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**INFORMATION ASYMMETRY AND ITS IMPACT ON COST OF EQUITY
CAPITAL: VOLKSWAGEN CASE**

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ABSTRACT

Information asymmetry takes place when the information between two parties undertaking a transaction differs. The disclosure of the information creates an impact on the organization's cost of capital (Diamond & Verrecchia, 1991). This paper is investigating the effect of this factor in cost of equity capital by using the Capital Asset Pricing Model. The study will be done through an analysis of the disclosure of positive and negative news for Volkswagen Company.

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1. INTRODUCTION

Information asymmetry takes place when the knowledge between two participants differs (Mankiw, 2011). There are four aspects of information asymmetry: disclosure of the information, the impact of separation of ownership and control, the quality and the control of the financial statement reporting. All four aspects affect the cost of capital which is the rate of return that the firm has to pay to its shareholders for compensating them for the capital they had provided (Schlegel D. , 2015). Why is that? The answer is related to the information which shareholders obtain and their response to the new information. Investors need information in order to properly assess the risk and return of investment decision which are related to: purchasing a stock, holding it or selling it. So, financial statements become the main source of information which enables investors to make the proper decision (Kazemi & Rahmani, 2013). In cases when unknown or distorted information enters into a market, i.e. not accurate financial statements, it creates an uncertainty among shareholders which in turn will create a change in the stock prices due to the additional risk (Francis, LaFond, Olsson, & Schipper, 2004). As a consequence, investors would demand a higher return for their investment which will create an increase in a firms' cost of capital.

Investors ask for a rate of return for holding the firm's stock, the expected rate of return, which can be computed through different models (Brealey, Myers, & Allen, 2010). This paper uses Capital Asset Pricing Model which computes the company's cost of equity capital which is the same as the expected rate of return for an investor. According to Graham and Harvey's study in 2001, where 392 CEOs were surveyed, 73.5% of participants who estimate the cost of equity capital state that they use this model.

This paper analyses the impact of disclosure of the information on the cost of equity capital measured through Capital Asset Pricing Model. In order to do so, negative and positive news were chosen for the Volkswagen Company which is a multinational automotive firm.

This document is organized in five parts where the first one will be a review of the literature related to the cost of capital where several methods to estimate it are explained. The second one explains the information asymmetry and its impact on the cost of capital. The third one describes the empirical part of my analysis: the data description, the methodology used as well as the results obtained in the analysis. The

fourth part is the robustness test of my model. The last part is the conclusion reached of my work and other further research which could be done in the future related to this topic.

2. COST OF CAPITAL

2.1 Cost of Capital Definition and Applications

The cost of capital is “the rate of return that it (firm) has to offer to compensate firm’s investors (shareholders and bondholders) for the capital they provide” (Schlegel D. , 2015: 11). The company’s cost of capital depends on the risk associated with the invested capital, and as a consequence investors ask firms for the return which will offset the risk they incur (Schlegel D. , 2015).

Several techniques, depending on the capital structure of the firm, are used to present the risk which the investors bear. If the firm is financed by equity and debt simultaneously the *Weighted Average Cost of Capital (WACC)* would be used because it exhibits the overall cost of capital of the firm by weighting the cost of using each source of capital, debt and equity, and the percentage usage of that one (Britzelmaier, 2013; Ionici, Small, & D'Souza, 2011). Since this thesis is concentrating only on the cost of equity, this methodology was not taken into further account.

The cost of equity, r_E , determines the firm’s cost of equity financing for the firm or it can be described as the expected rate of return that investors demand for holding firm’s common stock (Brealey, Myers, & Allen, 2010). The cost of equity is related to the risk of the company’s stocks. There exist several methodologies to assess it: dividend discount model (DDM), Capital Asset Pricing Model (CAPM), multibeta CAPM, weighted average of historical results of common stock or the residual value method. All these techniques are based on the stock prices; hence the firm must be listed on the stock exchange. For those companies which are not listed on the stock exchange some proxy methods could also be used (Schlegel D. , 2015).

The cost of capital is usually used as a discount rate or benchmark return in different fields: in the capital budgeting it expresses the minimum return that an investment project must yield in order to be accepted (Baker, Singleton, & Veit, 2011); in performance measurement it is used as a “target return for profitability measures or as capital charges for value-based measures” (Schlegel D. , 2015: 26). Moreover it could be used as a discounting rate for valuation processes like: the valuation of the company, i.e. it is the rate by which the cash flows are discounted (Dempsey, 2013) or the

valuation of the intangible assets (Schlegel D. , 2008). Moreover it forms a part of *Weighted Average Cost of Capital* formula.

2.2 Models to Estimate Cost of Equity Capital

Graham and Harvey's study in 2001 reveals which are the most used techniques according to 392 surveyed CEOs. Only 64% of them calculate the cost of equity and the most popular method is the CAPM model with 73.5% of respondents who almost always use it. The second method is the average historical stock return (39.41%) followed by the multibeta CAPM (34.29%). Only 15.74% use a dividend discount model to assess the cost of equity. The most common techniques are explained in the following section.

2.2.1 Capital Asset Pricing Model (CAPM)

This model is the most commonly used by the companies even if it is based on several assumptions. The first one is that markets are efficient which implies that there is perfect information among participants and furthermore, the assets are fairly priced. The second one relates to investors who are able to trade securities without any transactions costs or taxes, as a consequence they can borrow and lend at the risk-free rate. The third assumption states that investors choose the efficient portfolio, i.e. the one which provides the maximum expected return for a given risk. (Berk & DeMarzo, 2013: 379-380). This assumption is related to the Markowitz's portfolio theory (1952) which declares that an investor wants to maximize the expected return with a given risk. To do so, he creates or invests in a portfolio that includes different stocks which are not correlated between each other. Doing so, he is going to decrease the firm-specific risk (unsystematic risk). However, even if an investor has a well-diversified portfolio, he still has some risk which could not be removed: the systematic risk, i.e. general market risks (Sharpe, 1964). So, all investors use Markowitz portfolio selection methodology. The last assumption affirms that "investors have homogenous expectations regarding the volatilities, correlations, and expected returns of securities" (Berk & DeMarzo, 2013: 380).

All these premises are included in the Capital Asset Pricing Model which estimates the expected return by applying the following formula:

$$E(r_i) = r_f + (E(r_m) - r_f)\beta_i$$

Where:

- $E(r_i)$ is the expected return on stock i
- r_f is risk-free rate
- $E(r_m - r_f)$ is the expected market risk premium which is the expected return on the market portfolio minus risk-free rate
- β_i is the beta factor

According to Sharpe (1964), when the market is in equilibrium, the entire market portfolio would be placed in the Security Market Line (SML) which can be drawn by using CAPM formula. The SML line determines the required return for an investment. Therefore, it is necessary to understand each component of this equation correctly.

The expected return on stock is the required rate of return which an investor asks for when holding a firm's stock (Brealey, Myers, & Allen, 2010). For the firm it is the cost of equity financing.

The beta factor measures the volatility of the stock's return against market's return. (Watson & Head, 2010). The average beta of the stocks in the market is about 1 because the average stock price usually moves 1% for each 1% move in the overall market. Those securities which present beta between 0 and 1 would move in the same direction as the overall market but only those securities whose beta is higher than 1 will move to larger extent than the market does which translates into higher expected return (Brealey et al., 2009).

Risk-free interest rate is "the interest rate at which money can be borrowed or lent without risk over a given period" (Berk & DeMarzo, 2013: 1060). This risk-free interest rate differs depending on the stock market index.

The expected market risk premium or risk premium is the additional return that investors expect to gain in order to compensate them for the security's risk (systematic risk) (Berk & DeMarzo, 2013: 1060).

Although CAPM model is most frequently used, this one and the portfolio theory were criticized by several authors (Fama & French, 2004; Young & Saadi, 2011; Berkman, 2013) because of the unrealistic assumptions: the model only considers one period of

time and only one factor for pricing the securities instead of considering several years which are usually used for making an investment (Arnold, 2008).

Furthermore, some technical and methodological problems occur while applying this model into reality. There are obstacles with estimating the beta because of different data collection periods, i.e. daily, weekly, or monthly. In addition, all three data frequencies have provided different result for cost of capital (Arnold, 2008). On top of that, market portfolio is not observed in real life so the stock market index is used as a proxy. Another problem related to CAPM is the usage of historical data which is not a good estimator to predict the future (Arnold, 2008). Also the results of the CAPM would depend on the beta's performance over time (Watson & Head, 2010). This implies that the volatility of the beta could be a problem because if beta is more volatile over time, it would not be representative for the future betas so it should not be used as a proxy.

The studies performed by Fama and French (2004) about the empirical results of the CAPM show that this model does not explain the reality. They concluded that the intercept of the SML line should be higher than the predicted one in CAPM, therefore additional factors should be taken into account beside the undiversified risk (Watson & Head, 2010; Arnold, 2008); also the slope of the line should be lower than it is stated in the model (Fama & French, 2004; Watson & Head, 2010). Nevertheless, many studies confirm the positive relationship between systematic risk and return.

Despite the fact that CAPM presents several critiques, it is still one of the methods most used to assess the cost of equity capital according to Graham and Harvey 2001. Moreover, according to Welch (2008) about 75% of Finance professors suggest the usage of the CAPM to estimate the cost of capital for capital budgeting.

2.2.2 Multibeta Model

Multibeta model also known as Arbitrage Pricing Theory (APT) was developed by Ross (1976). This model is an extension of CAPM, in this model the expected return depends on several factors. The APT formula is:

$$E(r_i) = r_f + \sum_{k=1}^K E(r_k - r_f)\beta_{ik}$$

Where:

- $E(r_i)$ is the expected return on stock i
- r_f is the risk-free rate
- $E(r_k - r_f)$ is the expected risk premium on risk factor k
- β_{ik} is the sensitivity of stock i to risk factor k

The β_{ik} meaning is the same as in the CAPM but here each beta is used to express different risk factors. The author of this model had not specified any concrete risk factors (Schlegel D. , 2015). Some empirical studies performed by Roll and Ross (1984) concluded the importance of the following factors: inflation, industrial production, risk premiums and the slope of the term structure of interest rates.

This model was also criticized because is backward-looking so it is useless for future calculations (Câmara, Chung, & Wang, 2009), moreover the factors are not indicated (Young & Saadi, 2011; Arnold, 2008; Brailsford, 2007). Furthermore, Brailsford points out that the chosen factors may not be constant across time because of dynamic environment.

2.2.3 Average historical stock return

This model is based on the arithmetic average of historical returns. It can be expressed by the following formula:

$$E(r_i) = \frac{1}{n} \sum_{i=1}^n r_i$$

Where:

- $E(r_i)$ is the expected return on stock i
- r_i is a sequence of returns for n periods of time

This model also presents the backward-looking issue but it is the second best known model that is used to estimate the cost of equity. It presents also an advantage in that it is simple to use (Berk & DeMarzo, 2013).

2.2.4 Other models

Other models exist to assess the cost of equity like the Residual Value Method (or Residual Income Model) or Discount Dividend Model. Since these models are used by few enterprises this thesis only describes them without deeper understanding.

The Dividend Discount Model is based on the assumption that the market price of a firm's stock is equal to the present value of the future expected dividends that the firm will pay. The cost of equity capital could be obtained from this formula because this one is used as a discount factor of the future expected dividends (Berk & DeMarzo, 2013: 271-282).

The Residual Income Model is based on the assumption that the firm's value depends on all the future book value changes which arise as the deviations in the earnings, capital contributions or dividends. Once the firm's value is known as well as the current share price of the same firm, it would be possible to apply the formula where the discounted firm's value is equal to current share price. The cost of equity capital would be obtain because it acts as a discount factor, therefore if the other two values are known it is possible to compute the cost of equity capital (Hail L. , 2002).

3. INFORMATION ASYMMETRY

3.1 Definition and Consequences

Information asymmetry explains what happens if one party has more information than the other one before the transaction takes place (Mankiw, 2011). The example to illustrate it would be when the seller of a certain good has more information about that one than the buyer has. Therefore, the party which has more knowledge could take an advantage over the other party's lack of information.

