WORLD 1 / CHAPTER 3

FX OPTIONS

FX OPTIONS

1. Option terminology

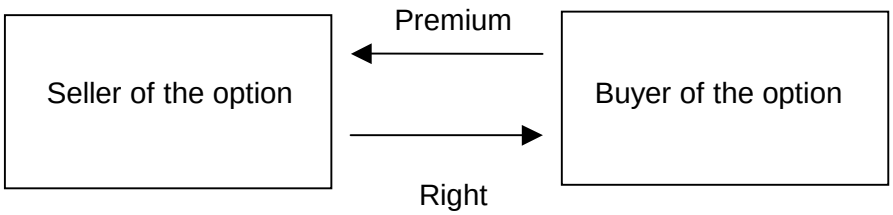
Ever since the mid-eighties currency options have become an additional liquid instrument in the FX market.

An FX option gives the right - but not the obligation - to the option buyer to buy (or to sell) a defined currency amount at an agreed rate (strike price) during the option term. This means that the holder has the right to exercise the option if this gives him an advantage compared to the actual market rates.

A Call option gives the right to buy, a put option gives the right to sell a currency. The seller of the option receives a premium for giving this right to the buyer. This premium has to be paid on the day the option is traded.

DEFINITION	***LONG BUY/HOLD***	***SHORT SELL/WRITE***
	RIGHT	OBLIGATION
PUT		
	to SELL	to BUY
	RIGHT	OBLIGATION
CALL		
	to BUY	to SELL

The seller of an option has the obligation to buy (or to sell) a defined currency amount at an agreed rate during the life of the option. For this obligation he receives a premium.



As option trader you have **four** possible **strategies**:

- By **buying a Call option** you acquire the right to buy an agreed amount of a currency at the expiry date. If the market rate on the expiry date is lower than the agreed price, the option will not be exercised and the currency can be bought spot. During the term of the option you can also profit from low market rates by buying the currency at any time at 'low' rates.

  Use of a long call: Hedging instruments for companies importing goods; hedging a short position; trading a long position with limited risk.

- By **selling a Call option** the seller has the obligation to sell the currency at the strike price at expiry, if the buyer decides to exercise. For undertaking this risk the seller receives a premium.

  Use: By selling a call against a long position, the option premium reduces the average buying price. This strategy however gives no hedge against declining rates and cuts the profit potential in case of higher rates.

- By **buying a Put option** you buy the right to sell the currency at the agreed price at expiry. In case of a higher rate at expiry the buyer of the option does not exercise and may sell at the higher market rate. Possible higher rates during the term can be locked in by selling (outright) the currency.

  Use: A hedge for export oriented companies; hedge against a long spot position; trading short position.

- The **seller of a Put option** takes on the obligation to buy the currency at the agreed price at expiry; if the buyer of the option decides to exercise. For taking on this risk the seller receives a premium.

  Use: A company being short a currency can bring down the average price by selling puts.

American / European options

An American option is an option that can be exercised at any trading day during the life of the option.

A European option is an option that can only be exercised on the expiry date.

In the money / the money / out of money

An option **at the money** has a strike price around the actual market rate. If the strike price is compared to the spot rate, the option is called at the money spot. By comparing the strike with the outright rate, the option is called at the money forward.

An option is **in the money** if the strike is better than the market rate. For a call this means that the strike is below the market rate. The put is in the money if the strike is higher than the market rate.

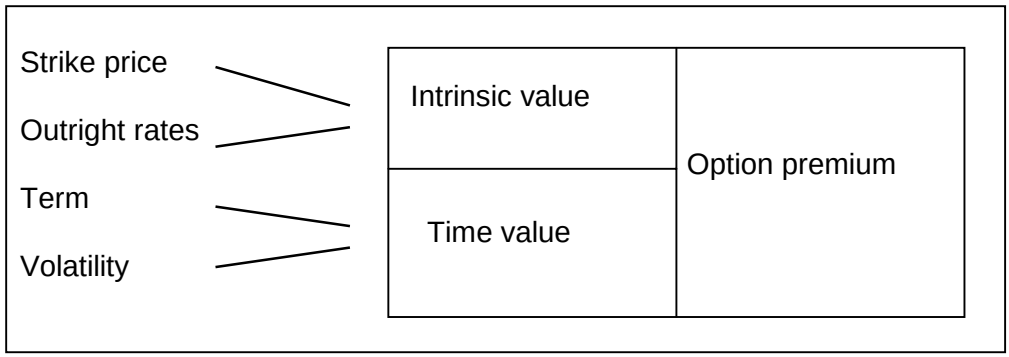
An option is **out of money** if the market rate is better than the strike rate. For a call out of money this means a lower market than the strike. A put is out of money if the market rate is higher than the strike.

