Abstract

The study provides empirical validity of mean-variance CAPM, Downside and Higher-order moments framework of CAPM in the Russian stock market. We test the unconditional and conditional CAPM specifications on a sample of weekly returns of most liquid Russian stocks over the financially stable period of 2004-2007 and over the crisis period of 2008-2009. The primary contribution of this study is ranking the models with respect to their explanatory power of cross-sectional return variations. The unconditional classical CAPM (where market risk is approximated by the beta coefficient) is compared against downside (mean-semivariance) CAPM extended to incorporate the third (skewness) and the fourth (kurtosis) moments. This paper establishes the unconditional CAPMs prove to have low explanatory power for the financially stable period and statistically insignificant test results for the crisis period. Incorporating additional risk measures of the third and fourth moments and adopting one-sided risk measures only slightly increases explanatory power. The highest explanatory power is offered by the unconditional CAPM of the Harlow-Rao downside systematic risk measure with zero benchmark. Our study confirms the feasibility of employing for the Russian stock market conditional CAPMs extended for systematic asymmetry (co-skewness) and systematic kurtosis (co-kurtosis) since these models yield better explanatory power for cross sectional return variations.

Key words: *Downside CAPM; Higher Moment CAPM, conditional CAPM, coskewness, cokurtosis*

Indexes of JEL classifications: G11, G12

EFM Classification Codes: 310

1. Introduction

One of the main problems of portfolio managers investing in emerging capital markets is to predict market returns and explain cross sectional return variations. The Capital Asset Pricing Model (CAPM)[i] like market equilibrium two-parameter return distributions model of capital assets pricing develops the relationship between the systematic risk of an asset, measured as market beta, and the expected rate of return on that asset. The CAPM has become an integral part of nearly all textbooks in financial economics. Since the 1970-s a number of academic studies has examined the background of CAPM and explanatory power of one factor market model both in various markets and under the different financial and economic conditions. The main idea of CAPM is to esteem return through Mean-Variance Analysis Framework with risk measured from the portfolio viewpoint. This two-parameter model confirms that no measure of risk, in addition to portfolio risk, systematically affects average returns. The model precondition is the normality of distribution of one-period percentage returns on all assets and portfolios (Fama and MacBeth, 1973). Investors are assume to be risk averse and to behave on the basis of maximum expected utility. The most common application of the CAPM is to estimate the expected and required return on equity, which is used for financial asset valuation, capital budgeting, portfolio performance evaluation and in setting regulated returns. CAPM and its beta measure of market risk are widely applied in practice.

Despite the fact that there is an enormous number of already existing critical works on reviewing practical applications CAPM on many emerging and developed capital markets commercial non-financial companies' investors, consultants and analysts continue using traditional CAPM construction. Survey of the 11 Thousand financial directors which are usually made by Duke University and CFO Magazine[ii] had shown that both in 2008 and 2009 nearly 75% respondents in asset valuation followed the CAPM construction. This model is described in every classic financial textbook[iii] and in every guideline of making analytic reports of the investment companies with using DCF method of calculation stock's intrinsic value. We can find quantitative beta estimations in such known bases, as Bloomberg, ValueLine, DataStream, Merrill Lynch.

Our study of analytical reports of 37 investment companies working in Russian capital market over 10-year period reveals that DCF is the most preferable approach to calculating a company's fundamental value and stock's target price. As a rule, analysts employ expanded CAPMs (Hybrid CAPM, HCAPM) where a proxy for the country risk premium is added to the global market parameters (the risk-free rate and the market risk premium). The beta coefficient is set either equal to the average global estimate of the corresponding industry or equal to a professional estimate additionally adjusted for marketability of stocks and financial leverage of firms. When tested in the Russian capital market, HCAPMs thus specified display both a poor explanatory and poor predictive power of cross-sectional return variations. Therefore, we aim at testing alternative CAPM specifications where the original beta coefficient as a risk measure is replaced by a one-sided systematic risk measures or higher-order moments.

The Russian capital market is an emerging market featured by lower level of capitalization, low number of stocks which are passed through listings and traded on the stock exchanges, low trading volumes and marketability, a market dominated by several large companies. Other important market characteristics, mean-variance-skewness and mean-variance-skewness-kurtosis, may cast serous doubts on the validity of results for two-parameter linear model.

A number of researches believe that advancement of CAPM construction (two-parameter linear model with market beta factor that systematically affects expected returns) for the emerging markets has to take place not only within the key model parameters (risk free rate, market risk premium, beta coefficient) but in consideration of specific characteristics of the listed assets on these markets. The important moment of application of CAPM construction is detecting time periods when the model can be used (when the correlation "the higher systematic risk – the higher returns on investment" is fulfilled) and the periods of time when the assumptions of the model don't fit the external conditions and must be rejected.

The investment opportunities vary over time. We hypothesize that over the business cycle investors may require different risk premiums for a given level of risk.

To identify a model displaying a better explanatory power of cross-sectional return variations in the Russian stock market the following test steps are done:

We expanded the traditional two-moment model to include systematic mean-variance-skewness and mean-variance-skewness-kurtosis. According to our hypothesis the inclusion of higher-order moments may better explain cross-sectional return variations.

We included a down-side risk measures in CAPM. We conjecture that taking into account the systematic downside deviation may improve explanatory power of cross-sectional return variations.

We replaced unconditional CAPM with conditional CAPM and compared specifications with various risk measures, both traditional, one-sided, and of higher-order moments. We hypothesize – the relation between risk and return become negative on «down-market» (with a negative market risk premium).

One of CAPM limitations is that it takes into account only two moments of return distributions (mean and variance). Variance is a measure of risk, that in calculating includes returns above and below the average return. We suppose that «mean - variance» does not indicate systematic risk fully, it doesn't indicate the risk which is related to the one or another stock on the emerging market. Two moments model is valid only under the following two assumptions: investors have a quadratic utility function, that is, an increase in the degree of risk aversion is accompanied by the growth of wealth (growth of wealth may cause risk aversion in emerging markets); the return distribution in normal (bell-shaped).

We suppose that employing downside measures of risk (mean-semivariance frameworks) has the following advantages for Russian market: first, the negative volatility of returns is something that investors are really concerned about. Second, the semivariance is more useful than the variance when the underlying distribution of returns is asymmetric and alternatively useful when the underlying distribution is symmetric; in other words, the semivariance is as useful measure of risk as the variance. We suggest using downside coefficient as a downside measure of systematic risk (as an indicator of negative sensitivity to market risk, the coefficient of downside coskewness and the coefficient of systematic downside kurtosis).

