Professor Maria CARACOTA-DIMITRIU, PhD
Faculty of Management
Olga Alexandra TERPEZAN TABĂRĂ, PhD Candidate
Faculty of Management
The Bucharest Academy of Economic Studies

THE IMPORTANCE OF MARKET RISK MEASUREMENT OF TRADED INSTRUMENTS IN THE BANKING RISK MANAGEMENT

Abstract: *The article presents the methods of measuring traded instruments that are very important for the management of market risk within a bank institution. Beginning with the definitions of different types of banking risk, the evaluation of instruments that a bank trades is presented, such as: debts instruments, forward rate agreements, equities, foreign exchange, forwards, futures, swaps and options. A profound approach is given to the measurement of debts instruments and options, very important to a market risk manager. For debt instruments their main characteristics are detailed: maturity, issuer credit ratings, payment structure and currency. For options the evaluation concerns their type, examples of options, time of expiration and their risk measurement by Greeks methods. Thus, a banking institution must have an adequate management of market risk, to ensure an optimal profitableness.*
Key words: *banking risk management, debt instruments, measurement, market risk, options, equities.*

JEL Classification : G24

The enhance competition among retail banks at the international and national level, leads to a hard pressure on the activity efficiency. The banking institutions are forced to maintain a long-term sustainable profit, in terms of internationalization of their activity and competition in the field.

The place and the level of banks in the economy are related to their intermediary quality in the savings-investments relationship, which is very important in the economic growth. Banks, being the intermediary between the depositors and the beneficiaries of savings, have the following activities: collecting funds, assuming debtors risks, that means analyzing the loans and assuming the associated risks, assuming the interest risk, because the intermediation suppose a maturity transformation.

From the accomplishment of these functions, banks gain recompense, representing the main source of the banking profit. The banking institutions, like other institutions producers of goods and services, have also a major purpose the responsibility to their shareholders, the maximization of the profits.

The major challenge is represented by the risk reduction. The risk might have an important impact on the value of the analyzed bank: not also an impact over the direct losses but also an impact over the clients, personal, partners and the banking authority. The risk exposure is permanently generated by a number of operations and procedures.

The bank management must have methods and techniques for reducing risk. In the banking sector, the risk must by considered as a interdependent risks complexity, being possible to have common causes or producing other risks. Banking risks can generally be divided in three categories: market risk, credit risk and operational risk.

Market risk arises from the possibility of losses as a result of unfavorable market movements. Market risk is a risk of losing money because the perceived value of an instrument has changed: for example, when the investors do not want to pay a high price for equity.

Credit risk arises from default, when counterparty fails to fulfill an obligation. Different subtle types of credit risk arise from trade transactions. *Counterparty risk* refers to the possibility that a commercial counterparty fails to pay in case of losing money. *Settlement risk* arises when a bank does not pay the established party.

Operational risk covers all the other ways of losing money for banks. Basel Committee on Banking defines operational risk as *„the risk of direct or indirect losses due to inadequate or wrong internal processes, human or system errors or due to external events"*.

Considering the importance of market risk, its measurement is imposed at each bank level by applying the measurement methods developed until this moment.

The difference between market risk and credit risk is that in credit risk there is the probability to be a failure by counterparty to fulfill an obligation. In market risk, we deal only with changes in the prices that investors are prepared to pay.

Valuation is very important in measuring risk because risk is all about potential changes in value. A bank trades the following instruments[1]:

A. Debt instruments, also known as fixed income or bonds
B. Forward rate agreements
C. Equities or stocks
D. Foreign exchange
E. Forwards

[1] Marrison Chris (2002), "The fundamentals of risk measurement", *McGraw-Hill Edition,* New York

F. Futures
G. Swaps
H. Options

Futures, swaps and options are different types of derivatives contracts. They are called derivatives because their value is derived from other instruments, like bonds.

