Five Steps in the Risk Management Process

Risk Governance

Centralized Versus Decentralized Risk Governance Systems

Characteristics of an Effective Risk Management System

Part of the overall corporate governance system and refers to the process of putting a risk management system into use. A good risk governance system will be

- Transparent
- Clear in accountability
- Cost efficient in the use of resources
- Effective in achieving desired outcomes

1. Setting policies and procedures for risk management.
2. Defining risk tolerance for various risks based on what the organization's risk profile.
3. Identifying risks faced by the organization. They can be grouped in financial and non-financial risks. This requires investment databases for both types of risk.
4. Measuring the current levels of risk.
5. Adjusting the levels of risk either upward or downward based on the desire to generate returns. These adjustments will involve
    - Executing transactions to change the level of risk using derivatives or other instruments.
    - Finding the most appropriate transaction for a given objective.
    - Considering the costs of such transactions.

- Identifies each risk factor to which the company has exposure.
- Quantifies the factor in measurable terms.
- Aggregates all risks into a single firm-wide risk metric. VaR is the most common.
- Identifies how each risk contributes to the overall firm risk.
- Give a process for allocating capital and risk to units of the organization.
- Monitor compliance with the allocated limits of capital and risk.

- A decentralized risk governance system puts responsibility for execution with each unit of the organization. The benefit is that risk management is handled by those closest to each part of the organization.
- A centralized system, or an enterprise risk management system, puts execution with one central unit. It gives a better view of how risk of each unit affects the risk of the firm as a whole. A centralized system offers economies of scale.

Financial Risk Factors

Non-financial Risk Factors

Tools for Risk Measurement

Issues to Consider When Using VaR

- **Operational risk** is loss due to failure of systems or from external events.
- **Settlement risk** is present when funds are exchanged. E.g., if one party makes payment and the other defaults. Risk is low for exchange trades using a clearinghouse. Much higher for OTC transactions.
- **Model risk** refers to the fact that models are only as good as their construction and inputs, (e.g., sensitivities, correlations, likelihoods, etc.).
- **Sovereign risk** is a form of credit risk in which the ability and willingness of a sovereign government must be considered.
- **Regulatory risk** is present when it's unclear how a transaction will be regulated or if that regulation will change.
- **Tax, accounting and legal risk** like regulator risk, refer to situations in which laws may change. Political risk refers specifically to changes in government triggering one of these risks.
- **Environmental, social and governance risk** (ESG) exists if company decisions cause environmental damage, human resource issues, or poor corporate governance which harm the company.
- **Performance netting risk** is when payments from a party are used for another.
- **Settlement netting risk** refers the liquidator of a counterparty in default changing terms of netting agreements such that the non-defaulting party now has to make payments to the defaulting party.

- **Market risk** is created by changes in interest rates, exchange rates, market prices, etc. This is frequently the largest component of risk.
- **Credit risk** is the risk of loss caused by a counterparty failing to pay. Historically, credit risk was a binary measurement, but credit derivatives allow for a more continuous measurement. It is often the second largest financial risk.
- **Liquidity risk** is the risk of loss due to the inability to take on or remove a position quickly at a fair price. It can be difficult to measure as liquidity can appear adequate until a certain even occurs. A narrow bid-ask spread generally indicates good liquidity. Average trading volume may give a better indication of liquidity. Liquidity of derivatives is generally linked to that of the underlying security.

- The VaR time period should relate to the situation. Stocks and bonds might use monthly VaR, while a leveraged derivatives portfolio might use daily VaR.
- The percentage selected will affect the VaR. A 1% VaR will generally show greater risk than a 5% VaR.
- The left tail should be examined. VaR measures the left tail of a distribution, i.e., the negative returns portion. But it only shows a snapshot at a particular percentage.

