

# The impact of a change in sovereign credit ratings on stock market volatility: A comparison of emerging and developed countries

A Dissertation

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## **LIST OF ACRONYMS**

AAV	Average Abnormal Volatility
BOVESPA	Bolsa de Valores do Estado de São Paulo
BRICS	Brazil, Russia, India, China, South Africa
CAAV	Cumulative Average Abnormal Volatility
CAV	Cumulative Abnormal Volatility
CBOE	Chicago Board Options Exchange
CDS	Credit Default Swap
CPI	Consumer Price Index
EMH	Efficient Market Hypothesis
ETF	Exchange Traded Funds
EU	European Union
EWZ	MSCI Brazil Capped ETF
FDI	Foreign Direct Investment
FTSE	Financial Times Stock Exchange
GARCH	Generalised Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
JSE	Johannesburg Stock Exchange
LSE	London Stock Exchange
MSCI	Morgan Stanley Capital International
NIFTY 50	National Stock Exchange India Fifty
NSE	National Stock Exchange

NYU	New York University
S&P	Standard and Poor
SA	South Africa
SAVI	South African Volatility Index
SCR	Sovereign Credit Ratings
UK	United Kingdom
USA	United States of America
USD	United States Dollar
VIX	Volatility Index
VXEWZ	CBOE Brazil Volatility Index
WACC	Weighted Average Cost of Capital
ZAR	South African Rand

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My baby cat Sox who could always remind me to take a break.

## **ABSTRACT**

Sovereign credit ratings affect a country's financial well-being. The financial markets, at large, have become quite topical within the public space, as well as policy makers and academics. This area has been examined in detail, especially after the global financial crisis of 2008. Rating agencies have been under great scrutiny against their issued ratings and accused of favouring developed economies over developing ones by providing higher ratings to the former.

Using a panel of emerging and developed countries over a period of ten years (June 2007 – June 2017), this study examines whether a change in sovereign credit ratings by one of the big three rating agencies has an effect on the volatility of the stock market. This dissertation makes use of an event study over various estimation windows, and the findings depict that changes in sovereign credit ratings do have an effect on stock market volatility. Rating downgrades tend to increase volatility whilst upgrades tend to decrease volatility. Countries that have lower ratings, classified as emerging economies, are no less sensitive to rating changes compared to developed markets and both observe a significant effect on volatility when there is a change in credit ratings.

The credit rating agency that had the greatest impact on the volatility of the stock market in response to a rating change is S&P. This was for both upgrades and downgrades. Fitch and Moody's did not elicit any significant findings. This shows that the market is more responsive to an announcement by S&P than the other agencies.

An understanding of the actual effect of this volatility in the equity stock market will have implications for investors, governments, pension funds and asset holders by providing them with country risk assessments and giving them the ability to rebalance their portfolios as required. It also has an impact in determining the cost of capital and evaluating investments, which affect asset allocation decisions.

This study has important information, which could help contribute to credit rating agencies' understanding of the implications that their issued ratings have on the stock market and their contribution to volatility within the market place. The policy implications of this study could affect institutions, especially the Basel committee and banking institutions whom are highly affected by the policies set out by Basel.

## **CHAPTER 1: INTRODUCTION**

### **1.1 Research Background**

“Moody's, S&P and other credit rating agencies deserve a failing grade” – (Joffe, 2013)

“Rating agencies still coming up short, years after the crises” – (Morgensen, 2016)

“‘Egregious’ and ‘compromised’: India thinks ratings firms like S&P and Moody’s are biased” – (Karnik, 2017a)

“How credit rating agencies rule the world” – (Kingsley, 2012)

“Moody's fined: Agency admits to false credit ratings” – (Gombert, 2017)

“S&P draws criticism as sets ratings reform” – (Stempel & Barley, 2008)

“The Indian government has delivered a piercing criticism of rating firms like Standard & Poor’s and Moody’s” – (Karnik, 2017b)

“The Credit Rating Controversy” – (Mallaby, 2015)

“Who rates the raters?” – (The Economist, 2005)

These are some of the international headlines that rating agencies have had to contend with in recent years—from questioning their ability to accurately assign ratings, to the informative value that their ratings have on the market. These credit rating agencies have further been criticised for not only being unable to predict the global financial crisis of 2008, but also the Asian crisis of 1997, with their slow reactions and actions possibly intensifying and prolonging the latter (Radelet & Sachs, 1998).

The methods used by these agencies in arriving at these ratings have been brought into question, as these assessments tend to result in lower ratings for emerging markets, thus constraining growth (“BRICS Summit 2016”, 2016). Brazil, Russia, India, China, and South Africa, a grouping of countries commonly referred to as BRICS, have publicly voiced their disagreement with their sovereign credit ratings issued by major credit agencies, citing unfairness in their assessment by favouring more developed western economies. This, in turn, has led to the New

Development Bank, a multilateral bank formed by the BRICS countries, exploring the option of creating their own rating agency; one which understands the dynamics of emerging markets better in order to rate them more fairly (“BRICS agrees to fast track new credit rating agency”, 2016). Other experts, such as Lourdes Casanova, have noted that rating agencies have a lesser-known understanding of countries and products geographically far away, as opposed to those closer to home. This is especially true for the big three rating agencies who control 95% of the market: the British Fitch, the American Moody’s, and Standard and Poor’s (S&P) (Karnik, 2017b).

Several studies have examined the effects of credit rating changes. Some of this research has considered the effects that credit ratings have on bond yields (Cantor & Packer, 1996; Hibbert & Barber, 2011; Afronso, Furceri, & Gomes, 2012). This research shows that credit ratings have a significant effect on bond yields and contagion effects on other bond markets within that geographic area. Other studies have looked at the effect that credit rating changes have on stock prices, with Kaminsky and Schmukler (2002) finding that changes in credit ratings affect stock returns, as well as country risks. Timmermans (2012) also found that rating changes have a negative effect on stock returns.

Nordern and Weber (2004) studied the effects that credit rating changes have on both the stock markets and credit default swaps (CDS) and documented, similarly to Kaminsky and Schmukler (2002) and Timmermans (2012), that rating changes do affect the stock market as well as the CDS market. These findings are in line with the theory that rating agencies are international institutions who provide information in the form of credit ratings to reduce the asymmetry of information between capital market participants. By providing new information to markets, this should intuitively have an effect on credit risk sensitive instruments such as stocks, bonds, and underlying derivatives.

Given the effects that these credit rating changes should have on the above instruments, the expectation is that it will give rise to volatility in the markets. Very few studies, however, have explicitly examined the effects of changes in credit ratings on the volatility of markets. Hooper, Hume and Kim (2008) found that ratings upgrades decreased volatility, whereas downgrades increased volatility in the stock markets, while Treepongkaruna and Wu (2012) found that stock and currency markets react heterogeneously to credit rating changes.

## **1.2 Problem Statement**

In light of the attention and criticism that the credit rating agencies have faced in the BRICS countries, it is of value to understand precisely what effects these announcements have on the markets of these countries. Fleming, Kirby and Ostdiek (1998) maintain that the best way to examine information and information linkages in financial markets is through volatilities. Yet, very few studies have explicitly examined the effect of changes in sovereign credit ratings on market volatility. In light of this gap, this study seeks to expand on the work of Hooper et al. (2012), Brooks, Faff, Hillier, and Hiller (2004), and Treepongkaruna and Wu (2012) by considering the impact of sovereign credit rating changes on stock markets. This research will particularly focus on the BRICS countries, where the actions of the credit rating agencies have been the subject of much debate.

The focus is not only on the effect of changes in the ratings, but the study also aims to distinguish whether upgrades or downgrades have different effects on volatility. It further investigates whether the volatility around the time of the announcement differs in emerging markets compared to developed markets and whether responses differ depending on which agency makes the announcement. As this study thus focuses on information and information linkages, it also provides important information about the efficiency of markets.

## **1.3 Research Questions and Scope**

The research question, which is the focus of this study, is:

*What is the effect of a sovereign credit rating change on stock market volatility?*

The specific research objectives of this study are as follow:

- to determine if a change in the sovereign credit rating (on both local and foreign currency debt) has an impact on the volatility of the stock market;
- to assess whether the type of credit rating change, either an upgrade or a downgrade, elicits abnormal volatility and if so, whether it increases or decreases volatility;
- to ascertain whether the impact of credit rating changes on stock market volatility differs between emerging and developed countries; and

- to examine if the announcement of a sovereign credit rating change by the different agencies has a different impact on the volatility of the stock market.

#### **1.4 Purpose and Significance of the Research**

The purpose of this study brings an understanding of the far-reaching effects and information conveyed to the market of a sovereign rating change. For example, following the downgrade by S&P on the South African (SA) foreign currency, rating it to junk status in response to the axing of Pravin Gordhan the finance minister, the Chief Executive Officer of Nedbank stated that “short-term volatility is expected in banking stocks” (Bonorchis, 2017).

This study contributes to the literature by not only analysing a unique sample but also using a different methodology to Hooper et al. (2008) and Treepongkaruna and Wu (2012). This enables the dynamic effects of the credit rating changes to be captured through an event study, as opposed to a static panel regression used by these authors. This study is in line with the methodology used by Brooks et al. (2004), Norden and Weber (2004), and Timmermans (2012), and will contribute to the findings of the sensitivity of emerging markets’ responses to these ratings, as well as the rating agencies that have the most effect on the stock markets.

The contribution of this study in examining the effect of changes in sovereign credit ratings on the volatility of stock markets in emerging countries will be to provide insight as to whether investors place substantial emphasis on these ratings when making investment decisions, and whether this differs across geographies. An understanding of the actual effect of this volatility in the equity stock market will have further implications for investors, governments, pension funds and asset holders by providing them with country risk assessments and giving them the ability to rebalance their portfolios as required. It also has an impact in determining the cost of capital and evaluating investments, which affect asset allocation decisions.

Volatility implies risk, which in turn deters long-term investment into a country making it harmful for an emerging market that requires investment to grow. Fear affects the markets, which can sometimes lead to contagion. Volatility is also driven by reactions to news and is commonly referred to as the fear gauge. Long-term investors seek a better risk adjusted return environment. Investors do not like to make long-term investments in a market that has a high incidence of volatility, as they perceive it as risky.

Long-term capital is more desirable as it enables countries to utilise these funds for long-term projects, which contribute to the growth of the country and economy. Long-term investors who want to understand the stability of markets, in light of credit rating changes, could use the research on the volatility effect of emerging and developed markets. This research will also assist short-term investors who can make quick money as speculators in a volatile market. Investors will also be able to align their investment horizons to longer or shorter periods, depending on the timing of the rating agency changes. Credit rating agencies themselves can benefit by understanding the effects that the ratings they issue have on the market.

Overall, this research has important policy implications in light of the increased role of sovereign credit ratings under the current Basel banking regulatory framework. Basel regulations now require that certain sectors hold a specified rating in order to be held as assets for compliance reasons. This will especially have an impact on the banking industry, being the most affected. As per these proposed new regulations, banks are now required to hold certain grades of capital, as well as values, based on the various buckets of debt that are categorised into different tiers. This makes it more costly and expensive, which will affect the end consumer and the economy at large. The public has become much more aware of the effect that credit ratings have on the country's economy. This information is more accessible to people given the rise of social media, as it affects their individual financial situation.

The significance of credit ratings information on the stock market has implications for the semi-strong form of market efficiency, which states that all public information should be immediately reflected in financial market prices (Treepongkaruna & Wu, 2012). The evidence found could influence the BRICS decision to create a new ratings agency by reinforcing the importance of credit ratings, as their impact could be much greater than generally perceived.

## **1.5 Structure of the study**

The remainder of this paper is organised as follows. Chapter two discusses the literature, including both the theoretical review, as well as an examination of previous empirical studies on the effects of sovereign credit rating announcements on stock and bond markets. Chapter three focuses on the research methodology, including the dataset that was compiled for the study and the data analysis techniques used to answer the research objectives outlined in this

chapter. Chapter four presents the findings of the study and analyses the results in the context of the relevant theory and previous empirical studies. The paper then concludes in chapter five.

## **CHAPTER 2: LITERATURE REVIEW**

### **3 Introduction**

This chapter provides a review of the literature on credit rating changes and its effect on the stock market. It will also discuss the background of the efficient market hypothesis (EMH) and credit ratings themselves. Firstly, the review begins by understanding the importance of credit ratings, as well as how they are calculated. This is followed by the types of credit ratings available, which will then move into a review of the EMH. An empirical review on the topic will also be examined. This chapter concludes with a summary of the discussion of the literature review, findings, and the intention of this study.

### **4 What are credit ratings and why are they important?**

Credit agencies provide credit risk information in the form of ratings to the public or a client, which could be a business or a country. This credit rating is issued by one of the credit rating agencies (S&P, Moody's and Fitch are the top three) using a complex rating process which encompasses qualitative and quantitative information about the client in question that is both public and non-public. These ratings provide information to the market as to the creditworthiness of the client by implying the risk of default and repayment ability (Kronwald, 2009).

This study focuses specifically on sovereign credit ratings (SCR), which provide assessments on a national government's ability and willingness to service debts in a timely manner (Treepongkaruna & Wu, 2012). By assigning a credit rating to a country, this provides country risk information to the market and to investors, which affect investment decisions. The lower the rating the higher the compensation required to attract investment as a reward for the riskiness of the bond (as per the fundamental relationship in finance of high risk, high reward). Whereas the higher the rating, the cheaper it is to borrow money due to lower risk. As such, for a country, these sovereign credit ratings influence the cost at which a country is able to borrow money in the market. The riskier the bond, the costlier it is to borrow for a country, further eroding the fiscus and increasing the debt to GDP ratio in order to service this debt. In contrast, the lower the risk, the cheaper it is for the government to borrow funds to grow the economy.

Sovereign ratings are not only important for the government, but for the economy as a whole, as corporations that operate within that country generally cannot have higher ratings than the sovereign in which it is domiciled. This is commonly referred to as the sovereign ceiling doctrine (Kaminsky & Schmukler, 2002). Thus, when there is a sovereign downgrade, debt instruments within that country may have to be downgraded in line with the sovereign in which it operates. The impact on a corporation will be an increased cost of borrowing. Higher rates of borrowing increase the corporation's weighted average cost of capital (WACC) thereby increasing the return that investors require to justify their investment (Bekaert & Harvey, 1997). Corporations, in general, are fairly leveraged and it is rare to see a large corporation operating without debt. This has a direct effect on the cost of doing business in the country, which either increases or decreases overall economic growth and profitability, depending on the direction of the rating change.

The rating agencies such as S&P, Moody's and Fitch allocate ratings to a country. The different agencies use different rating methodologies, as well as different scales in order to arrive at these conclusions. These scales are available in Appendix A. However, they all make use of key pillars. Each of these pillars provide information to the agencies that enable them to make an informed decision by being able to rate the countries on their ability and willingness to service their debt.