In valuing instruments, a principal technique is to decompose a complex instrument into a set of simple instruments with the same payments. The technical term for this is *arbitrage pricing theory*[2]. An arbitrage is a trade in which a set of securities are bought and sold such that the combination provides a profit but has no risk. Such a free risk profit is attractive, and once the combination is well known in the market, many investors will sell and buy the components of the arbitrage until their buying causes prices to adjust and the arbitrage opportunity is zero. In describing these equivalent arbitrage portfolios, it will be used the terms long and short. Being long corresponds to having an asset and being short corresponds to having a liability. If a bank is long an instrument, it owns the rights to the instrument. If it is short, it has promised to give the rights to another party. For example, if the bank is short a bond, it means they have promised to give the bond to another party.

A. Debt instruments

Debt instruments are securities that provide interest payments but no ownership claim on the issuer. Debt is a liability or an obligation on a company to make specified payments. Debt instruments include bonds, notes, commercial paper, syndicated loans, etc.

From a market-risk manager's perspective, there are four important characteristics for debt instruments[3]:

- Maturity
- Issuer credit ratings
- Payment structure
- Currency

<u>Bonds structure</u>

Maturity

Maturity is the time left until final payment. The time to final payment is a continuous variable; market convention has different names for different levels of maturity. Instruments with a maturity of over five years are called bonds. Instruments with a maturity of one to five years are called notes and those with a maturity of less

[2] A general theory of asset pricing.
[3] Marrison Chris (2002), "The fundamentals of risk measurement", *McGraw-Hill Edition*, New York

than one year are called bills or money market instruments. Corporations and banks, for short-term funding, use the money market. The short-term interest rates are driven by immediate supply and demand, and are relatively insensitive to the long-term economic conditions. Because of their short maturity, the value of a money market instrument is insensitive to the prevailing interest rates, and therefore has relatively low market risk.

Issuer credit ratings

A third party company, called *rating agency*[4], rates the credit risk of most bonds. These ratings are very important for the following reasons:

- Generally, ratings correspond to probabilities of default. Bonds with high probabilities of default trade at lower prices than risk free bonds. A lower price implies a higher interest rate. The difference between the interest rate for a risky bond and the interest rate for a risk-free bond of the same maturity is called the *credit spread.*
- Many institutional investors, such as pension funds, must accept the fund restrictions that require them to buy only bonds of investment grade. To be investment grade, a bond must be rated BBB (by the rating agencies) or better.
- The Basel Committee on Banking Supervision is prompting bank regulators, such as the Federal Reserve and the Bank of England, to set bank capital requirements according to the credit quality of the bonds they hold.

Payment structure

The payments of interest on a bond are called *coupons* and are either fixed or floating. Fixed-rate bonds pay the same percentage every time and the rate is fixed when the bond is first issued. Floating-rate bonds pay a variable percentage and the interest rate is reset periodically to a prevailing market rate.

Currency

Debt instruments can be denominated in any currency. The probability of default tends to be less if the currency of the bond is the same as the base currency of the entity issuing the bond.

<u>The valuation of bonds</u>

The valuation for bonds represents the foundation for measuring the risk of changes in bond values.

The valuation of bonds with a single payment

[4] Credit rating agency – a company that assigns credit ratings for issuers of certain types of debt obligations as well as the debt instruments.

Any bond promising to pay a certain amount at a future point in time has a value. The value is the price that investors are prepared to pay today to own that bond and therefore own the right to the future cash-flow[5]. If we consider a bond that promises to make a single payment, at time t, then the current value of the bond and the future payment amount can be used to define a discount factor (DF).

$$DF_t = \frac{Value}{Payment_t}$$

The discount factor will be less than one, because always is better to have cash now than the same amount promised in the future. The discount factor includes all the effects that cause the value to be less than the promised amount, including the effects of inflation and the possibility of default. When the cash-flow is certain (like a fixed-rate government bond), the discount is called risk-free discount. If the cash-flow is risky (there is a possibility of default) the value will be less and the discount factor will be smaller. The discount factor for a given maturity, t, can be used to define a discount rate, r_t, which is known as an interest rate. The usual expression for the discount rate is the following:

$$DF_t = \frac{1}{(1+r_t)^t}$$

This expression uses discrete compounding. For continuous compounding, the rate is defined by using the exponential function:

$$DF_t = e^{-t \times r_t}$$

where e $\approx$2,7.

