Derivative Securities on Romanian Capital Market

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ABSTRACT
This study aimed to investigate whether the world wide agreed models of valuation of derivates may be properly applied to the Romanian capital market, obtaining reliable results for decision makers. The most common valuation models take into account market data such as, interest and exchange rates, volatilities and the price of the underlying instrument. The procedures for valuation must clearly define the nature of the market data to be taken into consideration (for example the zero-coupon curve for the valuation of swaps) and the independent reference base to be used (Reuters at a given time, bid/offer or mid price, broker). In order to be able to obtain the results, I based my study on a self-developed software which can calculate the price and characteristics for different types of derivatives securities once the primary data are filled in. I compared the results obatined usig the valuation models with the actual prices on the Romanian capital market. I expected that the results obtained to be more accurate as the parameters used in the calculation models properly reflect market data as at that date being as widely as possible.. These assumptions were only supported for certain value orientations. In conclusion, explanations for these results are given and limitations for this study are discussed. Also, suggestions for future research are presented in the final part of the article.

KEYWORDS: *derivatives, investments, risk management, valuation models.*

JEL CLASSIFICATION: *G24*

INTRODUCTION

Derivative securities are relative recent financial instruments, which have newly penetrated Romanian capital market and are not yet used at their true potential. The only companies that are using on regular bases derivatives are the banks and the financial investments services companies. On the other hand, for the private investors, traders and public, the popularity of derivatives is still very low in Romania. The reason, for which this kind of instruments is not fully employed, is the fact that the novelty brings along the incertitude and reticence.

Based on the observations made above, I choose to present in this paper those aspects that make the derivatives a difficult instrument to use. The title of this paper is "Managing investments in derivative securities". My management research will be concentrated on

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developing an IT program, that will both display complex information and will be easy to access by specialists and anyone interested in this domain. The main target of this IT application is to increase the interest in derivatives transactions on the Romanian capital market. This application will enable users to make the correct decisions or provide reliable estimation.

In the first part of the study I present a short description of the reserches made on the management of the risk using derivative securities, by improvement the methods of valuation. The second part contains an anlysis of the main characteristics of the capital market in Romania and its evolution in time. The next chapter will be focused on the posibilities in which an option can be evaluated. For this I created a software application, which can be accessed by any user. Using this application, I will analyze the results obtained by applying the methods of valuation of the derived financial instruments available on the Romanian market. In the last chapter of this paper, I will illustrate the conclusion of this research and also the theoretical limitations of this dynamic field.

1. PRESENTATION OF THE ACTUAL KNOWLEDGE STAGE

The derivative securities are new generation instruments which emerged due to spectacular development of the capital markets during the globalization process. This kind of financial assets became more visible as instruments for covering the risks shown on the financial, monetary and capital markets. Thus, the main goal of any investor is to maximize the profit by undertaking as lower risk as possible, and then the reason for derivatives' transaction was established from the necessity to minimize that risk. The investors need protection against the variations of the financial parameters which impact their gains.

The matter regarding the valuation of activity on the financial markets occurred since the beginning of the 20th century, when Bachelier suggested "random walk" model for shares' price. Even Einstein has show interest for this subject. Bachelier study was continued by Weiner, who explained in 1923 the concept of Brownian motion in finance. In another research area, Markowitz presented at the half of last century, the concept of "efficient portfolio" and proposed for the first time a quantitative approach for compiling a portfolio which could yield maximum of gain by undertaking a certain risk. Due to the fact that Markowitz' model was rather difficult to be used in practice, Sharpe, Linter and Mossin brought an updated model which is used even nowadays – CAPM.

In the derivative securities area, the research started latter, when the first option contracts were commercialized at the Chicago Board Option Exchange – the model initiated by Black, Scholes and Merton (1973). Actually, the one who obtained the first results in this field was Thorp, but he preferred to keep them secret and used the results in order to increase his fortune and the fortunes of his clients. Thorp published his researches much latter, in 2001, when already have appeared similar studies. According to Hull (2006), *"Options, Futures & Others Derivatives*", Black-Scholes model is wide spread even nowadays, but there were researchers who continued their studies: Vasicek – 1977, Cox, Ross and Rubinstein – binomial model (1979), Ho and Lee in 1986, Paul Wilmott who published studies in years `90 and beginning of 21st century.

2. ROMANIAN CAPITAL MARKET

No. 297/2004 low, regarding the capital market is the one which supports the good function of the capital market in Romania and regulates the way that the financial instruments of the market work, with all their specific operations, with the purpose of the increasing of the number of investments in the financial instruments field.

The most significant stock exchange markets in Romania are:

- Bucharest Stock Exchange together with OTC Market RASDAQ,
- The Financial – Monetary and Commodities Exchange Market of Sibiu,
- The Romanian Commodities Exchange Market.

