition of 'matching model'; (ii) many fixtures have no (imo) match in the next month
- What is going on in the maritime transportation industry?

Introduction: some specific questions

- What are fixture prices?
- What freight rate indices are currently available and how are they produced?
- What issues need to be resolved when collecting and compiling fixture data?
- How do the existing indices compare with unit value, matched model, and hedonic indices?
- What is the impact of taking fixture duration into account?

No attention will be paid to historical contributions to the measurement of freight rate indices by Isserlis (1938) and Harley (1988, 1989) for the UK; Yasuba (1978) for Japan; and North (1958, 1960) and Shah Mohammed and Williamson (2003) for the US. These studies focus more on the choice of representative routes than on index construction

Fixture parties

Broker (MRI, Clarkson, SSY, etc)

Owner (Bergen-son, Cosco, etc)

Charterer (Cargill, Krupp, etc)

Examples of fixtures

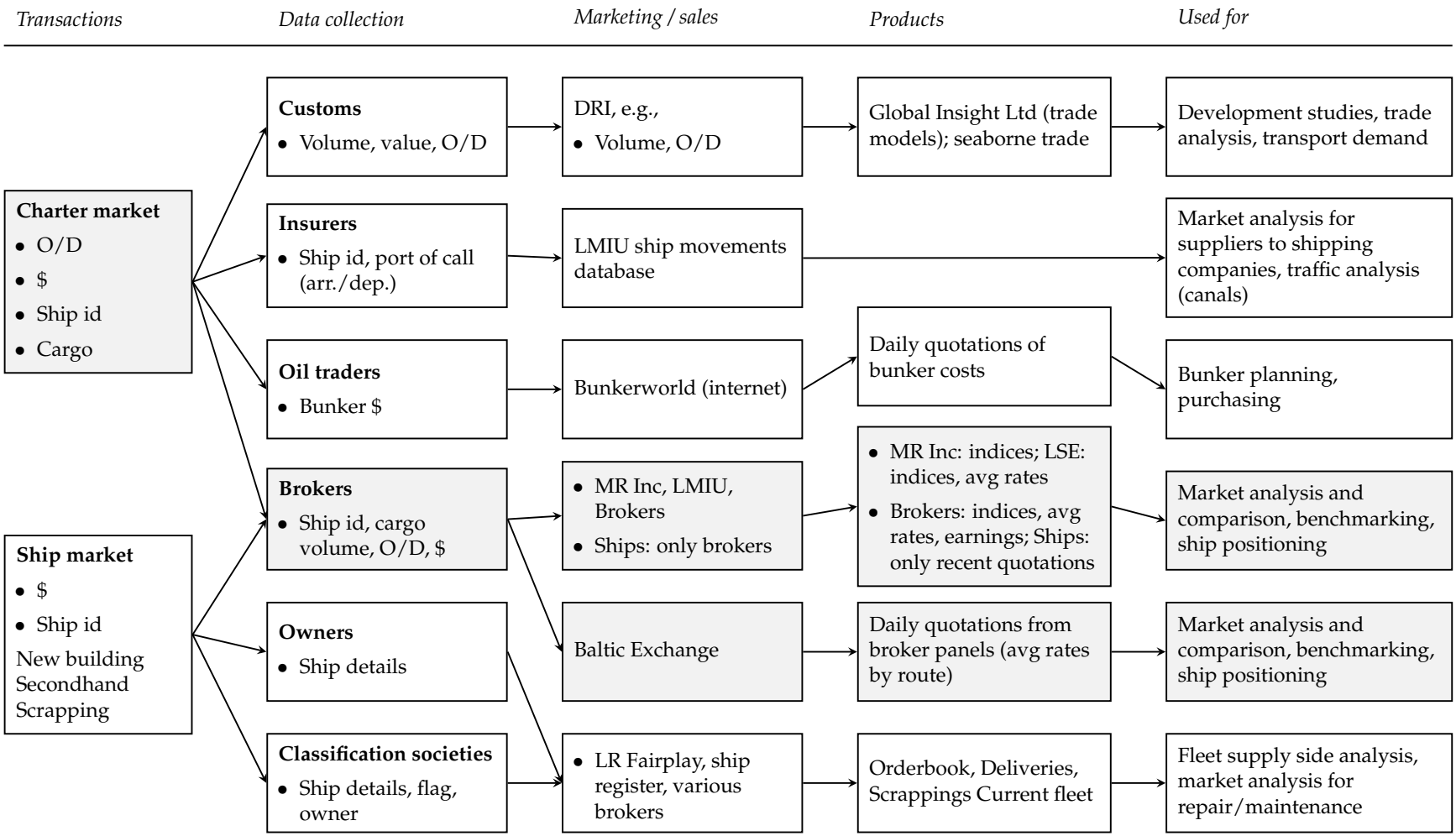
Erini (1982): Coal, Hroads-Antwerp; 125000-10%. Juli2030-FIO; 3,25 daysshinc25000tshinc (SwissMarin). 8.75$

Bulk carrier spot contract for owner Erini with a ship built in 1982. The shipment involves coal, transported from Hampton Roads (USA) to Antwerp. Total tonnage is 125000± 10%. The ship is expected in Hampton Road between 20 and 30 juli, free in and out. Loading may take 3.25 days including Sundays and holidays, at a rate of 25000 tons per day. Charterer SwissMarin agreed on a fixture price of 8.75$/ton.