The valuation of bonds with multiple payments

Zero-coupon bonds are bonds that explicitly do not pay interest. They have only a single "bullet" payment and are also known as bullet bonds. The bond is sold at a discount to face value, with the difference between the face value and the sale price implicitly being the interest payment. The value of a risk-free zero-coupon bond is the amount of the payment multiplied by the risk-free discount factor.

$$Value = Payment_t \times DF_t = \frac{Payment_t}{(1+r_t)^t}$$

[5] Cash-flow – balance of the amounts of cash being received and paid by a business during a defined period of time.

If there were many zero-coupon bonds being traded with different maturities, the above equation could be used to construct a graph with t in the x-axis and r_t in the y-axis, representing a yield curve.

The current yield curve can estimate the current value of any bond. Coupon-paying bonds have a series of fixed-intermediate-interest payments. The value of a coupon-paying bond is the sum of the value of the individual payments.

$$Price = \sum_t \frac{C_t}{(1+r_t)^t}$$

where: C_t is cash-flow at time t, and the price is the price at which the bond can currently be bought.

Many researchers have investigate the relationship between the yield curves and bonds, such as Fama and French (1989), which shown that excessive incomes of bonds are positively bounded to treasury instruments curves[6].

B. Forward rate agreements

Forward rate agreement (FRA) is a contract to give a loan at a fixed rate starting at some point in the future.

A forward rate agreement can be decomposed into being long a fixed-rate bond, with the first coupon being paid at some starting point in the future, and short a zero-coupon bond corresponding to the bank's initial payment to the company.

At the date on which the loan would have commenced, the parties pay the difference in *net present value* (NPV) of the cash-flows. The calculation of the NPV uses the market rate on the commencement date to discount the cash-flow.

When initiating a forward rate agreement, a bank will set the borrowing rate according to the forward rates currently observed in the market.

Forward rates are obtained from the current yield curve using arbitrage arguments. The procedure is that if an investor wants to invest money until some distant time, t_2, he has two choices:

1. Buy a bond that matures at t_2
2. Buy a bond that matures at an intermediate time t_1 and buy a forward rate agreement that maintain the same interest rate from t_1 to t_2.

Let use r_1 for the interest rate currently available for bonds maturing at t_1 and r_2 for those maturing at t_2. Also, $f_{1,2}$ will be the forward rate maintained between t_1 and t_2.

If the amount invested is EUR 100, the first investment strategy will yield the following result:

[6] McCown James Ross (2001), "Yield curves and international equity returns", *Journal of Banking & Finance*, Iss. 4, Vol. 25, Pg. 767

$$Cash_{t2} = EUR\ 100\ (1+r_2)^{t_2}$$

The second strategy will yield the following result:

$$Cash_{t2} = EUR\ 100\ (1+r_1)^{t_1}\ (1+f_{1,2})^{t_2-t_1}$$

If either of these strategies provided better results, all investors would move to that strategy, increasing the demand for the given product and changing the rates until both strategies gave the same result.

In this way, the forward rate is related to the two rates from the yield curve as follows:

$$(1+r_2)^{t_2} = (1+r_1)^{t_1}\ (1+f_{1,2})^{t_2-t_1}$$

$$f_{1,2} = \left[\frac{(1+r_2)^{t_2}}{(1+r_1)^{t_1}}\right]^{\frac{1}{t_2-t_1}} - 1$$

C. Equities

In a company, equities represent ownership for the holder and a right to the profits once all of the debts have been paid. Equity values reflect all of the factors associated with the business risks, and as a result, are very volatile compared with bonds.

Investors use many techniques to value equities, but most of these include a large amount of intuition and art. From a risk measurement perspective, equities are so complex as to be simple. There are so many factors that affect equity values that they are generally considered simply to be instruments whose future value is random. The future changes in value are typically considered to have a Normal or Log-normal distribution with the same standard deviation as the historical changes in the equity price.

