Scientific Annals
of the "Alexandru Ioan Cuza" University of Iaşi
Economic Sciences
62 (3), 2015, 453-480
DOI 10.1515/aicue-2015-0030

ECONOMETRIC TESTS OF THE CAPM MODEL FOR A PORTFOLIO COMPOSED OF COMPANIES LISTED ON NASDAQ AND DOW JONES COMPONENTS

Georgeta VINTILĂ*, Radu Alin PĂUNESCU**

Abstract

We tested empirically through econometric methods the classic CAPM model for 15 shares listed on the NASDAQ market in United States of America. The results showed that, for the majority of shares, there is a linear relation between expected return and market return. The shares of the largest companies from sample (AAPL, MSFT, GOOGL, etc. INTC) had a subunitary beta and the shares of smaller companies (ADBE, YHOO, BIDU etc.) had a beta greater than one. Compared with Security Market Line (SML) the shares were found to be overestimated and overstated and using GARCH-VECH model we identified the presence of high correlation between shares and the volatility spillover phenomenon.

Keywords: CAPM models; financial assets valuation; volatility spillover

JEL classification: G11, G12, G14

1. INTRODUCTION

Economic and financial world has been marked by negative events in recent years due to the financial crisis of 2007. They have tarnished the image of the entire financial system globally and determined the investors to be more reluctant with investments decisions but on the same time, they have strengthened the need for protection against risk. However, for stock markets risks are not necessarily a negative thing. A higher risk requires a higher gain. Kotler and Casoline (2009) believe that after the recent financial crisis, the world economy entered in "the new era of turbulence" in which the cyclicality has been replaced by uncertainty. Uncertainty has always been a feature of finances and especially of stock markets, but in time complex financial instruments have been developed, such as derivatives. We have chosen as research theme the CAPM model starting from Damodaran (2012) which divides investors into three categories, first type Buffet-like investors who are buying shares of companies with cash flows stable and liquid assets, the second category of investors rely solely on strategies derived from technical analysis and those in the third category seeking shares of new innovative

* Department of Finance, Bucharest University of Economic Studies, Romania; e-mail: *vintilageorgeta@yahoo.fr*.
** Doctoral School of Finance, Bucharest University of Economic Studies, Romania;
e-mail: *radupaunescu696@gmail.com.*

companies, with growth prospects optimistic. To have a satisfactory return on stock investments there is no successful model consecrated. It cannot use only the fundamental analysis or only technical analysis. The safest is to use as many methods and models to make a decision. We chose the CAPM model because it is widely studied in the academic literature and is a reference point in the stock evaluation. Besides intuition, instinct and technical analysis an investor must base their decisions on mathematical analysis. Optimal portfolio management involves consideration of return and risk of the shares into which it is desired to invest. The CAPM model is the easiest and complex (at the same time) mathematical model for analyzing the stocks. Unlike the Sharpe model, the CAPM contains variables with universal role and a better representation of financial reality. Bartholdy and Peare (2003) considered that the CAPM model is the most popular model used by practitioners to estimate the expected return. By using the CAPM model we wanted to analyze the quality and the status of stocks for companies' components of the NASDAQ, from technology sector. This can be achieved on the basis of return required by investors, estimated by CAPM model. Other issues pursued in this paper are the linear relationship between expected return and risk, whether beta fully capture the risk of the stocks chosen and empirical support for the theory that a higher risk brings higher profitability.

The rest of the paper is organized as follows. Section 2 includes prior research in the field, with reference to the research and conclusions of literature recognized in finance, Section 3 includes description of database, methodology used for empirical research and results. The final section highlights conclusions drawn from the analysis of the conducted study.

2. PRIOR RESEARCH OF CAPM

To better understand the CAPM model it requires a brief history of its occurrence and development. In financial theory innumerable researches are studying this model, some arguing its applicability, others contesting it. The CAPM model was originally designed by William Sharpe (1964) and concomitant, but independent by Lintner (1965). Other significant initial studies were carried out by Jack Treynor (1961), Jan Mossin (1966) and Fischer Black (1972). Thus it appeared the first model that linked the return of a financial asset and the return of a fully diversified portfolio through an indicator of systematic risk (beta). The CAPM model (capital asset pricing model) is preferred by investors with risk aversion because it introduces a new factor, namely the risk-free rate which showing the minimum level which must be accepted in order to achieve the investment in stocks. The beta volatility coefficient resulted from CAPM model is a handy tool for the investors to decide whether to invest in a riskier shares that might bring a higher gains (Radcliffe (1989). Graham and Harvey (2001) believed that the CAPM model is a preferred model for calculating the cost of capital by US companies. The great disadvantage of CAPM were restrictive assumptions that makes it quite inapplicable to real life. Megginson (1997) provided a short list with models developed after the CAPM model. The list include the CAPM model which takes into account taxes, the CAPM model which takes into account the heteroskedasticity of returns, models that take into account the beta variability and others. Megginson (1997) said that investors who use CAPM obtain unbiased estimates of future returns which be equal to the actual historical returns. Roll (1977) brought serious criticism to the CAPM model considering that this model cannot be tested and the previous studies were flawed because the investors often build portfolios so that they are located on the efficient frontier SML. Other critics have been those related to stability over time of the coefficients volatility brought by Blume (1975). He showed that beta indicators become more precise with the increase of the number of shares within portfolios.

Although it is a simple model its results are not fully satisfactory and this has been demonstrated by some researchers including Eugene Fama and Kenneth French (1992). They realized, studying the US market, other models of equilibrium like FF3 (Fama-French with three-factor) that want to be developments of the CAPM model but using more factors such as market-to-book ratio, PER, capitalization and debt. Guermat (2014) considers that the CAPM model can be tested and is effective but only if it is used concomitant the OLS estimation with the GLS method. Starting from FF3, Balvers and Huang (2009) have introduced and have tested in model the consumption factor (C-CAPM) and even comprised a factor that include the monetary growth and inflation to derive a MC-CAPM model to better capture the determinants of stock prices. Similar studies were carried out by Jensen and Mercer (2002), Parker and Julliard (2005). By introducing the monetary factor according to Marshall (1992) model, Balvers and Huang (2009) wanted to correct the model developed by Breeden (1979) who believed that a growth of consumption is enough to evaluate the price of an asset. Balvers and Huang (2009) considers that the money supply in the economy and consequently the liquidity of the economy affect the level of trading, a fact which will be reflected in the price of financial assets. For better results he used the Stein's in econometric models. Chordia et al. (2005) have tested econometric a similar CAPM model and the empirical results showed that capital market liquidity is better if it is correlated with growth of the money supply. Balvers and Huang (2009) tested the econometric model MC-CAPM based on studies of Lettau and Ludvigson (2001), that had at its origins the method originated by Fama and MacBeth (1973). So they used the model of GMM for estimation, a method called the generalized moments. The study results indicated a better robustness of the estimated returns, greater stability of the market risk premiums and low levels for the alpha terms (the intercept from econometric model[1)] through C-CAPM and MC-CAPM models. This explains 64% of the cross-sectional variation in returns of the stocks within the analyzed portfolio, exceeding the results of Campbell and Cochrane (1999). Thus, by introducing the monetary impact, the estimates for expected returns have outperformed those made by Lewellen et al. (2010), Cohen et al. (2005), Ahn et al. (2009). Another fact revealed was that the value of financial assets is influenced by monetary shocks. Fama and French (2004) argued that the standard CAPM model which using the market index as a proxy for the return of market portfolio do not properly estimate the expected return of a share. Dittmar (2002) conducted another CAPM model that takes into account, besides the attention of investors for average, variance and asymmetry coefficient (Harvey and Siddique, 2000) (skewness) and coefficient of flattening (kurtosis). This model is better than the standard CAPM model for the US capital market.

Another studies of CAPM model have focused on the issue of distribution of return. Berk (1998) considers that the hypothesis of elliptical distributions is very useful in CAPM model. From this hypothesis, Hodgson et al. (2002) have identified the fact that size of the market affects the return estimated by using CAPM model. The problem of normal distribution assumption is that there is no limit for loss and thus, implies that the investors can lose more than the wealth they hold Huang and Litzenberger (1988). Vorkink (2003) developed the idea of elliptical distribution and found that returns estimated using the CAPM model are influenced by outliers existing in data. An example of outlier is the January effect which no longer highlights the linear relationship between return and risk, specific to CAPM. and can lead to estimated returns erroneously that can lead to wrong investment decisions. Patton and Timmermann (2010) tried to study, using the CAPM, if there is a monotonic relationship between the expected return of a financial asset and its associated risk. Eakins *et al.* (1996) studied the position of institutional investors towards the classic CAPM assumptions. They found that institutional investors prefer to invest in shares with a greater beta to avoid stocks which have a higher unsystematic risk. The allocation process of resources is influenced by return measured ex-post and thus it does not support the CAPM assumptions for institutional investors. These are adverse to standard deviation, skewness and kurtosis.

Wen et al. (2008) have investigated whether the CAPM model used constantly by insurance companies is effective for them. Returns achieved in this sector follow a non-normal distribution so they considered that it is more effective to estimate expected returns using the model Rubinstein-Leland (RL) when estimating the cost of capital for a small insurance company. On the other hand, if the insurer is big and obtains symmetrically distributed returns than the CAPM model is more suitable to estimate beta and cost of capital. In addition to renowned authors who have studied the issue of CAPM model one can include studies of Kumar (2009), Stambaugh et al. (2012), Frazzini and Pederson (2013) who have made contributions to academic literature.

3. ECONOMETRIC RESEARCH METHODOLOGY

For this study we used the forte static assumption according to which the expected return - and anticipated - to be registered in the future, will be based on the average historical return on the time horizon considered in the analysis (Gourieroux *et al.*, 1997, p. 24). This assumption implies that the variance of historical returns is an estimator for the risk associated with the estimation.

Another hypothesis under consideration is "time interval" proposed by Theobald (1981). Theobald (1981) believes that the optimal period for CAPM analysis is 120 months, but, if there is a possibility of changes of beta, a shorter period should be considered. So we decided to analyze the period from 4 January 2010 to 26 December 2014, because earlier than 2010 there were recorded strongly influences of 2007's crisis. So, the analysis period covered 48 months, similar with period chosen by Roenfeldt et al. (1978). Groenewold and Fraser (2001), Bartholdy and Peare (2005), considers that the five years with monthly data is the CAPM optimal analysis period.

The actions chosen are components of the NASDAQ index and we chose the top 15 companies belonging to the technology sector, based on the market capitalization. List of selected companies can be found in Appendix, Table 1. As a source of database we used Yahoo Finance and NASDAQ official websites. NASDAQ is an electronic stock exchange in the United States, which lists about 3,200 companies. The name comes from the National Association of Securities Dealers Automated Quotations. It was founded in 1971 and is the second largest stock exchange in the world.

By using the CAPM model we wanted to verify whether the shares chosen in the quality of potential investors are undervalued, overvalued or properly assessed. If econometric expected return is lower than the actual return then the asset is undervalued and is a good decision to purchase those shares. Another method of analysis is comparing the theoretical price (exact) of the financial asset with that recorded on market. If theoretical price is higher than the market price the share is worth (on market) less than its real value, so it is undervalued. Other issues pursued in this paper follow the linear link between expected return and risk; whether beta fully capture the risk of the chosen shares; and theory that a higher risk brings higher return.

