

Foreign Exchange: Markets, Products, and Pricing

Winter Quarter 2023

Supplementary Slides – Barrier Options and Exotic Options



THE UNIVERSITY OF
CHICAGO

Financial Mathematics 37301

Barrier options and digital options



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Barrier options

Definition: Knock-out option

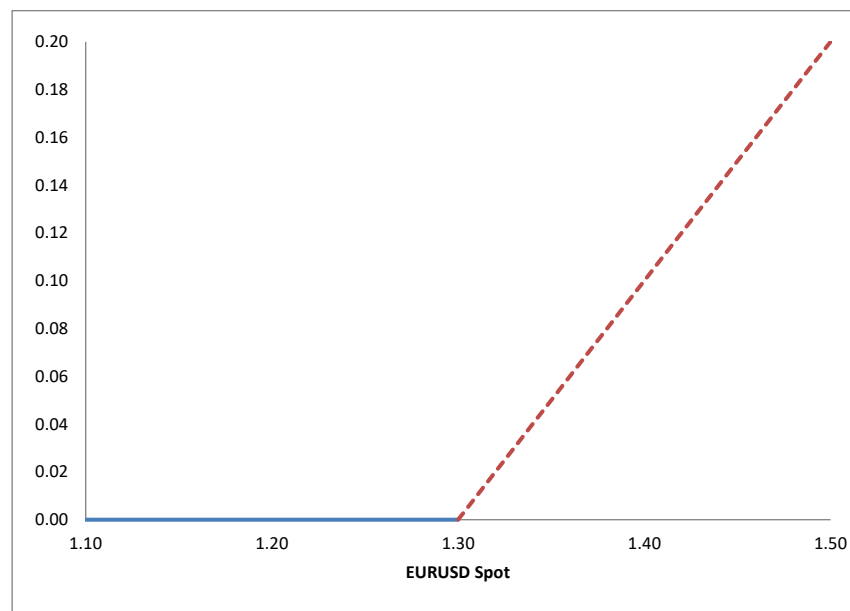
- Knock-out (KO): a standard call or put that disappears immediately if spot touches a barrier
 - OTM: knocks out away from the strike (barrier is OTM)
 - Down and out call
 - Up and out put
 - ITM, “Reverse”, “RKO”: knocks out well past the strike
 - Up and out call
 - Down and out put
- Can have an RKO where the barrier is less ITM than spot

Barrier options

Illustration: barrier call option



- OTM barriers
 - Down and out call
 - Down and in call
- Existence of the red payoff line depends on whether the barrier is reached





Barrier options

Definition: Knock-in option

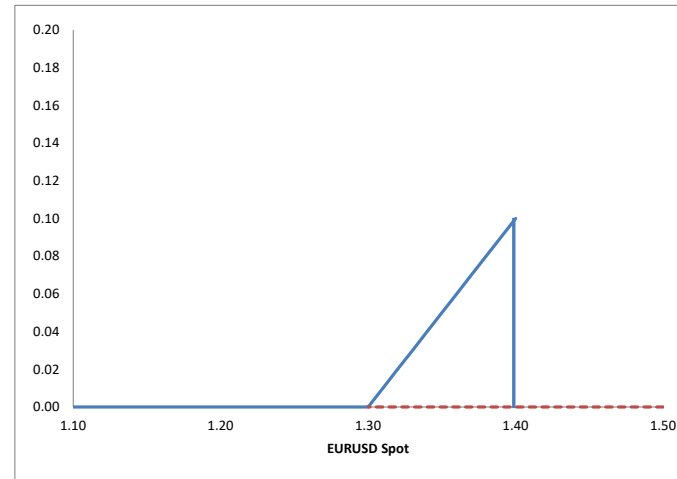
- Knock-in (KI): a standard call or put that does not appear unless spot touches a barrier
 - OTM: knocks in away from the strike (barrier is OTM)
 - Down and in call
 - Up and in put
 - ITM, “Reverse”, “RKI”: knocks in well past the strike
 - Up and in call
 - Down and in put
 - Can have an RKI where the barrier is less ITM than spot
- European-style barriers are possible (but not commonly used)

