Product Tanker Pool or Free Market? A Behavioral Approach

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Abstract
In the strategic policies for management of cargo ships, a shipowner evaluates the strategic alternative economically more favorable between hypotheses of choice at his disposal. In this article, we consider in particular behavioral approaches relating to the decision of product tanker pool or free market; which is the better strategic alternative? The main objective of this study is to estimate the more advantageous of these two strategic alternatives with the best risk profile for the shipowner. The correct decision will allow to obtain the best returns, thereby ensuring greater guarantees. Methodology is based on a choice criterion of the optimal business by a Multinomial Logit Model (MNL), which appraises the behavior of a shipowner in his decision making process. The result is to test an experimental application in maritime transport of oil products.

Introduction
The objective of a pool is to outperform the shipping markets, hence providing superior returns on shipping investment to customers, partners and investors. A pool is a collection of similar ship types under various ownerships... (Packard W.V. 1989) of the same sector.
Dynamic management of a pool’s shipping portfolio occurs through the employment of a unique approach integrating time-charter trade and ship owning with active freight, whilst implementing and developing advanced risk management and technology and performing to the highest industry standards of quality service and management.
In this article, we consider a ship owner who can choose between two different strategic alternatives to manage his vessels, considering the possibility of entrusting the vessel to a pool with varying risk profiles (lower, moderate and high) or to opt for the market with two risk profiles (time charter and voyage charter).
The main objective of this study is to estimate the more advantageous of these two strategic alternatives with the best risk profile for the ship owner as mentioned.
above. The correct decision will allow the ship owner to obtain the best returns, thereby ensuring greater guarantees.

The chosen criterion of the optimal business considers a Multinomial Logit Model (MNL), which appraises the behavior of ship owners in their decision making process.

The model uses a random utility function with variables including average time charter, gross freight, market risk, time/voyage charter. The database used in the model derives from a Stated Preference survey (SP) provided by shipping companies.

**Demand and supply dynamics of product tankers**

From an overall viewpoint, it is interesting to report some information about the demand and supply dynamics and earnings of product tankers in the year 2014.

In general, freight rates are always difficult to predict and on the global economic scene, the only sector currently making high market returns, and with similar future prospects, is crude oil tankers. It is no surprise, therefore, that owners are investing in oil shipping.

The demand for crude oil tankers is seasonally strong at present. So what is fueling the stronger freight market? It can only be new building, because the oil tanker demolition segment has contributed very little, in line with the all-year BIMCO forecast (2015).

In the product tanker sector, the drop in oil prices may have stimulated demand for LR1, LR2, Handy size and MR immediately, since they are separate segments. Handy and MR then caught up in a market in which the prices suddenly moved upwards as compared to the rather flat and steady oil prices. The freight rate at the end of 2014 was at a six-year-high for all product tankers.

In the years from 2008 to 2013, the demand for product tankers shows growth of about 4.6% y-o-y in 2013 (table 1). Moreover, it also highlights that entrepreneurial choices have favored product tankers of larger dimensions (80,000-120,000 dwt). These vessels have been purchased at the best conditions, increasing their demand by about 16% in 2013 compared to the previous year; the same applies to medium class vessels (60,000-80,000 dwt).

Throughout the same period, on the other hand, supply is positive (table 2) and characterized by the presence of a fleet surplus.

<table>
<thead>
<tr>
<th>Clusters dwt</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Trend 2013</th>
<th>Years 2008/2012 % change</th>
<th>Years 2012/2013 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-60.000 dwt</td>
<td>53.7</td>
<td>53.3</td>
<td>53.7</td>
<td>54.6</td>
<td>53.4</td>
<td>51.0</td>
<td>-0.6</td>
<td>-4.5</td>
</tr>
<tr>
<td>60-80.00 dwt</td>
<td>14.2</td>
<td>14.1</td>
<td>13.3</td>
<td>12.7</td>
<td>13.3</td>
<td>15.4</td>
<td>-6.3</td>
<td>16</td>
</tr>
<tr>
<td>80-120.00 dwt</td>
<td>21.7</td>
<td>21.0</td>
<td>21.4</td>
<td>24.2</td>
<td>28.8</td>
<td>33.4</td>
<td>32.7</td>
<td>16</td>
</tr>
<tr>
<td>total</td>
<td>89.6</td>
<td>88.5</td>
<td>88.4</td>
<td>91.6</td>
<td>95.5</td>
<td>99.9</td>
<td>6.6</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*Source: Clarkson Oil and Tanker Trades Outlook 2013*
Table 2: Product fleet growth 2008-2013

