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HOW MINING COMPANIES CAN UTILIZE SHIPPING DERIVATIVES TO HEDGE AGAINST FREIGHT RISK

TESIS PARA OPTAR AL GRADO DE MAGISTER EN GESTIÓN Y DIRECCIÓN DE EMPRESAS

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HOW MINING COMPANIES CAN UTILIZE SHIPPING DERIVATIVES TO HEDGE AGAINST FREIGHT RISK

Both shipping and mining industries share business behaviors that are characterized by frequent volatility in prices, strong business cycles and capital intensiveness. Risk management is extremely important in industries that demonstrate these cyclical patterns and potential for high capital gains or losses (Tamvakis 2007). Different types of shipping derivative products and techniques can help to mitigate the great risks that can result from the volatile nature of both industries. This study can be extremely valuable to mining companies, as shipping and freight are classified as a cost associated with the CIF sale of commodities. Obtaining a deeper understanding of the volatile risks in freight can help the mining company create a more profitable cost structure, taking into consideration the risk they are exposed to in the freight markets.

Methodology

In order to successfully complete the thesis and meet the stipulated objectives, the following methodology will be used:

● Define the key risk factors faced by mining companies:
Study the key areas of risk exposure that mining companies face in the freight market. Define the most important factors that cause uncertainty in the long run.
● Analyze commodities sales contracts:
The structure of common sales contracts between the charterer and receiver will be analyzed in order to find variables that are correlated with the structure of contracts of affreightment used in shipping.
● Study the patterns of indications within the stipulated trade route (Chile / Far East Asia):
The patterns of indications such as the Baltic Dry Index and bunker prices will be evaluated in order to form a hedging strategy that is in line with common risks associated with exposure to fluctuations in the shipping market. An analysis of how shipping companies utilize derivatives will be completed in order to create context for these patterns and indications and build a basic framework.
● Develop a method to use shipping derivatives to hedge against freight risk:
After studying and analyzing the main areas of risk and the variables in the shipping market a method will be developed to hedge against freight risk. The intended primary hedging tool will be the use of Forward Freight Agreements.
● Financial analysis and benefits of creating a plan:
A financial evaluation will be conducted for the recommended method stipulated above, in order to analyze the potential success to mitigate against future freight risk in the long run.

RESUMEN DE LA TESIS PARA OPTAR AL GRADO ACADÉMICO
DE: MAGÍSTER EN GESTIÓN Y DIRECCIÓN DE EMPRESAS
POR: HANNAH KIM
FECHA: NOVIEMBRE 2019
PROFESOR GUÍA: IVÁN BRAGA CALDERÓN

CÓMO UTILIZAR DERIVADOS DE CARGA EN LA INDUSTRIA MINERA PARA COBRAR CONTRA EL RIESGO DE CARGA

Tanto la industria naviera como la minera comparten comportamientos comerciales que se caracterizan por una frecuente volatilidad en los precios, ciclos comerciales fuertes e intensidad de capital. La gestión de riesgos es extremadamente importante en las industrias que demuestran estos patrones cíclicos y el potencial de grandes ganancias o pérdidas de capital (Tamvakis 2007). Los diferentes tipos de productos y técnicas de cargas derivadas pueden ayudar a mitigar los grandes riesgos que pueden resultar de la naturaleza volátil de ambas industrias. Este estudio puede ser valioso para las compañías mineras, ya que la carga y el flete se clasifican como un costo asociado con la venta CIF de productos. Obtener una comprensión más profunda de los riesgos volátiles en el transporte puede ayudar a la compañía minera a crear una estructura de costos más rentable, teniendo en cuenta el riesgo al que están expuestos en los mercados de transporte.

Metodología
Para completar la tesis y cumplir los objetivos estipulados, se utilizará la siguiente metodología:

● Definir los factores de riesgo clave que enfrentan las compañías mineras:
Estudie las áreas clave de exposición al riesgo que enfrentan las compañías mineras en el mercado de carga. Defina los factores más importantes que causan incertidumbre a largo plazo.
● Analizar los contratos de venta de productos básicos:
Se analizará la estructura de los contratos de venta comunes entre el fletador y el receptor para encontrar variables que estén correlacionadas con la estructura de los contratos de fletamentos utilizados en el envío.
● Estudiar los patrones de indicaciones dentro de la ruta comercial estipulada (Chile / Asia):
Los patrones de indicaciones como el Índice Báltico Seco y los precios de los bunkers se evaluarán para formar una estrategia de cobertura que esté en línea con los riesgos comunes asociados con exposición a fluctuaciones en el mercado de flete. Se completará un análisis de cómo las empresas navieras utilizan derivados para crear un contexto para estos patrones e indicaciones y construir un marco básico.
● Desarrollar un método para usar derivados de flete para protegerse contra el riesgo de carga:
Después de estudiar y analizar las principales áreas de riesgo y las variables en el mercado, se desarrollará un método para protegerse contra el riesgo de flete. La herramienta principal de cobertura prevista será el uso de contratos de envío anticipado
● Análisis financiero y beneficios de crear un plan:
Se realizará una evaluación financiera para el método recomendado estipulado anteriormente, con el fin de analizar el éxito potencial para mitigar el riesgo de flete futuro a largo plazo.

DEDICATION:

TO MY FAMILY

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Introduction

Risk management in industries that are extremely cyclical in its rates and prices and has made and destroyed companies over the years. Since the beginning of modern industry, goods and commodities have been transported by sea between countries and around the world. Shipping still represents the life-blood of international trade, especially for commodities such as copper concentrates that are transported in bulk and, is a crucial factor underpinning the health of the global economy (Carter 2012).

Shipping markets can be characterized as capital intensive, cyclical, volatile, seasonal and exposed to the international business environment. Shipping derivatives have the potential to offset freight rate risk of the dry-bulk and wet-bulk sectors of the shipping industry and its support industries (Gray 1987). During the 1970s and 1980s, derivatives, which were used for commodities, expanded to financial markets, where the underlying assets were fixed-income bonds, foreign exchange, stock indices and equities. Market agents of the shipping industry were using currency swaps to secure against fluctuations in foreign currencies for the payment of new buildings. This exposure to currency risk is due to the fact that ship-owners' income is in US dollars, while payments are mostly in the local currency of the shipyard, such as in Japanese yen. Derivatives seem to have become a buzzword in the shipping industry, with the concept often being related to the ever increasing sophistication of the industry to recognize financial risks and the need for risk management in order to stay competitive (Alizadeh and Nomikos 2009).

This paper concentrates on the most important source of business risk in the shipping industry, namely freight rate risk and on the freight derivatives instruments, which are currently used in hedging this risk. They include, freight futures, forward freight agreements (FFAs), and freight options contracts.

1.0 Shipping Business Overview

The shipping industry has been developed to facilitate international trade through connecting sources of supply and demand for commodities between ports and countries. The shipping market has been shaped and structured in a way to accommodate the needs of charterers (shippers) by defining different types of contracts varying in their duration, method of payment, and cost allocations.

For the purpose of shipping operations, market analysis, and research, the shipping industry can be classified into different segments such as: Liquid Bulk, Dry Bulk, Containers, and General Cargo. For the purpose of this thesis, the focus will be on the shipment of copper concentrates, which falls under the Dry Bulk category of shipping.

In Shipping, the charterer's decision to hire (or rent) a certain type of vessel for ocean transportation of a specified commodity depends on three main factors: the type of commodity, the commodity parcel size, and the route; including the loading and discharging port facilities. Since the type of commodity determines what type of ship the charterer will need, any change

in the trade pattern for that commodity will be reflected in the demand and freight rate for that type of vessel.

As an example, we can refer to the below market review for different bulk sized vessels on a variety of trade routes. The market value for each indication varies greatly based on the vessel's size and also the current market demand for each corresponding route.

If we compare the below BCI (Baltic Capesize Index) C10_14 and BSI (Baltic Supramax Index) S2_58, the market values vary from $10,913 and $7,914 respectively. These two indices compare similar routes and cargoes- coal on a Pacific round voyage originating from Pacific Asia or Australia (The Baltic Exchange 2018). The primary difference is the size of the vessels. As Capesize is a larger vessel, holding all other factors equal (such as routing and cargo), the operating cost will be higher. This is reflected in the market value we see below.

On the other hand, if we compare BCI C4 and BSI S8_58, the market values vary from $5,430 and $9,081 respectively. These two routes compare two different vessel sizes with very different routes and different cargoes. BCI C4 is an indication for capsize vessels with the Richards Bay/Rotterdam route carrying iron ore cargo. BSI S8_58 is an indication for supramax vessels with the South China / East Coast India route caring coal (The Baltic Exchange 2018). As we saw above, the larger capsize vessel should have a higher operating cost, which should in turn increase its index value; however, in this case, we can see that the difference in the routing and cargo can have an impact on the market value between different indices.

		Value		Change
Baltic Dry Index	May 8, 2019	940	▲	4
Baltic Exchange Capesize Index (BCI)				
Time Charter Average		1,159	▲	40
C2	Tubarao to Rotterdam (long tons)	5.861	▲	0.128
C3	Tubarao to Qingdao	14.741	▲	0.2
C4	Richards Bay to Rotterdam	5.430	▲	0.14
C5	West Australia to Qingdao	6.232	▲	0.273
C7	Bolivar to Rotteram	7.495	▼	-0.095
C8_14	Gibraltar-Hamburg transatlantic round voyage	8,600	▼	-425
C9_14	Continent-Mediterranean trip China-Japan	20,900	▼	-18
C10_14	China-Japan transpacific round voyage	10,913	▲	330
C14	China-Brazil round voyage	10,727	▲	172
C16	Revised backhaul	-1,825	▲	235
Baltic Exchange Panamax Index (BPI)				
Time Charter Average		1,188	▼	-1
P1A_03	Skaw-Gibraltar	9,955	▬	0
P2A_03	Skaw-Gibraltar trip to Taiwan-Japan	17,084	▼	-11
P3A_03	Japan-S. Korea, Pacific round voyage	8,198	▼	-24
P3A-IV	Newcastle to Qingdao - implied voyage	11.70	▲	0.06
P4_03	Japan-S. Korea, Pacific round voyage	2,798	▲	15
P5	S. Korea - Japan trip via NOPAC to Singapore - Japan	8,183	▲	33
Baltic Exchange Supramax Index (BSI)				
Time Charter Average		770	▲	9
S1B_58	Canakkale via Med or Bl Sea to China-Sth Kor	12,536	▲	50
S1C_58	US Gulf trip to China-south Japan	16,361	▼	-56
S2_58	North China one Aus or Pac RV	7,914	▲	185
S3_58	North China trip to West Africa	4,700	▲	60
S4A_58	US Gulf trip to Skaw-Passero	11,159	▼	-75
S4B_58	Skaw-Passero trip to US Gulf	5,359	▼	-22
S5_58	West Africa trip via ECSA to Nth China	12,054	▲	18
S8_58	South China trip via Indo to EC India	9,081	▲	194
S9_58	West Africa trip via ECSA to Skaw-Pass	8,164	▼	-4
S10_58	South China trip via Indonesia to south China	8,861	▲	219
S11_58	Mid China, Aus or trans-PAC RV	8,694	▲	188
Baltic Exchange Handysize Index (BHSI)				
Time Charter Average		382	▬	0
HS1	Skaw-Passero trip to Rio de Janeiro-Recalada	3,720	▲	10
HS2	Skaw-Passero trip to Boston-Galveston	4,483	▲	8
HS3	Rio de Janeiro-Recalada trip to Skaw-Passero	8,067	▼	-55
HS4	US Gulf trip via US Gulf via NCSA to Skaw-Passero	4,975	▲	11
HS5	SE Asia trip via Australia to Singapore-Japan	6,182	▲	3
HS6	S. Korea-Japan trip via NOPAC to Singapore-Japan	6,043	▲	11

Figure 1- Baltic Dry Index for various vessel sizes and routes. (Source: Affinity 2019)

Another factor that charterers consider is the size of cargo to be shipped, also called the parcel size. That is to say, the average shipment size of a commodity to be shipped; considering the economies of scale and associated transportation and storage costs for that commodity.

Finally, when deciding which size vessel to hire, the shipper must consider other factors such as loading and discharging port facilities, draft restrictions, and cargo handling equipment. Considering all of the above factors, shippers and charterers try to minimize the associated transportation costs through hiring an optimally sized vessel. This is where the charterer and shipper face a big portion of their risk (Alizadeh and Nomikos 2009).

1.1. Shipping Freight Contracts

Under a shipping freight contract, the ship owner agrees to provide a service to the charterer or shipper for a specified amount of money per day for ship "hire," or per ton of cargo transported between two ports- the "freight rate." These services are provided under certain contractual agreements and documentation, known as the "charter party." Depending on the type and duration of the service required by charterers, different types of contracts have been developed and are commonly used in the shipping industry, such as: Voyage Charter Contracts, Contracts of Affreightment (COA), Trip-Charter Contracts, and Time-Charter Contracts (Gray 1987).

