

➔ 6. barrier interest rate options

MIFID complexity

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Barrier options are a more cost-efficient protection than the vanilla options against rising or falling interest rates. In return of lower option premium, the level of protection is only partial.

There are several kinds of barrier interest rate options:

Barrier cap and floor options are built up of series of options similarly to plain vanilla options.

Barrier cap options are built up of caplets and barrier floor options are built up of floorlets. Cap and floor options are tied to an interest period. Barrier cap and floor options are built up of as many caplets or floorlets as the number of remaining interest periods from the given deal.

The barrier is an interest rate fixed in advance and reaching it comes with consequences that are fixed before concluding the transaction.

the barrier can be either European or American type.

- European barrier means that reaching the barrier interest rate level has consequences only for the given interest period, so it affects only the given caplet or floorlet
- American barrier means that reaching the barrier interest rate level has consequences for all the remaining interest periods, so it affects every remaining caplet or floorlet.

On the interbank market the European type barrier is the most widely used, so our Bank provides this type of barrier to our Clients.

according to the consequences of reaching the barrier (trigger) level we can speak about knock in and knock out levels.

- if the European knock in level is reached, the given caplet or floorlet comes into effect, but only for the given interest period. In the next period the caplet or floorlet comes into effect only if the trigger level is reached again
- if the European knock out level is reached, the caplet or floorlet terminates, but only for the given interest period. In the next interest payment period, the caplet or floorlet terminates only if the trigger level is reached again.

A) European knock out cap

The European knock out cap is a cap option, in which a European knock out level is built above the cap strike.

The knock out cap provides protection for its buyer in every interest rate period, where on the fixing date the floating interest rate is above the cap strike and below the knock out level. That is the barrier level

is watched separately for each caplet. If on the fixing date of a caplet:

- the floating interest rate reaches or exceeds the knock out level, only the caplet will be terminated (i.e. knocked out).
- the floating interest rate is below the knock out level and above the cap strike, the caplet is paid on the previously fixed settlement date (in general at the end of the interest period).
- the floating interest rate is below the cap strike, there is no payment between the parties

The premium, which is a percentage of the nominal value, is usually charged upfront when the contract is concluded.

B) European knock out floor

The European type knock out floor is a floor option, in which a European knock out level is built under the floor strike.

The knock out floor provides protection for its buyer in every interest period, where on the fixing date the floating interest rate is below the floor strike and above the knock out level. That is the barrier level is watched separately for each caplet. If on the fixing date of a caplet:

- the floating interest rate is below the knock out level, only the floorlet will be terminated (i.e. knocked out).
- the floating interest rate is above the knock out level and below the floor strike, the floorlet is paid on the previously fixed settlement date (in general at the end of the interest period).
- the floating interest rate is above the floor strike, there is no payment between the parties

The premium, which is a percentage of the nominal value, is usually charged upfront when the contract is concluded.

C) European knock in cap

The European knock in cap is a cap option, in which a European knock in level is built above the cap strike.

The knock in cap provides protection for its buyer in every interest period, where on the fixing date the floating interest rate is above the barrier. That is the barrier level is watched separately for each caplet.

If on the fixing date of a caplet:

- the floating interest rate exceeds the knock in level, the caplet will come into effect (i.e. knocked in). The caplet is paid on the previously fixed settlement date (in general at the end of the interest period).
- the floating interest rate is below the knock in level, the caplet does not come into effect and there is no payment between the parties

The premium, which is a percentage of the nominal value, is usually charged upfront when the contract is concluded.

D) European knock in floor

The European knock in floor is a floor option, in which a European knock in level is built below the floor strike.

The knock in floor provides protection for its buyer in every interest period, where on the fixing date the floating interest rate is below the barrier. That is the barrier level is watched separately for each caplet.

