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Impact of Macroeconomic News on Foreign Exchange Volatility

Tseke Maserumule

Student number: 352915

Supervisor:
Prof. Paul Alagidede

Masters of Management in Finance and Investments

University of the Witwatersrand

Johannesburg

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Declaration

I, Tseke Maserumule declare that the research work reported in this dissertation is my own, except where stated otherwise and the respective author has been acknowledged. This dissertation is submitted for the fulfilment of my Master of Management in Finance and Investment degree at the University of the Witwatersrand, Johannesburg. This thesis has not, either in whole or in part, been submitted for a degree or diploma to any other universities.

Tseke Maserumule

31 March 2016

Abstract

Financial economists have spent a considerable amount of time trying to understand the impact of macroeconomic news announcements on exchange rates, more so evaluating how new information is incorporated into exchange rates. This study examines the impact of macroeconomic news announcements on exchange rate volatility. Unlike most studies that utilise developed market currency pairs, this study utilises high frequency USD/ZAR data. Macroeconomic news can affect exchange rates directly and indirectly through public and private information. However, this study only focuses on scheduled macroeconomic news announcements as they usually have market forecasts available to conduct analysis regarding the asymmetric news effects. The following asymmetries are evaluated into the study: news items by geographical location, no-news vs. surprise news announcements and positive vs. negative news announcements. We make the following findings in our empirical study: (i) After the release of a news announcement, the level of foreign exchange volatility rises. This event is independent of whether the news item surprised the market or not. (ii) We find that both South African and US news items significantly impact USD/ZAR volatility, suggesting that both US and South African news items are being used to formulate investor expectations regarding the future prospects of the currency pair. (iii) Negative news appears to have a greater impact on exchange rate volatility relative to positive news. This result is also state dependent, as investors tend to behave differently to news depending on the economic climate at that point in time. Investor cognitive biases also give rise to the asymmetric news effects on exchange rate volatility. Investors do not always act in rational manner, especially when faced with multiple news items that are contradictory to each other.

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CHAPTER 1. Introduction

1.1 Context of the study

Financial economists have spent a considerable amount of time during the past few decades trying to understand how information is incorporated into asset prices, especially in the foreign exchange market. Currencies are the most actively traded financial assets relative to equities and bonds, with trading activity amounting to US$5.3 trillion per day in April 2013 (Bank for International Settlements, 2013). A significant amount of literature studying exchange rate determination focuses on how the arrival of new information regarding the current state or future prospects of the economy affects exchange rates. This is partly attributed to the fact that the foreign exchange market is highly integrated with the macroeconomic fundamentals of an economy, resulting in exchange rates being mostly driven by the macroeconomic fundamentals and monetary policies of a country (Li, et al., 2015).

Macroeconomic data has been widely used to test for informational efficiency in the foreign exchange market. Empirical literature examining the effects of macroeconomic news on exchange rates agree that macroeconomic news significantly affect exchange rates often resulting in a jump in the exchange rate level and a rise in volatility (Laakkonen, 2009). Since the acceptance of this hypothesis in modern day finance theory, academic focus has shifted to examining the asymmetric effects of news on the exchange rate level and volatility. While sufficient strides have been made to cover the first camp, very few studies analyse how news asymmetrically affects exchange rate volatility, especially for emerging market currencies.

The microstructure of the foreign exchange market has also changed significantly since the 2008 Great Financial Crisis, resulting from some of the findings of previous literature being inadmissible in the current environment. The change in the microstructure of the foreign exchange market also opens the study to the possibility of making new discoveries and providing results that are relevant in the new environment.

This study aims to fill the gap in literature regarding the analysis of macroeconomic news on exchange rate volatility in emerging markets (Li, et al., 2015). While some researcher such as Li

et al. (2015) and Fedderke & Flamand (2005) have conducted similar studies on emerging markets currencies, their focus was on the directional moves in the currency as opposed to its volatility. This study makes use of high frequency data rather than daily data as used in the study conducted by Fedderke & Flamand (2005). The use of high frequency data improves our understanding of the dynamic properties and drivers of volatility (Lunde & Hansen, 2011).

1.2 Problem statement

Laakkonen (2009) and Evans & Lyons (2005) state that the equilibrium spot exchange rate is an outcome of prices quoted by dealers. Therefore, news announcements regarding the current state or future prospects of the economy will only have an effect on the value of the currency, if dealers change their quotes in response to the new information. Naturally, dealers should only revise their quotes to the surprise component of the announcement i.e. the difference between the actual data print and market expectations, as their current expectations are already reflected in the price.

Andersen & Bollerslev (1998), Degennaro & Shrieves (1997) and (Bauwens, et al., 2003) have empirically shown that the announcement of macroeconomic data prints cause an instantaneous jump in the value of the currency and significantly increase its volatility. Bauwens et al. (2003) and Laakkonen (2007) have also gone to prove that exchange rate volatility behaves in an asymmetric manner to news announcements i.e. negative macroeconomic news result in greater volatility relative to positive news. However, not all studies agree with the notion that the sign of the surprise component results in an asymmetric effect (Pearce & Solakoglu, 2007). Given the unique nature of emerging market currencies and their lack of informational efficiency, it is not inconceivable that emerging market currency volatility could react different to the arrival of macroeconomic news i.e. domestic macroeconomic data could render insignificant in driving exchange rate volatility. We are currently not aware of any study that has taken the time to look at how macroeconomic news affects the volatility of emerging market currencies, particularly USD/ZAR. The closest study that focused on emerging market currencies was by Joo et al. (2009) and Fedderke & Flamand (2005), but as mentioned earlier their studies were limited to only the directional moves in the currency.

The study will also assess the presence of any asymmetric behaviour in the USD/ZAR currency pair to the arrival of macroeconomic news. The investigation will focus on how the exchange rate volatility reacts to the following variables: (i) domestic and international macroeconomic data (ii) surprise and no-news announcements (iii) positive and negative surprises. The study by Laakhonen (2007) evaluates similar variables, however the study was only limited to EUR/USD currency pair.

Given the changes in the microstructure of the foreign exchange market since the 2008 Great Financial Crisis, the study provides an updated report of the work done by Fedderke & Flamand (2005) and extends on it by studying the effects on the exchange rate volatility as well. It also uses high frequency data, which allows for greater understanding of the driving forces of USD/ZAR volatility (Lunde & Hansen, 2011).

1.3 Objectives of the study

The key objectives of the study are as follows:

1) To examine whether news announcements result in an increase in volatility as found in many empirical studies.
2) To ascertain whether local and international macroeconomic news releases, using US data as a proxy, significantly impacts USD/ZAR volatility.
3) To analyse whether it is only the surprise component of the news announcement that results in an increase in volatility, if any, or no-news announcements, i.e. data prints in line with market expectations, can also result in an increase in volatility.
4) To analyse whether negative surprises have a greater impact on volatility relative to positive surprises.

1.4 Research questions

This study aims to answer the following research questions:

1. Do macroeconomic news announcements result in a statistically significant rise in the level of volatility?

2. Is it only the surprise component of a news announcement that increases volatility or no-news announcements can also increase the level of volatility?
3. Do local and international macroeconomic news announcements have the same effect on the level of volatility?
4. Is the USD/ZAR volatility increase in response to negative news greater than the response to positive news?

1.5 Significance of the study

This study fills a gap in literature regarding the analysis of macroeconomic news impact on exchange rate volatility. As mentioned above, very few studies focus on emerging markets currencies on this subject. The little literature that does cover emerging market currencies, such as the study by Joo et al. (2009), has limited the analysis to the directional moves in the exchange rate caused by the arrival of new information or the studies were conducted pre-2008.

The results of this study will provide guidance to foreign exchange market participants who trade USD/ZAR derivatives and asset managers who include currency derivatives in their portfolios to hedge their currency risk. Volatility is a key input in derivative pricing under Black-Scholes option pricing framework and understanding this subject matter will allow participants to make better informed decisions when trading such securities (Hull, 2012). It will also allow for improved risk management by derivative traders, attributable to a better understanding of the potential effects of macroeconomic news on the underlying volatility.

1.6 Outline of the study

This empirical study consists of five chapters, with Chapter 1 outlining the rational governing the study and providing the objectives of the study. Chapter 2 evaluates previous work on the effects of macroeconomic news announcements on foreign exchange volatility. Chapter 3 describes the research methodology that will be used to conduct the empirical study. Furthermore, the properties and sources of the foreign exchange and macroeconomic data are also outlined. Chapter 4 reports and analyses the findings from the study, followed by Chapter 5, which discusses the findings with respect to current literature on the subject matter and concludes on the

discussion. The paper is then concluded with recommendations of any further work that can be conducted on the subject matter.

CHAPTER 2. Literature review

There is ample literature that evaluates the effects of macroeconomic announcements on exchange rate levels (Anderson, et al., 2003) (Ehrmann & Fratzscher, 2005) (Fatum & Scholnick, 2008). However, very few studies have been conducted analysing the news effects on exchange rate volatility. Studies by Laakkonen (2009) and Andersen & Bollerslev (1998) are the few studies whose results are applicable and serve as a good foundation for this study. The section below summarises some of the findings from the above-mentioned researchers and a list of others, who have conducted empirical studies on this subject matter in their own context. Section 2.1 provides definitions to key terms and concepts for this study, section 2.2 outlines the dynamics of the foreign exchange market, section 2.3 provides insight into how information is transmitted into exchange rates, section 2.4 describes the different kinds of information that could affect exchange rate quotes, and finally section 2.5 summarises results of previous empirical studies.

2.1 Definitions of key terms and concepts

Volatility

Volatility is a statistical measure of the dispersion of returns for a given security or market index. It can be categorised into two general categories, historical and implied volatility. Historical volatility is estimated from historical price data while implied volatility is the market's expectation of future volatility that is implied from options prices under the Black-Scholes or similar method (Hull, 2012).

Macroeconomic news announcement

Laakkonen (2009) describes macroeconomic news announcements as news releases regarding the macroeconomic fundamentals of a region such as changes in unemployment, national income, gross domestic product, inflation and price-levels. These variables provide market participants with insight regarding the current state or future prospects on an economy.

Surprise news announcement

Occurs when the actual announcement deviates from the markets consensus forecast (Laakkonen, 2009). Therefore, a positive surprise would be when the actual data print exceeds market expectations and a negative surprise would be when the actual data print underperforms market expectations.

No-news announcement

This occurs when the actual news announcement is in line with market consensus expectations.

Asymmetric

Having no balance or uneven in distribution.

Informational efficiency

It is the degree to which market prices of financial assets correctly and quickly reflect new information.

USD

United States Dollar

ZAR

South African Rand

2.2 Foreign exchange market

The foreign exchange market has undergone major structural changes over the years, which has been characterised by a substantial increase in trading volumes and a change in the mix of participants in foreign exchange trading. The Bank for International Settlements shows in its 2013 Triennial Central Bank Survey of turnover in foreign exchange markets that daily turnover was at an average of US$5.3 trillion in April 2013. This figure is nearly double that of 2007, which only printed at US$ 3.2 trillion per day (Bank for International Settlements, 2013). The daily trade

volumes can only keep growing given the growth in retail foreign exchange trading. Online trading platforms have made it easier for retail clients to trade currencies, resulting in retail clients being responsible for more than 30% of daily trade volumes (Li, et al., 2015). Retail foreign exchange traders also tend to exhibit different trading behaviour in comparison to institutional investors. Advancements in technology has also allowed for greater use of algorithmic trading strategies in the foreign exchange market, improving liquidity and informational efficiency (Li, et al., 2015).

Table 1 shows that USD is still the most traded currency in world, accounting for about 87% of the traded while EUR is the second most traded currency with a 33% market share (Bank for International Settlements, 2013). It is important to note that currencies trade in pairs; therefore, total market share will exceed 100%. The 2013 Triennial Central Bank Survey also shows that some emerging market currencies have become significant players in the currency market, with the Mexican peso and Chinese renminbi making it into the list of the world's top 10 most traded currencies (Bank for International Settlements, 2013). The Chinese renminbi has experienced a substantial surge in daily volumes - soaring from US$34 billion to US$120 billion in 2013- accounting for nearly 2.2% of global turnover.

