# Freight Transportation Derivatives Contracts:
# State of the Art and Future Developments

**Mei-Ting Tsai**
Ph.D. Candidate
Department of Civil & Environmental Engineering
University of California, Irvine
Irvine, CA 92697
TEL: (949) 824-5989
FAX: (949) 824-8385
E-MAIL: meitingt@uci.edu

**Amelia Regan**
Associate Professor
Department of Computer Science and
Institute of Transportation Studies
University of California, Irvine
Irvine, CA 92697
TEL: (949) 824-1871
FAX: (949) 824-8385
E-MAIL: aregan@uci.edu

**Jean-Daniel Saphores**
Associate Professor
Department of Civil & Environmental Engineering
and Economics Department
University of California, Irvine
Irvine, CA 92697
TEL: (949) 824-7334
FAX: (949) 824-8385
E-MAIL: saphores@uci.edu

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**Abstract**

In lean and demand-responsive logistics systems, orders need to be delivered rapidly, accurately and reliably, even under demand uncertainty. Increasing burdens on the industry motivate the introduction of new methods to manage transportation service contracts. One way to hedge transportation capacity and cost volatility is to use real options. To date, ocean transportation is the only mode of transportation where this type of contract, also known as a derivatives contract, has been applied. The purpose of this paper is to provide an overview of freight transportation derivatives. We start by reviewing the development of derivatives markets in the maritime industry. Based on our findings and on the experience accumulated in that industry, we investigate the adoption of derivatives contracts in trucking, which is the dominant freight transportation mode. This paper provides an understanding of the necessary conditions and potential benefits for the emergence of a market for truckload options.

## INTRODUCTION

Freight transportation contributes significantly to the U.S. economy. In 2005, the cost of business logistics was nearly 1.2 trillion and represented 9.5% of the U.S. Gross Domestic Product (GDP), up from 8.8% in 2004 (Wilson, 2006). Trucking is the main mode of freight transportation today, and according to a recent forecast by the American Trucking Association (ATA, 2006), it will continue to dominate domestic freight movements into the next decade. Forecasts suggest that the share of trucking's total tonnage could rise to 69.2% in 2011 from 68.9% in 2005 (ATA, 2006).

A flexible freight transportation service is a critical element in any supply chain. Manufacturers are increasingly adopting lean, demand-responsive, and resilient supply chain structures. These require orders to be delivered rapidly, accurately and reliably, even under demand uncertainty. This complicates shipping processes and results in more outsourcing of transportation services. Manufacturers would like to procure transportation contracts that can provide flexible transportation capacity adapted to their 'lean' schedules. Truckload carriers are currently experiencing challenges following the adoption by U.S. firms of real-time supply chain management practices (Corsi, 2005). These tougher demands on the industry create the need to introduce new methods to manage risk.

One possibility, which has begun to attract attention, is to use real options to hedge transportation capacity and cost volatility. To date, ocean transportation is the only market segment using this type of contract, also known as a derivatives contract. The next section introduces the basic concept of derivatives contracts. In section 3, the development of derivatives markets in maritime the industry is reviewed. Section 4 considers the necessary conditions and potential benefits of adopting derivatives contracts in the trucking industry. Section 5 summarizes our conclusions.

## WHAT ARE DERIVATIVES CONTRACTS?

Derivatives are instruments whose prices depend on, or are derived from, the prices of other assets (Hull, 2006). Derivatives contractually create rights and obligations for the participating counterparties. These provide a way to reduced risks by transferring them to the party most willing to bear them. The most basic derivatives contracts are Forward contracts, Futures contracts, and Option contracts.

### Forward Contracts

Forward contracts obligate the holder to buy or sell an asset for a predetermined delivery price at a predetermined future time (Hull, 2006). They are private agreements between two counter parties and are traded in over-the-counter markets. Therefore, forward contracts can be written in terms that satisfy the counter parties' unique needs. However, they also expose the counter parties to credit risks as over-the-counter markets are regulated by participants themselves, not by any formal organizations.

The payoffs from forward contracts are the difference between the spot price (denoted by $S_T$) at the predetermined time (denoted by $T$) and the predetermined price (denoted by $K$). Specifically, the payoff for the buyer (who is said to hold a long position) is ($K$-$S_T$); conversely, the seller is said to hold a short position and her payoff is ($S_T$ -$K$). These are illustrated in Figure 1.

**Futures Contracts**

Futures contracts obligate the holder to buy or sell an asset at a predetermined delivery price at a specified future time. Like Forward contracts, Futures contracts are agreements between two parties (Hull, 2006) where the payoff is the difference between the spot price and the contract price. Contrary to Forward contracts, however, Futures contracts are traded on an exchange, such as the Chicago Mercantile Exchange or the New York Mercantile Exchange, which standardizes the contract features and regulates trading. As a result, contractual risks are eliminated, but these standardized contracts may not provide perfect hedging.

**Option Contracts**

Option contracts provide the holder with the right to buy or sell an asset at a predetermined delivery price on or before a predetermined date. The predetermined price is referred to as the strike price or the exercise price; the predetermined date is known as the expiration date or the maturity date. There are two basic types of options: call options and put options. A call option gives the right to buy the underlying asset. A put option, by contrast, gives the right to sell it. Basic options can be American or European. American options can be exercised anytime up to the expiration date whereas European options can be exercised only on the expiration date.

Since either type of option gives the right but not the obligation to do something, the payoff is different from either Forward contracts or Futures contracts. Taking a European option as an example, the payoffs (see Figure 2) for the two sides of a call option and a put option are

$$\text{long call payoff} = \max(S_T - K, 0);$$
$$\text{short call payoff} = \min(K - S_T, 0);$$
$$\text{long put payoff} = \max(K - S_T, 0);$$
$$\text{short put payoff} = \min(S_T - K, 0).$$

Option contracts provide the holder with more flexibility. Consequently, the holder has to pay for these options. To get the actual profit or loss, the cost of an option contract must take this into account. Figure 2 illustrates this point.

