Assessing the Dynamic Impact of Exchange Rate Innovations on South Africa's Non-resident Portfolio Investment

by

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Contents

1. Introduction

Following the lifting of South Africa's (SA's) financial and economic sanctions (imposed under the apartheid regime) the country has seen a significant increase in the level of foreign (non-resident) capital inflows. Unlike the experience of many emerging market economies, with similar levels of economic development and risk characteristics, SA's cross-border capital inflows have largely taken the form of bond and equity related portfolio investment (Ahmed, et al., 2005, p. 4). Coinciding with the period of rapid growth in non-resident investment, roughly beginning in the mid-1990s, the South African economy experienced a strong recovery in the rate of economic growth (Du Plessis & Smit, 2007). This growth recovery was assisted in no small part by the rapid increase in foreign exchange entering the country through the surge in non-resident portfolio inflows (Aron, et al., 2010, p. 5). These inflows provided sufficient financing to not only maintain a large and persistent current account deficit, but also allowed for a significant build-up in the country's foreign exchange reserves (Frankel & Smit, 2008, p. 650).

Given SA's reliance on cross-border portfolio inflows, surprisingly few studies have been undertaken to identify the underlying determinants of SA's non-resident portfolio investment. The existing empirical studies focusing on SA: namely Ahmed et al. (2005), Aron et al. (2010) and Wesso (2001), broadly follow the method employed by Taylor et al. (1997) in distinguishing between domestic (pull) and international (push) factors – both with a heavy emphasis on economic fundamentals. Bearing in mind that asset markets have shown to display large deviations from movements predicted by fundamental factors [1], this paper abstracts from these factors as determinants of short to medium-term drivers of non-resident portfolio investment. By abstracting from these factors, this paper attempts to explain the dynamics of non-resident portfolio investment using a simple risk-return driven portfolio rebalancing approach.

Unlike that of resident investors, the risk-return profile of a non-resident investment is determined by both domestic asset market and exchange rate considerations. As *will* be shown in section 4, exchange rate movements in recent decades have displayed volatility comparable to that of domestic bond and equity markets. This would suggest that exchange rate movements may play a significant role in determining the risk-return profile of non-resident investments undertaken in SA. Under the assumption that the risk-return profile is the primary driver of short to medium-term portfolio flows, intuition would suggest that exchange rate movements play a significant role in

[1] See for example Bernanke and Gertler (1999) and Summers (1986).

determining non-resident portfolio investment. Using this logic as a point of departure, this paper aims to assess the dynamic impact of exchange rate movements on non-resident portfolio investment in SA.

In order to gain a better understanding of the key features of SA's domestic asset markets, and its relative attractiveness as a foreign investment destination, section 2 briefly introduces these markets and discusses some of their important characteristics. Section 3 then moves on to describe the increase in the level of non-resident involvement in these markets since the democratic transition. Section 4 highlights the important role exchange rate movements play in determining the risk-return profile of non-resident investment. Section 5 explains the theoretical motivations of exchange-rate induced portfolio rebalancing put forth in the academic literature. Section 6 then takes stock of existing empirical findings on the effect of exchange rate movements on foreign portfolio flows into South Africa and similar emerging markets. Section 7 presents this paper's empirical findings from a number of vector autoregressive (VAR) models. Finally, section 8 concludes.

2 South African asset markets [2]

2.1 Equity market

Equity trading in SA largely takes place through the Johannesburg Stock Exchange (JSE). Since its establishment in the late 19th century the JSE has grown to one of the largest emerging market exchanges in the world. As of early 2013 the total market capitalisation relative to gross domestic product (GDP) stood at approximately 190%; making it the world's third most capitalised equity market relative to GDP (Hassan, 2013, p. 3). Several studies assessing the pricing efficiency, risk-return trade-off and the aggregate risk premium, found that the JSE displays characteristics similar to that of many advanced economies.[3] Partly due to these desirable characteristics, the JSE is generally viewed as an attractive foreign investment destination – reflected in its relatively large weighting in many emerging market indices (e.g. 8% of the Morgan Stanley Capital International (MSCI) Emerging Market Index).

2.2 Bond market

The secondary trading of bonds in SA predominately takes place through the JSE's Bond Exchange of South Africa (BESA). Collectively – although dominated by South African government bonds – the South African bond market is one of the largest amongst all emerging markets, reaching a total nominal value of approximately R1.9 trillion in early 2014.[4] Other than the large nominal value, the South African bond market has proven to be highly liquid with annual turnover one of the highest in

[2] This section is largely a summary of the description of SA's asset markets found in Hassan (2013).
[3] See Hassan (2013) and Hassan & Van Biljon (2010).
[4] See SARB (2014, p. 64).

the world.[5] Over the last two decades several factors; such as the establishment of sovereign credit rating in 1994 and the inclusion of South African government bonds in the Citi World Government Bond Index in 2012, have assisted in increasing the attractiveness of SA's bond market as a destination for foreign bond investment. As a result, non-resident activity in this market has increased sharply in recent years. As of 2012 the total non-resident holdings of South African government bonds accounted for over 30% of bond issuance – shown to be largely rand denominated (Hassan, 2013, pp. 6-7).

2.3 Derivative market

The trading of derivative instruments in SA is either conducted through over-the-counter (OTC) transactions or through several JSE affiliated exchanges. The exchange traded derivative market in SA as of 2010 was shown to rank amongst the twenty largest in the world, according to the number of contracts traded (Hassan, 2013, p. 12). As of 2013, estimates on the notional value of the South African OTC market suggested the total value stood at approximately R27 trillion, significantly larger than the value of exchange traded derivatives (Hassan, 2013, p. 13).

Recent estimates suggest the two largest OTC instruments in SA consist of interest rate and foreign exchange (forex) derivatives. The OTC turnover in rand denominated interest rate derivatives (largely consisting of forward rate agreements) was one of the largest amongst all emerging market economies (Hassan, 2013, p. 12). Although the notional value of interest rate derivatives was shown to be the largest of all domestic derivative instruments, the total daily turnover in OTC rand forex derivatives was estimated to be substantially larger than the daily turnover of rand denominated interest rate derivatives (Hassan, 2013, p. 14). Unlike interest rate derivatives, rand forex derivative trading is dominated by swap trades.[6]

2.4 Foreign exchange (forex) market

For SA's level of economic development, the country has shown to have a relatively large forex market. As of 2013 the average value of daily rand related forex trades totalled $60 billion; making it one of the top twenty heaviest traded currencies in the world, and larger than the total daily turnover of the domestic bond and equity market combined (Hassan, 2013, p. 8). The majority of these trades were shown to have taken place outside of SA, with only a third of trades taking place within SA.[7] These transactions were also shown to have been largely undertaken in terms of the US

[5] For example see Citi (2012).
[6] See SARB (2014, p. 47).
[7] See BIS (2014).

dollar as the counterparty currency, with a large proportion of transactions being undertaken by financial institutions.[8]

3. Non-resident portfolio investment

3.1 Capital controls and restrictions

At current levels, foreign involvement in the domestic bond and equity market represents a sizable proportion of total turnover and holdings. However, prior to 1994 SA attracted negligible levels of non-resident portfolio investment. This was largely a result of the financial sanctions and capital controls imposed under the apartheid regime. After SA's democratic transition many of the international financial sanctions were lifted, allowing SA to re-enter international capital markets. During this period many of SA's highly restrictive capital controls were progressively loosened, starting with the abolishment of the financial rand mechanism and the progressive removal of essentially all capital controls for foreign investors (Aron, et al., 2010, p. 3).

3.2 Equity investment

Following the reintegration of SA's equity markets in the mid to late 1990s the country saw a sharp increase in non-resident purchases of domestic equity. During this period there was a general concern that these flows, along with the net outflow of resident capital seen during this period, may compromise the stability of SA's exchange rate and balance of payment position. Attempting to address these concerns the South African authorities implemented a progressive asset swap program beginning in 1995.[9] This program allowed domestic institutional investors to swap assets with non-residents to increase diversification, while still maintaining external stability due to the conditional lock-in period imposed on swapped assets (Aron, et al., 2010, p. 8).

During the period from January 1995 to December 2007, with the exception of 2002, SA's domestic equity market experienced a fairly consistent period of net monthly purchases by non-residents (see figure 1). Over this entire period monthly net non-resident purchases averaged R2.4 billion with a standard deviation of R3.4 billion.[10] With the onset of the international financial crisis the domestic equity market experienced several periods of large net sales by non-residents. Since the crisis net non-resident purchases have increased in volatility with periods of large net sales increasing in frequency (see figure 1). Since 2008 the average monthly net non-resident purchases declined to

[8] An assessment of the BIS (2014) Triennial Central Bank Survey notes that rand related foreign exchange transactions in 2013 involving financial institutions accounted for approximately 55% of spot, 61% of outright forward, 47% of swaps and roughly 35% of total option transactions.

[9] For a detailed discussion on SA's asset swap program see Vittas (2003).

[10] During this period Aron et al. (2010, p. 9) found that the typical non-resident investor would hold domestic equity, on average, for approximately twelve months. This was noted as a somewhat surprising result as equity flows into emerging markets are generally viewed as short termed and highly volatile in nature.

approximately R680 million, with the standard deviation increasing considerably to R6.5 billion. Despite the large net sales experienced during the post-crisis period, estimates on the total holdings of domestic equity by non-residents, as of 2012, was shown to be a non-negligible 15% of total JSE listed equity (Hassan, 2013, p. 6).

Figure 1

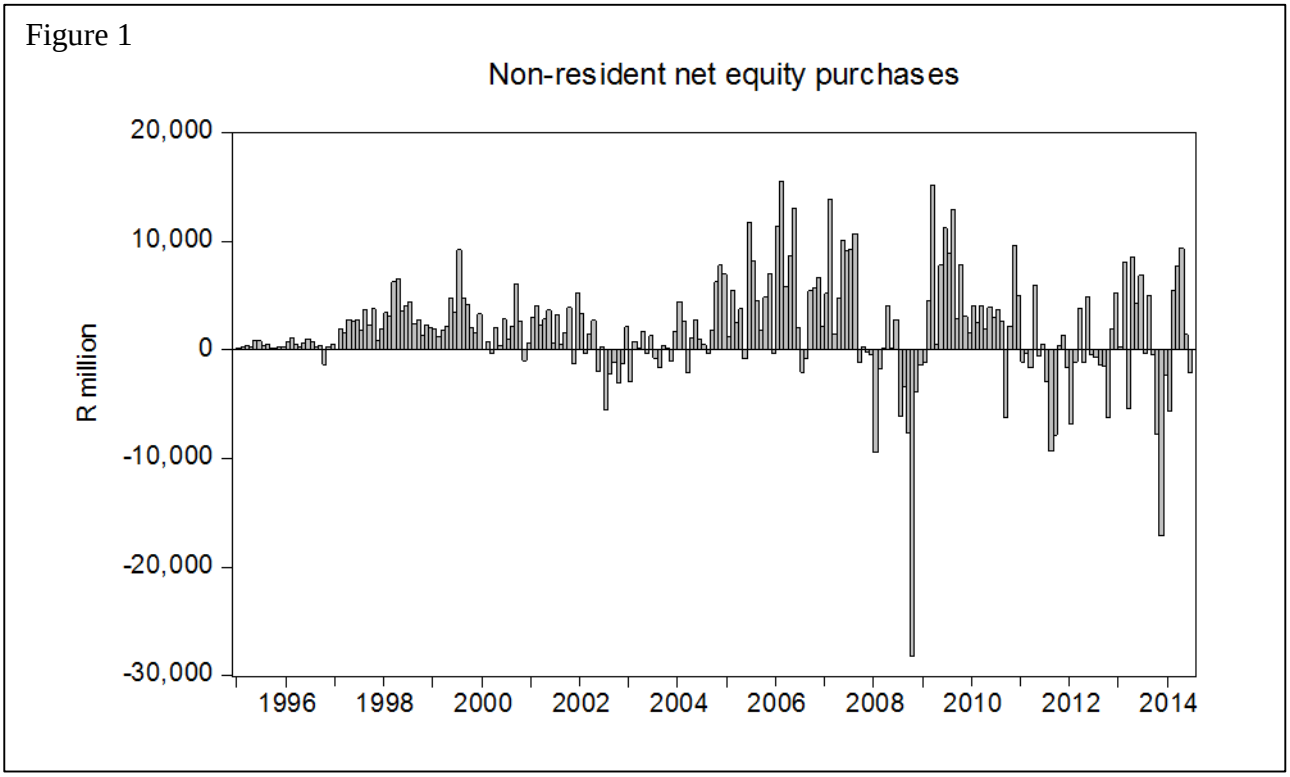

Figure 1: Monthly net non-resident purchases of South African (JSE) equity. Data Source: SARB *Quarterly Bulletin* (RBQ-R2050M_RT204).

