Group Assignment 1

Problem 1 (Currency Gain):
You have sold ¥104 million at a spot price of ¥104/$. One year later you pay dollars to buy back ¥104 million at the prevailing rate of ¥100/$. How much have you gained or lost in dollars?

Solution:
You initially receive $P_0^{\$} = P_0^{¥}/S_0^{¥/\$}$ = (¥104,000,000)/(¥104/$) = $1 million. When you buy back the yen, you must pay $P_1^{\$} = P_1^{¥}/S_1^{¥/\$}$ = (¥104,000,000)/(¥100/$) = $1.04 million. Your dollar loss is $40,000.

Problem 2 (Bid/Ask Spread and Quotes):

Citigroup quotes Danish Kroner as "DKK5.62/$ Bid and DKK5.87/$ Ask"

(a) Which currency is Citigroup buying at the DKK5.62/$ bid rate, and which currency is Citigroup selling at the DKK5.87/$ offer rate?
(b) What are the bid and ask prices in American terms? Which currency is Citigroup buying at these prices and which currency is Citigroup selling?
(c) With the foreign currency in the numerator, the "DKK5.62/$ Bid and DKK5.87/$ Ask" quotes are indirect quotes for a U.S. Resident. What are the Bid and Ask prices in direct terms for a U.S. Resident? At these prices, which currency is Citigroup buying and which currency is it selling?
(d) If you sell $1 million to Citigroup at a bid price of DKK5.62/$ and simultaneously buy $1 million at their offer price of DKK5.87/$, how many Danish krona (krona is the plural of kroner) will you make or loss? What is Citigroup's kroner profit or loss on the transaction?

Answer:

(a) The bid rate is less than the offer rate, so Citigroup is quoting the currency in the denominator. Citigroup is buying dollars at the DKr5.62/$ bid rate and selling dollars at the DKr5.87/$ offer rate.

(b) In American terms, the bid price is $0.1704/DKr and the ask price is $0.1779/DKr. Citigroup is buying and selling the kroner at these quotes.

(c) In direct terms, the bid quote for the dollar is $0.1779/DKr and the ask price is $0.1704/DKr.

(d) Selling USD 1 million will buy DKK 5.62 million. Then selling those DKK 5.62 million at the DKK5.87/USD is going to buy $DKK\,5{,}620{,}000 \times \frac{1}{DKK\,5.87/USD} = USD\,957{,}410.56$. So you are losing USD42,589.44.

Problem 3 (Forward Premium/Discount):

Credit Suisse First Boston (CSFB) quotes the following rates for the U.S. dollar.

	Bid (€/$)	Ask (€/$)
Spot rate	0.8894	0.8898
1-month forward	0.8938	0.8942
3-month forward	0.9028	0.9032
6-month forward	0.9164	0.9168
12-month forward	0.9443	0.9447

(a) Is the dollar selling at a forward premium or a forward discount? Calculate percentage premiums or discounts for each forward quote. Also state these percentage premiums or discounts on an annualized basis.

(b) Convert these to $/€ quotes for the euro. Is the euro selling at a forward premium or a forward discount? Calculate percentage premiums or discounts (not annualized) for each forward quote on the euro. Also state these percentage premiums or discounts on an annualized basis.

(c) Are the percentage forward premiums on the dollar equal in magnitude to the corresponding forward discounts on the euro? Why or why not?

(d) What would you receive from CSFB if you sold $10 million at the 6-month forward rate?

(e) What would you pay CSFB if you bought €10 million at the 12-month forward rate?

Solution:

(a) The dollar (in the denominator) is selling at a forward premium.

	$ Bid	$ Ask	Premium/discount		Annualized	
			$ Bid	$ Ask	$ Bid	$ Ask
Spot rate	0.8894	0.8898				
One-month forward	0.8938	0.8942	0.50%	0.50%	6.00%	6.00%
Three-month forward	0.9028	0.9032	1.51%	1.51%	6.03%	6.03%
Six-month forward	0.9164	0.9168	3.04%	3.04%	6.08%	6.08%
One-year forward	0.9443	0.9447	6.17%	6.17%	6.17%	6.17%

(b) Quotes and the associated discounts for the euro are as follows:

	€ Bid	€ Ask	Premium/discount		Annualized	
			€ Bid	€ Ask	€ Bid	€ Ask
Spot rate	1.1238	1.1244				
One-month forward	1.1183	1.1188	-0.50%	-0.50%	-5.97%	-5.97%
Three-month forward	1.1072	1.1077	-1.49%	-1.49%	-5.94%	-5.94%
Six-month forward	1.0907	1.0912	-2.95%	-2.95%	-5.90%	-5.90%
One-year forward	1.0586	1.0590	-5.81%	-5.81%	-5.81%	-5.81%

(c) The percentage premiums on the dollar are almost, but not quite, equal in magnitude to the corresponding percentage discounts on the euro. The difference in magnitude is because of the algebra of compound returns. Forward dollar premiums in this problem are based on a 0.5 percent per month forward premium on the dollar. Over 12 months, this compounds to $(1.005)^{12} - 1 = 6.17$ percent dollar premium. The corresponding 12-month euro forward discount is $1/(1.0617) - 1 = -5.81$ percent.

