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Measuring the Risk Aversion on Romanian Capital Market Using Optimal Portfolio Selection Method

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Abstract

Stock prices move as corporate earnings prospects change but they also move as investors change their aversion to risk. One of the central tenets of finance is that investors expect higher return for taking risk. They exchange some of their riskless securities for risky assets because they expect the total payoff in the long run to be optimal in terms of the risk-return trade-off. The previous studies proved that expected return is linearly related to risk and if we further assume investors are risk averse, the alluded relation will have to be positive. Aversion to risk is reflected on a risk premium, which consists of an expected extra return that investors require to be compensated for the risk of holding stocks. In this paper we tried to assess the risk aversion on Romanian Capital Market by using optimal portfolio selection method.

Key words: *risk aversion, utility, equity funds, optimal portfolio selection*

Introduction

The main contribution of the *foreign direct investments* in what regards the receiving economies is materialized in increased productivity and resources, assets and capabilities competitiveness, which generate beneficial effects on a social and economic level. The whole financial theory is based on the fundamental hypothesis of rational agents investing on the financial markets. This rationality is characterized by a continuous pursuit of the investors to maximize their utility function (maximizing the return of the investment for a given risk level or minimizing the risk for an expected return level).

The first trial of conceptualizing the investors' risk aversion belongs to Milton Friedman and Leonard Savage (Milton Friedman, Leonard Savage Utility Analysis of Choices Involving Risk, JPE, 1948) who defined the risk aversion by using the next decisional case: an investor who can choose among comparable investments will always choose the one with the lowest risk. Explaining the investment behavior using the returns of risky financial investments' utility function brought a new perspective to the risk aversion theory. Studies show that investors behave differently regarding the risks they have to take. In Friedman and Savage's opinion the

main factor that changes, in time, the investor's attitude towards risk is the size of their wealth. Accepting the three main investment behaviors (aversion, neutrality and preference), the specialists' attention was directed towards measuring the investors' degree of risk aversion – the first step in setting the risk premium (the price an aversive investor is willing to accept in exchange of the risks he has to take) expressed in wealth terms. The first notable efforts in understanding the factors that influence the degree of risk aversion were made by John W. Pratt[1] and Kenneth J. Arrow (Aspects of the Theory of Risk-Bearing, 1965). They point out that an investor with high risk aversion is less willing to take those risks, that is, for him the price of bearing it (the risk premium) is much larger. In their approach, the main factor of risk aversion is the wealth of the investors. The utility function concavity can thus be a relevant measure of the investors risk aversion degree. Further studies tried to assess what happens when in the market there are only risky titles and no risk-free ones.

A first hypothesis derived from Arrow-Pratt model, was that if an investor A is more risk aversive than B and α is the weight of the investment in the more risky title, and (1- α) is the weight of the investment in the less risky title, then $\alpha A \leq \alpha B$. The investors' behavior is influenced by the way they perceive and accept the risks. The risk aversion theory showed that always acceptance of the risky investment alternative over a risk free investment (or a less risky one) will be made only if there is a supplementary return. Analyzing the investors' attitude was observed that most of them are risk aversive and they value more the potential loss than the potential return. Studies performed showed that the investor is not directly interested in the expected value of the final return, but in its utility. For a risk aversive investor it is more important if in the end he will lose, considering the capital he initially had, while for an investor with preference for risk it is more important how much he will win in the end. The empirical studies performed demonstrated that the risk premium can have two parts: an objective one, given by the amount of risk involved by a risky investment alternative (measured by the return's variance Xi, with the probability pi) and a subjective one determined by the shape of the utility function U'/U''which is characteristic to each individual risk aversion. Other studies showed that the objective dimension is easier to determine based on the probable earnings volatility.

The risk premium depends directly on the risky investment alternative risk (measured by the variance), inversely on the amount invested initially and directly on the investors' absolute risk aversion degree (measured by Arrow-Pratt index). Therefore two investors can have different risk premiums when they decide to invest the same initial capital in the same financial titles, due to the different degree of risk aversion. The increase of the investor's initial wealth with risk preference calls forth an acceleration of the utility augmentation (the second grade derivative of the utility function is strictly positive), a decrease in the absolute risk aversion and, implicitly a reduction of the risk premium.

Methods of Measuring the Investors' Risk Aversion

There are at least four methods used for measuring risk tolerance: asking about investment choices, asking a combination of investment and subjective questions, assessing actual behavior, and asking hypothetical questions with carefully specified scenarios. The first method is based on a specialized questionnaire addressed to potential investors, testing their willingness to take risks in their investments. An example of this method is the questionnaire applied by Federal Reserve Board's Surveys of Consumer Finances[2] (SCF). Sung and Hanna[3] analyzed a subset of the 1992 SCF households and they found that only 4% of the sample were willing to take

[1] J.W. P r a t t , *Risk Aversion in the Small and in the Large*, Econometrica, Vol. 32, pag. 122-36, 1964
[2] Internet: http://webapp.icpsr.umich.edu/cocoon/ICPSR-SERIES/00055.xml
[3] See Sung, J., Hanna, S., Factors related to risk tolerance, *Financial Counseling and Planning*, 7, 11-20, 1996

substantial risks on investments in order to make a substantial return, and 40% were not willing to take any financial risks. Empirical studies based on SCF proved that risk tolerance increased with education and income, and female headed households had lower risk tolerance than otherwise similar married couple and male headed households.

