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STATISTICAL COST FUNCTIONS FOR OIL CHEMICAL TANKERS

M.Sc. THESIS

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PETROL VE KİMYASAL TANKERLERDE İSTATİSTİKSEL MALİYET ANALİZİ

YÜKSEK LİSANS TEZİ

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To my mother,

FOREWORD

I would like to express my deep appreciation and thanks to my advisor Assist. Prof. Dr. Barış Barlas who inspired me to write this thesis. I would also like to thank to all Green & Black Marine Logistics team for their support, especially to my manager, Mukremin Altuntas for encouraging me to be in the maritime business.

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TABLE OF CONTENTS

Page

ABBREVIATIONS

BV	**:** Bureau Veritas
GL	**:** Germanischer Lloyd
LR	**:** Lloyd's Register
DNV	**:** Det Norske Veritas
ABS	**:** American Bureau of Shipping
DWT	**:** Deadweight
BDI	**:** Baltic Dry Index
UT	**:** Deadweight Utilization Ratio
FR	**:** Freight
VLCC	**:** Very Large Crude Carrier
ULCC	**:** Ultra Large Crude Carrier
SPM	**:** Single Point Mooring
SBM	**:** Single Buoy Mooring
SPSS	**:** Statistical Package for the Social Sciences
SWL	**:** Safe Working Load
WS	**:** World Scale
WSE	**:** World Scale Equivalent
TCE	**:** Time Charter Equivalent
IMO	**:** International Maritime Organization

LIST OF TABLES

Page

LIST OF FIGURES

Page

STATISTICAL COST FUNCTIONS FOR OIL CHEMICAL TANKERS

SUMMARY

In this study maritime transportation with a particular importance among the other transportation modes is investigated. Tanker transportation which is a special sub sector of maritime transportation industry plays a vital role for the world trade. As oil is the fundamental component for developing industries, consequently the transportation of it becomes an indispensable issue. Especially, to determine the factors affecting the price of this service, i.e. freight, has a crucial importance. It is very hard to predict the freight rates in tanker transportation because of the complexity of the market and their sensitivity to international political issues. Therefore to determine the factors influencing tanker freight rates provide valuable information for investors, tanker owners and charterers.

The behavior of shipping freight rates and the timing of shipping contracts affect the transportation costs of charterers and the operating cash flows of shipowners. The object of this study is to investigate sea transportation cost functions for tanker vessels on the basis of the market data. Cost functions are interest to shipowners, shipbuilders and shippers, as they provide information on the relative importance of the effects on freight rates of economies of size, route length, and the general market situation. On this basis, this study aims to forecast the freight rates by estimating a mathematical model using data for the period May 2008 to December 2011. Statistical estimates of the main determinants of sea transport costs(deadweight utilization ratio, oil price, vessel age, baltic dry index and voyage routes) are presented for tanker vessels operating in the Black Sea, Mediterrenean, and West Europe region on vessels up 20000 mts DWT. As the statistical analysis and results show, this mathematical model can be used for freight estimation and can be used by charterers and shipbrokers operating in the the Black Sea, Mediterrenean, and West Europe area.

PETROL VE KİMYASAL TANKERLERDE İSTATİSTİKSEL MALİYET ANALİZİ

ÖZET

Ulaştırma genel olarak karayolu, demiryolu, havayolu ve boru hattı olmak üzere dört alt sistemden oluşmaktadır. Ancak, dünya ticaretine konu olan malların büyük bir bölümü denizyoluyla taşınmaktadır. Denizyolu taşımacılığının diğer taşıma sistemlerine göre toplam dünya ticaretinden daha fazla pay almasının nedenlerinin başında büyük parti malların taşınabilmesi gelmektedir. Böylece hacim avantajıyla ölçek ekonomisinden yararlanır ve birim maliyetler daha düşük seviyelerde tutulabilir.

Dünya ticaret hacminden büyük pay alan denizyolu taşımacılığı piyasasında oluşan fiyatlar yani navlunlar önem arz etmektedir. Denizyolu taşımacılığı hizmetinin ücreti olan navlun, hizmet maliyeti ve belli bir kâr marjından oluşur. Denizyolu taşımacılığı endüstrisini oluşturan farklı alt sektörlere göre navlun oranları farklılıklar göstermektedir. Özellikle kuru dökme yük ve tanker deniz taşımacılığı sektörlerinde hizmet rekabet piyasası içinde verildiğinden navlun oranlarında ciddi dalgalanmalar yaşanmaktadır.

Gemi kiralama sözleşmelerinin zamanı ve deniz navlun hareketleri, kiracıların ulaşım maliyetlerini ve armatör nakit akışını etkiler. Bu çalışmanın amacı, piyasa verileri temelinde tanker gemileri için istatistiksel olarak maliyet analizi fonksiyonu oluşturmaktır. Maliyet fonksiyonları armatörler, tersaneciler ve yükleyiciler için ticaretin uzaklığı, piyasa durumu temelinde bilgi sağlarlar. Bu çalışmanın amacı Mayıs 2008 ve Aralık 2011 tarihleri arasındaki bilgilere bakarak çoklu regresyon analizi yöntemiyle matematik model oluşturup navlun tahmini yapmaktır. Deniz taşımacılığının istatistiksel maliyet belirleyecileri(deadweight kullanım oranı, petrol fiyatları, gemi yaşı, baltik indeksi ve sefer uzaklığı) Karadeniz, Akdeniz ve Batı Avrupa bölgeleri için 20000 DWT'den küçük gemiler için ortaya konulmuştur.

Dünya endüstrileri için çok önemli bir enerji kaynağı olan petrolün taşınmasını sağlayan tanker taşımacılığı sektörü denizyolu taşımacılığının önemli sektörlerinden biridir. Bu çalışmada tanker deniz taşımacılığı sektöründe oluşan navlunlar ve bu navlunu etkileyen etmenler araştırılmıştır. Tanker navlun oranlarını nelerin etkilediğini bilmek gemi sahiplerinin gelecek nakit akımlarını ve kiralayan tarafın maliyetlerini öngörebilmelerini kolaylaştıracaktır.

Uluslararası piyasalarda işletmelerin varolabilmeleri, sürekli değişen Pazar taleplerini istenilen zamanda karşılayabilmeleriyle mümkündür. İşletmeler bir taraftan pazara erişim zamanını ve maliyetleri azaltmayı planlarken, diğer taraftan da kârlılığın ve etkinliğin arttırılmasını amaçlamaktadırlar. Gelişen rekabet koşulları, küreselleşen ekonomi, dünya piyasalarında taşımacılık hizmetlerinin önemini arttırmaktadır. Dış ticarette maliyetlerin düşürülmesi ve zamanında teslimin öneminin artması da taşımacılık sektörünün gelişimini tetiklemektedir.

Maliyetlerin diğer taşıma modlarına göre daha düşük olması, büyük hacimlerde yüklerin bir defada taşınabilmesine imkan sağlaması açısından dünya ticaretinde denizyolu taşımacılığının payının yüksek olduğu gözlenmektedir. Bu derece önemli bir sektör olması nedeniyle çalışmada denizyolu taşımacılığı fiyatların genel özelliklerinin anlaşılması açısından ekonomisi incelenmiştir.

Özel bir taşımacılık modu olan denizyolu taşımacılığı endüstrisi içinde önemli alt sektörlerden biri olan tanker deniz taşımacılığı dünya ticareti için büyük önem taşımaktadır. Çünkü hızla endüstrileşen dünya ekonomileri için petrol önemli bir enerji kaynağıdır ve buna bağlı olarak tanker deniz taşımacılığı da dünya ekonomileri için önemli hale gelmektedir. Çalışmada ayrıca dünya ekonomileri için bu derece önemli olan tanker deniz taşımacılığı tarihi gelişimi incelenmiş ve tanker navlunlarını iyi anlamak adına tanker deniz taşımacılığı ekonomisinden bahsedilmiştir. Böylece genelden özele gidilmiş, önce denizyolu taşımacılığı incelenerek genel bir fikir verildikten sonra özel bir sektör olan tanker deniz taşımacılığı incelenmiştir. Ayrıca, tanker deniz taşımacılığı piyasasıyla ilgili olarak literatürde yapılan çalışmalar incelenmiştir. Bu inceleme konuyla ilgili olarak bir ışık tutmanın yanı sıra nerelerde boşluklar olduğunun anlaşılmasını sağlamıştır.

Bir hizmet sektörü olan tanker deniz taşımacılığında hizmetin fiyatı olan navlunu nelerin etkilediğini bilmek önem arz etmektedir. Tanker navlunlarını nelerin etkilediğini bilmenin yatırımcılar, gemi sahipleri ve bu hizmeti alanlar için faydalı bir bilgi olduğu düşünülmektektedir.

Tanker deniz taşımacığında navlunları etkileyen birçok faktör vardır. Önemli olan piyasa katılımcılarının piyasanın arz ve talep boyutunun yanında taşımacılığı yapılan malın yani petrolün ekonomik gelişmelerinin ayrıntılı olarak incelenmesi gerekliliğidir. Ayrıca, denizyolu taşımacılığında bir sektör incelenirken diğer sektörlerdeki gelişmeler de takip edilmelidir. Böylece denizyolu taşımacılığı endüstisinin içindeki tüm sektörleri iyi analiz edilmiş olup daha doğru kararlar alınabilecektir.

Dünyada taşımacılık hizmetinde kara, hava ve deniz olmak üzere tüm taşımacılık modlarına olan talep türemiş taleptir. Yani taşımacılık talebi taşınacak ürüne olan talepten doğmaktadır. Bu nedenle taşınacak ürünle ilgili gelişmeler bu ürünün taşınmasıyla ilgili sektörü şekillendirir. Tanker deniz taşımacılığını anlamak ham petrol piyasasını anlamayı gerektirir. Bu açıdan ham petrol fiyatları ile tanker navlun oranları arasında kuvvetli bir ilişki olması beklenir. Çalışmada ham petrol piyasasıyla ilgili birçok değişken analize alınmıştır. Alınan değişkenler içinde tanker navlun oranlarını en çok etkilemesi beklenen değişken ham petrol fiyatlarıdır. Çünkü artan petrol talebi nedeniyle petrol fiyatları artacaktır. Petrole talebin artması ise tanker deniz taşımacılığına olan talebin artması anlamına gelir ki bu direk tanker navlunlarını etkiler. Yapılan analizde beklenen şekilde ham petrol fiyatları ile tanker navlun oranları arasında önemli bir ilişki olduğu ortaya çıkmıştır. Analizin sonucuna göre tanker navlunlarını en çok etkileyen değişken ham petrol fiyatlarıdır.

Dünya endüstrilerinin gelişmesiyle petrol ihtiyacının her geçen gün artması petrol ticaretinin hızla gelişmesine neden olmaktadır. Ayrıca bazı ülkelerin ürettiğinden çok daha fazla tükettiği ve tam tersi bazı ülkelerin de ürettiği kadar tüketmediği açıktır. Dolayısıyla petrolün ülkeler arası değişimi önem arz eder. Ayrıca daha ayrıntılı bakıldığında her ülke farklı yoğunluk ve içerikte petrole sahiptir. Ülkeler arası değişimin diğer bir nedeni de budur. Tüm bunların toplu etkisiyle artan petrol ticareti, tanker taşımacılığının önemini artırmaktadır. Glen ve Martin'in 2002 yılında yapmış olduğu bir çalışmaya göre dünya petrol üreticilerinin %59'u denizyoluyla ticaret yapmaktadır. Bu seviye 1990'daki %48'lik ve 1995'deki %56'lık seviyeye göre dikkate değer bir büyümedir.

Büyüyen tanker taşımacılığı ticaret hacmi, artan petrol ticaretine bağlıdır. Hala en büyük arz kaynağının Suudi Arabistan ve en büyük tüketicinin de ABD olduğu görülmektedir. Dolayısıyla bu ülkeler petrol ticaretini etkileyen önemli iki ülke konumundadırlar. Fakat tek başına petrol ticaretinin artması tanker taşımacılığının artması için yeterli değildir. Petrol ticaretinin yönü de çok önemlidir. Zaman içinde petrol ticaretinin yönünde meydana gelen değişikler tanker taşımacılığı hacminde de önemli değişikliklere sebep olmuştur.

Özellikle uluslarararası düzeyde analiz edildiğinde tanker deniz taşımacılığını etkileyen birçok faktör dikkate alınmalıdır. Politik olaylar, olabilecek krizler, emtia fiyatlarınıdaki beklentiler, ülkelerin büyüme hızları ve yeni enerji kaynaklarının bulunmasıyla ilgili konular yakından takip edilmelidir. Denizyolu taşımacılığı piyasası iyi analiz edildikten sonra uluslararası gelişmeler iyi takip edilirse piyasa katılımcılarının doğru karar almamaları için hiçbir sebep olmayacaktır.

Karadeniz, Akdeniz ve Batı Avrupa bölgelerinde küçük tanker navlunları genel olarak ticaret hacmine ve kar marjına bağlıdır. Çalışmada ki model bu bölgelerdeki 198 tanker bağlantısını içerdiği içinde son 4 yıldaki market hakkında da bize bilgi sunmaktadır. Sonuçlar göstermektedir ki bu fonksiyonlar brokerlar ve kiracılar tarafından navlun fikri almak adına kolayca kullanılabilirler.Çalışmada iki farklı model kullanılmıştır ve ikinci modelin market dalgalanmalarını da hesaba kattığı için daha iyi sonuçlar verdiği görülmüştür. İstenmeyen sonuçların nedeni araştırılmış, ve en büyük nedenin kargo karakteristiklerinden kaynaklandığı görülmüştür. İleri ki çalışmalarda verilerin kargo karasteristiklerine göre ayrılarak daha iyi sonuçlar elde edileceği düşünülmektedir.

1. INTRODUCTION

In 2008 the cargo carrying capacity of the world tanker fleet of 402 million tonnes was 38% of the total world shipping fleet and the number of tanker ships exceeded 4800. During the same year the tanker fleet transported 2795 million metric tonnes (mmt) of liquid bulk commodities around the world, out of which 2043 mmt was crude oil and 752 mmt was petroleum products(Alizadeh and Talley, 2011). The tanker shipping market is by far the largest sector of the world shipping industry in terms of trading volume and weight. Therefore, it is not surprising that a large number of studies have been devoted to analyzing tanker freight(charter) rates, chartering decisions and policies, transportation strategies, and fleet deployments and operations of the tanker shipping industry.

Freight rates in the tanker shipping industry fluctuate considerably in short run(Glen and Martin, 1998). Such fluctuations affect the formation of shipping policies, transactions, and contracts as well as cash flows and costs of shipowners and charterers(Laulajainen, 2008). While these fluctuations are argued to be due to the global economic activity as well as the state of the tanker shipping market, variables related to vessel and route characteristics (e.g., the size and age of the vessel and the geographical route in which the vessel is employed) are also important in determining shipping freight rates. In addition, the terms and conditions of the charter contract such as loading date in relation to contract date and cargo size in relation to vessel capacity are important determinants of freight rates.

There are two important dates in any vessel charter contract. The first date is the day on which negotiations between the shipowner and the charterer are completed,i.e., the day on which the contract is agreed and the charter-party is signed. This date is known as the fixture date or the hire date. The second date is the date on which the ship must present herself at the loading port ready for loading the cargo,i.e.,the layday. In practice, once the loading or lifting day for the cargo has been determined, the trader(charterer) will enter the market to find and charter the most suitable tanker for transportation of the cargo from the loading port to the destination port.

Depending on the nature of the trade, the route, and the type of cargo, the loading date may be anytime from a few days to a couple of months ahead of the time when the trading contract and transportation decisions are made. Hence, assuming vessels are available in the market at all time and at a constant flow, the trader has the option to enter into the freight market and hire a vessel anytime until the very last minute, as long as it is practical, before loading of the cargo. Therefore, it is the trader's or charterer's decision for all practical purposes as to when to enter the market and charter (or hire) a ship. For instance, if the conditions are not favorable and there is enough time prior to the cargo loading date, the trader may wait and not inform the shipbroker about the cargo and the need for a ship(Stopford, 2009). The charterer's decision of when to charter a ship is dependent on such market conditions as current and expected freight rates, the volatility of freight rates, and the cost to be incurred of not being able to find a ship to charter if the decision to hire is delayed.

It is clear that in order to distinguish the effects on costs of different vessel sizes and route lengths by using data on spot market freight rates one must allow for variations in market conditions. Especially in the spot market for voyage charters, freight rates will respond in a volatile manner to shifts in demand as the short-run supply of tonnage for particular trade is fairly inelastic (O'Loughlin, 1967). From the point of view of charterers the timing of entering into the market for fixing a vessel may affect the demand in the market and consequently move freight rates. However, waiting for more favorable freight rates may be risky as freight rates tend to move very sharply in a very short period of time. From the shipowners' point of view, information on the role of vessel and voyage specific factors in determination of freight rates can be used in investment, operations, and deployments strategies(Alizadeh and Talley, 2011).

1.1 Review of Literature

The tanker freight market is characterized by the interaction of supply and demand for tanker shipping services(Beenstock and Vergottis, 1993). The demand for tanker services is a derived demand, in the sense that it is derived from the international trade in oil and oil products, which in turn depends on world economic activity and imports and consumption of energy commodities (Stopford, 2009). The supply of tanker shipping services, on the other hand, depends, for example, on the size of the tanker fleet, the tonnage that is available for trading, tanker shipbuilding activities, bunker fuel prices, the scrapping rate of the fleet, and the productivity of the tanker fleet at any point in time. Studies by Hawdon (1978), Strandenes (1984), and Beenstock and Vergottis (1989, 1993), among others, empirically investigate the determination of shipping freight rates, the price for sea transportation, through the interaction between supply and demand for sea transportation. They find that factors such as world economic activity, growth in industrial production, seaborne trade in commodities, oil prices, availability of vessel tonnage, new vessel buildings on order, and tanker shipbuilding deliveries and the scrapping rates determine freight rates for sea transportation. More recent studies by Dikos et al. (2006) and Randers and Gölüke (2007) also use macroeconomic variables in a system dynamic setting to model and forecast tanker freight rates(Alizadeh and Talley, 2011).

Other studies have examined the time series properties of shipping freight rates such as their dependence on past values; further, they use univariate or multivariate time series models to capture the dynamics of freight rates and their volatilities. These models are then used to forecast shipping freight rates and volatilities (Veenstra and Franses, 1997). These studies utilize aggregate data and macroeconomic variables in an attempt to capture the dynamics and fluctuations in shipping freight rates and accordingly utilize the models for forecasting purposes. The underperformance of structural and time series models using macroeconomic variables for forecasting shipping freight rates may be attributed to the use of aggregate and macroeconomic data. While aggregate macroforecasts of freight rates could be useful for medium to long term investment purposes, shipowners and charterers require easy use freight forecasts to determine their trading decisions.

In the study by Tamvakis and Thanopoulou (2000), the existence of a two-tier dry-bulk ship charter market, reflecting the age of vessel, was investigated. However, the empirical results based on the time period 1989–1996 (that covered different stages of the shipping cycle) found no significant difference between freight rates paid for newer versus older vessels.

Although numerous studies have investigated the formation and behavior of shipping freight rates, vessel and voyage determinants of these rates in the tanker freight market have not been investigated in the literature specifically in small tonnage spot working vessels. This paper undertakes such an investigation for shipping freight rates that will be useful to shipowners, charterers, and investors in their decision-making processes with respect to tanker ships.

2. TANKER TRANSPORTATION

Tanker transportation serves as a vital link in facilitating the movement of oil and petroleum products from their limited sources of origin to their innumerable destinations the world over. This particular segment of the ocean shipping industry constitutes the largest component of seaborne cargo movements today, with tanker cargoes accounting for approximately one-third of all cargoes shipped by sea. Although oil is also transported through pipelines as well as by tanker trucks and tanker rail cars, these movements are relatively minor and often confined to national or (in some limited cases) intraregional trades(Kumar, 2003). Accordingly, this is a crucial transportation segment for the global community of oil consumers as well as for the oil suppliers and traders and also the owners of these ships. Aside from its vast commercial implications, tanker transportation is also becoming an epicenter of global attention for reasons ranging from environmental sensitivity to geopolitical apprehension, as evidenced through the actions and reactions resulting from a November 2002 catastrophe involving a laden tanker off the Brittany coast of Spain as well as the involvement of Venezuelan oil tankers in that South American nation’s ongoing economic paralysis(Kendall, 2001). Although not widely recognized outside the industry, tanker transportation has always had inextricable links with oil trading and its geopolitics from its very formative years(Kumar, 2003).