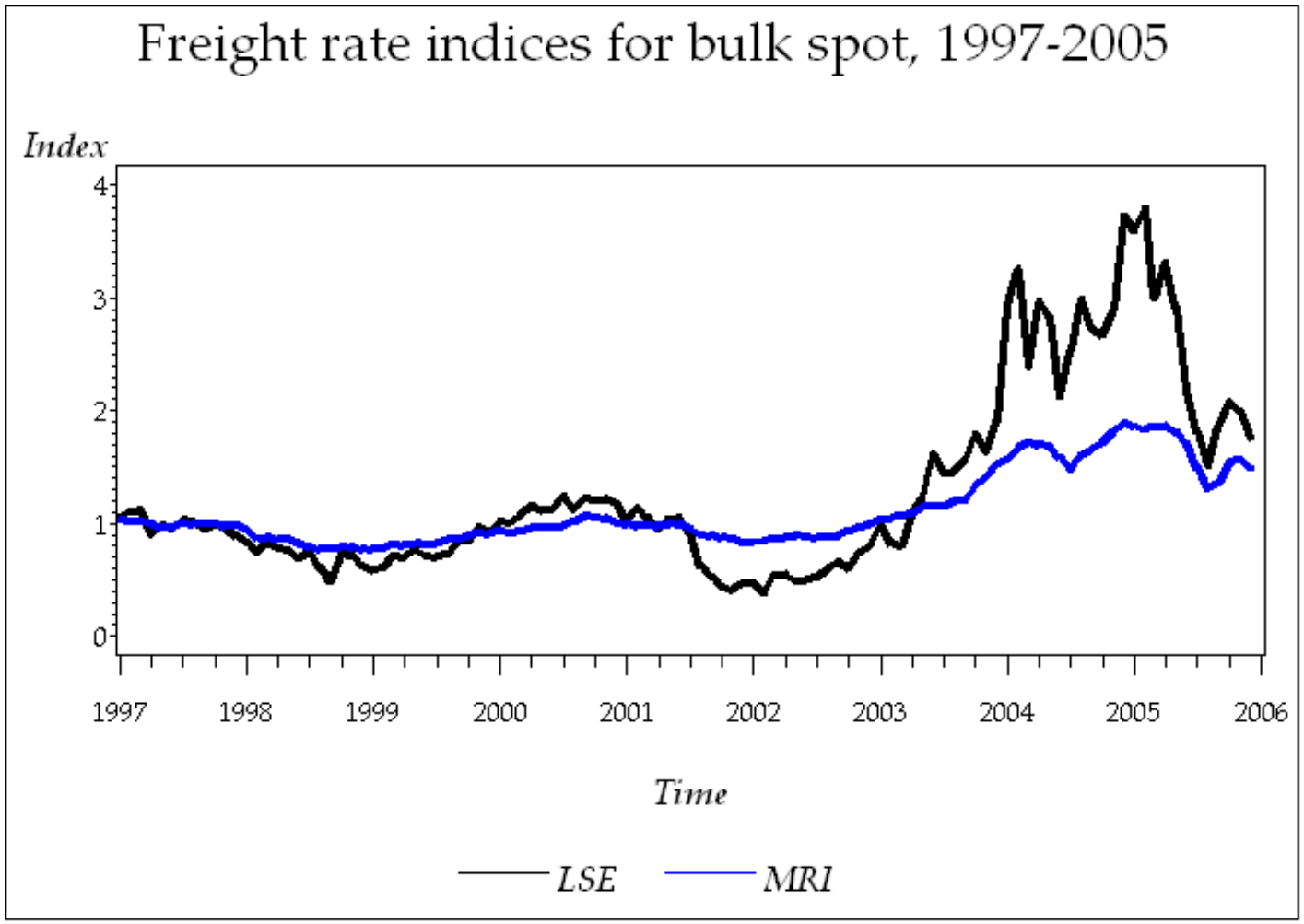
Habil Duckling (1981): Hvy grains, River Plate-China; 55000-5%. Juli1525-FIO; 7000t5000t (Wilmar). 34.75$

Bulk spot contract between owner Habil Duckling and charterer Wilmar to ship 55000± 5% tons heavy grain from River Plate (Argentina) to China at a rate of 34.75$/ton. Loading starts between 15 and 25 July.

Information collection and distribution



Indices published by LSE and MRI



Brief evaluation

- Much information collected and distributed in the marine transportation industry
- Many parties involved
- Existing indices show considerable differences
- Background existing indices roughly known (size weighted unit value indices), but not in detail (e.g. information used)

