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TESTING FOR THE UNCOVERED INTEREST PARITY HYPOTHESIS IN SOUTH AFRICA

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Abstract

The findings of the research have implications on the efficiency of the South African exchange rate market, and by extension, the efficiency of similar emerging foreign exchange markets. The study used Ordinary Least Square Approach and Johansen cointegration. Despite their theoretical appeal, and in line with a dozen of related past literature, the findings of the research generally favour the rejection UIP, PPP and IFE. The findings have implications on some regulatory measures that can be undertaken by the financial authority to improve the efficiency of the foreign exchange market. While there have been extensive studies on uncovered interest parity (UIP), purchasing power parity(PPP), and the international Fisher effect(IFE), research has scarcely tested these hypotheses in the context of emerging markets. This study attempts to bridge the existing gap by testing the three related parity condition for South Africa.

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List of Acronyms and Abbreviations

ADF	Augmented Dickey Fuller
CHN	China
ECB	European Central Bank
EM	Emerging Markets
EMH	Efficient Market Hypothesis
EUR	Europe
FDI	Foreign Direct Investment
FED	Federal Reserve Bank
GARCH	Generalized AutoRegressive Conditional Heteroskedasticity
GMM	Generalised Methods of Moments
HAC	Heteroskedasticity and Autocovariance
IFE	International Fisher Effect
IND	India
JAP	Japan
PPP	Purchasing Power Parity
SA	South Africa
SARB	South African Reserve Bank
UIP	Uncovered Interest Parity
US	United Sates
USD	United States Dollar
VECM	Vector Error Correction Model

CHAPTER 1

1. INTRODUCTION

One of the most widely researched empirical topics in the area of finance over the past few years has been the efficiency or, more accurately, the seeming inefficiency of the foreign exchange forward market. Specifically, a mammoth of surveys and studies have considered the supposed failure of the forward exchange rate to hold as unbiased predictors of future changes in spot rates, particularly during the flexible rate regime. One crucial factor determining the exchange rate is the uncovered interest rate parity (UIP) condition. The UIP theory emphasizes the efficiency of the forward market, indicating that a country's currency is expected to depreciate against a foreign currency when the domestic interest rate rises higher than that of the foreign country. Uncovered interest rate parity (UIP) supposes that the interest rate differential between domestic and foreign country equals the expected change in the exchange rate. UIP asserts that the differential in interest rate between the two countries will, on average, be similar to the *ex post* exchange rate movement. If the uncovered interest rate parity condition holds, the interest rate differential becomes an unbiased predictor of the *ex post* movement in the spot exchange rate. As an example, suppose the differential between one-year rand and dollar interest rates is six percent, with the rand being higher. Rational investors, who are deemed risk neutral, will then expect the rand to depreciate by six percent over the one year duration. This would cause the returns on the rand dollar to equalize. If instead the rand fails to adjust as expected, arbitrage opportunities would be created. Accordingly, the interest rate differential would be reflected by the difference between the domestic and foreign interest rate.

The fundamental conjecture forming the crux of the UIP theory relates to the notion that capital markets are efficient and that prices reflect thoroughly all the available information to all participants in the market (Stigler, 1957). Therefore, no profitable opportunities will be possible in the market. This suggests that exchange rates adjust swiftly to new information emerging in the market, which then becomes immediately reflected by changes in the exchange rate. In addition, market participants not only have rational expectations but are also assumed to be dominated by investors who are risk neutral. Supposing that the

assumptions are genuine and the UIP condition holds, the expected return realized from holding of domestic currency as opposed to holding a foreign currency is offset by the opportunity cost associated with holding funds in the domestic currency against the foreign currency (Foy, 2005). If the UIP condition holds, then no investors can gain attractive arbitrage opportunities arising from currency with high yield because such a currency will be anticipated to depreciate against the other currency in the market. The depreciation will be equivalent to the amount approximately equal to the differential in interest rate between the domestic and foreign country. Any deviation from this relationship implies the inefficiency of capital markets and opens up platform to explore arbitrage opportunities.