3.3 Bond investment

Contrary to the trend in the domestic equity market, between January 2000 and December 2008 the domestic bond market did not see a sustained period of net non-resident purchases (see figure 2). In fact, during this period the domestic bond market experienced an average monthly net non-resident sale of approximately R267 million with a monthly standard deviation of R5.44 billion. Reflecting the high standard deviation during this period, non-resident bond investors were shown to engage in high frequency trading, holding domestic bonds for approximately one month (Aron, et al., 2010, p. 10). Subsequently, beginning roughly in early 2009, there was a fundamental shift in the trend of non-resident bond investment. Between 2009 and mid-2014 average monthly net purchases increased substantially to nearly R2.95 billion with a standard deviation of R9.08 billion. As a result, total non-resident bond holdings increased sharply, reaching 30% of the total value of South African government bonds in 2012 (Hassan, 2013, p. 6).

Figure 2

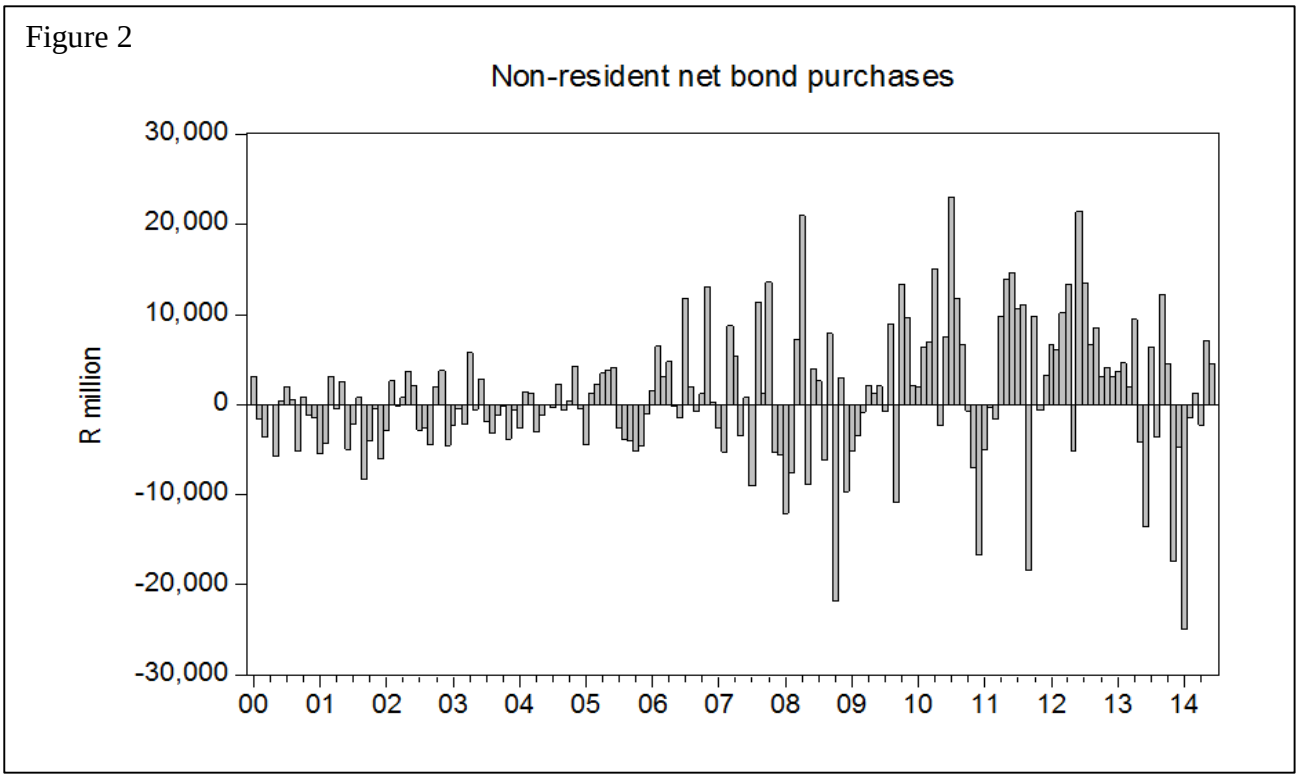

Figure 2: Monthly net non-resident outright purchases of South African domestic bonds. Data Source; SARB *Quarterly Bulletin* (RBQ-R2563M_RT204)

3.4 Forex and exchange rate derivative market activity

Shown in Figure 3 are non-resident transactions in the South African forex market. The most notable feature of these transactions is the sheer size of swaps relative to spot and forward transactions.[11] Reaching a peak of nearly $12 billion a day in 2011, swap transactions alone were found to be larger than the non-resident daily turnover in the domestic bond and equity market combined.

[11] Option transactions are not shown due to their relatively negligible size.

Figure 3

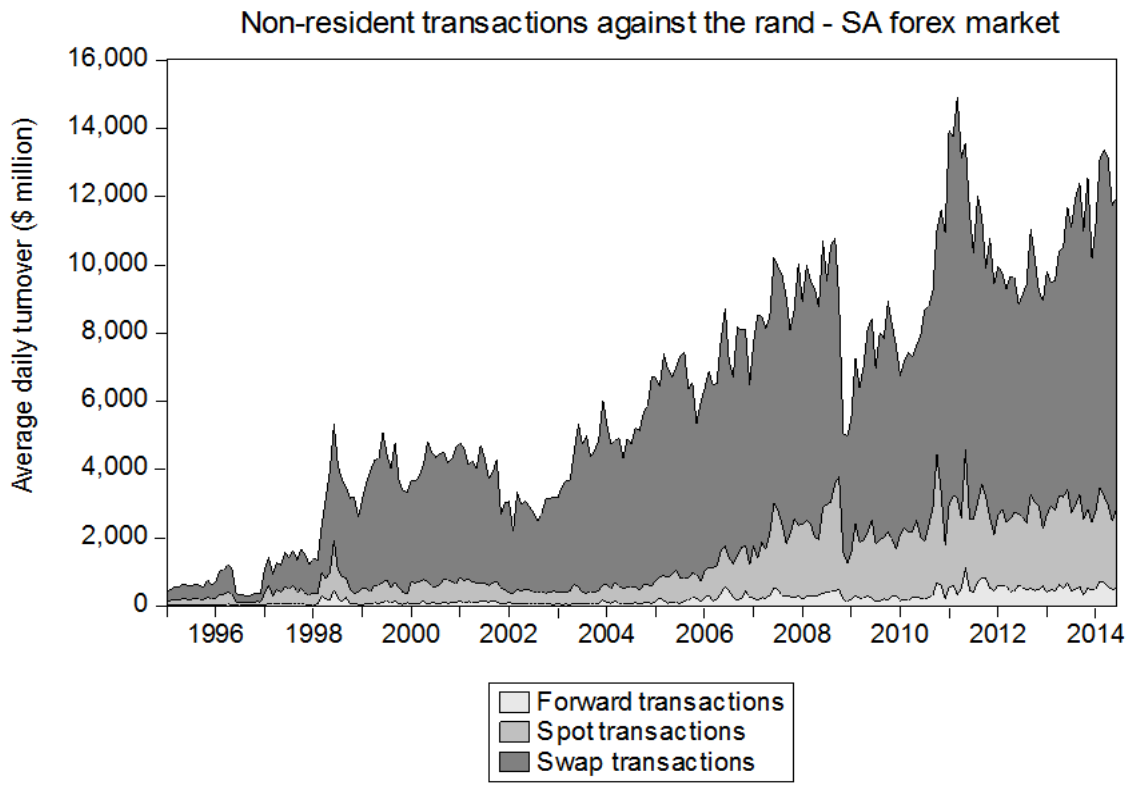

Figure 3: Average daily non-resident transactions against the rand in the South African forex market. Data Source; SARB *Quarterly Bulletin* (RBQ-R5456M_RT526, RBQ-R5452M_RT526 and RBQ-R5460M_RT526)

4. Non-resident investment returns [12]

In previous sections SA's bond and equity markets were discussed, as well as the increasing non-resident investment in these markets since 1995. This section now turns to assess the year-on-year returns associated with these investments. To calculate these returns it is important to note that the total US dollar return (henceforth exchange rate adjusted (ERA) return) is determined by two components: 1) the domestic asset market (rand denominated) return and 2) exchange rate movements. Likewise, calculating the risk (i.e. standard deviation) of a non-resident investment is determined by three distinct components: 1) domestic asset market risk, 2) exchange rate risk and 3) the covariance between domestic asset market and exchange rate movements.

Shown in equation 1 and 2 below are the calculations (using monthly data) for ERA returns associated with entirely unhedged and exchange rate hedged investments, respectively. As noted in section 3.4, the vast majority of non-resident forex transactions in SA are in the form of swap transactions. However, the return calculations of equation 1 and 2 are based on the assumption that

[12] Given that the United States (US) Dollar accounts for the majority of international financial transactions (see for example BIS (2014)), this paper will focus on the US dollar/rand exchange rate. It is therefore implicitly assumed that US dollar denominated risk and return is the primary driver of portfolio rebalancing.

exchange rate hedging is conducted using a twelve month forward exchange rate contract.[13] Although this method is undoubtedly flawed, imposing financial theory's standard arbitrage principle would suggest that the opportunity cost associated with hedging against exchange rate movement should be roughly equal across all hedging instruments.

Unhedged ERA return

$$R^{\$}_{j,t} = \left[R^{R}_{j,t} + log(\frac{\varepsilon^{\$R}_{t}}{\varepsilon^{\$R}_{t-12}}) \right] = R^{R}_{j,t} + ERR_t \qquad (1)$$

Hedged ERA return

$$\varphi R^{\$}_{j,t} = \left[R^{R}_{j,t} + log(\frac{F\varepsilon^{\$R}_{t-12}}{\varepsilon^{\$R}_{t-12}}) \right] = R^{R}_{j,t} + HC_{t-12} \qquad (2)$$

Where:

$R^{\$}_{j,t}$ denotes the unhedged ERA logarithmic return at period t from an investment made at t-12 in SA asset market j.

$\varphi R^{\$}_{j,t}$ denotes the hedged ERA logarithmic return at period t from an investment made at t-12 in SA asset market j.

$R^{R}_{j,t}$ denotes the rand denominated logarithmic return at period t from investment made at t-12, in SA asset market j

$\varepsilon^{\$R}_{t}$ & $\varepsilon^{\$R}_{t\text{-}12}$ denote the US dollar/rand exchange rate at period t and period t-12, respectively.

$F\varepsilon^{\$R}_{t\text{-}12}$ denotes the 12 month US dollar/rand forward exchange rate at t-12.

ERR_t denotes the logarithmic return of holding the rand from t-12 to t (henceforth exchange rate return (ERR)).

$HC_{t\text{-}12}$ denotes the realised "cost of hedging" from t-12 to t.[14]

4.1 Non-resident equity investment returns

In discussing non-resident equity investment, it is henceforth assumed that these investments are undertaken in the broad market index; namely the JSE All-Share Index (ALSI).[15] Under this assumption it may be possible to calculate the risk and return of a portfolio with all firm-specific risk fully eliminated through diversification. This assumption would *ipso facto* reduce the covariance of domestic asset and exchange rate returns (assuming all firms face different exchange rate exposure). By reducing this covariance it may be possible to alleviate some of the endogeneity issues of assessing the impact of exchange rate movements on non-resident equity holdings.

Over the sample period January 1995 to June 2014, JSE equity experienced an average year-on-year return of approximately 9.78% with a standard deviation of roughly 18.20% (see table 1). Comparing this with the unhedged and hedged ERA risk and return, shown in table 2, it becomes immediately apparent that exchange rate considerations play a significant role in both lowering average returns and increasing the level of risk. An unhedged equity investment by a non-resident

[13] This method was chosen due to the lack of reliable data detailing non-resident swap transactions.

