Portfolio Risk Control by Using Derivative Instruments

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Abstract: *The priority in portfolio management is a good risk assessment and management. Of great importance is the margin that an asset portfolio guarantor must use with specific expertise in certain areas of market temporal inefficiency in order to improve its management performance. The relevant validity of the financial market and the emphasis laid on risk management carried along the development of financial instruments tailored to risk management. New derivative financial instruments have revolutionized the methods of portfolio management, of corporate treasury management, of banking management and, more generally, all financial strategies.*

Keywords: *risk management; portfolio management; Treasury management; hedging; derivative structures; financial strategies; options; futures; OTC products; securities traded outside the Stock Exchange; financial leverage; PUT options; CALL options; bull spread; binomial model.*

1. Introduction

Major developments in financial theory after the 1980s and the positive evolution of the study and research activities of the financial market have profound implications on the financial theory in general, dealing with the corporate financial management or the financial and banking economy, and particularly with the portfolio management. It was thus developed the concept of the capital markets efficiency, exposing the most important empirical results, obtained both on the European and the American markets, and aiming at demonstrating the independence of securities rate and their behaviour analysis in relation to the occasional financial events.

Within the framework of the modern theory of capital markets it emerged the theory of new financial instruments for hedging the market risks: short-term futures contracts, options, swaps, caps, forward etc. These tools enable financial risk management depending on the particular previsions. Financial leverage brought through these tools, the flexibility in their use, association to very feasible transaction expenditure allow for a very precise risk management5.

It aimed at putting forward the principles and new models for the valuation of derivative financial instruments, and uses of the new financial instruments, with concrete examples, which prove to be very useful as instruments of control, and especially of insurance against risks (Alexandru Olteanu, Florin Olteanu "Managementul portofoliului si a riscului pe piata titlurilor financiare'', Editura Fundatiei "Andrei Saguna'', Constanta 2011).

2. Literature review

Derivatives and risk control[2]

A debate on the use of derivatives for the portfolio risk management, by giving examples of methods of risk control and alternation of portfolios, is aimed to discard the beliefs according to which the derivatives are particularly risky and dangerous instruments.

The derivative structures, especially the exchange-traded options, may offer some key benefits for institutional investors and investment managers in Romania[2], such as those related to:

- **Change of assets:** The exact identification of the market evolutionary changes and monetary liquidity in such critical moments is impossible to quantify. The immediate question is: What can a manager do to avoid such a situation, or at least mitigate its negative effects that could redound upon the portfolio. It appeals to derivative products which provide a continuous cash flow, even in times of market uncertainty, at a cost significantly lower than the one associated to limited non-cash.
- **Risk covering (hedging):** Options can be effectively used in a long-term hedging strategy to counter adverse market movements, with the benefit that the volatility of the structure costs is relatively small when hedging operations are initiated at the precise moment when a risk is perceived.
- **Low costs:** Losses arising as results of a fall in the cost of certain shares could be covered by the sale of CALL options. A manager who calculates the absolute profit generated by the portfolio may order the sale of options whose profits exceed that level.
- **Speculation:** The call for options can be done by participating on the moving market, without making use of a significant amount of capital, participation which may generate substantial profits if derivative instruments are used, but after understanding the mechanisms of operation and combination of effects.

Therefore, large volumes of derivative products that were globally traded on the alternative financial markets lastly are a proof of the appreciation thereof and increasingly large use in the financial community. On the one hand, 2006 - the most significant year before the crisis, has undoubtedly been a year of uncertainty, of small gains and corporate-level scandals. European stock markets closed the reporting period with losses ranging between 25% and 50%. On the other hand, it was a year characterized by growth in hedge operations and the increasing volume of derivative instruments markets.

Interestingly, the increase in the volume of traded derivatives was recorded only in the case of Stock Exchanges. The Report of the Bank for International Settlements has shown an increase in the value of derivatives, reaching the figure of over USD 700 billion. The explanation lies in the fact that the exchange-traded options have some advantages over packets (such as OTCs, securities traded outside the stock exchange via a brokerage agency or direct contract between the purchaser and the seller), making the same extremely attractive to managers.

Given the downgrade in confidence in some large financial institutions, following the triggering of the financial crisis in 2008, not surprisingly, traders prefer to avoid entering into contracts with individual parties. The exchange-traded options make possible the commitment of a central counterparty – the Clearing House. Moreover, the transparency of operations allows continuous monitoring of prices and the known number of participants generates a more competitive environment than in the case of OTC products.

