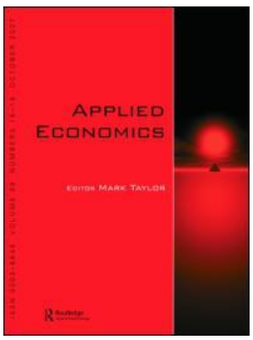

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An econometric model of the world market for dry cargo freight and shipping

世界干散货运输市场的经济计量模型

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An econometric model of the world market for dry cargo freight and shipping

世界干散货运输市场的经济计量模型

M I C H A E L B E E N S T O C K * and A N D R E A S V E R G O T T I S t
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I. INTRODUCTION

一。我不知道，我不知道，我不知道

In one of the earliest econometric applications Koopmans (1939) investigated the determin-ants of freight rates in terms of a model of supply and demand. Since then (e.g. Hawdon, 1978; Wergeland, 1981), there have been a number of empirical analyses of freight rates that build upon these earlier efforts. However, with the possible exception of Charemza and Gronicki (1981) the freight and ship markets have not been investigated in an inter-dependent setting in which freight market developments depend on the markets for ships and vice versa.

在最早的一个计量经济学应用中，库普曼斯(1939 年)根据供求模型研究了运费率的决定因素。自那时以来(例如，霍登，1978 年;韦格兰德，1981 年)，已有一些基于这些早期努力的运费率实证分析。然而，除了 Charemza 和 Gronicki(1981)可能的例外情况之外，对货运和船舶市场的调查并不是在一个相互依赖的环境中进行的，在这种环境中，货运市场的发展取决于船舶市场，反之亦然。

Beenstock (1985) has described a theoretical model in which freight markets and ship markets are interdependent and in which second-hand ships are treated as capital assets. In this paper an attempt is made-to apply this model empirically to the world dry cargo market. Accordingly an aggregate econometric model is estimated in which inter alia freight rates, lay-up, new and second-hand prices and the size of the fleet are jointly and dynamically determined. The model, estimated from annual data, assumes that shipping investors have 'rational expectations'.

Beenstock(1985)提出了货运市场和船舶市场相互依存、二手船作为资本资产处理的理论模型。本文尝试将该模型应用于世界干散货运输市场。因此，估计了一个综合计量经济模型，其中除其他外，运费率、停车费、新旧价格和车队规模是联合和动态确定的。根据年度数据估计，该模型假定船运投资者具有"理性预期"。

Rational expectations are implied by the Efficient Markets Hypothesis because they use information in an optimal and efficient way. Such expectations occur at several points in the model. Time charter rates are hypothesized to reflect rational expectations of freight

rates in the spot or voyage market. The price quoted to build a new vessel is hypothesized to reflect the rational expectation of the price of a comparable vessel prevailing at the time of its delivery. Finally, the demand to own vessels is hypothesized, inter alia, to depend upon rational expectations of future vessel prices in the second-hand market. In this paper no attempt is made to test this particular version of the Efficient Markets Hypothesis against alternative hypotheses. Instead, it is treated as an integral part of the specification which, as Beenstock (1985) shows, has major implications for the dynamic character of the model. In particular, anticipated shocks to the exogenous variables induce changes in the exogenous variables ahead of the events themselves as is illustrated in Section IV.

有效市场假说暗示了理性预期，因为理性预期以最优和有效的方式使用信息。这种预期发生在模型中的几个点上。定期租船费率假设反映了现货或航次市场对运费率的合理预期。建造新船的报价假设反映了对交货时通行的可比船舶价格的合理预期。最后，假设对自有船舶的需求，除其他外，取决于对二手市场未来船舶价格的合理预期。在本文中，我们没有试图用另一种假说来检验这一特定版本的有效市场假说。相反，它被视为规范的一个组成部分，如Beenstock(1985)所示，它对模型的动态特性有重要的影响。特别是，如第四节所示，预期对外生变量的冲击会在事件本身之前诱发外生变量的变化。

An alternative hypothesis is that expectations of freight rates and vessel prices are adaptive or extrapolative, i.e. they are backward- rather than forward-looking and depend on past values of these variables. Apart from major simplification of the econometric estimation of the model this alternative hypothesis has important theoretical implications. In particular, because the endogenous variables cannot react in advance to anticipated

另一种假设是，对运费率和船舶价格的预期是适应性的或外推性的，即它们是向后而不是向前看的，取决于这些变量的过去值。除了大大简化了模型的计量经济学估计之外，这种替代假设还有重要的理论意义。特别是因为内生变量不能事先对预期作出反应

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shocks they tend to have a higher variance. Indeed, it may be the case that the volatile nature of this market reflects adaptive rather than rational expectations. However, as stated, this possibility is not explored here.
冲击，他们往往有一个更高的方差。事实上，这个市场的波动性反映的可能是适应性，而不是理性预期。然而，如上所述，这种可能性在这里没有探讨。

The model is estimated from annual data over the period 1950-1985. However, data availability prevented us from setting common periods for each of its component equations. The model refers to the dry-cargo market and is aggregated in two respects. First, it does not distinguish the major dry bulk markets in iron ore, coal etc. Second, it does not distinguish the liner market that is quasi oligopolistic from the tramp market that is competitive. Data deficiencies prevented the latter; however, the weight of liner business is relatively small and in any case conference rates are adjusted at discrete intervals and thus partly respond to the balance of supply and demand. The case for the former aggregation reflects the high degree of substitutability of vessels between the various markets. However, the question as to whether a disaggregated model provides a better framework for applied econometric research is not investigated here.
该模型是根据 1950-1985 年期间的年度数据估计的。然而，数据可用性使我们无法为每个组成方程设置公共周期。该模型以干散货市场为研究对象，从两个方面进行了综合。首先，它没有区分铁矿石、煤炭等主要干散货市场。其次，它没有区分准寡头垄断的班轮运输市场和竞争的不定期船市场。由于数据不足，后者无法实现;然而，班轮业务的份量相对较小，而且无论如何，会议费率是以不连续的间隔进行调整的，从而部分地对供求平衡作出反应。前者的情况反映了不同市场之间船舶的高度可替代性。但是，这里没有研究分类模型是否为应用计量经济学研究提供更好的框架的问题。

Section I1 introduces the theoretical underpinnings of the model. Section 111 contains the econometric estimates of the relationships. Finally, the properties of the model are explored in Section IV.
第一节介绍了模型的理论基础。第 111 节包含对这些关系的计量经济学估计。最后，在第四节中对模型的性质进行了探讨。

11. T H E O R Y
T h e o r y

Overview
概览

Since a detailed account of the theory used has been written in (Beenstock, I985), here only a summary of its main features is given insofar as it assists comprehension of the econometric model reported in the Section 111. It is assumed that vessel owners maximize profits under conditions of perfect competition. They are price-takers on freight rates (F)as well as voyage costs (PB, bunkers, wages and port charges). The number of voyages is proportionate to the average speed of the vessel (S) but voyage costs vary disproportionately with speed. During any time period the profit from the vessel is defined as:

由于所使用的理论的详细说明已经写在(Beenstock，I985)，这里只是对其主要特点的概述，因为它有助于理解在第 111 节中报告的计量经济学模型。假设船东在完全竞争条件下实现利润最大化。他们是运费(f)和航运成本(PB、船坞、工资和港口费用)的价格承担者。航行次数与船舶的平均航速成比例，但航行费用随航速不成比例地变化。在任何时期内，船舶的利润定义为:

where ***Sa*** reflects the hypothesized relationship between voyage costs and speed, and OC denotes fixed costs. Maximizing **ll** with respect to S implies that the optimal speed of the vessel is:
其中 Sa 反映了航程成本和速度之间的假设关系，OC 则表示固定成本。相对于 s 最大的 ll 意味着船舶的最佳航速是:

S=(F/aPB)ll(a-"
S (f / apb) ll (a-"

i.e. speed varies directly with the ratio of freight rates to voyage costs. At this optimal speed the profit is equal to:
也就是说，航速直接随运费与航程费用的比率而变化。在这种最佳速度下，利润等于:

These relationships will be used in the specification of the model. The fleet size is inelastic in the short run because of the lead-time on shipbuilding. Freight rates are determined by demand and supply in the freight market. Supply is proportional to the trading fleet times its average speed. As indicated above, average speed depends on the ratio of freight rates to voyage costs. The former are included because fuel use rises disproportionately with speed and so optimal speed varies inversely with bunker prices. The latter are included because

这些关系将在模型的规范中使用。船队规模在短期内是没有弹性的，因为造船的准备时间很长。运费率是由货运市场的需求和供应决定的。供应量与交易车队的平均速度成正比。如上所述，平均航速取决于运费与航运成本的比率。前者包括在内是因为燃料消耗量随着速度不成比例地增加，因此最佳速度与燃料价格成反比。后者包括在内是因为

higher port charges increase the incentive to operate on the high seas instead of being anchored at port. The. trading fleet excludes ships that are laid-up but includes combined carriers operating in the dry cargo market.
较高的港口收费增加了在公海作业而不是在港口抛锚的动机。这个。交易船队不包括闲置的船舶，但包括在干散货市场运营的联合承运人。

Lay-up depends on freight rates, voyage costs and running costs relative to lay-up costs. In the longer term the fleet size varies because of shipbuilding and scrapping. Shipbuilding varies directly with the price of ships and scrapping varies inversely with ship prices. The fleet constitutes capital assets that must be held in the portfolios of wealth holders. The stock demand for ships as capital assets varies directly with the expected'relative rate of return. The latter depends upon expected operating profits on vessels, the expected capital gain on ships and competing returns to wealth. In the short run the second-hand price of ships is determined in the capital asset market for ships, i.e. the stock demand equals the stock supply which changes over time as described.