2.1 Tanker Types

Oil tankers can be classified into two broad categories: crude oil tankers and product tankers. Crude oil tankers are typically large dedicated ships that carry solely crude oil. As an example, the Jahre Viking, a crude oil tanker built in 1977, is the largest floating object ever built and would require 16,500 road tanker trucks to empty its full load of cargo. Although it is theoretically possible for a crude carrier to carry petroleum products, the time and monetary costs associated with tank cleaning for such a switch would be prohibitively high so that it is rarely done these days in tanker operations(Kumar, 2003). The crude carriers are classified based on their carrying capacity and suitability for a particular trade, as depicted in Fig. 2.1.

However, there is considerable variation in the deadweight figures for a particular class. For example, a deepening of the Suez Canal would propel an upward adjustment of the capacity of a Suezmax tanker. The VLCCs and ULCCs are usually used on the long-distance hauls, whereas the medium-sized vessels, Suezmax and Aframax, are used in the medium-distance ranges (e.g., from West Africa to the United States). The Panamax vessels are the largest tanker sizes that can transit the Panama Canal(Kumar, 2003).

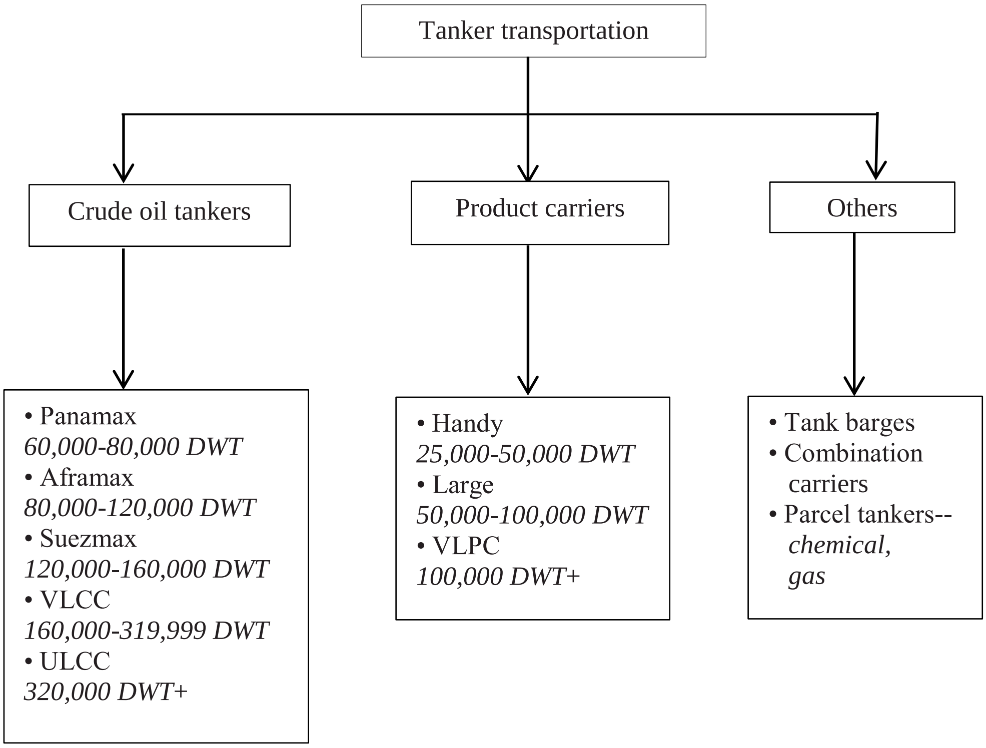


Figure 2.1 : Tanker classification(Kumar, 2003)

The product carriers, which are smaller vessels than the crude carriers, transport both the clean and dirty products of the petroleum refining process. However, because of the level of tank cleaning required, they usually do not switch from carrying clean products to carrying dirty products. Contrary to the crude carriers, product carriers are built to facilitate the carriage of multiple products simultaneously(Wood, 2000). They are kept well segregated throughout the loading, loaded passage, and unloading operations using a complex and sophisticated network of pipelines and valves on-board the ships. Furthermore, whereas the crude oil movements are typically one-way trades that consist of a loaded transit between one of the few export locations in the World and a major refining center followed by a ballast voyage back to the load port, product carrier movements are more dynamic and provide better vessel use(Stopford, 2009). It is not unusual to find a product carrier bringing certain products to a particular site followed by loading a different group of distillates from a refinery in that discharge port or its vicinity for discharging elsewhere(Kendall, 2001).

Figure 2.1 also includes a third category that consists of tank barges and other ships linked to the transportation of oil and its by-products. Tank barges usually operate in coastal trade. Combination carriers, specially constructed ships that can switch from trading bulk crude oil to trading dry bulk commodities, are relatively small players in today's tanker market(Kumar, 2003).

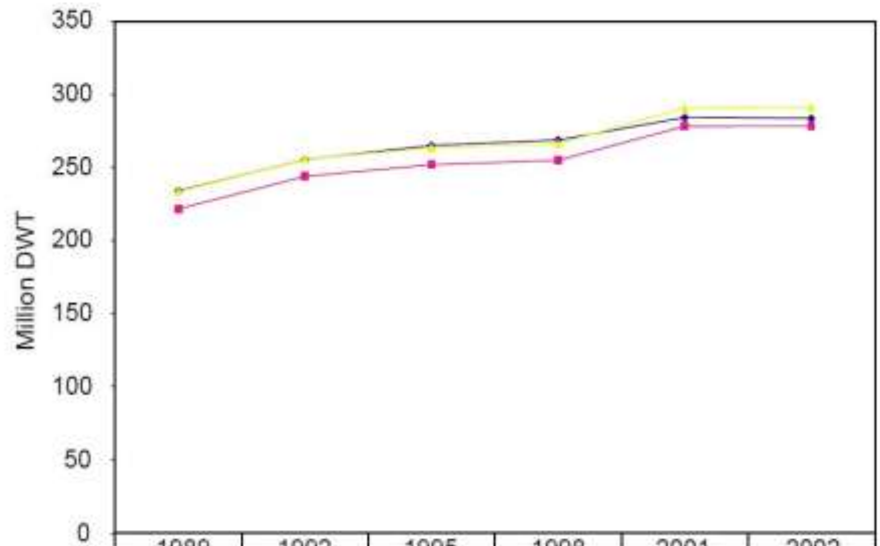
Figure 2.2 shows a oil tanker while Figure 2.3 shows an oil/chemical parcel tanker.

Figure 2.2 : Crude Oil Tanker(VLCC)

Figure 2.3 : Oil/Chemical parcel tanker

The parcel tanker sector consists of highly specialized chemical tankers, liquefied petroleum gas (LPG) carriers, and liquefied natural gas (LNG) carriers. These vessels also operate outside the tanker market and are not typically included in the discussion.

Figure 2.4 provides a summary of the tanker fleet developments during the past decade or so. It shows the total tanker (gross) and net tanker fleet for each of the years, with the difference being the idle capacity. The total active fleet for each year is obtained when the combined carrier tonnage is added to the net operating fleet for each chosen year. As shown, the global tanker fleet is on a rising trend once again and the idle capacity is on the decline, showing a tightening market in general(Platou, 2002).



	1989	1992	1995	1998	2001	2002
Tanker fleet	233.9	255.4	265	268.7	284.1	283.5
Net operating fleet	221.6	243.9	251.9	254.9	278.2	278.4
Active fleet	233.3	255.7	263.3	266.2	290.7	291.2

Figure 2.4 : Tanker fleet statistics. Data from R. S. Platou (2002).

2.2 History of Tanker Trades

The history of tanker transportation and trade will be explained under 3 titles as the early years, golden years and uncertain years.

2.2.1 The early years

Oil trading began during the late 19th century, with the United States being the leading source and the U.S.-based Standard Oil being the most dominant player, exporting refined oil to Europe using its fleet of purpose-built small ships. The Nobel brothers, sons of Alfred Nobel (the inventor of dynamite), built up a competing European fleet during the mid 1880s to trade oil from Russia that flourished until the Bolshevik revolution. Crude oil trading was not considered a feasible option during those years due to the relatively low value of the commodity. During the post-World War I era, short-haul crude oil trade originated, with most movements being to the United States from the nearby Latin American sources of Mexico and Venezuela. As the crude oil trade increased gradually, so did the need for new refining capacity in majör consumption markets(Stopford, 2009). The Middle East and its vast oil resources came under Allied control during World War II and helped to meet the wartime logistical needs of the Allied forces. Another major development during those war years was the rapid construction of a large number of T-2 tankers by U.S. shipyards to supply fuel to the Allied fleet. On completion of the war, the surplus T-2 tankers vary depending on daily market swings, it would have an impact on the price of crude oil from various suppliers despite its being a homogenous commodity. Accordingly, the oil majors procured barely onetenth of their transportation requirements of those years from the open market through spot charter agreements. Although they had the wherewithal to provide all of their tanker needs in-house, such an attempt would only help their competitors, especially the smaller oil companies (as postulated by Zannetos), so this was not attempted. were sold off at low prices, laying the foundation for the shipping fortunes of many entrepreneurial tanker owners during subsequent years(Kumar, 2003).

During the postwar era, the Middle East emerged as the focal point of the oil industry, which by this time had supplanted coal as the most dominant source of primary energy for a world economy recuperating from the ravages of two closely fought world wars. Thus, although the Gluckauf, a prototype of the modern oil tanker, was launched in 1886, the highly specialized tanker transportation sector of the current vintage did not originate until the 1940s and 1950s. The increased demand for crude oil came not only from the United States and Western Europe but also from a rapidly recovering Japan, a nation devoid of indigenous oil resources. The distances between such major consumption and production centers of crude and refined oils contributed toward increased demand for the transportation of those commodities, crude oil in particular. Accordingly, the demand for oil tankers rose, hence the meteoric growth of that specialized market in a very Short span of time. As viewed by maritime economists, tanker transportation is a derived demand industry, for fluctuations in the oil volumes traded usually lead to very perceptible impacts on the trading conditions within the tanker market(Wood, 2000).

Until 1952, tankers were operated primarily by the big oil companies, with independent ship Owners playing a fringe role. It was typical to find marine transportation divisions within the corporate hierarchies of the vertically integrated multinational oil majors. Traditional ship owners entered the market for a brief span in 1953, to be followed later by government-owned shipping companies. By the early 1960s, the oil majors' investment in direct ownership of oil tankers had dropped to approximately onethird of the global fleet. However, the oil majors still maintained direct control of 90% of their transportation requirements, supplementing their owned fleets with ships on long-term time charter from independent ship owners. It was important for the oil companies to maintain such control because the ocean transportation component was a factor input in the landed price of their commodity. If this were to vary depending on daily market swings, it would have an impact on the price of crude oil from various suppliers despite its being a homogenous commodity. Accordingly, the oil majors procured barely onetenth of their transportation requirements of those years from the open market through spot charter agreements. Although they had the wherewithal to provide all of their tanker needs in-house, such an attempt would only help their competitors, especially the smaller oil companies (as postulated by Zannetos), so this was not attempted(Kumar, 2003).

2.2.2 The golden years

The 1960s was a period of spectacular growth in the oil industry in general, and the tanker market in particular, due to its derived nature. The rapidly growing U.S., Western European, and Japanese economies consumed large quantities of crude and refined oils, and the United States, an oil exporter during earlier years, became dependent on foreign oil by the mid-1960s. Correspondingly, oil tankers began to increase in both number and size. The ship size limitation of 65,000 deadweight (DWT) imposed by the dimensions of the Suez Canal was no longer relevant, with the bigger vessel sizes benefiting from their economies of size and contributing toward lower unit cost of oil transportation(Stopford, 2009). The construction of Universe Apollo of 100,000DWT in 1959 was a major landmark, as was the construction of the first ultra large crude carrier (ULCC), Universe Iran, 10 years later in 1969. A study by Tusiani documented that although the first 200,000-DWT tanker was not delivered until 1966, by 1973 there were a total of 366 such very large or ULCCs in trade, with another 525 being under construction or on order at the time—ample testimony to the sanguinity of the period. Thus, with the increase in demand for crude and refined oils apparentlyshowing no end in sight, new tankers of increasing sizes, financed by overly optimistic shipping financiers, were being ordered at unprecedented levels, characterizing the 1960s and early 1970s as golden years of the tanker transportation sector(Wood, 2000).

From the oil majors' perspective, their domination of the retail market was challenged by the evolution of the oil spot market in Rotterdam, Netherlands, during the late 1960s that allowed the entry of nontraditional retailers in the market. The role of politics in oil trading and tanker transportation had also become clearly obvious by this time, starting with a brief closure of the Suez Canal in the wake of its nationalization by Egypt in 1956, leading to an immediate increase in freight rates for a brief span of time. A more lasting closure of the Suez Canal that began in 1967, as war broke out between Egypt and Israel, remained in effect until 1975. This increased the sailing time to destinations in Europe and North America, thereby increasing the demand for tankers and further consolidating the good fortune of some tanker owners. The Organization of Petroleum Exporting Countries (OPEC) cartel, formed in 1960, remained relatively benign during the decade and did not flex its political muscle until 1973. Thus, as discussed next, an era of turbulence and uncertainty quickly permeated the oil trade and tanker transportation market, in stark contrast to the opulent 1960s and early 1970s(Kumar, 2003).

2.2.3 The uncertain years

The Yom Kippur War of 1973 put a dramatic end to the phenomenal growth that oil and tanker markets experienced during the previous two decades. This, along with the Arab embargo of oil shipments to the United States and The Netherlands and the increasing dependence of the United States on oil imports, led to the first oil price shock during which the OPEC nations raised the price of a barrel of oil fivefold on an average to $10/barrel. Furthermore, the Arab nations expropriated American and European oil investments in their countries. However, all of these were merely temporary setbacks, and the global demand for oil increased again once the embargoes were lifted. TheMiddle East consolidated its position as the world's largest exporter of oil by the late 1970s, supplying close to three of every five barrels of oil exported in the World(Kumar, 2003). However, the increasing oil prices made oil exploration economically feasible in politically safer locations such as Alaska and the North Sea. The apparent reemergence of stability in oil market was once again disturbed by political events in Iran, hence the second oil supply shock in 1979–1980 that quadrupled oil prices. The subsequent introduction of oil conservation initiatives in major consuming nations, as well as the sudden growth of non-OPEC sources of oil, made significant inroads in the market share of the Middle East crude oil in particular. The collective effects of these developments were so remarkable that the level of global oil consumption reached in 1979 was not surpassed until 1990 and was only 13% higher even 21 years later in 2000(Stopford, 2000).

The events of this period were particularly troubling for tanker owners who were left with surplus shipping capacity (built under speculative contracts signed during the waning golden years discussed in the previous section) and huge mortgage payments. Thus, the golden era of the tanker transportation sector came to an abrupt end and was replaced by a period of gloom and doom that only worsened during the 1980s as the sector began to bear the full brunt of the conservation measures enacted after the second oil supply shock. As the oil prices began to stabilize, the cohesion of the OPEC cartel itself came under threat, with member nations undercutting each other and crude oil prices dropping to as low as $10/barrel. The price eventually stabilized at approximately $15 to $18 per barrel by the late 1980s, and trade volumes resumed their increasing trend(Kendall, 2001). Once again, the demand for oil tankers began to rise, as did the profitability of tanker owners, until that trend was altered by a new set of problems triggered by the grounding of the Exxon Valdez (discussed later). The next section discusses current trends in oil movements, an understanding of which is essential to comprehend the dynamics of the contemporary tanker transportation market(Kumar, 2003).

2.3 Geography for Tanker Chartering

There are 68 countries listed as oil producers in the International Petrolum Encyclepaedia. Virtually all producers are also consumers and therefore may not be exporters of crude or products. The importance of the Middle East as the World producer of crude oil in the long run makes the tanker industry consider how its transportation requirements will alter over the medium to long term(Stopford, 2009).The longer the sea route the bigger the ship required to carry the Cargo economically.

Figure 2.5 shows that crude oil is mainly shipped from Middle East and West Africa.

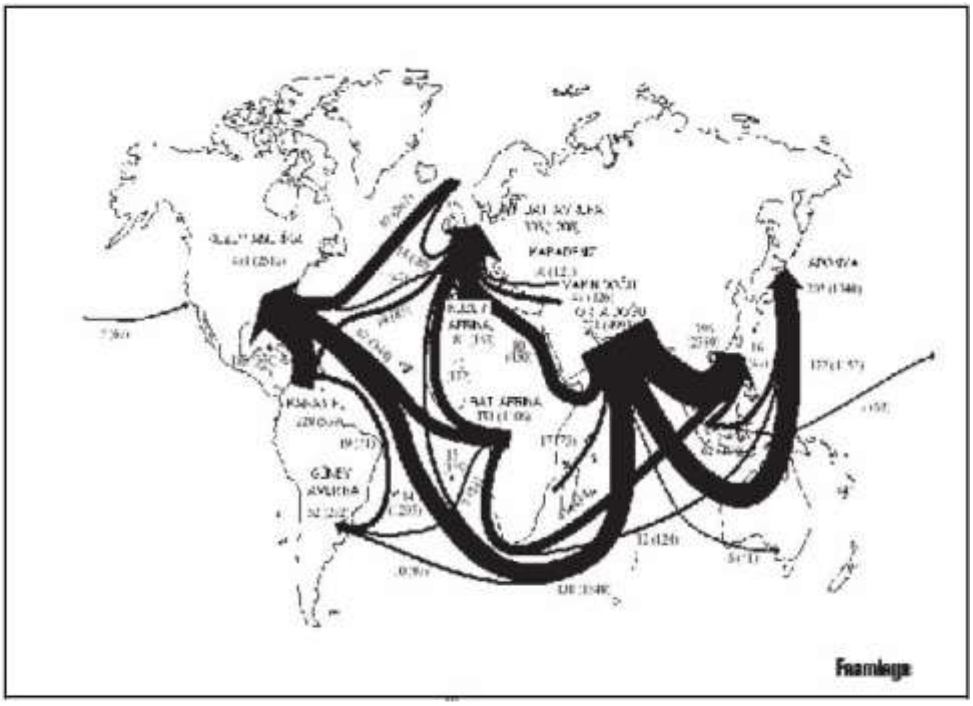


Figure 2.5 : Crude Oil and Tanker Trade Routes, 2002[Url-1]

As seen in Figure 2.6, the longer the sea route the bigger the ship required to carry the cargo economically. It presents the data for a given voyage distance, with tanker size measured on the horizontal axis.

The tanker ports have always been placed close to the sea. Somewhat influenced by the size of ships as well as the need to utilise a lot of acreage of land to build the refinery and its accompanying in the Middle East, are out of sight of land. Today there are a large number of offshore loading and discharging facilities where tankers make fast to a Single Point Mooring (SPM) or possibly a Single Buoy Mooring (SBM) which connect to an oil field ashore, an undersea oil production facility or in some cases floating storage/production vessels and semi-submersible platforms connected directly to the oil field. The first SPMs were introduced in 1959 in Brunei and they have become more popular ever since. In about 1973 the first oil from the British sector of the North Sea was shipped by Hamilton Brothers from a semi-submersible connected to a SBM. Today these facilities (i.e. SBM's or SPM's) are found in many of the loading areas(Tamvakis, 1995).

