USD/MYR Vanilla Lookback PGN

1. Product Description

USD/MYR Vanilla Lookback Principal Guarantee Notes offer an alternative investment opportunity for investors with a bearish view on the USD/MYR foreign exchange movement in the short-term. As one sixth of Malaysia's GDP relies on the oil, gas, and energy sector, a positive outlook for the crude oil price in the near future is believed to drive the USD/MYR FX rates downwards. Our product aims to take advantage of this trend, guiding our investors on making a better financial decision.

1.1 Economic Motivations

In justifying the accountability of our product, below is a brief summary of major economic justifications:

Short-term

Oil Price Rebound

OPEC's April Oil Market Report saw a rebound in oil and gas prices during the second half of 2016. This is mainly due to a sharp drop in the global oil supply, predicted to continue onto 2Q with the accelerated drop in the global activity. Moreover, political conflicts arising from the Middle East, especially between Iran and Saudi Arabia, along with the oil workers union's strike in Kuwait, are seen to increase the oil prices. By political conflicts, we refer to the airstrikes between the two countries, which further decreases oil production. A positive outlook for oil prices is evidenced from a rebound in Brent Crude Oil Price, quoted around $28 in January 2016 to $47.37 on April 29, 2016.

Improving Growth Outlook in China

China's economy has shown improvements with the government's aggressive monetary stimulus taking effect. The National Academy of Economic Strategy predicts a 6.8% GDP growth rate in 2Q16, seen to further increase later this year. One of the driving factors behind GDP growth is China's strong export performance with 11.5% y-o-y growth in 1Q16. This positively affects the appreciation of MYR, as China is Malaysia's No.1 trading partner. China's stabilizing economy improves Malaysia's import/exports, economic growth, and the appreciation of MYR.

Low Interest Rates

In April 2016, the Fed has been persistent on declaring a status quo on low interest rates, almost permanently postponing the possibility of an interest rate hike until further due. US low interest rates would keep the depreciation of USD against all other currencies, especially those of countries highly correlated with oil production- in our case, the MYR.

Long-term: yes, no, uncertainties?

As we are doubtful in accurately predicting the future outlook of macroeconomic factors in 2017 and onward, we propose a neutral view in the long-term. In addition to the already volatile oil market, there may be unexpected announcements at the next Doha meeting in June. The Fed may increase interest rates faster than expected, if they believe that the global economy has already shown firm improvements. Last but not least, the Chinese economy could turn negative, given the instability of trade and supply chain links and uneven global recovery.

1.2 Investment Objectives

Short-term objectives:
Principal guarantee
The entirety of their initial investment is guaranteed at the maturity.

Payoff
Following the economic trend mentioned above, payoffs from the underlying USD/MYR vanilla and lookback put options are to be distributed at the maturity.

Option to Exit
Should the investors change their mind about our product, they are given a chance exit at t= 1/2.

Long-term objectives:
Higher Payoffs
Should the investor choose to continue, the payoff from the previous vanilla put option is re-invested into lookback put options, resulting in a potentially higher payoff.

1.3 Product Description & Features

Principal Guaranteed
The investor buys our product for I and can expect to at least get back the principal of I.

Time to Maturity
The time to maturity of our product depends on the investor. It is either 6 months (T/2) or 1 year (T). Our product allows the investor to exit or continue the contract during T = ½, which also serves as a decision point. We believe by giving such choice to the investors, it makes our product more attractive as it gives them more control over the risk exposure. Hence, our product has a "Bermuda" element in it.

Underlying Asset
The underlying asset of our product is the USD/MYR Foreign Exchange Rate. Hence, the product tracks the performance of USD/MYR

Payoff
All final payoffs occur only at T, regardless of exiting at T/2. However, if the investor chooses not to continue at T/2, his payoff will be time-compensated by investing at the risk-free rate. The participation is denoted by $\boldsymbol{\pi}$, which is the number of corresponding options the issuer has to buy.

Payoff if investor decides to continue:

$$Payoff\ at\ T = I + \pi_{LB}\{\max\left(K - S^{min}_{\left[\frac{T}{2},T\right]}, 0\right)\}$$

Payoff if investor decides NOT to continue:

$$Payoff\ at\ T = \left(I + \pi_P\left\{\max\left(K - S_{\frac{T}{2}}, 0\right)\right\}\right) \times e^{r(\frac{T}{2})}$$

2. Structuring

Like any Bear PGN, the product is structured using bonds and options. We also show how the participation rate is determined.

2.1 Capital Allocation: Fixed Income Security

The investor invests I at time 0 and the issuer buys a zero coupon Chinese government bond for $B = I \times e^{-rT}$. The remaining $I - B$ is then used to purchase the options.