The second method is based on the theory developed by Arrow and Pratt. There are two different approaches based on Arrow-Pratt theory. Risk aversion could be measured taking into consideration the first and second derivation. In this particular case we deal with an absolute risk aversion (Aabsolute = - [U''(W) / U'(W)]) and a relative risk aversion (Arelative = - [W x U''(W) / U'(W)]). Kimball defined a coefficient of absolute prudence for a better characterization of investment behavior under risk and uncertainty (Pabsolute = - [U'''(W) / U''(W)]). This method is difficult because it supposes identification of utility function type that is relevant for a group of investors. The empirical studies proved that the most appropriate function that describes the investment behavior is the function defined as: strictly increasing function, strictly concave, with $A'(w)<0$[4], little relative risk aversion[5] ($0<R(w)<4$). This utility function is a HARA function (hyperbolic absolute risk aversion or linear risk tolerance utility function class)[6]. Testing the relation risk tolerance-income we can determine the value of b and the shape of utility function. Using the first and the second derivative of this function we have the possibility to determine the risk aversion for a specific group of investors and we can draw a comparative analysis. A method derived from the Arrow-Pratt theory of risk aversion measurement is based on optimal portfolio choice. This method consists in assessing the investors' preference for risky assets on a market, the risk aversion being determined from a relationship between this indicator, the risk of the risky assets (measured by standard deviation) and expected return (measured as an average or based on CAPM equation).

The third category of models used for risk aversion assessment consists in using a hypothetical scenarios constructed on economic models. The scenario takes into consideration a hypothetical investment with a 50% probability to double the initial wealth and with 50% probability to reduce your initial wealth to 1/2. If we note with n the number of investors willing to take de risk than we obtain that: $\lambda = (2 - 2(1-A))[1/(1-A)]$, where A is the measure of relative risk aversion (taking into consideration that the utility function for such an investment plan is: 50% x U(2C) + 50% x $U(\lambda C) \geq U(C)$. By asking questions with different levels of λ, we have the possibility to determine exactly the level of relative risk aversion. For instance, if one is indifferent between the current job and the new risky job with a 50-50 chance of either doubling income or a one-third cut, then $1-\lambda = 0.3333$ and relative risk aversion must equal 2.0.

The fourth group of models is a mixture between the methods presented above. In this particular case, the model is based on a questionnaire that focuses on a combination between investment and subjective questions. For instance, Grable and Lytton created a questionnaire containing a lot of questions about portfolio choice in different situations combined with questions that are measuring risk tolerance[7].

Empirical Evidence on Romanian Capital Market

For the estimation of the risk aversion on Romanian Capital Market we used the methodology based on optimal portfolio selection. Using the optimal allocation hypothesis we can approximate the following relation[8]:

[4] A(w) is the absolute risk aversion
[5] R(w) is relative risk aversion and it is equal to w x A(w)
[6] u is HARA if risk tolerance is an affine function T(y) = a + by
[7] See Internet link: http://www.rce.rutgers.edu:8080/money/riskquiz/default.asp
[8] The efforts of Kihlstrom (1981), Pratt and Zeckhauser (1987), Kimball (1993) and Gollier and Pratt (1996) to prove this relation

$$\alpha \approx \frac{E(\bar{z})}{\sigma_z^2 A_u(w)} \quad (1)$$

where α is the demand for risky assets on a market, E(z) is the expected excess risky return (difference between the risky portfolios' return and risk free rate) for a market, σz is the variance of the risky excess return and A(w) is the absolute risk aversion. So, if we want to determine the risk aversion on Romanian Capital Market we should calculate the demand for risky assets on a market, the expected return for an index, variance of the index's return and we have the possibility to assess the absolute risk aversion for a market. For estimation of α we used the structure of investment funds on Romanian Capital market. We included in our research all the equity funds and we determined their weight in the total investment funds.

Table 1. Alpha calculation for equity funds in 2004

2004	Net Assets	Investors	W(i)
FON	**19,148**	**493**	**8.4%**
Intercapital	**60,392**	**1,125**	**26.5%**
Napoca	**87,361**	**1,223**	**38.3%**
Omninvest	**61,251**	**3,930**	**26.8%**
Total Equity funds	**228,152**	**6,771**	**-**
Total Investment Funds	**4,643,927**	**-**	**-**
Alpha	**0.04912911**	**-**	**-**

Source: Monthly UNOPC Report

In 2004 on Romanian capital market we had only four 100% equity investment funds. Taking into consideration the total value of investment in these funds, the value for α in 2004 was 0.0491. In 2005 the number of equity funds increased significantly, with 8 pure equity funds.