Dates in the option contracts

- The trading date is the day when the option is dealt.
- Premium payment date is the day when the option premium has to be paid, usually 2 bank days after the trading day.
- Exercise day is the last day on which the option seller accepts the exercise of the option.
- Expiration day is the last day on which the option seller accepts the exercise.
- Settlement day for American options is 2 bank days after exercise date and for European options 2 bank days after the expiry date.

Factors affecting the option price

Factors affecting the price of the premium



- If an option has an intrinsic value this means that the strike price is better than the out-right rate. All calls with lower strikes than the outright rate and all puts with higher strikes than the outright rate have an intrinsic value (or are in the money).

- The time value of an option is a combination of the term of the option and the expected volatility during that term. The volatility is the measure for the variability of the exchange rates or underlying prices. There can be differentiated between historical and implicated volatility. The historical volatility is calculated out of historical data. The implicated volatility is calculated assuming the option-pricing formula.

GBP/USD Spot	1.7000
Outright rate	1.6800
Premium put for a strike of 1.6700	3 Cent
Intrinsic value put	2 Cent
Time value put	1 Cent

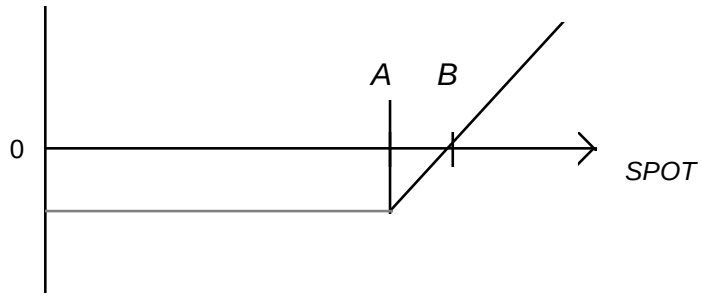
Option-premiums are quoted in the variable currency and in per cent of the contract volume.

GBP/USD Put, Strike 1.7000 , premium 2.0 %. If you buy the put with contract volume of GBP 5 mn you pay a premium of GBP 100,000 (= 5 mn x 0.02)

2. Profit and loss profiles

Call Options

Long Call Strike A, B = Break-even (Strike + Premium)



Loss for spot < Strike + Premium

Profit for spot > Strike + Premium

The break-even is reached, if the spot rate is above the strike plus premium on expiration day. The maximum loss is the premium.
Between point A and point B, exercising the option is profitable but not enough to cover the cost of the premium, therefore you make a loss.

Example

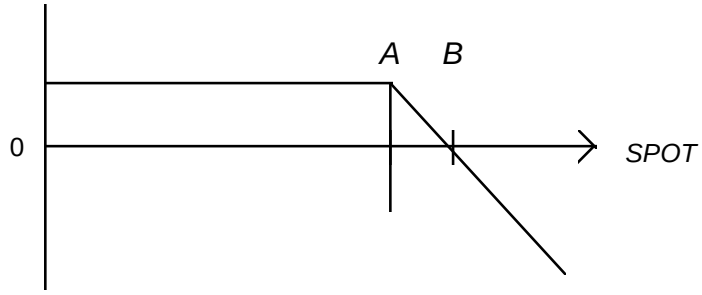
Buy Call EUR/USD: Strike 1,0200. premium: 1 Ct.

P&L in USD with the following EUR/USD Spot values at expiration day:

- 1,0100
- 1,0250
- 1,0300
- 1,0400

	1,0100	*1,0250*	*1,0300*	*1,0400*
Option – Long Call	0	+0,005	+0,01	+0,02
premium	-0,01	-0,01	-0,01	-0,01
total	-0,01	-0,005	0	+0,01

- Short Call Strike A, B= Break-even (Strike + Premium)



Loss for spot > Strike + Premium

Profit for spot < Strike + Premium

At expiration day the seller of the option makes a proft as long as the spot price stays below the strike price plus premium.
The potential loss is theoretically unlimited.