The consequences of information asymmetry:

- **Moral hazard:** ~~the~~ tendency of a person who is imperfectly monitored to engage in dishonest or otherwise undesirable behavior" (Mankiw, 2011: 468).
- **Adverse selection:** ~~the~~ tendency for the mix of unobserved attributes to become undesirable from the standpoint of an uninformed party" (Mankiw, 2011: 470).

George A. Akerlof, A. Michael Spence and Joseph E. Stiglitz were the three most known authors who were awarded in 2001 by the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel for their analyses of markets with asymmetric information (Nobelprize, 2001).

3.2 Relationship between Information Asymmetry and Cost of Capital

Investors in order to make investment decision need information to properly assess the risk and the return related with this one. Due to the fact that they provide capital for the companies, their decision making process is related to the purchase of the stocks, holding them or selling. In order to make these decisions, they should properly evaluate the return of different options they have; so they should focus on the evolution and methodology of the firm's dividend payout (Kazemi & Rahmani, 2013). Consequently shareholders are the main users of the firm's financial statements because they expect to obtain perfect, transparent and exact information from the companies in order to make the investment decision (Lambert, Leuz, & Verrecchia, 2011). If financial statements do not provide accurate and clear information, this would create uncertainty among shareholders and the resulting effect would be the change in the stock price due to the created risk (Francis, LaFond, Olsson, & Schipper, 2004). Thus shareholders would demand a higher risk premium and hence the firms' cost of capital increases. The

following section specifies other factors that are related to the asymmetry of information which affect the cost of capital.

Shareholders are able to estimate their cost of capital by using the Capital Asset Pricing Model (section 1.2.1) but the biggest disadvantage of this one is that it does not include the importance of the information in the calculations of the cost of equity of the company.

3.3 Review of Literature

Information asymmetry in perfect competitive markets affects the cost of capital. This logic can be explained in the following example: assume that in the market there are two investors A and B. Investor A has less information about the stock of the firm so he chooses to hold fewer securities because his uncertainty is higher. Investor B obtains more information about the same security so he has different expectations than investor A and therefore he can buy more financial instruments which will imply a change in the price. The uncertainty of the less informed investor will decrease because he perceives through the price which contains the new information that has appeared in the market. Hence, being in a competitive market, information asymmetry not necessarily affects negatively the cost of capital (Lambert, Leuz, & Verrecchia, 2011; Grossman & Stiglitz, 1980; Leland, 1992).

In the case of the imperfect competitive market the greater amount of information is connected with a lower cost of capital as a result of the decreased transactions costs and estimation risk. This situation happens because if in the market there is an increase in information, the uncertainty decreases so the investors can better estimate the assets return, which consequently will lower the cost of capital (Clarkson, Guedes, & Thompson, 1996; Coles, Loewenstein, & Suay, 1995; Klein & Bawa, 1976; Barry & Brown, 1985; Handa & Linn, 1993). In this kind of market, the number of competitors plays an important function because it helps to determine the relationship between the information asymmetry and the cost of capital. In the theoretical approach of Lambert et al. 2011 it is shown that market competition is an important factor in determining a relationship between information asymmetry and cost of capital in imperfect competitive environments. While in the competitive environment, this variable has no implications. The empirical studies of Armstrong et al. 2011 and Kazemi and Rahmani

(2012) have proven that the theory described by Lambert et al. 2011 has implications in real cases.

The following section will illustrate how different information factors affect the organization's cost of capital. These ones are arranged into three groups: disclosure of the information, the impact of separation of ownership and control and the quality of the financial statements reporting.

3.3.1 Disclosure of information

Financial theory affirms that disclosure of the information about the company impacts in its cost of capital. Diamond and Verrecchia (1991) and Kim and Verrecchia (1994) investigated the relationship between the disclosure, liquidity and cost of capital. They concluded that there is a negative relationship between the disclosure level and the cost of capital: the greater the disclosure level the lower the cost of capital because the shareholders are better informed and they are able to ameliorate reaction in case when there is a problem with liquidity. According to the Luzi Hail's empirical study in 2000, in which 73 Swiss firms were analyzed, the disclosure of the information decreases the cost of capital in univariate analysis. The same author says that there are three types of the voluntary disclosure: background and non-financial information; trend and analysis and management discussion and analysis; risk, value-based and projected information. Also Botosan's empirical study (1997) has provided the same evidence as Hail does: a negative and statistically significant relationship exists between voluntary disclosure level and the cost of capital from the sample of 115 firms from the machinery industry. In this study she created her own disclosure index. Furthermore, this study was extended in 2002 by the same author with Plumlee's collaboration. In this work they wanted to examine the relationship between the cost of capital and the three well known disclosures: annual report, quarterly reports, other published reports and investor relations. In this case they have used a larger and multi-industrial sample. The result of this investigation has proven that higher annual report disclosure was related with lower cost of equity capital after controlling for market beta and firm size.

Not only the voluntary disclosure matters but also the typology of the information, i.e. if it is public or private, has an effect on the cost of capital. Easley and O'Hara (2004) have concluded that investors who have less private information demand higher return for the stock due to the risk which is created by the appearance of private information

(information asymmetry). Those investors who have obtained more private information are able to better choose the weight of their portfolio as the new information appears, not as the ones with less private information. Furthermore, this implies that each type of investor perceives the return and risk differently and so, each of them have different portfolio.

Information quality is the next aspect which causes changes in cost of capital because this one determines the firm's future cash flows. This element was proposed by Leuz and Verrecchia (2004), they argue that poor-quality reporting creates information risk which is related to worse coordination between firm and investors. This risk has a negative impact on expected returns, which in turn increases the cost of capital.

According to Kothari and Short (2003) there is another factor which could cause changes in cost of equity capital: the person who is making the disclosure. The beneficial disclosure decreases the cost of capital but depending on who is going to make the disclosure the impact would differ. On the one hand, the strongest impact would be achieved if the financial press makes the disclosure because they act independently from the company and thus their reports are objective. Moreover, the financial press presents the news when it is happening. On the other hand, the analyst disclosure does not cause any impact on the cost of equity capital because of the lack of objectivity due to their relationship with the managers and additionally, they usually retransmit already available information without presenting any new one. In the case when the manager makes negative and strongly negative disclosure, the market reacts very quickly by increasing the cost of capital of the firm. When the management's disclosure is positive or strongly positive it does not create any impact in the cost of capital because managers have an incentive to present too optimistic news.

The following section would address the Agency-Principal theory which is another factor which is affecting the firm's cost of capital.

3.3.2 Agency-Principal theory

The separation of the ownership and control in the firm can create the agency problems, which are related to information asymmetry between the principals (shareholders) and the agents (managers) because most often agents have more information about the company than the principals. This situation raises the moral hazard problem because the managers are trying to maximize their interests using the shareholders wealth.

Moreover, the adverse selection appears because the investors do not know the real economic value of the company due to the fact that they have less information about the firm. Those two components create an additional risk factor for which the investors want to be compensated by demanding a higher risk premium (Habib, 2005).

The governance structure is one of the factors which create an impact on the cost of equity capital because a firm with better governance structure decreases the agency risks and so decreases the cost of equity capital (Ashbaugh, Collins, & LaFond, 2004). The opposite happens if the company presents weak governance structure because it exposes shareholders to additional risk: governance risk. According to the same author there are four types of governance attributes: (i) financial information quality, (ii) ownership structure, (iii) shareholder rights and (iv) board structure. The empirical study shows that: (i) there is negative relationship between the financial information and the cost of capital estimates, (ii) the autonomy of the board and the percentage of stock that the board owns are also negatively related to the cost of capital, (iii) the concentrated ownership of huge amount of shares or bonds is positively related to the cost of capital.

Considering the Huang's (2004) investigation about the shareholder rights and their ability to replace a current manager, he states that there is positive and significant relationship of this factor and the cost of equity capital. Therefore, the weaker shareholder rights¹ increases the agency costs and this effect could be translated into an increase in cost of capital.

Also the features of the countries institutions create an impact on the cost of capital. The Hail and Leuz's study (2004) have proven that the effectiveness of how the securities regulations support the legal institutions determines the impact on the cost of capital; in those countries where there are weak institutions the firms present larger cost of capital.

Not only the agency problems and disclosure of information create an impact on cost of capital but also the financial reporting quality. This one would be explained in the following section.

¹ The shareholder rights are measured with G-score. A high G-score is connected to weak shareholders rights which mean poor corporate governance.

3.3.3 Financial reporting quality

Business earnings are the main source of information about the profitability of the business and successfulness in the long run. This kind of information is priced so this also would create an impact on the cost of capital of the company. According to empirical study of Francis et al. in 2004, where 790 firms were analyzed, the study shows the negative relationship between earnings and the cost of capital. This is due to the fact that financial reporting of low quality earnings increases the risk related to inefficient allocation of resources.

In case of companies which present more transparent earnings the cost of capital lowers because the information asymmetry is reduced and so the investor's uncertainty about the equity value decreases (Barth, Konchitchki, & Landsman, 2013).

4. EMPIRICAL RESEARCH

In this section I will provide the summary information about the firm I have chosen to perform the study, the data utilized and the methodology to calculate the cost of capital. First, I will discuss basic information about the firm, after it I will comment the data collection process as well as the description of it followed by the example of disclosure of information and the methodology used to assess the cost of capital.

4.1 Volkswagen Group

The firm which I selected to perform the analysis is the Volkswagen Group. The Volkswagen Group is a publicly traded German multinational automotive manufacturing company. Its headquarters are located in Wolfsburg, Germany and it was founded in 1937 in Berlin with the name –Gesellschaft zur Vorbereitung des Deutschen Volkswagens mbH” (Company for the Preparation of the German Volkswagen Ltd.). This group is listed on the Frankfurt stock exchange and also in other stock exchanges like London stock exchange. Moreover, it operates in 119 production plants distributed in 20 European countries and a further 11 countries in the Americas, Asia and Africa (Volkswagen Group, 2016).

The Group is a collection of twelve brands from European countries: Volkswagen Passenger Cars, Audi, Seat, Skoda, Bentley, Bugatti, Lamborghini, Porsche, Ducati, Volkswagen Commercial Vehicles, Scania and MAN. Each one presents its own character and operates as an independent entity on the market. The market portfolio of products ranges from motorcycles, low-consumption small cars, pick-ups, buses, heavy trucks to luxury vehicles (Volkswagen Group, 2016).

This group also manufactures: large-bore diesel engines for marine and stationary applications (turnkey power plants), turbochargers, turbomachinery (steam and gas turbines), compressors and chemical reactors. Besides manufacturing, they also provide financial services like: dealer and customer financing, leasing, banking and insurance activities, and fleet management (Volkswagen Group, 2016).

4.2 Data Collection

The data collection process was divided into two parts: the first stage was related to the selection of the news while the second was connected to gathering necessary data to perform the cost of equity analysis.

The decision about the proper news was considered according to the example of Kothari and Short's news collection process determined in their paper in 2003. As reported in their work, they have used text retrieval software which classified each disclosure text by grouping the words and word phrases into six-categories. Then each disclosed text was analyzed using General Inquirer, analysis software, which: mapped word and word phrases and counted word frequencies on dictionary supplied categories. In order to know if a text presents positive or more negative disclosure the word counts and frequencies were compared.

In my case I have not used any software to determine the typology of the disclosure. I have chosen two different articles: one with positive news and another one with negative news for Volkswagen. In order to know if the news was positive or negative, I considered the number of good aspects versus the number of negative ones in the text. Depending on the positive and negative features, I have classified the articles as the one which present a negative or positive disclosure.