2. Review of Previous Results

Testing CAPM and risk-return relationship is widely presented in the academic literature. Last years there were many papers which analyze explanatory ability of traditional mean-variance CAPM, Downside CAPM and another specifications on individual stocks traded at emerging capital markets. For example, Iqbal and Brooks (2007), Iqbal et al (2010) and Javid (2009) show results of testing expanded and traditional CAPM at Pakistani market (Karachi Stock Exchange), Huang (1997) for Taiwan market, Messis et al (2007) for Athens stock market, Girard and Omran (2007) for five Arab capital markets, Wang and Iorio (2007) for Chinese A-share market, Giang (2010) for Vietnamese Stock Market, Teplova and Selivanova (2007) for Russian equity market.

According to the few markets' reviews (Harvey, 1995) simultaneous carrying-out of requirements of the symmetry and normality of distribution of the expected stock returns is not achieved and this lead to the investors' concern about higher order moments (Rubinstein, 1973; Scott and Horvath, 1980). Risk associated with skewness and kurtosis can not be diversified by increasing the size of a portfolio (Gibbons et al. 1989), therefore skewness and kurtosis become important factors in asset valuation. In the researches of Arditti (1971) and Francis (1975) it is shown that total skewness as risk factor is not priced. The most extensively tested asset pricing model is the three-moment CAPM model of Kraus and Litzenberger (1976), which provides preference over skewness. The same results on systematic coskewness are shown in the Lim's research (1989) where American Stock Exchange from 1950's to 1982 is analyzed. The author made a conclusion that investors prefer positive systematic coskewness. When market is positively skewed there is no negative attitude to the systematic coskewness even when the whole market is negatively skewed. In the Smith's work (2006) systematic coskewness is introduced as a measure of market risk in a popular Fama and French's (1993) three-factor model and the conclusion is made that introducing conditional systematic coskewness to the factors suggested by Fama and French (1993) makes the quality of the model better comparing to the traditional three-factor model.

Many of empirical researches which were made since 1970's and were related to the effect of systematic skewness on asset pricing show a mixed result depending on a choice of a market portfolio and other conditions: Jean (1971), Arditti and Levy (1972), Ingersoll (1975), Lee (1977), Schweser (1978), Kane (1982), Lim (1989), Friend and Westerfield (1980), Sears and Wei (1988), Hwang and Satchell (1990), Harvey and Siddique (1999). Introducing the systematic kurtosis into the research and testing a model with four moments of distribution which were taking place since the late 1980's: Homaifar and Graddy (1988), Fang and Lai (1997) and Iqbal et al. (2007), Cook and Rozeff (1984), Doan et al. (2009), Chi-Hsiou Hung (2007), Javid and Ahmad (2008), Javid (2009). Authors use different techniques of testing the influence of systematic co-skewness and co-kurtosis: traditional linear, quadric (Barone-Adesi, 1985) and cubic models (Ranaldo and Favre (2005), Christie-David and Chaudhry (2001), Chang et al. (2001), Hwang and Satchell (1999), Jurczenko and Maillet (2002), Galagedera et al. (2002)). Considering both the stock and the derivatives markets the mentioned instruments do not give the unilateral conclusion about the importance of this risk measure in assets pricing as well.

Doan et al. (2009) conducted a comparative analysis of the US and Australian markets to identify a model displaying a better explanatory power of cross-sectional return variations. In the authors' view a choice between models with systematic skewness and systematic kurtosis depends on a security profile as well as on the degree of investor risk aversion. Systematic skewness plays a more important role in explaining differences in stock price setting and differences in portfolio returns for the Australian market (statistically significant at 1%) while systematic kurtosis proves to be more important for the US market. Systematic kurtosis may be a significant factor for the Australian market depending on the size of the stock portfolio.

Two-parameter models do not make distinction between the returns superior and inferior to the mean value. Several researches prove that the investors differently treat the returns higher and lower than the mean and other benchmarks (zero or risk free rate). Some studies proposed to take into account the asymmetry of returns and the use of downside risk measures in the CAPM. Downside beta is both intuitively and theoretically appealing, and empirically can provide a better risk measure than the traditional beta (Post and van Vliet (2004), Pederson and Hwang (2003)). Hogan and Warren (1974) in a theoretical framework and Jahankhani (1976) in an empirical study compared mean-variance and mean-semivariance pricing models and observed no difference in the two models in terms of linear association between expected return and beta. Bawa and Lindenberg (1977), Harlow and Rao (1989), Estrada (2002, 2007) reveal that downside risk measures have advantages over the standard risk measures in explaining variability in the cross-section of returns in emerging markets.

Semivariance CAPM (*SV CAPM*) of Hogan and Warren (1974) is written as follows:

$$E(R_i) = R_f + \frac{CSV(R_{m,} R_i)}{SV(R_m)} \cdot (E(R_m) - R_f)$$

Where $E(R_i)$ - is the required return on asset *i*, R_f is risk free rate, $E(R_m)$ – average market return, $R_m - R_f = MRP$, $SV(R_m)$ - is the market's semivariance of returns, $CSV(R_m, R_i)$ - is the cosemivariance between market and asset i. Risk free rate (R_f) is considered as a target rate (benchmark).

Distinction of Hogan and Warren (1974), Harlow and Rao (1989) and Estrada (2002, 2007) models consists in an estimation of cosemivariance:

Hogan and Warren (1974) cosemivariance is defined as follows:

$$CSV(R_m, R_i) = E\left[(R_i - R_f) \cdot Min(MRP, 0)\right]$$

Estrada (2007) cosemivariance is defined as follows:

$$CSV(R_m, R_i) = E\left[Min\{R_i - \mu_i, 0\} \cdot Min\{R_m - \mu_m, 0\}\right]$$

We estimate the risk measures and risk premiums for conditional CAPM in Russian equity market as a number of researches prove an incorrectness of testing CAPM for the periods of positive and negative excess market returns. Pettengill et al. (1995) observe that the investigations of beta and test's results of cross-sectional return variations that use realized return as a proxy for the expected one may have produced bias results due to aggregation of positive and negative excess market return periods. Authors assume that in periods where excess market returns are negative, an inverse relationship between beta and returns should exist. Their empirical investigation of U.S. data reveals a positive slope on beta in the «up market» and a negative relationship in the «down market». The sample period for this study extends from January 1926 through December 1990. The similar result is received in research of Friend and Westerfield (1980). They examine beta and co-skewness in the up- and down-markets and report that while beta is significant in both markets and its signs are consistent with the CAPM theory, the co-skewness is statistically significant in regression models only in the "up-market".