Barrier options

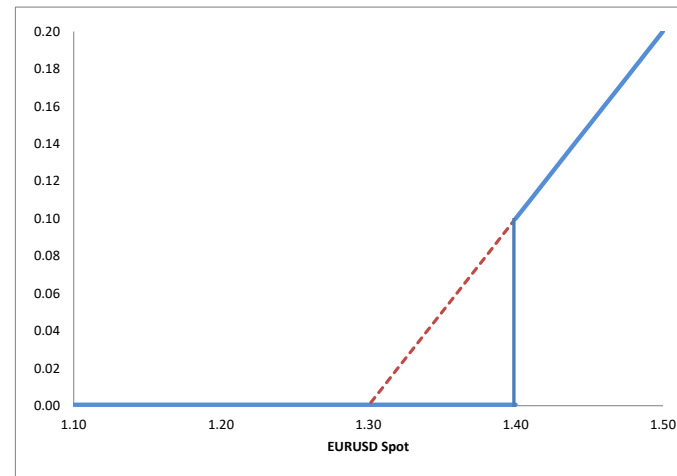
Illustration: barrier call option



- Barrier above spot
 - Up and out call



- Up and in call

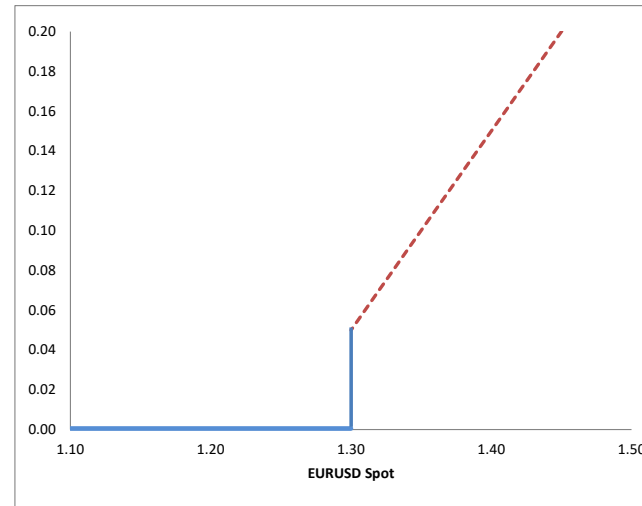


Barrier options

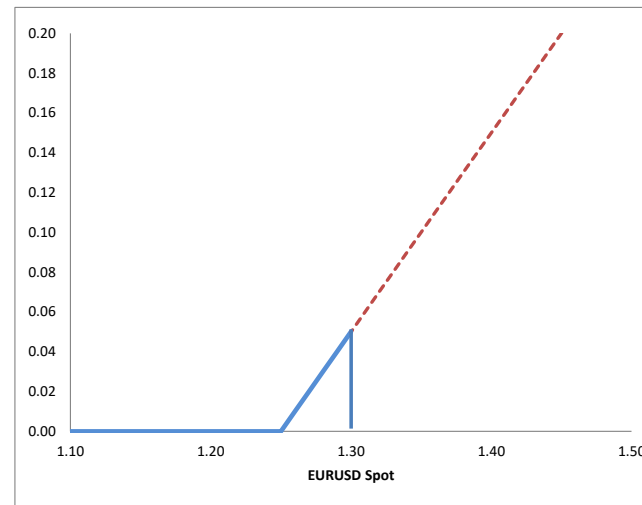
Illustration: barrier call option



- Barrier below spot
 - Down and out call



- Down and in call



Barrier options

“Parity” versus vanilla options



- Parity
 - $\text{KO call} + \text{KI call} = (\text{vanilla}) \text{ Call}$
 - $\text{KO put} + \text{KI put} = (\text{vanilla}) \text{ Put}$

Barrier options

DKO and KIKO



- Double knock-out (DKO)
 - Barriers above and below spot
 - One barrier can be set at the strike rate
 - Pricing by replicating with simpler options

- Knock-in knock-out (KIKO)
 - Two barriers
 - The option can knock out before it has knocked in

Digital options

Examples of digital options



- Options that provide a fixed cash flow (constant amount of a single currency) if a barrier is reached (or not)
 - Digital (binary option)
 - European-style barrier
 - One-touch (OT)
 - Continuously-monitored barrier
 - Payoff is made only if barrier is reached
 - No-touch
 - Continuously-monitored barrier
 - Payoff is made only if barrier is never reached

Digital options

DNT, range binary and accrual options



- Double no-touch (DNT)
 - Continuously-monitored barrier
 - Payoff is made only if neither of two barriers are ever reached

- Range binary options
 - Receive a fixed cash flow if spot does not touch either of two barriers
 - Typically European-style barrier

- Accrual options (“faders” or “fairway” options)
 - A fixed cash flow accrues for each day spot remains in a specified range
 - A portfolio of range binaries

Digital options

“Channeling Range Option”



“USDJPY channeling range”

