1. CURRENCY RISK. Spot and Forward Foreign Exchange Rates. Theories

Basic terms

Currency risk definition – schedule from the first lecture

Currency risk management involves choice of foreign assets (instruments), currency portfolio structuring and choice of currencies.

Currency systems
- system of fixed exchange rates
- system of floating exchange rates

International Currency Market
It is the wholesale market in which major banks trade with one another. Transactions between major banks account for about 95% of foreign exchange transactions. The standard transaction amount is about $10 million.

Quatations
- direct
- indirect

Transaction Costs

(1) $$\text{Percent spread} = \frac{\text{Ask price - Bid price}}{\text{Ask price}} \times 100$$

Appreciation, depreciation, revaluation, devaluation

Currency return (appreciation, or depreciation):

(2) $$r_d = \frac{S_t - S_{t-1}}{S_{t-1}} = \frac{S_t}{S_{t-1}} - 1 = \frac{\Delta S_{t-1}}{S_{t-1}}$$

where
r_d – percentage change in the spot exchange rate using the domestic perspective,
S_t – spot exchange rate today,
S_{t-1} – spot exchange rate yesterday,
ΔS_t - change in the spot exchange rate.

The percentage return from the foreign investor's perspective:

(3) $$r_f = \frac{\frac{1}{S_t}}{\frac{1}{S_{t-1}}} - 1 = \frac{S_{t-1}}{S_t} - 1 = \frac{1}{1+r_d} - 1 = \frac{-r_d}{1+r_d}$$

Continuously compounded returns

$$(4) \qquad r_d^* = \ln\left(\frac{S_t}{S_{t-1}}\right) = \ln(1 + r_d)$$

$$(5) \qquad r_f^* = \ln\left(\frac{\frac{1}{S_t}}{\frac{1}{S_{t-1}}}\right) = \ln(1 + r_f)$$

$$(6) \qquad r_d = e^{r_d^*} - 1$$
$$r_f = e^{r_f^*} - 1$$

Problem 1. Currency Return

The spot foreign exchange rate was 4,0 PLN/USD yesterday.
The current exchange rate is 4,2 PLN/USD.
(a) Calculate the appreciation rate for the dollar.
(b) Calculate the depreciation rate for the zloty.
(c) Calculate the continuously compounded appreciation rate for the dollar.
(d) Calculate the continuously compounded depreciation rate for the zloty.

Solution

(a)

S_0 = 4 PLN/USD
S_1 = 4,2 PLN/USD

The appreciation rate for the dollar is

5%

(b)

$1/S_0$ = 0,2500 USD/PLN
$1/S_1$ = 0,2381 USD/PLN

The depreciation rate for the zloty is

$$r_f = \frac{-r_d}{1 + r_d} = -4{,}8\%$$

(c)

The continuously componded appreciation rate for the dollar is

ln(4,2 : 4,0) = 4,879%

(d)

The continuously componded depreciation rate for the zloty is

ln(0,2381 : 0,2500) = -4,879%

Siegel's paradox

If two investors have the same expectations about the possibilities for future exchange rates, the expected values of the exchange rates from the two perspectives are not reciprocals of each other (Jensen's inequality).

Problem 2. Siegel's paradox

The forecasted exchange rates are 3,0 PLN/USD with a probability of 0,5 and 5,0 PLN/USD with a probability of 0,5.
(a) Calculate appropriate exchange rates for the zloty (USD/zł).
(b) Calculate the expected exchange rates for the dollar and the zloty.
(c) Calculate reciprocal exchange rates and compare with exchange rates in (b).

Solution

(a)

Probability	PLN/USD		USD/PLN	
0,5	S_1 =	3,0	$1/S_1$ =	0,3333
0,5	S_2 =	5,0	$1/S_2$ =	0,2000

(b)

	PLN/USD	USD/PLN
Expected exchange rates	4	0,2667

(c)

