TIØ4140 Project Evaluation and Financing

Exercise 2: Forwards and Futures

Posted: Thursday, January 16, 2024.
Submission deadline: Tuesday, January 28, 2024, 23:59.
Grading: Approved / Not approved.

N.B.:

- *To get "Approved", you should attempt to solve all mandatory tasks and have **70%** correct.*
- *Remember to write down the **main solution steps**!*

Overview of Tasks

- **Mandatory Tasks**:
  - **Ch. 3** An Introduction to Forwards and Options 5
  - **Ch. 7** Commodity Forwards and Futures 6, 12
  - **Ch. 8** Financial Forwards and Futures 5
  - **Exam problem**
- **Voluntary Tasks:**
  - **Ch. 8** Financial Forwards and Futures 15

Mandatory Tasks

- **Problems from McDonald (2013)**

Chapter 3: An Introduction to Forwards and Options

3.5. [Note: the text in this exercise is edited compared to the original exercise in McDonald (2013).] You are a financial advisor for NovaTech. The company frequently uses forward contracts to hedge against market price fluctuations. You are asked to perform specific calculations for NovaTech:

a. The company recently entered into a short 6-month forward position at a forward price of $48. You should calculate the payoff in 6 months for the following prices of $38, $43, $48, $53, and $58?
b. To mitigate potential losses, the company considers purchasing a 6-month put option with a strike price of $48 per unit. As a financial advisor, calculate the payoff at the end of 6 months for the following spot prices of the underlying asset: $38, $43, $48, $53, and $58.
c. Comparing the payoffs of parts (a) and (b), which contract should be more expensive (i.e., the long put or short forward)? Why?

Chapter 7: Commodity Forwards and Futures

For the next problems, assume that the continuously compounded interest rate is 6% and the storage cost of widgets is $0.03 quarterly (payable at the end of the quarter). Here is the forward price curve for widgets:

Year 0	Year 1				Year 3	
Dec.	Mar.	June	Sept.	Dec.	Mar.	June
3.000	3.075	3.152	2.750	2.822	2.894	2.968

7.6.

a. What are some possible explanations for the shape of this forward curve?
b. What annualized rate of return do you earn on a cash-and-carry entered into in December of Year 0 and closed in March of Year 1? Is your answer sensible?

7.12. Suppose you know nothing about widgets. You are going to approach a widget merchant to borrow one in order to short-sell it. (That is, you will take physical possession of the widget, sell it, and return a widget at time *T*.) Before you ring the doorbell, you want to make a judgment about what you think is a reasonable lease rate for the widget. Think about the following possible scenarios.

a. Suppose that widgets do not deteriorate over time, are costless to store, and are always produced, although production quantity can be varied. Demand is constant over time. Knowing nothing else, what lease rate might you face?

b. Suppose everything is the same as in (a) except that demand for widgets varies seasonally.

c. Suppose everything is the same as in (a) except that demand for widgets varies seasonally and the rate of production cannot be adjusted. Consider how seasonality and the horizon of your short-sale interact with the lease rate.

d. Suppose everything is the same as in (a) except that demand is constant over time and production is seasonal. Consider how production seasonality and the horizon of your short-sale interact with the lease rate.

e. Suppose that widgets cannot be stored. How does this affect your answers to the previous questions?

Chapter 8: Financial Forwards and Futures

8.5. Suppose you are a market-maker in S&R index forward contracts. The S&R index spot price is 1100, the continuously compounding risk-free rate is 5%, and the dividend yield on the index is 0.

a. What is the no-arbitrage forward price for delivery in 9 months?

b. Suppose a customer wishes to enter a short index futures position. If you take the opposite position, demonstrate how you would hedge your resulting long position using the index and borrowing or lending.

c. Suppose a customer wishes to enter a long index futures position. If you take the opposite position, demonstrate how you would hedge your resulting short position using the index and borrowing or lending.

- ## Exam problem

Today, we assume the following forward prices ($/Barrel) are observed for North Sea Oil (the spot price is 128):

Maturity of the contract	Price ($/Barrel)
3 Month	125
6 Month	123
1 Year	121
3 Year	120
5 Year	119

Assume the interest rate curve (government bills) in US today is given by:

Maturity of the contract	Interest rate
3 Month	0.20%
6 Month	0.40%
1 Year	0.80%
3 Year	1.30%

5 Year	2.30%

a) What do we call a forward curve for oil with the given shape? What is the lease rate for various maturities?

b) Discuss possible reason for this shape of the oil forward curve.

c) Discuss possible reasons why arbitrage might be difficult even if prices are out of equilibrium.

Voluntary Task

Chapter 8: Financial Forwards and Futures

8.15. Suppose the S&R index is 800, and that the dividend yield is 0. You are an arbitrageur with a continuously compounded borrowing rate of 5.5% and a continuously compounded lending rate of 5%. Assume that there is 1 year to maturity.

a. Supposing that there are no transaction fees, show that a cash-and-carry arbitrage is not profitable if the forward price is less than 845.23, and that a reverse cash-and-carry arbitrage is not profitable if the forward price is greater than 841.02.

b. Now suppose that there is a $1 transaction fee, paid at time 0, for going either long or short the forward contract. Show that the upper and lower no-arbitrage bounds now become 846.29 and 839.97.

c. Now suppose that in addition to the fee for the forward contract, there is also a $2.40 fee for buying or selling the index. Suppose the contract is settled by delivery of the index, so that this fee is paid only at time 0. What are the new upper and lower no-arbitrage bounds?

d. Make the same assumptions as in the previous part, except assume that the contract is cash-settled. This means that it is necessary to pay the stock index transaction fee (but not the forward fee) at both times 0 and 1. What are the new no-arbitrage bounds?

e. Now suppose that transactions in the index have a fee of 0.3% of the value of the index (this is for both purchases and sales). Transactions in the forward contract still have a fixed fee of $1 per unit of the index at time 0. Suppose the contract is cash-settled so that when you do a cash-and-carry or reverse cash-and-carry you pay the index transaction fee both at time 1 and time 0. What are the new upper and lower no-arbitrage bounds? Compare your answer to that in the previous part. (*Hint:* To handle the time 1 transaction fee, you may want to consider tailing the stock position.)

References

McDonald, R. L. (2013). *Derivatives markets*. 3rd. ed., New International Edition. Pearson Education.