University of Pretoria
Department of Economics Working Paper Series

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Working Paper: 2016-46
June 2016

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Abstract

This article analyzes the impact of US macroeconomic announcement surprises on the volatility of the South African equity market. We employ the asymmetric GJR-GARCH model that allows for both positive and negative surprises about inflation and unemployment rate announcements in the U.S. By examining daily data on South African stock market returns from 31 May 1994 to 8 March 2016, we find that shocks to volatility are persistent and asymmetric. While bad news about US inflation does not affect the volatility of South African stock returns, good news tend to increase the volatility. Further, the South African stock market becomes more risky with an unexpected increase in the US unemployment rate and less risky with the an unexpected decrease in the US unemployment rate, with the latter effect being stronger than the former. Our findings demonstrate that US economic conditions may have an impact on the risk profile of the South African equity market.

Key Words*:* Asymmetric GARCH, US macroeconomic news, surprises, South Africa.
JEL classification: C22, G1

I. Introduction

The relationship between macroeconomic risk and security returns has been central to financial economics. A well-known concept in capital asset pricing theory is that only systematic risk factors affect security prices. Macroeconomic news announcements are among the most important systematic risk factors for financial markets because the state of the economy is a major source of non-diversifiable risk. This study aims at investigating the effects of US macroeconomic news on South African stock markets, an analysis that has received no attention in the domestic or international literature.

The causes of stock market fluctuations have been extensively studied by researchers[1] who have identified that economic news, particularly macroeconomic news, as one of the important drivers of stock returns and volatility. Many studies investigated the effect of macroeconomic announcements on the volatility of the domestic financial markets. For example, Ederington and Lee (1993) found a significant effect of regularly scheduled US macroeconomic announcements on the volatility of the US treasury and foreign exchange futures. On the other hand, Cutler, Poterba, and Summers (1988) found that macroeconomic news affect stock returns. Andersen, Bollerslev and Chai (2000) studied the Japanese macroeconomic news announcements and found that they explains only 0.1% of the variation in the intraday volatility.

Due to the immense effect of globalization and economic integration, macroeconomic announcements of major economies, such as the European Union, Japan, and the US, not only affect their domestic financial markets, but also the financial markets of other countries. There are many examples and empirical evidence in support of the tangible effect of non-domestic macroeconomic news on the domestic financial markets. For example, Hanousek, Kocenda, and Kutan (2009), who studied the reaction of asset prices to macroeconomic announcements in Hungary, Czech Republic and Poland using intraday data[2], found that Czech stock market is impacted more by the U.S. macroeconomic announcements than by the EU macroeconomic announcements. On the contrary, the Hungarian and the Polish stock markets are more strongly affected by the EU macroeconomic news than by the US macroeconomic news. Moreover, Hanousek and Kocenda (2011) categorized EU and US macroeconomic announcements into four

[1] See Chen, Roll, and Ross, 1986; Campbell and Shiller, 1988; Fama and French, 1988). Chen et al. (1986) and Fama (1981) for more detailed literature.
[2] The period of the data is June 2, 2003- December 29, 2006.

general classes, reducing the number from fifteen different classes previously analyzed, to study their impact on Czech, Hungarian and Polish stocks for the period from 2004 to 2007. The findings of the study suggest that the Czech, the Hungarian, and the Polish equity markets responsd significantly to EU macroeconomic news, but not to U.S. macroeconomic news. However, these findings have been questioned by another study on the same stock markets. Using a GARCH model and data for the period 1999-2006, Buttner, Hayo, and Neuenkirch (2012) found that both EU and US macroeconomic news significantly affect the financial sectors of the above three countries. The only difference between the responses of the three stock markets is that in the Czech market, the impact of EU news dominates the impact of US news.