<table>
<thead>
<tr>
<th>Clusters dwt</th>
<th>Mldwt</th>
<th>Year 2008</th>
<th>Year 2009</th>
<th>Year 2010</th>
<th>Year 2011</th>
<th>Year 2012</th>
<th>Trend 2013</th>
<th>2013 % change</th>
<th>2012/2013 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-60.000 dwt</td>
<td>54.9</td>
<td>59.3</td>
<td>60.4</td>
<td>61.6</td>
<td>62.6</td>
<td>64.8</td>
<td></td>
<td>14.0</td>
<td>3.6</td>
</tr>
<tr>
<td>60-80.000 dwt</td>
<td>17.1</td>
<td>19.3</td>
<td>20.9</td>
<td>22.6</td>
<td>23.2</td>
<td>24.1</td>
<td></td>
<td>35.7</td>
<td>3.8</td>
</tr>
<tr>
<td>80-120.000 dwt</td>
<td>20</td>
<td>23.5</td>
<td>26.1</td>
<td>27.2</td>
<td>27.5</td>
<td>27.6</td>
<td></td>
<td>37.5</td>
<td>0.3</td>
</tr>
<tr>
<td>total</td>
<td>92</td>
<td>102.2</td>
<td>107.4</td>
<td>111.4</td>
<td>113.3</td>
<td>116.5</td>
<td></td>
<td>23.2</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Source:Clarkson Oil and Tanker Trades Outlook 2013

A cross analysis of the whole sector (2008-2013) generates a different progress profile: in effect, the increasing dynamic of supply compared to demand reaches a surplus of about 20 Mln dwt. This produces a critical situation in which market fluctuations create the conditions for lowering freight rates, resulting in reduced profits and forcing ship owners into financial speculations.

In these markets, orders have dried up, but during the first half of 2014, 57 new ships were ordered. This year is set to be another big delivery year for MR with 75 being delivered so far and 15 potentially still to come. Thus, 2014 has already topped the total for 2013, which saw 72 new MR, and the MR fleet has grown by 7.4% year-to-date.

Market conditions in the first half of the year resulted in a large number of postponements taking place but annual supply growth is still strong. Cancellations and postponements of investment in the oil industry may follow, reducing production and oil prices.

Lower oil prices may continue to generate higher demand for product tankers and could lead to some positive trends. This will happen in the case of seasonally lower oil demand and an unchanged level of oil supply, because producers need time to adjust output to a new normal level.

In this segment, with a supply that increased from last year – and which is set to go even higher in 2015 – the efforts made by individual owners to alleviate the pressure from oversupply appear to be bearing fruit. Going forward, it is important for product tankers not to depress freight rates.

Earnings in 2014, on the benchmark routes for LR1, remain around USD 15,000-25,000 per day; LR2 are also enjoying a stronger market, around USD 20,000-35,000 per day; handy perform strongly at USD 18,000-30,000 per day, with MR averaging around USD 12,500-25,000 per day, as shown in Figure 1 (BIMCO, Clarkson 2015).
Figure 1: Product tanker earnings 2014

<table>
<thead>
<tr>
<th>Product Tanker Earnings</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD per day</td>
<td></td>
</tr>
<tr>
<td>Jan 2014</td>
<td>LR1</td>
</tr>
<tr>
<td>Feb 2014</td>
<td>Handy</td>
</tr>
<tr>
<td>Mar 2014</td>
<td>MR</td>
</tr>
<tr>
<td>Apr 2014</td>
<td>LR2</td>
</tr>
<tr>
<td>May 2014</td>
<td></td>
</tr>
<tr>
<td>Jun 2014</td>
<td></td>
</tr>
<tr>
<td>Jul 2014</td>
<td></td>
</tr>
<tr>
<td>Aug 2014</td>
<td></td>
</tr>
<tr>
<td>Sep 2014</td>
<td></td>
</tr>
<tr>
<td>Oct 2014</td>
<td></td>
</tr>
<tr>
<td>Nov 2014</td>
<td></td>
</tr>
<tr>
<td>Source: BIMCO, Clarksons</td>
<td></td>
</tr>
</tbody>
</table>

### Workability of Pools

There are numerous different types of pool; in our case, we have considered Product Tanker Pools covering various size ranges of ships. The Pool Distribution System evaluates vessels on their TCE (time charter employment) performance on certain FFA (Forward Freight Agreement) routes and their trading characteristics such as DWT, IMO status, loading capacities, trading exclusion.