1.2 Voyage Charter Contracts

Under a voyage charter contract (or charter party), the ship owner agrees to transport a specified amount of cargo from a designated loading port to a designated discharging port (destination) in return for a specified amount of money, or "freight." These contracts are also known as "spot contracts." The freight paid by the charterers (in this case the cargo owner) is normally expressed in US dollars per metric ton of cargo, or as a lump sum. Once the cargo has been discharged safely, the contract is fulfilled and the ship owner's responsibility is over. Under a voyage charter contract, the ship owner is responsible for all expenses incurred during the voyage. These expenses are categorized into four main types: voyage costs; operating costs; capital costs, and cargo handling costs.

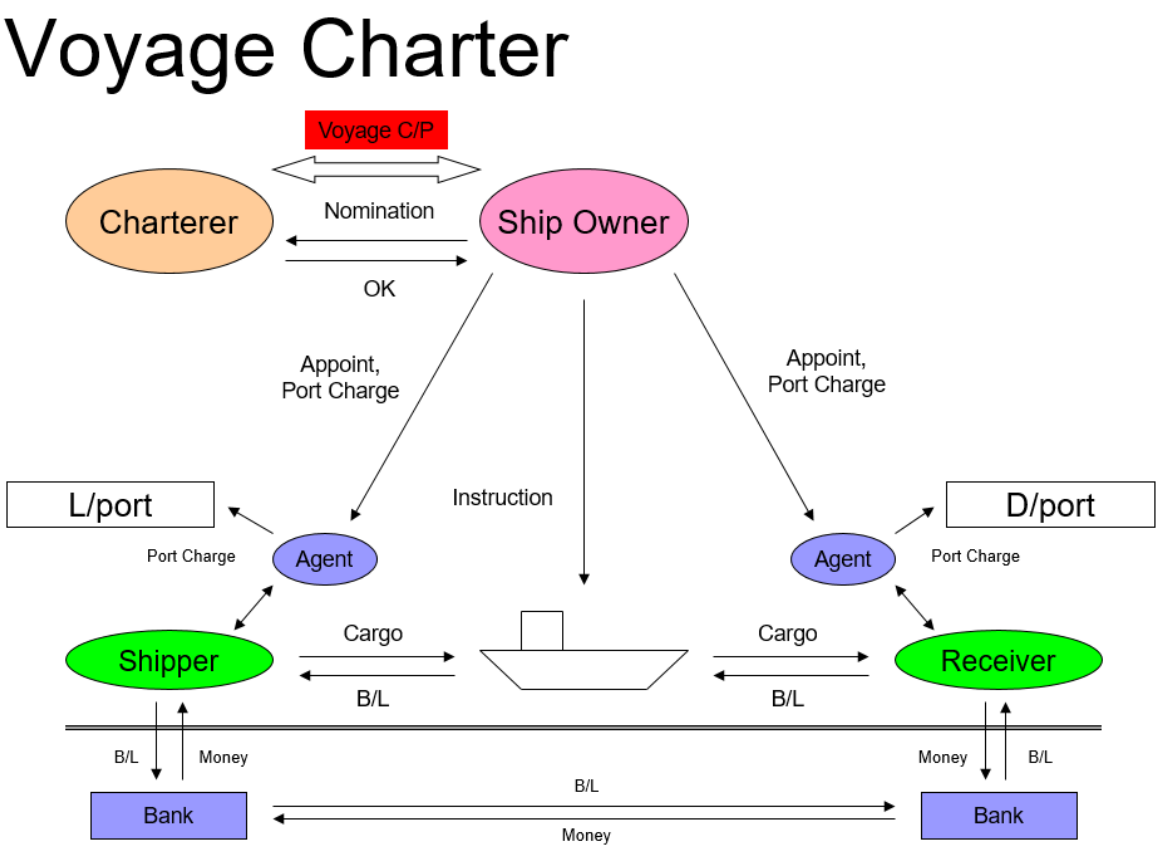


Figure 2: Voyage Charter Party Overview

1.3 Contracts of Affreightment (COA)

Contracts of affreightment (COA) are shipping contracts which the shipowner agrees to transport specified amounts of cargo from the loading port (or area) to the discharging port (or region). For example: “50,000 MT Copper Concentrates, 1 Safe Port Chile to 1 Safe Port Singapore – Japan Range.” This type of contract is normally used when the amount of cargo is large and cannot be transported in a single shipment. For example, in the case of industrial commodities such as copper concentrates, copper smelters purchase large amounts of concentrates (i.e. 1 or 2 million tons) in order to secure their supply of raw materials for a long period while minimizing their storage space and inventory. Therefore, the shipments should take place over a period time, on a regular basis. Similar to the voyage charter contract, the terms of COA payments is paid as a freight rate in USD/MT and the ship owner is responsible for all operating costs.

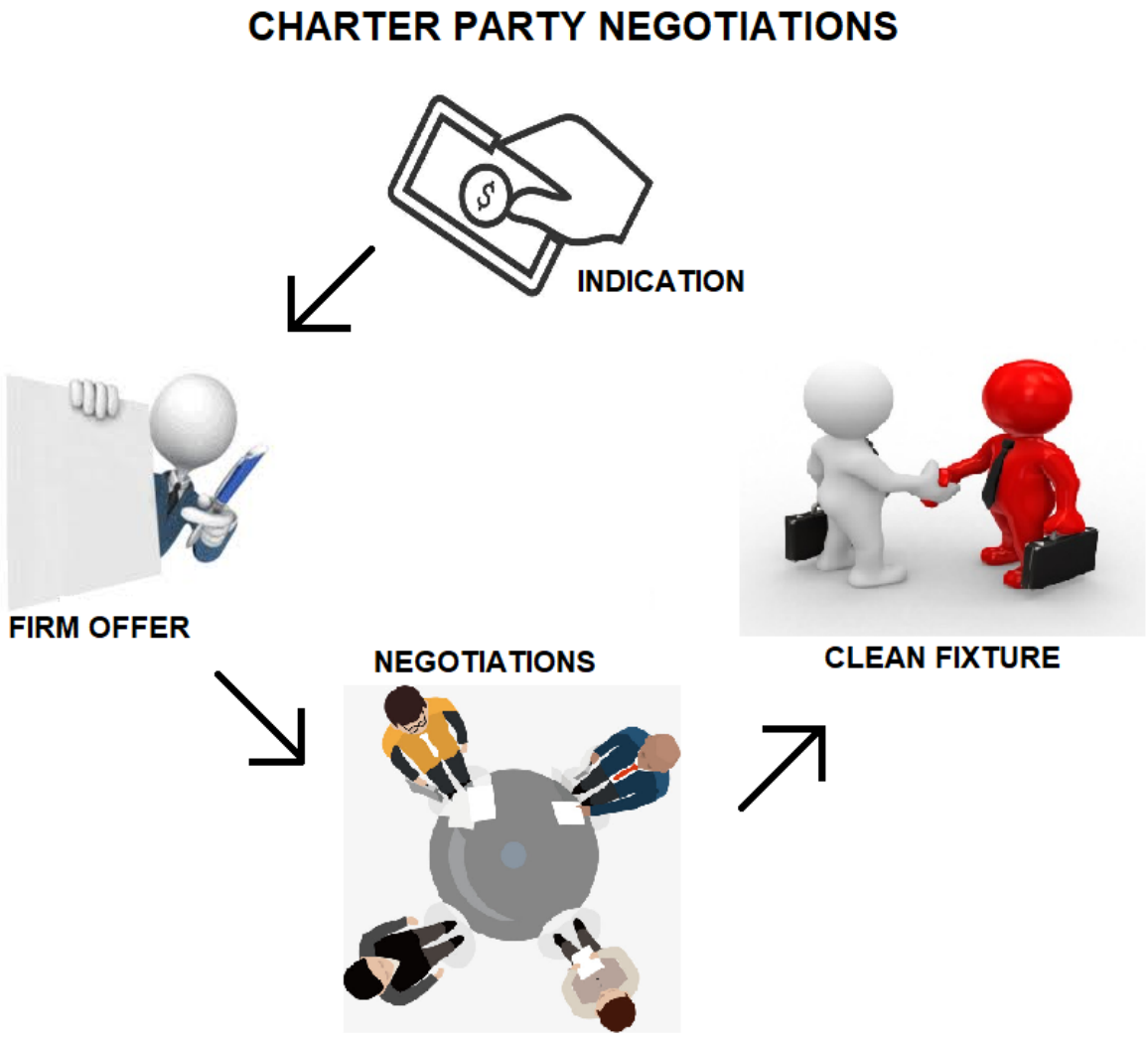


Figure 3: COA Negotiations

Similar to any kind of negotiation, the idea is to come to a mutually beneficially agreement that suits the needs of both parties.

1.4 Trip-Charter Contracts

A trip-charter contract is a shipping contract where the charterer agrees to hire the vessel from the ship owner for the duration of a specified trip. In this type of contract, normally the charterer takes charge of the vessel from the point of delivery to the port of redelivery (after transportation of cargo) and pays freight on a dollar per day basis (USD/day). Under this contract, the ship owner has the operational control of the vessel, while the charterer is responsible for the voyage costs during the trip. The delivery point is normally the loading port and the redelivery point is the discharging point.

1.5 Time-Charter Contracts

In a time-charter contract, the charterer agrees to hire the vessel from the ship owner for a specified period of time (can be round trip or even several years) and under certain conditions defined in the charter party. These conditions can include: the vessel's performance specifications (speed, consumption, etc.), the condition and location of the vessel during delivery and redelivery, fuel on board, and trading areas, among others. Freight rates are paid on a USD/MT basis, usually every 15 days, or month. Under this contract, the charterer takes the commercial control of the vessel, and benefits from operational flexibility as well as security in transportation costs. The charterer is responsible for the costs incurred during the voyage and the ship owner is responsible for all other costs.

1.6 Structure of Costs in Shipping

Ship owning and operating involves four main categories of costs: Capital Costs, Operation Costs, Voyage Costs, and Cargo Handling Costs. These costs can depend on a variety of factors such as size, age, speed, type, and financial structure of the purchased vessel. (I.e. A larger vessel or an older vessel may consume for fuel than smaller or newer vessels.) (The Baltic Exchange 2018)

Capital Cost:
Capital costs are those that cover interest and capital repayments and depend on the terms of finance of the purchase as well as the level of interest rates. A vessel's capital costs depend on the current and prevailing market conditions at the time of purchase as well as the terms of finance. To put into context, when freight rates are high and the ship owners has secured a long term time charter contract, fund providers may relax their financing terms compared to periods when the market is tight and the purchases does not have a secure contract. Capital costs may vary over time due fluctuations in interest rates which the vessel was financed.

Operating Costs:
Operating costs, or fixed costs, are those incurred in the day-to-day running of the ship. These costs are the responsibility of the ship owners (not the operator/charterer). These costs can include, crew salary, provisions, maintenance and insurance, management costs, and vessel maintenance, among others. Unlike voyage costs, operating costs do not fluctuate with time, but they grow at a constant rate, which is normally in line with inflation.

Voyage Costs:
Voyage Costs are costs incurred during a particular voyage in which the ship is involved, and mainly include fuel costs, port charges and pilotage. These costs can greatly depend on the specific voyage undertaken as well as the type and size of the vessel. As an example, port charges can greatly vary in Chilean ports depending on if the port is private or public, and which company has earned the concession rights at the terminal.

Cargo Handling Costs:
Cargo Handling Costs are the costs involved in the loading, stowage, and discharging of the cargo. These costs also can depend on the type, size, and age of the vessel (i.e. How efficient is the vessel, does it have its own cranes on board, etc.).

2.0 Introduction to the Dry Bulk Market

As there are many different sectors of the shipping industry (such as containers, LNG, bulk, etc.), This paper will be focusing mainly on dry bulk shipping and the shipping of dry bulk minerals (i.e. copper concentrates) in order to simplify this paper and have the ability to recommend more targeted strategies that fit the financial models of the dry bulk market and the copper concentrates sales market.

Dry bulk shipping is the movement of major commodities carried in bulk- such as grain, iron ore, coal, and copper concentrates. Major bulk cargoes account for over 50% of the total dry cargo trade. A bulk commodity is a raw material that is shipped in large, unpackaged amounts (Clarksons 2018).

The most common index to measure fluctuations in transportation costs of dry bulk commodities is the Baltic Dry Index. Changes in the index can give insight into global supply and demand trends.

The Baltic Dry Index is a composite of the 4 dry market segments: Cape, Panamax, Supra and Handy, each having its own separate composite Index BCI, BPI, BSI and BHSI the collective average of these thus making up the BDI (The Baltic Exchange 2018).

The BDI does not trade- in order for a product to trade in a market there has to be liquidity stemming from market interest who see volatility. The BDI is a barometer of price movement like any other Index (Dow Jones, STI, MSCI etc.). Economists look at the BDI as use it as a tool to help gauge global economic trade movement. If the BDI goes up and continues to do so for a certain period that indicates commodities are moving from one part of the world to a buying nation in another part of the world (Gray 1987).