Aside from the studies mentioned above, there is limited research on the impact of economic shocks of developed economies on the stock prices of emerging markets. Various other studies are concerned with the globalized outreach of other macroeconomic changes. Going beyond economic news, Onder and Mugan (2006) investigated the effect of unexpected political announcements in Turkey and Argentina. They analyzed the impact of newspaper publications and found that these do tend to increase the stock return volatility and trading volume on the Turkish and Argentinean stock markets. Cakan (2012) found that the US unemployment news have a significant positive effect on the long-term US bond returns, and this effect is only pronounced during the periods of economic expansions. Cakan (2012) also found that the effect of both unemployment and inflation news surprises on volatility of the US stock market is stronger during economic recessions than during expansion. Recently, Lee, and Chang (2011) examined the asymmetric effect of monetary policy announcements on the volatility of equity returns in Taiwan. They found that the significant asymmetric effects and asymmetric volatility movements could be due to an increase in financial leverage associated with declining

firm market values. Further, differentiating between good and bad news, Hayo and Kutan (2005) are among the first researchers to examine the reaction of emerging countries stock market returns and volatility to IMF stabilization measures during the Asian, Russian, and Brazilian crises in the period 1997-1999. Their results suggest that both good and bad news affect stock returns. More specifically, the authors found that positive IMF news tend to increase stock returns and negative IMF news tend to decrease stock returns by roughly one percentage point.

Chiang and Doong (2001) examined the time-series behavior of stock returns for seven Asian stock markets. They used the Treshold Autoregressive GARCH(1,1)-in-mean model and found that higher average returns appear to be associated with higher level of volatility. Cakan et al. (2015) also studied the US news effect on the volatility of the stock markets of twelve emerging markets by employing asymmetric GARCH models. Their study supports the idea that negative news from the US increase the volatility of emerging stock markets.

Our study, for the first time, analyzes the impact of US macroeconomic news on the volatility of the South African stock market. We consider daily data spanning from May 1st, 1994 to March 8th, 2016. Research on modeling and forecasting South African stock market volatility has been restricted to primarily univariate models (see, Babikir et al., (2012), Katzke and Garbers (2015), and Kgosietsile (2015) for detailed literature reviews in this regard). One exception is the work by Chinzara (2011), that analayzed the relationship between macroeconomic and stock market volatilities. The findings show that, volatilities in inflation, gold, and oil prices seem to be less important than , the volatility in short-term interest and exchange rates.[3] Given that South Africa is an emerging market and a small open economy, we

[3] Somewhat related to our paper is the work by Gupta and Reid (2013). The authors explored how industry-specific stock returns react to monetary policy and macroeconomic news of South Africa. Our departure form this study is in the fact that we look at stock market volatility instead of returns emanating from U.S., and not domestic

expect that foreign shocks, especially shocks in a major economy such as the U.S., are likely to drive the volatility of the domestic markets. In this paper, we aim at examining this hypothesis by looking at the role played by U.S. macroeconomic news on South African stock market volatility. To capture the effect of US inflation and unemployment on South African daily stock returns and volatility, we employ a GJR-GARCH model.

Recently, several studies (see for example Mensi et al., 2014; 2016 and references cited therein), have included South Africa while analyzing emerging market countries. This is because of the fact that South Africa has also a fast-growing economy,[4] with rapid financial market development and sophistication. In addition, South Africa is also one of the world's largest exporter of some strategic commodities that include coal, chrome, gold, and iron.[5] Thus, the inclusion of South Africa into the emerging group of countries provide investment diversification opportunities and, hence, deserves an analysis of its own. The remainder of the paper is organized into following sections. Section 2 describes the data and presents some statistical properties of stock returns. Section 3 investigates the impact of the US macroeconomic news surprises on the South African stock returns and and stock return volatility based on an asymmetric GARCH(1,1) model. Section 4 offers a summary and concluding remarks.

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macroeconomic surprises. The event study found that with the exception of the gold mining index, where the CPI surprise plays a significant role, monetary surprise is the only significant variable that negatively affects aggregate and sectoral stock returns. However, using a Bayesian VAR model based on monthly data, the authors found that, in addition to the monetary policy surprises, the inflation surprises also affect aggregate stock returns significantly. However, the effects of these surprises were insignificant and short-lived. In addition in terms of the literature on macroeconomic news surprises relevant to South Africa, Fedderke and Flamand (2005), and more recently Farrell et al., (2012) have shown that the rand-dollar nominal rate does respond to both dometic and US surprises related to macroeconomic news.

