

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

**Mei-Ting Tsai**

**Amelia Regan**

**Jean-Daniel Saphores**

University of California, Irvine

# Introduction

- Freight transportation contributes significantly to the U.S. economy.
  - Share of GDP: 8.8% (2004) → 9.5% (2005)
  - The main mode: trucking, today to the next decade
- Problems
  - The adoption of demand-responsive supply chain structure
  - Requiring orders to be delivered rapidly, accurately and reliably, even under demand uncertainty
  - The need of flexible transportation services

- Our solution
  - 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.

# OUTLINE

- What Are Derivatives Contracts?
- Derivatives Contracts In Maritime Industry
- Potential of Derivatives Contracts In Trucking Industry
- Conclusion

# What Are Derivatives Contracts?

- Derivatives are instruments whose price depend on the prices of other assets.
- Basic derivatives contracts:
  - Forward contracts
  - Futures contracts
  - Options contracts

– Forward contracts

- Obligate the holder to buy or sell an asset for a predetermined price at a predetermined future time
- Private agreements between two counter parties
- Traded in over-the-counter markets
- The good: written in terms that satisfy the counter parties' unique needs
- The bad: expose the counter parties to contractual risks

– Futures contracts

- Similar to forwards contracts, except that they are traded on an exchange which standardizes the contract features and regulates trading
- The payoff
- The good: contractual risks are eliminated
- The bad: standardized contracts may not provide perfect hedging

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– Options contracts

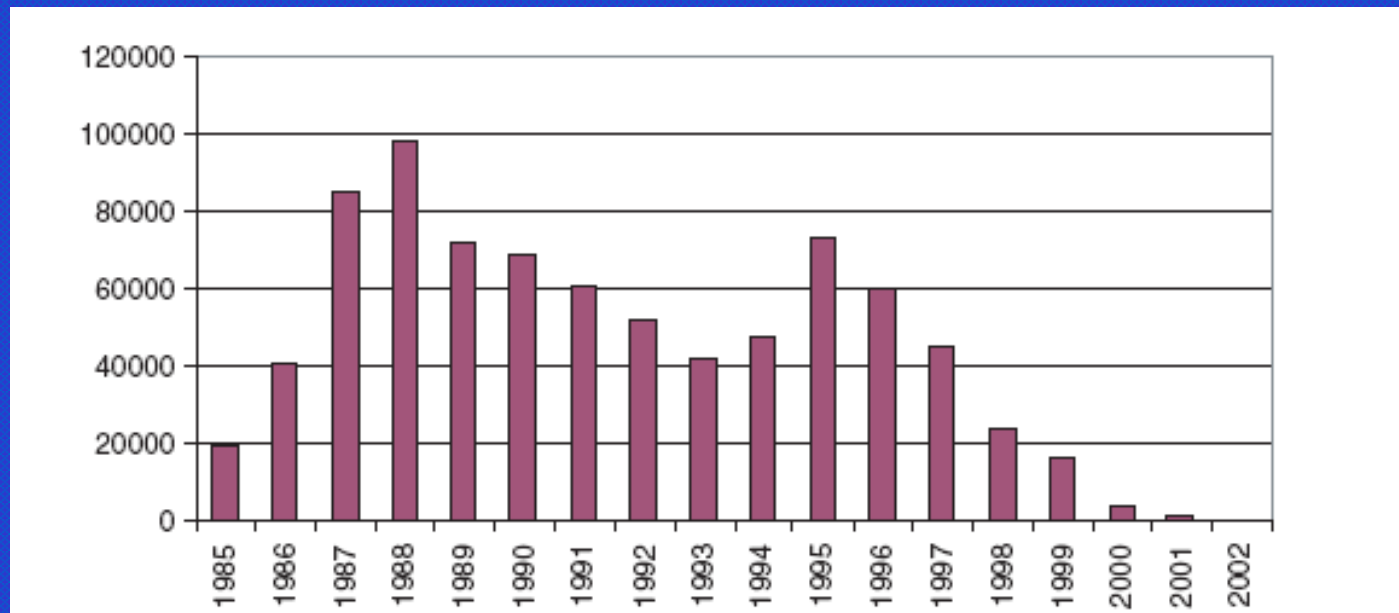
- provide the holder with the right to buy or sell an asset at a predetermined delivery price on or before a predetermined date
- The payoff
- The good: more flexible
- The bad: additional cost