ZAR has dropped from being one of the top 10 traded currencies, declining from its 10^{th} position in 1994 to 18^{th} in 2013. However, its overall market share of daily turnover has increased from 0.2% to 1.1% over the same period (Bank for International Settlements, 2013). USD/ZAR is the most traded currency pair with ZAR, constituting 92% of the US$60 billion turnover that is traded on a daily basis. This daily turnover is mostly traded in the form of foreign exchange swaps and spot transactions, amounting to US$31 billion and US$ 19 billion respectively. Currency options amount to only US$2 billion of daily turnover, but have been on the incline over the years (Bank for International Settlements, 2013).

Table 1. Microstructure of the foreign exchange market

	2004		2007		2010		2013	
	Amount	**% share**	**Amount**	**% share**	**Amount**	**% share**	**Amount**	**% share**
Total	1934	-	3324	-	3972	-	5345	-
Instrument								
Spot transactions	631	32.6	1 005	30.2	1 488	37.5	2 046	38.3
Outright forwards	209	10.8	362	10.9	475	12.0	680	12.7
Foreign exchange swaps	954	49.3	1 714	51.6	1 759	44.3	2 228	41.7
Currency swaps	21	1.1	31	0.9	43	1.1	54	1.0
Options and other products	119	6.2	212	6.4	207	5.2	337	6.3
Counterpart								
Reporting dealers	1 018	52.6	1 392	41.9	1 544	38.9	2 070	38.7
Non-financial customers	634	32.8	1 339	40.3	1 896	47.7	2 809	52.6
Other financial customers	276	14.3	593	17.8	532	13.4	465	8.7
Geographical distributions								
USD	-	88.0	-	85.6	-	84.9	-	87.0
EUR	-	37.4	-	37.0	-	39.1	-	33.4
ZAR	-	0.7	-	0.9	-	0.7	-	1.1

*Figures in the table are daily averages in billions of USD. Counterparty components do not sum to totals due to gaps in reporting not being excluded.

2.3 Exchange rate determination

The determination of exchange rates and transmission of new information into exchange rates are a phenomenon that have troubled financial economists for decades, leading to the development of an array of exchange rate theories. Many traditional models, such as the purchasing power parity (PPP) model, try to explain exchange rate moves using macroeconomic variables (Laakkonen, 2009). The standard set of fundamentals that are used in traditional exchange rate models are money supply, income levels, prices levels and interest rates (Engel & West, 2005). While these models are often successful at explaining the long-run moves in the currency, they fail to address the short-run dynamics. This shortcoming in traditional models lead to the development of a new strand of literature, which looked at the foreign exchange market microstructure to explain the short-run deviations from their fundamental values (Laakkonen, 2009). Unlike traditional models, which often make crude assumptions in attempt of finding a closed form solution to explain the exchange rate moves, market microstructure models focus on trying to understand the fundamentals that drive the foreign exchange market.

The law of one price forms the basis of many fundamental exchange rate models that use price levels. The concept is based on the premise that in the absence of transaction costs and official trade barriers, identical goods will have the same price in different markets when the prices are expressed in the same currency (Krugman & Obstfeld, 2011). This implies that the changes in the exchange rate should be in line with the changes in the price of goods across countries. The PPP model, which is based on the law of one price, asserts that the exchange rate between two countries over any given period of time is determined by the change in the two countries' relative price levels (Dornbusch, 1986). The Big Mac and IPad index, which are both modern day adaptations of the original PPP model, are often used to model the fundamental value of exchange rates. However, instead of using a comparable basket of goods to compare purchasing power across countries, these indices simplify the calculation to a single product whose inputs span across many spheres of the economy. By using a single standardized product, this eliminates the challenge of finding a comparable basket of goods, which may sometimes not be possible given the different consumption patterns in different countries.

Exchange rates sometimes exhibit random walk behaviour when fundamentals are insignificant in explaining the exchange rate moves (Engel & West, 2005). In this situation, there may be some other unobserved variables that drive the exchange rate that standard models may not capture. This was first noticed by Meese & Rogof (1983), who found that random walk models produced better out-of-sample exchange rate forecasts than economic models. This was largely attributed to parameter instability, a widespread phenomenon in empirical time series analysis (Rossi, 2006). While this discovery raises questions regarding the usefulness of economic models in predicting exchange rates, Engel & West (2005) and Anderson et al. (2003) find that macroeconomic fundamentals play a significant part in driving exchange rate. While this premise has been widely accepted, there is role for "unobserved" fundamentals such as risk premiums and money demand shocks in forecasting exchange rates.

The market microstructure approach of determining exchange rates focuses on the imbalances between buy- and seller-initiated trades in the foreign exchange market, as this represents the transmission link between fundamental information and exchange rates (Vitale, 2007). This approach understands that exchange rate quotes are an outcome of dealer perceptions regarding the economic prospects on the respective countries in the currency pair. Therefore, the arrival of new information that changes dealer perceptions will be reflect in their quotes – affecting the value of the currency (Laakkonen, 2009). This news flow can affect the dealers' quotes directly and indirectly. The first component, which affects the dealer directly, is the portion that is perceived to be common knowledge and all agents agree upon its impact on exchange rates. This information will instantaneously be reflected in the exchange rate. The second component, which is also known as private information, looks at the inferences that dealers make from client buy and sell orders (Evans & Lyons, 2005). Clients have dispersed information about the state of the economy, e.g. sales of a product, and this information can be correlated with macroeconomic variables (Laakkonen, 2009). Dealers may learn the pattern of client orders; therefore, deviations from this pattern may provide some information regarding the state of the economy. This information will gradually be reflected in the exchange rate (Evans & Lyons, 2005). Private information also extends to unreleased information by government agencies or central banks that could have a significant bearing on the exchange rate (Bauwens, et al., 2003).

Evans & Lyons (2008) find in their empirical study that scheduled macroeconomic news only account for approximately a third of the daily DEM/USD variation, while other observed macroeconomic news besides scheduled announcements and the volatility of the order flow account for a remaining variation. Order flow is also found to contribute the most to price-adjustments following a macroeconomic announcement, which contradicts what one would expect given that macroeconomic news mainly comprise of common-knowledge that is directly reflected in the exchange rate (Evans & Lyons, 2008). Theoretically order flow should contribute less post a scheduled announcement in comparison to any other time. This suggests that macroeconomic news could in fact release new dispersed information that affects exchange rates indirectly.

2.4 Macroeconomic news

Macroeconomic news are statistics regarding the economic activity within a particular region. These variables provide market participants with insight regarding the current state or future prospects on an economy. This information can be distinguished into scheduled and unscheduled news announcements (Bauwens, et al., 2003). Scheduled macroeconomic news compromise of news announcements by market agents such as central banks and other government agencies that are planned to take place at a fixed date and time and this information is known in advance. On the other hand, unscheduled news are disseminated randomly without any prior knowledge i.e. Reuters news feed. This group of information forms part of public information component in market microstructure theory.

A significant amount of literature looks at scheduled macroeconomic news to explain moves in the foreign exchange market, while very little emphasis is placed on private information and random news announcements. Rime (2000) finds that traditional macroeconomic exchange rate models have low explanatory powers in explaining currency moves within horizons shorter than 6 months due to its lack of consideration for private information. However, it is very difficult to quantify the effects of private information on exchange rates and using dummy variables to capture the effects of random news flow often yields insignificant results (Laakkonen, 2009).

Scheduled macroeconomic releases tend to be more desirable in such empirical studies as their release dates and times are known beforehand and make it is possible for analysts to forecast these

data figures (Laakkonen, 2009). Given that the exchange rates should only react to the surprise component of the news, these forecasts can therefore be used as a proxy of market expectations. By being able to compute the surprise component of an announcement, researchers are also able to distinguish the reaction in volatility that can be attributed to the magnitude of surprise from the existence of the announcement itself (Neely, 2011). However, it is remains arguable as to whether survey forecasts are perfect substitutes for market expectations.

While macroeconomic news have generally been found to have a significant impact on asset prices, it is not all news announcements that have a significant impact on the exchange rate (Alvaro, et al., 1998), (Anderson, et al., 2003) & (Neely, 2011). It is actually a few announcements that have a strong impact on markets. The significance of some news announcements has also varied over time, as market participants change the macroeconomic variables that they focus on. This is supported by one of the key takeaways from the Vega, et al. (2015) study, that the price response of a particular announcement cannot be viewed in isolation, as it is largely dependent on the information and overall economic environment at that point in time.

Table 2. Sample macroeconomic news announcements

US announcements

Name of announcement	Frequency	Frequency Lag	Release time (SAST)
Consumer Confidence index	Monthly	None	17:00
Consumer Price Index (CPI)	Monthly	2 weeks	15:30
Current Account	Quarterly	10 weeks	15:30
Factory inventories	Monthly	4 weeks	17:00
Industrial Production	Monthly	2 weeks	16:15
Unemployment Rate	Monthly	Few days	15:30
Trade Balance	Monthly	7 weeks	15:30

2.5 Impact of new information on exchange rates

Capital markets are said to be efficient if they fully and correctly reflect all relevant information in determining an asset prices (Malkiel, 1991). This phenomenon is known as the efficient market hypothesis and was first developed by Eugene Fama who argued that stocks always trade at fair value. This theory has since been accepted in other asset markets, including foreign exchange. Fama's (1970) semi-strong form of the efficient market hypothesis (EMH) has been used to link exchange rates to macroeconomic fundamentals. The hypothesis states that the current prices reflect all publicly available information. The basis of this principle is that market-participants are continuously exposed to information, which they use to develop expectations regarding future asset prices and trade on these convictions. Due to this process, asset prices should reflect the marginal investor's current expectations and asset prices should only react to the surprise component of announcement (Neely & Dey, 2010).

While the EMH has been widely accepted in modern finance, it has come under a lot of criticism for its assumption that market agents have rational expectations. It is argued that market agents sometimes can exhibit irrational expectations, due to cognitive biases such overreaction, informational and representative biases. Market participants can also incorrectly process the information. These biases have been attributed to the asymmetric reaction of exchange rates to news announcements (Laakkonen, 2009). Empirical studies by (Damodaran, 1985) and (Veronesi, 2000), evaluate the impact of imperfect information on asset prices. In the study by Veronesi (2000), it is assumed that the data releases may be incorrect and market agents are aware of this fact. This results in investors hedging themselves against inaccuracies in the announcement. On the other hand, Damodaran (1985) assumes that the reported news are correct, but market agents inaccurately process the information. This outcome is attributed to the short time frame that investors are expected to react to new information, resulting in a rise in excess volatility (Laakkonen, 2009). Given this evidence from microstructure literature, foreign exchange market agents cannot entirely be assumed to act in rational manner in the presence of new information. While all the proposed theories mentioned above may seem to contradict each other in some regard, they actually complement each other in providing insight into the dynamics of the foreign exchange market.

The market efficiency of the foreign exchange market and its close interaction with macroeconomic fundamentals has allowed extensive work to be covered regarding the informational efficiency of the asset class. While there is still some disagreement regarding certain aspects of the subject matter, one point that remains consistent throughout literature is that news announcements have a significant and positive effect on volatility i.e. macroeconomic news results in an increase in volatility, but only a selected number of announcements have a significant effect on volatility. Unlike Fama's (1970) EMH which suggests that the exchange rate should only react to the surprise component of a news announcement, it is found that the news announcement itself can result in a significant change in the exchange rate. Using high-frequency data, Laakhonen (2007) finds that macroeconomic news have a significant impact on exchange rate volatility irrespective of whether there was a forecast available or not. This highlights that it is not only the surprise component that results in an increase in volatility, but the actual announcement itself can lead to increased volatility. Due to the periodicity of intraday volatility, caused by events such as market open and closes and days of the week effects, Laakhonen (2007) uses the Flexible Fourier Form (FFF) method to model the intraday structure of volatility. This method was first popularised by Andersen & Bollerslev (1998), who studied the effects of macroeconomic news on exchange rates using high frequency data. While ARCH type models are generally considered as the best models to use when modelling conditional heteroscedasticity, they fail to consider the systematic periodical structure of volatility during the course of the day (Laakhonen, 2007). Useful results regarding volatility dynamics can only be discovered if the model explicitly accounts for the intraday pattern of volatility (Andersen & Bollerslev, 1998).