[4] South Africa was growing over 5% during 2005 to 2007 until the global financial crisis hit the economy resulting in negative growth rates. But the economy has now revived and growing over 2%.

[5] Though, diamond and gold production may now be well down from their peaks, South Africa is still the sixth in gold production. It is the world's largest producer of chrome, manganese, platinum,vanadium and vermiculite. It is the second largest producer of ilmenite, palladium, rutile and zirconium. It is also the world's third largest coal exporter. South Africa is also a huge producer of iron ore, with it overtaking India in 2012 to become the world third biggest iron ore supplier to China - the world's largest consumer of iron ore. Further details can be found at: https://en.wikipedia.org/wiki/Mining_industry_of_South_Africa.

2. Data

The data set that we investigated in this study includes the daily stock price indexes in domestic currency for the South African stock market for the period of May 1st, 1994 to March 8th, 2016.[6] More specifically, we analyze the Johannesburg All Share Index (JALSI). The stock index is obtained from Datastream. The daily composite stock returns are defined as logarithmic difference of the daily stock index times 100: $R_t = 100 * (\log P_t - \log P_{t-1})$.

We obtain the macroeconomic announcements related to the US inflation and unemployment rates from the websites of the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS) respecively.[7] Inflation and unemployment rate announcements are released at 8:30 am US Eastern time. Note that depending on whether US is on or not on daylight saving mode, South Africa is ahead of the US by seven or six hours respectively. So, the Johannesburg stock exchange is still operating when the announcements are made, as the exchange only closes at 5:00 pm local time. Given this, we do not need to lag the US news announcemet data by one day. Since, it is either 3:30 pm or 2:30 pm in South Africa when the US announcements are made, and hence, is late in the trading-day, we also experimented by lagging the US surprises by a day. However, our results were quantitatively and qualitatively the same as without a lag.[8]

We have a total of 5778 daily observations in our data. The sample includes 185 and 184 positive or negative announcements of the US CPI and unemployment rate, respectively. Data on

[6] The purpose of our study is to capture some historical effects. To that end, we are using daily data spanning 20 years. We are aware that some other studies have used intraday data and focused on more narrow periods of time, such as 4-5 years. Unlike these studies, we are not attempting to capture the "immediate" or intra-day effect of the surprises.
[7] Corresponding web sites are www.bea.gov; www.bls.org.
[8] Complete details of these results are available upon request from the authors.

market expectations of the unemployment and inflation rates for the period between 1994 to 2005 are obtained from the Money Market Survey. For the remaining sample period from 2005 to 2016, we obtain these data from the Bloomberg Survey extracted from the Bloomberg terminal. Using these data on market expectations, we calculate the surprise element of the US macroeconomic news announcements as follows.

Let F_i denote the median of the Bloomberg forecast survey and A_i the released value of announcement i. We measure the surprise in announcement i as:

$$E_i = A_i - F_i(A_t) \tag{1}$$

Further, we standardize the surprises E_i by dividing them by their standard deviation across all observations. The standardized surprise measure can therefore be expressed as:

$$S_i = \frac{E_i}{\sigma_i} \tag{2}$$

Following Balduzzi, Elton, and Green (2001), we compute the unexpected components of the announcements as the standardized differences between the actual announcement values and their median expected values.

In addition, we classify the surprises about US macroeconomic announcements as positive and negative. For each, inflaton and unemployment announcements, we create two dummy variables one for positive and one for negative surprises. The positive surprise of an inflation announcement is defined as $posCPI_t^{surprise}$=1 if S_i>0 and 0 otherwise; and negative surprise is defined as $negCPI_t^{surprise}$=1 if S_i<0 and 0 otherwise. Likewise, we create two dummy variables for unemployment announcements: $posUR_t^{surprise}$=1 if if S_i<0 and 0

otherwise; and $negUR_t^{surprise}$=1 if S_i<0, and 0 otherwise.[9] We can interpret these coefficients as "bad economic news" if S_i>0 since higher than expected unemployment (or inflation) is "bad news" for the economy; and we can interpret the coefficients as "good economic news" if S_i<0, since lower than expected unemployment (or inflation) is "good news" for the economy.