The purpose of a pool is to secure the highest possible earnings for participants through the commercial employment and operation of vessels in the pool. Pool Earnings are pooled together and distributed to the participants on a monthly basis, according to the pool points of each vessel and trading days in the relevant period.

The management and control of business activities are guaranteed by the Pool Administration; in this way, ship owners can take advantage of the experience of an independent commercial team which works to make the best use of ships. The pool optimizes market results and the distribution of profits to the owners, especially by means of contracts of affreightment, fleet optimization, a strong marketing position, penetration of protected markets (Haralambides H.E. 1996).

The Pool Administration enters effectively into a contract as a single entity and may transact and conclude a series of operations, negotiating voyage/time charter and better financing possibilities.

In such a way, with careful management of the client portfolio, the pool tries to guarantee the highest revenue distribution to the members according to the conditions stipulated in the contract, providing ship owners with the best possible service and reducing risk linked to market fluctuations.

The contracts have exact durations from individual quarters up to several years. Briefly speaking, the choice of a pool is important in order to achieve above:

- market returns by placing vessels in shipping pools
provide ship owners and traders with a better and more reliable service
- reducing their performance risk and increasing their average returns
- benefit from a range of products for different risk profiles offered by the
pool management.

In this paper, we will attempt to evaluate the conditions in which the strategic choice of
a pool may be the best alternative for the owner. However, freight rates, voyage
expenditure, revenue forecasts, quality of transport services, type of load, route and
destination of the cargo, are all essential elements to consider in relation to
decisions concerning a pool.

Literature review

Behavioural model. The behavioral models attempt to explain the freight and
passenger transportation as the result of a process of utility maximization by a known
decision-maker. A brief chronology of the most significant developments of the behavioral
theory can be summarized thus.
Thurstone in 1927 introduced the law in which the alternative choice for the perceived
usefulness differs utility systematic less than a random error and demonstrates its
probabilistic approach. Marschak in 1950 generalized the law of Thurstone and
analyzed the relations between the random utility functions and choice probabilities,
creating RUM models. Luce in 1959 showed that the ratio of the probability of choice for
i and j is the same for each set of choices and called IIA (Independence from Irrelevant
Alternatives). Quandt and Baumol in 1996 apply a model of modal distribution in the
analysis of transport demand of a multimodal corridor by binomial and multinomial logit
The inclusive utility was introduced as a weighted average of the probabilities of
systematic utility and Ben-Akivain 1973 develops the log sum formula for the exact
calculation of inclusive values. Others examples may be found in Watson, Hartwig and
Linton (1974). McFadden in 1974 and Ben-Akiva and Lerman in 1985 justify the use of
models RUM in nested logit application. This approach leads to the development of
GEV models, while the analysis of Daly 1987 places the basis for the equivalence
between the RUM choice model and those based on consumer utility. Daughety
(1979), Daughety and Inaba (1981) provided a more extensive but similar modeling
framework which is grounded in the economic theory of the firm McFadden, Winston,
Ben-Akiva and Morikawain 1990 develop a jointly revealed preferences (RP) and stated
preferences (SP) analysis. From 1990 onwards there is a further development of models of
choice consistent with the approach RUM, including GEV and hierarchical model.
For detailed Regan and Garrido (2000) and McFadden (1989).
Interesting in the desegregate - behavioural contest the work of Abdelwahab and
Sargious (1992) and Abdelwahab (1998) tackle the simultaneity of the decisions in the
freight market, through a utility maximisation discrete-continuous joint decision model
for mode choice and shipment size.
McFadden and Train in 2000, Trainin 2000 and 2001, Train and Sonnier in 2005, and
Train in 2008a-b developed a mixed logit model from Bayesian approach, with
correlated or uncorrelated parameter. One of the more advanced application on panel
data management.
As regards the shipper-carrier behavioural interaction there are different studies, Gilmour (1976), McGinnis (1979), Gray (1982), examine shipper perceptions of freight modes. Yield, speed and reliability, rather than cost are the attributes of modes considered most important to the shipper - carrier interaction. Three other examples are presented by Boerkamps, Van Bingsbergen and Bovy (2000), Holguin-Veras J. and Walton C.M., (1996), Holguin-Veras (2000), Catalani (2008). The formers describes a commodity-based freight model that incorporates supply chains. The latter estimate intermodal freight carriers based on profit maximization, market equilibrium and intelligent technology of container terminal management. The third the ship owner behavioural choices in port accessibility and maritime routing.