While macroeconomic news do have a meaningful impact on the prices, Fornari (2004) evaluates which announcements significantly impacted swaption volatility. The announcements are divided in categories based on the origin/region of the announcements and the type of data figure being announced. Consistent with the findings by Andersen & Bollerslev (1998), the results show that a small number of US macroeconomic variables tend to have a significant effect on US and Euro yields, while Euro region announcements have only a small or negligible effect on either European or US rates (Fornari , 2004). The following variables were found to significantly affected interest rate volatility: US Institute for Supply Management index (ISM). US non-farm payroll, US jobless claims, Chicago Purchasing Managers index, US durable goods orders and US retail sales. Given that both interest rates and exchange rates are driven by fundamental economic

factors and government policy, these results will mostly likely apply to currencies (Fornari , 2004).

Fedderke & Flamand (2005) undertook a study to determine whether macroeconomic news surprises drive the value of USD/ZAR exchange rate given the inefficiencies of the South African foreign exchange market. This study focuses on the directional moves in the currency rather than evaluating the impact on volatility. Using an Ordinary Least Square (OLS) regression model, they tested whether news announcements had a statistically significant impact on USD/ZAR exchange rate changes. The macroeconomic variables covered both US and South Africa, using real and nominal variables. Macroeconomic announcements covered for South Africa are: CPIX which is the South African Reserve Bank (SARB) indicator for domestic price inflation, Producer Price Index (PPI) which gives a measure of inflation growth of goods used in production, the Repo rate which is the central bank policy rate, GDP growth which measures the economy's output growth on a quarterly basis, money supply (M3) and trade figures for each month (Fedderke & Flamand, 2005). On the US front, the following data variables were used: US Consumer Price Index (CPI), Federal Funds rate, US non-farm payroll which indicates jobs created in a month, industrial production which is a measure of economic activity and trade figures (Fedderke & Flamand, 2005). The results of the study are similar to those found by Fornari (2004), indicating that macroeconomic news do impact USD/ZAR exchange rates. However, it is only US announcements that have a significant impact on the USD/ZAR exchange rate, while South African news have a negligible impact, if any. The country news asymmetry with respect to the US came as no surprise given the size of the economy and its dominance in foreign exchange trading (Fedderke & Flamand, 2005). The results also show that the impact of certain variables change over time, highlighting how traders focus on specific variables over a given period of time rather than all the potentially relevant news. This has raised questions regarding the efficiency of the exchange rate markets ability to absorb and reflect new information. While the study by Fedderke & Flamand (2005) has provided meaningful results that are consistent with the prevailing school of thought, using end of day data doesn't fully capture the intraday dynamics of the foreign exchange market. It also limits the amount of news announcements that can be studied as multiply announcements can be released in a day, making it hard to conclude the cause to the exchange rate moves. The macroeconomic news observed in the study are limited, leaving out

important macroeconomic variables such as Purchasing Managers' Index (PMI) figures – which are viewed as a leading indicator of the state of the economy.

A lot of the literature has focused on evaluating the effects of public information on exchange rates with very few researchers dedicating time to analyse private information. Bauwens et al. (2003) uses high-frequency data to estimate the impact of public and private announcements have on the volatility of EUR/USD returns. The study breaks down the observation period into pre-announcement, contemporaneous and post-announcement, allowing the behaviour of investors to be analysed before and after a news announcement. An E-GARCH model is used to model the intraday volatility. The results highlight that volatility increases in the pre-announcement phase of a scheduled announcement because of speculative trades, informed trades or traders closing out positions to avoid any adverse moves that may occur due to surprise news (Bauwens, et al., 2003). The changes in volatility are relatively small post announcement, despite the expected drop that should occur as the uncertainty would have passed. By separating the announcements into public and private, this provides insight into the role of private information in explaining moves in the exchange rate, especially when public information fails to explain the moves in the foreign exchange market.

2.5.1 *News from different countries*

According to microstructure literature, any change in the current state or future economic prospects of either country of the currency pair should be reflected in the exchange rate through a change in dealer quotes. Laakkonen (2009) and Fedderke & Flamand (2005) find that macroeconomic news from the respective countries of the currency pair have an asymmetric effect on the exchange rate.

News surprises from developed countries such as Japan, Germany and the Eurozone have been insignificant in explaining moves in the exchange rate ((Laakkonen, 2009), (Andersen & Bollerslev, 1997) & (Pearce & Solakoglu, 2007)). It is mostly US news surprises that have a meaningful impact on the foreign exchange market. This case is no different for South Africa, which comes as no surprise given that the economy is significantly smaller than the countries mentioned above. Laakkonen (2009) finds that US news increases EUR/USD volatility by as

much as 72% immediately after the news, while the next largest effect is caused by Germany with a 24% increase. The US dollar is the worlds most traded currency; therefore anything that happens to the US economy will have a substantial impact on global financial markets. The US is also a major trading partner to South Africa, accounting for US$10 billion of South Africa's exports and US foreign direct investment in to South Africa stood at US$5.5 billion in 2012 (United States Tarde Representative, 2016). South Africa is a big commodity exporter, which are priced using USD. Implicitly, any change in the economic prospects of the US should be reflected in the US currency, which in turn affects South Africa's economic health as one of its biggest export products is priced in USD.

2.5.2 *Surprise and no-news events*

According to Fama's (1970) efficient market hypothesis, market participants react to the surprise component of a news announcement as the expected component has already been reflect in the price of an asset (Fedderke & Flamand, 2005). Given the acceptance of this premise, very few studies analyse the effects of no-news announcements, i.e. market expectations are in-line with the actual news announcement, on asset prices.

In the study by Laakhonen (2007), she explicitly evaluates the effects of both surprise announcements and no-news announcements, aiming to establish whether no-news also increases foreign exchange volatility. The results from the study highlight that both surprise and no-news announcement significantly increase volatility. The effect of the no-news announcements is dependent on the type of announcement, as some announcements have a greater impact on market volatility than others. It was found that surprise announcements cause a 36% jump in volatility while no-news announcements resulted in a 65% jump in volatility following the announcement. One of the explanations put forward to explain this finding is that trade volumes are lower prior to an announcement and therefore volatility is lower. However, post the announcement volume increases irrespective of whether the information has surprised the market. Another reason to this could be the fact that no-news doesn't necessarily mean that the news weren't bad (or good), therefore volatility can increase on the back of a no-surprise announcement.

Fatum & Scholnick (2008) investigate whether exchange rates respond only to the surprise component of monetary policy changes and whether failure to disentangle the surprise component of an announcement underestimates the impact on the of the news. Rather than focusing only on the surprise component, Fatum & Scholnick (2008) disintegrated the news announcement into a linear function of the expected and actual announcement. This resulted in three explanatory variables (surprise, actual and expected component) that are separately analysed. The results were consistent with standard asset pricing theory; the expected component of the announcement had no impact on the exchange rate while the surprise component significantly affected the exchange rate. The results challenge a previous study that was conducted by Lewis (1995), who failed to disentangle the news announcement and therefore did not find conclusive evidence to support the notion that monetary policy significantly affects exchange rates.

The contradictory results by Laakhonen (2007) highlight the informational inefficiencies in the foreign exchange and the asymmetries that arise due to investor cognitive biases. Market participants have proven not to act in a rational manner on some occasions, highlighting the shortcomings in the EMH assumption that investors act in a rational manner. This also promotes the strand of microstructure literature, which does not rely on making assumptions regarding rational expectations, but assumes that some psychological issues may affect investor reaction to news. One of the frameworks is the theory of 'investor conservatism', which suggests that investors react asymmetrically to news due to their reluctance to change their beliefs as they receive new information (Laakkonen, 2009).

2.5.3 *Positive surprises vs. negative surprises*

In the study by Bauwens et al. (2003), it is found that negative shocks do not have a significantly greater impact on volatility than positive shocks. Both negative and positive news surprises lead to an increase in volatility prior to the announcement. However, it is found that volatility significantly drops 20 min after positive US data news while there is no significant drop after a negative announcement. This is attributed to the behaviour of traders and their anticipation to positive and negative news. Due to risk-aversion, traders who anticipate negative news announcements take positions prior to announcements and close them out when they've reached a

desired level in trading profits. Therefore, they do not wait for the actual news announcement to avoid spikes in volatility that could go against their positions (Bauwens, et al., 2003).

Laakhonen (2007) finds that volatility reacts in an asymmetric manner to surprise announcements. Negative news announcements are found to have a statistically greater impact on volatility than positive news. The empirical study by Liao & Williams (2015) also shows that the foreign exchange market reacts in an asymmetric manner to macroeconomic news, implying that investors react differently to good and bad news and these asymmetries should be considered if market participants are to make rational and efficient financial decisions. The study uses a multivariate BEKK GARCH to model volatility dynamics of exchange rates between 1971 and 2005. The asymmetric model is superior to the standard model that assumes that volatility reacts in a similar manner to good and bad news.

2.6 Conclusion

Literature tells us that news announcements have a significant bearing on the foreign exchange market, where the release of the macroeconomic news results in a significant move in the exchange rate and volatility increases upon the release of the announcement. However, there is no clear agreement regarding the asymmetric news effects on exchange rates. The foreign exchange market has also evolved over the years, resulting in some studies being inadmissible in the current environment. The growth in retail investors and the use of algorithmic trading strategies in the foreign exchange market has significantly changed the foreign exchange market microstructure, resulting in different trading patterns and informational efficiency levels.

While numerous theories have been put forward to explain the determination of exchange rates and how information is transmitted into asset prices, each method has its place in explaining these two factors. In the short-run, exchange rates have sometimes exhibited random walk properties but this is not to say that macroeconomic models do not have a place in explaining exchange rates. Traditional fundamental models do sufficiently explain currency moves in the long run, highlighting the close integration of the currency market with the state of the economy. Currencies can deviate from their fundamental values for extended periods of time, as the market is not always rational as proved by various researchers.

A lot of focus has been placed on public information in explaining exchange rate movements, with very little consideration for private information. Private information can play a pivotal role in exchange rate determination, especially in the short run. The only shortcoming with this information is computing its effect in a statistical model.

The US has also proved to be the powerhouse that drives financial markets, with news announcements out of the region significantly affecting volatility. Other major economies such as the Euro area and Japan have shown little or negligible influence. This is also supported by market share in the foreign exchange market.

While Fama (1970) advocates that the market should only react to the surprise component of a news announcement, numerous studies show that the announcement itself can lead to significant rises in volatility. This highlights that a no-news announcement doesn't necessarily imply that the news weren't good or bad. Investors have also reacted differently to negative news than to positive news. However, all the researchers studied did not unanimously reach this conclusion. Some researchers find that there are no news effect asymmetries with respect to the sign of the surprise announcement. Investors sometimes process the information incorrectly as they usually have short time frames to react to the information or they may have to process contradictory information at the same time.

CHAPTER 3. Data and Research Methodology

This chapter describes the exchange rate data that is used to conduct the research and the respective data sources. It also evaluates the macroeconomic data that is used to represent our news data and the different categories that are used to test the news effect asymmetries. The methodology that was used to test our research questions is also included in the section.

3.1 Exchange Rate Data

Our original data set consists of 1-minute bid-ask quotes on USD/ZAR from 2 January 2014 to 31 December 2015. The data was obtained from HistData.com, a free online data provider of high frequency currency data. We use 10-minute data instead of 5-minute data that is used in most high frequency data studies. Given the inefficiencies of the USD/ZAR foreign exchange market relative to the EUR/USD market, this time-interval was appropriate as it is short enough to capture the asymptotic nature of the return series without much efficiency being lost. The prices are obtained from the Ninja Trader trading platform. Mid exchange rate prices, which is an average of the bid and ask quotes, are used in the study and returns are calculated as the differences of the logarithmic prices.

$$r_t = \ln(P_t) - \ln(P_{t-1})$$

where r_t represents the return and P_t is the mid-price at time t

The dataset consists of data for all the trading days, which is all the weekdays excluding New Year's day and Christmas day. However, due to a decrease in liquidity during the weekend and certain public holidays, we've excluded these days from the study to maintain consistency with previous literature by Andersen & Bollerslev (1998) and Laakkonen (2009). Andersen & Bollerslev (1998) define a day as starting at 21.05 GMT the night before to 21:00 GMT that evening. For this study, a day is defined as starting 00:10 South Africa Standard Time (SAST) to 00:00 SAST. This equates to 22.10 GMT the night before to 22:00 GMT that evening. The weekend is defined as the duration between 00: 00 SAST on Friday till 23:50 SAST on Sunday. The following holidays were excluded from the study: Christmas, News Years, Good Friday and

Easter Monday. All other South Africa public holidays were included in the study as the market had sufficient liquidity on those days to conduct a meaningful experiment and some significant US news are released on those days, which significantly impacts the volatility on the currency pair. The data did have missing quotes at some time periods due to a lack of quotes, especially on South African or US public holidays. In cases where the time period of the missing data is less than an hour, a linear interpolation between the two end points was used to replace the missing data. If the time period of the missing data is more than an hour, these data points were excluded from our study.