The maximum gain is the premium. Between point A and B the spot value is above the strike price, but the seller gains more from the premium as he loses from the option.

Example

Sell Call EUR/USD: Strike 1,0200

premium: 1 Ct

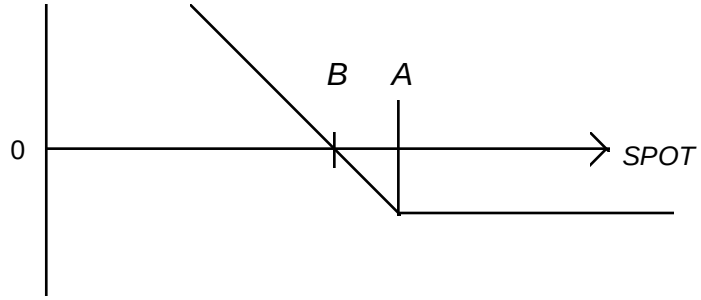
P&L in USD with the following EUR/USD Spot prices at expiration day:

- 1,0100
- 1,0250
- 1,0300
- 1,0400

	1,0100	*1,0250*	*1,0300*	*1,0400*
Option – Long Call	0	-0,005	-0,01	-0,02
premium	+0,01	+0,01	+0,01	+0,01
total	+0,01	+0,005	0	-0,01

Put Options

Long Put Strike A, B= Break-even (Strike – Premium)



Loss for spot > Strike – Premium

Profit for spot < Strike – Premium

The break-even is reached if the spot price at the expiration day is below the strike price minus premium. The maximum loss is the premium. Between Point A and B the spot price is below the strike price but the buyer of the option gains less from exercising the option than he has payed for it. Anyway the buyer reduces his premium costs.

Example

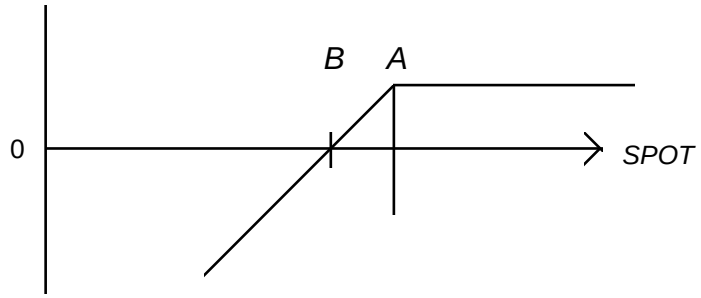
Buy Put EUR/USD: Strike 1,0200. premium: 1 Ct.

P&L in USD with the following EUR/USD spot prices at expiration date:

- 0,9050
- 1,0100
- 1,0200
- 1,0300

	0,9050	*1,0100*	*1,0200*	*1,0300*
Option – Long Put	+0,0250	+0,01	0	0
Premium	-0,01	-0,01	-0,01	-0,01
Total	+0,0150	0	-0,01	-0,01

- Short Put Strike A, B= Break-even (Strike – Premium)



Loss for spot < Strike – Premium

Profit for spot > Strike – Premium

For the seller the option is profitable untill the spot price at expiration is below the strike price. In this case the gain from the premium is less than the loss from the option exercise buy the buyer of the option. The loss is theoretically limited by a spot price with zero. But because a short put option is from the risk orientated sight a long position in the underlying (= risk of falling prices) and long FX-positions have unlimited risk, the risk of short put positions is also unlimited.
The maximum gain is the premium. Between Point A and B the spot price is below the strike but the seller gains more from the premium as he loses from the option.

Example

Sell Put EUR/USD: Strike 1,0200. premium: 1 Ct.

P&L in USD with the following EUR/USD spot prices at expiration:

- 0,9050
- 1,0100
- 1,0200
- 1,0300

	0,9050	***1,0100***	***1,0200***	***1,0300***
Option – Short Put	-0,0250	-0,01	0	0
Premium	+0,01	+0,01	+0,01	+0,01
Total	-0,0150	0	+0,01	+0,01

The tables show that the results for buyers and sellers are inverted.

Strategie

Straddle

A Straddle is the purchase resp. the sale of a call and a put with the same strike.