The value changes can be divided into systemic and idiosyncratic risks[7]. The systemic risk is the movement in the equity price that occurs because of a general movement in the stock market. The amount by which the stock tends to move with the market is called the beta (β). The idiosyncratic risk (e), describes price movements that are uncorrelated with the market and are due solely to the performance of the individual company. The changes in value are summarized in the following equation:

$$\Delta V = V_0(\beta \Delta M + e)$$

[7] Marrison Chris (2002), "The fundamentals of risk measurement", *McGraw-Hill Edition*, New York

where: V_0 is the current value
ΔM is the change in the market index
e is the uncorrelated idiosyncratic change.

For a diversified portfolio of many equities, the idiosyncratic risks tend to cancel each other out, leaving the investor exposed to the sum of the systemic risks of all the stocks:

$$\Delta V_{Portfolio} = \left[\sum_{k=1}^{N} V_{0,k} \beta_k \right] \Delta M$$

Where: N is the number of equities
β_k is beta for equity k
$V_{0,k}$ is current value of equity k.

This is the common approach used when assessing the overall risk of a portfolio.

D. Foreign exchange

Foreign exchange (FX) markets are the most liquid of all of the markets, large volumes of money are traded and it is easy to find someone to buy or sell at a price close to the current market value. There are many ways that currencies can be traded, including spot, forwards, foreign securities and derivatives.

Spot FX are an exchange of currencies and the settlement of the exchange happens within a day.

Forward trades are agreements to exchange specified amounts of each currency at a specified date in the future.

Securities with payment denominated in a foreign currency carry both the risk of changes in value of the security (for example, a drop in the value of a foreign equity) plus the risk of a change in the exchange rates.

The value of an instrument denominated in a foreign currency is found by calculating the current value of the instrument in the foreign currency, then exchanging to the local currency at the prevailing rate.

E. Forwards

A forward contract is an agreement to by a security or commodity at a certain point in the future.

The first forward contract dated from 1570, when has been established Royal Exchange (the later London Commodity Exchange), as a place where the metal traders could deal transactions[8].

[8] Bell Adrian R., Brooks Chris, Dryburgh Paul (2007), “Interest rates and efficiency in medieval wool forward contracts”, *Journal of Banking & Finance*, Iss. 2, Vol. 31, Pg. 361

At the time of agreeing to the forward contract, the amounts are fixed for the quantity of the security or commodity to be delivered, the delivery price to be paid and the delivery date. Usually, the delivery date is several months into the future.

Forwards are one of the types of derivative contracts because the value of the forward is derived from the value of the current or future spot prices of the underlying security or commodity. After the contract has been agreed, but before the delivery takes place, the value of forward will change. This change occurs because new contracts are being signed with different delivery prices.

Generally, the value of a forward agreement is the number of items to be delivered (N), timed the difference between current market delivery price (D_C) and the originally agreed delivery price (D_0), discounted by the risk-free rate (r_f) from the time of delivery (t):

$$\text{Contract value} = \frac{N}{(1+r_f)^t}(D_C - D_0)$$

F. Futures

Futures are the same as forward contracts, except that they are traded on exchanges. The market risk for futures is almost the same as forwards, but there are three practical differences:

- Futures are for standardized amounts and standardized delivery dates, and forwards can be for any amount and date;
- The credit risk for futures is reduced because they are exchange traded. If counterparties fail to honor their agreements to make deliveries, the exchange will make the deliveries in their place;
- The credit of risk futures is reduced because the change in the value of the futures contract is offset by compensatory daily payments, so the value of the contract minus the value of the cash received is always close to zero.

The value and the market risk for futures are evaluated in the same ways as for forwards.

For example, the positions on futures are detailed bellow: a short position and a long position[9].

a. Short position on Futures. On 15th of March 2008, a client sold 30 futures contracts on DESIF1 Index with a due time in June 2008, at the price of 2.64 points. Therefore, the client has a short position.