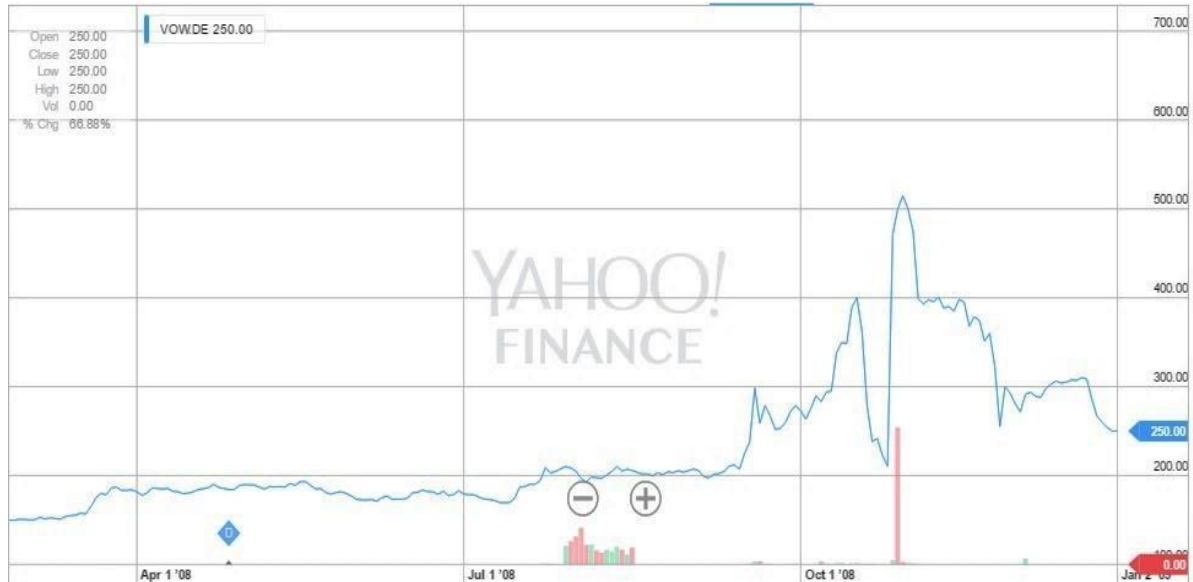
4.2.1 Positive news disclosure

The article which I considered as a positive disclosure is the one which took place on 28th of October 2008² and was collected from The New York Times website. In the light of my classification, it has presented more positive than negative features because Volkswagen has become one of the most valuable companies in the world due to the Porsche disclosure where they announced that that they had increased their stakes in Volkswagen (VW) from 35 per cent to 74.1 per cent (Story, J. de la Merced, & Dougherty, 2008). As it is mentioned, the disclosure was done through an agent who is related to the firm because there is a link between the two companies. If the market views this relationship as independent, which would imply that Porsche is a separate company from Volkswagen, then this news will create an impact on the cost of equity capital. Otherwise, given the previous results of Kothari and Short (2003), we would expect not to have any impact in the cost of equity capital. Due to this fact, I would like to check how the market views this situation and moreover if this news has created some impact on the cost of equity capital of the Volkswagen firm. Since my process of news selection is subjective, I have checked the news impact on the stock prices which is shown in the Figure 1. As it can be seen, the huge increase in the stock prices takes

² The articles can be found in Appendix I

place after the news had appeared in the market. The prices increased from 270.15€ to 396.3€ which is an increase of 46.15% according to data obtained from Thomson Reuters Datastream; but Yahoo Finance reports the increase in prices from 210.52€ to 514.60€ which translates into an increase of 144.44%.

Figure 1: Volkswagen's stock prices (2008)



Note. Retrieved from Yahoo Finance.

4.2.2 Negative news disclosure

The negative news, which is also related to the same company, took place on 18th of September 2015. The article, which was gathered from the New York Times website, explains the CO₂ scandal. In short, The Environmental Protection Agency (E.P.A) held Volkswagen responsible for using special software which was activating or deactivating the equipment that was responsible for CO₂ emissions. That is, the software through sensors knew when the tests were taking place and during these times, it was activating the equipment to decrease the CO₂ emissions. During regular driving, this equipment was deactivated which was causing an increase of emissions beyond the legal limits. This system allows the car to save fuel and to improve the car's torque and acceleration. Once this situation was known, Obama's administration ordered Volkswagen to recall almost a half-million cars. Due to the fact that the emissions are linked to some health problems and they contribute to creation of ozone and smog, the E.P.A and Justice Department were working together and they were considering penalizing Volkswagen with fine of \$18 million for all recalled vehicles (Davenport & Ewing, 2015; Gates, Ewing, & Watkins, 2016).

The disclosure in this case is done through an independent agent: Environmental Protection Agency. Therefore, as the theory states, it should create a huge impact on cost of equity capital making it more costly. The impact of this article on the stock prices is shown in the Figure 2 where the huge decrease in the prices of the stocks takes place. In this case the stock prices went from 160.9€ (September 2015) to 105.95€ (October 2015) which translates into a decrease of 34.15% according to Thomson Reuters Datastream. The Yahoo Finance reports a decrease from 164.35€ to 96.5€, respectively, which implies a decrease of 41.28%.

Figure 2: Volkswagen's stock prices (2015)



Note: Retrieved from Yahoo Finance.

The second part of the data collection process was related to obtaining the necessary data to estimate the cost of equity capital. All the data was gathered from Thomson Reuters Datastream.

4.3 Methodology

According to Brounen et al. (2004) who performed a survey among 313 CFOs in different European countries, including Germany, concluded that the biggest part of European CFOs determine the cost of capital using CAPM. Moreover, 53% of 2.000 German firms, who participated in this study, compute their cost of capital explicitly and from those, the biggest percentage: i.e. 34% uses CAPM model (Brounen, De Jong, & Koedijk, 2004). Considering this investigation, I have decided also to use Capital Asset Pricing Model in order to compute the cost of equity capital because as it was

already mentioned it is the most widely used and also financial professors recommend its usage despite all the limitations it presents.

The CAPM states that the expected rate of return equals the risk-free rate plus a risk premium which depends on beta and the market risk premium. Therefore, the first element in my analysis is the risk-free interest rate, r_f . As it was already mentioned in the theoretical frame, the risk-free represents “the risk-free rate at which an investor can both borrow and save” (Berk & DeMarzo, 2013: 404). The usage of the yield depends on the investors’ horizon, so there does not exist a correct way to apply it. As stated in Berk and DeMarzo, large US firms and financial analysts are using long-term yields of 10 to 30-year bonds (Berk & DeMarzo, 2013: 406). Apart from this observation, another study performed by Bruner et al. (1998) where 27 highly regarded US and Canada corporations and 10 financial advisers were surveyed; a big portion of them use the CAPM model to estimate cost of equity capital. In fact 33% of the corporations and 30% of financial analysts use ten-year treasuries, furthermore, another 33% of the firms and 40% of financial analysts use ten to 30-year treasuries. Considering these facts, I have used a 10 year German Government bonds yield as a good proxy for a risk-free rate.

The second element which should be determined is the market portfolio which is “a portfolio of all stocks and securities traded in the capital markets” (Berk & DeMarzo, 2013: 337). As it also is not observed in reality the market index is used as a proxy because it represents “the market value of a broad-based portfolio of securities” (Berk & DeMarzo, 2013: 1056). According to the same authors, in the case of US firms the S&P500 or Wilshire 5000³ indexes are used as a good approximation of market portfolio because it is assumed that they are large enough to be well diversified. In case of Germany, the well-known German stock index is Deutscher Aktienindex (DAX) which consists of 30 of the largest German companies (Börse Frankfurt, 2016). Another index which is used by authors is a DAFOX⁴ which was developed for research purposes. DAFOX is an index which provides a value-weighted portfolio of all the stocks that are traded on the Frankfurt Stock Exchange. Despite the constraint that DAX30 presents, i.e. it contains fewer enterprises than DAFOX, it was chosen as a

³ The Wilshire 5000 provides the weighted-value of all US stocks which are listed in the most important stock exchanges. This index represents better the market than S&P 500 due to the higher number of firms included in its index (Berk & DeMarzo, 2013).

⁴ See Göppl & Schütz (1995) for details.

proxy for market portfolio due to complications in data obtainability of DAFOX index. This component is essential for risk premium estimation as well as for the beta estimation.

The beta prediction is the last element of the CAPM formula. To calculate it, the Volkswagen's historical prices and DAX30 prices are needed to see how sensitive this stock to market portfolio is. In order to do so, monthly data from 01/01/2004 to 01/04/2016 is needed for both elements. The range of data is quite wide because of the news proximity. After collecting all the necessary data, I have used Stata software to further data manipulation which had to be done before applying the CAPM equation.

As for the first element, the monthly return for Volkswagen and also for DAX30 had to be performed by using the following formula:

$$\text{Monthly return} = \frac{P_1 - P_0}{P_0} \cdot 100$$

Where P_1 represents the price of the stock/DAX index at time 1 and the P_0 is the price at time 0. This formula was multiplied by 100 so as to have everything in percentages.

The second component was related to modification of the risk-free rate because as it is represented by 10 year Government bonds, these present the annual yield and so they have to be transformed to monthly data in order to have homogenous data set. For this reason, I have used the following formula:

$$\text{Monthly rate} = \left[\left(1 + \frac{i}{100} \right)^{\frac{1}{12}} - 1 \right] \cdot 100$$

Where i represents the annual rate which have been collected from the database. Moreover, I have also multiplied this formula by 100 to obtain percentages.

Applying these steps was essential to be able to calculate the excess return which is the difference between the DAX30/ Volkswagen's monthly return and the monthly rate of 10 year Government bonds. These steps allow estimating the stock's betas by regressing the Volkswagen's excess return against the DAX30 excess return.

Afterwards, the risk premium has to be computed. As I have used the long-term treasuries as a risk-free interest rate, therefore, according to Brealey et al. (2010) I have to restate the market risk premium as the average difference between market returns and

returns on 10 year Government bonds which correspond to long-term treasuries. As the average of DAX30 monthly returns is 0,774% and the average of monthly rate of 10 year Government bonds is 0,219%; this gives me the market risk premium of 0,556%⁵.

The betas were estimated for each month for Volkswagen by using a rolling window of three years (36 observations in one window) of monthly returns ending in the month for which the beta is estimated. Due to the fact that the first was positive news took place on 28th of October 2008 and that I wanted to see the impact of the news in the cost of equity, I needed to compute the cost of equity (and therefore to estimate beta) for a period before and after the news. So I decided to estimate the first beta for 1st of January 2007 which required data from 01/02/2004 until 01/01/2007. To estimate second beta the window had to move one place, i.e. 01/03/2004 – 01/02/2007. The same technique was applied for all the betas. Finally, as all the elements are completed the expected rate of return could be estimated.

The Kothari and Short's (2003) approach differs from mine because their three-factor model⁶ was estimated each quarter⁷ for each firm they were examining by using the five years rolling window of monthly returns. Furthermore, besides cost of equity capital they have also analyzed other variables to measure risk like: standard deviation of the stock and the standard deviation of analysts' forecast errors.

4.4 Results

This section will describe the results of empirical analysis of the effect of disclosure of information on the cost of equity capital. First I would like to present the descriptive statistics for variables I have used in the test. The time period considered in this analysis was from 2004 to 2016.

⁵ This result is close to the monthly excess return obtained by Elsas et al. (2003) which was 0.6411% from 1960 to 1995. The market proxy used in this study was DAFOX index.

⁶ They have used three factors: Size factor, book-to-market factor and the market factor.

⁷ Their decision to analyse the data quarterly was link with the financial reporting cycle which takes place each quarter.