[14] Note that the terms "hedging cost" and "cost of hedging" in this paper are loosely used to define the log difference in the forward and spot exchange rate in any given period.

[15] The FTSE/JSE ALSI is a market index designed to reflect the aggregate movement in JSE listed equity. For simplicity, the relatively negligible returns associated with dividend payments are ignored.

investor would deliver an average year-on-year return of 4.28% with a standard deviation of 25.98%. If the same investor chose to hedge their exchange rate position, they would have experienced an average year-on-year return of 4.01% with a standard deviation of 19.45%. These results would therefore suggest, on a risk adjusted return (i.e. mean/standard deviation ratio) basis, a hedged exchange rate position would have been the optimal decision, over the entire sample period, from the perspective of a non-resident investor.

Table 1: Summary statistics 1995:01 – 2014:06

	R^{R}_{jse}	ERR	HC	$R^{\$}_{jse}$	$\varphi R^{\$}_{jse}$
Mean	9.78	-5.51	-6.15	4.28	4.01
Std. Dev.	18.20	16.50	2.55	25.98	19.45
Mean/Std. Dev	0.5374	-	-	0.1647	0.2062
Jarque-Bera	61.8424	15.1974	16.3641	34.2754	50.7181
Probability	0.0000***	0.0005***	0.0003***	0.0000***	0.0000***

Table 1: Summary statistics of year-on-year equity and exchange rate returns. Data Source: SARB *Quarterly Bulletin*, author's own calculations. **** significance at 1%, ** significance at 5% and *significance at 10%*

Although table 1 provides a useful summary, these summary statistics may be hiding important trends and patterns in the data. In order to gain a better understanding of non-resident returns, figure 4 and 5 plot the change in unhedged and hedged ERA return over time. Two important features of these returns become apparent with a visual assessment of the figures. Firstly, as would be expected, the magnitude of fluctuations in unhedged ERA returns are consistently larger than that of hedged ERA returns. Secondly, the two ERA returns appear to display some degree of cyclicality.

Separating the returns associated with the domestic equity market and the exchange rate, figure 6 and 7 highlight several interesting features of the two components of total ERA return. Illustrated in figure 6, exchange rate returns display volatility comparable to domestic equity returns (also shown in table 1). It is also clear that the correlation of domestic equity and exchange rate returns appear to be time varying. From these results, exchange rate movements appear to be a vitally important consideration from the perspective of an unhedged non-resident investor. From the perspective of a hedged investor, figure 7 shows that the "cost" associated with a fully hedged exchange rate position is relatively stable. Over the sample period the hedging cost ranged between 2% and 14.2%, implying that if a non-resident chose to hedge away exchange rate risk they would be guaranteed a negative exchange rate return of between 2% to 14.2%.

Figure 4

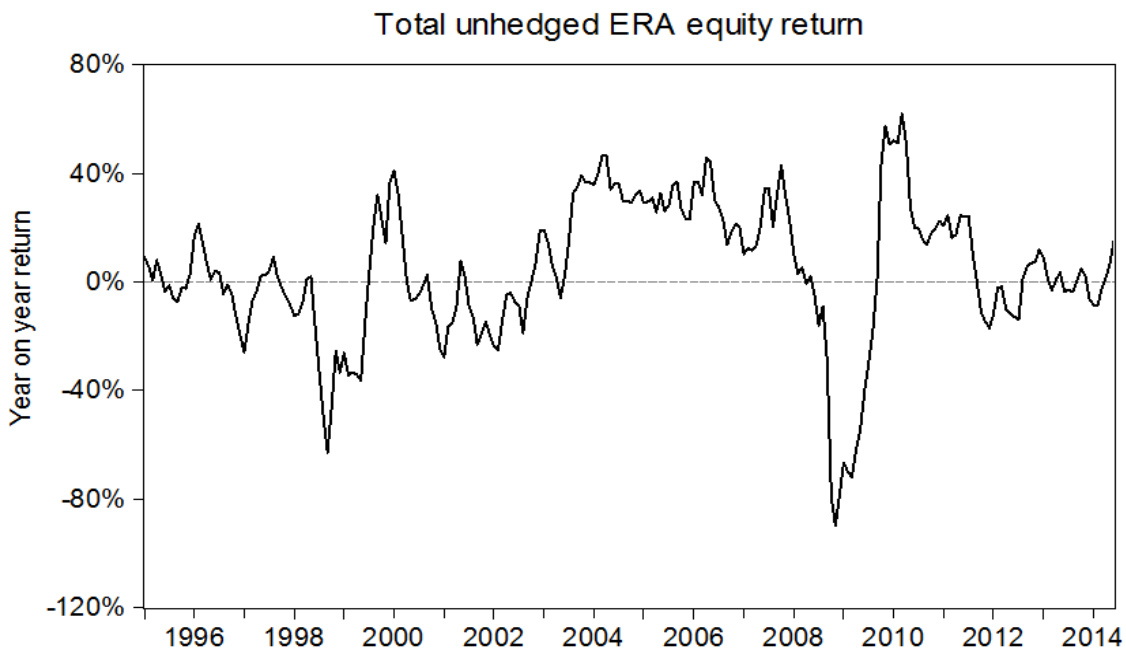

Figure 4: Total unhedged year-on-year logarithmic ERA equity return. Data Source: SARB *Quarterly Bulletin*, author's own calculations.

Figure 5

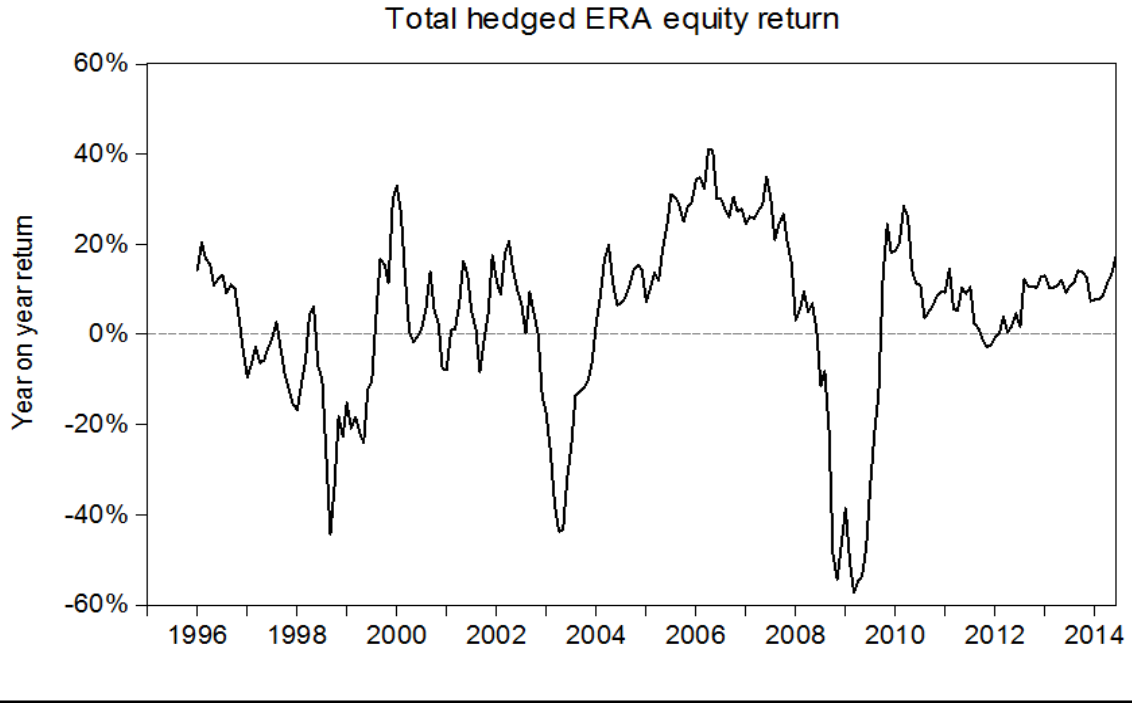

Figure 5: Total exchange rate hedged year-on-year logarithmic ERA equity return. Data Source: SARB *Quarterly Bulletin*, author's own calculations

Figure 6

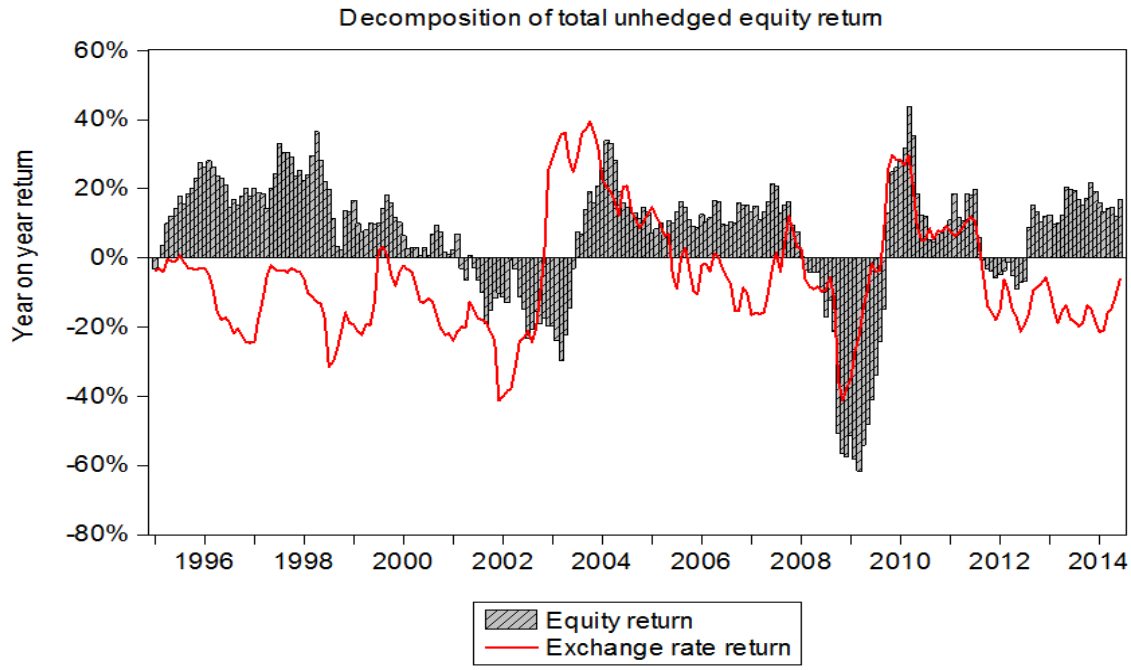

Figure 6: Decomposition of total unhedged year-on-year-logarithmic ERA equity return. Data Source: SARB Quarterly *Bulletin*, author's own calculations

Figure 7

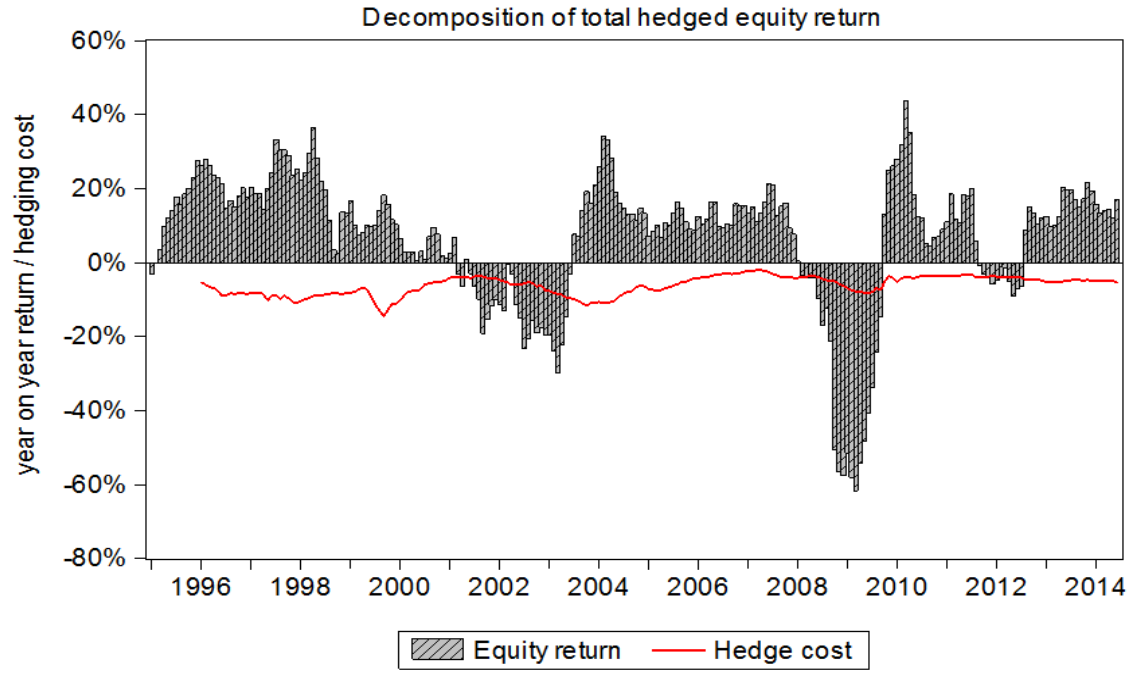

Figure 7: Decomposition of total exchange rate hedged year-on-year logarithmic ERA equity return. Data Source: SARB *Quarterly Bulletin*, author's own calculations

4.2 Non-resident bond investment returns

In section 2.2 it was noted that the South African bond market is dominated by the issuance and trading of SA government bonds. Therefore in discussing non-resident bond investment, it is assumed that investors choose to hold a portfolio of SA government bonds (i.e. an index which

assigns a fixed weighting to bonds with differing maturities). It was also noted that non-resident investors tend to hold domestic bonds for a relatively short period of time. Therefore, rather than calculating returns associated with coupon payments, returns are calculated as the year-on-year capital gains from actively trading bonds in the secondary market. For simplicity, the returns associated with coupon payments are ignored.

