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ESTIMATING THE COST OF EQUITY IN ABNORMAL TIMES LESSONS LEARNED FROM GREECE

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ABSTRACT

The cost of capital is a necessary tool for investment analysis composed by the cost of equity and the cost of debt. The cost of debt has easily determined cost; but it is not the case for equity. The cost of equity is often related to subjective judgment; although there are mathematical models that seek to explain the relationship between risk and return, such as the Capital Asset Pricing Model (CAPM), which is the best known model used to determine the expected rate of return. However, the parameters of CAPM are easily affected by the general economic conditions and the results of it require further consideration in abnormal times.

The study uses the case of the Greek metallurgical sector, including enterprises from Athens Stock Exchange Market. The dataset covers a period of four years (2010-2013), in the heart of the Greek financial crisis, and includes enterprises selected according to their level of capitalization and marketability that produce aluminium alloy and profiles, steel, and nonferrous metals.

This paper wishes to shed light on the complications, which have arisen from estimating the cost of equity in abnormal economic times, setting as case study the severe economic crisis in Greece.

Keywords: *cost of capital, cost of equity, beta coefficient, Greek economic crisis.*

I. INTRODUCTION

The estimation of cost of capital is the first necessary step for the capital providers to evaluate any investment decision within the enterprise (or an investment plant within the examined industry). The cost of capital reflects the minimum required rate of return the company must earn from existing assets and still meet the expectations of its capital providers. The Discounted Cash Flow (DCF) analysis is probably the most widely used technique of investment analysis, in general. The DCF method values an investment based on a number of project performance criteria, such as the Net Present Value (NPV) and the Internal Rate of Return (IRR).

Regardless of the criterion used, the DCF value of any project under consideration, and thus the investment decision, is basically influenced by two factors, namely the timing of project cash flows and the uncertainty of receiving the expected cash flows [1]. In order to account for the risk attributed to the reliable estimation of earnings and costs expectations and the time value of money, investors use a discount rate that corresponds to the risk-adjusted cost of capital of the project and reflects the opportunity cost for investing. Selecting an appropriate discount rate is one of the most critical issues in investment analysis, since it affects and at the same time is affected by the general economic conditions.

In 2008 the global economy and financial system entered a severe crisis. The crisis spread to Europe rapidly and affected much of the region with several countries already in recession from February 2009, and many others suffering marked economic setbacks. Furthermore, the unstable market and economic conditions have created challenges into the general economic environment of the enterprises, which in some cases had serious adverse consequences. Specifically, the cost of borrowing for corporation for Euro area was constantly changing; creating a major impact on the company's financial. The decline in real GDP in many countries was almost entirely in investments, including investment-type purchases by consumers, business investments in plant, equipment, etc., and residential investment [2]. The uncertainty imposed by the economic situation has also raised the concerns in estimating an investment project, based on mathematical models. For example, as Grabowski [3] notes, the traditional methods, which typically employed in estimating cost of equity and as a result cost of capital are subject to significant estimation and data input problems. The economic crisis has influenced investment decisions and as a result the mathematical model, that seek to explain the relationship between risk and return are not always reliable.

Taking all the above in consideration, the objective of this present study is the critical overview of the mathematical model Capital Asset Pricing model (CAPM), which is the best-known model used to determine the expected rate of return desirable for a 'variable income investment' [4,5]. The basic idea

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behind the direction of this research was the findings of the international literature on the complications, which have arisen in estimating the cost of equity in abnormal economic times.
The study uses as case the Greek metallurgical sector, including enterprises from the Athens Stock Exchange Market covering a period of four years (2010 – 2013). The selected time period represents the heart of the Greek finance crisis, and the sample includes enterprises selected according to their level of capitalization and marketability that produce aluminum alloy and profiles, steel, and nonferrous metals.

II. CHALLENGES IN INVESTMENT ANALYSIS

The discounted Cash Flow Analysis

The Discounted Cash Flow (DCF) analysis is a tool for investment analysis. A DCF model is commonly used to estimate the expected return on the market (e.g., the S&P/TSX companies) [5] and it is based on a number of project performance criteria, such as the Net Present Value (NPV), the Internal Rate of Return (IRR), the Cost-Benefit Ratio (CBR), the Payback Period (PP), etc.
Regardless the criterion used for the investment analysis, the value of the project is influenced by two factors: the time value of the money and the uncertainty of receiving the expected future cash flow. The idea behind the time value of money is that a dollar (or euro, or yen) today has a higher value than a similar amount to be received in the future, since over time money loses value because of inflation [5]. As for the uncertainty of receiving the expected future cash flow, it can be defined as the risk of an investment. Both the time value of money and risk can be reflected by the discount rate. The sum of the discounted present value of each future period's net cash flow or other measure of return equals the present value of investment. The terms discount rate, cost of capital and required rate of return are often used interchangeably [4].