The biggest drawback of the options, put forward in the past, has been the inability to absorb large volumes of issues, non-existent aspect in the case of OTCs. Although this statement could be true, it is no longer a current problem. The increased volume of the value of exchange-traded contracts and the special interest thereto prove the ability to place large volumes of issues.

2.1. Incorrect use of derivatives - a trap of ignorance

Derivatives are not inherently dangerous, as many commentators might believe. They are definitely not “financial weapons of mass destruction”. On the contrary, for many institutional investors, the derivatives were the instruments that kept them afloat. This does not mean that derivative instruments (like many other financial products) mechanisms of operation and their role in risk management. Flexibility and the nature of options strategies require continuous monitoring of changing markets conditions, the risk and the value of the option and require a regular revaluation of financial assets. Once these conditions are met, the benefits of using derivative products, such as options (insurance against future risks), outweigh the costs.

Hedging strategies used in transactions with derivative instruments [(7)]

[7] Bookstaber R “Option Pricing and Strategies in Investing”, Ed. Addison Wesley, 1981

There are several methods whereby options can be incorporated into the portfolio. Thus, options can be used to develop hedging strategies, because it offers multiple possibilities of risk management to economic agents[4]. In this respect, in return for payment of a premium, options contracts account for a substantial protection against adverse movements in the underlying asset price, while offering opportunities to obtain some returns, this time as result of favorable changes in prices. Among the derivatives trading strategies, indicated to be used, are listed by way of example the following:

Covering risk hedging: example - the spread strategy[8]

A spread strategy involves taking a position on two or more options of the same type (two or more CALL options or two or more PUT options).

It is considered one of the most widely used spread strategies, namely bull spreads, which involves buying a CALL option on a futures contract with a certain strike price and selling a CALL option on the same type of contract, but with a higher strike price. Both options have the same expiration date. The investor hopes that the price of the security goes up.

Suppose, at a certain moment, a low volatility on the futures market of the USD BRM contract. A fund manager at an import-export company, analyzing the commercial evolution of the last quarter of the year, reaches the conclusion that the evolution of the RON/USD ratio will suffer considerable variations, which could seriously affect the value of the portfolio. In this respect, the administrator shall order its broker on the BRM options market to purchase CALL options on futures contracts, worth USD 100,000, paying a premium of 700 u.m/USD, at a strike price of 26,000 u. m/USD and sell CALL options on futures worth USD 100,000, the premium of 200 u. m/USD, at a strike price of 28,000 u.m/USD.

The first scenario assumes an increase in futures price (S_T) up to the value of 27,000 u.m. Fully confident in his forecast, the manager expects the maturity date of the USD BRM futures contract in December. Upon the maturity date of the USD BRM futures contract in December, the settlement price is 27,200 u.m. This means a gain of 1,200 u.m/USD, out of which is deducted the premium, resulting in a final profit of 500 u. m/USD, amount covering part of the devaluation incurred by the Romanian RON.

Another possibility would have been that, on the maturity date, the manager would opt for the execution of the contract through physical delivery and thus take possession of USD 100,000 at a price of USD 26,000, once the market rate reaches the level of 27,200 u.m/USD.

The second scenario would have been the increase of the futures price up to 28,300 u. m, in which case the manager earns 1,800 u.m/USD, the final profit being 1,600 u.m/USD, profit which would maintain this level unchanged, no matter how much the futures price may increase. Such a strategy results in that, while the CALL price goes down as the strike price goes up, the value of the sold option is always less than the value of the option purchased. The volatility was thus significantly reduced, and the costs were relatively small.

Participation in the moving markets with the view to earn profits: example – buying a PUT option[9]

The use of such derivative trading strategy can be explained by way of an example. Thus, after analysing the futures market trend at EURO BRM contract, it is estimated a price decrease. Because the customer is not firmly convinced that this trend will manifest, he decides not to open a futures position and decides to buy a EURO BRM August 2012 PUT option at a strike price of 29,100 u.m. If the current futures price tends to rise, the premium paid for this option is small, managing to buy a PUT option against a premium of 300 u.m./EURO. For those who are in a similar position in terms of market analysis results, it is recommended buying “in the money” options or even “out of the money” options because it may be cheaper. When the futures settlement price falls below the strike price, the intrinsic value relevant for these options begins to go up and, therefore, the premium thereof to rise. At this point, the customer can proceed to obtain funds to cover the futures margin and wait for the time of exercising the option. Upon exercise, the customer will have the PUT option position cancelled and the futures selling position initiated.

Buying a PUT option is less risky than selling a futures contract, because an increase in futures quotation does not entail mark-to-market losses, the maximum loss being related to the premium paid.

