Do monetary policy announcements affect foreign exchange returns and volatility? Some evidence from high-frequency intra-day South African data.

Cyril May, Greg Farrell and Jannie Rossouw

ERSA working paper 672

March 2017

Economic Research Southern Africa (ERSA) is a research programme funded by the National Treasury of South Africa.

Do monetary policy announcements affect foreign exchange returns and volatility? Some evidence from high-frequency intra-day South African data.

Cyril May*, Greg Farrell† and Jannie Rossouw‡

March 6, 2017

Abstract

This paper examines the temporal effect of domestic monetary policy surprises on both the levels and volatility of the South African rand/United States dollar exchange rate. The analysis in this 'event study' proceeds using intra-day minute-by-minute exchange rate data, repo rate data from the South African Reserve Bank's scheduled monetary policy announcements, and Bloomberg market consensus repo rate forecasts. We find statistically and economically significant responses in intra-day high-frequency exchange rate returns and volatility to domestic interest rate surprises, but anticipated changes have no bearing on the rand. Our results suggest that monetary policy news is an important determinant of the exchange rate for approximately 5 to 40 minutes after the estimated time of the pronouncement – suggesting a relatively high degree of market 'efficiency' in its mechanical sense (and not 'efficient' market in the deeper economic-informational sense) in processing this information.

JEL Code: C22, E52, E58, F31, F41, G14 and G15

Keywords: Exchange rate, expectations, monetary policy surprises, repo rate, returns, volatility.

1 Introduction

Analysing the response of nominal exchange rates – in terms of their level and volatility – to economic and noneconomic news, in developed and emerging markets, has become a very active research area in international finance over the

*School of Economic and Business Sciences, University of the Witwatersrand, Johannesburg, South Africa.

†South African Reserve Bank, Pretoria, South Africa and School of Economic and Business Sciences, University of the Witwatersrand, Johannesburg

‡School of Economic and Business Sciences, University of the Witwatersrand, Johannesburg, South Africa

past decade or so. This paper examines the behaviour of the rand/US dollar exchange rate in reaction to domestic monetary policy announcements, employing an event study approach and using intra-day high-frequency (one-minute-slice) exchange rate data from 2003 to 2013. More specifically, the paper examines how the rand/dollar exchange rate digests information contained in the surprise component of scheduled repo rate announcements – how soon the exchange rate responds after this news release, to what extent the exchange rate reacts and how long the news effect lasts. The 'surprise' or unexpected component of the repo rate announcement is defined here as the difference between the actual rate announcement and the market consensus median rate forecast.

This paper contributes to the South African literature on exchange rate responses to monetary policy repo rate announcements in three ways. This is the first such study on South African interest rate announcement effects using intra-day high-frequency (minute-by-minute) exchange rate data; Fedderke and Flamand (2005) employ daily exchange rate data.[1] Second, in addition to estimating the currency returns reaction function, volatility responses are also considered. And third, this study covers a much longer period of the inflation targeting regime – 2003 to 2013 – allowing more time for the South African Reserve Bank's (SARB's) inflation targeting framework to become entrenched.

The three key empirical questions that this analysis attempts to answer are: a) How do the returns of the rand/dollar exchange rate respond to shocks in scheduled domestic monetary policy committee (MPC) repo rate announcements? b) Do these repo rate surprise announcements also elevate rand/dollar volatility? and, c) How much of the fluctuations in returns and volatility in the rand do monetary policy 'surprises' account for (or explain)?

To preview our results, we find both statistically and economically significant responses of the level and volatility of the rand returns to repo rate shocks, but anticipated changes have no bearing on the rand. Our results suggest that monetary policy news is an important determinant of the exchange rate in the immediate 20 minutes after the estimated time of the pronouncement. The *relatively* rapid rate of exchange rate response to a 100-basis-point hike 5-minutes post-event – elevated returns peak within 30 minutes post-announcement and volatility subsides about 40 minutes following the event – suggest a *relatively* high degree of market efficiency in this event study context. Here we mean the word 'efficient' only in a mechanical sense – communications are speedy and exchange rates adjust rapidly to new unanticipated announcements – and not 'efficient' market in the deeper economic-informational sense.

The structure of the paper is as follows. Section 2 provides a brief overview of the relevant literature. A description of the proposed methodology– and the justifications for this approach – is presented in Section 3, and Section 4 discusses data issues and the preliminary data analysis results. Section 5 presents and analyses the empirical findings, and Section 6 concludes. An overview of the inflation targeting framework, workings of the repo rate system in South Africa

[1] Farrell *et al.* (2012) also use high-frequency data but look at South African inflation and not interest rate surprises. They also do not consider the impact of announcements on volatility.

and changes that were made over time is presented in Appendix D.

2 The impact of monetary policy surprise on exchange rates: A review

2.1 *Some theoretical considerations*

Taylor (1995) argues that macroeconomic fundamentals are clearly important in setting the parameters within which the exchange rate moves in the short term, but they do not appear to tell the whole story. While short-horizon changes tend to be dominated by noise, this noise is apparently averaged out over time, thus revealing systematic exchange-rate movements that are determined by economic fundamentals in the long run. Whilst a substantial amount of historical econometric exchange rate modelling focused on long-run relationships, much progress has been made in recent years on macro fundamentals explanations of short-term exchange rate movements. In particular, macroeconomic announcements, be it local or foreign government statistical agencies' news releases, are the source of some of the fluctuations in exchange rates around the time of the data or information broadcast.

Evans (2011) examines the total spot exchange rate responses to macro news releases from two perspectives – the traditional macro-based view of exchange rate determination and a micro-based perspective. Macro exchange rate models predict that macro announcements can potentially affect spot rates though three channels. First, the domestic currency will depreciate if the data release causes an unanticipated rise in the current risk-adjusted real interest rate differential.[2] An immediate depreciation of the local currency if the expected differentials are revised upwards is the second channel through which the macro information announcement affects the exchange rate. The third channel is the changing long-term real exchange rate expectations in response to the data release.[3] In summary, data releases that contain *new* information on current and future macro variables will affect the exchange rate provided that the information communicated in the release does not have offsetting effects on the risk-adjusted interest rate differentials through the three channels.

The micro-based models show how macro announcements affect both high intra-day and low daily and weekly frequency spot exchange rates by changing the structure of information about the macroeconomy available to traders and other market participants. Here, three channels are also identified through which data releases might affect the dynamics of the spot exchange rate and order flows.[4] As long as the data release contains financial asset price-relevant information, but the information is not clear-cut, dealers undertake risk-return

[2] The current risk-adjusted real interest rate differential is the foreign real interest rate *minus* the domestic real interest rate *plus* foreign exchange risk premium. See Evans (2011).

[3] This channel is shut down if purchasing power parity (PPP) holds in the long run.

[4] Order flow or transaction flow occurs when someone believes the price of a security will move and then decides to execute an order (transaction) in the market.

analysis of providing liquidity to the market and adjust their spot quotes accordingly to reflect the new information. Consequently, order flows – long and short currency positions – ensue causing traders to adjust their quotes yet again. At length, three channels through which the releases affect spot rate quotes and order flows are identified. First, spot rates respond immediately to the shock if the release contains common knowledge information;[5] a channel that is operable only if everyone agrees on the price implications of the news. The second channel is through the quotes and order flow responses to dispersed information shocks.[6] Finally, the process through which the dispersed information is impounded into prices is the third channel. Evans and Lyons (2008) find that approximately one-third of the effect of a macro announcement is transmitted directly into the US dollar/Deutschemark spot rate and two-thirds is transmitted indirectly through order flows.[7]

With particular emphasis on exchange rate reactions to monetary policy surprises, the main focus of this study, Kearns and Manners (2006) provide two reasons why an understanding of the interest rate impact on exchange rates is important: i) to test the validity of the uncovered interest parity (UIP) condition; and, ii) the vital monetary transmission channel role of exchange rates in small open economies. The *basic* UIP condition, a key economic theory governing exchange rate predictions, is represented by the equation

$$i_t - i_t^* = \frac{\Delta s_{t+1}^e}{s_t}. \tag{1}$$

where i_t and i_t^* denote the domestic and foreign interest rates, respectively, s_t is the direct spot exchange rate of the domestic currency (amount of units of domestic currency required to purchase a unit of foreign currency), and $\Delta s_{t+1}^e (= s_{t+1}^e - s_t)$ is the expected change in the spot exchange rate between periods t and $t+1$. Equation (1) is interpreted as the interest rate differential equals the expected appreciation or depreciation of the foreign currency when UIP holds. The prediction of UIP, *ceteris paribus*, is that if domestic interest rates, i_t, are higher than foreign interest rates, i_t^*, the domestic currency should appreciate, relative to the foreign currency, in order to equalise returns. Macroeconomic models that incorporate rational expectations, such as Dornbusch (1976), typically predict an immediate sharp appreciation in the domestic currency in response to a surprise domestic monetary tightening in order for the domestic currency to subsequently depreciate in line with UIP in the long-run.

Monetary policy surprises (and macroeconomic shocks in general) have also been theoretically and empirically identified as one of the sources of exchange

[5] Evans (2011) defines the 'common knowledge' component of a shock as that part of the surprise that represents unambiguous (or precise) price-relevant information that is simultaneously observed by everyone and impounded fully and instantaneously into dealers' spot rate quotes. This shock affects spot rates instantaneously and directly.

[6] A dispersed information shock is one which is viewed by different agents as having different price implications.

[7] The data is drawn from time-stamped, tick-by-tick transactions in the Deutschemark/dollar spot market over a four-month period, May 1 to August 31, 1996.

rate volatility. The volatility effects of announcements can be explained using theories on the microstructure of the foreign exchange market. On the basis of a simple descriptive theoretical model, for example, Moosa and Shamsuddin (2003) argued that exchange rate volatility can be explained in terms of the heterogeneity of traders with respect to their currency trading – buying and selling – strategies.

Fundamentals have relevance for exchange rate determination in the short run because unexpected changes in the macro-fundamentals affect volatility indirectly through their impact on various trading strategies. Hashimoto and Ito's (2009) theoretical predictions of the impact of surprise components of the news on foreign exchange returns volatility is approached from a statistical rather than a microstructural perspective. They assert that if a shock has a significant impact on the return, it should significantly affect volatility as well, since volatility is the sum of the accumulated absolute changes. The magnitude of volatility will depend on whether the exchange rate moves from one level to another in several miniature changes or by one big jump, and whether the changes to the new level are monotonous or include some reversals.

2.2 *Empirical analysis of monetary policy surprises and exchange rates*

This section first looks at some of the recent literature on exchange rate movements or responses to scheduled monetary policy announcements, followed by a review of empirical evidence on the effects of these shocks on exchange rate volatility.