	USD/PLN	PLN/USD
Reciprocal relationships	0,2500	3,7500

Spot and forward exchange rates

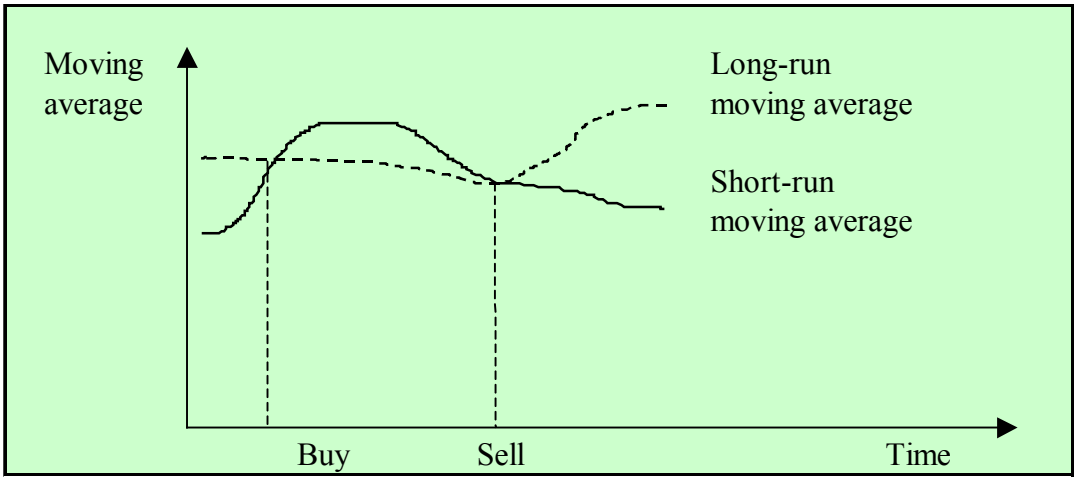
(7) $$F = S_0 \frac{\left(1 + i_d^N T\right)}{\left(1 + i_f^N T\right)}$$

Forward premium (or discount)

(8) $$f = \frac{F - S_0}{S_0} = \frac{F}{S_0} - 1$$

(9) $$f^* = \ln(1+f) = \ln\left(1 + i_d^N T\right) - \ln\left(1 + i_f^N T\right) = \left(i_d^{N*} - i_f^{N*}\right)T$$

Forecasting exchange rates with technical methods



Structural Models of Exchange Rate Determination

1. Purchasing Power Parity

Absolute purchasing power parity

$$(10) \quad S_0 = \frac{P_d}{P_f}$$

where
S_0 – spot exchange rate
P_d – the current price of commodity in home currency units,
P_f – the current price of commodity in foreign currency units.

Relative purchasing power parity

$$(11) \quad E(S) = S_0 \frac{(1+\pi_d T)}{(1+\pi_f T)}$$

2. Tinternational Fisher Effect

$$(12) \quad 1+i^N T = (1+i^R T)(1+\pi T)$$

gdzie:
π - the expected inflation rate
i^N – the annualized nominal interest rate,
i^R – the annualized real interest rate.

$$(13) \quad \frac{(1+i_d^N T)}{(1+i_f^N T)} = \frac{(1+\pi_d T)}{(1+\pi_f T)}$$

gdzie:
i_d^N - nominalna stopa procentowa w skali rocznej w kraju,
i_f^N - nominalna stopa procentowa w skali rocznej za granicą.

Uncovered interest arbitrage

$$(14) \quad E(S) = S_0 \frac{(1+i_d^N T)}{(1+i_f^N T)}$$

Covered interest arbitrage

$$(15) \quad F = S_0 \frac{(1+i_d^N T)}{(1+i_f^N T)} \qquad \text{lub} \qquad F = S_0 e^{(i_d^{N*} - i_f^{N*})T}$$

3. Balance of payments

4. Monetary models

- flexible price monetary model (Frenkel, Kouri i Mussa)
- sticky price monetary model (Dornbusch)

5. The Asset Market Approach (exchange rate dynamics)

Problem 3. Covered Interest Arbitrage

Assume that you can borrow 1000 USD or 4600 zł to make an arbitrage profit.
The current spot exchange rates and spot interest rates are as follows:

	bid	ask	
foreign exchange spot rate	4,5000	4,6000	PLN/USD
interest rate on zloty deposits	17,00%	18,00%	
interest rate on dollar deposits	5,00%	6,00%	

(a) Show the series of arbitrage operations for the one-year long currency position. What is the marginal forward rate. Calculate an arbitrage profit, when the market forward rate is 4,9570 PLN/USD.

(b) Show the series of arbitrage operations for the one-year short currency position. What is the marginal forward rate. Calculate an arbitrage profit, when the market forward rate is 5,1795 PLN/USD.

Solution

(a)

	Today		One year later			
	USD	PLN	USD	PLN		
Borrow USD	1000		-1060		6,00%	ask interest rate
Sell USD		4500			4,5000	bid exchange rate
Deposit PLN		-4500		5265	17,00%	bid interest rate
Buy forward USD			1060		4,9670	marginal exchange rate
		result	0			

Marginal forward exchange rate (bid): 4,5000*(1+17%)/(1+6%)=4,9670

At 4,9570 PLN/USD, the forward exchange rate is too low. We need to buy.

Buy forward USD	4,9570	1062
	result	2

(b)

	Today		One year later			
	PLN	USD	PLN	USD		
Borrow PLN	4600			-5428	18,00%	ask interest rate
Buy USD		1000			4,6000	ask exchange rate
Deposit USD		-1000	1050		5,00%	bid interest rate
Sell forward USD				5428	5,1695	marginal exchange rate
			result	0		

Marginal forward exchange rate (ask): 4,6000*(1+18%)/(1+5%)=5,1695

At 5,1795 PLN/USD, the forward exchange rate is too high. We need to sell.

Sell forward USD	5,1795	5439
	result	11