Selecting an appropriate discount rate is one of the most critical issues in investment analysis, and unfortunately the current economic environment has created more challenges in estimating an appropriate overall cost of capital, as discussed in the following section.

The Cost of Capital

The capital structure of most companies includes two or more sources of financing, each of which has its own cost. The weighted average cost of capital (WACC) is the average cost of the permanent financial resources of a firm [5]. The WACC depends on the sources of the capital structure of the firm, their relative weights and the cost of each of the sources of funds, as follows (Formulae 1):

$$WACC = \frac{E}{V} * R_e + \frac{D}{V} * R_d * (1 - T) \quad (1)$$

Where: WACC is the weighted average cost of capital; R_e is the cost of equity; R_d is the cost of debt; E is the market value of the firm's equity; D is the market value of the firm's debt; V equals to E + D; E/V is percentage of financing that is equity; D/V is the percentage of financing that is debt; and T is the tax rate.

Although debt and preferred stocks are contractual obligations that have easily determined costs, it is not easy to measure the cost of equity. In principle, the cost of equity involves an opportunity cost [4].

The cost of equity and the Capital Asset Pricing Model, CAPM

The cost of equity and the Capital Asset Pricing Model is based on the portfolio theory and is the best-known model used to determine the expected rate of return desirable for a 'variable income investment' [5]. Thus, according to the CAPM, the desired or expected return for share x at any point in time would be estimated as follows (ibid.) (Formulae 2):

$$R_e = r_f + \beta * (r_m - r_f) \quad (2)$$

Where: R_e is the required rate of return on equity; R_f is the minimum level of expected return required from a risk-free asset; R_m is the market rate of return; $(R_m - R_f)$ is the expected market risk premium (equity risk market premium – ERMP) used to encourage investing in the stock market over and above from risk-free rate; and β represents the systematic risk in the share under consideration and measures how much a company's share price reacts against the market as a whole, i.e. the general market risk premium.
The cost of equity is the risk-free rate (for example, a 20-year U.S. Treasury bond) plus a premium for taking a risk as to weather a return will be received. It should be noted though that in reality the risk-free rate does not exist since even the safest investment carries a small amount of risk. The risk-free rate includes inflation and is expressed in nominal terms, so when discounting net cash flows at this

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rate, the cash flow should also be stated in nominal values. Alternatively, the risk-free rate should be estimated in real terms (i.e. typically by subtracting inflation), if cash flows are in constant terms.
The equity risk premium is an estimate of the additional return that investors expect – or demand- for holding relatively risky stocks as compared to holding a safe "risk-free" asset [5]. Typically, it is an average return on the market – typically the return for Standard & Poor's 500 largest U.S. stocks, less the risk free rate [4]. There is no one universally accepted methodology for estimating ERP. Usually the EMRP is based on the historical average annual excess return, which is calculated using an arithmetic mean or a geometric mean and are obtained from investing in the stock market above the risk-free rate. A wide variety of premiums are used in practice and recommended by academics and financial advisors. Any estimate of the ERP must be made in relation to a risk-free security, the uncertainties owing to economic and political instability in the particular country and the size of the business [4].
This premium is multiplied by beta. The beta measures the sensitivity of excess total returns (total returns over the risk-free rate of returns) on any individual security or portfolio of securities to the total excess return on some measure of the market, such as the Standard and Poor's 500 Index [4]. In other words the beta measures the historical correlation of changes in the returns on the firm's equity and those on an overall market proxy. This correlation indicates that the movements of both variables are linearly related in the proportion indicated by the coefficient [5].
Formulae (3):

$$\beta = \frac{Cov(r r_m)}{\sigma_m^2}.$$

where:

$$Cov(r r_m) = \frac{1}{T} * \sum_{t-1}^{T} \left[(r_t - \bar{r}) * (r_{mt} - \bar{r_m} \right]$$

and

$$\sigma_m^2 = \frac{\sum (r_{mt} - \bar{r}_m)^2}{T-1}$$

Where:

β= Beta Coefficient

r_t = Return on a share in time period t

r_{mt} = Return of market portfolio

The results will determine the degree of sensitivity to which the return of a particular security and the overall market's return move together. Covariance is not volatility. Covariance is a measure of the two variables' tendency to vary in the same direction and in the same relative amounts [4]. Therefore, from a numerical standpoint, beta has the following interpretations:
If $\beta>1$ it means that on average the stock is more volatile than the market, on the other hand of $\beta<1$ it means that on average the stock is less volatile than the market.
As with any model, certain assumptions are made in developing CAPM, and those assumptions also represent limitations. Despite its limiting assumptions, CAPM helps explain the relationship of the risk among stocks and their expected returns [4].

The Cost of Capital and the economic environment

The current economic environment has created challenges in estimating the cost of equity capital, since the recent 2008 crisis has revealed new complications.
The decline in real GDP in many countries was almost entirely in investments, including investment-type purchases by consumers, business investments in plant, equipment, and inventories, and residential investment [2]. To a large extent, this happens because all components of investment rely on financial markets for funds (ibid.). For instance, in the US economy although the Treasury rate fell dramatically in late 2008, the borrowing cost elevated following the Baa corporate bond rate, discouraging plant and equipment investments. The same situation appeared in EU, as well (Fig. 1). Cost of borrowing for corporation for Euro area increased from 3.9% in the early of 2006 to more than 6% in September 2008, and returned to levels below 3% in 2010. This problem is more intense in countries facing macroeconomic and political challenges. In addition to that, the lack of liquidity in the banking system forces corporation to alternative sources of financing, e.g. corporate bonds. Nevertheless, corporate bonds come also at a cost.

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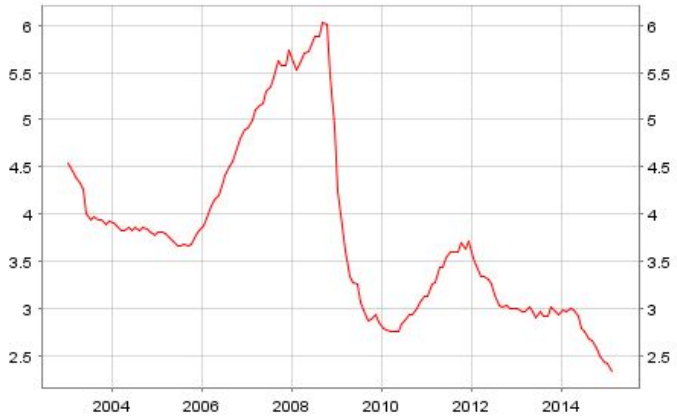

Figure 1. Cost of borrowing for corporations - euro area (source: European Central Bank, https://sdw.ecb.europa.eu/browse.do?node=9613587)

A second issue related to the macroeconomic environment is the selection of the risk-free rate. For many years, it was assumed that this rate refers to government bonds, which were considered risk-free. The economic crisis, however, proved that this is not always the case. Moreover, the economic crisis raised certain questions regarding practical issues, and specifically data input problems. For example, as Grabowski [3] notes, the U.S. Treasury bond yields, typically used in CAPM estimates, were temporarily low for several months and resulted in unreasonably low estimates of cost of capital (COC). The same issues were noticed in EU where the five-year German government bonds reached a negative yield. In addition, there are markets where the government does not issue long-term bonds (e.g. when there is a chance of sovereign debt default), and the only yields one can get are for short-term government bonds. To deal with this issue, Grabowski [3] suggests that analysis should ignore the "spot" bond yield and use a longer-term average bond yield.

A third problem concerns the estimation of the EMRP. Damodaran [8] indicates that realized market premiums, on the average, have decreased as the Treasury bond yields decrease and this could lead to a very low of an estimate of the COC. According to Pratt & Grabowski [4] and others, the historical evidences show that the long-run EMRP in the US market is between 3.5% and 6% and add: "…*when the economy is near or in recession (and reflected in recent relatively low returns on stocks), the conditional ERP is more likely at the higher end of the range…. When the economy is near its peak (and reflected in recent relatively high stock returns), the conditional ERP is more likely at the lower end of the range*…". Therefore, Grabowski [3] suggests using the historically estimated EMRP according to current market conditions. However, political and macroeconomic risks could lead to the exact opposite situation. As mentioned, the ERMP is not uniform across global equity markets and, thus, expanded CAPM versions add a country risk premium to the COC of investments, e.g. because of the probability that the government will fail to meet its obligations.