停运取决于运费率、航次成本和运营成本相对于停运成本。从长远来看，船队的规模因造船和报废而有所不同。造船业与船舶价格成正比，报废率与船舶价格成反比。车队构成资本资产，必须在财富持有者的投资组合中持有。船舶作为资本资产的库存需求与预期的"相对收益率"直接相关。后者取决于船舶的预期营业利润、船舶的预期资本收益和相互竞争的财富回报率。在短期内，船舶的二手价格是由船舶资本资产市场决定的，也就是说，股票需求等于股票供应量，股票供应量随着时间的推移而变化。

Since the size of the fleet affects freight rates while freight rates affect the stock demand for vessels, freight rates, ship prices and fleet size are dynamically interdependent. In the rest of this section these relationships are set out more formally in terms of equations that are estimated in Section 111.

由于船队规模影响运费率，而运费率影响船只的库存需求，因此运费率、船价和船队规模在动态上是相互依赖的。在本节的其余部分，这些关系以第 111 节中估计的方程式的形式更加正式地阐述。

The freight market
货运市场

Supply, measured in ton-miles, is hypothesized to be proportional to the size of the fleet trading in the dry cargo market times the average speed. The average speed depends on the ratio of height rates to bunker prices and port charges. When this ratio rises it pays to use the vessel more intensively and to incur the extra costs in terms of higher fuel consumption and port charges. Hence:
供应量，以吨英里计算，假设是成正比的规模的船队交易在干货市场乘以平均速度。平均航速取决于高度费率与燃料价格和港口费用的比率。当这一比率上升时，就需要更加集中地使用船舶，并产生更高的燃料消耗和港口费用方面的额外成本。因此:

$$MS = Fl(K^*, (F/PB), Z1) \quad (1)$$
$$\qquad\quad + \quad +$$

where MSis ton-miles (supply); K* is fleet trading in dry cargo routes; F is freight rate; PB is index of unit voyage costs (bunker costs plus port charges) and Z1 is a vector of exogenous variables affecting the supply.

其中 MSis 吨英里(供应);k*是干货航线的船队贸易;f 是运费率;PB 是单位航程成本指数(燃料成本加港口费用)，Z1 是影响供应的外生变量的向量。

In Equation 1 and subsequent equations. the signs of partial derivatives are indicated

在等式 1 和随后的等式中。偏导数的符号表示

above variables to which they refer. The fleet trading in the dry cargo market consists of the dry cargo ships not laid-up plus the combined carriers (vessels that are dual purpose and can be used as tankers) in dry.

以上是他们提到的变量。干散货市场的船队贸易包括没有闲置的干散货船和干散货的联合承运人(具有双重用途并可作为油轮使用的船只)。

where ***p*** is the proportion of dry cargo, fleet laid-up; ***COM*** is the combined carriers in dry; and K is the dry cargo fleet.

其中 p 是干货的比例，船队闲置;COM 是干货的联合承运人;k 是干货船队。

The lay-up decision is hypothesized to depend on the opportunity cost of layiup. This cost varies directly with the freight rate and the direct cost of laying-up the vessel, and it varies with the costs of operating the ship on'the high seas. Since the lay-up rate is naturally bounded between zero and one the functional form for ***p*** is logistical, i.e.

上篮决策假设取决于上篮的机会成本。这一成本与运费率和船舶停泊的直接成本直接相关，并与在公海上操作船舶的成本相关。由于储备率自然地在 0 和 1 之间有界，p 的函数形式是逻辑形式，即。

where RC represents running costs (wages, maintenance, etc.) and LC, lay-up costs.

其中钢筋混凝土代表运行成本(工资，维修等)和信用证，上市成本。

The demand for freight services MD,expressed in ton-miles inevitably reflects the volume of sea-borne trade which in turn reflects the level and structure of world economic activity

以吨里数表示的货运服务需求不可避免地反映了海运贸易量，而海运贸易量又反映了世界经济活动的水平和结构

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both geographically and in terms of the kind of commodities traded. In theory demand will vary inversely with freight rates because higher freight rates will create an incentive to use other forms of transportation and to import more from areas closer to the market, as described by Eriksen .(1983). In practice, the scope for substitution and such economies is very limited. Indeed, we have been unable to discover a negative relationship between demand and freight rates and consequently, in line with previous models of the freight market, we have assumed it to be predetermined in terms of exogenous rates of world economic activity. Hence, the demand for freight services is simply written as
无论是在地理上还是在商品交易方面。理论上，需求将与运费成反比，因为更高的运费将刺激人们使用其他运输方式，并从更靠近市场的地区进口更多的货物，正如埃里克森所说。(1983 年)。在实践中，替代和这种经济的范围是非常有限的。事实上，我们一直未能发现需求与运费率之间的负相关关系，因此，根据以前的运费市场模型，我们假定它是根据世界经济活动的外生比率预先确定的。因此，对货运服务的需求被简单地写成

$$M \sim = \bar{M} \qquad (4)$$

where $\bar{M}$ is the exogenously determined volume of sea-borne trade expressed in terms of ton-miles. The supply of freight service is hypothesized to be equal to the demand (MS=***M D)***in which case freight rates move to clear the market. Equations 1-4 are recursive to the rest of the model and determine the equilibrium level of F, M, K * and ***p*** given $\bar{M}$***, PB,*** Z,, ***C O M , RC*** and ***L C .***
其中 fi 是以吨英里表示的外来确定的海上贸易量。假设货运服务的供应量等于需求量(MSmd)，在这种情况下，运费率变动以清空市场。方程 1-4 对模型的其余部分是递归的，并确定 f，m，k*和 p 的均衡水平给定 fi，PB，z，，com，RC 和 lc。

Time charter rates
定期租船费率

The freight rate, F that has been determined by Equations 1 to 4 is a spot or voyage rate. Ship owners have the choice of chartering their vessels in the spot market or in the time charter market. In the former case they pay for voyage costs (PB)as Equation 1 indicates; in the latter case they do not. The operating profit on the vessel **(13)** is therefore defined as
由公式 1 至 4 确定的运费率 f 是现货或航次运费率。船东可以选择在现货市场或定期租船市场租船。在前一种情况下，他们支付航程费用(PB)，如等式 1 所示；在后一种情况下，他们不支付。因此，船舶的营业利润(l3)被定义为

if it is time chartered and
如果它是时间特许和

if it is chartered in the trip market. If (as discussed below) the difference between **ll** and **ll'** is likely to be constant these relationships imply that the rate of change of an index of F* **+** ***P B*** should equal the rate of change of F.
如果是在旅游市场租的。如果(如下所述)ll 和 ll'之间的差可能是常数，这些关系意味着 f*+pb 指数的变化率应该等于 f*+pb 指数的变化率。

The Efficient Markets Hypothesis suggests that the time charter rate will reflect the spot rates and voyage costs that are expected to prevail over the relevant time horizon. If, for example, spot markets are expected to be more profitable in the future, owners will demand a higher time charter rate in order to make the profitability of the time charter competitive with that of the spot market. Because of backwardation and associated risk premia time charter rates will be at a discount since risk averse owners prefer the time charter in the hand. The risk premium is therefore likely to vary with the lay-up rate.

有效市场假说认为，定期租船费率将反映预计在相关时间范围内占优势的即期租船费率和航程费用。例如，如果现货市场预计未来会更有利可图，业主将要求更高的定期租船费率，以使定期租船的利润率与现货市场的利润率具有竞争力。由于现货溢价和相关的风险溢价，定期租船费率将是一个折扣，因为规避风险的船东更喜欢手头的定期租船。因此，风险溢价很可能随着存货率而变化。

These considerations suggest the following hypothesis about the relationship between time and voyage rates:

这些考虑提出了关于时间和航次费率之间关系的下列假设:

where ***F :*** is the one year time charter rate fixed at the end of year ***t ,*** and *E(*) is the

其中 f:是年末 t 固定的一年期租船费率，e()是

expectation based on information available at the end of year ***t .***

基于年末可用信息的期望。

Since time charters, unlike spot charters do not pay voyage costs Equation 5 appropriately includes a negative term on the expected voyage costs.