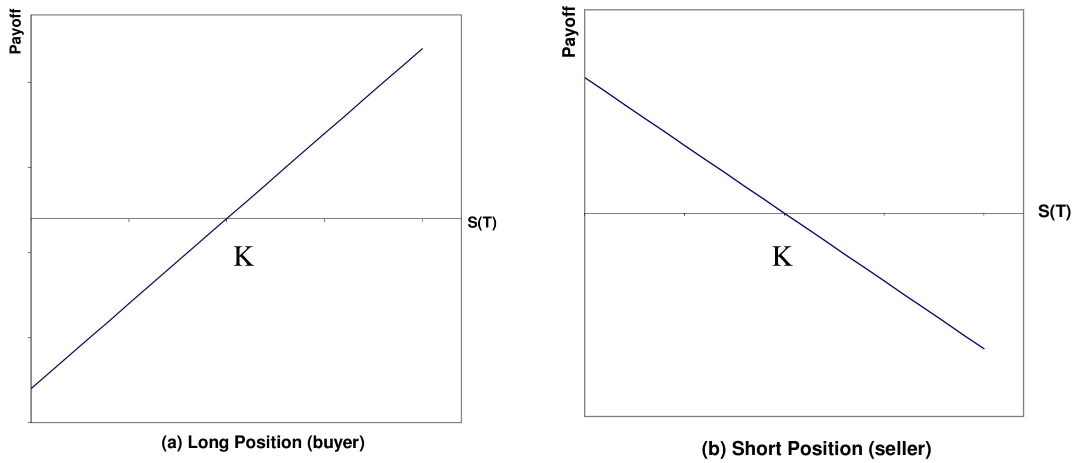


FIGURE 1: Payoffs from Forward Contracts

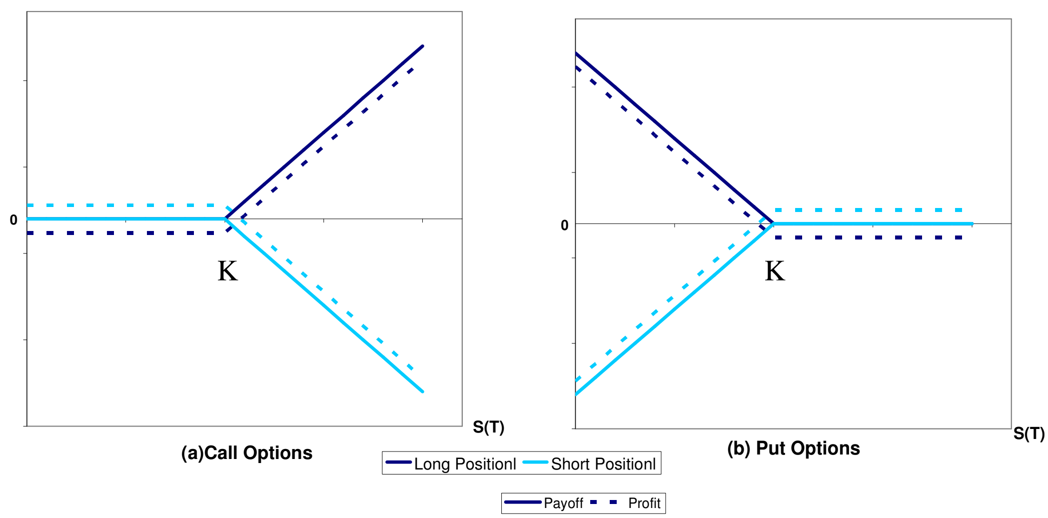


FIGURE 2: Payoffs and Profits from Option Contracts

The options presented above are called "vanilla options" and their payoffs are path independent because they are determined by spot values. By contrast, options whose payoffs are path dependent are called "exotic options." An example of exotic option is an Asian option, i.e., an option whose payoff depends on the average price of the underlying asset over a certain period of time. Asian options are attractive in currency and commodity markets. The price of an Asian option is cheaper than a European option because the volatility of the average value of the underlying asset tends to be lower than the volatility of the asset itself. Another reason is that, in practice, many indexes are given as arithmetic averages of the underlying spot price. Generally, whenever the underlying asset is thinly traded or there is potential for price manipulation, Asian options are preferred. That is also why derivatives contracts used in the maritime industry are usually of the Asian type.

## DERIVATIVES CONTRACTS MARKETS IN THE MARITIME INDUSTRY

Shipping markets can be characterized as capital intensive, cyclical, volatile, seasonal and exposed to the international business environment. The parties involved in the market, ship owners, charterers, and shipbrokers, all face significant risks. Therefore, risk management in shipping has been critical for a long time. Freight derivatives contracts are popular and effective tools for hedging freight rates in the shipping industry. The introduction of trading freight derivative contracts can be traced back to 1985 when the Baltic International Freight Futures Exchange (BIFFEX) was established.

### Past Derivatives Markets

The Baltic International Freight Futures Exchange (BIFFEX), a London-based exchange for trading ocean freight futures contracts with settlement based on the Baltic Freight Index (BFI), was the world's first freight futures market. At the beginning, BIFFEX worked well. However, trading volumes began to fall in 1989 (see Figure 3). In 1992, the appearance of new contracts, namely freight options on BFI, over-the-counter forward freight agreements (FFAs) etc, led to an increase in BIFFEX trading for a couple of years. Eventually, though market agents switched completely to FFAs and the volume of trading on BIFFEX steadily declined until the contracts ceased to exist in 2002.