If on the fixing date of a caplet:

- the floating interest rate is below the knock in level, the floorlet will come into effect (i.e. knocked in). The floorlet is paid on the previously fixed settlement date (in general at the end of the interest period).
- the floating interest rate is above the knock in level, there is no payment between the parties

The premium, which is a percentage of the nominal value, is usually charged upfront when the contract is concluded

example: purchase of a knock-out cap: a company has a EUR 300 000 floating-rate loan with 3 years to maturity, on which it will be paying interest quarterly on the 3-month EURIBOR rate. There is no amortization during the maturity; repayment is at the end of the maturity in one sum. The current 3-month EURIBOR is 0.50%. The fixed EUR market reference rate is 0.85% In the middle term, this company expects interest rates to increase by less than what is expected by the market (ie. the yield curve), but it would also like to exclude any scenario in which its financing expenses would suddenly exceed 1.00% annually. Buying a normal (without knock-out) cap option costs 0.40% of the notional, which is too expensive for the company. The company does not expect the 3 month EURIBOR to increase above 2% in the coming 3 years. Therefore it buys a knock-out cap option with an option strike at 1% with a knock-out level of 2% for a tenor of 3 years for which it pays 0.12% of the notional. By buying the knock-out cap option it ensures that the expenditures of the loan will not exceed the level of 1% in each period (+the proportional part of the cap option premium that was paid) as long as the 3 month EURIBOR is between 1% and 2% two days before the starting date of the period.

The purchase of a knock-out cap offers a relative protection for the floating rate payer:

Two banking days before the start of the each interest period, the strike of the cap is compared to the 3-month EURIBOR level. If 3-month EURIBOR:

- is lower than the cap strike, no settlement is made for that period.
- exceeds the cap, but not the barrier, the difference between the cap strike and 3-month EURIBOR, applied on the notional amount and for the time period will be paid to the client. The settlement will occur at the end of the interest period.
- is higher or equal to the KO barrier, no settlement is made for that period.

In most cases settlement is based on the reference interest rate fixing 2 days before the end of the interest period, however it is possible to agree otherwise.

So the cap buyer is protected against higher rates until the barrier level and will benefit from EURIBOR rates lower than the cap strike. The barrier has a quarterly reset: its activation on a specific quarter will only affect that specific period. Following quarters may produce a pay-out if conditions are met.

parameters of the knock-out cap option (with European barrier)	
notional	EUR 300 000
tenor	3 years
variable notional	no
cap strike	1.00%
knock-out barrier	2.00% (applicable separately to each interest period)
frequency of interest payment	quarterly
fixing day of floating interest rate	2 working days before onset of given interest period
interest rate calculation convention	actual number of days/360
settlement of interest payments	net, at the end of each interest period
precondition for settlement of cap interest payment	if the 3-month EURIBOR fixing rate is between 1,00% and 2,00% two banking days before the start of the interest period
current 3-year ICAP EURO offer rate against 6-month EURIBOR (Day count: ANN 30/360 vs 6M EURIBOR)	0.85%
current 3-month EURIBOR	0.50%
option premium (paid by the client on the trade date)	0.12% * notional, EUR 360 up front (approx. 0.042% p. a., EUR 32 payable every 3 months)
possible scenarios at the end of each interest period assuming that on the fixing dates the 3-month EURIBOR is	
A) On the fixing days 3-month EURIBOR below 2.00%	
A/1) 3-month EURIBOR above 1.00%	your company pays 1% interest on the loan in every interest period
A/2) 3-month EURIBOR below 1.00%	your company pays 3-month EURIBOR on the loan in every interest period
B) on the fixing days 3-month EURIBOR reaches or exceeds 2.00%	your company pays 3-month EURIBOR on the loan in every interest period
best-case scenario (treasury transaction on a standalone basis)	On every fixing day 3 month EURIBOR below 2.00% and above 1.00%. Your company receives of the time proportional difference between 1.00% and 3 month EURIBOR for the actual notional amount in each interest rate period.
worst-case scenario (treasury transaction on a standalone basis)	On every fixing day 3 month EURIBOR is at or above 2.00%. No net settlement between the parties. The loss of your company is equal to the option premium.

the market value of the position one year after the contract conclusion from the customer's point of view

market value: the cost of liquidating the position calculated at a given point of time and under the prevailing market terms and conditions (in case of a positive value the company can close the transaction with profit)

(assumption: there is parallel shift in the entire yield curve in the extent of the change of the 3-month EURIBOR, and the shape of the yield curve remains unchanged)

