1. Currency Derivatives. Forward. Futures. Currency Interest Rate Swap. Currency Basis Swap. Currency Options

1.1 Currency Derivatives

1.1.1 FX Forward

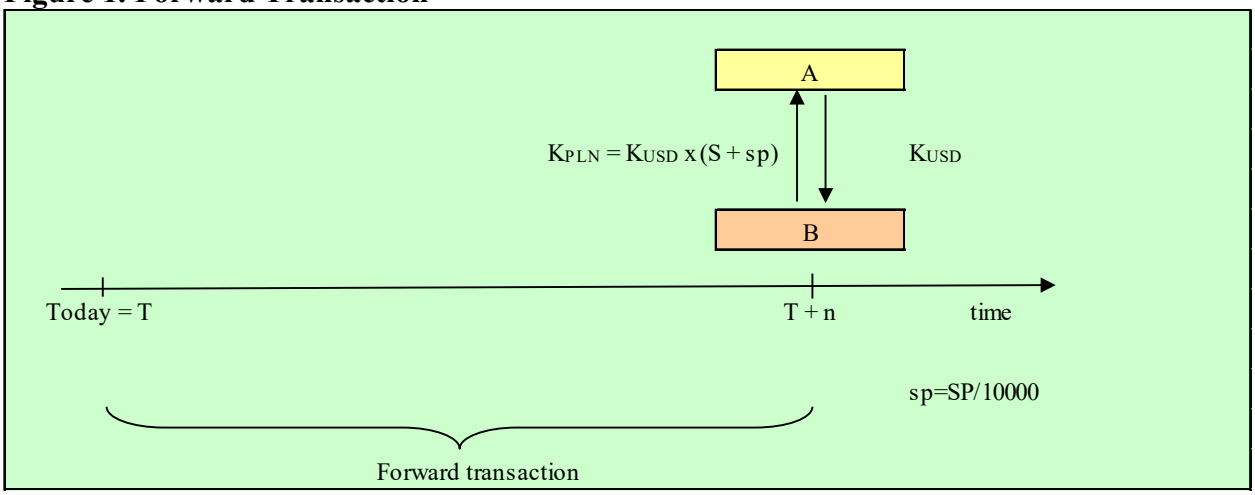
FX forward contracts are nonstandardized transactions that call for the exchange of some quantity of a foreign currency at a future date. Sometimes it is called outright forward to emphasize that there is no corresponding spot transaction. Non-delivery forward (NDF) assumes only cash settlement at a future date. Maturities range from 1 week to 1 year. Transactions are mostly executed between banks.

In practice forward contracts offered by banks are not negotiated. Banks (dealers) offer standardized transactions, which may be accepted by a second party and transaction is concluded. The second party of a forward contract may be one of two types: end user or other dealer. An end user is typically a corporation, government or an individual.

The dealer quotes a bid and ask price or rate. The bid is the price at which the dealer is willing to pay and the ask price is the price at which the dealer is willing to sell. The competition makes bid-ask spreads low. Dealers make a profit from the market making activity. Usually they do not hold the exposure. They offset the exposure with other derivative or spot transactions.

Forward contracts are usually settled at maturity. But it is also possible to terminate the position prior to expiration by entering a new forward contract expiring at the same time as the original contract. To completely offset the original forward position the second transaction must be with the same counterparty. The termination of the original forward position with the other counterparty does not eliminate credit risk.

Figure 1. Forward Transaction



Source: author.

Problem 1. Swap Points and Forward Exchange Rates

EUR/USD Swap Points on Thursday, 8 December 2016.

Maturity	Spot Date	Maturity	Bid	Ask
SPOT		08-12-2016	1.0787	1.0788
ON	08-12-2016	09-12-2016	0.27	0.29
TN	09-12-2016	12-12-2016	0.79	0.95
SN	12-12-2016	13-12-2016	0.28	0.31
SW	12-12-2016	19-12-2016	2.40	2.55
2W	12-12-2016	27-12-2016	5.94	6.01
3W	12-12-2016	03-01-2017	14.14	14.74
1M	12-12-2016	12-01-2017	18.96	19.36
2M	12-12-2016	13-02-2017	34.17	34.52
3M	12-12-2016	13-03-2017	47.42	48.11
4M	12-12-2016	12-04-2017	64.45	65.01
5M	12-12-2016	12-05-2017	79.03	80.43
6M	12-12-2016	12-06-2017	93.62	97.62
7M	12-12-2016	12-07-2017	113.14	114.24
8M	12-12-2016	14-08-2017	130.76	131.90
9M	12-12-2016	12-09-2017	146.82	148.68
10M	12-12-2016	12-10-2017	165.03	166.47
11M	12-12-2016	13-11-2017	183.82	185.36
1Y	12-12-2016	12-12-2017	200.25	201.75
15M	12-12-2016	12-03-2018	256.17	260.55
18M	12-12-2016	12-06-2018	315.61	322.61
21M	12-12-2016	12-09-2018	379.23	384.23
2Y	12-12-2016	12-12-2018	442.47	447.70
30M	12-12-2016	12-06-2019	570.42	590.42
3Y	12-12-2016	12-12-2019	711.90	726.90
4Y	12-12-2016	14-12-2020	990.61	1016.39
5Y	12-12-2016	13-12-2021	1264.94	1299.05
6Y	12-12-2016	12-12-2022	1569.00	1594.00
7Y	12-12-2016	12-12-2023	1768.75	1808.75
8Y	12-12-2016	12-12-2024	2083.00	2113.00
9Y	12-12-2016	12-12-2025	2290.00	2330.00
10Y	12-12-2016	14-12-2026	2365.00	2410.00
12Y	12-12-2016	12-12-2028	2831.00	2906.00
15Y	12-12-2016	12-12-2031	3301.00	3401.00
20Y	12-12-2016	12-12-2036	4115.00	4265.00