Table 1: Descriptive statistics (2004-2016)

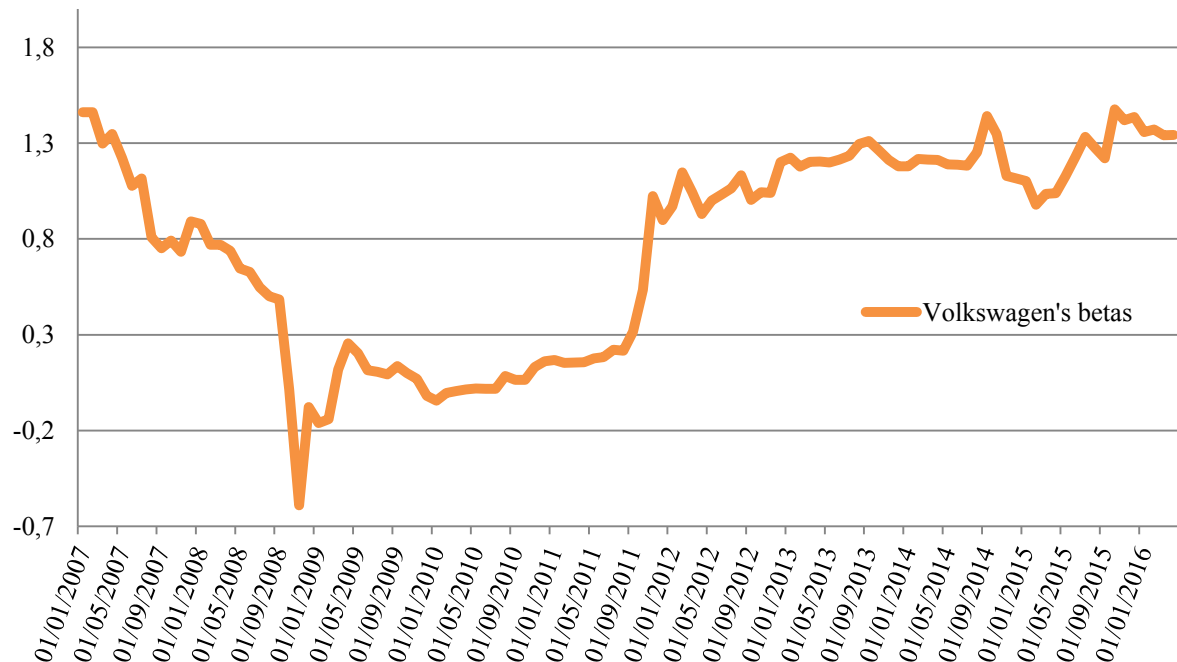
Variable	n	Mean	S.D.	Quantiles				
				Min	.25	Mdn	.75	Max
VW	147	1.47	11.96	-51.37	-3.89	1.06	8.37	46.15
DAX30	147	0.77	5.57	-17.59	-2.07	1.52	4.38	15.45
RF	148	0.22	0.10	0.01	0.13	0.25	0.31	0.38
RP	147	0.55	5.58	-17.77	-2.30	1.42	4.07	15.19

Note. Adapted from Thomson Reuters Datastream.

The sample has 148 observations, i.e. from 01/01/2004-01/04/2016. In the Table 1, the acronym VW is related to Volkswagen's return, which presents a monthly mean of 1.47%. The second variable is DAX30 which represents market historical return in monthly percentage. The third acronym is RF which is related to risk-free monthly interest rate which is 0.22%. The last variable is RP, risk premium, which in my sample is 0.55%.

Secondly, I present the beta estimations for the period from 01/01/2007 to 01/04/2016 to see its behaviour through time:

Figure 3: Volkswagen's betas through 2007-2016



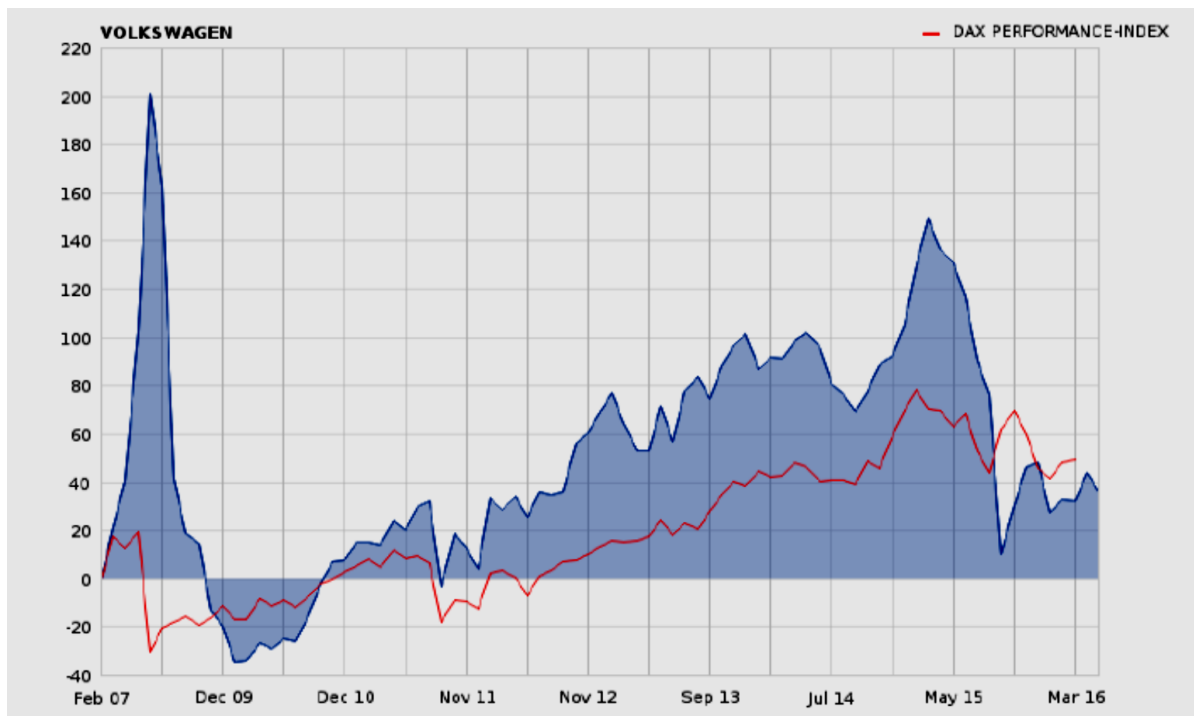
Note: Adapted from Thomson Reuters Datastream.

As it was explained in the theoretical frame, the beta shows how Volkswagen's stocks behave depending on the market changes. As it can be seen, the lowest beta takes place

on November 2008, which takes a negative value of -0.59, and the highest positive beta, i.e. 1.48, takes place on October 2015.

In order to clearly see what beta represents, the next figure represents the variations in Volkswagen's stock prices and the variations in DAX30 index. As it can be seen, there is generally a positive relationship between the two variables which implies that they move in the same direction. Volkswagen's stock prices move to a higher extent than the DAX30 index which is represented by the beta higher than 1. Also there is one period in 2008 where the Volkswagen's stock price skyrocketed while the market was in decline. This situation would represent the negative beta because of the opposite direction of both variables.

Figure 4: Volkswagen's stock prices and DAX30 performance index

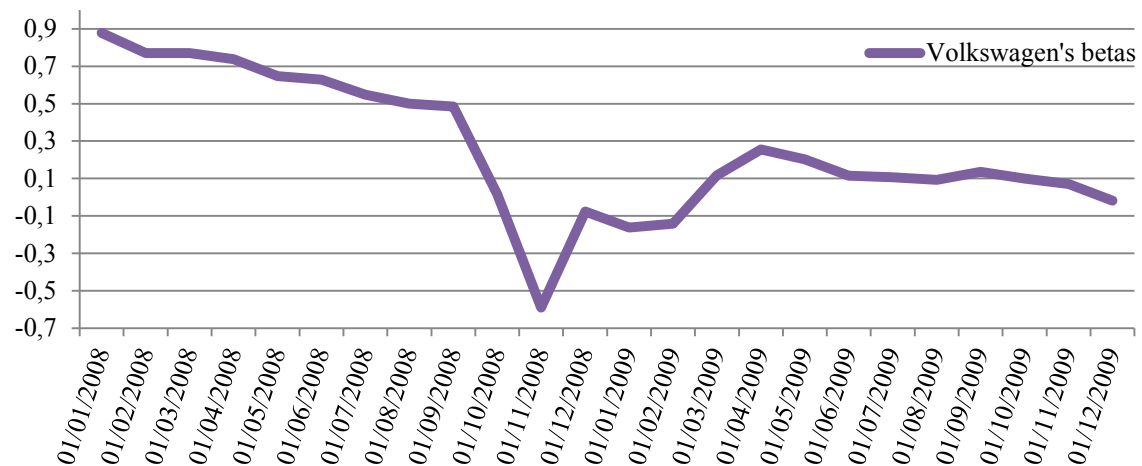


Note. Retrieved from Boursorama.

4.4.1 Results for the positive news disclosure

In order to clearly see the impact of positive news on the betas which takes place on October 2008, Figure 5 is showing the betas evolution through 2008-2009.

Figure 5: Volkswagen's betas (2008-2009)



Note: Adapted from Thomson Reuters Datastream.

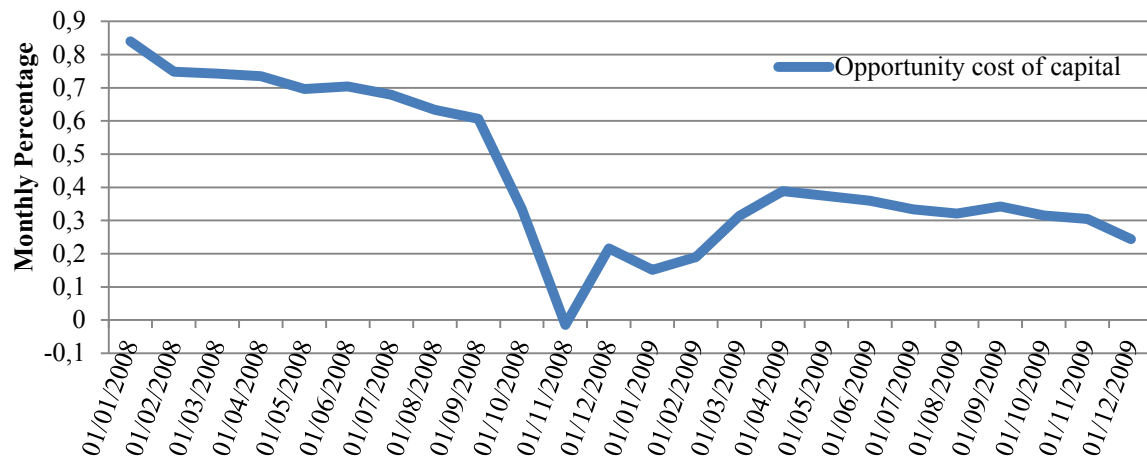
Considering the fact that the positive news has taken place on 28th of October 2008, the impact on the three years betas shows us that the beta in that month was positive but it was very close to 0 (i.e. 0.0153) but from November until February of 2009 it was negative. The highest negative value was reached in November 2008 (-0.59), this situation is due to the data collection process because the beginning of each month was taken as a representative data of that month. As the news takes place in late October, the November would be considered as a moment in which the news takes place.

The reasoning behind the negative beta is associated with the behaviour of this stock related to the market situation: this stock in bad times will tend to do well and it might be seen as an insurance asset (Berk & DeMarzo, 2013). The interesting point here is to know why this happens. To understand this situation it is necessary to know that from 2007 to 2008 the financial crisis⁸ had taken place. As the market was declining, one of the factors which contributed to the increase of Volkswagen's stock prices was the disclosure of the positive news and other different elements which translated into negative beta. This situation is represented in the Figure 4 where Volkswagen's stock prices and DAX30 performance index are represented.

The cost of equity capital will present the impact of the news and it is represented in Figure 6.

⁸ The economic downturn which started in 2007 was caused by the crash of the housing bubble and credit bubble. The improper credit-rating of securities which were including toxic financial assets (with bad mortgages inside) was one of the causes of credit bubble, which in turn, caused disappearance of some financial giants like Lehman Brothers (Jones, 2009; Thomas, Hennessey, & Holtz-Eakin, 2011).