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# Derivatives Contracts in Maritime

- Past derivatives markets
  - 1985: the first freight futures market called the Baltic International Freight Futures Exchange (BIFFEX) appeared
  - 2002: BIFFEX ceased to exist



## • Derivatives Contracts in Maritime

### – Low liquidity was the main reason.

- The underlying asset is a weighted average of the spot prices from different shipping routes.
- Have cross-hedging issue due to the diversity of cargoes, vessel sizes etc.
- Not a good hedging instrument for particular freight rate risk

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 Vostochny (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%

- Current derivatives markets
  - Currently available contracts: freight forward agreements (FFAs), Futures, and Options
  - The main market places:
    - The Baltic Exchange
    - New York Mercantile Exchange (NYMEX)
    - International Maritime Exchange (IMAREX)

- The Baltic Exchange
  - Provides daily freight market prices, maritime shipping cost indices, and a market for FFAs
  - The underlying asset of an FFA is the market rate of a specific route or an index of a small basket of routes.

- New York Mercantile Exchange (NYMEX)
  - Provides an internet-based system of trading and clearing freight Futures
  - Nine routes are available for trading.
  - The trading unit is 1,000 metric tons.
  - The price for each contract month equals the average of the rates for each business day for the corresponding route.

• Derivatives Contracts in Maritime

– Example: a charterer needs to ship 10,000 metric tons (mt) from Europe to the U.S. Atlantic Coast

June 25, 2007

**Physical market**  
  
TC2 rate:  
30.5457  
(\$/mt)

**NYMEX market**  
  
TC2 October  
2007  
Futures:  
25.2241  
(\$/mt)

**Charterer**  
Buy  
October  
2007  
Futures for  
10,000 mt

Oct. 31, 2007

**Physical market**  
  
TC2 rate:  
26.5937  
(\$/mt)

**NYMEX market**  
  
TC2 October  
2007  
Futures:  
26.5328  
(\$/mt)

-\$265,937

+\$13,087

**Charterer**  
Final cost:  
25.6283(\$/  
mt)

**June 25, 2007**

**Physical market**

TC2 rate:  
30.5457  
(\$/mt)

**NYMEX market**

TC2 October  
2007  
Futures:  
25.2241  
(\$/mt)

**Charterer**  
Buy  
October  
2007  
Futures for  
10,000 mt

**Oct. 31, 2007**

**Physical market**

TC2 rate:  
23.5937  
(\$/mt)

**NYMEX market**

TC2 October  
2007  
Futures:  
23.5328  
(\$/mt)