Considering non-resident investment in SA's bond market was nearly non-existent prior to 2000, the sample period was selected as January 2000 to June 2014. Over this period domestic bonds experienced an average year-on-year return of 11.28% (rand denominated) with a standard deviation of 6.70% (see table 2). Taking into account unhedged ERR a non-resident would have experienced an average ERA return of 7.62% with a standard deviation of 19.91%. Choosing to undertake a hedged exchange rate position the same investor would have achieved an average year-on-year return of roughly 5.90% with a standard deviation of 6.23%. As was the case for non-resident equity investors, a hedged exchange rate position would have been the optimal strategy on a risk adjusted basis over the entire sample period; from the perspective of a non-resident bond investor.

Table 2: Summary statistics 2000:01 – 2014:06

	R^{R}_{bonds}	ERR	HC	$\varphi R^{\$}_{bonds}$	$R^{\$}_{bonds}$
Mean	11.28	-3.65	-5.37	5.90	7.62
Std. Dev.	6.70	18.01	2.17	6.23	19.91
Mean/Std Dev.	1.68	-	-	0.94	0.38
Jarque-Bera	2.2868	5.9081	31.4046	4.8798	8.3834
Probability	0.3187	0.0521*	0.0000***	0.0872*	0.0151**

Table 2: Summary statistics of year-on-year bond and exchange rate returns. Data Source: SARB *Quarterly Bulletin*, author's own calculations. **** significance at 1%, ** significance at 5% and *significance at 10%*

Shown in figure 8 is the time-varying unhedged total ERA return for a non-resident bond investor. Illustrated in figure 10 is the unhedged ERA return decomposed into the domestic bond and ERR. Relative to non-resident equity investments (both hedged and unhedged), the unhedged ERA bond return displays considerably less downside variation (see figure 8).

Evaluating the total ERA bond returns in figure 8 and 9, it is clear that the unhedged ERA returns displays a high level of persistence (also seen in hedged ERA return albeit to a lesser extent). The volatility of ERA bond returns appears to be largely upside risk, with downside risk significantly lower relative to ERA equity returns. This is largely due to the gradual decline in South African bond yields over the sample period, guaranteeing investors consistent and sustained positive rand denominated bond returns (see figure 10 and 11).

Figure 8

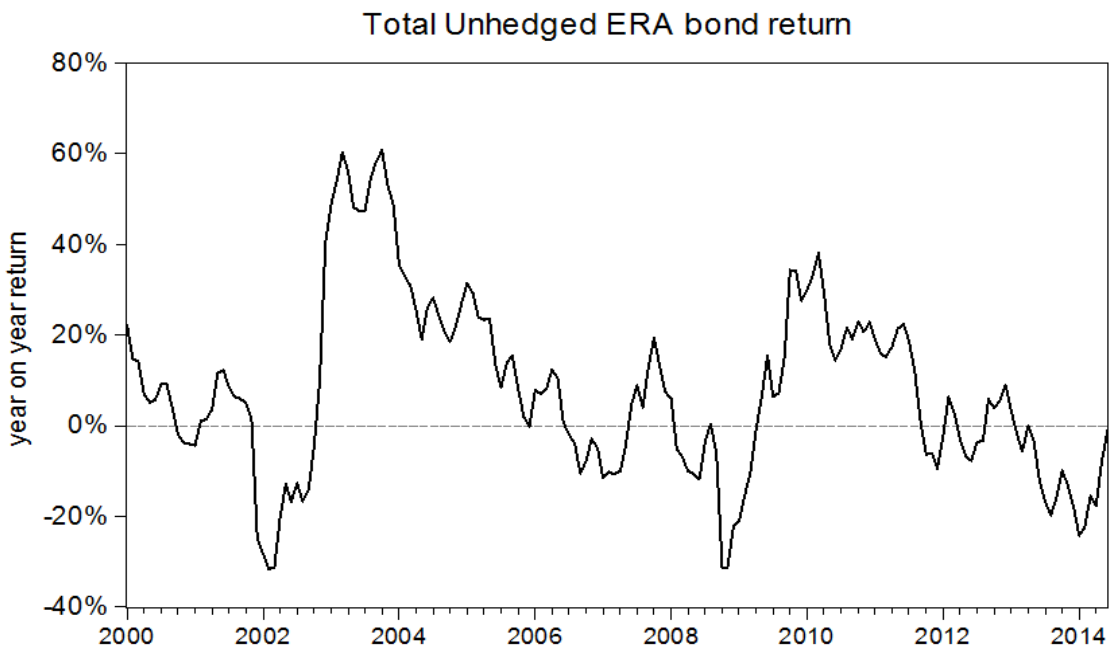

Figure 8: Total unhedged year-on-year logarithmic ERA bond return. Data Source: SARB *Quarterly Bulletin*, author's own calculations.

Figure 9

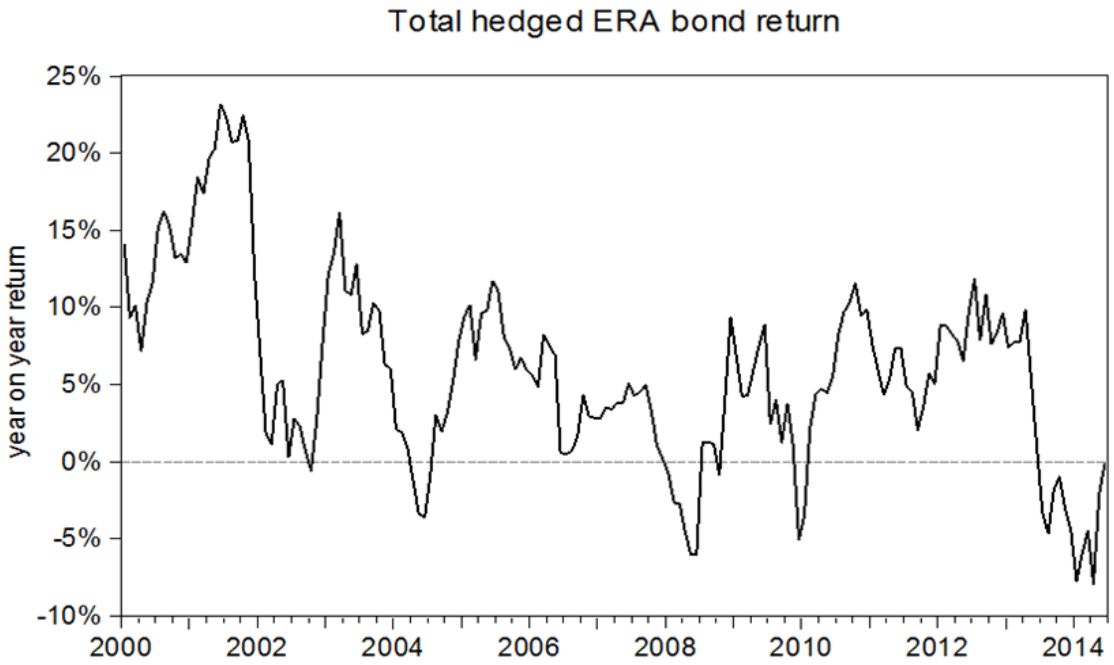

Figure 9: Total exchange rate hedged year-on-year logarithmic ERA bond return. Data Source: SARB *Quarterly Bulletin*, author's own calculations.

Figure 10

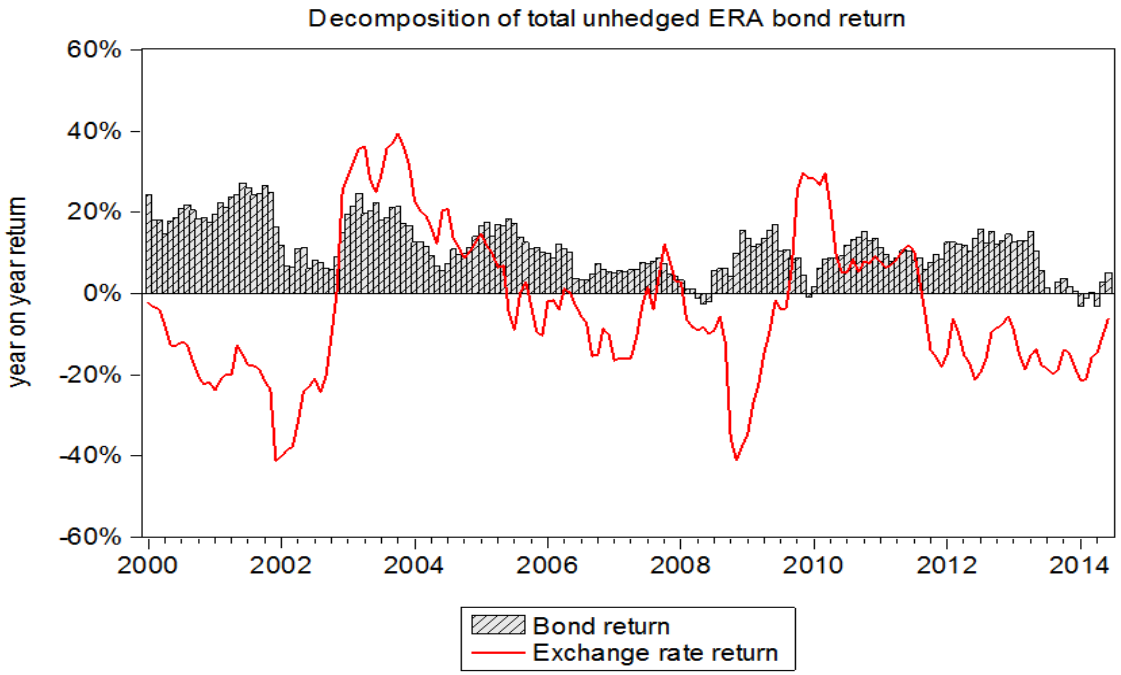

Figure 10: Decomposition of total unhedged year-on-year logarithmic ERA bond return. Data Source: SARB *Quarterly Bulletin*, author's own calculations.