	Long Straddle	*Short Straddle*
purchase / sale	purchase Call, purchase Put	sale Call, sale Put
Strikes	same, mostly at the money	same, mostly at the money
maturity	same	same

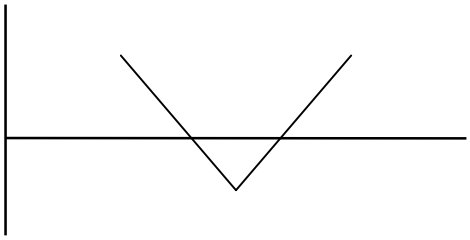
Why is a straddle used?

A **Long Straddle** gains with exchange-rate fluctuations (= volatility) independent of the direction. Because the positions is purchased at-the-money a Long is a agressive position. If the underlying does not fluctuate much the relatively high premium is lost.

A **Short Straddle** is used if low volatilities are expected. If the expected volatility is met, the premium is earned, if there are stronger fluctuations than expected the loss is proportional higher the higher the fluctuations are.

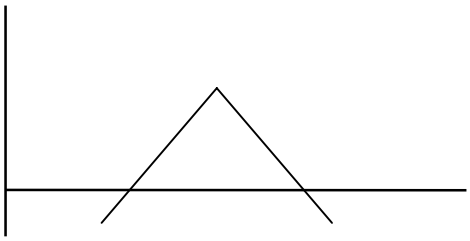
Long Straddle

Long call and long put, same term, same strike, normally at the money.



Short Straddle

Short call and short put, same term, same strike, normally at the money.



Strangle

A Strangle is the purchase resp. The sale of a Call and a Put with different Strike-prices.

	Long Strangle	*Short Strangle*
Purchase / Sale	buy Call, buy Put	sell Call, sell Put
Strikes	different, out of the money	different, out of the money
maturities	same	same

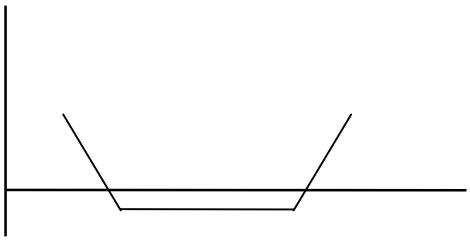
Why are Strangles dealt?

The **Long Strangle** gains if there are exchange rate strong fluctuations (= volatility) independent from the direction. In comparision with the Straddle is the maximum loss smaller, because the options are purchased out of the money, but the maximum loss is also higher. Because of the out-of-the-money purchase of the option is the leverage-effect of the Strangle higher than for the Straddle.

For the **Short Strangle** the expected volatility is lower. The effects are contrary to the Long Strangle.

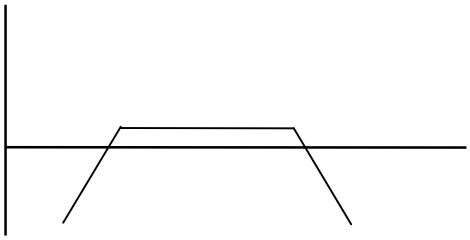
Long Strangle

Long call and long put, same term, different strikes, usually out of the money.



Short Strangle

Short call and short put, same term, different strikes, usually out of the money.



Spread

A Spread is the purchase and sale of a call or of a put. Contrary to the straddle or strangle this strategy is a

- buy and sell strategy
- strategy with only one optiontype

	vertical spread	*horiziontal spread *)*	*diagonal spread *)*
purchase / sale	buy / sell Call or buy / sell Put	buy / sell Call or buy / sell Put	buy / sell Call or buy / sell Put
Strikes	different, one in the money, the other out of the money	same	different, one in the money, the other out of the money
Laufzeiten	Ident	Verschieden	Verschieden

**) not often used in practice*

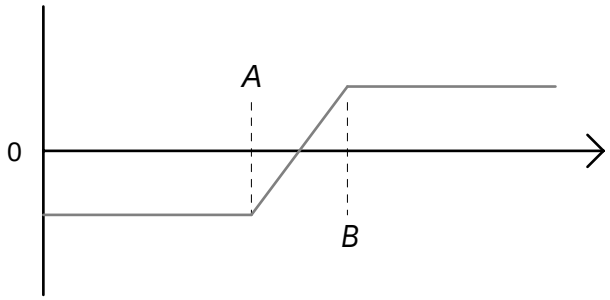
The most usual Spread-Strategie is the vertical Spread. There is differntiated between **Bull** and **Bear Spreads.**

Bull Spread

Bull Spreads are usually formed with call options, with one call purchased in or at the money and one call sold out of the money.
If a Bull spread is traded with put options, one put is written in the money and the other put is purchased out of the money.