2.2.1 *Monetary policy surprises and foreign exchange returns*

Some important empirical results on the effects of monetary policy surprises on the exchange rates of the currencies of developed economies is presented first, followed by evidence on developed countries-emerging markets exchange rates, including the rand/US dollar exchange rate reaction to SARB repo rate shocks. This section concludes with a summary of evidence on exchange rate responses to broader macro-fundamentals; an important exercise for comparison purposes.

Using seven calendar years (January 1992 to December 1998) real-time (5-minute) exchange rate quotations, macroeconomic expectations (forecasts) and macroeconomic realisations (actual announcements), Andersen *et al.* (2003) find that U.S. target Federal funds rates surprises (amongst other macroeconomic shocks) produce statistically significant mean returns jumps for the pound/dollar, yen/dollar, Deutschemark/dollar, and Swiss franc/dollar at the 5% level of significance; but not for the euro/dollar. The returns responses for the former four spot rates are not only statistically significant but also large with signs consistent with economic theory; for example within 5 minutes from the Fed rate pronouncement, the dollar appreciates by between 0.032% and 0.072% against four major European currencies (pound, euro, Deutschemark and Swiss franc) and yen rates for a one percentage point positive *standardised* shock to the

Fed rate. The r-squareds (ranging between 0.14 and 0.26) are also striking. Also, given that intra-day high-frequency 5-minute data was employed in the study, the responses suggest that exchange rates adjust almost instantaneously following monetary policy surprise announcements.

Faust *et al.* (2007) cover a longer span (January 1987 to December 2002) of data than was usually used in the literature pre-2007. In a 20-minute window (5-minutes before the data release and 15-minutes after the data release), they uncover a stronger than expected U.S. Fed rate announcement also appreciates the dollar against the Deutschemark (euro) and pound; for a 100 basis point surprise rise in the Fed rate, the Deutschemark (euro) and pound depreciate by 1.23% and 0.66%, respectively, against the dollar. (This translates into a 1.25% and 0.664% appreciation in the dollar against the Deutschemark and pound respectively.)[8] Conrad and Lamla's (2010) model predicts that a European Central Bank (ECB) surprise monetary policy tightening of 50 basis points appreciates the euro by 0.43% against the US dollar in the subsequent 5 minutes, employing irregularly spaced tick-by-tick quotes from the period of January 1999 to October 2006. Generally, bad news is found to have a greater impact than good news. Conrad and Lamla (*ibidem*) also find that the ECB introductory statement provides forward-looking information for expectation formation – there is compelling evidence that statements that indicate increasing risks to price stability induce an appreciation of the euro. Therefore, the dollar/euro exchange rate tends to adjust in a theoretically consistent direction even before the actual interest rate change is announced as long as the monetary policy statement information that precedes the announcement of the actual decision suggests such a change.

Contrary to the results that were obtained for a number of developed economies, empirical evidence on some emerging markets – Brazil, Chile and Mexico – fail to provide evidence of currency appreciation when their central banks raise interest rates (Kohlscheen, 2014). Like the developed economies' studies, the MPC meetings of central banks in emerging markets countries (between January 2003 and May 2011) were pre-scheduled in this case. However, daily data and market interest rates, instead of central bank policy rates, are employed. To address Zettelymeyer's (2004) concern of low-frequency data contamination, observations that may have been influenced by other events, or due to reverse causality resulting from central bank foreign exchange market interventions, are dropped from the sample (Kohlscheen, 2014). Kohlscheen (*ibidem*) concludes that this elusive link between interest rates and exchange rates has implications

[8] Let $e_{DC/FC}$ denote the direct exchange rate of the domestic currency; that is, the amount of units of domestic currency (DC) required to purchase one unit of foreign currency (FC). A positive (negative) percentage change in this exchange rate measures percentage appreciation (depreciation) of the foreign currency. Let this percentage change equal x (expressed as a decimal instead of percent). Then the magnitude of depreciation (appreciation) of the domestic currency (based on the indirect exchange rates of the domestic currency, namely, $e_{FC/DC}$) equals $\frac{1}{1+x} - 1 = -\frac{x}{x+1}$. When the percentage change in any given exchange rate is small, then the differences between that currency's percentage appreciation and the other currency's contemporaneous percentage depreciation are negligible but the deviation between the two measures rises with an increase in the percentage change in the given exchange rate.

for monetary policy effectiveness and resolving this puzzle should indeed be a research priority.

Turning to the South African literature on this topic, Fedderke and Flamand (2005) test the impact of macroeconomic news surprises on the rand/dollar exchange rate between June 2001 and June 2004. Similar to the emerging economies studies above, daily data is analysed. However, the monetary policy shock is the actual repo rate surprise, consistent with the major economies' investigations presented above. Although the sign of the surprise coefficient is consistent with the UIP prediction, it is nevertheless statistically insignificant in explaining the exchange rate. In one respect, the investigation of exchange returns data in this study is an extension of Fedderke and Flamand's (*ibidem*) analysis – the focus is on repo rate shock reactions but using high-frequency data as opposed to daily data. Not only are the economic channels through which monetary policy affects the economy important, but so is the mass media that conveys the central bank's verbal and nonverbal monetary policy utterances. Reid and du Plessis (2011) find a relative lack of critical assessment of monetary policy by the media – although the media increases the extent of coverage when inflation breaks through its target range, inter-meeting communication by both the media and central bank can be made more effective. For Africa in general, Plenderleith (2003) stresses that both the clarity of an inflation target and its effective communication are important for delivering consistency and transparency in inflation targeting. Moreover, the inscrutable relationship between interest rates and exchange rates of African countries (but not necessarily South Africa) poses a challenge for the role the currency plays as an additional transmission channel of monetary policy (Plenderleith, *ibidem*).

The inflation coefficient sign in Fedderke and Flamand (2005) is counter-intuitive. Evidence that only US-based news drives the rand/dollar exchange rate is also an important research finding in the latter study. Following the growing developed countries literature, Farrell *et al.* (2012) follow the high-frequency approach of Clarida and Waldman (2008) and extend Fedderke and Flamand's (2005) event study on inflation shocks effects on the rand/dollar exchange rate during 10-minute interval frequencies (five minutes before and five minutes after the inflation statistics release). The data set runs from the beginning of 1997 to the end of August 2010. During the pre-inflation targeting period, immediate rand depreciation followed higher than anticipated inflation releases but the effect was statistically insignificant. The statistically significant and positive coefficient for the inflation surprise for the inflation targeting period shows that bad (good) inflation news appreciates (depreciates) the rand because poor (good) inflation data leads to an expectation of monetary policy tightening (loosening) in the form of higher (lower) interest rates. Interpreted jointly, these two sets of results signal credible central bank monetary policy under inflation targeting. Asymmetric news responses are also evident based on the sign of the shock and whether the inflation target is breached or not. Farrell *et al*'s (2012) main results are consistent with those of Clarida and Waldman (2008) for US consumer inflation and the dollar performance against the currencies of nine developed economies; the sample period is 1993 to 2000.

Many more recent studies – over the past 15 years or so – have also had success in identifying the level responses of exchange rates to monetary policy changes: Eichenbaum and Evans (1995), Engel (1996), Kuttner (2001), Bernanke and Kuttner (2005), and Piazzesi and Swanson (2008), to mention a few. Neely and Dey (2010) review the huge literature on macroeconomic news effects on foreign exchange returns.

2.2.2 *Monetary policy surprises and foreign exchange rate volatility*

Studies on exchange rate volatility responses to central bank rates are discussed first, followed by a survey of some of the important broad macroeconomic fundamentals studies that excluded policy rates, and a reference to some other relevant work. Sager and Taylor (2004) test the volatility reaction of 5-minute euro/dollar exchange rate data on the days the ECB Governing Council (GC) announced its interest rate decisions in 2002 and 2003 compared with other days. Their Markov switching model is based on two volatility regimes; a high-volatility state associated with informed trading and a low-volatility state associated with liquidity trading. Two important findings are reported. First, on GC meeting days when interest rate decisions are announced, the probability of switching into a high-volatility state rose significantly with a significant concurrent fall in the probability of remaining in a low volatility state. The full impact of the announcement on volatility took 15 minutes to be felt and dissipated in approximately one hour. Significant evidence of an increase in the probability of being in an informed state commencing one hour before the announcement (an interest change or no change) suggests that dealers were closing their positions to minimise risk exposure rather than a response to policy rate information leakages.

In a similar study, Melvin *et al.* (2010) find that the volatility state transition probabilities switch systematically and significantly to a high-volatility state on Bank of England MPC meeting days when interest rates were changed by an amount different from the *ex ante* median consensus forecast or rates were unchanged when a change was expected by the market. And similar to Sager and Taylor's (2004) regression results, there is evidence of pre-positioning during the morning of the meeting. The data sample spanned more than a decade – June 1997 to October 2007 – of dollar/pound exchange rates tick data.

Conrad and Lamla's (2010) investigation of ECB monetary policy shocks on the high-frequency euro/dollar exchange rates provides evidence of an initial instantaneous jump in volatility on impact, followed by a gradual decline. Also, positive surprises tend to trigger stronger volatility reactions than negative ones.

Other empirical work on monetary policy shocks and exchange rate volatility includes, amongst others: Jansen and Haan (2005), and Hayo and Neuenkirch (2012). Neely (2011) reviews research that studies the reaction of foreign exchange volatility to macroeconomic news.

3 Methodology

Whereas the common 'purely statistical approach' applies regression analysis to estimate the relationship between time series variables – based on their contemporaneous values – the 'event study approach' or 'narrative approach' employed in this analysis assesses the impact of an event(s) on the price of a financial asset around the time of the event(s) – shortly before and/or after the event(s). The 'event study approach' focuses on the identification of 'shocks' through non-statistical procedures and then estimating the impact of these shocks on other economic variables.[9] Although this methodology was popularised by Romer and Romer (1989) and Cook and Hahn (1989), it can be traced to as far back as the early 1960s – Romer and Romer (1989) credit Friedman and Schwartz (1963) for pioneering this procedure. Schwartz and Friedman (1989) contest Romer and Romer's (1989) latter assertion arguing that this methodology goes further back to the "Digression concerning the variations in the value of silver during the course of the last four centuries" in Adam Smith's *Wealth of Nations* (1776).

More specifically, this study applies the 'event study' methodology to investigate the reaction of the rand/US dollar exchange rate – percentage changes in levels and shifts in their variance – to unexpected changes in the policy variable (repurchase agreement or repo rate) around the time of the monetary policy announcement using intra-day high-frequency minute-by-minute data in narrow event windows. Shocks or surprises are identified as unexpected or unpredictable monetary policy repo rate announcements, measured as the realised (or actual) repo rate *minus* the expected repo rate. To ensure that the policy change is exogenous, Kearns and Manners (2006) advise that the sample periods should be carefully selected. Kearns and Manners (*ibidem*) and Zettelmeyer (2004) recommend that observations when the exchange rate may have reacted to other news that became public on the same day (or around same time) of monetary policy announcements and those periods where the central bank intervenes in the foreign exchange market to offset or mitigate the policy shock effect should be excluded to deal with the potential endogeneity and misspecification problems. Endogeneity arising from bank interventions in the foreign exchange market is not a problem in our sample period as the Bank pursued a 'free' float. To minimise the number of observations that would have to be discarded due to the endogeneity problem, and compare and contrast with other empirical studies, the *principal* regressions in this study experiment with a 5-minute window (5 minutes after the rate decision announcement) and a 20-minute window (5 minutes before the rate decision announcement and 15 minutes after the event); a 70-minute window is used in the *preliminary* regressions to examine market activity some time before the lifting of the MPC statement embargo and later after the Governor has completed the delivery of her/his media statement.