The 10-minute return data series has the following statistical characteristics:

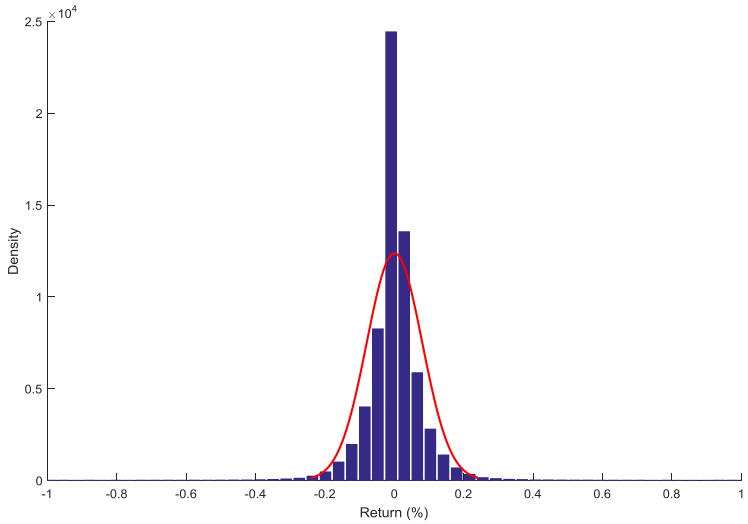


Figure 1. 10-minute USD/ZAR return histogram

Table 3. Statistical properties for 10-minute USD/ZAR returns and their corresponding absolute return

	Mean	St. dev	Kurtosis	Skewness	Min	Max
Returns	0.0006	0.0800	439	0.3296	-4.954	4.710
Absolute returns	0.0474	0.0645	988	16.290	0.000	4.954

The statistical properties of the return series clearly show that USD/ZAR exhibits the fat tail distribution that is common to most financial assets. Due to the large kurtosis of the returns, the distribution is larger in the tails and thinner in the midrange than is implied by a normal

distribution. The skewness in the returns highlights ZAR's tendency to depreciate rather than appreciate over the period of study. The minimum and maximum returns of -4.95% and 4.71% respectively, also highlights the volatile nature of USD/ZAR relative to other currency pairs such as EUR/USD which has a minimum and maximum of -1.35% and 2.79% respectively (Laakkonen, 2009). The absolute returns, which are used as a proxy for intraday volatility, also support the notion that the currency pair is volatile.

The intraday volatility pattern exhibits strong periodicity due to events such as market opens and closes and macroeconomic data announcements being made at particular times of the day. In Figure 2, we plot the average intraday volatility pattern in a day by computing the mean absolute returns per 10-minute interval. The figure clearly shows that the opening and closing of the various major markets around the world have a significant bearing on market volatility. The level of volatility rises at various points in the day due to different trading times of the various markets:

- 02:00 – Asian Market
- 09:00 – South African Market
- 10:00 – European Market
- 15:00 – United States Market

It is worth noting that there is a spike in volatility around 15:30 SAST; this can be attributed to the fact that most US macroeconomic announcements are usually released around this time – which seems to significantly increase the volatility. The sporadic spike in volatility at 02:00 SAST is due to the flash crash of most emerging market currencies on 24 August 2015 sparked by fears over the economic health of China, causing ZAR to depreciate by 4.71% within a 10-minute interval. This figure skewed the average volatility at this point and a similar incident can be said for the spike at 09:00 SAST. These spikes in volatility are a result of public information being disseminated into the market, in form of both scheduled and unscheduled news announcements.

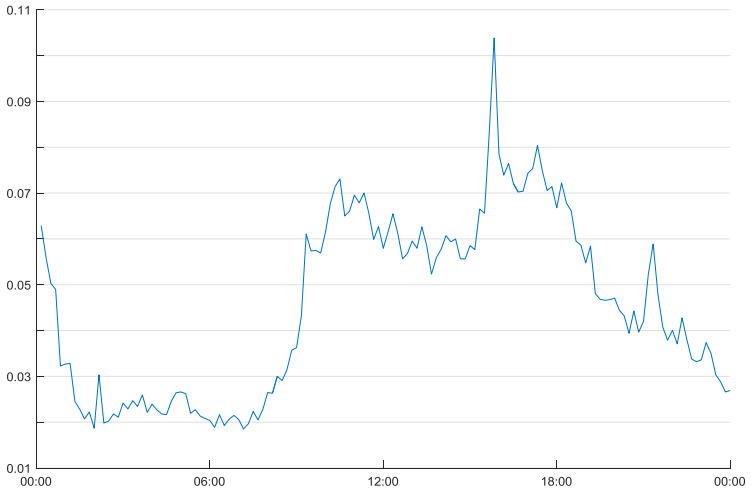


Figure 2. The average intraday USD/ZAR volatility over the period January 2014 and December 2015.

Overall, it is evident USD/ZAR is most volatile during South African market open. This volatility increases even more during the overlap between the South African and US trading times, which is between 15:00 and 17:00 SAST. The local foreign exchange market also exhibits lunchtime effects, as we can see a decline in volatility between 12:00 and 14:00 SAST. Volatility seems to peter out as the market nears its closing time, which is around 17:00 for the South African market.

The U-shape autocorrelation of the 10-minute USD/ZAR returns in Figure 3 shows that the volatility pattern is repeated on a daily basis, which is consistent with the findings of Andersen & Bollerslev (1998) on EUR/USD volatility. The autocorrelation that's present in the return data series will require to be de-trended before it is analysed, as the presence of autocorrelation will violate the key assumptions of the linear regression model. Laakkonen (2009) evaluates a range of popular methods that are used to remedy the seasonality issue often experienced with high frequency financial market data. She evaluates the advantages and the shortcomings of using the Flexible Fourier Form (FFF) model, Locally Weighted Scatterplot Smoothing method (LOWESS) and the Intraday Average Observations Model (IAOM). While Laakkonen (2009) and Andersen & Bollerslev (1998) utilise the FFF model to filter the periodicity in the return series as it yields

superior results most scenarios, we utilise IAOM as it is an equally as robust, easily computed and capable of filtering out the periodicity in volatility.

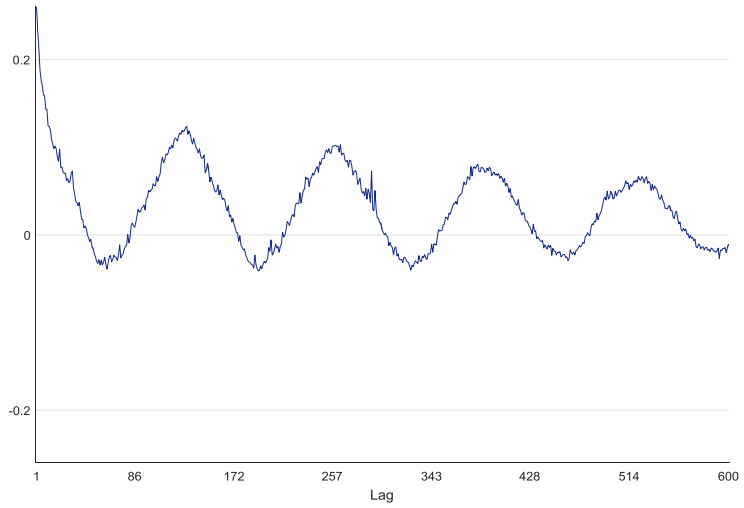


Figure 3. Five day autocorrelation of 10-minute USD/ZAR absolute returns

3.2 Macroeconomic News Data

The macroeconomic news data used in this study is sourced from Bloomberg's World Economic Calendar platform. The platform contains a calendar of all the scheduled economic news that are set to be announced, stating both the date and time of the announcement and any market analyst expectations for the economic data print. In this study, we collect all the scheduled macroeconomic news from the 1St January 2014 and 31st December 2015. The market forecasts are median expectation by analysts from the survey conducted by Bloomberg. While forecasts are available for a wide range of data prints, less supervised data prints often lack forecasts. Since this is a point in time study, we use the original data print that is announced when computing the surprise component instead of using the revised figure, if the figured is revised at a later point in time.

We isolate the study to news announcements released out of South Africa and the US, which amounts to 728 and 3229 news announcements respectively. While this is the total number of news announcements that are released during our observation period, the number of unique news

variables during this period amount to 42 and 216 for South Africa and the US respectively. The reason behind the number of unique observations being significantly lower is because most data prints are released on a monthly and quarterly basis i.e. some data such as non-farm payrolls could contribute 24 news announcements to the total number of US announcements over the observation period.

Table 4. Number of macroeconomic announcements in the different countries

Region	Number of News	Number of unique news
South Africa	728	42
United States	3 229	216

To test the asymmetrical news effects, the news announcements are divided into different categories. Given our research questions, the data was separated according into the following groups:

- Positive surprise news
- Negative surprise news
- No news announcements
- Consistent news
- Contradictory news

As mentioned earlier, not all news announcements have available forecasts, resulting in only 546 and 2507 news announcements from South Africa and the US being eligible for our asymmetrical news effects analysis. A positive news announcement is defined as a data print that exceeds what is expected by the market, except when considering macroeconomic variables such consumer price index (CPI), producer price index (PPI) and unemployment figures. In the CPI instance, a news item that is lower than the market forecast would be considered as a positive news announcement. This statement is also conditional on CPI being in positive territory in the region, as an increase in CPI above market expectations in a country with negative CPI changes would be regarded as positive by market agents. Negative news items are defined as news items where the market had been overly optimistic about the actual news announcement i.e. actual news item is lower than market expectations. This definition is consistent with most literature, but questions are still being raised whether survey forecasts serve as a good proxy for market expectations

(Laakkonen (2009) and Andersen & Bollerslev (1998)). No-news announcements, which are defined as news items that are in line market expectations, only amounted to 49 and 326 news items for South Africa and the US respectively.

In instances where more than one news item is released at a specific date and time, we evaluate whether the news items are contradictory or consistent with each other. Contradictory news items occur when a positive and negative news announcement is released at the same date and time, while consistent news items occur when the multiple news items that are released at the same time are either all positive or negative. This provides insight into how investors process multiple news items that are disseminated at the same time. This will also contribute to the work done by Damodaran (1985) regarding information processing biases, which he attributed to market agents being under pressure to respond very quickly to new information. Market agents could also act in an irrational manner due to contradictory news items being very hard to interpret.

Table 5. Frequency of news announcements at the same time

Frequency	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
South Africa	190	172	9	39	1	1										
United States	662	280	96	81	42	49	32	20	8	21	10	6	1	1	0	1

The frequency table clearly indicates that market agents are frequently exposed to multiple news announcements at the same time. This is largely due to announcements being released at certain times in a day. South African data is usually released at 10:00 and 11:00 SAST and US news are usually released at 15:30 and 17:00 SAST. The Bloomberg world economic calendar also splits certain macroeconomic variables in multiple news items i.e. CPI is split into Headline CPI, Core CPI, CPI MoM and CPI YoY. This characteristic results in there being a lot more news items occurring at the same time.

