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Commodities Case

OVERVIEW

The Commodities Case challenges the ability of participants to trade in a closed supply and demand market for crude oil. Natural crude oil production and its use coupled with regulatory compliance in the form of carbon credits will form the framework for participants to engage in direct trade to meet each other's objectives. The case will test each participant's ability to understand sophisticated market dynamics and optimally perform his/her role, while stressing teamwork and communication. The case will involve crude oil production, refinement, storage, and trading of its synthesized physical products and carbon credits.

KEY OBJECTIVES

- Design a model to calculate the effect of news releases on the prices of Crude Oil, Heating Oil, and RBOB Gasoline. Using information gathered from news releases and trading data, track the supply and demand of oil throughout the simulation to determine optimal storage usage and trading strategies.
- Maximize profits as a team of producers, refiners, and traders by communicating private news information with each other.

DESCRIPTION

The Commodities Case will comprise 6 independent heats with 4 team members competing together. Each heat will be 16 minutes long and represent two months, or 40 trading days, of calendar time. Each heat will involve six tradable securities and four assets. Order submission using the RIT API will be disabled. Data retrieval via the RIT API will be enabled; but, VBA RTD Links will be disabled. We strongly encourage students to use Python for data retrieval using RIT API.

- Number of trading heats: 6
- Trading time per heat: 360 seconds (10 minutes)
- Calendar time per heat: 2 months (40 trading days)
- Maximum order size: 5 contracts
- Mark-to-market frequency: Daily (24 seconds)

In this case, each team member will have 1 of 3 specific roles and the team will determine the role of each member:

- ABCD-1: Role of Producer
- ABCD-2: Role of Refiner
- ABCD-3: Role of Trader #1
- ABCD-4: Role of Trader #2

Commodities Case: Each team member is required to trade in a specific role for this Case.

Producer

The producer has access to an oil rig that can extract Crude Oil (hereafter referred to as production of Crude Oil) and also to storage facilities to store Crude Oil. The production of Crude Oil requires a lease cost of an oil rig and the purchase of corresponding units of Carbon Credits. The lease cost is $34,000 per day but may fluctuate throughout the case because of external factors. Producers are required to have corresponding units of Carbon Credits when producing Crude Oil in order to satisfy regulatory requirement for emissions of carbon dioxide or carbon dioxide equivalents.

Rotman Carbon Allowance (RCA) is a Carbon Credit contract traded in a spot market. Each contract contains 1,000 Assigned Amount Units (AAUs, hereafter referred to as units) of Carbon Credits that allow an entitlement to emit one tonne of carbon dioxide or carbon dioxide equivalent per unit. For every barrel of Crude Oil production, 0.5 tonnes of carbon dioxide is emitted.

Producers will be provided with a weekly allocation of RCA at the beginning of each week, but may decide to purchase additional Carbon Credits in order to have enough units to produce Crude Oil.

Producers will be provided with a total storage capacity of 20,000 barrels of Crude Oil at the beginning of each heat at no cost. However, in the event that a producer exceeds their storage limit or leases a storage unit again by clicking on “Lease” in the “Assets” tab on the RIT Client, he or she will be forced to lease additional storage for the remainder of the heat at a more expensive distressed storage cost.

Refiner

The refiner has access to two separate facilities: New Refinery (N-Refinery) and Old Refinery (O-Refinery). The New Refinery is more efficient and costs $30/barrel while the Old Refinery costs $45/barrel. The New Refinery turns four barrels of Crude Oil into two barrels of Heating Oil and two barrels of RBOB Gasoline, whereas the Old Refinery turns eight barrels of Crude Oil into four barrels of Heating Oil and four barrels of RBOB Gasoline. RBOB Gasoline and Heating Oil are traded in gallons, where *one barrel equals 42 gallons*.

Each refinery asset has a refinery time and a refinery lease time; a refinery time is how long the refinery process takes and a refinery lease time is how often refiners are ‘charged’ with the lease price. The New Refinery has a refinery time of 84 seconds and a refinery lease time of 120 seconds and the Old Refinery has a refinery time of 108 seconds and a same refinery lease time of 120 seconds. Note that leasing new refineries will be disabled when the remaining time in the sub-heat is less than the refinery time.

Refiners will also need to make sure that they have enough units of Carbon Credits prior to running the refinery facilities. They will be provided with a weekly allocation of Carbon Credits but may decide to purchase additional Carbon Credits in order to have enough units prior to refining Crude Oil. For every barrel of Crude Oil refined through the New Refinery, one tonne of carbon dioxide is emitted whereas one and a half tonnes of carbon dioxide are emitted for every barrel of Crude Oil refined through the Old Refinery.

Refiners will receive news impacting the prices of RBOB Gasoline and Heating Oil, and will have to evaluate the impact of these news items in order to decide which refinery, if any, is profitable to operate.

The RBOB Gasoline price will be mainly affected by news items related to market demand. These news items will need to be evaluated by refiners in order to determine their impact and how the future RBOB Gasoline price might change in response to the news.