Finally, the estimation of COC by means of traditional techniques, such as the WACC and the CAPM is influenced by the estimation of beta, since the latter is a function of all risks affecting a company both operating and financial leverage. Beta estimation has changed dramatically compared to periods before the 2008 crisis. An explanation is that the overall stock market indices are influenced by financial stocks and stocks of highly leveraged companies, particularly for companies with little or no long-term debt. The relative volatility of returns of a sector or of a company with no debt has declined relative to the volatility of a market over-weighted by financial companies. Thus, it appears to have decreased in risk, although the business risk relative to the overall economy did not change [3]. However, as Lütolf-Carroll & Pirnes [9] mention, there is an even greater risk of failure in estimating beta. In abnormal economic times, use risky debt for financing, are in financial distress, or are nearing bankruptcy. In such cases, "…*we are in a world of nonlinear effects…. there is no theory and little empirical evidence for how to adjust the levered beta formula for these nonlinear financial distress effects. …. There is no liquid "bankruptcy" market in which these costs can be isolated, measured, and priced daily*…" [9].

III CASE STUDY

The Greek Metallurgical sector was one of the most dynamic and high-growth sectors in Greek manufacturing. For much of the early and mid 1990s Greek mining products were gaining ground in the global market and by 2008 that sector of mining industry reached its heyday. The new conditions

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that prevailed in the Greek and the global economy (early 2009) significantly affected the trade of mining – metallurgical products, and in combination with the reduction of the construction activities [10], resulted in a minimized activity of the Greek mining-metallurgical sector and affecting negatively future investments. Towards this direction, this study aims to determine the cost of equity for metallurgical industries as a whole, based on the volatility of the stock prices of the sector considering the returns of the Athens Stock Exchange General Index.

The Case of Metallurgical Sector

The dataset covers a period of four years, (2010-2013), in the heart of the Greek finance crisis and includes enterprises selected according to their capitalization and marketability that produce aluminum alloy and profiles, steel and non ferrous metals.

The figure 2 represents the weekly historical stock prices of the selected sample of Greek metallurgical enterprises, considering at the same time the returns of the Athens Stock Exchange General Index.

The Athens Stock Exchange General Index is strongly response to the latest Greek crisis. As the Financial crisis of 2007–08 began to affect Greece's economy; its results were published in a report dated 8 January 2010. From that date until the middle of 2012, the country's General Index fell constantly, and on June 5, 2012 the general index closed down 500 points, the minimum value for the time period 2010-2013. From the second half of 2012 until 2013, the trend of the general index is relatively upward, but still at very low level.

During the economic crisis the Greek Metallurgy faced a continued downward trend, following the significant decline in demand and prices of raw materials. The recession boosted by volatility in the international markets for raw materials, the reduction in international metal prices and the raise at energy prices across the EU. Specifically, the Non-Ferrous Metal Industries, represented by Mytilineos Group (Aluminium of Greece S.A.), Halcor (metal processing sector) and ELVAL (aluminium sector), are affected by the current economic conditions by means of (a) decline in consumer confidence and (b) competitive disadvantage, because of the increased energy taxation in Greece. As far as the steel sector is concerned (Sidenor S.A. and Corinth Pipeworks S.A.) its domestic consumption has decline since the construction activities followed a significant decline. Finally, the firm Viohalco S.A. has been adversely affected by crisis, for this reason "*Viohalco-Hellenic Copper and Aluminium Industry S.A.*" and "*Cofidin S.A.*" merged into Viohalco, which then got listed on the regulated market of Euronext Brussels.