The Baltic Index comes out each business day in London indicating the Physical price movement (freight) for each of the defined Voyage and Time Charter Routes. The Time Charter Routes are each weighted which then gives the “basket” Time Charter Average for each of the four asset classes.

The Index is comprised of the submissions from an approved panel of ship brokers, some twenty companies on average. The submission figures are then averaged out establishing the average price for that day. This methodology is independent, meaning the brokers do not have a direct vested price interest. Any submission outside the market parameter, high or low, gets excluded (The Baltic Exchange 2018).

3.0 Freight Market Information

This section will outline Baltic Exchange freight market information, focusing mainly on the Baltic Dry Index, which is the standard index used in the dry bulk shipping business. It will also detail the calculation of the Baltic indices and the freight futures market.

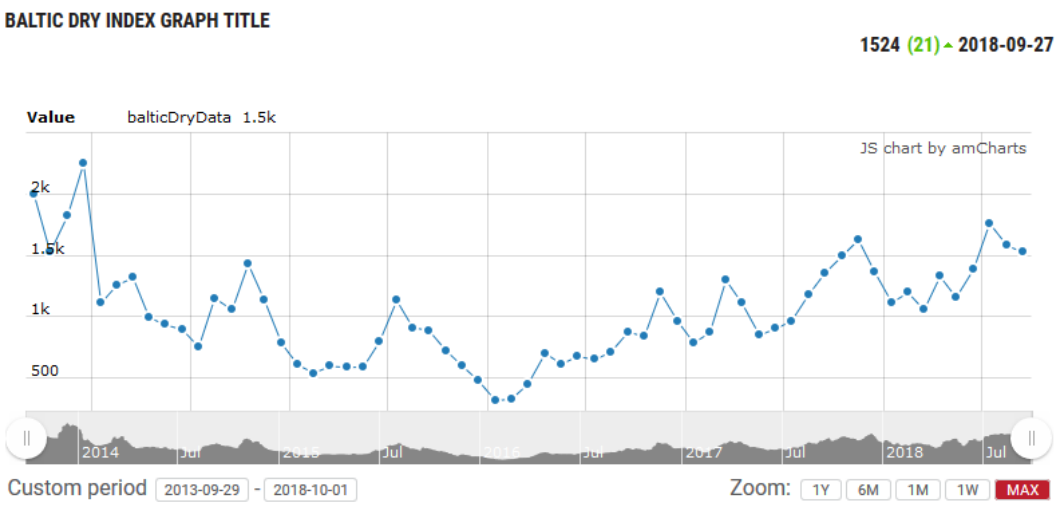
In the shipping industry- similar to other various industries- exposure to unanticipated fluctuation from cost and revenue sides is not ideal, but is the nature of the industry. Extreme fluctuations in freight rates and ship prices affect the cash flows of shipping companies. In markets dominated by risk and uncertainty, it is important to employ methods to mitigate such uncertainties. The significance of risk management in the freight market is already recognized by all players in the shipping industry, which is proven by the development of common hedging methods such as period time charter contracts and contracts of affreightment (COA).

In addition to these commonly recognized hedging methods, other risk management techniques that are common in commodity and financial markets such as futures, forwards, swaps, and options, can also be developed and applied for risk management in the shipping industry.

In order to trade freight derivatives, reliable price information on the underlying freight market must be available. The Baltic Exchange is headquartered in London, and is the world's only independent source of maritime market information for the trading and settlement of physical and derivative shipping contracts. Daily indices for a number of voyage routes are quoted in terms of USD/MT of cargo and trip charter routes in USD/day are published for the following:

- Baltic Capesize Index (BCI): reflects cargo movements of Capesize vessels
- Baltic Panamax Index (BPI): reflects cargo movements of Panamax vessels
- Baltic Supramax Index (BSI): reflects cargo movements of Supramax vessels
- Baltic Handysize Index (BHSI): reflects cargo movements of Handysize vessels
- Baltic Dry Index (BDI): a composite index calculated as the equally weighted average of the BCI, BPI, BHSI, and BHI. It is often used as a general market indicator reflecting the movements in the dry bulk market.

(The Baltic Exchange)



Baltic Indices	SEP 27		SEP 26		SEP 25		SEP 24		SEP 21	
Baltic Dry Index	1524	+21	1503	+53	1450	+16	1434	+21	1413	+17
Baltic Capesize Index	1949	+39	1910	+42	1868	+4	1864	+24	1840	+2
Baltic Panamax Index	1689	+12	1677	+38	1639	+30	1609	+23	1586	+29
Baltic Supramax Index	1195	+1	1194	+4	1190	+5	1185	+10	1175	+6
Baltic Handysize Index	627	+1	626	+4	622	0	622	+5	617	+5

Figure 4: Example of the Baltic Indices (Source: The Baltic Exchange)

The foremost reason is to manage price fluctuation in shipping markets is to hedge. If a ship owner has taken a ship in on a one year time charter and is locked into price X for the next 12 months, once they have done their first own cargo voyage they are then exposed to the market's mercy.

If the rates go down to Y by a $1000 per day, the ship owner is out of pocket by that $1000 and any further amount the market might go down. To mitigate losses, the shipowner would do an FFA Contract–in this case they would SELL a contract. Speculation, would be another approach by either BUYING or SELLING a Contract depending on which way they believe the market will go in the future. Mostly Traders seeing an opportunity.

If one party has Freight as in the case of a Ship Owners (they are "long" freight) will want to hedge against the market going down so they will sell a Contract. If the party does not have freight cover as in the case of a Charterer (they are "short" freight) thus will want to do the opposite and hedge against the market going up whilst they are uncovered so will Buy a Contract (Gray 1987).

4.0 Risk Management in Shipping

Business risk management in shipping deals with possible declines in the value of a shipping company due to an event, or change, in any of the factors that could affect its value. From a fundamental point of view, the value of a company depends on the expected net cash flows from its operations. Thus, any factor that may have a negative impact on the expected net cash flows is considered as a risk (Alizadeh and Nomikos 2009).

Types of risks include Business, Market, Credit, Operational, and Other Types of risk. Business risks deal with the risk of loss due to unforeseen changes in demand, technology, competition, and other factors that affect the fundamentals of a business activity. Market risk is the risk of loss arising from unexpected changes in market prices or market rates. Credit risks are losses arising from the failure of a counter party to make a promised payment. Operational risks arise from the failures of internal systems or the people who operate in them. Other types of risks could include such risks as legal or liquidity issues (Gray 1987).

There is a justification for risk management in shipping, as there is no clear distinction between its business risks and market risks. Financial results in shipping are directly affected by the movements in the world's freight rate markets. As a result, ship owners are essentially in the business of managing shipping risk affecting a portfolio of physical assets, rather than simply managing a fleet of vessels (Gray 1987).

The objective of risk management in shipping is, not necessarily to eliminate risk, but rather to alter the risk profile according to the prevailing market conditions, risk preferences, and potential regulatory or contractual requirements. In this way, informed risk decisions can be made in regards to Asset Allocation Decisions- such as expanding a ship fleet, buying new or used ships, Chartering (Commercial) Decisions- such as trading in the spot market, or locking in a longer term charter at a rate that is currently lower than the spot rate, and Funding Decisions- such as deciding a loan period or taking on new debt (Alizadeh and Nomikos 2009).

As previously discussed, derivatives are financial instruments whose promised payoffs are derived from the value of something else. In shipping there are a few types of freight derivatives such as: Forward Freight Agreements (FFAs), Options, and Swaps. Freight derivatives existed since 1985 with the creation of the Baltic Freight Index (BFI) with a basket of individual dry cargo routes (The Baltic Exchange 2018). This index served as a settlement mechanism for freight futures listed on the exchange. Since 1992, the individual shipping routes can be traded over the counter (i.e. not through an exchange) in the form of FFAs (Clarksons 2018).

This is where the mining companies can intervene and find the opportunity to take advantage of managing their freight risks in logistics. The key players in the current freight derivatives markets are ship owners, charterers (such as mining companies), trading houses, and the ship brokers that facilitate all of the transactions and agreements. For the purpose of this thesis, focus will be made the movement of copper concentrates on bulk ships.

5.0 Copper Business Overview and Contracts

Copper is traded on three commodity exchanges: The London Metal Exchange (LME), the Commodities Exchange Division of the New York Mercantile Exchange (COMEX/NYMEX), and the Shanghai Metal Exchange (SHME). On the LME, copper is traded in 25-ton lots and quoted in US dollars per ton. On COMEX, copper is traded in lots of 25,000 pounds and quoted in US cents per pound. On the SHME, copper is traded in lots of 5 tons and is quoted in Renminbi per ton (Carter 2012).

The role of the exchanges is to facilitate the process of settling prices. Prices are settled by bid and offer, reflecting the market's perception of supply and demand of the commodity on a particular day. The exchanges establish a price for the present day, called the spot price, and a price for some specified time in the future called the future price. The exchanges allow for trading futures and options contracts, which enable producers and consumers to fix a price in the future, thereby providing a hedge against price variations.

In this process, the participation of speculators, who are ready to buy the risk of price variation in exchange for monetary reward, gives liquidity to the market. A futures or options contract defines the quality of the product, size of the lot, delivery dates, delivery warehouses, and other aspects related to the trading process. The existence of futures contracts also allows producers and their clients to agree on different price settling schemes to accommodate different interests.

Commodities exchanges also provide for warehousing facilities that enable market participants to make or take physical delivery of copper, in accordance with each exchange's criteria (Tamvakis 2007).

5.1 Introduction to Copper Concentrates Sales Contracts

Traditionally, copper is sold by mining companies in two ways, concentrate sales (impure copper powder) and cathode metal sales (pure copper) depending on the type of ore deposit processed (Philippine Metals Inc. 2018).

In the sale of concentrates, producers sell a concentrate powder containing 24%- 40% copper metal content to a smelter and refinery. The concentrate is sold using a formula that is unique to each smelter but general terms are as follows:

The smelter pays the producer about 96% of the metal value based on metal content contained in the concentrate and based on a future average price known as the quotation price, less the treatment charges and refining charges. Historically, the smelters and refiners have participated in price upside via an arrangement known as "price participation" in which the smelters and refiners share in 10% of the value of the copper above a certain threshold, historically approximately 90 cents per pound of payable copper metal. Currently, price participation terms are not included in most smelter sales contracts. Tcs are charged on a $ per ton of concentrate treated and Rcs on a $ per pound of metal refined. The charges fluctuate with the market but are often fixed on an annual basis. By-product metals such as gold and silver have separate refining charges. In addition, the smelters and refiners require concentrate specifications that

limit the amount of impurities allowable in the concentrate (ex: the amount of allowable arsenic) and these limits vary from smelter to smelter. If the concentrate producer does not meet these specifications financial penalties are levied. Normally third party assayers take samples of the concentrate during the shipping of concentrate to a smelter and determine the level of payable metal, moisture and impurities in the concentrate. If there are disagreements between the concentrate producer and the smelter as to the assay results they are usually settled by a third party umpire.

The timing of the quotation pricing, payments and final price settlement between the concentrate producer and the Smelter Refiner generally works as follows:

- Concentrate is produced
- Concentrate is shipped to smelter: Date of Production (DOP) + 1-2 months
- Provisional payment made by smelter:* DOP + 2 months
- Quotation period (final month of pricing):** DOP + 5-6 months
- Umpire settlements if necessary: DOP + 7-8months
- Final settlement payment: DOP + 6-9 months

As result of the long time period between mine concentrate production and final settlement payments most concentrate producers have a significant working capital element (Philippine Metals Inc).

6.0 Basic Structure of the Charter

The copper concentrates sales contract and the charter party between the ship owner and the charterer have many similar clauses and variables, which make the comparison quite straightforward. The main terms are as follows:

- Expense
    - Time: Time at port and sailing time. Clauses related to time are NOR Tendering, Loading/Discharging Rate, Demurrage and Desptach.
    - Bunker Consumption: This is can sometimes be incorporated in both contracts back-to-back as a bunker adjustment clause; otherwise it is built into the freight rate and sales price

- Revenue
    - Freight/Sales Revenue: Revenue received by the Ship Owner from the freight rate and the sale revenue received by the charterer from the receiver. This amount will depend on the amount of cargo loaded by the Ship Owner and delivered to the receiver at the final destination.

These are the basic similarities one would find in the sale contracts and the shipping charter party. There are other variables such as cargo insurance, port costs, vessel hire, and crewing/manning that are borne by the ship owner; however these are built into the freight rate that is charged to the charterer. This will discussed in more detail in the following section, but

is important to bear in mind, as the ship owner will always take this into account when negotiating the freight rate with the charterer.

For the purpose of this paper, we are assuming that the sales contract between the mining company charterer and the cargo receiver is CIF (cost insurance and freight), as the contract and freight is calculated on this basis.

6.1 The Structure of a Charter– A Ship Owner/Operator's Point of View

The most important business risk in the shipping industry is freight risk. Forward Freight Agreement (FFA) contracts were introduced to provide a mechanism for hedging freight risk in the dry bulk and wet bulk sectors of the shipping industry (Alizadeh and Nomikos 2009). FFA contracts are principal to principal contracts between a seller and a buyer to settle a freight or hire rate, for a specified quantity of cargo or type of vessel, for usually one, or a combination of the major trade routes. An example could be a FFA contract between a ship owner and a mining company, looking to ship our copper concentrates from Chile to the Far East.