As regards the shipper - carrier relationship some of the mode choice models analyze the option of using vehicles of one’s own fleet. Hall and Rancer (1995) describe a decision support system that allocates vehicles in the presence of private fleet and carrier option. On the contrary, Crum and Allen (1990) examine the impact of logistics strategies of JIT systems on shipper-carrier relationships.

Quandt and Baumolin 1966 analyzed the level of service for different transport aggregate modes based on land use characteristics. The model utilizes a gravity demand function with inelastic modal splitting. Morton (1969), Boyer (1977) based their analysis on aggregate logit freight rates and level of service for each mode. Catalani–Zamparelli (2010) analysed the shipper-carrier interaction of a leader company on home care exports from Italy. Cascetta (2001) with an overall and complete volume on transportation planning, Catalani and Zamparelli 2010 based their analyses on desegregate data of RP survey on board a cruise ship to test a behavioral model of passenger pricing choosing with MNL and HEV model.

Pool agreements. The idea behind bulk shipping pools is that usually similar tonnages pooled together and there is not much scope in trying to enter a bulk carrier, a tanker and a reefer in the same pool. No matter how appealing such an idea might appear, the predominant reason for creating a pool, as explained below, is the possibility of undertaking large contracts of affreightment (COA). Packard in 1989: "...a pool is a collection of similar vessel types under various ownerships, where weighing earnings are distributed to individual owners under a pre-arranged system". Successively Murray, in 1994, defined shipping pools "...joint ventures between shipowners to pool vessels of similar types, with central administration..." Haralambides, in 1996, resumes the thought of the two previous authors in complete manner structure and operations of bulk shipping pools.

In March 2005 EU sentenced that Shipping Pool Agreements could be illegal. Shipping pool agreements need to be reviewed and possibly revised, if they are to meet new EU regulations.

In 13th September 2007 EU Antitrust drafts guidelines for maritime transport companies have to themselves assess whether their agreements with other companies, whether competitors, suppliers or distributors, comply with EU competition rules operating under a single administration (e.g. a pool manager) responsible for the commercial management and the commercial operation as Packard, Murray, Haralambides.

BIMCO publishes in 2012 the industry’s first standard pooling agreement for use by tramp pools operating in dry and liquid bulk trades primarily on a COA or spot basis. Lorenzon and Nazzini in 2009 argued that Maritime Transport Guideline of EU do not provided any indication as the circumstances in which may constitute an infringement of art 81 by object. As regards, on the contrary, fixing price element it increases significantly the risk for the pool managers and the participating ship owners.
Actually we have operative, in all maritime transport of passenger and freight, over the world, about 1500 pools as Federal Maritime Commission 2015.

**Random Utility Maximization theory (RUM)**

In the economic analysis conducted in the field of transport wide uses made of discrete choice models that help to describe, understand and predict the decisions of the operators and in which the choice set is represented by a finite number of possibilities. The development of these models is founded upon the random utility function and its maximization by decision-makers (RUM - Random Utility Maximization). This was introduced for the first time in 1960 by Marschak who contributed to its theoretical development.

The theory of random utility considers the choices of individuals using the probabilistic approach. Analysts do not know how the next person will behave, so they will use a survey based on a statistically relevant sample.

In this article we have used a sample based on the repeated choices of different owners (D’Amato Group).

RUM models consider that the individual will choose the alternative \( j \) with the maximum utility.

The output of these models provides the probability of each alternative for each individual. Random utility models are therefore based on the assumption that every operator is a decision maker who maximizes the utility relative to his choices.