Moody's uses four factors in order to arrive at their ratings:

- economic strength: which depends on the growth potential, diversification, competitiveness, as well as national income and scale;
- institutional strength: this drives economic policies of governments that contribute to economic growth and social welfare;
- fiscal strength: the position of the public finances of the country; and
- susceptibility to event risk: understanding the risk that sudden or extreme events will have on public finances (Moody's, 2013b).

S&P uses five factors when arriving at their credit ratings, these being:

- political score: this reflects the political risks that a country may be facing as well as the institutional efficiency;
- economic score: which analyses growth prospects as well as economic structure;

- external score: which looks at external liquidity as well as the international investment position;
- fiscal score: reflects the fiscal performance and flexibility as well as the debt burden; and
- monetary score: which reflects monetary flexibility (S&P, 2012).

Fitch uses four factors in their analyses, which are:

- macroeconomic performance: reflected by inflation, as measured by the consumer price index (CPI), real growth in gross domestic product (GDP), as well as the volatility of this growth;
- public finances: which includes gross debt, interest payments, budget balances, as well as public debt in foreign currency;
- external financing: this is evaluated by looking at current account balances net of foreign direct investment (FDI), gross sovereign external debt, international reserves and external interest service; and
- structural features of the economy: factors analysed include GDP per capita, reserve currency status, and years since default and governance indicators (Fitch, 2012).

The political landscape and policy plans of a sovereign and their effects on the metrics used to arrive at a rating, are large contributors to the ratings. Given their ability to provide valuable forward-looking information, affects all aspects of a country, from social spending to economic growth and, accountability within the public and private sector (Fitch, 2012).

## **5 Types of credit ratings**

Various types of rating announcements are important and need to be understood when gauging a country's creditworthiness. This consists of not only an actual rating upgrade or downgrade, but an outlook or watch announcement as well. An outlook announcement is an announcement that an agency might make before the rating announcement. This generally happens a few weeks or months before a decision on an actual rating occurs.

Further to this, there are two different types of currency credit ratings, being local and foreign currency, both for long- and short-term debt. Local ratings are allocated to countries that issue bonds in their local currency, for example, South African Rand (ZAR) bonds for South Africa

or Peso bonds for Brazil. Foreign ratings are issued to countries that issue foreign denominated bonds, for example, South Africa issuing a bond denominated in United States Dollars (USD), commonly referred to as Eurobonds. Initially, countries were only allocated a foreign rating as funding was only raised in foreign denominations. Over time, however, countries began to issue bonds in their own currency, which necessitated rating agencies issuing different ratings based on the different currency denominations of the bonds (Packer, 2003).

As a credit rating is the ability and willingness of a country to service this debt, this definition led to differences between the foreign and domestic currency ratings of a country, commonly referred to as the ratings gap (Moody's, 2010). Typically, a domestic currency rating is higher (i.e. a lower chance of default) than a foreign currency rating, mainly because of the ability of a country to service their local debt by having complete control over the supply of money. This control enables them to print more currency when required upon redemption (not taking into account inflationary concerns). This, however, holds true only for countries that use their own currency, but not for those that do not.

For example, all countries within the European Union (EU) need to operate within the laws that govern the monetary policy of the Eurozone. As such, when Greece experienced difficulties in repaying their Eurobond debt in 2010, they were unable to print more money to service these debts. The same applies to countries that are dollarized and do not have their own currency, such as Zimbabwe. Countries that issue Eurobonds upon redemption will have to dig into their foreign currency reserves or go out and purchase the foreign currency from the market. This will open them up to foreign exchange risk, which in turn increases the risk of default, hence, accounting for a lower foreign currency debt rating.

The rating gap that has existed between foreign and local currency has begun to narrow in recent years. Moody's has found that defaults and losses within a sovereign are not specific to a foreign or local currency debt instrument, but rather, that these defaults occur across both foreign and local currency debt instruments. For example, if a country defaults, they default across all debt instruments thereby the risk of local and foreign currency debt is similar. As such, rating gaps are far smaller and less frequent (Moody's, 2010).

Credit ratings fall into two investment areas, namely investment grade and non-investment grade, with the latter commonly referred to as junk. If two or more rating agencies classify either the foreign or local currency debt as junk it makes that specific currency rated non-

investment grade and vice versa for investment grade. Thus, it is possible to have a single agency classify it as junk whilst still maintaining an investment grade rating on the asset class. If, however, either S&P or Moody's grade the local currency as investment grade irrespective if the foreign currency has been downgraded to junk, the sovereign will remain on the key global bond index such as the Citigroup World Bond index (Donnelley, 2017).

When a country receives a junk rating on their debt, it is usually followed by capital flight where money flows out of the country. This happens because numerous investments, especially those by institutional investors such as pension funds, have a mandate that does not allow investments in junk bonds given the perceived riskiness of the investment. Capital flight, in turn, causes currency weakness (and fluctuations) due to the currency selloff that arises with moving capital offshore. Massive movements within the stock market are seen, as well as an increase in CDS spreads due the increased riskiness of the bonds; all of which could wipe substantial value off the stock exchange (Veritas Wealth, 2017).

## 6 The Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) of Fama (1970), which explains how markets price information, is one of the cornerstones of financial theory and provides the theoretical underpinning for this study. This theory states that it is impossible to "beat the market" because existing share prices always incorporate and reflect all relevant information. According to the EMH, stocks trade at their fair value on the stock exchanges, making it impossible for investors to either purchase undervalued stocks or sell stocks for inflated prices. As such, it should be impossible to outperform the overall market through expert stock selection or market timing, and the only way an investor can possibly obtain higher returns is by purchasing riskier investments (Fama, 1970; Jensen, 1978). Fama (1970), differentiated between three forms of market efficiency:

### 1. Weak Form EMH

If a market is weak form efficient, stock prices reflect all market information. This means that the rates of return on the market should be independent; past rates of return have no effect on future rates. Given this assumption, trading rules based on technical information, such as those

used by traders to buy or sell stocks, will be ineffective, as they will not lead to abnormal returns (Fama, 1970).

## 2. Semi-Strong Form EMH

Under the semi-strong form of the EMH, a market is efficient if stock prices reflect all publicly available information such as annual financial statements and earnings releases, dividend announcements and macroeconomic factors. This form of market efficiency rests on the assumption that stocks adjust quickly to absorb new information. The semi-strong form EMH also incorporates the weak form efficiency conditions. Given the assumption that stock prices reflect all new available information and investors purchase stocks after this information is released, an investor cannot benefit over and above the market by trading on new information (Jensen, 1978).

## 3. Strong Form EMH

A market is strong form efficient if stock prices reflect all public and private information; thus, building on and incorporating the weak and semi-strong forms of the EMH. Given the assumption that stock prices reflect all information (public as well as private) no investor will be able to profit above the average investor even with new inside information (Fama, 1970).

The strong form of EMH means that private information is priced into the share prices, and people with this information should not be able to make abnormal profits by trading on this. This is not consistent with Jaffe (1974), who finds considerable evidence that insider trades are profitable. Insider trading is illegal and people who engage in this practise are generally prosecuted.

The announcement of a credit rating change provides information to the market. In an efficient market, this will have a direct impact on the market itself. Sovereign credit ratings provide information of the willingness and ability of a country to service their debts within a reasonable period. As bonds are debt instruments and are generally priced on credit ratings, a change in these credit ratings will change the pricing of these bonds. That is, it will become more expensive to service in the event of a downgrade and less expensive in the event of an upgrade, as the creditworthiness of an instrument increases, the risk of default becomes less.

The riskier the instrument the higher the return required in order to compensate for the higher risk, making the instrument attractive to investors. Given that debt is generally an integral part of an organisation, this in turn should affect the share price, as the cost of capital is expected to increase. Studies such as Fama, Fisher, Jensen, & Roll (1961) have proven markets to be efficient, incorporating information into the share price. Griffin, Kelly, & Nardari (2010) found that both developed and emerging markets exhibit the weak to semi-strong form of market efficiency, which encompassed all the countries within the sample used in this study.

The expectation will then be that if a credit rating change provides new public information to the market then if the market is efficient, this information should immediately be reflected in the stock prices. This would thereby not allow investors to consistently profit by trading on this information, as found by Ross (1989), where the volatility of prices is directly linked to the rate of information flow in the market (Bekaert & Harvey, 1997).

In the context of this study, the EMH will be the information flow (transmission mechanism) between credit rating changes and the volatility of the stock market. If a credit rating announcement consists of an information flow to the market (where the share prices did not fully reflect all available information), one will expect to see an effect on volatility as found by Ross (1989), given the markets the sample operates in have been found to be weak to semi strong efficient as per Griffin et al. (2010).

## 7 Empirical review on rating changes

Numerous studies have examined the effects that credit rating changes have on the economy. Most of these studies focused on the effect on stock market returns and bond yields. There have also been studies that looked at the different reactions between emerging and developed markets, as well as the different informational value that the three rating agencies communicate to the market.

Using a panel of emerging markets and performing both panel regressions and event studies within a ten-day window and a hundred-day estimation period, Kaminsky and Schmukler (2002) questioned whether changes in sovereign debt ratings and outlooks contribute to market instability by affecting market risk and stock returns. They found that rating changes directly affect the stock and bond markets within these countries. Moreover, their results revealed that

emerging market sovereign rating news is contagious for bond and stock markets in these markets, particularly during periods of turmoil and particularly for neighbouring countries. These rating changes may unveil new (private) information about a country, which might fuel market rallies or downturns. The effect is likely stronger in emerging markets where problems of asymmetric info and transparency are more severe.

Brooks et al. (2004) also made use of this ten-day window and hundred-day estimation period in an event study to examine the effect of downgrades and upgrades on national stock market indices. Their study built on other studies, which examined individual stocks by looking at national stock market returns. They found that only downgrades convey information to the market and only S&P and Fitch's downgrades result in significant market falls. Their findings contradict Kaminsky and Schmukler (2002), in that they found no evidence that emerging markets are more sensitive to credit rating changes.

In terms of the informational value of credit rating agencies, an event study by Norden and Weber (2004) found that S&P and Moody's exhibit the largest impact on both stock market returns and CDS spread changes. A study by Hand, Holthausen and Leftwich (1992) found that rating announcements directly affect corporate securities, although market anticipation often mutes the average effects. Richards and Dedouche (1999) expanded on the study of Hand et al. (1992) and found, by using emerging market data on bank stocks and examining the impact of rating changes on these stocks, no statistically significant effects were found.

Timmermans (2012) also looked at individual stocks, however, this study was done within the European market and across industries. Using an event study, the researcher found that downgrades result in significant abnormal returns, whilst upgrades result in negative significant abnormal returns, even though this is only for the period preceding the rating announcement.

From an amplification perspective, Radelet and Sachs (1998) argue that severe downgrades during crisis periods can cause a country to become isolated from the international economy if its commercial banks get rated below investment grade, thereby amplifying the impact of the rating changes. This feeds into the importance of sovereign credit ratings of a country. The new Basel standards place a large emphasis on these ratings, as well as various levels of capital that financial institutions have to hold, which in turn can affect the liquidity in the market. Banks are generally more susceptible to changes in ratings rather than other types of stocks as found by Hardouvelis (1987).

Turning to the effects of sovereign credit ratings on markets, emerging markets have been found to be more susceptible to sovereign rating changes than developed markets. This literature also documents a more general heightened sensitivity to macroeconomic events in emerging countries (Calvo & Mendoza, 2000; Chang, Cheng, & Khorana, 2000; Hooper et al., 2008). This is consistent with prior studies of the bond market reaction to sovereign rating changes (Larrain, Reisen, & von Maltzan, 1997).

These studies, however, fell short in looking at the volatility effect on stock markets, which prompted the study of Hooper et al. (2008). By using a panel regression over an eight-year period, they found that among the rating agencies examined, only downgrades by S&P and Fitch, resulted in significant market falls. This is in line with the findings by Brooks et al. (2004), who found S&P and Fitch elicit significant findings. Researchers found no differences between the sensitivity to rating changes in emerging markets and non-emerging markets. Their study further expanded on the finding that rating upgrades (or downgrades) significantly increased (or decreased) USD denominated stock market returns and decreased (or increased) volatility. Both return and volatility are more pronounced in the cases of downgrades, foreign currency debt, emerging market debt, and during crisis periods, which could amplify a crisis.

Volatility is important to understand, as it affects the market in a way that can be unpredictable. Excess volatility within a market causes panic, which in turn can affect the market itself. This could lead to contagion and in extreme cases, lead to financial sector collapse. Therefore, understanding the drivers of volatility is an important risk management tool.

The importance of volatility was discussed by Bekaert and Harvey (1997) who looked at the drivers of volatility in emerging markets, as it is a key input into the cost of capital calculation, making it critical in decisions to effectively allocate assets. Using the generalised autoregressive conditional heteroscedasticity (GARCH) models, as well as regression analysis, they concluded that in fully integrated markets or developed markets, world factors strongly influence volatility, whereas in segmented or emerging markets, local factors strongly influence volatility. There is also a difference between emerging countries themselves and how they respond to drivers of volatility, with the conclusion that more open economies (open to world trade) tends to have lower volatility. Liberalisations in capital markets tend to decrease volatility given the shift towards this more open economy.

Expanding on this, Treepongkaruna and Wu (2012) found that volatility is of particular concern as evidenced from the Asian financial crisis, using a pooled panel regression on both outlooks and credit rating changes. The researchers found that credit rating changes (outlooks having a more significant impact than actual rating changes) had a significant effect on stock market realised volatilities, with upgrades (downgrades) decreasing (increasing) volatility. During financial crises, these markets are sensitive to rating downgrades. Investment grade countries were found to have significantly lower realised volatilities in both stock and foreign currency markets.

The literature above does speak to an effect of ratings on the stock market, as well as an amplified movement within emerging markets and some agencies receiving a greater reaction to their ratings than others do. This will enable this study to make a comparison by bringing all these pieces of information together to understand whether there is volatility in the market when there is news of a change in rating, if the market anticipates it, as well as whether this reaction is different between emerging and developed markets. This study aims to expand on this with a specific view on the equity portion of the market, focusing on volatility.

## **8 Summary**

This chapter examined the concept of credit ratings, the reasons they are issued, as well as the informational value that accompanies them. It then went on to discuss the different types of credit ratings issued by the different credit agencies and into a discussion of the factors that each agency uses to arrive at their rating for a country. In further understanding the informational value that these ratings communicate to the market, a discussion on the efficient market hypothesis in terms of the theories that underline this study was discussed. As per the literature review, it was found that most markets are weak to semi-strong form efficient.