FFA Contracts are traded in over the counter derivatives markets in any place of the world where two parties agree to do business with each other. As trading takes place between individual parties, each party accepts credit risk from the other party. The contract is essentially a way of buying tomorrow today, as it is a futures price for freight. Terms of the contract are bought and sold at an agreed rate per ton and can be settled over different periods from one month to several years ahead (The Baltic Exchange 2018).

6.2 The Structure of a Charter – A Charterer's Point of View

From the charterer's point of view, they need to acquire freight to cover cargo transportation needs. If we assume we are a mining company that has sold CIF a contract to supply 500,000 metric tons of copper concentrates from Chile to China, evenly spread of one cargo per month over 2018. Shipments are handymax size liftings of about 42,000 metric tons each. The charterer could believe that some cargoes could be covered under a mini (i.e. shorter term) contract of affreightment, and leave some tonnage uncovered to ship on the spot market when the market is below the freight rate assumption used in the CIF contract pricing.

Given that the charterer is exposed, as the freight market could go above or below the CIF freight rate, a Forward contact should be considered to manage the price risk during this period. Forward contracts that are mutually beneficial to the charterer and the ship owner can be constructed by carefully studying the structure of the contract and its risk variables.

7.0 Estimating the Result/Benefit of a Contract – The Shipper's Point of View

A voyage estimate aims at calculating the profit or loss that a vessel will make from a proposed voyage. In other words, voyage estimates are simply profit and loss accounts for the particular voyage in question that are arrived at by calculating the income and then subtracting all related expenses. Unlike time charters, in voyage charters all the vessel-related expenses that include

operating costs (crew costs, repairs and maintenance, insurance, stores and lubes, etc.) and voyage (variable) costs (fuel, diesel oil, port dues and costs, canal tolls, etc.) are paid for by the shipowner. Hence, a voyage estimate must take into account freight income (bill of lading amount loaded on the ship in tons by freight rate in dollars) and subtract all voyage-related expenses, including address commission and brokerage. A voyage estimate is an indispensable part of chartering negotiations as it helps owners assess the financial feasibility of a particular trip vis-a-vis alternative voyages that may be available and in relation to the amount of profit required as well as prevailing competing freight rates. Voyage estimates, however, are also performed by charterers, as they can assist them in evaluating the appropriate vessel and the economic implications for their required voyage in their attempt to minimize the cost of the transportation service and include more favorable terms for them in the charter party. A shipowner may be presented with alterative voyages, and each alternative needs to be estimated prior to negotiating and completing any chartering deal. Voyage estimation must be performed as accurately as possible. Although it is an estimate, it gives a very good indication for the potential profitability of a particular voyage and can also provide comparisons with a time charter equivalent charter. A time charter equivalent estimate is a figure that denotes the daily hire that the vessel will obtain if chartered on the particular voyage trip.

7.1 The Process of Voyage Estimation

Voyage estimating is a process that takes into account the following factors:

a. Amount of cargo that can be lifted
b. Ship characteristics
c. Time at sea
d. Time at port for loading and discharging operations
e. Time at bunkering port if any
f. Bunker costs
g. Port charges and canal transit fees
h. Freight income calculations
i. Operating expenses, commissions, and TCE

In order to determine the amount of cargo that can be lifted, the ship owner calculates a stow plan that is approved by the vessel’s captain, based on the specific ship’s characteristics and capability of safely loading the proposed cargo. The same is proposed to the charterer for approval. The below is a sample of a stow plan for 44,000 MT of copper concentrates to be loaded from Caleta Coloso to Onahama, Nanjing, and Nantong.

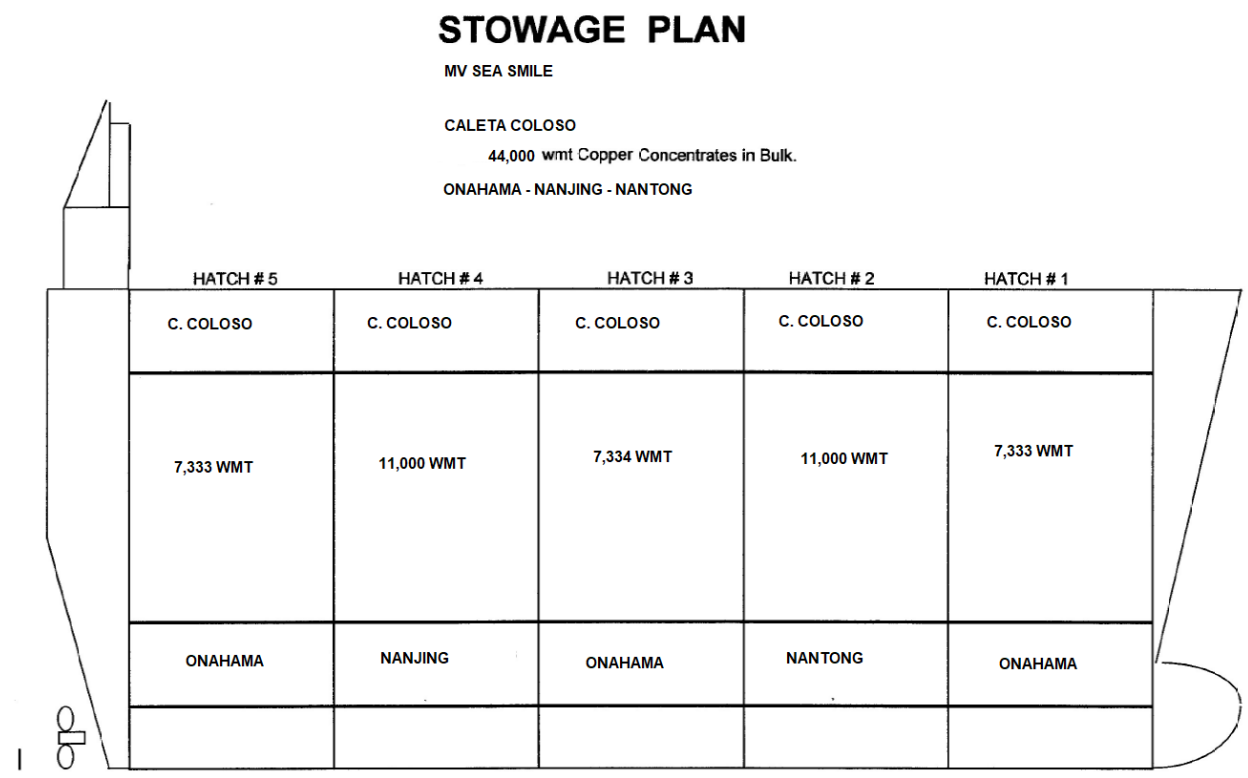
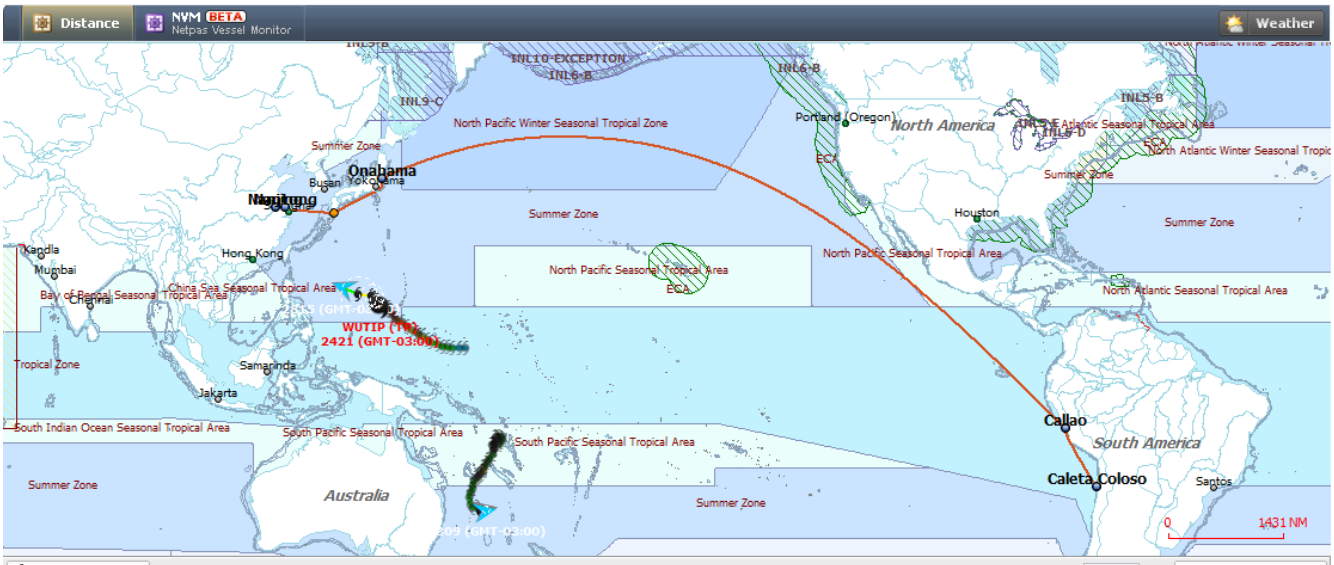


Figure 5 - Sample Stowage Plan

Time at each port is calculated based on loading and discharge rates. Time at sea is calculated based on the distance between each port and routing. Bunkering is determined by the amount of expected fuel to be consumed throughout the voyage.

The below image shows a sample distance calculation for our sample voyage: Loading at Caleta Coloso, with bunkering operations at Callao, and discharging at Onahama, Nantong, and Nanjing. A Distance calculation program such as “Netpas” can be useful to estimate these figures.



Create Voyage | SUEZ | PANAMA | KIEL | 10,539 NM | 45.69 days | Speed : 12.9 kt's | Simple Estimation

No	Port Name or Coordinates	Distance TTL	(S)ECA	Weather	Speed	Sea	Port	Port Charge	Arrival	Departure
1	Caleta Coloso (CL) [-04:00]						0.00	0.00	24-Feb-19 20:00	24-Feb-19 20:00
2	Callao (PE) [-05:00]	815	0	0 %	11.50	2.95	0.50	0.00	27-Feb-19 18:54	28-Feb-19 06:54
3	Onahama (JP) [+09:00]	8,270	0	0 %	11.50	29.97	3.00	0.00	30-Mar-19 06:04	02-Apr-19 06:04
4	Nanjing (CN) [+08:00]	1,322	0	0 %	11.50	4.79	2.00	0.00	07-Apr-19 01:00	09-Apr-19 01:00
5	Nantong (CN) [+08:00]	132	0	0 %	11.50	0.48	2.00	0.00	09-Apr-19 12:28	11-Apr-19 12:28
6										
7										
	Total	**10,539**	**0**	**NM**		**38.19**	**7.50**	**0.00**	**24-Feb-19 20:00**	**11-Apr-19 12:28**

Figure 6 - Voyage Distance estimator (Source: NETPAS Distance)

Distances and time at port can be entered into our estimation calculator to determine time at sea and estimated bunker consumption, based on each vessel's characteristics. Port cost has been entered below basis historical information from previous port calls. These could also be easily obtained via a port agent.

Schedule

Port Name	Function	Distance	At Sea	In Port	Drifting	ETA/ ETD	FO ROB	DO ROB	FO Supply/ DO Supply	FO Price/ DO Price	Port Charge(USD)
Caleta Coloso	L	0	0.00			21-02-19 20:00	800.00	150.00			
				3.00	0.00	24-02-19 20:00	791.00	149.70			$ 110,000.00
Callao	B	815	2.95			27-02-19 18:54	726.10	149.41	400.00	$ 490.00	
				0.50	0.00	28-02-19 6:54	1,121.10	149.40			$ 10,000.00
Onahama	D	8,270	29.97			30-03-19 6:04	461.76	146.40			
				3.00	0.00	02-04-19 6:04	452.76	146.10			$ 65,000.00
Nanjing	D	1,322	4.79			07-04-19 1:00	347.38	145.62			
				2.00	0.00	09-04-19 1:00	341.38	145.32			$ 25,000.00
Nantong	D	132	0.48			09-04-19 12:28	330.82	145.31			
				2.00	0.00	11-04-19 12:28	324.82	145.11			$ 25,000.00
Total		**10,539**	**38.19**	**10.5**	**0.00**	Final ROB	324.82	145.11	400.00	FO	**$ 235,000.00**
						Consumption	875.18	4.89	0.00	DO	

Figure 7 - Sample of our voyage estimator. Port schedules and Costs.