Profit occurs when the futures settlement price falls below 29,000 u.m., when exercising this option causes the customer to have a futures selling position initiated at a price of 29,100 u.m. If the settlement price is

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[4] R. Ferrandier, V. Koen “Marchés de capitaux et tehniques financières”, Ed. Economica, 1997

[8] Black F., Sholes M ‘The evaluation of option contracts and attest of market efficiency”, Journal of Finance, May 1972

[9] Cox J., Rubinstein M “Option Market”, Prentice-Hall, 1985.

29,050 u.m., the customer earns 50 u.m. from the mark-to-market, and if the settlement price is 29,090 u.m., the same earns 90 u.m. As the futures settlement prices go down, the profit goes up.
The loss is limited to the premium paid upon registration of the transaction. If the futures settlement prices range above the value of 29,100 u.m., the buyer does not exercise his option, remaining with the loss of 300 u.m. Note that the premium paid of 300 u.m./contract must be recovered in order to record a net profit. The mark-to-market gain, resulting following the exercise of the option, must be higher than the premium paid and is registered at futures settlement prices below 29,070 u.m.

Selecting the use of models for the valuation of derivative financial instruments, in particular of options [10,11]

All models for the valuation of financial instruments are derived from arbitrage reasoning between derivative instruments and the underlying securities-asset. For example, for a stock option, the arbitrage reasoning used for the capitalization of a stock and option contract is as follows: all investors can establish, by combining the purchasing of shares and options, a perfectly covered portfolio, risk-less, in other words the value is independent of the evolution of the course of stock. In such a case, the portfolio may not be reported to the risk-free interest rate during the period of ownership. Therefore, it is recommended to be used as models for the valuation of derivative financial instruments the One-Period or Multiple-Period Binomial Model, and the Black and Sholes Model. [1,8]

The Binominal Model

This model has the advantage of a large simplicity. It involves checking the classic assumptions of capital market perfection and responds to the principle according to which no risk-free arbitrage may exist in such a market. The Binomial Model leads to the continuous-time model of Black and Sholes.

Capitalization of a buying option under the Black and Sholes arbitrage model [8,12]

For the formalization and reasoning of the arbitrage within the model proposed a certain number of assumptions are required:

The risk-free interest rate must be continuous and constant at the period rate;

The security price follows progress at random, with a variation of its fluctuations in direct proportion with the square of its security rate. Also, the distribution of the different possible prices of the security at the end of a certain period follows a normal logarithmic law. The variation in the rate of return is constant during this period.

The security shall not entitle to any dividend or interest distribution;

The option to be "European" and cannot be exercised on each due date;

There should not be trading costs related to the security's or option's buying or selling;

It is possible to make a loan to the daily interest rate, the security's rate faction being unimportant.

The assumptions are indispensable to the demonstration. R. Merton[12] argued, in 1973, that the original model of Black and Sholes is very robust and conditions are sufficient and much less numerous than MEDAF (the market model of H.M.Markowitz). The analyses carried out show that the model does not require any particular securities market balance. Investors may not have a homogeneous anticipation, especially in terms of the rate of return.

However, an investor can establish a portfolio of securities containing a basic security (e.g. stock) and for which the funding is provided by the sale of "n" purchase options. In this case, the value of the "V" relevant for such a portfolio is calculated as follows:

$V = x - nw$ (1)

Where:

V – value of the portfolio

X – value of the security

W – premium of the negotiable option (call or

[10]Geske R., Shastri K "Valuation by approximation: a comparison of alternative valuation techniques", Journal of Financial and Quantitative Analyses, march 1985.

[11]Geske R "The valuation of compound options", Journal of Financial Economics, 7, 1979.

[1] Alexandru Olteanu, Florin Olteanu "Managementul portofoliului si a riscului pe piata titlurilor financiare'', Editura Fundatiei "Andrei Saguna'', Constanta 2011

[8] Black F., Sholes M 'The evaluation of option contracts and attest of market efficiency", Journal of Finance, May 1972

[12] Merton R., „Options pricing when underlying stock returns are discountinuous", Journal of Financial Economics, Jan-March 1976

It is worth mentioning that, during a small period of time "dt", the rate varies at a volume "dx", the premium of "dw"" volume and a "dv" volume portfolio calculated as follows:

$dV = dx - ndw$ (2)

Under the assumptions hereabove, the premium "w" is not based on the "x" rate and the due date upon the maturity of the "t" option contract, as follows:

$W = w(x,t)$ (3)

Where:

t – time;

x – the rate of the financial instrument is a diffusion process that can be written as a variation of the price and is depending on the variation of the basic security rate and time:

$dw = w_1 dx + w_2 dt + \frac{1}{2} w_3 \delta^2 x^2 dt$ (4) where:

w_1 – w first derivative with respect to x;

w_2 - w first derivative with respect to t;

w_3 - w second derivative with respect to x.