- Standard deviation to measure price or surplus volatility.
- Standard deviation of excess return (i.e., the return minus the benchmark return). The standard deviation of excess return is called active risk or tracking risk.
- First-order projections of change in price include beta for stocks, duration for bonds and delta for options. Second-order techniques include convexity for bonds and gamma for options.
- Option price analysis can also include theta and vega which measure change in price due to change in time to expiration and change in volatility, respectively.

Analytical VaR Method

Advantages and Disadvantages of the Analytical VaR Method

Advantages and Disadvantages of the Historical VaR Method

Advantages and Disadvantages of the Monte Carlo VaR Method

- Advantages
  - Easy to calculate and understand.
  - Allows modeling the correlations of risks.
  - Can be applied to varying time periods as relevant.
- Disadvantages
  - Assumes normal distribution of returns.
    - Some securities have skewed returns. Long option positions have positive skew with frequent small losses to due premia and occasional large gains. Short option positions have the opposite situations and negative skew.
    - Variance-covariance VaR is modified to deal with skew using the delta-normal method. But these adjustments are complex and don't allow convenient second-order modeling.
  - Many assets have leptokurtosis (i.e., fat tails). VaR tends to underestimate the loss.
  - Difficult to estimate standard deviation in large portfolios as it requires correlations between assets which grows quadratically with the number of assets.

Based on the normal distribution and one-tailed confidence intervals.

$$\text{VaR} = \left(\hat{R}_p - z\sigma\right) V_p$$

where:

$\hat{R}_p$ = expected return on the portfolio
V_p = value of the portfolio
z = z-value corresponding to the level of significance
σ = standard deviation of returns

5% and 1% VaR are 1.65 and 2.33 standard deviations below the mean, respectively. For periods less than one year, divide the return and the standard deviation by the number of periods and the square root of the number of periods, respectively. For 1-day VaR, return can be approximated as zero.

The Monte Carlo method generates thousands of possible outcomes from the distributions of inputs specified by the user. The inputted distributions can be normal for some assets, skewed for others, etc. The possible outcomes are then ranked similar to the historical VaR method.

- Advantages
  - Can incorporate any assumptions regarding return patterns, correlations, or other factors.
- Disadvantages
  - The output is only as good as the inputted assumptions.
  - Its complexity can lead to an overconfidence in the results.
  - Can be costly and computer intensive to implement.

Historical VaR or historical simulation takes past daily returns, ranks them and identifies the lowest N%. The highest of these lowest N% is the 1-day N% VaR.

- Advantages
  - Very easy to calculate and understand.
  - Does not assume a distribution of returns.
  - Can be applied to different time periods.
- Disadvantages
  - Assumes the pattern of historical returns will repeat in the future. Many securities also change characteristics with the passage of time.

Advantages and Disadvantages of VaR

Tools and Metrics to Complement VaR

Scenario Analysis and Stress Testing

Types of Credit Risk

- **Back-testing** should be used to compare actual results with expected outcomes projected by VaR.
- **Incremental VaR** (IVaR) is calculated by measuring the difference in VaR before and after the portfolio is changed in some way (e.g., an asset is added). It measures the effect of an individual item.
- **Cash flow at risk** (CFaR) measures the risk of the company's cash flows. CFaR is useful for companies which cannot be valued directly. CFaR measures the minimum cash flow loss at a given probability over a give time period.
- **Earnings at risk** (EaR) is analogous to CFaR from an accounting earning standpoint.
- **Tail value at risk** (TVaR) is VaR plus the average of the outcomes in the tail.
- **Cerdit VaR** measures risk due to credit events.
- **Stress testing** tests various situations which may occur and their impact on the portfolio.

- Advantages
  - Industry standard required by many regulators.
  - Aggregates all risk into a single, easy to understand number.
  - Can be used in capital allocation by giving each unity a certain amount of VaR. When units have less than perfect correlation, the firm-wide VaR is less than the sum of the unit VaR.
- Disadvantages
  - Some methods, e.g., Monte Carlo, are difficult and expensive.
  - Different computation methods can generate different VaR estimates.
  - Can generate a false sense of security. Only as good as inputs. Additionally, it's a measure of probability, so the situation can always be worse.
  - One-sided focusing on the downside while ignoring any upside potential.