A general reason for conducting the study over these varying window sizes is the trade-off between minimising contamination and allowing some time for the market to fully digest the shock. Contamination includes the endogeneity

[9] One definition of the word 'narrative' is an account of connected events, and thus the terms 'narrative study' and 'event study' are equivalent.

problem – simultaneous relationship between exchange rates and interest rates – and the additional exchange rate effect of variables other than the interest rate. This contamination is reduced when the window is narrowed. However, too narrow a window may not allow enough time for market participants to digest the policy news shock (Rigobon and Sack, 2004). To gauge how rapid the exchange rate responds to the shock, we first estimate the cumulative minute-by-minute exchange rate responses (over 1-minute periods from 10 minutes before the pronouncement up to the announcement time and 1-minute after the announcement up to 60 minutes after the policy declaration) to a 100-basis point repo rate surprise using the ordinary least squares (OLS) estimation method, and then plot the regression surprise coefficients from the latter set of regressions graphically. This will demonstrate whether exchange rate changes take place immediately after the announcement or whether markets need a substantial amount of time to digest the information. And given that the actual rate pronouncement does not occur at a specific time, the 70-minute window period also allows us to estimate the approximate average time of the announcement from the start of the media release statement.

In many cases, monetary policy decisions are widely anticipated by the market, and so their impact should already be incorporated into interest rates and exchange rates – in line with the efficient market hypothesis (EMH). The EMH implies that financial asset prices should respond instantaneously to the surprise component of announcements that have direct or indirect bearings on asset prices. To test the validity of the efficiency of the foreign exchange market – 'efficiency' from a mechanical perspective (that is, how soon the shock is absorbed into the exchange rate and how long it takes to die-off), currency returns and their variance responses to repo rate surprises are estimated over different window sizes. Finally, we test whether the market reacts to the component of the repo rate change that is anticipated by the market.

3.1 *Econometric models*

Our measure of the repo rate surprise component (S_{kt}) of the announcement k, is defined as the difference between the actual announced value of the repo rate (A_{kt}) and the median expected repo rate of the Bloomberg market consensus survey(F_{kt}):

$$S_{kt} = A_{kt} - F_{kt}. \tag{2}$$

To estimate the effect of the repo rate news shock on the exchange rate, we first regress foreign exchange returns on the surprise in the repo rate

$$(Model\ A) : r_{k,t+k} = \theta_0 + \theta_1 S_{kt} + \varepsilon_t \tag{3}$$

where, $r_{k,t+k}$ is the percentage change in the rand bilateral exchange rate between time periods k and $t+k$ (around the time of the event),[10] and θ_1 is the

[10] For reasons already stated, and further explicated in section 5, we experiment with various values for k and $t+k$; the exact values will be specified before running each of the regressions.

sensitivity of the exchange rate to the news shock.[11]

To estimate the impact of shocks on volatility, our second model is specified as follows:

$$(Model\ B) : r_{k,t+k} = \theta_0 + \theta_1 S_{kt} + \varepsilon_t \tag{4}$$

$$h^2_{k,t+k} = \omega + \sum_{k=1}^{p} \alpha_k \varepsilon^2_{t-k} + \sum_{j=1}^{q} \beta_j h^2_{t-j} + \delta_1 S_{it} \tag{5}$$

where equations (4) and (5) are the GARCH model mean and variance (conditional volatility) equations. The policy shock enters both equations – θ_1 measures the foreign currency returns sensitivity to the repo rate surprise, δ_1 captures the exchange rate returns conditional volatility reaction to this policy shock – and β and α are the lagged conditional volatility coefficient (up to $t-q$) and the lagged disturbance term parameter which measures the conditional volatility response to shocks in previous periods (up to $t-p$) other than the repo rate surprise, respectively. By assumption, $\varepsilon_t (= h_t z_t)$ is serially uncorrelated with a mean equal to zero, ($z_t \sim N(0,1)$), but its conditional standard deviation, h_t, is time varying.[12] A test to detect the absence or presence of serial correlation is carried out in the next section.

4 Data

4.1 *Data issues*

The sample period, 14 August 2003 to 24 January 2013, is dictated by the availability of historical market consensus forecasts for the repo rate, information regarding the MPC repo rate decision and the intra-day high-frequency exchange rate data.[13] In this period the SARB employed an inflation-targeting monetary policy framework, together with a single floating exchange rate mechanism. The period was also accompanied by gradual exchange control relaxations. The four raw data series are the minute-by-minute bid and ask quotes of the US dollar in terms of the rand obtained from Olsen Financial Technologies, the actual repo rate announced by the SARB on the day of the release of its MPC statement and the Bloomberg median repo rate market consensus forecasts. On average, approximately 20 economists were surveyed regarding expectations for each announcement over the sample interval. The secondary data generated before running the regressions are the mid-point currency quotes

[11] To compare the magnitudes of regression coefficients on announcement surprise series with different units of measurement, for example, exchange rate response to repo rate surprise *versus* the exchange rate reaction to trade balance shock, researchers typically follow Balduzzi *et al.* (2001) by dividing the surprises by their standard deviation across all observations to facilitate interpretation. The standardised shock measure is $SS_{kt} = S_{kt}/\sigma_k$ and the regression coefficient is interpreted as the change in the return for a one standard deviation change in the surprise.

[12] $z_t (= \varepsilon_t / h_t)$ is the standardised residuals.

[13] This empirical analysis uses the levels of the direct nominal foreign exchange rates of the rand. A rise in the exchange rate is interpreted as rand depreciation.

(average of the bid and ask quotes), the currency returns (percentage change in the mid-point currency quotes) and the surprise component of the repo rate announcement (arithmetic difference between the actual repo rate and median repo rate forecast measured in percentage points). Use of median shocks (as opposed to mean shocks) is consistent with a substantial amount of the empirical research reviewed thus allowing comparison of results in this study with those surveyed. A first statistical advantage of the median over the mean is that extreme values (outliers) do not affect the median as strongly as they do the mean. And congruent with Conrad and Lamla's (2010) repo rate shocks data generated using the median rate, median surprises occur less frequently than mean surprises but the magnitudes of the former are significantly larger than the latter, thus allowing for a 'strong' separation in surprise and no-surprise days.

Here only scheduled monetary policy announcement decisions are considered; that is, those that the market knew beforehand would take place. There are no events when the policy was known to have reacted to contemporaneous exchange rate movements. Also, there does not appear to be any day(s) where the policy announcement coincided with other important economic and noneconomic news that might have affected the exchange rate as well. After taking all these factors into account, the full sample is 43 observations compared with Zettlemeyer's (2004) sample range of between 23 and 60 observations for three developed economies, and Kearn and Manners' (2006) sample ranges of between 33 and 82 observations for four industrialised economies.

4.2 *Policy surprise data: A descriptive analysis*

In Table A1 in Appendix A, there is a trend lower in the frequency of policy surprises – both the number and magnitude of shocks decline, accompanied by a fall in the incidence of uncertainty amongst economists on central bank repo rate decisions. Of the total 43 monetary policy decisions incorporated in this study, more than 80% of the actual repo rate changes were fully anticipated and their sizes were also in line with the market consensus median forecast. One should err on the side of caution though before generalising given the relatively small sample size, but this finding is broadly consistent with those of Swanson (2006) for the US and a number of South African studies that we return to. There were no instances where the market expected a change in the policy rate in the opposite direction to the change actually announced. On 6 occasions, the MPC changed the repo rate with no adjustment anticipated by the market. This is a tentative but non-scientific indication that market participants have gained improved (though not perfect) understanding of which macroeconomic variables condition the SARB's monetary policy reaction function, and that the SARB's more effective (verbal and nonverbal) communication of its policy stance since late 1999, to make its conduct of monetary policy more transparent to the public, have been highly fruitful. We hypothesise that the introduction of scheduled monetary policy announcement dates and central bank policy signals between MPC meetings since the implementation of the inflation targeting framework

in 2000 have contributed to the ability of market participants to better understand the monetary policy reaction function. The descriptive information in Table A1 (Appendix A) tentatively suggests that the SARB has made progress in achieving its goal of improving monetary policy transparency. (Melvin *et al*, (2010) use a similar crude approach to infer monetary policy transparency.) This evidence on monetary policy transparency reinforces earlier findings, using divergent approaches and for different sample periods, such as Ballim and Moolman (2005), Aron and Muellbauer (2008), Arora (2008), and Reid and du Plessis (2011).[14]

4.3 *Preliminary data analysis*

Table A2 in Appendix A displays the statistical properties of the currency returns, surprise components of the changes in the repo rate and the raw and squared residuals generated from the GARCH mean equation. Significant skewness and excessive kurtosis are detected in both the returns and repo rate surprises. Excessive kurtosis present in the surprise data is due to a significant number of shocks being equal to zero and the remaining almost evenly spread at 50 and -50 basis-points; there is one more unexpected monetary tightening than policy loosening. However, the standardised residuals of the 20-minute returns are close to a normal distribution with a low level of non-normality in the corresponding 5-minute returns standardised residuals. Both the augmented Dickey-Fuller and Phillips-Perron unit root tests suggest that both the returns and policy surprise series do not have a unit root. Congruently, the KPSS (Kwiatkowski-Phillips-Schmidt-Shin) stationarity test does not refute the null of stationarity. Looking at the Q_{LB}-statistics (Ljung-Box Q-statistics for the standardised residuals, $z_t = \varepsilon_t / h_t$), the null hypothesis that there is no serial or autocorrelation in the standardised residuals cannot be rejected; suggesting that estimation of the returns equation may proceed using the OLS technique.