Chiao et al. (2002) presents a comprehensive study of the risk-return characteristics of the Taiwan stock market, using monthly return data from January 1974 to December 1998 in up- and down-market conditions. Results of the investigation show that investors expect a lower (higher) return when the distribution of stock returns demonstrates positive co-skewness (co-kurtosis). In addition, results show evidence of the relative importance of the co-skewness and the co-kurtosis risks, compared with that of the covariance risk in explaining stock return variations. This is particularly evident over the up - market subperiods.

Galagedera and Maharaj (2004) investigate risk-return relationship with conditional model using wavelet timescales in the two-, three- and four-moment asset pricing on Australian stock market. They indicate strong positive linear association between beta, co-kurtosis and portfolio return in the "up-market" and a strong inverse linear association between the beta, co-kurtosis and portfolio return in the "down market". Iqbal et al (2010) investigate whether allowing the model parameters to vary improves the performance of the CAPM and the Fama–French model and indicate that conditional models with global risk factors scaled by global conditioning variables perform better than the unconditional models with global risk factors.

3. Methodology

We estimate the risk measures and risk premiums for different risk factors that are expected to determine asset prices in local capital market (Russia) and explain cross-section return variations. We test well-known capital asset pricing model (CAPM) with different specifications on individual stocks traded at MICEX, the main equity market in Russia. The procedure followed that of Fama and MacBeth (1973), Pettengill et al (1995), Harvey and Siddique (2000), Chung et al (2006) that is, risk factors of each individual stocks were first estimated and then a number of regression models were evaluated with regard to the level of explanatory power of cross-sectional return variations. The procedure works with multiple assets across time (time series data). The parameters are estimated in two steps. First we regress each stock against the proposed risk factors to determine that asset's beta for that risk factor. Betas are estimated in time series regression framework. Then we regress (one and multifactor models) all actual mean asset’s returns (*MR*) for a fixed time period against the estimated risk measures to determine the risk premium for each risk factor. Risk factors were proxies by the traditional beta coefficient of mean-variance approach, one-sided beta coefficients (mean-semivariance approach, downside beta), and higher-order moments of returns distribution (gamma and delta). We use cross section regression to estimate the risk premium in one and multifactor models to test the adequacy of CAPM.

The one-factor tested equations are defined as follows:

$$MR_{it} = \lambda_0 + \lambda_1 \cdot risk\ \ factor + \varepsilon_{it}$$

The validity of mean-variance-skewness and mean-variance- skewness-kurtosis is tested as follows:

$$MR_{it} = \lambda_0 + \lambda_1 beta_i + \lambda_2 gamma_i + \lambda_3 delta_i + \varepsilon_{it}$$

The validity of mean-semivariance-skewness is tested as follows:

$$MR_{it} = \lambda_0 + \lambda_1\ downside\ beta_i + \lambda_2 gamma_i + \varepsilon_{it}$$

We report that weekly estimation of model parameters is more preferable for Russian market analysis. Weekly return is calculated as difference between closing price logarithm by the end of the week (Friday) and closing price logarithm by the beginning of the week (Monday). In case the needed data are missing there was used the closing price of the previous day.

The asset returns in Russian stock market deviate from normality indicating that investors are concerned about the higher moments of return distribution. The first direction of investigation suggests the evaluation of extended CAPM with higher-order moments performance in explaining the cross-section variation in expected returns across assets in the Russian stock market. First, we examine the relationship between equity return and higher-order moments as systematic risk factors. In our research we estimate four systematic risk factors: beta (as a traditional measure of risk), one-sided beta, the systematic skewness (co-skewness or gamma) and systematic kurtosis (co-kurtosis or delta) by using the following equations 1 -3:

(1) $$\beta_{im} = \frac{E\left[(R_{it} - E(R_i))(R_m - E(R_m))\right]}{E(R_m - E(R_m))^2}$$

(2) $$\gamma_{im} = \frac{E\left[(R_{it} - E(R_i))(R_m - E(R_m))^2\right]}{E(R_m - E(R_m))^3}$$

(3) $$\theta_{im} = \frac{E\left[(R_{it} - E(R_i))(R_m - E(R_m))^3\right]}{E(R_m - E(R_m))^4}$$

The next step of the first direction is the cross - sectional analysis. There were tested the regressions of mean returns (*MR*) for selected time periods (2004-2007, 2008-2010, 2004-2010) to the estimated coefficients on the first step of beta, one-sided beta, gamma and delta (based on daily and weekly estimation). Cross-sectional analysis allows us to estimate the risk premium, corresponding to each selected parameter of risk (traditional - beta coefficient, one-sided beta with different specifications: HWbeta, HRbeta, Ebeta, gamma (co-skewness) and delta (co-kurtosis)) and to identify the significance of these model parameters.

Cross-sectional analysis based on single-factor, two-factor and three-factor model allows us to select the most adequate model with the introduction of risk measures in explaining cross – sectional variations in returns of selected companies.

The first direction is based on the unconditional CAPM constructions.

In the second direction of our research we examine the explanatory power of different specifications of downside risk models. In our research there was evaluated four different measures of downside systematic risk: the models of Bawa and Linderberg (1977) with BL beta, Harlow and Rao (1989) with HRbeta, Hogan and Warren (1974) with HWbeta and Estrada (2007) with Ebeta and with three benchmarks marked as τ (zero, risk free rate and asset's mean return, marked as μ).

The cross-sectional analysis of models relating average stock's return and the estimated downside systematic risk measures allows ranking the explanatory power of asset pricing models in downside framework with different benchmarks. The analysis of downside models is based on one-factor models that include the downside beta or downside asymmetry (co-skewness), two-factors models that include the downside beta and co-skewness. We use the estimated risk factors according to the method of Harlow and Rao (1989) – marked as HRbeta, HRgamma and HRdelta and Estrada (2007) – marked as Ebeta, Egamma, Edelta to demonstrate the results that we have received.

The third direction of the research involves testing hypothesis that conditional models with accommodation market movements demonstrate better results in explaining cross-sectional security returns than unconditional models in such emerging market like Russia. We examine the explanatory ability of the pricing models depends on the period of financial stability and crisis. At first step we follow Harvey and Siddique (1999) approach to test two-moment conditional CAPM with conditional covariance. Then the conditional CAPM is extended by incorporating third and fourth moments (co-skewness and co-kurtosis) of return distributions. The average risk premium is calculated for the different test periods in conditional framework. We ascertain that the different models show the advantages at different periods of economic stability.