Current credit risk is the amount of a payment currently due. Current credit risk is zero on all but one date.

Potential credit risk is based on payments due in the future and exists even if there is no current credit risk. It can change over time.

Cross-default provisions are present in most lending agreements and specify that if a debtor defaults on one payment, he defaults on all obligations. This means that there is a credit risk associated with payments to due to other creditors.

In scenario analysis, a user defines events such as

- Yield curve shifts and twists.
- Changes in yield volatilities.
- Changes in the value and volatility of equity indices.
- Changes in the value of currencies or foreign exchange rate volatilities.
- Changes in swap spreads.

The value of the portfolio is compared before and after these events. Sometimes actual or hypothetical extreme events are used.

Scenario analysis weakness is the inability to measure byproducts of factor movements. I.e., it's hard to model the interactions of multiple factors.

Stress testing is often used as a complement to VaR. The idea is to reveal abnormal situations which might not be covered when using historical standard deviations. Some stressing models are

- **Factor push analysis** in which factors are pushed to the most disadvantageous combination.
- **Maximum loss optimization** which uses mathematical and computer modeling to find the worst combination of factors.
- **Worst-case secenario** which uses the worst case an analyst thinks likely to occur.

Credit VaR

Credit Risk of Swaps and Options

Relationship of Liquidity to VaR

Methods of Managing Market Risk

Swaps can be modeled as a series of forward contracts. As such, swaps have current credit risk on each payment date and potential credit risk throughout their lives. The credit risk is highest at the middle of the life. At initiation, the credit risk is zero, and later in life there are fewer payments so credit risk decreases. Currency swaps don't fit this model because of the return of notional at the end of the swap. Thus, their credit risk is between the midpoint and end of the swap's life.

In an option, on the long position faces credit risk. The buyer decides when to exercise the option and faces the risk the seller will be unable to perform. Both American and European style options have potential credit risk equal to the market value of the option. Current credit risk only exists after the option is exercised.

- Also called credit at risk or default VaR.
- Defined as an expected loss due to default at a given probability during a given time period.
- Is much more difficult to calculate than VaR.
- While VaR is a measure of left-tail risk, credit VaR measures right-tail risk because defaults are most likely when market values are highest and returns are greatest.
- Even if the probability of default can be estimated, recovery rates still need to be calculated.
- Pricing data on credit derivatives and option pricing models are sometimes used to estimate credit VaR. Credit risk is one-sided like options.
- Credit risk across multiple exposures is difficult to aggregate and depends on the correlations between them.

Risk budgeting finds acceptable levels of risk and allocates risk to different business units. In an enterprise risk management (ERM) system, capital is allocated to portfolio managers based on risk and exposure to each sector. This allow monitoring of the risk budget as well as measuring risk-adjusted performance with return on VaR.

In addition to VaR, other methods for budgeting risk include

- **Position limits** that put a dollar cap on a position.
- **Liquidity limits** which set nominal position limits as a percentage of trading volume.
- **Performance stopouts** which set absolute dollar losses over a certain period.
- **Risk factor limits** which limit exposure to particular risk factors.
- **Scenario analysis limits** which limit loss due to a particular scenario.
- **Leverage limits** which limit the amount of leverage a manager can use.

Liquidity is not considered when measuring VaR. There is an implicit assumption that positions can be sold at their estimated market values. Thus, VaR can give a misleading estimation of potential loss.

Liquidity is difficult to measure because historical volatilities may not be accurate. The inability to quickly adjust a position can lead to large losses, and managers should be aware of their positions as they relate to trading volume and bid-ask spreads.