5 Empirical analysis

5.1 *Shock response plots (speed of impact): 70-minute window period analysis*

Following Kearns and Manners (2006), the timing of the impact of the repo rate surprise on the exchange rate here is determined by estimating equations (3), (4) and (5) and recording θ_1 and δ_1 for k ranging from 10 minutes before the scheduled embargo is lifted to 60 minutes after the scheduled commencement

[14] But our descriptive analysis does not constitute empirical proof that there has indeed been learning and that communication has definitely improved over time. Elliott and Muller (2006) and Muller and Petalas (2010) developed a methodology to formally and empirically test monetary policy transparency; that is, the stability of the asset price returns response to surprises, and the paths of these effects, which has also been applied by Goldberg and Grisse (2013). Applying this test to South Africa entails an entire new study which can be explored in later research.

time of the MPC statement release – at one-minute intervals – with the actual scheduled embargo lift time as the reference point in each case. For example, $r_t = \ln(\frac{e_0}{e_{-8}})$ is the approximate cumulative percentage change in the exchange rate from 8 minutes before the scheduled time of the commencement of the MPC release statement to the actual time that the embargo is lifted, and $r_t = \ln(\frac{e_{20}}{e_0})$ is the approximate cumulative percentage change in the exchange rate from the actual time that the embargo is lifted to 20 minutes after the Governor starts delivering the MPC statement. A benefit of this approach is that it allows us to evaluate whether there is an immediate response or whether the response builds up over time and positioning or possible new repo rate leakages before the official pronouncement on the MPC's decision. The 70 regression estimates are summarised in Table A3 (in Appendix A) while Appendix B presents the same results in the form of diagrammatic reactions of exchange returns (θ_k) and volatility (δ_k) to a one percentage point unanticipated hike in the repo rate, in two separate diagrams, with their respective standard error bands. The combined effects excluding their standard error bands are shown in Figure A1 in Appendix A. Time zero, denoted as '0' in the graphs represents the time that the SARB is scheduled to lift the embargo on its MPC statement – this is not the time the final decision on whether to change the repo rate or not is announced. The concluding remark in the press statement that contains the actual interest rate decision is made publicly available only immediately after the Governor announces the actual decision; and not before.

We first interpret the results in Table A3 (in Appendix A). We find significant (θ_k) and (δ_k) coefficients (at the 5% level) from around $k = 18$; both coefficients are simultaneously and uninterruptedly statistically significant at the 10% or lower levels of significance from $k = 18$ up to $k = 60$ for the returns and from $k = 18$ up to $k = 54$ for volatility. The negative θ_1 coefficient signs mean that a positive repo rate surprise is correlated with rand appreciation. Returns from positive (negative) surprises are maximised (minimised) after 51 minutes from the time of the start of the MPC report press statement (about 30 minutes after the rate announcement) while the impact on volatility starts to die off much earlier at around 39 minutes into the MPC report release (approximately 10 minutes after the repo rate decision is released). Conditional volatility due to the surprise only becomes statistically insignificant after 54 minutes from the commencement of the Governor's press statement or in the region of 35 minutes after the rate pronouncement. The significance of the shocks from 18 minutes after the scheduled time is more or less consistent with the average time of most recent 22 MPC statement deliveries in Appendix C.

Note that statistically significant and correctly signed regression θ_1 estimates (Table A3 in Appendix A) before the (general) expected or estimated time of the actual rate change (or 'no change') announcement would be indicative of a leakage of the MPC's decision. An interesting observation is the 10 or so statistically significant δ_1 coefficients (with positive and negative signs) during the $-10 < k < 18$ interval. This is probably evidence of dealers' positioning before the repo rate announcement where some traders expect a positive shock,

others expect no shock and yet another group anticipate a negative shock. Sager and Taylor (2004) argue that one would expect greater positioning when the probability of movement to a high volatility state is due to information leakage. Thus, systematic exchange rate behaviour tends to be observed on the MPC (or other macroeconomic data) announcement days – news effects after the announcement preceded by some positioning before the announcement.

5.2 *Principal regression estimates*

Interval returns, window periods and the measure of the surprise – actual or standardised shock – vary across empirical studies. To minimise data contamination while simultaneously allowing for adequate time for the market to absorb the data, and to compare the results with a similar and recent study in our literature review by Faust *et al* (2007), we initially estimate the coefficients in a regression of 20-minute exchange rate returns on announcement surprise. In Faust *et al* (*ibidem*) the 20-minute window period runs from 5 minutes before the surprise to 15 minutes afterwards. Since the SARB's monetary policy stance announcement takes place anywhere from 8 to 22 minutes after the start of the press conference, as shown in Appendix C, we run seven regressions based on 20-minute windows to incorporate the earliest and latest announcement times in Appendix C : 8–28 minutes, 10–30 minutes, 15–35 minutes, 16–36 minutes, 18–38 minutes, 20–40 minutes and 22–42 minutes. To compare our results with very recent empirical work by Conrad and Lamla (2010), we follow the same procedure based on shorter 5-minute windows: 8–13 minutes, 10–15 minutes, 15–20 minutes, 16–21 minutes, 18–23 minutes, 20–25 minutes and 22–27 minutes.[15]

The statistically insignificant results for the 5-minute returns in Table A4 (in Appendix A) may be an indication of a somewhat slower market initial response to the unexpected policy rate changes than the euro's response to an ECB surprise – in the 5 minutes following a 100 basis point surprise monetary policy tightening by the ECB, the euro appreciates by about 0.86% against the dollar (Conrad and Lamla, 2010). Dollar appreciation against the pound, euro, Deutschemark, Swiss franc and yen in response to a 100 basis point standardised Fed rate shock ranges between a meagre 0.032% and 0.072% (Andersen *et al.*, 2003). However, these Fed rate shocks explain a significant proportion of these small moves – adjusted r-squareds range between 0.14 and 0.26.[16] The inability of our investigation to find statistically significant exchange rate reactions over shorter 5-minute intervals might be due to the varying times of each event – the gap between the earliest and latest release of around 13 minutes is substantial for an intra-day high-frequency event study.

By contrast, a significant and theoretically coherent relationship between the monetary policy shocks and exchange rate movements emerges for South Africa for the 20-minute windows. OLS regressions results in Table A4 (in Appendix A)

[15] Although the results in Table 4 (p1410, Conrad and Lamla, 2010) are the 5-minute returns response to standardised shocks, the raw shocks response result is reported in the discussion on p1411 (*ibidem*).

[16] Conrad and Lamla (2010) do not report the regression $r-$squareds.

suggest that a 100-basis-point surprise tightening of domestic monetary policy is estimated to lead to rand appreciation against the dollar by as much as 1.28%.[17] This is about double the pound/dollar reaction to Fed surprises (0.66%) for the same window (Faust *et al.*, 2007). Also, a larger proportion of rand returns movements – up to 32% – are explained by repo rate surprises. So not only is the rand more sensitive to SARB policy rate surprises but the reaction is also far more economically significant. Since Fed rate and ECB rate shocks tend to have pervasive direct and indirect effects, another useful comparison would be one based on the dollar/rand reaction to a Fed rate surprise and the euro/rand reaction to an ECB rate shock.[18]

Some interesting results are produced by the variance equation for both the 5-minute and 20-minute windows (Table A5 in Appendix A). To start with, the statistically significant and positively (negatively) signed variance equation shock coefficients means that policy rate shocks raise (reduce) returns volatility. At the extreme ends of the 5-minute windows (8m-13m and 22m-27m), the statistically significant δ_1 show a shift from a low volatility regime to a high volatility regime. In the 20-minute windows, the statistically significant δ_1 suggest shifts in volatility regimes in the 10m-30m, 16m-36m and 18m-38m windows. The magnitude of $\alpha + \beta$ significantly lower than unity suggests that the effects of the other minor shocks during the event study interval are not persistent. In the 20-minute windows, the magnitudes of the adjusted r-squareds, $\bar{R}^2$, in Tables A4 and A5 (in Appendix A), suggest that the policy surprises explain as much of the conditional volatility as the returns (12% to 32%). Faust *et al* (2007) do not estimate volatility responses so a variance reaction comparison is not possible. Also, our volatility results cannot be directly compared with those of Conrad and Lamla's (2010) filtered returns asymmetric effects because our investigation looks at the raw returns and there is inadequate data to estimate the asymmetric effects. Additionally, Andersen *et al* (2003) do not report the repo rate conditional volatility response coefficients for the central bank rate but only the nonfarm payroll employment, durable goods orders, trade balance and initial unemployment claims surprise effects on volatility coefficients.

In an earlier analysis that covered a broader set of macro announcements and the rand/dollar exchange rate effects, Fedderke and Flamand (2005) find that only US-based important news events have a statistically significant effect on the rand in contrast to the evidence in this study. The differences may be explained by two main factors. First, their sample period covers 37 months compared with the 11-year interval in our research. Second, and probably more importantly, we extend their study by using intra-day high-frequency exchange rate data as opposed to daily data – lower-frequency daily data are noisier indicators which weakens the explanatory power of regressions.

[17] Calculated from the 1.2589% dollar depreciation against the rand in the 15–35 minute window period.

[18] See Tozana and May's (2014), a working paper on the rand/dollar exchange rate returns response to Fed rate surprises.

5.3 *Exchange rate response to anticipated repo rate changes*

"A market in which prices always fully reflect available information is called efficient" (Fama, 1970). An expanded definition of an efficient market is a market where there are large numbers of rational, profit 'maximisers' actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. Two implications of the EMH are that: i) market traders will only react to new information in the form of unexpected announcements; and, ii) profit opportunities will be short-lived as traders would respond immediately or very quickly to such news. In this last section of the analysis, we test the first implication of the EMH; that is, whether the market responds to repo rate surprises only. We estimate the 20-minute window returns and variance models with the expected repo rate change as an additional explanatory variable

$$(Model\ C) : r_{k,t+k} = \theta_0 + \theta_1 S_{kt} + \theta_2 E_{kt} + \varepsilon_t \tag{6}$$

$$(Model\ D) : r_{k,t+k} = \theta_0 + \theta_1 S_{kt} + \theta_2 E_{kt} + \varepsilon_t \tag{7}$$

$$h^2_{k,t+k} = \omega + \sum_{k=1}^{p} \alpha_k \varepsilon^2_{t-k} + \sum_{j=1}^{q} \beta_j h^2_{t-j} + \delta_1 S_{it} + \delta_2 E_{it} \tag{8}$$

where E_{kt} is the repo rate change that the market expects the MPC to announce (measured as the market median consensus forecast *minus* the level of the repo rate before the announcement), θ_2 is the sensitivity of the exchange rate to expected changes in the repo rate, and δ_2 is the responsiveness of volatility to expected changes in the repo rate. (The other variables and parameters maintain the same definitions from the methodology section.) Table A6 (in Appendix A) reports the results from regression models C and D. The coefficient for the expected repo rate change is statistically insignificant, and so are all the parameters in the variance equation. The r-squareds are marginally bigger than the ones from Models A and B above. The finding that anticipated repo rate changes effect neither the foreign exchange returns nor volatility of the rand/dollar exchange rate in the window period after the policy announcement means that the foreign exchange market response to repo rate shocks conforms with the first implication of the EMH; that is, market traders react to only new information in the form of unexpected announcements.

