

## Hedging with Options

We now return to put and call option contracts on exchange rates.

### Basic Concepts:

In the context of hedging, we are looking to reduce our risk exposure. You might think this means using put options only, but that is not always the case....we need to be aware of the currency pair!

#### **Basic Currency Option Hedging Example:**

A US Manager is holding assets denominated in Canadian Dollars (CAD). The Manager believes that the CAD is going to depreciate relative to the USD. So to hedge this risk the Manager takes a long position in a put option on the CAD.

This answer assumes that the currency pair is USD/CAD!

The option contract refers to the BASE currency!

#### **What if the currency pair was CAD/USD?**

Now we need to find choices that are equivalent to selling the CAD or buying the USD, and these could be:

Short a put option on CAD/USD  $\leq$  this obligates the Manager to buy USD

Buy a call option on CAD/USD  $\leq$  this gives the Manager the right to buy USD

### **Bottom Line:**

On the exam you should be ready to look for the best available answer if this shows up in Item Set format.

### **Option Cost**

The next issue you may see on the exam relates to cost of the hedge....if the question states that the Manager is concerned about the cost of hedging, you will need to recommend (if essay) or select (if Item Set) lower cost strategies that can achieve the hedging goal.

In the interdealer market, currency options are described in terms of their **delta**, not strike:

“25 delta” means delta of 0.25 and “10 delta” means delta of 0.1, etc.

	<b>Delta</b>	<b>Cost</b>	<b>Return</b>
In the money	Above 0.5	More expensive	Higher payoff
At the money	0.5		
Out of the money	Below 0.5	Less expensive	Lower payoff

The lower the delta, the lower the cost of the option.

## Other Suggestions to Lower the Cost

- 1) Use a collar
- 2) Use a risk reversal
- 3) Use a spread

A *collar* consists of a long put option and a short call option.

A *risk reversal* consist of a short put option and a long call option.

A *spread* consists of a long put option and a short put option that has a lower exercise rate.

## General Comments:

- Because of their symmetrical payoffs, hedging with forwards provide no potential for further upside gains.
- Because of their asymmetrical payoffs, hedging with options provides potential for further upside gains.
- Options can be used to replicate forwards, a risk reversal is equivalent to a long forward position and a collar is equivalent to a short forward position.

Using option contracts the portfolio manager achieves downside protection while leaving the potential for upside gains.

## Protective Put

If the manager holds assets denominated in the BASE currency, the manager would buy a put option quoted as **StrikePRICE/BASE**

If the PRICE/BASE quote depreciates, the manager would exercise the put option

IF the PRICE/BASE quote appreciates, the manager would not exercise the put option

## Decision to Hedge: Cost/Benefit

The decision to hedge is based on evaluation of the option premium paid, the potential currency savings and the degree of risk aversion

## Currency Management Strategies

1. If you think the currency is going to depreciate a lot, then **over hedge** using forward contracts
2. If you think the currency is going to appreciate a lot, then **under hedge** using forward contracts
3. If you think the currency is going to depreciate, then increase the **hedge ratio**
4. If you think the currency is going to appreciate, then decrease the **hedge ratio**
5. Accept some downside risk by using **out of the money** put options
6. Creating a **collar**, which entails buying a put and selling a call (**short risk reversal** position)
7. **Risk reversal**, which entails, buying a call and selling a put

## Hedging Multiple Currencies

On the exam you may be faced with a cross hedging situation. The process is much the same as it was for single currency portfolios, now the currency hedge *must incorporate the correlation* between the various currencies held in the portfolio:

### Individual Asset Risks:

$$\sigma_1 = (1 + RF_1)(\text{Currency Risk}_1)$$

$$\sigma_2 = (1 + RF_2)(\text{Currency Risk}_2)$$

Where:

RF = Foreign currency asset return  $R_{FC}$

Currency Risk =  $R_{FX}$

### Portfolio Risk:

$$\sigma^2(R_{DC}) = (w_1^2)(\sigma_1^2) + (w_2^2)(\sigma_2^2) + (2)(w_1)(w_2)(\sigma_1)(\sigma_2)(\rho_{1,2})$$

### Bottom Line:

Currency correlation and portfolio weightings affect the overall currency risk.

### Minimum Variance Hedge Ratio

Using regression we can *find the optimal cross hedging ratio*:

$$R_{DC} = a + B (\% \Delta S_{DC/FC}) + e$$

Where: B is the minimum variance hedge ratio

Be aware, we could calculate the “Beta” using correlation and standard deviation (just like you did in Level 1!):

$$\text{Minimum Variance Hedge Ratio} = B = \rho(R_{DC}, R_{FX}) \times \left( \frac{\sigma_{R_{DC}}}{\sigma_{R_{FX}}} \right) \leftarrow \text{this is the } \% \Delta S_{DC/FC}$$

**Cross Hedge Learning Example:**

A U.S. fund manager holds an equal weighting of assets denominated in Euros (EUR) and Canadian Dollars (CAD). The Manager has summarized currency data in the following table:

	<b>Canada</b>	<b>Eurozone</b>
Foreign-currency asset return $R_{FC}$	3%	5%
Foreign-currency return $R_{FX}$	6%	7%
Asset risk $\sigma(R_{FC})$	0%	0%
Currency risk $\sigma(R_{FX})$	9%	11%
Correlation (USD/CAD; USD/EUR)	0.75	