Figure 6: Expected Cost of Equity Capital



Note: Adapted from Thomson Reuters Datastream

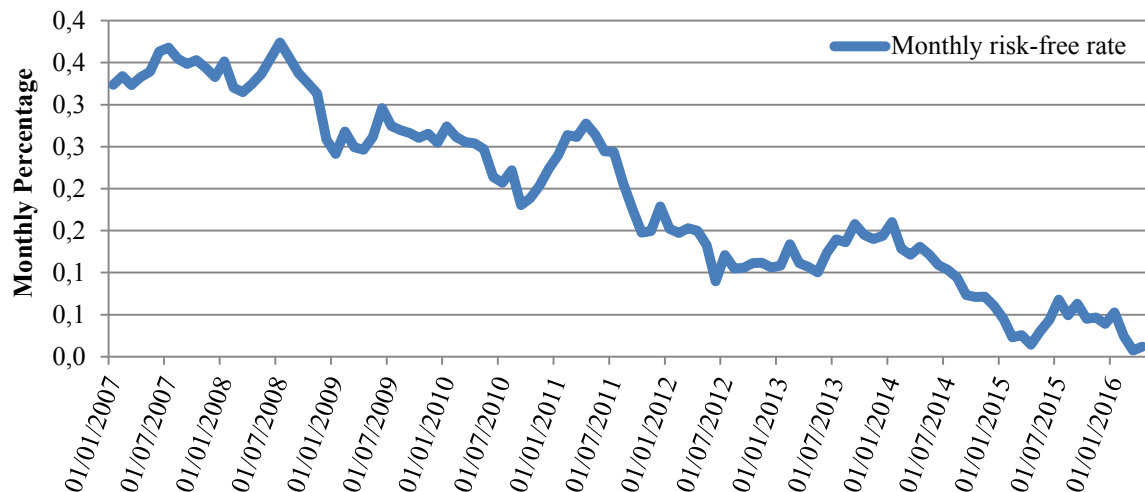
The impact of this news should be considered cautiously due to high speculation on the Volkswagen stock which had taken place at the same moment as the news had appeared. This one is related to the hedge funds and the Porsche disclosure. During the economic crisis the hedge funds expected the Volkswagen's (VW) shares prices to fall so they started to short sell its shares meanwhile Porsche was increasing its stake in VW up to 74.1% through intermediaries. When Porsche made the disclosure, Volkswagen's share prices increased. This information caused a panic and losses for hedge funds who were obliged to buy shares at the market price because there were fewer shares to be traded (Rayner, 2008). This situation shows the speculation which took place during the same period when the news had appeared.

As the two impacts were taking place simultaneously the results for cost of equity capital, i.e. Figure 6, should be considered with prudence: the negative opportunity cost of equity capital, i.e. -0.0145%, which takes place in November 2008 shows us the impact of speculation and news. The definition of this negative outcome could be explained as if shareholders were financing and paying an extra interest to the firm. They are paying an extra interest in order to be able to invest in that company.

This negative estimation was possible due to three reasons. The first one was related to the DAX30 performance which due to the crisis was decreasing. The second element is the Volkswagen share price which increased to the point that it was one of the most valuable companies in a few hours. The third element was the one related to the risk-free rate, the Figure 7 represents the evolution of this factor from 2007 to 2016. The German long-term treasuries yield as the news had appeared was declining as a

response to the Sovereign Debt Crisis⁹. The effect of the first two elements was related to very negative beta which multiplied by the risk premium, which is constant, gave us a large number that monthly interest rate could not offset. In practice obtaining a negative beta is impossible but as the three things take place simultaneously the result is negative CAPM.

Figure 7: Evolution of monthly yields of 10 years German Government bonds rates



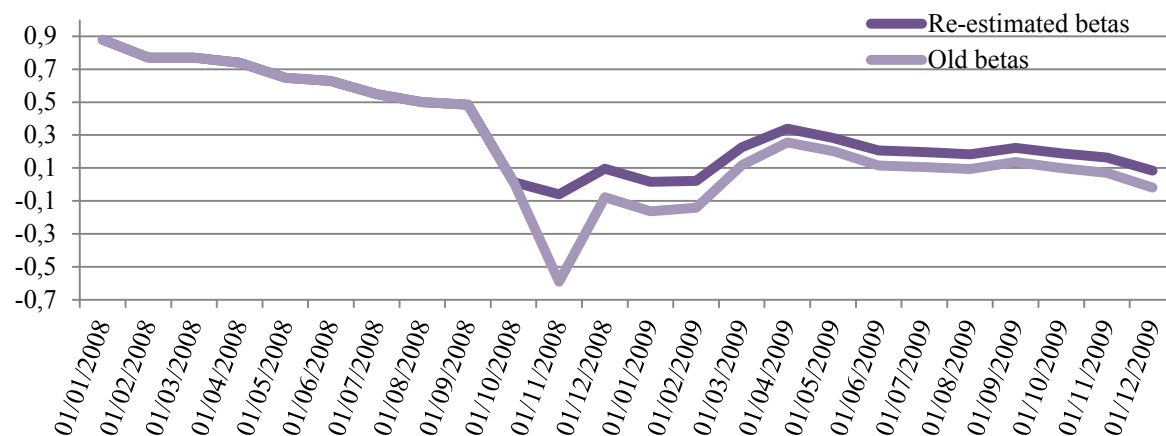
Note: Adapted from Thomson Reuters Datastream

As the negative CAPM is suspicious and moreover the speculations had taken place, it implies that CAPM assumptions were violated because the share prices were higher than its intrinsic value. This theory is linked with the efficient market assumption which was not fulfilled. Therefore, in order to be able to solve this problem I have used the theory which states that: “the estimates of beta may be distorted if there are extreme returns in one or two months” (Brealey, Myers, & Allen, 2010: 217). This is the case for November 2008 where the highest Volkswagen’s share price took place; so this implies that the expected cost of equity capital is affected by this highest point. The theory in such a case recommends giving less weight to the observation which presents extreme value or to omit it. (Brealey, Myers, & Allen, 2010). Otherwise, without applying this methodology it would not be possible to estimate the proper opportunity cost.

⁹ The independent rating agencies had decreased the rating of government debt for Greece, Italy, Spain, Ireland and Portugal due to the repayment inability of public debt. This caused an increase in the yields of long-term treasuries of these countries. Germany’s 10 year Governmental bonds were the safest ones which turned into lowest interests (De Haan, Oosterloo, & Schoenmaker, 2009).

Consequently, I have re-estimated the betas and CAPM for the period 2008-2009 where the rolling window consisted of 35 observations. The risk-premium remains unchanged. The results of the betas re-estimation was the following:

Figure 8: Comparison between betas

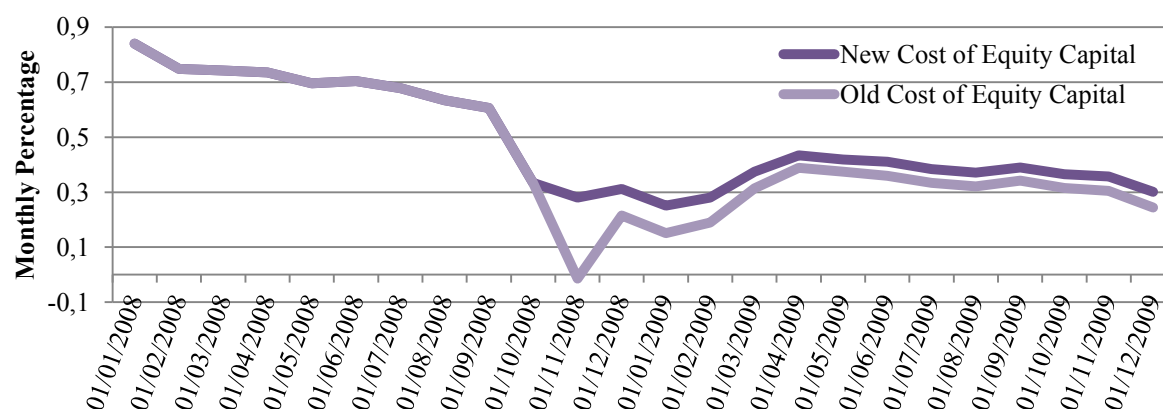


Note: Adapted from Thomson Reuters Datastream

The re-estimated beta for November 2008 has decreased because now it is -0.06, instead of being almost -0.6. The shares are still acting as a safety asset but to a lower degree.

The results for the expected cost of equity capital have also changed. The re-estimated CAPM is positive for the whole 2008-09 period as can be seen in Figure 9. In November 2008, when the news happens, the expected opportunity cost takes a positive value of 0.28%. Although I have eliminated the extreme value and mitigated the effect of speculation, these results should be considered with caution as it still might be influenced by the speculation.

Figure 9: Comparison of Cost of Equity Capital between models



Note: Adapted from Thomson Reuters Datastream

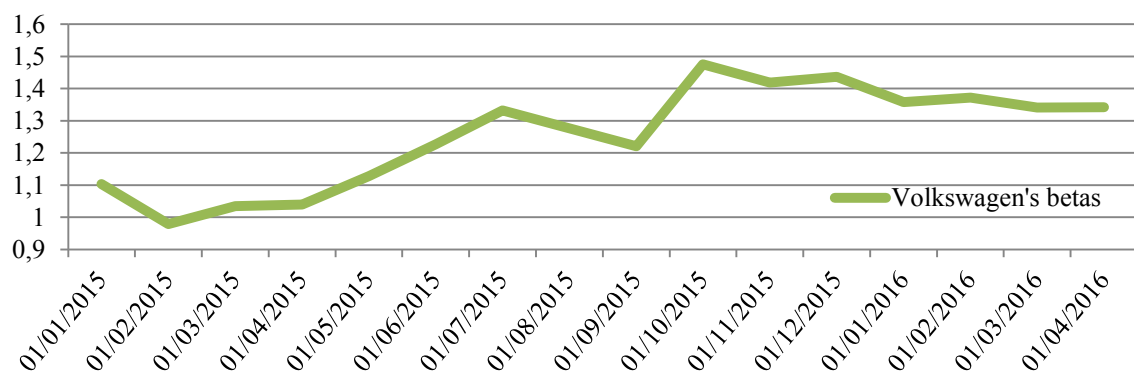
Due to the fact that the beta in this month was almost zero, the CAPM was relying only on the monthly risk-free interest rate. Moreover, the comparison between the expected rate of return and the share prices increase is interesting because the opportunity cost in October 2008 was 0.33% while in November 2008 it was 0.28% without the extreme value which implies a decrease of 0.05 percentage points or the decrease of 15.15%. With the extreme value the CAPM takes a value of -0.01% in November 2008 which turns into a decrease of 0.34 percentage points or the decrease of 103,03%. The increase in prices in the same months was 271.15€ and 396.3€ respectively, which turns into an increase of 46.15%. Therefore we can see that an increase of 46.15% in stock prices translated into a decrease of 103.03% in cost of equity capital. These results include the fact that speculation and news takes place at the same time.

Considering the fact that the speculation took place simultaneously with the news appearance, it is difficult to estimate the impact of the news on the opportunity cost of capital. Given that I obtained a lower result when the extreme value was omitted, despite the fact that the speculation still forms part of it, I can conclude that the market viewed the Porsche disclosure as a separate entity and so, it caused a decrease in cost of equity capital but it is difficult to know the exact effect.

4.4.2 Results for the negative news disclosure

Following the previous methodology, the first element to be analyzed would be related to the betas analysis for the period when the news takes place, i.e. 18th of September 2015. As it is negative news, I expect the cost of equity capital to increase when the information appears in the market. The Figure 10 presents betas evolution from 01/01/2015 to 01/04/2016.

Figure 10: Volkswagen's betas 2015-2016



Note: Adapted from Thomson Reuters Datastream

As it can be seen, there is an increment in Volkswagen's betas between the September and October 2015, which corresponds to the period when the news takes place. As the beta in that month is the highest one in the chart, i.e. 1.48, this implies that at this precise time a 1% change in DAX30 return caused a change in Volkswagen's return by 1.48%. Therefore, this stock was moving in the same direction as the market was but to higher extend.

The opportunity cost of capital during the same time frame is represented in the Figure 11. In this chart the news disclosure made an increase in cost of equity capital from 0.74% in September to 0.86% in October. The positive cost of equity capital implies that investors ask for a positive rate of return for holding Volkswagen's stocks.

Figure 11: The Cost of Equity Capital for negative news



Note: Adapted from Thomson Reuters Datastream

In this case the results should also be considered carefully because the negative news was one of the possible elements which created the increase in Volkswagen's expected return. But there might be some other unknown reasons which have influenced the results simultaneously with the news. This result follows what Kothari and Short's theory states: that the strongest impact in cost of equity capital would be achieved if the financial press makes the disclosure because they act independently from the company and so their reports are objective. In this case it was not the financial press but it was an independent agency which made the disclosure and therefore, it created an effect on opportunity cost.