Figure 11

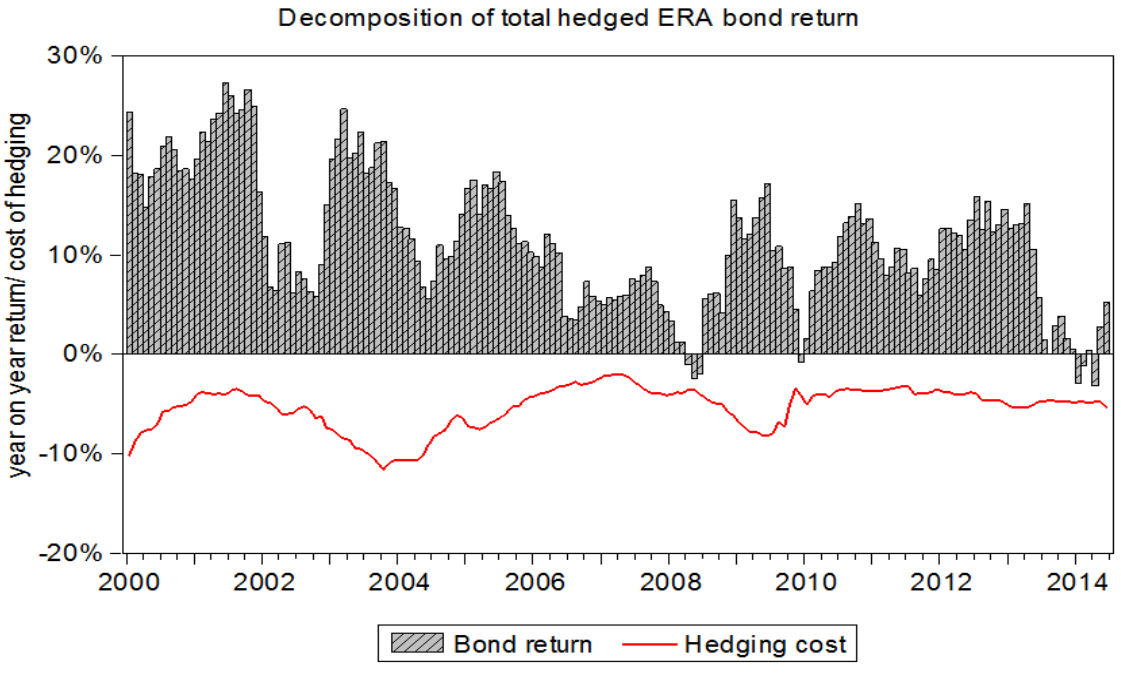

Figure 11: Decomposition of total exchange rate hedged year-on-year logarithmic ERA bond return. Data Source: SARB *Quarterly Bulletin*, author's own calculations.

5. Theoretical framework of exchange rate induced portfolio rebalancing

As noted by Ramcharan (2009), within efficient equity markets such as in SA (see section 2.1), the response of non-resident equity flows to domestic asset returns and exchange rate innovations is largely dependent on portfolio rebalancing considerations.[16] A comprehensive survey of the academic literature identifies three broad theories attempting to explain exchange rate induced the portfolio rebalancing: namely, the complete-hedging hypothesis, return-chasing hypothesis, and the relatively new formal theory of uncovered equity parity (UEP). Under these theories non-resident investors faced with exchange rate innovations will either ignore them, chase them or rebalance away from them. In this section these three theories will be briefly discussed.

5.1 Complete-hedging hypothesis

Highlighted at the beginning of section 4, non-resident investment risk is determined by three components: 1) domestic asset market risk 2) exchange rate risk and 3) the covariance between domestic asset market and exchange rate returns. By undertaking a hedged exchange rate position a non-resident investor is able to eliminate the exchange rate risk component (see Adler et al (1983)[17]). Assuming a non-resident investor holds a market portfolio which eliminates all firms-specific exchange rate exposure (through diversification), the covariance component of the total risk ought to be reduced to insignificant levels. Therefore the total risk of an exchange rate hedged non-resident, investing in the broad market index, should be determined solely by the domestic asset market risk component. Under these conditions, under what we shall call the "complete-hedging hypothesis", exchange rate innovations have no impact on the risk-return profile of existing non-resident domestic equity holdings. The complete-hedging hypothesis therefore suggests that past exchange rate movements should not induce portfolio rebalancing. However, it is important to note that even if the complete-hedging hypothesis holds, it does not necessarily imply that *subsequent* investment decisions, be it hedged or unhedged, are not impacted by past exchange rate movements. Volatile exchange rate movements in the recent past may cause an increase in the "cost of hedging" and thereby reduce the future expected hedged ERA return, *ceteris paribus*. Therefore a higher cost of hedging may discourage non-residents from investing additional capital in the domestic asset markets.

5.2 Return-chasing

In what is commonly referred to as return-chasing, investors are said to decide on their asset allocation depending on the performance of assets in the recent past (see Bohn et al (1996)). The

[16] Portfolio rebalancing is defined as the adjusting of portfolio asset weightings in response to changes in the risk-return profile of a portfolio's underlying assets.

[17] Adler et al (1983) discusses the methods available to international investors to hedge against exchange rate risk.

theory of return-chasing suggests that a strong performance in a particular asset market leads to an increase in net purchases in that particular market. Much of the theoretical work in the finance literature focuses on return-chasing in the context of resident investor's asset allocation in their domestic asset market, and therefore does not consider the effects of exchange rate returns.

A form of return-chasing heavily influenced by exchange rate movements is the carry trade strategy. The carry trade strategy involves purchasing high interest rate currencies (e.g. South African Rand) by borrowing in low interest rate currencies (e.g. US dollar). Once the carry trade has been undertaken, the high interest rate currency may be used to purchase assets in the high interest rate country.[18] The existence of carry trades suggests that investors should increase their allocations of assets in countries whose currency recently appreciated and are expected to continue appreciating (see amongst others Burnside et al. (2007), Burnside et al. (2010) and Brunnermeier et al. (2008)). Under the assumption that the initial currency proceeds are invested in bonds and/or equity in the high interest rate economy, both the domestic asset market and exchange rate returns are important from the perspective of a non-resident investor.

5.3 Uncovered equity parity (UEP)

Largely as a result of the work of Hau and Rey (2002), a new theory of portfolio rebalancing has emerged in the academic literature, namely the Uncovered Equity Parity (UEP).[19] Attempting to provide a theoretical framework explaining the dynamics of international portfolio rebalancing, Hau and Rey (2002) developed a micro founded theory of foreign portfolio rebalancing with endogenously determined equity and exchange rate returns. This theoretical framework provides a general equilibrium model to assess portfolio flows, equity returns and exchange rate movements.

The underlying assumption of UEP is that international investors are unable to perfectly hedge against exchange rate movements. As a result, portfolio rebalancing may be a vitally important risk management tool. Faced with a domestic currency appreciation (relative to the US dollar), a non-resident investor's ERA asset holdings in the domestic asset market will increase in dollar value. Assuming non-resident investors have an optimal currency exposure in mind, and are unable to perfectly hedge against exchange rate risk, a domestic currency appreciation may lead to a net sale of domestic equity by non-residents. This occurs as non-residents attempt to re-weight their portfolio in an effort to reduce exposure to exchange rate risk. The UEP therefore predicts that a strong performance in the domestic equity market and/or an appreciation of the domestic currency

[18] Although the carry trade is generally thought of as strategy involving currencies alone, Hassan and Smith (2011, p. 5) conjecture that a significant portion of fixed income flows into South Africa are due to the carry trade.

[19] For a comprehensive discussion on UEP see Cappiello & De Santis (2005, 2007), Curcuru, et al. (2011), Hau and Rey (2006) and Kim (2011).

will increase the perceived exchange rate risk faced by non-resident investors. The increased exchange rate risk exposure should therefore result in a net sale of assets by non-resident portfolio investors, until the desired level of risk exposure is once again achieved.

6. Literature review of empirical findings [20]

The theories put forth in section 5 allow for three possible portfolio rebalancing responses by non-resident investors faced with exchange rate innovations. This section aims to take stock of existing empirical findings relating to these theories.

6.1 Exchange rate hedging

Examining the aggregate data on foreign exchange transactions against the rand shows that rand related exchange rate derivative trading is an extraordinarily large market (see section 3.4). As of 2013 the average daily turnover of rand related exchange rate swaps and outright forwards by financial institutions amounted to $14,660 billion and $4,315 billion respectively (BIS, 2014). This suggests that a market allowing for non-resident portfolio investors to hedge and actively trade exchange rate risk exposure does indeed exist. However, without firm/investor level data it is impossible to determine the true extent of exchange rate hedging by non-resident investors.

After a comprehensive survey of the literature it became apparent that there is a severe lack of micro level research on the extent of exchange rate hedging by international investors in emerging markets. To the best of the author's knowledge only one such empirical study has been conducted postdating 1995. In a survey study by Levich et al. (1998) a large number of US institutional investors where sampled in an attempt to determine derivative use and risk management practices. Unfortunately, the scope of the sample was rather limited, focusing predominately on fiduciary asset managers; and excluding hedge funds and investment managers. The study found that of the institutional investors facing exchange rate risk exposure, 93% of the respondents were permitted to utilise derivatives to hedge against exchange rate risk. Of the investors permitted to utilise derivatives, on average, only 10% of the value of their foreign exchange exposure was hedged against exchange rate risk. Therefore, from this result alone, it appears that assuming complete exchange rate hedging appears to be a highly counterfactual benchmark.

6.2 Return-chasing

Using monthly data on equity portfolio flows and hedged ERA returns, Bohn and Tesar (1996) found that US equity purchases in emerging markets appeared to be largely driven by return-

[20] Although a relatively large literature exists on the long-run determinants of foreign investment in emerging markets, this section focuses on the empirical literature relating to the exchange rate induced portfolio rebalancing theories put forth in section 5. Due to the severe lack of empirical work this section will discuss findings relating to South Africa were possible, but will also draw on the rather limited findings relating to other emerging markets.

chasing motives. However, a close examination of the paper's empirical findings for SA suggests a negative correlation between portfolio flows and equity returns. The same results are seen in Griffin et al. (2004), who use high frequency data to assess the dynamics of foreign equity purchases in emerging markets. These findings for SA therefore contradict the return-chasing conclusion of the two paper's overall findings for emerging markets, and suggest positive domestic returns are associated with a net sale of non-resident portfolio holdings.[21]

Using a VAR model to assess the dynamic relationship between JSE returns and foreign equity flows, French (2011) finds a "strong" positive relationship between the two variables. These findings provide evidence in favour of the return-chasing hypothesis. However, French's (2011) methodology fails to account for movements in the exchange rate and the varying cost of exchange rate hedging. Therefore, the results may be biased and possibly misspecify the underlying dynamics.

In a case study conducted by Kim and Wei (2002), using data on Korea's non-resident investors before and after its 1997 currency crisis, several interesting behavioural dynamics of non-resident portfolio investors were highlighted. The study found that non-resident portfolio investors typically purchased Korean equity subsequent to a strong ERA equity returns. This suggests that, at least in the Korean equity market, non-resident investors display return-chasing behaviour.

In a study of six emerging Asian markets Chai-Anant and Ho (2008) attempts to explain the dynamic relationship between net foreign equity purchases, local equity market returns and exchange rate movements. The authors find that following an increase in local equity market returns, foreign investors undertake a net purchase of domestic equity. The study also found that exchange rate movements did not have a significant impact on net foreign equity purchases. These findings are consistent with a similar study of six emerging Asian markets conducted by Richard (2005).

6.3 Uncovered equity parity

Estimating several richly specified error correction models for the period 1994:Q1 to 2007:Q4, Aron et al (2010) consistently finds a significantly negative relationship between the year-on-year ERA JSE equity returns and SA's non-resident portfolio flows relative to GDP. This suggests that a strong JSE performance and/or and an appreciation of the rand (i.e. a positive exchange rate return),

[21] These findings for SA may be partly due to the political uncertainty, and associated capital flight, experienced during the time of the studies. In a study of 44 countries (including SA), Froot et al. (2001) found that, on average, foreign investors displayed the tendency to chase past returns. However, we are unable to discern whether the discrepancy in the findings for SA, seen in Bohn and Tesar (1996) and Griffin et al. (2004) exist in Froot et al (2001) due to the grouping of countries.

ceteris paribus, causes non-resident investors to rebalance their portfolios *away* from SA equity. These dynamics therefore provide evidence in favour the UEP holding in SA's equity market.

In a series of papers, Curcuru et al (2010, 2011, 2014) assess the response of US international investors to changes in foreign equity market returns and exchange rate movements. The authors find evidence that US investors do in fact move away from foreign equity markets which have recently performed well, but do not respond to past currency movements. They argue that foreign equity market conditions (from the perspective of a US investor) are the driving force behind portfolio rebalancing; rather than currency movements.

Using high frequency data, for the period 2005-2006, Gyntelberg et al (2014) assess the dynamic relationship between non-resident equity flows, exchange rate movements and local equity returns in Thailand. The study found that positive local equity market innovations were associated with a net sale of non-resident equity and a depreciation of the Thai Baht. The study also found no significant impact of exchange rate movements on non-resident equity investment.