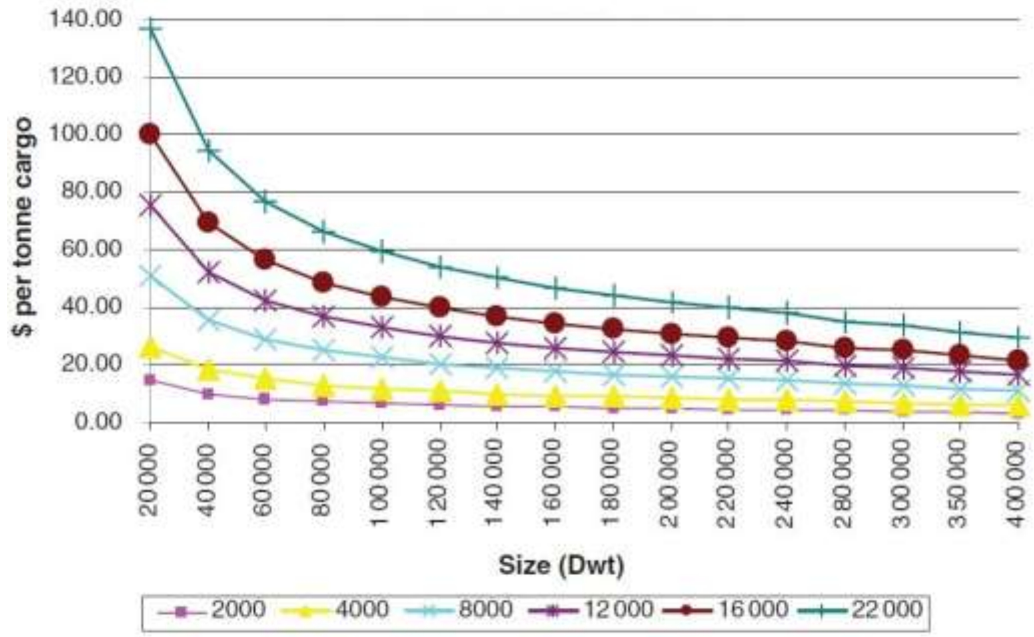


Figure 2.6 : Economies of scale in Tankers 2008(Glen and Reid, 2010)

The SBM: the buoy is used to moor the loading tanker and hold the pipelines. The loading will often take place through submarine hoses which have to be picked up by the vessel's own equipment, thus derricks of minimum 15 tonnes SWL will be preferred(Wood, 2000).

The SPM facility will have a similar mooring method but will be rigidly secured to the sea bed and possibly have a storage facility included. The Cargo hoses may well be buoyant(Kendall, 2001).

The SPM may well be directly connected to a process storage tanker – such a vessel collects oil from a small producing field through a well head platform and SPM facility, carries out some basic processing and stores the oil until there is sufficient Cargo to be transferred to a shuttle tanker. The SPM facilities are used in Louisiana, USA, Malaysia, the Indonesian Archipelago, East and West Africa, Japan, Middle East Gulf, North Africa, Mexico, North Sea, South Korea, Australia, Brazil and China(Wood, 2000).

3. ECONOMICS of TANKERS

Zannetos's extensive analysis of the tanker market found it to be rather concentrated, with 1.5% of the owners owning 35% of the fleet and the remaining 65% dispersed among the rest of the owners, none of which had a capacity share that exceeded 7% of the global fleet. Paradoxically, despite the seemingly concentrated nature of tanker ownership, Zannetos found that the market for oil tankers behaved as if it were perfectly competitive(Zannetos, 1966)). Although a study by Kumar in 1995 based on the tanker market conditions of the post-Exxon Valdez years highlighted the elevation of entry barriers in tanker markets and the potential for oligopolistic behavior by incumbents, it is fair to surmise that the market has remained highly competitive throughout its life span(Beenstock and Vergottis, 1993).

In this part, market dynamics(supply and demand), tanker freight rates and new worldwide tanker freight scale will be explained.

3.1 Freight Rates

It is to be noted that transportation cost is a very small component in the retail price of oil. The study by Glen and Martin noted that in the United Kingdom, the transportation cost component amounts to less than 1.3% of the landed cost of petrol. The relatively minor incidence of the freight component in the landed cost makes it highly inelastic in nature, as predicted by economic theory and also as documented by various studies. However, as was made painfully clear especially after the second oil price shock, the demand for tanker transportation is directly related to economic activity in general so is elastic. Thus, it would be typical to find a global recession during which manufacturing activity is considerably reduced, negatively affecting the demand for oil tankers and with the resulting excess supply of shipping capacity suppressing the freight rates. The industry is very cyclical in nature, with no reliable forecasting mechanism to predict its vacillations. A period of high freight rates, whether caused by external stimuli (e.g., war, political boycott) or random events (e.g., an unusually strong winter in the northern latitudes), usually leads to high exuberance in the market(Alizadeh and Talley, 2011). It is immediately reflected through increased new orders for ships, rising prices of second-hand ships, and reduced scrapping of older tonnage. The ship owners often find the circumstances to be changing precipitously in the other direction, more often for reasons beyond their control, although their own actions during the years of opulence may have indirectly contributed to the volatility and made the transition even more painful(Stopford, 2009).

Figure 3.1 shows the correlation between oil price and the freight rates. As oil price increases, freight rates increases also.

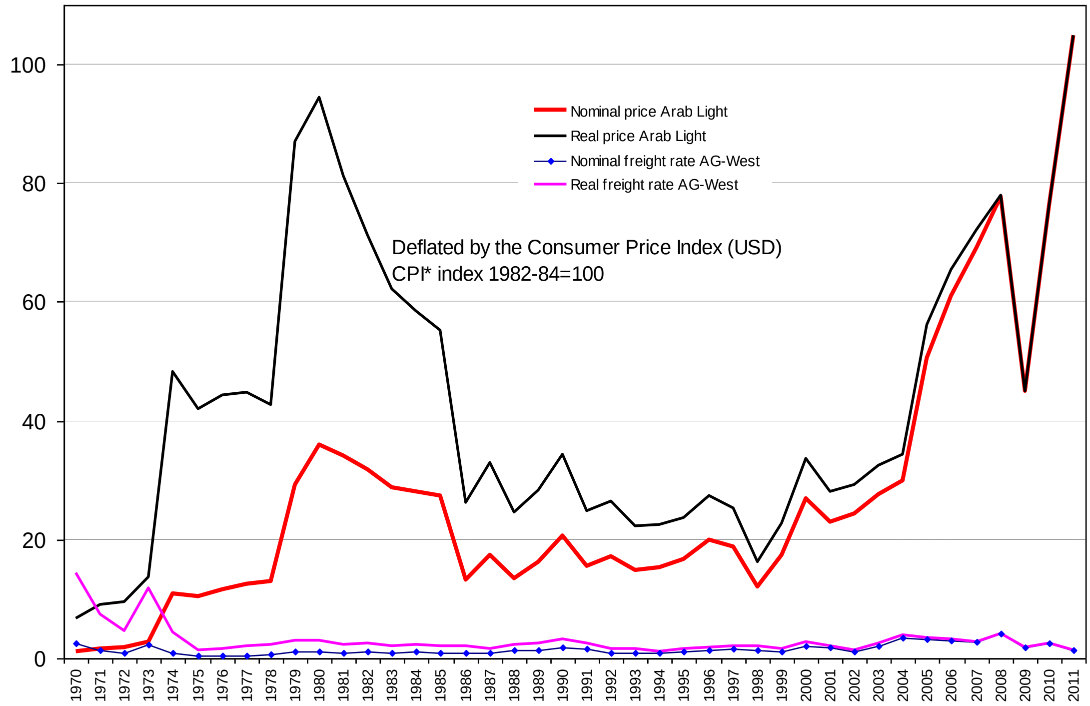


Figure 3.1 : Oil price and average freight rates 1970-2011[Url-1].

Ship owners have the option of laying up their ships when the market conditions are poor. Although this eliminates their voyage costs and reduces the running costs, there will be no respite from making capital cost payments(Kumar, 2003). As the market recovers, idle capacity reenters the trade. However, as noted by R. S. Platou, a leading ship broker, so long as the capacity use remains below 80%, freight rates remain relatively stable. Glen and Martin referred to this as the elastic segment of the short-run supply curve of tankers. The slope of the curve increases beyond the 80% range and becomes fully vertical (completely inelastic) when all existing ships are used. Under such circumstances, any increase in the derived demand would cause dramatic fluctuations in the freight rate and, hence, the profitability of tanker owners.

In the long run, the introduction of newer and more efficient ships would bring down the marginal cost of transporting the oil, culminating in the low incidence of ocean freight in the landed cost of oil discussed earlier(Alizadeh and Talley, 2011). Furthermore, recent studies by Kavussanos and by Glen and Martin showed that different sizes of tankers operate in distinct markets with varying levels of risk and returns, although all of the submarkets remain interdependent in the long run. One commonality that affects all segments of the market, and that is becoming increasingly significant, is the regulatory environment in which all tankers operate.

3.1.1 New Worldwide Tanker Nominal Freight

The World scale index is essentially a measure of the break even rate of a standard tanker on a round trip between a loading port and the discharging port under certain assumptions regarding the vessel's specifications, port charges, fuel prices, and other factors.This index has evolved and has been used by the tanker industry since World War II. The break even rate for the standard tanker is calculated on a US dollar per metric ton($/mt) basis by the World scale association for every possible tanker route around the world and published every January. The calculated break even freight rate in every tanker route is known as the ''flat rate'', which is considered as Worldscale 100 for that route. Following the publication of these rates, charterers, tanker owners, tanker operators, and brokers negotiate and draft shipping contracts on the basis of Worldscale. Perhaps the main benefit of the World scale index in the tanker freight market is that if fuel and other costs are assumed to be the same across different routes, then one can easily compare the profitability of voyages by simply comparing the market or negotiated rates across tanker routes(Alizadeh and Talley, 2011).

There are different ways of expressing tanker freight rates. The term used to quote freight rates in the spot market is in WorldScale (WS), where WS100 is a nominal index number. The WorldScale Association publishes an annual listing of WS100 rates (in dollars/ metric ton) for all potential trade routes for a standard 75,000-DWT tanker operating under assumed conditions and earning a notional daily hire of $12,000. The principle behind the WS system is that regardless of the voyage undertaken, identical tankers will earn the same gross revenue per day.

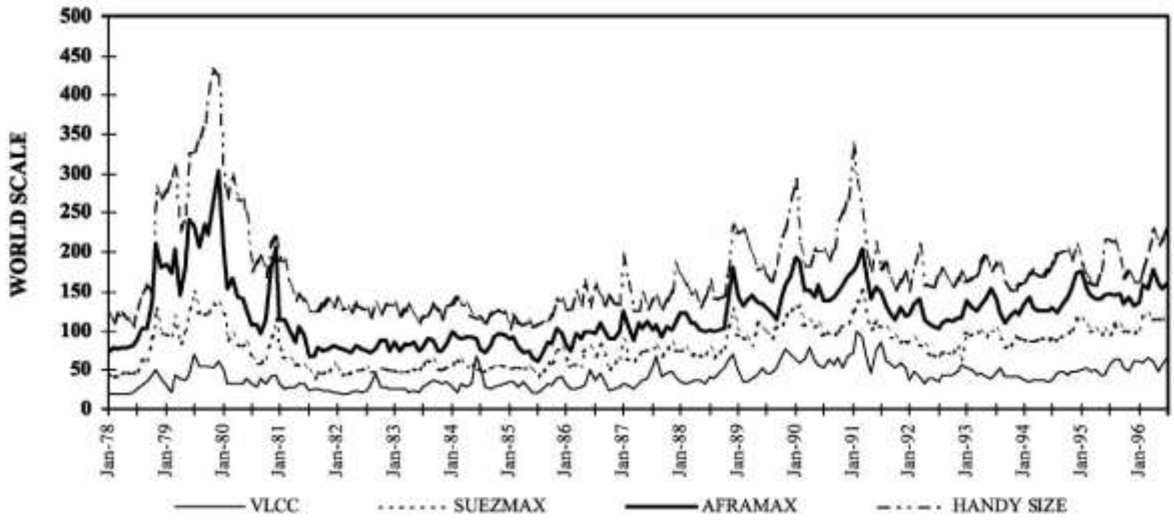


Figure 3.2 : Different Tonnage Tanker's Monthly Freight Rates t(Kumar,2003).

The WS nominal rate serves as a starting point for spot charter negotiations, and because the total earnings are proportional to the quantity of cargo carried, a vessel with a lower carrying capacity would typically bargain for a higher WS rating than would a larger vessel, assuming that both were trading on an identical trade. Any spot market fixture in which freight rates are expressed in dollars per ton can be converted into WS figures that facilitate easier comparison of market conditions. By converting the WS figures into time charter equivalent (TCE), a comparison can be made to the current rates in the time charter market. Likewise, a fixture in the time charter market can be converted into a WorldScale equivalent (WSE) for comparison with rates in the spot market(Glenn and Martin, 1998). From a ship owner's perspective, it would be preferable to have the ship on long-term time charter when the spot rates are headed down, whereas spot fixtures would be more attractive in a rising market. However, tanker chartering still remains more of an art than a science given the inability to foresee the market changes with any level of comfort.

3.2 Supply and Demand in Tankers

International Energy Agency statistics show that total primary energy supply through crude oil increased from 2880 million tons of energy in 1973 to 3700 million tons of energy in 2000(Zannetos, 1966). Table 3.1 shows the major producers of crude oil and petroleum products in 2001, and Table 3.2 shows the major exporters and importers for the year 2000. Glen and Martin estimated that 59% of world oil produced in 2000 was traded by sea, a significant increase from the prior levels of 48% in 1990 and 56% in 1995(1988). However, estimating demand for tanker transportation based purely on the volumes traded would be inaccurate unless the distances involved were also included. As an example, the disruption in oil movements caused by the Iraqi invasion of Kuwait induced nations such as the United States to partially substitute their dependence on Middle East oil with oil from closer, politically safer locations such as the North Sea, West Africa, Venezuela, Mexico, and Colombia. In such cases, even if the volumes imported were to stay the same, the demand in ton-miles would drop(Kumar, 2003).

Table 3.1 : Major Producers of Crude Oil and Petroleum Products(Kumar, 2003)

Crude Oil			**Petroleum Products**		
Producer	**Million Tons**	**Worl pct**	**Producer**	**Million Tons**	**Worl pct**
Saudi Arabia	421	11,8	United States	823	23,7
United States	354	9,9	Japan	207	6
Russia	347	9,7	China	196	5,6
Iran	186	5,2	Russia	174	5
Mexico	179	5	Korea	122	3,5
Venezuela	173	4,8	Germany	116	3,3
China	166	4,6	India	101	2,9
Norway	162	4,5	Italy	95	2,7
Canada	125	3,5	Canada	94	2,7
United Kingdom	118	3,3	France	89	2,6
Rest of World	1343	3,7	Rest of World	1453	42
World total	**3574**	**100**	**World total**	**3475**	**100**

Table 3.2 : Major Exporters and Importers of Crude Oil and Petroleum Products in 2000 (Kumar, 2003).

Crude Oil				**Petroleum Products**			
Exporter	Million Tons	Importer	Million Tons	Exporter	Million Tons	Importer	Million Tons
Saudi Arabia	320	United States	511	The Netherlands	63	United States	74
Norway	146	Japan	214	Russia	54	Japan	51
Russia	144	Korea	123	Saudi Arabia	56	The Netherlands	45
Iran	116	Germany	104	United States	49	Germany	42
Venezuela	115	Italy	90	Singapore	41	Singapore	39
Nigeria	107	France	86	Korea	40	France	27

Simply, a supply(trade volume) of oil(or chemicals) in ton-miles would increase demand of Tankers and consequently the freight rates. As in Figure 3.3, the x axis shows ton-miles whereas y-axis shows the freight.

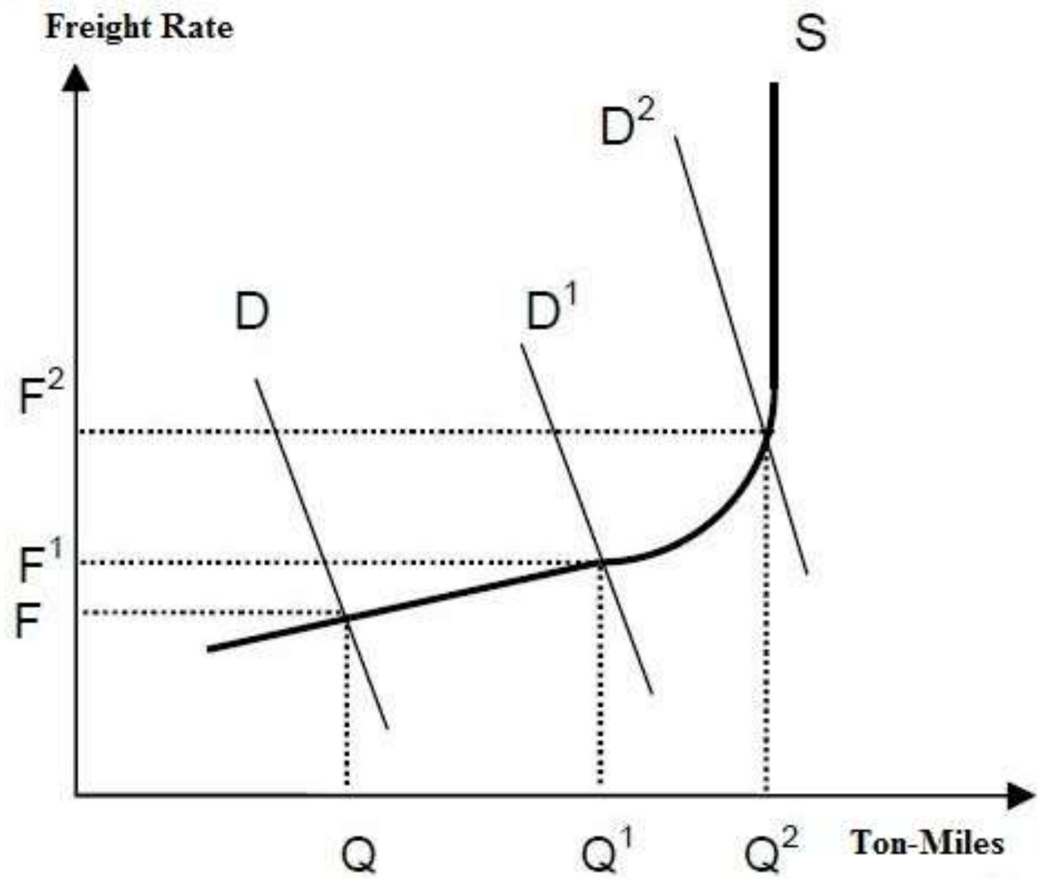


Figure 3.3 : Supply and demand in tanker market.

A shift in the sourcing of crude oil in Western Europe from the Middle East to closer sources, such as Russian and North Sea oil, would have a similar detrimental effect on tanker demand. In situations like this, unless tanker demand in other optimum long-distance routes pick up, the very large tankers will migrate into suboptimal routes that are usually served more efficiently by smaller vessels, and this will lower the freight rate for all players in the market(Hawdon, 1978).

Asia 80%, Europe 18% and US 17% is dependent on Middle East Oil(Intertanko, 2011). As the oil production increased, trade volume in ton-miles increased also which can be seen from Figure 3.4

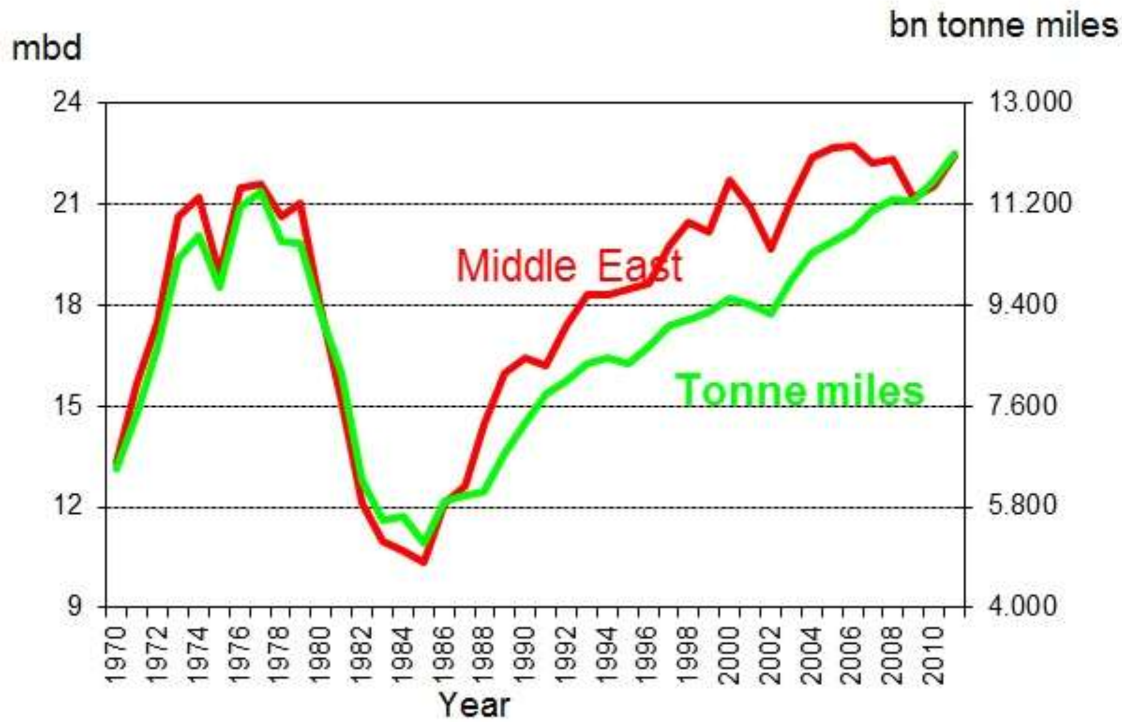


Figure 3.4 : Seaborne Oil Trade and Middle East Oil production[Url-1]

It is worth noting that the ton-mile demand for oil tankers reached its highest value in 1977, whereas the crude oil volume traded continued its upward trend until 1979. The ton-mile peak reached for crude oil movements remains unsurpassed even today. Currently, although the United States alone is responsible for one-quarter of the world crude oil consumption, much of its imports come from closer locations that include Canada, Mexico, Venezuela, West Africa, and Colombia. The Former Soviet Union is now a prominent supplier of oil to Europe.