A number of reasons have been advanced to explain the failure of UIP. Amongst these are expectations assumption and the presence of a time-varying risk premia that is equivalent to the differential between the actual and expected rate of deprecation. The assumption of risk–neutrality is also considered another reason behind the failure of the UIP as investors are typically risk-averse (Chinn & Meredith, 2005). In this research, I make an attempt to reconsider outstanding issues and analyze evidence of the UIP relation using data from South Africa as the base country, United States, India, Eurozone, Japan and China. Compared to developed economies, South Africa, just like other Emerging Markets (EMs), is often characterized by higher nominal interest rate and higher inflation (Alper et.al, 2009). Differences with respect to economic conditions may also have a direct impact on the relationship between nominal interest rate differences and the exchange rate depreciation (Chinn, 2006). Therefore, it is interesting to test the UIP in the context of an emerging market like South Africa.

The closely related Purchasing Power Parity (PPP) and the International Fisher Effect hypothesis are also tested to credence to the validity of the models in the context of South Africa. Section 1.1 begins by providing a brief background and context to the topic while section 1.2 lays out the problem statement. The research objectives and the importance of the research is briefly outlined in section 1.3 and section 1.4 respectively. Chapter 2 covers an extensive review of previous literature on the topic, including detailed review of critical regional studies done abroad and domestically. After laying out an elaborate review, Chapter 3 renders a description of the data and the methodology employed in the research. Chapter 4 entails an analysis of the findings derived from the regression results. The chapter

also makes an attempt to explain the reasons of the findings by relating the results with the contemporary developments in South Africa's capital markets. Chapter 5 concludes by providing a summary of the findings in the research and offers an explanation on the implications of the results on capital market efficiency and policy.

1.1. Background and Context

The Uncovered Interest Parity hypothesis posits that interest rate differential between two countries is equal to the expected change in the currencies of the two countries. The inherent implication of the UIP is that an investor should be indifferent between holding securities of both countries as profit opportunities are eliminated. Suppose at a given point in time, South Africa's interest rate exceeds US interest rate by a particular percentage, South Africa's currency (rand) will be expected to depreciate against the US dollar by an amount equal to the interest rate differential between the two countries.

Since the 1970s, South Africa has had three monetary policy regimes. The liquid asset ratio-based system characterized by quantity controls on credit and interest rate was typical and predominantly favored through the 1970s until the 1980s (Aron & Muellbauer, 2007). The 1985 Commission Report by de Kock recommended reforms which led to a move towards cash-reserves based system enacted along with the controls on interest rate. By 1986, the second regime was in operation and focused more on monetary targets whose effectiveness was undermined by the liberalization of financial markets which had already commenced in the early 1980s (Fry, 1997). The interest rate trend was more volatile and the systems of the two regimes were less credible (Aron & Muellbauer, 2007). In an effort to enhance the transparency, predictability and credibility of monetary policy, the South African Reserve Bank transitioned into the third regime by adopting inflation targeting in 2000. Under this regime, interest rate is set and determined by the Monetary Policy Committee. Comparison between the three monetary policy regimes reveals that South Africa's interest rates were relatively higher during the 1970s. The ensuing chapter will show that at the end of 2000, South Africa's nominal interest rate began falling sharply from their historical level, reaching 7 percent in 2006. In the same year, interest rate trend reversed, rising moderately to 12 percent in 2008. However, the 2008-2009 Global Financial Crisis led to interest rate decline.

1.2. Problem Statement

The Uncovered Interest Parity Condition has implications regarding the foreign exchange market efficiency. If the UIP does not hold, a country with lower interest rate may not experience expected appreciation of its currency as presumed under UIP hypothesis. On the contrary, the currency of such a country may depreciate against the currency of the trading partner. The failure of the UIP presents opportunity for international investors to make profit. In the event that South Africa's currency does not appreciate following a decline in interest rates below those prevailing in the US, investors can earn a risk-free return by moving funds from South Africa in favour of holding of American securities. This process may result in excessive capital outflows which may result in unfavorable outcome for the country, thereby affecting economic growth negatively.