7. Empirical analysis

In the previous sections it was clear that no theoretical or empirical consensus exists on how foreign investors respond to domestic exchange rate movements. Therefore in this section several simply econometric methods are employed in an attempt to gain a better understanding of the dynamics for South Africa.

7.1 Methodology

To assess the dynamic impact of exchange rate innovations on non-resident portfolio investment, several unrestricted vector autoregressive (VAR) models are estimated.[22] This class of model is appropriate due to the lack of any clear unidirectional impact of a particular variable included in the matrix X_t shown below, and as such no individual variable can be viewed as strictly exogenous.

The model can be stated as follows:

Let $X_t = \left(X_{1,t}\, X_{2,t}\, \ldots\, X_{n,t}\right)'$ denote a $k \times 1$ vector of time series variables. The vector autoregressive model of order q can be stated as:

$$X_t = c + \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \cdots + \Pi_q X_{t-q} + \Omega Z_t + u_t \qquad t=1,\ldots,T$$

Where c is a $k \times 1$ vector of constants, Π_i are $k \times k$ matrices of the endogenous variable coefficients, Ω is a $k \times n$ matrix of the exogenous variable coefficients, Z_t is a $n \times 1$ vector of

[22] Chai-Anant and Ho (2008), French (2011), Froot et al (2001), Griffin et al (2004), Hau and Rey (2004) and Richards (2005) all use a similar model in their assessment of foreign (non-resident) portfolio flows and investment returns.

exogenous variables and u_t is a $k \times 1$ unobservable white noise vector process with a zero mean vector.

The VAR models used in this study assume that no endogenous variable contemporaneously impacts other endogenous variables in the model. The assumption of no contemporaneous impact across endogenous variables allows for the use of Choleski decomposition. Using the Choleski decomposition procedure requires imposing a causal ordering of variables. As noted by Hau and Rey (2004, p. 126), due to the nature of portfolio flows and investment return variables, simply imposing a causal ordering is highly implausible and may result in a misspecified model. However, several studies using portfolio flow and return data found that the ordering of the variables did not significantly alter the results of the model (see French (2011), Bekarert et al (2002) and Dahlquist and Robertsson (2004)). Therefore, the ordering of variables in VAR models of this paper were chosen subjectively with recognition of established theoretical priors.

Prior to model estimation, all variables were tested for stationarity using the Augmented Dickey Fuller (ADF) unit root test. All variables included in the models were found to be stationary at a 5% level of significance. The lag selection criterion was based on the Akaike information criterion (AIC). After model specification and estimation, with the appropriate number of lags, the model's residuals were tested for autocorrelation (using the Portmanteau test), normality (using the Jarque-Bera statistic) and heteroskadasticity (using the White Test). Once the models passed the necessary residual checks, the models are used to conduct Granger-causality tests and impulse response analysis.

In the econometric analyses that follow, non-resident bond and equity investment are assessed independently. Separating portfolio investment into bond and equity investment may allow one to account for differing motives driving total portfolio investment. Rather than evaluating the impact of exchange rate innovations on these *flows*, this study aims to assess the impact on the total *stock* of non-resident bond and equity holdings. Initially the proxy for the total asset holdings was calculated as the cumulative net purchases of domestic assets since the 1980s. However, the cumulative non-resident net purchases of bond and equity result in large negative cumulative values for an extended period.[23] The ad hoc method used in this paper to overcome the problems

[23] The occurrence of significantly negative cumulative values for net non-resident bond and equity purchases, since the 1980s, remains an unresolved discrepancy in the data and cannot be explained by factors such as capital gains. After consultation with Nico Katzke (Department of Economics, University of Stellenbosch) and Michael Lamont (Department of Business Management, University of Stellenbosch) the discrepancy remains unresolved.

associated with calculating growth rates for negative values is to simply add a constant term in the cumulative value calculation; equal to the largest negative cumulative value.[24]

Initial tests for stationarity rejected stationarity for the growth in non-resident equity holdings (NREH) at a 5% level of significance. This was largely due to the rapid growth in NREH coinciding with the 1995–2001 asset swap period. Therefore to account for this period and achieve stationarity, the growth in NREH is regressed against a dummy variable for the asset swap period (with no constant included). The residual of the regression is redefined as the adjusted growth in NREH (denoted π_e*) and used in all subsequent equity models.

7.2 Data

The sample periods selected for the non-resident bond and equity models were largely selected to start coinciding with the period of reintegration and sustained growth of non-resident involvement in the respective asset markets. The sample period for the non-resident bond (NRB) models include data for the period 2000:01 to 2014:06. The sample period for non-resident equity (NRE) models includes data for the period 1995:01 to 2014:06. Selecting these sample periods provide a sufficiently large sample while avoiding the complexities of accounting for structural breaks in the data. All data used in subsequent models is monthly data extracted (using the *Easydata* database) from the *Quarterly Bulletin* of the South African Reserve Bank (SARB).

Using original data from the *Quarterly Bulleti*n (see table A.1 of appendix A), the following calculations were made to derive the variables used in subsequent models (see table A.2 of appendix A for a list of derived variables):

1. **Adjusted percentage change in total non-resident equity holdings $(\pi_{e,t}{}^{*})$**

Let $F(NPE_t)$ denote the cumulative non-resident net purchases of JSE listed equity at period t. The log year-on-year difference at period t is denoted as $\pi_{e,t}$. Regressing π_e on a dummy variable $D_{AS,t}$ for the 1995-2001 asset swap period we derive the residual term r. The residual term r is then redefined as the adjusted growth in total non-resident equity holdings and denoted as $\pi_{e,t}$*.

$$F(NPE_t) = \sum_{N=1}^{t} NPE_t + \min(NPE)$$
$$\pi_{e,t} = \log(F(NPE_t)) - \log(F(NPE_{t-12}))$$
$$\pi_{e,t} = \beta D_{AS,t} + r_t$$
$$r_t = \pi_{e,t}{}^{*}$$

[24] Although the method employed to overcome this data problem has several flaws, the method was shown to be the most tractable method with only minimal distortionary effects.

2. Percentage change in total non-resident bond holdings ($\pi_{b,t}$)

Let $F(NPB_t)$ denote the cumulative net non-residents outright purchases of South African listed bonds at period t. The log year-on-year difference in $F(NPB_t)$ at period t is denoted as $\pi_{b,t}$.

$$F(NPB_t) = \sum_{N=1}^{t} NPB_t + \min(NPB)$$

$$\pi_{b,t} = \log(F(NPB_t)) - \log(F(NPB_{t\text{-}12}))$$

3. Exchange rate return (ERR)

From the perspective of a non-resident investor, an appreciation of the rand relative to the US dollar is defined as a positive exchange rate return. Let the exchange rate return at period t be denoted ERR_t and calculated as the log year-on-year difference in the dollar/rand spot exchange rate.

$$ERR_t = \log\left(E_{\$/R}\right)_t - \log\left(E_{\$/R}\right)_{t\text{-}12}$$

4. Contemporaneous hedging cost (HC)

The contemporaneous hedging cost is defined as the log difference in the forward and spot exchange rate at period t. The contemporaneous hedging cost at period t is denoted as HC.

$$HC_t = \log(FE_{\$/R})_t - \log\left(E_{\$/R}\right)_t$$

5. SA and US equity returns ($R_{JSE,t}$ and $R_{NYSE,t}$)

The SA and US equity return is calculated as the log year-on-year difference in the JSE ALSI and NYSE composite index, respectively. Let $R_{JSE,t}$ and $R_{NYSE,t}$ denotes the log year-on-year return in the respective equity markets.

$$R_{JSE,t} = \log(JSE\ index)_t - \log(JSE\ index)_{t\text{-}12}$$

$$R_{NYSE,t} = \log(NYSE\ Index)_t - \log(NYSE\ Index)_{t\text{-}12}$$

6. SA bond index return ($R_{b,SA,t}$)

Capturing the return associated with capitals gains in the South African bond market, the log year on year difference in the SA government all-bond index at time t is denoted as $R_{b,SA,t}$.

$$R_{b,SA,t} = \log(BIX_{sa})_t - \log(BIX_{sa})_{t\text{-}12}$$

7.3 Findings

To evaluate the response of non-resident investors to exchange rate innovations, in each of the two subsequent sections (section 7.3.1 and 7.3.2) two separate models are estimated for non-resident bond and equity investment. Model 1 in each section evaluates the response of non-resident investors to past exchange rate movements by including the dollar/rand exchange rate as an endogenously determined variable in the VAR model. In model 2 of each section (estimated using

ordinary least squares (OLS) estimation[25]) the endogenously determined exchange rate is replaced by the exogenously determined contemporaneous hedging cost. By capturing changes in the contemporaneous cost of hedging it may be possible to determine whether changes in the guaranteed exchange rate return of hedged investors significantly influences changes in non-resident portfolio holdings.

For detailed specifications and regression outputs of all subsequent models refer to appendix B.

7.3.1 **Equity findings**

NRE model 1 (appendix B.1)

In table 3 below is the Granger Causality/Block Exogeneity Wald test for NRE model 1. The table indicates that movements in exchange rate returns do not Granger-cause changes in NREH at any conventional level of significance. However, there does appear to be some evidence that exchange rates and domestic equity returns *collectively* (i.e. total ERA return) Granger-cause changes in NREH.

Table 3: Summary of the NRE model 1 Granger Causality/Block Exogeneity Wald Tests

	Chi-sq	df	Prob.
Exchange rate return causes SA equity return	4.694163	4	0.3201
Change in NREH causes SA equity return	3.111409	4	0.5394
Exchange rate return and Change in NREH causes SA equity return	7.500403	8	0.4837
SA equity return causes Exchange rate return	3.358833	4	0.4997
Change in NREH causes Exchange rate return	2.305795	4	0.6797
SA equity return and Change in NREH causes Exchange rate return	5.703673	8	0.6804
SA equity return causes Change in NREH	13.59997	4	0.0087***
Exchange rate return causes Change in NREH	1.012519	4	0.9079
SA equity return and Exchange rate return causes Change in NREH	14.50800	8	0.0694*

Table 3: Summary of the NRE model 1 Granger Causality/Block Exogeneity Wald Tests. Note: the "returns" and "change" are all in terms of percentage. *** *significance at 1% ** significance at 5% and *significance at 10%*

Assessing the dynamic impact of exchange rate innovations, figure 12 shows the impulse response functions derived from NRE model 1. As suggested by the Granger-causality test, panel C of figure 12 shows that past exchange rate movements have essentially zero impact on NREH. From the results of the Granger-causality tests in table 3 and impulse response of panel C in figure 12 it does however appear that total ERA returns (i.e. SA equity return and ERR collectively) – although dominated by the domestic return component – significantly influences NREH (note the *negative*

[25] Model 1 in each section is estimated using a VAR model in order to understand the joint dynamics of exchange rates and non-resident portfolio holdings. With the exclusion of exchange rates, and under the assumption that the cost of hedging is determined exogenously, for the sake of simplicity model 2 is estimated using Ordinary Least Squares (OLS) estimation.

relationship). These dynamics are consistent with UEP findings of Aron, et al. (2010) for SA, and Gyntelberg, et al.'s (2014) findings for Thailand.

