

In the earlier magazine article arbitrage was introduced by considering the case of triangular arbitrage in spot markets. This was a situation where we had a directly quoted rate that could be compared with a rate obtained by working through the cross rate and was described in the previous article as Case 1. The basic principle was to make a profit by buying a currency in the cheaper market and selling the same currency in the market where it was dearer.

The same principle of buying cheap in one market and selling dear in another market can also be applied where an asset has two different values due to differences between the forward rate and the rate that can be derived using interest rate parity. This is the case that we consider here in the remainder of the article started in the magazine. It was also the situation that was examined in the May 2008 exam.

Case 2: A single asset with a difference between its known price now and the price it should be trading at (as implied by discounting its future price by the appropriate risk free interest rate).

A forward contract is an asset with a known price now. This may not be trading at the price implied by discounting its future price by the appropriate risk free interest rate. This can present the possibility of arbitrage. Again there has to be a price difference that can be exploited. The secret to working out what to do is to reason through in a methodical fashion (and write down) what needs to be done to in order to make a profit. A couple of examples should make it clear.

Example 1

Using the same spot rate as before of £1 = \$2 and money interest rates are known to be 5% in the UK and 10% in the USA. To keep it simple we assume that these rates are for one year. If the one year forward rate is given as £1 = \$2.05 this is indicative that the £ is expected to rise against the \$ as is suggested by interest rate parity.

Step 1: calculate deduced rate using interest rate parity

Using the IRPT formula we have:

$$\begin{aligned} \text{£1} &= \$2 \times 1.10/1.05 \\ \text{or} \quad \text{£1} &= \text{US\$}2.0952 \end{aligned}$$

Step 2: write down and compare the two rates

£1 = US\$2.05 (direct quote for forward)	⇐	cheap price for £, dear price for \$
£1 = US\$2.0952 (calculated rate from above)	⇐	dear price for £, cheap price for \$

Step 3: work out what to do from the comparison (and write this down *in detail*)

We need to buy £ and sell \$ through the forward market. We also need to sell £ and buy \$ using IRPT. To buy the \$ we take out a loan in £ now say of £100,000 (this will cost us interest on the loan). We convert this to \$ at the spot rate, depositing the funds in the USA and at the same time cover ourselves against risk by selling these \$ in the forward market. (This is why we have to work out how many \$ we will earn first because the forward contract has to cover the whole amount).

Step 4: the steps in the transactions

Transaction	Start	Action	rate	Calculation	Finish
1	£100,000	Borrow the £s	@ 5%	£100000 x 1.05	Need to repay: £105,000
1a	£100,000	Sell £s to get \$s	@ £1 = \$2	\$100,000 x 2	\$200,000
2	\$200,000	Deposit the \$s	@ 10%	\$200,000 x 1.10	Will receive: \$220,000*
3	\$220,000	Sell these \$s forward	@ £1 = \$2.0500	\$220,000 / 2.0500	£107,317.07

* This is the amount that we have to cover with a forward contract. It is also the amount that has to be considered if the company has trading limits.

Step 5: calculate profit by deducting any transaction costs

$$£107,317.07 - £105,000 = £2,317.07$$

This profit is higher risk than the spot market arbitrage cases because should interest rates be different from those used here during the period then the interest paid and received will alter but there is a commitment to deliver under the forward. If for example interest rates fell in USA and we were unable to secure a fixed rate deposit then the extra dollars would have to be found in the spot market possibly involving a loss and reducing the profit. Similarly a rise in interest rates in the UK would increase costs of borrowing reducing the profit. This latter case is particularly likely if the company has not been able to borrow at fixed rates. There is also always the possibility that the bank in which funds have been deposited in the US fails and yet there is still the obligation to deliver \$s under the forward contract.

Example 2:

This time we use the same information but the one year forward rate is given as £1 = \$2.2000 this is still indicative that the £ is expected to rise against the \$ as is suggested by interest rate parity, but by even more than in the previous example.