[9] Caracota Dimitriu M., Băltăreț A. (2006), “Derivative Securities”, *ASE Publishing House, Bucharest.*

On the 11th of May 2008, the price is 2.3 points. The settlement of the contract at this moment has a positive result, profit:

1.000 RON x (selling price – market price) x number of contracts

In our case, the profit will be: 1.000 x (2.64 – 2.3) x 30 = 10.200 RON

On 30th May 2008, the client close his short position buying 30 futures contracts on DESIF1 for June 2008, at the price of 2.25.

The profit will be: 1.000 x (2.64 – 2.25) x 30 = 11.700 RON

Therefore, the client anticipated the positive evolution of DESIF1 index. The brokerage company pays the client the amount of 11.700 RON.

b. Long position on Futures. On the 20th of April 2008, a client bought 15 futures contracts on exchange rates RON/USD with due time in September 2008, at the price of 2.97 RON/USD. The client has a long position.

On 25th of August 2008, suppose the price will be 2.8 RON/USD. Therefore, the result for this moment is:

1.000 RON x (market price – buying price) x number of contracts

In our case, we will have a loss: 1.000 x (2.8 – 2.97) x 15 = - 2.550 RON

On 15th of September 2008, the client closes the long position (to diminish the risk), selling 15 futures contracts on the exchange rate RON/USD in September 2008, at the price of 2.9 RON/USD.

The loss will be: 1.000 x (2.9 – 2.97) x 15 = - 1.050 RON

The loss will be deducted from the client's account.

G. Swaps

A swaps contract is an agreement between two counterparties to exchange payments at several specified points in the future. The amount of the payments is determined by a formula in the contract. The formula will specify the payments as a function of market factors, such as the short-term interest rates, FX rates or commodity prices.

Swaps are derivatives because their values are derived from the current and future values of underlying securities.

Swaps were first developed in the 1980s, and now there are many types, including the following:

- *Interest-rate swap*: in this contract, a regular fixed amount is paid by one counterparty and a floating amount is paid by the other counterparty. The floating amount is the prevailing short-term interest rates multiplied by a notional loan amount.
- *Currency swap*: is a combination of an FX spot and FX forward transaction with principal amounts exchanged at the beginning and end of the transaction. Thus, risk measurement of currency swaps is accomplished by simply disaggregating the swap into a spot and a forward.

- *Basis swap*: is the regular payment of one floating amount against a different floating amount.
- *Equity swap*: is the regular payment of equity index or an equity value against a floating interest rate, such as LIBOR[10].

Generally, deconstructing the swap into the two underlying instruments on each side of the swap and then valuing those instruments can accomplish the valuation of a swap.

Interest-rate swaps are the most used derivatives for the interest risk management. While the swaps became extremely important, the economic arguments behind these transactions are partially understood. Interest-rate swaps allow banks to benefit from short-term loans and to avoid the interest risk[11].

H. Options

An option is a type of derivative contract. An option gives the holder the right but not the obligation to buy or sell an underlying as set at a future time, at a predetermined price. The predetermined price is called the strike price. The party holding the right to choose is said to be long the option and the counterparty that sold or wrote the option is said to be short the option.

Options are similar to futures, but with one important difference: the holder can choose whether to exercise the option at the time of contract expiration. Options carry an "aura of mystery" because they can be difficult to value. Plus, there are many option classifications, as follows:

- *Vanilla options* – (so called because traders consider them to be as plain as vanilla ice cream). These have very simple contract terms for payments and are relatively easy to value;
- *Packages of vanilla options* – are the sum of several vanilla options put together into one deal;
- *Exotic options* – are non-vanilla options that are complex and typically tailored for an individual customer. It is possible to write virtually any form of option contract depending on any observable market factor, such as equity prices, exchange rates or even the weather. Exotic options are particularly challenging for traditional numerical methods, which can perform inaccurately due to the discontinuities in the payoff function[12].