Example

Long call basis A, short call basis B, same term

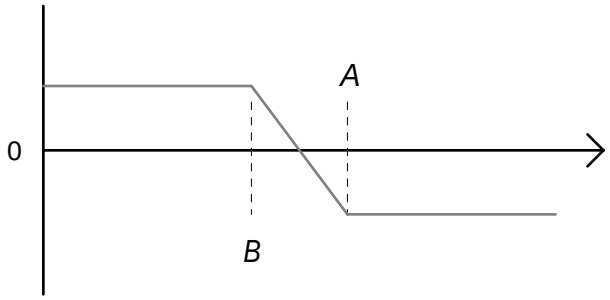


Bear Spread

A bear Spread is usually formed with a sold put in or at the money and a put which is purchased out of the money.
As well Bear Spreads can be constructed with call options (sell in the money call plus buy out of the money call).

Example

Long put basis A, short put basis B, same term



3. Option pricing

The option market started to boom with the development of option pricing models. These models determine the price of an option as a function of variables like market data, volatility, strike price, term and interest rates.

The best known valuation model in option markets is the Black-Scholes model, published in 1973 by F. Black and M. Scholes. It was originally used for pricing share options. In later publications the models were adjusted for other markets.

The main difference between FX and share options is that the foreign currency interest rates have to be integrated in the Black-Scholes model as continuos dividend payments. For FX options the option price is influenced by the interest rates in both currencies. The differences in the assumptions and in the valuation formula were published in an essay by Mark B. Garman and Steven W. Kohlhagen (December 1982).

The Garman-Kohlhagen valuation model still is - even if slight modifications were done - the most common FX option valuation model.

The price of a call is the following:

$$CALL = \frac{1}{\left(1 + i_B \cdot \frac{T}{B_B}\right)} \cdot \left\{\left[O \cdot N(d1)\right] - \left[S \cdot N(d2)\right]\right\}$$

with:

$$d_1 = \frac{\ln\left(\frac{O}{S}\right) + \left(0{,}5 * V^2 * T\right)}{V * T^{1/2}}$$

$$d_2 = d_1 - V \cdot T^{0.5}$$

S = Strike
O = Outright
V = Volatility
T = Term of the option (in % of a year)
I_B = Interest rate p.a. in decimals, base currency
N(.) = Cumulative normal distribution
B = Day base (360 or 365)

The so called put-call-parity helps to determine the price of a put once the call price is known and vice versa.

$$\text{Put} = \text{Call} + \frac{(S - O)}{\left(1 + \left(i_V \cdot \frac{T}{B_V}\right)\right)}$$

$$\text{Call} = \text{Put} + \frac{(O - S)}{\left(1 + \left(i_V \cdot \frac{T}{B_V}\right)\right)}$$

The reasoning behind the call put parity is the no arbitrage condition. By selling a call and shortening the underlying, you can resemble the profit/loss profile of a put. Note, that this is only valid for European options. The put/call parity is best illustrated by an example

Example

USD/CHF option

Strike	1.46
Call price	5.52 Rp
Spot rate	1.45
Outright	1.4714
Interest rate variable currency	2½ %
Term	90 days
Basis of term calculation	360

$$\text{Price of a put} = 0.0552 + \frac{(1.46 - 1.4714)}{(1+0.025)^{0,25}} = 0.0406708 \text{ or } 4.07 \text{ Rp}$$

Is the market price of the put is, e.g., 4.50 Rp., a risk-free profit can be realised by selling the put, selling the outright and buying the call

Spot rate at expiry	Premium	1.3000	1.4000	1.5000	1.6000
Sell put 1.46	+ 0.0450	– 0.1600	– 0.0600	-	-
Sell outright at 1.4714		+ 0.1714	+ 0.0714	– 0.0286	– 0.1286
Buy call 1.46	– 0.0552	-	-	+ 0.0400	+ 0.1400
Total premium	– 0.0102				
Total premium incl. Interests	– 0.0103	– 0.0103	– 0.0103	– 0.0103	– 0.0103
Total:		+ 0.0011	+ 0.0011	+ 0.0011	+ 0.0011

As the theoretic put price is 11 BP cheaper than the market price, these 11 BP can be arbitraged.