1. Based on the data in the table, what type of assets must the CAD and EUR holdings be?
2. **Calculate** the expected domestic-currency return for the Canadian asset:
3. **Calculate** the expected domestic-currency return for the Eurozone asset:
4. **Calculate** the expected domestic-currency return for the U.S. fund:
5. **Calculate** the standard deviation for the U.S. fund:
6. Briefly summarize what this exercise has accomplished:

**Solutions:**

1) With zero asset risk, Asset risk  $\sigma(R_{FC})$ , they must be government securities (such as t-bills).

$$2) R_{DC} = (1.03)(1.06) - 1 = 9.18\%$$

$$3) R_{DC} = (1.05)(1.07) - 1 = 12.35\%$$

$$4) \text{Portfolio } R_{DC} = (0.5)(9.18\%) + (0.5)(12.35\%) = 10.765\%$$

5) First we need to calculate the standard deviation for each asset:

$$\text{Canadian Asset } \sigma(R_{DC}) = (1.03)(9\%) = 9.27\%$$

$$\text{Eurozone Asset } \sigma(R_{DC}) = (1.05)(11\%) = 11.55\%$$

Now we can calculate the variance of the fund:

$$\sigma^2(R_{DC}) = (0.5^2)(9.27^2) + (0.5^2)(11.55^2) + (2)(0.5)(0.5)(9.27)(11.55)(0.75) = 94.984$$

$$\sigma(R_{DC}) = 9.746\%$$

6) We have calculate the USD-denominated returns on this fund as well as the cross hedging effects of these investments.

The individual asset risks are 9.27% and 11.55%, taken together in the fund the combined risk is 9.746%.

### **Minimum Variance Hedge Ratio Learning Example:**

Bill Samarit is a U.S. Portfolio Manager. His Global Equity Fund holds assets denominated in Euros, Canadian Dollars and British Pounds.

Samarit's outlook for the Canadian Dollar is negative based on his expectation of slower growth in the Canadian economy.

Next, Samarit's associate gathers the following data:

**Table 1**

$\sigma(R_{FX})$	10%
$\sigma(R_{USD})$	12%
$\rho(R_{USD}, R_{FX})$	0.3
<b>Note:</b> $R_{FX}$ is quoted as USD/EUR	

Using regression, Samarit formulates the following equation for the USD and GBP:

$$R_{USD} = 1.3 + 2.55 (\% \Delta S_{USD/GBP}) + e \quad \text{[equation 3]}$$

- Given Samarit's outlook for the Canadian Dollar, what would be the most appropriate hedging transaction assuming the quotation is:
  - CAD/USD
  - USD/CAD
- Assume the portfolio holds EUR 50,000,000 in assets. Using the data in Table 1, construct the minimum variance hedge:
- Using equation 3, calculate the minimum variance hedge ratio for Samarit's exposure to the GBP:
- Assume the currency pair is quoted as GBP/USD. Using equation 3 and assuming the portfolio has exposure to GBP 2,000,000, outline the correct hedging strategy:

**Solutions:**

1.a) He should go long a forward contract if it is quoted as CAD/USD

b) He should short a forward contract if it is quoted as USD/CAD

Remember, you are buying and selling the BASE currency!

On the exam look for basic macroeconomic data to use as you signals to judge the outlook for the currency:

Factor	Effect on the Currency
Increase interest rates	Positive
Decrease interest rates	Negative
Higher inflation	Negative
Lower inflation	Positive
Higher exports	Positive
Lower exports	Negative
Stronger economy	Positive
Weaker economy	Negative

**Other Signals:**

If the spot rate is below the moving average, this indicates resistance at the moving average rate.

If the spot rate is above the moving average, this indicates a support level at the moving average rate.

$$2. \quad \text{Minimum Variance Hedge Ratio} = B = \rho(R_{DC}, R_{FX}) \times \left( \frac{\sigma_{R_{DCBU}}}{\sigma_{R_{FX}}} \right) = 0.3 \times \left( \frac{12}{10} \right) = 0.36$$

The manager needs to short  $0.36 \times \text{EUR } 50,000,000 = \text{EUR } 18,000,000$  forward.

Stated more formally, the manager should short a USD/EUR Forward contract with a notional size of EUR 18,000,000

3. The minimum variance hedge ratio should be set at 255%

4. The long GBP 2,000,000 exposure should be hedged with a short position in GBP against the USD in the amount of  $2.55 \times \text{GBP } 2,000,000 = \text{GBP } 5,100,000$ .

Because the currency quote is given as GBP/USD, the manager should take a long position....did you write a short position?...hold on before you go crazy....remember going long means buying the BASE currency and selling the PRICE currency!

## **Managing Emerging Markets Currency Exposure**

I think a trivial qualitative question could show up regarding this point...just know, the issues faced by the manager when dealing in “emerging markets”:

### **Issues:**

- 1) Higher trading costs (in the form of wider bid-offer spreads).
- 2) Increased likelihood of extreme market events and severe illiquidity under stressed market conditions. => **link** to carry trade issues!
- 3) Potential for government intervention to “fix” exchange rates.

### **Bottom Line:**

All of these issues make hedging more difficult to do, with the results you want!