

EXAMINATION QUESTION PAPER - Course paper

Component of continuous assessment

GRA 65131 Financial Risk Management

Department of Finance

Start date: 02.03.2020 Time 09.00

Finish date: 16.03.2020 Time 09.00

Component weight: 15% of GRA 65131

Total no. of pages: 5 incl. front page

No. of attachments files to question paper: 2

To be answered: In groups of 1 - 5 students.

Answer paper size: Maximum of 10 Pages excl. attachments

Max no. of answer paper attachment files: 1

Allowed answer paper file types: pdf

Allowed answer paper attachment file types: zip

The exam paper must also include a table of contents, a summary at the beginning and a bibliography/reference list at the conclusion of the paper. These pages are counted separately from the main paper. You will find a thorough explanation of how to use quotes and references on the BI library webpage: <https://portal.bi.no/en/examination/assignment-thesis/cite-sources/>. For information on formal requirements and template paper; see www.bi.edu/templatepaper

Financial Risk Management Spring 2020: Assignment 2

Your team has been approached by the risk management division at Exxon Mobil, a Fortune 500 oil refining company based in Irving, Texas and with operations around the world. They would like you to help analyze their risk management practices for the coming year. Exxon's primary line of business is the production, refining and sale of refined oil products including gasoline, diesel, jet fuel, lubricants and other distillates. This involves exploration, drilling, and production of oil feedstocks (crude oil), refining where the feedstocks are the key input and outputting refined oil products (gasoline, diesel, distillates, etc.).

The amount converted from one barrel of crude oil to one barrel of products is known as its "yield" and the difference between the purchase price of the oil and the sale price of the products (less any operating expenses) from that barrel of crude is the refining margin and sometimes referred to as the "crack spread". Exxon Mobil is particularly concerned about recent changes in the oil market, including an influx of US based shale oil, demand shocks from China, and rising risks stemming from climate change.

One particular concern is the changing demand for different types of crude oil, e.g. heavy/sour vs. light/sweet. Traditionally, much of their production was of light/sweet oil. However, with the rise of shale and tar sands derived oil, they have been increasingly producing heavy/sour oil. Due to this they are considering building a new refinery that has flexibility to refine either type of oil. However, this refinery is more expensive than a traditional one that only refines a single type.

Exxon Mobil would like to evaluate their current risk management program and their refinery investment and wants an outside opinion. Specifically, they would like your team to evaluate three scenarios:

- 1) Building a refinery that only refines light/sweet crude oil
- 2) Building a refinery that can refine heavy/sour crude oil via additional coking units
- 3) Building a refinery that can switch between oils depending on the changing input prices.

They would like to evaluate these three scenarios in terms of the optimal investment, taking into account potential downside risks, alternative hedging strategies, etc. **You can assume that the first refinery investment is for 350 million USD, the second costs 650 million USD, and the third costs 800 million USD, and that production starts immediately.**

They are particularly interested in using more advanced analysis to analyze their risk exposures, particularly in light of their use of crude oils as a feedstock. Given the limited time they propose that you use the following simplifying assumptions:

Assumptions

- 1. Focus only on the downstream/refining side of their operations (excluding exploration, production, retail, etc.) as the refining unit is meant to be viewed as separate. At the end you can discuss how relaxing this assumption might change your results/conclusion.**
- 2. Assume the average daily production throughput for the new refinery is 500K barrels per day, roughly the size of their Baytown and Baton Rouge facilities.**
- 3. Assume that average output from the refinery is sold at the CBOB Price.**
- 4. Assume the operating expense per barrel of throughput starts at \$4.25.**
- 5. You can assume a yield of 1:1 for throughput to product for both types.**
- 6. Assume if the firm builds the light/sweet refinery, then they cannot process any sour crude. If they build the heavy/sour refinery, they can process only heavy/sour crude and it costs an additional \$2.50 in operating costs (so 6.75) total. Finally, assume that if they choose the joint refinery, it can process both crude types but heavy/sour crude costs an additional \$2.00 per barrel (so 6.25 for heavy/sour, and 4.25 for sweet crude).**
- 7. You do not need to worry about taxes, depreciation, or other expenses. Just focus on the refining business cash flows.**
- 8. Start your simulation of cash flows beginning January 1st of 2020.**
- 9. Assume there are 30-days per month (so 30/360 calendar).**

Support Materials:

Attached are:

- Series of prices from 01.01.2012-31.12.2019 for Louisiana Sweet, Sour Crude and CBOB Gasoline. All values are in USD/barrel. This data is from Bloomberg.**
- Exxon Mobil's 2018 10-K.**

Questions

You should examine the following items (not necessarily in this order) and report your findings to the refinery division's risk management team. These questions are meant as a guide in writing your report, the final product should not be written in a question/response format. They would like to examine your work so please include any backup material and calculations. Your write-up should be less than 10 pages not including any tables, figures, or backup.

- 1. What are the key risk exposures that the refinery division at Exxon Mobil faces? (5 points)**
- 2. Why is Exxon Mobil concerned about the spread between sweet and sour crudes and the spread between gasoline prices and oil prices? Does this relate to any of their current existing projects in the downstream refining sector? (5 points)**
- 3. Assume you can just focus on their two most important market factors for Exxon Mobil, the price of inputs and the price of outputs. These are represented by the Sweet Crude price (Input), the Sour Crude Price (Input), and the CBOB Gasoline Price (output). Estimate a model for future monthly movements in the Sweet, Sour, and CBOB prices over the next 5-years assuming that the three prices are correlated. You can choose to simplify your analysis by assuming that sweet crude returns are the common factor off of which sour and CBOB are determined. (25 points)**
 - a. What are the main inputs that go into your model?**
 - b. Simulate the return series. Explain why you chose your method and discuss the advantages of the model you chose over other potential models. Can include discussion of parametric assumptions, how much historical data was used to form inputs, and the specifics of the model (copula types, volatility estimation, etc.).**
 - c. Discuss the sensitivity of your model to your modeling assumptions and technique. Perform a sensitivity analysis on some of your assumptions and discuss the sensitivity of your analyses.**
- 4. Estimate Exxon Mobil's refining cash flows over the next 5-years year using your price estimates from above in each of the three investment scenarios discussed. (20 points)**
 - a. Use this to estimate Exxon Mobil's expected monthly cash flows and the minimum monthly cash flows with 95% certainty over the next 5-years.**
 - b. Give a discussion of these measures of cash flow risk and why it might matter to Exxon Mobil management. What other measures of risk could they use?**

5. Discuss the value of the three refineries. In your analysis, you should consider the initial investment relative to the cash flows discounting the cash flows properly. When determining the discount rate you should consider this project to be 100% equity financed and only consist of a pure-play on refining operations. Again, for simplicity, you can assume the investment is made at the start and production begins immediately. (30 points)
- a. What is the discount rate you used for each of the three refineries? How did you calculate it?
 - b. Which of the three investments appears to have the highest NPV? Which appears to have the lowest risk?
 - c. Is the joint refinery is similar to an option? If so, could Exxon Mobil replicate this investment with a set of derivatives?
 - d. Discuss if you could use derivatives as an alternative way to value the investment, or to replicate these cash flows, potentially as a robustness check.
6. What general recommendations do you have for Exxon Mobil's risk management team concerning this investment? This can include discussions of: (15 points)
- a. What other forms of market risk might exist for them and how these risks might affect your estimates (i.e., exchange rate, other product prices, etc.)?
 - b. The value of investment in refinery operations that allows for changes in their input oil mix.
 - c. What types of things should they consider when implementing and deciding on a risk management strategy?