We used as risk-free rate the iShares 1-3 Year Treasury Bond (SHY). To facilitate comparisons, we used simple returns, applying the formula proposed by Brooks (2014) :

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\% \qquad (1)$$

R_t - share return at the moment „t”
P_t – share price at the moment „t”

From an econometric point of view, CAPM model is similar with Sharpe model. This helps in the econometric writing of the regression formula.

Based on market model described by Sharpe[2] and adding the risk-free rate we obtain:

$$R_{it} - R_f = \alpha_i - r_f + \beta_{i,m} \times (R_{mt} - r_f) + \varepsilon_{it}.$$

From here we can deduce the *excess return market model* denoted α_i^*. According to SML (*Security Market Line*) for CAPM model is necessary to restrict the intercept $\alpha_i^* = 0$.

For CAPM model econometric regression equation is:

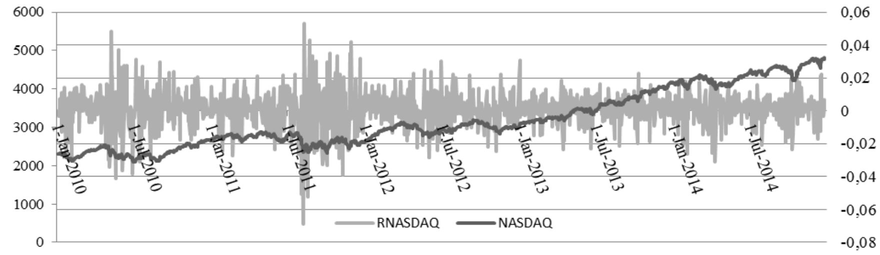
$$R_{it} - R_{ft} = \alpha_i + \beta_i [R_{mt} - R_{ft}] + e_{it}$$

We applied the notation Y= Rit - Rrf (the excess return brought by the asset „i" at t moment compared to risk-free asset return) for the dependent variable and for independent variable X= Rmt - Rrf (market risk premium). The new regression is Y= α + β × X. Thus, initial for Apple share, the linear regression will be: RAAPL – RRF= α +β × (RNASDAQ – RRF). After notation, the new CAPM regression is: CRAAPL= α + β× CRNASDAQ.

Although the series has constant frequency, due to public holidays, which can not be defined in Eviews 7 software, it cannot choose option Dated. Instead, we chose Unstructured/Undated option with the advantage of rapidity of data entry. For stock markets that only works five days a week from Monday to Friday we can choose Dated – regular frequency (Daily-5 day weeks) and the format is MM/DD/YYYY.

4. EMPIRICAL RESULTS

In Figure 1 we attached a representation of return and of closing market price, for the NASDAQ index. There is a greater variation in NASDAQ index return during July 2011.



Source: author’s computation

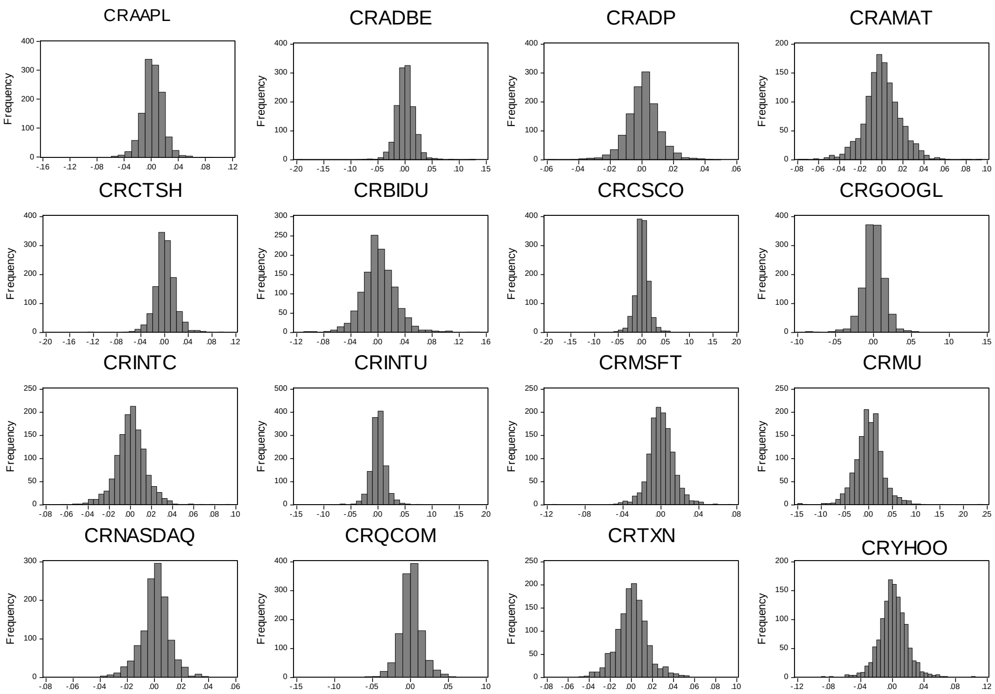
Figure no. 1 – NASDAQ – Return (RNASDAQ) and Market Price

We attached in Appendix, at Figure 2 the graphic representation for Apple (return and price) that will be the benchmark in this paper. In Table 2 we attached descriptive statistics of shares analyzed and it can be seen that INTU has the highest return followed by ADBE. From Jarque-Bera statistics it can be noted that data is not normally distributed a common fact for financial data.

Table no. 2 – Descriptive Statistics

	CRADBE	CRAMAT	CRADP	CRAAPL	CRBIDU	CRCSCO	CRCTSH	CRGOOGL
Mean	0.000699	0.000668	0.00078	0.001199	0.00169	0.0003	0.00083	0.000523
Median	0.000399	1.35E-05	0.00078	0.0011	0.00029	0.00038	0.00041	0.000365
Maximum	0.127564	0.091606	0.04786	0.088416	0.14218	0.1603	0.1091	0.13796
Minimum	-0.19023	-0.0759	-0.0572	-0.12345	-0.1096	-0.1605	-0.192	-0.0845
Std. Dev.	0.018844	0.017692	0.01069	0.016881	0.02612	0.01741	0.01938	0.015821
Skewness	-0.15536	0.123025	-0.0931	-0.147179	0.44247	-0.5798	-0.8076	0.663596
Kurtosis	16.66197	4.900759	5.37948	7.712987	5.73519	23.5998	15.7835	15.33235
Jarque-Bera	9765.252	192.0894	297.884	1166.046	432.157	22260.4	8681.75	8044.99
Probability	0	0	0	0	0	0	0	0
Sum Sq. Dev.	0.4453	0.392507	0.14337	0.357359	0.85529	0.37992	0.47086	0.313897
Observations	1255	1255	1255	1255	1255	1255	1255	1255
	CRINTC	**CRINTU**	**CRMSFT**	**CRNASDAQ**	**CRMU**	**CRQCOM**	**CRTXN**	**CRYHOO**
Mean	0.000677	0.000998	0.00052	0.000614	0.00136	0.00055	0.00077	0.001019
Median	0.000597	0.000595	1.17E-05	0.001022	0.00103	0.00056	0.00067	0.000742
Maximum	0.09277	0.150778	0.07287	0.051869	0.23419	0.0819	0.08517	0.103065
Minimum	-0.06291	-0.1105	-0.1146	-0.069353	-0.145	-0.1429	-0.0718	-0.08784
Std. Dev.	0.014889	0.015211	0.01404	0.011425	0.03047	0.01599	0.01542	0.01933
Skewness	0.222644	0.640895	-0.2105	-0.340401	0.291	-0.6652	0.18571	0.16208
Kurtosis	5.862991	15.32279	8.06215	6.330592	7.82544	11.2878	5.02639	6.391609
Jarque-Bera	438.9885	8026.46	1349.27	604.2999	1235.32	3684.37	221.937	607.0064
Probability	0	0	0	0	0	0	0	0
Sum Sq. Dev.	0.277979	0.290129	0.24718	0.163694	1.1639	0.32079	0.29802	0.468533

Source: Author's Computations in Eviews 7



Source: Author's Computations in Eviews 7

Figure no. 4 – NASDAQ stock return distributions

At Appendix, Figure 3 contains the distribution of quantiles for the analyzed returns. It can be seen that they are not normally distributed. Figure 4 contains NASDAQ stock return distributions. In Table 3 we attached the OLS estimation results.

Table no. 3 – Estimation Results

Dependent Variable	R-squared	F-statistic	Prob F-statistic	Durbin-Watson stat	Ramsey RESET (P-value)	White (P-value)
AAPL	0.3910	804.3291	0.0000	1.9238	0.2463	0.9099
MSFT	0.4536	1040.0090	0.0000	1.9672	0.8922	0.8724
GOOGL	0.4453	1005.7820	0.0000	1.9346	0.8750	0.6459
INTC	0.4581	1059.4410	0.0000	2.0202	0.1269	0.5999
CSCO	0.3771	758.6172	0.0000	1.9823	0.1308	0.1183
QCOM	0.4653	1090.3180	0.0000	1.9742	0.8495	0.8094
BIDU	0.3721	742.3932	0.0000	2.0509	*0.0453*	0.1645
TXN	0.5816	1741.9940	0.0000	2.1894	*0.0060*	0.0000
YHOO	0.3501	675.0251	0.0000	1.9674	0.4263	0.0228
ADP	0.6403	2230.8140	0.0000	2.1778	0.9542	0.0050
MU	0.0073	9.1546	0.0025	2.0270	*0.0136*	0.0000
ADBE	0.4096	869.2039	0.0000	2.2048	0.8078	0.7100
CTSH	*0.0004*	*0.4497*	*0.5026*	*2.1272*	0.0892	0.0271
AMAT	0.5356	1445.1890	0.0000	2.0769	0.2307	0.0342
INTU	0.4368	971.8969	0.0000	2.2133	0.5023	0.8810

Source: Author's computations in Eviews 7

The determination report[3] one of the most common godness of fit statistic, must be as close to 1 for assessing the quality of a model. Being daily data with high dispersion, econometric theory recommends a lower limit for the determination report of 0.15% (Andrei and Bourbonnais, 2008). For the 15 shares examined, the report of determination was in average close to 50%, maximum being touched by the stock ADP with a value of 64.03%. For companies CTSH and MU the determination report had a very low value (0.04%). Thus we can confirm that for the 13 shares examined, the econometric models are valid with exception of CTSH and MU stocks that should be excluded from the portfolio or analyzed by other methods. Since these values are relatively low or even very low, it is possible that much of the variation in return of shares to be determined by factors not included in the model, specific to company. For example, Apple shares indicates that about 39% of the variation in return is explained by the variation of the market portfolio return, so 61% of the variation for AAPL return is due to the company specific risk, a risk which can be adjusted by portfolio diversification. For company ADP, 64% of the variation is explained by the variation of return of the market portfolio, so 36% of the ADP return variation is due to the company specific risk. From these two examples it is difficult to determine which most cost-effective share is and it require a further investigation of return- risk ratio. To validate the estimated CAPM model is not enough just coefficient of determination[4]. If the 1 to 4 properties from the footer are satisfied then the estimated parameters are called Best Linear Unbiased Estimators (BLUE). BLUE means that alpha and beta linear estimators ($\hat{\alpha}$ and $\hat{\beta}$) give the true values for model parameters and are consistent, unbiased and efficient (see Brooks, 2014).

F-Fisher Snedecor Test checks the linear dependence (the validity of the model). The F-Test verify if all the regression coefficients (except the constant) are significantly different from zero. If $F_{calculating}$ by Eviews is bigger than $F_{critical}$ then the model is valid and it can accept the existence of a linear dependence. If $F_{calculating} < F_{critical}$ then the model is not valid and it cannot accept the existence of a linear dependence. In this case, $F_{critical}$ is: $F_{\alpha;\ k;\ n-1-k} =$ 3.087. Another way is to analyze the *P-value* associated with this test. *P-value*, is less than 5% for all stocks analyzed with CAPM model. Thus, this test validates all models except CTSH share.

