anemon
Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi
Journal of Social Sciences of Muş Alparslan University
Yıl/Year: 2016 ● Cilt/Volume: 4 ● Sayı/Number: 1

ISSN: 2147-7655 ● e-ISSN: 2149-4622

ÖZGÜN ARAŞTIRMA ● ORIGINAL ARTICLE

A Validity Analysis of Capital Asset Pricing Model (CAPM) in Istanbul Stock Exchange

Bahadır KARAKOC [1a]

[1] Research Assistant, Muş Alparslan University, Department of Business Administration – Muş / Türkiye.

Başvuru tarihi: 05 Mayıs 2015 Düzeltme tarihi: 27 Mart 2016 Kabul tarihi: 08 Nisan 2016

Abstract

Capital asset pricing model (CAPM) suggests that there exists a linear relationship between stock beta and profit. Beta, in this relationship, measures the level of systematic risk to which an asset is exposed. Accordingly, the higher the beta of an asset is, the higher the return must be. However, studies investigating this relationship have produced mixed results and indicated that the validity of CAPM changes according to the data and the methodology which is used. These and similar tests have led us to question the beta coefficient's ability to measure the risk. As systematic risk is higher, especially in developing markets, the role of the beta coefficient becomes more significant. In this study, CAPM time series method has been used and the result has shown that the model can statistically explain the changes in the rate of the profits. However, against long odds, it also has shown that the relationship between beta coefficient and profit isn't positive.

Keywords

Capital Asset Pricing Model, Istanbul Stock Exchange, Beta Coefficient, Systematic Risk

[a] Sorumlu Yazar/Correspoding Author: Muş Alparslan Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İşletme Bölümü, Güzeltepe Kampüsü, 49250, Muş / Türkiye.
e-posta: b.karakoc@alparslan.edu.tr

doi : 10.18506/anemon.09569
URL: http://dergipark.ulakbim.gov.tr/anemon
Copyright © 2013-2016 Muş Alparslan Üniversitesi

Borsa İstanbul'da Klasik Varlık Fiyatlama Modeli (CAPM) Analizi

Öz

Klasik varlık fiyatlama modeli (CAPM), risk ile getiri arasında doğrusal bir ilişki olduğunu önermektedir. Beta katsayısı bu ilişkide varlıkların maruz kaldıkları sistematik risk seviyesini ölçer. Dolayısıyla riskin yüksek olması durumu varlığın getirisinin yüksek olmasını gerektirmektedir. Fakat bu model üzerine yapılan çalışmalar bu konuda farklı sonuçlara ulaşarak, CAPM'nin geçerliliğinin kullanılan veriye ve kullanılan metoda göre değiştiğini göstermiştir. Bu ve benzeri sonuçlar bizi beta katsayısının riski ölçme kabiliyetini sorgulamaya yöneltmiştir. Özellikle gelişen piyasalarda sistematik risk daha yüksek olduğu için beta katsayısının rolü daha büyük önem taşımaktadır. Bu çalışmada CAPM zaman serileri yöntemi kullanılarak test edilmiş ve sonuçlar modelin getiri oranlarındaki değişmeyi istatistiksel olarak açıklayabildiğini göstermiştir. Ancak beta katsayısı ile getiri arasındaki ilişkinin beklenenin aksine pozitif olmadığını da göstermiştir.

Anahtar Kelimeler

Varlık Fiyatlama Modeli, Borsa İstanbul, Beta Katsayısı, Sistematik Risk

1. INTRODUCTION

Emerging markets create desirable investment opportunities through that they usually offer higher return and have low correlation with developed markets which is very important for diversification. However, this higher return comes with greater volatility in stock markets mainly caused by the country specific factors. Naturally, those who invest in these countries expect greater return for being exposed to greater risk. Among asset pricing models classical capital asset pricing model (CAPM) is the most commonly used asset pricing model both in developed and emerging markets. Success of the model in developed countries has been investigated repeatedly and it usually produced mixed results, depending both the method and data used in the analysis. Similarly, use of CAPM in emerging markets is even more controversial because of inherent dynamics of emerging markets. In this study, it has been attempted to analyze the compatibility of CAPM to an emerging market, namely Istanbul stock market. To achieve that weekly data from 2007 to 2014 has been tested as time series. As a result, model show that intercept parameter is not significantly different than zero, supporting the validity of the model. However, a cross sectional analysis of betas and average return shows no linear relationship.