Figure12: Impulse response functions of the NRE model 1

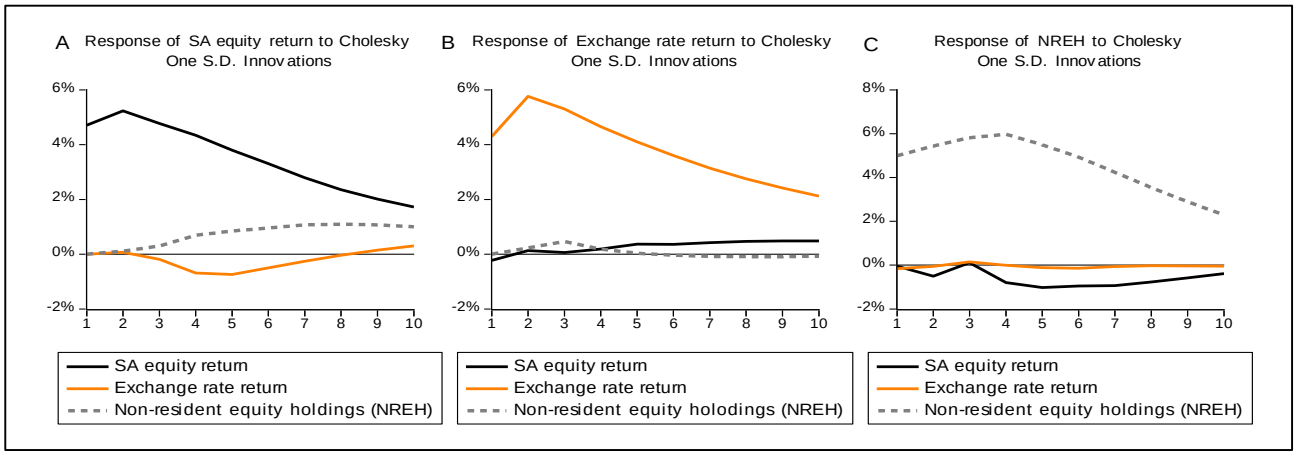

Figure 12: NRE model 1 impulse response functions. Note: all impulse responses stabilise at 0% after 16 months. The impulse responses in this figure are non-cumulative.

NRE Model 2 (appendix B.2)

The regression output of NRE model 2 suggests that the cost of hedging is not statistically significant at any conventional level of significance. The coefficient of the contemporaneous cost of hedging suggests that a 1 percentage point increase in the contemporaneous cost of hedging, on average, is associated with a decrease in the growth of NREH of approximately 0.101 percentage points, ceteris paribus. This result suggests that changes in the cost of hedging have no statistically significant impact on NREH.

7.3.2 Bond findings

In the theoretical and empirical literature discussed in sections 5 and 6, much of the literature focuses on portfolio rebalancing in the context of foreign equity investment. Given that non-resident bond investors in SA are shown to display trading behaviour typically associated with international equity investors (e.g. high frequency trading), it may be possible to explain the dynamics of non-resident bond investments using the equity centred portfolio rebalancing theories put forth in section 6.

NRB model 1(appendix B.3)

Using the first differenced growth and return variables (in order to account for the persistence and non-stationarity), table 4 shows the Granger Causality/Block Exogeneity Wald test for NRB model 1. The table shows that the first differenced change in exchange rate returns appears to Granger-cause the first differenced growth in non-resident bond holdings (NRBH) at a 10% level of significance.

Table 4: Summary of the NRB model 1 Granger Causality/Block Exogeneity Wald Tests

	Chi-sq	df	Prob.
1st dif. Change in NRBH causes 1st dif. Exchange rate return	2.824266	2	0.2436
1st dif. Exchange rate return cause 1st dif. Change in NRBH	5.271700	2	0.0717*

Table 4: Summary of the NRB model 1 Granger Causality/Block Exogeneity Wald Tests. Note: the "returns" and "change" are all in terms of percentage *** *significance at 1%, ** significance at 5% and *significance at 10%*

Shown in panel B of figure 14 is the impulse response of the first differenced growth in NRBH to a one standard deviation increase in the first differenced exchange rate return. The impulse response suggests that an increasingly appreciating rand causes an increase in the growth rate of net non-resident bond purchases. After three months the growth rate in NRBH starts to decline to the level prevailing prior to the exchange rate innovation. After 6 months the growth of NRBH stabilises at the growth rate experienced prior to the exchange rate innovation. This result, coupled with the positive coefficient on the first differenced return on SA government bonds (shown in the regression output of Appendix B: Table B.3.2) conforms to the theoretical predictions of the return-chasing hypothesis.

Figure 14: Impulse response function of the NRB model 1

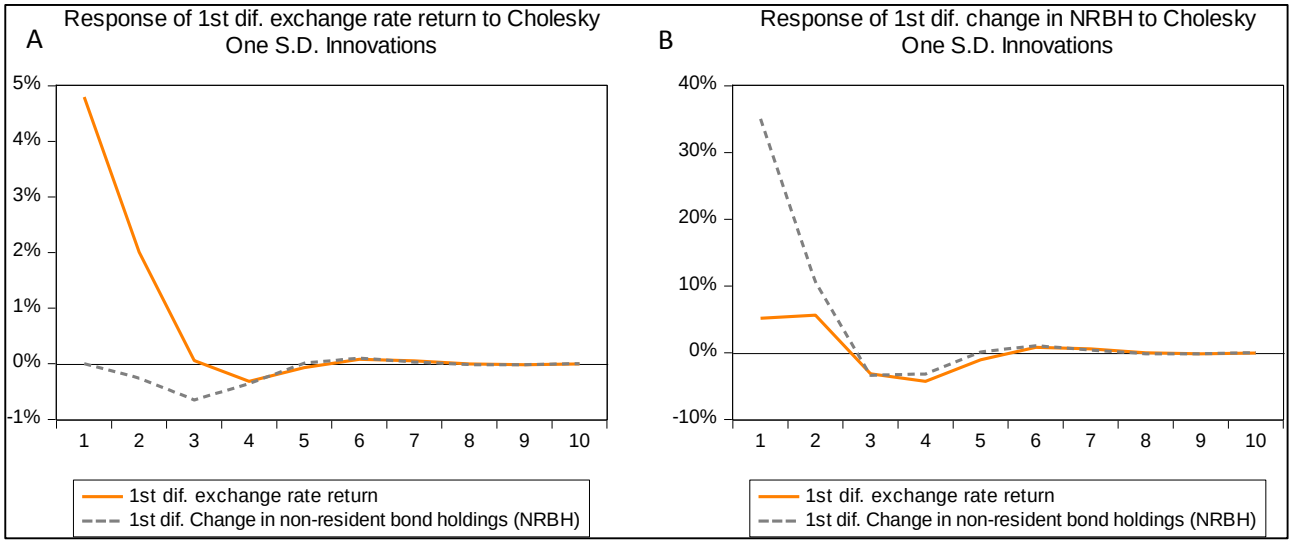

Figure 14: NRB model 1 impulse response functions. Note: The impulse responses in this figure are non-cumulative.

NRB model 2 (appendix B.4)

In estimating NRB model 2, it was found that the contemporaneous cost of hedging was not statistically significant at any conventional level of significance. The results of the model suggest that a 1 percentage point increase in the contemporaneous cost of hedging, on average, is associated with a relatively small decrease in the first difference growth of NRBH of approximately -0.2739 percentage points.

8. Conclusions

In briefly introducing SA's domestic bond and equity markets it was shown that these markets display characteristics typically associated with an attractive foreign investment destination. Since SA's democratic transition, the level of non-resident investment in these markets has increase substantially. Due to the nature of international investment, non-resident investors face exposure to both domestic asset market and exchange rate movements. As a result of the volatile nature of the rand over the past two decades, exchange rate movements have contributed significantly to SA's non-resident investors risk and return. Under the assumption that the risk-return profile is the primary driver of net purchases, several bond and equity models were estimated to assess whether the response of non-resident investors to exchange rate innovations conform to the theoretical predictions put forth in the academic literature.

In the two NRE models estimated, it was found that neither past exchange rate innovation nor changes in the cost of hedging have a significant impact on NREH. These results would therefore appear to provide partial support of the complete-hedging hypothesis. However, in assessing the impact of innovations in total ERA return, the dynamics appear to conform to the theoretical predictions of the UEP. In estimating the NRB models, it was found that non-resident investors do not appear to respond to changes in the cost of hedging; they do however appear to respond to innovations in past exchange rates. Following a positive innovation in the first differenced exchange rate return, non-resident investors were found to increase their NRBH in SA. Therefore, these dynamics are in line with theoretical predictions put forth by the return-chasing hypothesis.

Although the econometric methods employed are somewhat rudimentary, the findings of this paper may have several policy implications. For example, given the findings for non-resident bond investment, a sharp depreciation of the rand may be perpetuated by a net outflow of non-resident bond investment. Therefore the findings of this paper highlights the potential dangers of large foreign holdings of domestic bonds. However, considering the current levels of NRBH in SA, it is unlikely that a self-perpetuating currency crisis could arise from a cascading outflow of non-resident bond investment. Lastly, the findings of this paper are derived from a sample period spanning nearly 20 years and therefore may not reflect the current determinants of non-resident portfolio investment. This may be particularly true during the period of expansion, and current tapering, of the US Federal Reserve's quantitative easing (QE) programme initiated in 2008. Assessing the impact of QE on the dynamics assessed in this paper may be a promising area of future research.

References

Adler, M. & Dumas, B., 1983. International Portfolio Choice and Corporation Finance: A Synthesis. *Journal of Finance,* 38(3), pp. 925-984..

Ahmed, F., Arezki, R. & Funke, N., 2005. The Composition of Capital Flows: is South Africa different?. *IMF Working Paper WP/05/40.*

Aron, J., Leape, J. & Thomas, L., 2010. Foreign Portfolio Investment and Capital Markets in South Africa. *Unpublished working paper.*

Bekaert, G., Harvey, C. & Lumsdaine, R. L., 2002. The Dynamics of Emerging Market Equity Flows. *Journal of International Money and Finance,* 21(3), pp. 295-350.

Bernanke, B. & Gertler, M., 1999. Monetary Policy and Asset Price Volatility. *Economic Review,* 84(4), pp. 17-51.

BIS, 2014. Triennial Central Bank Survey. *Global foreign exchange market turnover in 2013,* February.

Bohn, H. & Tesar, L., 1996. U.S. Equity Investment in Foreign Markets: Portfolio Rebalancing or Return Chasing?. *The American Economic Review,* May , 86(2), pp. 77-81.

Brunnermeier, M. K., Nagel, S. & Pederson, L. H., 2008. Carry Trades and Currency Crashes. *J. Frankel and C. Pissarides (ed)* NBER International Seminar on Macroeconomics, pp. 314-347.

Burnside, C., Eichenbaum, M. & Rebelo, S., 2007. The Returns to Currency Speculation in Emerging Markets. *American Economic Review*, 97(2), pp. 333-338.

Burnside, C., Eichenbaum, M. & Rebelo, S., 2010. Carry Trade: The Gains of Diversification. *Journal of the European Economic Association,* Volume 6, pp. 581-588.

Cappiello, L. & De Santis, R., 2005. Explaining Exchange Rate Dynamics: The Uncovered Equity Return Parity Condition. *ECB Working Paper 529.*

Cappiello, L. & De Santis, R., 2007. The Uncovered Return Parity Condition. *ECB Working Paper 812.*

Chai-Anant, C. & Ho, C., 2008. Understanding Asian equity flows, market returns and exchange rates. *BIS Working Papers No 245,* January .

Citi, 2012. South Africa Fixed Income Market Guide. *Citi Markets: Rates and Currencies*.

Curcuru, S. E., Thomas, C. P., Warnock, F. E. & Wongswan, J., 2010. What Influences U.S. International Equity Investment: Equity or Currency Returns. *Draft,* December.

Curcuru, S. E., Thomas, C. P., Warnock, F. E. & Wongswan, J., 2011. U.S. International Equity Investment and Past and Prospective Returns. *International Finance Discussion Papers.*

Curcuru, S. E., Thomas, C. P., Warnock, F. E. & Wongswan, J., 2014. Uncovered Equity Parity and Rebalancing in International Portfolios. *International Finance Discussion Papers,* may.

Dahlquist, M. & Robertsson, G., 2004. A note on foreigners' trading and price effects across firms. *Journal of Banking and Finance,* Volume 28, pp. 615-632.

Du Plessis, S. & Smit, B., 2007. South Africa's Growth Revival After 1994. *Journal of African Economies,* 16(5), pp. 668-704.

Frankel, J. & Smit, B. S. F., 2008. South Africa: Macroeconomic challenges after a decade of success. *Economics of Transition,* Volume 16, pp. 639-677.

French, J. J., 2011. The Dynamic Interaction Between Foreign Equity Flows and Returns: Evidence From the Johannesburg Stock Exchange. *The International Journal of Business and Finance Research,* 5(4).

Froot, K. A., O'Connell, P. G. C. & Seasholes, M. S., 2001. The portfolio flows of international investors. *Journal of Financial Economics,* Volume 59, pp. 151-193.

Griffin, J. M., Nardari, F. & Stulz, R. M., 2004. Are daily cross-border equity flows pushed or pulled?. *Review of Economics and Statistics,* 86(3), pp. 643-657.