Although roughly one-half of all current world crude oil exports originate from the Middle East, and its major export markets are currently in the Asia Pacific region to countries such as Japan and South Korea. Because the Middle East–Asia Pacific trade is a relatively long distance trade optimal for the large tankers and also because the overall crude oil volumes transported by sea are on a rising trend, the redundancies made by the crude oil sourcing shifts in Western Europe and the United States have not had a sustained direct impact on the market for very large tankers(Kumar, 2003).

As indicated in Table 3.3, the estimated productivity of tanker fleet in terms of cargo loaded per deadweight ton, as well as the tonmile demand, is on a steady upward trend after its precipitous drop during the 1980s and early 1990s.

As noted by Glen and Martin, the average tanker haul recorded in 2000 was 4917 miles, while the average in 1977 was 6651 miles. The 26% drop in ton-mile demand is too severe a shock for a forlorn tanker owner reminiscing about the golden years(Glen and Martin, 1998).

Table 3.3 : Estimated Productivity of Oil Tankers for Selected Years(Kumar, 2003)

Year	Oil cargo carried (in million tons) by Tankers > 50.000 DWT	Tons per DWT	Demand in n ton-miles	Ton-miles per DWT
1970	1182	8,58	6039	43,82
1980	1564	4,79	9007	27,56
1990	1427	5,96	7376	30,81
1998	1985	7,1	9465	33,86
1999	1988	7,04	9586	33,94
2000	2070	7,25	10.107	35,41

Another fact in supply and demand, Figure 3.5 shows, shipowners renewed their vessels with the increasing trade volume and regulations.

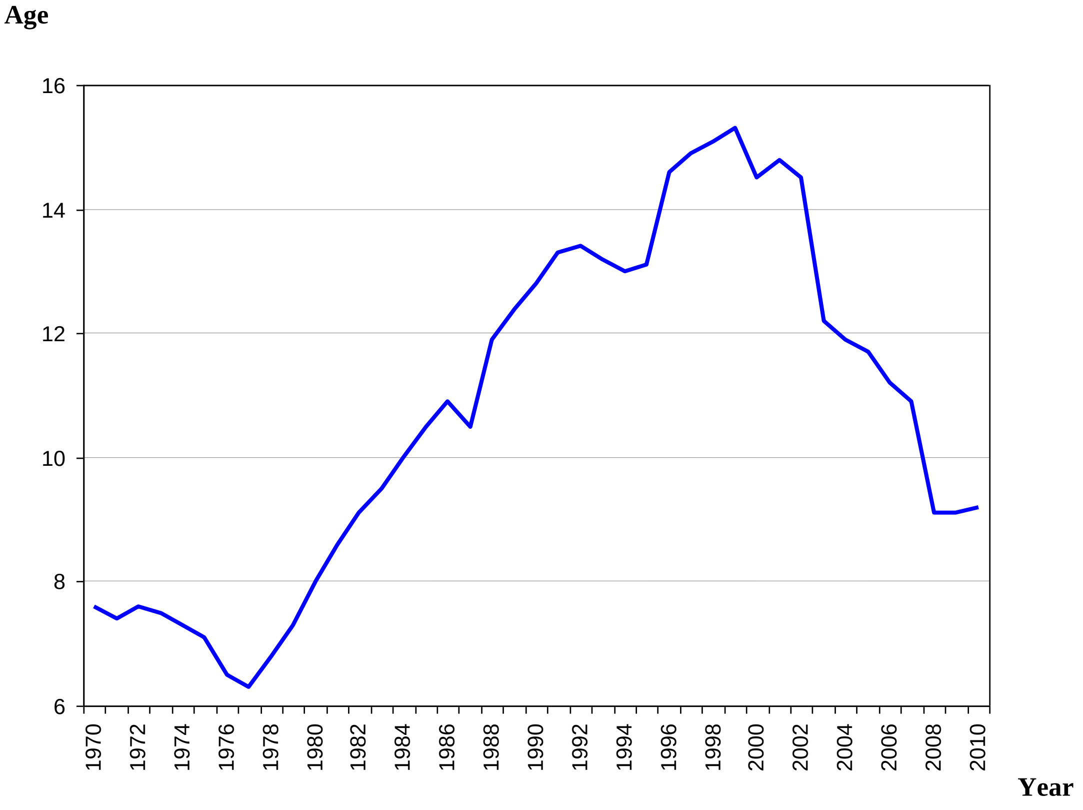


Figure 3.5 : Average age tanker fleet above 10,000 dwt[Url-1]

The major export areas in oil trade for the year 2000, in descending order, were the Arabian Gulf, West Africa, Venezuela, Mexico, North Africa, the Black Sea, Sidi Kerir, Indonesia/East Malaysia, China, the East Mediterranean, the Baltic Sea, and the Red Sea. The major import areas for 2000, also in descending order, were Western Europe, the United States, Japan, South Korea, Canada's east coast, Taiwan, and Hong Kong(Wood, 2000).

As shown in Figure 3.6 the increasing rate of tanker fleet is higher than oil demand which creates a surplus of supply.

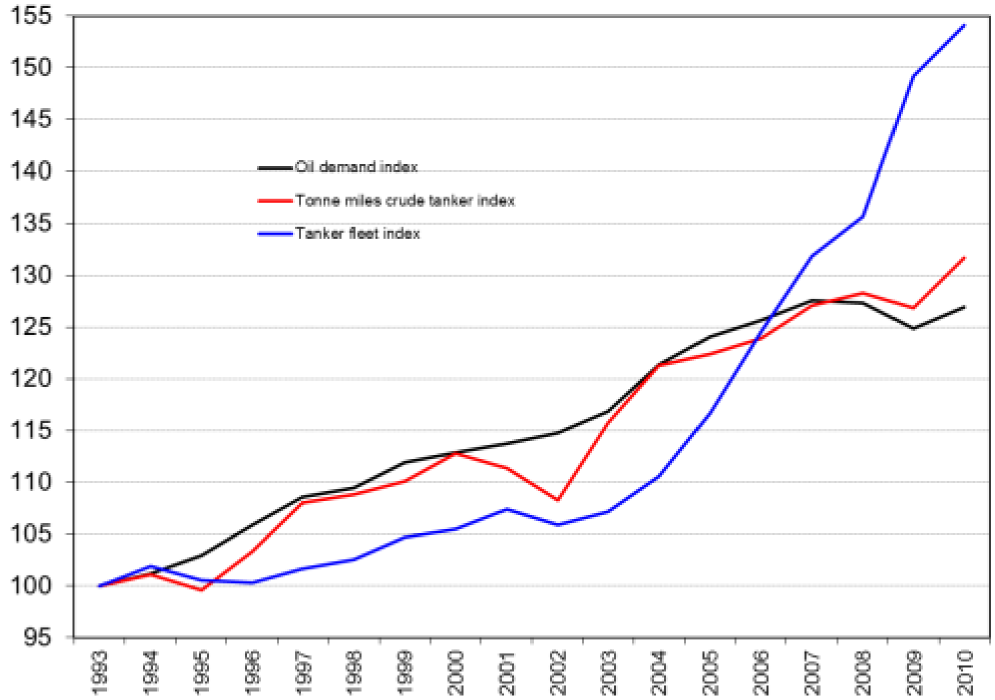


Figure 3.6 : Oil demand, tonne-mile, and tanker fleet indices[Url-1]

4. STATISTICAL ANALYSIS

Statistical analysis includes many techniques for modeling and analyzing several variable when the focus is on the relationship between a dependent variable and one or more independent variables. Taking this into account, two modes were estimated by collecting, organizing and analyzing the data given in Appendix A.

4.1 Methodology

In order to investigate the vessel and voyage specific determinants of the freight rates for tanker shipping contracts, the following two models can be estimated;

Model 1. $Fr_{i,t} = \alpha_0 + \alpha_1 UT_i + \alpha_2 OP_i + \alpha_3 AGE_i + \alpha_4 R_i$ (4.1)

Model 2. $Fr_{i,t} = \alpha_0 + \alpha_1 UT_i + \alpha_2 OP_i + \alpha_3 \mathrm{BDI}_t + \alpha_4 R_i$ (4.2)

where where $Fr_{i,t}$ is freight rate of the ith fixture(contract) at time t, UT_i is the deadweight utilization ratio of the fixture expressed as the ratio of cargo tonnes to deadweight(dwt) of the vessel, OP_i is the Brent Oil price[Url-2], AGE_i is the vessel's age in contract i and R_i is the length of the route between the loading port and discharging port. In second model, to control for macrodeterminants of tanker freight rates in the model, Baltic Dry Index(BDI)[Url-2], a benchmark indicator for the condition of the tanker freight market, and measuring the volatility of the freight market is used instead of vessels age.

In order to investigate if the methodology will work with data collected, SPSS program is used and data is analysed. For a model with more than 3 independent variables R square needed to be between 0.4-0.6(Kelley, 1994). Where for first model it is 0,514 and for the second model it is 0,512.

Other than the R square Durbin-Watson number should be investigated. Durbin–Watson statistic is a test statistic used to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from a regression analysis(Miller, 2008). In order not to have autocorrelation, the output needs to be between 1,5 and 2,0(Kelley, 1994). Where for the first model it is 1,750 and for the second model it is 1,752.

Table 4.1 : SPSS output for the Model 1

Model	R	R Square	Adjusted R Square	Std.e	Change Statistics					Durbin-Watson
					Sig. F Change	R Square Change	F	df1	df2	
1	,717(a)	0,514	0,504	6,10	0,514	53,641	4	203	0,0	1,750

Table 4.2 : SPSS output for the Model 2

Model	R	R Square	Adjusted R Square	Std.e	Change Statistics					Durbin-Watson
					Sig. F Change	R Square Change	F	df1	df2	
2	,717(a)	0,512	0,505	6,10	0,514	53,643	4	203	0,0	1,752

4.1.1 Decription of data

Chemical/Oil tankers up to 20000 mts DWT in the area of Black Sea, Mediterrenean and partly West Europe region can be called parcel tankers. Especially these chemical tankers can carry up different parcels up to its number of tanks fitted. As can be see from the data in Appendix A, a 11259 mts DWT oil/chemical tanker can carry a 2000 mts Mono Ethylene Glycol(MEG) as part cargo.

The data for this study were collected from Green&Black Marine Logistics company data and comprise information on tanker spot fixtures for the period May 2008 to December 2011. Since most of the information on the data is confidential for the broker company, some information is not shown such as vessels name, loading and dicharging ports. The data include such information as vessel characteristics, voyage characteristics, Brent Oil Price and Baltic Dry Index for the dates given. The data of missing values, omitted information, and other unusable observations are filtered. The vessels calling any other ports than the mentioned regions such as East of Suez, Africa, United States Costs and South America are also omitted.

Finally, for the mentioned contracts, vessels calling more than one loading or dicharging port haven’t been considered since port waiting times would highly differenciate. With the above information, total of 198 fixture observations remain for Oil/Chemical Tankers. Since The Baltic Tanker Index (BDTI) values were not available for free, The Baltic Dry Index (BDI) values obtained from Bloomberg over the same period.

The data for tanker age show that the average age of the tankers are 15,33 years. It is also important to note that the maximum age is 35 years which would show variety of the data.

4.1.2 Voyage costs

The variable cost of transportation depends on two main components: vessel fuel oil costs and port fees. We do not consider any fixed costs, like manning expenses or charter costs, because we assume a fixed fleet for the transportation task. All fixed costs for the fleet are constant for the planning period and are not subject to optimization. The largest part of a tanker's variable cost on a route is determined by its fuel oil consumption.

A tanker burns different fuel amounts per day while sailing, port operations or when waiting. It uses most fuel oil when sailing and least when waiting. The other cost component, port fees, has to be paid whenever a tanker enters a port. While port fees and sailing costs are determined by the actual routing choice, port operation costs and waiting costs are time dependent. The more a tanker loads or discharges in a port, the more costly is the operation. In the sameway longer waiting times result in higher cost(Hennnig et al., 2009).

Whilst the vessel is at sea, it incurs a charge for the daily operating and capital costs. In addition, there are also costs directly related to the voyage itself. These include port and harbour dues, pilotage, but the main additional element is the cost of fuel and lubricants consumed during the voyage. The standard modelling approach is to estimate fuel expenditures. Many studies have estimated fuel-size elasticities rather than overall voyage cost elasticities(Hawdon, 1978). This relationship is more complex than the first two components, because there are interdependencies between vessel speed and fuel consumption, and vessel speed and overall journey time.

In this study, calculations are made regardless of above mentioned costs except oil price.

4.1.3 Oil prices

Oil is the paramount energy source in the global economy and its pricing has profound macroeconomic, political and social effects. An important element of the world oil market is the tanker industry, which moves oil from producer areas to consumer markets. Spot tanker prices are strongly influenced by the crude oil market, specifically spot prices, future contract prices, and petroleum inventories(Kendall, 2003).

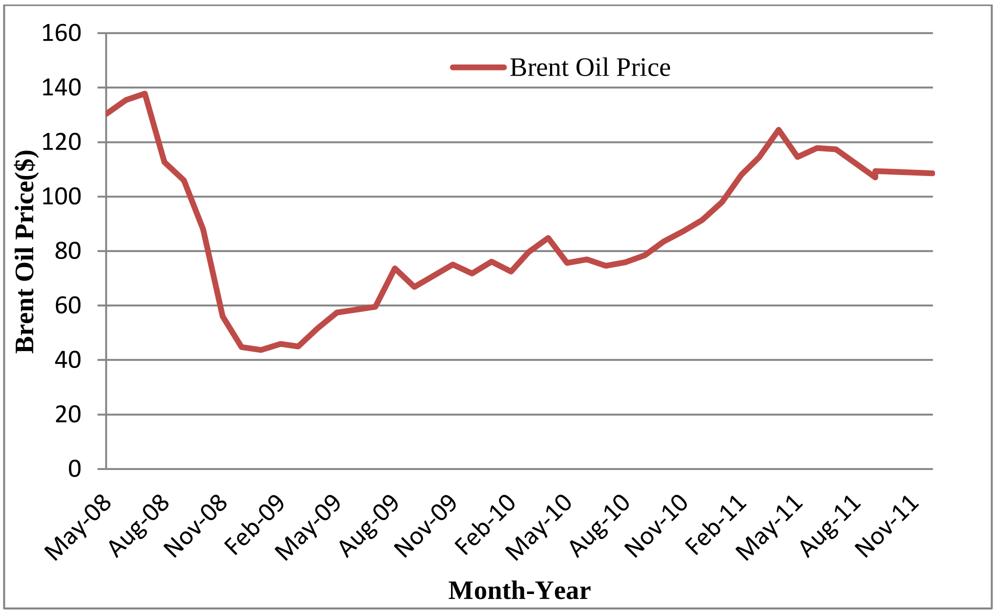


Figure 4.1 : Brent Oil Price between May 2008 and December 2011[Url-1]

Oil prices had moved to a much higher plateau, and the tanker market entered a period of high volatility including some major price cuts. Additional upward pressure on tanker rates was the market having entered a period of higher level of political/military risks due to heightened Middle Eastern instability, pushing up the rates was a significant increase in maritime insurance rates due to the perception of heightened risk, especially in the Persian Gulf area, where tankers would naturally congregate.

4.2 Multiple Regression Analysis

The Method of Least Squares is a procedure to determine the best fit line to data; the roof uses simple calculus and linear algebra. It is a standard approach to the approximate solution of overdetermined systems, i.e., sets of equations in which there are more equations than unknowns. "Least squares" means that the overall solution minimizes the sum of the squares of the errors made in the results of every single equation(Miller, 2008).

The basic problem is to find the best fit straight line $y = ax + b$. The method easily generalizes to finding the best fit of the form.

$$y = \alpha_0 + \alpha_1 f_1(x) + ... + \alpha_K f_K(x) \tag{4.3}$$

It is not necessary for the functions It is not necessary for the functions f_K to be linearly in x – all that is needed is that y is to be a linear combination of these functions(Kelley, 1994).

There are two reasons that one cannot observe a perfect linear relationship. The first is experimental error; the second is that the underlying relationship may not be exactly linear, but rather only approximately linear(Kelley, 1994).

In Figure 4.2 for a simulated data set of displacements and forces for a spring with spring constant equal to 5 can be seen.

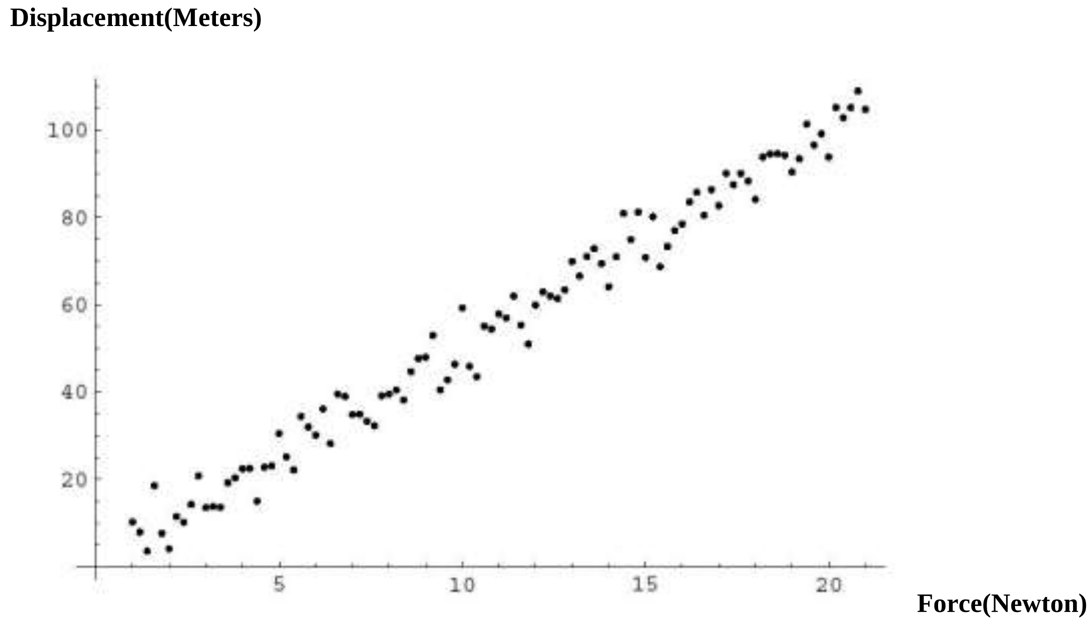


Figure 4.2 : 100 “simulated” observations of displacement and force(Kelley, 1994).