Very nature of financial markets in developing countries such as Turkey, Brazil, Indonesia, and India significantly differs in comparison to the developed markets such as USA, United Kingdom, and Japan etc. Finance literature mainly cite that low integration with developed markets, higher return on financial assets which is usually associated with higher volatility, greater interest rates, and predictability of stock returns in general are some of the outstanding characteristics of developing markets. Research on this subject indicates that because those markets function in low correlation with the developed markets, stock prices are usually driven by social and economic events. Main reasons for that are inherent elements of emerging markets. Harvey (1995), and Serra (2000) have documented that the correlation among developed and emerging markets is very low and those markets are usually much more sensitive to the social and political events. The data obtained from countries such as Brazil, Chile, Indonesia, Turkey have presented that sudden shocks and sharp increases and decreases in stock prices are associated with political and social events according to the nature of the news. They appear to be less sensitive to worldwide crisis due to lower correlation. For instance, Aggarwal et al. (1999) argue that in order to explain what lies behind the sudden changes in stock prices, social and political events should be investigated first.

In theory it is assumed that by increasing the level of integration among capital markets, which would require capital move freely across the borders, volatility and return on financial assets would follow a downward trend, promoting more efficient markets. However, research shows that even in some of the developing countries where financial regulation is relaxed volatility has not decreased instead it has moved upward. It is well documented that increase in trade volume comes with increase in volatility so whether the observed increase in volatility is created by the increasing volume or by other factors is still in question. Even though trade volume is significantly lower in developing countries, volatility is considerably greater in emerging markets than it is in developed countries. Especially in countries where segmentation is more evident financial markets are much more sensitive to dynamics of that country than world market trends. In those countries it can be seen that free capital flow is restricted, domestic investors have limitations against investing in foreign markets and similarly foreign investors have to overcome legal barriers when investing in those countries. All of these restrictions contribute to financial markets to be more vulnerable to developments in home. If such regulation in place in a country, firms usually have to face restrictions in regard to their operations, such as financing as well as marketing. Thus, earnings, cost of production, cost of financing and as well as capital gains that goes into pocket of investors are very sensitive to the economic, social, political variables and as well as legal regulations Serra (2000), and Abdymomunova and Morley (2011). Because asset prices are prone to all of these variables to a greater extent measuring and pricing the systematic risk is very important for investors. CAPM suggests that this can be achieved by a single coefficient, namely stock beta.

In this study it is aimed to investigate the compatibility of one of the most commonly used capital asset pricing model through simple time series regression by using seven years of weekly data of BIST 30 Turkish Stock market. CAPM is created initially by William Sharpe in 1964. However, the model has been developed and over the years, different versions of it are proposed. Because the model has theoretically sound foundation and more importantly it is very convenient with respect to application (As explained below the data required to use the model can easily be obtained and processed through simple knowledge of financial markets) it is commonly used by investors and financial analyst's and taught by academics in every school with a finance program Fama and French (2003). The model takes into account the risks associated with the financial asset, which should be evaluated when investing in financial markets. CAPM states that underlying risk factors in a financial asset can be grouped into two: Systematic risk and non-systematic. Of course the research has indicated that the measure of systematic risk is not fixed over time so the predictive power of beta remains in question but in short term investments beta appears to be a reliable tool when evaluating the systematic risk of a stock.