Within the third direction of our research we test the hypothesis that the excess market return has asymmetric effects on the parameters of models depending on the sign of a market risk premium (*MRP*). On the "growing" market (up market) relationship is positive, and "down" (bear) market with the negative market risk premium (down market), when the market returns are lower than the risk-free interest rate, the relationship is negative, i.e. there is an inverse relationship between the return of stocks and measures of risk (as traditional factor - beta, and also higher order moments).

Our study tested the hypothesis of the existence of a systematic conditional relationship between stock returns in the Russian market and higher order moments, which is formalized as follows:

$$R_{it} = \delta_{0t} + \delta_{1t} k\beta_{im} + \delta_{2t}(1-k)\beta_{im} + \delta_{3t} k\gamma_{im} + \delta_{4t}(1-k)\gamma_{im} + \delta_{5t} k\theta_{im} + \delta_{6t}(1-k)\theta_{im} + \varepsilon$$

where $k = 1$ when $(R_{mt} - R_{ft}) > 0$ and $k = 0$ when $(R_{mt} - R_{ft}) < 0$

Testing the conditional models for the periods 2004-2007 and 2008-2009 confirmed our assumption.

4. Empirical results

Our research is based on the daily data of 50 financial assets of the Russian market (common stocks and preference stocks), that constituting the 95% capitalization of Moscow Interbank Currency Exchange (MICEX)1. This study analyzes a period of 6 years starting

January 14th 2004 to January 14th 2010. Moscow Interbank Currency Exchange index is considered as a market portfolio. The effective return of Russian government short-term notes is considered to the risk-free rate in a certain time periods. The selection of best asset pricing model is based on the cross-section analysis of weekly returns. The following table 4.1 calculated on MICEX index gives a good image of index dynamics.

Table 4.1 Indicators of risk and return on MICEX index (Russia)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Average Weekly Volatility, %	6,83	4,87	3,75	4,2	4,89	3,01	5,15	2,88	9,67	6,32
Average Weekly Return, %	-0,5	1,09	0,42	0,92	0,14	1,19	1,01	0,21	-2,14	1,83
Average Annual Return, %	-25,5	57,6	21,8	47,7	7	60,5	51,6	10,9	-111,5	64,2
Sharpe Ratio (Weekly)	-0,09	0,21	0,09	0,19	0	0,38	0,18	0,05	-0,23	0,26
Sortino Ratio (Weekly)	-0,09	0,22	0,07	0,16	0	0,39	0,15	0,05	-0,23	0,24
Asymmetry	0	-0,44	-0,19	-0,94	-0,24	-0,44	-0,63	-0,53	0,27	-0,11
Excess	0,51	1,67	0,09	4,93	1,98	2,11	3,36	2,03	8,65	0,62

The analysis of summary statistics of Russian companies' returns has shown no simultaneous symmetrical and normal distribution of the expected return. Leptokurtosis, skewness and high volatility are characterized the distribution of Russian stock market. The same results are observed at different stock markets - Harvey (1995), Hussain and Uppal (1998), Javid (2009).

Table 4.2 shows leptokurtosis of nearly all selected stocks[1]. We have to note that we present top 10 companies that have the highest level of capitalization on the end of 2007 in order to demonstrate our results. The same situation is observed in 2008 to 2009. The majority of the companies demonstrate negative asymmetry (in 2004 to 2007 - 25 financial assets out of 50, and 30 financial assets out of 50 in 2008 to 2010).

Table 4.2 Top 10 summary statistics: January 2004 –December 2007

Aseet's MICEX TIKER	Mean (in %)	St. Dev.	Sample dispersion	Excess kurtosis	Asym-metry	Jarque-Bera	P-value	Data begin
LKOH RM Equity	0,36	4,19	17,51	2,72	-0,12	59,71*	0,00	02.01.2004
SBER03 RM Equity	1,04	4,51	20,38	1,61	0,38	25,08	0,00	02.01.2004
SNGS RM Equity	0,09	4,78	22,81	2,87	-0,38	70,67*	0,00	02.01.2004
GMKN RM Equity	0,56	5,63	31,71	1,88	-0,26	30,36*	0,00	02.01.2004
SIBN RM Equity	0,27	4,36	19	1,59	-0,26	22,16*	0,00	02.01.2004
MTSI RM Equity	0,50	4,25	18,06	0,93	0,34	10,52*	0,01	02.01.2004
NLMK RU Equity	0,86	5,09	25,93	1,52	-0,71	14,09*	0,00	21.04.2006
CHMF RM Equity	0,91	4,41	19,48	1,35	-0,11	8,8*	0,01	24.06.2005

Notes: Significant at the 1 percent level, *Significant at the 5 percent level

The normality test has been conducted using the Jaque-Bera statistics, which checks if both skewness and kurtosis simultaneously equal to zero. The normality test proves that the normality hypothesis can be rejected as at the significance level of 0,1 (Table 4.2) and it is possible to say that the data do not follow the law (43 companies out of 50 – in the period of financial instability and 49 – during the crisis). Some academic studies offer to solve the problem of non-normal distribution by using either semi-variance frameworks or conditional capital asset pricing models. Traditionally the following advantages of downside risk measures are declared: investors are more concerned about the negative return volatility; it is not necessary to reach symmetric distribution when using the semi-variance. We propose to use the downside beta (as a market risk negative sensitivity factor) and the relevant asymmetry (skewness) as a comprehensible systematic risk measures.

Calculated alternative measures of risk are shown in Tables 4.3 and 4.4 for the two periods: financial stability (2004-2007) and crisis (2008-2010).