In December 1997, the futures contracts were registered with the State Office for Inventions and Trademarks, patents BMFMS, fact that constitute the evidence of Sibian establishment in this priority area. July 11, Sibiu became the first stock exchange for derivative contracts in Romania through implementation of the first currency and stock index futures (futures contract was launched with the active support own index - BMS1). The introduction of futures contracts was a crucial step in transforming the stock exchange into a national center that stock market participants are able to cover their risks or to speculate on price changes using derivative securities. In November 1998, launched futures options contracts traded on the Sibiu Exchange, operators thus had full range of derivatives needed to hedge operations. In December 2000, launched BMFMS to trading, the first derivative actions.

Table 1. Evolution of derivative contracts at BMFMS

Year	Futures contracts	Option contracts	Total Derivative contracts
2011 (April)	353 660	3 829	357 489
2010	1 620 078	17 716	1 637 794
2009	2 430 849	52 438	2 483 287
2008	3 578 582	40 184	3 618 766
2007	3 456 023	34 900	3 490 923
2006	4 232 059	36 651	4 268 710
2005	696 109	11 629	707 738
2004	72 901	2 273	75 174
2003	168 545	19 369	187 914
2002	225 069	67 300	292 369
2001	135 242	53 731	188 973
2000	158 536	46 752	205 288
1999	159 927	15 215	175 142
1998	193 203	133	193 336
1997	77 877	0	77 877

Source: SIBEX, 2011http://www.sibex.ro/index.php?p=statistici&s=1&l=ro

In September 2007 took place first derivative transactions on the Bucharest Stock Exchange. At that date was launched the future contract for trading on BET, the main BSE index. This event was followed in April 2008 by the introduction of futures contracts on shares of listed companies such as Erste Bank (EBS), SIF Banat Crisana (SIF1), SIF Moldova (SIF2), SIF Transilvania (SIF3), SIF Muntenia (SIF4) SIF Oltenia (SIF5), Petrom (SNP), CNTEE Transelectrica (TEL), SNTGN Transgaz (TGN), Banca Transilvania (TLV) - and exchange rates EUR / USD and USD / GBP.

Table 2. Evolution of derivative contracts at BSE

Year	No of dealing sessions	No of transactions	No of contracts	Value (RON)	Average daily value (RON)
2007	71	41	64	540 535	7 613
2008	250	922	18 018	19 308 628	77 235
2009	250	507	15 613	67 049 100	268 196
2010	255	1 745	25 099	107 068 791	419 878
2011	89	343	2 326	1 906 640	21 423

Source: BVB, 2011 http://www.bvb.ro/TradingAndStatistics/GeneralStatistics.aspx?tab=5&m=0

The derivatives market development appears to be an ambitious projects aiming to expand the range of financial instruments available for trading and the qualitative improvement of the trading and clearing model. The market making services for the BSE Derivatives market proved to be benefic for increasing the trading volumes, in 2010 being registered the highest traded volume and notional value. In December were launched, for the first time, the market making services for a futures contract underlying shares, respectively the ones of SIF Muntenia. At the end of 2010, were available for trading 14 futures contracts, counting 42 listed series.

In September 2010, BSE issued contract specifications for three new derivatives, obtaining the CNVM registration certificates for two of them, the ones underlying ROTX index and the shares of Bucharest Stock Exchange. The contract underlying the shares of Fondul Proprietatea is going to be listed as soon as the CNVM registration certificate is issued.

3. VALUATION MODELS OF AN OPTION – SOFTWARE APPLICATION

In order to take full advantage of the opportunities the derivatives afford, we need to have a thorough understanding of how derivatives contracts are valued. As Whaley (2006), *”Derivatives: Markets, Valuation, and Risk Managemen”* said, without an understanding the economic factors that drive valuation, we cannot measure risk accurately, and if the risk cannont be measured, certainly cannot be managed effecively. In order to be able to compute the price of a selected option traded on Romanian market, I developed a software called “Modele de evaluarea instrumentelor financiare derivate” (*“Valuation Models of derivatives securities”*). Please see below the main window of the software which offers the posibility od choosing the model for valuation. The proposed valuation models are the once used most often on the Romanian market.