The first order autocorrelation tests and superior order (Durbin-Watson) verify if errors are linearly independent one of another (residuals are no autocorrelate). Residual values from one time are not correlated with residual values of another time. The simplest case of autocorrelation of residuals is the first order autocorrelation[5]. The consequences of ignoring the autocorrelation are similar to those of ignoring the heteroskedasticity. The coefficients estimated with OLS method are unbiased, but are not BLUE, and therefore are inefficient. It may be combated by estimating with GLS method or Cochrane-Orcutt method. Durbin - Watson procedure is only used for consecutive errors. The DW statistic is between [0,4]. But a value close or equal to 2 highlights the lack of autocorrelation for errors. DW depends on the number of variables included in the model. The Durbin - Watson test it applies only if the regression equation has free term, the regressors are non-stochastic and the dependent variable has no lags. The decision is taken according to Figure 5. For d_L and d_U the intercept is not included for the table values. The critical values of statistics depend on the number of exogenous variables, the number of observations and the significance threshold chosen. Figure 5 and Table 3 show that the DW statistic analyzed is within an interval of values [1.92; 2.21] that corresponding to lack of autocorrelation.

Interval	Result
0 - d_L	Reject H_0 / Positive autocorrelation
d_L - d_U	Indecision
d_U - 2	Accept H_0
2 - (4-d_U)	No autocorrelation
(4-d_U) – (4d_L)	Indecision
4d_L - 4	Reject H_0 / Negative autocorrelation

0_______**dL=1.65**_______**dU=1.69**______2_____4-dU=2.31_________4dL=2.35________4

Source: Author's computation

Figure no. 5 – The Durbin-Watson Test decision

Ramsey Test verifies the linearity of the model chose, in other words, if the relationship between the asset's expected return and market return can be represented by a straight line. The command function is RESET in Eviews. It is a residual test. This test implies that after the OLS estimation of the regression, building a new auxiliary regression in turn, which will be estimated OLS. The decision is taken by test F test applied to auxiliary estimated regression. If the decision of F test adopts the null hypothesis, then one can accept H_0 from Ramsey test and the model is linear. If the decision of F test adopts the H_1 hypothesis then at least one parameter is not equal to one and we can accept the H_1 from Ramsey test so the model is not linear. The decision may also be made by analyzing the *P-value* of F test associated with auxiliary regression estimates. Thus, following the penultimate column of Table 3 we see that F test *P-value* is greater than 5% for all shares analyzed except the BIDU, TXN, MU stocks, which have a P-*value* less than 5%. By exceeding the 5% threshold we consider that CAPM models analyzed are linear models. By this test we have shown that between the return of the analyzed stocks and the market portfolio return there is a direct linear connection, a fact that can predict, to some extent, the return of the chosen stocks if we analyze the NASDAQ market index. For shares that are not linear models under the Ramsey test, there may be other factors of influence.

White Test verifies the homoscedasticity of the model. The variance of each random variable is the same[6]. The homoscedasticity supposes that the dispersion should be constant and for heteroskedasticity the dispersion varies. Lack of the homoscedasticity can occur by not including the key explanatory variables in the model. A consequence of the application of OLS which do not check the hypothesis of homoscedasticity is the distortion of the quality of statistical tests performed on the model parameters. The estimator is unbiased and consistent in those conditions. After CAPM model estimation, White Test creates an auxiliary regression on which is applied the F test. If the decision of the F test is to accept the null hypothesis then the White test H_0 hypothesis is accepted and the model is homoscedastic. If the decision is to accept the F-test hypothesis H_1, then at least one parameter is zero, so we accept the H_1 from White test, so the model is heteroskedastic and the dispersion does not has an uniform development throughout the range. Or it may be decided and according to *P-value* associated. For the present study the White test results, applied for CAPM model, can be found in Table 3. It is noted that the stocks AAPL, MSFT, GOOGL, INTC, CSCO, QCOM, BIDU, ADBE, and INTU have a *P-value* associated with F test of auxiliary regression higher 5%, a fact that shows that the models have homoscedasticity. For CAPM models, applied to stocks TXN, YHOO, ADP, MU, CTSH, AMAT the *P-value* associated with F test is less than 5% a fact that signifies the presence of heteroskedasticity for errors. If errors are heteroskedastic, the standard error formula cannot be applied properly to coefficients. For example, the heteroskedasticity presence leads to high standard errors for the intercept. All statistics used for inferences - Student test, F test and others, will be affected. The estimators will be consistent and unbiased but they will not have minimal variance so any inferences based on them will be wrong. The heteroskedasticity can be countered by estimating Generalized Least Squares (GLS). Another solution would be the use of the logarithms but has the disadvantage of ignoring the negative or zero values.

The Normality Test (Jarque-Bera) verifies the normality of the residue $u_t \sim N(0, \sigma^2)$. To see if the results are reliable or not, it must check the errors of the regression equation that have to be normally distributed. Normal distribution of errors is important especially for making predictions based on estimated econometric equation. To define the confidence intervals of the parameters and for making predictions it starts from the hypothesis of normal distribution of the residues. For a normally distributed random variable, the value of the asymmetry coefficient (Skewness) is zero and the flattening coefficient (Kurtosis) is 3 (normal distribution – *mesokurtic* - and shows the form of the extremities). If the distribution has the kurtosis greater than 3, is called *leptokurtic* (and has a height greater than a normal distribution) and if kurtosis has a value of less than 3, the distribution is called *platykurtic*. Overall financial data series have leptokurtic distribution. A feature of this distribution is that the likelihood of extreme events is higher than for the normal distribution. The P-value associated with Jarque-Bera test was very low which leads to the idea that the series are not normally distributed.

After OLS estimation, the next step is to analyze the estimators' properties. An important property is related to dispersion. A lower level means a greater relevance of the estimator and the confidence which we will give in statistical inference is higher. It is therefore important to calculate the variances for the estimators. For the CAPM model is good to know how suitable are the parameters estimators $\hat{\alpha}$ and $\hat{\beta}$ and how accurate. For this, the standard errors[7], resulted from estimation, are studied. Ideally, is that they to have the lowest possible values. The standard error of regression is called the standard deviation of the residue of each regression. In the market model (Sharpe) is interpreted as company specific risk (or risk diversifiable). Table 4 notes that standard errors are lower than estimation coefficients which give a high degree of confidence to the results obtained. Additional to the example with AAPL and ADP shares, we can say that AAPL has, under standard error assumption, a 3% unsystematic risk and ADP share has a 1.6% unsystematic risk.

Table no. 4 – The OLS estimated results - CAPM model

Dependent variable	**BETA ($\hat{\beta}$)**	Std. Error	t-Stat	Prob.
AAPL	**0.9238**	0.0326	28.3607	0.0000
MSFT	**0.8276**	0.0257	32.2492	0.0000
GOOGL	**0.9240**	0.0291	31.7141	0.0000
INTC	**0.8820**	0.0271	32.5491	0.0000
CSCO	**0.9356**	0.0340	27.5430	0.0000
QCOM	**0.9549**	0.0289	33.0200	0.0000
BIDU	**1.3943**	0.0512	27.2469	0.0000
TXN	**1.0290**	0.0247	41.7372	0.0000
YHOO	**1.0011**	0.0385	25.9812	0.0000
ADP	**0.7489**	0.0159	47.2315	0.0000
MU	**-0.2271**	0.0751	-3.0257	0.0025
ADBE	**1.0555**	0.0358	29.4823	0.0000
CTSH	**-0.0321**	0.0479	-0.6706	0.5026
AMAT	**1.1333**	0.0298	38.0156	0.0000
INTU	**0.8799**	0.0282	31.1753	0.0000

Source: Author's computation in Eviews 7

T-Student Test tests if the parameters are significantly different from zero. If the module of t-Statistic calculated by Eviews is bigger than $t_{tabular}$ (taken from the Student distribution table) then we accept the alternative hypothesis that the value of the slope coefficient is significantly different from zero, the null hypothesis is rejected and we keep the X_i independent variable in the regression model. If $|t_{calculating}| < t_{tabular}$ then H_0 hypothesis which state that the value of the slope coefficient is not significantly different from zero, is accepted. The decision can be taken on behalf of P-value associated with the test. Table 4 shows that P-value associated with Student test is less than 5% a fact which leads to the idea that all coefficients are significantly different from zero and the model is valid.

The results from the CAPM model estimation can be found in Table 4 and they are essential to testing of this particular model, especially *Coefficients* column that identifies the beta coefficients which represents the risk of the shares. The beta (β) indicator can be can be interpreted in several ways. If is greater than 1 the share is more risky than the market portfolio and analog, if is smaller than 1, the share is less risky than the market portfolio. The stocks BIDU, TXN, YHOO, ADBE, and AMAT have a beta greater than one and stocks AAPL, MSFT, GOOGL, CSCO, QCOM, INTC, INTU, ADP have a beta subunitary but close to 1. Some stocks (MU and CTSH) have a negative beta what means that there exists an inverse relationship between the return on these assets and the market portfolio. Subunitary beta can indicate that the respective shares could be blue chips. One of the proposals of this paper was the link between risk and return of the chosen stocks. According to CAPM model a greater beta should bring with it a higher return.

In Table 5 we attached the results from the OLS estimation regarding the intercept. CAPM assumes the efficiency of the market portfolio. According to SML, the CAPM must comply with the restriction that the intercept $\alpha_i^* = 0$. This can be checked either using the Wald test or through applying the Student test to the Intercept, to see if the estimated coefficients are significantly different from zero. From Table 5, it is noted that all stocks analyzed have the P-value associated with Student test greater than 5% leading to accepting the null hypothesis, namely that the constant term α_i^* is not significantly different from zero. This condition should be respected for that comes from the market model (Sharpe) and would distort the conditions imposed by CAPM model.

Table no. 5 – The OLS estimation results

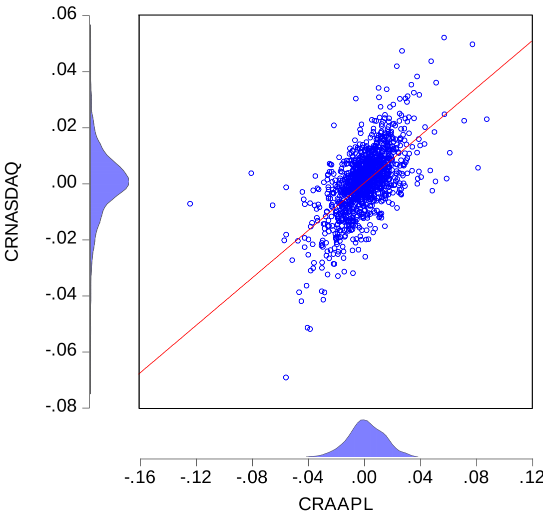
Dependent Variable	**ALFA ($\hat{\alpha}$)**	Std. Error	t-Stat	Prob.
AAPL	**0.0006**	0.0004	1.6967	0.0900
MSFT	**0.0000**	0.0003	0.0249	0.9801
GOOGL	**0.0000**	0.0003	-0.1319	0.8951
INTC	**0.0001**	0.0003	0.4391	0.6607
CSCO	**-0.0003**	0.0004	-0.7054	0.4807
QCOM	**0.0000**	0.0003	-0.1246	0.9009
BIDU	**0.0008**	0.0006	1.4312	0.1526
TXN	**0.0001**	0.0003	0.4814	0.6303
YHOO	**0.0004**	0.0004	0.9176	0.3590
ADP	**0.0003**	0.0002	1.7920	0.0734
MU	**0.0015**	0.0009	1.7434	0.0815
ADBE	**0.0001**	0.0004	0.1266	0.8993
CTSH	**0.0008**	0.0005	1.5414	0.1235
AMAT	**0.0000**	0.0003	-0.0791	0.9370
INTU	**0.0005**	0.0003	1.4184	0.1563

Source: Author's computation in Eviews 7

By respecting the Intercept condition it can be considered that for all 15 stocks analyzed, the CAPM model is sustained and can be used as a model to estimate the expected future return. If the parameters alpha (α) would have been statistically significant different from zero, the analysis of these shares would be: the alpha negative means shares undervalued and overvalued those with positive alpha.