6 Concluding remarks and discussion

The goal of this analysis – the first on South African interest rate announcements using high-frequency exchange rate data – was to deepen our understanding of

the reaction of the intra-day high-frequency rand/dollar exchange rate returns and their volatility to expected and unexpected South African Reserve Bank repo rate changes. To that end, we have documented important news effects. The main overall conclusion of this paper is that domestic repo rate surprises have a significant effect on the rand/dollar exchange rate. In particular, we find a significant and theoretically-coherent response to domestic repo rate shocks emerges only after 5 minutes following the repo rate announcement; that is in the 20-minute windows. A 100-basis point surprise tightening of domestic monetary policy is estimated to lead to a 1.28% rand appreciation against the dollar, about double the pound/dollar 0.66% reaction to Fed surprises for the same window. The statistically significant and positively signed variance equation shock coefficients means that policy rate shocks raise returns volatility – in the 20-minute windows, the statistically significant conditional volatility response parameter suggests shifts in volatility regimes in the 10m-30m, 16m-36m and 18m-38m windows. The magnitude of $\alpha + \beta$ in the GARCH specifications is significantly lower than unity, indicating that the effects of the shocks during the event study interval are not persistent. Not only is the rand sensitive to SARB policy rate surprises but the adjusted r-squareds of up to 32% for both the returns and conditional volatility suggest economic significance in the responses as well.

The relatively rapid exchange rate response to a 100-basis-point hike – elevated returns peak within 30 minutes post-announcement and volatility subsides about 40 minutes following the event – suggest a relatively high degree of market 'mechanical efficiency' in this event study context. The non-instantaneous returns response based on the 5-minute window may be attributed to inconsistent event times or an initially less swift price adjustment as market participants absorb the information and revise expectations. The finding that anticipated repo rate changes affect neither the foreign exchange returns nor volatility of the rand/dollar exchange rate after the event indicates that the foreign exchange market response to repo rate shocks conforms to the first implication of the EMH; that is, market traders react to only new information in the form of unexpected announcements.

Evidence of declining magnitudes and incidences of repo rate shocks in the most recent years in our analysis tentatively suggests that the central bank has reinforced the gains from policy transparency uncovered in earlier work between 2005 and 2007. This is consistent with the Bank's (verbal and nonverbal) articulation of monetary policy aiding the modelling of repo rate decisions leading to greater precision in financial market forecasts.

Where to from here? Like all empirical studies, there are a number of limitations in our inquiry which have future research implications. The use of intra-day ultra-high-frequency tick-by-tick data has been shown to produce more robust results – substantially larger sample size and smaller standard errors – than 1-minute or lower frequency data. Shocks can also be extracted from the future rate agreement (FRA) rates but this approach will also be limited by the availability of an adequately long sample of high-frequency interest rate data for South Africa. Our models can also be extended in a number of ways to capture

exchange rate responses to future exchange rate expectations implied in the MPC release statements and immediate 3-month and say 12-month FRA rate movements. The relatively small sample size (although not small when compared to other similar studies) has inhibited an investigation of different sample responses; for example, exchange rate responses during times of turbulence and normal times, recessions and booms, and asymmetric responses to good and bad news. It is generally found that bad news has a greater impact than good news. Andersen *et al* (2003) contend that these asymmetric responses may be driven by different degrees of uncertainty with respect to the underlying economy, related to theoretical work on information processing and price discovery.[19] When the sample size for South Africa becomes sufficiently large, the interest rate surprise measure can be split into positive and negative surprises in order to control for potential asymmetries. The impact of a wide-range of other (local and foreign) macroeconomic news announcements also requires investigation; and so does a formal econometric approach to empirically test monetary policy transparency along the lines of Elliot and Muller (2006) and Muller and Petalas (2010).

References

[1] ANDERSEN, T.G., BOLLERSLEV, T., DIEBOLD, F.X., and VEGA, C. (2003). Micro effects of macro announcements: Real-time price discovery in foreign exchange. *American Economic Review*, 93(1): 38-62.

[2] ARON, J., and MUELLBAUER, J. (2008). *Transparency, credibility and predictability of monetary policy under inflation targeting in South Africa.* European Economic Association (EEA) Conference, Milan.

[3] ARORA, V. (2008). Monetary policy transparency and financial market forecasts in South Africa. *Journal of Economic Financial Sciences*, 2(1): 31-56.

[4] BALDUZZI, P., ELTON, E.J., and GREEN, T.C. (2001). Economic news and bond prices: Evidence from the U.S. treasury market. *Journal of Financial and Quantitative Analysis*, 36(4): 523-543.

[5] BALLIM, G., and MOOLMAN, E. (2005). *Testing the potency and transparency of the South African Reserve Bank's inflation targeting policy.* Standard Bank Economics Division, South Africa.

[6] BERNANKE, B.S., and KUTTNER, K.N. (2005). What explains the stock market's reaction to Federal Reserve policy? *Journal of Finance*, 60(3): 1221-1257.

[19] See also Veronesi (1999). Veronesi (*ibidem*) shows that in equilibrium, investors have a higher sensitivity to bad news during good times and underreact to good news in bad times.

[7] CLARIDA, R.H., and WALDMAN, D. (2008). *Is bad news about inflation good news for the exchange rate? And, if so, can that tell us anything about the conduct of monetary policy*? In J.Y. Campbell (eds.), Asset Prices and Monetary Policy. National Bureau for Economic Research, Chicago: University of Chicago Press.

[8] CONRAD, C., and LAMLA, M.J. (2010). The high-frequency response of the EUR-USD exchange rate to ECB communication. *Journal of Money, Credit and Banking*, 42(7): 1391-1417.

[9] COOK, T., and HAHN, T. (1989). The effect of changes in the federal funds rate target on market interest rates in the 1970s. *Journal of Monetary Economics*, 24(3): 331-351.

[10] DORNBUSCH, R. (1976). Expectations and exchange rate dynamics. *The Journal of Political Economy*, 84(6): 1161-1176.

[11] EICHENBAUM, M., and EVANS, C.L. (1995). Some empirical evidence on the effects of shocks to monetary policy on exchange rates. *The Quarterly Journal of Economics*, 110(4): 975-1009.

[12] ELLIOTT, G., and MULLER, U.K. (2006). Efficient tests for general persistent time variation in regression coefficients. *Review of Economic Studies*, 73(4): 907-940.

[13] ENGEL, C. (1996). The forward discount anomaly and the risk premium: A survey of recent evidence. *Journal of Empirical Finance*, 3(2): 123-192.

[14] EVANS, M.D.D. (2011). *Exchange-Rate Dynamics*. Princeton: Princeton University Press.

[15] EVANS, M.D.D., and LYONS, R.K. (2008). How is macro news transmitted to exchange rates? *Journal of Financial Economics*, 88(1): 25-60.

[16] FAMA, E.F. (1970): Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*, 25(2): 383-417.

[17] FARRELL, G.N., HASSAN, S., and VIEGI, N. (2012*). The high-frequency response of the rand-dollar rate to inflation surprises*. South African Reserve Bank, Working Paper No. 12/03.

[18] FAUST, J., ROGERS, J.H., WANG, S-Y.B. and WRIGHT, J.H. (2007). The high-frequency response of exchange rates and interest rates to macroeconomic announcements. *Journal of Monetary Economics*, 54(4): 1051-1068.

[19] FEDDERKE, J., and FLAMAND, P. (2005). Macroeconomic news "surprises" and the rand/dollar exchange rate. *Journal for Studies in Economics and Econometrics*, 29(3): 1-16.

[20] FRIEDMAN, B.M., and SCHWARTZ, A.J. (1963). *A Monetary History of the United States: 1867-1960*. Princeton: Princeton University Press.

[21] GOLDBERG, L.S., and GRISSE, C. (2013). *Time variation in asset price responses to macro announcements*. Federal Reserve Bank of New York, Staff Report No. 626.

[22] HASHIMOTO, Y., and ITO, T. (2009). *Effects of Japanese macroeconomic announcements on the dollar/yen exchange rate: High-resolution picture*. National Bureau for Economic Research, Working Paper No. 15020.

[23] HAYO, B., and NEUENKIRCH, M. (2012). Domestic or U.S. news: What drives Canadian financial markets? *Economic Inquiry*, 50(3): 690-706.

[24] JANSEN, D-J., and DE HAAN, J. (2005). Talking heads: The effects of ECB statements on the euro-dollar exchange rate. *Journal of International Money and Finance*, 24(2): 343-361.

[25] KEARNS, J., and MANNERS, P. (2006). The impact of monetary policy on the exchange rate: A study using intra-day data. *International Journal of Central Banking*, 2(4): 157-183.

[26] KOHLSCHEEN, E. (2014). The impact of monetary policy on the exchange rate: A high frequency exchange rate puzzle in emerging economies. *Journal of International Money and Finance*, 44(C): 69-96.

[27] KUTTNER, K.N. (2001). Monetary policy surprises and interest rates: Evidence from Fed funds futures market. *Journal of Monetary Economics*, 47(3): 523-544.

[28] MELVIN, M., SABOROWSKI, C., SAGER, M., and TAYLOR, M.P. (2010). Bank of England interest rate announcements and the foreign exchange market. *International Journal of Central Banking*, 6(3): 211-247.

[29] MOOSA, I.A., and SHAMSUDDIN, A. (2003). Heterogeneity of traders as a source of exchange rate volatility: Some simulation results based on a descriptive model. *Journal of Financial Studies*, 11(2): 43-69.

[30] MULLER, U.K., and PETALAS, P-E. (2010). Efficient estimation of the parameter path in unstable time series models. *Review of Economic Studies*, 77(4): 1508-1539.

[31] NEELY, C.J. (2011). A survey of announcement effects on foreign exchange volatility and jumps. *Federal Reserve Bank of St. Louis Review*, 93(5): 361-407.

[32] NEELY, C.J., and DEY, S.R. (2010). A survey of announcement effects on foreign exchange returns. *Federal Reserve Bank of St. Louis Review*, 92(5): 417-463.

[33] PIAZZESI, M., and SWANSON, E.T. (2008). Futures prices as risk-adjusted forecasts of monetary policy. *Journal of Monetary Economics*, 55(4): 677-691.

[34] PLENDERLEITH, I. (2003). *Is monetary policy different in Africa?* Speech at Symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole. (Plenderleith was the Deputy Governor of the South African Reserve Bank then.)

[35] REID, M., and DU PLESSIS, S. (2011). *Talking to the inattentive Public: How the media translates the Reserve Bank's communications*. Department of Economics and the Bureau for Economic Research at the University of Stellenbosch, Working Paper No. 19/11.

[36] RIGOBON, R., and SACK, B. (2004). The impact of monetary policy on asset prices. *Journal of Monetary Economics*, 51(8): 1553-1575.

[37] ROMER, C.D., and ROMER, D.H. (1989). Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. *NBER Macroeconomics Annual*, 4: 121-170.

[38] SAGER, M.J., and TAYLOR, M.P. (2004). The impact of European Central Bank Governing Council announcements on the foreign exchange market: A microstructural analysis. *Journal of International Money and Finance*, 23(7-8): 1043-1051.