Before the news appeared in the market the stock prices in November 2015 was 160.9€ and after the news the prices had decreased in October 2015 to 105.95€, this translates into a decrease of 34.15%. The cost of equity capital in the same months was 0.74% and 0.86% respectively. This implies an increase of 0.12 percentage points or an increase of 16.22%. In short, a decrease of 34.15% in stock prices translated into an increase of 16.22% in opportunity cost of capital.

The fact that other unexpected factors could create an impact on the expected rate of return is one of limitations of this study. In order to fully explain the impact of the news on cost of equity capital one would need to control all other elements like the growth and size of the firm, the sales, etc. The model applied by Kothari and Short (2003) tries to control all other aspects which makes it possible to clearly see the impact of the news in a firm's opportunity cost.

4.5 Robustness Check

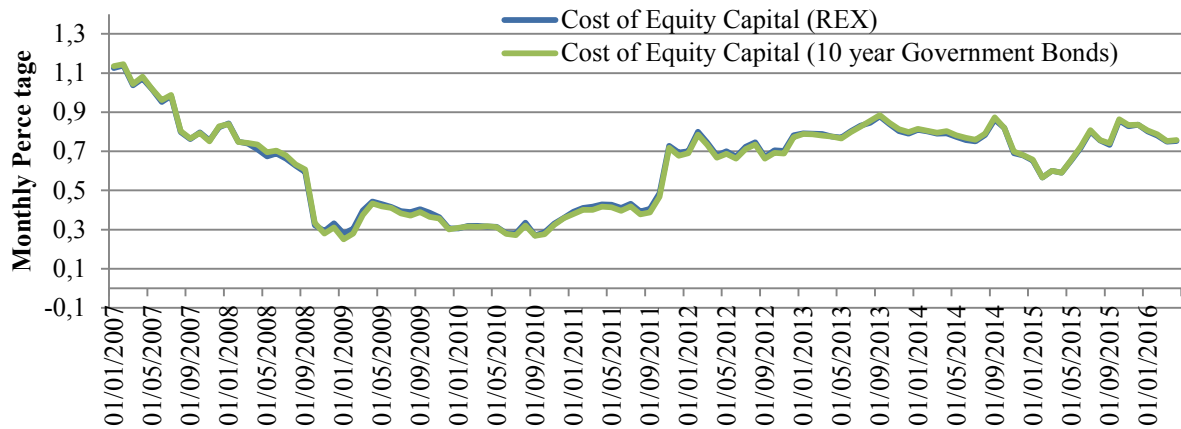
In this section I want to check how Capital Asset Pricing Model reacts when some of its elements would change. The first change would be related to risk-free interest rate while the second is related to rolling window change.

4.5.1. *REX interest rate*

In other papers, like the one of Daske, Gebhardt and Klein (2006), the risk-free interest rate used was the REX¹⁰ interest rate. Considering this new approach, I have also used the same risk-free proxy in order to see if there are any differences. That is why I have compared the results obtained by using this approach with the previous approach where 10-year German Government bonds were used. The rolling window was of the same size as previously, i.e. 3-years rolling window.

¹⁰ The REX index is computed on the basis of government bonds which are traded on the German bond market, comprising all Federal government bonds, Federal debt obligations and Treasury notes with a fixed coupon and remaining term between six months and 10.5 years, issued by the Federal Republic of German, the German Unity Fund as well as the former *Treuhandanstalt* privatization agency" (Deutsche Börse, 2014).

Figure 12: Risk-free comparison without including extreme value

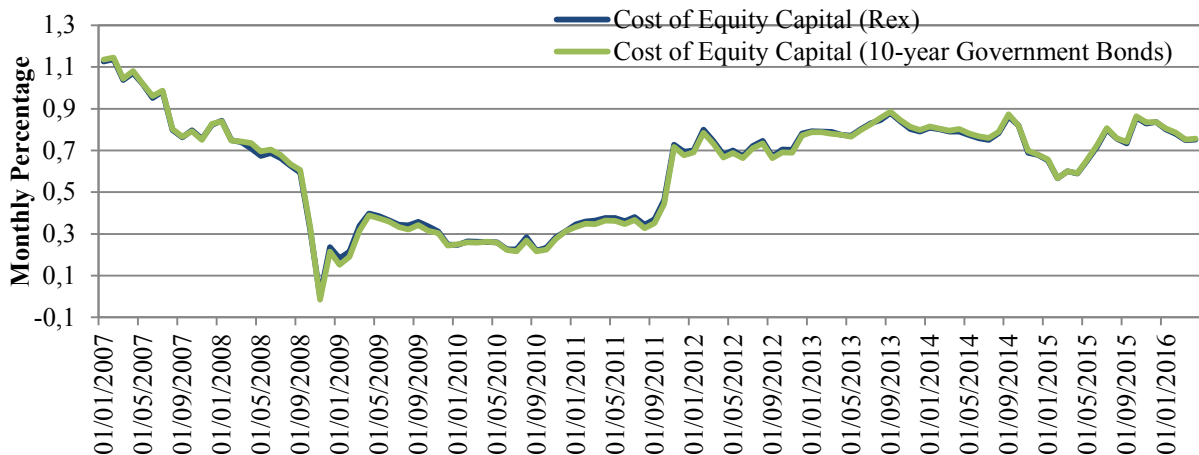


Note: Adapted from Thomson Reuters Datastream

The comparison between the two different risk-free proxies with the adjustment of extreme value is shown in Figure 12. As it is shown in the graph, the cost of equity capital does not differ between the two approximations. When the positive news takes place the opportunity cost of capital, considering REX as a risk-free rate, decreases from 0.323% (October 2008) to 0.293% (November 2008) while with 10-year Government bonds it decreases from 0.33% to 0.28% respectively. An increase in cost of equity capital takes place when the negative news happen, this is when the expected rate of return increases from 0.733% (September 2015) to 0.858% (October 2015) applying the REX proxy. When the 10-year Government bonds are used there was an increment from 0.741% (September 2015) to 0.864% (October 2015). Therefore, these two models do not differ when two long-term proxies are used. So, the results are not affected by the change of long-term risk-free proxy.

As it is shown in Figure 13, the graphs are almost equal despite including or not including the extreme value of November 2008.

Figure 13: Risk-free comparison with extreme value included

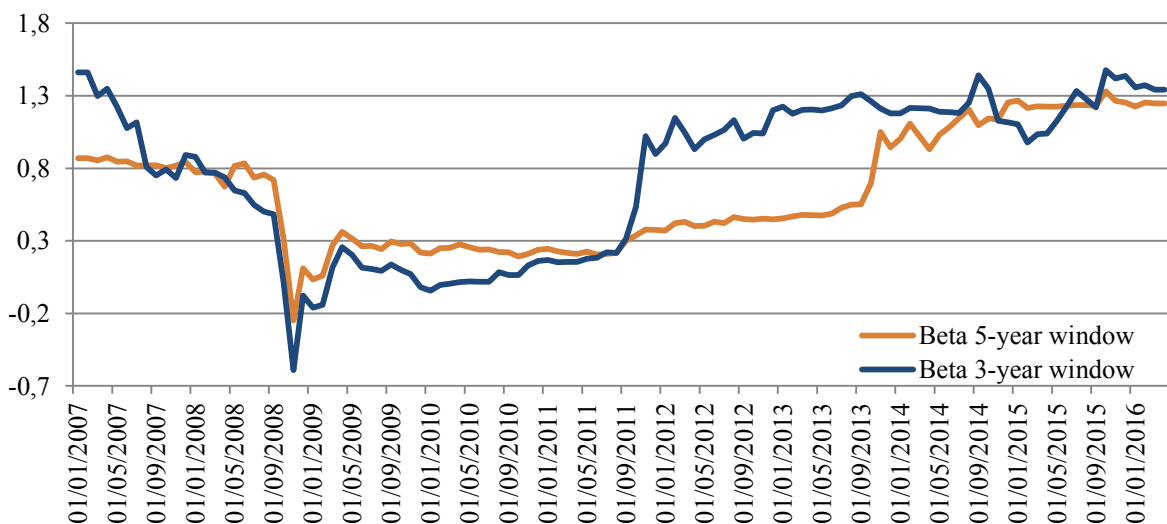


Note: Adapted from Thomson Reuters Datastream

4.5.2. Rolling window change

The second test which I have performed to see how the results might change is the one which was related to the rolling window modification. In this case I have considered 5 year periods, the same window as Kothari and Short's used in their study in 2003, instead of 3 years window, in order to estimate the beta. Figure 14 represents the results for the beta comparison between two models. Risk-free proxy considered in this study is the 10-year Government bonds.

Figure 14: Beta comparison between 5 year and 3 year window including extreme value

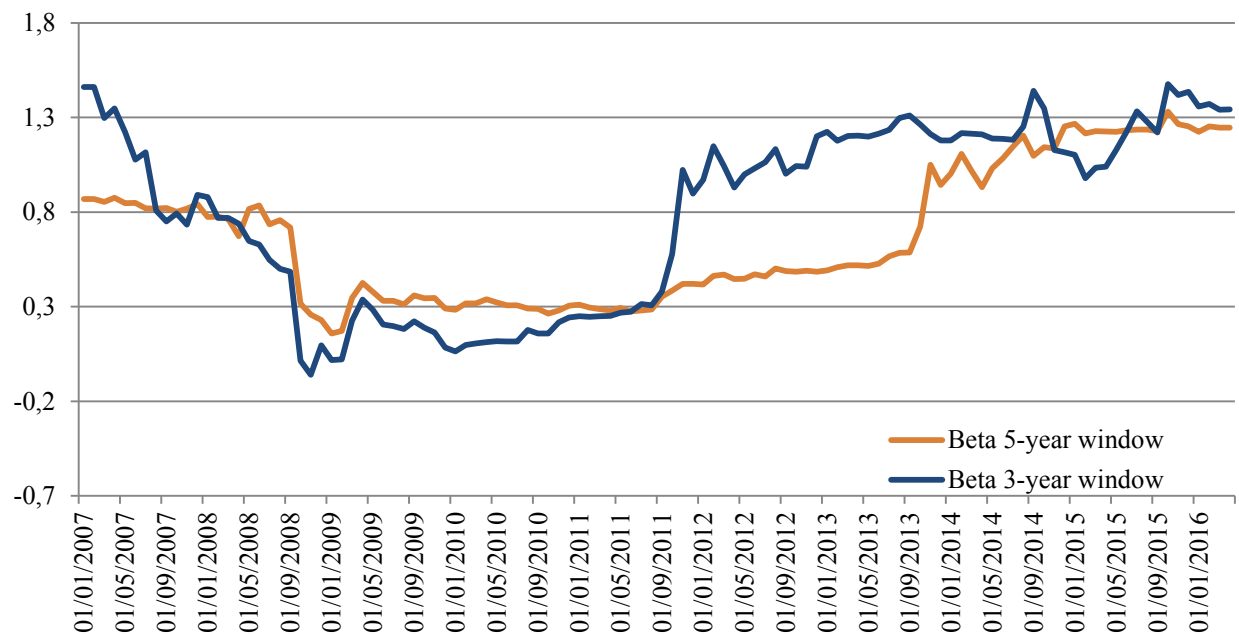


Note: Adapted from Thomson Reuters Datastream

In this graph the extreme value, i.e. November 2008, is included which can be observed in the huge drop of the betas at this date. As it can be shown, the five years betas are not

as volatile as the three years betas. This is due to the fact that betas in five year window are estimated by using 60 observations while betas in three years window consisted of 36 observations. This implies that each observation in the five-year model makes for a lower weighting than in the three-year model, which in turn translates into smaller changes. When the positive news takes place, i.e. November 2008, the beta in both models is negative. In the three years model it takes a value of -0.59 while in the five years model it is almost -0.25. While in the case of negative news, October 2015, the difference is not that big because the three year model presents a beta of 1.48 while the five year beta in this month is 1.33. The next graph presents the beta estimation without considering the extreme value of November 2008.