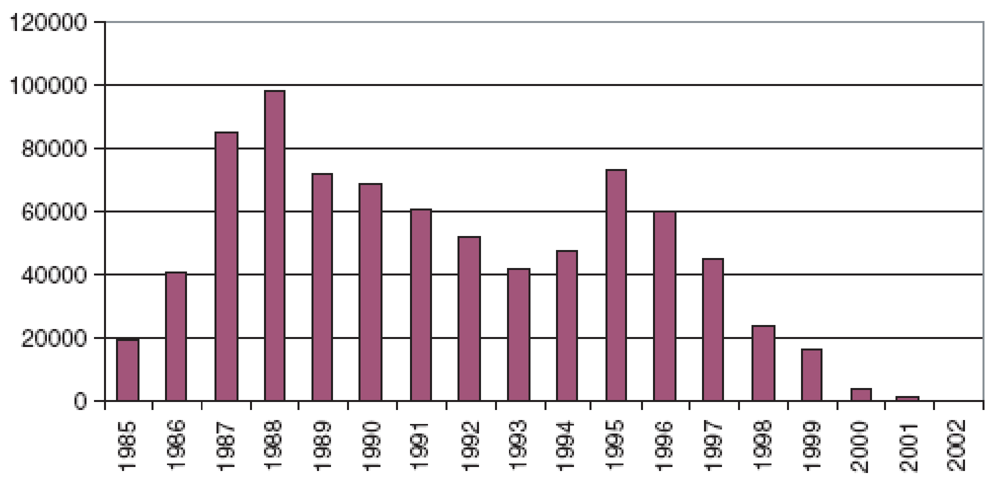


FIGURE 3 Yearly Volumes of the BIFFEX Contracts (May 1985 – April 2002)
Source: Kavussanos and Visvikis (2006)

The termination of BIFFEX was mainly due to low liquidity (Koekebakker and Adland, 2004) due to the poor hedging performance of BIFFEX contracts (Kavussanos and Nomikos 2000, Dalheim 2002, Haigh and Holt 2002, Kavussanos and Visvikis 2006). The underlying asset of BIFFEX contracts, the Baltic Freight Index (BFI), is a weighted average of the spot prices from 11 shipping routes. Dalheim (2002) argues that the weighting and composition of the index changed over the years. If a market player wants to hedge his particular freight rate risk during the transportation of a specific commodity on a specific route, then a derivative written on a weighted price index of other routes and commodities may not be a good hedging instrument. The two risks may not be strongly correlated. Kavussanos and Nomikos (2000) point out that the routes included in the BFI were diverse in terms of cargoes, vessel sizes etc, which implies cross-hedging. Consequently, BIFFEX contracts did not perform well as hedging instruments. They were much less effective in eliminating spot market risk (4-19%) than contracts in other commodity and financial futures markets (98%). Most market agents work on specific routes, so they demand contracts tailored to their specific needs. Hedging performance will be improved if contracts are based on an individual route rather than on an underlying index. It is therefore not surprising that FFA contracts which trade on specific routes rather than on the entire index have become popular.

**Current Derivatives Markets**

Even though BIFFEX ceased to trade in 2002 due to low liquidity, the hedging function of freight derivatives contracts is regarded positively by many in this industry. Different types of contracts have been launched since 1995, and FFAs, Futures, and Options are currently available for trading. The Baltic Exchange, NYMEX, and IMAREX are the three main market places for these contracts. Each has specific products and trading rules, but their common characteristic is increasing trading volumes.

*The Baltic Exchange*

The Baltic Exchange provides daily freight market prices, maritime shipping cost indices, and a market for FFAs. Based on market segmentation, the principal daily indices it publishes are the Baltic Panamax Index (BPI), the Baltic Capesize Index (BCI), the Baltic Supramax Index (BSI), the Baltic Exchange Dirty Tanker Index (BDTI) and the Baltic Exchange Clean Tanker Index (BCTI) (Baltic Exchange, 2007). Each index has a specific composition. For instance, the composition of BPI is shown in Table 1.

TABLE 1: Baltic Panamax Index (BPI) Composition, 2006.

| Routes | Vessel size (dwt) | Cargo | Route description | Weights |
|---|---|---|---|---|
| P1 | 55,000 | Light grain | 1–2 safe berths/anchorages US Gulf (Mississippi River not above Baton Rouge) to ARA | 10% |
| P1A | 74,000 | T/C | Transatlantic (including east coast of South America) round of 45/60 days on the basis of delivery and redelivery Skaw–Gibraltar range | 20% |
| P2 | 54,000 | HSS | 1–2 safe berths/anchorages US Gulf (Mississippi River not above Baton Rouge)/1 no combo port to South Japan | 12.5% |
| P2A | 74,000 | T/C | Basis delivery Skaw–Gibraltar range, for a trip to the Far East, redelivery Taiwan-Japan range, duration 60–65 days | 12.5% |
| P3 | 54,000 | HSS | 1 port US North Pacific/1 no combo port to South Japan | 10% |
| P3A | 74,000 | T/C | Transpacific round of 35/50 days either via Australia or Pacific (but not including short rounds such as Vostochy (Russia)/Japan), delivery and redelivery Japan/South Korea range | 20% |
| P4 | 74,000 | T/C | Delivery Japan/South Korea range for a trip via US West Coast—British Columbia range, redelivery Skaw–Gibraltar range, duration 50/60 days | 15% |

Source: Kavussanos and Visvikis (2006)

In light of the BIFFEX experience, the underlying asset of an FFA is the market rate of a specific route or an index of a small basket of routes. This is an improvement over the hedging performance of BIFFEX instruments. As a result, trading volumes have steadily increased (see Figure 4).

