

Pricing and Valuation of Forward Commitments

Literature

Chapter 2: Pricing and Valuation of Forward Commitments, p. 111-176

PIRIE, Wendy L. **Derivatives**. Hoboken: Wiley, 2017. CFA institute investment series. ISBN 978-1-119-38181-5.

Chapters 5, 6, p. 107-154

HULL, John. **Options, futures, and other derivatives**. Ninth edition. Harlow: Pearson, 2018. ISBN 978-1-292-21289-0. Learning Outcomes

Learning Outcomes

- describe and compare how equity, interest rate, fixed-income, and currency forward and futures contracts are priced and valued;
- calculate and interpret the no-arbitrage value of equity, interest rate, fixed-income, and currency forward and futures contracts;
- describe and compare how interest rate, currency, and equity swaps are priced and valued;
- calculate and interpret the no-arbitrage value of interest rate, currency, and equity swaps.

Problems

The following information relates to Questions 1-7

Donald Troubadour is a derivatives trader for Southern Shores Investments. The firm seeks arbitrage opportunities in the forward and futures markets using the carry arbitrage model.

Troubadour identifies an arbitrage opportunity relating to a fixed-income futures contract and its underlying bond. Current data on the futures contract and underlying bond are presented in Exhibit 1. The current annual compounded risk-free rate is 0.30%.

Exhibit 1 - Current Data for Futures and Underlying Bond

Futures Contract		Underlying Bond	
Quoted futures price	125.00	Quoted bond price	112.00
Conversion factor	0.90	Accrued interest since last coupon payment	0.08
Time remaining to contract expiration	Three months	Accrued interest at futures contract expiration	0.20
Accrued interest over life of futures contract	0.00		

Troubadour next gathers information on three existing positions.

Position 1 (Nikkei 225 Futures Contract):

Troubadour holds a long position in a Nikkei 225 futures contract that has a remaining maturity of three months. The continuously compounded dividend yield on the Nikkei 225 Stock Index is 1.1%, and the current stock index level is 16,080. The continuously compounded annual interest rate is 0.2996%.

Position 2 (Euro/JPY Forward Contract):

One month ago, Troubadour purchased euro/yen forward contracts with three months to expiration at a quoted price of 100.20 (quoted as a percentage of par). The contract notional amount is ¥100,000,000. The current forward price is 100.05.

Position 3 (JPY/USD Currency Forward Contract):

Troubadour holds a short position in a yen/US dollar forward contract with a notional value of \$1,000,000. At contract initiation, the forward rate was ¥112.10 per \$1. The forward contract expires in three months. The current spot exchange rate is ¥112.00 per \$1, and the annually compounded risk-free rates are -0.20% for the yen and 0.30% for the US dollar. The current quoted price of the forward contract is equal to the no-arbitrage price.

Troubadour next considers an equity forward contract for Texas Steel, Inc. (TSI). Information regarding TSI common shares and a TSI equity forward contract is presented in Exhibit 2.

Exhibit 2 - Selected Information for TSI

Selected Information for TSI

- TSI has historically paid dividends every six months.
 - The price per share of TSI's common shares is \$250.
 - The forward price per share for a nine-month TSI equity forward contract is \$250.562289.
 - Assume annual compounding.
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Troubadour takes a short position in the TSI equity forward contract. His supervisor asks, "Under which scenario would our position experience a loss?"

Three months after contract initiation, Troubadour gathers information on TSI and the risk-free rate, which is presented in Exhibit 3.

Exhibit 3 - Selected Data on TSI and the Risk-Free Rate

Selected Data on TSI and the Risk-Free Rate

- The price per share of TSI's common shares is \$245.
 - The risk-free rate is 0.325% (quoted on an annual compounding basis).
 - TSI recently announced its regular semiannual dividend of \$1.50 per share that will be paid exactly three months before contract expiration.
 - The market price of the TSI equity forward contract is equal to the no-arbitrage forward price.
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1. Based on Exhibit 1 and assuming annual compounding, the arbitrage profit on the bond futures contract is closest to:
 - A. 0.4158.
 - B. 0.5356.
 - C. 0.6195.
2. The current no-arbitrage futures price of the Nikkei 225 futures contract (Position 1) is closest to:
 - A. 15,951.81.
 - B. 16,047.86.
 - C. 16,112.21.
3. The value of Position 2 is closest to:
 - A. -¥149,925.
 - B. -¥150,000.

- C. -¥150,075.
4. The value of Position 3 is closest to:
- A. -¥40,020.
 - B. ¥139,913.
 - C. ¥239,963.
5. Based on Exhibit 2, Troubadour should find that an arbitrage opportunity relating to TSI shares is
- A. not available.
 - B. available based on carry arbitrage.
 - C. available based on reverse carry arbitrage.
6. The most appropriate response to Troubadour's supervisor's question regarding the TSI forward contract is:
- A. a decrease in TSI's share price, all else equal.
 - B. an increase in the risk-free rate, all else equal
 - C. a decrease in the market price of the forward contract, all else equal.
7. Based on Exhibits 2 and 3, and assuming annual compounding, the per share value of Troubadour's short position in the TSI forward contract three months after contract initiation is closest to:
- A. \$1.6549.
 - B. \$5.1561.
 - C. \$6.6549.