由于定期租船不同于现货租船不支付航程费用等式 5 首先包括预期航程费用的负数。

Econometric model of world market for dry cargo, freight and shipping
还有航运
世界干散货运输市场的计量经济模型

The market in vessels
船舶市场

The .size of the fleet at the end of period t is
这个。舰队的规模 是的

$$K,=K,-l+D,-S,-L, \quad (6)$$
$$K，K,-l + D,-S,-l, \quad (6)$$

where ***D,=*** deliveries of new vessels; S = vessels scrapped and L = vessels lost.
其中 d，新船交付;s 船报废，l 船损失。

The supply of vessds for scrapping is hypothesized to vary inversely with the second-hand price of vessels relative to the price of scrap and also with the age profile of the fleet. This accords with vintage models of optimal scrapping in which operating costs are assumed to vary directly with age. Thus

假设用于报废的船只的供应量与船只的二手价格相对于废料价格以及船队的船龄状况成反比。这符合最佳报废的老式模型，其中运营成本被假定为与年龄直接不同。因此

where ***s*** = S/(K*AlO), P is the index of second-hand prices, Ps is the price of scrap, A10, the proportion of fleet over 10 years old and A20 the proportion of fleet over 20 years old.
其中 s/(k*AlO)、p 是二手物品价格指数，p 是废品价格，A10 是 10 年以上船队的比例，A20 是 20 年以上船队的比例。

In Equation 7 above it has been assumed, in the light of the data, that no ship less than 10 years old is ever offered for scrap. This also allows the calculation of A10 from the previous history of deliveries.

在上面的方程式 7 中，根据数据假定，从来没有任何船龄小于 10 年的船舶被当作废料提供。这也允许根据以前的交付历史计算 A10。

A20, is hypothesized to depend on A10, - ,,, A20, - ,, and the average scrapping rate over the last 10 years:
A20，被假设依赖于 A10,-，，，A20,-，和过去 10 年的平均报废率:

The price of scrap metal is assumed to be predetermined by the price of ferrous metals prevailing on world markets.
废金属的价格被认为是由世界市场上流行的黑色金属的价格决定的。

It is assumed that deliveries depend on past orders as follows:
假定交货取决于以下过去的订单:

where Q is orders for new vessels and ***w,,*** weights in the lag distribution.

其中 q 是新船的订单，w，，在滞后分布中的权重。

Although delivery rates might be accelerated or slowed down under certain circumstances, it was found that the fixed'distributed lag relationship in Equation 10 was more reliable empirically.

虽然在一定的环境条件下，分娩率可能会加快或减慢，但从经验上看，方程 10 中的固定分布滞后关系更为可靠。

Drawing on the model proposed (e.g. Witte, 1966)the supply of new ships (as measured by the size of the order book) varies directly with the newbuilding price and inversely with the price of other vessels. This is because shipbuilders also build tankers and will supply other vessels if it is profitable at the expense of dry cargo ships. Supply varies inversely with costs

根据提出的模型(例如 Witte，1966 年)，新船的供应量(以订单的大小衡量)与新船价格成正比，与其它船只的价格成反比。这是因为造船厂也建造油轮，如果利润丰厚，就会供应其它船只，而干货船则要付出代价。供给与成本成反比 and directly with subsidies to shipbuilding.

Hence

$$Q=Fs(P,, P', , C) \qquad (1\ 1)$$

where P, is the price of dry cargo newbuildings; **Pb ,** the price of other newbuildings and **,C,** production costs (inclusive of subsidies).

其中 p 是干货新建筑物的价格;Pb 是其他新建筑物的价格;c 是生产成本(包括补贴)。

Since new ships cannot be delivered instantaneously P, is equivalent to a forward price of vessels. The Efficient Markets Hypothesis suggests the following relationship between new

由于新船不能即时交付 p，相当于船舶的远期价格。有效市场假说提出了以下新兴市场和新兴市场之间的关系

and second-hand ship prices:
以及二手船的价格

$$\ln P_{nl} = E_{1n}\ln P_{1+,+} + k_{l'}$$
$$1 + , \quad + k_{l'}$$

where k, is a constant that reflects indexing, technological and risk premia in the forward market for ships and PI is the index of second-hand ship prices. For example, a change in the rate of technical progress would raise k as second-hand vessels fell in value relative to new vessels that embodied the technical progress. Alternatively k would rise if investors considered that ships were a less risky forward investment. Rational expectations suggest that:
其中 k，是一个常数，反映了指数，技术和风险溢价在远期市场的船舶和 PI 是二手船价格指数。例如，随着二手船相对于体现技术进步的新船的价值下降，技术进步速度的变化将提高 k。或者，如果投资者认为船舶是一种风险较低的远期投资，那么 k 就会上升。理性预期表明:

$$\ln P_{,+,} = E_{1n}\ln P_{1+,+e,+,}$$
$$1 + , \quad + e,$$

where (e) is white noise. Substituting this into the previous expression implies that:
(e)为白噪音。将其替换为前面的表达式意味着:

As reported in Section 111 it was found that k was constant and that the residuals generated by Equation ***12*** were indeed white noise.
正如在第 111 节中报道的那样，人们发现 k 是常数，而且公式 12 产生的残差确实是白噪声。

Finally the capital asset demand for ships depends on the expected operating profit and expected capital gain on vessels. It also varies inversely with competing asset returns and depends on the level of wealth, i.e.
最后，船舶资本资产需求取决于预期营运利润和预期船舶资本收益。它也与相互竞争的资产收益成反比，并取决于财富水平，即。

where W= wealth; **13**= operating profit (= ***F**** - RC), and R =competing rate of return.
Equations ***1*** to **13** solve dynamically for ***Ms, K * , p, F, F*, K , S , D, Q, A10, A20,*** P,, and Pin terms of COM, PB, RC, LC, L, P,, Pfn,C, Wand R.
其中 w 财富;13 营业利润(f*-RC)，r 竞争回报率。方程 1 到 13 动态求解 COM，PB，RC，LC，l，p，Pfn，c，Wandr 的 Ms，k，k，s，d，q，A10，A20，p，和 Pin 项。

The analytical properties of a model of this type in which expectations of ship prices etc. are rational have been discussed at length by Beenstock (1985). In the present paper the properties of the model in terms of its empirical representation as reported in the next section, are discussed.

本文用 Beenstock(1985)的方法详细讨论了这类模型的分析性质，在这类模型中，船舶价格等的预期是合理的。本文讨论了该模型的性质及其在下一节中的经验表述。

Glossary of terms
术语汇编

Endogenous
内源性的

MS Supply of freight (ton-miles)
供应货物(吨-英里)

K* Trading fleet (millions of dwt)
K*贸易船队(数百万吨)

F Freight rate index - voyage ($ per ton-mile)
运费指数航次(每吨英里$)

p Proportion of fleet laid-up (percentage)
船队闲置比例(百分比)

KFleet (millions of dwt)
Kfleet(百万吨级)

F*Time charter rate index ($ per day)
F*定期租船费率指数(每日$)

D Deliveries of new vessels (millions of dwt)
新船交货(数百万吨)

SVessels scrapped (millions of dwt)
船舶报废(百万载重吨)

PSecond-hand price of index of vessels ($)
二手船只价格指数(元)

New building price index of vessels ($)
新船舶建筑物价格指数(元)

Proportion of fleet over ***10*** years (%)
10 年以上船队比例(%)

Proportion of fleet over ***20*** years (%)
20 年以上船队所占比例(%)

Orders of new vessels (millions of dwt)
新船订单(数百万吨)

Econometric model of world market for dry cargo, freight and shipping
世界干散货运输市场的计量经济模型

Exogenous
外生的

P B . Unit voyage costs (bunkers plus port charges, $)
P b. 单位航程费用(燃料舱加港口费，美元)

. Combined carriers operating in dry trades (millions of dwt)
COM 经营干散货业务的联合承运人(数百万吨级)
. Com

RC Running costs (wages, insurance, maintenance, etc. $)
混凝 运营成本(工资、保险、维护等)
土 .Lay-up costs ($)
.LC .分摊费用(美元)
.立法
会

M Demand for freight (ton-miles)
货运需求(吨-英里)

LVessels lost (millions of dwt)
船舶损失(数百万吨)

P, Scrap price index ($ per ton)
P, 废料价格指数(每吨$)

Pf Price of new tankers ($ per ton)
n
Pfn 新油轮价格(每吨美元)

C Shipbuilding costs ($)
造船成本(美元)

WWorld wealth ($)
世界财富($)

RRate of interest ($, % p.a.)
年息率($,%)

111. E S T I M A T I O N
111.英国科学家协会

Methodology
方法论

The task in the present paper is to use the data, as defined in the appendix, to estimate the dynamic set of simultaneous relationships described in Section II. Moreover, several of these include 'rational expectations' of variables.
本文件的任务是使用附录中定义的数据来估计第二节中描述的动态同时关系集。此外，其中一些包括变量的"理性预期"。

It has been assumed that the freight market is recursive because the volume of the fleet is largely predetermined. During a year (our observations are annual) the size of the fleet cannot respond to current freight rates and related shocks because of gestation lags implied by Equation 10. The only scope for simultaneity arises if current scrapping is influenced by contemporaneous freight rates, which is very limited. Accordingly, Equations 1 to 4 are estimated by 3SLS as a market-clearing system with K recursive. The recursion in K enables the separate estimation of the freight market equations (Equations 1, 3 and 4) on the one hand and the ship market equations on the other. Equations 7, 10

and 11 are estimated by OLS. Equations 5, 12 and 13 involve 'rational expectations' of future variables. These are represented by forward market data according to the theory and as such have to be estimated by the 'errors in variables' method with appropriate instrumentation (see e.g. Wickens, 1982).This is not as efficient as the 'substitution method' proposed, for example, by Wallis **(1** 980) but is more robust and computationally much cheaper especially in a relatively large model such as ours.