Options can be divided function the rights given to the holder:

[10] LIBOR - The London InterBank Offer Rate

[11] Li Haitao, Mao Connie X. (2003), "Corporate use of interest rate swaps: Theory and evidence", *Journal of Banking & Finance*, Iss. 8, Vol. 27, Pg. 1511

[12] Khaliq A. Q. M., D. A. Voss, M. Yousuf (2007), "Pricing exotic options with L-Stable Pade Schemes", *Journal of Banking & Finance*, Accepted Manuscript

- *Puts*: A put option gives the holder the right to sell the underlying security and receive a predetermined strike price.
- *Calls*: A call option gives the holder the right to buy the underlying security by paying a predetermined strike price.

The strike price is agreed on at the beginning of the option contract and is the cash amount to be paid for the underlying security. At the beginning of the contract, the counterparties also agree on the ultimate maturity (or expiration date) and alternatives to exercising the option, including[13]:

- *European-style*, which can only be exercised at the end date;
- *American-style*, which can be exercised on any date until maturity;
- *Bermudan-style*, which can only be exercised on certain dates;
- *Asian-style*, which bases payments on an average price over a period. This technique is useful for shallow markets that are highly volatile or exposed to the risk of price manipulation.

Each option style can now be traded in any geography. When the option is exercised, there are two possibilities for settlement: physical delivery and cash settlement. Physical delivery requires that the strike price be paid and the underlying security should be delivered. Cash settlement requires only that the difference in the value of the security at the time of exercise and the strike price of the option should be delivered.

Option valuation and time of expiration

In the example above, there can be great value in holding an option, and therefore, a price has to be paid to obtain an option. The first step in determining what price to pay for an option is to understand the potential payoff at the expiration date. The payoff is the value of the option contract at the time of maturity. It depends on the structure of the contract and the value of the underlying security.

Let's use the symbol V for the value of the payoff, X for the exercise price and S for the value of the underlying stock that is bought or sold.

Generally, on the expiration date, the value of a call is the maximum of 0 and $S – X$.

$$\text{Call: } V = max(0, S – X)$$

If S is more than X, the call is said to be in the money. Otherwise, it is said to be out the money.

The value of a put at expiration is the maximum of 0 and $X – S$.

$$\text{Put: } V = max(0, X – S)$$

If S is less than X, the put is in the money. Otherwise, it is out of the money.

[13] Marrison Chris (2002), “The fundamentals of risk measurement”, *McGraw-Hill Edition*, New York

The logic for the put and call is summarized in Table 1.

Table 1. Logic and payoff for exercising options

Option	Stock price less than strike	Stock price more than strike
Call	Out of the money – do not buy the stock, make no profit	In the money – buy stock at the strike price, make profit
Put	In the money – sell stock for strike price, make profit	Out of the money – do net sell the stock, make no profit

Data sources: Marrison Chris (2002), "The fundamentals of risk measurement", McGraw-Hill Edition, New York

We can make different strategies with options such as:

- Simple strategies: Long Call (buy a Call), Short Call (sell a Call), Long Put (buy a Put) and Short Put (sell a Put);
- Options combinations: Straddle (short and long), Strangle (short and long), Spreads (bull and bear for Call and Put), Butterfly (long and short for Call and Put).

From these strategies we explain the Strangle[14]. A Strangle consists of a put and a call with the same expiration date and the same underlying asset, but the put and call have different exercise prices X1 > X2.

The holder of the strangle buys a call and a put (Long Strangle = Long Call with the exercise price X1 + Long Put with the exercise price X2) and the writer of the strangle sells a call and a put (Short Strangle = Short Call with the exercise price X1 + Short Put with the exercise price X2). The profit or the loss of a strangle is the sum of the profit or the loss of the call option or the put option.

Consider C_T the price of the Call, P_T the price of a Put, X1 exercise price for Call, X2 the exercise price for Put, S_T the underlying asset price and time T.