The literature then goes on to examine the findings that other studies had explored when looking at the effect that credit rating changes have on the markets. Effects on bond yields, CDS spreads, contagion and stock returns have been examined in detail, with very few studies looking specifically at the volatility in the stock market, which is what this study aims to understand. Conflicting information on the effect of these credit ratings on emerging versus developed economies was found, as well as the informational value that the different credit rating agencies elicit after an announcement.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This chapter will look at the research methodology behind the event study adopted by this dissertation and is broken down as follows. Section two will look at the research approach and strategy that this study will follow and the main hypotheses. Section three will go into the sampling process to understand how the researcher arrived at the sample. The study will then expand into section four, which will analyse the data collection process as well as the frequency and choice of data chosen. Section five goes into the data analysis method used and the accompanying calculations that have been followed. Understanding the reliability and validity will be examined in section six. This chapter ends by understanding the limitations of this study.

### **3.2 Research Approach and Strategy**

This study seeks to examine the effects of sovereign credit rating changes on the volatility of the market. This study investigated the research question in the form of four main hypotheses linked to the research objectives specified in Chapter One. These hypotheses are as follow:

#### Hypothesis one:

H0: Sovereign credit rating changes (both local and foreign currency debt) do not have a significant effect on the volatility of stock markets.

H1: Sovereign credit rating changes (both local and foreign currency debt) have a significant effect on the volatility of stock markets.

#### Hypothesis two:

H0: An upgrade has the same effect on the volatility of the stock market as a downgrade.

H1: An upgrade has a different effect on the volatility of the stock market to a downgrade.

#### Hypothesis three:

H0: The effect of a ratings change is similar for both emerging and developed markets.

H1: The effect of a rating change has different effects for emerging and developed markets.

#### Hypothesis four:

H0: A rating agency's announcement has a similar effect on the volatility on the market compared to other agencies.

H1: A rating agency's announcement has a different effect on the volatility on the market compared to other agencies.

The approach of this study was similar to that of Essaddam and Mnasri (2014) in evaluating the effects of certain events on the volatility of the stock market by calculating the cumulated average volatility (CAV). Moreover, the standard calculations associated with an event study method across various event windows were used, following Timmermans (2012) amongst others. Other studies that have analysed credit rating changes using the event study methodology include, Brooks et al. (2004), and Norden and Weber (2004), although these studies focused on returns as opposed to volatility. Other studies that have utilised different methods include the panel regression model in understanding the effects of an event on volatility. Studies that have used this method include Hibbert and Barber (2011), Kaminsky and Schmukler (2002), and Treepongkaruna and Wu (2012).

Both these methodologies are complementary in the sense that they show different aspects of the data. However, whilst the panel regression model is good in studying the effect of ratings on spreads and stock returns, it fails to examine the dynamic effects that occur in the case of upgrades and downgrades. It is important to analyse the dynamic effects, as market participants generally anticipate rating changes, hence an event study will be able to observe any changes that take place before the announcements. De Jong (2011), and Kaminsky and Schmukler (2002) believe that an event study is a useful tool in defining abnormal residuals of a market model, as it accounts for “beta” differences when calculating abnormality.

Several countries are included in the sample. Examining one country only is unlikely to provide particularly informative results, because rating changes do not occur that regularly and thus, by stacking/pooling events across countries, there are more observations. The countries comprise of both emerging and developed markets. This is an exploratory research topic of a quantitative nature, given the nature of volatility in trying to ascertain the relationship between a credit rating announcement and the effect this has on the equity stock market.

### **3.3 Sample**

As mentioned in the previous section, because changes in sovereign credit ratings occur infrequently, in order to obtain more, robust conclusions, this study examined a panel of countries rather than only a single country. In particular, five countries were included with a mixture of both emerging and developed markets.

In choosing the sample, given that one of the motivations of this study was the BRICS bank citing unfairness in the credit rating of developing countries, this study began by studying the BRICS countries and the data available. However, after analysing the existing data, especially around reliability and transparency, the developing country sample was driven down to include only SA, India and Brazil. That is, China and Russia were excluded from the sample due to the lack of trust around the accuracy of the economic indicators that both Russia and China publish (Movchan, 2017). “China has reported its latest economic growth data and once again it is almost perfectly in line with the official target. Investors in China and the global economic community may be breathing a sigh of relief, but like every other time, there is suspicion over whether we can actually trust these figures” (Illmer, 2016). Given the factors that credit rating agencies use as discussed previously, a large portion of what they use to arrive at their credit rating has to do with the economic and financial indicators, which in turn could cast doubt on these ratings.

Two developed countries were also chosen namely, the United Kingdom (UK) and the United States of America (USA), to be able to have them as a point of comparison for the three emerging markets. The period used by other studies examining the effects of credit rating changes varies. Hooper et al. (2008) used an eight-year period and Timmermans (2012) used a 15-year period. Volatility studies such as Essaddam and Mnasri (2014) used an 11-year period with Agrawal, Bharath and Viswanathan (2003) examining only a period of five years. Recognising that a longer horizon enables more events to be included, the period for this study was chosen at ten years, covering the period from the 1 July 2007 to 30 June 2017. Moreover, this period also includes the most recent global financial crises of 2008 and the Euro debt crisis, which created economic difficulties for numerous countries.

### **3.4 Data Collection, Frequency and Choice of Data**

The data gathered for the purposes of this analysis are all secondary in nature. In addition, credit rating changes were obtained. Firstly, sovereign credit ratings for both the long-term local and foreign currency for the five countries in the sample were obtained from the top three rating agencies namely S&P, Moody's and Fitch. These three agencies account for 94% of the rating announcements in the world (OECD, 2010), which justifies the selection in not considering any other rating agency. The Moody's rating changes were gathered from the Moody's website, whilst those from Fitch and S&P were obtained from Bloomberg. Secondly, daily data on each country's volatility index was required. Initially, information for the various volatility indexes available on all the major stock exchanges was considered as a viable measure.

For example, the USA Chicago Board Options Exchange (CBOE) Volatility Index commonly referred to as the VIX, is a volatility index based on the underlying S&P 500, although prior 2003, the underlying index was the S&P 100 (CBOE, 2014). However, given that this study commenced in July 2007, this change in the underlying index would not have had an effect on the dataset. A breakdown in the calculation of the VIX is available in Appendix B.

The index most commonly used to refer to the UK stock market is the Financial Times Stock Exchanges (FTSE) 100, which comprises of the 100 corporations listed on the London Stock Exchange (LSE) that have the highest market capitalisation. The implied volatility from this index is known as the FTSE 100 IVI, which is similar to the VIX (UK VIX).

The SA equivalent of this volatility index is known as the South African Volatility Index (SAVI), with the underlying being the Johannesburg Stock Exchange (JSE) Top 40 index. This volatility index was only introduced to the market in 2007 and the calculation was changed in 2009 in order to encompass all aspects of volatility (Kotze, Joseph & Oosthuizen, 2009) which, however, makes the SAVI index not ideal to use. The new calculation is available in Appendix C.

The Indian VIX is based on the National Stock Exchange India Fifty (NIFTY 50) index, which comprises the 50 largest stocks on the National Stock Exchange (NSE) of India. It is computed based on the method of the CBOE VIX (India VIX brochure), making it quite similar in calculation with a few amendments in order to cater for the underlying index.

Brazil does not have its own volatility index based on the Bolsa de Valores do Estado de São Paulo (BOVESPA), the most common index of the country's stock market, comprising of about sixty stocks. Instead, a volatility index called the CBOE Brazil Emerging market exchange traded funds (ETF) Volatility Index, known as VXEWZ, exists. It tracks the forward-looking volatility of a dollar-denominated index, Morgan Stanley Capital International (MSCI) Brazil Capped ETF (EWZ), of both equities from the Brazilian market and the foreign exchange market (A volatility index and the volatility premium in Brazil). Thus, to use this index would differ notably from those of the other countries, which are purely based on the stock market.

The selected countries in this study have all experienced changes in the calculations over time. There is also different methodology that exists across the various markets, and in some cases, markets do not have volatility indexes. These facts led to this study instead utilising the conditional volatility estimate from a regression of stock market returns in order to ensure uniformity within the analysis. The Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model was used for this purpose. Other studies that have utilised the GARCH method when using volatility as an input include Afonso, Fuceri and Gomes (2012), and Essaddam and Mnasri (2014).

By using the major indexes from the sample countries as the underlying index, as well as the MSCI world market index for a global comparative, the GARCH model was then applied to these underlying indexes to arrive at daily volatility figures. These daily volatility figures were obtained directly from the New York University (NYU) Volatility institute for the ten-year period 1 July 2007 to 30 June 2017. The GARCH calculation and approach that was used by the institute in arriving at these values is available in appendix D.

### **3.5 Data Analysis Methods**

As mentioned previously, to study the effects of a credit rating change on the volatility of the stock market across five countries, this paper employed an event study methodology, which is commonly used in finance literature. The event study technique provides an estimate of the market's reaction to a sovereign credit rating announcement and captures the dynamic effects around the time of changes in ratings (Pukthuanthong-Le, Elayan, & Rose, 2007). In addition, it can help determine whether the actions of rating agencies have sustained or had transitory effects on financial markets (Hooper et al., 2008). Other studies that have utilised the method

of an event study include Afonso, Furceri and Gomes (2011), who found a significant response of government bond yield spreads to changes in both the credit rating and outlook. Reisen and von Maltzan (2007) also utilised an event study when examining the link between sovereign ratings and bond yield spreads.

Standard event study methodology entails linking events to abnormal returns (Kaminsky & Schmukler, 2002). However, as this study examines volatility rather than returns, it will follow the event study approach of Essaddam and Mnasri (2014) and Agrawal et al. (2003), by calculating the abnormal volatility and examining these effects using various windows as done by Timmermans (2012) who utilised De Jong's (2011) three step approach. This methodology will allow examination of the effects of credit rating changes on the volatility of the stock markets. It will further be broken up into examining the effect of upgrades and downgrades, as well as being able to compare whether developed and emerging markets may react differently and finally, whether the effects on volatility of a rating change differ across the rating agencies.

The credit events were “clean” events and this study only examined actual upgrades and downgrades by the three rating agencies. In order to keep these clean, there could not be an overlap of another rating change within the event window. This was done in order to isolate the effect of each rating change, which follows Kaminsky and Schmukler (2002) and Hooper et al. (2008).

The three steps in an event study according to De Jong (2011) are as follow:

- identifying the event itself and the timing of this event;
- calculating the expected volatility for the normal volatility behaviour; and
- calculating and analysing the abnormal volatility around the event date.

There is no commonly accepted length of the estimation window, with Essaddam and Mnasri (2014) using 500 days, Timmermans (2012) using 250 days, and Kaminsky and Schmukler (2002) and Brooks et al. (2004) both utilising a 100-day estimation window. This event study will use 100 days before the window period as the estimation period for computing the expected volatility in keeping with Kaminsky and Schmukler (2002) and Brooks et al. (2004).

This study evaluated different window periods around each event to examine if there are significant effects over various periods of a credit rating change. The window periods that was

examined in this study are  $-29/30$  days;  $-15/15$  days;  $-10/10$  days;  $-10/1$  days ;  $-1/1$  day and  $-1/5$  days, where the credit rating change occurs on day 0 (thus minuses indicate days prior to the credit rating change and pluses indicate days post the credit rating change). These window periods follow those of Timmermans (2012) and enable a comprehensive review of the volatility effects to be undertaken.

The expected volatility for the window period is needed in order to be able to compute the abnormal volatility. This expected volatility represents what the volatility would have been, had the event not occurred i.e. the “normal”. The first step in this process was to estimate the following regression:

$$V_{it} = \alpha_t + \beta_t V_{wt} + \varepsilon_t \quad (1)$$

Where:  $V_{it}$  is the volatility of country  $i$ 's stock market at time  $t$  and  $V_{wt}$  is the volatility of the world index at time  $t$ . This regression was estimated using ordinary least squares for the 100 days prior to the start of the event window. The expected (or normal) volatility for each day in the event window was then computed as:

$$EV_{it} = \hat{\alpha} + \hat{\beta} V_{wt} \quad (2)$$

Where:  $EV_{it}$  is the expected or normal volatility of country  $i$  on day  $t$  of the event window (Timmermans, 2012).

The abnormal volatility ( $AV_{it}$ ) can then be easily computed as follows:

$$AV_{it} = V_{it} - EV_{it} \quad (3)$$

The abnormal volatility was calculated for each event, but this is not particularly informative, as there could be other drivers of volatility unrelated to rating changes within these individual events. Computing an average of the information over the events improves the information content of the analysis. The unweighted cross-sectional average abnormal volatility ( $AAV_t$ ) at time  $t$  was computed as follows:

$$AAV_t = \frac{1}{N} \sum_{t=1}^N AV_{it} \quad (4)$$

Where:  $N$  is the number of events in the sample. In calculating this average, the information unrelated to the volatility effect of a ratings change associated with each event should cancel each other out.

In order to test whether the average abnormal volatility on day  $t$  of the event window is statistically significantly different from zero, the t-statistic is calculated as follows:

$$T \text{ stat} = \sqrt{N} \frac{AAV_t}{S_t} \quad (5)$$

Where:  $S_t$  is the standard deviation and is computed separately according to equation 6.

The t-statistic is approximately normal distribution with a mean of zero and a standard deviation of one (Timmermans, 2012).

$$S_t = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (AV_{it} - AAV_t)^2} \quad (6)$$

Given that the effect of the sovereign credit rating change could be reflected in the volatility indexes several days prior to, as well as several days post the announcement, it is important to look at longer periods, which is the reason this study has used various event windows. This is reflected in the cumulative abnormal volatility ( $CAV_t$ ), calculated according to the formula:

$$CAV_t = \sum_{t=t_1}^{t_2} AV_{it} \quad (7)$$

Where: the daily abnormal volatilities are summed from the start of the event window  $t_1$  to the end of the event window  $t_2$  (Agrawal et al., 2003).

Finally, the cumulative average abnormal volatility ( $CAAV_t$ ) was obtained by summing the  $AAV_t$  across the cross section of events as per standard event studies (Timmermans, 2012). This is seen in equation 8:

$$CAAV_t = \sum_{t=t_1}^{t_2} AAV_t \quad (8)$$

To test for significance, the cumulative average abnormal volatility, the t-statistic, which also approximately follows a normal distribution, was obtained:

$$T \text{ stat} = \sqrt{N} \frac{CAAV_t}{S_t} \quad (9)$$

With:

$$S_t = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (CAV_i - CAAV)^2} \quad (10)$$

The results from these calculations will be discussed in the next chapter.