-\$235,937

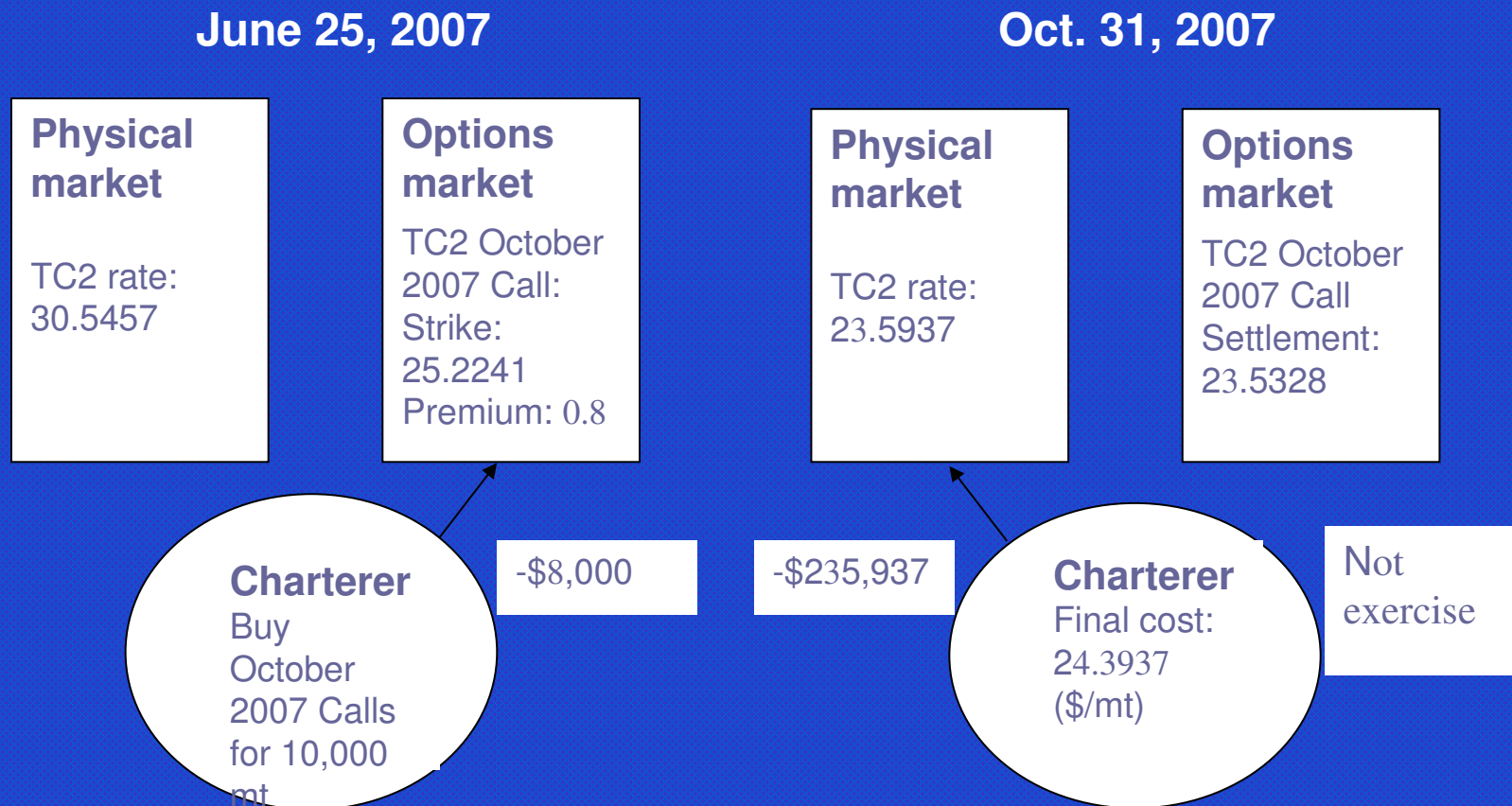
**Charterer**  
Final cost:  
25.2825(\$/  
mt)

-\$16,913

- International Maritime Exchange (IMAREX)
  - Provides FFAs, freight futures, and freight options trading
  - The value of trading in June 2007 grew 376 percent from a year earlier.
  - The settlement of each contract is the average of the spot prices over the given period.
  - Freight options are either over the counter (OTC) or cleared at the clearinghouse .

• Derivatives Contracts in Maritime

• Example:



**June 25, 2007**

**Physical market**  
  
TC2 rate:  
30.5457

**Options market**  
  
TC2 October  
2007 Call:  
Strike: 25.2241  
Premium: 0.8

**Charterer**  
Buy  
October  
2007 Calls  
for 10,000  
mt

-\$8,000

**Oct. 31, 2007**

**Physical market**  
  
TC2 rate:  
26.5937

**Options market**  
  
TC2 October  
2007 Call  
Settlement:  
26.5328

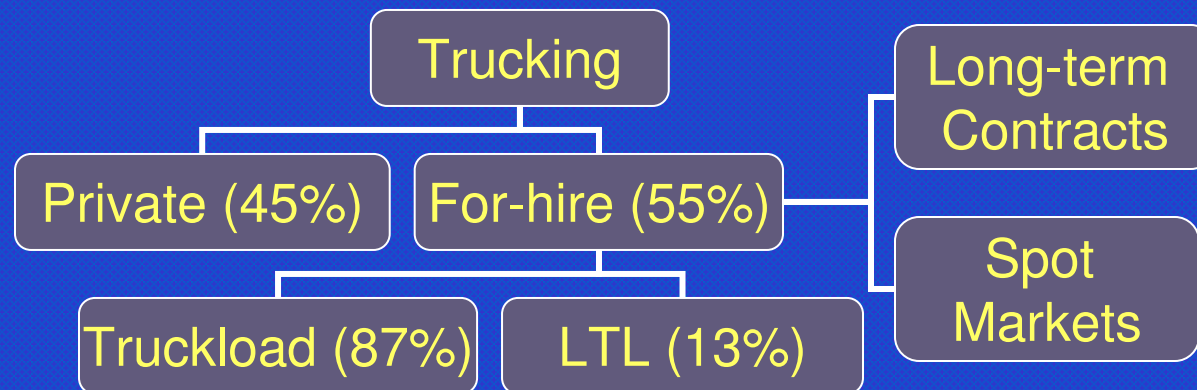
**Charterer**  
Final cost:  
26.0850  
(\$/mt)

-\$265,937

exercise  
+\$13,087

# Potential of Derivatives Contracts in Trucking Industry

- Current trucking contracting market
  - The structure of trucking industry



## • Potential of Derivatives Contracts in Trucking

- The common method of procuring transportation services: auction
- Recently, combinatorial auctions (where carriers bid on bundles of lanes simultaneously and shippers award contracts to multiple carriers) have become popular for procurement.
- To some extent, this type of contracting is essentially a forward contract.
- Issue: the contracting process assumes that demand is deterministic and known. It hardly handles the uncertain demands.

- Potential of Derivatives Contracts in Trucking

- Potential of trucking option contracts
  - Need derivatives not only for hedging price uncertainty but also for capacity uncertainty
  - The financial-settlement derivatives are not sufficient for hedging demand uncertainty.
  - Propose trucking option contracts with truckload service as the underlying asset