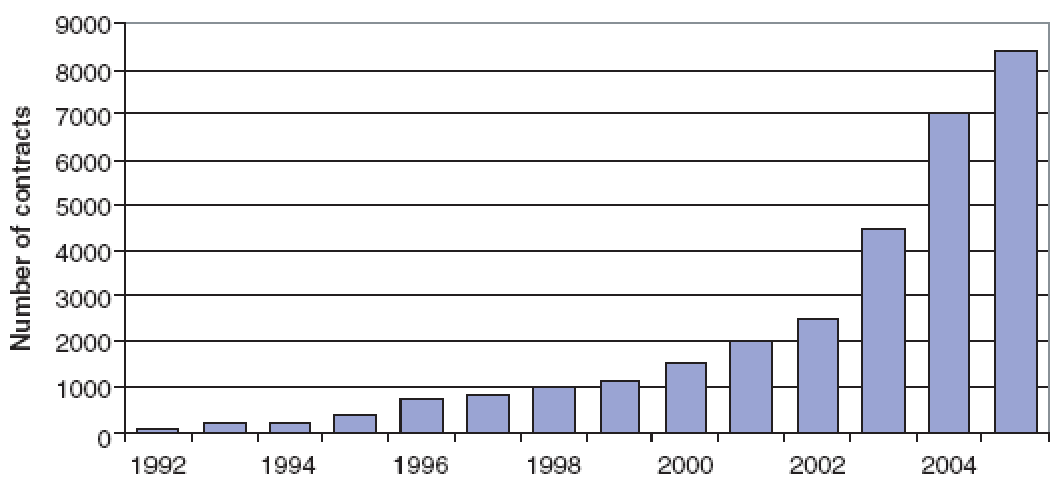


FIGURE 4. Yearly Volumes of Dry-Bulk FFA Contracts (Jan. 1992 – Sept. 2005)
Source: Kavussanos and Visvikis (2006)

*New York Mercantile Exchange (NYMEX)*

NYMEX provides a flexible, internet-based system of trading and clearing freight Futures. Currently, nine tanker routes are available for trading. Each freight futures contract may be listed for up to 36 consecutive months forward, depending on demand. The trading unit is 1,000 metric tons. Trading ceases on the last business day of the contract month. The price for each contract month equals the arithmetic average of the rates for each business day as published either by the Baltic Exchange or by Platts Oilgram Price Report for the corresponding route. Details are summarized in Table 2.

TABLE 2. NYMEX Freight Futures

| Route Description | Price Index |
|---|---|
| **TC1** Ras Tanura to Yokohama for 75,000 metric tons | Platts |
| **TC2** Rotterdam to USAC for 37,000 metric tons | Baltic |
| **TC4** Singapore to Japan for 30,000 metric tons | Platts |
| **TC5** Ras Tanura to Yokohama for 55,000 metric tons | Platts |
| **TD3** Middle Eastern Gulf to Japan for 250,000 metric tons | Baltic |
| **TD5** West Africa to U.S. Atlantic for 130,000 metric tons | Baltic |
| **TD7** North Sea to Europe for 80,000 metric tons | Baltic |
| **TD9** Caribbean to U.S. Gulf for 70,000 metric tons | Baltic |
| **TD10D** Caribbean to U.S. Atlantic Coast for 50,000 metric tons | Baltic |

Source: NYMEX (2007)

Figure 5 illustrates numerically how to hedge freight rates using NYMEX Futures. Assume a charterer needs to ship 10,000 metric tons (mt) from Europe to the U.S. Atlantic Coast in October, 2007. On June 25, the freight rate for the TC2 tanker route in the physical market is $30.5457/mt, and the contract price of for this route in the October 2007 Futures is $25.2241/mt (see Table 3 for the settlement (closing price) for this route). In order to lock the freight rate at $25.2241/mt, she buys 10 units (i.e., 10,000 mt) of October Futures. Suppose that the settlement of October Futures, which is the average of the rates for each business day within October, is $26.5328/mt, while the actual freight rate in the physical market is $26.5973/mt. Then the charterer gains $13,087 = ((26.5328- 25.2241) * 10,000) from the Futures market and she pays $265,937 = (26.5973 * 10,000) to the physical market. Finally, the realized shipping cost is $256,283 or $25.6283/mt which is lower than the spot rate. Note that it is slightly higher than her expected rate, $25.2241, because the settlement of the Futures is an average of the rates instead of the spot rate.

On the other hand, in a falling market, if the spot rate and the settlement are $23.5937 and $23.5328 respectively, then the charterer has to pay $16,913 (= (25.2241-23.5328)*10000). As a result, the final cost for shipping is $252,825 or $25.2825/mt which is relatively higher than the spot rate.

TABLE 3. Settlement (closing price) of TC2 Rotterdam to USAC 37k ($/mt)

| Contract | June 25 | June 22 | June 21 |
|---|---|---|---|
| June 2007 | 30.5457 | 29.3466 | 31.1746 |
| July 2007 | 24.4265 | 24.6259 | 24.6259 |
| August 2007 | 25.7226 | 25.5232 | 25.5232 |
| September 2007 | 25.5232 | 25.2241 | 25.5232 |
| October 2007 | 25.2241 | 25.1244 | 25.2241 |

Source: NYMEX (2007)