The primary driver of Heating Oil prices will be fluctuations in temperature, since demand for Heating Oil will increase as expected temperatures fall. Hence, the price impact of changes in temperature will be estimated based on the simplified equation below:

$$P_{HO} = E_{HO} + \frac{\Delta_{HO}}{\sigma_{HO}}$$

Where;

P_{HO} is the final close-out price for Heating Oil;
$E_{HO}$is the expected price for Heating Oil;
Δ_{HO} is the expected weekly temperature change;
σ_{HO} is the standard deviation of the temperature change.

Expected weekly temperature change = Expected weekly temperature – Realized weekly temperature

The expected price for Heating Oil will start at $3.00/gallon. News regarding the weather will be released on a weekly basis. Furthermore, it is possible for Heating Oil prices to be also affected by external shocks affecting market demand and supply. These external shocks must be evaluated by refiners to determine their impact and to estimate future Heating Oil prices.

Refiners will need to accurately determine the profitability of running their refineries by evaluating the prices of their inputs (Crude Oil and Carbon Credits) as well as their future outputs (Heating Oil and RBOB Gasoline).

Refiners will be provided with a total storage capacity of 20,000 barrels of Crude Oil at the beginning of each heat at no cost. However, in the event that a refiner leases a storage unit by clicking on “Lease”, he or she will be forced to lease additional storage for the remainder of the heat at a more expensive distressed storage cost (see “Market Dynamics” below). Heating Oil and RBOB Gasoline do not require storage.

Traders

Traders have access to Crude Oil markets as well as Heating Oil and RBOB Gasoline futures markets. During the trading period, traders will receive institutional orders from overseas clients who wish to buy or sell Crude Oil. Traders act as the “shock absorbers” for the market. They balance the supply and demand, and help markets achieve equilibrium by filling up their storage tanks when Crude Oil prices are very low and by selling Crude Oil back to the market when prices are relatively high.

Traders will be provided with a total storage capacity of 20,000 barrels for Crude Oil at the beginning of each heat at no cost. However, in the event that a trader leases a storage unit by clicking on “Lease”, he or she will be forced to lease additional storage for the remainder of the heat at a more expensive distressed storage cost (see “Market Dynamics” below).

In addition, traders have access to the Carbon Credits spot market and are required to participate in the auction process for Carbon Credits. On a weekly basis, they will be required to provide a bid for a set quantity of Carbon Credits through a *blind, reserve-auction* process. Any traders who bid higher than the hidden reserve price will be able to win the set quantity of Carbon Credits at the price that they bid. Traders may then decide to sell the Carbon Credits in the market.

MARKET DYNAMICS

Producers, Traders, and Refiners will be able to trade the securities according to the table below.

Securities: CL
Description: Crude Oil Spot
Contract Size: 1,000 Barrels
Accessibility: Producer, Refiner, Trader
Shortable: No

Securities: RB
Description: RBOB Gasoline
Contract Size: 42,000 Gallons
Accessibility: Refiner
Shortable: No

Securities: HO
Description: Heating Oil
Contract Size: 42,000 Gallons
Accessibility: Refiner
Shortable: No

Securities: HO-2F
Description: Month 2 futures contract for HO
Contract Size: 42,000 Gallons
Accessibility: Trader
Shortable: Yes

Securities: RB-2F
Description: Month 2 futures contract for RB
Contract Size: 42,000 Gallons
Accessibility: Trader
Shortable: Yes

Securities: RCA
Description: Rotman Carbon Allowance
Contract Size: 1,000 AAUs
Accessibility: Producer, Refiner, Trader
Shortable: No

Participants will be able to utilize the following assets, which are required for storing and refining Crude Oil.

Asset: CL-PRODUCTION
Description: Production Asset for Crude Oil
Capacity (Barrels): 4,000
Cost: $34,000 per day
Conversion Period: 0.25 trading days

Asset: CL-STORAGE
Description: Storage for Crude Oil
Capacity (Barrels): 10,000
Cost: Endowed storage: Free*
Conversion Period: N/A

Asset: N-REFINERY
Description: New Refinery to Process Crude Oil
Capacity (Barrels): 4,000
Cost: $120,000 per 5 trading days
Conversion Period: 3.5 trading days

Asset: O-REFINERY
Description: Old Refinery to Process Crude Oil
Capacity (Barrels): 8,000
Cost: $360,000 per 5 trading days
Conversion Period: 4.5 trading days

*All starting endowments of storage are free. Subsequent storage leased (due to overproduction or the use of the “Lease” button) will be charged at a lease price of $500,000 per storage unit, which can hold up to 10,000 barrels.

Industry-specific news will be released to participants based on their roles. Producers will receive reports of their production and storage facilities (which are subject to changes throughout the case). The lease prices may also fluctuate, influencing the production cost of Crude Oil.

Refiners will receive news information on the RBOB Gasoline and Heating Oil markets, and they must use this information to forecast future prices. Traders will receive “The International Tender Report” which describes the expected institutional orders activity.