The following information relates to Questions 8–16

Sonal Johnson is a risk manager for a bank. She manages the bank’s risks using a combination of swaps and forward rate agreements (FRAs).

Johnson prices a three-year Libor-based interest rate swap with annual resets using the present value factors presented in Exhibit 1.

Exhibit 1 - Present Value Factors

Maturity (years)	Present Value Factors
1	0.990099
2	0.977876
3	0.965136

Johnson also uses the present value factors in Exhibit 1 to value an interest rate swap that the bank entered into one year ago as the receive-floating party. Selected data for the swap are presented in Exhibit 2. Johnson notes that the current equilibrium two-year fixed swap rate is 1.00%.

Exhibit 2 - Selected Data on Fixed for Floating Interest Rate Swap

Data	
Swap notional amount	\$50,000,000
Original swap term	Three years, with annual resets
Fixed swap rate (since initiation)	3.00%

One of the bank’s investments is exposed to movements in the Japanese yen, and Johnson desires to hedge the currency exposure. She prices a one-year fixed-for-fixed currency swap involving yen and US dollars, with a quarterly reset. Johnson uses the interest rate data presented in Exhibit 3 to price the currency swap.

Exhibit 3 - Selected Japanese and US Interest Rate Data

Days to Maturity	Yen Spot Interest Rates	US Dollar Spot Interest Rates
90	0.05%	0.20%
180	0.10%	0.40%
270	0.15%	0.55%
360	0.25%	0.70%

Johnson next reviews an equity swap with an annual reset that the bank entered into six months ago as the receive-fixed, pay-equity party. Selected data regarding the equity swap, which is linked to an equity index, are presented in Exhibit 4. At the time of initiation, the underlying equity index was trading at 100.00.

Exhibit 4 - Selected Data on Equity Swap

Data on Equity Swap	
Swap notional amount	\$20,000,000
Original swap term	Five years, with annual resets
Fixed swap rate	2.00%

The equity index is currently trading at 103.00, and relevant US spot rates, along with their associated present value factors, are presented in Exhibit 5.

Exhibit 5 - Selected US Spot Rates and Present Value Factors

Maturity (years)	Spot Rate	Present Value Factors
0.5	0.40%	0.998004
1.5	1.00%	0.985222
2.5	1.20%	0.970874
3.5	2.00%	0.934579
4.5	2.60%	0.895255

Johnson reviews a 6 × 9 FRA that the bank entered into 90 days ago as the pay-fixed/ receive-floating party. Selected data for the FRA are presented in Exhibit 6, and current Libor data are presented in Exhibit 7. Based on her interest rate forecast, Johnson also considers whether the bank should enter into new positions in 1 × 4 and 2 × 5 FRAs.

Exhibit 6 - 6 x 9 FRA Data

Data	
FRA term	6x9
FRA rate	0.70%
FRA notional amount	US\$20,000,000
FRA settlement terms	Advanced set, advanced settle

Exhibit 7 - Current Libor

Current Libor	
30-day Libor	0.75%
60-day Libor	0.82%
90-day Libor	0.90%
120-day Libor	0.92%
150-day Libor	0.94%
180-day Libor	0.95%
210-day Libor	0.97%
270-day Libor	1.00%

Three months later, the 6 x 9 FRA in Exhibit 6 reaches expiration, at which time the three-month US dollar Libor is 1.10% and the six-month US dollar Libor is 1.20%. Johnson determines that the appropriate discount rate for the FRA settlement cash flows is 1.10%.

8. Based on Exhibit 1, Johnson should price the three-year Libor-based interest rate swap at a fixed rate closest to:
 - A. 0.34%.
 - B. 1.16%.
 - C. 1.19%.
9. From the bank’s perspective, using data from Exhibit 1, the current value of the swap described in Exhibit 2 is closest to:

- A. -\$2,951,963.
 - B. -\$1,967,975.
 - C. -\$1,943,000.
10. Based on Exhibit 3, Johnson should determine that the annualized equilibrium fixed swap rate for Japanese yen is closest to:
- A. 0.0624%.
 - B. 0.1375%.
 - C. 0.2496%.
11. From the bank's perspective, using data from Exhibits 4 and 5, the fair value of the equity swap is closest to:
- A. -\$1,139,425.
 - B. -\$781,323.
 - C. -\$181,323.
12. Based on Exhibit 5, the current value of the equity swap described in Exhibit 4 would be zero if the equity index was currently trading the closest to:
- A. 97.30.
 - B. 99.09.
 - C. 100.00.
13. From the bank's perspective, based on Exhibits 6 and 7, the value of the 6 x 9 FRA 90 days after inception is closest to:
- A. \$14,817.
 - B. \$19,647.
 - C. \$29,635.
14. Based on Exhibit 7, the no-arbitrage fixed rate on a new 1 x 4 FRA is closest to:
- A. 0.65%.
 - B. 0.73%.
 - C. 0.98%.
15. Based on Exhibit 7, the fixed rate on a new 2 x 5 FRA is closest to:
- A. 0.61%.
 - B. 1.02%.
 - C. 1.71%.
16. Based on Exhibit 6 and the three-month US dollar Libor at expiration, the payment amount that the bank will receive to settle the 6 x 9 FRA is closest to:
- A. \$19,945.
 - B. \$24,925.
 - C. \$39,781.