Knock-In Knock-Out Barrier Option

Vector Risk Pty Ltd

April 06, 2017

Version 8.0.7905

1 Input to Function

Description	*Symbol*	*min*	*max*	*Reasonable range*
Underlying price	S	0^+	$+\infty$	
Strike price	X	0^+	$+\infty$	
In barrier level	I	0^+	$+\infty$	
Out barrier level	O	0^+	$+\infty$	
Continuous risk-free interest rate	r	0^+	$+\infty$	
Continuous secondary rate	q	0^+	$+\infty$	
Volatility	σ	0^+	$+\infty$	
Time to option maturity	T	0^+	$+\infty$	
Put or Call	*inIndicator*	–	–	"P", "C"
Up or Down for in barrier		–	–	"U", "D"
Up or Down for out barrier	*outIndicator*	–	–	"U", "D"

Table 1: Inputs for Knock-In Knock-Out Barrier Option pricing function

2 Properties of Instrument

In knock-in knock-out (KIKO) barrier option, one of the barrier O acts as a knock-out barrier, while the other barrier I acts as a knock-in barrier. That is, the payoff of a knock-in knock-out barrier option is that of a similar vanilla option only if during the lifetime of the option, the underlying price S_t

1) has gone above I, but not gone above O in the case of both in and out barriers are up barriers,

2) has gone above I, but not dropped below O in the case of in barrier is an up barrier and out barrier is a down barrier,

3) has dropped below I, but not gone above O in the case of in barrier is a down barrier and out barrier is an up barrier, or

4) has dropped below I, but not dropped below O in the case of both in and out barriers are down barriers.

Knock-in knock-out barrier options can be valued as combinations of single[1] and double[2] barrier options. Tables 2-5 illustrates the properties for each type of knock-in knock-out barrier option. In each instance, we read the table row by row. For any particular row, on top of the stated condition, the conditions from the rows above have to be not satisfied.

[1]See pricing specification *Single Barrier Option* for details.
[2]See pricing specification *Double Barrier Option* for details.

Condition	Valuation method
$I \geq O$	the option can never be in the money.
$S \geq O$	the option is knocked-out, regardless of whether it was previously knocked-in or not.
$S \geq I$	the option is knocked-in, and can be valued as an up-and-out single barrier option, with barrier O.
$S < I$ and $S < O$	the option can be valued as the difference between an up-and-out single barrier option with barrier O, and an up-and-out single barrier option with barrier I.

Table 2: Valuation method for knock-in knock-out barrier options where both in and out barriers are up barriers

Condition	Valuation method
$S \leq O$	the option is knocked-out, regardless of whether it was previously knocked-in or not.
$S \geq I$	the option is knocked-in, and can be valued as a down-and-out single barrier option, with barrier O.
$O < S < I$	the option can be valued as the difference between an out-type double barrier option, and an down-and-out single barrier option, with barrier O.

Table 3: Valuation method for knock-in knock-out barrier options where in barrier is an up barrier and out barrier is a down barrier

Condition	Valuation method
$S \geq O$	the option is knocked-out, regardless of whether it was previously knocked-in or not.
$S \leq I$	the option is knocked-in, and can be valued as a up-and-out single barrier option, with barrier O.
$I < S < O$	the option can be valued as the difference between an out-type double barrier option, and a up-and-out single barrier option, with barrier O.

Table 4: Valuation method for knock-in knock-out barrier options where in barrier is a down barrier and out barrier is an up barrier

Condition	Valuation method
$I \leq O$	the option can never be in the money.
$S \leq O$	the option is knocked-out, regardless of whether it was previously knocked-in or not.
$S \leq I$	the option is knocked-in, and can be valued as an down-and-out single barrier option, with barrier O.
$S > I$ and $S > O$	the option can be valued as the difference between an down-and-out single barrier option with barrier O, and an down-and-out single barrier option with barrier I.

Table 5: Valuation method for knock-in knock-out barrier options where both in and out barriers are down barriers