人们一直认为，货运市场是递归的，因为船队的数量在很大程度上是预先确定的。在一年内(我们的观察是每年)的规模的船队不能响应当前的运费率和相关的冲击，因为妊娠期滞后等式 10 暗示。同时发生的唯一范围是当前的报废是受当时的运费率的影响，这是非常有限的。相应地，方程 1 到 4 被 3SLS 作为一个具有 k 递归的市场清算系统估计。利用 k 矩阵的递归性，可以将运输市场方程(等式 1、3、4)和船舶市场方程分开估计。方程 7、10 和 11 由 OLS 估计。等式 5、12 和 13 涉及对未来变量的理性预期。根据这一理论，这些数据可以用远期市场数据来表示，因此必须使用适当的仪器，用"变量误差"方法来估计(例如，Wickens，1982)。这不像沃利斯(1980)提出的"替代方法"那样有效，但是更加健壮，计算成本更低，特别是在我们这样一个相对较大的模型中。

It was found that for most of the equations a static specification gave satisfactory results. For the remaining equations the suggestion (Hendry and Mizon, 1980) that autocorrelation should not be treated as a nuisance but as a guide to dynamic model selection was followed. Because of the presence of lagged endogenous variables in some of the equations the DW statistic is invalid and Breusch and Pagan (1980) have suggested a Langrange multiplier portmanteau test for autocorrelation. However, this is only appropriate for single-equation estimators and is not valid in 3SLS contexts. In the absence of appropriate portmanteau tests for autocorrelation in dynamic simultaneous equations systems the autocorrelation coefficients (AR) for the ;esiduals and associated Box-Ljung (BL) statistics are reported.

结果表明，对于大多数方程，静态规范给出了令人满意的结果。对于其余的方程组，遵循的建议是(HendryandMizon，1980)，自相关不应被视为讨厌的东西，而应作为动态模型选择的指南。由于在一些方程中存在滞后内生变量，DW 统计量是无效的，Breusch 和 Pagan(1980)提出了一个用于自相关的 Langrange 乘数一元混成检验。然而，这仅适用于单方程估计，在 3SLS 上下文中无效。在缺乏合适的自相关检验的动态方程组系统的自相关系数(AR);esiduals 和相关的 Box-Ljung(BL)统计报告。

Results

结果

~cbnornetricestimates of the behavioural equations discussed in Section 11 are presented

在第 11 节中讨论了行为方程的~cbnoretric 估计被提出

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below. To a$sist comprehension Equation 1 is our estimate of Equation 1 etc. t values are shown in parentheses. .
下面。对于一个存在的理解方程 1 是我们对方程 1 等的估计 t 值在括号中显示。.

Freight market
3SLS 1962-1985

$$\ln \sim = -1.096 + \underset{(0.45)}{0.142} \ln(FIPB) + \underset{(9.1\,8)}{0.776} \ln(AH) + \underset{(5.9)}{1.26}(AS) - \underset{(1.35)}{0.057}DUM + \underset{(2.35)}{\ln K^*} \quad (1)$$

a = 0.023, DW = 2.14, ARl = - 0.082, AR2 = - 0.136, AR3 = 0.206, AR4 = 0.049, RL(2) = 0.72, BL(4) = 2.05
Rl (2)0.72，BL (4)2.05

Time charter rates
定期租船费率
1950-1984 'errors in variables'
1950-1984 年"变量误差"

Scrapping
报废
OLS 1957-1985
苏丹生命线行动 1957-1985 年

Ageing
1966-1985

$$\ln(A20/(1-A20)) = -0.659 + 0.763LA2010 + 0.564LA20 - 0.589 \quad \ln ZS, - \sim \quad (9)$$

(1.05) (9.95) (5.26) (2.04)

where

RA2010=(A10~,,- A20-,,)K- ,,/K, LA2010=ln(RA2010/(1- RA2010))

RA20= A20-,oK-10, LA20 = ln(RA20/(1- RA20))

u = 0.063, DW = 1.46

Deliveries (shipbuilding)
OLS ***1952-1985***

1nD = - ***0.309 0.0881nD*** + ***0.728*** 1nD- **,-** **-,+** ***0.598*** lnQ - **,-** ***0.21 7*** 1nQ**-,**

(2.04) (3.79) (0.79) (7.2) (1.52)

(I^ O) (他回来了)

New orders

1nQ = - ***0.337*** + ***0.949*** InQ- **,-** ***0.597*** InD + ***0.656 In(P,/C)-0.189*** In ***(P J C)***

(0.338) (3.88) (2.15) (3.81) (1.485)

+ ***3.938*** In ***Y - 3.402*** In **Y-,**

3.938 In y-3.402 In y-,

(2.32)(2.09)

(2.32)(2.09)

(6

(6

New building prices
新楼价
19661984 'errors in variables'
19661984'变量中的错误'

Asset market
资产市场
19661984 'errors in variables'
19661984'变量中的错误'

Equation 1 captures the effect of changes in freight rates and bunker prices on optimum speed via the term ***FIPB.*** Since the freight market is perfectly competitive and clears instantaneously and since there are no costs in fully adjusting speed to current market conditions, we expect that a static specification should give good results. The freight rate elasticity was found to be quite small, around ***0.14.*** Dry cargo ships spend a considerable unproductive proportion of their time in port waiting for loading and unloading. This

proportion is expected to be lower the higher the average length of haul ***(AH)*** **.**Therefore ***AH*** was included as an additional regressor and was found to be significant. The average maximum speed ***(AS)*** of the feet was also included to represent technical progress while DUM is a dummy variable that controls for the effect of significant exogenous port delays during ***1980.*** The coefficienton lnK* is constrained to unity and the constraint is acceptable according to an F-test.

方程式 1 通过 FIPB 这一术语抓住了运费率和燃料价格变化对最佳速度的影响。由于货运市场是完全竞争的，而且是即时清算的，而且由于完全调整速度以适应当前的市场条件是没有成本的，我们期望一个静态的规范应该会带来好的结果。运费弹性很小，约为 0.14。干货船在港口等待装卸的时间中，有相当一部分是非生产性的。这一比例预计将降低较高的平均拖运长度(AH)。因此，AH 被列为一个额外的回归因子，并被认为是重要的。脚的平均最高速度(AS)也包括在内，以代表技术进步，而 DUM 是一个虚拟变量，控制 1980 年期间重大外部端口延误的影响。系数 lnK*被约束为统一和约束是可以接受的根据 f 检验。

Equation 3 is the empirical version of Equation **3.** Since there are costs of moving in and out of lay-up we expect, a dynamic specification to be more appropriate in this case. The freight rate was found to have a significant negative effect on lay-up while we expected voyage costs to have .a positive effect. The presence of the lagged dependent variable implies that the long-run effects of changes in F and PB are higher than their short run counterparts. The logistical specification implies that supply can be quite elastic at high levels of lay-up while it becomes very inelastic as lay-up approaches zero. In the absence of direct observations on running costs **(RC)** and lay-up costs **(LC)** they were both proxied by the world wholesale price index as noted in the data appendix.