Another way to analyze the CAPM model was bound by the relation $\varepsilon_i = y_t - \hat{y}_t$, where $y_t = E[R_i] - R_f$. This can be done by using Figure 6. If one of the points is above the red line then the actual return of the Apple share is above the characteristic line, so is higher than the estimated return on CAPM model. $E[R_{AAPL}] = 0.0006 + 0.9238 \times E[R_{NASDAQ}]$.

To validate the results with certainty we need to check if beta is stable over time. For this, Chow test it can be used to identify the existence of a structural breaks in the analyzed data. It is estimated regression equations on subsamples, dividing the sample into two or more sub-samples to check the existence of differences between estimated coefficients. Chow's test model verifies the parameters stability[8]. Basically, the initial data series are divided into two subintervals and new estimations are made on them and compared with the first estimations made on the entire period. The test decision is: If *P-value* associated with Chow test has a value of less than 5% then H_0 is rejected (β coefficients are stable) and accept the H1 hypothesis with β coefficients that depend on time and are not stable. We attached the Chow test in Table 6.



Source: Author's computations using Eviews 7

Figure no. 6 – The characteristic line for Apple shares

We divided the sample in two subsamples: a) 2010M01 – 2012M07 and b) 2010M01 – 2013M09. It is noted that the probability associated with the F test indicates a structural rupture for stocks CSCO, YHOO, INTU. Testing the beta stability on other two samples, Apple and Google shares have presented ruptures which suggested that beta is not stable over time. Overall, the Chow test showed that all stocks considered in addition to those mentioned, have a beta stable over time.

Table no. 6 – Chow Test

Stock	1 August 2012		16 October 2013	
	F-stat	Prob. F(2,1251)	F-stat	Prob. F(2,1251)
AAPL	2.157857	0.116	2.634917	0.0721
MSFT	0.516913	0.5965	1.217264	0.2964
GOOG	2.231862	0.1078	5.266869	0.0053
INTC	0.145241	0.8648	2.458897	0.0859
CSCO	3.55774	0.0288	4.318618	0.0135
QCOM	2.358257	0.095	2.236919	0.1072
BIDU	0.690831	0.5014	0.335568	0.715
TXN	0.907903	0.4036	0.528539	0.5896
YHOO	4.215209	0.015	6.428098	0.0017
ADP	0.132548	0.8759	0.360217	0.6976
MU	1.779577	0.1691	0.52585	0.5912
ADBE	1.311362	0.2698	0.617939	0.5392
CTSH	1.220319	0.2955	0.959884	0.3832
AMAT	1.778039	0.1694	0.584298	0.5576
INTU	3.455892	0.0319	0.958645	0.3837

Source: Author's computations in Eviews 7

The next step is to test the **stationarity** of the analyzed series. The regression with nonstationary series is called spurious and cannot be interpreted in a conventional manner, because all tests (t-statistic, F-statistic etc.) change their properties. Also, the relationship between non stationary series tends to be very high (usually in such cases, the coefficients R^2 and R^2 adjusted are high), but the correlation is not conclusive because it may be due to a common trends (deterministic or stochastic) available in this series. A stationary series is not changing its properties over time. The mean, the variance and covariance for each lag are constant. A non-stationary series has a unit root. From an economic point of view, a series is stationary if a shock over it is temporary (is absorbed in time) and do not remain permanently. When the series is not stationary, by differentiation it obtain a stationary series. Thus, the integration order of the series is the number of successive differentiations necessary to obtain a stationary series (or the number of unit roots). In economics, the most common non-stationary series are integrated of order I (requires a single differentiation, have one unit root). For each series we applied unit root's tests using Eviews 7 software: one based on the assumption of WN (white noise) and one based on the assumption of RW (random walk); more precisely, we applied the stationarity test based on correlogram and unit root test (Dickey-Fuller). Econometric analysis was performed using logarithmic series because the logarithm facilitates the interpretation of the regression coefficients obtained (they are elasticities). As example for Microsoft share we use *genr* to apply the logarithmic form: lmsft= log (msft). For first difference: dl_msft=lmsft - msft (-1).

In Figure 6 is observed visually that the series are stationary. But a glance on the graphics is not enough and must be applied the unit root tests on stationarity.

A first step is to start from yt-yt-1= γ yt-1 + et. It formulates hypotheses on the time series:

- H0: the series is nonstationary, has a unit root, (is RW)
- H1: the series is stationary

As the series values y1, y2 ... yt come from a process RW as it was the assumption, does not follow the distribution t (Student) so it cannot check if the coefficients are significant. But they followed a τ distribution, studied by Dickey and Fuller. The decision for Augmented Dickey-Fuller test is similar to that of the Student. Calculate the value of ADF statistics, which are compared with critical values τcrt corresponding to a confidence level of 1%, 5% or 10%.

Table no. 7 – ADF test

Dependent Variable	t-Stat	Prob.
AAPL	-34.7081	0.0000
MSFT	-35.4642	0.0000
GOOGL	-35.6535	0.0000
INTC	-36.4457	0.0000
CSCO	-35.5344	0.0000
QCOM	-35.3206	0.0000
BIDU	-35.5892	0.0000
TXN	-37.6955	0.0000
YHOO	-34.9654	0.0000
ADP	-38.6035	0.0000
MU	-35.9129	0.0000
ADBE	-38.0837	0.0000
CTSH	-37.7084	0.0000
AMAT	-36.3383	0.0000
INTU	-39.5947	0.0000

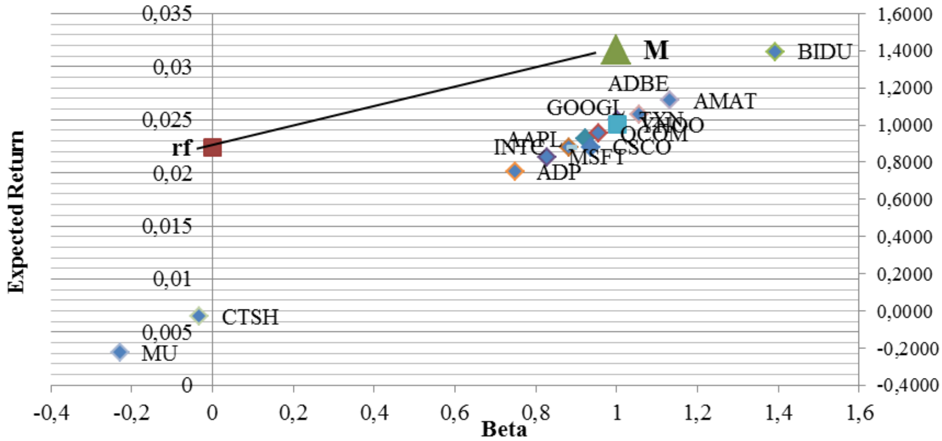
Source: Author's computations in Eviews 7

The ADF test decision can be taken in according to test *P-value* associated with F test. If is greater than all three confidence thresholds then it follows that the series is non-stationary. From Table 7 it is observed that *P-value* is zero in all three thresholds, so all series are stationary.

To take a decision on which of the 15 stocks an investor should invest, according to CAPM model, he must compare the expected return with the return from the market. In this respect, the security market line (SML) should be constructed. The risk-free rate is R_f = 2.24% according to Bloomberg, and the market risk premium is 5.4% according to Fernandez *et al.* (2014). Next, we attached the return computed through CAPM model based on Eviews results.

$$E[R_{AAPL}] = 2.24\% + 0.9238 \times 5.4\% = 7.23\ \%$$
$$E[R_{MSFT}] = 2.24\% + 0.8276 \times 5.4\% = 6.71\ \%$$
$$E[R_{GOOGL}] = 2.24\% + 0.9240 \times 5.4\% = 7.23\ \%$$
$$E[R_{INTC}] = 2.24\% + 0.8820 \times 5.4\% = 7.00\ \%$$
$$E[R_{CSCO}] = 2.24\% + 0.9356 \times 5.4\% = 7.29\ \%$$
$$E[R_{QCOM}] = 2.24\% + 0.9549 \times 5.4\% = 7.40\ \%$$
$$E[R_{BIDU}] = 2.24\% + 1.3943 \times 5.4\% = 9.77\ \%$$
$$E[R_{TXN}] = 2.24\% + 1.0290 \times 5.4\% = 7.80\ \%$$
$$E[R_{YHOO}] = 2.24\% + 1.0011 \times 5.4\% = 7.65\ \%$$
$$E[R_{ADP}] = 2.24\% + 0.7489 \times 5.4\% = 6.28\ \%$$
$$E[R_{MU}] = 2.24\% - 0.2271 \times 5.4\% = 1.01\ \%$$
$$E[R_{ADBE}] = 2.24\% + 1.0555 \times 5.4\% = 7.94\ \%$$
$$E[R_{CTSH}] = 2.24\% - 0.0321 \times 5.4\% = 2.06\ \%$$
$$E[R_{AMAT}] = 2.24\% + 1.1333 \times 5.4\% = 8.36\ \%$$
$$E[R_{INTU}] = 2.24\% + 0.8799 \times 5.4\% = 6.99\ \%$$

From theory we know that beta for risk-free asset is zero and for the market portfolio is 1, so only two points are necessary ((0, R) and (1, E (RM))) to form the SML as it can be seen in Figure 8.



Source: author's computations

Figure no. 8 – Share valuation using SML

If the stocks are properly valued by the market, they should be on the SML. If they are above the line SML are undervalued, and if they are below the SML are overstated. From Figure 8 it is noted that all stocks are considered right beneath the SML, a fact leading to the idea that market shares are overvalued. Not surprising, since that stocks came from technology companies characterized by investors with high expectations from these companies. On the other hand they are companies that rely on innovation so are quite risky because in technology sector new products can occur at any time and can eclipse the products of these companies. For example it can follow Polaroid or Kodak which were some of the strongest companies in this field, and the most appreciated by investors, and now they almost disappeared due to technological advances with which they could not keep up. Normally it would be risky to invest in these overvalued shares because the market will react at a time and prices will fall, which will lead to losses. But on the short term is unlikely to occur revolutionary technologies affecting profits respective companies and should be noted that they are stocks of giant companies known globally as Microsoft, Google and Apple which are highly regarded by investors. But they are somewhat companies mature and it is easy to see that they have a beta lower than companies like BIDU or AMAT which, to a percentage increase of 1% for market return, they will increase by 1.4 and, respectively, 1.15 the expected return which leading to profitability higher for these companies.