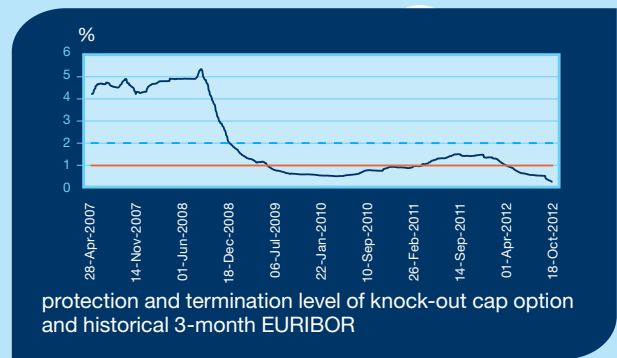
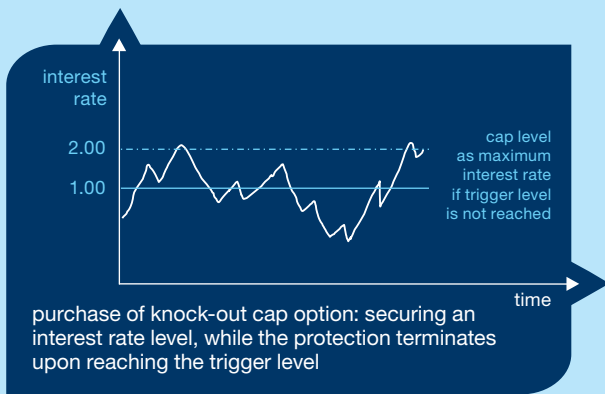
The number of possible outcomes is unlimited, and there may be even more extreme values than the ones presented below.

3-month EURIBOR in one year (%)	market value of the position (EUR)
- 1.00	0
0.50	270
2.00	1 965

financial outcome of some possible scenarios 1 year after the trade date, supposing that the 3-month EURIBOR evolves as below in the last quarter of the given year

The number of possible financial outcomes is unlimited, and there may be even more extreme values than the ones presented below.

end of period (outstanding principal EUR 300 000)	3-month EURIBOR at the start of the interest period (%)	underlying exposure's financial outcome with no treasury transaction (3 months' interest expense without cap, EUR)	profit / loss of the product on a standalone basis (net settlement at the end period, payable by client if value is "+", EUR)	underlying exposure's financial outcome with the treasury transaction, hedged position (3 months' interest expense with cap and premium, EUR)	underlying exposure's financial outcome with the treasury transaction, hedged position (3 months' interest expense with 0,60% IRS, EUR)
1 year	-1.00	-750	0	$-(750 - 31.5) = 718.5$	450
1 year	0.00	0	0	31.5	450
1 year	0.50	375	0	$(375 + 31.5) = 406.5$	450
1 year	1.50	1 125	-375	$(750 + 31.5) = 781.5$	450
1 year	2.50	1 875	0	$(1875 + 31.5) = 1 906.5$	450



The chart shows the interest level(s) of the treasury deal and the historical evolution of 3 month EURIBOR. The historical data is intended merely to compare the interest level(s) of the deal to the historical rates. Future evolution of interest rates and interest changes for the remaining tenor are unforeseeable in advance, actual profit and loss depends on the interest rate prevailing on the fixing days. The chart is not suitable to forecast interest rates and market value of the position.

example for purchase of a knock-in floor with European barrier: a company wishes to hedge its interest income from its floating rate deposit for 3 years. The current 3-month EURIBOR is 0.50%. The fixed EUR market reference rate is 0.85% In the middle term, this company expects interest rates to increase by more than what is expected by the market (ie. the yield curve), but it would also have protection against a sharp decline in interest rates. The company would like to exclude any scenario in which interest rates drop below 1.00% annually and to optimize costs the company takes the risks that the protection comes into effect only below the 0.3% knock-in level. Therefore it buys a knock-in floor option with an option strike at 1% with a knock-in level of 0.3% for a tenor of 3 years for which it pays 1.10% of the notional up front. By buying the knock-in floor option it ensures that the interest income of the deposit will not drop below the level of 1% in each period (+the proportional part of the floor option premium that was paid) as long as the 3 month EURIBOR is under 0.30% two days before the starting date of the period. However, above the knock-in level there is no protection against falling interest rates.

The purchase of a knock-in floor offers a relative protection for the floating rate payer:

Two banking days before the start of the each interest period, the strike of the cap is compared to the 3-month EURIBOR level. If 3-month EURIBOR:

- is lower than the barrier, the difference between the floor strike and 3-month EURIBOR, applied on the notional amount and for the time period will be paid to the client. The settlement will occur at the end of the interest period.
- is higher than the barrier, no settlement is made for that period.
- is higher than the floor strike, no settlement is made for that period.

In most cases settlement is based on the reference interest rate fixing 2 days before the end of the interest period, however it is possible to agree otherwise.