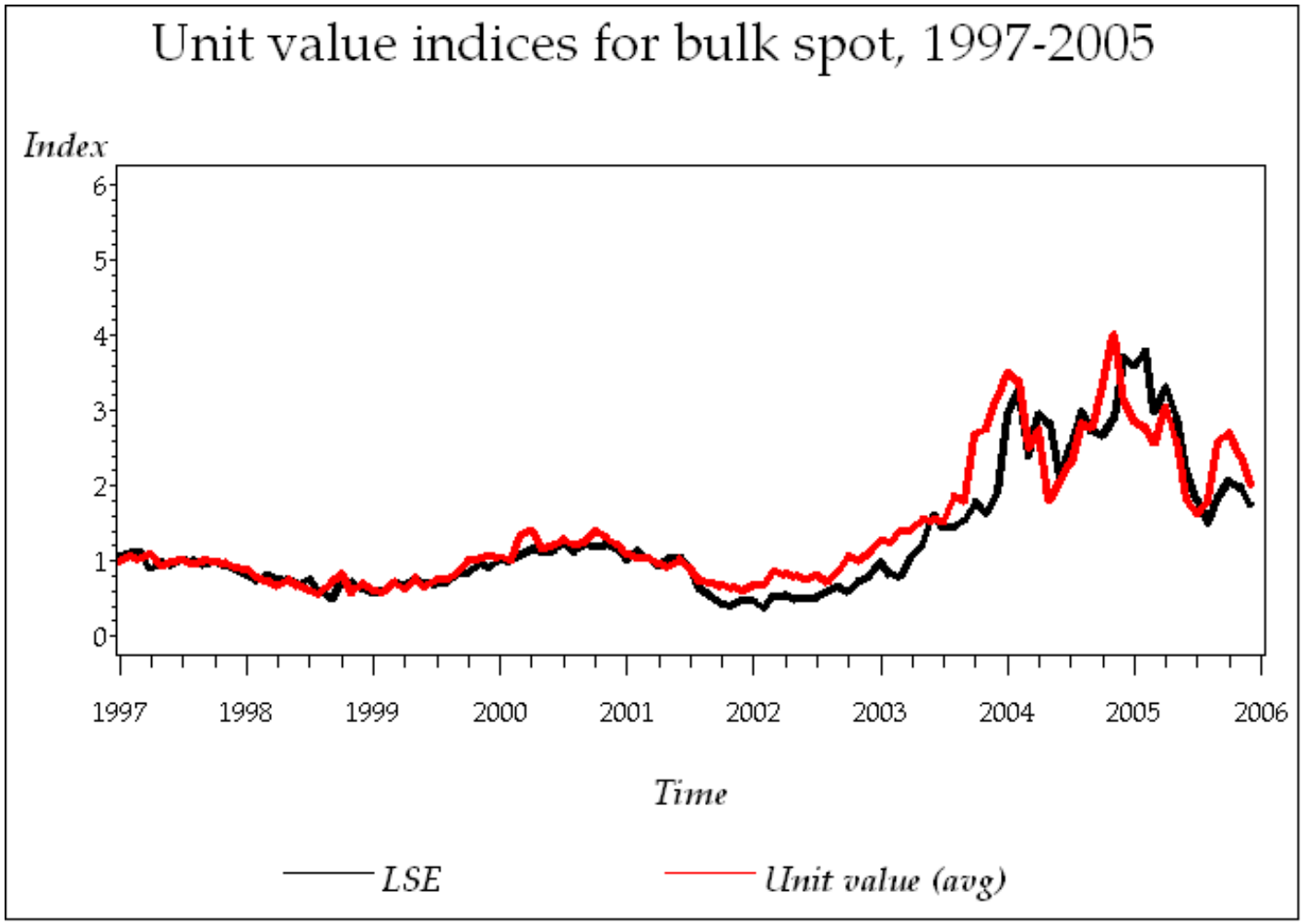
Data sources used

- Fixture data from Maritime Research Inc (MRI). Contains information about contract prices for spot/time contracts, bulk carriers/tankers. Spot prices for bulk carriers are in $/ton, while time charter rates are $/day. Tanker rates are in worldscale.
- Ship characteristics from LR Fairplay ship register. Contains information about various size measures, nationality of flag, country and year of build and design speed and consumption for all ships *in existence* in december 2005
- MRI fixture prices are used by many economic researchers, though others report the use of data supplied by Drewry Shipping Consultants, Clarkson Research Studies or LMIU
- Merging the two databases leads to a huge loss of records, partly caused by Fairplay's policy to remove scrapped ships from their current administration