Under this hypothesis, it is not possible to predict with certainty which alternative the decision maker will choose, while it is possible to know the probability that chooses the alternative \( j \), as the probability that this alternative has perceived utility greater than all other available alternatives (McFadden D. and Winston C. 1981):

\[
p^i[j / I^i] = \Pr[U^i_j > U^i_k; \forall k \neq j, k \in I^i] \quad (1)
\]

The perceived utility \( U^i_j \) can be expressed by the sum of the systematic utility \( V^i_j \), which represents the mean of the expected value of perceived utility among all users with the same context of choice for the decision maker \( I \) (alternatives and attributes), and a random residual \( \varepsilon^i_j \) that represents the gap of perceived utility by \( I \) from that value

\[
U^i_j = V^i_j + \varepsilon^i_j; \forall j \in I^i
\]

and

\[
p^i[j / I^i] = \Pr[V^i_j - V^i_k > \varepsilon^i_k - \varepsilon^i_j; \forall k \neq j, k \in I^i] \quad (3)
\]
The choice model shown in (3) is represented by a choice map that associates to each vector of systematic utilities \( V_i \) a vector of choice probability \( p_i = \pi(V_i) \), whose components are, by definition of probability, in the range \([0,1]\).

From (3) it is clear that the choice probability of an alternative depends on the values of the systematic utility of all available alternatives and on the law of joint distribution of residual random \( \varepsilon \).

A dummy variable is introduced in the systematic utility of generic alternative \( j \): its value \( 1 \) for alternative \( j \) and 0 for the all others. This variable is called the ASA (Alternative Specific Attribute) and its coefficient \( \beta \) is noted as Alternative Specific Constant (ASC). This constant is a kind of known term of the systematic utility. These general notes about random utility models will be used later in this study.

**Multinomial logit model**

The Multinomial logit model (MNL) is well defined in literature. The model, through selected and advanced applications, reviews the impact of obvious and non-obvious attributes, such as market risk, highlighting the importance of the Stated Preference (SP) survey data disaggregate for a robust assessment of the parameters of the model (McFadden D. 1974); (Oum T. 1979); (Ben-Akiva M. and Lerman S. 1985). At the same time, it retains a closed analytical expression with multiple observations of the same decision-maker underlying the multinomial logit model (Ben Akiva M., Maersman H., Van de Voorde E. 2013).

Also of interest is the desegregate-behavioral model theory of freight demand modeling in the works of Abdelwahab W. and Sargious M. (1992), Catalani M. and Zamparelli S. (2010).

The Multinomial Logit is based on the hypothesis that the random residuals \( \varepsilon_j \) relating to the different alternatives are independently and identically distributed (i.i.d.) according to a Gumbel random variable (r.v.) of zero mean and parameter \( \theta \) (Cascetta E. 2001).

The marginal probability distribution function of each random residual is given by:

\[
F_{\varepsilon_j}(x) = \Pr[\varepsilon_j \leq x] = \exp[-\exp(-x/\theta - \Phi)]
\]

where \( \Phi \) is the constant of Euler (\( \Phi \approx 0.577 \)).

In particular, mean and variance of the Gumbel variable are:

\[
E[\varepsilon_j] = 0 \quad \forall j
\]

\[
\text{Var}[\varepsilon_j] = \sigma^2_{\varepsilon} = \frac{\pi^2}{6}\theta^2 \quad \forall j
\]

\[
\text{Cov}(\varepsilon_j, \varepsilon_h) = 0 \quad \forall j, h \in I
\]
The perceived utilities $U_j$, sum of a constant $V_j$ and the random variable $\varepsilon_j$, is also a Gumbel random variable with probability distribution function, mean and variance given by:

$$F_{U_j}(U)=\Pr[V_j+\varepsilon_j \leq U]=\Pr[\varepsilon_j \leq U-V_j]=\exp[-\exp(-(U-V_j)/\theta-\Phi)]$$

$$E[U_j]=V_j \text{\quad var } [U_j]=\frac{\pi^2}{6}\theta^2$$

The Gumbel variable has an important property known as stability respect to maximization, that is to say the variable $U_M$:

$$U_M = \max_j \{U_j\}$$

is again a Gumbel variable with parameters $0$ and $V_M$ given by:

$$V_M = E[U_M]=\theta \ln \sum_j \exp(V_j / \theta)$$

its analytical structure, is defined "logsum":

$$Y = \ln \sum_j \exp(V_j / \theta)$$

The probability of choosing alternative $j$ among those available, belonging to the set of choices $(1,2,..m) \in I$, can be expressed in closed form as:

$$p[j]=\frac{\exp(V_j / \theta)}{\sum_{i=1}^{m}\exp(V_i / \theta)}$$

Expression (12) defines the probability of the Multinomial Logit model, which is one of the most used random utility models.