2.2 Capital Allocation: Options

For simplicity, we assume that the investors always choose to continue the contract because they will be compensated with a higher payoff. However, in reality, investors have a choice to exit the contract early and not continue to take the risk. Our product has two options embedded, which are the following:

Vanilla Put Option, P_0

- Starts at $t = 0$
- Matures at $T/2$
- Strike price $K = S_0$
- Participation rate of $P = \frac{\pi_p}{I}$

Lookback Put Option, LB_0 *(Applicable only if investor decides to continue the contract)*

- Payoff of earlier put used to buy the lookback put options
- Starts at $T/2$
- Matures at T
- Strike price $K = S_{T/2}$
- Participation of $P = \frac{\pi_{LB}}{I}$

2.3 Participation Rate

The participation rate depends on the investor's choice of continuing the contract or not. This is because the final payoff if the investor decides to continue the contract depends on the participation rate of the lookback option. If the investor decides not to continue the contract, the final payoff will depend on the participation rate of the put option.

If the investor chooses to continue-

At time T/2, the payoff from the earlier put will be used to purchase the lookback options. Hence, the following equation must satisfy:

$$\pi_p \times \Phi(S^{put}_{T/2}) = \pi_{LB} \times LB_0$$

Hence, this implies:

$$\frac{\pi_{LB}}{I} = P = \frac{(I - B) \times \Phi(S^{put}_{T/2})}{I \times P_0 \times LB_0}$$

If the investor chooses NOT to continue-
The participation rate is direct and can be expressed as:

$$\frac{\pi_P}{I} = P = \frac{(I - B)}{I \times P_0}$$

2.4 Issuer's Profit

The issuer will be able to make a profit both ways, regardless of whether the investor chooses to continue or discontinue the product after time T/2. To recap, the payoff from π_p amount of put options will be used to purchase π_{LB} amount of lookback options. Hence, if the investor decides to continue, before buying the lookback options, the issuer can take a percentage of the put payoffs, q, as management fee. Therefore, there will be less lookback options to be bought for the investor. If the investor decides not to continue, he can also take a percentage of the put payoffs, q, as management fee before investing the remaining at the risk free rate for the investor. The issuer's profit will then be:

$$q \times \pi_p \{\max (K - S_{\frac{T}{2}}, 0)\}$$

3. Risk

Currency Risk

As the USD/MYR movement is sensitive to oil price movements as well as changes in US interest rates, our product is prone to currency risk. To hedge, we introduce a lookback put option to hedge against the possible appreciation of USD/MYR.

Market Risk- US Interest Rates

In the event of a US interest rate hike, USD/MYR is predicted to increase, negatively impacting our product's payoff. Hence, we need to keep an eye on decisions made by the Fed and adjust our hedging strategies accordingly.

Market Risk- Oil Price Fluctuations

Because Malaysia is essentially an oil exporting country, fluctuations in the oil price movement are to impact the exchange rate significantly. In order to hedge against this risk, we may monitor continuous changes in Brent crude oil prices as well as oil volatility index.

4. Option Pricing

Our underlying asset is the FX rate USD/MYR. Upon conducting analysis on the behaviour of its returns using qqnorm() and qqline() in R, we discovered that it has heavy tails. Hence, we have decided to use the Heston Model to model our underlying, which will be used to price our options. The Heston Model, proposed by Heston (1993) describes the movement in underlying as:

$$dS_t = \mu S_t dt + \sqrt{v_t} S_t dW_t^S$$
$$dv_t = \kappa(\theta - v_t)dt + \xi\sqrt{v_t} dW_t^v$$

Parameters used

Risk-free rate
The risk-free rate we will use is 2% as it is the rate of a 1 year bond.

Volatility
The volatility we will use is 30% as it is the historical volatility.

Kappa and Xi
We will be using the estimated values of Kappa = 9.7 and Xi = 4.8. We obtained these estimated values by using optimization function GenSA() from R to minimize the qqplot difference between the simulated underlying and the historical underlying.

Option pricing methodology
As we modeled movements of our underlying using the Heston Model, there is no closed form solution for pricing our put options and lookback options. Therefore, we carried out the pricings using Monte Carlo Simulation.

5. Investment Advice
Investors should buy our product if they:

Have a bearish view on USD/MYR in the short-term
Investors can gain from short-term drops in USD/MYR.

Expect the oil price to go up in the short-term
Oil price is negatively correlated with USD/MYR, giving the investors a chance to profit from short-term increases in oil price.

Have a mild risk appetite
Due to our principal guarantee feature and the combination of two put options, our product has a low level of risk, suitable for rather conservative investors.

6. Hedging
As our product is a linear combination of risk-free bonds, European put options, and lookback put options, the bank can hedge its exposure by simply holding these securities.

At T = 0, the bank can take a long position in π_P units of European put options with maturity date T = 1/2 and invest Ie^{-rT} in risk-free bonds with maturity date T = 1.

At T = 1/2, if the investor chooses not to continue the contract, the bank can simply wait until T = 1 and pay back the investor. Otherwise, the bank can take a long position in π_{LB} units of lookback put options with maturity date T = 1 using payoff from the European put options.

The bank can therefore replicate the product and perfectly hedge its risk.

7. References

Heston, S. (1993). A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options. Review of Financial Studies, 6, 327-343.