According to data collected by the World Bank, the capital account balance declined from $31 billion in 2010 to $25 billion in 2013, despite efforts by the Reserve Bank to reduce interest rate during this period. Mohamed & Finnoff (2004) found that capital flight as a percentage of GDP was on average 6.6 percent between 1980 and 2000. Excessive capital flight may lead to significant currency and financial crisis. The 2008 Global Financial Crisis which also affected South Africa implies the vulnerability of the country to foreign financial contagion. For a country with an integrated and relatively open capital market such as South Africa, failure of the UIP, the related PPP and the International Fisher Effect hypothesis to hold, has often led to high capital outflows to which the country is susceptible. This may necessitate a need for capital controls by the financial authority, though other dynamic peculiarities may hinder such measures.

1.3. Research Questions and Objectives

The Uncovered Interest Parity test, PPP and International Fisher Effect hypothesis is crucial because it has implied connotations related to how efficient the country's international exchange market is. Market inefficiency implies that arbitrage opportunity is possible whereby investors can earn additional returns by borrowing funds from a country which has relatively lower interest and subsequently invest those funds in a country with higher interest rate in order to earn higher proceeds. . On the other hand, in order to affirm the Law of one Price, it is important to ascertain whether past increases in domestic prices has often been accompanied by

commensurate depreciation on the domestic currency. Deviation from the PPP has direct implication on the efficiency of the markets. The International Fisher Effect posits that countries with higher interest rate, generally tends to have higher inflation. While this case is generally accepted as valid, it is important to statistical test the significance of the hypothesis. Inter alia, the study attempts to answer the following questions:

1) Does uncovered interest parity, purchasing power parity and the International Fisher Effect hold in South Africa?

2) Are results different when testing the UIP for short term horizon as opposed to the long term horizon?

3) What are the implications of the findings on the foreign exchange/capital markets?

4) Is there any causal link between the findings of the paper and the movements in South Africa's capital account?

5) Given the findings of the paper, should South Africa implement capital controls?

1.4. Importance of the Study

The Uncovered Interest Rate Parity hypothesis has scarcely been tested in South Africa. The study contributes to the work attempting to test the validity of the UIP by applying the UIP models on South Africa. The findings of the study are important as they have implications on the efficiency of the foreign capital markets. Implied inefficiencies may provide arguments in favor of capital controls aimed at reducing the vulnerability of the South African economy to foreign financial contagion. The study uses long horizon data which is more useful in testing the hypothesis that UIP generally holds when long horizon data is used. It is important to statistically investigate how valid the Law of One Price is considering that the Law is used as a rationale justifying the PPP. This will in turn provide some level of clarity on the implications for markets.

CHAPTER 2

2. LITERATURE REVIEW

A variety of economic literature studies focusing on testing the validity of interest parity condition have been done both at empirical and theoretical level. Past literature on UIP has found that an economy which generally has high nominal interest rates will on average experience currency appreciation over time. These findings have made the UIP hypothesis testing an empirical failure for many studies. Most of the previous literature did not find adequate evidence to support the validity of the Uncovered Interest Parity condition. Some aspects of the encountered challenges in testing the UIP hypothesis stems from the difficulty associated with testing it directly, thereby relying heavily on rational expectations theories and unbiased hypothesis argument. Studying the UIP, PPP and Fisher Effect for Emerging Market has often been approached with more highlighted caution. Alper et al. (2009) notes that unlike developed markets, emerging markets are characterized by poor macroeconomic fundamentals, unstable economic conditions, weak financial markets, and need for greater institutional reforms.

Consequently, these inherent differences between the emerging and developed markets have implications on the UIP empirical tests. The peculiarity of emerging capital markets may violate some fundamental assumptions typically advanced when studying UIP, PPP and the International Fisher Effect in developed markets. These assumptions may include perfect substitutability of assets and negligible transactional costs. Surprisingly, despite the peculiarities already pointed and the expectation that UIP results from emerging markets was supposed to be more unfavourable when using the same methodology as the one typically applied for developed markets, the results are nonetheless less unfavourable (Alper, 2009).