Methods of Managing Credit Risk

Methods of Measuring Risk-Adjusted Performance

Methods for Risk-Based Capital Allocation

FX Swap

- **Sharpe ratio** measures excess return over the risk-free rate per unit of risk measured as standard deviation.

$$S_P = \frac{\overline{R}_P - \overline{R}_F}{\sigma_P}$$

  Its biggest disadvantage is that it relies on excess returns having a normal distribution, which options and other asymmetric payoff instruments don't have.
- **Risk-adjusted return on invested capital** (RAROC) is the ratio of expected return to a measure of risk like VaR. This is then compared to historical RAROC or a benchmark RAROC.
- **Return over maximum drawdown** (RoMAD) is the annual return divided by the largest drawdown. A drawdown is the percentage drop from a high water mark to a subsequent low.

$$\text{RoMAD} = \frac{\overline{R}_P}{\text{maximum drawdown}}$$

- **Sortino ratio** is excess return, calculated as portfolio return less minimum acceptable portfolio return (MAR), divided by risk, measured as standard deviation of returns using only returns below MAR. By only using downside volatility measurements, good performance cannot inflate the risk metric.

$$\text{Sortino Ratio} = \frac{\overline{R}_P - \text{MAR}}{\text{downside deviation}}$$

- **Limiting exposure** of loans to any particular counterparty.
- **Marking to market** is used in derivative contracts in which the value is positive to one party and negative to another. The negative party pays the positive and the contract is repriced.
- **Collateral** may be used in transactions with credit risk. Margin is a form of collateral in derivatives contracts.
- **Payment netting** is used when one side pays and other other receives. The payments are netted and only one side pays.
- **Closeout netting** is used in bankruptcy proceedings. All transactions between a bankrupt company and a counterparty are netted.
- **Minimum credit standards** for debtors are a good idea, but can be difficult to impose. Low-credit entities can use SPVs to create a high credit subsidiary.
- **Credit derivatives** transfer credit risk to another party.
  - **Credit default swaps** protect the buyer after a credit event.
  - **Credit spread forwards** require payment from one party based on the credit spread at a particular date.
  - **Credit options** receive a payment when the rate on an asset exceeds a reference by the specified spread.
  - **Toal return swaps** get a variable return from a dealer in exchange for the total return on an asset.

An FX swap is not actually a swap. It rolls a maturing forward contract using a spot transaction into a new forward contract. It swaps the old contract for the new one.

- **Nominal position limits** specify amount allocated to managers based on desired return and exposure to risk. Has the downside of being exceeded by using derivatives to replicate the exposure of other assets.
- **VaR-based position limits** can be used in lieu or or in addition to nominal limits. Capital is allocated to units according VaR. The benefit is firm VaR is the sum of the unit VaR. The drawback is that it doesn't consider correlation between units which may cause overestimation of VaR and misallocation.
- **Maximum loss limits** specify a maximum allowable loss. The benefit is the ability to set limits such that the maximum losses never exceed the firm's capital. The drawback is the possibility of all units exceeding their limits due to unforeseen events.
- **Internal and regulatory capital requirements** are often specified using VaR to limit the probability of insolvency. They may be set by bank regulators, internal management, or other entities.
- **Behavioral conflicts** must be considered when allocating capital. A common example is portfolio managers who have performance-based compensation taking on more risk than necessary. A risk management system must take this conflict into account.

Currency Option Mechanics

Currency Call and Put Option Relationships

Domestic Currency Returns for a Foreign Currency Investment

Variance of Domestic Currency Returns

As the price of the base currency increases	*The call option to buy the base currency*	*The put option to sell the base currency*
From 0 to the strike price	Is out-of-the-money and rising in value. Delta is shifting from 0 to 0.5.	Is in-the-money and falling in value. Delta is shifting from -1 to -0.5.
To the strike price	Is at-the-money. Delta is approximately 0.5.	Is at-the-money. Delta is approximately -0.5.
From the strike price upward	Is in-the-money and rising in value. Delta is shifting from 0.5 to 1.0.	Is out-of-the-money and falling in value. Delta is shifting from -0.5 to 0.