方程 3 是方程 3 的经验版本。因为我们预计移入和移出停留区会有成本，所以动态规范在这种情况下更合适。运费率被发现有一个重大的负面影响停留，而我们预计航程成本有。积极的影响。滞后因变量的存在意味着 f 和 PB 变化的长期效应高于短期效应。物流规格意味着，高层次的储备供应可能非常有弹性，而随着储备接近零，供应变得非常缺乏弹性。如数据附录所示，由于没有直接观察到运营成本和备用成本，它们都由世界批发价格指数代理。

Equation 3 corresponds to Equation 5. Since (as noted in Section I) a given percentage change in F* and PB should be associated with an equiproportionate change in F, this equation has been estimated subject to the constraint that the coefficients of F and PB should add up to unity. The constraint was accepted via an F test. Lay-up was not found to be significant in determining current time charter rates. The freight rate elasticity of time charter rates was found to be around ***1.16.***

等式 3 对应于等式 5。由于(如第一节所述)f*和 PB 的某一百分比变化应与 f 的等比例变化相关联，因此这一等式的估计受到 f 和 PB 的系数加起来应等于单位数的约束。通过 f 测试接受了约束。在确定目前的定期租船费率方面，没有发现滞留问题很重要。定期租船费率的运费弹性约为 1.16。

Equation *5* is the estimate of the supply of ships for scrap. Ship prices relative to scrap values were expected to have a significant negative effect on scrapping. Moreover, the current level of lay-up was found to have an independent positive influence on scrapping. In the absence of capital market imperfections, however, there should be no such effect. The significance of ***p*** in Equation 7 is most probably due to the fact that the index of ship prices mostly reflects the changes in values of relatively new ships. To explain scrapping, however, the values of older ships is likely to be more relevant. At times of high lay-up the price of old ships drops more than the price of newer ships, and vice versa in times of low lay-up. In Equation 7 therefore ***p*** might be controlling for the small divergence between old ship prices and the index of ship values. It, therefore, does not necessarily imply that lay-up is independently influencing scrapping. The presence of ***A20*** with a lag of ***2*** in Equation 7 implies that the age of ***22*** is critical for the scrapping of dry cargo ships.

等式 5 是对废船供应量的估计。船舶价格相对于废料价值预计会对报废产生重大的负面影响。此外，目前的停留水平被发现有一个独立的积极影响报废。然而，在资本市场不存在缺陷的情况下，不应该存在这种效应。方程式 7 中 p 的重要性很可能是由于船舶价格指数主要反映了相对较新的船舶价值的变化。然而，为了解释废弃问题，旧船的价值可能更具相关性。在高停泊时期，旧船的价格比新船的价格下降得更多，在低停泊时期，反之亦然。因此，在方程式 7 中，p 可能控制了旧船价格和船舶价值指数之间的微小差异。因此，这并不一定意味着停业是独立影响报废。A20 在方程式 7 中的滞后为 2，这意味着 22 岁对于干货船的报废至关重要。

The age profile of the fleet is obviously endogenous. The assumption that ships aged less than ***10*** years are not scrapped allows ***A10*** to be calculated using the simple identity, Equation 8. However, ***A20*** will depend in a very complex way on a long history of past deliveries and scrappings of ships of various ages, for which there are no data available. Moreover the stochastic structure of Equation 9 is additionally complicated by the fact that ***A20, A10*** are ratios of stocks. The error term in Equation 9 is therefore likely to be highly autocorrelated given also the fact that ***A20*** is explained by its own ***10*** year lagin Equation 9. Equation 9 is, therefore, an attempt to endogenize and model in a simple way what is obviously a very complex process. In summary, it says that the current stock of ships over ***20*** years old is related to the ***10*** year lagged stock of ships between ***10*** years and ***20*** years, to the ***10*** year lagged stock of ships over ***20*** years old and to the average scrapping rate over the past ***10*** yearsA

船队的年龄分布显然是内生的。假设船龄小于 10 年的船舶没有报废，允许使用简单的恒等式计算 A10。然而，A20 将以一种非常复杂的方式依赖于过去交付和不同年龄船舶报废的漫长历史，这方面没有可用的数据。此外，方程 9 的随机结构由于 A20，A10 是股票的比率而更加复杂。因此，方程 9 中的误差项很可能是高度自相关的，因为 A20 也可以用它自己的 10 年的拉金方程 9 来解释。因此，方程式 9 试图以一种简单的方式将显然是一个非常复杂的过程内生化和建模。总之，报告说，目前 20 年以上的船舶存量与 10 年至 20 年滞后的船舶存量有关，与 20 年以上的船舶存量滞后 10 年有关，与过去 10 年的平均报废率有关

Equation ***10*** is the empirical version of Equation ***10.*** It implies that the long-run elasticity of deliveries with respect to orders is almost unity as expected. However, the short-run response is smaller. In addition, deliveries are predetermined in the short-run since they do not depend cn the current order book.

方程 10 是方程 10 的经验版本。这意味着交货的长期弹性相对于订单几乎是一致的预期。然而，短期的反应是较小的。此外，交货是预先确定的短期内，因为他们不依赖于当前的订单。

Equation ***1 1*** is our estimate of Equation ***11.*** It implies a long-run own price elasticity of supply of newbuildings of unity and a long-run cross elasticity of about ***-0.3. P,/C*** and ***Pf,/C*** were found to be stationary stochastic processes while the supply of newbuildings exhibits trends that obviously reflect expanding shipbuilding capacity. World GDP has been

等式 11 是我们对等式 11 的估计。这意味着一个新建筑的长期供给的价格弹性和一个长期的交叉弹性约-0.3。P，/c 和 Pf，/c 是平稳随机过程，而新建筑物的供应显示出明显的扩大造船能力的趋势。世界各国的 GDP 一直在增长

included as an additional regressor in Equation 11. This would be appropriate if changes in shipbuilding capacity. are affected by ship prices and world GDP.
作为方程式 11 的附加回归因子。这将是适当的，如果造船能力的变化。受到船舶价格和世界 GDP 的影响。

Equation 2 is the empirical counterpart of Equation 12. The hypothesis that newbuilding prices are an if\ndex.ofexpected future second-hand prices implies that the coefficient of In P,, in Equation 12 should be equal to unity. An F-test on this restriction indicated that it was reasonable. An additional implication of the rational expectations hypothesis is that the. error term in Equation 12 should be serially independent. This hypothesis cannot be rejected by the Box-gung statistic deiived from the equation variables.

方程 2 是方程 12 的经验派生物。假设新建筑物的价格是预期的未来二手房价格的 if/dex.ofexpectedfuturesecond-handprice 意味着方程 12 中 Inp，，的系数应该等于 1。对这一限制的 f 检验表明它是合理的。理性预期假说的另一个含义是。方程 12 中的误差项应该是串行无关的。从方程变量中提取的 Box-gung 统计量不能否定这一假设。

Equation 13 is solved for ***P,*** and Equation 13 is the empirical estimate of the transformed equation. Expected second-hand prices are proxied by the current new building price based on the discussion surrounding Equation 12 while the expected freight rate is proxied by the charter rate and expected tanker prices following the discussion surrounding Equation 5. The equation is estimated by the 'errors in variables' method. The t-statistic on the wealth variable is statistically insignificant. However it was included, since if demand is very sensitive to relative rates of return the true value of the coefficient on ***W,*** is indeed expected to be very small. Given the limited number of observations the standard error of the statistic is likely to be relatively high and this together with the fact that the true value of the coefficient is likely to be very small 'produces an **insignificant.t-statistic** in small samples. Since the economic lifetime of ships is very long, we expect that the effect of future profits on current ship prices to be much smaller than the effect of the future price. Indeed the profit elasticity of current ship prices is 0.29 whereas the expected price elasticity is 0.77 implying a long-run profit elasticity of 1.26 which is not statistically different from unity.

方程 13 解为 p，方程 13 是变换后方程的经验估计。预期的二手价格由基于方程式 12 讨论的当前新建筑物价格代替，而预期的运费率则由租船费率和围绕方程式 5 讨论后的预期油轮价格代替。这个方程是用"变量误差"法估计的。财富变量的 t-统计量在统计上无显著性。然而，它被包括在内，因为如果需求是非常敏感的相对回报率的系数 w 的真实价值，预计的确是非常小。由于观察数量有限，统计数据的标准误差可能相对较高，再加上该系数的真实值可能很小这一事实，在小样本中产生了无意义的 t-statistical_report。由于船舶的经济寿命很长，我们预计未来利润对当前船舶价格的影响远小于未来价格的影响。实际上，当前船舶价格的利润弹性为 0.29，而预期价格弹性为 0.77，这意味着长期利润弹性为 1.26，在统计学上与统一无异。

IV. SIMULATIONS
四。Simulations

Preliminaries

初步报告

In this section the properties of the model are explored by computing some of its dynamic multipliers. In doing so we distinguish between anticipated and unanticipated shocks to the exogenous variables. The former are assumed to be anticipated 5 years before they occur. This is carried out by entering the shock in year t + 5 and solving the model from year t. Table 1 reports the effects of a 5% permanent increase in the level of demand in the freight market. Since the model is non-linear the solutions are necessarily state-dependent. The tighter the state of the market in the base run, the larger the effect of a given change in demand on ship prices, freight rates and fleet size. In a depressed (base run) market on the other hand, a given change in demand will mostly affect lay-up with little impact on prices, rates and fleet size. The simulations have been carried out with respect to a base run in which extreme values of the state variables have been intentionally removed in order not to distort the pattern of the simulations.