### **3.6 Research Reliability and Validity**

The event study methodology that was used has been employed by many other scholars, as discussed in previous sections, over different type of data, markets and periods; thus providing validity and reliability to the approach used. In order to reduce biases and errors across different panel data, the event windows were kept “clean” by ensuring that there was only one rating change that occurred during the window in the analysis. The use of GARCH estimates of the volatility of the market across all countries means that the results across the countries are directly comparable and can be included in the same event study, which would not have been the case if the volatility indexes had been used.

### **3.7 Limitations**

Given time constraints, this study did not look at contagion between countries or bond correlation and focused specifically on the volatility arising due to a sovereign credit rating change. This study did not include outlooks or rating watches as part of the events but rather only specific rating changes being either an upgrade or a downgrade. Only long-term rating changes for both the local and foreign currency were used. Short-term rating changes have been excluded from this study.

### **3.8 Summary**

This chapter laid out the various hypotheses that this study has undertaken to analyse in order to answer the research question of the effect of sovereign rating changes on the volatility of the stock market. It then went on to provide an in depth view of the empirical methodology used in this study, as well as the reasoning behind choosing this method.

The secondary data obtained from Bloomberg, the various rating agencies and the NYU volatility institute were discussed, as well as the sampling process in choosing the countries to

form part of the analysis. The event study methodology used was then broken down into each step that this study followed, as well as the reliability and validity of both the methodology and the variables employed.

In completion of this chapter, limitations as to what will not be analysed in this study were discussed. The results of this analysis will be put forward in the next chapter.

## CHAPTER 4: RESEARCH FINDINGS AND DISCUSSION

### 4.1 Introduction

This chapter presents the findings of the analysis on credit rating changes, as well as their effect on the volatility of the stock market. Section two provides a historical background analysis of credit rating changes over time per country to understand the drivers, as well as the results from the event study. Section three then presents the results from the event study and examining the significance of results under the various hypotheses presented in the previous chapter and what these finding mean.

### 4.2 Country analysis of rating changes

Over the ten-year period that this study examined, being from 1 June 2007 to 30 June 2017, the following rating upgrades and downgrades, sources of which are secondary in nature, have been observed per each country within the sample.

Table 1: Upgrades and Downgrades by country

	Total Changes	Upgrades	%	Downgrades	%
<b>SA</b>	14	1	7%	13	93%
<b>Brazil</b>	15	7	47%	8	53%
<b>India</b>	2	2	100%	0	0%
<b>USA</b>	1	0	0%	1	100%
<b>UK</b>	4	0	0%	4	100%
<b>Total</b>	<b>36</b>	<b>10</b>	<b>28%</b>	<b>26</b>	<b>72%</b>

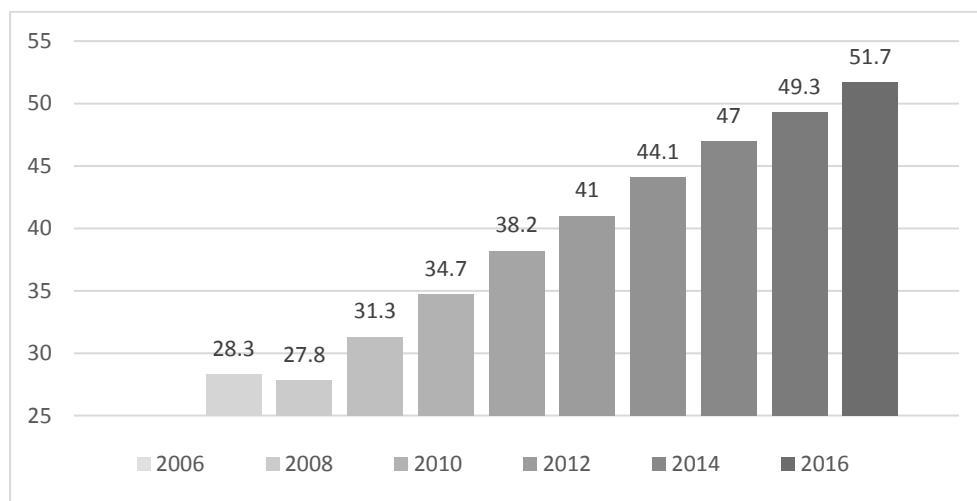
Source: (Moody's, Bloomberg, 2017)

The sovereign credit rating history of each country in the sample is briefly examined in the following sections to better understand the economic, political and other factors that have contributed to the changes in each country's perceived ability to repay its debt according to the credit rating agencies. The country analysis will include reasons around rating and outlook changes, as this is a more descriptive analysis.

#### 4.2.1 South Africa

South Africa ranks as the best performing of the developing countries in the sample regarding their historical ratings over the study period from 2007 to 2017. It managed to maintain its investment grade ratings for most of this period across both local and foreign currency debt. Up until 2009, SAs credit rating improved across all credit agencies due to good macroeconomic and fiscal policies, maintaining the free-floating exchange rate, well-handled public sector finances and a large amount of exports given the country's abundant natural resources. The latter strengthened the country's foreign reserves position, which in turn improved the foreign currency credit ratings. Liquidity was not a concern and the country did not hold substantial amounts of debt relative to their GDP at 31.3%, as seen in Figure 1.

Figure 1: South Africa Government Debt as a Percentage of GDP



Source: (Trading economics, 2016)

Given the high foreign currency reserves and low debt levels, the ratings gap began to close in 2009 according to Moody's (2009a). Fitch, on the other hand, only closed this gap in 2016. As per S&Ps ratings, a gap for South Africa still existed with the foreign currency debt rated lower than the local currency debt. Over the long-term, this gap has narrowed, given that it began with an average of a three-notch difference that has been reduced to a single-notch difference between the local and foreign ratings as seen in Table 2.

Table 2: South African credit rating changes and outlook history

South Africa				
Date	Agency	Announcement	Foreign Currency Rating	Local Currency Rating
05-Jun-07	M	Foreign Currency : Positive Outlook	Baa1	A2
12-Mar-09	M	Local currency constant :Downgrade watch	Baa1	A2
16-Jul-09	M	Foreign currency upgrade and Local currency downgrade	A3	A3
25-Jan-11	S&P	Local currency downgrade	BBB+	A
27-Sep-12	M	Local and foreign currency downgrade	Baa1	Baa1
12-Oct-12	S&P	Local and foreign currency downgrade	BBB	A-
10-Jan-13	F	Local and foreign currency downgrade	BBB	BBB+
17-Jul-13	M	Local and foreign currency constant : Negative outlook	Baa1	Baa1
13-Jun-14	S&P	Local and foreign currency downgrade	BBB-	BBB+
06-Nov-14	M	Local and foreign currency downgrade	Baa2	Baa2
04-Dec-15	F	Local and foreign currency downgrade	BBB-	BBB
15-Dec-15	M	Local and foreign currency constant : Negative outlook	Baa2	Baa2
08-Mar-16	M	Local and foreign currency constant : Downgrade watch	Baa2	Baa2
06-May-16	M	Local and foreign currency constant : Negative outlook	Baa2	Baa2
22-Jul-16	F	Local currency downgrade	BBB-	BBB-
02-Dec-16	S&P	Local currency downgrade	BBB-	BBB
03-Apr-17	M	Local and foreign currency constant : Downgrade watch	Baa2	Baa2
03-Apr-17	S&P	Local and foreign currency downgrade : Negative outlook (Foreign)	BB+*	BBB-
07-Apr-17	F	Local and foreign currency downgrade	BB+*	BB+*
09-Jun-17	M	Local and foreign currency downgrade	Baa3	Baa3

\*Junk status

Source: (Moody's, Bloomberg, 2017)

From 2009, the ratings began to come under pressure due to a higher demand on public finances, which were driven by service delivery. This social requirement began affecting the economy from a financial perspective. During this time, Moody's upgraded the foreign currency rating due to higher foreign currency reserves and a net foreign asset position in the banking system. Whilst issuing a downgrade to the local currency rating, citing concerns over the debt ratio due to expected increased spending as shown in Figure 1.

Since then, socioeconomic and political issues have plagued the SA government resulting in steady credit rating decreases. Reasons for these downgrades included high unemployment rates, a decline in the institutional strength of government departments, slower growth and a reduction in competitiveness due to the high labour costs in the country, relative to the rest of the world. Infrastructure shortfalls were costly and there was a large percentage of the population without basic infrastructure years after democracy (Moody's, 2012). Setbacks occurred in the mining sector in the form of lower commodity prices and strikes (such as that at Marikana) that forced shutdowns, as well as higher wage demands. Mines are the country's biggest employer contributing to growth and as the biggest exporter in the country, they are the main source of foreign exchange earnings (Moody's, 2013a)

Coupled with these woes was a shortage of electricity, which further dampened growth prospects in South Africa. Interest rates were also increased, hurting the consumer. The debt ratio continued to rise year-on-year as illustrated in Figure 1.

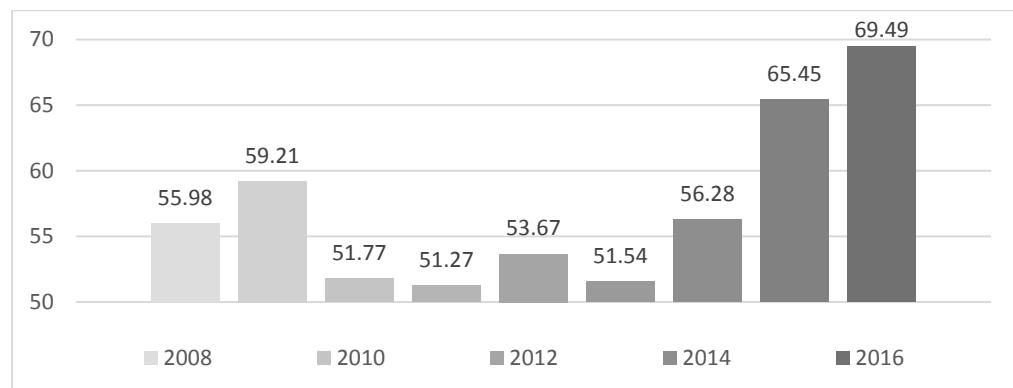
Political risk became a major concern for the country towards the end of 2016, when the then president, Jacob Zuma, who was facing corruption charges, replaced a respected finance minister with an unknown candidate, spooking investors. He was forced to backtrack on this decision, but billions of Rand were already wiped off the stock exchange, thereby questioning the integrity of government institutions. Transparency and integrity of institutions are important pillars contributing to the rating of a sovereign.

In 2017, S&P as well as Fitch downgraded South Africa. S&P downgraded the foreign currency rating into junk, whilst maintaining an investment grade of the local currency, whereas Fitch downgraded both local and foreign currency ratings into junk as at 26/4/2017. SA local currency bonds are still investment grade as only one rating agency (Fitch) has deemed it junk. Given that S&P as well as Fitch have rated the long-term foreign currency rating as non-investment grade, it reaffirms the rating making South African foreign currency bonds junk.

#### **4.2.2 Brazil**

Brazil's ratings gap is quite similar to SAs from S&P. They maintained this gap until 2016 when it was eventually closed. Fitch and Moody's did not have a ratings gap for the country. Brazil's rating was in junk territory until 2007 when there was a gradual increase of ratings across all agencies, with S&P being the first to push their local rating into investment grade in 2007, Fitch following in 2008, and Moody's a year after that. The rationale for this was that the government of Brazil began managing their debt well with further plans to reduce their debt burden during 2007. This resulted in favourable debt ratios, which improved the overall debt structure of the country itself and led to the credit rating being an investment grade as shown in Figure 2.

Figure 2: Brazil Government Debt as a Percentage of GDP



Source: (Trading economics, 2016)

This positivity on the debt front coupled with the ability of Brazil to withstand the global financial crisis of 2009 demonstrated their strengths of policies, markets and their economy, which had previously been largely untested. This further improved their rating with all agencies. In particular, the rating agencies highlighted the country's "shock absorption capacity, policy capability of government, strong economic and financial resilience, evidence of strong economic and financial resilience, features typically associated with investment-grade sovereign credits, as could be seen in the modest and short-lived contraction in GDP, minimal weakening in the country's international reserve position, moderate deterioration in the government debt indicators and lack of financial stress in the banking system" (Moody's, 2009b).

Brazil's highest rating as per all rating agencies occurred in 2011 due to the above factors, as well as policy adjustments made by government in order to maintain these changes, which provided comfort for sustainable growth in the medium term. From 2014, S&P began to downgrade Brazil firstly by outlook and then by the ratings themselves (again the first agency to do so) followed by Moody's and then Fitch as per the Table 3.

Table 3: Brazil credit rating changes and outlook history

<b>Brazil</b>					
<b>Date</b>	<b>Agency</b>	<b>Announcement</b>	<b>Foreign Currency Rating</b>	<b>Local Currency Rating</b>	
23-Aug-07	M	Local and foreign currency upgrade	Ba1*	Ba1*	
30-Apr-08	S&P	Local and foreign currency upgrade	BBB-	BBB+	
29-May-08	F	Local and foreign currency upgrade	BBB-	BBB-	
06-Jul-09	M	Constant rating : Upgrade watch	Ba1*	Ba1*	
22-Sep-09	M	Local and foreign currency upgrade	Baa3	Baa3	
04-Apr-11	F	Local and foreign currency upgrade	BBB	BBB	
20-Jun-11	M	Local and foreign currency upgrade	Baa2	Baa2	
17-Nov-11	S&P	Local and foreign currency upgrade	BBB	A-	
02-Oct-13	M	Rating affirmed: Stable outlook	Baa2	Baa2	
24-Mar-14	S&P	Local and foreign currency downgrade	BBB-	BBB+	
09-Sep-14	M	Constant rating : Negative outlook	Baa2	Baa2	
11-Aug-15	M	Local and foreign currency downgrade	Baa3	Baa3	
09-Sep-15	S&P	Local and foreign currency downgrade	BB+*	BBB-	
15-Oct-15	F	Local and foreign currency downgrade	BBB-	BBB-	
09-Dec-15	M	Constant rating : Downgrade watch	Baa3	Baa3	
16-Dec-15	F	Local and foreign currency downgrade	BB+*	BB+*	
17-Feb-16	S&P	Local and foreign currency downgrade	BB*	BB*	
24-Feb-16	M	Local and foreign currency downgrade	Ba2*	Ba2*	
05-May-16	F	Local and foreign currency downgrade	BB*	BB*	
15-Mar-17	M	Constant rating : Stable	Ba2*	Ba2*	
22-May-17	S&P	Constant rating : Negative watch	BB*	BB*	
26-May-17	M	Constant rating : Negative outlook	Ba2*	Ba2*	

\*Junk status

Source: (Moody's, Bloomberg, 2017)

Growth in the country was subdued and the effects of poor governance began to filter through in the form of deteriorating government reporting, as well as increased borrowing which in turn was used to finance bank lending adversely affected credit metrics (Moody's, 2014).