Table 6. Number of macroeconomic news items per asymmetric category

News item	South Africa	United Sates	Total
All news	728	3229	3957
Forecast available	546	2461	3007
Forecast not available	182	768	950
Positive news	251	984	1235
Negative news	246	1151	1397
No-news	49	326	375
One announcement	190	662	852
Contradictory	91	418	509
Consistent	127	207	334

Table 7. Largest volatility swings

Date	Time	Weekday	Absolute Return	Event
14-Dec-15	00:00	Mon	4.954	Hiring of Pravin Gordhan
24-Aug-15	02:00	Mon	4.710	China's 'Black Monday'
09-Dec-15	21:00	Wed	2.426	Removal of Finance Minister
28-Oct-15	21:10	Wed	1.473	FOMC Rate Decision
29-Jun-15	00:20	Mon	1.469	China Fears - Risk off
29-Jan-14	15:30	Wed	1.325	SARB Announce Interest Rate
06-Nov-15	15:40	Fri	1.312	Nonfarm Payrolls
06-Mar-15	15:40	Fri	1.303	Nonfarm Payrolls
24-Aug-15	02:30	Mon	1.246	China's Black Monday
09-Dec-15	20:30	Wed	1.244	Removal of Finance Minister

3.3 Seasonality Filtering

The intraday volatility of 10-minute USD/ZAR returns exhibit strong periodicity that needs to be filtered in order to remove the seasonality. Microstructure literature states that news announcements, opening and closing of markets and days of the week can lead to cyclical seasonality into many foreign exchange variables such as volatility (Omrane & de Bodt, 2004). While a wide variety of filtration methods have been proposed throughout literature, there is no one method that has been unanimously accepted.

The intraday seasonality can either exhibit a deterministic or stochastic nature – in some cases it may be both. Where the seasonality is deterministic, classic methods such as the intraday average observation method (IAOM) perform well in fitting the cyclicality. It is only when the seasonality exhibits stochastic characteristics that these models fall short. The stochastic seasonality component can be induced by a change in the times in which macroeconomic news items are released (Omrane & de Bodt, 2004). Andersen & Bollerslev (1998) and Laakkonen (2007) adopt a linear model to estimate the periodicity component. The FFF model uses sinusoids as exogenous variables to capture the periodicity.

Two broad categories exist in seasonality adjustment methods. The first method is a one-step procedure that aims to remove the periodicity through a regression model that contains exogenous variables that capture the seasonality component (Omrane & de Bodt, 2004). The second method is a two-step method which first aims to adjust the raw return data in such a way that the periodicity is filtered out. Once the seasonality component of the return series is filtered, a regression model is used to model the adjusted returns against a set of exogenous variables.

In all the seasonality adjustment methods that were evaluated by Laakkonen (2007), the models were consistent in this regard: The model produced an estimate of intraday volatility, which we represent using $v_{t,n}$. This estimate is then normalized such that the mean of the normalized intraday volatility equals one. The normalised intraday volatility is calculated as follows:

$$\widetilde{v_{t,n}} = \frac{T.v_{t,n}}{\sum_{t=1}^{T/N}\sum_{n=1}^{N} v_{t,n}}$$

where T= number of observations in whole sample, N is the number of intervals in a day and T/N denotes the total number of days under observation.

To calculate the set of adjusted returns, the original return series, $r_{t,n}$, is divided by normalized estimate of intraday volatility $\widetilde{v_{t,n}}$ i.e. $\widetilde{r_{t,n}} = \frac{r_{t,n}}{\widetilde{v_{t,n}}}$. This method reduces volatility during periods of high volatility and increases volatility during periods of low volatility.

3.4 Models

In this study we employ the two-step approach of modelling the periodicity of the 10-minute USD/ZAR return series. We use the IAOM method to filter out the seasonality in the original return data, followed by a FFF consistent model to regress the intraday exchange rate volatility against a set of exogenous variables. The two processes are explained in details below:

3.4.1 *The Intraday Average Observation Model*

The Intraday Average Observation Model (IAOM) fits under the average observations category of seasonality adjustment models. Omrane & de Bodt (2004) finds that this method successfully estimates the periodicity without estimation error. However, it falls short when the seasonality contains both a deterministic and stochastic component.

The estimate of intraday volatility $v_{t,n}$ is computed by averaging the squared returns per each intraday interval and then taking the square root. The computation is defined as follows:

$$v_{t,n} = (\frac{1}{W}\sum_{w=1}^{w} r_{w,d,n}^2)^{0.5}$$

where W denotes the number of weeks in the dataset, d= 1,2,3,4,5, denotes the weekday and n=1,2,…,N denotes the intraday interval. In this study we define Monday as the start of the week, resulting in Monday being equal to 1 and Sunday being equal to 7.

In Figure 4, we clearly see that the IOAM decreased the volatility of returns during periods of high volatility and increased the volatility during periods of high returns. While we applied the

IAOM to the whole dataset, the method can be applied to different subsets of the dataset. The model can be separately applied to weekly, quarterly and yearly datasets (see Laakkonen (2009)), with the amount of periodicity being filtered out increasing when the subsets are shortened. While this may filter out the periodicity of the returns, it could also filter out the news effect that we are trying to study.

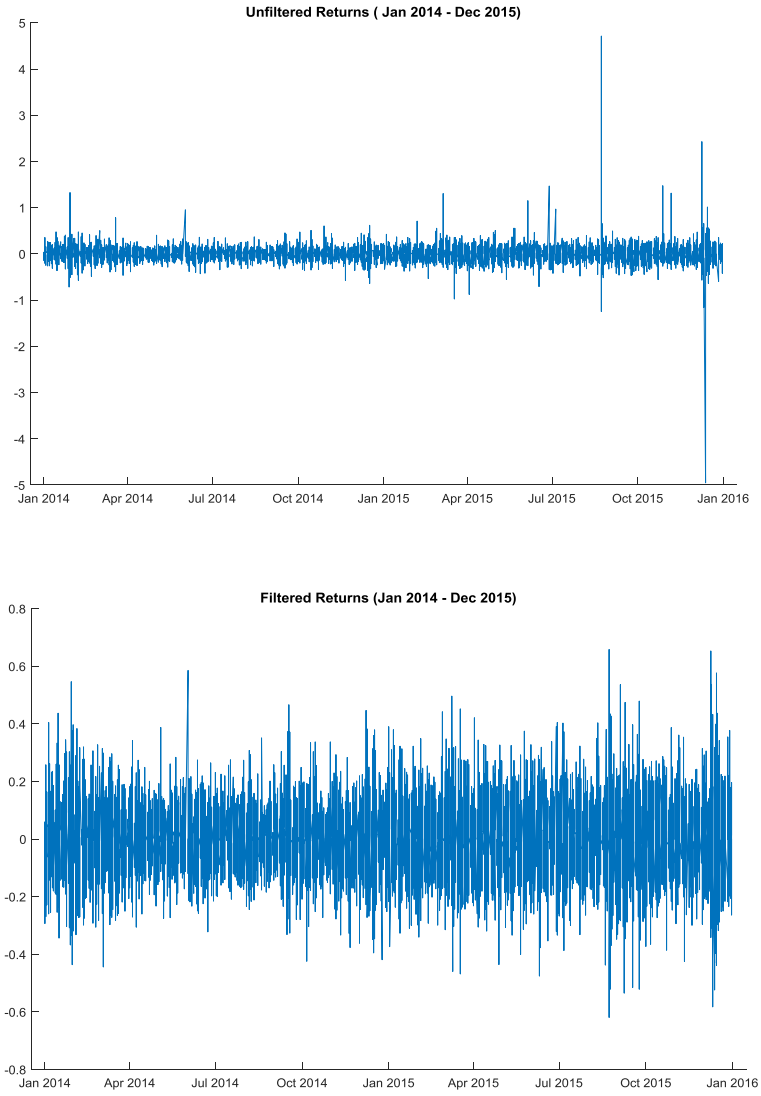


Figure 4. Unfiltered and filtered 10-minute return after applying the IAOM

The IAOM has sufficiently managed to filter out the cyclicality in the autocorrelation of the original absolute return data series (see Figure 5). While there is still some periodicity present, we wanted to strike a balance between the filtering out the periodicity and maintaining the news

effect in the return data. The sporadic spikes in the autocorrelation function were also filtered out, resulting in much smoother changes in correlation.

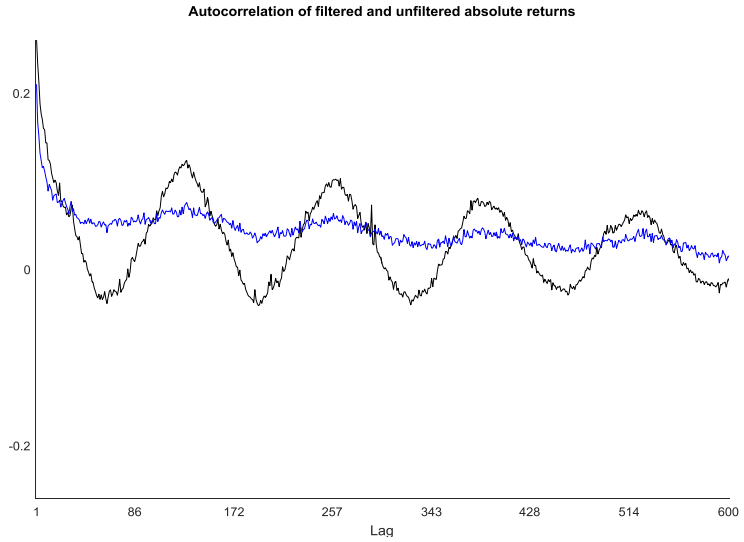


Figure 5. Autocorrelation of original and filtered absolute return data

Since the returns data has been adjusted for seasonality, the statistical properties should change accordingly, to reflect those changes. The mean and standard deviation of the original and filtered returns data are relatively the same. The kurtosis of the filtered returns data has decreased significantly, suggesting that the tails of the distribution have been reduced. This can also be seen by the drastic reduction in the maximum and minimum for the filtered returns data. The skewness of the filtered returns has dropped meaningfully compared to the original returns data.

This highlights that seasonality adjustment methods do not affect the mean and variance, but rather the third and fourth moment of the returns data. This is consistent with Laakkonen's (2009) findings across the three filtering methods that she used - FFF model, LOWESS and IAOM respectively.

Table 8. Statistical properties of the original and filtered returns

	Mean	St. deviation	Kurtosis	Skewness	Min	Max
Original Returns	0.0006	0.0800	439	0.3296	-4.954	4.710
Filtered Returns	0.0008	0.0700	8.24	0.0916	-0.619	0.658

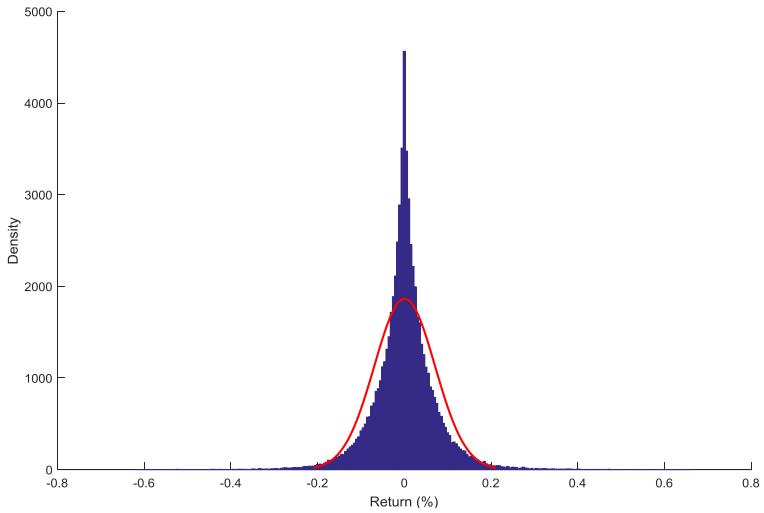


Figure 6. Filtered 10-minute USD/ZAR return histogram

3.4.2 *Fourier Form model*

The Flexible Fourier Form (FFF) model is a linear projection technique that was popularised by Andersen & Bollerslev (1998) in his intraday volatility study. This method uses sinusoids to capture the periodicity in high frequency return data. The model takes the following form:

$$r_{t,n} - \overline{r_{t,n}} = \sigma_{t,n}.v_{t,n}.Z_{t,n}$$

where $r_{t,n}$ denotes the 10-minute USD/ZAR returns, $\overline{r_{t,n}}$ is the expected 10-minute returns, $v_{t,n}$ represents calendar and news announcements effects on intraday volatility, $\sigma_{t,n}$ denotes the remaining volatility component that is usually captured by ARCH-type models and $Z_{t,n}$ is an independent and identically distributed (i.i.d) variable. All the returns are assumed to be independent.