Table 4.3 Risk factors for the period 2004-2007 (top 10)

Aseet's MICEX TIKER	E(Ri)	Gamma	Delta	Gamma Estrada with τ=μ	Gamma Estrada with τ=0	Gamma HR with τ=μ	Gamma HR with τ=0
GAZP RM Equity	0,57	1,10	1,03	1,04	1,04	1,04	1,03
ROSN RM Equity	0,57	0,97	0,77	0,78	0,79	0,77	0,77
LKOH RM Equity	0,36	1,02	1,01	0,98	1,00	0,98	1,00
SBER RM Equity	1,04	0,69	0,89	0,84	0,76	0,84	0,75
SNGS RM Equity	0,09	1,12	1,17	1,12	1,19	1,11	1,18
GMKN RM Equity	0,56	1,11	1,22	1,20	1,21	1,20	1,20
SIBN RM Equity	0,27	0,85	0,60	0,71	0,72	0,69	0,70
MTSI RM Equity	0,50	1,03	0,70	0,78	0,77	0,77	0,76
NOTK RM Equity	0,86	4,02	0,80	1,06	1,03	1,04	1,01
CHMF RM Equity	0,91	0,54	0,81	0,76	0,73	0,72	0,68

Table 4.4 Risk factors for the period 2008- 2010 (top 10)

Aseet's MICEX TIKER	E(Ri)	Gamma	Delta	Gamma Estrada with τ=μ	Gamma Estrada with τ=0	Gamma HR with τ=μ	Gamma HR with τ=0
GAZP RM Equity	-0,61	1,40	1,19	1,04	1,07	1,04	1,07
ROSN RM Equity	-0,06	1,11	1,09	1,09	1,08	1,08	1,07
LKOH RM Equity	-0,13	0,97	0,96	0,96	0,95	0,95	0,95
SBER RM Equity	-0,26	1,31	1,30	1,28	1,27	1,26	1,25
SNGS RM Equity	-0,39	1,11	0,79	0,68	0,70	0,67	0,70
GMKN RM Equity	-0,14	1,89	1,43	1,23	1,22	1,18	1,17

SIBN RM Equity	0,08	1,17	1,16	1,13	1,10	1,11	1,09
MTSI RM Equity	-0,64	0,68	1,12	1,29	1,30	1,28	1,30
NLMK RU Equity	-0,26	0,63	0,97	1,19	1,19	1,16	1,16
CHMF RM Equity	-0,61	-0,38	0,56	1,14	1,17	1,14	1,17

The standard CAPM framework uses the standard algorithm (regression link between the asset risk premium and the market risk premium) to calculate the beta for each company. This model shows ineffectual results in the given time periods (Table 4.5). The cross-sectional analysis of the period from 2004 to 2007 shows the beta explanatory power at 0,5% (during the sample period R quadratic equals to 0,005 of the beta in one-factor regression models of weekly return for every asset). From 2008 to 2009 the explanatory power of beta is even less precise (R quadratic equals to 0,2%). Replacement of the standard risk measure (beta) by the downside measures (βE and βHR) improves the explanatory power of the one-factor models in the period of economic stability 2004-2007. For the time period from 2008 to 2010 there are no advantages of the downside risk measures seen. The best measure for the time period of sustainable economic development becomes the downside beta of Harlow and Rao (βHR*)* with benchmark (target return) $\tau=0$ (R^2 equal to 36,2%).

Table 4.5. Risk Premium for Traditional and Downside CAPM

MRit=λ0+λ1β+ε				
		λ0	λ1	Adj R2
2004-2007	Estimate	0,843	0,613	0,005
	P-value	0,005	0,12	
2008-2010	Estimate	0,7	0,067	0,019
	P-value	0	0,755	
MRit=λ0+λ1βE+ε with τ=μ				
2004-2007	Estimate	1,016	0,774	0,091
	P-value	0,009	0,099	
MRit=λ0+λ1βHR+ε with τ=μ				
2004-2007	Estimate	0,886	0,665	0,094
	P-value	0,004	0,096	
MRit=λ0+λ1βE+ε with τ=0				
2004-2007	Estimate	1,189	1,033	0,357
	P-value	0	0,003	
MRit=λ0+λ1βHR+ε with τ=0				
2004-2007	Estimate	0,999	0,874	**0,362**
	P-value	0	0,002	

The advantages of the risk measure based on co-skeweness are obvious during the period of financial and economical stability (2004-2007), which is shown the Table 4.6. So the explanatory ability of single-factor models, where skewness measure stands for a single factor, in the classical and the traditional approach is influenced by market conditions, which means, results vary depending on when the model is tested. All the tested measures of downside risk, a measure which appears co-skewness: downside co-skewness Harlow and Rao (1989), downside co-skewness Estrada with different versions of the target return, demonstrated higher values of R squared ($AdjR^2$), than models with a traditional co-skewness. The best explanatory power has demonstrated the model with downside co-skewness within Harlow and Rao (1989) construction with benchmark equal to zero return ($AdjR^2$ = 0,275) - Table 4.6.

Table 4.6. Risk Premium for Downside Co-skewness Model (Top 50)

*MRit=λ0+λ1*γE*+ε with τ=μ*					*MRit=λ0+λ1γHR+ε with τ=μ*				
Period		λ0	λ1	Adj R2	Period		λ0	λ1	Adj R2
2004-2007	Estimate	0,887	-0,655	0,074	2004-2007	Estimate	0,837	-0,609	0,079
	P- value	0,007	0,123			P-value	0,005	0,116	
*MRit=λ0+λ1*γE*+ε with τ=0*					*MRit=λ0+λ1*γHR*+ε with τ=0*				
Period		λ0	λ1	Adj R2	Period		λ0	λ1	Adj R2
2004-2007	Estimate	1,023	-0,873	0,262	2004-2007	Estimate	0,949	-0,812	**0,275**
	P-value	0,000	0,010			P-value	0,000	0,009	

Downside co-skewness measures in Harlow and Rao (1989) and Estrada (2007) framework while benchmarks equal to zero is statistically significant at the level of 5%, while the other factors of systematic risk aren't important. We conclude from the given analysis that for the downside gamma factor as well as for the downside beta coefficient the best results in explaining return variations in Russian market are seen using zero as the target return (benchmark for investing).

Table 4.7 Risk Premium for Expanded Unconditional CAPM (Top 50)

		λ0	λ1	λ2	λ3	Adj **R2**
MRit-Rf =λ0+λ1β+λ2γ+ε						
2004-2007	Estimate	0,253	0,052	0,088		0,038
	t-value	1,332	0,187	**1,262**		
2008-2010	Estimate	-0,663	-0,086	0,19		0,126
	t-value	-4,002*	-0,411	2,585*		

MRit- Rf =λ0+λ1β+λ2γ+λ3δ+ε						
2004-2007	Estimate	0,255	-0,067	0,09	0,112	0,039
	t-value	1,329	-0,111	1,267	0,221	
2008-2010	Estimate	-0,67	-0,029	0,207	-0,066	0,127
	t-value	-3,718*	-0,051	1,193	-0,11	
Notes: *Significant at the 5 percent level and ** significant at the 10 percent level Computed on weekly data						

Classical systematic skewness is statistically significant at 5% level in single-and two-factor models, and the explanatory power of models including systematic asymmetry improves relatively to the other considered structures: Adj R^2 = 0,123 (Adj R square equals to 12,3%) in one-factor and AdjR^2 = 0,126 in the two-factor model (Table 4.7). In such manner, systematic skewness demonstrates the best predictive ability among the examined risk measures from 2008 to 2010.