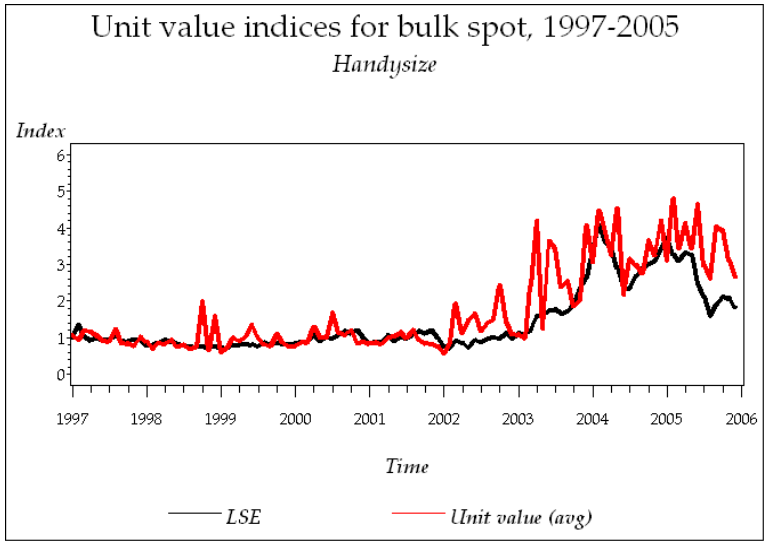
Calculation of unit value indices

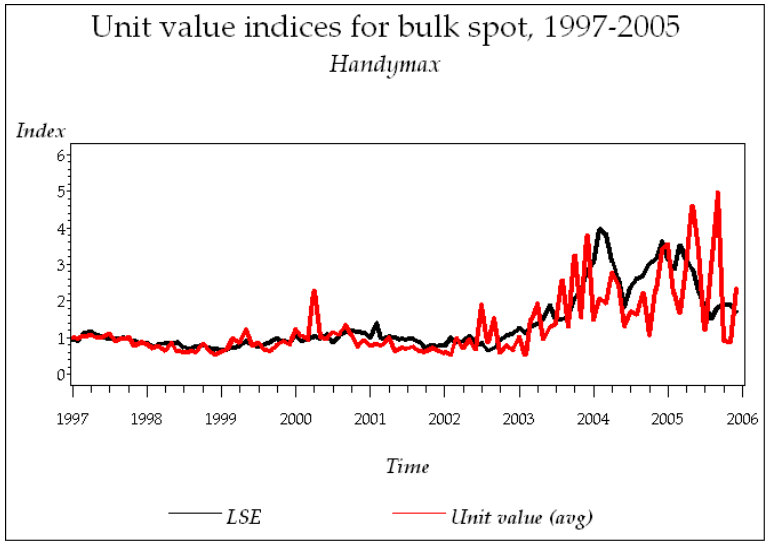
- Assume K elementary categories $k = 1, \ldots, K$ (combinations of ship type, contract type and size class) with varying numbers of fixtures n_{tk}. Fixture prices of individual contracts are denoted p_{tkj}
- Elementary prices per t and k are calculated as arithmetic average, median and geometric average weighted by size (in deadweight tonnage): p^A_{tk}, p^M_{tk} and p^G_{tk}
- For each segment, unit value freight rate indices are obtained as ratios of elementary prices and the base period price: $I^m_k(t, t_0) = p^m_{tk}/p^m_{t_0,k}$, with m the method to calculate the elementary price
- Aggregate freight rate indices by ship type (bulk/tanker) and contract type (spot/time charter) are determined as weighted averages of the elementary indices: $I^m_U(t, t_0) = \sum_{k=1}^{K} s_{tk} I^m_k(t, t_0)$, with weights $s_{tk} = d_{tk} / \sum_{k'=1}^{K} d_{tk'}$, $d_{tk} = \sum_{j=1}^{n_{tk}} d_{tkj}$ shipped tonnage in segment k