- Tenor: 3 Month
- Initial Range: 78.00-82.50
- Daily Shift 4 pips (10am NY cut)
 - Each day, the range will shift up by 4 pips.
 - For example, on day 2, the new range will be 78.04-82.54.
- Offer Price: 10.25% of USD Payout
- Spot Reference: USDJPY: 80.25
- Static Range: 3m USDJPY 78.00-82.50 range is 14% of USD payout

- Positioning
- Spot: Moderately Bullish USDJPY spot
- Volatility: Short USDJPY volatility
Short USDJPY risk-reversal

Second generation exotics

See Canvas

Files > Supplementary Material > FX Volatility and Option Structures



Basket option

“FX Trade idea: Asia Basket Appreciation”



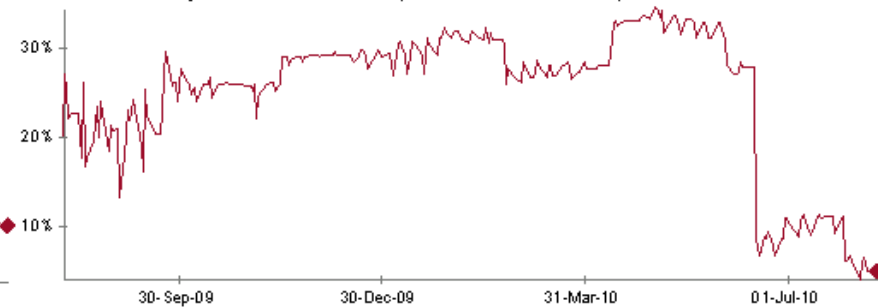
- The strong rally in equities and commodities in recent weeks has buoyed optimism about the strength of Emerging market economies relative to the US. Bullish inflation data and large inflows of capital to emerging Asian countries in particular, have also helped their currencies strengthen versus the USD.
- The strength of a number of currencies across Asia has raised the prospect of central bank intervention. Indeed, there has been talk that the Bank of Korea has been intervening to slow down the Won's rise. With the Singapore dollar approaching its all-time high (vs. the USD), and the yen approaching its 15-year high of 84.80 (vs. the USD), the scope for further rapid appreciation may be limited.
- Clients wishing to take advantage of this may be interested in the Asia FX Basket Call with Knock-out ideas below - the premium is significantly reduced compared to a standard basket call by incorporating a knock-out barrier (idea 1: the knock-out barriers are on each of the individual basket currencies, idea 2: the knock-out barrier is on the basket)
- The 3 month Implied correlations between USD/KRW and USD/SGD vs. USD/JPY have come off in recent months giving sizeable correlation savings for a basket that is bullish KRW and SGD vs. USD

Implied Correlation of (USD/JPY - USD/KRW), Tenor 3M



Source: Credit Suisse Locus

Implied Correlation of (USD/SGD - USD/JPY), Tenor 3M



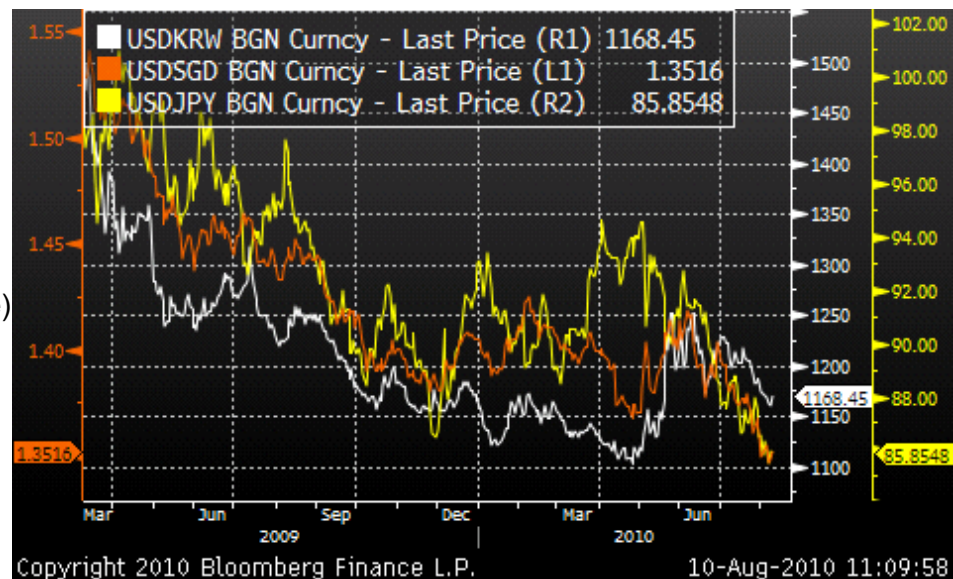
Source: Credit Suisse Locus

Basket option

“FX Trade idea: Asia Basket Appreciation” (cont’d)