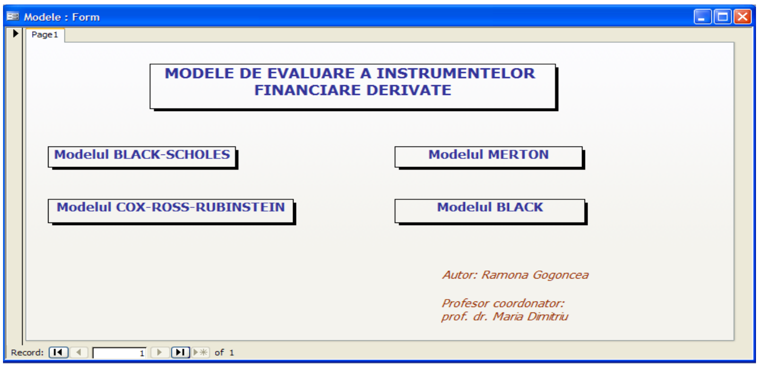

Figure 1. Software - main window
Source: authors

3.1. Black-Scholes model

Is based on the following assumptions: trading takes place continuously (continuous-time model), underlying asset's profitability has a normal distribution, underlying asset does not generate dividend on the duration of the option, interest rate is constant, underlying annual rate volatility (measured by standard deviation of annual yields) is constant, no arbitrage opportunities (AOA), European-style option is valued, all economic agents can borrow and lend at the risk-free interest rate, all financial instruments are perfectly divisible, there are no transaction costs.

The equation for evaluating a derivative if the Black-Scholes model is as follows:

$$\begin{cases} \frac{\partial D}{\partial t} + rS\frac{\partial D}{\partial S} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 D}{\partial S^2} = rD \\ D(T,S) = payoff = F(S) \end{cases} \quad (1)$$

To find the premium of a call option with exercise price K and maturity T, equation above should be solved providing the limit D (T, S) = max (S - E, 0). The solution is called the Black-Scholes formula for valuing a call option.

Let c (t,T) the premium for European CALL option with maturity T. The exercise price, according to Black F.; Scholes M. (1973) *"The Pricing of Options and Corporate Liabilities"* is K and the underlying asset price at time t is S. It can be proved that

$$C(t,T)=SN(d_1)-Ke^{-r(T-t)}N(d_2) \quad (2)$$

Where

$$d_1=\frac{\ln\frac{S}{K}+(r+\frac{\sigma^2}{2})(T-t)}{\sigma\sqrt{T-t}} \quad (3)$$

$$d_2=d_1-\sigma\sqrt{T-t} \quad (4)$$

For computing the premium of a PUT option, it might be used the call-put parity relationship:

$$C+Ke^{-r(T-t)}=P+S \quad (5)$$

where P is the put option price. Substituting this relation in the theoretical formula of CALL option price (2), we obtain the Black - Scholes European put option price:

$$P(t,T)=Ke^{-r(T-t)}N(-d_2)-SN(-d_1) \quad (6)$$

3.2. Valuation of a an option with uderlying asset AZUR share

I will consider a share option AZUR, traded on 01.03.2011 maturity 01.09.2011. Option has the following characteristics at time t = 0: exercise price K = 3.55 RON; maturity T = 6 months = 0.5; spot rate S = 3.02 RON; r = risk-free interest rate 8.25%; volatility σ = 29.70%. I used the model to estimate volatility by historical data.

Filling in the dates in the software, I obtained the following results:
CALL premium: 0.187
PUT premium: 0.5735

Therefore, if an investor decides to buy a call option, he must pay a premium of 0.187 RON. Such an investor would resort to this position or if he expects that the rate would increase in the next 6 months to a value at least equal to 3.737 RON, amount that enable him to cover all costs, or if he is already involved in another transaction and he wants to minimize risk. For example, the investor may have a short position in a futures contract, which matures in September 2011. Through this contract, the investor would commit to sell shares at a price of 3.7 RON, so it would be at risk of share price growth. To protect himself, he enters into a CALL contract with the above specifications, pays a premium of 0.187 RON, a low value, because in these circumstances, the option is "out of the money (S <K). At maturity, the investor faces the following situations:

- if the spot price ST ≤ 3.55 RON, the investor gains from the futures contract (3.7-ST), call option is not exercised, but pays the CALL premium of 0.187, so the final result: 3.7-0.187- ST = 3.513-ST. Maximum loss for the investor would be 3.513-3.55 = = 0.037 RON an action, and the maximum theoretical gain would be 3.513;
- if the spot price 3.55 <ST ≤ 3.7, then the investor gains from the futures contract (3.7-ST), call options are exercised, the gain would be ST-3.55, so the final result is 3.7-3.55-ST + ST-0187 =- 0037;
- if the spot price ST> 3.7, then the investor loses the futures contract (3.7-ST), call options are exercised, the gain would be ST-3.55, so the final result is 3.7-3.55-ST + +ST-0187 =- 0037.

So, the investor succeeded to secure positions and at maturity may gain benefit, in terms of maximum possible losses of only 0.037 per share.