This low growth persisted over the next few months, negatively influencing investor sentiment, resulting in negative capital flows. The deterioration of the economy resulted in a recession, which was exacerbated by a lack of political consensus on fiscal reforms by government, continued rising debt burdens, affordability and high government spending. This forced S&P to downgrade Brazil's foreign currency credit rating to junk or non-investment grade in September 2015. Fitch followed suit in December of that year although they downgraded both foreign and local currency into junk in the following February. As poor governance as well as the relevant metrics could not justify an investment grade with Moody's, they downgraded the country as well. S&P then downgraded the local currency debt as the local currency had depreciated by approximately 20%. By February 2016, both local and foreign currency long-term ratings were rated junk by all agencies. Moody's projected that within the next three years

debt will likely exceed 80% of Brazil's GDP with political issues and uncertainty likely to delay or prevent the implementation of any structural reforms to address the deterioration in the economy (Moody's, 2016).

Although the economic numbers saw an improvement at the beginning of 2017, (Moody's, 2017) (Moody's rating action 2017), such as lower inflation and the stabilisation of the economy, Brazil is on a negative watch with possibilities of further downgrades. This is due to the political turmoil that has plagued the country in the form of the president's corruption allegations further stalling any policy reforms that could take place.

#### **4.2.3 India**

India is an interesting country in terms of credit ratings, as it is one of only four where the foreign currency long-term rating has been higher than the local currency rating, which occurred between 2007 and 2011 by Moody's. The reason cited for this was a larger balance of foreign exchange reserves relative to the smaller portion of outstanding foreign currency debt (Packer, 2003). The other agencies were keeping with the norm that if a ratings gap did exist, the local currency debt was rated higher than the foreign currency debt.

Moody's was the first country to upgrade India's foreign currency rating, with Fitch following suit two and a half years later and S&P another six months thereafter, though they have upgraded both the foreign currency and local currency debt ratings. Moody's finally upgraded the local currency debt to investment grade in 2011, almost eight years after their upgrade of the foreign currency rating for the country. This is largely due to closing the ratings gap and citing the resilience of the Indian economy during the global economic crisis. The credit metrics remained stable and the institutional and structural reforms implemented by the government over the preceding few years have been favourably received by the agencies.

India's economic growth has been phenomenal, with the country recording the highest growth among the G20 countries in the first quarter of 2015 (OECD, 2015). Various economic and institutional reforms to encourage and maintain this high growth environment have been implemented, such as inflation targeting, which is expected to keep inflation in check and avoid a hyperinflationary situation. India's last rating change, as per the sample window, was by Moody's in 2016, which left it at an investment grade with a positive outlook as shown in Table 4.

The agencies have been heavily criticised by the government of India. Even though the fundamentals of the country have been improving, the rating has been constantly maintained one notch above junk. Fitch has maintained its rating for India for the past 11 years, citing a weak fiscal position and a difficult business environment even though there is a strong medium-term growth as per their last assessment ("Fitch keeps India's ratings at "BBB", unchanged for 11 years," 2017). S&P has also maintained their investment grade one notch above junk for the past decade.

Table 4: India credit rating changes and outlook history

<b><u>India</u></b>				
<b>Date</b>	<b>Agency</b>	<b>Announcement</b>	<b>Foreign Currency Rating</b>	<b>Local Currency Rating</b>
15-Jul-08	F	Foreign Currency : Stable outlook	BBB-	BBB-
15-Dec-09	M	Local Currency : Positive outlook	Baa3	Ba2*
18-Mar-10	S&P	Foreign Currency : Stable outlook	BBB-	BBB-
26-Jul-10	M	Local Currency upgrade	Baa3	Ba1*
25-Feb-11	S&P	Local Currency : Positive outlook	BBB-	BBB-
20-Dec-11	M	Local Currency upgrade	Baa3	Baa3
25-Apr-12	S&P	Foreign Currency : Negative outlook	BBB-	BBB-
13-Jul-12	F	Foreign Currency : Negative outlook	BBB-	BBB-
12-Jun-13	F	Foreign Currency : Stable outlook	BBB-	BBB-
26-Sep-14	S&P	Foreign Currency : Stable outlook	BBB-	BBB-
09-Apr-15	M	Rating affirmed : Positive outlook	Baa3	Baa3
16-Nov-16	M	Rating affirmed : Positive outlook	Baa3	Baa3

\*Junk status

Source: (Moody's, Bloomberg, 2017)

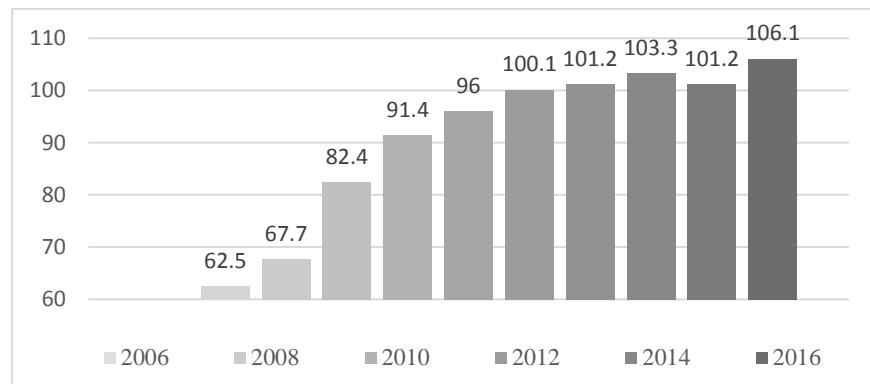
#### **4.2.4 United States of America**

Turning to the developed countries in the sample, the USA is frequently referred to as the superpower of the world, both politically and economically. They have been afforded the highest credit rating by all agencies, commonly referred to as the gold standard, having always been investment grade for both their foreign and local currency debt. The former is intuitive given that most foreign currency debt of the rest of the world is usually priced in USD, meaning that a ratings gap should not occur given that both the foreign and local currency are denominated in the same currency.

The only time the USA has ever had their rating downgraded or received a negative outlook, was in the aftermath of the global financial crisis in 2011. The reason cited was the amount of debt that the USA had relative to GDP. As shown in Figure 3, this rose dramatically from 2007

to 2011. However, what is interesting in comparing the debt-to-GDP ratio of the USA to the developing markets in the sample is that it is far higher, with the ratio consistently above 100%. Yet, despite this, the USA has a far higher credit rating; thus confirming that the level of debt is not necessarily the driving force behind the ability or willingness of the country to repay its debt. In 2011, for example, when debt was 96% of GDP, there was a concern that the USAs debt ceiling would not be raised to meet the country's debt obligation (Moody's, 2011). Republicans and Democrats could not agree to this with each side pushing back on certain aspects, which forced S&P as well as Moody's to issue a negative outlook on their respective ratings.

Figure 3: USA Government Debt as a Percentage of GDP



Source: (Trading economics, 2016)

The debt ceiling is a limit on the amount of debt that the country can hold at any given time, the value of which is set by Congress. When this limit is reached, the country is unable to pay bills, or even service debt as the tax revenues will be unable to meet the requirements of servicing the running expenses of the country as well as keeping up with interest payments of the debt holders. It is imperative that this ceiling is raised to ensure the country is able to operate. This has been the case as this ceiling was raised ten times in the past ten years. This debt ceiling is the biggest risk that faces the ability of the USA to service their debts, which ties into the political situation of the country as Congress has the power to either approve or decline this request (Amadeo, 2018).

Following the raising of the debt ceiling itself, Moody's removed the downgrade watch from its rating, though they did keep the outlook negative whereas S&P downgraded the USA credit rating by a single notch with a negative outlook as shown in Table 5. This was the first time in the history that the USAs credit rating has not been AAA rated by one of the top three agencies.

Table 5: USA credit rating changes and outlook history

<b><u>USA</u></b>				
<b>Date</b>	<b>Agency</b>	<b>Announcement</b>	<b>Foreign Currency Rating</b>	<b>Local Currency Rating</b>
24-Feb-11	S&P	Rating maintained	AAA	AAA
13-Jul-11	M	Downgrade watch	Aaa	Aaa
14-Jul-11	S&P	Rating maintained : Negative outlook	AAA	AAA
02-Aug-11	M	Rating maintained : Negative outlook	Aaa	Aaa
05-Aug-11	S&P	Local and foreign currency downgrade	AA	AA
18-Jul-13	M	Rating maintained : Stable	Aaa	Aaa
15-Oct-13	F	Rating maintained : Negative outlook	AAA	AAA
21-Mar-14	F	Rating maintained	AAA	AAA

Source: (Moody's, Bloomberg, 2017)

S&P believed that using the vote of increasing the debt ceiling was becoming a political bargaining chip amongst the parties. The difficulty and uncertainty of this increases risk and questions the stability and predictability of policymaking, which affects the fiscal stability of the USA. In 2013, Fitch again put the USA on a negative outlook over the uncertainty that the debt ceiling was not going to be raised in time to avoid a default.

Overall, apart from the policy issues relating to the debt ceiling discussed, the USA has a very strong economy and currency and it continues to grow. In 2015, the USD appreciated by 13.5%, and being a developed economy with various industries and trade deals they currently enjoy with the rest of the world, they were the least exposed to the slowdown in the emerging economies.

#### **4.2.5 United Kingdom**

The UK, the second developed country in this sample, also enjoyed the gold standard of rating from the time of their initial rating up until 2013 on both their foreign and local currency debt. The reason for the downgrade in 2013 as shown in Table 6, had to do it with the country's reduced growth prospects as well as an increased debt burden arising from a larger deficit. Tax

revenues were not expected to increase due to the tougher economic environment as well as slower growth. Moody's further cited the deterioration of the shock absorption capacity of the government's balance sheet. Interestingly, for the first time within this sample, Moody's was the first agency to downgrade the UK. Fitch followed with a negative outlook and shortly thereafter issued an actual downgrade of one notch.

Table 6: UK credit rating changes and outlook history

Date	Agency	Announcement	Foreign Currency Rating	Local Currency Rating
17-Feb-11	SP	Rating maintained	AAA	AAA
22-Feb-13	M	Local and foreign currency downgrade	Aa1	Aa1
22-Mar-13	F	Rating maintained : Negative outlook	AAA	AAA
19-Apr-13	F	Local and foreign currency downgrade	AA+	AA+
19-Sep-14	M	Rating maintained : Stable	Aa1	Aa1
24-Jun-16	M	Rating maintained : Negative outlook	Aa1	Aa1
27-Jun-16	F	Local and foreign currency downgrade	AA	AA
27-Jun-16	SP	Local and foreign currency downgrade	AA	AA

Source: (Moody's, Bloomberg, 2017)

Over the next few years, the UK economy performed well. Politically a Scottish referendum took place during this time, which did not hurt them as the outcome of vote for independence by the Scottish failed to go through, keeping Scotland within the UK. However, in 2016, a referendum was put forward to decide if the UK should leave the EU having been a member since 1973. This relationship facilitated trade with the rest of the world and gave the UK substantial bargaining power, since negotiations were done as a bloc. In a vote that shocked the world as well as the UK policy makers themselves, Britain voted to leave the EU, in what is popularly referred to as Brexit. The fallout of this decision resulted in a change of Prime Minister, and massive uncertainties around what a UK not part of the EU will look like as well the financial repercussions of trade deals and the economy at large. The institutional strength of Britain was put into question regarding their ability to be able to manage these risks as well as the political uncertainty that arose with it. For these reasons, in June 2016, all of the three credit agencies reacted negatively to the news. Moody's outlook changed to negative, Fitch downgraded both the foreign and local currency debt ratings of the UK by a single notch, whilst S&P's downgrade was two notches, its first downgrade in its history of rating the UK.

### 4.3 Empirical Results

This section details the results of the various analyses that were undertaken in order to answer the research questions posed in Chapter One of this study.

### 4.3.1 All Rating Changes

This analysis will test the first hypothesis being:

H0: Sovereign credit rating changes (both local and foreign currency debt) do not have a significant effect on the volatility of stock markets.

H1: Sovereign credit rating changes (both local and foreign currency debt) have a significant effect on the volatility of stock markets.

In Figure 4, the AAV is presented for the longest window in the sample being  $(-29, 30)$  days. Around day zero, the abnormal volatility is very close to zero, showing muted volatility around the announcement day. However, markets seem to be less volatile in the days leading up to the announcement but more volatile afterwards, although none of these findings is significant.

Figure 4: Average abnormal volatility for all rating changes

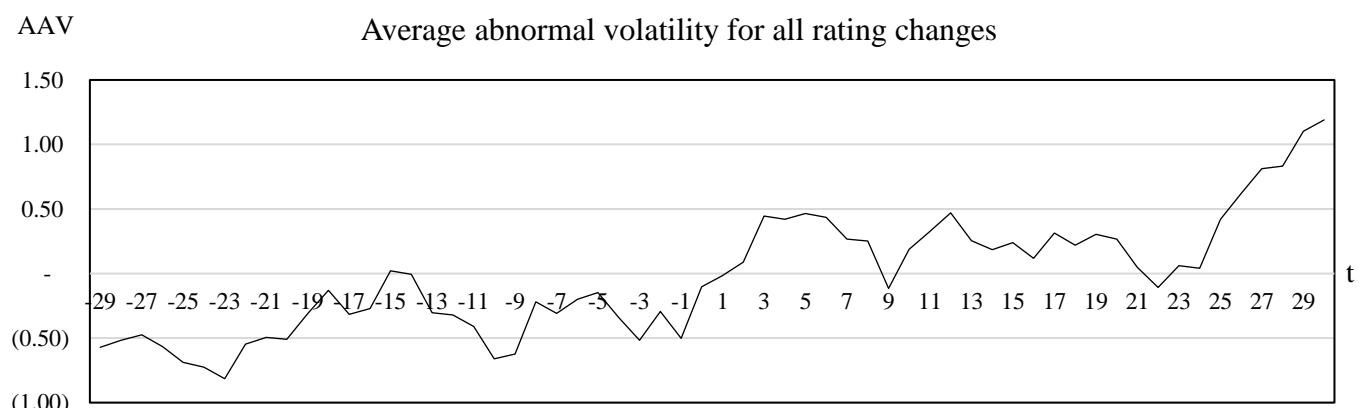


Table 7 contains the CAAV for all rating changes for the different event windows. The CAAVs, though mostly positive, are quite small, demonstrating a small increase in volatility around a credit rating change. However, none of these is significant.

Table 7: CAAV and p-values for all rating changes

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
<b>CAAVt</b>	-1.73	2.96	2.46	2.46	0.76	2.75
<b>t stat</b>	-0.13	0.33	0.38	-0.07	0.55	0.94
<b>p-value</b>	0.25< p <0.5	0.15< p <0.2				

Given the lack of significance found across all rating changes, this study accepts the null hypothesis.

