CHAPTER 6

Solutions

Exercise 1

(a) Synthetic for Contract A involves:

'Sell EUR (to get USD)' is equivalent to

- **Loan:** Borrow EUR at t_0 for maturity t_1
- **Spot operation:** Buy USD against EUR
- **Deposit:** Deposit USD at t_0 for maturity at t_1

Here, t_0 is March 1, 2004 and t_1 is March 15, 2004. The underlying sum sold is 1,000,000 EUR. Synthetic for Contract B involves:

'Buy EUR against USD' is equivalent to

- **Loan:** Borrow USD at t_0 for maturity t_1
- **Spot operation:** Buy EUR against USD
- **Deposit:** Deposit EUR at t_0 for maturity at t_1

Here, t_0 is March 1, 2004 and t_1 is April 30, 2004. The underlying sum bought is 1,000,000 EUR.

(b) In this part of the question, if we have correctly identified our synthetics we can simply interpret the data given to us in the question and use the pricing equation (7) from Section 6.3 of this Chapter. This is given by

$$F_{t_0} = e_{t_0} \frac{B(t_0, t_1)^{EUR}}{B(t_0, t_1)^{USD}}$$

Consider Contract A and its synthetic from the previous part of this question above. We borrow EUR at 2.36%, buy USD at spot rate 1.1500 and deposit USD at 2.25%. So,

$$F_{t_0}^1 = e_{t_0} \frac{B(t_0,t_1)^{EUR}}{B(t_0,t_1)^{USD}} = 1.15 \times \frac{2.36}{2.25} = 1.206$$

Now, consider Contract B and its synthetic from the previous part of this question above.

We borrow USD at 2.27%, buy EUR at spot rate 1.1505 and deposit EUR at 2.35%. So,

$$F_{t_0}^2 = e_{t_0} \frac{B(t_0,t_1)^{EUR}}{B(t_0,t_1)^{USD}} = 1.1505 \times \frac{2.35}{2.27} = 1.1108$$

(c) The basic idea is as follows: now the outright forward spot rate is 1.1510/1.1525. With this new rate, consider both synthetics. Long the one that gives you higher profit and short the other. This will give arbitrage.

Exercise 2

(a) To use the given data to create a 1×4 NZ $ FRA, the overall strategy would be:

• Replicate the forward borrowing in NZ $ by combining FX forwards at 1 month and 4 month with spot borrowing of A $ in the future (1 month - 4 month) plus a 1 × 4 A $ FRA.

• After we obtain the synthetic forward borrowing in NZ $ via the A $ FRA market, we retrieve the synthetic 1 × 4 NZ $ FRA.

The eventual complete contractual equation could be summarized as:

1 × 4 NZ$ FRA equals:

1. Spot lending NZ $ at t_1 = 1 month till t2 = 4 months at rate LNZ t_1 .

2. Forward sale A $ at t_1 = 1 month.

3. Forward purchase of A $ at t_2 = 4 month.

4. Spot borrowing of A $ at t_1 = 1 month till t_2 = 4 month at rate $L_{t_1}^{A}$

5. 1 ×4 A $ FRA

Note that we can leave out the spot lending and spot borrowing out of the contractual equation since they are spot operations.

(b) Left as exercise - use each of the 5 points from part (a) of the question to describe a cash flow.

(c) This position involves spot lending and borrowing in the future (1 to 4 month period) at the Libor rate. These spot operations bring with them additional credit and liquidity risks.

(d) Since a domestic FRA can be replicated by combining an FX FRA with forward currency transactions and spot lending and borrowing in the future, FRA markets and currency forwards should be related by some arbitrage relationships. These arbitrage relationships are implicit in the contractual equation. The cost of locking in a future domestic borrowing cost should be equal to the cost of combining the domestic and foreign positions that are required to build the synthetic FRA.

Exercise 3

1. The question implies that the ti are measured at annual intervals. Using this we can easily calculate arbitrage-free bid-ask prices for the two zero coupon bonds. For example,

$$B_2^{ask} = \frac{1}{(1+0.081)(1+0.0901)} = 0.8486$$

$$B_2^{bid} = \frac{1}{(1+0.0812)(1+0.0903)} = 0.8483$$

Note that there is a small arbitrage possibility. One can buy the synthetic bond at .8486 and sell the actual bond for .85 at the quoted price. This will leave a gain of .0014.

2. Three period swap rate will be a weighted average of the quoted forward rates:

$$s_0 = \sum_{i=0}^{2} \omega_i f_i$$

where the ω_i are given by:

$$\omega_i = \frac{B_{i+1}}{B_1 + B_2 + B_3}$$

The key point in applying this formula is the following. Instead of using the B_i quoted by the dealer, one needs to calculate arbitrage-free bond prices as in part (a) of this question.

Exercise 4

Additional data on USD and EUR FRA's will not be directly relevant for finding arbitrage opportunities in the GBP sector. However, they will be relevant if one had in addition, quotes on forward GBP/USD and forward GBP/EUR exchange rates. Such forward rates incorporate not one, but two term structures and the additional data might help.

Exercise 5

1. The foreign investor is subject to withholding tax if the issuer is a resident of Australia. In this case the question suggest that the Spanish issuer is not a resident institution. So, the foreign buyer is not subject to withholding taxes.
2. A resident issuer who would like to issue AUD bonds, can issue in a different currency and then swap the proceeds with a foreign issuer. In this case the foreign issuer is issuing in

AUD and swapping to the other currency. Hence there will be two fixed rate swaps and a currency swap that will have to be involved.

3. With the data provided in this question no precise numerical answer can be given. However, the arbitrage gains will be within 10% of the quoted rates.

4. FRA's themselves are not sufficient. One would need in addition the proper forward exchange rate contracts on, say, the USD/AUD. One would also need the USD FRAs. Then one can synthetically reconstruct all the IRSs and the currency swaps desired.

5. Theoretically they will give the same results. However, FRAs will involve a much larger number of contracts and may end up being less convenient.

6. The Spanish company will issue in Australia and then swap the proceeds into a desired currency. This will be more "profitable".

Exercise 6

1. This is similar to Figure 6-8.
2. The bottom part of Figure 6-8 shows this.
3. Here we should first note that the currency swap spreads of around 75 basis points are unrealistically high for real markets. For these currencies such spreads were normally around 10-20bp during 2004. Ignoring this aspect we can see that for the immediate period issuing in EUR and then swapping the proceeds into USD will yield an all-in cost that is about 10bp higher for the immediate settlement period, since the issuer will be paying 5.8% in USD after the currency swap. This issuer will pay USD Libor-90 and then receive EUR Libor flat.

Exercise 7

1. Dirty price is the clean price plus accrued interest = 97 + 3 = 100

2. On the dirty price.

3. Dollars received = 0.97 × 1/0.87 × 40m = 44.59m

(taking into account the exchange rate and the haircut)

4. 3%.

Exercise 8

Going by swap market conventions, the fixed payments for fixed payer swaps are:

- 100 × .0506 × 1 = USD 5.06 million per year
- 100 × .0506 × 1 = Euro 5.06 million per year

Fixed payments for the fixed receiver swaps are:

- 100 × .0510 × 0.5 = JPY 2.55 million per 6 months
- 100 × .0510 × 0.5 = GBP 2.55 million per 6 months