The value of the Long Strangle at expiration will be:

$$\mathbf{C_T(S_T, X1, T) + P_T(S_T, X2, T) = \max\{0; S_T - X1\} + \max\{0; X2 - S_T\}}$$

The value of the Short Strangle at expiration will be:

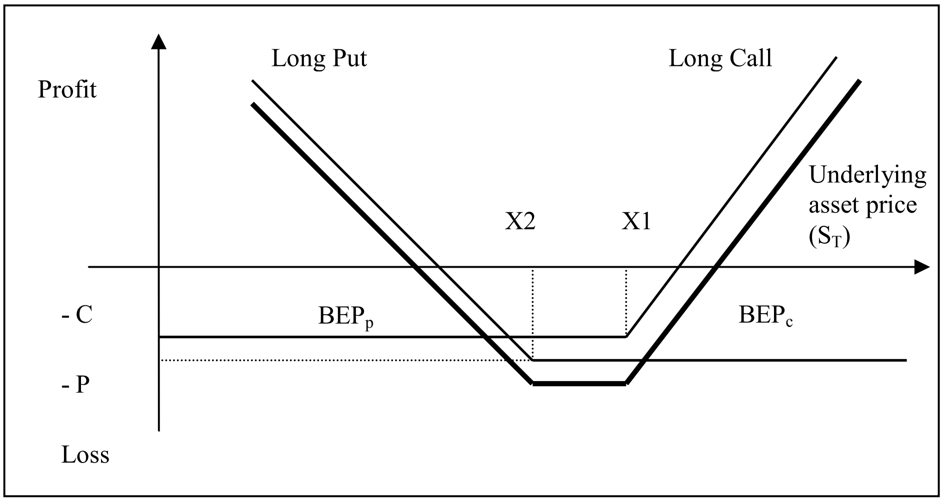
$$\mathbf{- C_T(S_T, X1, T) - P_T(S_T, X2, T) = - \max\{0; S_T - X1\} - \max\{0; X2 - S_T\}}$$

The holder of a strangle expects an increasing volatility for the underlying asset. The writer of a strangle expects the decreasing volatility for the underlying asset.

The Long Strangle is illustrated in Figure 1.

[14] Caracota Dimitriu M., Băltăreț A. (2006), "Derivative Securities", *ASE Publishing House, Bucharest*

Figure 1. Long Strangle



Data sources: Caracota Dimitriu M., Băltăreț A. (2006), "Derivative Securities", ASE Publishing House, Bucharest

Where: BEP_p is break even point for put (X2 – P) and BEP_c is break even point for call (X1 + C).

The calculations of the long strangle are summarized in Table 2.

Table 2. Results of Long Strangle

	Long Call	**Long Put**	**Long Strangle**
S_T <= X2	- C	- P + X2 – S_T	- C - P + (X2 – S_T)
X2 < S_T < X1	- C	- P	- C - P
S_T >= X1	- C + S_T – X1	- P	- C - P + (S_T – X1)

Data sources: Caracota Dimitriu M., Băltăreț A. (2006), "Derivative Securities", ASE Publishing House, Bucharest

The results are:

1. If S_T <= X2 then the holder of the strangle loses the call premium and the put gives a loss, smaller than the put premium if BEP_p < S_T < X2 or a profit if S_T < BEP_p;

2. If $X2 < S_T < X1$, then the holder of the strangle does not exercise the strangle and loses both the put premium and the call premium;
3. If $S_T >= X1$, then the holder of the strangle loses the put premium and the call gives a profit if $S_T > BEP_c$ or a loss smaller than the call premium if $X1 < S_T < BEP_c$.

For example, there is a trader who chooses a long strangle position on RON/USD future contract. The future contract has the maturity in June.

The positions:

- Long call option with expiration in June, X1=2.95 and call premium C=0.055
- Long put option with expiration in June, X2=2.90 and put premium P=0.045.

Suppose that at a time till expiration the RON/USD future market price is 2.86 RON/USD.

Thus, for $S_T <= X2$, the results are:

- Long Call: -0.055
- Long Put: -0.045 + 2.9 – 2.86
- Long Strangle: -0.055 – 0.045 + (2.9 – 2.86)

As $S_T <= X2$, the holder of the strangle loses the call premium wins on put. Therefore, the trader has a loss of 1.000 x (-0.06) = -60 RON.