The results obtained in this study open doors for investor who uses beta and return data to form their portfolios. Unlike conventional view, the results show that Although CAPM can explain the return but risk-return relationship is in fact not proportional. As described below our results indicate that CAPM can explain excess stock return when a time series regression model is employed. However, a cross sectional test would indicate that CAPM is not a valid model for this data. In fact, the beta and return relationship appears to be rather flat. Although validity of CAPM as an asset pricing model will be subject to more research time series test of the model, using weekly data of BIST (Istanbul Stock Exchange) from 2007 to 2014 reveals that we cannot reject the hypothesis CAPM holds for this data set. If the test results indicate that we actually can explain the excess return with the beta but there seems to exist a conflicting relationship regarding what is proposed theoretically may be the role of beta is to blame. All in all, findings of this study is very useful for investors who adjust their portfolio based on beta-return relationship. The next section evaluates risk in CAPM framework. Section four examines existing literature, section five describes the data and methodology of this study and finally last section presents concluding remarks.

2. RISK IN CAPM FRAMEWORK

CAPM classifies the risk attached to the securities based on whether it can be diversified or not. Therefore, there are two main kind of risk CAPM considers.

2.1. Systematic Risk and Role of the Beta

Systematic risk is defined as the risk to which all firms operating in a country or in a market are exposed. Because this kind of risk is stemmed from the

fundamentals of a market it cannot be eliminated through diversification, and investor should be compensated for bearing that risk. In particular countries that have a tumultuous political and economic history would pose greater systematic risk. Most commonly known source of systematic risks are interest rate risk, exchange rate risk, inflation risk, and risk caused by unsettled democratic structure etc. Here it is safe to assume that for a firm to be exposed to a certain kind of systematic risk in a country it should mainly operate in that country. Given the nature of its operations, an average firm should produce, sell or finance its operations in the country X so it can be fully exposed to the systematic risk in country X. CAPM suggests that this systematic risk is measured by the beta coefficient. However, this description may not be telling the whole story. A firm's operations are vulnerable to the macroeconomic variables of a country in which it maintains its operations. In today's economic conditions most companies, however, have extended their operations out of their home countries. For instance, a car manufacturer that manufactures in China maybe marketing its products in Europe. And even it may be financing its operations through credit channels in USA or in another country. Such a company will be sensitive to macroeconomic variables in China, Europe and as well as USA. However, the beta coefficient calculated on the equity of that company (assuming it is listed only in USA) will only signify the covariance of the stock with the overall market (market portfolio in USA) but not the true systematic risk attached to it. In fact, intuitively it makes sense because if the variable that shapes the stock prices is future cash flows than we should consider what affects it. In today's world most companies operate internationally they have access to cheapest financing options and the most lucrative markets which makes the companies internationally vulnerable to a various systematic risk factors. Future cash flows depend on the operations of a company, namely 1. Financing, 2. Producing 3. Marketing. If a company manages any of those three in a country or in a market other than the one that would be taken as the proxy for market portfolio, it raises some issues such as what should be taken as a proxy for market portfolio as we know the true source of systematic risk is varied? Another explanation for this situation could be that by taking one single stock market as a market portfolio proxy we fail as Roll (1977) suggest we would. There exist other systematic risk sources in effect that we fail to account for when taking one single stock market as a proxy.

2.2. Non-Systematic (Firm Specific) Risk

Non-systematic risk however is described as the risk that arises from the dynamics of a company and its operations. We can say that non-systematic risk is also the firm specific risk. Since it varies from company to company and affected by company's operations it can be eliminated through diversification. For example, low correlation among the different sector creates advantage for diversification which can help eliminate non-systematic risk or increasing the number of assets in a portfolio will also help diversify away the non-systematic risk. That way it will be close to market portfolio which according to the base theory of CAPM is

affected by only the systematic risk. Bearing that risk should not be rewarded extra return because it can be eliminated via diversification.

In general, we could argue that although non-systematic risks are similar in both emerging and developed markets systematic risk factors differ greatly. For example, for an ice cream company, any issue that occurs in supply chain in a developed market is as likely to occur as it is in an emerging market because this is a problem of how the management run the business and organize the operations. On the other hand, systematic risk cannot be controlled by the firms and they are affected differently in different markets. Major sources of systematic risk are exchange rate, inflation, political instability etc. all of which are usually very consistent and not subject to sudden changes in developed markets. And CAPM is developed in a way that it accounts for different risk sources. It assumes that bearing non-systematic risk should not be rewarded but on the other hand bearing systematic risk requires extra return.