**Data input and MNL model calibration**

In this article, a MNL model is applied to ship owners’ behavior in choosing either to entrust the management of their ship to a Pool or to entrust it to the free market. In particular, these two strategic alternatives offer, in total, five different risk profiles.

The detailed risk profiles are:

- **for the Pool**
  - lower risk (spot revenue with collar) – protection against sharp market drops. The spot revenue between an agreed floor and an agreed ceiling;
- moderate risk (timecharter) – the income is fixed as under a timecharter, giving protection from a declining free spot market;
- high risk (spot Tonnage) – the vessel of an owner is traded in a large pool of similar vessels, optimizing earnings and reducing risk in the short-term freight market. The revenue is a share of the pool’s total income and will be benchmarked against spot market indices;

*for the free market*

- time charter risk – the owners operate in competition and subject to the dynamics of trade oscillation with certain protection only through long-term contracts;
- voyage charter risk – this is higher risk with freight rates deriving from market trends.

The time charter risk and voyage charter risk are strongly affected by the dynamics of the free market, whereas a pool provides a prompt response to changing market conditions. In these conditions, the alternatives considered (pool and free market) are sufficiently distinct, and therefore, the hypothesis on the independence of irrelevant alternatives (IIA) of random residues can be accepted.

The input data were obtained from a survey based on stated preferences (SP) (Hensher D.A, Rose J.M, and Greene H. 2005) of ship owners. It was necessary to define the type and number of attributes to include in the choice alternatives. The quantitative variables are: voyage days, gross freight, voyage expenditure, total demurrage result, and average time charter; the qualitative variable is the total risk. The SP survey is currently organized by games based on Full Factorial Design. The framework of the games was obtained by choosing a subset of scenarios, using specific software.

Using dominance analysis, in respect of the IIA rule, the scenarios with a dominant preference were excluded. The survey was carried out on a sample of 25 ships. The database is confidential.

The structure of the model is represented by the following utility function $U$ with attributes.

$$U = b_1*VD+b_2*GF+b_3*DMG+b_4*VYE+b_5*TTL+b_6*AVGTC+b_7*RSKT(13)$$

Where:

- $VD$ = Voyage days
- $GF$ = Gross freight
- $DMG$ = Demurrage
- $VYE$ = Voyage expenditure
- $TTL$ = Total result
- $AVGTC$ = Average time charter
- $RSKT$ = Total market risk

$b_1,b_2,b_3.. = coefficients$

Gross freight as an equivalent dummy variable interaction (Nlogit4.0 econometric software).
Seven variables were in the application: voyage days, voyage expenditure, total
demurrage, result, average time charter, risk and gross freight. The fundamentals are
observations related to the possible decision to entrust the vessel to a pool or to the
market.
Therepeated answers of ship owners, for this study, are elaborated based on their real
experience and on market trends (Clarkson, BIMCO v. y.).