### 4.3.2 Upgrades and downgrades

The next hypothesis to be tested will be in relation to upgrades and downgrades.

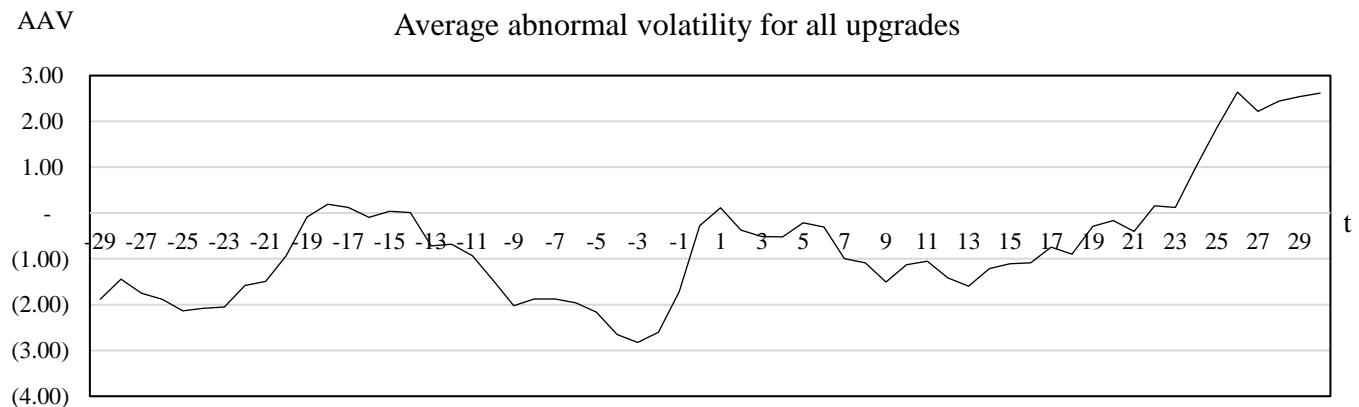
H0: An upgrade has the same effect on the volatility of the stock market as a downgrade.

H1: An upgrade has a different effect on the volatility of the stock market to a downgrade.

#### 4.3.2.1 Upgrades

In Figure 5, upgrades from all countries are presented for the window period (-29, 30). As can be seen, volatility is negative just before and after the rating announcement, implying a decrease in volatility around the announcement date, with a rapid increase towards the end of the event window. These results are significant. It should be noted that this upgrade sample only consists of emerging market data, as there were no upgrades for developed markets within the sample period.

Figure 5: Average abnormal volatility for all upgrades



The majority of the CAAVs are negative suggesting that (good news) an upgrade reduces volatility, especially for the longer event windows before the rating announcement. It seems that in the case of an upgrade, the market anticipates this beforehand as shown by the 59 and 11-day windows, which are statistically significant at the 5% level.

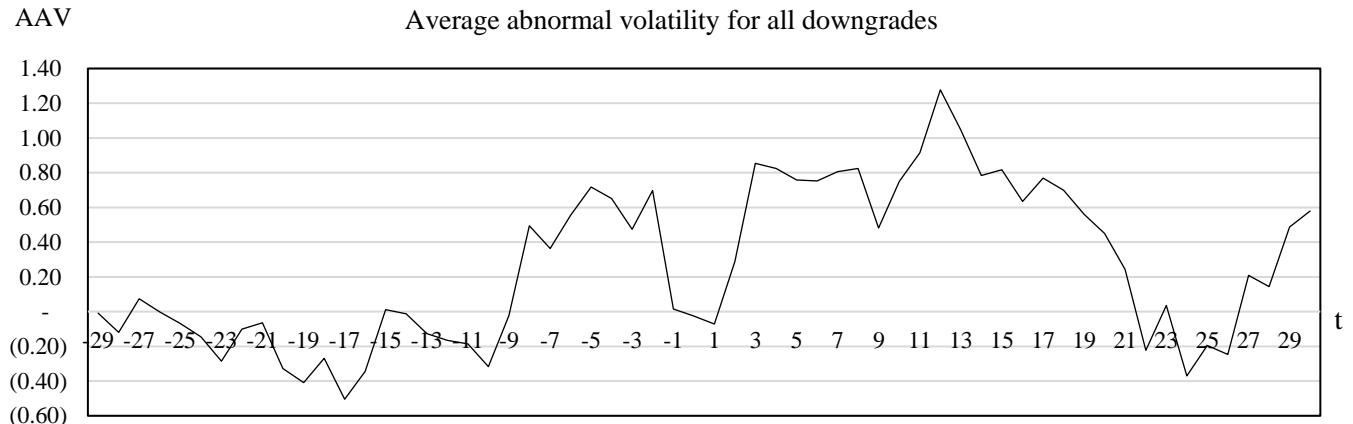
Table 8: CAAV and p-values for all upgrades

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
<b>CAAVt</b>	-41.76	-23.32	-17.67	-14.47	1.28	2.58
<b>t stat</b>	-1.76	-1.12	-1.14	-1.61	0.40	0.33
<b>p-value</b>	<b>0.025&lt; p&lt;0.05</b>	0.1< p<0.15	0.1< p<0.15	<b>0.025&lt; p&lt;0.05</b>	0.25< p<0.5	0.25< p<0.5

#### 4.3.2.2 Downgrades

For downgrades, as depicted in Figure 6, volatility increases substantially before (approximately 10 days) and after the announcement. These findings are significant. This suggests that the market anticipates a downgrade and reacts to this anticipation increasing volatility. These results are in keeping with the findings by Norden and Weber (2004), who find that markets anticipate downgrades.

Figure 6: Average abnormal volatility for all downgrades



For downgrades, there is an increased CAAV across all event windows, as shown in Table 9, which suggests an increase in volatility around downgrade announcements. The windows of significance are 30, 20 and 11. This is in line with Hooper et al.s' (2008) study that downgrades increase volatility. The fact that downgrades increase volatility while the opposite is true for upgrades means that the effects analysed together, may offset each other. This may account for the largely insignificant findings when examining both these announcements (upgrades and downgrades) jointly.

Table 9: CAAV and p values for all downgrades

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
<b>CAAVt</b>	15.43	15.34	11.09	5.81	0.54	2.82
<b>t stat</b>	1.05	1.84	1.92	1.49	0.36	1.04
<b>p-value</b>	0.1< p <0.15	<b>0.025 &lt; p &lt; 0.05</b>	<b>0.025 &lt; p &lt; 0.05</b>	<b>0.05 &lt; p &lt; 0.1</b>	0.25 < p < 0.5	0.15 < p < 0.2

Given these findings, this study will have to reject the null hypothesis as upgrades and downgrades do not elicit similar responses in volatility, with upgrades decreasing volatility and downgrades causing an increase in volatility.

#### 4.3.3 Developed versus Emerging Markets

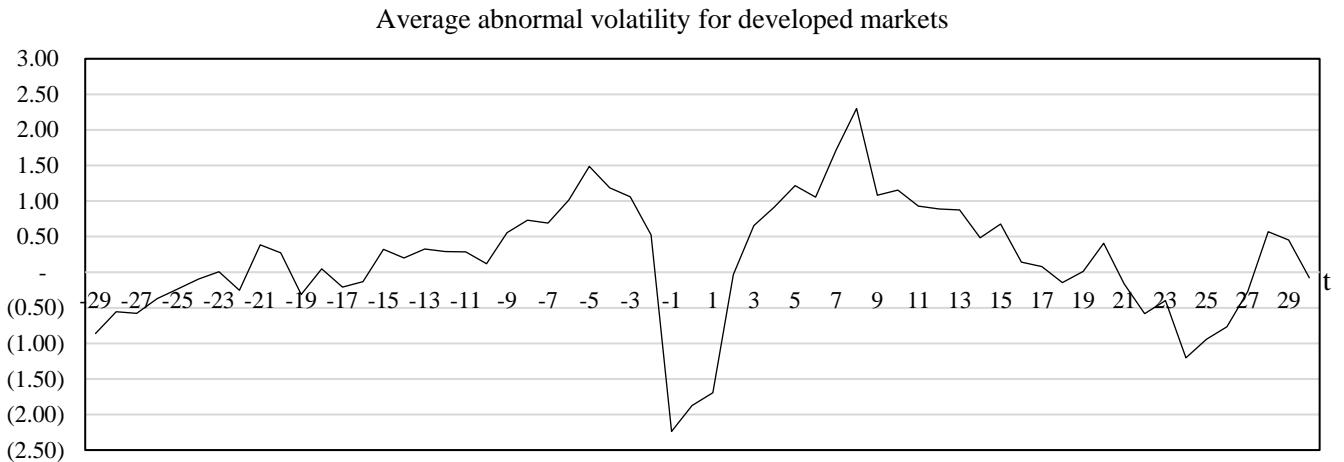
A comparison between reactions in developed and emerging markets gives rise to the third hypothesis:

H0: The effect of a ratings change is similar for both emerging and developed markets.

H1: The effect of a rating change has different effects for emerging and developed markets.

Figure 7 shows that around the rating announcement date there were large movements of significance in volatility of the stock markets of the UK and USA, decreasing drastically before day zero then increasing quite steadily afterwards.

Figure 7: Average abnormal volatility for all developed markets



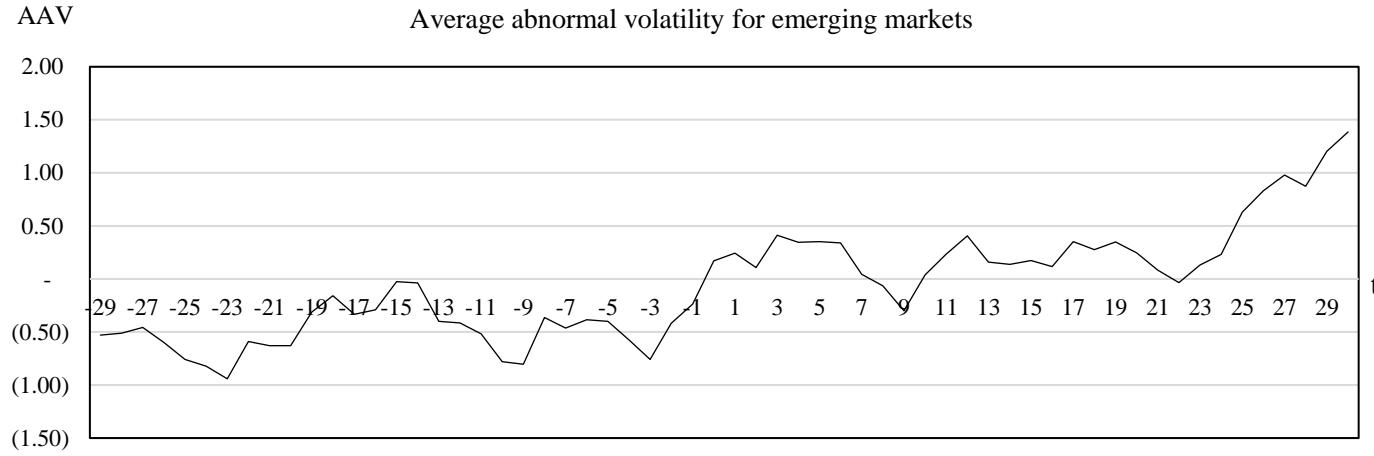
In this sample, all ratings that occurred within the developed markets were downgrades. This could explain the large increase in volatility, as shown earlier with downgrades increasing volatility. This increase in volatility for developed markets is statistically significant at the 30, 20 and 11-day window. It shows that rating changes in developed markets have an increased effect on the volatility within them.

Table 10: CAAV and p-values for developed markets

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
CAAVt	11.11	15.86	11.81	7.76	-3.09	-2.02
t stat	0.68	1.46	1.68	1.97	-0.67	-0.33
p-value	0.2< p <0.25	<b>0.05 &lt; p &lt; 0.1</b>	<b>0.025 &lt; p &lt; 0.05</b>	<b>0.025 &lt; p &lt; 0.05</b>	0.25 < p < 0.5	0.25 < p < 0.5

Abnormal volatility in the emerging markets are a bit more subdued with a gradual increase seen just before the rating announcement and increasing afterwards, as well as for a few days afterwards, however these are not significant. This could imply that the market reacts once an announcement is made rather than in anticipation of the announcement.

Figure 8: Average abnormal volatility for all emerging markets



Within the emerging markets, some CAAVs are positive and others negative across the varying event windows, this could be attributable to the inclusion of both upgrades and downgrades in the sample, which could also be the reason that none of these results is significant.

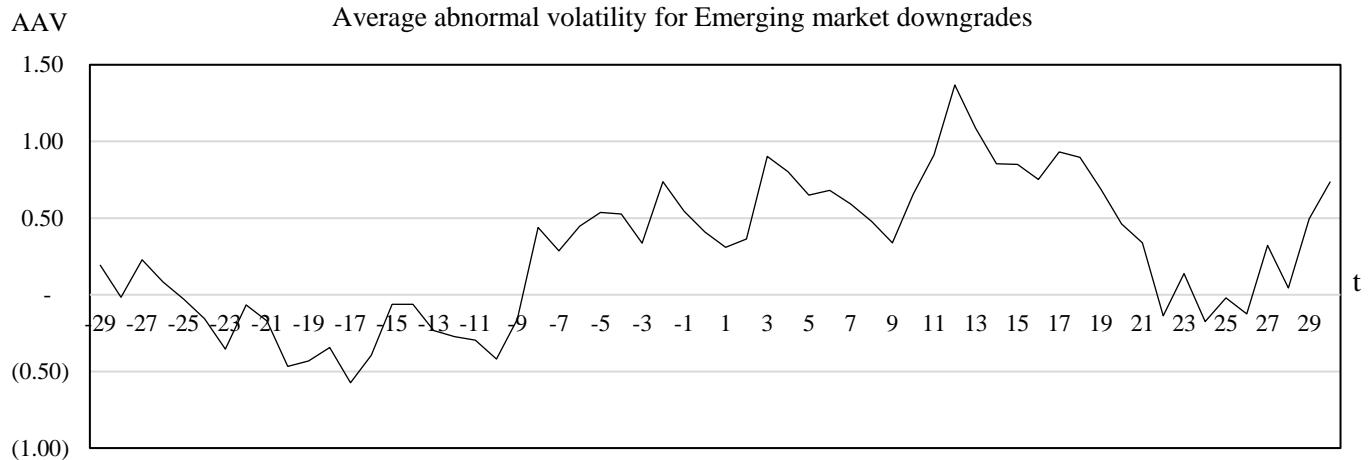
Table 11: CAAV and p-values for emerging markets

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
<b>CAAVt</b>	-3.70	0.98	1.02	-1.51	1.36	3.48
<b>t stat</b>	-0.25	0.10	0.14	-0.32	0.94	1.07
<b>p-value</b>	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.15< p <0.2	0.1< p <0.15

In order to compare emerging and developed markets fairly, it is intuitive to strip out the upgrades from the emerging market sample. Results of upgrades within emerging markets are the same as Figure 8 and Table 11, as that sample only consisted of data from emerging economies. The findings of downgrades within emerging markets are as follows:

There is a sharp rise in volatility before a downgrade announcement is made, as shown in Figure 9 and it continues well after the event date, which is significant. This behaviour differs from the developed markets, which saw a decrease around the announcement date before experiencing an increase afterwards.