- Idea 1: Regular Basket Call with Knock-out on Individual Basket Currencies
- Tenor: 3 months
- Basket Currencies: KRW, SGD, JPY vs. USD (equally weighted)
- Basket Strike: 101% (1% out-of-the-money spot)
- KO condition: If at expiry, any of the following conditions hold true:
 - $\text{USDKRW} < 95\% * \text{USDKRW (initial)}$
 - $\text{USDSGD} < 95\% * \text{USDSGD (initial)}$
 - $\text{USDJPY} < 95\% * \text{USDJPY (initial)}$
- the option is rendered worthless.
- Premium: 0.35% USD
- Max Payout ratio: 12.0x
- Fwd Ref: USDKRW fwd points: +4.8
- Regular Basket: 1.07% (101% basket strike)
- For comparison
- Average of Vanillas: 2.2% (1% OTMS strike)

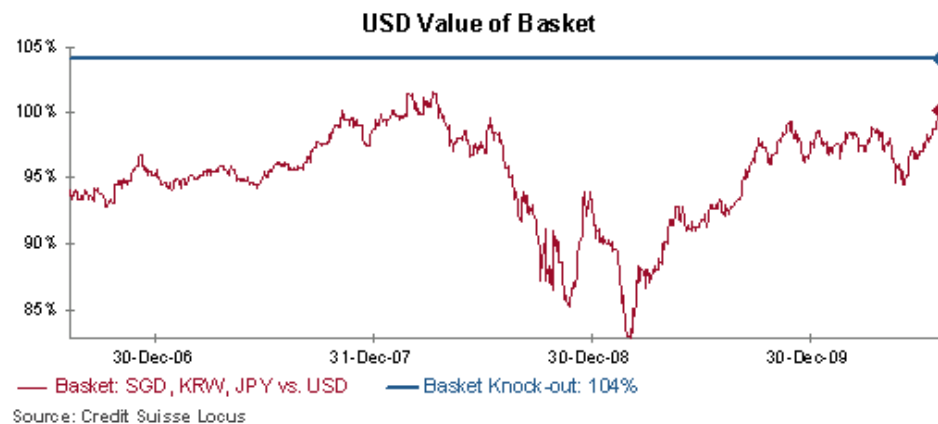


Basket option

“FX Trade idea: Asia Basket Appreciation” (cont’d)



- Idea 2: Regular Basket Call with Knock-out on Basket
- Tenor: 3 months
- Basket Currencies: KRW, SGD, JPY vs. USD (equally weighted)
- Basket Strike: 101.0% (1% out-of-the-money spot)
- KO condition: If the Basket has appreciated by 4% or more at expiry, the option is rendered worthless.
- Premium: 0.50% USD
- Max Payout ratio: 5.9x
- Fwd Ref: USDKRW fwd points: +4.8
- Regular Basket: 1.07% (101% basket strike)
- For comparison
- Average of Vanillas: 2.2% (1% OTMS strike)



Volatility swap

“Sell three-month EURCHF volatility swap”



- We expect the EURCHF floor at 1.20 to remain unchanged well into 2012 and possibly longer.
- Since the 1.20 floor was announced in early September, there have been no material surprises to the medium-term outlook for inflation.
- Since early September, the CHF TWI is down 17% from its peak, which together with base effects, should reverse the pre-September undershoot of inflation vis-a-vis Germany during the course of 2012.
- We recommend selling EURCHF volatility via a three-month EURCHF volatility swap currently bid at 10.25% of the EUR vega.
- The maximum downside is potentially unlimited if realized/ delivered volatility is higher than the pre-set level of implied vol (10.25%).

See Canvas: “Sell three-month EURCHF volatility swap”