(d) CSFB is buying dollars at their dollar bid price, so you will receive (€0.9028/$) x ($10 million) = €902,800.

(e) CSFB is selling euros and hence buying dollars. CSFB will buy dollars at the dollar bid price, so you will pay (€10 million) / (€0.9447/$) = €1,058,558.

Problem 4 (Interest Rate Parity):

Quotes for the dollar and euro are as follows:

Spot contract midpoint	$S_0^{€/\$}$	= €0.8890/$
One-year forward contract midpoint	$F_1^{€/\$}$	= €0.8960/$
One-year Eurodollar interest rate	$i^{\$}$	= 3% per year

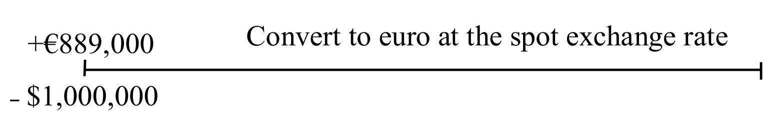
(a) Your newspaper does not quote one-year Eurocurrency interest rates on EU euros. Make your own estimate of $i^{€}$.

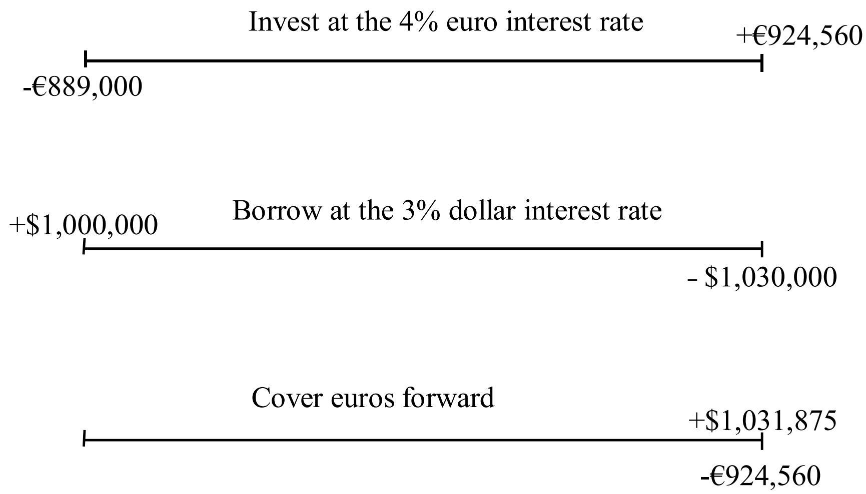
(b) Suppose that you can trade at the prices for $S^{€/\$}$, $F^{€/\$}$ and $i^{\$}$ just given and that you can also either borrow or lend at a Thai Eurocurrency interest rate of $i^{€} = 4\%$ per year. Based on a $1 million initial amount, how much profit can you generate through covered interest arbitrage?

Solution:

(a) $F_t^{€/\$}/S_0^{€/\$} = (1 + i^{€})^t/(1 + i^{\$})^t \Rightarrow i^{€} = (1.03)(€0.8890/\$)/(€0.8960/\$) - 1 = 3.81102\%$

(b) $F_1^{€/\$}/S_0^{€/\$} = (€0.896/\$)/(€0.889/\$) = 1.007874 < 1.009709 = (1+i^{€})/(1+i^{\$}) = (1.0381102)/(1.03)$. So, borrow at $i^{\$}$ and lend at $i^{€}$.





This leaves a net gain at time 1 of $1,031,875 - $1,030,000 = $1,875, which is worth $1,875/1.03 = $1,820 in present value.

Problem 5 (Triangular Arbitrage):
You go to a bank and are given these quotes:

- You can buy a euro for 14 pesos.
- The bank will pay you 13 pesos for a euro.

- You can buy a US dollar for 0.9 euros.
- The bank will pay you 0.8 euros for a US dollar.

- You can buy a US dollar for 10 pesos.
- The bank will pay you 9 pesos for a US dollar.