As we saw in chapter which summarizes the literature on the CAPM, Fama-French and others use to estimate return Generalized Method of Moments (GMM). Because GMM estimation involves advanced econometric knowledge we did not go into details but we conducted a short estimation to see if such models have estimated a different beta indicator and if return is better estimated in that way. GMM was introduced by Hansen (1982) and has applications in determining prices of financial assets. Table 8 comprise the GMM estimation method results.

From Table 8 it can be seen that there are no significant differences between beta estimated using the OLS and beta estimated with GMM for analyzed stocks which indicates a stability of the returns estimated using the CAPM. The only shares that can attract attention because they have a greater difference in both beta versions are GOOGL and MU.

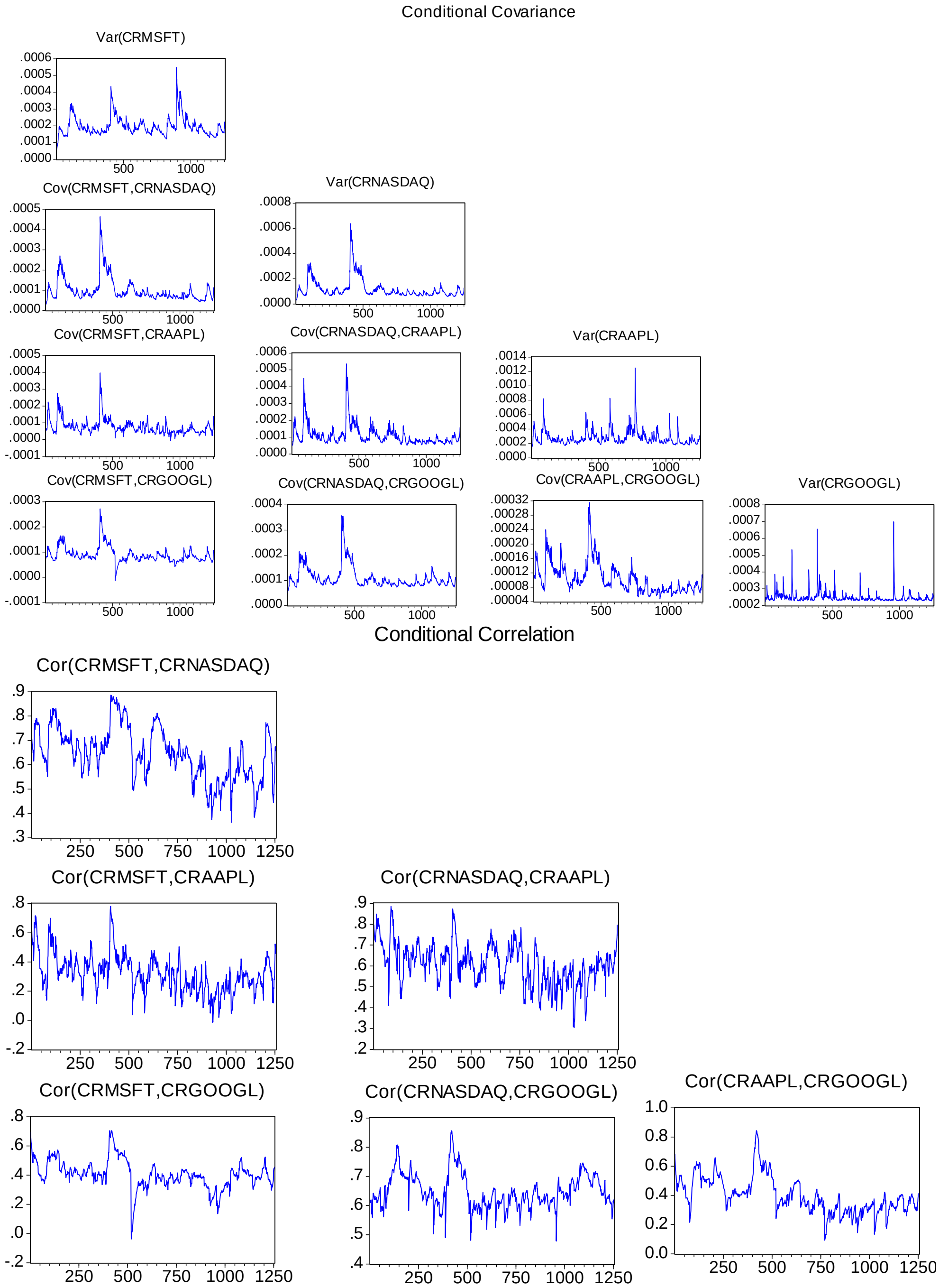
For alpha, the differences are very low and insignificant. Jensen (1968) studied the so-called "Jensen's alpha" and found that when alpha is positive and significant then it can gain profits in excess or abnormal. The stocks analyzed don't have this effects because they come from US capital markets. It should be noted that the MU and CTSH stocks estimated using the GMM, the same as in the OLS, the model is not valid, a fact claimed by both associated *P-value* of t-Student test and by correlation coefficient R^2. This suggests that for these two stocks, the expected return is not affected by variation of NASDAQ market return but by other factors. For AAPL share it can be considered that an increase of the market return with one percentage point will lead to an increase of 0.87973 for the estimated returns. The beta indices obtained by OLS and GMM estimation methods, are based on historical returns and are "backward-looking". As investors, it is of interest a beta which can capture what will happen to those shares in the future. GARCH multivariate models to estimate beta fulfill these conditions. More specifically, by using GARCH models is estimated the evolution of the covariance over time. The Q-stat of Ljung–Box test is bigger than critical value $\chi^2_\alpha(m)$ for five degrees of freedom and hence, the null hypothesis is rejected and it is accepted that the residues are not from a white noise process.

Table no. 8 – The GMM estimation results

Dependent Variable	$\hat{\beta}$	Std. Err	t-Stat	Prob.	R^2	DW
AAPL	**0.880**	0.042	20.755	0.000	0.390	1.921
MSFT	**0.806**	0.024	33.033	0.000	0.453	1.967
GOOGL	**0.861**	0.027	31.554	0.000	0.442	1.934
INTC	**0.884**	0.037	23.886	0.000	0.457	2.016
CSCO	**0.886**	0.035	25.442	0.000	0.376	1.980
QCOM	**0.898**	0.036	24.788	0.000	0.461	1.964
BIDU	**1.389**	0.052	26.912	0.000	0.371	2.048
TXN	**1.016**	0.041	24.840	0.000	0.581	2.187
YHOO	**0.971**	0.047	20.606	0.000	0.349	1.965
ADP	**0.730**	0.019	38.482	0.000	0.640	2.181
MU	**0.064**	0.106	0.604	0.546	-0.005	2.029
ADBE	**1.051**	0.032	33.342	0.000	0.409	2.204
CTSH	**0.034**	0.064	0.526	0.599	-0.003	2.123
AMAT	**1.148**	0.048	23.994	0.000	0.535	2.074
INTU	**0.893**	0.026	34.191	0.000	0.436	2.210
Dependent Variable	$\hat{\alpha}$	Std. Err	t-Stat	Prob.	**$\hat{\beta}$ OLS - $\hat{\beta}$ GMM**	
AAPL	**0.001**	0.000	2.791	0.005	0.044	
MSFT	**0.000**	0.000	0.571	0.568	0.021	
GOOGL	**0.000**	0.000	-1.481	0.139	0.063	
INTC	**0.000**	0.000	-1.089	0.276	-0.002	
CSCO	**0.000**	0.000	0.443	0.658	0.050	
QCOM	**0.001**	0.000	2.450	0.014	0.057	
BIDU	**0.000**	0.001	0.240	0.810	0.005	
TXN	**0.000**	0.000	-0.885	0.377	0.013	
YHOO	**0.000**	0.000	0.109	0.914	0.031	
ADP	**0.000**	0.000	1.314	0.189	0.019	
MU	**0.002**	0.001	2.524	0.012	-0.291	
ADBE	**0.000**	0.000	0.809	0.418	0.004	
CTSH	**0.002**	0.000	3.427	0.001	-0.066	
AMAT	**-0.001**	0.000	-1.628	0.104	-0.015	
INTU	**0.000**	0.000	0.477	0.633	-0.013	

Source: Author's computation in Eviews 7

The model GARCH-VECH [9] was proposed by Bollerslev *et al.* (1988). The conditions to be met by a GARCH's coefficients are: the coefficients of variance equation should be positive; the sum of the coefficients of the variance equation is less than 1. Otherwise, the model is integrated GARCH (I-GARCH), and the volatility is explosive. We have attached to Table 9 of Appendix the output of GMM estimation for Apple shares. It can be seen that all the estimated parameters are statistically significant and are therefore plausible. In Figure 12 we attached the volatility results from the application of GARCH-VECH model for shares AAPL, MSFT and GOOGL in comparison with the index NASDAQ.



Source: Author's computations in Eviews 9

Figure no. 9 – The results of GARCH-VECH

Conditional variance and *conditional correlations* show variability and dynamics of returns over time for shares analyzed. Thus it can be seen that present a high correlation for all three stocks (AAPL, MSFT, and GOOGL) relative to the NASDAQ market return.

Table no. 10 – GARCH results regarding the correlation and the volatility spillover

	Cor(CRMSFT,CRNASDAQ)	Cor (CRNASDAQ,CRAAPL)	Cor(CRNASDAQ,CRGOOGL)
Min	0.362365163	0.304562055	0.478440645
Max	0.885325084	0.885889011	0.856774586

Source: Author's computations in Eviews 7

In Table 10 we attached the results of GARCH-VECH estimation model regarding the correlation of returns for the three largest IT companies in the US market. From the CAPM model we have obtained that the returns for these three stocks are correlated with market return and that they have a subunitary beta which indicates a less volatility than the market volatility. The GARCH-VECH model can better test the implications of CAPM and see if there is a contagion at the level of volatility of the assets if they are interrelated and correlated and if there is the phenomenon of market *volatility spillover*. The contagion phenomenon is not clear from Table 10 because of the interval values being extended (0.36-0.88) but it can notes that all three stocks present a fairly high correlation with market volatility having an average value of 0.64. A moderate correlation exists between the three stocks. Similar results have been obtained by Song (2009) for the Chinese markets.