EURCHF floor: established in 2011, abandoned in 2015

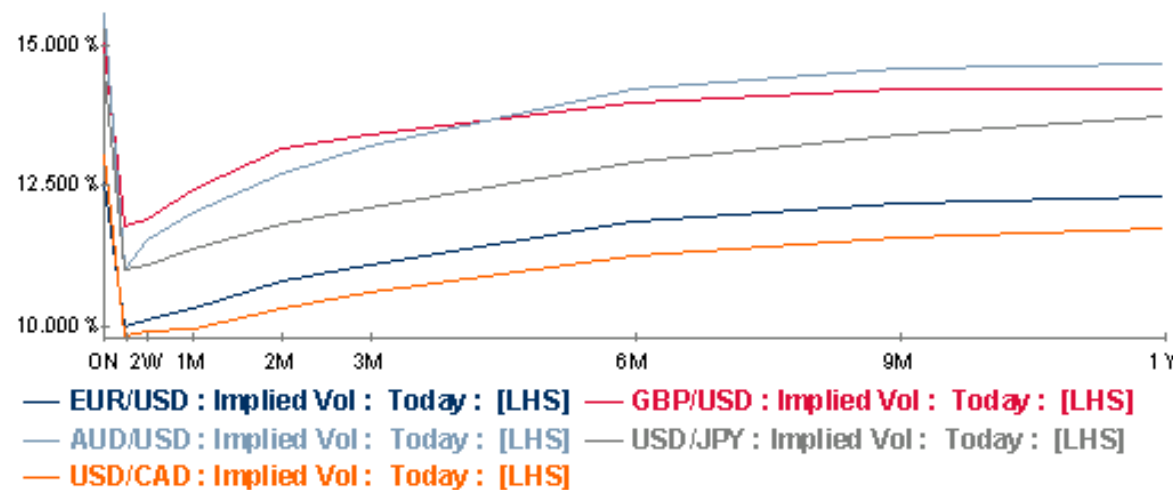


Forward volatility agreement

“Sell 3m in 6m USDJPY FVA”



- Vol curves continue to look steep across the majors as back end vols remain sticky downwards. As shown in the attached charts, most major G7 vol curves are trading close to some of their steepest levels since the beginning of the year.



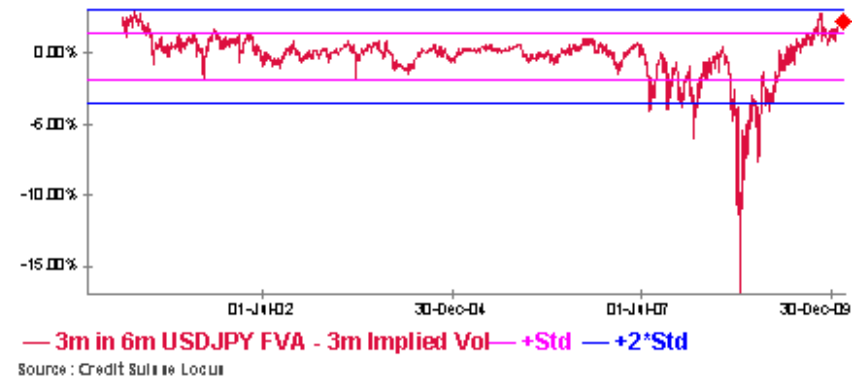
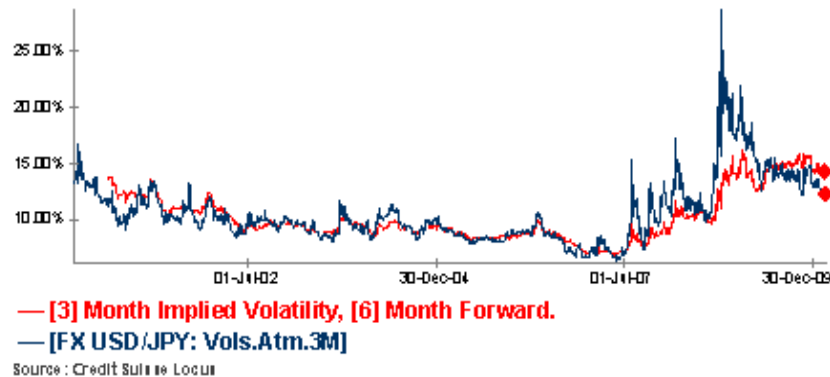
Source: Credit Suisse Locus

Forward volatility agreement

“Sell 3m in 6m USDJPY FVA”



- Sell 3m in 6m USDJPY FVA at 14.10% (indicative pricing, compares to 12.25% for the regular 3m ATM vol)
- Rationale: USDJPY curve stands out as being one of the steepest vol curves within the G10 universe. The steepness of the curve is particularly well pronounced in the 3m-9m part of the curve. As a consequence, the spread between the USDJPY 3m in 6m FVA and the USDJPY 3m ATM vol is at historically wide levels.



Forward volatility agreement

“Sell 3m in 6m USDJPY FVA”



- Historically, selling USDJPY 3m in 6m FVA conditional on the 3m in 6m FVA - 3m Implied Vol spread being more than 1 vol wide proved to be profitable around 74.7% of the time (without bid/offer). If we impose an extra condition for the 3m in 6m FVA to trade above 13%, the trade always made profits over the last ten years (again without bid/offer).