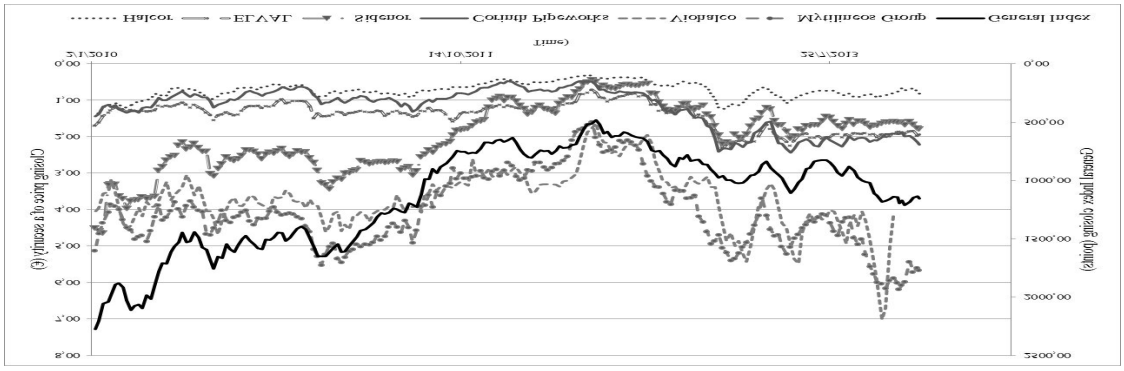

Figure 2: The fluctuation of the share prices of the metallurgical sector and the Athens Stock Exchange General Index

IV. RESULT & DISCUSSION

Calculation of beta coefficient

The beta coefficient was calculated, according to the historical data of the selected sample. Firstly, the daily closing prices of the stocks of the selected sample and the Athens Stock Exchange General Index were selected. Then the two maximum and the two minimum values were deducted from each sample, as special events, since they were intervening on statistical forecast. According to the equation (3) the beta coefficient was calculated and the results for the beta coefficient are presented below.

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Table 1. The beta coefficient and the coefficient of determination for the sample enterprises

Metallurgical Enterprises	Beta Coefficient	R^2
Mytilineos Group	0.30	4.44%
ELVAL S.A.	0.54	14.08%
Viohalco S.A.	0.57	11.06%
Halcor S.A.	0.71	14.54%
Corinth Pipeworks S.A.	0.79	21.72%
Sidenor S.A.	0.84	21.30%

The Table 1 indicates that the beta coefficient of the Greek Metallurgical Enterprises ranges between 0.30 and 0.84 and the average value is 0.63. The average beta may be considered as the beta coefficient of the Greek Metallurgical sector. The beta coefficient of less than 1 suggests a portfolio that fluctuates less than the benchmark. The Greek Metallurgical Enterprises are mainly operating in global market, therefore the fluctuations of Greek Market seems to have a small effect on the sector.
The coefficient of determination (R^2) reveals that that the Metallurgical sector does not correlate with the fluctuations of the Athens Stock Exchange General Index. Furthermore, the low R-squared values are significantly related to the special features of the produced metals, such as the price. The consequent depreciation of some industrial metals trade including aluminium in the London Metal Exchange is a special risk factor that influences the total risk.

Estimation of Equity Risk Market Premium – ERMP

As mentioned, the ERMP is not uniform across global equity markets and, thus, expanded CAPM versions add a country risk premium to the cost of equity, e.g. because of the probability that the government will fail to meet its obligations. In Greece, for instance, the EMRP used in 2010 by companies in Greece was 5.7% on average [11] and increased in 7.4% in 2011 [12], and in 15% in 2014 [15]. The high ERMP values for Greece will lead to unrealistic results. Therefore, as Grabowski mentions the selection of ERMP is based on current market conditions. The following table presents the ERMP for time period 2010- 2014 for many countries. According to Table 2 the average ERMP for the EU27 is estimated between 5,43% to 6,43% (2010 – 2014).

Table 2. Market Risk Premium Used in 19 countries and the average ERMP for EU27 [11, 12, 13, 14, 15]]

Countries	Equity Risk Market Premium – ERMP % Average Return				
	2010	2011	2012	2013	2014
Australia	5.4	5.8	5.9	6.8	5.9
Austria	5.3	6.0	5.7	6.0	5.5
Belgium	5.3	6.1	6.0	6.1	5.6
Canada	5.1	5.9	5.4	5.4	5.3
Denmark	5.2	5.4	5.5	6.4	5.1
Finland	5.0	5.4	6.0	6.8	5.6
French	5.6	6.0	5.9	6.1	5.8
Germany	5.9	5.4	5.5	5.5	5.4
Greece	5.7	7.4	9.6	7.3	15
Ireland	5.5	6.0	6.6	6.2	6.8
Italy	5.8	5.5	5.6	5.7	5.6
Netherlands	5.3	5.5	5.4	6.0	5.2
Norway	5.0	5.5	5.8	6.0	5.8
Portugal	5.4	6.5	7.2	6.1	8.5
Spain	5.9	5.9	6.0	6.0	6.2
Sweden	5.3	5.9	5.9	6.0	5.3
Switzerland	5.2	5.7	5.4	5.6	5.2
UK	5.2	5.3	5.5	5.5	5.1
USA	5.1	5.5	5.5	5.7	5.4
EU27	5.4	5.8	6.1	6.1	6.4