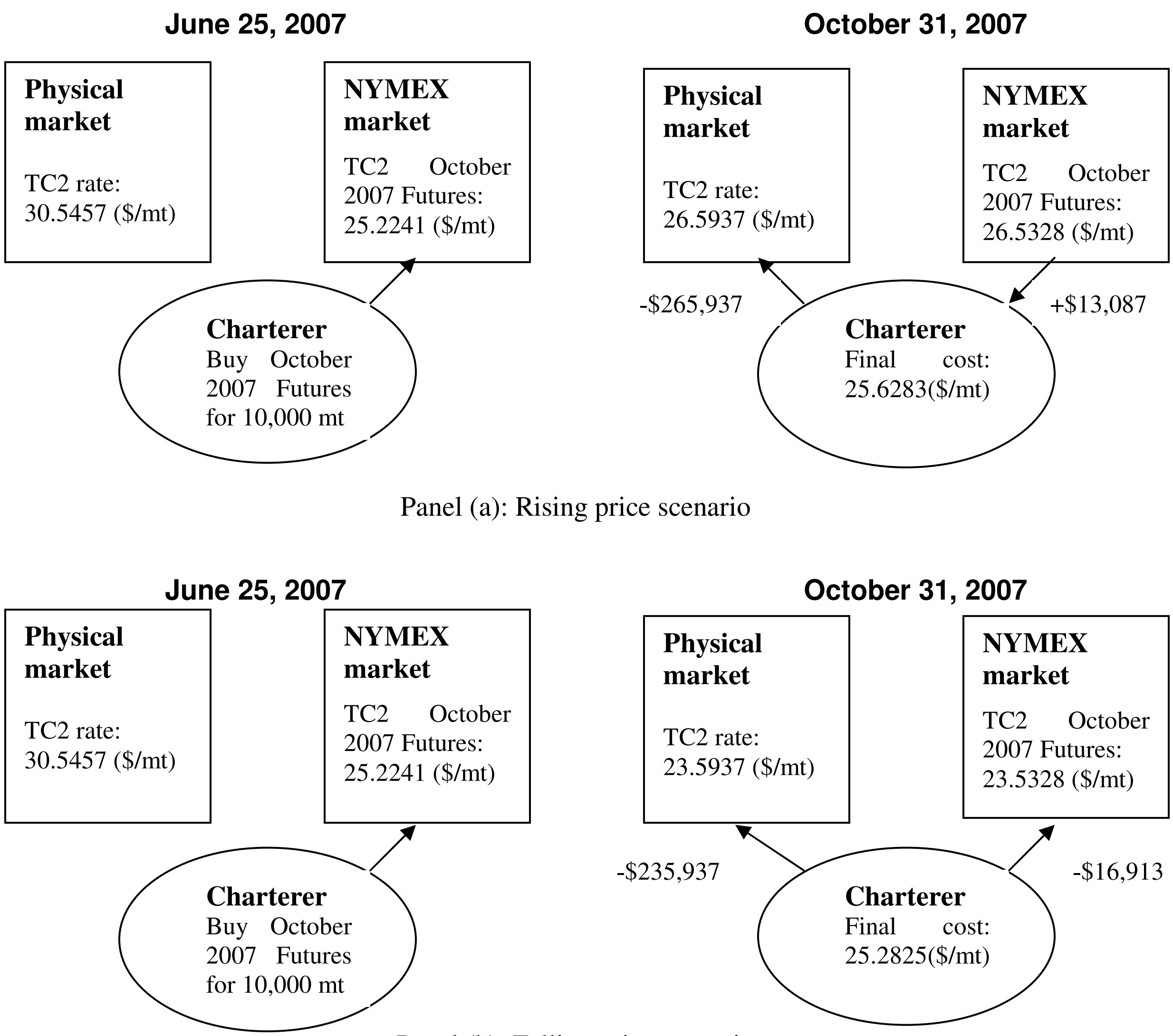


FIGURE 5: An Example of Hedging Freight Rate Using NYMEX Futures

*International Maritime Exchange (IMAREX)*

IMAREX is a market offering FFAs, freight futures as well as freight options trading in both the tanker market and the dry bulk market, while NYMEX only offers freight futures trading in the tanker market. The value of dry freight derivatives trading on IMAREX in June grew 376 percent from a year earlier to a record $776 million (Ambrogi, 2007). Each contract can be traded monthly, quarterly, or yearly. The last trading day is the 20th day of a given month, the last day of the first month of a quarter and the last day of the first month of a year for monthly contracts, quarterly contracts, and yearly contracts, respectively. The settlement of each contract is the average of the spot prices over the given period. Table 4 shows the tanker and dry bulk FAAs and freight futures available traded at IMAREX, respectively.

TABLE 4. IMAREX Tanker FFAs and Freight Futures

| **Tanker** | | **Dry Bulk** | |
|---|---|---|---|
| Route | Price Index | Route | Price Index |
| **TC1** Ras Tanura to Chiba, 75,000 metric tons | Platts | **C4** Richards Bay to Rotterdam, 150,000 metric tons | Baltic |
| **TC2** Rotterdam to New York, 37,000 metric tons | Baltic | **C7** Bolivar Roads to Rotterdam, 150,000 metric tons | Baltic |
| **TC4** Singapore to Chiba, 30,000 metric tons | Platts | **CS4TC**<br>Combination of<br>C8 (Gibraltar to Hamburg, 172,000 mt)<br>C9 (Continent to Mediterranean, 172,000 mt)<br>C10 (Pacific RV, 172,000 mt)<br>C11 (China to Japan, 172,000 mt) | Baltic |
| **TC5** Ras Tanura to Chiba, 55,000 metric tons | Platts | | |
| **TC6** Skikda to Lavera, 30,000 metric tons | Baltic | | |
| **TD3** Ras Tanura to Chiba, 260,000 metric tons | Baltic | **P2A** Skaw Gibraltar to Far East | Baltic |
| **TD4** Bonny to Loop, 260,000 metric tons | Baltic | **P3A** S. Korea to Japan | Baltic |
| **TD5** Bonny to Philadelphia, 130,000 metric tons | Baltic | **PM4TC**<br>Combination of<br>P1A (Transatlantic RV, 74,000 mt)<br>P2A (SKAW to Far East, 74,000 mt)<br>P3A (Japan to Pacific, 74,000 mt)<br>P4 (Far East to Nopac, 74,000 mt) | Baltic |
| **TD7** Sullom Voe to Wihelmshaven, 80,000 metric tons | Baltic | | |
| **TD8** Mina al Ahmadi to Singapore, 80,000 metric tons | Baltic | **SM6TC**<br>Combination of<br>S1A (Antwerp to SKAW Trip Far East)<br>S1B (Canakkale Trip Far East)<br>S2 (Japan via S. Korea to Australia)<br>S3 (Japan via S. Korea to SKAW range)<br>S4 (US Gulf via SKAW to Passero)<br>S4B (Passero via SKAW to US Gulf) | Baltic |
| **TD9** Puerto La Cruz to Corpus Christi, 70,000 metric tons | Baltic | | |
| **TD12** Antwerp to Houston, 55,000 metric tons | Baltic | | |