Figure 9: Average abnormal volatility for emerging market downgrades



These results are consistent with the findings of downgrades in developed markets, in that a downgrade results in an increase in volatility. This finding is significant at the 10% level for the 30 and 20-day window.

Table 12: CAAV and p-values for downgrades in emerging markets

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
CAAVt	16.45	15.22	10.92	5.35	1.40	3.96
t stat	0.92	1.51	1.55	1.13	0.92	1.29
p-value	0.15< p<0.2	<b>0.05&lt; p&lt;0.1</b>	<b>0.05&lt; p&lt;0.1</b>	0.1< p<0.15	0.15< p<0.2	0.1< p<0.15

Given the consistency of the results between developed and emerging economies, allows the study to accept the null hypothesis that developed and emerging markets have similar reactions to a change in credit ratings.

The results from this analysis between emerging and developed markets, demonstrate that both upgrades and downgrades provide information to the markets. This suggests that the markets, both emerging and developed, are weak to semi-strong form efficient from observing their reactions to ratings news.

#### 4.3.4 Credit Rating Agencies

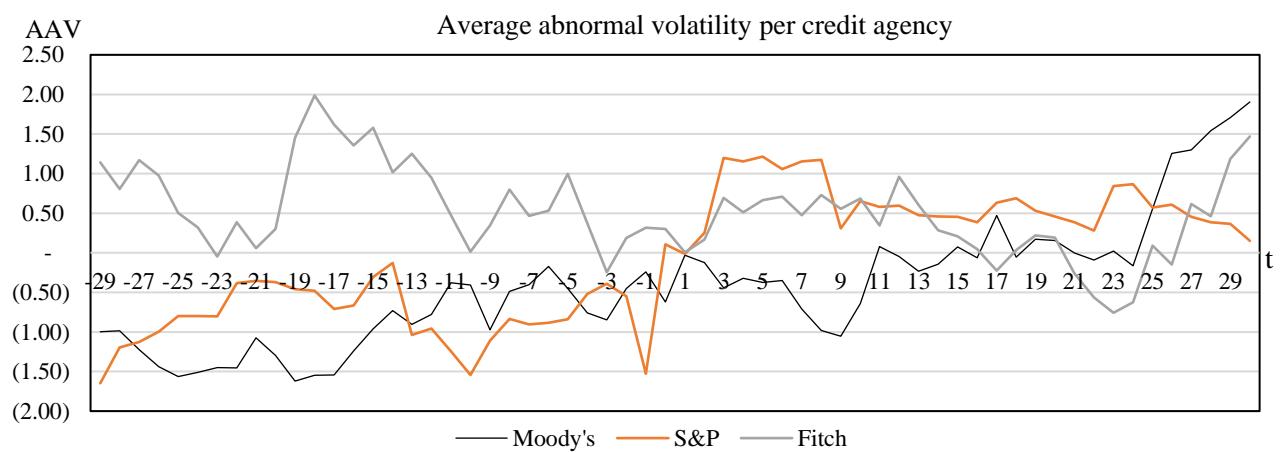
In testing the fourth and final hypothesis this study will look at the following:

H0: A rating agency's announcement has a similar effect on the volatility on the market compared to other agencies.

H1: A rating agency's announcement has a different effect on the volatility on the market compared to other agencies.

As mentioned previously, some studies have found that certain rating agencies elicit a larger reaction to their announcements than others do. In this sample, for the days preceding the announcement, volatility seems to be higher in anticipation of an announcement from Fitch in comparison to Moody's and S&P. After the announcement, volatility increases for Fitch and S&P, with Moody's prompting a decrease in volatility immediately after the announcement. However, none of these movements is significant.

Figure 10: Average abnormal volatility per credit agency



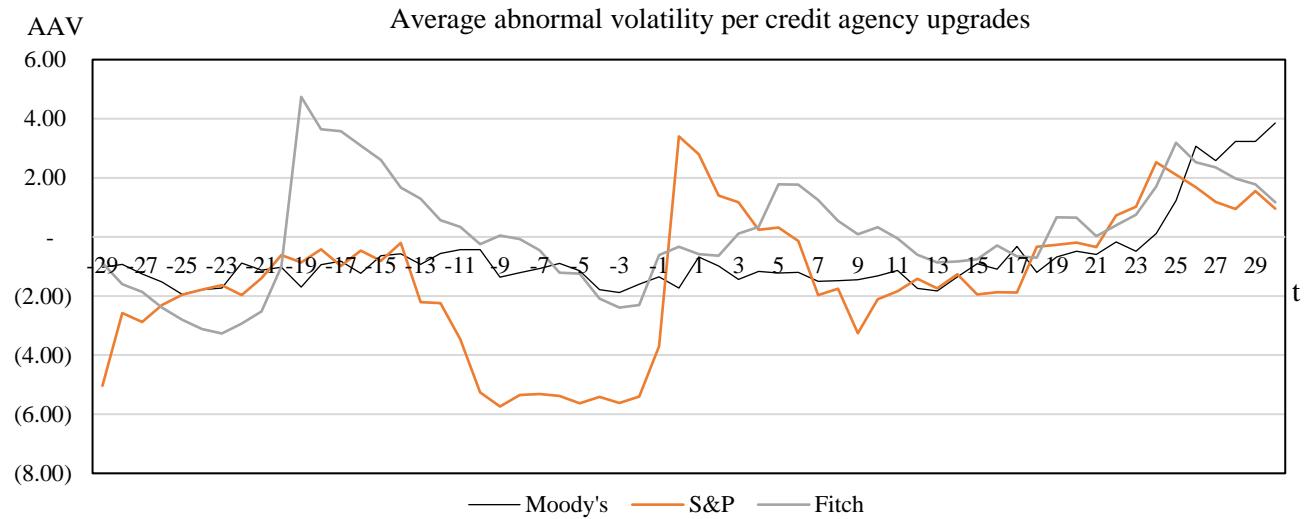
As noted in Table 13, none of these results is significant, as both upgrades and downgrades are included in the data. A more accurate analysis will be to break it up between upgrades and downgrades as done in the previous analysis.

Table 13: CAAV and p-values per credit agency

<b>Event window</b>	<b>(-29,30)</b>	<b>(-15,15)</b>	<b>(-10,10)</b>	<b>(-10,1)</b>	<b>(-1,1)</b>	<b>(-1,5)</b>
<b>Moody's</b>						
<b>CAAVt</b>	-25.13	-6.03	-1.36	-1.23	1.17	2.08
<b>t stat</b>	-1.10	-0.36	-0.13	-0.19	0.68	0.50
<b>p-value</b>	0.1< p <0.15	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5
<b>Fitch</b>						
<b>CAAVt</b>	30.69	12.15	3.77	1.63	-0.51	-0.01
<b>t stat</b>	1.26	0.77	0.33	0.20	-0.19	-0.00
<b>p-value</b>	0.1< p <0.15	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5
<b>S&amp;P</b>						
<b>CAAVt</b>	-5.16	4.59	5.48	-0.94	1.46	5.98
<b>t stat</b>	-0.26	0.30	0.43	-0.12	0.49	0.99
<b>p-value</b>	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.15< p <0.2

By breaking the announcements up between upgrades and downgrades, a new trend emerges in Figure 11 for upgrades. Moody's volatility reaction is quite subdued around the *x*-axis indicating little or no volatility until the end of the window, whilst Fitch tends to elicit an increased volatile reaction on the market both before and after the announcement. S&P sees a large drop in volatility before an announcement is made around the 13-day window but this gradually increases and spikes around the day of the announcement before decreasing again. S&P is the only agency that elicits a significant response around upgrades.

Figure 11: Average abnormal volatility per credit agency upgrade



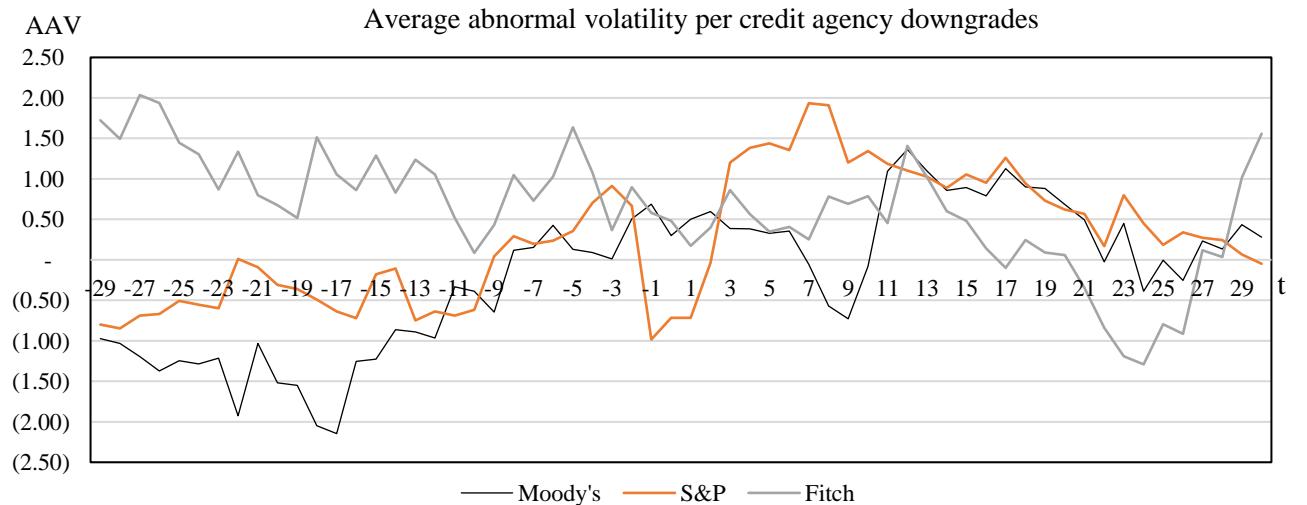
In studies such as Brooks et al. (2004) and Norden and Weber (2004), S&P was the rating agency that consistently appeared to have the most substantive effect on the stock market. From the results in Table 14, one can see that upgrades are only significant upon the announcement of S&P, which is in line with these studies. The reaction in the market is decreased volatility upon the announcement of an upgrade by S&P, which is significant at the 5% level for the 29-day window and at 0.5% at the 11-day window. This demonstrates that in the days leading up to the announcement, the market anticipates an upgrade as previously found in the results above.

Table 14: CAAV and p-values per credit agency upgrades

Event window	(-29,30)	(-15,15)	(-10,10)	(-10,1)	(-1,1)	(-1,5)
<b>Moody's</b>						
<b>CAAVt</b>	-42.64	-25.46	-13.20	-7.86	-0.15	-0.81
<b>t stat</b>	-1.17	-0.85	-0.66	-0.65	-0.05	-0.11
<b>p-value</b>	0.1< p <0.15	0.15< p <0.2	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5
<b>S&amp;P</b>						
<b>CAAVt</b>	-86.94	-57.03	-44.08	-39.89	6.17	11.54
<b>t stat</b>	-1.95	-1.17	-0.89	-2.71	0.46	0.34
<b>p-value</b>	<b>0.025&lt; p &lt;0.05</b>	0.1< p <0.15	0.15< p <0.2	<b>0.001&lt; p &lt;0.005</b>	0.25< p <0.5	0.25< p <0.5
<b>Fitch</b>						
<b>CAAVt</b>	5.61	4.09	-2.44	-5.59	-0.05	2.11
<b>t stat</b>	0.20	0.08	-0.07	-0.29	-0.01	0.12
<b>p-value</b>	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.5	0.25< p <0.6	0.25< p <0.7

In observing the effects of downgrades, Moody's tends to increase towards the announcement date, whilst Fitch remains relatively constant at higher volatility levels well past the announcement date, which decreases towards the end of the window, however neither of these results are significant. As in the case of upgrades, S&P sees a sharp drop in volatility before the downgrade and a quick increase afterwards that is of significance.

Figure 12: Average abnormal volatility per credit agency downgrade



As with the upgrades, Table 15 highlights that S&P is the only rating agency that shows significance at the 5% level for windows 30 and 11, whilst an increased significance level of 0.5% can be seen in the 20-day window period. The CAAV demonstrates that for a downgrade pronouncement by S&P, there is increased volatility across all periods.

Table 15: CAAV and p-values per credit agency downgrades

<b>Event window</b>	<b>(-29,30)</b>	<b>(-15,15)</b>	<b>(-10,10)</b>	<b>(-10,1)</b>	<b>(-1,1)</b>	<b>(-1,5)</b>
<b>Moody's</b>						
<b>CAAVt</b>	-10.54	10.16	8.51	4.29	2.28	4.49
<b>t stat</b>	-0.35	0.58	0.82	0.68	1.28	0.96
<b>p-value</b>	0.25< p<0.5	0.25< p<0.5	0.2< p<0.25	0.25< p<0.5	0.1< p<0.15	0.15< p<0.2
<b>Fitch</b>						
<b>CAAVt</b>	37.85	14.45	5.54	3.69	-0.64	-0.62
<b>t stat</b>	1.23	0.82	0.44	0.39	-0.20	-0.11
<b>p-value</b>	0.1< p<0.15	0.2< p<0.25	0.25< p<0.5	0.25< p<0.5	0.25< p<0.5	0.25< p<0.5
<b>S&amp;P</b>						
<b>CAAVt</b>	15.29	20.00	17.88	8.80	0.28	4.59
<b>t stat</b>	0.96	1.87	2.28	1.83	0.11	1.14
<b>p-value</b>	0.15< p<0.2	<b>0.025&lt; p&lt;0.05</b>	<b>0.001&lt; p&lt;0.005</b>	<b>0.025&lt; p&lt;0.05</b>	0.25< p<0.5	0.1< p<0.15

Brooks et al. (2004) found that S&P have the biggest impact on market returns when announcing a downgrade. This study also finds that S&P produced the largest significant finding at 0.5% for an impact on volatility within a 20-day window, which is in line with their study. However, a 0.5% significance level is also observed for an upgrade by S&P at the 11-day window, which shows that at various windows of observations, significance may change.