Step 1: calculate deduced rate using interest rate parity

Using the IRPT formula we have (as before):

$$\begin{aligned} & \text{£1} = \$2 \times 1.10/1.05 \\ \text{or} & \text{£1} = \text{US\$}2.0952 \end{aligned}$$

Step 2: write down and compare the two rates

$$\begin{aligned} \text{£1} = \text{US\$}2.20 \text{ (direct quote)} & \quad \Leftarrow \quad \text{dear price for £, cheap price for \$} \\ \text{£1} = \text{US\$}2.0952 \text{ (calculated rate from above)} & \quad \Leftarrow \quad \text{cheap price for £, dear price for \$} \end{aligned}$$

Step 3: work out what to do from the comparison (and write this down *in detail*)

We need to sell £ (and buy \$) through the forward market. We also need to buy £ (and sell \$) using IRPT. To do this we need to take out a \$ loan of say \$200,000 (this will cost us interest on the loan). We convert this to £ at the spot rate, depositing the funds in the UK and at the same time cover ourselves against risk by selling these £s for \$s in the forward market. (This is why we have to work out how many \$ it will cost us first because the forward contract has to cover the whole amount).

Step 4: the steps in the transactions

Transaction	Start	Action	rate	Calculation	Finish
1	\$200,000	Borrow the \$s	@ 10%	\$200,000 x 1.10	Need to repay: \$220,000
1a	\$200,000	Sell \$s to get £s	@ £1 = \$2	\$200,000/\$2	£100,000
2	£100,000	Deposit the £s	@ 5%	£100,000 x 1.05	Will receive: £105,000
3	£105,000 (but see below)	Sell these £s forward	@ £1 = \$2.20	£105,000 x 2.20	\$231,000

Step 5: calculate profit by deducting any transaction costs

$$\$231,000 - \$220,000 = \$11,000$$

In this case there is a further complication if we are based in the UK as the profit has been made in \$s which need to be remitted back to the UK. One way to make sure that this would be riskless is to cover the profit with a further forward contract but this is expensive and unnecessary. We only need to adjust the size of the original forward contract to ensure that it is sufficient to meet the loan and interest costs in the USA. In other word we don't sell the whole £105,000 forward: we only sell that amount this is necessary to cover the loan and interest costs i.e. $\$220,000 / 2.20 = £100,000$. Thus we will have made a profit of £5000 (this is the equivalent of \$11,000 at the forward rate of £1 = \$2.20 calculated above). This would modify the third and final leg of the transaction.

The examiner can (and has) made the situation more complicated by using a period of less than one year for the calculation and has also included trading limits and transactions costs.

If a period of less than one year is used we would need to adjust the annual interest rates in both countries for the period. A simple adjustment is acceptable, so if the period is six months simply dividing rates by 2 would be okay.

If there are trading limits you would need to make sure that transactions stayed within the limits. So if we include them in our first example and the limit is set at £100,000, this means that the maximum amount we could deal with under the forward contract would be £100,000 or \$205,000 (converted at forward rate). We would have work backwards from this point using the interest rate in the USA to work out the size of \$ deposit this relates to $(205,000/1.10 =)$ \$186,364. This amount would then need to be converted to £ at spot to work out the size of the loan in the UK to take out $(\$186,364/2 =)$ £93,182. The sequence is shown below in the forward direction:

Transaction	Start	Action	rate	Calculation	Finish
1	£93,182	Borrow the £s	@ 5%	£93,182 x 1.05	Need to repay: £97,841
1a	£93,182	Sell £s to get \$s	@ £1 = \$2	\$93,182 x 2	\$186,364
2	\$186,364	Deposit the \$s	@ 10%	\$186,364 x 1.10	Will receive: \$205,000*
3	\$205,000	Sell these \$s forward	@ £1 = \$2.0500	\$205,000 / 2.0500	£100,000

The profit in this case is obviously less than before: £100,000 - £97,841 = £2,159 less any transaction costs incurred.

The important thing is not to lose sight of what you are doing and a sensible exam preparation strategy would be to ignore the issue of trading limits to start with until you have grasped the general principles that are involved. The figures can then be adjusted later to allow for them.

If transactions costs are included then it is simply a case of counting the number of transactions and multiplying by the given value per transaction and deducting this figure from the profit.