Table 1 presents the summary statistics of daily returns of the South African stock market index. The statistics include mean return, standard deviation, skewness, excess kurtosis, and the Jarque-Bera normality test statistics. The mean daily return is 0.0161%, while the standard deviation is 1.7034%. The market return has excess kurtosis, and negative skewness (Table 1). The p-value of the Jarque-Bera statistics (that has a χ^2 distribution with 2 degrees of freedom) is very close to zero, indicating that the return distribution is not Gaussian, which is typical of financial data.

In Figure 1 we plot the stock market return of the South Africa. The most volatile time appears to be during the financial crisis of 2007-2008. The observed volatility clustering explains the presence of excess kurtosis. In order to take volatility clustering into account, we employ the generalized autoregressive conditional heteroscedasticity (GARCH) model based on Bollerslev (1986).

3. Methodology and Empirical Results

To analize the financial data in our study, we employ a variant of the GARCH model developed

[9] In a separate exercise, we ran our models with the size (rather than dummies) of positive and negative surprises. The coefficients obtained from these models are comparable in statistical significance with those obtained from the models that utilize dummy variables. Since the results are consistent across both types of models, for the ease of coefficient interpretation we keep surprises as dummy variables.

by Bollerslev (1986). GARCH(1,1) eliminates the autoregressive conditional heteroscedasticity (ARCH) effect in the data. However, due to the fact that the GARCH model are unable to account for the asymmetric effects of positive and negative shocks, Exponential GARCH (E-GARCH, Nelson, 1991) and the Threshold Autoregressive GARCH (TAR-GARCH) model (Glosten, Jagannathan and Runkle, 1993, henceforth, GJR-GARCH; Engle and Ng, 1993; and Tsay, 1998) are employed by researchers. After testing for both EGARCH and GJR-GARCH models and checking the standardized residuals, we have selected the GJR-GARCH as the best specification and performed the estimation based on it. The choice of the GJR-GARCH model as a preferred asymmetric framework for analyzing volatility in South Africa has also been stressed by Babikir et al., (2012). By applying these models we are able to account the asymmetric effect of positive and negative surprises and hypothesize that a negative macroeconomic shock will lead to more volatility than a positive shock of equal magnitude.

We use the following GJR-GARCH(1,1) specification enhanced with the four news surprise variables:

$$R_t = \mu + \rho R_{t-1} + \varepsilon_t \tag{3}$$

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \beta h_{t-1} + d_1 posCPI_t^{surprise} + d_2 negCPI_t^{surprise} + d_3 posUR_t^{surprise} + d_4 negUR_t^{surprise} \tag{4}$$

R_t represents the South African stock market return series and ε_t is the stochastic disturbance term that is assumed to be normally distributed with zero mean. The conditional variance h_t depends on the mean volatility level (ω), the lagged error (ε_{t-1}^2) and the lagged conditional variance (h_{t-1}). The asymmetric effect is captured by the $\varepsilon_{t-1}^2 d_{t-1}$ term, where $d_t = 1$ if $\varepsilon_t^2 < 0$;

and $d_t = 0$ otherwise. The shocks have asymmetric impact on conditional variance if γ is statistically significant.

The dummy variables used to capture the positive and negative news announcement surprises are: $posCPI_t^{surprise}$, $negCPI_t^{surprise}$, $posUR_t^{surprise}$ and $negUR_t^{surprise}$. The d_1, d_2, d_3 and d_4 parameters represents the effects of surprises on the conditional variance. As we explained above, we name these variables as "bad economic news" for $posCPI_t^{surprise}$ and $posUR_t^{surprise}$; and "good economic news" for $negCPI_t^{surprise}$ and $negUR_t^{surprise}$. A positive coefficient of "bad economic news" indicates that conditional volatility increases, while a negative coefficient of "good economic news" indicates that conditional volatility decreases. As we explained above, even with time zone differences, we do not need to introduce a one-day lag in the effect of U.S. news on the local market, as the Johannesburg stock exchange is still operative when the US announcements are made.