4.2.1 Model 1

$$Fr_{i,t} = \alpha_0 + \alpha_1 UT_i + \alpha_2 OP_i + \alpha_3 AG_i + \alpha_4 R_i \tag{4.4}$$

The difference between real value and estimated value should be minimum, so partial derivates for all independent variables are taken.

$$E = \sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right]^2 \quad (4.5)$$

$$\frac{\partial E}{\partial \alpha_0} = -2\sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right] \quad (4.6)$$

$$\frac{\partial E}{\partial \alpha_1} = -2\sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right] \times UT \quad (4.7)$$

$$\frac{\partial E}{\partial \alpha_2} = -2\sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right] \times OP \quad (4.8)$$

$$\frac{\partial E}{\partial \alpha_3} = -2\sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right] \times AG \quad (4.9)$$

$$\frac{\partial E}{\partial \alpha_4} = -2\sum_{0}^{5}\left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 AG - \alpha_4 R \right] \times R \quad (4.10)$$

$$208\alpha_0 + \alpha_1\sum UT + \alpha_2\sum OP + \alpha_3\sum AGE + \alpha_4\sum R = \sum Fr \quad (4.11)$$

$$\alpha_0\sum UT + \alpha_1\sum UT^2 + \alpha_2\sum UT\times OP + \alpha_3\sum UT\times AGE + \alpha_4\sum UT\times R = \sum UT\times Fr \quad (4.12)$$

$$\alpha_0\sum OP + \alpha_1\sum OP\times UT + \alpha_2\sum OP^2 + \alpha_3\sum OP\times AGE + \alpha_4\sum OP\times R = \sum OP\times Fr \quad (4.13)$$

$$\alpha_0\sum AGE + \alpha_1\sum AGE\times UT + \alpha_2\sum AGE\times OP + \alpha_3\sum AGE^2 + \alpha_4\sum AGE\times R = \sum AGE\times Fr \quad (4.14)$$

$$\alpha_0\sum R + \alpha_1\sum R\times UT + \alpha_2\sum R\times OP + \alpha_3\sum R\times AGE + \alpha_4\sum R^2 = \sum R\times Fr \quad (4.11)$$

Parameters(Independent variables) are taken as UT/1000, OP/1000, AG/100 and R/1000.

Lets call $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4$ as x, y, z, u, v respectively. When the model is inserted in to data of 198 contracts given in Appendix A;

198x+145.1y+18.1z+29.9u+160.9v=4669 (4.12)

145.1x+113.7y+13.3z+22.5u+116.1v=3272.3 (4.13)

18.1x+13.3y+1.8z+2.8u+13.3v=424.4 (4.14)

29.9x+22.5y+2.8z+7.6u+18.2v=657.5 (4.15)

160.9x+116.1y+13.3z+18.2u+247.9v=4559.4 (4.6)

5 unknows from 5 equations is computed by Wolfram Mathematica[Url-3] as;

Table 4.3 : Variable results for model 1

x	26,651
y	-18,881
z	54,937
u	0,707
v	6,937

First model reveals the freight formula as below.

$$Fr_{i,t} = 26,651 - 18,881 UT_i + 54,937 OP_i + 0,707 AG_i + 6,937 R_i \qquad (4.21)$$

As mentioned, 198 different voyage is calculated and the results are given the section 5.1. If we take 198th fixture;

Table 4.4 : 198th fixture's data

Vessel	**Built**	**DWT**	**Tonnage**	**Loading**	**Dicharge**	**Freight($)**	**Route(nm)**	**Oil Price($)**
A	2008	6138	5000	X	Y	20	230	109

Month	**Year**
December	2011

Table 4.5 : Independent variable values for Model 1

UT	**OP/1000**	**AG/100**	**R/1000**
0,815	0,109	0,040	0,230

Freight is found as,

$$Fr_{i,t} = 26,651 - 18,881 \times 0,815 + 54,937 \times 0,109 \ +$$

$$0,707 \times 0,040 + 6,937 \times 0,230 \ = \ 18,858 \qquad (4.22)$$

4.2.2 Model 2

For the second model same calculations are used by changing the independent variable AGE with the independent variable BDI.

$$Fr_{i,t} = \alpha_0 + \alpha_1 UT_i + \alpha_2 OP_i + \alpha_3 BDI_i + \alpha_4 R_i \tag{4.23}$$

$$E = \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right]^2 \tag{4.24}$$

$$\frac{\partial E}{\partial \alpha_0} = -2 \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right] \tag{4.25}$$

$$\frac{\partial E}{\partial \alpha_1} = -2 \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right] \times UT \tag{4.26}$$

$$\frac{\partial E}{\partial \alpha_2} = -2 \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right] \times OP \tag{4.27}$$

$$\frac{\partial E}{\partial \alpha_3} = -2 \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right] \times AG \tag{4.28}$$

$$\frac{\partial E}{\partial \alpha_4} = -2 \sum_0^5 \left[Fr - \alpha_0 - \alpha_1 UT - \alpha_2 OP - \alpha_3 BDI - \alpha_4 R \right] \times R \tag{4.29}$$

$$208\alpha_0 + \alpha_1 \sum UT + \alpha_2 \sum OP + \alpha_3 \sum BDI + \alpha_4 \sum R = \sum Fr \tag{4.28}$$

$$\alpha_0 \sum UT + \alpha_1 \sum UT^2 + \alpha_2 \sum UT \times OP + \alpha_3 \sum UT \times BDI + \alpha_4 \sum UT \times R = \sum UT \times Fr \tag{4.29}$$

$$\alpha_0 \sum OP + \alpha_1 \sum OP \times UT + \alpha_2 \sum OP^2 + \alpha_3 \sum OP \times BDI + \alpha_4 \sum OP \times R = \sum OP \times Fr \tag{4.30}$$

$$\alpha_0 \sum BDI + \alpha_1 \sum BDI \times UT + \alpha_2 \sum BDI \times OP + \alpha_3 \sum BDI^2 + \alpha_4 \sum BDI \times R = \sum BDI \times Fr \tag{4.31}$$

$$\alpha_0 \sum R + \alpha_1 \sum R \times UT + \alpha_2 \sum R \times OP + \alpha_3 \sum R \times BDI + \alpha_4 \sum R^2 = \sum R \times Fr \tag{4.32}$$

When the data of 198 contracts in Appendix A inserted into model 2;

198x+145.1y+18.1z+70,8u+160.9v=4669 (4.33)

145.1x+113.7y+13.3z+52.2u+116.1v=3272.3 (4.34)

18.1x+13.3y+1.8z+7.7u+13.3v=424.4 (4.35)

70.8x+52.2y+7.7z+45.4u+48v=1665 (4.36)

160.9x+116.1y+13.3z+48u+247.9v=4559.4 (4.37)

5 unknows parameters from 5 equations is computed by Wolfram Mathematica[Url3] as;

Table 4.6 : Variable results for model 2

x	26,747
y	-18,833
z	55,063
u	-0,019
v	6,900

First model reveals the freight formula as below.

$$Fr_{i,t} = 26,747 - 18,833UT_i + 55,063OP_i - 0,019AG_i + 6,900R_i \tag{4.38}$$

As mentioned before, 208 different voyage is calculated and the results are given the section 5.1. If we take 208th fixture;

Table 4.7 : Independent variable values for Model 1

UT	OP/1000	BDI/1000	R/1000
0,815	0,109	10,843	0,230

Freight is found as,

$$Fr_{i,t} = 26,747 - 18,833\times 0,815 + 55,063\times 0,109$$

$$-0,019\times 0,040 + 6,900\times 0,230 = 18,966 \tag{4.39}$$

5. CONCLUSION AND RECOMMENDATIONS

Tanker transportation which is a special sub sector of maritime transportation industry plays a vital role for the world trade. As oil is the fundamental component for developing industries, consequently the transportation of it becomes an indispensable issue. Especially, to determine the factors affecting the price of this service, i.e. freight, has a crucial importance. It is very hard to predict the freight rates in tanker transportation because of the complexity of the market and their sensitivity to international political issues. Therefore to determine the factors influencing tanker freight rates provide valuable information for investors, tanker owners and charterers.

Developments during the first 4 years after world economic crisis in 2008 serve as an excellent synopsis of the unpredictability of the tanker transportation sector(Alizadeh and Talley, 2011). Although it charterers, owners gain from the ongoing market volatility, there are notable troubling developments as well. For this reason, estimating freight rates for traders are very essential in order to make up their trading strategies(countries, products, tonnage..etc).

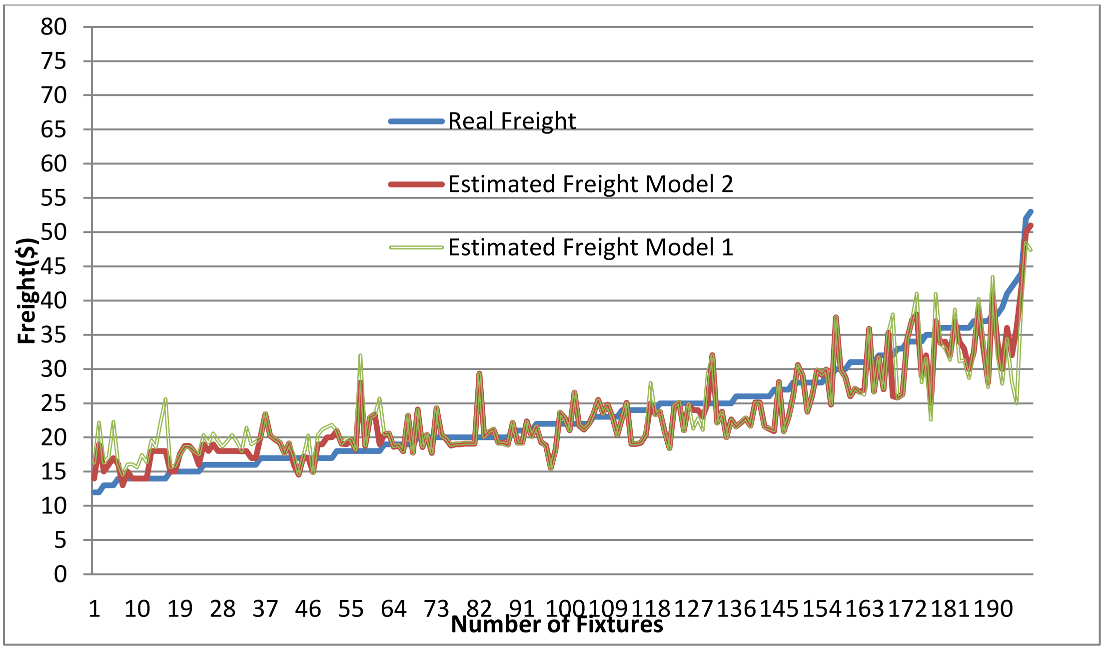


Figure 5.1 : Comparison of Results for Model 1 and 2

When both models of this study are compared it can be seen from Figure 5.1 that Model 2 gives better results by taking into account volatility of the market with the indicator Baltic Dry Index. But it should be noted that using Baltic Tanker Index would give better results because Baltic Dry Index cannot 100 percent explain freight volatility very well for the tanker market.

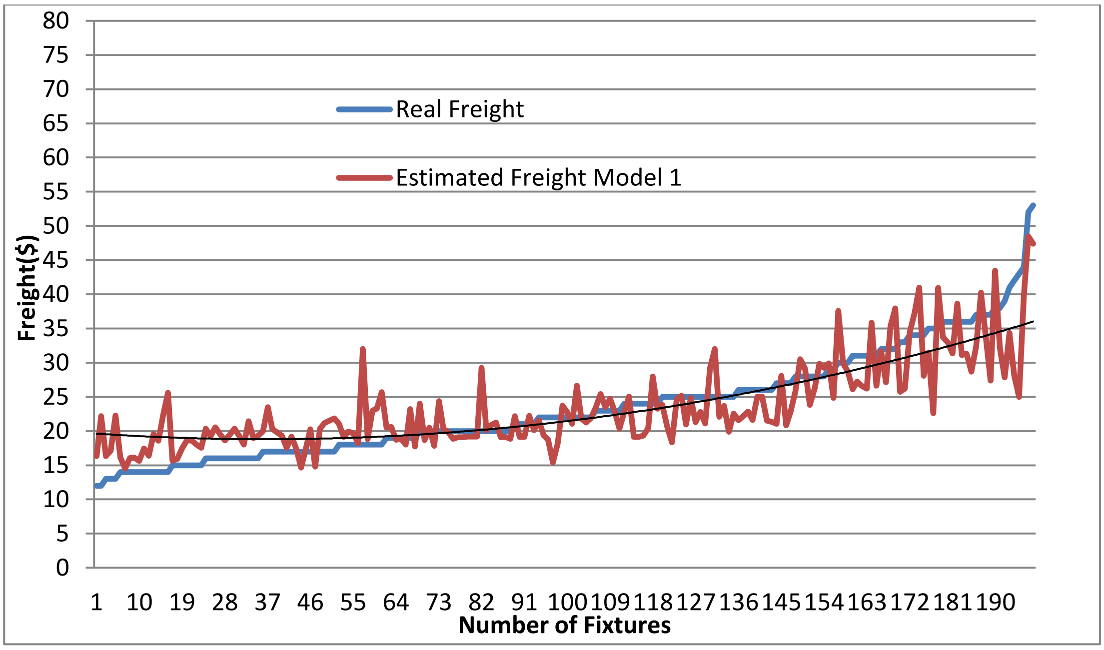


Figure 5.2 : Calculation Results for Model 1

The unexpected differences in some estimations are mainly because of the cargo characteristics. A corrosive chemical's freight is expected to be heigher. As in Number 55th fixture of Figure 5.2 there is a 15 dolar difference because the cargo carried there is acetic acid.

The freight in the region of Black Sea, Mediterrenean Sea and West Europe for small tonnage vessels is highly dependent on trading volume, profit margins of small and middle size traders. The behavior of shipping freight rates and the timing of shipping contracts affect the transportation costs of charterers and the operating cash flows of shipowners.

As mathematical model was constructed from 198 contracts in this region, it also gives good idea about the market rates for the last 4 years.

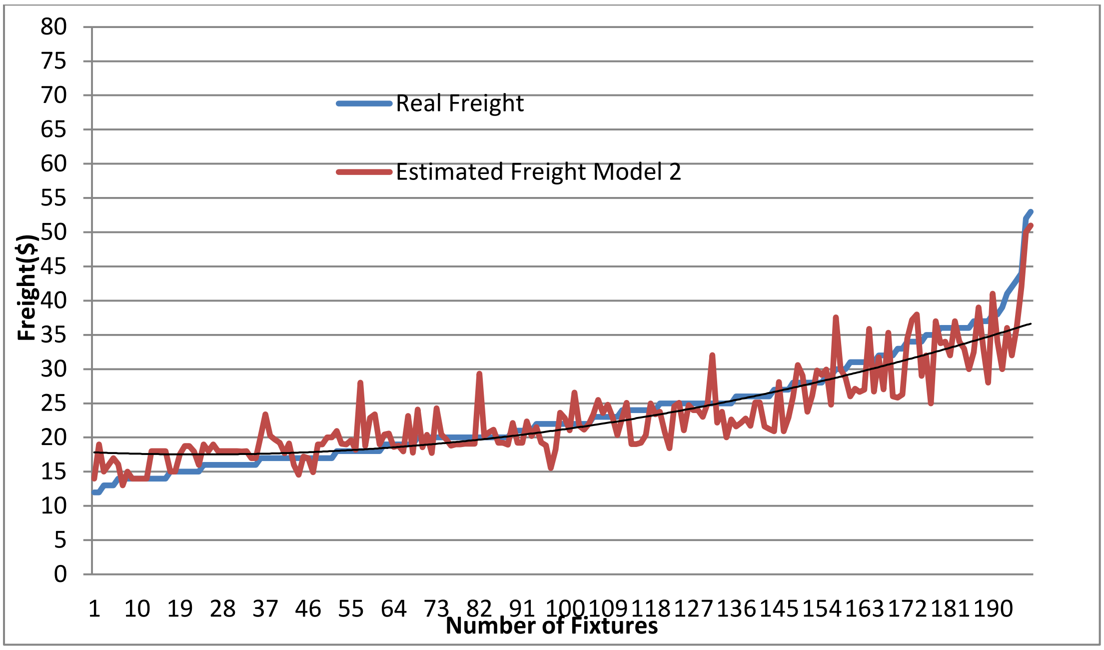


Figure 5.3 : Calculation Results for Model 2

.As the results show, this mathematical models can be easily used by charterers and shipbrokers to have a idea of freight rates depending on the vessels, cargo's and market's characteristics Lastly it should be noted that accuracy between the freights 20 and 27 dolars have higher accuracy.

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APPENDICES

APPENDIX A: Vessel, Voyage data and calculation tables for Model 1 and Model 2

Table A.1 : Voyage Data tables for model 1 and model 2

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
1	2005	5850	1000	36	450	130	May	2008	0,17	0,13	0,04	0,45	1,0843
2	2008	5707	1200	36	450	130	May	2008	0,21	0,13	0,01	0,45	1,0843
3	2008	5707	5200	28	1328	130	May	2008	0,91	0,13	0,01	1,33	1,0843
4	1982	4563	4000	23	866	130	May	2008	0,88	0,13	0,27	0,87	1,0843
5	1984	4028	3200	22	375	130	May	2008	0,79	0,13	0,25	0,38	1,0843
6	1984	4028	3200	21	458	130	May	2008	0,79	0,13	0,25	0,46	1,0843
7	2007	5820	3400	20	175	130	May	2008	0,58	0,13	0,02	0,18	1,0843
8	1984	4028	3200	18	291	130	May	2008	0,79	0,13	0,25	0,29	1,0843
9	2007	6308	5200	17	248	130	May	2008	0,82	0,13	0,02	0,25	1,0843
10	1982	3872	3150	16	248	130	May	2008	0,81	0,13	0,27	0,25	1,0843
11	1980	3660	3200	16	248	130	May	2008	0,87	0,13	0,29	0,25	1,0843
12	2007	4581	3000	32	1430	135	June	2008	0,65	0,14	0,02	1,43	1,0245
13	1984	6525	6000	31	1328	135	June	2008	0,92	0,14	0,25	1,33	1,0245
14	2007	15995	7500	28	756	135	June	2008	0,47	0,14	0,02	0,76	1,0245
15	1974	3181	2900	27	564	135	June	2008	0,91	0,14	0,35	0,56	1,0245
16	1981	3914	3100	25	649	135	June	2008	0,79	0,14	0,28	0,65	1,0245
17	2008	3529	3000	25	381	135	June	2008	0,85	0,14	0,01	0,38	1,0245
18	1984	4028	3200	19	175	135	June	2008	0,79	0,14	0,25	0,18	1,0245
19	1981	6275	4000	17	176	135	June	2008	0,64	0,14	0,28	0,18	1,0245
20	1982	3914	3150	17	176	135	June	2008	0,80	0,14	0,27	0,18	1,0245
21	1982	3914	3200	16	248	135	June	2008	0,82	0,14	0,27	0,25	1,0245
22	1980	3660	3200	16	248	135	June	2008	0,87	0,14	0,29	0,25	1,0245
23	1991	7715	6900	39	1495	138	July	2008	0,89	0,14	0,18	1,50	0,8935
24	2005	5850	3000	37	1130	138	July	2008	0,51	0,14	0,04	1,13	0,8935
25	1988	6375	3000	35	866	138	July	2008	0,47	0,14	0,21	0,87	0,8935
26	2008	3529	3200	25	175	138	July	2008	0,91	0,14	0,01	0,18	0,8935
27	1977	3400	3025	22	248	138	July	2008	0,89	0,14	0,32	0,25	0,8935
28	2008	3529	3200	22	230	138	July	2008	0,91	0,14	0,01	0,23	0,8935
29	1984	4028	3200	19	175	138	July	2008	0,79	0,14	0,25	0,18	0,8935
30	1980	3660	3200	18	176	138	July	2008	0,87	0,14	0,29	0,18	0,8935
31	1977	3400	3000	18	308	138	July	2008	0,88	0,14	0,32	0,31	0,8935
32	1980	3660	3100	18	176	138	July	2008	0,85	0,14	0,29	0,18	0,8935
33	1981	3914	1000	36	450	113	Aug	2008	0,26	0,11	0,28	0,45	0,74
34	1982	3914	2000	31	556	113	Aug	2008	0,51	0,11	0,27	0,56	0,74
35	1983	7650	4000	28	866	113	Aug	2008	0,52	0,11	0,26	0,87	0,74
36	1980	3660	3200	20	308	113	Aug	2008	0,87	0,11	0,29	0,31	0,74
37	1982	3233	2600	20	381	113	Aug	2008	0,80	0,11	0,27	0,38	0,74
38	1980	3660	3200	18	248	113	Aug	2008	0,87	0,11	0,29	0,25	0,74
39	1981	4034	3200	17	248	113	Aug	2008	0,79	0,11	0,28	0,25	0,74