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Estimation of risk free rate

The general notion of a "risk-free rate" is that it is equivalent to the return available on a security that the market generally perceives as free of the risk of default as of the valuation date. Analysts typically use the yield to maturity on U.S. government securities as of the valuation date, as proxy for the risk-free rate in estimating the cost of equity capital [2]. Practitioners usually use the yield on a 20 year government bond, because these are thought to match the life span of the equivalent investment in the firm's assets better than the alternatives [5].

However, every system of rating investments responds differently to the risk assessment. The current debt crisis in the euro-zone triggered many debates about the government risk. In financial markets for a long time the government risk is underestimated and modern financial theory was based on the assumption that government bonds are risk free. The question that arises is how to evaluate an investment when the Greek Government Bond is extremely high and on the other hand the five-year German government bond reached a negative yield.. To deal with this issue, Grabowski [2] suggests that analysis should ignore the "spot" bond yield and use a longer-term average bond yield.

The mean value of the risk – free interest rate over the sample period (2010-2013) is selected according to the current economic conditions in the Euro-zone and it is based on the German 10 year government bond, because it has the lowest return among the bonds within the euro zone. The highly declining trend that government bonds show over the last decade and the estimations that the return of yields will stabilize, make the assumption for the return realistic (1%).

The Cost of Equity

According to the above calculations, the cost of equity for the sample of metallurgical enterprises before taxes can be calculated. The following table presents the results for the sample period. The estimated rate represents the earn form a project, which was financed entirely from its equity funds, assuming that the project's risk is about the same as the average risk of the company's assets and operations.

Table 3. The cost of equity capital for the Greek Metallurgical sector

	2010	2011	2012	2013	2014
Risk free rate	1.00%	1.00%	1.00%	1.00%	1.00%
ERMP	5.43%	5.85%	6.15%	6.11%	6.43%
Beta	0.63	0.63	0.63	0.63	0.63
CAPM	4,42%	4,69%	4,87%	4,85%	5,05%

The impact of the recession on building activity in Greece has leaded the sector to international markets. As a result the Greek Market fluctuations seem to have small effect on the sector. Substantially, the sector is affected by foreign markets and fluctuations in the prices of metals (London Metal Exchange).As far as the risk-free parameter is concerned the Greek Government Bond are temporary high, resulting in high estimates of cost of equity. Therefore, in order to avoid this complication, it was decided to use the German 10 year government bond, because it has the lowest return among the bonds within the euro zone and represents properly the risk free rate. A third issue related to the macroeconomic environment concerns the estimation of the EMRP, since it is affected by political and macroeconomic risks. In this time of uncertainty, the EMRP of Greece could lead to incorrect results and this is the reason why this study has selected to use the average ERMP for the EU27. According to the results presented on Table 3 the cost of equity is entirely affected by the ERMP and its increasing trend between 2010 -2014.

V. CONCLUSION

This study aims to investigate the effectiveness of the CAPM in abnormal economic times. The decline in real GDP, the lack of liquidity and the increase of cost of borrowing has leaded to irrational fluctuations at government bonds and equity risk premium. Furthermore, the economic crisis induces the reduction of investments, in general, since financing constraints among other lead to reduction of demand. This time of uncertainty raise the question, if the traditional investment analysis tools can lead to realistic results.

The economic crisis created difficulties in estimating the cost of equity and as a result the cost of capital. The cost of equity is always difficulty measured, since the determination of parameters as the risk free rate and ERMP are very challenging. The traditional investment analysis tools are based on linear mathematical model, which are not able to represent the current economic conditions. Therefore,

special attention is required in order to calculate the cost of equity. The CAPM requires balance between the correct application of the model and input selection, which represent economic theory and the climate of the times. As a consequence, the subjective judgment for the selection of data input, along with the result, is the key for the estimation of the equity cost in abnormal conditions.

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