本节通过计算模型的一些动态乘子来探讨模型的性质。在这样做的过程中，我们区分了对外生变量的预期冲击和未预期冲击。前者假定在发生之前 5 年就已预料到。这是通过进入第 t+5 年的冲击和从第 t 年开始求解模型来实现的。表 1 报告了货运市场需求水平永久性增长 5%的影响。由于模型是非线性的，解必然与状态相关。基本运行的市场状况越紧张，需求变化对船舶价格、运费和船队规模的影响就越大。另一方面，在一个低迷的(基本运行)市场，需求的一个给定的变化将主要影响停车，对价格，利率和车队规模的影响很小。对一个基本运行进行了模拟，在这个基本运行中故意删除了状态变量的极端值，以免扭曲模拟的模式。

As is well known the simulation of rational expectations models necessitates the specification of terminal conditions in order to achieve unique and stable saddle-path solutions. One possibility is to impose equilibrium (long-run) terminal conditions. However, if the time horizon of the simulation is relatively short and if this equilibrium is not expected to be achieved within this time period, equilibrium terminal conditions will distort the simulation. Another possibility, adopted here, is to require that the rate of change of the state variables in the terminal period is unchanged. This and other terminal conditions have been

众所周知，理性预期模型的模拟需要具体说明终端条件，以实现唯一和稳定的鞍路解。一种可能性是施加平衡(长期)终端条件。然而，如果模拟的时间范围相对较短，并且在这段时间内不能达到平衡，则平衡终端条件将扭曲模拟结果。这里采用的另一种可能性是要求状态变量在终端期间的变化率保持不变。这个和其他的终端条件已经

Table 1. **5% Shock to *level* of *demand (M)* (% changes)***

Year	Time charter rate		Freight rate		Lay-up		Ship prices		Fleet		Deliveries		Scrapping	
	A	U	AU		AU		A	U	A	U	A	U	A	U
0	-0.2	31.7	-0.1	27.3	0	-1.24	5.5	41.5	0.03	0.24	0	0	-0.1	-0.93
1	- 1.0	26.7	- 1.0	22.7	0.05	- 1.03	5.0	22.0	0.19	1.01	3.3	8.5	-0.15	-1.10
2	-4.0	21.2	-3.3	18.3	0.10	-0.53	7.8	1.4	0.56	2.07	7.1	13.5	-0.12	-0.77
3	-8.9	13.9	-7.5	12.2	0.17	-0.31	19.7	6.9	1.26	3.11	13.5	12.9	-0.1	-0.51
4	21.6	7.7	19.2	7.2	-0.18	0.19	12.7	4.6	2.2	3.88	15.2	9.8	-0.19	-0.36
5	13.3	4.3	12.6	4.0	-0.12	-0.12	13.4	4.8	3.07	4.37	12.3	6.0	-0.21	-0.28
6	8.8	3.1	8.3	3.4	-0.17	-0.09	4.0	5.3	3.71	4.58	10.9	4.1	-0.26	-0.23
7	6.2	3.1	5.8	3.0	-0.13	-0.07	8.1	5.7	4.20	4.68	9.0	3.6	-0.26	-0.19
8	4.1	2.8	3.6	2.7	-0.09	-0.06	5.0	5.3	4.57	4.76	7.2	4.4	-0.26	-0.16
9	2.3	2.4	2.4	2.3	-0.06	-0.05	2.0	4.3	4.81	4.84	5.7	4.9	-0.24	-0.12
10	1.0	2.1	1.6	1.8	-0.05	-0.05	1.2	4.2	4.94	4.92	3.8	5.0	-0.2	-0.06

***Lay-up, Scrapping: changes in % rate; A = Anticipated; U =Unanticipated.**

*停车、报废:%的变化率;a 预期的;u 未预期的。

examined numerically by Wallis ***et al.*** (1986) who conclude that the current choice is more robust. However, the, solution values as the terminal date is approached become distorted.

沃利斯等人(1986)，他们得出结论认为，目前的选择是更稳健的。但是，当接近终止日期时，，个解决方案值变得扭曲。

. These distortions propagate backwards in a damped way. It is for this reason that we do not report the solutions for the last four years prior to the terminal date. Our algorithm is similar to that of Wallis and iterates on the basis of conventional Gauss-Seidel inner loops to solve for the state variables and an outer loop that solves dynamically for the rational expectations variables using the terminal conditions as already described.

.这些扭曲以阻尼的方式向后传播。正是由于这个原因，我们没有报告解决方案的最后四年之前的终止日期。我们的算法类似于 Wallis 的算法，在传统的 Gauss-Seidel 内循环的基础上迭代求解状态变量，并利用已经描述的终端条件动态求解理性预期变量的外循环。

Demand shock

需求冲击

When the shock is anticipated it leads to immediate speculative increases in ship prices that depress scrapping instantaneously. Deliveries are predetermined in the short-run since they depend on past orders which means that they cannot respond in year 0. However, the increase in ship prices leads to an increase in the current size of the order book and therefore future deliveries. The speculative increases in shipbuilding and reductions in scrapping imply a higher fleet size throughout the whole time period. In the first four years with the level of demand unchanged, this implies a reduction in freight rates and increases in lay-up. Ship price increases reach a ~naximumof about **20%** just before the shock occurs. With accumulating effects of increasingly higher reductions in scrapping and expansions in shipbuilding, freight rates are also at a low just before the occurrence of the shock.

当预计到冲击时，它会导致船舶价格的投机性立即上涨，从而立即压制了经济崩溃。交货在短期内是预先确定的，因为它们取决于过去的订单，这意味着它们不能在第 0 年作出反应。然而，船舶价格的上涨导致了当前订单量的增加，从而导致了未来交货量的增加。造船活动的投机性增加和报废活动的减少意味着整个时期的船队规模更大。在需求水平不变的前四年，这意味着运费下降和储备货物增加。就在冲击发生之前，船舶价格涨幅达到最高约 20%。由于造船拆解和扩张的影响越来越大，运费率在冲击发生之前也处于低水平。

The speculative percentage increase in the size of the fleet by year **4** is less than the expected increase in demand. This leads to higher freight rates and reductions in lay-up from year **4** onwards. With no change in the long-run growth rate of demand ship prices almost return to their previous long-run equilibrium after a period of overshooting. With ship price being the only endogenous variable affecting the supply of newbuildings the time profile of shipbuilding mirrors that of ship prices with the exception of year **0.** Scrapping, however, is independently influenced by lay-up in addition to prices. This implies that there are additional reductions in scrappings after year **4** when lay-up is low and this compensates for the positive effect of weakening ship prices.

到第 4 年，船队规模的投机性增长百分比低于需求的预期增长。这导致较高的运费率和减少停车从第 4 年起。在长期需求增长率没有变化的情况下，船舶价格在经过一段时间的超调后几乎回到了以前的长期均衡水平。由于船舶价格是影响新造船供应的唯一内生变量，船舶价格的时间曲线反映了船舶价格的时间曲线，但 0 年除外。报废，但是，是独立的影响，除了价格上涨。这意味着，在停泊率较低的第四年之后，废弃物的数量会进一步减少，这弥补了船舶价格下降的积极影响。

The fleet eventually rises by almost **5%** so that in the long-run there is very little effect on freight rates and ship prices. The small positive long-run effects are due to higher newbuilding requirements needed to replace the higher stock of fleet at a given scrapping rate. In addition there are wealth effects arising from the fact that the larger fleet can only be absorbed in shipowners' portfolio at a slightly higher expected return.

船队最终上升了近 5%，所以从长远来看，对运费和船价的影响很小。小的积极的长期影响是由于更高的新建筑需求，以取代较高的存量车队在给定的报废率。此外，还有财富效应，因为更大的船队只能以略高的预期收益率被船东的投资组合吸收。

When the shock is unanticipated no anticipating speculative changes in shipbuilding and scrapping occur so that the fleet is unchanged when the shock occurs. This necessarily implies a much stronger boom in the freight market in year 0. Freight rates increase by 27% while lay-up drops by a whole percentage point. Most important, however, is the fact that in the short-run shipbuilding can only respond a little to the large unexpected increase in ship prices. Deliveries in the first two years are largely determined by the orders of the previous years, In addition there is little scope of increasing the fleet by reducing scrapping since (in the base run) this has been very low. As a result there are strong freight rate increases in year 1 as well, being **23%** higher.