SOUTH AMERICA ($/mt) (PGB page 870)

		IFO 380 CST	mid	change
Delivered				
Buenos Aires	PUAYH00	472.95–473.05	473.000	+1.000
El Callao	PUAYP00	489.95–490.05	490.000	+1.000
Valparaiso	PUAYR00	586.95–587.05	587.000	+6.000
Guayaquil	AAJOC00	468.95–469.05	469.000	+1.000
Libertad	PUAYT00	467.95–468.05	468.000	+1.000
Cartagena	AAJOA00	466.95–467.05	467.000	+1.000
Montevideo	PUBAQ00	509.95–510.05	510.000	+1.000
Santos	AAXWJ00		424.000	-3.000
Ex-wharf				
Balboa	PUBAD00	448.95–449.05	449.000	-3.000
Cristobal	PUAEF00	448.95–449.05	449.000	-3.000
Panama Canal	AAXWG00		449.000	-3.000

Figure 8 - Bunker Price can be obtained from an index such as Platts (Source: S&P Global 2019)

Bunker expense is a significant expense in the voyage for the ship owner. It is usual to check the average price of the bunkers on board the vessel (considering previous bunker supply ports) and plan the next voyage accordingly; optimizing the voyage by choosing the most price efficient bunkering port in terms of price and also potential extra deviation. This point is quite critical in the West Coast of South America, as there are very limited number of ports where bunker is available. In Chile especially, the price tends to be high. In the case of calling Chile, it may be more beneficial for ship owner to deviate the vessel to another port (such as Callao or Bilbao) to save cost. It is possible that even if the vessel has to spend more time and bunker to deviate to another port, the bunker price differential is worth the deviation. The above figure 7 show a sample of bunker prices (IFO) in South America (Feb 2019).

Operating expenses such as insurance and crew management are all expenses that are in the ship owner's account- all of which are factored into calculating the freight rate. Freight and income of course will be variable depending on the agreed freight rate with the charterer.

Commonly a "TCE" or Time Charter Equivalent is used as a per day amount to evaluate the profitability of the ship owner's voyage- such as USD 10,000 per day.

8.0 Estimating the Result/Benefit of a Contract – The Charterer's Point of View

From the charterer's point of view, the results of the contract depend on a smaller number of variables, as they are not exposed to the business and operational risks that a ship owners is directly exposed to.

Charterers must consider the following factors:

a. Amount of cargo that can be lifted
b. The shipping route
c. Time at port for loading and discharging operations
d. Commodity sales price.

8.1 Simulation of a Contract

As a simulation, we will consider the following RFP (request for proposal) from “Mining Company A” (“MCA”) for a requirement of copper concentrates shipment from Chile to Far East:

Mining Company A (“MCA”) is pleased to issue a Request for Proposal (RFP) for a Contract of Affreightment (COA) for the carriage of Copper Concentrates from Caleta Coloso, Chile to destinations in Japan / Korea / China.

RFP Process

RFPs will be issued to several of our selected strategic partners at the same time. It will be open to these strategic partners to submit proposals for the relevant routes and volumes until the deadline fixed in the RFP document. Once the deadline for proposals has passed, “MCA” will review all proposals and may decide to proceed to contract with one, all or some of the strategic partners who have submitted proposals.

“MCA” will endeavor to run the RFP process in a fair and transparent manner. Please note, however, that it is intended to be a flexible process and for that reason, “MCA” reserves the right to change RFP deadlines, procedures, scopes and contract terms, as well as the right to cancel the RFP or award no contracts once all the submissions have been received.

Request for Proposal – Chile Copper Concentrates
“MCA” requests your proposal for a 12-month COA for 8 to 12 voyages in charterers’ option carrying 3 to 5 parcels each of between 10,100wmt and 11,800wmt copper concentrates in bulk from Caleta Coloso, Chile to 1 to 5 discharge ports in Japan and/or Korea and/or China.
Please use the attached Proposal Form (“Appendix E”) to prepare and complete your proposal in response to this RFP.

Appendix E

Freight Pricing Matrix (Per Wet Metric Ton) in US$

		# of Parcels		
		Three (3)	Four (4)	Five (5)
# of Discharge Ports	One (1)			
	Two (2)			
	Three (3)			
	Four (4)			
	Five (5)			

Per WMT Premium for South China Discharge (Defined as Xiamen Port and ports geographically south of Xiamen)	US$

Per Day Demurrage Rate (as per Main Terms)	US$

Figure 9- Sample Form of Appendix E for Freight Proposal

9.0 Incorporation of the VoyageSimulation Tool

As a next stage, the ship owner would need to do a variety of voyage simulations based on the requirements of the RFP, considering the above factors that are normally considered in a voyage estimation.

Basis the requirements of “MCA,” the ship owner can make an assumption about the ship size, which would fall into the handymax category of ships. Handymax ships can include Imabari 61 model or Tess 58 model ships which come with a standard set of characteristics for speed, and fuel oil consumption (basic performance), and cargo loading capacity. Also considering that the

vessel will load cargo in Chile, the ship owner must consider the cost of bunker at the nearest bunking ports on the West Coast of South America; considering that bunker is not supplied in many West Coast ports.

We can see an assumption of the above variables as follows:

Speed & Consumption

		55%	55%
		Imabari-61	Tess 58
Ballast	Speed	12.50	12.50
	FO	23.80	23.00
	DGO	0.10	0.20
Laden	Speed	12.10	11.50
	FO	23.80	23.50
	DGO	0.10	0.20
Port Idle	FO	4.00	4.00
	DGO	0.20	0.20
Port Work	FO	6.00	6.00
	DGO	0.20	0.20

Vessel Particular

		Imabari61	Tess58
Built			
Flag			
DWT	MT	61400	58105
Draft	m	13.01	12.826
TPC		61.4	57.46
LOA	m	199.98	189.99
Beam	m	32.24	32.26
GRT	t	34800	32320
G.Capa	cbf	2656865	2566672

Bunker		
	FO	513
	DO	826

<<< FO Price Up Margin
0.0%

Spot Bunker Price (February 20, 2019)

	3P Ave.	Guayaquil	Callao	Valparaiso
FO	513	468	489	581
DO	826	795	793	890

Figure 10- Vessel Specification Example

The above Figure 10 shows the specification of our possible performing vessel(s) basis vessel size/model “Imabari-61” and “Tess 58.” The vessel’s speed and bunker consumption is shown for each corresponding model based on ballast voyage (without cargo carriage) and laden voyage (with cargo carriage) - both basis 55% engine output- and idle and working in port. Ballast and laden voyage figures are important, as vessel’s delivery position (i.e. where the vessel is free) may determine whether the vessel will have some sailing time without cargo carriage- for example, the vessel may be free and empty at Callao, Peru and sail to Caleta Coloso, Chile for its first loading. Therefore, sailing between Callao and Caleta Coloso is considered a ballast leg. In general terms, a ship owner will have the tendency to decrease its ballast legs as much as possible, as time without cargo carriage can be inefficient and unprofitable.

As the RFP also specifies a route with one Chilean loading port (Caleta Coloso), and a limited range of discharging ports (China/Japan/Korea), it is possible to narrow down the simulation in regards to the amount of time spent at the ports and the expected cost of each port call. Time in port and sea is not only important for the voyage duration, but also the amount of bunkers to be consumed. Bunkers are a significant cost to the voyage, so are an important consideration. In the above Figure 9, we can see that the Estimator considers the spot bunker price, using a bunker price index such as “Platts S&P.”

As each voyage performance is measured against the TCE (time charter equivalent) rate- used to compare period-to period changes in a ship owner’s performance on a per day rate, each

day that passes in a voyage should be considered as a cost (i.e. “time is money”). For this reason, both contracts between the ship owner and the charterer and the charterer and the receiver have stipulations about “Laytime.” Laytime is the time allowed by the ship owner to the charterer and the charterer to the receiver, in which to load or discharge the cargo; usually expressed in tons per day. Laytime may be set in running days (calendar days), working days (excluding Sundays and holidays), or weather working days. (Clarksons 2018)

In case cargo is loaded or unloaded more quickly than the allotted time, the charterer and the receiver may be eligible for an incentive called “despatch” (depending on the terms of contract). On the other hand, if the cargo is loaded or unloaded in a time that exceeds the contracted time, the charterer and the receiver may have to pay a penalty called “demurrage.”

Another important factor related to the laytime is the Notice of Readiness (NOR). The NOR is issued by the performing vessel to indicate when the vessel is in all aspects ready to load or discharge the contracted cargo. Contracts often specify when an NOR is considered valid. For example: “Notice of readiness (NOR) shall be tendered by the Owners to the Charterer at any time during normal office hours (from 08.00 to 18.00 hours) from Monday to Sunday, whether in berth or not, and is ready in all respect to load the cargo.” Often, NOR terms differ from port to port.

Some other common laytime terms are as follows:

- SHINC: Sundays and Holidays Included
- SHEX: Sundays and Holidays Excluded
- SSHEX: Saturday, Sundays, and Holidays Excluded
- (P)WWD: (Per) Weather Working Day
- EIU: Even If Used
- UU/IU: Unless Used/If Used
- USC : Unless Sooner Commenced
- ATUTC: Actual Time Used To Count
- HATUTC: Half Actual Time Used To Count

An example laytime clause could be: “The loading rate at PORT X shall be 15,000 MT PWWD of twenty-four consecutive hours, SHINC. Laytime to commence at 3:30 pm the same working day, if Notice of Readiness is tendered and accepted during normal office hours, before 12:00 noon, USC in which case HATUTC. ” Given these terms, a charterer would be allowed two days to load cargo at PORT X if cargo to be loaded is 30,000 MT. If the vessel arrived and tendered NOR at 8:00 am on Tuesday, then laytime would commence at 3:30 pm on that same Tuesday- that is to say that time from 8:00 am to 3:30 pm does not count toward laytime and is excluded from the two days allowed for the 30,000 MT of cargo to be loaded.

Load/Disch Rate, NOR Risk & Holidays for Terms

			NOR Window / week	Holidays / year	C/P Rate	Actual Rate	
	Load Ports	Coloso	168 hours	15 days	13000	13000	
		Others	168 hours	15 days			
	Disch Ports	Japan	43 hours	16 days	3000	7000	Except Onahama(Act Rate 3000)
		Korea	43 hours	16 days	4000	9000	
		China	43 hours	19 days	3500	9000	
T.Time	Load Ports	Coloso	0.5 day				
		Others	0.5 day				
	Disch Ports		0.5 day				
No Count	Load Ports	Coloso	0.5 day	Possible swell, arrival before lay/can, etc			
	Disch Ports		0.25 day				

Dem/Detention Rate			Hmax	Handy			
	Load Ports	Coloso	21000	17000	per day		
		Peru	21000	17000	per day	Demurrage	
	Disch Ports	All	21000	17000	per day	Demurrage	Japan, Korea China

Figure 11 - Estimating Time at Port in the Voyage Estimator

The above Figure 11 aims to estimate average time used on a yearly basis at each port, from a laytime calculation point of view. Looking at the above Coloso "NOR Window / week," we can see that the estimator is considering NOR to be tendered anytime day or night SHINC (24 hours x 7 days = 168 hours). At the Discharge port (Japan, Korea, China), we can see that NOR terms a more restrictive, only during office hours (usually 8:00 – 17:00 or 9:00 – 17:00) and SHEX.

Other information included in Figure 11 is turn time, which is possible dead time to consider for preparation of loading/discharging, time after completion of loading/discharging, and time between NOR acceptance and laytime commencement. This is in order to account for time that may not be covered under laytime. "No Count" time is also considered in case of laytime exclusions such as WWD. In the case of Chilean ports, port closure due to swell can often result in a non-WWD, which is considered as time excluded from the laytime calculation. Demurrage and Despatch rates are also evaluated in this section, as well as the CP loading and discharge rate (in order to evaluate the amount of laytime allotted per port for X amount of cargo).

Another variable to consider in the Estimator is port cost. Most ship owners will generally store historical data on past port call expenses, but this easily obtained via a port agent. Port costs will usually include items such as: agency fee, wharfage, towage, pilotage, and port/light dues. Costs can vary significantly from port to port and vessel to vessel (depending on size/type and time at port) - sometimes between USD 25,000 and over USD 100,000 per port call. Given the potentially large total, it is an important expense to consider in the voyage result estimation.

Country	FULL LIGHT DUES (Chile 1.18) (Peru 0.12)	TESS 58						
	PORT COSTS (IN USD)	11,000wmt	16,500wmt	22,000wmt	27500wmt	33,000wmt	38500wmt	44,000wmt
	LOAD PORTS							
Chile	Arica	91,957	106,721	121,483	136,244	151,007	165,771	180,534
	Punta Patache	86,886	97,969	108,652	119,534	130,408	141,301	152,183
	Michilla	82,641	95,546	99,838	112,768	125,698	138,107	142,401
	Mejillones	106,794	114,129	122,029	129,929	137,830	145,164	153,064
	Angamos	75,821	78,654	81,487	84,724	87,557	90,390	93,627
	Antofagasta	77,013	79,441	81,679	85,107	87,939	90,772	93,605
	Coloso	75,495	84,442	92,068	99,694	109,723	118,550	125,461
	Punta Padrones	87,756	90,840	96,367	100,814	105,222	109,729	113,833
	Punta Chungo	95,880	97,527	99,324	100,972	102,800	104,447	106,095

Figure 12- Example Database of Port Costs (DA Desk 2018)

Next, a review of recent spot and COA markets would need to be evaluated in order to evaluate possible future markets. This is evaluated utilizing a variety of resources such as the Baltic Exchange Indices, and other reputable sources such as Clarksons Research and Simpson Spence Young. As discussed in previous sections, the market can be evaluated based on the freight market and the vessel time charter index. Both variables will depend on: cargo type, cargo size, routing, and vessel size.