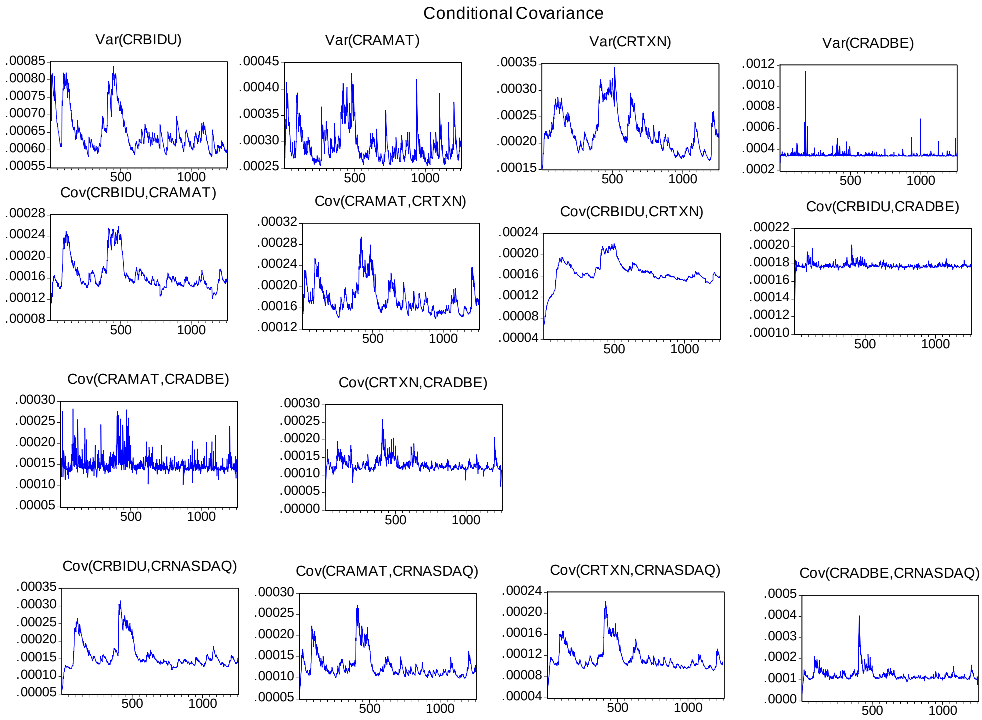
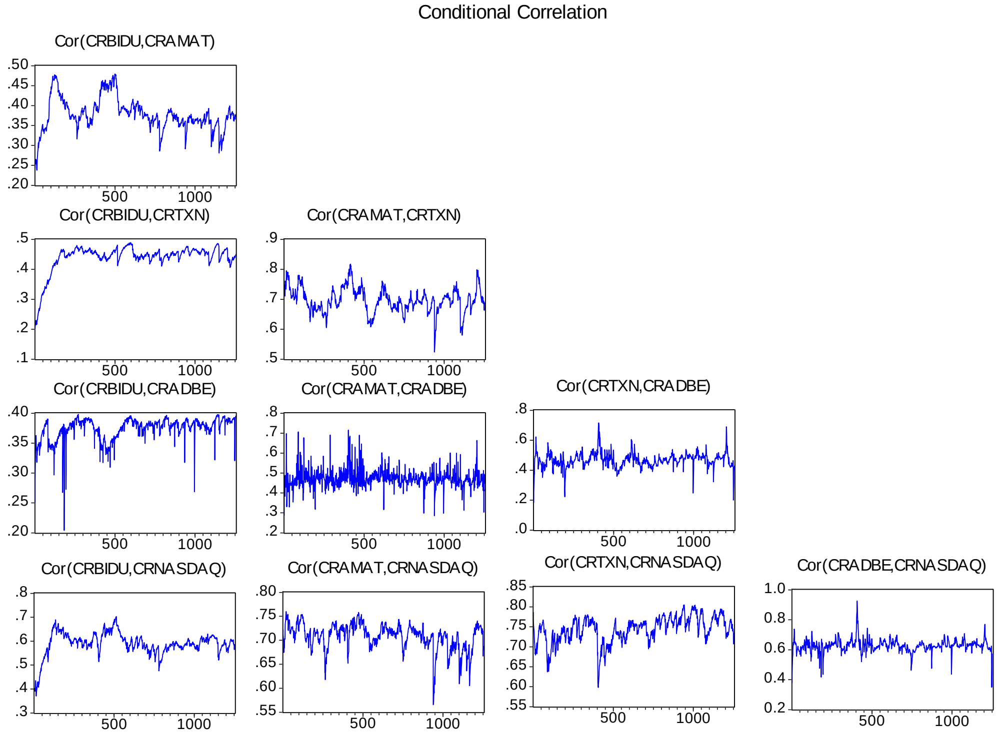


Figure no. 10 – The GARCH-VECH results for shares with supraunitary beta



Source: Author's computation in Eviews 7

Figure no. 10 – The GARCH-VECH results for shares with supraunitary beta (continuation)

In Figure 10 we applied GARCH-VECH model for stocks which had through CAPM model a supraunitary beta to try to identify the differences in the level of volatility compared to the stocks with beta subunitary.

Table no. 11 – The GARCH results regarding the correlation for stocks with beta supraunitary

	Cor(CRBIDU,CRNASDAQ)	Cor(CRAMAT,CRNASDAQ)
Min	0.37029026	0.565483333
Max	0.702809738	0.760040972
	Cor(CRTXN,CRNASDAQ)	Cor(CRADBE,CRNASDAQ)
Min	0.598237482	0.348600624
Max	0.804737161	0.925197176

Source: Author's computations in Eviews 7

From Table 11 it can be observed that at a correlation level with market volatility, the level is higher for shares with beta above 1 and for the ADBE share it can speak about a contagion having a high level of 0.92.

5. CONCLUSIONS

Beginning from the academic literature, we studied the classic CAPM model, theoretically and empirically, through econometric models. CAPM is easy to apply and is a reference point (a benchmark) for the valuation of stocks. We wanted to analyze if the NASDAQ component stocks from technological field, chosen in the quality of potential investors, are undervalued, overvalued or properly assessed. We also studied the linear connection between expected return and risk. From econometric models it resulted that from 15 stocks only two (CTSH and MU) could not be validated and we could not decide whether there is a linear relationship between return and risk. Except actions BIDU, TXN and MU we discovered that all stocks analyzed had a linear relation between expected return and market return. We estimated the beta index by using the OLS and GMM methods and for both variants we achieved similar results. Thus, for stocks BIDU, TXN, YHOO, ADBE and AMAT we obtained a beta greater than one indicating that an increase in market return will lead, by itself, to a greater growth of return for estimated assets. W obtained subunitary beta for stocks AAPL, MSFT, GOOGL, INTC, CSCO, INTC, INTU and ADP all of them being very large sized companies, some mature, which might explain why beta was subunitary. Investors know that a big and mature company is no longer expected to have a growth out of the blue and they don't hope for an abnormal return for such type of stocks. On the other hand, smaller companies have a riskier growth opportunities (beta higher than one) and as a result, it is expected from them a higher return. For MU and CTSH we could not identify a clear conclusion related to the risk associated with them. Compared to SML all shares were overvalued, a fact expected for IT companies because is a continuous development field and investors are expecting high earnings. We used GARCH-VECH model to track the volatility between the analyzed shares and NASDAQ index and we noticed that both classes of shares analyzed (beta over / under unit) had presented a high correlation with market volatility. We obtained even a contagion effect for ADBE share and it can speak about the phenomenon called volatility spillover. The results are not surprising because the analyzed stocks came from technology sector and their products depend on each other and hence they are interdependent, a fact reflected in the volatility level.

References

Ahn, D. H., Conrad, J., and Dittmar, R. F., 2009. Basis Assets. *The Review of Financial Studies, 22*(12), 5133-5174. DOI: http://dx.doi.org/10.1093/rfs/hhp065

Andrei, T., and Bourbonnais, R., 2008. *Econometrics*. Bucharest: Ed. Economică.

Balvers, R. J., and Huang, D., 2009. Money and the C-CAPM. *Journal of Financial and Quantitative Analysis, 44*(2), 337-368. DOI: http://dx.doi.org/10.1017/S0022109009090176

Bartholdy, J., and Peare, P., 2003. Unbiased estimation of expected return using CAPM. *International Review of Financial Analysis, 12*(1), 69-81. DOI: http://dx.doi.org/10.1016/S1057-5219(02)00122-9

Bartholdy, J., and Peare, P., 2005. Estimation of expected return: CAPM vs. Fama and French. *International Review of Financial Analysis, 14*(4), 407-427. DOI: http://dx.doi.org/10.1016/j.irfa.2004.10.009

Berk, J. B., 1998. A simple approach for deciding when to invest. *National Bureau of Economic Research*(w6678).

Black, F., 1972. Capital Market Equilibrium with Restricted Borrowing. *The Journal of Business, 45*(3), 444-455. DOI: http://dx.doi.org/10.1086/295472

Bloomberg. United States Government Bonds. from http://www.bloomberg.com/markets/rates-bonds/government-bonds/us/

Blume, M. E., 1975. Betas and Their Regression Tendencies. *The Journal of Finance, 30*(3), 785-795. DOI: http://dx.doi.org/10.2307/2326858

Bollerslev, T., Engle, R. F., and Wooldridge, J. M., 1988. A Capital Asset Pricing Model with Time-Varying Covariances. *Journal of Political Economy*, *96*(1), 116-131. DOI: http://dx.doi.org/10.1086/261527

Breeden, D. T., 1979. An intertemporal asset pricing model with stochastic consumption and investment opportunities. *Journal of Financial Economics, 7*(3), 265-296. DOI: http://dx.doi.org/10.1016/0304-405X(79)90016-3

Brooks, C., 2014. *Introductory Econometrics for Finance* (3 ed.): Cambridge University Press.

Campbell, J. Y., and Cochrane, J. H., 1999. By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior. *Journal of Political Economy*, *107*(2), 205-251. DOI: http://dx.doi.org/10.1086/250059

Chordia, T., Sarkar, A., and Subrahmanyam, A., 2005. An Empirical Analysis of Stock and Bond Market Liquidity. *Review of Financial Studies*, *18*(1), 85-129. DOI: http://dx.doi.org/10.1093/rfs/hhi010

Cohen, R. B., Polk, C., and Vuolteenaho, T., 2005. Money Illusion in the Stock Market: The Modigliani-Cohn Hypothesis. *The Quarterly Journal of Economics, 120*(2), 639-668. DOI: http://dx.doi.org/10.1093/qje/120.2.639

Damodaran, A., 2012. *Investment philosophies : successful strategies and the investors who made themwork*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Dittmar, R. F., 2002. Nonlinear pricing kernels, kurtosis preference and evidence from the cross section of equity returns. *The Journal of Finance, 57*(1), 369-403. DOI: http://dx.doi.org/10.1111/1540-6261.00425

Eakins, S., Stansell, S., and Below, S., 1996. The determinants of institutional demand for common stock: Tests of the CAPM vs. individual stock attributes. *International Review of Financial Analysis, 5*, 237-257.

Fama, E. F., and French, K. R., 1992. The Cross-Section of Expected Stock Returns. *The Journal of Finance, 47*(2), 427-465. DOI: http://dx.doi.org/10.1111/j.1540-6261.1992.tb04398.x

Fama, E. F., and French, K. R., 2004. The capital asset pricing model: Theory and evidence. *Journal of Economic Perspectives, 18*(3), 25-46.

Fama, E. F., and MacBeth, J. D., 1973. Risk, Return, and Equilibrium: Empirical Tests. *Journal of Political Economy*, *81*(3), 607-636. DOI: http://dx.doi.org/10.1086/260061

Fernandez, P., Linares, P., and Fernández Acín, I., 2014. Market Risk Premium used in 88 countries in 2014: a survey with 8,228 answers. from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2450452

Frazzini, A., and Pederson, L. H., 2013. Betting Against Beta. *Working Paper, New York University*.

Gourieroux, C., Scaillet, O., and Szafarz, A., 1997. *Econometrie de la finance. Analyses historique*. Paris: Ed. Economica.

Graham, J. R., and Harvey, C. R., 2001. The theory and practice of corporate finance: Evidence from the field. *Journal of Financial Economics, 60*(2-3), 187-243. DOI: http://dx.doi.org/10.1016/S0304-405X(01)00044-7

Groenewold, N., and Fraser, P., 2001. Tests of asset-pricing models: How important is the iid-normal assumption? *Journal of Empirical Finance, 8*(4), 427-449. DOI: http://dx.doi.org/10.1016/S0927-5398(01)00035-4

Guermat, C., 2014. Yes, the CAPM is testable. *Journal of Banking & Finance, 46*, 31-42. DOI: http://dx.doi.org/10.1016/j.jbankfin.2014.05.001

Hansen, L., 1982. Large Sample Properties of Generalized Method of Moments Estimators. *Econometrica*, *50*(4), 1029-1054.