Calculate forward exchange rates for EUR/USD.

Solution

(1) $$F_{bid} = S_{bid} + \frac{SP_{bid}}{10000}$$

(2) $$F_{ask} = S_{ask} + \frac{SP_{ask}}{10000}$$

F – forward exchange rate,

S – spot exchange rate,

SP –swap points.

	Forward Bid	Forward Ask
ON	1.078727	1.078829
TN	1.078779	1.078895
SN	1.078728	1.078831
SW	1.078940	1.079055
2W	1.079294	1.079401
3W	1.080114	1.080274
1M	1.080596	1.080736
2M	1.082117	1.082252
3M	1.083442	1.083611
4M	1.085145	1.085301
5M	1.086603	1.086843
6M	1.088062	1.088562
7M	1.090014	1.090224
8M	1.091776	1.091990
9M	1.093382	1.093668
10M	1.095203	1.095447
11M	1.097082	1.097336
1Y	1.098725	1.098975
15M	1.104317	1.104855
18M	1.110261	1.111061
21M	1.116623	1.117223
2Y	1.122947	1.123570
30M	1.135742	1.137842
3Y	1.149890	1.151490
4Y	1.177761	1.180439
5Y	1.205194	1.208705
6Y	1.235600	1.238200
7Y	1.255575	1.259675
8Y	1.287000	1.290100
9Y	1.307700	1.311800
10Y	1.315200	1.319800
12Y	1.361800	1.369400
15Y	1.408800	1.418900
20Y	1.490200	1.505300

1.1.2 FX Futures

FX futures are standardized exchange traded contracts calling for delivery of a specified quantity of a foreign currency at a fixed date in the future. Investors must post margin, which is marked to market daily.

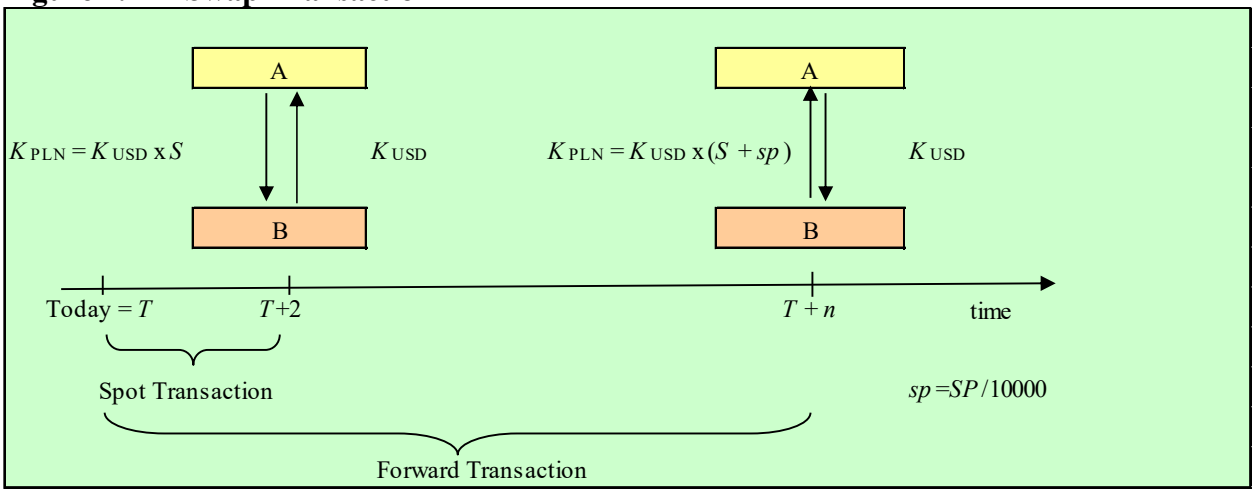
FX futures were introduced in September 1998 on Warsaw Stock Exchange. There were also traded on Warsaw Commodities Exchange and Polish Financial Exchange. All FX futures contracts are settled in cash.