The interaction between the different market participants (producer, refiner, and traders) within each team, including their profit maximization objectives, will largely influence the overall profits of each team. Therefore, participants should optimize the dynamics between each member.

The following is a simplified example of the case:

Traders successfully submit a bid for 6 contracts of RCA at $20/unit. Traders are then able to sell 2 contracts of RCA to producers and 4 contracts of RCA to refiners in the market for $30/unit.

Producers operate a production asset and use 2 contracts of RCA to produce 4,000 barrels of Crude Oil. The production asset costs $8/barrel to lease (assuming a single extraction in the day) and a per-barrel cost for RCA is $15/barrel. Producers sell 2 contracts of Crude Oil to traders at $45/barrel and 2 contracts of Crude Oil to refiners at $50/barrel.

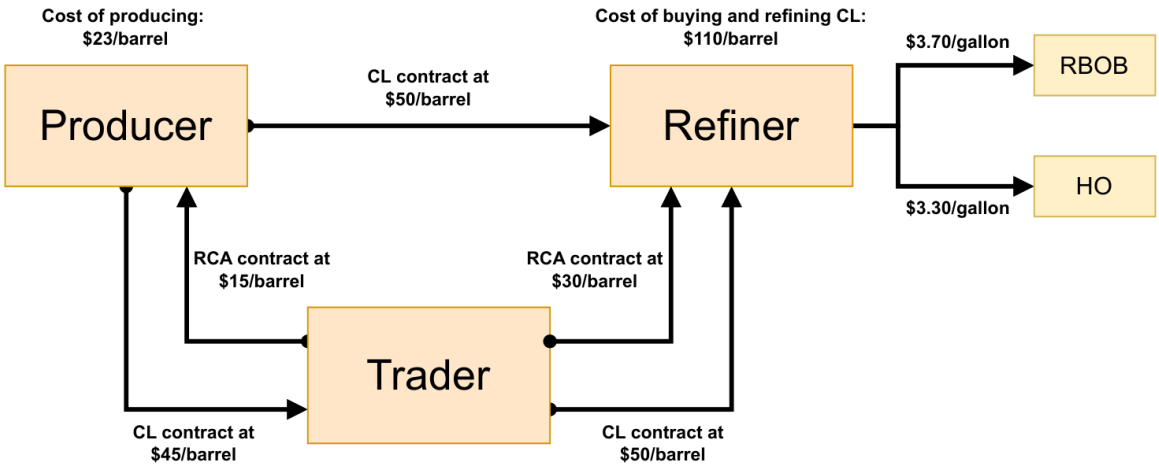
Refiners buy 4 contracts of Crude Oil, agreeing to buy 2,000 barrels of Crude Oil from the producers and 2,000 barrels of Crude Oil from traders at a price of $50/barrel each. In this scenario, refiners choose to operate the New Refinery which requires a lease cost of $30/barrel and 4 contracts of RCA purchased

from traders. A per-barrel cost for RCA for New Refinery is also $30/barrel. Refiners are able to sell RBOB and HO at the current market price of $3.70/gallon and $3.30/gallon, respectively. If you convert this value into barrels: 42,000 * $3.5/gallon = $147,000 per 1,000 barrels, or $147/barrel.

Profit generated by each team member (per barrel):

- Traders: (price of RCA contract sold – cost of buying RCA1) + (price of CL contract sold – cost of buying CL) = ($22.5 - $15) + ($50 - $45) = $12.50
- Producers: price of CL contract sold - cost of producing oil per barrel = $47.50 – ($8 + $15) = $24.50
- Refiners: value of refined products - cost of buying and refining oil = $147 – ($50 + $30 + $30) = $37

* Converted per barrel based on the total output of 8,000 barrels



TRADING/POSITION LIMITS AND TRANSACTION COSTS

Each participant will be subject to trading/position limits. Separate limits will be maintained for Crude Oil (CRUDE), RBOB/HO Products (PRODUCT), and Carbon Credits (RCA). Trading limits will be strictly enforced and participants will not be able to exceed them by trading. However, production and refining assets can and will cause limit breaches if they are not managed properly, resulting in a penalty of $25,000 per contract over each gross and net limit.

The maximum trade size will be 5 contracts, restricting the volume of the contracts transacted per trade to 5. The maximum trade size applies to all tradable securities.

POSITION CLOSE OUT

All futures positions will be marked-to-market every 24 seconds with any profits and losses reflected in the traders' cash balance by the mark-to-market operation.

Each security position, except Crude Oil and Carbon Credits, will be closed out at the last traded price. Crude Oil will be closed out at $35/barrel and Carbon Credits will be closed at $50/unit regardless of the market price.

BMO Financial Group
Finance Research and Trading Lab
Rotman School of Management
University of Toronto
105 St. George Street
Toronto, ON M5S 3E6, Canada

Phone: +1 416 946 3296

Location and operating hours

Lab operating hours
Monday to Friday, from 9:00 AM to 5:00 PM

Lab location
105 St. George St., 2nd floor, room 290

Graduate Rotman students access
24/7 access using the fob

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