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
40	1982	3914	3200	17	248	113	Aug	2008	0,82	0,11	0,27	0,25	0,74
41	2008	3548	3200	17	248	113	Aug	2008	0,90	0,11	0,01	0,25	0,74
42	1981	6275	4900	32	1328	106	Sept	2008	0,78	0,11	0,28	1,33	0,4975
43	1982	3233	2600	17	248	106	Sept	2008	0,80	0,11	0,27	0,25	0,4975
44	1980	3660	3200	17	176	106	Sept	2008	0,87	0,11	0,29	0,18	0,4975
45	2004	3500	3000	26	896	88	Oct	2008	0,86	0,09	0,05	0,90	0,18
46	1980	3660	3200	20	381	88	Oct	2008	0,87	0,09	0,29	0,38	0,18
47	2005	5695	4200	33	1430	56	Nov	2008	0,74	0,06	0,04	1,43	0,0818
48	1984	6525	5000	25	1328	56	Nov	2008	0,77	0,06	0,25	1,33	0,0818
49	1980	3660	3200	17	175	56	Nov	2008	0,87	0,06	0,29	0,18	0,0818
50	1980	3660	3100	15	248	56	Nov	2008	0,85	0,06	0,29	0,25	0,0818
51	1984	4028	3200	14	176	56	Nov	2008	0,79	0,06	0,25	0,18	0,0818
52	2005	5850	3500	43	946	55	Dec	2008	0,60	0,06	0,04	0,95	0,0743
53	2008	6970	1500	41	1342	45	Dec	2008	0,22	0,04	0,01	1,34	0,0743
54	2007	7000	1500	34	1342	45	Dec	2008	0,21	0,04	0,02	1,34	0,0743
55	2008	5850	4000	31	1495	45	Dec	2008	0,68	0,04	0,01	1,50	0,0743
56	1988	6375	5500	26	1328	45	Dec	2008	0,86	0,04	0,21	1,33	0,0743
57	1982	6930	4900	25	1328	45	Dec	2008	0,71	0,04	0,27	1,33	0,0743
58	2008	5543	5100	25	1328	45	Dec	2008	0,92	0,04	0,01	1,33	0,0743
59	2008	5543	5200	22	576	45	Dec	2008	0,94	0,04	0,01	0,58	0,0743
60	2005	5850	4500	31	1673	45	Dec	2008	0,77	0,04	0,04	1,67	0,0743
61	1982	4563	3200	19	381	45	Dec	2008	0,70	0,04	0,27	0,38	0,0743
62	1982	4563	3200	17	175	45	Dec	2008	0,70	0,04	0,27	0,18	0,0743
63	1980	3660	3200	14	248	45	Dec	2008	0,87	0,04	0,29	0,25	0,0743
64	1982	3914	3000	14	176	45	Dec	2008	0,77	0,04	0,27	0,18	0,0743
65	2008	5604	5000	35	1495	44	Jan	2009	0,89	0,04	0,02	1,50	0,0904
66	2007	15857	12750	30	3414	44	Jan	2009	0,80	0,04	0,03	3,41	0,0904
67	1982	6930	5000	25	1328	44	Jan	2009	0,72	0,04	0,28	1,33	0,0904
68	1980	5380	4900	25	1328	44	Jan	2009	0,91	0,04	0,30	1,33	0,0904
69	1981	4613	4000	25	1430	44	Jan	2009	0,87	0,04	0,29	1,43	0,0904
70	1982	3872	3150	25	1040	44	Jan	2009	0,81	0,04	0,28	1,04	0,0904
71	1982	6930	4000	20	866	44	Jan	2009	0,58	0,04	0,28	0,87	0,0904
72	2008	5707	5000	18	2806	44	Jan	2009	0,88	0,04	0,02	2,81	0,0904
73	2003	3851	2100	24	556	46	Feb	2009	0,55	0,05	0,07	0,56	0,1815
74	1982	3914	3000	19	576	46	Feb	2009	0,77	0,05	0,28	0,58	0,1815
75	1981	4035	3200	14	242	46	Feb	2009	0,79	0,05	0,29	0,24	0,1815
76	2007	13086	9500	36	3349	45	March	2009	0,73	0,05	0,03	3,35	0,1957
77	2007	17998	14250	34	3316	45	March	2009	0,79	0,05	0,03	3,32	0,1957
78	2005	5850	2000	29	1040	45	March	2009	0,34	0,05	0,05	1,04	0,1957

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
79	1980	3660	3000	15	293	45	March	2009	0,82	0,05	0,30	0,29	0,1957
80	2008	7003	4000	23	964	52	April	2009	0,57	0,05	0,02	0,96	0,1619
81	1982	4563	3000	19	108	52	April	2009	0,66	0,05	0,28	0,11	0,1619
82	2008	5707	2000	30	964	57	May	2009	0,35	0,06	0,02	0,96	0,2539
83	2008	6234	4950	15	382	57	May	2009	0,79	0,06	0,02	0,38	0,2539
84	2007	13086	12000	31	3349	60	July	2009	0,92	0,06	0,03	3,35	0,3361
85	2005	5850	1200	25	450	60	July	2009	0,21	0,06	0,05	0,45	0,3361
86	1980	3660	3000	18	602	60	July	2009	0,82	0,06	0,30	0,60	0,3361
87	2008	11259	2000	52	3045	74	August	2009	0,18	0,07	0,02	3,05	0,2684
88	2008	11259	8300	37	3380	74	August	2009	0,74	0,07	0,02	3,38	0,2684
89	2007	13080	6000	25	1435	74	August	2009	0,46	0,07	0,03	1,44	0,2684
90	2009	5538	1400	30	450	67	Sept	2009	0,25	0,07	0,01	0,45	0,2351
91	2008	13581	9400	35	3349	75	Nov	2009	0,69	0,08	0,02	3,35	0,394
92	2008	5604	4000	20	434	75	Nov	2009	0,71	0,08	0,02	0,43	0,394
93	1981	3841	3200	20	661	75	Nov	2009	0,83	0,08	0,29	0,66	0,394
94	1993	9108	2000	53	3003	72	Dec	2009	0,22	0,07	0,17	3,00	0,3572
95	1980	3660	3200	20	661	72	Dec	2009	0,87	0,07	0,30	0,66	0,3572
96	2006	5794	3200	24	661	76	Jan	2010	0,55	0,08	0,05	0,66	0,3168
97	1980	3660	3200	24	661	76	Jan	2010	0,87	0,08	0,31	0,66	0,3168
98	1980	3660	3200	24	661	76	Jan	2010	0,87	0,08	0,31	0,66	0,3168
99	2006	5794	5250	22	661	72	Feb	2010	0,91	0,07	0,05	0,66	0,2677
100	1980	3660	1700	22	239	72	Feb	2010	0,46	0,07	0,31	0,24	0,2677
101	1984	4028	2000	26	203	72	Feb	2010	0,50	0,07	0,27	0,20	0,2677
102	2008	5707	5000	31	1749	80	March	2010	0,88	0,08	0,03	1,75	0,3206
103	1980	3660	3200	24	661	80	March	2010	0,87	0,08	0,31	0,66	0,3206
104	2005	5850	4000	22	661	80	March	2010	0,68	0,08	0,06	0,66	0,3206
105	2009	5545	4750	14	108	80	March	2010	0,86	0,08	0,02	0,11	0,3206
106	2005	5850	3000	42	884	90	April	2010	0,51	0,09	0,06	0,88	0,3043
107	2005	5850	2750	38	2984	90	April	2010	0,47	0,09	0,06	2,98	0,3043
108	1984	4028	2000	28	203	90	April	2010	0,50	0,09	0,27	0,20	0,3043
109	1996	10044	9500	22	1038	90	April	2010	0,95	0,09	0,15	1,04	0,3043
110	2010	6340	5000	14	108	90	April	2010	0,79	0,09	0,01	0,11	0,3043
111	1984	4028	2000	28	661	76	May	2010	0,50	0,08	0,27	0,66	0,3838
112	1980	3660	3200	20	661	76	May	2010	0,87	0,08	0,31	0,66	0,3838
113	1980	3660	3200	20	661	76	May	2010	0,87	0,08	0,31	0,66	0,3838
114	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
115	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
116	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
117	2007	10857	9900	13	382	77	June	2010	0,91	0,08	0,04	0,38	0,3088

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
79	1980	3660	3000	15	293	45	March	2009	0,82	0,05	0,30	0,29	0,1957
80	2008	7003	4000	23	964	52	April	2009	0,57	0,05	0,02	0,96	0,1619
81	1982	4563	3000	19	108	52	April	2009	0,66	0,05	0,28	0,11	0,1619
82	2008	5707	2000	30	964	57	May	2009	0,35	0,06	0,02	0,96	0,2539
83	2008	6234	4950	15	382	57	May	2009	0,79	0,06	0,02	0,38	0,2539
84	2007	13086	12000	31	3349	60	July	2009	0,92	0,06	0,03	3,35	0,3361
85	2005	5850	1200	25	450	60	July	2009	0,21	0,06	0,05	0,45	0,3361
86	1980	3660	3000	18	602	60	July	2009	0,82	0,06	0,30	0,60	0,3361
87	2008	11259	2000	52	3045	74	August	2009	0,18	0,07	0,02	3,05	0,2684
88	2008	11259	8300	37	3380	74	August	2009	0,74	0,07	0,02	3,38	0,2684
89	2007	13080	6000	25	1435	74	August	2009	0,46	0,07	0,03	1,44	0,2684
90	2009	5538	1400	30	450	67	Sept	2009	0,25	0,07	0,01	0,45	0,2351
91	2008	13581	9400	35	3349	75	Nov	2009	0,69	0,08	0,02	3,35	0,394
92	2008	5604	4000	20	434	75	Nov	2009	0,71	0,08	0,02	0,43	0,394
93	1981	3841	3200	20	661	75	Nov	2009	0,83	0,08	0,29	0,66	0,394
94	1993	9108	2000	53	3003	72	Dec	2009	0,22	0,07	0,17	3,00	0,3572
95	1980	3660	3200	20	661	72	Dec	2009	0,87	0,07	0,30	0,66	0,3572
96	2006	5794	3200	24	661	76	Jan	2010	0,55	0,08	0,05	0,66	0,3168
97	1980	3660	3200	24	661	76	Jan	2010	0,87	0,08	0,31	0,66	0,3168
98	1980	3660	3200	24	661	76	Jan	2010	0,87	0,08	0,31	0,66	0,3168
99	2006	5794	5250	22	661	72	Feb	2010	0,91	0,07	0,05	0,66	0,2677
100	1980	3660	1700	22	239	72	Feb	2010	0,46	0,07	0,31	0,24	0,2677
101	1984	4028	2000	26	203	72	Feb	2010	0,50	0,07	0,27	0,20	0,2677
102	2008	5707	5000	31	1749	80	March	2010	0,88	0,08	0,03	1,75	0,3206
103	1980	3660	3200	24	661	80	March	2010	0,87	0,08	0,31	0,66	0,3206
104	2005	5850	4000	22	661	80	March	2010	0,68	0,08	0,06	0,66	0,3206
105	2009	5545	4750	14	108	80	March	2010	0,86	0,08	0,02	0,11	0,3206
106	2005	5850	3000	42	884	90	April	2010	0,51	0,09	0,06	0,88	0,3043
107	2005	5850	2750	38	2984	90	April	2010	0,47	0,09	0,06	2,98	0,3043
108	1984	4028	2000	28	203	90	April	2010	0,50	0,09	0,27	0,20	0,3043
109	1996	10044	9500	22	1038	90	April	2010	0,95	0,09	0,15	1,04	0,3043
110	2010	6340	5000	14	108	90	April	2010	0,79	0,09	0,01	0,11	0,3043
111	1984	4028	2000	28	661	76	May	2010	0,50	0,08	0,27	0,66	0,3838
112	1980	3660	3200	20	661	76	May	2010	0,87	0,08	0,31	0,66	0,3838
113	1980	3660	3200	20	661	76	May	2010	0,87	0,08	0,31	0,66	0,3838
114	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
115	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
116	1980	3660	3200	20	661	77	June	2010	0,87	0,08	0,31	0,66	0,3088
117	2007	10857	9900	13	382	77	June	2010	0,91	0,08	0,04	0,38	0,3088

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
118	2007	10857	9900	12	382	77	June	2010	0,91	0,08	0,04	0,38	0,3088
119	2009	1845	1200	26	450	75	July	2010	0,65	0,07	0,02	0,45	0,1909
120	2006	13061	12000	32	3158	75	July	2010	0,92	0,07	0,05	3,16	0,1909
121	2005	5850	3200	26	661	75	July	2010	0,55	0,07	0,06	0,66	0,1909
122	2005	5850	3200	26	661	75	July	2010	0,55	0,07	0,06	0,66	0,1909
123	1984	4028	2000	19	239	75	July	2010	0,50	0,07	0,27	0,24	0,1909
124	1999	13864	12000	13	382	75	July	2010	0,87	0,07	0,12	0,38	0,1909
125	2010	14374	12950	14	382	75	July	2010	0,90	0,07	0,01	0,38	0,1909
126	2010	14374	12000	15	525	75	July	2010	0,83	0,07	0,01	0,53	0,1909
127	2010	14374	12000	15	525	75	July	2010	0,83	0,07	0,01	0,53	0,1909
128	2009	14368	9000	34	3171	76	Aug	2010	0,63	0,08	0,02	3,17	0,2432
129	2009	5543	4000	25	705	76	Aug	2010	0,72	0,08	0,02	0,71	0,2432
130	2005	5850	3700	23	661	76	Aug	2010	0,63	0,08	0,06	0,66	0,2432
131	2008	6405	5000	27	1706	78	Sept	2010	0,78	0,08	0,03	1,71	0,2719
132	2004	4804	4500	19	634	78	Sept	2010	0,94	0,08	0,07	0,63	0,2719
133	1984	4028	2100	18	239	78	Sept	2010	0,52	0,08	0,27	0,24	0,2719
134	2009	16655	14600	18	1279	78	Sept	2010	0,88	0,08	0,02	1,28	0,2719
135	2005	5850	5250	16	661	78	Sept	2010	0,90	0,08	0,06	0,66	0,2719
136	2009	6400	4800	16	382	78	Sept	2010	0,75	0,08	0,02	0,38	0,2719
137	1989	13937	9950	17	382	78	Sept	2010	0,71	0,08	0,22	0,38	0,2719
138	1989	13937	9900	16	382	78	Sept	2010	0,71	0,08	0,22	0,38	0,2719
139	2009	3442	1800	34	964	84	Oct	2010	0,52	0,08	0,02	0,96	0,2693
140	2009	5543	4200	26	661	84	Oct	2010	0,76	0,08	0,02	0,66	0,2693
141	1984	4028	2000	22	661	84	Oct	2010	0,50	0,08	0,27	0,66	0,2693
142	2009	19991	11500	20	1279	84	Oct	2010	0,58	0,08	0,02	1,28	0,2693
143	2010	4753	5300	17	661	84	Oct	2010	1,12	0,08	0,01	0,66	0,2693
144	1980	3660	3200	16	634	84	Oct	2010	0,87	0,08	0,31	0,63	0,2693
145	2006	5794	5200	21	661	87	Nov	2010	0,90	0,09	0,05	0,66	0,2321
146	2006	5794	5200	21	661	87	Nov	2010	0,90	0,09	0,05	0,66	0,2321
147	1980	3660	3200	14	634	87	Nov	2010	0,87	0,09	0,31	0,63	0,2321
148	1989	13937	12000	15	382	87	Nov	2010	0,86	0,09	0,22	0,38	0,2321
149	1989	13937	12000	16	382	87	Nov	2010	0,86	0,09	0,22	0,38	0,2321
150	1980	3660	1000	36	630	91	Dec	2010	0,27	0,09	0,31	0,63	0,203
151	2008	6273	5000	36	2113	91	Dec	2010	0,80	0,09	0,03	2,11	0,203
152	2005	13062	11900	32	3380	91	Dec	2010	0,91	0,09	0,06	3,38	0,203
153	2004	4274	3500	27	661	91	Dec	2010	0,82	0,09	0,07	0,66	0,203
154	2010	7003	5200	21	661	91	Dec	2010	0,74	0,09	0,01	0,66	0,203
155	2010	14374	12000	14	382	91	Dec	2010	0,83	0,09	0,01	0,38	0,203
156	1999	6967	1000	37	630	98	Jan	2011	0,14	0,10	0,13	0,63	0,1401

No	Built	DWT	Cargo	FR	R	OP	Month	Year	UT	OP/1000	AG/100	R/1000	BDI/1000
157	1982	4563	4000	24	684	98	Jan	2011	0,88	0,10	0,30	0,68	0,1401
158	1980	3660	3200	17	661	98	Jan	2011	0,87	0,10	0,32	0,66	0,1401
159	2010	6623	4000	14	248	98	Jan	2011	0,60	0,10	0,02	0,25	0,1401
160	1989	13937	9900	16	382	98	Jan	2011	0,71	0,10	0,23	0,38	0,1401
161	2008	10200	8500	16	382	98	Jan	2011	0,83	0,10	0,04	0,38	0,1401
162	2009	5543	2100	38	964	108	Feb	2011	0,38	0,11	0,03	0,96	0,1181
163	2008	3500	2000	33	630	108	Feb	2011	0,57	0,11	0,04	0,63	0,1181
164	1984	4028	1600	28	661	108	Feb	2011	0,40	0,11	0,28	0,66	0,1181
165	2010	4753	4300	21	661	108	Feb	2011	0,90	0,11	0,02	0,66	0,1181
166	2010	4753	4300	20	661	108	Feb	2011	0,90	0,11	0,02	0,66	0,1181
167	1980	3660	3200	20	661	108	Feb	2011	0,87	0,11	0,32	0,66	0,1181
168	1980	10211	7000	18	838	108	Feb	2011	0,69	0,11	0,32	0,84	0,1181
169	2010	14374	9950	12	382	108	Feb	2011	0,69	0,11	0,02	0,38	0,1181
170	1984	4028	1500	28	450	114	March	2011	0,37	0,11	0,28	0,45	0,1492
171	1982	4563	4000	26	684	114	March	2011	0,88	0,11	0,30	0,68	0,1492
172	2009	6250	5000	25	838	114	March	2011	0,80	0,11	0,03	0,84	0,1492
173	2008	3500	3300	25	684	114	March	2011	0,94	0,11	0,04	0,68	0,1492
174	1980	3660	3200	20	661	114	March	2011	0,87	0,11	0,32	0,66	0,1492
175	2007	11300	8640	17	382	114	March	2011	0,76	0,11	0,05	0,38	0,1492
176	2008	11259	8400	17	382	114	March	2011	0,75	0,11	0,04	0,38	0,1492
177	2004	3500	3000	36	1634	124	April	2011	0,86	0,12	0,08	1,63	0,1342
178	2008	6138	5000	25	634	124	April	2011	0,81	0,12	0,04	0,63	0,1342
179	1980	3660	1500	24	287	124	April	2011	0,41	0,12	0,32	0,29	0,1342
180	2010	6623	5200	24	661	124	April	2011	0,79	0,12	0,02	0,66	0,1342
181	2010	8403	6500	23	838	124	April	2011	0,77	0,12	0,02	0,84	0,1342
182	2008	6273	5000	23	634	124	April	2011	0,80	0,12	0,04	0,63	0,1342
183	1980	3660	3200	22	661	124	April	2011	0,87	0,12	0,32	0,66	0,1342
184	2008	7057	5350	17	382	124	April	2011	0,76	0,12	0,04	0,38	0,1342
185	2006	13040	9600	13	382	124	April	2011	0,74	0,12	0,06	0,38	0,1342
186	2008	10200	8600	44	3281	115	May	2011	0,84	0,11	0,04	3,28	0,1352
187	1982	4563	3150	29	684	115	May	2011	0,69	0,11	0,30	0,68	0,1352
188	1980	3660	3200	22	661	115	May	2011	0,87	0,11	0,32	0,66	0,1352
189	1980	3660	3300	15	200	115	May	2011	0,90	0,11	0,32	0,20	0,1352
190	2008	18818	10000	14	382	115	May	2011	0,53	0,11	0,04	0,38	0,1352
191	2009	6487	5000	16	108	118	June	2011	0,77	0,12	0,03	0,11	0,1433
192	1984	4028	2200	37	630	117	July	2011	0,55	0,12	0,28	0,63	0,1365
193	2010	6480	5900	27	997	117	July	2011	0,91	0,12	0,02	1,00	0,1365
194	2008	6273	5000	22	634	107	Sept	2011	0,80	0,11	0,04	0,63	0,184
195	2008	6273	5000	20	230	107	Sept	2011	0,80	0,11	0,04	0,23	0,184
196	1992	1800	1450	23	398	109	Oct	2011	0,81	0,11	0,20	0,40	0,2072
197	2007	6250	5000	20	230	109	Dec	2011	0,80	0,11	0,05	0,23	0,2072
198	2008	6138	5000	20	230	109	Dec	2011	0,81	0,11	0,04	0,23	0,1868