Even though some scholars for example Roll (1977) argue that CAPM is not testable because it is practically impossible to compose true market portfolio for the purpose of testing the model we use BIST 100 (Istanbul Stock Exchange) index return as a proxy for market portfolio. However, Sharpe (1964), Lintner (1965), Black (1972) have tested the model and argued that test results confirmed the applicability of CAPM, it is a very elegant model, which can help improve investing strategy of investors by being at least a reference point when comparing the financial assets with respect to risk and return.

3. LITERATURE REVIEW

Ever since classical CAPM is proposed asset pricing literature mainly refers to its implications. However relevant literature has questioned CAPM's ability to adequately price the financial securities. Although most of the literature focuses on data from developed markets such USA and UK etc. studies that use emerging market data have seem to present similar result to those that fail to establish stock beta and excess return relationship. For example, Michailidis et al. (2006) test the model using Greek stock market data, which is also accepted as an emerging market, they have found that there is no linear relationship between beta and excess stock return. Similar results have been documented in another study conducted using Indian stock market very recently Choudhary and Choudary (2010). Another emerging market data, namely Romanian stock market, is tested by Trifan (2009) and he finds that none of the stock return had the proposed relationship. Trifan further argues that the results that have documented are not conclusive because of the time period the data covers. He uses data that belongs to a period of financial crisis so the data has little representativeness. Perković (2011) tests CAPM using Croatian stock market data from 2000 to 2010 and finds that CAPM is not applicable in Croatian stock market. A more recent study concerning emerging market data conducted by Minović and Živković (2010) where they use daily data for the period of 2005–2009. They find that Liquidity

Capital Asset Pricing Model (LCAPM) performs better in explaining stock returns than the standard CAPM. Acheampong and Agalega (2013) examine the applicability of CAPM in explaining the risk-return relation of a group of stocks traded in Ghanaian stock market. The data used in their work covers the period from January 2006 to December 2010, which also coincides with subprime mortgage crisis. The results indicate that CAPM is not a valid model to explain stock return in Ghanaian Stock Market. Setyowati (2011) examines the applicability of CAPM using stock return data of 213 companies that are listed in Indonesian stock market from 2004 to 2009. Similar to most of CAPM studies that use emerging market data he concludes that CAPM is not a valid model in explaining the stock return of Indonesian stock market. Most of the literature focusing on CAPM studies in Turkey has also failed to find significant results regarding the validity of model. Some of the studies include for example, Gürsoy and Rejepova (2007) analyze Turkish stock market data using weekly returns over the period of 1995-2004 and they find no meaningful relationship between beta and return. Another study conducted by Bilgin and Bastı (2011) produces insignificant beta-return relation in Istanbul Stock Exchange. Another study done by Demircioğlu (2015) particularly focuses on Turkish firms operating in cement sector. He uses daily data from 2012 to 2013 and able to establish no significant relationship. How successfully does the model manage to provide answers which it was created to provide? As mentioned earlier the model has produced modest results in some developed markets and mostly failed in emerging markets. Over time different methodology has been suggested to test the model. In order to provide a sound analysis of the model we should first visit main variables that can impact the results greatly and the methodology that is employed when evaluating the model.

4. DATA, METHODOLOGY AND EMPIRICAL RESULTS

Today, CAPM is one of the most commonly used asset pricing model in the world. It is taught as a major subject of finance courses because of its intuitive theory and easy use. CAPM is first created by William Sharpe in 1964. It proposes that there is a linear relationship between risk and return. Investors should be rewarded extra return for bearing one more unit of extra risk, by which it refers to systematic risk due to its undiversifiable nature. According to the model a stock return is formulized as following.