Estimated parameters for Equations 3 and 4 are reported in Table 2. As the results in the table indicate, all of the GARCH parameters, ω, α, and β are statistically significant at 1% significance level. Furthermore, a sufficient condition for the conditional variance h_t to be non-negative is that ω, α and β are non-negative. This condition is satisfied since the estimated values of these parameters are non-negative. The sum of α and β is less than one, which rules out the possibility that the model is an integrated GARCH model. Since the estimated β coefficient in in (6) is considerably larger than the estimate of α, the conditional volatility prediction is dominated by the autoregressive dynamics .

Two particularly striking results emerge from the estimated variance equation . The first is that the hypothesis of no asymmetry in the news effect ($\gamma = 0$) is strongly rejected. Second,

evolution of volatility occurs in a persistent fashion and that effects of volatility shocks are long-lived, given that the volatility persistence (=α+ β+(γ/2)) is equal to 0.9876. The coefficient of asymmetric volatility, γ, is statistically significant and positive. Positive γ means that bad news ($\varepsilon_t^2 < 0$) increases volatility more than good news. Bad news ($\alpha + \gamma$) increases volatility more than good news (α).[10] These results are consistent with the literature (Engle and Ng, 1993; Wu and Xiao; Bekaert and Wu, 2000).

The observed differential impact of news in the GARCH models have far-reaching implications for portfolio selection and asset pricing (Amin and Ng, 1993; Duan, 1995). , For example, after a significant positive news event, the two models predict different market risk and thus different risk premia for individual stocks, under a pricing model that includes conditional volatility. Moreover, since the two models imply different volatility shocks following major good news, the dynamic hedging strategies would be very different.

U.S. news announcement surprises about inflation affect the volatility of the South African stock market differently. d_1 (i.e., the coefficient associated with bad news) is positive but not statistically significantly. To the contrary, d_2, is positive and statistically significant at 5% significance level, indicating that "good economic news" about inflation increases the volatility (Table 2). This could possibly be because, the lower inflation rate is associated with higher interest rate in the US, resulting in capital outflow from an emerging market like South Africa. Moreover, it would be simply because, lower inflation rates imply better domestic situation for the US with higher real returns on assets, and hence, fostering inward-looking investment.

[10] Using the EGARCH model, our results were qualitatively similar. Complete details of these results are available upon request from the authors.

The coefficient d_3 shows the impact of "bad economic news" about US unemployment rate. It is positive and statistically significant at 1% level of significance. In other words, an unexpected increase in the unemployment rate in US may make the South African market riskier and more volatile.

The coefficient d_4 shows the effect of "good economic news" about US unemployment on the conditional volatility. We find that d_4 is negative and significant, again at the 1% level. This finding is very important. It means that an unexpected decrease in unemployment in the US impacts the South African stock market volatility negatively and its market risk goes down. Unemployment news contains information regarding the growth of the US economy, which, given the dominance of the US when it comes to imports, has important effects on most developing countries and stock markets (Cakan et al., 2015) including South Africa. We can conclude that a better than expected US employment news will make the South African stock market less volatile and more safe.

3. Summary and Conclusion

In this study, we examine, for the first time, the asymmetric effect of the US inflation and unemployment announcement surprises on the South African stock market volatility during the period between 31 May, 1994 and 8 March, 2016.. We assess this effect by using the GJR-GARCH(1,1) model enhanced by the US macroeconomic news surprises. All our estimated GARCH parameters are statistically significant. We conclude based on our results, we that the effect of US macroeconomic news announcements is asymmetric.

We find that volatility in South Africa increases following bad news about US inflation and unemployment. On the other hand, responding to good news about US unemployment, the volatility in the South African stock market decreases. The South African stock market become less risky with an unexpected decrease in the unemployment rate in the US. These findings demonstrate that positive developments in the US economic growth and employment situation contribute to more stable and, thus, less volatile stock markets in developing countries,. This is, arguably, an important finding for portfolio allocation and asset pricing.