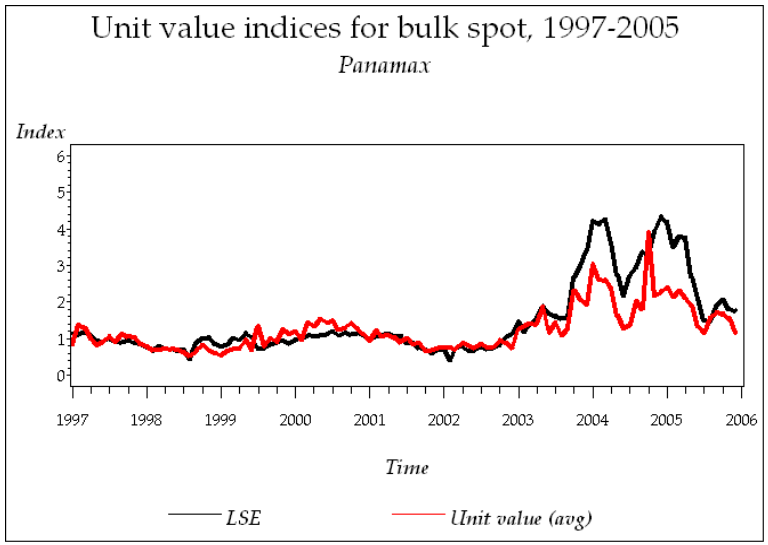
Aggregate unit value indices versus LSE

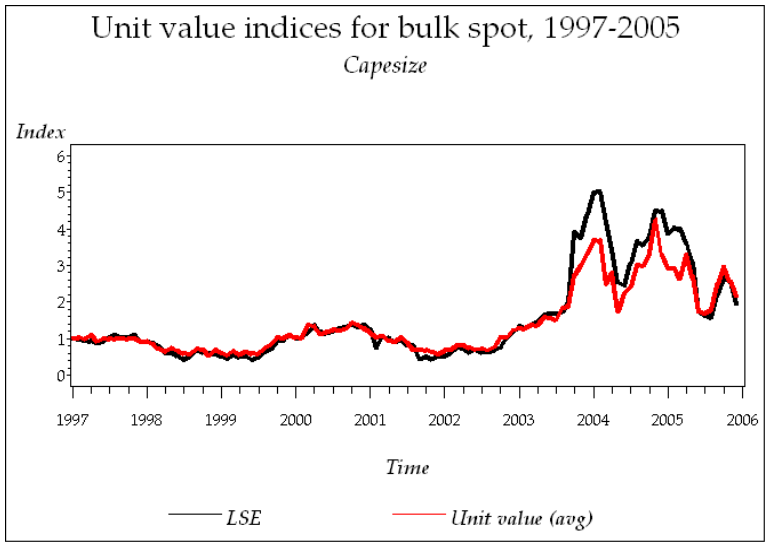


Unit value indices versus LSE per size class







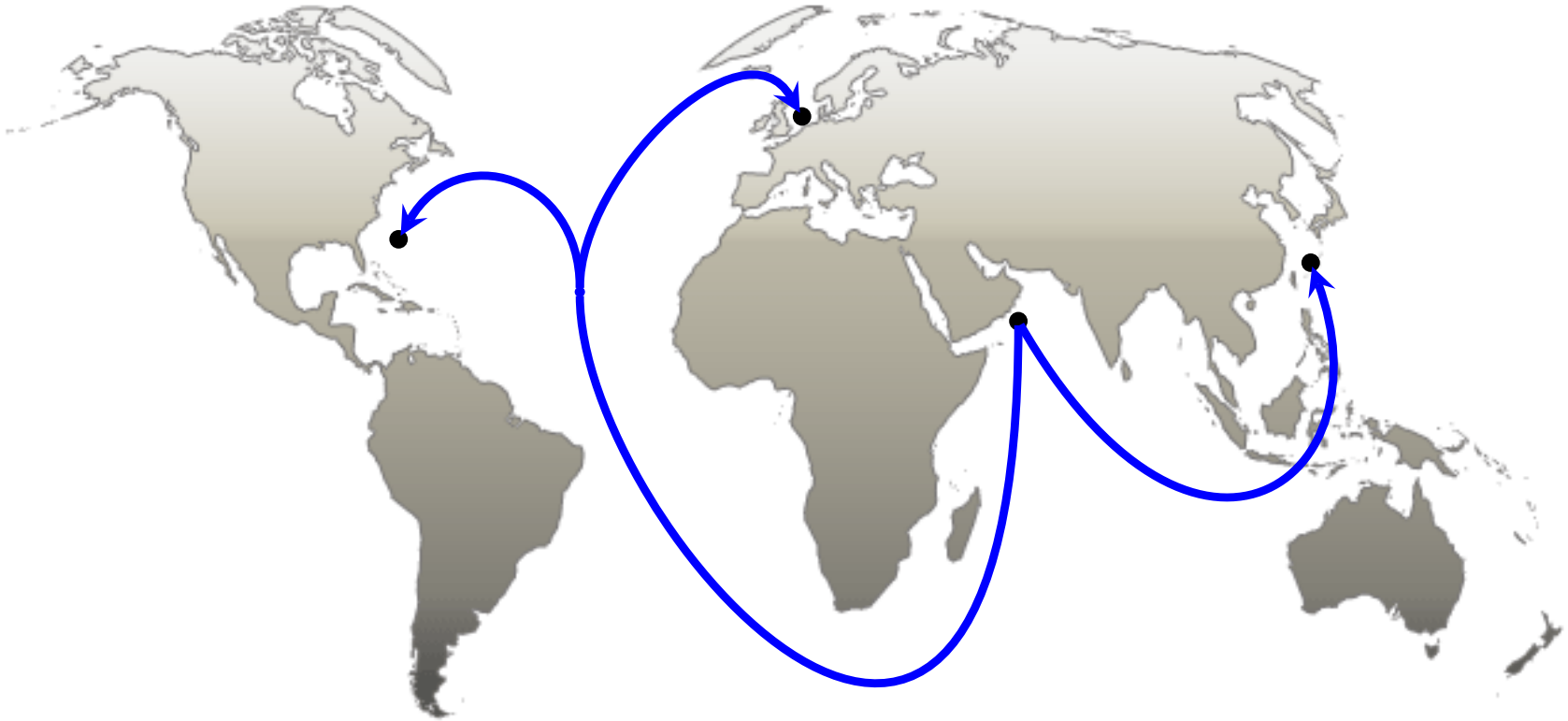


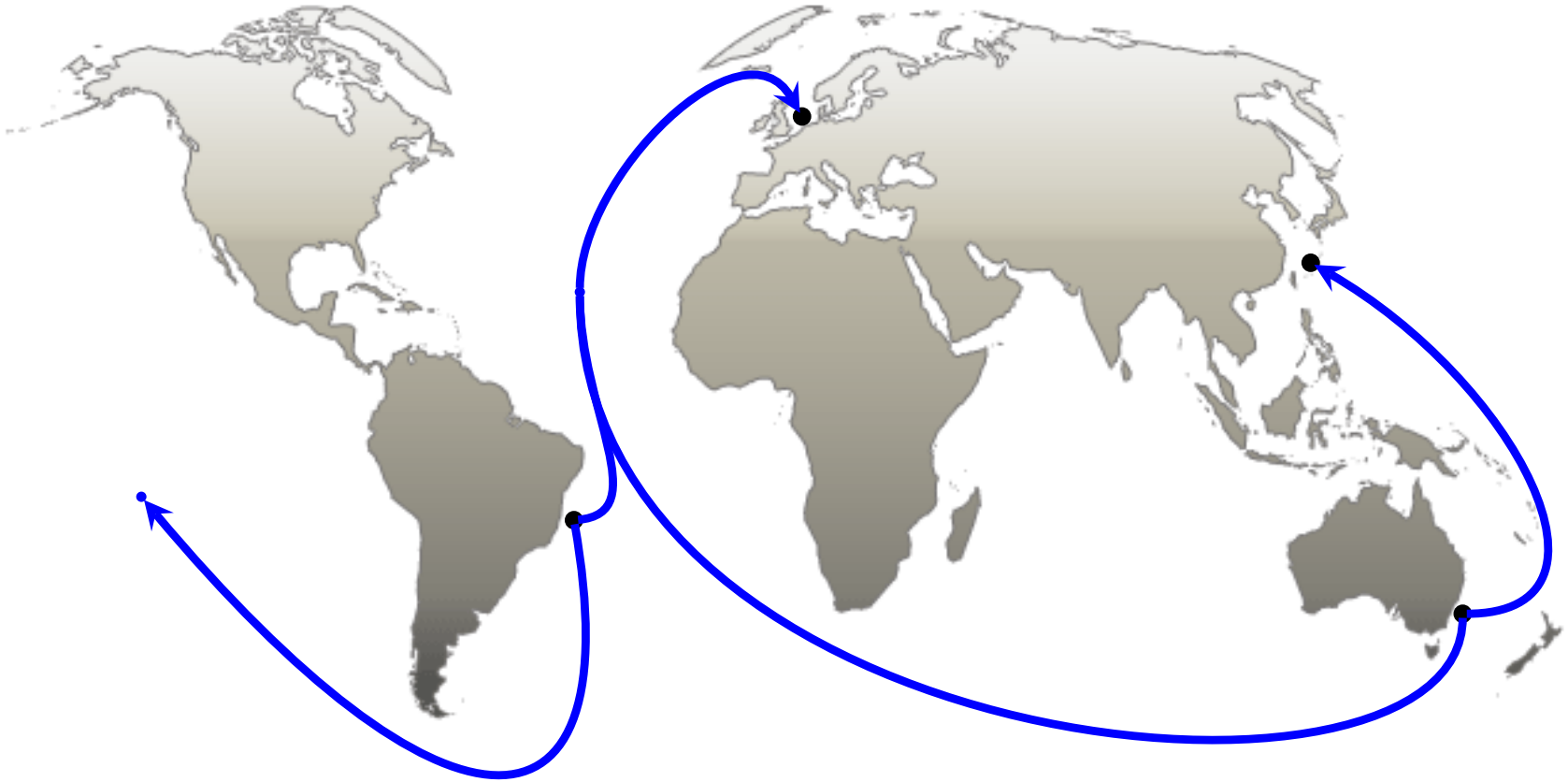
Results unit value indices

- Overall tendency of the freight rate developments equally reflected by existing LSE indices and calculated unit value indices
- Aggregate unit value index systematically above (2002-2004) and below (2005) the aggregate LSE index
- Unit value indices for Handysize and Handymax size classes show much more volatility than the corresponding LSE indices
- Unit value indices for the larger Panamax and Capesize classes are systematically below the corresponding LSE indices since about 2004