$$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \quad (1)$$

Where R_{it}, describes stock i's rate of return at time t, β represents a coefficient that measures the degree to which stock i moves together with the market portfolio, R_{mt} market portfolio return at time t, R_{ft} risk free rate of return and finally ε_{it} represents firm specific risk. CAPM requires a linear relation between risk and return and every unit of risk that cannot be eliminated through diversification should be rewarded extra return. Accordingly, in practice we assume $\varepsilon_{it}=0$ because it turns out that creating a market portfolio means perfect diversification, which

eliminates the firm specific risk. The beta coefficient shows how much a certain stock is affected by the systematic risk. Model assumes that investors can borrow at risk free rate and diversify their portfolio. And it makes sense because when one holds index portfolio she will have different asset groups from different segments of the stock market which is only vulnerable to systematic risk and beta coefficient of the portfolio naturally becomes one, which is the beta of market portfolio.

In this study we use BIST 100 index as a proxy for market portfolio and 25 largest stock listed in Istanbul Stock Exchange. The time period covers from 2007 to 2014 in order to cover last structural changes in the economy, 7 years–weekly returns are used. As the risk free rate Turkish government 3-month bill rate is used which is divided by 12 for each data point. Although this may raise question about the risk free nature of Turkish government bond but given that it is commonly used as a benchmark by local investors it is an appropriate choice. Main goal here is to understand if the excess return of a stock can be explained by its beta if so for each individual asset, regression model would show that the intercept is not significantly different than zero.

Return of the stock *i* at time *t*;

$$R_{it} = \log\left(\frac{S_t}{S_{t-1}}\right) \quad (2)$$

If we denote excess return by

$$R_{it} - R_{ft} = \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \quad (3)$$

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it} \quad (4)$$

given that $E[\varepsilon]=0$ then α for each stock *i* should not be significantly different from zero.

For 25 stocks i= 1,2,3…..25 a would represent abnormal return, β_i measures the systematic risk for *ith* stock, R_{mt} represents the market return at time *t*, R_{ft} stands for the risk free rate at time *t* and ε_{it} represents stock specific return where R_{it} is and nx1 vector, ε_{it} *nx1* vector.

Clearly, if the excess return ($R_{it} - R_{ft}$) of a stock can be explained by the systematic risk that it bears, then no return should be left unexplained. Under these conditions CAPM claims that α_i should be zero because all the risk involved in this equation is captured by the beta and reflected in the risk premium $(\beta(R_{mt} - R_{ft}))$. So accordingly our hypothesis is;

H_0: $\alpha_1 = \alpha_2 = \ldots\ldots\ldots = 0$ CAPM can adequately explain the excess return,

H_1: $\alpha_1 = \alpha_2 = \ldots\ldots\ldots \neq 0$ CAPM cannot adequately explain the excess return for this data set.

Since this is a two tail test with the *t* value calculated for each stock in both side of the distribution with 90% confidence level we use *t* distribution to verify our

findings. *t* and *p* values for the time series regression result (intercept coefficient) are provided in a table below.