Currency options require two currencies. A call on one currency is a put on the other. The option is from the perspective of the base currency.

$$\sigma^2(R_{\text{DC}}) = w_{\text{FC}}^2\sigma^2(R_{\text{FC}}) + w_{\text{FX}}^2\sigma^2(R_{\text{FX}}) + 2w_{\text{FC}}w_{\text{FX}}\sigma(R_{\text{FC}})\sigma(R_{\text{FX}})\rho(R_{\text{FC}}, R_{\text{FX}})$$

where:

$\rho(R_{\text{FC}}, R_{\text{FX}})$ = the correlation between R_{FC} and R_{FX}

If an investor holds a single foreign currency denominated asset, the formula simplifies to

$$\sigma^2(R_{\text{DC}}) = \sigma^2(R_{\text{FC}}) + \sigma^2(R_{\text{FX}}) + 2\sigma(R_{\text{FC}})\sigma(R_{\text{FX}})\rho(R_{\text{FC}}, R_{\text{FX}})$$

If R_{FC} is a risk free return, the formula for the standard deviation of R_{DC} is

$$\sigma(R_{\text{DC}}) = \sigma(R_{\text{FX}})(1 + R_{\text{FC}})$$

$$\begin{aligned} R_{\text{DC}} &= (1 + R_{\text{FC}})(1 + R_{\text{FX}}) - 1 \\ &= R_{\text{FC}} + R_{\text{FX}} + R_{\text{FC}}R_{\text{FX}} \end{aligned}$$

where:

R_{DC} = the domestic currency return

R_{FC} = the return of the foreign asset measured in its local currency

R_{FX} = the percentage change in value of the foreign currency

R_{FC} and R_{FX} are sometimes called the local market return and the local currency return, respectively. For investments in multiple currencies, the equation becomes

$$R_{\text{DC}} = \sum_{i=1}^{n} w_i R_{\text{DC},i}$$

where:

w_i = the proportion of the portfolio invested in assets traded in currency i

$R_{\text{DC},i}$ = the domestic currency return for asset i

Arguments for and Against Active Currency Risk Management

Different Levels of Currency Hedging

Currency Risk Hedging and the IPS

Issues with Diversification of Strategic Currency Risk Management

- **Passive hedging** is rule-based, usually matching the currency exposure to the benchmark. Requires rebalancing.
- **Discretionary hedging** deviates from passive hedging by a specified percentage. Allows a manager to pursue modest currency returns relative to the benchmark.
- **Active currency management** allows for greater deviations from the benchmark. It is expected to generate positive currency return and alpha, not reduce risk.
- **Currency overlays** outsource currency management. At the extreme, overlay managers purely seek currency alpha, not risk reduction.

- Arguments against hedging currency risk
  - Hedging and trading currencies takes time and money.
  - In the long run, unhedged currency effects are a zero-sum game. If one currency appreciates, the other must depreciate.
  - In the long run, currencies revert to a theoretical fair value.
- Arguments for hedging currency risk
  - In the short run, currency movements can be large.
  - Inefficient pricing can be exploited.
  - Many FX trades are decided by international trade transactions or central bank policies, which are not motivated by fair value.

- In the long run, currency volatility is lower than in the short run, which reduces the need to hedge long-term portfolios.
- Positive correlation of R_{FC} and R_{FX} increase the volatility of R_{DC} and increases the need for currency hedging.
- Correlation varies by time period, giving diversification at times and not at others. This suggests a varying hedge ratio.
- Evidence suggests higher correlation for bond than equity portfolios, meaning hedging is more important for bond portfolios.
- The hedge ratio—the percentage of currency exposure to hedge—varies by manager preference.

The client's IPS should specify whether or not to hedge currency risk. Relevant sections might be, investor objectives, time horizon, liquidity need, and the benchmark used. The IPS should also specify

- Target percentage of hedged currency exposure.
- How much discretion managers have around the target.
- Frequency of rebalancing.
- Benchmarks to use to evaluate currency decisions.
- Allowable or prohibited hedging tools.