So the knock-in floor buyer is protected against interest rates lower than the floor strike in case interest rates are lower than the knock-in level. The company can benefit from interest rates higher than the floor strike without limit.

The barrier has a quarterly reset: its activation on a specific quarter will only affect that specific period. Following quarters may produce a pay-out if conditions are met.

parameters of the knock-in floor option (with European barrier)	
notional	EUR 300 000
tenor	3 years
variable notional	no
cap strike	1.00%
knock-in barrier	0.30% (applicable separately to each interest period)
frequency of interest payment	quarterly
fixing day of floating interest rate	2 working days before onset of given interest period
interest rate calculation convention	actual number of days/360
settlement of interest payments	net, at the end of each interest period
precondition for settlement of floor interest payment	if the 3-month EURIBOR fixing rate is below 0.30% two banking days before the start of the interest period
current 3-year ICAP EURO offer rate against 6-month EURIBOR (day count: ANN 30/360 vs 6M EURIBOR)	0.85%
current 3-month EURIBOR	0.50%
option premium (paid by the client on the trade date)	1.10% * notional, EUR 3 300 up front (approx. 0.3657%, EUR 275.36 every 3 months if paid in quarterly installments)
possible scenarios at the end of each interest period assuming that on the fixing dates the 3-month EURIBOR is	
3-month EURIBOR above 0.30%	your company receives 3-month EURIBOR interest on the deposit in every interest period
3-month EURIBOR below 0.30%	your company receives 1.00% interest on the deposit in every interest period
best-case scenario (treasury transaction on a standalone basis)	On every fixing day 3 month EURIBOR below 0.30%. Your company receives the time proportional difference between 1.00% and 3 month EURIBOR for the actual notional amount in each interest rate period.
worst-case scenario (treasury transaction on a standalone basis)	On every fixing day 3 month EURIBOR above 0.30%. No net settlement between the parties. The loss of your company is equal to the option premium.

the market value of the position one year after the contract conclusion from the customer's point of view

market value: the cost of liquidating the position calculated at a given point of time and under the prevailing market terms and conditions (in case of a positive value the company can close the transaction with profit) (assumption: there is parallel shift in the entire yield curve in the extent of the change of the 3-month EURIBOR, and the shape of the yield curve remains unchanged)

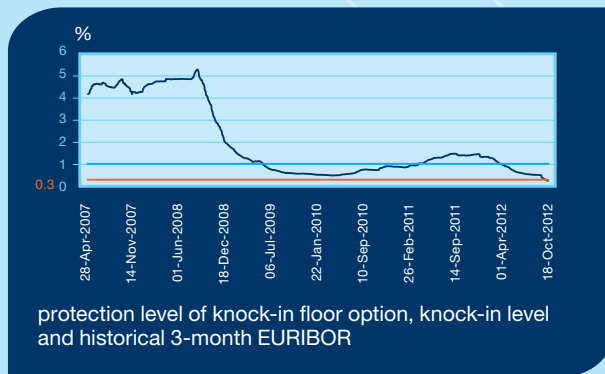
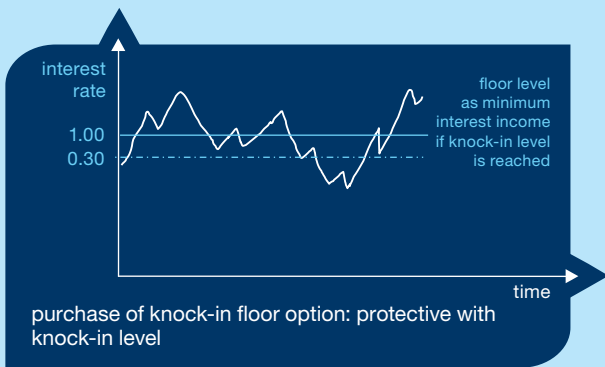
The number of possible outcomes is unlimited, and there may be even more extreme values than the ones presented below.