Without applying further restrictions, the component of equation above cannot be separated into distinct variables. By squaring and taking logs of the equation, we are able to separate the news announcement effects variable $v_{t,n}$ and express it as an independent variable in the equation,

$$2\ln\left(\left|r_{t,n} - \overline{r_{t,n}}\right|\right) - \ln\left({\sigma_{t,n}}^2\right) = \ln\left({v_{t,n}}^2\right) + \ln({Z_{t,n}}^2)$$
$$2\ln\left(\left|r_{t,n} - \overline{r_{t,n}}\right|\right) - \ln\left({\sigma_{t,n}}^2\right) = c + \ln\left({v_{t,n}}^2\right) + e_{t,n}$$

where $c = E[ln\left({Z_{t,n}}^2\right)]$ and $e_{t,n} = ln\left({Z_{t,n}}^2\right) - E[ln\left({Z_{t,n}}^2\right)]$.The price and volatility reaction will reflect the news effect, the dispersion of beliefs by market agents and all other market conditions at the time of the release (Andersen & Bollerslev, 1998). It is assumed that $\ln\left(\sigma_{t,n}\right)$ is strictly stationary and has an unconditional mean, $E[\ln\left(\sigma_{t,n}\right)]$. To calculate $\sigma_{t,n}$, we use its estimator $\sigma_{t,n} = \frac{\sigma_t}{\sqrt{N}}$ where $\sigma_t$denotes daily volatility and N is the number of 10-minute intervals in a day. The daily volatility σ_t is estimated using a standard GARCH(1,1) model. Andersen & Bollerslev (1998) suggests a parametric representation for the regressor $\ln\left({v_{t,n}}^2\right)$ and uses a flexible functional form using trigonometric functions to estimate the cyclical pattern. The FFF regression model is defined as follows,

$$f_{t,n} = c + \mu_0 + \sum_{l=1}^{L} \lambda_l I_{l;t,n} + \sum_{p=1}^{P} (\gamma_{c,p} \cos\left(\frac{p2\pi}{N} n\right) + \gamma_{s,p} \sin\left(\frac{p2\pi}{N} n\right)) + \varepsilon_{t,n}$$

where $f_{t,n} = 2\ln\left(\left|r_{t,n} - \overline{r_{t,n}}\right|\right) - \ln\left({\sigma_{t,n}}^2\right) = 2ln\frac{|r_{t,n} - \overline{r_{t,n}}|}{\sigma_{t,n}} = 2ln\frac{|r_{t,n} - \overline{r_{t,n}}|}{\frac{\sigma_t}{\sqrt{N}}}$, $I_{l;t,n}$ is an indicator variable that denotes the event *l* on interval *n* of day *t* and μ_0, λ_l, $\gamma_{c,p}$ and $\gamma_{s,p}$ are fixed coefficients. The estimate for intraday volatility $\widetilde{v_{t,n}}$ is obtained in the following manner, $\widetilde{v_{t,n}} = \exp\left(\frac{\widetilde{f_{t,n}}}{2}\right)$, where $\widetilde{f_{t,n}}$ is the models estimate of $f_{t,n}$. The estimate $\widetilde{v_{t,n}}$ is normalized using the following equation, $\widetilde{\widetilde{v_{t,n}}} = \frac{T.\widetilde{v_{t,n}}}{\sum_{t=1}^{T/N}\sum_{n=1}^{N}\widetilde{v_{t,n}}}$, such that the mean of the periodicity estimate $\widetilde{\widetilde{v_{t,n}}}$ equals 1.

Since we employ a two-step method, we use the following equation to study the news effects on exchange rate volatility,

$$f_{t,n} = \mu_1 + \sum_{l=1}^{L} \phi_l I_{l;t,n} + \varepsilon_{t,n}$$

where $f_{t,n} = 2ln \frac{|\widetilde{r_{t,n}} - \overline{r_{t,n}}|}{\frac{\sigma_t}{\sqrt{N}}}$ is our measure of exchange rate volatility, μ_1 denotes the intercept and $\widetilde{r_{t,n}}$ denotes the filtered returns which replace the original returns $r_{t,n}$.Since the original returns $r_{t,n}$ are filtered using IAOM to remove the periodicity, there is no need to estimate the cyclical component using trigonometric functions resulting in the omission of the trigonometric terms. Furthermore, the indicator variable $I_{l;t,n}$ will take on the value 1 to denote an event *l* on interval *n* of day *t* or 0 otherwise.

3.4.3 *Decay structure model*

It is well documented that the effects of news announcements on exchange rate volatility usually have a long –lasting effect, rather than being a short-lived event. Andersen & Bollerslev (1998) finds that the news effect usually last for an hour or two, and could even last longer in an underdeveloped market where new information takes longer to be fully incorporated into the exchange rate. Volatility instantaneously spikes after the news announcement is disseminated but gradually diminishes and converges to the mean level of volatility.

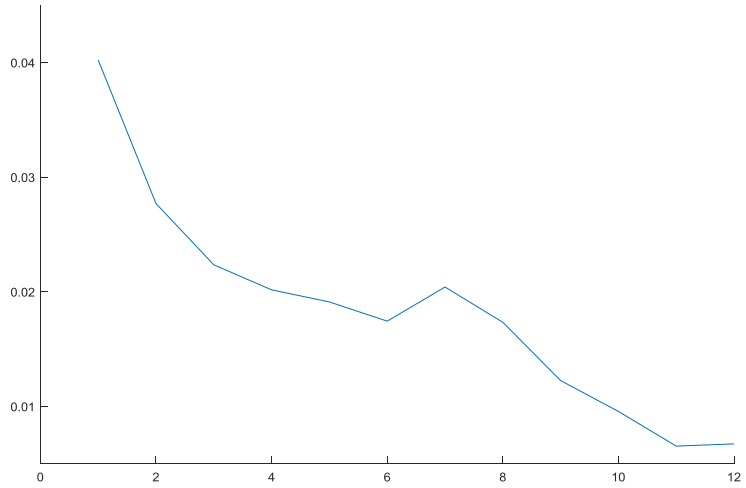


Figure 7. Average decay structure of volatility after a news announcement

We model the decay structure of volatility after a news announcement by assuming that it steadily decreases to zero after 2 hours, maintaining consistency with literature by Andersen & Bollerslev (1998) and Laakkonen (2009). In Figure 7, we can clearly see that this an appropriate assumption as the average volatility, which is presented by the mean absolute returns, converges to its overall average volatility 1 hour 50 minutes to 2 hours after the announcement. To fit the average news impact decay structure, we calculate the average absolute returns at each 10-minute interval post a news announcement minus the mean absolute return from the whole sample. A third order polynomial is then used to fit the average news effect pattern, resulting in following in following OLS regression equation,

$$\lambda_k = 0.049747\left(1-\left(\frac{k}{12}\right)^3\right) - 0.013444\left(1-\left(\frac{k}{12}\right)^2\right)k + 0.001913\left(1+\frac{k}{12}\right)k$$

Where k=1,2,3…12 denotes the 10-minute intervals after the news announcement. The regression model smoothly fits the decay structure of the news impact and also forces the average news impact to converge to zero after 2 hours (see Figure 8). The results of the independent variable λ_k are greater than zero for k=1,2,3…12 and zero otherwise.

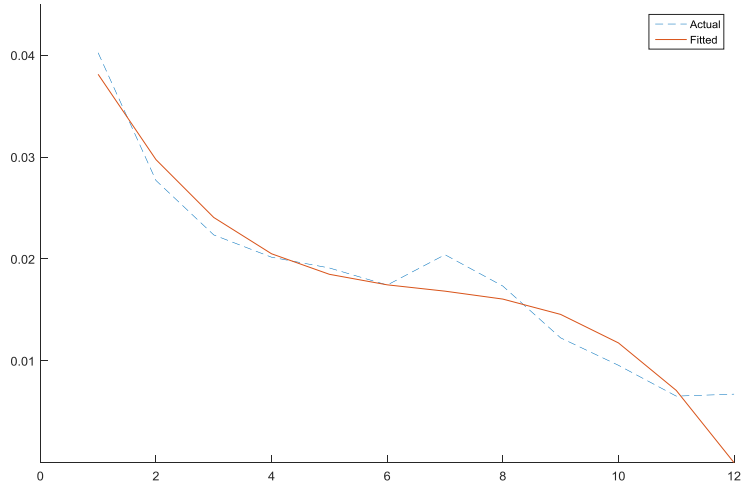


Figure 8. Actual and fitted decay structure of volatility after a news announcement

Once the average decay structure of volatility is estimated, we can use results from our regressions model λ_k and coefficients ϕ_l from our news announcement indicator variable to

calculate the news impact on volatility. The volatility impact of news announcement *l, k* intervals after the news announcement can be calculated with following equation,

$$M_{l,k} = \exp(\frac{\phi_l . \lambda_k}{2})$$

where $M_{l,k}$ denotes the volatility impact of news announcement l, k intervals after the news announcement.

CHAPTER 4. Empirical Analysis

This chapter presents the findings from our empirical study on the impact of news announcements on USD/ZAR volatility. The results are presented in a manner, which answers the research questions regarding asymmetric news effects. The subsections categorise the different news announcements as follows; all macroeconomic news announcements, news announcements from different countries, no-news announcements, positive and negative news.

4.1 Macroeconomic news announcements

While it is well documented that the release of macroeconomic news results in a significant rise in volatility, we test this theory on USD/ZAR volatility as most studies have focused on developed market currencies. Our analysis is limited to news announcements from South Africa and the US. While news announcements out of China and the Euro area could have a meaningful bearing on USD/ZAR volatility as exhibited in some events during our period of study, we assume that only US news announcements have a significant bearing on volatility as found in the study by Laakhonen (2007). Therefore, we use US and South Africa news items as a proxy for all news announcements. The regression model is defined as follows,

$$f_{t,n} = \mu_1 + \phi_{news} I_{news;t,n} + \varepsilon_{t,n}$$

where $I_{news;t,n}$ denotes all the macroeconomic news announcements that we consider in this study and ϕ_{news} is the coefficient of the news variable.

In Table 9 below, the results from the regression equation clearly show that news announcements in general result in a significant increase in USD/ZAR volatility. While news announcements increase volatility, the increased volatility deteriorates over time, as the uncertainty associated with the announcement is resolved. The average decay structure after a news announcement also supports this notion (see Figure 7). On average, volatility increases by 142% in the first 10-minute interval after the release of a news announcement. This can be attributed to the surprise component - good or bad- of the news announcement which market participants haven't factored into their price quotes. Bauwens, et al. (2003) also finds that volatility increases prior to a

scheduled news announcement as traders who expect negative figures adjust their quotes in order to avoid significant price jumps that may go against their positions.

Table 9. Regression model results: All macroeconomic news

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{news;t,n}$	46.37	6.81	6.81	0.00	242%

4.2 Country news

Earlier we found that macroeconomic news announcements lead to a rise in volatility, however it is not all news announcements that lead to a significant rise in volatility. Instead of analysing this asymmetry using individual news items, we use the origin of the announcement. By testing the news effect by different countries, we are able to ascertain which countries drive the foreign exchange market. In our study, we focus only on South African and US news announcements as mentioned above. The regression model is defined as follows,

$$f_{t,n} = \mu_1 + \phi_{SA} I_{SA;t,n} + \phi_{US} I_{US;t,n} + \varepsilon_{t,n}$$

where $I_{SA;t,n}$ *and* $I_{US;t,n}$ *denotes news announcements from South Africa and the US respectively.*

We find that both South African and US news have a significant impact on volatility. US news are statistically more significant in increasing volatility post a news announcements than the South African news, with t-statistics of 4.04 and 5.67 respectively. The results also show that South African news result in a far greater increase in volatility relative to US news. Volatility increases by 186% and 130% in the first 10-minute interval after the news announcement from South Africa and the US respectively. This result contradicts findings by Fedderke & Flamand (2005), who found that US news events impact USD/ZAR exchange rate with greater strength than South African events. In fact, they find little evidence that South African news significantly impacts USD/ZAR daily rates. The conflict in results may be due to the fact that we used high-frequency data in our study, instead of end of day data. By using high-frequency data, we are able to get a much deeper understanding of the underlying dynamics of USD/ZAR, which may not necessarily

be captured by end of day data. Fedderke & Flamand (2005) highlights that news events are time varying, therefore the news variables used in their study may not have been significant at that point in time but may be significant during our period of study. South Africa's macroeconomic fundamentals were relatively weak during our observation period, resulting in wide range swings in the currency that may have demanded traders to pay close attention to variables driving the currency.