Cross-sectional analysis of the four-factor model demonstrated that the risk premium associated with beta, gamma and delta aren't statistically significant, only the constant term is statistically significant at 5% level explanatory ability (AdjR^2 = 0,127), which is much higher compared to the quality of the two-factor market model form 2008 to 2010 (AdjR^2 = 0,002) and slightly superior to single-factor model with gamma inclusion (AdjR^2 = 0,123). This doesn't permit us to conclude the advantages of four moment unconditional model over the traditional market model CAPM.

Therefore we come to a conclusion that the unconditional CAPM does not show a very high explanatory capacity during 2004 to 2007 and is not applicable on the period 2008-2010. Introduction of coskewness increases the explanatory power of CAPM.

Testing the conditional pricing models involves plotting two data sets: positive excess market return period (when the market return is lower than the risk-free return) and negative excess market return period (when the market return is higher than the risk-free return) (denoted in Table 4.8 – «Up market» and «Down market»).

Table 4.8. Risk Premium for Conditional CAPM (Top 50)

Traditional conditions – positive MRP - "Up market"							**Negative MRP - «Down market»**			
MRit-Rf =λ0+λ1β+ε										
		λ0	λ1	λ2	Adj**R2**		**λ0**	λ1	λ2	Adj**R2**
2004-2007	Estimate	1,279	0,825		0,148		-1,167	-1,017		0,189
	t-value	6,020*	2,888*				-4,914*	-3,343*		
2008-2010	Estimate	1,968	0,856		0,075		-2,352	-2,201		0,456
	t-value	5,502*	1,976**				-6,416*	-6,348*		

MRit-Rf =λ0+λ1γ+ε										
2004-2007	Estimate	1,724	0,117		0,01		-1,638	-0,245		0,022
	t-value	10,853*	0,703				-7,022*	-1,029		
2008-2010	Estimate	2,06	0,8		0,087		-3,118	-1,708		0,375
	t-value	6,817*	2,143*				-10,315*	-5,371*		
MRit=λ0+λ1γ+λ2δ+ε										
2004-2007	Estimate	1,357	-0,564	1,214	0,169		-1,492	0,317	-0,879	0,207
	t-value	7,093	-2,055	2,999			-6,264	0,868	-1,981	
2008-2010	Estimate	2,048	-2,628	1,781	0,112		-2,892	3,704	-5,669	0,449
	t-value	6,791	-1,591	1,136			-9,619	1,702	-2,511	

Notes: * Significant at the 5 percent level and ** significant at the 10 percent level

We ascertain that the down and up market behavior has significant systematic asymmetric impact on the beta risk premium. According to the test results the beta-risk premium is positive in all models and statistically does not equal to zero in the up market. On the contrary it is negative and statistically significant at 5% in the down market as we have assumed.

The explanatory power of a two-moment CAPM (one-factor model) with the standard beta is considerably higher in the down market (average AdjR square equals to 32% for the whole period in down market) than the quality of model in the up market (average AdjR square equals to 11%).

The results of negative weekly market premium in the down market turned out to be even more significant. For example, the explanatory power of a model that includes the standard beta is 46%, with beta statistically equals to 5% during the period from 2008 to 2009. The beta generally has showed a higher explanatory power in the down market than other higher order moments (gamma and delta) during both periods form 2004 to 2007 and from 2008 to 2009.

The results of the study show that the systematic skewness added to beta is not significant (we don’t demonstrate these results due to low explanatory power) either in up market or down market (t statistic = -1,662 in the “up market” and 0,844 in the “down market” during the period of financial stability). However the risk premium of the systematic skewness is negative in the “up market” and positive in the “down market” as we have assumed.

It should be noted that two-factor model includes co-skewness and co-kurtosis shows the best results on the “AdjR squared” criterion, and both factors are statistically significant (Table 4.8). On the «growing (Up) market» average $AdjR^2$ equals 14% for 2004-2010. On the «down market» average $AdjR^2$ is significantly higher (33%). Variables are significant, gamma risk premium is negative in the “up market” and positive in the “down market”, co-kurtosis risk premium is negative in the «down» and positive in the “up market” (Table 4.8), which confirms our hypothesis.

Finally, we estimate the risk premiums of conditional four-moment pricing model. The results are reported in Table 4.9. The explanatory power of the four-moment conditional model is higher in the "down market" (with average adjusted R-square 36 percent) than in the up market (where average adjusted R-square equal to 17,5 percent). The beta and kurtosis risk premium are negative, co-skewness risk premium is positive, while risk factors are not statistically significant.

Table 4.9 Risk Premium for Four - moment Conditional CAPM (Top 50)

«Up market» $MRit=\lambda 0+\lambda 1\beta+\lambda 2\gamma+\lambda 3\delta+\varepsilon$						
		λ0	**λ1**	**λ2**	**λ3**	Adj**R2**
2004-2007	Estimate	1,205	0,871	-0,508	0,544	0,210
	t-value	5,656	1,540	-1,859	0,922	
2008-2010	Estimate	1,667	1,871	3,120	-3,710	0,140
	t-value	3,869	1,229	1,845	-1,677	
«Down market» $MRit=\lambda 0+\lambda 1\beta+\lambda 2\gamma+\lambda 3\delta+\varepsilon$						
2004-2007	Estimate	-1,098	-2,163	-0,216	1,278	0,239
	t-value	-4,243	-2,930	-0,561	1,515	
2008-2010	Estimate	-2,471	-1,382	2,729	-3,557	**0,480**
	t-value	-6,312	-1,639	1,229	-1,386	

Thus, while there is a reverse relation between the equity return and beta in all tested models in the down market during both time periods, the relation between the systematic skewness and return is negative during the crisis period and positive during the period of financial stability (2004-2007).

5. Conclusion

Our research is primarily aimed at identifying a model specification which best suits the Russian capital market with regard to the level of explanatory power of cross-sectional return variations. Our tests was performed on a sample of daily, weekly, and monthly returns of 50 largest and marketability Russian stocks (constituting 95% of the MICEX stock capitalization) over period 2004-2009. The procedure followed that of Fama and MacBeth (1973), Pettengill et al (1995), Harvey and Siddique (2000), that is, historical risk factors of every stock were first estimated and then a number of regression models were evaluated with regard to the level of explanatory power of cross-sectional return variations (we have estimated the cross-sectional relationship between the mean return of assets and risk factors for each period and then compared models). Risk factors were proxied by the traditional beta coefficient of mean-variance approach, downside beta coefficients, and higher-order moments of returns distribution (gamma and delta).