[39] SCHWARTZ, A.J., and FRIEDMAN, B.M. (1989). Comment. *NBER Macroeconomics Annual*, 4: 171-184.

[40] SMITH, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*. London: Methuen and Co.

[41] SWANSON, E. (2006). Have increases in Federal Reserve transparency improved private sector interest rate forecasts? *Journal of Money, Credit and Banking*, 38(3): 791-819.

[42] TAYLOR, M.P. (1995). The economics of exchange rates. *Journal of Economic Literature*, 33(1): 13-47.

[43] TOZANA, L., and MAY, C. (2014). *The impact of U.S. monetary policy announcements on the South African rand/U.S. dollar exchange rate: An event study using intra-day high-frequency exchange rate data*. Working Paper No. 5.

[44] VAN DER MERWE, E.J. (2004). *Inflation targeting in South Africa*. South African Reserve Bank, Occasional Paper No. 19.

[45] VERONESI, P. (1999). Stock market overreactions to bad news in good times: A rational expectations equilibrium model. *The Review of Financials Studies*, 12(5): 975-1007.

[46] ZETTELMEYER, J. (2004). The impact of monetary policy on the exchange rate: Evidence from three small open economies. *Journal of Monetary Economics*, 51(3): 635-652.

APPENDIX A

Table A1: Monetary policy meetings and Bloomberg repo rate surprise measures

Date	Shock (act-med)*	Shock (act-mean)*	Uncertainty (high-low)*	Rate change	Expected direction
2003/06/12	Yes	-0.40	1.00	Yes	Yes
2003/08/14	No	0.09	0.50	Yes	Yes
2003/12/11	Yes	0.55	0.50	Yes	Yes
2004/02/26	No	0.11	0.50	No	-
2004/06/10	No	0.00	0.00	No	-
2004/12/09	No	0.10	0.50	Yes	-
2005/02/10	No	0.20	0.50	No	-
2005/04/14	Yes	-0.50	0.00	Yes	-
2005/08/11	No	0.04	0.50	No	-
2006/06/08	Yes	0.48	0.25	Yes	-
2006/10/12	No	-0.08	0.50	Yes	Yes
2007/02/15	No	-0.17	0.50	No	-
2007/06/07	No	0.10	0.50	Yes	Yes
2008/01/31	No	-0.07	0.50	No	-
2008/12/11	No	-0.16	0.50	Yes	Yes
2009/02/05	No	-0.18	0.50	Yes	Yes
2009/03/24	No	0.00	0.00	Yes	Yes
2009/04/30	No	-0.02	0.50	Yes	Yes
2009/05/28	No	-0.17	0.50	Yes	Yes
2009/06/25	Yes	0.44	0.50	No	-
2009/08/13	Yes	-0.44	0.50	Yes	-
2009/09/22	No	0.06	0.50	No	-
2009/10/22	No	0.05	0.50	No	-
2009/11/17	No	0.04	0.50	No	-
2010/01/26	No	0.05	0.50	No	-
2010/03/25	Yes	-0.46	0.50	Yes	-
2010/05/13	No	0.02	0.50	No	-
2010/07/22	No	0.15	0.50	No	-
2010/09/09	No	-0.06	0.50	Yes	Yes
2010/11/18	No	-0.11	0.50	Yes	Yes
2011/01/20	No	0.02	0.50	No	-
2011/03/24	No	0.00	0.00	No	-
2011/05/12	No	0.00	0.00	No	-
2011/07/21	No	0.00	0.00	No	-
2011/09/22	No	0.03	0.50	No	-
2011/11/10	No	0.09	0.50	No	-
2012/01/19	No	0.00	0.00	No	-
2012/03/29	No	0.00	0.00	No	-
2012/05/24	No	0.00	0.00	No	-
2012/07/19	Yes	-0.44	0.50	Yes	-
2012/09/20	Yes	0.03	0.50	No	-
2012/11/22	No	0.00	0.00	No	-
2013/01/24	No	0.00	0.00	No	-

*Act – actual repo rate announced
Med – market survey consensus median forecast
Mean – market survey consensus mean forecast
High – market survey highest forecast;
Low – market survey lowest forecast.

Table A2: Statistical properties of exchange rate returns and repo rate surprises*

	Min.	Max.	Mean	Med	Std. Dev.	Skew.	Kurt.	JB (*prob*)	Q_{LB} (20)	ADF stat.	PP stat.	KPSS stat.
*5-minute returns (16 minutes to 21 minutes after lifting of scheduled embargo)***												
Returns	-0.79	0.27	-0.10	-0.05	0.23	-0.87	3.45	5.81 (0.06)	-	-6.00	-6.00	0.17
Surprises	-0.50	0.50	-.02	0.000	0.22	-0.26	5.32	10.1 (0.01)	-	-7.70	-8.52	024
Residuals***	-2.84	1.540	-.01	0.24	1.01	-0.82	3.02	4.85 (0.09)	19.47 (0.49)	-	-	-
*20-minute returns (16 minutes to 36 minutes after lifting of scheduled embargo)***												
Returns	-1.98	1.02	-0.11	-0.10	0.53	-0.81	5.49	15.80 (0.00)	-	-7.29	-7.29	0.13
Surprises	-0.50	0.50	-.02	0.000	0.22	-0.26	5.32	10.1 (0.01)	-	-7.70	-8.52	0.24
Residuals***	-2.09	2.28	-0.02	0.05	0.97	0.02	3.02	0.00 (0.99)	11.97 (0.92)	-	-	-

* Returns are the approximate percentage changes calculated by the differences in the logarithms of the foreign exchange mid-rates. Interest rate shocks are measured in percentage points.

** This window period opens around the average time that the repo rate announcement is made; explained in section 5.

*** GARCH mean equation standardised residuals.

The 1%, 5% and 10% asymptotic critical values for both the augmented Dickey-Fuller (DF) (based on the modified Akaike information criterion with a maximum lag of 13) and Phillips-Perron (PP) nonstationarity tests with drift and no trend are: -3.59, -2.93 and -2.61, respectively. Both test hypotheses are H_0: unit root (nonstationary), H_1: no unit root (stationary).

The 1%, 5% and 10% asymptotic critical values for the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test with drift and no trend are 0.739, 0.463 and 0.347, respectively. The KPSS test hypotheses are the converse; that is, H_0: no unit root (stationary), H_1: unit root (nonstationary).

Table A3: Returns and conditional volatility regression estimates (70-minute window period)*

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	-0.1314	0.0464		-0.0461	0.0326		-0.5682	-0.0892		-1.3207	0.5185		-1.7300	0.3444
-10	(0.1210)	(0.0284)	5	(0.1022)	(0.0050)	19	(0.2341)	(0.0531)	33	(0.3496)	(0.2231)	47	(0.3967)	(0.1511)
	[0.2841]	[0.1029]		[0.6544]	[0.0000]		[0.0198]	[0.0930]		[0.0005]	[0.0201]		[0.0001]	[0.0226]
	-0.1134	0.0386		-0.0708	0.0229		-0.5728	-0.1415		-1.5768	0.5122		-1.7105	0.3557
-9	(0.1142)	(0.0370)	6	(0.1152)	(0.0369)	20	(0.2529)	(0.0322)	34	(0.3406)	(0.1380)	48	(0.3850)	(0.1361)
	[0.3267]	[0.2976]		[0.5423]	(0.5348)		[0.0290]	[0.0000]		[0.0000]	[0.0002]		[0.0001]	[0.0089]
	-0.1401	0.0331		-0.1253	0.0499		-0.5826	-0.1244		-1.5866	0.5289		-1.7871	0.2887
-8	(0.1035)	(0.0237)	7	(0.1304)	(0.0154)	21	(0.2602)	(0.0678)	35	(0.3560)	(0.1598)	49	(0.3884)	(0.1578)
	[0.1835]	[0.1625]		[0.3424]	[0.0012]		[0.0308]	[0.0663]		[0.0001]	[0.0009]		[0.0000]	[0.0674]
	-0.1026	0.0272		-0.0343	-0.0532		-0.6340	-0.6439		-1.6368	0.4602		-1.8292	0.3281
-7	(0.1100)	(0.0311)	8	(0.1434)	(0.0388)	22	(0.2737)	(0.3626)	36	(0.3846)	(0.2331)	50	(0.3867)	(0.1375)
	[0.3205]	[0.3811]		[0.8123]	[0.1707]		[0.0257]	[0.0757]		[0.0001]	[0.0483]		[0.0000]	[0.0170]
	-.0726	0.0270		-0.0581	0.0742		-0.7349	-0.1811		-1.6082	0.5236		-1.8353	0.2703
-6	(0.0924)	(0.0104)	9	(0.1499)	(0.0208)	23	(0.2783)	(0.1142)	37	(0.3966)	(0.1940)	51	(0.3774)	(0.1516)
	[0.4367]	[0.0090]		[0.7004]	[0.0004]		[0.0118]	[0.1128]		[0.0002]	[0.0070]		[0.0000]	[0.0744]
	-0.1096	0.0209		-0.0768	0.0660		-0.7238	-0.2031		-1.5828	0.6932		-1.7654	0.2422
-5	(0.0909)	(0.0052)	10	(0.1452)	(0.0315)	24	(0.2840)	(0.1554)	38	(0.4016)	(0.2448)	52	(0.3616)	(0.2900)
	[0.2347]	[0.0001]		[0.6000]	[0.0363]		[0.0148]	[0.1911]		[0.0003]	[0.0046]		[0.0000]	[0.4033]
	-0.1452	0.0027		-0.2132	-0.0802		-0.7243	-0.01181		-1.5719	0.4614		-1.7611	0.2452
-4	(0.0696)	(0.0064)	11	(0.1633)	(0.0476)	25	(0.2890)	(0.0507)	39	(0.3990)	(0.1266)	53	(0.3626)	(0.2407)
	[0.0433]	[0.6686]		[0.1991]	[0.0919]		[0.0164]	[0.0198]		[0.0003]	[0.0003]		[0.0000]	[0.3084]
	-0.0768	-0.0054		-0.1937)	-0.0961		-0.7551	-0.1258		-1.5757	0.4600		-1.7494	0.2900
-3	(0.0741)	(0.0059)	12	(0.1763)	(0.0821)	26	(0.2896)	(0.0655)	40	(0.4007)	(0.2251)	54	(0.3649)	(0.1576)
	[0.3060]	(0.3643)		[0.2785]	[0.2416]		[0.0128]	[0.0548]		[0.0003]	[0.0410]		[0.0000]	[0.0657]
	-0.0268	0.0026		-0.2289	-0.0742		-0.9240	-0.1129		-1.6864	0.4638		-1.7111	0.1094
-2	(0.0530)	(0.0066)	13	(0.1722)	(0.0686)	27	(0.3014)	(0.0703)	41	(0.4161)	(0.2718)	55	(0.3833)	(0.4203)
	[0.6158]	[0.6941]		[0.1914]	[0.2791]		[0.0039]	[0.1084]		[0.0002]	[0.0879]		[0.0001[	[0.7947]
	0.0007	0.0006		-0.1579	-0.0814		-0.8602	-0.1288		-1.6835	0.4440		-1.6775	0.0871
-1	(0.0511)	(0.0031)	14	(0.1665)	(0.0234)	28	(0.3175)	(0.0658)	42	(0.4230)	(0.3404)	56	(0.3757)	(0.3363)
	(0.9885)	[0.8377]		[0.3486]	[0.0005]		[0.0099]	[0.0502]		[0.0003]	[0.1921]		[0.0001]	[0.7955]
	0.0570	0.0045		-0.2248	-0.0913		-0.9084)	-0.1610		1.7000	0.5446		-1.6768	0.0297
1	(0.0470)	(0.0041)	15	(0.1755)	(0.0550)	29	(0.3276)	(0.0772)	43	(0.4335)	(0.1677)	57	(0.3799)	(0.4209)
	(0.2319)	[0.2737]		[0.2076]	[0.0967]		[0.0084]	[0.0370]		[0.0003]	[0.0012]		[0.0001]	[0.9437]
	0.0709	0.0095		-0.3274	-0.0905		-1.3294	0.3624		-1.6578	0.4860		-1.7180	0.0822
2	(0.0723)	(0.0056)	16	(0.1918)	(0.0951)	30	(0.3363)	(0.2598)	44	(0.4271)	(0.3030)	58	(0.3913)	(0.4574)
	(0.3326)	[0.0905]		[0.0956]	[0.3415]		[0.0003]	[0.1631]		[0.0004]	[0.1087]		[0.0001]	[0.8574]
	0.0402	0.0104		-0.3323	-0.1223		-1.3338	0.1265		-1.6560	0.4371		-1.6973	-0.0009
3	(0.0941)	(0.0124)	17	(0.2063)	(0.1019)	31	(0.3345)	(0.4143)	45	(0.4145)	(0.1583)	59	(0.3849)	(0.4476)
	(0.6717)	[0.3992]		[0.1151]	[0.2302]		(0.0003)	(0.7602)		[0.0003]	[0.0058]		[0.0001]	[0.9984]
	0.0431	-0.0241		-0.5334	-0.1308		-1.3984	0.4939		-1.7082	0.4057		-1.6311	-0.0416
4	(0.0988)	(0.0107)	18	(0.2098)	(0.0557)	32	(0.3486)	(0.1221)	46	(0.4018)	(0.1789)	60	(0.3864)	(0.4267)
	(0.6646)	[0.0248]		[0.0150]	[0.0190]		(0.0003)	(0.0001)		[0.0001]	[0.0234]		[0.0001]	[0.9223]