Source: IMAREX (2007)

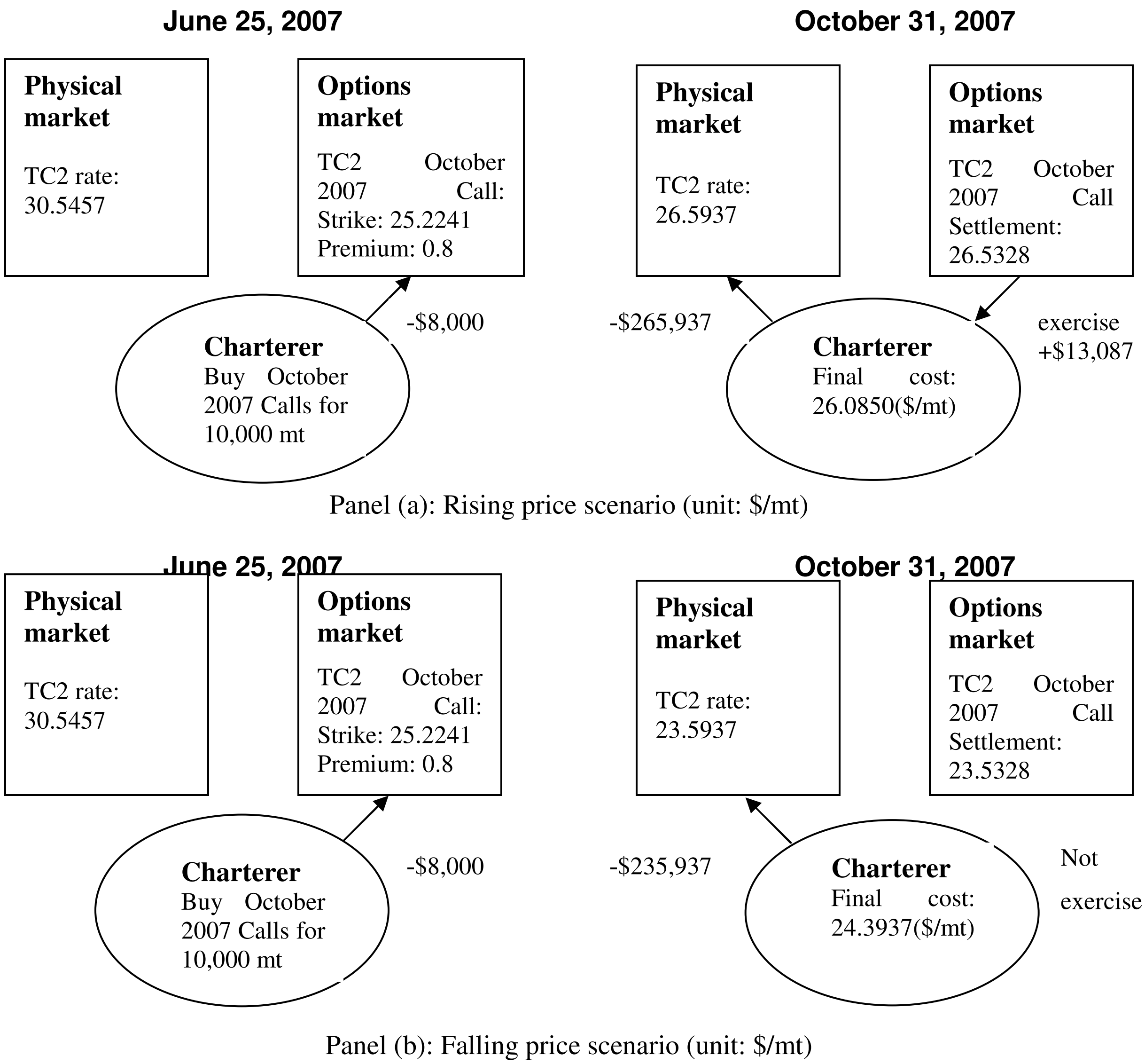


FIGURE 6. An Example of Hedging Freight Rate Using Options

Freight options traded at IMAREX allow the holder the right to buy or sell an FFA at a predetermined price. They are either over the counter (OTC) or are cleared at the clearinghouse (the Norwegian Futures and Options Clearinghouse for the international commodities markets known as NOS) by paying a fee equal to 1.25% of the option premium. Following the example of futures, Figure 6 illustrates how to hedging freight rate using freight options.

Assume the strike price of TC2 October 2007 Options is $25.2241/mt and the premium (the price of options) is $0.8/mt. To hedge the freight rate, the charterer pays $8,000 to buy the October options for shipping 10,000 mt. Suppose that the settlement of October Options, which is the average of the rates for each business day within October, is $26.5328/mt, while the actual freight rate in the physical market is $26.5973/mt. Since the spot rate is higher than the strike price ($26.5937>$25.2241), the charterer exercises her options. She gains $13,087 (=(26.5328-25.2241)*10,000) from the Options market while she pays $265,937 (= 26.5973*10,000) to the physical market. Taking the cost of Options into account, the actual shipping cost is $260,850 or $26.085/mt. Obviously, under those prices, Options have less hedging ability than Futures because of the premium charged.

However, if market prices are falling so that the spot rate and the settlement are respectively $23.5937 and $23.5328, then the charterer does not exercise her options because the spot rate is lower than the strike price ($23.5937 < $25.2241). Consequently, she does not need to pay anything to the Options market, while in the Futures case, she would pay $16,913 = ((25.2241-23.5328)*10000). With the premium, her final shipping cost is $243,937 or $24.3937/mt. In this scenario, Options show their strength over Futures. Consequently, with corresponding hedging ability and risk exposure, it is hard to say which kind of derivatives contracts is best. The choice of derivatives depends on the users' specific needs and their perception of the future markets.