1.1.3 FX Swap

FX swap is a transaction in which one (foreign) bank makes a foreign currency deposit in a second (domestic) bank and simultaneously the second (domestic) bank makes a domestic currency deposit in the first (foreign) bank. The typical size of transaction is USD 10 million. Such transaction is a real financial transaction (just two real deposits). This transaction developed enormously from 1999 as it offered short-term zloty financing for foreign traders investing in Polish government bonds and T-bills offering extremely high real interest rates.

An FX swap transaction is just a combination of spot and forward.

Figure 2. FX Swap Transaction



Source: author.

1.1.4 CIRS

A cross currency interest rate swap (CIRS) is an agreement to exchange principal and interest payments in one currency for principal and interest payments in another currency. Because the cash flows are denominated in different monetary units the interest payments are exchanged on each settlement date (there are no **net** interest payments). The principal amounts are usually exchanged at the origination and generally exchanged on maturity of the agreement.

For a local counterparty A (in the below Exhibit) CIRS provides liquidity in the foreign currency.

Currency swap is just an exchange of borrowing and lending. When a counterparty A initiates a swap transaction, it borrows foreign currency (pays an ask exchange rate, and pays an ask foreign interest rate, receives a bid local interest rate).

CIRS is a collateralized transaction. For a counterparty A the received foreign currency is a collateral for a loan in local currency to a counterparty B. For a counterparty B the received local currency is a collateral for a loan in foreign currency to a counterparty A.

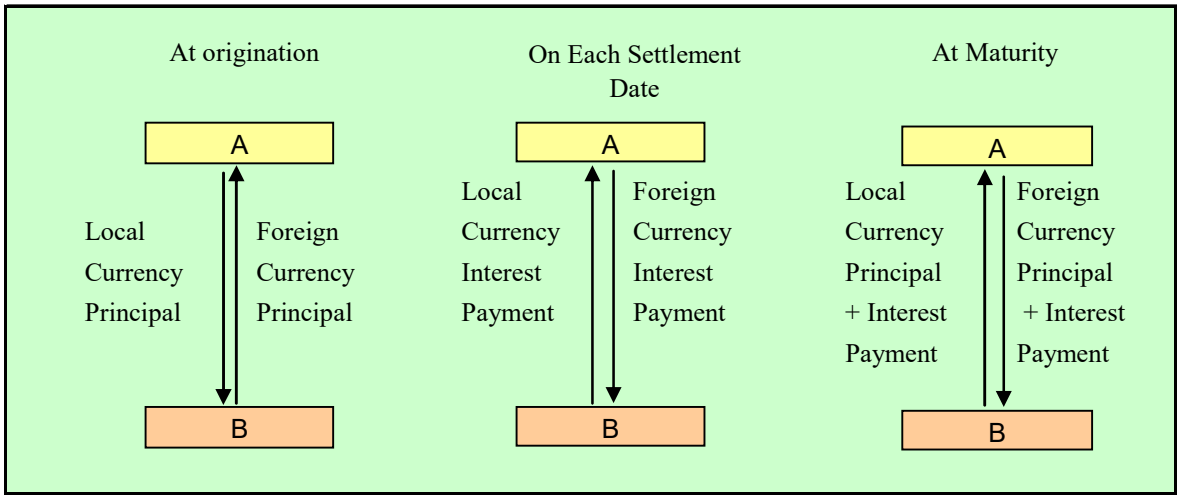


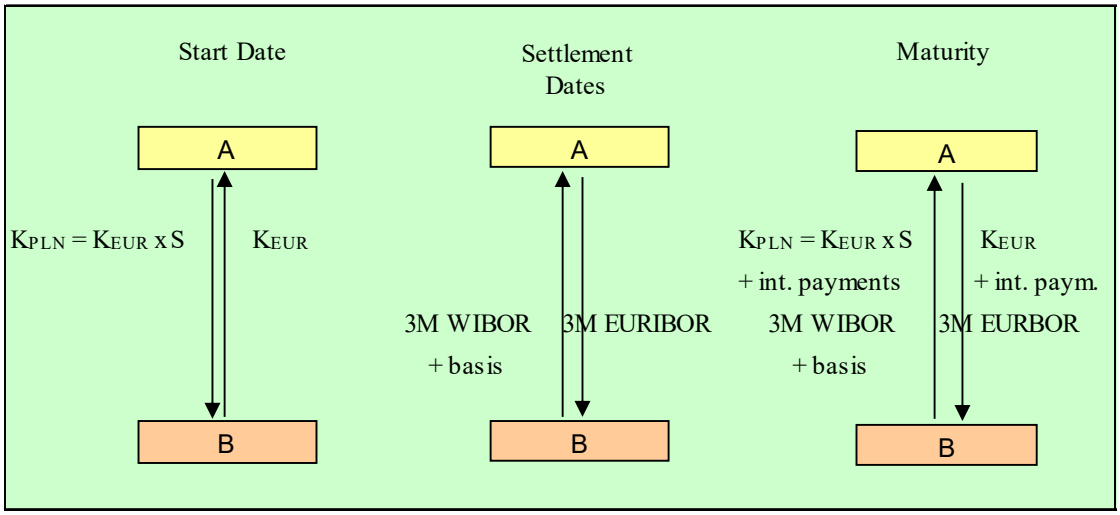
Exhibit 3. Currency Interest Rate Swap
Source: author.

