Triangular Arbitrage

1. Doug Bernard specializes in cross-rate arbitrage. He notices the following quotes:

Swiss franc/U.S dollar = SFr 1.5971/$
Australian dollar/U.S. dollar = A$ 1.8215/$
Australian dollar/Swiss franc = A$ 1.1440/SFr

- Ignoring transaction costs, does Doug Bernard have an arbitrage opportunity based on these quotes?
- If there is an arbitrage opportunity, what steps would he take to make an arbitrage profit, and how would he profit if he has $1,000,000 available for this purpose.

Answer

A.

The implicit cross-rate between Australian dollars and Swiss franc is A$/SFr = A$/$ x $/SFr =(A$/$)/(SFr/$) = 1.8215/1.5971 = 1.1405. However, the quoted cross-rate is higher at A$1.1.1440/SFr.

So, triangular arbitrage is possible.

B.

In the quoted cross-rate of A$1.1440/SFr, one Swiss franc is worth A$1.1440, whereas the cross-ratebased on the direct rates implies that one Swiss franc is worth A$1.1405. Thus, the Swiss franc is overvalued relative to the A$ in the quoted cross-rate, and Doug Bernard's strategy for triangular arbitrage should be based on selling Swiss francs to buy A$ as per the quoted cross-rate. Accordingly, the steps Doug Bernard would take for an arbitrage profit is as follows:

i. Sell dollars to get Swiss francs: Sell $1,000,000 to get $1,000,000 x SFr1.5971/$ = SFr1,597,100.

ii. Sell Swiss francs to buy Australian dollars: Sell SFr1,597,100 to buy SFr1,597,100 x A$1.1440/SFr = A$1,827,082.40.

iii. Sell Australian dollars for dollars: Sell A$1,827,082.40 for A$1,827,082.40/A$1.8215/$ =

$1,003,064.73.

Thus, your arbitrage profit is $1,003,064.73 - $1,000,000 = $3,064.73.

2. Assume you are a trader with Deutsche Bank. From the quote screen on your computer terminal, you notice that Dresdner Bank is quoting €0.7627/$1.00 and Credit Suisse is offering SF1.1806/$1.00. You learn that UBS is making a direct market between the Swiss franc and the euro, with a current €/SF quote of .6395. Show how you can make a triangular arbitrage profit by trading at these prices. (Ignore bid-ask spreads for this problem.) Assume you have $5,000,000 with which to conduct the arbitrage.

What happens if you initially sell dollars for Swiss francs? What €/SF price will eliminate triangular arbitrage?

Answer

To make a triangular arbitrage profit the Deutsche Bank trader would sell $5,000,000 to Dresdner Bank at €0.7627/$1.00. This trade would yield €3,813,500= $5,000,000 x .7627. The Deutsche Bank trader would then sell the euros for Swiss francs to Union Bank of Switzerland at a price of €0.6395/SF1.00, yielding SF5,963,253 = €3,813,500/.6395. The Deutsche Bank trader will resell the Swiss francs to Credit Suisse for $5,051,036 = SF5,963,253/1.1806, yielding a triangular arbitrage profit of $51,036.

If the Deutsche Bank trader initially sold $5,000,000 for Swiss francs, instead of euros, the trade would yield SF5,903,000 = $5,000,000 x 1.1806. The Swiss francs would in turn be traded for euros to UBS for €3,774,969= SF5,903,000 x .6395. The euros would be resold to Dresdner Bank for $4,949,481 = €3,774,969/.7627, or a loss of $50,519. Thus, it is necessary to conduct the triangular arbitrage in the correct order.

The *S(€/SF)* cross exchange rate should be .7627/1.1806 = .6460. This is an equilibrium rate at which a triangular arbitrage profit will not exist. (The student can determine this for himself.) A profit results from the triangular arbitrage when dollars are first sold for euros because Swiss francs are purchased for euros at too low a rate in comparison to the equilibrium cross-rate, i.e., Swiss francs are purchased for only €0.6395/SF1.00 instead of the no-arbitrage rate of €0.6460/SF1.00. Similarly, when dollars are first sold for Swiss francs, an arbitrage loss results because Swiss francs are sold for euros at too low a rate, resulting in too few euros. That is, each Swiss franc is sold for €0.6395/SF1.00 instead of the higher no-arbitrage rate of €0.6460/SF1.00.

3. Suppose we have the following data:

iJPY = 1% for 1 year (T=1 year)

iBRL = 10% for 1 year (T=1 year)

S = .025 BRL/JPY

We construct the following strategy, called *carry trade*, to "profit" from the interest rate differential:

Today, at time t=0, we do the following (1)-(3) transactions:

(i) Borrow JPY 1,000 at 1% for 1 year. (At T=1 year, we will need to repay JPY 1,010.)

(ii) Convert to BRL at S = .025 BRL/JPY. Get BRL 25.

(iii) Deposit BRL 25 at 10% for 1 year. (At T=1 year, we will receive BRL 27.50.)

Now, we *wait* 1 year. At time T=1 year, we do the final step:

(iv) Exchange BRL 27.50 for JPY at ST

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If St+T = .022 BRL/JPY, we will receive JPY 1250, for a profit of JPY 240.

- If St+T = .025 BRL/JPY, we will receive JPY 1100, for a profit of JPY 90.
- If St+T = .027 BRL/JPY, we will receive JPY 1019, for a profit of JPY 9.
- If St+T = .030 BRL/JPY, we will receive JPY 916, for a profit of JPY -74.