Harvey, C. R., and Siddique, A., 2000. Conditional skewness in asset pricing tests. *The Journal of Finance, 55*(3), 1263-1295. DOI: http://dx.doi.org/10.1111/0022-1082.00247

Hodgson, D. J., Linton, O., and Vorkink, K., 2002. Testing the capital asset pricing model efficiently under elliptical symmetry: a semiparametric approach. *Journal of Applied Econometrics, 17*(6), 617-639. DOI: http://dx.doi.org/10.1002/jae.646

Huang, C. F., and Litzenberger, R. H., 1988. *Foundations for Financial Economics*. New York: Elsevier Science Ltd.

Jensen, G. R., and Mercer, J. M., 2002. Monetary Policy and the Cross-section or expected Mock Return. *Journal of Financial Research, 25*(1), 125-139. DOI: http://dx.doi.org/10.1111/1475-6803.00008

Jensen, M. C., 1968. The Performance of Mutual Funds in the Period 1945-1964. *The Journal of Finance, 23*(2), 389-416. DOI: http://dx.doi.org/10.1111/j.1540-6261.1968.tb00815.x

Kotler, P., and Casoline, J. A., 2009. *Chaotics. The business of managing and marketing in the age of turbulance*. New York: American Management Association.

Kumar, A., 2009. Who gambles in the stock market? *The Journal of Finance, 64*(4), 1889-1933. DOI: http://dx.doi.org/10.1111/j.1540-6261.2009.01483.x

Lettau, M., and Ludvigson, S. C., 2001. Resurrecting the (C) CAPM: A Cross-Sectional Test When Risk Premia are Time- Varying. *Journal of Political Economy, 109*(6), 1238-1287. DOI: http://dx.doi.org/10.1086/323282

Lewellen, J., Nagel, S., and Shanken, J., 2010. A Skeptical Appraisal or Asset-Pricing tests. *Journal of Financial Economics, 96*(2), 175-194. DOI: http://dx.doi.org/10.1016/j.jfineco.2009.09.001

Lintner, J., 1965. The Valuation of Risk Assets and the Selection of the Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics, 47*(1), 13-37. DOI: http://dx.doi.org/10.2307/1924119

Marshall, D. A., 1992. Inflation and Asset Returns in a Monetary Economy. *The Journal of Finance, 47*(4), 1315-1342. DOI: http://dx.doi.org/10.1111/j.1540-6261.1992.tb04660.x

Megginson, W., 1997. *Corporate Finance Theory*: Addison Wesley.

Mossin, J., 1966. Equilibrium in a Capital Asset Market. *Econometrica, 34*(4), 768-783. DOI: http://dx.doi.org/10.2307/1910098

Parker, J. A., and Julliard, C., 2005. Consumption Risk and the Cross Section of Expected Returns. *Journal of Political Economy, 113*(1), 185-222. DOI: http://dx.doi.org/10.1086/426042

Patton, A. J., and Timmermann, A., 2010. Monotonicity in asset returns: New tests with applications to the term structure, the CAPM, and portfolio sorts. *Journal of Financial Economics, 98*(3), 605-625. DOI: http://dx.doi.org/10.1016/j.jfineco.2010.06.006

Radcliffe, R. C., 1989. *Investments*. Glenview, IL: Scott Foresman, Little Brown

Roenfeldt, R. L., Griepentrog, G. L., and Pflaum, C. C., 1978. Futher Evidence on the Stationarity of Beta Coefficients. *The Journal of Financial and Quantitative Analysis, 13*(1), 117-121. DOI: http://dx.doi.org/10.2307/2330526

Roll, R., 1977. A critique of the asset pricing theory's tests Part1: On past and potential testability of the theory. *Journal of Financial Economics, 4*(2), 129-1176. DOI: http://dx.doi.org/10.1016/0304-405X(77)90009-5

Sharpe, W. F., 1964. Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance, 19*(3), 425-442.

Song, X., 2009. *Multivariate GARCH Models for the Greater China Stock Markets.* (Master Thesis), Singapore Management University. Retrieved from http://ink.library.smu.edu.sg/etd_coll/30/

Stambaugh, R. F., Yu, J., and Yuan, Y., 2012. Arbitrage Asymmetry and the Idiosyncratic Volatility Puzzle. *NBER Working Papers*.

Theobald, M., 1981. Beta Stationarity and Estimation Period: Some Analytical Results. *Journal of Financial and Quantitative Analyisis, 16*(5), 747-757. DOI: http://dx.doi.org/10.2307/2331058

Treynor, J., 1961. *Toward a Theory of the Market of Risky Assets*. unpublished manuscript.

Vorkink, K., 2003. Return Distributions and Improved Tests of Asset Pricing Models. *The Review of Financial Studies, 16*(3), 845-874. DOI: http://dx.doi.org/10.1093/rfs/hhg015

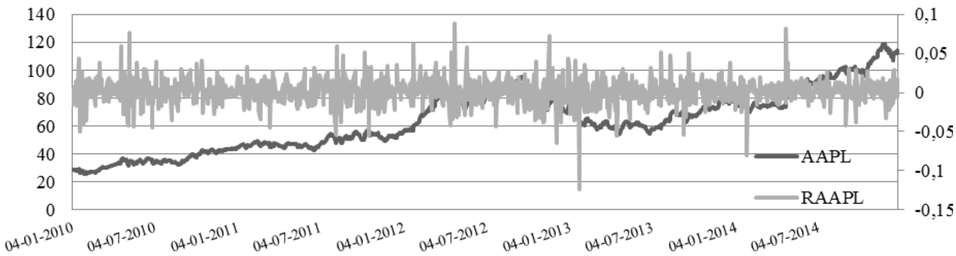
Wen, M. M., Martin, A. D., Lai, G., and O'Brien, T. J., 2008. Estimating the Cost of Equity for Property-Liability Insurance Companies. *The Journal of Risk and Insurance, 75*(1), 101-124. DOI: http://dx.doi.org/10.1111/j.1539-6975.2007.00250.x

Appendix

Tabel no. 1 – NASDAQ Companies

Symbol	Name	LastSale	MarketCap	IPOyear	Sector
ADBE	Adobe Systems Incorporated	87.86	$ 43,824,510,803.1	1986	Technology
GOOGL	Alphabet Inc.	719.33	$ 493,126,070,663.1	n/a	Technology
AAPL	Apple Inc.	119.08	$ 679,080,135,760.0	1980	Technology
AMAT	Applied Materials, Inc.	16.44	$ 20,247,475,690.3	1972	Technology
ADP	Automatic Data Processing, Inc.	90.53	$ 42,169,790,887.8	n/a	Technology
BIDU	Baidu, Inc.	157.6	$ 43,665,064,184.0	2005	Technology
CSCO	Cisco Systems, Inc.	29.35	$ 148,548,958,090.8	1990	Technology
CTSH	Cognizant Technology Solutions Corp	68.83	$ 41,953,899,516.4	1998	Technology
INTC	Intel Corporation	34.9	$ 165,914,600,000.0	n/a	Technology
INTU	Intuit Inc.	97.94	$ 27,159,408,991.6	1993	Technology
MU	Micron Technology, Inc.	17.24	$ 18,678,430,226.7	n/a	Technology
MSFT	Microsoft Corporation	52.87	$ 422,320,968,346.2	1986	Technology
QCOM	QUALCOMM Incorporated	60.725	$ 95,411,252,866.3	1991	Technology
TXN	Texas Instruments Incorporated	58.98	$ 60,536,234,130.1	n/a	Technology
YHOO	Yahoo! Inc.	33.17	$ 31,225,934,229.1	1996	Technology

Source: http://www.nasdaq.com/screening/companies-by-industry.aspx?industry=ALL&exchange=NASDAQ&pagesize=200&page=3



Source: Authors' computation

Figure no. 2 – APPLE Return and price

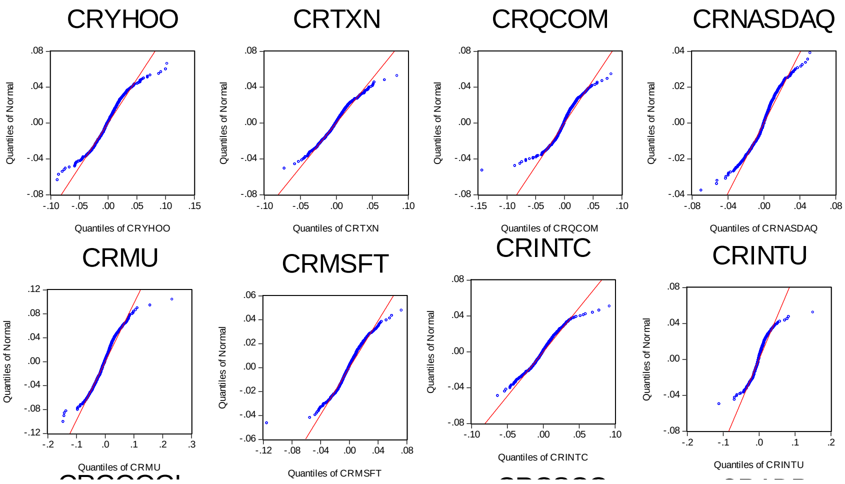
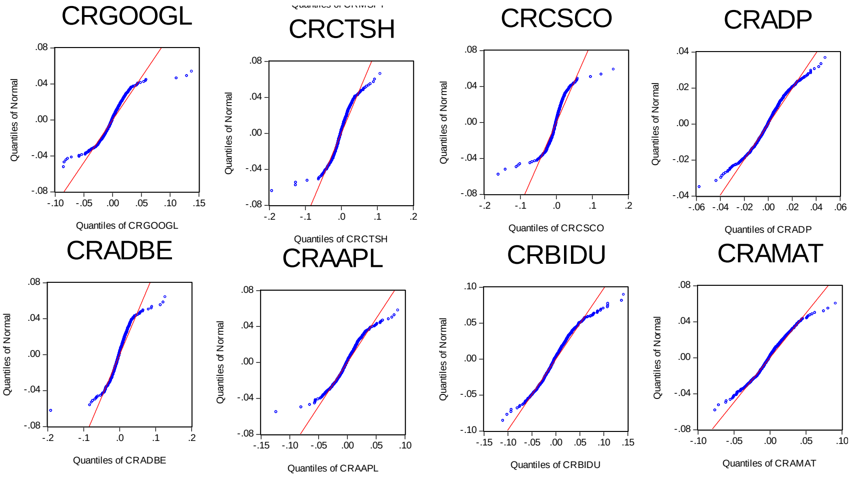
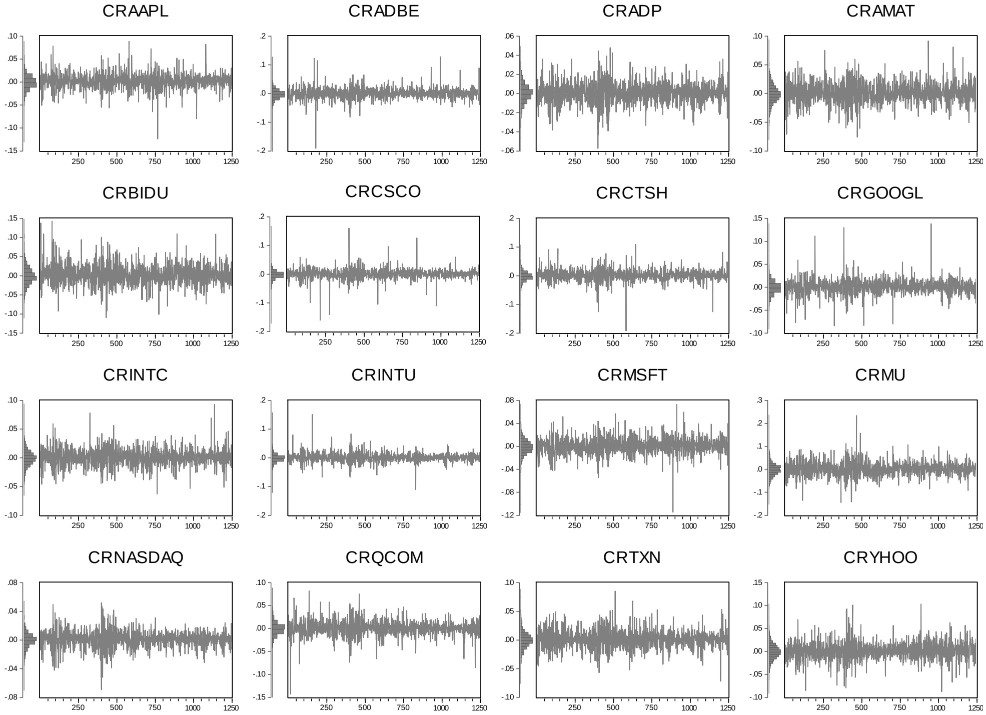