Figure 15: Beta comparison between 5 year and 3 year window excluding extreme value



Note: Adapted from Thomson Reuters Datastream

Also in this case the two models differ, but now they are less volatile than in the case when extreme value was included. The beta for the three year window decreases from -0.59 to -0.06 when the positive news takes place (November 2008). Meanwhile, the beta for five years model changed from a negative value of 0.25 to a positive one of 0.26. The beta for negative news is the same as previously stated when the model included the extreme value.

Both graphs are showing big differences between the end of 2011 and 2014. As can be seen, the gap between the three year and five year model is smaller when the extreme

observation of November 2008 is eliminated (Figure 15). The differences between two models from 2011 to 2014 take place due to two factors: rolling window estimation and to one extreme observation which affects the betas estimation.

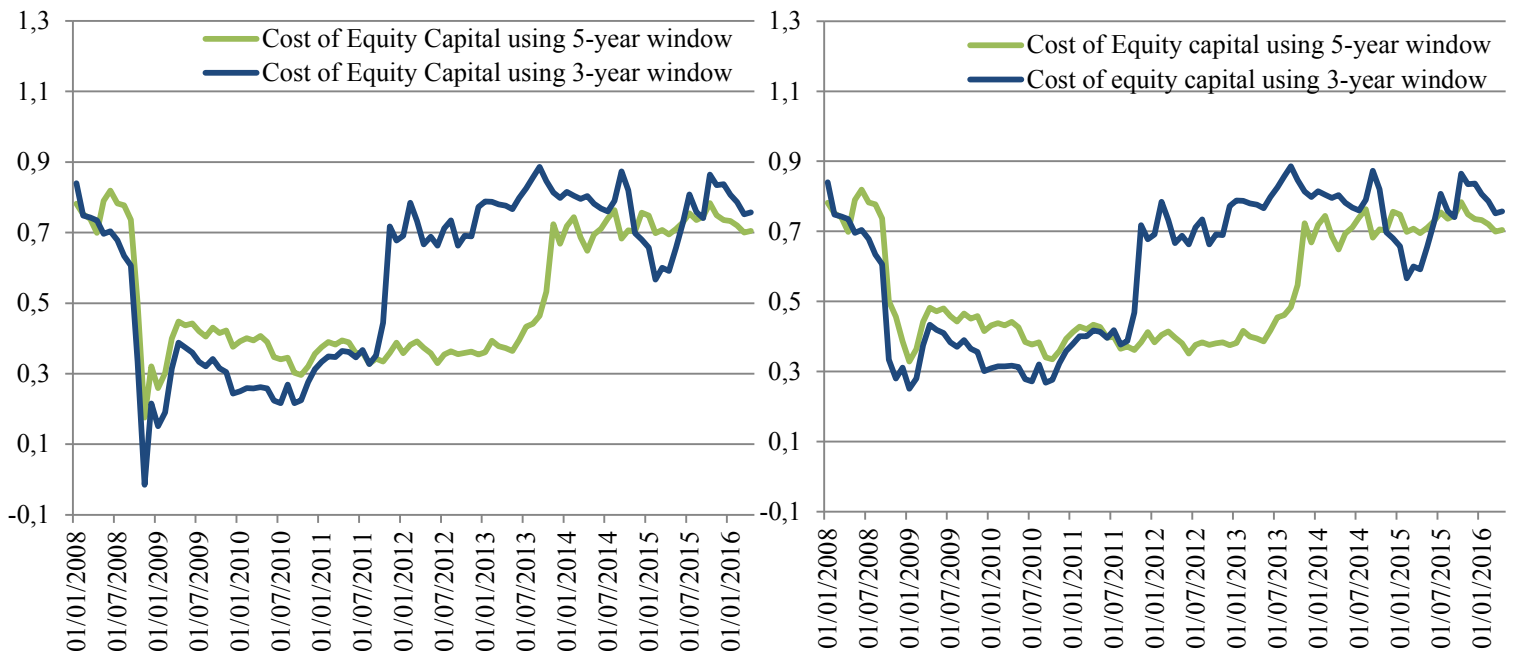
In the Figure 15 it can be seen that the sudden increase in betas estimation in two models but it takes place two years earlier in case of three years beta than in five years model. This is because the window of five years is two years larger than three years window, which explains the time frame difference. The second element which explains the sudden increase in beta is related to the observation of October 2008 which presents high stock prices compared to September 2008. This has a consequence in high values of Volkswagen's excess return which in turn, affect the beta estimation. Furthermore, this observation acts like November 2008 which is an extreme observation. The betas which contain this observation, i.e. betas from October 2008 until October 2011 for three years window or October 2013 for five year window, are affected by this extreme value. This observation is undervaluing the regression line which adapts to this abnormal observation by diminishing the slope of the best fitting line. That is why the betas obtained during the period of October 2008 until October 2011 (for three year model) or October 2013 (for five year model) are very low. When the extreme value is not considered in the beta estimation, i.e. after October 2011 or October 2013, the regression line better fits to the sample and so the slope, which represents the beta, is higher. The result of these two factors explains the gap between the two models. I expect the gap to decrease if the extreme value of October 2008 would be eliminated.

As it is shown in Figure 14 and 15, the beta estimation differs depending on the window considered. Moreover, both models are sensitive to extreme values which do affect the outcomes. Furthermore, the betas in model which consider five year window are not as volatile as with three year window because of the higher number of observations included in five year model than in other one.

The following step, after beta estimation, is to see how the change in window length impacted on the cost of equity capital. For this the Figure 16 would be used. In this figure we can see two graphs, on the left-hand side, the graph represents the opportunity cost of capital estimation using both windows in which the extreme value of November 2008 is included. On the right-hand side, the graph shows the opportunity cost of capital where extreme value is not considered. Both graphs are based on the risk-premium

which is equal to 0.55% and 10-year German Government bonds which are used as a risk-free rate.

Figure 16: Cost of Equity Capital using five and three years model. On the left, the model with extreme value, on the right the model without extreme values



Note: Adapted from Thomson Reuters Datastream

The first news to be analyzed would be the positive one where the extreme value is included. In this case in three years model the expected rate of return for October 2008 is 0.33% while for November 2008 it was -0.01%. The difference between the two values is 0.34 percentage points or a decrease of 103.03%. The opportunity cost of capital by using five year model for October 2008 is 0.5% while one month later it decreased up to 0.18%. The difference between the two values is 0.32 percentage points or a decrease of 64%. As can be seen the cost of equity capital has decreased in both cases, and moreover it presents a similar percentage points decrease.

Due to the fact that the speculation takes place simultaneously with news appearance in the market, the right-hand side graph will be used to analyze the news impact on cost of equity capital.

The cost of equity capital in five years model for October 2008 is 0.5% while for November 2008, the moment when the news takes place, the opportunity cost of capital decreased up to 0.46%. This result differs from three year model where the cost of equity capital for October 2008 was 0.33% and for November 2008 it was 0.28%. As it

can be seen, the expected rate of return for a five year model is higher than for a three years model. The decrease in five year model is related to 0.04 percentage points or the decrease of 8% while the decrease in three year model is 0.05 percentage points or the decrease of 15.15%. These results should also be considered with caution as they can be influenced by speculation.

In general, in the case of positive news, in both models, with and without the inclusion of the extreme values, there was a decrease in cost of equity capital which is due partially to news appearance among other factors.

For the analysis of negative news publication both graphs from Figure 16 could be used because this news is not affected by the adjustment for extreme value. In this case, the cost of equity capital by using the three year model increased from 0.74% (September 2015) to 0.86% (October 2015) which implies an increase of 0.12 percentage points or an increase of 16.22%. The opportunity cost of capital estimated by five years model increased from 0.75% (September 2015) to 0.78% (October 2015). So the increase of 0.03 percentage points took place (4% increase). Therefore, it could be concluded that the negative news has created an increase in expected rate of return but depending on the model the impact differs.

It should not be forgotten that the results of this part should be considered with prudence. First of all because of speculation which takes place when the positive news appears. Secondly, the news is one of the elements which affects the changes in opportunity cost of capital.

It can be concluded that the window length is an important factor because depending on it, observations weight differently and so the model would be more or less volatile.

5. CONCLUSIONS

Information for investors is the most important component because it enables them to switch their portfolio in a way that will provide them the highest return for a given risk. That is why the information is priced and sometimes it leads to speculation as it is shown in the Porsche disclosure. The actions which investors take are reflected in the stock price changes which have an effect on the firm's cost of equity.

The analysis showed that in the case for Volkswagen's positive disclosure of information, the Capital Asset Pricing Model is not the best estimator of an opportunity cost of capital because of the assumptions on which it is based. The expected rate of return in this case has dropped from 0.33% in October 2008 to 0.28% in November 2008 (where the extreme values are not considered) which shows that there was an impact on cost of equity capital due to news appearance. The results obtained should be considered with caution as they may be affected by speculation or other elements like growth and size that could take place simultaneously with the news appearance.

Moreover, considering the adjusted model where the extreme value is eliminated, it can be concluded that the cost of equity capital has decreased when the news has appeared. This fact could mean that Porsche, to a certain extent, is considered by the market as a separate entity.

It would be interesting to know: what is the effect of the Porsche disclosure and the hedge funds actions in opportunity cost of capital separately. The interesting point is also the percentage changes between prices and expected rate of return because the prices had to increase almost 144.4% in order to make the CAPM decrease of 103.03% (given that extreme value is included).

In the case of negative news it is clear that the news has created some impact on the cost of equity which increased. It was shown that the CAPM in September 2015 was 0.74% while one month later it increased to 0.86%. As a matter of fact I have found that in case of Volkswagen's negative news a decrease in its stock prices of 34.15% translated into an increase of cost of equity capital of 16.22%. Therefore, considering that here the speculation does not taken place, the 2.11% of price change will cause a change of 1% in expected rate of return. However, one should bear in mind that I have not controlled for other variables that could affect the cost of capital. Personally, I was expecting a higher increase in cost of capital because, when this news appeared in the market, all the

media were talking about the way in which Volkswagen, a worldwide known firm, was cheating. Thus, as this news created such a big impact on media, I expected the opportunity cost of capital to increase further than 16.22%. It would be interesting to know exactly how this scandal would affect VW in the future because the news has hurt this firm's image. In view of this situation, not only the clients who bought the car with damaged software are affected but also the potential future buyers who were considering buying a car from VW. As a consequence, this news can create a negative impact on the profits of the firm which would result in different risk perception by the investors which would finally end in different cost of equity capital. Taking into consideration this logic, it would be interesting to analyze after some time by how much the profits changed due to this scandal and what would be its impact on cost of equity capital.

As it was demonstrated in the robustness check part, this model is not sensitive to risk-free changes if they present the same long-term horizon. But, cost of equity capital responds to different beta estimations because different results were obtained when five year betas were estimated instead of three year rolling window. Moreover, the betas obtained with five year model are less volatile because each observation counts less than in the model with fewer years. As the beta changed, the opportunity cost of equity capital has also changed. The five-year model presented lower increase or decrease in cost of equity capital than the other model.

It should not be forgotten that CAPM is a model which presents a backward looking issue instead of being forward looking because the investors want to know the future interest they would get if they invested in the firm. Despite this fact and all other issues related with this model, according to Welch (2008) 75% of Finance professors suggest the usage of this proxy. Moreover, this equation is also used as an estimator of cost of equity capital for big percentage of firms.

The following section will present some of the possible future research which could mitigate some of the difficulties found during the research and other proposals related with the same field of interest.

6. FUTURE RESEARCH

The Capital Asset Pricing model was used in this paper as a model to estimate cost of equity capital. This model in the case of the positive news had to be readopted in order to mitigate the effect of speculation. This fact questions if CAPM was the correct model to be used in this case. Therefore, it would be interesting to compare different models of cost of equity to see how the results differ. One of the models which could be used is multibeta model, explained in the theoretical frame, because this model would make possible to control different elements which affect the cost of capital. The application of this model would make possible to estimate better the cost of equity capital.