## • Potential of Derivatives Contracts in Trucking

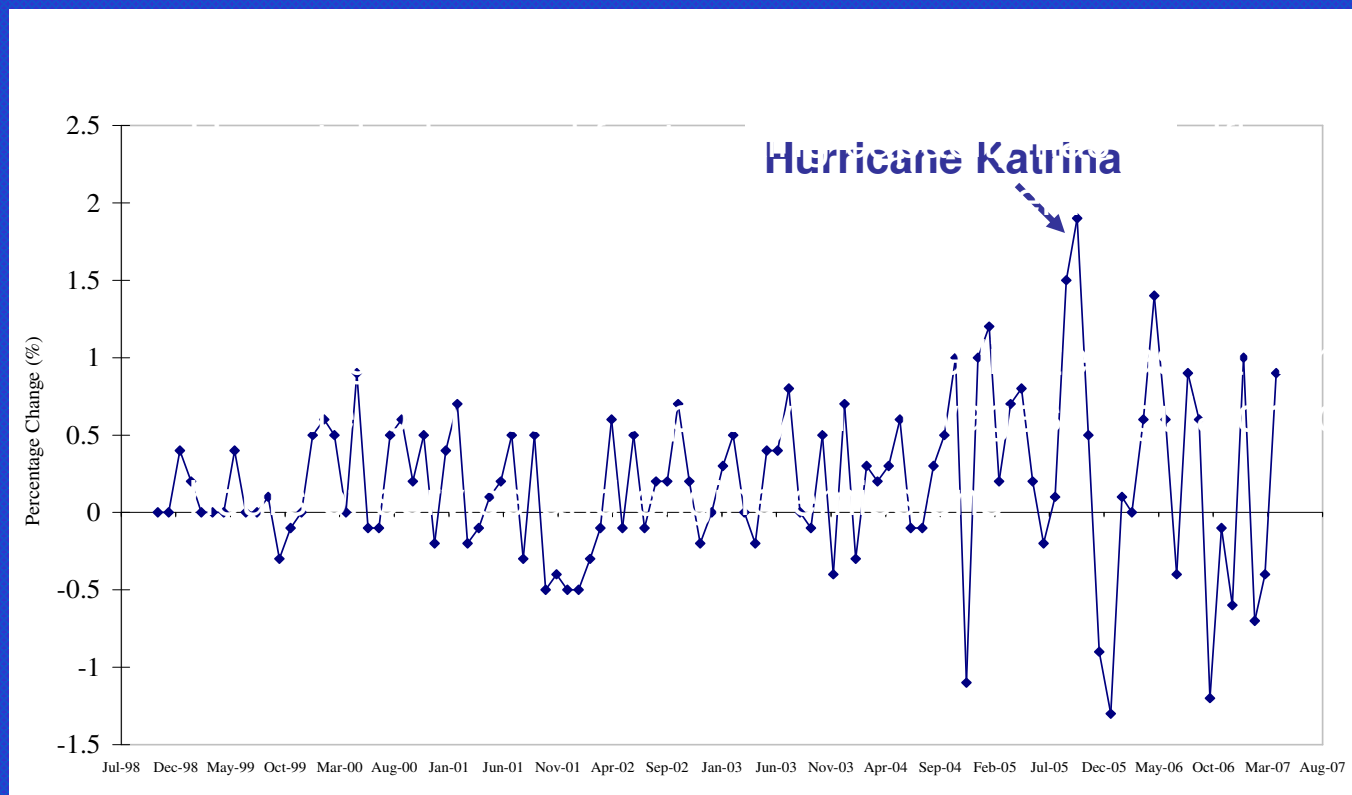
- The shippers' perspective
  - uncertain demand + perception of price increase  
→ buy call options
  - If true, then exercise options. If not true, then do not exercise them. Instead, procure capacity from the spot markets.
- The carriers' perspective
  - Concern idle fleets + perception of price decrease  
→ buy put options
  - If true, then exercise options. If not true, then do not exercise them. Instead, sell capacity in the spot markets.
- Trucking options provide the shipper/carrier with flexibility on capacity procurement/sale.

- Potential of Derivatives Contracts in Trucking

- Necessary conditions

- Uncertainty

- Price uncertainty: because of trucking capacity tightness, driver shortages as well as high fuel prices



## • Potential of Derivatives Contracts in Trucking

### – Hedging Effectiveness

- Lessons from maritime: the underlying index could not hedge well for individual route.
- A good choice: one truckload for a specific lane

### – Liquidity

- A seller should always be able to find a buyer without much difficulty.
- The freight flow of lanes and the seasonality effect should be considered.
- Some examples: Los Angeles (LA) – Dallas, LA – San Francisco, LA- Las Vegas

- Pricing

- A great amount of literature is devoted to pricing options in financial markets.
- Model the trucking options prices to benefit both parties and characterize trucking price dynamics

- Organization

- Functions: setting the marketplace specifics, i.e. trading rules, types of options, closure prices.
- One possibility: the former exchange organizations, ex. NYMEX
- Another alternative: the former transportation marketplaces, ex. on-line marketplaces

# Conclusions

- Derivatives contracts are useful tools for managing risk in transportation
- Uncertainties in trucking:
  - Prices: oil prices, driver shortages, and capacity tightness
  - Capacity supply and demand: lean and demand-responsive supply chain management
- Making trucking options a win-win solution
  - high hedging effectiveness
  - sufficient liquidity
  - appropriate pricing
  - effective organization

- Directions for future research
  - modeling trucking rate dynamics and investigating pricing formulas for trucking options
  - developing market institutions
  - exploring trading strategies for shippers and carriers

Thank You!

Questions? Comments?