Results of model calibration

In order to obtain the results of the model calibration, in the simulation of random utility,
NLOGIT 4.0 software (Greene W. 2007) was used. Parameter estimation is shown in table 3 below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>coefficient</th>
<th>Std. Error</th>
<th>b/stdt.Er.</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voyage days</td>
<td>7.72765881</td>
<td>6.44961337</td>
<td>1.198</td>
<td>.2309</td>
</tr>
<tr>
<td>Demurrage</td>
<td>-2.65294321</td>
<td>2.42512337</td>
<td>-1.094</td>
<td>.2740</td>
</tr>
<tr>
<td>Voyage expenditure</td>
<td>-.84507002</td>
<td>2.12841021</td>
<td>-.397</td>
<td>.6913</td>
</tr>
<tr>
<td>Total result</td>
<td>.93598480</td>
<td>.78273767</td>
<td>1.196</td>
<td>.2318</td>
</tr>
<tr>
<td>Avgtchday</td>
<td>.68697246</td>
<td>.47308880</td>
<td>1.452</td>
<td>.1465</td>
</tr>
<tr>
<td>Market risk</td>
<td>-.86882078</td>
<td>.45071235</td>
<td>-1.928</td>
<td>.0539</td>
</tr>
<tr>
<td>A_2</td>
<td>-1.24181592</td>
<td>60.5220032</td>
<td>-.021</td>
<td>.9836</td>
</tr>
<tr>
<td>2xGRO1</td>
<td>-3.45548606</td>
<td>16.1280447</td>
<td>-.214</td>
<td>.8303</td>
</tr>
<tr>
<td>A_3</td>
<td>1.64114433</td>
<td>3.30403884</td>
<td>.497</td>
<td>.6194</td>
</tr>
<tr>
<td>3xGRO2</td>
<td>-.55395194</td>
<td>.93279807</td>
<td>-.594</td>
<td>.5526</td>
</tr>
<tr>
<td>A_4</td>
<td>-6.96599078</td>
<td>5.07277656</td>
<td>-1.373</td>
<td>.1697</td>
</tr>
<tr>
<td>4xGRO3</td>
<td>1.49438508</td>
<td>1.32295521</td>
<td>1.130</td>
<td>.2587</td>
</tr>
</tbody>
</table>

Log likelihood function = -15.18
\[ \rho_2 = 0.47 \]
\[ \rho_{2adjst} = 0.35 \]
\[ \chi^2 = 13.59 \]

The first column of table 3 shows the name of the variables, the second shows the value of the estimated coefficients; the standard error is in the third column, the fourth gives the t-statistics by relationship between the estimated value of the coefficient and standard error, and the last column contains the p-value, indicating the probability of making a mistake.

The initial output of the model highlights no probability for lower risk of the pool and no choices for this profile; therefore, it was excluded and the analysis is concentrated on four risk profiles: moderate, high, time charter and voyage charter.

The results of the application show that the model has explanatory power with a sufficiently high R-squared value equal to .47857.

The value of the maximum likelihood (Log Likelihood) is -15.18, although the model still has margins for improvement that could be achieved with the introduction of other dummy variables.

The tests on the t statistic, except for the constant modal A2 linked to gross freight, are significant. The total market risk is considerable.

The choice probability result highlights a net preference for the strategic alternative of the pool and its high-risk profile with a value of 0.46, followed by the other alternatives, with a value of 0.33 for voyage charter market risk and 0.19 for time charter market risk; the moderate risk alternative is not significant.

The probability values are acceptable and confirm the validity of the predictive model with a performance of 71% of estimated alternatives coincident with the actual choice of the ship owner. Furthermore, the probability values also confirm that high-risk pool management is the best choice.

**Conclusions**

Simulation models in the shipping industry are difficult to calibrate because they need wide-ranging information about the strategic choices of the owners involved in the decision making process. Administration controlled pools are usually transparent and open to scrutiny.

The existence of a pool agreement (including the weighing system) is important for attracting new members.

Our application assumes an experimental form with a model that attempts to simulate the behavior of individuals (ship owners) in their decision making process.

The modal share attracted by the strategic alternative of the pool, based on stated preference repeated choices, is probably underestimated. Ship owners are not willing to change their behavior if the service offered is "weak" in terms of performance, economic efficiency and earnings.

When the characteristics of the service are "strong", on the other hand, such as in the case of direct management of the pool, the probability of a ship owner choosing the pool alternative is considerably higher than the free market.
Finally, the application is recognized as satisfactory considering its experimental nature, albeit within the limits of the reduced sample used. The collaboration of shipping companies owning oil product tankers, which also operate inside a product tanker pool, was very useful for this paper.

It seems interesting to consider possibilities of extending this application to other maritime sectors. A particularly congenial hypothesis on the future progress of complex models is the Hierarchical Logit Model, which allows us to partially overcome the assumption of the independent random residual underlying the Multinomial Logit Model (MNL). At the same time, it retains a closed analytical expression. Another, more advanced model is the random parameters Logit Model (mixed logit), which surpasses the independent and irrelevant alternatives (IIA) and correlation between coefficients of MNL. Through these two models we can, thus, foresee the development of applications capable of simulating choices concerning the economic-financial aspects of shipping companies.

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