当冲击是意料之外的，没有预期的投机变化造船和报废发生，以便船队是不变的时候，冲击发生。这必然意味着，货运市场在第 0 年将出现更强劲的繁荣。运费上涨了 27%，而滞留货物下降了整整一个百分点。然而，最重要的是，在短期内，造船业只能对出人意料的船舶价格大幅上涨做出一点反应。头两年的交货量主要取决于前几年的订单，此外，通过减少报废来增加船队的余地很小，因为(在基本运行期间)这一数字非常低。因此，第一年的运费也出现了强劲的增长，增长了 23%。

In anticipation of the sluggish response of shipbuilding and the associated strong boom in the freight market ship prices rise by **42%** initially. By year **4** the size of the fleet is **3.9%** higher. Because shipbuilding is not responsive initially, the burden of increasing the fleet falls on reduced scrapping. Scrapping falls by a whole percentage point initially and is on average

由于预期造船业反应迟缓以及与之相关的货运市场的强劲繁荣，船舶价格最初上涨了 42%。到了第四年，船队的规模增加了 3.9%。由于造船业最初并不积极响应，增加船队的负担落在减少报废上。报废率最初下降了整整一个百分点，而且是平均水平

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0.7%lower throughout the first five years. This compares with a maximum of **0.26%** drop in the case of the anticipated scenario. There the anticipation of the shock allowed shipbuilding to respond more fully to the expected high future ship prices leading to lower ship price changes on a ~ e r a g e . . ~largeh fall in scrapping is consistent with the large increase in ship prices and the significant drop in lay-up.
在最初的五年里，这个数字下降了 0.7%。相比之下，在预期的情况下，最多下降 0.26%。在这种情况下，对冲击的预期使造船业能够更充分地应对未来预期的高船价，从而降低船价的变动幅度。.船舶报废率的大幅下降与船舶价格的大幅上涨和停运量的大幅下降是一致的。

After 10 years most of the effects of the shock seem to die out. Small long-run effects similar to the ones of the anticipated scenario, are found. After **10** years the fleet is almost 5% higher and therefore freight rates are almost unchanged under both scenarios. However, ship prices in year **10** seem to be slightly higher under the unanticipated scenario. This is because in this case most of the 5% increase in the fleet has been achieved by scrapping reductions rather than newbuildings implying a higher average age of the fleet at year **10** onwards in the unanticipated scenario and therefore higher current prices. In summary it can be said that in the unanticipated scenario much stronger short-run responses are observed as compared with the anticipated case where the response is milder and more evenly distributed over time, for all variables except deliveries.

10 年后，大部分冲击的影响似乎都消失了。小的长期影响类似于预期的情景，被发现。10 年后，船队几乎高出 5%，因此运费率几乎没有变化，在这两种情况下。然而，在意料之外的情况下，第 10 年的船舶价格似乎略高。这是因为在这种情况下，车队 5%的增长大部分是通过废弃的减少而不是新建筑物来实现的，这意味着在未预料到的情况下，车队在 10 年以后的平均车龄更高，因此目前的价格也更高。总之，可以说，对于除交付外的所有变量，在意料之外的情况下，与预期情况相比，短期反应要温和得多，而且随着时间的推移分布更加均匀。

Indeed most of the differences in the time pattern of the responses is due to this fact that deliveries cannot be too responsive in the unanticipated case, at least initially. Deliveries increase by an average of **6.6%** when the shock is unforeseen as compared with **8 %** in the anticipated run in spite of much higher increases in ship prices of about 5% on average.

事实上，答复时间模式的差异主要是由于这样一个事实，即在意料之外的情况下，至少在最初阶段，分娩的反应不能太积极。尽管船舶价格平均上涨约 5%，但如果没有预料到这一冲击，交货量平均增长 6.6%，而预计交货量为 8%。

Bunker price shock
燃料价格冲击

Table 2 shows the response of freight rates, ship prices and fleet size to a foreseen and an unforeseen **50%** increase in the price of fuel. Fuel costs have represented by far the biggest component of operating costs since **1974.** The theoretical effects on vessel profitability of an increase in voyage costs ***(PB)***depend on the elasticities of supply and demand in the freight market. It might be surmised that an increase in voyage costs must harm profitability because these costs are incurred directly or indirectly by the vessel owner. However, if the demand for freight is price inelastic the incidence of these costs is borne entirely by the charterer. Indeed, under these circumstances profitability will improve because voyage costs are only a part of total costs.

表 2 显示了运费率、船舶价格和船队规模对可预见的和未预见的燃料价格上涨50%的反应。自 1974 年以来，燃料成本一直是运营成本的最大组成部分。航次成本增加对船舶盈利能力的理论影响取决于货运市场的供求弹性。可以推测，航程费用的增加一定会损害利润，因为这些费用是由船东直接或间接引起的。然而，如果运费需求是价格无弹性的，这些费用的负担完全由租船人承担。实际上，在这种情况下，利润率将会提高，因为航程成本只是总成本的一部分。

To establish this the equation on page **340** may be solved under the restriction that demand for freight is completely price insensitive. The result is:

为了建立这个方程，340 页上的方程可以在运费需求完全对价格不敏感的约束下求解。结果是:

Since a **> 1** the exponent of ***PB*** is positive in which case an increase in voyage costs raises profitability.

因为 PB 的指数是正的，在这种情况下，航程成本的增加提高了盈利能力。

By comparing Tables **1** and **2** it can be seen that basically both the demand and supply shocks produce very similar patterns of responses. This is because both shocks operate throughthe creation of a shortage in the freight market that raises profits while at the same time they do not, directly affect any other markets. The only scope for differing responses arises from the fact that there is an additional link between the freight market and the markets for vessels. This is the link between lay-up and scrapping. Fuel price and demand increases can have different effects on lay-up giving rise to different responses. However, this link is much weaker.

通过比较表 1 和表 2 可以看出，基本上需求和供应冲击都会产生非常相似的反应模式。这是因为这两种冲击都是通过货运市场短缺产生的，货运市场短缺提高了利润，但同时又不直接影响到任何其他市场。不同反应的唯一范围是，货运市场和船舶市场之间存在着额外的联系。这就是上篮和拼抢之间的联系。燃料价格和需求的增加对停产有不同的影响，从而引起不同的反应。然而，这种联系要弱得多。

An anticipated increase in fuel prices leads to expected shortages in the freight market which cause immediate speculative increases in ship prices. This reduces scrapping and

预期的燃料价格上涨将导致预期的货运市场短缺，造成船舶价格的投机性立即上涨。这样可以减少废弃物的排放

Table 2. 50% *Rise in bunker prices* (% *change)**
表 二 。燃料价格上涨 50% (% change) *

Year 年份	**Time charter rate** 定期租船费率		**Freight rate** 运费率		**Lay-up** 上篮		**Ship prices** 船舶价格		**Fleet** 舰队		**Deliveries** 送货		**Scrapping** 报废	
	A A	**U** u	**A** A	**U** u	**A**	**U**	**A**	**U**	**A**	**U**	**A**	**U**	**A**	**U**

***Lay-up, Scrapping: changes in % rate; A = Anticipated, U = Unanticipated.**
*停车，报废:%的变化率;a 预期，u 意料之外。

stimulates shipbuilding after a lag. Because there is plenty of time for shipbuilding to respond to the anticipated shortage, there is a significant increase in deliveries without prices rising by more than **12%.** As a result the drop in scrapping is very small. Because of the speculative increase in prices the fleet grows initially and this reduces freight rates and increases lay-up. When the shock occurs in year 4 it raises freight rates by **14%** and this compensates for the 50% increase in fuel prices, as can be seen from the time charter rate. Just before the shock occurs ship prices reach a maximum while freight rates reach a minimum. After year **4** the shortage is gradually eliminated with time charter rates and ship prices returning to a level slightly above their previous long-run level. However, there is a more significant permanent increase in freight rates which is needed in order to maintain profits at similar long-run levels, while fuel prices remain permanently higher. There is also a permanent increase in the size of the fleet of around **3%.** This implies that the long-run level of demand is satisfied now by a bigger fleet and slower steaming. Deliveries are also permanently increased in order to maintain a higher fleet at a given scrapping rate, whilst there is little change in the long-run level of scrapping.