You have $1,000. Can you use triangular arbitrage to generate a profit? If so, explain the order of the transactions that you would execute and the profit that you would earn, If you cannot earn a profit from triangular arbitrage, explain why.

Solution:

Without transaction costs, $S^{MXP/euro} \times S^{euros/USD} \times S^{USD/pesos} = 1$. With transaction costs, we need to use the relevant exchange rate which make the arbitrage more difficult. If we use the midpoint between the bid and ask quotes, we get,

$$S^{MXP/euro} \times S^{euros/USD} \times S^{USD/pesos} = \frac{13.5\ pesos}{1\ euro} \times \frac{0.85\ euro}{1\ USD} \times \frac{1\ USD}{9.5\ pesos} = 1.2079$$

Given that the number is greater than 1, the currencies in the denominator are overvalued. Therefore, we sell the currencies in the denominator to buy the currencies in the numerator, taking care of the appropriate exchange rates,

- Sell euros and buy pesos
- Sell USD and buy euros
- Sell pesos and buy USD

Investing \$1,000 this strategy will yield,

- Sell USD and buy euros(2): $-USD\,1{,}000 \rightarrow +USD\,1{,}000 \times \dfrac{0.8\,euros}{1\,USD} = +800\,euros$
- Sell euros, buying pesos (1): $-800\,euros \rightarrow +800\,euros \times \dfrac{13\ pesos}{1\,euro} = 10{,}400\ pesos$
- Sell pesos, buy USD (3): $-10{,}400\ pesos \rightarrow +10{,}400\ pesos \times \dfrac{1\,USD}{10\ pesos} = USD\,1{,}040$

Therefore, despite transaction costs, your profit is \$40 from you initial investment of \$1,000 (4%).

Problem 6 (Real exchange Rate and RPP percentage Changes):
One year ago, the spot exchange rate between the Japanese yen and Swiss franc was $S_{-1}^{¥/SFr}$ = ¥160/SFr. Today, the spot rate is $S_0^{¥/SFr}$ = ¥155/SFr. Inflation during the year was $p^{¥}$ = 2 percent and p^{SFr} = 3 percent in Japan and Switzerland, respectively.

(a) What was the percentage change in the nominal value of the Swiss franc?
(b) One year ago, what nominal exchange rate would you have predicted for today based on the differences in inflation rates?
(c) What was the percentage change in the real exchange rate, $X_0^{¥/SFr}$, during the year?
   1. What was the percentage change in the relative purchasing power of the franc?
   2. What was the percentage change in the relative purchasing power of the yen?

Solutions:

(a) $s^{¥/SFr} = (S_0^{¥/SFr})/(S_{-1}^{¥/SFr})-1$ = (¥155/SFr)/(¥160/SFr) -1 = -3.125%.

(b) From relative purchasing power parity, the spot rate should have been:

$E[S_0^{¥/SFr}] = (S_{-1}^{¥/SFr})\,[(1+p^{¥})/(1+p^{SFr})]$ = (¥160/SFr) [(1.02)/(1.03)] = ¥158.45.

(c) As a difference from the expectation, the real change in the spot rate is:

$x^{¥/SFr}$ = (Actual-Expected)/(Expected) = $(S_0^{¥/SFr} - E[S_0^{¥/SFr}])/E[S_0^{¥/SFr}]$

= (¥155/SFr-¥158.45/SFr)/¥158.45/SFr = -2.18%.

Alternatively, change in the real exchange rate is equal to:

$x^{¥/SFr} = \left((S_0^{¥/SFr})/(S_{-1}^{¥/SFr})\right)\left((1+p^{SFr})/(1+p^{¥})\right) - 1$

= ((¥155/SFr)/(¥160/SFr)) ((1.03)/(1.02)) - 1 = -2.18%.

(d) The franc depreciated by 2.18% in purchasing power.

(e) In real terms, the yen rose by

$$x^{SFr/¥} = \left((S_0^{SFr/¥}) / (S_{-1}^{SFr/¥})\right) \left((1+p^{¥}) / (1+p^{SFr})\right) - 1$$

$$= \left((S_0^{¥/SFr})^{-1} / (S_{-1}^{¥/SFr})^{-1}\right) \left((1+p^{¥}) / (1+p^{SFr})\right) - 1$$

$$= \left((¥155/SFr)^{-1} / (¥160/SFr)^{-1}\right) \left((1.02)/(1.03)\right) - 1 = +2.23\%$$

$$= \left((SFr.0064516/¥)/(SFr.00625000/¥)\right) \left((1.02)/(1.03)\right) - 1 = +2.23\%.$$

Because the SFr fell by 2.18% in real terms, the yen rose by 1/(1-0.0218) ≈ 2.23%.