Matched model indices

- Unit value indices do not cope with period-to-period variations in the quality mix
- Matched model indices may be preferable, but matching on ship may not be sensible
- Instead matching by route may be an option





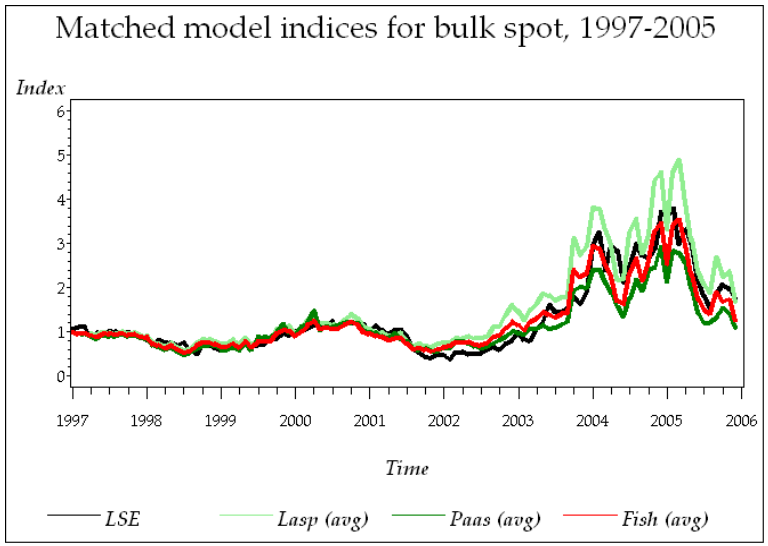
Calculation of matched model indices

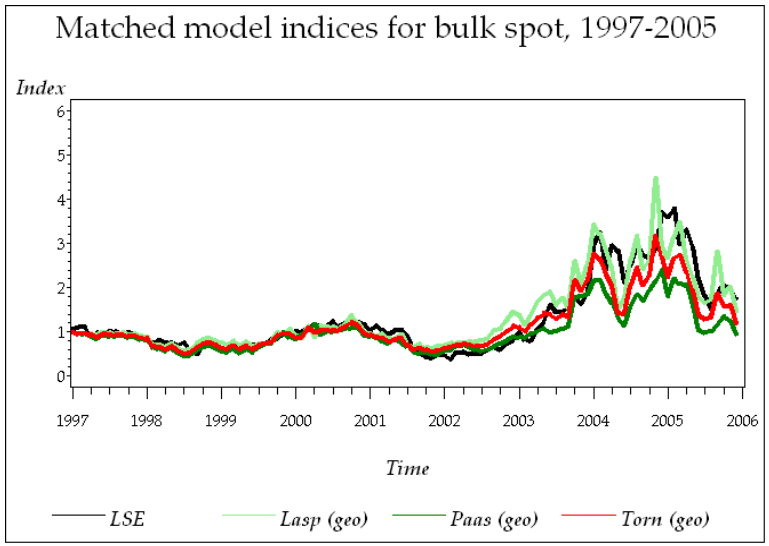
- Following previous notation, we denote the number of routes in each category and period as L_{tk}, and the number of fixtures on each route as n_{tkl}, $\sum_{l=1}^{L_{tk}} n_{tkl} = n_{tk}$ for all segments k.
- Elementary prices are calculated for all routes, segments and periods conform as arithmetic average p^A_{tkl}, geometric average p^G_{tkl} and median price p^M_{tkl} weighted by shipped tonnage
- A Laspeyres-like freight rate index for the (arithmetically weighted average) prices for two adjacent periods in segment k is defined as:

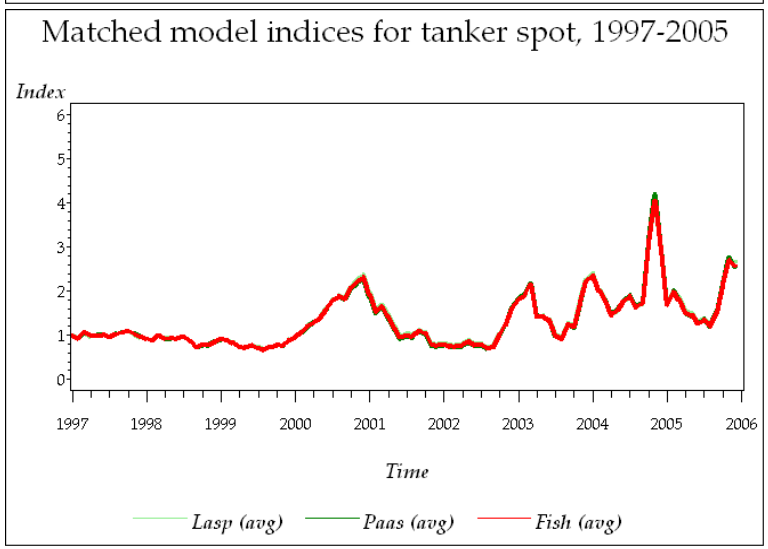
$$I^{L,A}_{t,t-1} = \frac{\sum_{l=1}^{L_{tk}} d_{t-1,kl} p^A_{tkl}}{\sum_{l=1}^{L_{tk}} d_{t-1,kl} p^A_{t-1,kl}} = \sum_{l=1}^{L_{tk}} w_{t-1,kl} \frac{p^A_{tkl}}{p^A_{t-1,kl}} \tag{1}$$