Note: The option premium has to be paid in advance, whereas the results of the options and of the outright deal are only realised at the end of the term. Therefore interests on the paid premium have to be calculated.

Example

In our example:

$$0.0102 \cdot \left(1 + 0.025 \cdot \frac{90}{360} = 0.0103\right)$$

Exkurs: Put-Call parity

The put-call parity is the possibility to rebuilt any call- or put-position buy the use of a combination of thee underlying and a put- resp. a call-option.
For the FX-market the following statements are true:

Long outright + long put	= long call
Long outright + short call	= short put
Short outright + short put	= short call
Short outright + long call	= long put

Underlying positions can be rebuilt with options too:

Short put + long call = long underlying
Short call + long put = short underlying

The put-call parity can also been used for optionpricing. If the put-call parity does not hold arbitrage is possible.

4. Exotic options: Overview

Exotic options (second generation options) are characterised by more complex return/risk profiles. Minimal trading volume ranges from about USD 5 to USD 20 mio.

Average-rate-option/Weighted-rate-option (ARO) / Asian option

Compared to a standard option, the intrinsic value of an average option is the difference between the strike price and the **average** spot rates. The computation of the average price can be done at any moment during the life of the option. The average rate option usually is less expensive than the standard option and is cash-settled at expiry.

Compound option

The option gives the right to the buyer to buy a standard option at a given price and at a given date. The better the strike of the compound option, the higher the premium of the option and the higher the probability that the strike premium ends in the money and leads to low total costs. By exercising the compound option, the acquired option works like a standard option.

Down and out call option/Up and out put option

(Knock out barrier options)

An out option is a standard option, expiring immediately when the spot reaches a determined level during a determined term (out strike). As this option may expire earlier than a standard option it is less expensive.

- Down-and-out-call option
- Up-and-out-put option

Reverse Knock-Out (Kick-Out)

Knock-out options with outstrike point in the money

- Up-and-out-Call
- Down-and-out-Put

Double Kock-out

Knock-out options with two outstrike points

Alternative (dual) option

An alternative call (put) option gives the buyer the right to buy (sell) one of two currencies (but not both) against a third defined currency.

Look back option

At expiry of a look back call option the buyer of the option receives the difference between the spot at expiry and the lowest rate during the term (for a look back put: highest rate).

Contingent option

The premium of this option is paid only, if the option ends in the money. If the option ends out of money or at the money, no premium is paid.

Ladder option

A ladder option has the characteristic that the strike price may be changed to the advantage of the buyer if there are certain changes in the spot rate. For a put the strike price goes up, if the spot rate touches a defined level. For the call the strike price decreases if spot rates touch a defined level.

Deferred strike option

This option allows the buyer to fix the strike price during the term of the option. This strike price is defined with an agreed formula at the trading date.

Basket option

An option on a basket of underlyings.

Lock in option

An option, where a certain profit - if achieved during the term - is guaranteed.

Better of option

An option on many underlyings, where the best one can be chosen at expiry.

Chooser option

An option where the buyer can choose between a call and a put option on expiry.

Knock in option (kick in the end option)

Standard option, that only starts once a given kick in level is touched (comparable to knock out options).

Double kock in option

Kock in option with two instrike points.

Rebate option

An option where the premium is paid back if a determined spot level is reached.

Bandwith option

The buyer gains from minor price movements within a certain range (like a short Strangle). The amount paid to the buyer at the expiry date depends on how often the option was in the agreed range on certain dates during the life of the option. In this, bandwith options differ from short Strangles

Rebate option

An option where the premium is paid back if a determined spot level is reached.

One touch (lock-in, touch digital) / double one touch

A distinct amount is payed if a prespecified spot-price is reached once during the maturity of the one touch option. The double one touch option has two distinct spot-prices as touch levels.

No touch (lock-out) / range binary (double no touch)

A distinct amount is payed if a prespecified spot-price is never reached during the maturity of the no touch option. The range binary has two distinct spot-prices as no touch points.