The trader has to change his initial position, expecting a decreasing market and a decreasing volatility. He can sell 2 call options (one of them clears the long call in the initial position) and also clears the long put position. Thus, he has a short call position:

$$\text{Profit} = 0.055 \times 1.000 = 55 \text{ RON}$$

Risk measurement for options

The value of options is sensitive to changes in the value of the underlying, interest rates and volatility. This means that changes in market conditions can lead to the risk of losses for banks that hold options. The sensitivity of options to these market changes is described by what is known as the Greeks. They are called Greeks because they are symbolized by the Greek letters: Delta, Gamma, Vega, Theta and Rho. The Greeks are similar to duration in that they estimate the change in the value of the option if one of the market variables changes. Each of the Greeks is described below[15].

Delta (Δ)

Delta is the first derivative of the option price (P) with respect to the value of the underlying stock (S).

[15] Marrison Chris (2002), "The fundamentals of risk measurement", *McGraw-Hill Edition,* New York

$$\Delta = \frac{\partial P}{\partial S}$$

Delta is the linear approximation of how much the value of the option will change if the value of the underlying changes by 1 unit. Delta is not an exact description of the change in the value of the option because the option value is not a simple linear function of the stock price; therefore, the change in the option value is not proportional to the change in the underlying. The difference between the true value change and the change predicted by delta is called gamma risk.

Gamma (Γ)

Gamma is the second derivative of value (P) with respect to the price of the underlying (S), and it describes how much more the price of the option will change beyond the linear approximation of delta.

$$\Gamma = \frac{\partial^2 P}{\partial S^2}$$

Gamma describes the nonlinear risk of the option by using the *Taylor Series Expansion*, as follows:

$$dP = \Delta(dS) + \frac{1}{2}\Gamma(dS)^2$$

Vega (υ)

Vega describes the option value's sensitivity to changes in the volatility (σ). It is the first derivative of the option price with respect to implied volatility. It represents how much the option value will change if the volatility of the stock price changes by 100% per year.

If Vega equals 0.6, the value of the option will increase by 60% if volatility increased by 100%.

$$\upsilon = \frac{\partial P}{\partial \sigma}$$

Rho (ρ)

Rho is the first derivative of the option price in relation to interest rates. It represents how much the option value changes when interest rates change:

$$\rho = \frac{\partial P}{\partial r}$$

Theta (θ)

Theta is the first derivative of the option in relation to time. It represents how much the option value changes as it moves toward maturity:

$$\theta = \frac{\partial P}{\partial T}$$

The Greeks can be calculated analytically by using calculus to differentiate a pricing equation, such as the Black-Scholes equation[16]. Alternatively, the Greeks can be calculated by pricing the option with one value of the risk factor and then slightly moving the risk factor and pricing again.

For example, delta would be calculated from the following equation, where *e* is a small addition to S. Typically *e* would be chosen to be approximately equal to the volatility of the risk factor:

$$\Delta = \frac{P(S+e) - P(S)}{e}$$

Notice that the Greeks give linear approximations to changes due to one risk factor. If several factors change, the total value change can be estimated by summing the Greeks:

$$\delta V \approx \Delta \times \delta S + \frac{1}{2}\Gamma \times \delta S^2 + \upsilon \times \delta\sigma + \rho \times \delta r + \theta \times \delta T$$

The risk measurement had a constant evolution, therefore, today exist many respectable methods of measuring risk of which a manager could choose; these cover coherent methods of measuring risk, methods based on predictions, distortions or many others. Moreover, today are too many methods of measuring risk, without a certain possibility to assess which method is best. The most adequate method depends on the assumptions made and sometimes it will depend on the context. Any effort to seek the best method of measuring risk, in all ways, will be useless and the practitioners would be pragmatic.

Concluding, all banks and financial institutions must improve the comprehension and the practice of the banking risks management to successfully manage different range of products. If the process of banking risks management and the global system of management are effective, then the bank succeeds. Banks could successfully manage the banking risks if they recognize the strategic role of risks, if they use the analyzed and management paradigm to increasing efficiency.

[16] Black-Scholes equation is a partial differential equation, which must be satisfied by the price of a derivative on the equity.

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