The first currency may be local (or foreign) and the second currency may be foreign (or local). The fixed rate may be any negotiated rate (also off the market rate). In the following text and examples I assume that nonadjusted fixed rates are equal to the actual market IRS rates (bid, ask or mid). Such an assumption allows to show CIRS spreads against IRS rates.

The CIRS interest rates can be expressed on either a fixed rate or a floating rate basis adjusted by an upfront fee or a spread. This leaves the following possibilities:

1. a fixed rate (IRS rate) in the first currency, the fixed rate (IRS rate) in the second currency and the upfront fee,
2. a fixed rate (IRS rate) + spread in the first currency and the fixed rate (IRS rate) in the second currency,
3. a fixed rate (IRS rate) + spread in the first currency and the floating rate in the second currency,
4. a floating rate + spread in the first currency and the fixed rate (IRS rate) in the second currency,
5. a floating rate + spread in the first currency and the floating rate in the second currency (CBS transaction),
6. a fixed rate (IRS rate) in the first currency and the fixed rate (IRS rate) + spread in the second currency,
7. a floating rate in the first currency and the fixed rate (IRS rate) + spread in the second currency,
8. a fixed rate (IRS rate) in the first currency and the floating rate + spread in the second currency,
9. a floating rate in the first currency and the floating rate + spread in the second currency (CBS transaction).

1.1.5 CBS



1.1.6 Currency Options

FX options in Poland are offered by few banks. Quotations are in the form implied volatilities (Garman-Kohlhagen formula is used to calculate option premium). Banks and dealers quote prices for option combinations (strategies): straddle, strangle, sea-gull and risk reversal with maturities from 1 week to 1 year. The FX option market is an OTC (dealer) market

1.2 Currency forward pricing

The fair price of a foreign exchange forward contract is:

$$F = S_0 \frac{\left(1 + i^N_{Md} T\right)}{\left(1 + i^N_{Mf} T\right)} \quad (3)$$

where

S_0 – the spot exchange rate,

i^N_{Md} - nominal domestic interest rate,

i^N_{Mf} - nominal foreign interest rate.

T – time to expiration.

The implied repo rate is:

$$i^N_d = \frac{\left[\frac{F_M\left(1 + i^N_f T\right)}{S_0} - 1\right]}{T} \quad (4)$$

Problem 2. Pricing of Currency Forward

The forward exchange rate is 4,6400 zł/USD. Life of the contract: 78 days. Current spot exchange rate is: 4,5709zł/USD. Domestic risk-free interest rate is 18,00%, foreign interest rate is 6,00%.
(a) Calculate the "fair" futures price on this contract and the implied repo rate.
What arbitrage positions would create this rate.
(b) It is now 30 days later. The spot exchange rate is 4,5600.
Calculate the forward price and the value of the contract.
(c) What is the value of the forward contract at expiration. The spot exchange rate is 4,5000.

Solution

(a)

The "fair" forward exchange rate is

$$F = S_0 \frac{\left(1 + i^N_{Md} T\right)}{\left(1 + i^N_{Mf} T\right)} \qquad = \ 4{,}676867 \qquad 4{,}68822$$

The implied repo rate is

$$i^N_d = \frac{\left[\frac{F_M\left(1 + i^N_f T\right)}{S_0} - 1\right]}{T} \qquad 13{,}07\%$$

The annualized cost rate is 13,07% plus transaction costs.

An investor should

1. borrow foreign currency at 6,00%,
2. sell currency at the current spot rate.
3. invest local currency at 18,00%,
4. buy cheap currency forward.

Ad 2.

$$W_t = \frac{S_t}{\left(1 + r^f\right)^{T_1}} - \frac{F_0}{\left(1 + r\right)^{T_1}}$$

4,525191 - 4,540096 = -0,0149

Ad 3.

4,5000 - 4,6400 = -0,1400