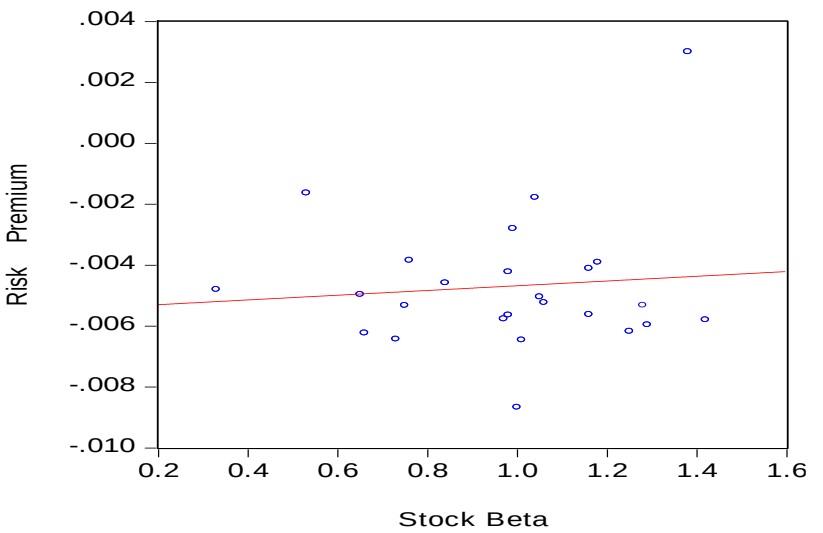
Table 1. Time Series Regression Results

Stock	t (α)	p (α)	R^2	F Stat
AKBNK	0.293	0.769	0.58	0.000
ARCLK	0.041	0.966	0.41	0.000
BIMAS	-0.220	0.825	0.08	0.000
DOHOL	0.920	0.358	0.01	0.316
ENKA	0.989	0.323	0.02	0.001
EREGL	-1.000	0.317	0.01	0.671
FROTO	0.237	0.812	0.34	0.000
GARAN	0.752	0.452	0.58	0.000
HALKB	-1.182	0.237	0.03	0.001
ISCTR	0.198	0.843	0.65	0.000
KCHOL	0.483	0.628	0.46	0.000
KOZAA	-0.504	0.614	0.25	0.000
KRDMD	0.795	0.426	0.39	0.000
MGROS	-0.242	0.808	0.19	0.000
PETKM	-0.819	0.413	0.31	0.000
SAHOL	0.134	0.893	0.53	0.000
SISE	0.050	0.960	0.45	0.000
TAVHL	0.353	0.724	0.31	0.000
TCELL	-0.733	0.941	0.19	0.000
THYAO	0.666	0.505	0.27	0.000
TOASO	0.670	0.503	0.40	0.000
TUPRS	-0.164	0.869	0.45	0.000
ULKER	-0.314	0.753	0.24	0.000
VAKBN	0.847	0.397	0.65	0.000
YKBNK	0.469	0.638	0.57	0.000

As clearly shown in the table, which shows t statistics and P value for intercept, with 90% confidence level we cannot reject the main hypothesis it is not significantly different than zero. If the model was valid for Turkish stock market it would mean that there is no abnormal return on an asset to be explained by some unknown variable that is currently missing from the present model. Accordingly, for this period almost all securities analyzed here seem to offer no abnormal return beyond what CAPM can explain for that reason we conclude that for this time period, CAPM can adequately explain the variation return on stocks of companies listed in Istanbul Stock Exchange. One particular issue however goes unanswered. Most of the assets generate negative average excess return for the period. This issue creates a problem that there is a systematic risk attached to an asset but no positive excess return accordingly no positive abnormal return. Given that the overall period the markets in general are bearish so this may complicate the findings.

Over time different methodologies have been developed to further analyze the validity of CAPM. Above CAPM is investigated applying individual assets. We have calculated the beta and excess return for each assets. CAPM suggests that beta signifies the systematic risk level and if it goes up for a stock then the risk attached to that asset is higher and excess return should be relatively higher, too. Accordingly, beta and return for individual assets laid out in a two dimensional plane it should give us upward sloping regression line.

Figure 1. Individual betas and average excess return.



At a first glance regression line may appear rather flat but in fact a close up visual inspection of Figure 1 shows that relationship is in fact linear and upward sloping with a positive slope of 0.0007. As touched upon earlier that average excess return for the whole period is negative so CAPM requires an upward sloping relationship among betas and excess return with positive excess return. A cross sectional test of these result (not provided here) also indicate statistically insignificant relationship between risk and return at 90% confidence level. This shows that CAPM may not be an appropriate model to explain return of this period.

5. CONCLUSION

In this study, it is attempted to investigate if CAPM equation can help us understand the risk return dynamics of 25 largest companies of Turkey between 2007 and 2014. The results of the study are similar to those of earlier studies focusing on CAPM model in Istanbul Stock Exchange. Conducting a time series regression test revealed that in fact CAPM can explain the variation in stock return.