Table A.2 : Calculation table for Model 1

No	UT^2	OP^2	AGE^2	R^2	UT*OP	UT*AG	UT*R	OP*AG	OP*R	AG*R	UT*Fr	OP*Fr	AG*Fr	R*Fr
1	0,03	0,02	0,00	0,20	0,02	0,01	0,08	0,01	0,06	0,02	6,15	4,69	1,44	16,20
2	0,04	0,02	0,00	0,20	0,03	0,00	0,09	0,00	0,06	0,00	7,57	4,69	0,36	16,20
3	0,83	0,02	0,00	1,76	0,12	0,01	1,21	0,00	0,17	0,01	25,51	3,65	0,28	37,18
4	0,77	0,02	0,07	0,75	0,11	0,24	0,76	0,04	0,11	0,23	20,16	3,00	6,21	19,92
5	0,63	0,02	0,06	0,14	0,10	0,20	0,30	0,03	0,05	0,09	17,48	2,87	5,50	8,25
6	0,63	0,02	0,06	0,21	0,10	0,20	0,36	0,03	0,06	0,11	16,68	2,74	5,25	9,62
7	0,34	0,02	0,00	0,03	0,08	0,01	0,10	0,00	0,02	0,00	11,68	2,61	0,40	3,50
8	0,63	0,02	0,06	0,08	0,10	0,20	0,23	0,03	0,04	0,07	14,30	2,35	4,50	5,24
9	0,68	0,02	0,00	0,06	0,11	0,02	0,20	0,00	0,03	0,00	14,01	2,22	0,34	4,22
10	0,66	0,02	0,07	0,06	0,11	0,22	0,20	0,04	0,03	0,07	13,02	2,09	4,32	3,97
11	0,76	0,02	0,08	0,06	0,11	0,25	0,22	0,04	0,03	0,07	13,99	2,09	4,64	3,97
12	0,43	0,02	0,00	2,04	0,09	0,01	0,94	0,00	0,19	0,03	20,96	4,33	0,64	45,76
13	0,85	0,02	0,06	1,76	0,12	0,23	1,22	0,03	0,18	0,33	28,51	4,20	7,75	41,17
14	0,22	0,02	0,00	0,57	0,06	0,01	0,35	0,00	0,10	0,02	13,13	3,79	0,56	21,17
15	0,83	0,02	0,12	0,32	0,12	0,32	0,51	0,05	0,08	0,20	24,61	3,66	9,45	15,23
16	0,63	0,02	0,08	0,42	0,11	0,22	0,51	0,04	0,09	0,18	19,80	3,39	7,00	16,23
17	0,72	0,02	0,00	0,15	0,12	0,01	0,32	0,00	0,05	0,00	21,25	3,39	0,25	9,53
18	0,63	0,02	0,06	0,03	0,11	0,20	0,14	0,03	0,02	0,04	15,09	2,57	4,75	3,33
19	0,41	0,02	0,08	0,03	0,09	0,18	0,11	0,04	0,02	0,05	10,84	2,30	4,76	2,99
20	0,65	0,02	0,07	0,03	0,11	0,22	0,14	0,04	0,02	0,05	13,68	2,30	4,59	2,99
21	0,67	0,02	0,07	0,06	0,11	0,22	0,20	0,04	0,03	0,07	13,08	2,17	4,32	3,97
22	0,76	0,02	0,08	0,06	0,12	0,25	0,22	0,04	0,03	0,07	13,99	2,17	4,64	3,97
23	0,80	0,02	0,03	2,24	0,12	0,16	1,34	0,02	0,21	0,27	34,88	5,38	7,02	58,31
24	0,26	0,02	0,00	1,28	0,07	0,02	0,58	0,01	0,16	0,05	18,97	5,10	1,48	41,81
25	0,22	0,02	0,04	0,75	0,06	0,10	0,41	0,03	0,12	0,18	16,47	4,82	7,35	30,31
26	0,82	0,02	0,00	0,03	0,12	0,01	0,16	0,00	0,02	0,00	22,67	3,45	0,25	4,38
27	0,79	0,02	0,10	0,06	0,12	0,28	0,22	0,04	0,03	0,08	19,57	3,03	7,04	5,46
28	0,82	0,02	0,00	0,05	0,12	0,01	0,21	0,00	0,03	0,00	19,95	3,03	0,22	5,06
29	0,63	0,02	0,06	0,03	0,11	0,20	0,14	0,03	0,02	0,04	15,09	2,62	4,75	3,33
30	0,76	0,02	0,08	0,03	0,12	0,25	0,15	0,04	0,02	0,05	15,74	2,48	5,22	3,17
31	0,78	0,02	0,10	0,09	0,12	0,28	0,27	0,04	0,04	0,10	15,88	2,48	5,76	5,54
32	0,72	0,02	0,08	0,03	0,12	0,25	0,15	0,04	0,02	0,05	15,25	2,48	5,22	3,17
33	0,07	0,01	0,08	0,20	0,03	0,07	0,11	0,03	0,05	0,13	9,20	4,05	10,08	16,20
34	0,26	0,01	0,07	0,31	0,06	0,14	0,28	0,03	0,06	0,15	15,84	3,49	8,37	17,24
35	0,27	0,01	0,07	0,75	0,06	0,14	0,45	0,03	0,10	0,23	14,64	3,15	7,28	24,25
36	0,76	0,01	0,08	0,09	0,10	0,25	0,27	0,03	0,03	0,09	17,49	2,25	5,80	6,16
37	0,65	0,01	0,07	0,15	0,09	0,22	0,31	0,03	0,04	0,10	16,08	2,25	5,40	7,62
38	0,76	0,01	0,08	0,06	0,10	0,25	0,22	0,03	0,03	0,07	15,74	2,03	5,22	4,46
39	0,63	0,01	0,08	0,06	0,09	0,22	0,20	0,03	0,03	0,07	13,49	1,91	4,76	4,22

No	UT^2	OP^2	AGE^2	R^2	UT*OP	UT*AG	UT*R	OP*AG	OP*R	AG*R	UT*Fr	OP*Fr	AG*Fr	R*Fr
40	0,67	0,01	0,07	0,06	0,09	0,22	0,20	0,03	0,03	0,07	13,90	1,91	4,59	4,22
41	0,81	0,01	0,00	0,06	0,10	0,01	0,22	0,00	0,03	0,00	15,33	1,91	0,17	4,22
42	0,61	0,01	0,08	1,76	0,08	0,22	1,04	0,03	0,14	0,37	24,99	3,39	8,96	42,50
43	0,65	0,01	0,07	0,06	0,09	0,22	0,20	0,03	0,03	0,07	13,67	1,80	4,59	4,22
44	0,76	0,01	0,08	0,03	0,09	0,25	0,15	0,03	0,02	0,05	14,86	1,80	4,93	2,99
45	0,73	0,01	0,00	0,80	0,08	0,04	0,77	0,00	0,08	0,04	22,29	2,29	1,30	23,30
46	0,76	0,01	0,08	0,15	0,08	0,25	0,33	0,03	0,03	0,11	17,49	1,76	5,80	7,62
47	0,54	0,00	0,00	2,04	0,04	0,03	1,05	0,00	0,08	0,06	24,34	1,85	1,32	47,19
48	0,59	0,00	0,06	1,76	0,04	0,19	1,02	0,01	0,07	0,33	19,16	1,40	6,25	33,20
49	0,76	0,00	0,08	0,03	0,05	0,25	0,15	0,02	0,01	0,05	14,86	0,95	4,93	2,98
50	0,72	0,00	0,08	0,06	0,05	0,25	0,21	0,02	0,01	0,07	12,70	0,84	4,35	3,72
51	0,63	0,00	0,06	0,03	0,04	0,20	0,14	0,01	0,01	0,04	11,12	0,78	3,50	2,46
52	0,36	0,00	0,00	0,89	0,03	0,02	0,57	0,00	0,05	0,04	25,73	2,37	1,72	40,68
53	0,05	0,00	0,00	1,80	0,01	0,00	0,29	0,00	0,06	0,01	8,82	1,84	0,41	55,02
54	0,05	0,00	0,00	1,80	0,01	0,00	0,29	0,00	0,06	0,03	7,29	1,52	0,68	45,63
55	0,47	0,00	0,00	2,24	0,03	0,01	1,02	0,00	0,07	0,01	21,20	1,39	0,31	46,35
56	0,74	0,00	0,04	1,76	0,04	0,18	1,15	0,01	0,06	0,28	22,43	1,16	5,46	34,53
57	0,50	0,00	0,07	1,76	0,03	0,19	0,94	0,01	0,06	0,36	17,68	1,12	6,75	33,20
58	0,85	0,00	0,00	1,76	0,04	0,01	1,22	0,00	0,06	0,01	23,00	1,12	0,25	33,20
59	0,88	0,00	0,00	0,33	0,04	0,01	0,54	0,00	0,03	0,01	20,64	0,99	0,22	12,67
60	0,59	0,00	0,00	2,80	0,03	0,03	1,29	0,00	0,07	0,07	23,85	1,39	1,24	51,86
61	0,49	0,00	0,07	0,15	0,03	0,19	0,27	0,01	0,02	0,10	13,32	0,85	5,13	7,24
62	0,49	0,00	0,07	0,03	0,03	0,19	0,12	0,01	0,01	0,05	11,92	0,76	4,59	2,98
63	0,76	0,00	0,08	0,06	0,04	0,25	0,22	0,01	0,01	0,07	12,24	0,63	4,06	3,47
64	0,59	0,00	0,07	0,03	0,03	0,21	0,13	0,01	0,01	0,05	10,73	0,63	3,78	2,46
65	0,80	0,00	0,00	2,24	0,04	0,02	1,33	0,00	0,07	0,03	31,23	1,53	0,70	52,33
66	0,65	0,00	0,00	11,66	0,04	0,02	2,75	0,00	0,15	0,10	24,12	1,31	0,90	102,42
67	0,52	0,00	0,08	1,76	0,03	0,20	0,96	0,01	0,06	0,37	18,04	1,09	7,00	33,20
68	0,83	0,00	0,09	1,76	0,04	0,27	1,21	0,01	0,06	0,40	22,77	1,09	7,50	33,20
69	0,75	0,00	0,08	2,04	0,04	0,25	1,24	0,01	0,06	0,41	21,68	1,09	7,25	35,75
70	0,66	0,00	0,08	1,08	0,04	0,23	0,85	0,01	0,05	0,29	20,34	1,09	7,00	26,00
71	0,33	0,00	0,08	0,75	0,03	0,16	0,50	0,01	0,04	0,24	11,54	0,87	5,60	17,32
72	0,77	0,00	0,00	7,87	0,04	0,02	2,46	0,00	0,12	0,06	15,77	0,79	0,36	50,51
73	0,30	0,00	0,00	0,31	0,03	0,04	0,30	0,00	0,03	0,04	13,09	1,10	1,68	13,34
74	0,59	0,00	0,08	0,33	0,04	0,21	0,44	0,01	0,03	0,16	14,56	0,87	5,32	10,94
75	0,63	0,00	0,08	0,06	0,04	0,23	0,19	0,01	0,01	0,07	11,10	0,64	4,06	3,39
76	0,53	0,00	0,00	11,22	0,03	0,02	2,43	0,00	0,15	0,10	26,13	1,62	1,08	120,56
77	0,63	0,00	0,00	11,00	0,04	0,02	2,63	0,00	0,15	0,10	26,92	1,53	1,02	112,74
78	0,12	0,00	0,00	1,08	0,02	0,02	0,36	0,00	0,05	0,05	9,91	1,31	1,45	30,16
79	0,67	0,00	0,09	0,09	0,04	0,25	0,24	0,01	0,01	0,09	12,30	0,68	4,50	4,40

No	UT^2	OP^2	AGE^2	R^2	UT*OP	UT*AG	UT*R	OP*AG	OP*R	AG*R	UT*Fr	OP*Fr	AG*Fr	R*Fr
160	0,50	0,01	0,05	0,15	0,07	0,16	0,27	0,02	0,04	0,09	11,37	1,57	3,68	6,11
161	0,69	0,01	0,00	0,15	0,08	0,03	0,32	0,00	0,04	0,02	13,33	1,57	0,64	6,11
162	0,14	0,01	0,00	0,93	0,04	0,01	0,37	0,00	0,10	0,03	14,40	4,11	1,14	36,63
163	0,33	0,01	0,00	0,40	0,06	0,02	0,36	0,00	0,07	0,03	18,86	3,57	1,32	20,79
164	0,16	0,01	0,08	0,44	0,04	0,11	0,26	0,03	0,07	0,19	11,12	3,03	7,84	18,51
165	0,82	0,01	0,00	0,44	0,10	0,02	0,60	0,00	0,07	0,01	19,00	2,27	0,42	13,88
166	0,82	0,01	0,00	0,44	0,10	0,02	0,60	0,00	0,07	0,01	18,09	2,16	0,40	13,22
167	0,76	0,01	0,10	0,44	0,09	0,28	0,58	0,03	0,07	0,21	17,49	2,16	6,40	13,22
168	0,47	0,01	0,10	0,70	0,07	0,22	0,57	0,03	0,09	0,27	12,34	1,95	5,76	15,08
169	0,48	0,01	0,00	0,15	0,07	0,01	0,26	0,00	0,04	0,01	8,31	1,30	0,24	4,58
170	0,14	0,01	0,08	0,20	0,04	0,10	0,17	0,03	0,05	0,13	10,43	3,20	7,84	12,60
171	0,77	0,01	0,09	0,47	0,10	0,26	0,60	0,03	0,08	0,21	22,79	2,97	7,80	17,78
172	0,64	0,01	0,00	0,70	0,09	0,02	0,67	0,00	0,10	0,03	20,00	2,86	0,75	20,95
173	0,89	0,01	0,00	0,47	0,11	0,04	0,64	0,00	0,08	0,03	23,57	2,86	1,00	17,10
174	0,76	0,01	0,10	0,44	0,10	0,28	0,58	0,04	0,08	0,21	17,49	2,29	6,40	13,22
175	0,58	0,01	0,00	0,15	0,09	0,04	0,29	0,01	0,04	0,02	13,00	1,94	0,85	6,49
176	0,56	0,01	0,00	0,15	0,09	0,03	0,28	0,00	0,04	0,02	12,68	1,94	0,68	6,49
177	0,73	0,02	0,01	2,67	0,11	0,07	1,40	0,01	0,20	0,13	30,86	4,48	2,88	58,82
178	0,66	0,02	0,00	0,40	0,10	0,03	0,52	0,00	0,08	0,03	20,36	3,11	1,00	15,85
179	0,17	0,02	0,10	0,08	0,05	0,13	0,12	0,04	0,04	0,09	9,84	2,99	7,68	6,89
180	0,62	0,02	0,00	0,44	0,10	0,02	0,52	0,00	0,08	0,01	18,84	2,99	0,48	15,86
181	0,60	0,02	0,00	0,70	0,10	0,02	0,65	0,00	0,10	0,02	17,79	2,86	0,46	19,27
182	0,64	0,02	0,00	0,40	0,10	0,03	0,51	0,00	0,08	0,03	18,33	2,86	0,92	14,58
183	0,76	0,02	0,10	0,44	0,11	0,28	0,58	0,04	0,08	0,21	19,23	2,74	7,04	14,54
184	0,57	0,02	0,00	0,15	0,09	0,03	0,29	0,00	0,05	0,02	12,89	2,12	0,68	6,49
185	0,54	0,02	0,00	0,15	0,09	0,04	0,28	0,01	0,05	0,02	9,57	1,62	0,78	4,97
186	0,71	0,01	0,00	10,76	0,10	0,03	2,77	0,00	0,38	0,13	37,10	5,04	1,76	144,36
187	0,48	0,01	0,09	0,47	0,08	0,21	0,47	0,03	0,08	0,21	20,02	3,32	8,70	19,84
188	0,76	0,01	0,10	0,44	0,10	0,28	0,58	0,04	0,08	0,21	19,23	2,52	7,04	14,54
189	0,81	0,01	0,10	0,04	0,10	0,29	0,18	0,04	0,02	0,06	13,52	1,72	4,80	3,00
190	0,28	0,01	0,00	0,15	0,06	0,02	0,20	0,00	0,04	0,02	7,44	1,60	0,56	5,35
191	0,59	0,01	0,00	0,01	0,09	0,02	0,08	0,00	0,01	0,00	12,33	1,89	0,48	1,73
192	0,30	0,01	0,08	0,40	0,06	0,15	0,34	0,03	0,07	0,18	20,21	4,34	10,36	23,31
193	0,83	0,01	0,00	0,99	0,11	0,02	0,91	0,00	0,12	0,02	24,58	3,17	0,54	26,92
194	0,64	0,01	0,00	0,40	0,09	0,03	0,51	0,00	0,07	0,03	17,54	2,35	0,88	13,95
195	0,64	0,01	0,00	0,05	0,09	0,03	0,18	0,00	0,02	0,01	15,94	2,14	0,80	4,60
196	0,65	0,01	0,04	0,16	0,09	0,16	0,32	0,02	0,04	0,08	18,53	2,52	4,60	9,15
197	0,64	0,01	0,00	0,05	0,09	0,04	0,18	0,01	0,02	0,01	16,00	2,17	1,00	4,60
198	0,66	0,01	0,00	0,05	0,09	0,03	0,19	0,00	0,02	0,01	16,29	2,17	0,80	4,60

Table A.3 : Calculation table for Model 2

No	UT^2	OP^2	BDI^2	R^2	UT*OP	UT*BDI	UT*R	OP*BDI	OP*R	BDI*R	UT*Fr	OP*Fr	BDI*Fr	R*Fr
1	0,029	0,017	1,176	0,203	0,022	0,185	0,077	0,141	0,059	0,488	6,154	4,695	39,035	16,200
2	0,044	0,017	1,176	0,203	0,027	0,228	0,095	0,141	0,059	0,488	7,570	4,695	39,035	16,200
3	0,830	0,017	1,176	1,764	0,119	0,988	1,210	0,141	0,173	1,440	25,513	3,651	30,360	37,184
4	0,768	0,017	1,176	0,750	0,114	0,951	0,759	0,141	0,113	0,939	20,162	2,999	24,939	19,918
5	0,631	0,017	1,176	0,141	0,104	0,861	0,298	0,141	0,049	0,407	17,478	2,869	23,855	8,250
6	0,631	0,017	1,176	0,210	0,104	0,861	0,364	0,141	0,060	0,497	16,683	2,739	22,770	9,618
7	0,341	0,017	1,176	0,031	0,076	0,633	0,102	0,141	0,023	0,190	11,684	2,608	21,686	3,500
8	0,631	0,017	1,176	0,085	0,104	0,861	0,231	0,141	0,038	0,316	14,300	2,347	19,517	5,238
9	0,680	0,017	1,176	0,062	0,108	0,894	0,204	0,141	0,032	0,269	14,014	2,217	18,433	4,216
10	0,662	0,017	1,176	0,062	0,106	0,882	0,202	0,141	0,032	0,269	13,017	2,087	17,349	3,968
11	0,764	0,017	1,176	0,062	0,114	0,948	0,217	0,141	0,032	0,269	13,989	2,087	17,349	3,968
12	0,429	0,018	1,050	2,045	0,089	0,671	0,936	0,139	0,194	1,465	20,956	4,334	32,784	45,760
13	0,846	0,018	1,050	1,764	0,125	0,942	1,221	0,139	0,180	1,361	28,506	4,199	31,760	41,168
14	0,220	0,018	1,050	0,572	0,064	0,480	0,354	0,139	0,102	0,775	13,129	3,792	28,686	21,168
15	0,831	0,018	1,050	0,318	0,123	0,934	0,514	0,139	0,076	0,578	24,615	3,657	27,662	15,228
16	0,627	0,018	1,050	0,421	0,107	0,811	0,514	0,139	0,088	0,665	19,801	3,386	25,613	16,225
17	0,723	0,018	1,050	0,145	0,115	0,871	0,324	0,139	0,052	0,390	21,252	3,386	25,613	9,525
18	0,631	0,018	1,050	0,031	0,108	0,814	0,139	0,139	0,024	0,179	15,094	2,573	19,466	3,325
19	0,406	0,018	1,050	0,031	0,086	0,653	0,112	0,139	0,024	0,180	10,837	2,302	17,417	2,992
20	0,648	0,018	1,050	0,031	0,109	0,825	0,142	0,139	0,024	0,180	13,682	2,302	17,417	2,992
21	0,668	0,018	1,050	0,062	0,111	0,838	0,203	0,139	0,034	0,254	13,081	2,167	16,392	3,968
22	0,764	0,018	1,050	0,062	0,118	0,896	0,217	0,139	0,034	0,254	13,989	2,167	16,392	3,968
23	0,800	0,019	0,798	2,235	0,123	0,799	1,337	0,123	0,206	1,336	34,880	5,376	34,847	58,305
24	0,263	0,019	0,798	1,277	0,071	0,458	0,579	0,123	0,156	1,010	18,974	5,100	33,060	41,810
25	0,221	0,019	0,798	0,750	0,065	0,420	0,408	0,123	0,119	0,774	16,471	4,824	31,273	30,310
26	0,822	0,019	0,798	0,031	0,125	0,810	0,159	0,123	0,024	0,156	22,669	3,446	22,338	4,375
27	0,792	0,019	0,798	0,062	0,123	0,795	0,221	0,123	0,034	0,222	19,574	3,032	19,657	5,456
28	0,822	0,019	0,798	0,053	0,125	0,810	0,209	0,123	0,032	0,206	19,949	3,032	19,657	5,060
29	0,631	0,019	0,798	0,031	0,110	0,710	0,139	0,123	0,024	0,156	15,094	2,619	16,977	3,325
30	0,764	0,019	0,798	0,031	0,121	0,781	0,154	0,123	0,024	0,157	15,738	2,481	16,083	3,168
31	0,779	0,019	0,798	0,095	0,122	0,788	0,272	0,123	0,042	0,275	15,882	2,481	16,083	5,544
32	0,717	0,019	0,798	0,031	0,117	0,757	0,149	0,123	0,024	0,157	15,246	2,481	16,083	3,168
33	0,065	0,013	0,548	0,203	0,029	0,189	0,115	0,083	0,051	0,333	9,198	4,055	26,640	16,200
34	0,261	0,013	0,548	0,309	0,058	0,378	0,284	0,083	0,063	0,411	15,841	3,492	22,940	17,236
35	0,273	0,013	0,548	0,750	0,059	0,387	0,453	0,083	0,098	0,641	14,641	3,154	20,720	24,248
36	0,764	0,013	0,548	0,095	0,098	0,647	0,269	0,083	0,035	0,228	17,486	2,253	14,800	6,160
37	0,647	0,013	0,548	0,145	0,091	0,595	0,306	0,083	0,043	0,282	16,084	2,253	14,800	7,620
38	0,764	0,013	0,548	0,062	0,098	0,647	0,217	0,083	0,028	0,184	15,738	2,027	13,320	4,464
39	0,629	0,013	0,548	0,062	0,089	0,587	0,197	0,083	0,028	0,184	13,485	1,915	12,580	4,216