A common route for vessels coming into the West Coast of South America is Japanese steel cargoes discharged in the West Coast of South America. In this case, Far East (FEAST) to West Coast of South America (WCSA) is an inbound voyage, and Copper Concentrates loaded in WCSA (i.e. Chile) to FEAST is the outbound voyage. It is useful to think of this as a “Pacific Round” (PAC RV) voyage, as the shipowner is constantly evaluating its TCE against its vessels availability/opening throughout this round voyage. One would reference the BSI Baltic Index which corresponds to the specific vessel size and route. For example, the BSI S2 58 would correspond with the index for supramax sized vessels (about 58,000 DWT) on a Pacific round voyage from South Korea, Japan, or North China range.

Especially when evaluating a potential longer term contract, it is important to analyze historical data and forecasting. This is why almost all shipping market reports will include freight and T/C information from previous quarters and years. An estimate or “feeling” based forecast is also included in these market reports. These two sets of information should be considered during contract negotiation in order to place oneself in a more informed position during negotiations. It is also important to be able to read the market in order to use its movements to one’s advantage to fix forward freight in a way that is contractually beneficial.

ROUTES

Outbound

Routes	Cargo Size	Freight ($) (1-1)	37/38 K Dwt T/C	50 K Dwt T/C	58 K Dwt T/C	Trend	Dur ***
CHILE - FEAST	11,000 WMT	$35	$10,000	$12,000	$13,000	↗	65
PERU - FEAST	11,000 WMT	$28	$10,000	$12,000	$13,000	↗	60
WCMEX - FEAST	11,000 WMT	low-mid $20s	N/A	$7,000	$8,000	↗	50
WCSA - INDIA	11,000 WMT	N/A	N/A	N/A	N/A	↗	75
WCSA - CONT	11,000 WMT	N/A	$7,500	$8,000	$8,500	↗	55
WCSA - MED/BLACK SEA	11,000 WMT	N/A	$7,500	$8,000	$8,500	↗	65
WCSA - ECSA*	40,000 MT	N/A	$5,000	$5,500	$6,500	↗	25
WCSA - USEC**	50,000 MT	N/A	$5,500	$8,000	$9,000	↗	35

* basis Phosphate Rock Peru/Brazil

** basis Chilean Rock Salt cargo / Batimore-Port Newark Range

*** based on Supramax duration

	Tess 58	28/32k DWT
PAC RV	$8,000	$5,500
S/P PAC	$10,250	$8,000

Historical Rates

		Average Rates		
		2019Q1	2018Q4	2018
11,000 WMT Parcel	CHILE/FEAST	$38.38	$48.50	$44.70
	PERU/FEAST	$29.75	$40.20	$37.85
T/C Rate	37/38k DWT	$11,813	$15,200	$14,180
	50k DWT	$14,375	$19,850	$18,300
	58k DWT	$15,313	$20,900	$19,300

Forecast (Target in GRS)

		Forecast *			
		2019 Q1	2019 Q2	2019 Q3	2019 Q4
T/C Rate	37/38k DWT	$14,000	$16,000	$14,000	$18,000
	58k DWT	$17,000	$20,000	$17,000	$22,000

* Based on sentiment/market feeling and sub to change

SPOT (Bunker Prices)

Port	IFO 380	LSGO
Valparaiso	$587	$915
Callao	$490	$799
Guayaquil	$469	$796
Balboa	$451	$653

Commodity Prices

Commodity	FOB Price ($/mt)	Trend
Copper	$6,398	↗
Zinc	$2,698	↘
Lead	$2,045	↘

Figure 13 - Sample Market Report with both freight and TC data

The above Figure 13 shows a sample review of market information that is useful to obtain a general knowledge of the status of the shipping market- freight rates, T/C rates, historical and forecast, bunker prices, and commodity prices relevant to the evaluated market.

In our voyage estimator, we can input this market information in the below Figure 13 in order to simulate the contract basis different freight and T/C rates.

Freight of Cargoes to be combined

Spot Market Cargo (June 2017)

(11K, 1/1 basis) Difference

Lort Port	JPN	KR	N.China	YR	S.China
Market (Chile)	29.00	29.00	29.00	29.00	34.00

(22K, 1/1) Discount -2.0

Lort Port	JPN	KR	N.China	YR	S.China
Market (Chile)	27.00	27.00	27.00	27.00	32.00

(22K, 1/2) Premium 1.0 Same Areia Discnt

Lort Port	JPN	KR	N.China	YR	S.China
Market (Chile)	28.00	28.00	28.00	28.00	31.00

Freight (22K, 1/2 basis)

Disch Ports	1Port Only	2 Ports				
		Japan	S.Korea	N.China	CJK	S.China
Japan	39.75	41.75	41.75	41.75	43.75	49.75
South Korea	39.75	41.75	41.75	41.75	43.75	49.75
North China	39.75	41.75	41.75	41.75	43.75	49.75
CJK Ports	41.75	41.75	41.75	41.75	43.75	49.75
South China	47.75	49.75	49.75	49.75	49.75	49.75

Net Freight (22K, 1/2 basis)

Disch Ports	1Port Only	2 Ports				
		Japan	Onsan	N.China	CJK	S.China
Japan	24.55	26.48	26.48	26.48	28.40	34.18
South Korea	24.55	26.48	26.48	26.48	28.40	34.18
North China	24.55	26.48	26.48	26.48	28.40	34.18
CJK	26.48	26.48	26.48	26.48	28.40	34.18
South China	32.25	34.18	34.18	34.18	34.18	34.18

Figure 14- Market data inputs in the voyage estimator

As a recap, the relevant variables to consider the voyage estimation are the following:

- Charterer's cargo requirement- cargo type, quantity, and contract duration/period
- Possible routes- loading port(s) and discharge port(s) range
- Prospective vessel(s) specifications and performance (i.e. speed and fuel efficiency)
- Bunker market conditions
- Laytime clauses- NOR, time counting, and dead time
- Port cost
- Freight and time charter market review- current, historical, and forecast

Once all of the above information is obtained, it can be inputted in the main frame of the voyage estimator in order to evaluate the profitability of the voyage. The below figure 14 shows the output of the estimation result in the section "Expected Result."

The Expected Result can be broken down as follows:

- Ope Income: total income received in the voyage, which includes: freight, despatch, and demurrage.
- Ope Expense: total expense incurred during the voyage, which includes: bunker consumption, port costs, and any address commission or brokerage to be paid to involved third parties during contract negotiation.
- Ope Balance: Income – Expense
- Daily C/B and Ope C/B: The equivalent daily TCE rate to be evaluated for this voyage, calculated as Ope Balance over duration. Daily C/B considers the rate for the voyage in local time and Ope C/B considers the rate for the voyage duration in GMT time. Strictly speaking, GMT is more accurate, as it accounts for time zone differences throughout the performed voyage.
- Hire: The amount of hire the ship owner expects to pay for the entire voyage duration
- Daily H/B and Ope H/B: The amount of hire represented as a daily figure (Hire/Duration). This is easier to compare against the market hire rates
- Profit/Loss: Expressed as the TCE x Duration – Hire Base x Duration.

EXPECTED RESULT		
Ope Income	$	1,320,000.00
Ope Expense	$	668,239.20
Ope Balance	$	651,760.80
Daily C/B	$	13,387.00
Ope C/B	$	13,329.96
Hire	$	488,944.44
Daily H/B	$	10,042.79
Ope H/B	$	10,000.00
Profit/Loss	$	162,816.36
Initial Bunker Price		
HFO	$	490.00
MDO	$	900.00
Latest Bunker Price		
HFO	$	490.00
MDO	$	900.00

	Type
SEA SMILE V22A	Oshima 50
VOYAGE RESULT ESTIMATE	

	DD-MM-YY HH:MM			DD-MM-YY HH:MM	
From (LT)	21-02-19 20:00		From (GMT)	21-02-19 23:00	
To (LT)	11-04-19 12:28		To (GMT)	11-04-19 20:28	
Dur. (LT)	48.69	days	Dur (GMT)	48.89	days
			Net Duration:	48.89	days

Bunker Detail		
Initial	HFO	800.00
	MDO	150.00
Supply	HFO	400.00
	MDO	0.00
Final ROB	HFO	324.82
	MDO	145.11
Consumption	HFO	875.18
	MDO	4.89

Schedule

Port Name	Function	Distance	At Sea	In Port	Drifting	ETA/ ETD	FO ROB	DO ROB	FO Supply/ DO Supply	FO Price/ DO Price	Port Charge(USD)
Caleta Coloso	L	0	0.00			21-02-19 20:00	800.00	150.00			
				3.00	0.00	24-02-19 20:00	791.00	149.70			$ 110,000.00
Callao	B	815	2.95			27-02-19 18:54	726.10	149.41	400.00	$ 490.00	
				0.50	0.00	28-02-19 6:54	1,121.10	149.40			$ 10,000.00
Onahama	D	8,270	29.97			30-03-19 6:04	461.76	146.40			
				3.00	0.00	02-04-19 6:04	452.76	146.10			$ 65,000.00
Nanjing	D	1,322	4.79			07-04-19 1:00	347.38	145.62			
				2.00	0.00	09-04-19 1:00	341.38	145.32			$ 25,000.00
Nantong	D	132	0.48			09-04-19 12:28	330.82	145.31			
				2.00	0.00	11-04-19 12:28	324.82	145.11			$ 25,000.00
Total		**10,539**	**38.19**	**10.5**	**0.00**	Final ROB	324.82	145.11	400.00	FO	**$235,000.00**
						Consumption	875.18	4.89	0.00	DO	

Income	Port Name	Amount (USD)	Total (USD)	Remarks (optional)
Freight	Caleta Coloso	$ 1,320,000.00		44,000 wmt x $30/mt
			$ 1,320,000.00	
Despatch	Caleta Coloso Onahama Nanjing Nantong			
			$ -	
Demurrage	Caleta Coloso Callao Onahama Nanjing Nantong			
			$ -	
		Total:	**$ 1,320,000.00**	

Expense	USD	*enter as a positive number! (unless "negative" expense.. i.e. in our favor)
Port Charge	$ 235,000.00	
Address Commission		
Brokerage		
Brokerage		
Total	**$ 235,000.00**	

Bunker								
	FO	875.18	MT	x	$ 490.00	=	$	428,838.20
	DO	4.89	MT	x	$ 900.00	=	$	4,401.00
Bunker (Off Hire)								
	FO	0.00	MT	x		=	$	-
	DO	0.00	MT	x		=	$	-
TOTAL EXPENSE					**$ 668,239.20**			**this includes bunkers above

Hire					
$ 10,000.00	x	48.89	days	=	**$ 488,944.44**

Figure 15- Voyage Estimator Main Frame

Generally speaking, one would like to obtain a result in which the TCE is higher than the daily hire rate. That is to say, that the period earnings for the voyage are higher than the daily rate of hire paid. This is a straightforward method to evaluate strictly the Profit and Loss of a particular voyage. However, ship owners with larger fleets that are operator on longer term hired contracts may be better off evaluating each voyage TCE result against the market value in order to hedge against the opportunity cost of hiring from the market.

As the TCE and Hire Base are figures that constantly fluctuate within the market indices, it is important to regularly compare these figures against the current market rates. Essentially, the main objective for the ship owner is to negotiate a freight rate with the mining company charterer that will cover its operational expenses incurred during the voyage and evaluate the resulting voyage TCE against the market rate in order to assess if the particular fixture with the mining company is worthwhile or not.

10.0 Utilizing the Voyage Estimator from the Charterer's Side

The estimator tool has obvious and direct benefits to the ship owner, but it can also be useful for charterers from mining companies that sell cargo on a CIF basis. As mentioned previously, both the shipping and mining industries are extremely volatile and cyclical in nature. This relationship is important because the demand for shipping is derived from the demand of commodities, such as mining minerals. Because of their close cyclical patterns and shipping's nature of derived demand from commodities, mining companies are exposed to the risks of both freight and commodities markets. However, mining companies are also in a good position to evaluate the health and status of the shipping markets.

Also similar to shipping markets, aggregate demand for mining is considered to be linked to international trade activities. That is to say- the state of the world economy, volume of trade, and other external factors. Comparatively, the landed value of mining commodities such as copper concentrates is much higher than the cost of shipping, thus the freight rate is still considered a small component of the total cost of shipping. Shipping by sea is still one of the cheaper transport alternatives, resulting in fewer substitute methods of transport (Gray 1987).

Even considering the comparatively lower cost of freight, it is important for mining companies to hedge their bets against potential rises and falls in their own commodities market. The voyage estimator allows the mining company to evaluate the full scope of the cost of shipping against the market, which better positions them to make a more informed decision during forward fixing negotiations.