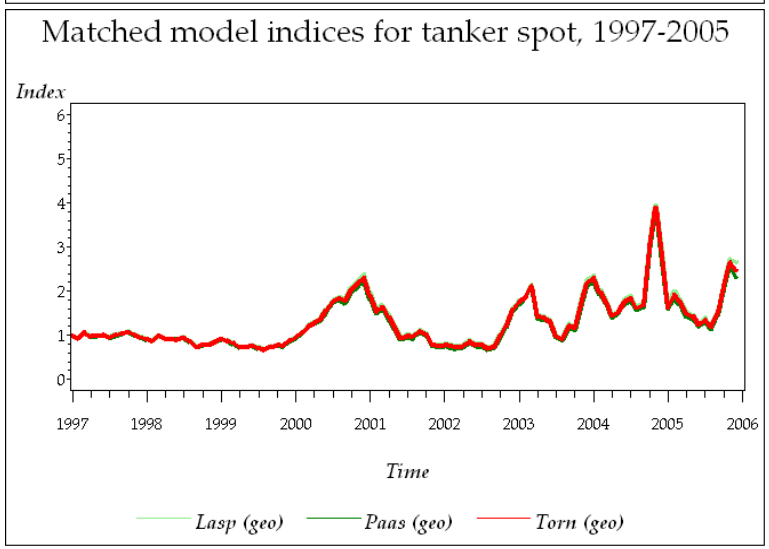
- The period-to-period indices are chained to have the index series over the entire period.
- In like manner, Paasche, Fisher, geometric Laspeyres and Paasche, and Törnqvist indices are obtained

Aggregate matched model indices versus LSE









Results matched model indices

- Overall tendency of the freight rate developments equally reflected by existing LSE indices, unit value and matched model indices
- Similar to unit value indices, the aggregate matched model Fisher index tends to be systematically above (2002-2004) and below (2004-) the aggregate LSE index. Huge differences can be observed between the Laspeyres and Paasche indices
- The geometric Laspeyres, Paasche and Törnqvist indices show less volatility, but their negative difference with the LSE index since 2004 is larger than that of the unit value indices
- For tanker spot prices, the differences between the various indices are marginal

Hedonic indices

- For a more comprehensive analyses of quality effects, we estimated hedonic indices using (adjacent period and fully) pooled models (Fisher and Shell, 1971; Muellbauer, 1974; Triplett, 2006):

$$\ln p_{tkj} = \beta_t + \pi_t dt_t + \mathbf{x}'_{tkj}\boldsymbol{\beta}_t + \epsilon_{tkj}$$

- Explanatory variables include ship size (in dwt), ship's age (in years) cf. Hall (1971); Berndt et al. (1995), contract duration (in days), and region of origin (dummies for nine regions, only for spot contracts)
- Upon estimation, index series are calculated in the usual way as:

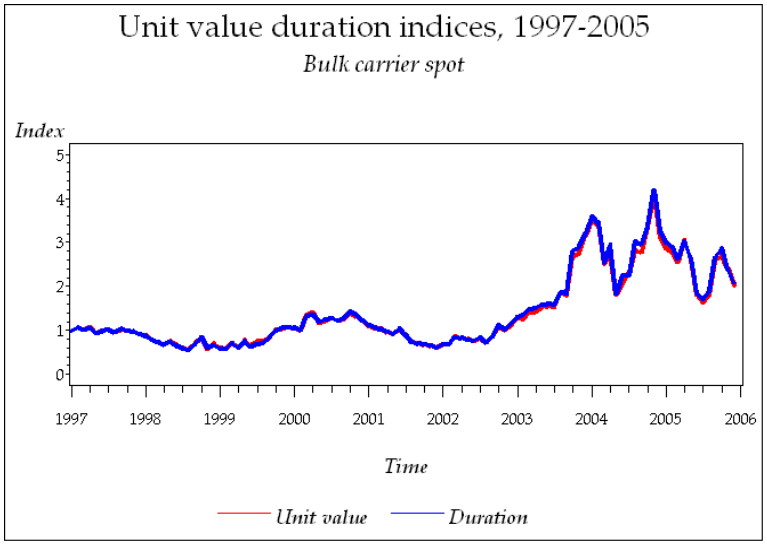
$$\begin{aligned} I^{H,A}_{t,t-1,\ldots,1} &= \exp(\hat{\pi}_t) I^{H,A}_{t-1,\ldots,1} \\ I^{H,P}_{t,t-1,\ldots,1} &= \exp(\hat{\pi}_t) \end{aligned}$$

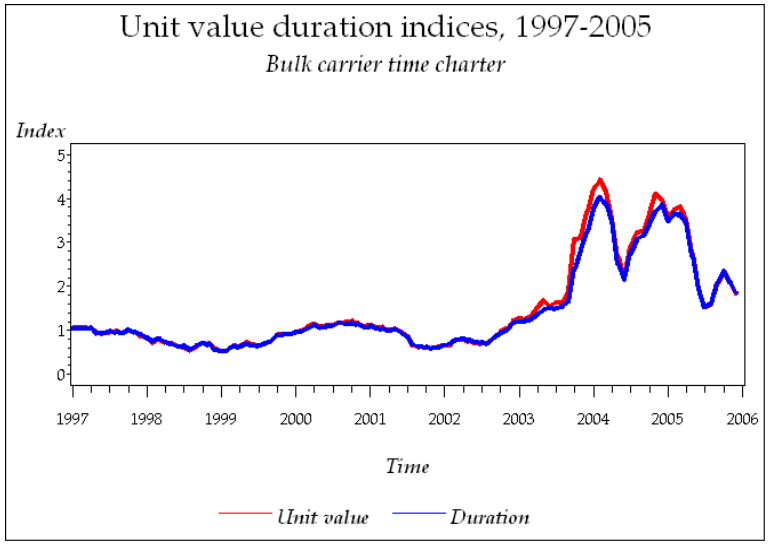
- Not many significant effects. Resulting hedonic indices largely similar to the unit value indices (tanker time charters are an exception)