在一段时间后刺激造船。由于造船业有足够的时间来应对预期的短缺，交货量大幅增加，而价格上涨幅度不超过 12%。因此，报废率的下降很小。由于投机性的价格上涨，船队最初增长，这降低了运费率和增加储备。当冲击发生在第 4 年，它提高了运费率 14%，这弥补了燃料价格 50%的增长，可以从定期租船费率看到。就在冲击发生之前，船舶价格达到最高，而运费达到最低。4 年后，随着定期租船费率和船舶价格回到略高于先前长期水平的水平，短缺逐渐消除。然而，为了在燃料价格长期居高不下的情况下将利润维持在类似的长期水平，运费率需要长期大幅度提高。此外，船队的规模也会永久性地增加 3%左右。这意味着现在更大的船队和更慢的航行速度可以满足长期的需求。交货量也在不断增加，以便在给定的报废率下保持较高的车队，同时报废率的长期水平几乎没有变化。

When the shock is unanticipated the stock of the fleet is unchanged, so initially it produces a much greater shortage in the freight market. Freight rates rise therefore by 18% in year 0. Again shipbuilding is mainly determined by past decisions in the short-run so that freight rates are still 17% higher than year 1. This results in much stronger speculative increases in ship prices initially of about 26%. Accordingly scrapping reductions are much larger. These are reinforced by reductions in lay-up. At the peak deliveries increase by 8 % as compared with 10% in the anticipated scenario in spite of ship prices increasing by 26% as compared with **12%.** Again here all the responses except that of shipbuilding are much stronger and occur in a shorter space of time as compared with the lower and more gradual responses of the anticipated scenario. However, the long-run effects are similar.

当这种冲击出乎意料时，船队的存货没有变化，因此在最初阶段，货运市场会出现更大的短缺。因此，运费在第 0 年上涨了 18%。同样，造船主要是由过去短期内的决定决定的，因此运费率仍然比第一年高 17%。这导致船舶价格最初大约 26%的投机性大幅上涨。因此，废除减排的规模要大得多。裁员的减少使这些问题更加严重。尽管船舶价格上涨了 26%，而预期的情况是 12%，但在交货高峰期，交货量增加了 8%，而预期的情况是 10%。这里所有的反应，除了造船是强大得多，发生在一个较短的时间空间相比，较低和更渐进的反应的预期情景。然而，长期影响是相似的。

V. CONCLUSIONS
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The efforts described in this paper have had a twofold objective. First an estimate was sought of an empirical model of the dry cargo market in which the market for freight and the market for vessels were jointly determined. In doing so an attempt was made to take into account stock-flow considerations that arise out of the fact that vessels are capital assets which provide flows of freight services and which depreciate. Second, a specification of the model in terms of the Efficient MarketsIRational Expectations Hypothesis was sought. In doing so the alternative hypotheses have not been explored since our task has been fullsome in its own right.

本文所描述的努力具有双重目的。首先，对干散货市场的实证模型进行了估计，其中货运市场和船舶市场是共同确定的。在这样做时，试图考虑到由于船舶是提供货运服务流动和折旧的资本资产而产生的库存流动因素。其次，根据有效市场理性预期假说对模型进行了说明。在这样做的过程中，由于我们的任务本身已经完成了一些，其他的假设还没有被探索。

The model provides a good statistical account of the dry cargo market since 1960 and tracks the data quite accurately. Because the model incorporates rational expectations, anticipated and unanticipated shocks to the exogenous variables could be distinguished.

该模型提供了自 1960 年以来干货市场的良好统计帐户，并相当准确地跟踪数据。由于该模型包含了理性预期，因此可以区分对外生变量的预期和未预期的冲击。

DATAAPPENDIX
Datapendix

M Ton-miles: Fearnleys Review
Ton-miles: Fearnleys Review
KDry cargo fleet
kdry 货运船队

1950-1962: American Bureau of Shipping
1962- : Fearnleys Review
Voyage freight rate index: General Council of British Shipping (1980= 100)
航次运价指数:英国航运总理事会(1980100)
End year, 12 months time charter rate index: General Council of British Shipping Deliveries of new dry cargo vessels
年底，12 个月定期租船费率指数:英国航运总理事会交付新的干货船
195&1962: Lloyds Register of Shipping, Merchant Ships Launched (Conversion factor GRT/DWT= 0.7)
195 年和 1962 年:劳埃德船舶注册，商船下水(换算系数 grt/dwt0.7)
1963-1985: Fearnleys Review
1963-1985 年:《费恩利评论》
Dry Cargo Order Book
干货订单簿
1950-1963: American Shipbuilders Bureau (conversion factor GRT/DW =0.7)
1950-1963 年:美国造船局(换算系数 grt/dw0.7)
1964- : Fearnleys Review
1964-:《费恩利评论》
Vessels scrapped
报废的船只
1955-1966: Estimated as total dwt scrapped (Source: Platou Report) minus Tanker dwt scrapped (Source: J. I. Jacobs, World Tanker Fleet Review)
1955-1966 年:估计总载重吨报废(资料来源:普拉图报告)减去油轮载重吨报废(资料来源:j ｉ雅各布斯，《世界油轮船队评论》)
1967- : Platou Report
1967 年:《普拉图报告》
Proportion of fleet laid up
搁置船队的比例
Estimated as vessels laid up divided by K
估计为停泊船只除以 k
Vessels laid up:
搁置船只:
1955-1972: Shipping Statistics, Bremen Institute of Shipping Economics
1955-1972 年:不来梅航运经济研究所航运统计
1973- : Fearnleys Review
1973-:《费恩利评论》
Second-hand price index
二手物价指数
1950-1969: Index constructed from estimates of second-hand values of dry cargo ships of various sizes and ages (Platou Report, Fearnleys Review, Fairplay) 1969- : Second-hand price of 5-year-old 60000 dwt Bulk Carrier (Fearnleys Review)
1950-1969 年:根据各种尺寸和年龄的干货船的二手价值估算编制的指数(《普拉图报告》，《费恩里斯评论》，费尔普莱)1969-:已有 5 年历史的 6 万吨散装货船的二手价格(《费恩里斯评论》)

Newbuilding price iridex
新建筑价格
1950-1964: Index constructed from estimates of newbuilding prices of dry cargo ships of various size!; (various sources) 1964- : Newbuilding Price of 30000 dwt Bulk carrier (Fearnleys Review)
1950-1964 年:根据各种尺寸的干货船的新建造价格估计建造的指数！(各种来源)1964 年-:新建 30000 吨散装货船的价格(费恩里斯评论)
Newbuilding price of tankers
油轮新造价格
1950-1964: Index constructed from estimates of newbuilding prices of Tankers of various sizes (various sources).
1950-1964 年:根据各种大小(不同来源)油轮的新建造价格估计数构成的指数。
1964-1973, 1977- : Newbuilding Price of 210000 dwt Tanker (Fearnleys Review)
1964-1973,1977-:210000 吨油轮的新建造价格
1974-1976: Resale value of VLCC Newbuilding (J. I. Jacobs World Tanker Fleet Review)
1974-1976:VLCC 新大楼的转售价值(j i 雅各布斯世界油轮船队评论)
Proportion of Dry Cargo Fleet over 10 years old.
10 年以上干货船队的比例。
Lloyds' Register of Shipping, Statistical Tables
劳埃德船舶登记册，统计表
Proportion of Dry Cargo Fleet over 20 years old.
船龄超过 20 年的干货船队所占比例。
Lloyd's Register of Shipping, Statistical Tables
劳氏船级社统计表
Unit voyage costs (bunkers plus port charges)
单位航程费用(船用燃料加港口费用)
Estimated as 5*PF + PC
估计为 5*PF+PC
Port charges ($)
港口费($)
Price of fuel oil per barrel ($)
每桶燃油价格(美元)
Estimated as average marine fuel prices in various ports of the world (various sources)
估计世界各港口(各种来源)的海洋燃料平均价格
Estimated as IPIEDOL
估计为 IPIEDOL

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IP Industrialized Countries Wholesale Price Index (1980= 100)
知识产权工业化国家批发价格指数(1980-100)
Source: IFS (International Financial Statistics, IMF)
资料来源:国际货币基金组织国际金融统计

EDOL Exchange rate of the dollar against SDR (1980= 100)
美元对特别提款权的汇率(1980100)
Source: IFS
来源:财政研究所

L C Lay-up costs
信用证上市费用
Estimated as ***LC = IPIEDOL***
估计为 LCIPIEDOL

RC Running costs
运行成本
Estimated as RC = ***IPJEDOL***
估计为驻地协调员 IPJEDOL

L Vessels lost
船只损失
Lloyds Register of Shipping, Statistical Tables
劳埃德船舶注册，统计表

P , Price of scrap
废料价格
1950-1966: Price of scrap in Japan. United Nations, Monthly Bulletin of Statistics 1967- : Scrap price per light dwt ton in the Far East Fearnleys Review
1950-1966 年:日本废料价格。《联合国统计月报》，1967-:《远东地区每轻吨废料价格》

C Shipbuilding cost Index
造船成本指数
Estimated as 2 ***x P M E T + IPIEDOL***
估计为 2xpmet+IPIEDOL

W World Wealth proxied as ***P I P J E D O L***
世界财富代理人:pipjedol

Y World GDP at constant prices **(1980=** 100)
Source: IFS
按不变价格计算的世界国内生产总值(1980100)
资料来源:财政研究所

R End year, one year US Treasury Bill Rate ***C***
O M Combined carriers in dry
年底，一年期美国国库券利率
Source: Fearnleys Review
来源:FearnleysReview

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