No	UT^2	OP^2	BDI^2	R^2	UT*OP	UT*BDI	UT*R	OP*BDI	OP*R	BDI*R	UT*Fr	OP*Fr	BDI*Fr	R*Fr
40	0,668	0,013	0,548	0,062	0,092	0,605	0,203	0,083	0,028	0,184	13,899	1,915	12,580	4,216
41	0,813	0,013	0,548	0,062	0,102	0,667	0,224	0,083	0,028	0,184	15,333	1,915	12,580	4,216
42	0,610	0,011	0,248	1,764	0,083	0,388	1,037	0,053	0,141	0,661	24,988	3,390	15,920	42,496
43	0,647	0,011	0,248	0,062	0,085	0,400	0,199	0,053	0,026	0,123	13,672	1,801	8,458	4,216
44	0,764	0,011	0,248	0,031	0,093	0,435	0,154	0,053	0,019	0,088	14,863	1,801	8,458	2,992
45	0,735	0,008	0,032	0,803	0,075	0,154	0,768	0,016	0,079	0,161	22,286	2,288	4,680	23,296
46	0,764	0,008	0,032	0,145	0,077	0,157	0,333	0,016	0,034	0,069	17,486	1,760	3,600	7,620
47	0,544	0,003	0,007	2,045	0,041	0,060	1,055	0,005	0,080	0,117	24,337	1,848	2,699	47,190
48	0,587	0,003	0,007	1,764	0,043	0,063	1,018	0,005	0,074	0,109	19,157	1,400	2,045	33,200
49	0,764	0,003	0,007	0,031	0,049	0,072	0,153	0,005	0,010	0,014	14,863	0,952	1,391	2,975
50	0,717	0,003	0,007	0,062	0,047	0,069	0,210	0,005	0,014	0,020	12,705	0,840	1,227	3,720
51	0,631	0,003	0,007	0,031	0,044	0,065	0,140	0,005	0,010	0,014	11,122	0,784	1,145	2,464
52	0,358	0,003	0,006	0,895	0,033	0,044	0,566	0,004	0,052	0,070	25,726	2,365	3,195	40,678
53	0,046	0,002	0,006	1,801	0,010	0,016	0,289	0,003	0,060	0,100	8,824	1,836	3,046	55,022
54	0,046	0,002	0,006	1,801	0,010	0,016	0,288	0,003	0,060	0,100	7,286	1,523	2,526	45,628
55	0,468	0,002	0,006	2,235	0,031	0,051	1,022	0,003	0,067	0,111	21,197	1,388	2,303	46,345
56	0,744	0,002	0,006	1,764	0,039	0,064	1,146	0,003	0,059	0,099	22,431	1,164	1,932	34,528
57	0,500	0,002	0,006	1,764	0,032	0,053	0,939	0,003	0,059	0,099	17,677	1,120	1,858	33,200
58	0,847	0,002	0,006	1,764	0,041	0,068	1,222	0,003	0,059	0,099	23,002	1,120	1,858	33,200
59	0,880	0,002	0,006	0,332	0,042	0,070	0,540	0,003	0,026	0,043	20,639	0,985	1,635	12,672
60	0,592	0,002	0,006	2,799	0,034	0,057	1,287	0,003	0,075	0,124	23,846	1,388	2,303	51,863
61	0,492	0,002	0,006	0,145	0,031	0,052	0,267	0,003	0,017	0,028	13,325	0,851	1,412	7,239
62	0,492	0,002	0,006	0,031	0,031	0,052	0,123	0,003	0,008	0,013	11,922	0,761	1,263	2,975
63	0,764	0,002	0,006	0,062	0,039	0,065	0,217	0,003	0,011	0,018	12,240	0,627	1,040	3,472
64	0,587	0,002	0,006	0,031	0,034	0,057	0,135	0,003	0,008	0,013	10,731	0,627	1,040	2,464
65	0,796	0,002	0,008	2,235	0,039	0,081	1,334	0,004	0,065	0,135	31,228	1,529	3,164	52,325
66	0,647	0,002	0,008	11,655	0,035	0,073	2,745	0,004	0,149	0,309	24,122	1,310	2,712	102,420
67	0,521	0,002	0,008	1,764	0,032	0,065	0,958	0,004	0,058	0,120	18,038	1,092	2,260	33,200
68	0,830	0,002	0,008	1,764	0,040	0,082	1,210	0,004	0,058	0,120	22,770	1,092	2,260	33,200
69	0,752	0,002	0,008	2,045	0,038	0,078	1,240	0,004	0,062	0,129	21,678	1,092	2,260	35,750
70	0,662	0,002	0,008	1,082	0,036	0,074	0,846	0,004	0,045	0,094	20,338	1,092	2,260	26,000
71	0,333	0,002	0,008	0,750	0,025	0,052	0,500	0,004	0,038	0,078	11,544	0,874	1,808	17,320
72	0,768	0,002	0,008	7,874	0,038	0,079	2,458	0,004	0,123	0,254	15,770	0,786	1,627	50,508
73	0,297	0,002	0,033	0,309	0,025	0,099	0,303	0,008	0,026	0,101	13,088	1,101	4,356	13,344
74	0,587	0,002	0,033	0,332	0,035	0,139	0,441	0,008	0,026	0,105	14,563	0,872	3,449	10,944
75	0,629	0,002	0,033	0,059	0,036	0,144	0,192	0,008	0,011	0,044	11,103	0,642	2,541	3,388
76	0,527	0,002	0,038	11,216	0,033	0,142	2,431	0,009	0,151	0,655	26,135	1,620	7,045	120,564
77	0,627	0,002	0,038	10,996	0,036	0,155	2,625	0,009	0,149	0,649	26,920	1,530	6,654	112,744
78	0,117	0,002	0,038	1,082	0,015	0,067	0,356	0,009	0,047	0,204	9,915	1,305	5,675	30,160
79	0,672	0,002	0,038	0,086	0,037	0,160	0,240	0,009	0,013	0,057	12,295	0,675	2,936	4,395
80	0,326	0,003	0,026	0,929	0,030	0,092	0,551	0,008	0,050	0,156	13,137	1,190	3,724	22,172

No	UT^2	OP^2	BDI^2	R^2	UT*OP	UT*BDI	UT*R	OP*BDI	OP*R	BDI*R	UT*Fr	OP*Fr	BDI*Fr	R*Fr
81	0,432	0,003	0,026	0,012	0,034	0,106	0,071	0,008	0,006	0,017	12,492	0,983	3,076	2,052
82	0,123	0,003	0,064	0,929	0,020	0,089	0,338	0,015	0,055	0,245	10,513	1,725	7,617	28,920
83	0,630	0,003	0,064	0,146	0,046	0,202	0,303	0,015	0,022	0,097	11,910	0,862	3,809	5,730
84	0,841	0,004	0,113	11,216	0,055	0,308	3,071	0,020	0,200	1,126	28,427	1,847	10,419	103,819
85	0,042	0,004	0,113	0,203	0,012	0,069	0,092	0,020	0,027	0,151	5,128	1,490	8,403	11,250
86	0,672	0,004	0,113	0,362	0,049	0,275	0,493	0,020	0,036	0,202	14,754	1,072	6,050	10,836
87	0,032	0,005	0,072	9,272	0,013	0,048	0,541	0,020	0,224	0,817	9,237	3,829	13,957	158,340
88	0,543	0,005	0,072	11,424	0,054	0,198	2,492	0,020	0,249	0,907	27,276	2,724	9,931	125,060
89	0,210	0,005	0,072	2,059	0,034	0,123	0,658	0,020	0,106	0,385	11,468	1,841	6,710	35,875
90	0,064	0,004	0,055	0,203	0,017	0,059	0,114	0,016	0,030	0,106	7,584	2,004	7,053	13,500
91	0,479	0,006	0,155	11,216	0,052	0,273	2,318	0,030	0,251	1,320	24,225	2,627	13,790	117,215
92	0,509	0,006	0,155	0,188	0,054	0,281	0,310	0,030	0,033	0,171	14,276	1,501	7,880	8,680
93	0,694	0,006	0,155	0,437	0,063	0,328	0,551	0,030	0,050	0,260	16,662	1,501	7,880	13,220
94	0,048	0,005	0,128	9,018	0,016	0,078	0,659	0,026	0,215	1,073	11,638	3,802	18,932	159,159
95	0,764	0,005	0,128	0,437	0,063	0,312	0,578	0,026	0,047	0,236	17,486	1,435	7,144	13,220
96	0,305	0,006	0,100	0,437	0,042	0,175	0,365	0,024	0,050	0,209	13,255	1,828	7,603	15,864
97	0,764	0,006	0,100	0,437	0,067	0,277	0,578	0,024	0,050	0,209	20,984	1,828	7,603	15,864
98	0,764	0,006	0,100	0,437	0,067	0,277	0,578	0,024	0,050	0,209	20,984	1,828	7,603	15,864
99	0,821	0,005	0,072	0,437	0,066	0,243	0,599	0,019	0,048	0,177	19,934	1,594	5,889	14,542
100	0,216	0,005	0,072	0,057	0,034	0,124	0,111	0,019	0,017	0,064	10,219	1,594	5,889	5,258
101	0,247	0,005	0,072	0,041	0,036	0,133	0,101	0,019	0,015	0,054	12,910	1,884	6,960	5,278
102	0,768	0,006	0,103	3,059	0,070	0,281	1,532	0,026	0,139	0,561	27,160	2,470	9,939	54,219
103	0,764	0,006	0,103	0,437	0,070	0,280	0,578	0,026	0,053	0,212	20,984	1,912	7,694	15,864
104	0,468	0,006	0,103	0,437	0,054	0,219	0,452	0,026	0,053	0,212	15,043	1,753	7,053	14,542
105	0,734	0,006	0,103	0,012	0,068	0,275	0,093	0,026	0,009	0,035	11,993	1,115	4,488	1,512
106	0,263	0,008	0,093	0,781	0,046	0,156	0,453	0,027	0,080	0,269	21,538	3,780	12,781	37,128
107	0,221	0,008	0,093	8,904	0,042	0,143	1,403	0,027	0,269	0,908	17,863	3,420	11,563	113,392
108	0,247	0,008	0,093	0,041	0,045	0,151	0,101	0,027	0,018	0,062	13,903	2,520	8,520	5,684
109	0,895	0,008	0,093	1,077	0,085	0,288	0,982	0,027	0,093	0,316	20,808	1,980	6,695	22,836
110	0,622	0,008	0,093	0,012	0,071	0,240	0,085	0,027	0,010	0,033	11,041	1,260	4,260	1,512
111	0,247	0,006	0,147	0,437	0,038	0,191	0,328	0,029	0,050	0,254	13,903	2,120	10,746	18,508
112	0,764	0,006	0,147	0,437	0,066	0,336	0,578	0,029	0,050	0,254	17,486	1,514	7,676	13,220
113	0,764	0,006	0,147	0,437	0,066	0,336	0,578	0,029	0,050	0,254	17,486	1,514	7,676	13,220
114	0,764	0,006	0,095	0,437	0,067	0,270	0,578	0,024	0,051	0,204	17,486	1,539	6,176	13,220
115	0,764	0,006	0,095	0,437	0,067	0,270	0,578	0,024	0,051	0,204	17,486	1,539	6,176	13,220
116	0,764	0,006	0,095	0,437	0,067	0,270	0,578	0,024	0,051	0,204	17,486	1,539	6,176	13,220
117	0,831	0,006	0,095	0,146	0,070	0,282	0,348	0,024	0,029	0,118	11,854	1,000	4,014	4,966
118	0,831	0,006	0,095	0,146	0,070	0,282	0,348	0,024	0,029	0,118	10,942	0,923	3,706	4,584
119	0,423	0,006	0,036	0,203	0,048	0,124	0,293	0,014	0,034	0,086	16,911	1,938	4,963	11,700
120	0,844	0,006	0,036	9,973	0,068	0,175	2,901	0,014	0,235	0,603	29,401	2,386	6,109	101,056

No	UT^2	OP^2	BDI^2	R^2	UT*OP	UT*BDI	UT*R	OP*BDI	OP*R	BDI*R	UT*Fr	OP*Fr	BDI*Fr	R*Fr
121	0,299	0,006	0,036	0,437	0,041	0,104	0,362	0,014	0,049	0,126	14,222	1,938	4,963	17,186
122	0,299	0,006	0,036	0,437	0,041	0,104	0,362	0,014	0,049	0,126	14,222	1,938	4,963	17,186
123	0,247	0,006	0,036	0,057	0,037	0,095	0,119	0,014	0,018	0,046	9,434	1,416	3,627	4,541
124	0,749	0,006	0,036	0,146	0,065	0,165	0,331	0,014	0,028	0,073	11,252	0,969	2,482	4,966
125	0,812	0,006	0,036	0,146	0,067	0,172	0,344	0,014	0,028	0,073	12,613	1,044	2,673	5,348
126	0,697	0,006	0,036	0,276	0,062	0,159	0,438	0,014	0,039	0,100	12,523	1,118	2,864	7,875
127	0,697	0,006	0,036	0,276	0,062	0,159	0,438	0,014	0,039	0,100	12,523	1,118	2,864	7,875
128	0,392	0,006	0,059	10,055	0,048	0,152	1,986	0,018	0,241	0,771	21,297	2,580	8,269	107,814
129	0,521	0,006	0,059	0,497	0,055	0,176	0,509	0,018	0,054	0,171	18,041	1,897	6,080	17,625
130	0,400	0,006	0,059	0,437	0,048	0,154	0,418	0,018	0,050	0,161	14,547	1,745	5,594	15,203
131	0,609	0,006	0,074	2,910	0,061	0,212	1,332	0,021	0,134	0,464	21,077	2,118	7,341	46,062
132	0,877	0,006	0,074	0,402	0,073	0,255	0,594	0,021	0,050	0,172	17,798	1,491	5,166	12,046
133	0,272	0,006	0,074	0,057	0,041	0,142	0,125	0,021	0,019	0,065	9,384	1,412	4,894	4,302
134	0,768	0,006	0,074	1,636	0,069	0,238	1,121	0,021	0,100	0,348	15,779	1,412	4,894	23,022
135	0,805	0,006	0,074	0,437	0,070	0,244	0,593	0,021	0,052	0,180	14,359	1,255	4,350	10,576
136	0,563	0,006	0,074	0,146	0,059	0,204	0,287	0,021	0,030	0,104	12,000	1,255	4,350	6,112
137	0,510	0,006	0,074	0,146	0,056	0,194	0,273	0,021	0,030	0,104	12,137	1,334	4,622	6,494
138	0,505	0,006	0,074	0,146	0,056	0,193	0,271	0,021	0,030	0,104	11,365	1,255	4,350	6,112
139	0,273	0,007	0,073	0,929	0,044	0,141	0,504	0,023	0,081	0,260	17,780	2,841	9,156	32,776
140	0,574	0,007	0,073	0,437	0,063	0,204	0,501	0,023	0,055	0,178	19,701	2,172	7,002	17,186
141	0,247	0,007	0,073	0,437	0,041	0,134	0,328	0,023	0,055	0,178	10,924	1,838	5,925	14,542
142	0,331	0,007	0,073	1,636	0,048	0,155	0,736	0,023	0,107	0,344	11,505	1,671	5,386	25,580
143	1,243	0,007	0,073	0,437	0,093	0,300	0,737	0,023	0,055	0,178	18,956	1,420	4,578	11,237
144	0,764	0,007	0,073	0,402	0,073	0,235	0,554	0,023	0,053	0,171	13,989	1,337	4,309	10,144
145	0,805	0,008	0,054	0,437	0,078	0,208	0,593	0,020	0,058	0,153	18,847	1,834	4,874	13,881
146	0,805	0,008	0,054	0,437	0,078	0,208	0,593	0,020	0,058	0,153	18,847	1,834	4,874	13,881
147	0,764	0,008	0,054	0,402	0,076	0,203	0,554	0,020	0,055	0,147	12,240	1,222	3,249	8,876
148	0,741	0,008	0,054	0,146	0,075	0,200	0,329	0,020	0,033	0,089	12,915	1,310	3,482	5,730
149	0,741	0,008	0,054	0,146	0,075	0,200	0,329	0,020	0,033	0,089	13,776	1,397	3,714	6,112
150	0,075	0,008	0,041	0,397	0,025	0,055	0,172	0,019	0,058	0,128	9,836	3,291	7,308	22,680
151	0,635	0,008	0,041	4,465	0,073	0,162	1,684	0,019	0,193	0,429	28,694	3,291	7,308	76,068
152	0,830	0,008	0,041	11,424	0,083	0,185	3,079	0,019	0,309	0,686	29,153	2,926	6,496	108,160
153	0,671	0,008	0,041	0,437	0,075	0,166	0,541	0,019	0,060	0,134	22,110	2,469	5,481	17,847
154	0,551	0,008	0,041	0,437	0,068	0,151	0,491	0,019	0,060	0,134	15,593	1,920	4,263	13,881
155	0,697	0,008	0,041	0,146	0,076	0,169	0,319	0,019	0,035	0,078	11,688	1,280	2,842	5,348
156	0,021	0,010	0,020	0,397	0,014	0,020	0,090	0,014	0,062	0,088	5,311	3,625	5,184	23,310
157	0,768	0,010	0,020	0,468	0,086	0,123	0,600	0,014	0,067	0,096	21,039	2,352	3,362	16,416
158	0,764	0,010	0,020	0,437	0,086	0,122	0,578	0,014	0,065	0,093	14,863	1,666	2,382	11,237
159	0,365	0,010	0,020	0,062	0,059	0,085	0,150	0,014	0,024	0,035	8,455	1,372	1,961	3,472
160	0,505	0,010	0,020	0,146	0,070	0,100	0,271	0,014	0,037	0,054	11,365	1,568	2,242	6,112

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