3-month EURIBOR in one year (%)	market value of the position (EUR)
-1.00	1 620
0.50	1 076
2.00	0

financial outcome of some possible scenarios 1 year after the trade date, supposing that the 3-month EURIBOR evolves as below in the last quarter of the given year

The number of possible financial outcomes is unlimited, and there may be even more extreme values than the ones presented below.

end of period (outstanding principal EUR 300 000)	3-month EURIBOR at the start of the interest period (%)	underlying exposure's financial outcome with no treasury transaction (3 months' interest income without knock-in floor, EUR)	profit / loss of the product on a standalone basis (net settlement at the end period, receivable by client if value is "+", EUR)	underlying exposure's financial outcome with the treasury transaction, hedged position (3 months' income with floor and premium, EUR)	underlying exposure's financial outcome with the treasury transaction, hedged position (3 months' interest income with 0,60% IRS, EUR)
1 year	-1.00	-750	1 500	$-(750 - 275.63) = 474.37$	450
1 year	0.00	0	750	$(750 - 275.36) = 474.37$	450
1 year	0.50	375	0	$(375 - 275.36) = 99.37$	450
1 year	1.50	1 125	0	$(1 125 - 275.36) = 849.37$	450
1 year	2.50	1 875	0	$(1 875 - 275.36) = 1599.37$	450



The chart shows the interest level(s) of the treasury deal and the historical evolution of 3 month EURIBOR. The historical data is intended merely to compare the interest level(s) of the deal to the historical rates. Future evolution of interest rates and interest changes for the remaining tenor are unforeseeable in advance, actual profit and loss depends on the interest rate prevailing on the fixing days. The chart is not suitable to forecast interest rates and market value of the position.

advantages of transaction

- purchase of a barrier option is more cost effective than a plain vanilla option with the same strike, but the protection may terminate upon reaching the barrier or the protection comes into effect only when reaching the barrier level.
- possibility to benefit from advantageous changes in interest rates
- a buyer of the barrier option receives a right, thus the position can never have a negative market value
- the only cost is the option premium
- available for both loans and deposits
- an option can be attached to a loan taken out from, another financial institution, because the interest rate option is (in legal terms) separate from the underlying loan or deposit transaction
- available in most liquid currencies
- start and expiry dates, strike and barrier, as well as the frequency of interest payments can be set at your will, in accordance with your expectations, plans and budget; the change of one parameter will cause the rest of the parameters to change, too.
- available for any kind of repayment schedule.
- your position can be closed at any time by means of a counter-deal (selling of the option) in the market.

risks of transaction

- barrier options cannot be considered a perfect hedge, as the protection will disappear when mostly needed. Barrier interest rate options may be combined with other interest rate options to produce effective hedges at an attractive cost.
- similarly to an insurance premium, the option premium is paid either up-front, or at the end of each interest period, evenly spread over the tenor of the contract
- similarly to foreign exchange options, interest rate options also involve the paradox that the holder of the option is in a better situation if at expiry there is no need to exercise the option (below the cap strike)
- when the underlying loan is prepaid or the deposit is broken, it is advisable to close the interest rate option, as well, because the risk arising from the underlying business activity is no longer there. When closing the deal, that is, on selling the option, you may incur a loss; although an option never has a negative value, you may receive less on selling your option than what you paid as a premium when the contract was made. Similarly if you wish to buy back the previously sold option it is possible that the price is much higher. The value of a cap option increases as interest rates rise (up to the barrier), and can even come to zero if interest rates are cut sharply. The value of a floor option decreases as interest rates fall (until to the barrier), and can even come to zero if interest rates are cut sharply.
- the market value of interest rate derivatives is determined by the evolution of market interest rates, the length of interest rate periods, the number of days remaining until the expiry of the transaction, the day-count method and the evolution of the notional until expiry. In the case of an interest rate option the evolution of market volatility also influences the market value. The drop in market liquidity could lead to a bid-offer spread widening, which could also affect the market value of the position negatively.
- the change in market value could lead to an obligation of temporary or permanent increase of collateral which may affect the company's liquidity and solvency negatively. In case of exceptional market circumstances (eg, money market and other crisis) the negative market value of the position from the Client's viewpoint could reach so extreme levels that providing the adequate collateral may lead to the company's insolvency. Moreover, failure to provide additional collateral in time might lead to the closure of open positions thus prompt realization of losses, which may affect the company's liquidity and solvency negatively.
- chapter I/b. entitled "Risk Factors" of "K&H Treasury Handbook of Market Risk Management" lists those risks that do not originate exclusively from the nature of the product described here, but rather, from other factors.

product structure

The product is built up of a barrier interest rate option. The sections on barrier interest rate options of Chapter I/c. entitled "5 Basic Products" of "K&H Treasury Handbook of Market Risk Management", also applies to this product.