Gyntelberg, J., Loretan, M. & Subhanij, T., 2014. Exchange Rate Fluctuations and International Portfolio Rebalancing in Thailand. *Emerging market review ,* Volume 18, pp. 34-44.

Hassan, S., 2013. South African Capital Markets: An Overview. *South African Reserve Bank, Working Paper Series: WP/13/04.*

Hassan, S. & Smith, S., 2011. The Rand as a Carry Trade Target: Risk, Returns and Policy Implications. *Working Paper Number 235,* University of Cape Town.

Hassan, S. & Van Biljon, A., 2010. The equity premium and risk-free rate puzzles in a turbulent economy: evidence from 105 years of data from South Africa. *South African Journal of Economics,* March.78(1).

Hau, H. & Rey, H., 2004. Can Portfolio Rebalancing Explain the Dynamics of Equity Returns, Equity Flows, and Exchange Rates?. *The American Economic Review,* 94(2), pp. 126-133.

Hau, H. & Rey, H., 2006. Exchange Rate, Equity Prices, and Capital Flows. *Review of Financial Studies,* Volume 19, pp. 273-317.

Hau, H. & Rey, H., 2008. Global Portfolio Rebalancing Under the Microscope. *NBER Working Paper Series, Working paper 14165.*

Kim, H., 2011. The risk adjusted uncovered equity parity. *Journal of International Money and Finance,* 30(7), pp. 1491-1505.

Kim, W. & Wei, S., 2002. Foreign portfolio investors before and during a crisis. *Journal of International Economics,* Volume 56, pp. 77-96.

Levich, R. M., Hayt, G. S. & Ripston, B. A., 1998. 1998 Survey of Derivative and Risk Management Practices by U.S. Institutional Investors.: Survey conducted by the NYU Salomon Center.

Ramcharan, R., 2009. The Impact of Monetary Policy Shocks on Capital Flows in South Africa. In: *IMF Country Report No. 09/276; South Africa: Selected Issues.* s.l.:International Monetary Fund, pp. 22-40.

Richards, A., 2005. Big fish in small ponds: The trading behaviour and price impact of foreign investors in Asian emerging equity markets. *Journal of Financial and Quantitative Analysis,* March.40(1).

Rizeanu, S. & Zhang, H., 2013. Exchange Rates and Portfolio Rebalancing: Evidence from Emerging Economies. *International Journal of Economics and Finance,* 5(2), pp. 15-27.

SARB, 2014. Quarterly Bulletin, March 2014.

Summers, L., 1986. Does the Stock Market Rationally Reflect Fundamental Values?. *The Journal of Finance,* 41(3), p. 591–601.

Taylor, M. P. & Sarno, L., 1997. Capital Flows to Developing Countries: Long- and Short-Term Determinants. *The World Bank Economic Review,* September, 11(3), pp. 451-470.

Vittas, D., 2003. The Use of "Asset Swaps" by Institutional Investors in South Africa. *World Bank Policy Research Working Paper 3175.*

Wesso, G. R., 2001. The dynamics of capital flows in South Africa: an empirical investigation. *June 2001 Quarterly Bulletin.*

Appendix

Appendix A: Data and manipulations

Table A.1: Original data

Variable	Identifier	Reference code*	Notes	Secondary data source	Primary data source
Net purchases of domestic (SA) equity by non-residents	E_NP	RBQ-R2050M_RT204	R millions (Period)	SARB Quarterly Bulletin	The JSE Limited.
Net outright purchases of domestic (SA) bonds by non-residents	B_NP	RBQ-R2563M_RT204	R millions (Period)	SARB Quarterly Bulletin	The JSE Limited.
Dollar/Rand twelve month forward cover rate ($FE_{\$/R}$)	ER_F_12m	RBQ-R5363M_RT521	(Period average)	SARB Quarterly Bulletin	
Dollar/ Rand spot exchange rate ($E_{\$/R}$)	ER_$_R	RBQ-R5339M_RT521	(Period average)	SARB Quarterly Bulletin	
SA government all-bond index(BIX_{sa})	B_SA_IX	RBQ-R2013M_RT201	30 June 2000 = 100 (Period)	SARB Quarterly Bulletin	The JSE Limited and the Actuarial Society of SA.
US government 10 year bond yield (i_{us})	B_SA_Y_10	RBQ-R2003M_RT201	% (Period)	SARB Quarterly Bulletin	The JSE Limited and the Actuarial Society of SA.
JSE ALSI index - (JSE Index)	E_SA_IX	RBQ-R2592M_RT206	2005=100 (Period)	SARB Quarterly Bulletin	The JSE Limited.
JSE ALSI annual dividend yield - (JSE Div.)	E_SA_Div	RBQ-R2097M_RT207	% (Period)	SARB Quarterly Bulletin	The JSE Limited.
NYSE Composite index - (NYSE Index)	E_US_IX	MEI-USA_SPASTT01_IXOBM	2010=100 (Period)	SARB Quarterly Bulletin	
SA government 10 year bond yield (i_{sa})	B_SA_Y_10	MEI-USA_IRLTLT01_STM	% p.a.	SARB Quarterly Bulletin	

Table A.1 shows the original data extracted from the *Easydata* database. Note: **Easydata* reference code. All data is at a monthly frequency.

Table A.2: Derived variables

Variable	Identifier
Adjusted percentage change in total non-resident equity holdings ($\pi_{e,t}{}^{*}$)	E_NP_GCM_12m_asa
Percentage change in total non-resident bond holdings ($\pi_{b,t}$)	B_NP_GCM_12m
Exchange rate return (ERR)	ER_$_R_12m
Contemporaneous hedging cost (HC)	ER_HC_12m
SA equity return ($R_{JSE,t}$)	E_SA_IX_12m
US equity return ($R_{NYSE,t}$)	E_US_IX_12m
SA bond index return ($R_{b,SA,t}$)	B_SA_IX_12m

Table A.2 shows the variables derived from the original data. Note: all variables are at a monthly frequency.

Appendix B: Model specifications and output

Appendix B.1: NRE model 1

Table B.1.1: NRE model 1 specification

Order (lags)	4		
Endogenous variables:	SA equity return (R_{JSE})	Exchange rate return (ERR)	Adjusted growth in total non-resident equity holdings ($\pi_e{}^*$)
Exogenous variables:	JSE ALSI annual dividend yield (JSE Div.)	US equity return (R_{NYSE})	
Cholesky ordering:	1 - SA equity return (R_{JSE})	2 - Exchange rate return (ERR)	3- Adjusted growth in total non-resident equity holdings ($\pi_e{}^*$)

Table B.1.2: Summary of NRE model 1 results:

	E_SA_IX_12M	ER_$_R_12M	E_NP_GCM_12M_ASA
E_SA_IX_12M(-1)	1.112908***	0.091607	-0.095470
E_SA_IX_12M(-2)	-0.225995**	-0.147201	0.245734**
E_SA_IX_12M(-3)	0.049088	0.112832	-0.380205***
E_SA_IX_12M(-4)	-0.032928	-0.038295	0.227878*
ER_$_R_12M(-1)	**0.017130**	**1.342275*** **	**0.027934**
ER_$_R_12M(-2)	**-0.083306**	**-0.568560*** **	**0.010661**
ER_$_R_12M(-3)	**-0.017152**	**0.191560***	**-0.098161**
ER_$_R_12M(-4)	**0.100825**	**-0.046068**	**0.061581**
E_NP_GCM_12M_ASA(-1)	0.022396	0.045109	1.088488***
E_NP_GCM_12M_ASA(-2)	0.009491	-0.019938	-0.018721
E_NP_GCM_12M_ASA(-3)	0.042301	-0.094554	-0.055215
E_NP_GCM_12M_ASA(-4)	-0.048592	0.067000	-0.108895*
C	0.078223***	-0.038115	0.024986
E_US_IX_12M	0.700705***	0.301421***	0.125099*
E_US_IX_12M(-1)	-0.782360***	-0.349627***	0.037173
E_US_IX_12M(-2)	0.046972	0.045009	-0.365727***
E_US_IX_12M(-3)	0.052131	0.136586	0.457377***
E_US_IX_12M(-4)	-0.025552	-0.143826*	-0.237181**
E_SA_DIVIDEND	-2.525166*	1.179824	-0.655750
R-squared	0.939455	0.938301	0.924903
Adj. R-squared	0.934290	0.933038	0.918496

Table B.1.2 shows the coefficients from NRE model 1. *** significance at 1%, ** significance at 5% and *significance at 10%

Appendix B.2: NRE model 2

Table B.2.1: NRE model 1 specification

Order (lags)	2			
Endogenous variables:	Adjusted growth in total non-resident equity holdings ($\pi_e{}^*$)			
Exogenous variables:	Contemporaneous hedging cost (HC)	JSE ALSI annual dividend yield (JSE Div.)	SA equity return(R_{JSE})	US equity return (R_{NYSE})

Table B.2.2: Summary of NRE model 1 results:

Variable	Coefficient
E_NP_GCM_12M_ASA(-1)	1.095463***
E_NP_GCM_12M_ASA(-2)	-0.031892
E_NP_GCM_12M_ASA(-3)	-0.042210
E_NP_GCM_12M_ASA(-4)	-0.114098*
E_SA_IX_12M(-1)	-0.103491
E_SA_IX_12M(-2)	0.233222**
E_SA_IX_12M(-3)	-0.365888***
E_SA_IX_12M(-4)	0.216152***
E_US_IX_12M(-1)	0.197543**
E_US_IX_12M(-2)	-0.402127***
E_US_IX_12M(-3)	0.436960***
E_US_IX_12M(-4)	-0.221692**
E_SA_DIVIDEND	-1.032038
-ER_HC_12m	**-0.101645**
C	0.043460
R-squared	0.923421
Adjusted R-squared	0.918435

Table B.2.2 shows the coefficients from NRE model 2.

*** significance at 1%, ** significance at 5% and *significance at 10%

Appendix B.3: NRB model 1

Table B.3.1: NRB model 1 specification

Order (lags)	2		
Endogenous variables:	1st dif. Exchange rate return (ERR)	1st dif. Growth in total non-resident bond holdings (π_b)	
Exogenous variables:	1st dif. SA government 10 year bond yield(i_{sa})	1st dif. US government 10 year bond yield (i_{us})	1st dif. SA bond index return ($R_{b,SA}$)
Cholesky ordering:	1 - 1st dif. Exchange rate return (ERR)	2 - 1st dif. Growth in total non-resident bond holdings (π_b)	

Table B.3.2: Summary of NRB model 1 results:

	D(ER_$_R_12M)	D(B_NP_GCM_12M)
D(ER_$_R_12M(-1))	**0.426795*** **	**0.844836**
D(ER_$_R_12M(-2))	**-0.144096***	**-1.175673****
D(B_NP_GCM_12M(-1))	-0.007422	0.303675***
D(B_NP_GCM_12M(-2))	-0.013232	-0.182618**
C	0.000236	-0.001103
D(B_SA_Y_10)	-0.036578***	-0.003594
D(B_US_Y_10)	0.044941**	-0.026368
D(B_SA_IX_12M)	0.408318**	1.772695
R-squared	0.272771	0.156358
Adj. R-squared	0.241919	0.120567

Table B.3.2 shows the coefficients from NRB model 1.
*** significance at 1%, ** significance at 5% and *significance at 10%

Appendix B.4: NRB model 2

Table B.4.1: NRB model 2 specification

Order (lags)	**2**			
Endogenous variables	1st dif. Growth in total non-resident bond holdings (π_b)			
Exogenous variables:	Contemporaneous hedging cost (HC)	1st dif. SA government 10 year bond yield (i_{sa})	1st dif. US government 10 year bond yield (i_{us})	1st dif. SA bond index return ($R_{b,SA}$)

Table B.4.2: Summary of NRB model 2 results:

Variable	Coefficient
D(B_NP_GCM_12M(-1))	0.319751***
D(B_NP_GCM_12M(-2))	-0.219378***
D(B_SA_IX_12M)	1.638906
D(B_SA_Y_10)	-0.018853
D(B_US_Y_10)	-0.034635
-ER_HC_12m	-0.273943
C	0.012750
R-squared	0.129637
Adjusted R-squared	0.098178

Table B.4.2 shows the coefficients from NRB model 2.
*** significance at 1%, ** significance at 5% and *significance at 10%