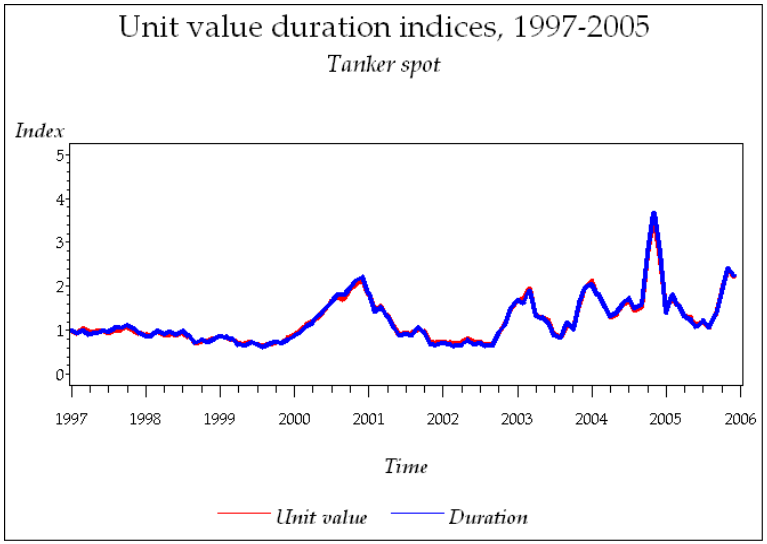
Unit value indices incorporating fixture duration

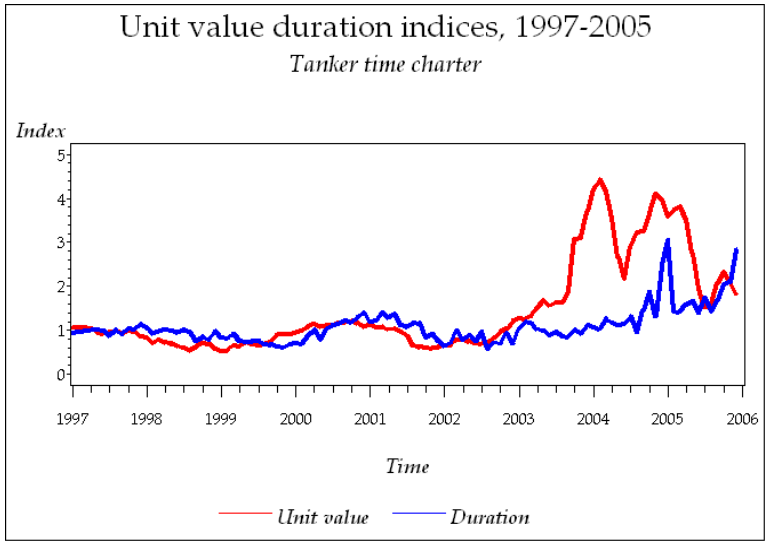
- Typically, commodity prices refer to transactions at a point in time, while fixture prices quoted in \$/ton or \$/day, reflect the idea of rental prices or user costs over a period of time
- Duration is an important feature of the transportation services agreed upon in the contract
- In the case of time charters, duration is an attribute of the fixture. In the case of spot contracts, duration can be estimated based on on/off dates of the contract, or route in combination with distance and speed information
- Including contract duration has two effects: (i) longer contracts receive more weight, (ii) contracts may extend into next period
- 'Duration' indices are obtained as unit value indices using the price information for every day of the contract period

Duration indices and unit value indices









Results duration indices

- The unit value indices and duration indices are very similar in the case of spot contracts (both bulk carriers and time charters)
- 'Slight' differences are observed for bulk carrier time charters (the average absolute difference between the bulk spot series is still 0.13 or 9.6% of the unit value index)
- Huge differences are observed for tanker time charters, particularly after 2003 when the duration index is much lower than the unit value index
- The latter difference is due to the longer term contracts in tanker trade, and partly to the a substantial number of short term ('lightering') tanker contracts that receive much less weight in the duration index
- The important role of duration argues against the combination of spot and time charters in a single index (as some of the Baltic Exchange and SSY capesize indices seem to do)

Concluding remarks

- Method matters: different index measures (unit value, matched model, hedonic, duration) yield different results
- Information matters: choices as to which fixtures (routes, contracts, etc) greatly influence outcomes
- Differences between index results tend to be larger at times when the number of fixtures is limited
- Industry indices are often based on thin data sets, especially when issued at a monthly or even weekly basis. Expert judgement may thus have a much larger effect on index measurement and subsequent decision making than currently realized by the industry
- The findings for the duration indices question the validity of existing indices using time charter information. This have consequences for recent studies of the time charter structure
- The uniqueness of fixtures opposes the idea that observed freight rates evolve steadily within periods

Suggestions and further research

- More transparency needed about index construction methods and relevant choices as to information used
- More theoretically, the issue of substitution between spot and time charter contracts deserves attention
- Consequences of using different indices for the findings of related studies in this field could be evaluated
- Specific issues related with Isserlis' index (based on the mid-range) need to be explored

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