Figure no. 3 –The quantile distribution for the analyzed returns



Source: Author's computation in Eviews 7

Figure no. 3 –The quantile distribution for the analyzed returns (continuation)



Source: Author's computation in Eviews 7

Figure no. 7 – Graphical representation of series for stationarity

Table no. 9 – The GMM– Apple Stocks estimation

Dependent Variable: CRAAPL
Method: Generalized Method of Moments
Sample: 1 1255
Included observations: 1255
Linear estimation with 1 weight update
Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed)
bandwidth = 8.0000)
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: CRAAPL CRNASDAQ C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRNASDAQ	0.879727	0.042387	20.75480	0.0000
C	0.001038	0.000372	2.791449	0.0053

R-squared	0.389561	Mean dependent var	0.001199
Adjusted R-squared	0.389074	S.D. dependent var	0.016881
S.E. of regression	0.013195	Sum squared resid	0.218146
Durbin-Watson stat	1.920895	J-statistic	59.04336
Instrument rank	3	Prob(J-statistic)	0.000000

Source: Author's computations in Eviews 7

Table no. 10 – The GARCH – VECH estimation

System: UNTITLED
Estimation Method: ARCH Maximum Likelihood (Marquardt)
Covariance specification: Diagonal VECH
Sample: 1 1255
Included observations: 1255
Total system (balanced) observations 5020
Presample covariance: backcast (parameter =0.7)
Convergence achieved after 177 iterations

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.000770	0.000384	2.003682	0.0451
C(2)	0.001021	0.000273	3.738892	0.0002
C(3)	0.001884	0.000428	4.405074	0.0000
C(4)	0.001002	0.000439	2.281330	0.0225
Variance Equation Coefficients				
C(5)	5.64E-06	9.27E-07	6.082627	0.0000
C(6)	2.49E-06	4.32E-07	5.780161	0.0000
C(7)	4.58E-06	1.39E-06	3.301556	0.0010
C(8)	3.77E-06	1.19E-06	3.162448	0.0016
C(9)	3.50E-06	5.80E-07	6.026188	0.0000
C(10)	5.93E-06	1.05E-06	5.642879	0.0000
C(11)	4.10E-06	5.56E-07	7.374525	0.0000
C(12)	2.15E-05	3.77E-06	5.702674	0.0000
C(13)	3.38E-06	1.07E-06	3.159204	0.0016
C(14)	5.75E-05	2.08E-05	2.766296	0.0057

C(15)	0.028202	0.004409	6.396092	0.0000
C(16)	0.035867	0.004235	8.468314	0.0000
C(17)	0.045403	0.007704	5.893652	0.0000
C(18)	0.020559	0.004408	4.664517	0.0000
C(19)	0.044767	0.004980	8.989173	0.0000
C(20)	0.051572	0.006661	7.742406	0.0000
C(21)	0.024783	0.003644	6.801170	0.0000
C(22)	0.059034	0.010804	5.464245	0.0000
C(23)	0.022769	0.005463	4.167468	0.0000
C(24)	0.024882	0.011030	2.255833	0.0241
C(25)	0.943781	0.007121	132.5302	0.0000
C(26)	0.937101	0.006949	134.8541	0.0000
C(27)	0.889566	0.022189	40.09045	0.0000
C(28)	0.936120	0.013467	69.51385	0.0000
C(29)	0.922290	0.008688	106.1586	0.0000
C(30)	0.890550	0.014444	61.65588	0.0000
C(31)	0.935944	0.007095	131.9133	0.0000
C(32)	0.863351	0.022823	37.82782	0.0000
C(33)	0.942961	0.013203	71.42153	0.0000
C(34)	0.744145	0.090795	8.195856	0.0000

Log likelihood	15448.16	Schwarz criterion	-24.42529
Avg. log likelihood	3.077323	Hannan-Quinn criter.	-24.51211
Akaike info criterion	-24.56440		

Equation: CRMSFT = C(1)

R-squared	-0.000330	Mean dependent var	0.000515
Adjusted R-squared	-0.000330	S.D. dependent var	0.014040
S.E. of regression	0.014042	Sum squared resid	0.247262
Durbin-Watson stat	2.003884		

Equation: CRNASDAQ = C(2)

R-squared	-0.001273	Mean dependent var	0.000614
Adjusted R-squared	-0.001273	S.D. dependent var	0.011425
S.E. of regression	0.011433	Sum squared resid	0.163903
Durbin-Watson stat	2.068280		

Equation: CRAAPL= C(3)

R-squared	-0.001646	Mean dependent var	0.001199
Adjusted R-squared	-0.001646	S.D. dependent var	0.016881
S.E. of regression	0.016895	Sum squared resid	0.357947
Durbin-Watson stat	1.958253		

Equation: CRGOOGL= C(4)

R-squared	-0.000915	Mean dependent var	0.000523
Adjusted R-squared	-0.000915	S.D. dependent var	0.015821
S.E. of regression	0.015829	Sum squared resid	0.314184
Durbin-Watson stat	2.013349		

Covariance specification: Diagonal VECH
GARCH = M + A1.*RESID(-1)*RESID(-1)' + B1.*GARCH(-1)
M is an indefinite matrix
A1 is an indefinite matrix*
B1 is an indefinite matrix*

Transformed Variance Coefficients

	Coefficient	Std. Error	z-Statistic	Prob.
M(1,1)	5.64E-06	9.27E-07	6.082627	0.0000
M(1,2)	2.49E-06	4.32E-07	5.780161	0.0000
M(1,3)	4.58E-06	1.39E-06	3.301556	0.0010
M(1,4)	3.77E-06	1.19E-06	3.162448	0.0016
M(2,2)	3.50E-06	5.80E-07	6.026188	0.0000
M(2,3)	5.93E-06	1.05E-06	5.642879	0.0000
M(2,4)	4.10E-06	5.56E-07	7.374525	0.0000
M(3,3)	2.15E-05	3.77E-06	5.702674	0.0000
M(3,4)	3.38E-06	1.07E-06	3.159204	0.0016
M(4,4)	5.75E-05	2.08E-05	2.766296	0.0057
A1(1,1)	0.028202	0.004409	6.396092	0.0000
A1(1,2)	0.035867	0.004235	8.468314	0.0000
A1(1,3)	0.045403	0.007704	5.893652	0.0000
A1(1,4)	0.020559	0.004408	4.664517	0.0000
A1(2,2)	0.044767	0.004980	8.989173	0.0000
A1(2,3)	0.051572	0.006661	7.742406	0.0000
A1(2,4)	0.024783	0.003644	6.801170	0.0000
A1(3,3)	0.059034	0.010804	5.464245	0.0000
A1(3,4)	0.022769	0.005463	4.167468	0.0000
A1(4,4)	0.024882	0.011030	2.255833	0.0241
B1(1,1)	0.943781	0.007121	132.5302	0.0000
B1(1,2)	0.937101	0.006949	134.8541	0.0000
B1(1,3)	0.889566	0.022189	40.09045	0.0000
B1(1,4)	0.936120	0.013467	69.51385	0.0000
B1(2,2)	0.922290	0.008688	106.1586	0.0000
B1(2,3)	0.890550	0.014444	61.65588	0.0000
B1(2,4)	0.935944	0.007095	131.9133	0.0000
B1(3,3)	0.863351	0.022823	37.82782	0.0000
B1(3,4)	0.942961	0.013203	71.42153	0.0000
B1(4,4)	0.744145	0.090795	8.195856	0.0000

* Coefficient matrix is not PSD.

Source: Author's computations in Eviews 7

Notes

[1] Theoretical form of econometric model CAPM: $E[R_{it}] - rf = \alpha_i + \beta_{i,M}(E[R_{Mt}] - rf)$.
[2] Econometric Sharpe Model: $R_{it} = \alpha_i + \beta_{i,m} \times R_{mt} + \varepsilon_{it}$.
[3] The determination report: $R^2 = 1 - \frac{SSE}{SST}$ it suppose the variance decomposition for y data series based on the influence of factors included in the model. It measures the intensity of the linear dependence of the endogenous variable (Y) with the regression factors (X). Its value increases with the number of exogenous variables used in the model.
[4] The classical linear regression model $yt = \alpha + \beta xt + ut$ presumes five properties to be fulfilled:

1) $E(ut) = 0$, residual variable (errors) have zero mean
2) $var(ut) = \sigma 2 < \infty$, the variance of the errors is unchanging over time (homoscedasticity) and finite over all xt.

[5] The Order 1 autocorrelation verifies the relationship: $\varepsilon_{t=} \rho\, \varepsilon_{t-1} + u_t$, where u_t is white noise (WN) and ρ is the linear correlation coefficient of first order for prior / current errors. Autocorrelation test is performed on residuals û.
[6] Through White Test must be verified the hypothesis regarding the unchanging variance of residues values (the variances are equal). So VAR[ε_i] = σ_ε^2(constant). Thus, VAR[ε_i] =σ_i^2 so the series is characterized by the homoscedasticity („the point cloud" does not have a linear strip form).
[7] SE($\hat{\alpha}$); SE($\hat{\beta}$) are the standard errors of the regression model $s = \sqrt{\sum_{i=1}^{n} \frac{r_i^2}{n-2}}$.
[8] The Chow test has the form $y_t = \beta_1 + \beta_2 x_2 t + \beta_3 x_{3t} + ut$. The results are follow from the perspective: SSE (RSS) - $\sum_t (yt - \widehat{yt})^2 = \sum_{i=1}^{n} \hat{u}_t{}^2$ sum of squared residues.
[9] It has the form: VECH (Ht) = C + AVECH (Ξt-1 Ξ't-1) + BVECH (Ht-1) where Ξt | ψ_{t-1} $\sim N(0, \mathrm{Ht})$ and A, B, C are parameters. The model have to estimate 21 parameters (C has 3 elements, A and B have each one 9 elements). The operator VECH take "the top triangle" within the matrix and places its elements in a column vector. For matrix

$$H_t = \begin{bmatrix} h11t & h12t \\ h21t & h22t \end{bmatrix} \text{ results } VECH(H_t) = \begin{pmatrix} h11t \\ h22t \\ h12t \end{pmatrix}.$$