As an example, if looking at market figures for week 18 of 2019, we can see that freight for a cargo size of 11,000 metric tons to the Far East from Chile was valued at about $42.00 per metric ton. On the other hand, looking back at market figures for the same week of 2018 for the same cargo size and route, the freight is valued at about $39.00 per metric ton (Simpson Spence Young). Considering a shipment size of 11,000 tons, this is a difference of $33,000.

As previously mentioned, this is a comparatively small cost compared to the value of copper. For reference, the market figure for week 18 of 2019 was about $2,015 per metric ton (London Metals Exchange 2019). However, it is worth noting that copper concentrates vary in pure copper content- about 30% by weight. Even in view of the small cost, as both copper price and freight rates fluctuate over time and cycles, it puts the mining company in greater control if they learn how to evaluate how freight is evaluated from a ship owner's side in order to better position themselves to anticipate when it is better fix spot or to fix forward.

10.1 Calculating Freight Rates

As discussed above, one of the main objectives of the ship owner is to negotiate a freight rate that will cover its operational expenses and also result in a TCE that is at least in line with the market. Once the charterer is familiar with the breakdown of the voyage estimator, it is simple to commence a knowledgeable freight negotiation process with the ship owner and enter the process well-informed and with confidence.

Using a simple example, we can evaluate the below example cargo declaration; written in a standard style.

Mining Company A hereby declares our December 2018 spot requirement as follows:

Cargo: 22,000 WMT Copper Concentrates from Caleta Coloso, Chile to Onahama, Japan.
Laydays: December 15 to December 20 2018
Load Rate: 20,000 WMT PWWD SHINC IU ATUTC
Discharge Rate: 6,000 WMT PWWD SHINC IU ATUTC
NOR SHINC with 12 HR Turn Time
Demurrage/Despatch: $10,000 PDPR DHD BENDS

The ship owner may come back with the following vessel nomination:

Ship Owner A is pleased to nominate the following vessel for Mining Company A's December 2018 spot shipment:

Vessel: Ship Name A
Flag: Panama
DWT: 58,000 MT
Number of Cargo Holds 5

Current Itinerary:
Antofagasta, Chile: December 15 – December 17
Caleta Coloso, Chile: December 18

After receiving the vessel nomination, the mining company should review the vessel's specifications to confirm that it meets the necessary requirement (such as port restrictions). As the vessel's size and specifications are given in the above nomination, the mining company can infer that the nominated vessel has similar characteristics as the standard Tess 58 ship model. As this is a standard model, the following information can be used for the purpose of modeling the freight:

Tess 58 - Speed and Fuel Consumption		
Ballast	Speed (knots)	12.50
	FO (MT/day)	23.00
	DGO (MT/day)	0.20
Laden	Speed (knots)	11.50
	FO (MT/day)	23.50
	DGO (MT/day)	0.20
Port	FO (MT/day)	6.00
	DGO (MT/day)	0.20

Figure 16 - Tess 58 Vessel Specifications

It is important to know the vessel specifications in order to more accurately evaluate the ship owner's operating costs. From the Voyage Estimator Tool, we can see that operating costs (i.e. voyage expenses) were broken down into time, bunkers, and port cost. For this example, it can be identified as follows:

- Time at Port:
  - Caleta Coloso: 22,000 WMT loaded at 20,000 WMT per day = 1.1 days
  - Onahama: 22,000 WMT discharged at 6,000 WMT per day = 3.67 days

  *For the simplicity of the calculation, we assume that cargo is loaded and discharged as per declared rates, thus demurrage and despatch values will be $0.
- Time at Sea:
  - Antofagasta to Caleta Coloso at 12.5 knots (ballast, as the vessel will be empty)
    - 19 NM / 12.5 knots / 24 hours = 0.06 days
  - Caleta Coloso to Onahama at 11.50 knots (laden, as the vessel will have cargo)
    - 9,001 NM / 11.50 knots / 24 hours = 32.61 days
- Bunkers at Port:
  - Valparaiso Price, December 2018 average = $543/MT FO and $942/MT DGO (Platts Bunkerwire, December 2018)
  - (3.67 days + 1.1 days) x 6 MT FO/day = 28.62 MT FO
  - (3.67 days + 1.1 days) x 0.2 MT DGO/day = 4.77 MT DGO
- Bunkers at Sea:
  - Ballast 0.06 days x 23 MT FO/day= 1.38 MT
  - Ballast 0.06 days x 0.2 MT DGO/day = 0.012 MT
  - Laden 32.61 days x 23 MT FO/day = 750 MT
  - Laden 32.61 days x 0.2 MT DGO/day = 6.52 MT

- Port Cost:
    - Caleta Coloso: $75,495
    - Onahama: $40,000

    (DA Desk, 2018)

Time	Days	Demurrage/Despatch	Total
Time at Port	4.77	$0	$0
Time at Sea	32.67	$0	$0
Bunkers	**MT**	**Bunker Price**	**Total**
FO at Port	28.62	$ 543.00	$ 15,540.66
DGO at Port	4.77	$ 942.00	$ 4,493.34
FO at Sea	751.38	$ 543.00	$407,999.34
DGO at Sea	6.52	$ 942.00	$ 6,141.84
Port Cost			**Total**
Caleta Coloso			$ 75,495.00
Onahama			$ 40,000.00
		Total Expenses:	**$549,670.18**

Figure 17 - Total Expense for Freight Simulation

Once familiar with the voyage simulator, the mining company will know that the ship owner has a priority to evaluate the voyage result against the market TCE in order to hedge against the opportunity cost of fixing in the market.

If we evaluate against a market rate of $9,500 in 2018 (Clarksons 2018), we can reasonably calculate a proposed freight rate as follows:

TCE = (Voyage Revenue – Voyage Expense) / Voyage Duration

$9,500 = (Voyage Revenue - $549,670.18) / 37.44 days

Voyage Revenue = $905,350.18 / Total Cargo 22,000 WMT Copper Concentrates
$41.15 /WMT Proposed Spot Freight Rate.

Given the above evaluation, $41.15/WMT would be a reasonable position to start the freight negotiations. One must keep in mind that adjustments might be made based on the actual voyage intention (such as additional port calls which could add or save cost), a change in

expected time at port and sea (such as seasonal weather changes or planned port closures), updates in port expense, and other variables that could affect the actual revenue and expense for the voyage.

10.2. Evaluating the Benefits of Fixing Forward

Fixing forward is an important alternative for the mining company to consider when hedging their exposure to their own market risk and potential freight risk. Negotiating a forward contract with a ship owner can be beneficial for the mining company, especially if they are geared with knowledge of freight market movements, and how they are applied to a ship owner's own cost and voyage evaluation. When done properly, the mining company can fix a contract when freight rates are at a low period, and fix this rate in the longer term, protecting them against future rises in the freight market.

2018	Spot Freight $/MT (Chile to Far East) - Quarterly	Forward Freight (January 2017 Price)	Freight Differential	Cargo Quantity (MT)	Total Freight Difference Spot v. Forward	Copper $/MT FOB
January	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 7,006.52
February	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 7,006.52
March	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 6,799.18
April	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 6,851.51
May	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 6,825.27
June	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 6,965.86
July	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 6,250.75
August	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 6,051.05
September	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 6,050.76
October	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 6,219.59
November	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 6,195.92
December	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 6,075.32
	*MOL Internal Pricing	*Clarksons				*London Metal Exchange

Figure 18- Benefits of Fixing Forward in 2017

The above Figure 18 simulates the possible benefits had the charterer fixed forward in January 2017 versus fixing on a spot only basis throughout 2018. As freight indications were markedly lower in January 2017 compared to the whole of 2018, it is clear to see that fixing forward in January 2017 would have been an ideal choice for the charterer.

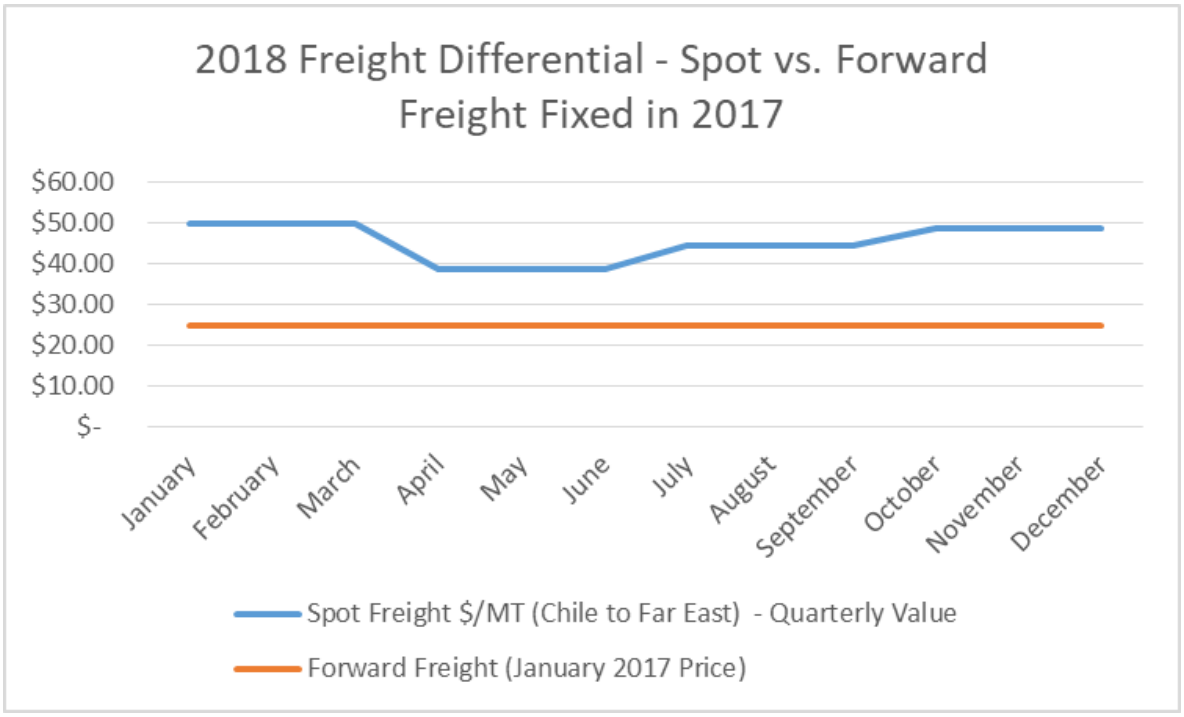


Figure 19- 2018 Spot Freight Rates v. Forward Freight Fixed January 2017

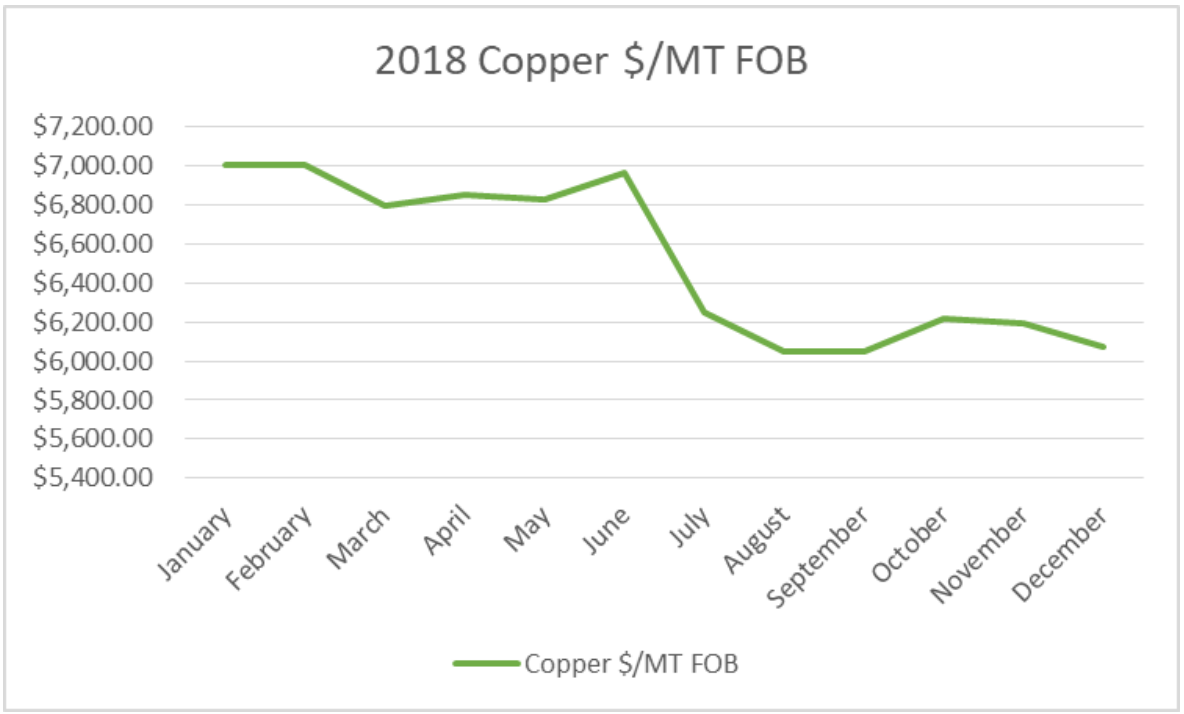


Figure 20 - Copper Price Trend 2018

From Figures 19 and 20, it is also notable that copper prices had a downward trend toward the end of 2018, while the spot freight rate had a tendency to increase. In this case, it is clear that fixing freight on a spot basis would have cut into the profitability of copper sales, due to increased shipping expense and lower revenue.