Due to this finding, this study will have to reject the null hypothesis as S&P had a different effect on the volatility of the market compared to Moody's and Fitch.

## **4.4 Summary**

This chapter examined the history of credit rating changes and outlooks for the countries within this sample and the reasons these occurred over the ten-year period. The chapter then went into the examination of the empirical analysis in testing the various hypotheses that were put forward at the beginning of this study. The findings of which can be summarised as follow:

### Hypothesis one:

H0: Sovereign credit rating changes (both local and foreign currency debt) do not have a significant effect on the volatility of stock markets.

H1: Sovereign credit rating changes (both local and foreign currency debt) have a significant effect on the volatility of stock markets.

The study found that when using both upgrades and downgrades together in analysing the effect of a ratings change on volatility, they tend to cancel each other out resulting in no significant effect on the volatility of the stock market.

### Hypothesis two:

H0: An upgrade has the same effect on the volatility of the stock market as a downgrade.

H1: An upgrade has a different effect on the volatility of the stock market to a downgrade.

Opposite effects have been observed when looking at the reactions to upgrades and downgrades on the volatility of the market. Upgrades have been found to decrease the volatility of the stock market, whilst downgrades increased volatility.

### Hypothesis three:

H0: The effect of a ratings change is similar for both emerging and developed markets.

H1: The effect of a rating change has different effects for emerging and developed markets.

Downgrades within both emerging and developed markets showed an increase in volatility. There is no difference in reaction for a downgrade between an emerging or developed economy.

Hypothesis four:

H0: A rating agency's announcement has a similar effect on the volatility on the market compared to other agencies.

H1: A rating agency's announcement has a different effect on the volatility on the market compared to other agencies.

The only agency that was found to have any significant effect on volatility was S&P for both upgrade and downgrade announcements.

## CHAPTER 5: RESEARCH CONCLUSIONS AND RECOMMENDATIONS

This study investigated the effect of credit rating changes on the volatility of stock markets. A sample with daily volatility for the specified countries, as well as a global volatility index was used. The analysis was conducted by calculating abnormal volatility over various event windows. It also questioned the difference in reactions between developed and emerging markets, as well as the response in volatility to different credit agencies' announcements.

The key findings of this study are as follow:

- Upgrades result in a decrease in volatility, which is consistent with the findings of Hooper et al. (2008).
- Downgrades result in an increase in volatility, which is also in line with the findings of Hooper et al. (2008).
- Developed and emerging markets react similarly regarding volatility to credit rating downgrades. This is in contradiction to the results found by Hooper et al. (2008), which revealed that the effect on emerging markets' debt was more pronounced. This is also in contradiction to Kaminsky and Schmukler (2002) who cites asymmetric information and lack of transparency resulting in a larger reaction to a credit rating change albeit for stock returns and country risk. However, these results are in line with Brooks et al. (2004) who found no significant sensitivity to ratings changes within emerging markets.
- S&P is the only rating agency to elicit any significant effect on the volatility of the stock market. This was the case for both upgrades and downgrades. Fitch and Moody's provided no significant responses in volatility. Norden and Weber (2004) found that both Moody's and S&P exhibit the largest impact on the markets, with Brooks et al. (2004) finding that S&P and Fitch's downgrades impact the market the most.

In line with the Hooper et al. (2008) study, in relation to financial theory, the results of this study show that a rating change does communicate new information to the markets. It speaks to the efficiency of the market in being able to process new information provided to it. This is in line with the findings from Griffin et al. (2010) who found that both developed and emerging markets exhibit the weak to semi-strong form of market efficiency.

This study contributes to previous research on the effects that credit ratings have on the volatility of the stock markets by not only analysing a unique sample, but also using a different methodology to that of Hooper et al. (2008) and Treepongkaruna and Wu (2012). These findings will contribute to the observations around the sensitivity of emerging market responses to these rating changes, as well as the rating agencies that have the most effect on the stock markets as found by Brooks et al. (2004).

Recommendations to the various stakeholders is to be mindful that a change in credit rating, effect not just bond prices and forex, but also volatility within the stock market. This study has implications for investors, governments, pension funds and asset holders by providing them with country risk assessments and giving them the ability to rebalance their portfolios in response to credit rating changes that may have an effect on the volatility of the stock market. It also has an impact in determining the cost of capital and evaluating investments, which affect asset allocation decisions. This study has important information, which could help contribute to credit rating agencies' understanding of the implications that their issued ratings have on the stock market and contribution to volatility within the market place. The policy implications of this study could affect institutions, especially the Basel committee and banking institutions whom are highly affected by the policies set out by Basel in their understanding of the effects that credit rating changes have on the volatility of the stock market. The expected volatility that arises from a change in credit rating could affect the calculations used by Basel in arriving at the capital requirements for specific asset classes.

Further research is needed to understand if other variables that occurred during the event window could have contributed to the increased volatility as seen around the event dates. Different analysis methods such as bootstrapping the data, as done by Essaddam and Mnasri (2014), as well as panel data analysis that Kaminsky and Schmukler (2002) and Treepongkaruna and Wu (2012) conducted, could be useful in finding out if the results still hold under different methodologies.

Having a sample that includes upgrades for developed markets could prove insightful to understand if these have the same reaction as upgrades in emerging economies. Further research could look at rating outlook changes, as well as watch announcements to understand if these have the same effects on volatility as found this study. It will be interesting to observe the

volatility (if any) and to what extent it exists when countries move in and out of junk status, but specifically in and out of the Citigroup World Bond Index.

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## Appendices

### APPENDIX A: Rating codes for the various rating agencies

Fitch	S&P	Moody's	Rating grade description (Moody's)	
AAA	AAA	Aaa	Investment grade	Minimal credit risk
AA+	AA+	Aa1		Very low credit risk
AA	AA	Aa2		
AA-	AA-	Aa3		
A+	A+	A1		Low credit risk
A	A	A2		
A-	A-	A3		
BBB+	BBB+	Baa1		Moderate credit risk
BBB	BBB	Baa2		
BBB-	BBB-	Baa3		
BB+	BB+	Ba1	Speculative grade	Substantial credit risk
BB	BB	Ba2		
BB-	BB-	Ba3		
B+	B+	B1		High credit risk
B	B	B2		
B-	B-	B3		
CCC+	CCC+	Caa1		Very high credit risk
CCC	CCC	Caa2		
CCC-	CCC-	Caa3		
CC	CC	Ca		In or near default, with possibility of recovery
C	C			
DDD	SD	C		In default, with little chance of recovery
DD	D			
D				

Source: (Fitch, 2012; Standard and Poor's, 2012; Moody's, 2013b)

## APPENDIX B: CBOE VIX Calculation

The generalised formula used in the VIX Index calculation is:

$$\sigma^2 = \frac{2}{T} \sum_t \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T} \left[ \frac{F}{K_0} - 1 \right]^2$$

WHERE...

$\sigma$  is  $VIX/100 \Rightarrow VIX = \sigma \times 100$

T Time to expiration

F Forward index level derived from index option prices

$K_0$  First strike below the forward index level, F

$K_i$  Strike price of  $i^{th}$  out-of-money option; a call if  $K_i > K_0$  and a put if  $K_i < K_0$ ; both put and call if  $K_i = K_0$

$\Delta K_i$  Interval between strike prices – half the difference between the strike on either side of  $K_i$ :

$$\Delta K_i = \frac{K_{i+1} - K_{i-1}}{2}$$

(Note:  $\Delta K$  for the lowest strike is simply the difference between the lowest strike and the next higher strike. Likewise,  $\Delta K$  for the highest strike is the difference between the highest and the next lowest strike.)

R Risk-free interest rate to expiration

$Q(K_i)$  The midpoint of the bid-ask spread for each option with strike  $K_i$ .

(CBOE, n.d.)

## APPENDIX C: New SAVI calculation

### Calculating the new SAVI

The new SAVI is not a polled volatility measurement<sup>6</sup>. The new SAVI is calculated as the weighted average prices of calls and puts<sup>7</sup> over a wide range of strike prices, that expires in 3-months' time. In short:

$$newSAVI = \sqrt{\sum_{i=1}^{n-F} W_{iP} P_i(K_i) + \sum_{i=n}^n W_{iC} C_i(K_i)} \quad (1)$$

Here:  $F$  is the current (on value-date) forward of the FTSE/JSE Top40 index level, determined using the risk-free interest rate and dividend yield.  $F$  marks the price boundary between the liquid put options  $P_i(K_i)$ , and call options  $C_i(K_i)$  with strikes  $K_i$ . The prices of the calls and put options are determined using the traded market volatility skew that expires in 3-months' time.

The 3-month ( $T$ ) volatility skew,  $\sigma_k(O, T)$ , is determined using the time weighted interpolation function (with  $N_1$  and  $N_2$  being the days to the near skew, and next nearest skew, from the 3-month skew expiry date, respectively) defined by:

$$\sigma_K(O, T) = \sqrt{\left\{ T_2 \sigma_K^2(O, T_2) \left[ \frac{N_1}{N_2 - N_1} \right] + T_1 \sigma_K^2(O, T_1) \left[ \frac{N_2}{N_2 - N_1} \right] \right\} \frac{N_0}{N_3}}.$$

Here:  $N_o$  is the number of days in the year (365 is the South African convention), and  $N_3$  is the number of days from the value date to the 3-month date.

The weights used in equation (1) are that published by Derman et al [3]. The Derman<sup>8</sup> weightings are piecewise linear recurring option weightings:

$$W_{iP} = \frac{f(K_{i+1}) - f(K_i)}{K_i - K_{i+1}} - \sum_{j=0}^{i-1} W_{jp}, \text{ and } W_{iC} = \frac{f(K_{i+1}) - f(K_i)}{K_{i+1} - K_{i+1}} - \sum_{j=0}^{i-1} W_{jc}$$

Where: the log-contract is defined by:

$$f(F_r) = \frac{2}{T} \left[ \frac{F_r}{F_0} - \log \frac{F_r}{F_0} - 1 \right].$$

The new SAVI evaluation methodology for implied volatility measurement using the thinly traded Top40 futures option data has been tested extensively. It was found that with a strike

spacing,  $K_i - K_{i+1}$ , of 10 index level points leads to negligible approximation errors within the strike range of 70% and 130% option moneyness. Safex therefore calculates the new SAVI using a strike spacing of 10 index level points, and a strike range of 70% - 130% option moneyness.

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<sup>5</sup> This crash protection premium is sometimes referred to as the volatility skew convexity premium.

<sup>6</sup> This minimises the chances that the calculated volatility index value can be manipulated by the polled volatility contributors.

<sup>7</sup> Using calls and puts to find the price of volatility are allowed given that option prices (especially at-the-money options) are directly proportional to their input volatility.

(Joseph & Oosthuizen, 2009)

## APPENDIX D: GARCH Model used by V-Lab

### Definition

Consider a return time series  $r_t = \mu + \varepsilon_t$ , where  $\mu$  is the expected return and  $\varepsilon_t$  is a zero-mean white noise. Despite of being serially uncorrelated, the series  $\varepsilon_t$  does not need to be serially independent. For instance, it can present conditional heteroskedasticity. The Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model assumes a specific parametric form for this conditional heteroscedasticity. More specifically, we say that  $\varepsilon_t \sim GARCH$  if we can write  $\varepsilon_t = \sigma_t z_t$ , where  $z_t$  is standard Gaussian and:

$$\sigma_t^2 = w + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

### Estimation

V-Lab estimates all the parameters ( $\mu$ ,  $\omega$ ,  $\alpha$ ,  $\beta$ ) simultaneously, by maximising the log likelihood. The assumption that  $z_t$  is Gaussian does not imply the returns are Gaussian. Even though their conditional distribution is Gaussian, it can be proved that their unconditional distribution presents excess kurtosis (fat tails). In fact, assuming that the conditional distribution is Gaussian is not as restrictive as it seems—even if the true distribution is different, the so-called Quasi-Maximum Likelihood (QML) estimator is still consistent, under fairly, mild regularity conditions.

Besides leptokurtic returns, the GARCH model captures other stylised facts in financial time series, like volatility clustering. The volatility is more likely to be high at time  $t$  if it was also high at time  $t - 1$ . Another way of seeing this is noting that a shock at time  $t - 1$  also affects the variance at time  $t$ . However, if  $\alpha + \beta < 1$ , the volatility itself is mean reverting, and it fluctuates around  $\sigma$ , the square root of the unconditional variance:

$$\sigma^2 := Var(r_t) = \frac{\omega}{1 - \alpha - \beta}$$

Usual restrictions on the parameters are  $\omega, \alpha, \beta > 0$  though it is possible to have  $\omega = 0$  and  $\alpha + \beta = 1$ . The conditional variance is then an integrated process (shocks to the variance are persistent) hence the model is called IGARCH (Integrated GARCH). This is the model Risk Metrics used to compute Value-at-Risk (VaR).

## Prediction

Let  $r_T$  be the last observation in the sample, and let  $\hat{\omega}, \hat{\alpha}, \hat{\beta}$  be the QML estimators of the parameters  $\omega$ ,  $\alpha$  and  $\beta$ , respectively. The GARCH model implies that the forecast of the conditional variance at time  $T + h$  is:

$$\hat{\sigma}_{T+h}^2 = \hat{\omega} + (\hat{\alpha} + \hat{\beta})\hat{\sigma}_{T+h-1}^2$$

And so, by applying the above formula iteratively, we can forecast the conditional variance for any horizon  $h$ . Then, the forecast of the compound volatility at time  $T + h$  is:

$$\hat{\sigma}_{T+1:T+h} = \sqrt{\sum_{i=1}^h \hat{\sigma}_{T+i}^2}$$

Notice that, for large  $h$ , this forecast of the compound volatility converges to:

$$\sqrt{h} \sqrt{\frac{\hat{\omega}}{1 - \hat{\alpha} - \hat{\beta}}}$$

scaling over the forecast horizon with the well-known square-root law, times the estimate of the unconditional volatility implied by the GARCH model.

## GARCH ( $p, q$ )

The specific model just described can be generalised to account for more lags in the conditional variance. A GARCH ( $p, q$ ) model assumes that:

$$\sigma_t^2 = \omega + \sum_{i=1}^q \alpha_i e_{t-i}^2 + \sum_{j=1}^p B_j \sigma_{t-j}^2$$

The best model ( $p$  and  $q$ ) can be chosen, for instance, by Bayesian Information Criterion (BIC), also known as Schwarz Information Criterion (SIC), or by Akaike Information Criterion (AIC). The former tends to be more parsimonious than the latter. V-Lab uses  $p = 1$  and  $q = 1$  though, because this is usually the option that best fits financial time series.

(NYU - V Lab, n.d.)