Table 2. Alpha calculation for equity funds in 2005

2005	Assets	Investors	%
Active	0.314	1816	0.54%
BCR	1.721	174	0.00%
BT	12.165	401	0.00%
FON	2.974	530	5.09%
Intercapital	21.501	2456	36.82%
Napoca	16.424	1681	28.13%
Omninvest	5.023	4070	8.60%
KD	12.158	732	20.82%
Total Equity funds	58.394	11285	-
Total Investment Funds	436.891	71021	-
Alpha	**0.1337**		

Source: Monthly UNOPC Report

Based on reported data for 2005, calculated alpha was 0.1337, higher than previous year. The explanation consists in the higher volume of investment in all pure equity funds. Another important observation is related with the concentration of capital on a greatly reduced number of investment funds (only 3 funds concentrated more than 80% of the total market). In 2006 the number of equity funds decreased to 7 active equity funds.

Table 3. Alpha calculation for equity funds in 2006

2006	Assets	Investors	W(i)
Active	6.903	1832	6.4%
BCR Expert	10.078	627	9.3%

Table 3. (cont.)

BT	19.206	1085	17.7%
FON	2.29	520	2.1%
Intercapital	26.165	3148	24.2%
Napoca	18.407	1770	17.0%
Omninvest	6.03	4125	5.6%
KD Maximus	19.183	817	17.7%
Total Equity Funds	108.262	13924	100.0%
Total Funds	493.59		
Alfa	**0.2193**		

Source: Monthly UNOPC Report

The value for alpha determined in this case is 0.2193.

Table 4. Equity funds evolution of parameters

Year	E(Ri)	RFR	Stdev
2004	**0.27%**	**0.05%**	**0.10710**
2005	**0.16%**	**0.023%**	**0.019216**
2006	**0.09%**	**0.017%**	**0.01407**

The following step was to determine the market excess return and the standard deviation for the market index. We used for the analysis of these two elements the daily value for BET index during 2004 – June 2006 and we obtained the results presented in the table above. As the results reflected, the daily expected rate of return for the market index significantly decreased, and so did volatility (risk). Risk free rate (RFR) was calculated daily based on the monthly average return for T-Bills. Risk free rate was used to determine the market excess return as a difference between expected return for the market index and T-Bills rate. Using the value of Alpha and the formula for risk aversion derived from the portfolio selection theory, the obtained results about absolute risk aversion for Romanian Capital Market are:

Table 5. Absolute risk aversion

Year	E(Ri)	RFR	Stdev	Alfa	Aversion
2004	**0.27%**	**0.05%**	**0.10710**	**0.04912911**	**8.473587**
2005	**0.16%**	**0.023%**	**0.019216**	**0.133658052**	**4.07840**
2006	**0.09%**	**0.017%**	**0.01407**	**0.219335886**	**1.08651**

We can observe that the absolute risk aversion had important changes between 2004 and 2006 from a value above 8 to a value close to 1. So, we appreciate that the model proposed allows a relevant evaluation of the dynamic for the absolute risk aversion.

This paper showed the complexity of risk aversion and the importance of it in optimal capital allocation. There are no leading methods to assess absolute and relative risk aversion but the specialists developed a lot of possible tools and models that could be used to draw comparative analysis between different financial markets or investors' categories.

These models take into consideration a specific questionnaire applied on a representative sample of investors, the determination of specific shape for utility function based on the relationship between risk tolerance and income level or the spread between options and real price of stocks. The assessment of risk aversion is important for understanding the investment behavior, to create and to promote appropriate instruments to mitigate the risks. Portfolio selection seems to be an alternative solution for the efforts to test and to measure risk aversion on a market.

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Măsurarea aversiunii investitorilor faţă de risc pe piaţa românească de capital folosind metoda selecţiei portofoliului optim

Rezumat

Preţurile acţiunilor variază odată cu schimbarea câştigurilor corporative din prospecte, dar şi odată cu schimbarea aversiunii investitorilor faţă de risc. Unul dintre principalele principii ale finanţelor spune că investitorii aşteaptă beneficii mai mari pentru acceptarea riscurilor. Ei schimbă unele dintre valorile lor mobiliare lipsite de risc sau cu risc mic cu altele cu un grad crescut de risc deoarece aşteaptă un profit pe termen lung optim în sensul ecuaţiei risc – beneficiu. Studiile anterioare au demonstrat că acel câştig aşteptat este direct proporţional cu riscul şi dacă presupunem că investitorii au o aversiune faţă de risc, atunci relaţia respectivă este pozitivă. Aversiunea faţă de risc este reflectată în prima de risc, care constă într-un beneficiu suplimentar aşteptat pe care investitorul îl cere în compensaţie faţă de riscul deţinerii de valori mobiliare. În acest articol se încearcă evaluarea aversiunii faţă de risc pe piaţa de capital din România prin folosirea metodei selecţiei portofoliului optim.