Table 10. Regression model results: News by country

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{SA;t,n}$	55.22	13.68	4.04	0.00	286%
$I_{US;t,n}$	43.77	7.72	5.67	0.00	230%

4.3 No news announcements

Fama's (1970) EMH states that current exchange rate quotes reflects all publicly available information. This premise is based on the fact that investors are continuously exposed to information, which allows them to develop expectations regarding future asset prices and trade on these convictions. Due to this process, asset prices should reflect the marginal investor's current expectations and asset prices should only react to the surprise component of announcement (Neely & Dey, 2010). We test whether this theory holds for USD/ZAR volatility. The result from this analysis will provide insight into the informational efficiency of the USD/ZAR exchange rate market. We define our regression models as follows,

$$f_{t,n} = \mu_1 + \phi_{No-news} I_{No-news;t,n} + \phi_{Surprise} I_{Surpise;t,n} + \varepsilon_{t,n}$$

where $I_{No-news;t,n}$ denotes no-news announcements while $I_{Surpise;t,n}$ denotes all news announcements with a positive or negative surprise component.

Our results are consistent with the Fama's (1970) EMH, suggesting that no-news effects do not necessarily result in a statistically significant rise in volatility. This is not to say that exchange rate volatility does not rise on average after a no-news announcement, in fact it increases by 72% in

the first 10-minutes interval after the news announcement. The standard error of the impact of no-news announcements is relatively high, highlighting how some no-news may result in a negligible increase in volatility while others could significantly increase volatility. Laakhonen (2007) suggests that one reason why no-news events increase exchange rate volatility is because no-news announcements do not necessarily mean that the news weren't bad or good. Surprise news announcements result in a significant rise in volatility at 5% significant level, increasing volatility by 136% in the immediate 10-minute interval. This finding is consistent with general exchange rate determination theory, highlighting that investors adjust their quotes accordingly in light of new information. This process results in the increase in volatility after the surprise news announcement. In Laakhonen's (2007) empirical study, she reports that no-news announcements have a far greater impact on volatility than surprising news. It is found that no-news announcements result in a 65% jump in EUR/USD volatility in the first 5-minute interval after the announcement, while surprise news only increase volatility by 36%. This contradicts conventional thinking, as one would expect the surprise component to result in a greater rise on volatility even though Laakhonen (2007) suggests that the increase in trading volumes after a scheduled announcement, whether or not the announcement surprised, can be attributed to the discrepancy.

Table 11. Regression model results: Surprise vs. No-news announcements

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{No-news;t,n}$	28.57	20.73	1.38	0.17	172%
$I_{Surpise;t,n}$	44.98	7.15	6.29	0.00	236%

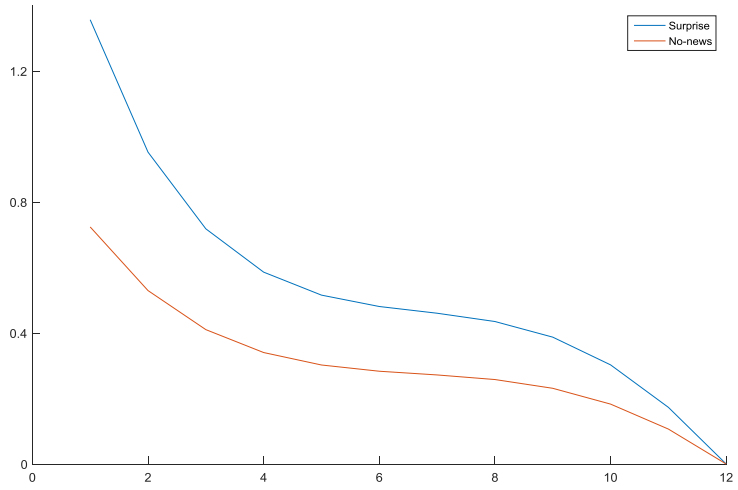


Figure 9. Estimated news impact: Surprise vs. No-news announcements

The Wald-test, which is used to test relationships between data items, shows that the effects of surprise news on USD/ZAR volatility are insignificantly different from the effects of no-news. The p-value of nearly 0.5 shows on all three test statistics, namely t-test, F-statistic and Chi-squared test, that we cannot reject the null hypothesis that the coefficient of no-news announcement is the same as the coefficient of surprise announcements at 5% and 10% significance level. This supports the assumption that no-news announcements do not necessarily mean that the news was neither good nor bad.

Table 12. Wald test results: Surprise vs. No-news announcements

Equation: $\phi_{No-news;t,n} = \phi_{Surpise;t,n}$

Test Statistic	**Value**	**DF**	**Probability**
t-statistic	-0.69	65658	0.49
F-statistic	0.48	(1, 65658)	0.49
Chi-square	0.48	1	0.49

Instead of bundling all no-news and surprise news from South Africa and the US, we decompose these news items by their country of origin. The regression model is defined as follows,

$$f_{t,n} = \mu_1 + \phi_{SA:No-news} I_{SA:No-news;t,n} + \phi_{SA:Surprise} I_{SA:Surpise;t,n} + \phi_{US:No-news} I_{US:No-news;t,n} + \phi_{US:Surprise} I_{US:Surpise;t,n} + \varepsilon_{t,n}$$

The decomposed regression provide mixed results, reporting that SA no-news announcements have a far greater impact on USD/ZAR volatility than surprise news from the region, increasing volatility 395% and 157% respectively. Beyond the reasons provided by Laakhonen (2007) as to why no-news events could result in greater volatility than surprise news, we think that the negative investor sentiment on South African during this period of study could have attributed to greater volatility. The no-news announcements could have actually been perceived as negative news given the weak macroeconomic fundamentals. The South African no-news variable also consisted of only 34 no-news events, which may be considered as an inadequate sample size to generate an informed view regarding the impact of South African no-news announcements on volatility.

Table 13. Regression model results: Surprise vs. No-news announcements by country

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{SA:No-news;t,n}$	83.96	48.14	1.74	0.08	495%
$I_{US:No-news;t,n}$	15.91	22.99	0.69	0.49	135%
$I_{SA:Surpise;t,n}$	49.51	14.13	3.50	0.00	257%
$I_{US:Surpise;t,n}$	43.96	8.15	5.40	0.00	231%

The Wald-test results in Table 14 and Table 15 are consistent with the results found in the overall analysis. This suggests that the impact of no-news announcements on volatility is not significantly different to that of surprise news. As we've mentioned above, no-news announcement don't necessarily represent a non-event, as market participants could perceive this information as good or bad, resulting in as much volatility as a surprise announcement. The statistical tests produce a p-value of 0.51 and 0.29 for South Africa and US respectively.

Table 14. Wald test results: South African Surprise vs. No-news announcements

Equation: $I_{SA:No-news;t,n} = I_{SA:Surpise;t,n}$

Test Statistic	Value	DF	Probability
t-statistic	0.65	65656	0.51
F-statistic	0.43	(1, 65656)	0.51
Chi-square	0.43	1	0.51

Table 15. Wald test results: US Surprise vs. No-news announcements

Equation: $I_{US:No-news;t,n} = I_{US:Surpise;t,n}$

Test Statistic	Value	DF	Probability
t-statistic	-1.06	65656	0.29
F-statistic	1.12	(1, 65656)	0.29
Chi-square	1.12	1	0.29

4.4 Negative vs. Positive news

As illustrated above, surprise news significantly affects USD/ZAR volatility while no-news announcements result in a small or negligible rise in volatility. Investor cognitive biases make it vital to decompose the surprise component into negative and positive surprises, as asymmetries may exist in their effects on volatility. Laakhonen (2009) reports two ways of calculating positive and negative news. One could use Bloomberg forecasts or use the sign of the return following the news announcement to determine whether the news were positive or negative. We adopt the market forecast methodology as consistent with most literature. We test the asymmetric news effect on exchange rate volatility using the following equation,

$$f_{t,n} = \mu_1 + \phi_{Positive} I_{Positive;t,n} + \phi_{Negative} I_{Negative;t,n} + \varepsilon_{t,n}$$

where $I_{Positive;t,n}$ and $I_{Negative;t,n}$ denote positive and negative news announcements respectively.

Table 16. Regression model results: Positive vs. Negative news

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{Positive;t,n}$	2.83	10.79	0.26	0.79	105%
$I_{Negative;t,n}$	45.82	10.57	4.33	0.00	240%

The regression model results suggest that it is only negative news that result in a significant rise in volatility. This is consistent with Laakhonen's (2007) finding on EUR/USD volatility. She also finds that positive news are insignificant at 5% significance level and only increases EUR/USD volatility by 18% in the first 5-minute interval after a positive news release. Positive news announcements result in a 5% increase in volatility, while negative news result in a 140% increase in the first 10-minute interval after the news release in this study. This highlights the presence of cognitive biases in the manner in which investors react to news. The assumption that underpins most financial theories, which is that investors act in a rational manner is not always true, as behavioural finance proves that investors do sometimes overreact to news, especially negative news. This also highlights that negative news have a far greater impact on investors' psychology than positive news. The fact that negative news increase volatility far greater than positive news suggests that investors strongly prefer to avoid losses than to acquire gains. The manner in which investors react to good and bad news is also dependent on the state of the economy. Veronesi (1999) finds that investors often hedge against uncertainty regarding the state of the economy, resulting in overreaction to bad news in good times and under-reaction to good news in bad times.

Table 17. Wald test results: Positive vs. Negative news announcements

Equation: $I_{Positive;t,n} = I_{Negative;t,n}$

Test Statistic	**Value**	**DF**	**Probability**
t-statistic	-2.20	65658	0.03
F-statistic	4.84	(1, 65658)	0.03
Chi-square	4.84	1	0.03

The Wald test results (see Table 17) support earlier conclusions regarding the effects of positive and negative news effects on volatility. The effect of negative news on volatility is significantly different to that of positive news, with a p-value of 0.03.

To gain a deeper understanding of the source of the asymmetries, we categorised the negative and positive surprise variables by country. The regression equation is defined as follows,

$$f_{t,n} = \mu_1 + \phi_{SA:Positive} I_{SA:Positive;t,n} + \phi_{SA:Negative} I_{SA:Negative;t,n} + \phi_{US:Positive} I_{US:Positive;t,n} + \phi_{US:Negative} I_{US:Negative;t,n} + \varepsilon_{t,n}$$

Table 18. Regression model results: Positive vs. Negative news announcements by country

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$\phi_{SA:Positive}$	1.03	20.41	0.05	0.96	102%
$\phi_{SA:Negative}$	54.37	20.25	2.68	0.01	282%
$\phi_{US:Positive}$	5.50	12.52	0.44	0.66	111%
$\phi_{US:Negative}$	41.97	12.26	3.42	0.00	223%

Results above are still consistent with previous findings regarding negative and positive news effects. Positive news from both South Africa and the US do not lead to a meaningful rise in volatility, suggesting that investors do underreact to good news especially South African good news. Positive news surprises out of South Africa and the US lead to a 2% and 11% rise in volatility respectively.

These asymmetries can also be attributed to informational biases such as incorrectly processing the information. This often arises when market participants have a short timeframe to act or multiple news announcements, which may be contradictory, are released at the same time.

Table 19. Wald test results: South African Positive vs. Negative news announcements

Equation: $I_{SA:Positive;t,n} = I_{SA:Negative;t,n}$

Test Statistic	Value	DF	Probability
t-statistic	-1.47	65656	0.14
F-statistic	2.17	(1, 65656)	0.14
Chi-square	2.17	1	0.14

Table 20. Wald test results: US Positive vs. Negative news announcements

Equation: $I_{US:Positive;t,n} = I_{US:Negative;t,n}$

Test Statistic	Value	DF	Probability
t-statistic	-1.60	65656	0.11
F-statistic	2.55	(1, 65656)	0.11
Chi-square	2.55	1	0.11

Since informational biases can contribute to news effect asymmetries, we studied the difference between contradictory and consistent news effects on volatility. Single news announcements

accounted for only 26% and 21% of scheduled news announcements out of South Africa and the US respectively. Therefore market participants often have to process more than one news item at a time, which could lead them into irrationally reacting to the news i.e. underreacting to positive news when released at the same time as negative news. We define the regression model as follows,

$$f_{t,n} = \mu_1 + \phi_{One} I_{One;t,n} + \phi_{Contradict} I_{Contradict;t,n} + \phi_{Consistent} I_{Consistent;t,n} + \varepsilon_{t,n}$$

where $I_{One;t,n}$, $I_{Contradict;t,n}$ and $I_{Consistent;t,n}$ denote single new announcements, multiple announcements that are contradictory and multiple announcements that are consistent respectively.