* The information in round parentheses is the standard errors.
The probability statistics are inserted in square parentheses.

Table A4: Impact of a 100-basis-point monetary policy surprise on returns

5-minute window periods			*20-minute window periods*		
Time interval*	θ_1	$\bar{R}^2$	**Time interval***	θ_1	$\bar{R}^2$
8m–13m	-0.0767 (0.1013) [0.4530]	0.01	8m–28m	-0.6917 (0.2754) [0.0161]	0.11
10m–15m	-0.1392 (0.1166) [0.2397]	0.01	10m–30m	-1.1945 (0.0276) [0.0000]	0.32
15m–20m	0.2219 (0.1834) [0.2331]	0.01	15m–35m	-1.2589 (0.3225) [0.0003]	0.25
16m–21m	-0.1243 (0.1663) [0.4591]	0.01	16m–36m	-1.0613 (0.3438) [0.0036]	0.19
18m–23m	-0.1947 (0.1355) [0.1585]	0.05	18m–38m	-0.8387 (0.3475) [0.0203]	0.12
20m–25m	-0.1077 (0.1005) [0.2903]	0.00	20m–40m	-0.8470 (0.3223) [0.0120]	0.12
22m–27m	-0.1455 (0.1125) [0.2032]	0.02	22m–42m	-0.8175 (0.3414) [0.0213]	0.10

The information in round parentheses is the standard errors.
The probability statistics are inserted in square parentheses.
* 'm' denotes minutes.

Table A5: Impact of a 100-basis-point monetary policy surprise on volatility

5-minute window periods					*20-minute window periods*				
Time interval*	δ_1	α	β	$\bar{R}^2$	**Time interval***	δ_1	α	β	$\bar{R}^2$
8m–13m	-0.0361 (0.0158) [0.0227]	-0.1170 (0.0773) [0.1301]	0.4593 (0.4604) [0.3184]	0.00	8m–28m	-0.0085 (0.2976) [0.9772]	-0.1614 (0.0980) [0.0988]	0.4686 (0.5420) [0.3873[	0.13
10m–15m	-0.0428 (0.0285) [0.1329]	0.0260 (0.0620) [0.6745]	0.6341 (0.2422) [0.0089]	0.00	10m–30m	-0.2679 (0.1141) [0.0189]	-0.1961 (0.1407) [0.1636]	0.9209 (0.2066) [0.0000]	0.32
15m–20m	0.0483 (0.1073) [0.6527]	-0.0915 (0.1528) [0.5493]	0.4801 (1.0012) [0.6316]	0.03	15m–35m	0.0687 (0.1648) [0.6768]	-0.1498 (0.0463) [0.0012]	1.0405 (0.0707) [0.0000]	0.27
16m–21m	0.0208 (0.0988) [0.8337]	-0.1105 (0.0001) [0.0000]	0.4452 (1.0410) [0.6689]	0.01	16m–36m	0.4169 (0.1382) [0.0026]	0.1568 (0.2808) [0.5766]	0.4405 (0.3707) [0.2347]	0.19
18m–23m	-0.0096 (0.0438) [0.8260]	-0.1028) (0.0588) [0.0805]	1.1267 (0.1733) [0.0000]		18m–38m	-0.1746 (0.0979) [0.0745]	0.1051 (0.1669) [0.5291]	0.7874 (0.1841) [0.0000]	0.12
20m–25m	-0.0.024 (0.0120) [0.3063]	-0.1675 (0.0462) [0.0003]	0.9662 (0.0473) [0.0000]	0.00	20m–40m	-0.0267 (0.1128) [0.8131]	0.2088 (0.3486) [0.5491]	0.6664 (0.2858) [0.0197]	0.14
22m–27m	0.0273 (0.0082) [0.0009]	0.5937 (0.2900) [0.0406]	-0.2636 (0.1700) [0.1210]	0.02	22m–42m	0.0340 (0.1483) [0.8189]	0.1855 (0.2292) [0.4182]	0.6795 (0.2339) [0.0037]	0.12

The information in round parentheses is the standard errors.
The probability statistics are inserted in square parentheses.
* 'm' denotes minutes

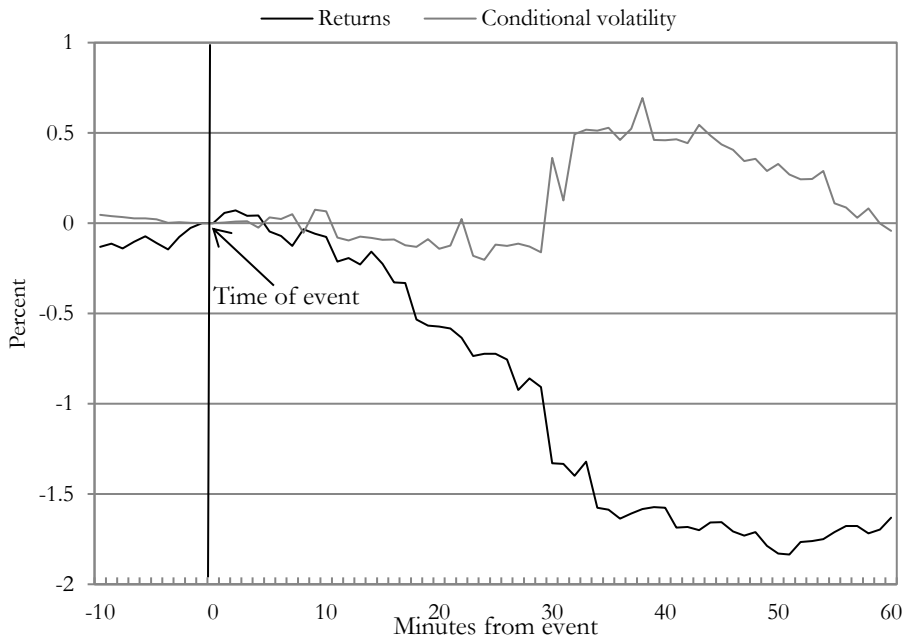
Table A6: Exchange rate response to expected and unexpected repo rate changes

20-minute window period (16m-36m)

Dependent variable	θ_1	θ_2	δ_1	δ_2	α	β	$\bar{R}^2$
Returns levels	-1.2639 (0.6088) [0.0444]	-0.2003 (0.4942) [0.6875]	- - -	- - -	- - -	- - -	0.1919
Returns conditional volatility	- - -	- - -	0.4353 (0.3989) [0.2751]	0.1538 (0.3269) [0.6380]	-0.1714 (0.2274) [0.4510]	0.4797 (0.2582) [0.0632]	0.1897

The information in round parentheses is the standard errors.
The probability statistics are inserted in square parentheses.