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Figure 1. Daily stock returns of South Africa

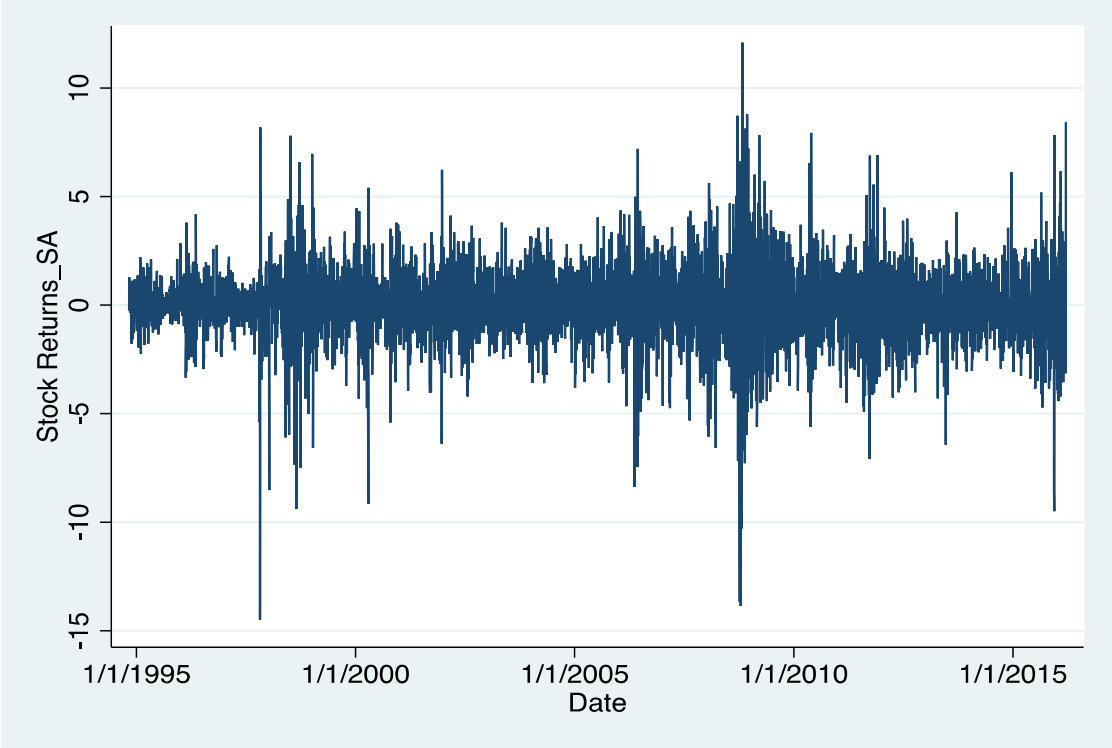

Table 1. Descriptive statistics of daily stock index returns in all emerging markets

Returns	Mean	St. Dev.	Min	Max	Skewness	Kurtosis	JB
South Africa	.0161	1.7034	-14.4883	12.0959	-0.4881	9.1880	9121.0620 (0.0000)

Notes: All numbers are in percentages. All statistics are for daily series from 31 May 1994 to 18 March 2016 yielding 5,578 observations. All stock index prices are expressed in domestic currency. Under the null hypothesis of a normal distribution, the Jargue-Bera (JB) statistics for normality statistic measures the difference between the skewness and kurtosis of the series with those from the normal distribution. p-values are provided in parentheses.

Table 2. GJR-GARCH(1,1) model estimation results for South Africa's stock return

$R_t = \mu + \rho R_{t-1} + \varepsilon_t$

$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \beta h_{t-1} + d_1 posCPI_t^{surprise} + d_2 negCPI_t^{surprise} + d_3 posUR_t^{surprise} + d_4 negUR_t^{surprise}$

	GJR-GARCH(1,1)
μ	0.0307** (0.0173)
ρ	0.0956*** (0.0138)
Volatility	
ω	0.0307*** (0.0049)
α	0.0294*** (0.0052)
γ	0.0934*** (0.0080)
β	0.9115*** (0.0046)
d_1	0.1329 (0.0996)
d_2	0.1581** (0.0761)
d_3	0.2954*** (0.0983)
d_4	-0.2398*** (0.0626)
N	5777

Note: The standard errors are given in parenthesis. ** and *** indicate that the coefficient is significant at 5% and 1% levels of significance respectively.