Issues with Costs of Strategic Currency Risk Management

Overall Factors Influencing Hedging Currency Risk

Economic Factors Affecting Currency Value

Principals and Patterns of Technical Analysis of Currencies

- Time horizon for portfolio objectives.
- High risk aversion.
- Client's concern with opportunity costs of missing currency returns.
- High short-term income and liquidity needs.
- High foreign currency bond exposure.
- Low hedging costs.
- Client's doubt of benefits of discretionary management.

- The bid-ask cost on currency trades is generally small, but frequent rebalancing can be costly.
- Options require a premium which is lost if the option expires out-of-the-money.
- Forward currency contracts are often shorting than the hedging period, so they require FX swaps. This creates cash flow volatility from gains and losses on the contracts.
- Overhead costs can be high, requiring a back office and trading infrastructure. Cash must be held in multiple currencies for settlement and margins.
- Hedging every currency movement is generally too costly. Managers choose partial hedges and rebalance monthly instead of daily.

The three principals driving technical analysis of currencies are

1. Past price data can predict future price movement, and because prices reflect fundamental information, there is no need to analyze said information.
2. People tend to react to similar events in similar ways, and so past price patterns tend to repeat.
3. It doesn't matter what the currency should be worth, only what it will trade at.

Some patterns used by technical analysts are

- An overbought market has gone up too far and the price is likely to reverse.
- A support level exists where there are many bids. A price that falls to that level is likely to reverse as the purchases are executed.
- A resistance level exists where there are many offers. A price that rises to that level is likely to reverse as the sells are executed.
- A shorter-term moving average crosses a longer-term moving average.

Currencies with the following characteristics will tend to increase in value.

- More undervalued relative to their fundamental value.
- Have the greatest rate of increase in their fundamental value.
- Higher real or nominal interest rates.
- Lower inflation relative to other countries.
- Countries with decreasing risk premia.

Currencies with the opposite conditions will tend to decrease in value.

Carry Trades

Volatility Trading Strategies

Currency Hedging Actions Based on Market Expectations

Advantages of Forward Contracts in Currency Hedging

- **Delta hedging.** Uses a delta-neutral position, which has zero delta. It will only change value when the volatility of the underlying assets changes.
- **Long straddle.** An at-the-money call and put, bought when volatility is expected to increase. The options' deltas will offset each other creating a delta-neutral position.
- **Short straddle.** Selling an at-the-money call and put, used when volatility is expected to decrease.
- **Strangle.** Out-of-the-money calls and puts with offsetting deltas are purchased. Gives similar but more moderate payoffs to a straddle. Costs less than a straddle.

- Covered interest rate parity (CIRP) holds by arbitrage and states that the currency with the higher interest rate will trade at a forward discount ($F_0 < S_0$) and the currency with the lower interest rate will trade at a forward premium ($F_0 > S_0$).
- The carry trades uses violations of uncovered interest rate parity (UCIRP). UCIRP states that the forward rate determined by CIRP is an unbiased estimate of the future spot rate. This means that the currency with the higher interest rate will decrease by the interest rate differential.
- Historical evidence indicates that
  - Generally, the higher interest rate currency depreciated less than expected, and a carry trade has earned a profit.
  - A small percentage of the time, the higher interest rate currency has depreciated a lot generating large losses on the carry trade.

Carry trades are usually done by borrowing in the lower interest rate currencies of developed economies (funding currencies) and investing in the higher rate currencies of emerging economies (investing currencies).

- Can be customized while futures are standardized.
- Available for almost any currency pair, while futures trade for only a limited number of currencies.
- Don't require margin.
- Higher trading volume than futures which gives better liquidity.

Expectation:		*Action:*
Relative currency:	Appreciation	Reduce the hedge on or increase the long position in the currency.
	Depreciation	Increase the hedge on or decrease the long position in the currency.
Volatility:	Rising	Long straddle or strangle.
	Falling	Short straddle or strangle.
Market conditions:	Stable	Carry trade.
	Crisis.	Discontinue the carry trade.