A comparison of models with different return intervals reveals that the best explanatory power is achieved by models with weekly returns. Price dynamics of the sample stocks and the performance of the index give evidence that the assumption of symmetrical and normal expected return distribution is valid neither in a short run (one year) nor in a long run.

Traditional models where market risk of assets is measured by the beta coefficient of the unconditional CAPM display statistically significant results only for segmented periods of Russian economic development (2004-2007). None of the models with the CAPM beta coefficient or the one-sided beta coefficient is significant for the crisis period (2008-2009). The empirical results indicate that traditional unconditional CAPM is inadequate for Russian's stock market in explaining cross-section return variations and significant role of market risk for the determination of average return.

One of the hypotheses tested states that downside risk measures (downside betas) are better for explaining cross-sectional return variations. Our tests display that the explanatory power does improve in terms of higher coefficient of determination for the financially stable period of 2004-2007 if the traditional CAPM beta coefficient is replaced by one-sided risk measures. Also the tests support the supposition that, for the zero rate of return benchmark, the models display better explanatory power. The downside beta specification of Harlow and Rao (1989) proves to be more efficient in explaining cross-sectional return variations than that of Estrada (2007).

Another hypothesis tested states that the inclusion of higher-order moments (the gamma coefficient of systematic asymmetry and the delta coefficient of systematic kurtosis) may contribute to explanatory power of one- and-multi-factor models. Our tests refute this hypothesis except for the model with the Harlow and Raw one-sided beta coefficient with the zero benchmark and gamma coefficient. This model displays a comparatively good explanatory power of cross-sectional return variations in the Russian stock market.

We explain the tests results by the fact that the models tested bear an embedded assumption of the symmetric impact of risk on return in falling and rising markets. To complete the research we divided the sample period into two subperiods differing by the sign of the market risk premium (*MRP*), that is, a period with positive *MRP* (associated with a rising market) and a period of negative *MRP* (associated with a falling market). The conditional models including those with higher-order moments were tested in the rising and falling market. Again, the tests results are consistent with the hypothesis of feasibility of conditional CAPM-based models that incorporate higher-order moments of distribution such as systematic asymmetry (co-skewness) and systematic excess (co-kurtosis).

We sum up wit the following concluding remarks. One-sided beta specification proves to be more feasible for explaining cross-sectional return variations in the Russian stock market relative to the traditional beta coefficient of mean-variance approach. Unconditional models expanded to include higher-order moments of distribution do not give evidence of any improvement in explanatory power. Conditional models are best to explain cross-sectional return variations. Higher-order moments of distribution (co-skewness and co-kurtosis) contribute to explanatory power.

References

1. Arditti, F.D. 1967. Risk and required return on equity. Journal of Finance 22, pp.19–36.
2. Bakaert, G.; Harvey, C.R. 1997. Emerging equity market volatility. Journal of Financial Economics 43, pp.29-77.
3. Barone-Adesi, G. 1985. Arbitrage equilibrium with skewed asset returns. Journal of Financial and Quantitative Analysis 20, pp.299-313.
4. Bawa, V.; Lindenberg, E. 1977. Capital market equilibrium in a mean-lower partial moment framework, Journal of Financial Economics 5, pp.189–200
5. Chiao, C.; Hung, K.; Srivastava S., 2003. Taiwan stock market and four-moment asset pricing model. Int. Fin. Markets, Inst. and Money 13, pp.355- 381.
6. Chung, Y.P.; Johnson, H.; Schill, M. 2006. Asset pricing when returns are non-normal: Fama- French factors vs higher-order systematic co-moments. Journal of Business 79, pp.923-940.
7. Chunhachinda, P.; K. Dandapani; S. Hamid; A.J. Prakash. 1997. Portfolio selection and skewness: Evidence from international stock markets. Journal of Banking and Finance 21, pp.143-167.
8. Conine, T.E.; Tamarkin, M.J. 1981. On diversifcation given asymmetry in returns. Journal of Finance 36, pp.1143-1155.
9. Dittmar, R.F. 2002. Nonlinear pricing kernels, kurtosis preference, and evidence from the cross section of equity returns. Journal of Finance 57, pp.369-403.
10. Doan, P., Lin C.; Zurbruegg R. 2010. Pricing assets with higher moments: Evidence from the Australian and US stock markets. Int. Fin. Markets, Inst. and Money 20, pp.51-67.
11. Estrada, J. 2002. Systematic Risk in Emerging Markets: the D-CAPM. Emerging Markets Review 3, pp.365-379
12. Estrada, J.; Serra, A. 2005. Risk and return in emerging markets: family matters. Journal of Multinational Financial Management 15, pp.257-272.
13. Estrada, J. 2007. Mean-Semivariance Behavior: downside risk and capital asset pricing. International Review of Economics and Finance 16,pp.169-185.

14. Fama, E.; MacBeth, J.D. 1973. Risk return and equilibrium: empirical test. Journal of Political Economy 81, pp.607-636.
15. Fang, H.; T. Y. Lai. 1997. Co-Kurtosis and Capital Asset Pricing. The Financial Review 32, pp.293-307.
16. Francis, J.C. 1975. Skewness and investors' decisions. Journal of Financial and Quantitative Analysis 10, pp.163-176.
17. Friend, I.; Westerfield, R. 1980. Co-skewness and capital asset pricing. Journal of Finance 35, pp.1085-1100.
18. Galagedera, D. H.; P. Silvapulle. 2002. Conditional Relation Between higher moments and Stock Returns: Evidence from Australian Data, Proceedings from the Econometric Society Australian Meeting. CD Rom, Queensland University of Technology. Brisbane, Australia.
19. Giang, V. M.. 2010. An Empirical Examination of the Validity of the CAPM in the Vietnamese Stock Market. Vietnam Securities Review 140, pp. 9-11.
20. Gibbons, M.; Ross, S.; J. Shanken. 1989. A test of the efficiency of a given portfolio. Econometrica 57, pp.1121- 1152.
21. Girard, E.; M.Omran. 2007. What are the risks when investing in thin merging equity markets: Evidence from the Arab world Journal of International Financial Markets, Institutions and Money 17, Is.1, pp. 102-123
22. Goriaev, A.; A. Zabotkin. 2006. Risks of investing in the Russian stock market: Lessons of the first decade. Emerging Market Review 7(4), pp.380-397
23. Harlow, V.; R. Rao. 1989. Asset pricing in a generalized mean-lower partial moment framework: Theory and evidence. Journal of Financial and Quantitative Analysis 24, pp.285-301
24. Hartmann, M.A.; Khambata, D. 1993. Emerging stock markets: investment strategies for the future. Columbia Journal of World Business 21, pp.83-103.
25. Harvey, C.; Siddique, A., 1999. Autoregressive conditional skewness. Journal of Financial and Quantitative Analysis 34, pp.465-488.
26. Harvey, C.; Siddique, A. 2000. Conditional skewness in asset pricing tests. Journal of Finance 55, pp.1263-1295.
27. Hogan,W.W.; J.M.Warren. 1974. Toward the development of an equilibrium capital market model based on semivariance. Journal of Financial and Quantitative Analysis 9, pp.1-11.
28. Homaifar, G.; D. Graddy. 1988. Equity Yields in Models Considering Higher Moments of the Return Distribution. Applied Economics 20, pp.325-334.
29. Huang, Y.S., 1997. An Empirical Test of the Risk-return Relationship on the Taiwan Stock Exchange. Applied Financial Economics 7, pp. 229-239.