The other proposal would be related to the risk-free proxy. As it was shown, REX and 10-year German Government bonds have given almost the same results. But what would happen if instead of choosing long-term bonds I picked the short-term ones, like Euribor? As it depends on the investor's horizon, by adapting a short-term horizon the results of expected cost of equity capital should also change. Also in this case it would be interesting to compare both horizons and see its impact on opportunity cost of capital as there is no correct way to choose the risk-free proxy.

As my market proxy was DAX30 which only presents the 30 largest German firms it would be intriguing to use DAFOX which is a value-weighted portfolio of all the stocks that are traded on the Frankfurt Stock Exchange. Hence, DAFOX would represent a better market proxy. Consequently, the interesting point here would be to see how this market proxy would alter the results.

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APPENDIX I: NEWS DISCLOSURE

1. Positive News Disclosure

Panicked Traders Take VW Shares on a Wild Ride

By: Louise Story, Michael J. de la Merced and Carter Dougherty

Staff Reporter of *The New York Times*

28/10/2008 *The New York Times Journal*

The auto industry is struggling, but for a few minutes on Tuesday, Volkswagen became the most valuable company in the world, one with a market value greater than Apple, Philip Morris and Intel combined.

That soaring value reflected engineering of a financial, rather than automotive, sort. It came as stock traders scrambled when Porsche, a rival seeking to build one of Europe's great car dynasties, revealed it had increased its holdings in VW, giving it an economic stake equal to about 75 percent of the company's voting shares.

Volkswagen's stock soared to as high as 1,005 euros a share, about \$1,258, on Tuesday before closing at 918 euros. The shares ended last week at 210 euros.

The wild ride continued Wednesday morning as the price fell to 510 euros in German trading, after Porsche said it would take steps to increase the supply of stock, Bloomberg Newsreported.

Porsche shares jumped as much as 43 percent to 65.98 euros midday in Frankfurt, the steepest gain since at least 1996. The rise appears to have come from a short squeeze of historic proportions, as speculators who had borrowed the stock and sold it scrambled to buy shares. Many had expected the share price to fall after Porsche gained control and stopped buying shares.

Among the known short sellers are two large American hedge funds, Glenview Capital and Greenlight Capital. It is not clear if, or at what price, they covered any of their short positions.

Porsche now has huge paper profits, while some Wall Street firms may be facing losses that are just as big.

On Sunday, Porsche said it raised its stake in Volkswagen to 42.6 percent from 35 percent, and that it had taken options for another 31.5 percent.

Porsche said it made the announcement to give investors who sold the stock short ~~the~~ opportunity to close their positions unhurriedly and without bigger risk.”

The opposite happened. The risk soared, and the short sellers were forced to act quickly.

~~We’re~~ getting a sense of the sturm und drang in the markets now,” said Michael Holland, the manager of Holland & Company, an investment management firm. ~~When~~ you get into panicked markets as we’ve had in the past few months, you get these vicious moves which happen on the downside and then to the opposite direction. It’s incredible to watch.”

German regulators are scrutinizing the torrent of panicky trading, but it is not clear if they will act.

Porsche has waged a series of bitter legal and political battles over the last three years to gain control of Volkswagen.

Its strategy has been to make a creeping takeover of the company, purchasing options or shares in the open market and later announcing its new shareholding level in the company.

Porsche, the maker of legendary sports cars like the 911, earlier this year suggested it would stop its purchases when it got near 50 percent. That calmed long-running tensions with the German state of Lower Saxony, which owns a 20.2 percent stake in VW.

Volkswagen has a deal that would force Porsche to take control of the Swedish truck maker Scania, if it takes a majority stake in VW. That could cause Porsche to stop buying stock.

Hedge funds had used several strategies in VW shares. One was to exploit the difference in value between two classes of Volkswagen stock. Another was to buy into Porsche while betting that Volkswagen shares would fall.

As of last week, roughly 12.9 percent of Volkswagen shares were lent out, according to Data Explorers, a London-based research firm.

Volkswagen is one of the 30 companies in the DAX index, Germany's most prominent stock index, and index funds own a significant number of shares.

Those funds, however, may sell shares Wednesday. On Tuesday night the German stock exchange said it would reduce from 27 percent to 10 percent the weighting of VW in the index. To rebalance, the funds will have to sell VW and buy the 29 other companies.

Porsche gave few details of the options, other than to say they would be settled in cash.

Whoever sold Porsche the options might have been scrambling to buy shares this week to cut risk. When the options expire, Porsche will receive the difference between the market price of the shares and the exercise price of the options.

That could amount to tens of billions of euros. It seems unlikely that Porsche would have had the cash to exercise the options if it were required to pay for them and take delivery of the shares, but cash settlement means it will not have to put up cash if the options are profitable.

Shares in Morgan Stanley, Goldman Sachs and Société Générale of France tumbled during trading Tuesday, but the American firms made up the losses in the last hour of trading.

Jeanmarie McFadden, a spokeswoman for Morgan Stanley, said the firm had less than \$25 million in exposure to Volkswagen. A person who had talked to Goldman officials, but who refused to be quoted by name, said that firm did not have a large exposure to Volkswagen.

Porsche has made big profits on trading options in VW before. Most of the profits it earned in its 2007 fiscal year came from that source, but the potential profit from these options could vastly exceed that amount.

One hedge fund manager, Larry Robbins, the chief executive of Glenview, wrote to investors last week that his fund had shorted the stock.

“Fundamentally, things look bleak for the global automotive industry,” Mr. Robbins wrote. He added that the fund was committed to maintaining the short exposure for the eventual recoupling between the stock and its intrinsic value.”

Another hedge fund, Greenlight Capital, told its investors that it expected to profit eventually. “On a fundamental basis,” wrote David Einhorn, the manager, “we believe that Volkswagen is highly overvalued.”

It is not the first time Volkswagen shares have fallen prey to speculative gyrations. It lost a quarter of its value on Oct. 20, amid worries that Porsche might be able to steer decisions at the larger company to its advantage.

Although the two companies are linked by one powerful individual, Ferdinand Piëch, who heads Volkswagens board and also sits on Porsche’s, VW employees and their union have fought against a full takeover by Porsche, largely through their alliance with Lower Saxony, whose “golden share” lets it block major decisions about Volkswagen.

But the European Union is closing in on a ruling that could force Germany to alter the law underpinning the state’s stake. That has created an opening for Porsche to take control.

2. Negative News Disclosure

VW Is Said to Cheat on Diesel Emissions; U.S. to Order Big Recall

By: Coral Davenport and Jack Ewing

Staff Reporter of *The New York Times*

18/09/2015 *The New York Times Journal*

WASHINGTON — The Obama administration on Friday directed Volkswagen to recall nearly a half-million cars, saying the automaker illegally installed software in its diesel-power cars to evade standards for reducing smog.

The Environmental Protection Agency accused the German automaker of using software to detect when the car is undergoing its periodic state emissions testing. Only during such tests are the cars' full emissions control systems turned on. During normal driving situations, the controls are turned off, allowing the cars to spew as much as 40 times as much pollution as allowed under the Clean Air Act, the E.P.A. said.

“We expected better from Volkswagen,” said Cynthia Giles, the E.P.A.’s assistant administrator for the Office of Enforcement and Compliance. She called the automaker’s actions “a threat to public health.”

Agency officials issued the car company a notice of violation and said it had admitted to the use of a so-called defeat device. The recall involves 4-cylinder Volkswagen and Audi vehicles from model years 2009-15.

A spokeswoman for Volkswagen confirmed that the company had received the notice and said the automaker was cooperating with the investigation. She declined to comment further on the case.

The software was designed to conceal the cars’ emission of the pollutant nitrogen oxide, which contributes to the creation of ozone and smog. The pollutants are linked to a range of health problems, including asthma attacks, other respiratory diseases and premature death.

Experts in automotive technology said that disengaging the pollution controls on a diesel-fueled car can yield better performance, including increased torque and acceleration.

“When the pollution controls are functioning on these vehicles, there’s a trade-off between performance and emissions,” said Drew Kodjak, executive director of the International Council on Clean Transportation, a research group. “This is cutting corners.”

It was Mr. Kodjak’s group, in conducting research on diesel vehicles, that first noticed the discrepancy between Volkswagen’s emissions in testing laboratories and on the road. They brought the issue to the attention of the E.P.A., which conducted further tests on the cars, and ultimately discovered the use of the defeat device software.

California has issued a separate notice of violation to the company. California, the E.P.A. and the Justice Department are working together on an investigation of the allegations.

Over the next year, E.P.A. officials said, owners of the affected vehicles should expect to receive recall notices from the company, including information about how to get their cars repaired at no cost to them.

The recall covers roughly 482,000 diesel passenger cars sold in the United States since 2009.

Affected diesel models include the 2009-15 Volkswagen Jetta, 2009-15 Beetle, 2009-15 Golf, 2014-15 Passat and 2009-15 Audi A3.

Friday’s notice of violation was the Obama administration’s “opening salvo” in the Volkswagen case, said Thomas Reynolds, an E.P.A. spokesman. The Justice Department’s investigation could ultimately result in fines or penalties for the company. Under the terms of the Clean Air Act, the Justice Department could impose fines of as much as \$37,500 for each recalled vehicle, for a possible total penalty of as much as \$18 billion.

The notice of violation is part of a broader, more aggressive enforcement effort by federal regulators on the auto industry. Analysts and activists said it was intended to send a message to automakers that they would be harshly treated for compromising federal rules.

“This is several steps beyond the violations that we’ve seen from other auto companies,” said Tyson Slocum, director of the energy program at Public Citizen, a

consumer advocacy group. —They appear to have designed a system with the intention to mislead consumers and the government. If that’s proven true, it’s remarkable and outrageous. It would merit a heck of a lot more than just a recall and a fine. We would see criminal prosecution.”

In recent years, the federal government has aggressively pursued automakers for failing to disclose safety violations, although the settlements often reached have fallen short of expectations. On Thursday, General Motors agreed to pay the federal government a \$900 million penalty for failing to disclose defects in ignition switches, a deal that disappointed many of the victims’ families. In 2013, Toyota recalled more than 10 million vehicles and agreed to pay the United States government a \$1.2 billion settlement, admitting that it concealed information from consumers and regulators about problems with that caused the cars to unexpectedly accelerate.

Analysts said that the administration now appears to be pursuing similar tactics against automakers that conceal violations of health and environmental rules. In November 2014, the administration announced the largest penalty ever for a violation of the Clean Air Act after the Korean automakers Hyundai and Kia agreed to pay a combined \$300 million as part of a settlement for overstating vehicle fuel-economy standards on 1.2 million cars.

—They want to make it clear that they’re going to crack down on cheaters,” said Frank O’Donnell, president of the environmental advocacy group Clean Air Watch. —They’re cheating not only car buyers but the breathing public. They want to lay down the law, enforce the law and show they’re not going to tolerate cheaters. The laws and regulation are only as good as the enforcement.”

The notice of violation is especially embarrassing for Volkswagen because it comes days after the company trumpeted plans to introduce 20 plug-in hybrid or all-electric vehicles by 2020 as part of a campaign to reduce vehicle emissions.

News of the recall request also arrives in the midst of the Frankfurt Motor Show, one of the biggest events on the auto industry calendar. Volkswagen has taken over an entire exhibition hall to show off its cars, while Audi has a separate pavilion.

Volkswagen, which also owns the high-end sports car makers Porsche and Lamborghini, recently surpassed Toyota as the world’s biggest automaker. But VW has

been struggling to gain market share in the United States, where it has long been weak. The investigation is unlikely to help. In the eight months through August, sales of Volkswagen brand cars in the United States fell 3 percent, to 238,000 vehicles. By comparison, Toyota sold 1.15 million vehicles in the same period.

Richard Corey, an executive officer on the California Air Resources Board, credited “dogged detective work in the lab” for the discovery of the software, which he said resulted in the admission from Volkswagen that the company was using the devices.

E.P.A. officials declined to reveal why they chose to initiate the investigation.

The Volkswagen case is not the first federal investigation into the use of defeat devices. In 2007, the federal government reached a landmark settlement requiring Casper’s Electronics, of Mundelein, Ill., to stop selling the devices, and to pay a \$74,000 civil penalty. The company had sold approximately 44,000 defeat devices through its website and retailers since 2001.