Roll Yield

Impact of Forward Premia and Discounts and Roll Yield on Hedging Costs

Trading Strategies Designed to Reduce Hedging Costs

Examples of Exotic Options

If the hedge requires:	$\boldsymbol{F_{P/B} > S_{P/B}}$ and $\boldsymbol{i_B < i_P}$ Upward-sloping forward price curve.	$\boldsymbol{F_{P/B} < S_{P/B}}$ and $\boldsymbol{i_B > i_P}$ Downward-sloping forward price curve.
A long forward position in currency B, the hedge earns	Negative roll yield, increasing hedging costs.	Positive roll yield, decreasing hedging costs.
A short forward position in currency B, the hedge earns	Positive roll yield, decreasing hedging costs.	Negative roll yield, increasing hedging costs.

Roll yield or roll return is a return from the movement of the forward price toward the spot price. Effectively the profit or loss on a forward or futures contract if the spot price is unchanged at expiration. Roll yield on a contract held to expiration is calculated as $(F_T - S_T)/S_0$.

- **Knock-in options** are plain vanilla options which come into existence if the underlying reaches a specified level.
- **Knock-out options** are plain vanilla options which cease to exist if the underlying reaches a specified level.
- **Binary** or **digital options** pay a fixed amount that doesn't vary with the difference in price between the strike and underlying price.

- **Over- or under-hedge with forward contracts** based on the manager's view. If a manager expects a currency to appreciate or depreciate, he can reduce or increase the hedge ratio, respectively. This creates a positive convexity situation
- **Buy at-the-money put options** gives asymmetric protection with full upside potential and no downside risk. Has high initial cost, but no opportunity cost.
- **Buy out-of-the-money put options** is less expensive but offers less protection.
- **Risk reversal** or **collar** is buying and selling puts and calls with offsetting deltas, respectively. This has lower initial cost, but limits upside potential compared to buying only puts.
- **Put spread** is buying out-of-the-money puts and selling puts that are further out of the money. There is downside protection starting at the strike price of the bought put, but it will be lost if the price falls below the strike price of the second put.
- **Seagull spread** is a put spread combined with selling a call. Has less initial cost than a put spread, with the same downside protection, but limits upside potential.

Cross Hedge and Macro Hedge

Minimum-variance Hedge Ratio

Considerations for Hedging Emerging Market Currency Exposures

A mathematical approach to determining hedge ratio. It's a regression of the past changes in the value of the portfolio (R_{DC}) to the past changes in the value of the hedging instrument. The hedge ration is the beta (slope) of this regression. It minimizes tracking error.

A cross hedge refers to hedging with an instrument that is not perfectly correlated with the exposure being hedged. Generally not necessary in currency hedging because forward contracts for most currency pairs are available.

Cross hedges introduce more risk. When the correlation of returns between hedging instruments and the position being hedged is imperfect, there is residual risk.

A macro hedge is a type of cross hedge covering portfolio-wide risk factors. E.g., using bond futures, credit derivatives, and volatility trading to hedge multiple risks in a portfolio.

One example of a macro hedge is using derivatives contracts based on a basket of currencies which may not match the portfolio exactly. This can reduce hedging costs, however.

- Larger bid-ask spreads because of low trading volume. Spreads tend to increase during financial crises.
- Lower liquidity and higher transaction costs. One example is multiple investors using carry trades all attempting to liquidate during a financial crisis.
- Transactions between two emerging market currencies can be costly.
- Currency returns are non-normal with a negative skew.
- Higher yield of currencies leads to large forward discounts which produces negative roll yield.
- Contagion is common. During financial crises, correlations of emerging markets with each other tend towards 1.0.
- There is tail risk generated by governments which intervene in the markets creating long periods of stability followed by sharp price movements. These negative events are more frequent that would be predicted by a normal distribution.