3.3. Cox-Ross-Rubinstein model

Is based on the main assumption that the price of the underlying assets follows a binomial distribution which is the discreet time version of geometric Brownian motion. In a risk-neutral universe, the value of a CALL or PUT option is:

$$C = e^{-r(T-t)}\left[\sum_{j=0}^{n}\frac{n!}{j!(n-j)!}p^j(1-p)^{n-j}\max\left(Su^jd^{n-j}-K;0\right)\right], \quad (7)$$
$$P = e^{-r(T-t)}\left[\sum_{j=0}^{n}\frac{n!}{j!(n-j)!}p^j(1-p)^{n-j}\max\left(K-Su^jd^{n-j};0\right)\right].$$

Cox J. C., S. A. Ross & M. Rubinstein (1979), *"Option Pricing: A Simplified Approach"*, mentioned the recommandation that this model is to be used in real market only when the maturity of the contract is high or the volatility is low. For exemple BMFMS, uses on SIBEX market the binomial model on American options, having as underlying asset the future contracts.

3.4. Valuation of a an option with uderlying asset AZUR share

Considering the share option from chapter 4.2, with same caracteristics and number of periods of revaluation equal to 20 and filling in the details in the software, I obtained the following results:

CALL premium: 0.2027
PUT premium: 0.5892

Given that the call option is "out of the money", I calculated the number of increases is needed for it to exercise, where *a* is the number of increments. According to calculations made, obtain a = 3, so for any variant, with i <3, the call option is not exercised and the holder's payoff is 0. PUT premium is higer then the CALL premium because the PUT option is "in the money", so chances for it to exert are greater than for other options.

3.5. Merton model

Is a continued variance of the Black Scholes model, as it shows the value of an option with underlying assets which distributes dividend. The difference between an share which does not distribute dividend and another one identical which does distribute is that once the dividend is distributed, that leads to a decrease in the trade price equal to the dividend (Dimitriu M. & Bălţăreţ A., (2006), *"Derivative securities"*)

Using the same reasoning as in the assumptions of Black and Scholes, we obtain:

$$C = Se^{-q(T-t)}N(d_1) - Ke^{-r(T-t)}N(d_2), \qquad (8)$$

$$d_1 = \frac{\ln\frac{S}{K} + \left(r - q + \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}, \quad d_2 = \frac{\ln\frac{S}{K} + \left(r - q - \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}} \qquad (9)$$

3.6. Valuation of a an option with uderlying asset AZUR share

Considering the share option from chapter 4.2, with same caracteristics and dividend rate of 0.03, the results obtained using the software are as follows:
CALL premium: 0.1652
PUT premium: 0.5967

CONCLUSIONS

Table 3. Centralization of results

Model	CALL Premium	PUT Premium
Black-Scholes	0,187	0,5735
Cox-Ross-Rubinstein	0,2027	0,5892
Merton	0,1652	0,5967
Option DEAZUR - BMFMS	0,14	0,25

Source: authors

In all models presented, the price of an option depends on the degree of risk aversion of investors. However, the solutions proposed by this study are characteristics for a neutral attitude to risk. This explains the difference between the theoretical values resulting from the model, and those found in the market. Comparing the premium obtained using the first model against the prices which are currently traded for call and put options on the real market in Sibiu, I found a significant gap in the case of PUT options. This difference indicates a lack of market investors, which is why the price of an option "in the money" came down from a high of 0.6858 to a theoretical market value of only 0.25.

The results obtained by applying the theoretical models differ from market prices. The differences are even greater because the market is not fully developed. In theoretical models it is assumed that any offer finds its counterpart. Another limitation of the models is that given the assumption that the underlying asset price follows a log-normal distribution, and volatility is considered to be constant and estimated by different methods. On the other hand, if volatility is not considered to be known a priori, the empirical results can be used to obtain the implied volatility of an option at a given spot price, duration and a certain exercise price. Applicability of the models presented is various, explaining in a coherent manner the correlation between the results obtained and the variables involved. Limitations faced by the models presented do not discredit the results, but it turns into an objective starting point for further refinements and more refined models of evaluation.

REFERENCES

Black, F. & Scholes M. (1973). The Pricing of Options and Corporate Liabilities, Journal of Political Economy, *University of Chicago, 3, 637-654*

Cox, J. C., Ross, S. A. & Rubinstein, M. (1979). Option Pricing: A Simplified Approach, *Journal of Financial Economics*, 7

Dimitriu, M. & Băltăreţ, A. (2006). *Derivative securities*, Editura ASE, Bucharest

Hull, J. (2006). *Options, Futures & Others Derivatives*, 6th edition, Prentice Hall

Whaley, R. (2006). *Derivatives: Markets, Valuation, and Risk Managemen,* John Wiley & Sons, Inc., Hoboken, New Jersey

BVB, (2011), *Statistics Section*, Bursa de Valori Bucuresti, Retrieved from www. bvb.ro/TradingAndStatistics/GeneralStatistics.aspx?tab=5&m=0

BMFMS, (2011), *Statistics Section,* Bursa Monetar Financiara si de Marfuri Sibiu, Retrieved from www.sibex.ro/index.php?p=statistici&s=1&l=ro