## POTENTIAL OF DERIVATIVES CONTRACTS MARKETS IN TRUCKING

This section reviews the current state of trucking contracting market. Next, we analyze the potential benefits of derivatives contracts for trucking, and investigate the necessary conditions for the emergence of a market for derivatives.

### Current State of Trucking Contracting Market

Trucking is the dominant mode of freight transportation today, and, according to a recent forecast by the American Trucking Association, its share of the nation's freight pool will increase: it is forecasted to reach 69.2% in 2011 and 69.5% by 2017, from 68.9% in 2005 (ATA, 2006).

The trucking industry is divided into two sectors: private carriage and for-hire. The value of services provided by private carriage was approximately 45% of the trucking market in 2006 (Kirkeby, 2007). Since private carriage refers to trucks and drivers owned and operated by shippers, this sector is not included in the trucking contracting market. We, therefore, focus on the for-hire sector.

The for-hire sector accounted for approximately 55% of the market, of which 87% came from truckload (TL) and 13% from less-than-truckload (LTL) services. In order to procure for-hire services, shippers either write long-term contracts with carriers, usually for one or two years, or outsource to common carriers that mostly operate in spot markets.

The common method of procuring transportation services is to bid for capacity on some origin-destination movements ("lanes"). The shipper, first, forecasts its demands and, accordingly, announces the lanes and corresponding demands on which to bid. Then the shipper communicates details of his shipment needs to potential carriers and obtains rate quotes from them. Finally, the shipper chooses the winner after analyzing submitted bids. Thanks to advances in information technologies, shippers and carriers can communicate through the internet, which improves contracting efficiency. Recently, combinatorial auctions (where carriers bid on bundles of lanes simultaneously and shippers award contracts to multiple carriers) have become popular for procurement. Transplace, Elogex, and Nistevo are examples of collaborative logistics networks providers. They bring a group of shippers and carriers together to increase asset use and reduce logistics costs (Ergun et. al, 2007). To some extent, this type of contracting is essentially a forward contract as the contract defines details about price, lanes, and time of delivery.

One issue in the auctions, however, is that while demand is highly stochastic, the contracting process assumes that demand is deterministic and known. This means that the benefits of combinatorial packages of lanes can be overestimated by the models used by truckers to bid and by shippers to award contracts. Let's examine a real world example. A leading food manufacturer conducted an auction for procuring trucking services. The manufacturer did everything right and reached the targeted saving through the bidding process. Then demand suddenly increased so much that the winning bidder could not provide service to handle it. This fact forced the manufacturer to turn to other carriers at higher rates. As a result, the effort of conducting the original auction did not pay off as expected (CTL, 2004).

The risk of uncertain demand has significantly increased in some industries. Intel, for example, has been challenged by demand uncertainty since each of the company's products has a different life cycle. An Intel team, therefore, has proposed an innovative solution based on capacity options to hedge demand risk. At maturity, these options give Intel the right to place orders at a pre-determined price, so the company benefits from the ability to postpone orders. The use of options for equipment will extend into transportation contracting at Intel (Vaidyanathan et. al, 2005).

**Potential of Trucking Option Contracts**

As in the maritime industry, the demand for derivatives contracts for hedging uncertainty in trucking has appeared. Unlike the maritime industry, however, the trucking industry needs derivatives not only for hedging price uncertainty but also for capacity uncertainty. In other words, the current financial-settlement derivatives used in the maritime industry are not sufficient for hedging demand uncertainty in the trucking industry because those derivatives are operated separately from the physical shipping markets. As a result, the price risk may be fixed but the capacity for delivering cargos is not guaranteed. Hence, we propose the following trucking capacity option contracts.

The trucking option contracts we propose include call and put options, which are defined as option contracts in the previous section. The underlying asset for either type of option is truckload service. We investigate the potential use of trucking options for shippers and carriers separately.

*The Shippers' Perspective*

A shipper who is uncertain about its demand for truckload services and who believes that rates may increase in the near future may buy call options (if their price is reasonable), because they would provide her with a guaranteed number of truckloads at a predetermined price. For example, if demand occurs at some point in the future and the spot price is higher than the predetermined price, then she would exercise her options to procure guaranteed capacity at a price lower than the spot market price. In that case, holding a call option would benefit her. On the other hand, if demand occurs but the spot price is lower than the predetermined price, then she would not exercise her options if she can get enough truckloads from that spot market.

Therefore, trucking call options provide the shipper with flexibility on capacity procurement. The minimum value of the call option is zero while the maximum differs from shipper to shipper, which depends on the degree of uncertainty a shipper faces.

*The Carriers' Perspective*

A carrier who is concerned about fleet availability and decreasing rates may buy put options to secure guaranteed freight for delivery at a predetermined price and time. This option will be exercised depending on future spot market prices. For example, if at some time in the future the spot price is lower than the predetermined price, then he would exercise his options and procure the guaranteed freight for delivery at a price higher than the spot market price. The value of these put options is the difference between the predetermined price and the spot price. If there are idle fleets but the spot price at a future time is higher than the predetermined price, then he might not exercise the contract if he can get enough freight to move from the spot market.

**Necessary Conditions**

Based on the experience accumulated in the maritime derivatives markets and on current practice in the trucking industry, let us now look at some conditions necessary for making trucking options attractive and feasible.

*Uncertainty*

Let us first examine truckload price uncertainty (without uncertainty, options would have no value). Figure 7 presents the monthly percentage change in average truckload rates, which is similar to that for deep-sea freight rates; it shows that the degree of volatility has increased significantly since the end of 2004. The monthly percentage changes in specific lane prices are even more volatile. The magnitudes of monthly price changes for Los Angeles – Las Vegas, for example, are from 0 to about 30% during the past six months, according to our price quotes. This results from a combination of trucking capacity tightness, driver shortages and related pay increases, as well as high fuel prices. In addition, Hurricane Katrina is behind the high peaks observed during September and October, 2005. Rate volatility is expected to continue and possibly even increase because of unstable oil prices resulting from steady world oil demand growth, and geopolitical instability. Moreover, increasing and uncertain labor costs also contribute to volatility since the shortage of drivers remains unresolved.