Figure A1: Rand response to a 100-basis-point repo rate surprise



APPENDIX B

Figure B1: Foreign exchange returns levels: Response to 100-basis-point repo rate shock

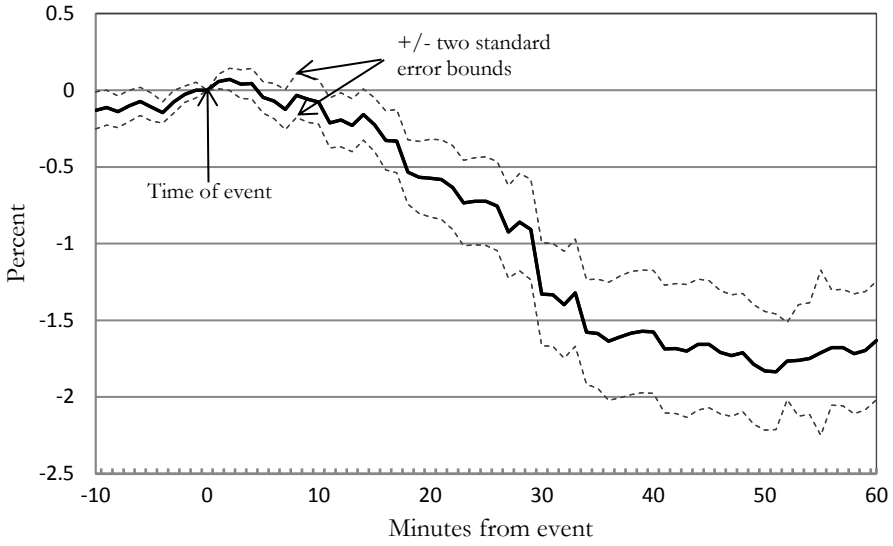
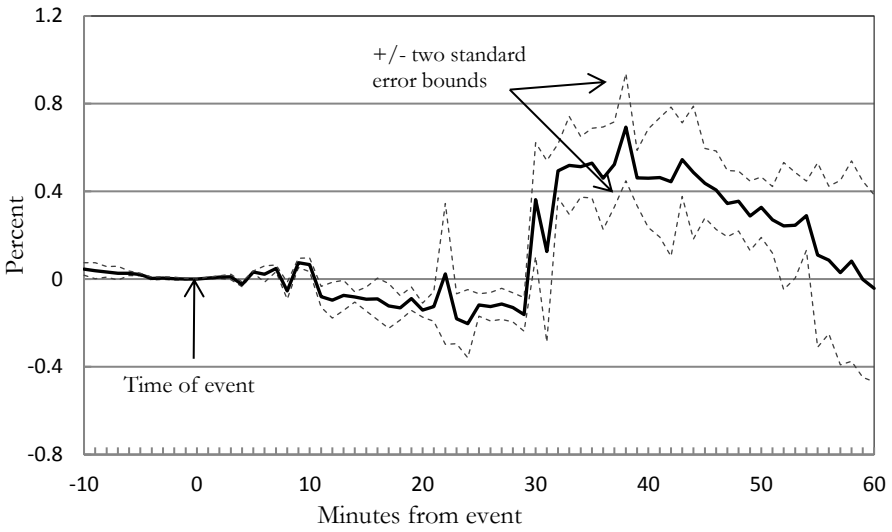


Figure B2: Foreign exchange returns conditional volatility: Response to 100-basis-point repo rate shock



APPENDIX C

Table C1: Repo rate scheduled embargo and decision announcement times

Scheduled MPC conference date and time	Repo rate pronouncement time after start of event
2009/06/25 - *15h00*	00h13m48s
2009/08/13 - *15h00*	00h12m10s
2009/09/22 - *15h00*	00h11m42s
2009/10/22 - *15h00*	00h11m23s
2009/11/17 - *15h00*	00h13m04s
2010/01/26 - *15h00*	00h08m32s
2010/03/25 - *15h00*	00h11m12s
2010/05/13 - *15h00*	00h14m14s
2010/07/22 - *15h00*	00h14m35s
2010/09/09 - *15h00*	00h16m35s
2010/11/18 - *15h00*	00h15m59s
2011/01/20 - *15h00*	00h16m38s
2011/03/24 - *15h00*	00h16m23s
2011/05/12 - *15h00*	00h14m10s
2011/07/21 - *15h00*	00h16m45s
2011/09/22 - *15h00*	00h18m06s
2011/11/10 - *15h00*	00h16m02s
2012/01/19 - *15h00*	00h17m54s
2012/03/29 - *15h00*	00h18m42s
2012/05/24 - *15h00*	00h16m40s
2012/07/19 - *15h00*	00h17m30s
2012/09/20 - *15h00*	00h19m17s
2012/11/22 - *15h00*	00h19m30s
2013/01/24 - *15h00*	00h19m13s
2013/03/20 - *12h00*	00h19m09s
2013/05/23 - *15h00*	00h17m51s
2013/07/18 - *15h00*	00h20m07s
2013/09/19 - *15h00*	00h20m18s
2013/11/21 - *15h00*	00h18m48s
2014/01/29 - *15h00*	00h19m55s
2014/03/27 - *15h00*	00h21m16s
Time range	00h08m32s – 00h21m16s
Average time to repo rate announcement	00h16m14s

APPENDIX D

D.1 Monetary policy frameworks and repo rate system in South Africa: An overview

Between 1960 and 1998, South Africa followed a number of monetary policy and complementary exchange rate frameworks. These included exchange-rate targeting, discretionary monetary policy, monetary-aggregate targeting and an eclectic approach. Ultimately, South Africa officially adopted inflation targeting in February 2000 after announcing its intentions to introduce the framework in August 1999; at the same time, a floating exchange rate mechanism with no SARB interventions intended to influence the exchange rate was also adopted where the central bank no longer targeted the exchange rate (Van der Merwe, 2004).[1] The primary objective of monetary policy in South Africa is to achieve and maintain price stability in the interest of sustainable and balanced economic development and growth. Under South Africa's inflation targeting regime, the Bank focuses on ensuring that inflation is in line with the government-set explicit year-on-year consumer price inflation target range of 3% to 6%; a relatively more flexible inflation targeting framework than a point target.[2] The SARB then adjusts the repo rate in an attempt to keep forecast inflation within this band; 'no changes' are made should the central bank be satisfied with its current policy stance. Since the adoption and subsequent introduction of inflation targeting and a fixed repo rate system, South Africa's repo rate is reviewed and set at MPC meetings. An MPC was constituted shortly before South Africa adopted the inflation-targeting framework, in line with the global trend, so that rate decisions are based on diverse view points from constituent members. The timetable for meetings is finalised and publicised before the beginning of each year, alleviating uncertainty

Table D1: South African Reserve Bank Monetary Policy Committee meetings

Years	Scheduled Meetings (per year)	Unscheduled Meetings (per year)
2000-2002	7-8	3
2003	5	1
2004-2008	2-3	0
2009	9	0
2010-2012	6	0

Source: South African Reserve Bank and Bloomberg

regarding the timing of possible rate changes. The Bank experimented with varying the number of scheduled yearly meetings since 2000, eventually settling at 6 scheduled MPC yearly meetings, commencing on a Tuesday followed by the MPC media conference at 15h00 two days later (Thursday), in recent years. An infrequent number of unscheduled meetings were held during the early phase of inflation targeting – a total of four such incidences between the years 2000 and 2003. For example, the unscheduled announcement and unexpected tightening on 15 January 2002 was prompted by significant upward inflationary expectations elicited by a plunge in the rand during the last quarter of 2001 following the terrorist attacks on the U.S. on 9 September 2001.

Monetary policy repo rate decisions are publicly announced shortly after the end of the SARB's MPC meeting. Although the overwhelming majority of repo rate decisions in South Africa since the adoption of inflation targeting framework have been on scheduled dates, there is no guarantee that

[1]South Africa had a floating exchange rate with central bank intervention applied during periods of rapid rand movement and escalated volatility; for example, during the 1998 Asian crisis. After 1998 when the SARB's fingers were burnt, it had less appetite and resources to intervene in the foreign exchange spot and forward markets. The net open forward position (NOFP) was eliminated during Governor Tito Mboweni's reign and the more flexible exchange rate adopted in 2000 entailed no central bank intervention in the foreign exchange market to influence the rand but to gradually accumulate foreign currency reserves, *albeit*, only when market conditions were conducive.

[2]Since the introduction of the more flexible inflation-targeting framework in February 2000, the specification of the target has been reviewed on a number of occasions. From an initial target of the CPIX (consumer price index excluding interest costs on mortgage bonds) in metropolitan and other urban areas, headline consumer price index (CPI) was targeted thereafter (commencing February 2009) owing to a change in the treatment of housing in the CPI when mortgage interest costs no longer had to be removed from the CPI when evaluating monetary policy.

each statement is released exactly at the pre-announced time; that is, it is not necessarily released on the stipulated embargo time. The Governor takes between 15 to 25 minutes to announce the MPC's rate decision after the commencement of the media conference – the timing of the announcement of each decision would depend on the actual commencement time of the written statement, the pace of the reading of each statement and the length of each statement.[3] This has been confirmed by viewing the last 22 available webcasts of the press conference on the Bank's website. However, for the most recent 31 webcasts, the announcement of the monetary policy stance on the repo rate takes places as early as around 8 minutes 32 seconds after the commencement of the conference to as late as 21 minutes 16 seconds after the beginning of statement delivery (Appendix C). So the difficulty here, unlike other macroeconomic releases, is that the actual time of the rate announcement is not invariant – posing a challenge for accurately identifying the initial response time of exchange rates to the surprise using the information at hand when high-frequency analysis is undertaken.

All in all, the data suggests progressively greater certainty about the timing of policy announcements and potential repo rate moves. Additionally, South Africa's simultaneous adoption of a more flexible exchange rate mechanism together with an inflation targeting framework and scheduled MPC meetings averts the endogeneity problem because adjustments in the exchange rate to repo rate shocks do not trigger immediate central bank alterations to the repo rate again to support the exchange rate.

Since the focus of this investigation is the exchange rate impact of repo rate shocks, a brief history of how the mechanics of the South Africa's repo system evolved is valuable in understanding how the SARB arrived at its present scheduled repo rate practice. The repo system was introduced in March 1998 before the formal adoption of inflation targeting in 2000. The repo rate – established under the repurchase tender system of the central bank – is the rate at which the SARB lends money to the banking sector to meet daily liquidity shortages. Liquidity here means commercial banks' credit balances with the central bank that are available to settle interbank transactions over and above the minimum statutory level of reserves that they are required to hold. To force commercial banks to borrow substantial amounts from the central bank and thus make the repo rate system effective, the Bank creates the required liquidity shortage (or drains excess liquidity) through open-market transactions using various instruments at its disposal. The Bank then refinances the liquidity shortage it created through repurchase agreement auctions – it purchases selected liquid bonds and other money market instruments from commercial banks in return for cash paying the central bank borrowing rate (repo rate) for the cash they receive. On maturity, commercial banks return the cash to the Bank in exchange for the securities they sold to the Bank at the auction thus reversing the initial transaction. In its early stages, daily liquidity was provided through repurchase agreements at a variable repo rate which was market determined – the objective was for the market to provide signals to the Bank about underlying liquidity conditions and an adjustment in the repo rate to reflect the changes in market liquidity.

Inefficiencies in mainly the interbank market caused a sub-optimal functioning of the system. The oligopoly-type structure of the banking sector caused less flexibility in the rate and markets not clearing effectively. Therefore, the initial repo rate system did not accurately reflect market conditions, occasionally resulting in unclear monetary policy signals. To improve the functioning of the system, the central bank made some modifications, including, amongst others, fixing the repo rate to eliminate ambiguity in the Bank's monetary policy signals and replacing the daily repo auctions with weekly ones with a seven-day maturity. By the time inflation-targeting was officially adopted, the Bank had already shifted from a variable to a fixed repo rate set by the Bank instead of the market.

[3] Note that the Governor usually briefly greets the guests and invites them to ask questions – but the questions may only be posed after she/he has delivered the prepared MPC statement. Also, note the commencement of the delivery of each formal MPC statement may start a bit later (or possibly a tad earlier) than scheduled for additional reasons to the one just mentioned. So a mismatching in the time of release of the MPC statements (relative to the scheduled time) leads to a mismatch in the actual repo rate pronouncement compared with the information in Appendix C.