Statistical results show that all the variables defined above significantly increase volatility. Consistent news induce the most volatility, increasing volatility by 228% in the first 10-minute interval after the news release. Consistent news are easy for investors to interpret as there is no conflicting information, resulting in investors being able to quickly act on the information with minimal informational biases. Even though the information may be consistent, there is still scope for investors to act irrationally, especially if they believe that the data is incorrect as assumed in the study by Veronesi (2000).

In comparison, contradictory news resulted in the least rise in volatility, only increasing volatility by 121% in the first 10-minute interval after the news release. This is inconsistent with Laakkonen's (2009) results, who found that contradictory news lead to the highest volatility increase. Laakkonen (2009) reports that in cases where market agents are not given a clear positive and negative sign, they will mostly likely find it hard to evaluate the effects of the news and this causes excess volatility. However, this could also deter market agents from acting quickly on the information resulting in lower volatility. This supports the notion that the clarity of the news announcement matters. Once market agents are able to get a broader picture of state of the economy, they are able to act accordingly. Zhang (2006) finds that the degree of incompleteness of the market reaction increases monotonically with the level of information uncertainty. As a result, investors tend to underreact to new information when there is ambiguity with respect to the implications for firm value. The same can be said about the foreign exchange market, where the economy can be inferred to be the firm and the currency value represents its underlying firm

value. This explains the positive relation between the news effect on volatility and the level of ambiguity of the news i.e. consistent news result in the highest volatility. Single news announcements increase volatility by 142% in the first 10-minute interval after the news release and are significant at 5% significance level.

Table 21. Regression model results: Consistent vs. Contradictory news

Variable	Coefficient	Std. Error	t-Statistic	Probability	$M_{l,1}$
$I_{Consistent;t,n}$	62.30	0.15	4.12	0.00	328%
$I_{Contradict;t,n}$	41.60	12.28	3.39	0.00	221%
$I_{One;t,n}$	46.30	9.56	4.84	0.00	242%

These results show that the asymmetric news effects that arise due to negative and positive news cannot be evaluated in isolation as other variables can also affect these results. The number of news released at that point in time and whether they were consistent with each other or not will have a significant bearing on the news effect on volatility. The greater the quality of information that is dissimilated to investors, the higher the chances of them acting in a rational manner – an assumption that underlies EMH. The magnitude of the surprise and the type of announcement released will also play a role in the magnitude of the increase in volatility, suggesting that it is not entirely correct to evaluate the effects of positive and negative news on volatility without considering the size of the surprise. While reasonable inferences can be made from our results, the dominance of highly important data figures in the negative or positive surprise news item could also skew the results. We know that the importance of data figures to investors is time varying, therefore the same analysis could produce conflicting results during a different observation period (Fedderke & Flamand, 2005).

CHAPTER 5. Discussion and Conclusion

In this conclusive chapter, empirical findings of the study will be discussed and compared to other empirical studies on this subject. Section 5.1 outlines the findings from our empirical study and any links to previous literature on news effects on volatility. It also tries to explain any underlying difference in our results and other previous work. Section 5.2 concludes on our empirical study, while Section 5.3 provides future recommendations.

5.1 Discussion

In this empirical study we explored the asymmetric news effects on USD/ZAR volatility, evaluating news from different geographical locations, positive and negative news, surprise news that are consistent and contradictory with one another and no-news announcements. One clear point that has been consistent in the study is that the release of macroeconomic news results in an increase in volatility, irrespective of whether the news surprised or not. This highlights that it is the news announcement itself that results in a significant rise in volatility rather than the surprise component.

While one would expect volatility to decrease after the release of a news announcement, as the uncertainty surrounding the news announcement would be resolved, this is not the case as highlighted above. This could be attributed to investors waiting for the uncertainty to be resolved before taking any positions in the market. If the news announcement surprises the market, this would result in investors adjusting their positions to reflect the new information. Another point that has been highlighted is that no-news announcements do not necessarily imply that the news announcement was neither good nor bad. A no-news announcement could have the same bearing as surprise news, emphasizing that no-news could be interpreted as either good or bad by market participants. This contradicts Fama's (1970) EMH, which proposes that current prices should reflect all publically available information. Due to the process of investors adjusting their positions to reflect their expectations regarding the state of the economy, asset prices should reflect the marginal investor's expectations. Since investor's current expectations have already been factored into price quotes, it is the only surprise component of the news announcement that

should result in an increase in the volatility. The shortcoming of this premise is that it assumes that market agents are rational, which has been proved on many occasions that it is not entirely the case. Cognitive biases by investors can be attributed to the asymmetric news effect on volatility.

The manner in which investors react to news announcements is not always rational and this was acknowledged by John Maynard Keynes with the following, "Markets can remain irrational longer than you can remain solvent". Investors often suffer from cognitive biases such as overreacting/underreacting to surprise news, informational and representative biases. Due to these biases, they often exhibit irrationality in their expectations. This is often exhibited in the manner in which they react to positive and negative news surprises. If investors were rational, the sign of the surprise component would be insignificant. However, we find that negative news tend to have a greater impact on volatility relative to positive news. This finding is consistent with empirical studies by Anderson, et al. (2003) and Laakhonen (2007), while Pearce & Solakoglu (2007) argues that there is no asymmetry with respect to the sign of the surprise news. One explanation for the different results is that the reaction by investors to surprise news is dependent on the state of the economy. Therefore, the period of study will influence the results. Laakhonen (2009) highlights that negative news increased volatility more than positive news only when the economy was in its expansionary phase. This economic state dependency was explained by Veronesi (1999), who argued that due to investors' willingness to hedge against uncertainty about the state of the economy, they tend to overreact to bad news in good times and underreact to good news in bad times. The South African economy is going through a stagflation period during our period of study, which can be used to explain the under-reaction of investors to positive news – suggesting that economic state dependency could also apply to our results.

Economic state dependency could also explain the difference in findings between our study and Fedderke & Flamand (2005), regarding whether South African news have a significant impact on USD/ZAR exchange rate. Fedderke & Flamand (2005) find that US news announcements impact USD/ZAR with greater strength than South African news and there is little evidence that South African news has a significant impact on USD/ZAR. It is important to note that their study was conducted during the recovery period post the 9/11 recession. Given the risk-averse nature of investors and investor fears over the state of the US economy at the time, focus would have been

on US news. In our study, the US economy is in a boom phase while South Africa is in a stagflation environment; therefore attention has switched to South Africa given investor concerns over the state of the economy. But this is not to say that US news items are insignificant, its impact on volatility is just at a lower scale relative to South African news announcements.

Market agents are often exposed to more than one news announcement at a time, which often results in uncertainty when interpreting the news announcement. When investors are exposed to multiple news items that are consistent with each, investors have an improved and clearer understanding of the economy and this results in the most volatility increase relative to a single announcement or multiple announcements that are contradictory to each other. This is attributed to the lack of ambiguity, which decreases the probability of investors underreacting to the news. Zhang (2006) finds that the degree of incompleteness of the market reaction increases monotonically with the level of information uncertainty. Multiple news announcements that contradict to each other often confuse investors, resulting in some investors taking longer to respond to the new information or incorrectly interpreting the information. Investors could also choose to focus on a few news items that are perceived as important at that point in time, resulting in only a fraction of the information being regarded when adjusting their quotes. In the study by Laakkonen (2009), it's stated that contradictory news items result in the most volatility while consistent news items result in the least volatility increase in some cases. The result was dependent on the country being observed. Laakkonen (2009) attributes this finding to the premise that the clearness of the signal has a negative relationship with the volatility increase post the announcement. When multiple news items are contradictory to each other, investors occasionally process the information inaccurately given the short time frame in which they have to react, leading to a rise in excess volatility. While we accept that incorrectly interpreting the news announcement could result in excess volatility in some occasions, it could also lower volatility as market participants underreact to this informtaion.

Cognitive biases play a crucial role in accounting for news effect biases that are often experienced in the foreign exchange market. Investors could suffer from anchoring bias where they evaluate news items not only on their current merits, but anchor their decision to the previous data prints when evaluating the data. When positive (negative) news persistent for some time, followed by a negative (positive) news item, it may be hard for investors to evaluate whether this signals a

turning-point or not. Therefore, they may underact to the surprise news. Conversely, if positive or negative news surprises persist, investors could overreact to the information as they may perceive this information as a clear sign that the economy is in contractionary or expansionary phase. In an ideal environment, the manner in which market agents act to information should be in a logical and rational manner which would result in financial market theories such as Fama's (1970) EMH holding true under all environments. But unfortunately this is not the case as highlighted by our findings regarding news effect asymmetries.

While our results provide in-depth insight into the asymmetric effects of news on USD/ZAR, we are cognisant of the time-varying nature in which markets react to information. This idea was first highlighted by Laakkonen (2009) and Fedderke & Flamand (2005), who found that the manner in which investors react to positive and negative news is economic state dependent and that news events that significantly impact the market change over time – suggesting that traders only focus on a few variables at any given point in time. This highlights that the results should be considered in the context of the economic environment.

5.2 Conclusion

The key finding of the study, which is consistent with most empirical literature, is that news announcements do impact the exchange rate. After the release of a news announcement, the level of foreign exchange volatility rises. The occurrence of the increase in volatility is independent of whether the news item surprised the market or not. No-news announcements also have a meaningful bearing on volatility, suggesting that no-news announcements do not necessarily mean that the news were neither good nor bad. With that being said, it is not all announcements that result in a significant rise in volatility, but a selected few that do so and this list of news variables changes over time.

We do not find any asymmetric news effects on USD/ZAR volatility with regards to the country of the news. We find that both South African and US news items significantly impact USD/ZAR volatility, suggesting that both US and South African news items are being used to formulate investor expectations regarding the future prospects of the currency pair. South African news also had a greater impact on volatility relative to US news items; however their effects are not statistically different from each other.

Negative news announcements appear to have a greater impact on exchange rate volatility relative to positive news. Positive news announcements were found to be insignificant in increasing volatility, suggesting the possibility of an under-reaction by the market. Negativity bias and loss aversion can be attributed to the under-reaction by investors to positive news. This result is also economic state dependent, as investors tend to behave differently to news depending on the economic climate at that point in time.

Investors are often exposed to more than one news item at a time, resulting in the erosion of clarity when investors try to interpret the information. Single news announcements accounted for only 26% and 21% of scheduled news announcements out of South Africa and the US respectively over the period of study. Damodaran (1985) reports that due to the short-time frame in which investors need to respond, they sometimes make errors in evaluating new information and this is more so when the quantity of information increases. The quality of the information plays an important in how investors react to information. The clearer the signal is to the investor

regarding the current state or future prospects of the economy, the higher the probability that investors will act in a rational manner and factor this new information into their price quotes – minimising the chances of an under-reaction from the market. Contradictory news lead to the least increase in volatility, suggesting that market participants tend to underreact to contradictory news information as the contradictory information may be hard to interpret and result in confusion. Consistent news announcements appear to have the greatest impact on exchange rate volatility in comparison to single news announcements and contradictory news. This is because consistent news are easy for investors to interpret as there is no conflicting information, resulting in investors being able to quickly act upon the information with minimal informational biases.

5.3 Future Research

In our study, there was no consideration for the magnitude of the surprise component, which is one of the shortcomings of the study. The magnitude of the surprise component plays an important role in determining the magnitude of the increase in volatility post the news announcement. Analysis can be conducted on this subject matter, as this will provide greater insight into the estimated impact on the surprise component on volatility.

Since a select number of announcements have a significant impact on volatility, studies can be conducted evaluating which news variables have a significant effect on USD/ZAR volatility.

The fact that some of results were economic state dependent creates an opportunity to perform the study in all phases of the business cycle. This will provide insight into how investors evaluate and interpret good and bad news in different economic environments.

Furthermore, the role of cognitive biases in affecting asymmetric news effects could be an area that can be explored. Cognitive biases play a crucial role in affecting the way in which investors' process new information and outcomes thereof.

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