Let us now consider capacity uncertainty. In the trucking industry, the overall demand for truckloads is strong. The shippers' uncertain demand for trucking capacity, in terms of time and volume, has also significantly increased because of the adoption of demand responsive logistics by various industries. The case of Intel described above is just one of many examples. In addition, the supply of trucking capacity tends to be limited as carriers hesitate to increase capacity because they find it difficult to hire drivers at prevailing wages and because of regulatory changes concerning hours of service and engine emissions (Kirkeby, 2007). Coupled with strong demand and tight supply, it is harder for shippers to procure sufficient trucking capacity to satisfy their needs.

*Hedging Effectiveness*

The maritime derivatives BIFFEX ceased to trade mainly because of low hedging effectiveness. The underlying index which is derived from the prices of a basket of routes could not hedge well for individual route. Therefore, the underlying asset of trucking options must sufficiently measure the specific movement that buyers are interested in. One truckload for a specific lane is a good choice.

*Liquidity*

A successful derivatives market must be liquid, which means that a seller should always be able to find a buyer without much difficulty (*10*). Lack of liquidity is another reason for BIFFEX's failure. In order to secure liquidity for trucking options, the freight flow of lanes and the seasonality effect should be considered. Trucking options would be more attractive on lanes with high freight flow during the peak season, namely Los Angeles (LA) – Dallas, LA – San Francisco, LA- Las Vegas, and so on (BTS, 2006).

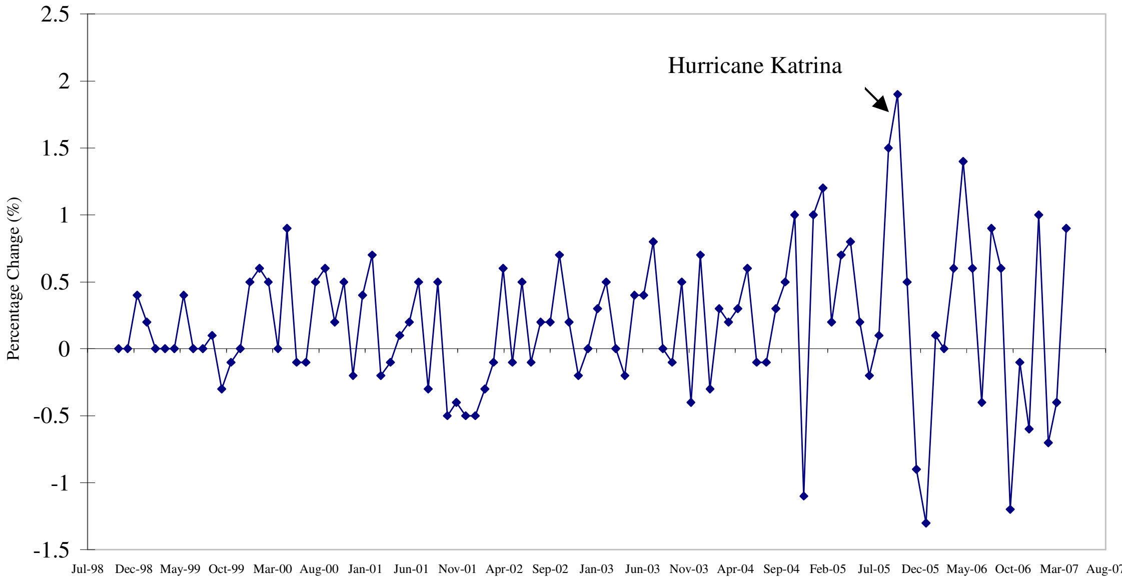


FIGURE 7: Percentage Change in Monthly TL Prices, Nov. 1998 – April 2007
Source: Authors' compilation of data from Logistics Management.

*Pricing*

Pricing different options is also a key issue for derivatives contracts. A great amount of literature is devoted to pricing options in financial markets.

*Organization*

To fulfill TL options trading, an organization specialized in setting the marketplace specifics will be essential. It is responsible for setting the contract details, including trading rules, types of options, closure prices, and so on. Thus, all potential participants, no matter what the size of their companies, will be able to access the spot market and option prices. One possibility would be the former exchange organizations. The New York Mercantile Exchange is one example. Since it is already well-functional, the emergence of TL options would be much easier, just by creating several new products and establishing a TL pricing panel. Another alternative would be one of the former transportation marketplaces. There exist many recent successful large on-line transportation marketplaces. These appear to work well and provide an example of how a large market could be conducted. Small firms who might not have either the sophistication or the personnel needed to participate in complicated contracts could gain the sophisticated needed by participating through a large third party logistics company.

**CONCLUSIONS**

This paper investigates derivatives contracts applied for the freight transportation. By reviewing the termination of BIFFEX, and surveying the current options market in the maritime industry, we conclude that derivatives contracts are useful tools for managing risk in transportation. Freight forward agreements, freight futures, and freight options are currently traded derivatives contracts in the maritime industry.

The trucking industry faces not only uncertain prices but also uncertain supply and demand. Price uncertainty mainly results from unstable oil prices, driver shortages, and capacity tightness. Demand uncertainty is primarily caused by lean and demand-responsive supply chain management, which makes planning ahead difficult and causes volatility in the demand for truck capacity. These tough conditions challenge current contracting methods, which are better suited to an environment where demand is known. Based on these observations, we believe trucking options could be a win-win solution for both shippers and carriers if the following conditions can be met: high hedging effectiveness, sufficient liquidity, appropriate pricing and effective organization.

Pricing trucking options is challenging but possible. Directions for future research include: 1) modeling trucking rate dynamics and investigating pricing formulas for trucking options; 2) developing market institutions; and 3) exploring trading strategies for shippers and carriers.

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