Entering the value of "dw" shown in the equation (4), in the expression "dV" indicated in the equation (1), we get:

$dV = dx - nw_1 dx - n(w_2 dt + + \frac{1}{2} w_3 \delta^2 x^2 dt)$ (5)

where:

dx – is the only random variable of this expression.

To the extent that "n"" was selected, such as $(1-nw_1)$ is equal to zero, the variation of the portfolio value becomes certain and the portfolio is risk-free. For this it is enough to get "n" equal to $\frac{1}{w}$; the portfolio will be constantly revised since w_1 varies in time:

$dV = \frac{1}{w1}(w_2 dt + + \frac{1}{2} w_3 \delta^2 x^2 dt)$ (6)

Under the penalty of arbitrage, a risk-free portfolio cannot be reported at the risk-free investment rate of the financial market, and hence the equation:

$dV = rVdt$

respectively: $dV = r(x - \frac{1}{w1} w)\, dt$ (7)

By equalling the two equations, we get:

$r(x - \frac{1}{w1} w)\, dt = \frac{1}{w1}(w_2 dt + + \frac{1}{2} w_3 \delta^2 x^2 dt)$ (8)

and hence:

$w_2 = w_r - w_1 rx - \frac{1}{2} w_3 \delta^2 x^2$

We agree to translate this differential equation with the boundary conditions specific to the option considered. Hence, the following equations:

$W(s, o) = s - k$ if $s \geq k$

(9) $W(s, o) = 0$ if $s < k$

Thus, the value of a CALL C is resolved by this differential equation. Solving this problem is well known in mechanics. This result is given in the equation (2).

For a PUT- P the boundary conditions are:

$W(s, o) = 0$ if $s > k$

$W(s, o) = k - s$ if $s \leq k$ (10)

The solution is given in the equation: $dw = w_1 dx + w_2 dt + \frac{1}{2} w_3 \delta^2 x^2 dt$

The value of other European options types can be equally determined in part by this equation, adapted to the boundary conditions. However, some options lead us to differential equations, for which analytical solutions are not required.

It is worth mentioning that an American option, which is allowed to exercise at any given time, has boundary conditions at any time, and, by way of consequence, the differential equation will be solved by numerical methods.

3. Conclusions

The analysis showed that there are many advantages for institutional investors and financial managers of romanian companies as a result of the use of derivative instruments for hedging and profit generation, a fact attested by the growing number of participants in the market that use these products currently and growing volumes of transactions concluded through its. Properly understood and used for risk management, derivative instruments are significantly less "dangerous" than other financial products.

In the last two decades has registered an increase in the importance of portfolio strategies and especially to use derivative financial instruments for the supervision and management of financial risks. The choice of a specific portfolio strategies, the use of financial instruments and appropriate valuation models are based on the needs and desires of customers. Successful portfolio management and adequate financial instruments involve more than just coordination of some technical information. Such information is useful only to the extent that help in generating high profitableness.

Global financial crisis triggered alternative markets derivatives has led to multiple debates related to the use of these financial instruments. These debates of financial and banking analysts have different opinions on the causes and forms of manifestation of the so-called crisis of confidence".

Some analysts have put the crisis on behalf of the „interventionist role on mortgage market", which has led to a failure of markets („market failure"). Finally, the most plausible relates to the use of „toxic" financial products, in the form of CDOS and CDS (collateralized debt obligations, credit default swaps), synthetic non-regulated products respectively, and put in circulation by the major banks via the process of „originating and distributing ". Also, banks have turned to securitisation operations of bonds considering it a profitable business, to the extent that apparently eliminates the risk. They were selling securities (bonds) for some investors, removing them out of their own balance sheets. But what seemed a convenient dissemination of individual risks in the entire financial and economic system resulted in a high risk amplification system.
The bottom line is that no new financial product complexity is responsible mainly for the financial crisis, but the pattern of financial innovation and financial products features that undermined what is essential for the proper functioning of markets: transparency and confidence.

Regarding the mechanisms of options contracts recently developed models and the equilibrium model of financial assets, allow endorsers of portfolios perform a rigorous manner the price of such contracts and the risks that must be covered. Tradable options market had experienced a successful culmination because it allows portfolio strategies based on speculation, arbitration or insurances, that increase profitability-risk benefit.

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