However, a cross sectional analysis would indicate that this relationship is not constructed as the way CAPM suggests. The reason is that slope of the line is not statistically significant, suggesting that higher beta is not corresponding to the higher average return and wise versa. Most of the literature that focuses on CAPM produces different results not only because of the data but also due to the methodology employed to conduct the test. Additionally, increasing global integration makes the companies vulnerable a wide variety of systematic risk sources. Such an assumption that companies get affected by the systematic risk in a country/market where their headquarters are located or where they are listed in stock market that would be misleading. Therefore, relaying on the beta's ability to fully measure the systematic risk may not be as accurate.

REFERENCES

Abdymomunova, A., & Morley, J. (2011). Time variation of CAPM betas across market volatility regimes. *Applied Financial Economics*, 21(19), 1463–1478.

Acheampong, P., & Agalega, E. (2013). Does the capital assets pricing model (CAPM) predicts stock market returns in Ghana? Evidence from selected stocks on the Ghana Stock Exchange. *Research Journal of Finance and Accounting*, 4(9), 27-35.

Aggarwal, R., Inclan, C., & Leal R. (1999). Volatility in emerging stock markets. *The Journal of Financial and Quantitative Analysis*, 34(1), 33-55.

Bilgin, R., & Basti, E. (2011). A Test of the Validity of Capital Asset Pricing Model in Istanbul Stock Exchange. *EuroEconomica*, 30(4), 98-108.

Black, F. (1972). Capital market equilibrium with restricted borrowing. *The Journal of Business,* 45(3), 444-455.

Choudhary, K., & Choudhary, S. (2010). Testing capital asset pricing model: empirical evidences from Indian equity market. *Eurasian Journal of Business and Economics*, 3(6), 127-138.

Demircioglu, E. (2015). Testing of Capital Assets Pricing Model (CAPM) in Cement Sector & Power Generation and Distribution Sector in Turkey. *International Journal of Advanced Multidisciplinary Research and Review*, 3(4), 1-25.

Fama, E. F., & French, K. R. (2003). The capital asset pricing model: Theory and evidence. CRSP Working Paper No. 550; Tuck Business School Working Paper No. 03-26. doi:10.2139/ssrn.440920

Gürsoy, C. T., & Rejepova, G. (2007). Test of capital asset pricing model in Turkey. *Doğuş Üniversitesi Dergisi,* 8(1), 47-58.

Harvey, C. (1995). Predictable risk and return in emerging markets. *Review of Financial Studies*, 8(3) 773-816.

Lintner, J. (1965). The valuation of risky assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, 47(1), 13-37.

Mankiw, G., & Shapiro, M. (1984). Risk and Return: Consumption versus market beta. *Review of Economics and Statistics*, 68(3), 452-459.

Michailidis, G., Tsopoglou, S., Papanastasiou, D., & Mariola, E. (2006). Testing the capital asset pricing model (CAPM): The case of the emerging Greek securities market. *International Research Journal of Finance and Economics*, 4(2006), 78-91.

Minović, J., & Živković, B. (2015). CAPM augmented with liquidity and size premium in the Croatian stock market. *Economic Research*, 27(1), 191-206.

Perković, A. (2011). Research of beta as adequate risk measure?. *Croatian Operational Research Review*, 2(1), 102–111.

Roll, R. (1997). A critique of the asset pricing theory's tests' part I: On past and potential testability of the theory. *Journal of Financial Economics*, 4(2), 129-176.

Ross, S. A. (1976). Arbitrage theory of capital asset pricing. *Journal of Economic Theory*, 13(3), 341-360.

Serra, P. (2000). Country and industry factors in returns: Evidence from emerging markets' stocks. *Emerging Markets Review*, 1(2000), 127-151.

Setyowati, A. (2011). Capital Asset Pricing Model (CAPM): The Theory and Evidence in Indonesia Stock Exchange. *Journal Business & Management*, 11(1), 1-12.

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under condition of risk. *Journal of Finance*, 19(3), 425-442.

Trifan, A. (2009). Testing capital asset pricing model for Romanian capital market. *Annales Universitatis Apulensis Series Oeconomica*, 11(1), 426-434.

Weinraub H., & Kuhlman, B. (1994). The effect of common stock beta variability on the variability of the portfolio beta. *Journal of Financial and Strategic Decisions*, 7(2), 79-85.