30. Hwang, S.; S. Satchell. 1999. Modeling Emerging Risk Premia Using Higher Moments. International Journal of Finance and Economics 4(1), pp.271-296.
31. Ingersoll, J. 1975. Multidimentional Security Pricing. Journal of Financial and Quantitative Analysis 10(4), pp.785-798.
32. Iqbal, J.; R. D. Brooks. 2007. A Test of CAPM on the Karachi Stock Exchange International Journal of Business 12 (4), pp.429-445.
33. Iqbal, J.; R. Brooks; D. A. U. Galagedera. 2007. Asset Pricing with Higher Comovement And Alternate Factor models: The Case of Emerging Markets. Working Paper, Monash University, Australia.
34. Iqbal, J.; R. Brooks; D. U. Galagedera. 2008. Testing Conditional Asset Pricing Model: An Emerging Market Perspective, Working Paper 3/08. Monash University, Australia.
35. Iqbal, J.; R.Brooks; D.U.A. Galagedera. 2010. Testing conditional asset pricing models: An emerging market perspective. Journal of International Money and Finance 29 (5), Sept., pp. 897-918.
36. Javid, A. 2009. Test of Higher Moment Capital Asset Pricing Model in Case of Pakistani Equity Market. European Journal of Economics, Finance and Administrative Sciences 15, pp.144-162
37. Jegadeesh, N.; Titman, S. 1993. Returns to buying winners and selling losers: implications of stock market inefficiency. Journal of Finance 58, pp.65-91.
38. Korajczyk, R.A. 1996. A measure of stock market integration for developed and emerging markets. World Bank Economic Review 10, pp.167-289.
39. Kraus, A.; Litzenberger, R. 1976. Skewness preference and valuation of risk assets. Journal of Finance 31, pp.1085- 1100.
40. Lai, T.Y. 1991. Portfolio selection with skewness: A multiple-objective approach. Review of Quantitative Finance and Accounting 1, pp.293-305.
41. Lee, C. F., 1977. Functional Form, Skewness Effect and the Risk Return Relationship, Journal of Financial and Quantitative Analysis, 12(1), 55-72.
42. Lim, K.G. 1989. A new test of the three-moment CAPM. Journal of Financial and Quantitative Analysis 24, pp.205-216.
43. Messis,P.; G. Latridis; G. Blanas. 2007. CAPM and Efficency of Higher Moment CAPM in the Athens Stock Market: an Empirical Approach. International Journal of Applied Economics 4(1), pp.60-75.
44. Mitra, D.; Low, S.K. 1998. A study of risk and return in developed and emerging markets from a Canadian perspective. Mid-Atlantic Journal of Business 34, pp.75-91.

45. Peiro, A. 1999. Skewness in financial returns. Journal of Banking and Finance 32, pp.847-862.
46. Pettengill, G.N.; Sundaram, S.; Mathur, L. 1995. The conditional relation between beta and returns. Journal of Financial and Quantitative Analysis 30, pp.101-116
47. Ranalddo, A.; L. Fave. 2005. How to price Hegde Fungs: From Two to Four Moment CAPM. Working Paper, Swiss National Bank, Zurich, Switzerland.
48. Schweser, C.; T. Schneeweis. 1980. Risk return and the multidimensional security pricing market. Journal of Financial Research 3, pp.23-31.
49. Sears, R.S.; Wei, K.C.J. 1985. Asset pricing, higher moments, and the market risk premium: a note. Journal of Finance 40, pp.1251-1253.
50. Simkowitz, M.; Beedles, W. 1978. Diversification in a three moment world. Journal of Financial and Quantitative Analysis 13, pp.927-941.
51. Smith, D. 2007. Conditional coskewness and capital asset pricing. Journal of Empirical Finance 91, pp.91-119.
52. Tan, K.J. 1991. Risk return and the three-moment capital asset pricing model: another look. Journal of Banking and Finance 15, pp.449- 460.
53. Teplova T.; Selivanova N. 2007. DCAPM testing in Russia stock market. EJournal of Corporate Finance 3, pp.5-25.
54. Wang, Y.; Amalia Di Iorio. 2007. The cross section of expected stock returns in the Chinese A-share market. Global Finance Journal 17, Is.3, pp. 335-349.

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[i] Sharpe (1965), Lintner (1966), Black (1972)

[ii] Graham, John; Campbell Harvey, Equity risk premium amid a global financial crisis, Evidance from the Global CFO Outlook survey 2009. SSRN WP; Graham, J. R., C. R. Harvey, 2009, The CFO Global Business Outlook: 1996-2009. http://www.cfosurvey.org.

[iii] Brealey, Richard; Stewart Myers; Franklin Allen Principles of Corporate Finance, 8th Edition, 2006, McGraw-Hill Inc.; Brigham, Eugene F.; Louis C. Gapenski; Phillip R. Daves, Intermediate Financial Management, Dryden Press, 6th Edition, 1999; Fabozzi, Frank; Pamela P.

Peterson, Financial Management and Analysis, 2 Ed., Wiley Finance, 2003; Damodaran A. Equity Risk Premiums (ERP): Determinants, Estimation and Implications - The 2010 Ed. Stern School of Business, NYU, http://pages.stern.nyu.edu/~adamodar/