In this example, the benefits to the mining company are straight forward and clear, so one might question the merits of fixing forward for the ship owner.

Fixing forward is also a beneficial option to the ship owner, even if they have fixed a long term contract at a low rate. Due to the longer term nature of a forward contract of affreightment, the ship owner can secure tonnage in the long term. Additionally, because a specific ship, or ships, are not named in the contract of affreightment, ship owners can utilize their own long term ship fleet, or take a spot ship from the market. In the case of most knowledgeable and experienced ship owners, the fleet would contain a range of long term vessel contracts that were fixed forward at different market levels. Therefore, the ship owner could utilize a ship that was fixed at a hire rate that is most suited for the contract of affreightment cargo with the mining company. For example, if the freight rate they are receiving from the mining company's COA is lower than the market, the ship owner may choose to utilize a ship that has a lower rate that the market TCE. Additionally, the ship owners could have options to further hedge their losses in the freight market with forward bunker contracts.

2018	Spot Freight $/MT (Chile to Far East) - Quarterly Value	Forward Freight (January 2017 Price)	Freight Differential	Cargo Quantity (MT)	Total Freight Difference Spot v. Forward	Handymax Size Vessel Index - Pacific Round (hire/day)	Vessel Hired Forward January 2017 (hire/day)	Hire Differential	Total Hire Difference Spot v. Forward (60 day trip basis)
January	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 12,000.00	$ 7,500.00	$ 4,500.00	$ 270,000.00
February	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 10,000.00	$ 7,500.00	$ 2,500.00	$ 150,000.00
March	$ 49.65	$ 25.00	$ 24.65	11,000	$ 271,150.00	$ 10,500.00	$ 7,500.00	$ 3,000.00	$ 180,000.00
April	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 10,600.00	$ 7,500.00	$ 3,100.00	$ 186,000.00
May	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 11,000.00	$ 7,500.00	$ 3,500.00	$ 210,000.00
June	$ 38.77	$ 25.00	$ 13.77	11,000	$ 151,470.00	$ 11,500.00	$ 7,500.00	$ 4,000.00	$ 240,000.00
July	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 9,000.00	$ 7,500.00	$ 1,500.00	$ 90,000.00
August	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 9,650.00	$ 7,500.00	$ 2,150.00	$ 129,000.00
September	$ 44.60	$ 25.00	$ 19.60	11,000	$ 215,600.00	$ 10,250.00	$ 7,500.00	$ 2,750.00	$ 165,000.00
October	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 9,500.00	$ 7,500.00	$ 2,000.00	$ 120,000.00
November	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 8,250.00	$ 7,500.00	$ 750.00	$ 45,000.00
December	$ 48.50	$ 25.00	$ 23.50	11,000	$ 258,500.00	$ 9,500.00	$ 7,500.00	$ 2,000.00	$ 120,000.00
	*MOL Internal Pricing	*Clarksons				*Clarksons	*Clarksons		

Figure 21- Fixing Forward from the Ship Owner's Perspective

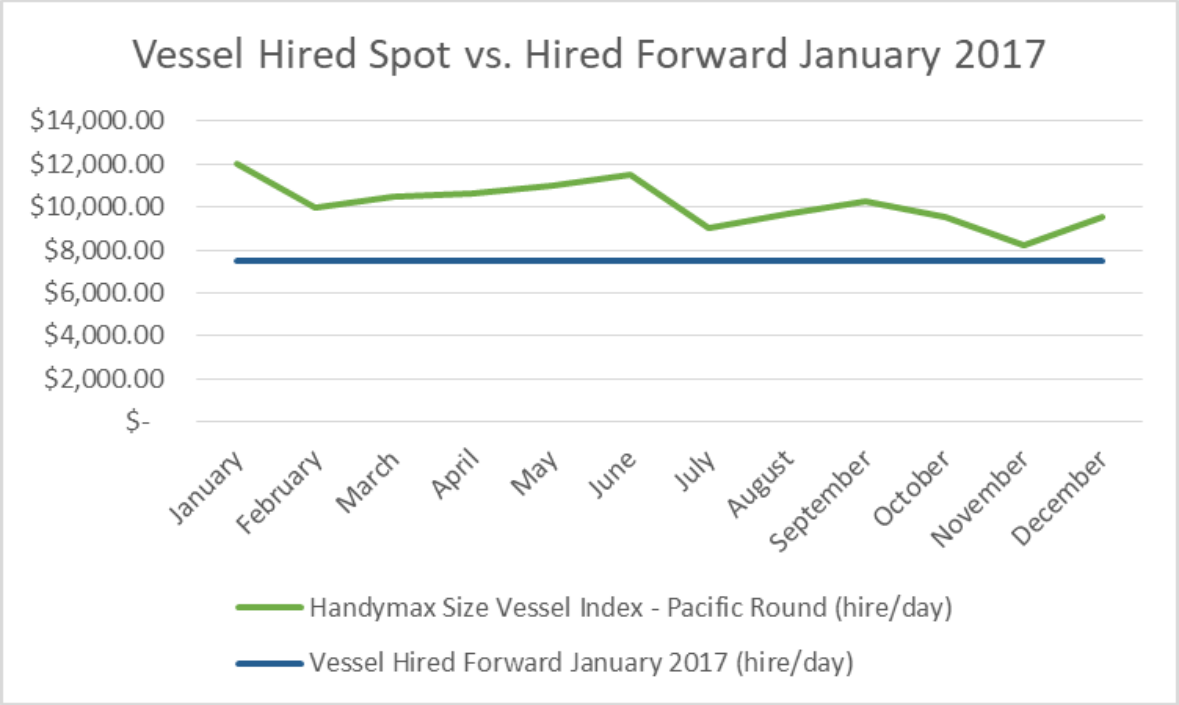


Figure 22- Spot vs. Forward Vessel Spread

Figures 21 and 22 show the forward fixing simulation from the ship owner's side. The primary difference is that the per day hire paid for operating the ship must be evaluated. The above shows the case that a vessel was hired forward in January 2017 (Clarksons 2017). An additional consideration is that the ship owner would have the option to fix additional cargo parcels other than the 11,000 metric tons stipulated in the above table. The idea for the ship owner is to mix and match forward fixed cargoes with cargoes on the spot market in order to gain the most benefit from the simulation. For example, the ship owner could fix 11,000 metric tons of cheap forward fixed cargo with 33,000 metric tons of spot cargo fixed at the higher market rate. This also allows some flexibility for the owner to choose ships from either the market or their long term fleet.

Summary

In summary, due to the market reliant behaviors in the shipping and mining industries, the two industries are a good fit to utilize forward hedging strategies to mitigate risks that are posed to each market. As shipping is considered as a cost in the mining sales process, the main objective of hedging against freight risk would be to reduce long term costs.

If mining companies use shipping cycles to their advantage, and gain further insight on how shipping companies cost freight – based on cyclical market rates and operational expenses – they will be better positioned to negotiate forward fixtures such as a contract of affreightment.

The use of the voyage estimator tool is invaluable to the mining company to see a clear view of how time charter equivalents and hire rates are used to evaluate a ship's voyage. If mining companies can properly time their entrance into the market, by evaluating indices such as the Baltic Exchange and Platt S&P, they will become well placed in negotiations to fix low freight levels in the long term. On the other hand, the ship owner also benefits, as a long term cargo commitment can be booked forward, and utilizing a diversified fleet portfolio can hedge against contracts fixed forward with a low freight rate.

Conclusion

In conclusion, this paper has provided a background to the shipping markets: different charter party types, the impact vessel type and position has on the market, shipping indices, and risk management in shipping. This background is essentially to understand how mining companies can use these variables in the shipping market in their favor.

An emphasis was placed on the cyclical nature of both the shipping and mining industries and how timing of these cycles can be analyzed in order to make a hedge by fixing forward. A simple method for this was introduced as the contract of affreightment.

The forward contract of affreightment is a suitable hedge as it mimics the terms of a CIF sales contract of mining commodities such as copper concentrates. This allows for easy back to back terms and negotiation between the final receiver of the cargo, the mining company, and the shipping company. Opportunities for savings can be found within the terms of the contract once the voyage cost from the shipping side is understood.

The voyage estimator was introduced in order to see a clear breakdown of how each voyage result is calculated by the ship owner. The tool shows the revenue and expense that ship owners need to consider for each voyage in order to make it profitable. The TCE and the vessel hire rate are important factors that are dependent on the market. Revenue is sourced via freight, but it is also clear from the tool that profit and loss can be manipulated by modifying the vessel duration- which can be done by adjusting the vessel's speed, or routing.

Once the basic function of the voyage estimator tool is understood, the mining company can experiment with its variables in order to simulate voyages that could potentially be performed under a contract of affreightment. Know-how in the market TCE and vessel hire rates was emphasized in order to obtain a more accurate result.

Once the mining company has more diversified knowledge in the shipping market, it is more informed and better placed for negotiations in order to fix forward contracts that will hedge against potential rises in freight rates, while also maintaining a mutually beneficial relationship with the ship owner.

The main business impact of hedging against freight risk would be the potential cost savings from long term shipping costs. The key variables that make this impact are: the type of cargo to be carried, the cargo quantity, the possible trade routes, and the duration of the contract. In the long term, the success of the freight hedging mechanism would be evaluated against the actual performance of the freight markets and the shipping markets. As depicted in Figure 18, the exercise would be deemed successful if the contracted, or hedged freight rate is fixed at a time the freight market is at a low period. If the freight contract is not timed well (i.e. at a high freight cycle), the hedge would not be successful. Of course, the idea is for the mining company to become more familiar with the freight and shipping market movements in order to place itself in a more informed negotiating position.

On the other hand, if the mining company wanted to take an additional step to invest in gaining full control over its own shipments, a possibility is to develop its own shipping departments to

trade its own cargo on their own spot ships taken from the market. This is currently not a common trend in the mining industry, but there could be potential trends moving in this direction in the future. If the mining company has enough resources and know-how to hire their own ships from the market and carrying their own cargo with a mix of long term fixed contracts, it could be a possibility to even further control their costs. Having almost complete control over their own freight would mean avoiding additional costs such as commissions and time loss; however it would mean taking on additional operational risks as a consequence of managing the ships carrying their own cargo and possibly other cargos taken from the market.

If a mining company were to invest to move in this direction, it would be extremely important to have continuous contact and exposure to the market in order to make a proper analysis and evaluation of the shipping and freight market, as it is constantly moving on a daily basis. The Baltic Exchange indices are assessed regularly by members of the exchange which are comprised of reputable members of the industry such as ship brokers. In this regard, it is recommended for the mining company to develop close relationships with reputable brokers who are qualified by the member panel.

Although the industry still may not be ready to move in this direction, this paper presents the necessary background and tools to evaluate this possibility. The voyage estimator tool gives a clear idea to the operational risks and expenses incurred by a ship owner, which ultimately determine the freight. When mixed with a variety of forward contracts of affreightment with different ship owners, taking control of its own cargo and ships on a spot basis could be a positive move forward to hedging freight risk with a diversified range of long term contracts and spot fixtures from the market.

Bibliography

Affinity Research LLP. “Affinity Daily Market Report.” 2017-2019. E-mail.

Alizadeh, Amir H., and Nomikos, Nikos K. Shipping Derivatives and Risk Management. Palgrave Macmillan, 2009.

The Baltic Exchange. The Baltic Exchange Ltd and its Subsidiaries, 2018, https://www.balticexchange.com/

Carter, Bill. Boom, Boom, Bust- A Story About Copper, The Metal That Runs The World. Scribner, 2012

Clarksons. Clarksons Platou and Research, 2017-2019, https://www.clarksons.com/

DA-DESK. Macura DA-Desk: Port Cost Management Services, 2018 – 2019, https://switch.da-desk.com/

Gray, James Whiteside. Future and Options for Shipping. Lloyd’s of London, 1987

“London Metal Exchange.” LME Market Data, Monthly Averages, 2018

Netpas Distance (2002-2019). Netpas Distance 4.0 [Computer Software]. SeaFuture Inc.

Philippine Metals Inc., 2018, http://www.philippinemetals.com

“Platts Bunkerwire.” S&P Global, vol. 43, issue 37, 21 February 2019, pp. 5

SeaFuture Inc. (2002-2019). NETPAS [Netpas Distance 3.4]. Seoul, 134-884, Rep. of Korea

Simpson Spencer Young., 2018, https://www.ssyonline.com/markets/

Tamvakis, Micael N. Commodity Trade and Finance. Informa Law, 2007.