In the previous empirical literature, various attempts have been made to test international parity hypotheses, including the Purchasing Power Parity as well as the closely related Uncovered Interest Parity hypothesis. Both these hypotheses play a fundamental role in exchange rate and currency determination (MacDonald & Taylor, 1990). These parity hypotheses are usually considered as either arbitrage relations, which in the case of UIP is assumed to hold constantly, or sometimes just as long-run equilibrium relations, such as is the case in the PPP. With regard to the PPP, for most of the previous earlier works, there were two competing views whereby on the

one side there were researchers arguing that real exchange rates series are non-stationary (Roll, 1979; Adler & Lehmann, 1983; MacDonald, 1985).

On the other side, as more investigations intensified, studies found that the real exchange rate exhibited stationary patterns and therefore free from unit root (Huizinga, 1987; Dornbusch, 1989; Diebold, Husted & Rush, 1991; Whitt, 1992,). Testing for the PPP using Cointegration methodology advanced by Engle & Granger (1987), Taylor (1988) argues that the PPP fails to hold in the long run. However, contrary to Taylor (1988), a plethora of studies relied on the Johansen (1991) cointegration methodology to test the PPP and found that the parity condition holds in the long run (Kugler & Lenz, 1993; MacDonald & Marsh, 1994; Fisher & Park, 1991). Assuming that investors are risk neutral and market participants have rational expectations, studies based on the uncovered interest parity condition have typically favoured the rejection of the UIP (Cumby & Obstfeld, 1981; Davidson, 1985; Taylor, 1987).This failure of the PPP and UIP condition to hold suggest markets are inefficiency and irrational (MacDonald & Taylor, 1992).

Closely related with the UIP and PPP is the Fisher Effect which states that worldwide real interest rates are made equal across boarders through arbitrage. In this process, the supply and demand of funds plays an imperative role in determining what the real interest rate at a particular given time in the economy will be. During this process, foreign investors are found chasing investment opportunities in countries where real interest rates are higher. Interest rate differentials between two integrated capital markets can be attributed to factors such as psychological barriers, political risk, (Solnik & Roulet, 2000), legal constraints, transaction costs, and currency risks (Taylor, 1998). However, in the absence of capital market imperfections and free capital mobility, interest rate differentials between markets are eliminated. Equilibrium in capital markets is therefore characterized by a state where the differential in nominal interest rate is approximately equal to the differential in expected inflation between the domestic and foreign country (Demirag & Goddard, 1994). Essentially, the international Fisher Effect hypothesis implies that the differential in the nominal interest rate component between two economies is ascribed to differences in inflation.

The absolute PPP is based on the Law of One price and deduces that the price of a commodity is equal between two countries such that P (price of domestic goods) is

equal with P^* (price of a foreign good). Based on Dornbusch (1985), the relative PPP expresses the absolute PPP through the exchange rate and relative price levels. The relative PPP is a more realistic representation of the price of goods and services between two economies with two different exchange rates. The relationship between the UIP and relative PPP and IFE is shown in equation form as:

$$\Delta e = \Delta P - \Delta P^* \qquad \text{(Relative PPP)}$$

$$\frac{\Delta e_t(S_{t+k})}{S_t} = i_d - i_f \qquad \text{(UIP)}$$

$$E(e) = \frac{(1+i_d)}{(1+i_f)} - 1 \qquad \text{(IFE)}$$

In the equations above, Δ denotes a percentage change, *e* ($e = \Omega * \frac{P}{P^*} = \frac{\Delta e_t(S_{t+k})}{S_t}$) is the exchange rate and (or the expected rate of depreciation of the rand) determined as a ratio of domestic prices to foreign prices times a measure of obstacle to trade, denoted here as Ω . The term $(i_d - i_f)$ in the UIP equation denotes the interest rate differential between the domestic $i(_d)$ and foreign $i(_f)$ nominal interest rate. The relative PPP equation expresses the changes on the exchange rate in terms of the changes in relative domestic and international prices. The UIP equation uses the interest rate differential between two countries to explain fluctuations in the exchange rate, hence the relationship between the relative PPP and the UIP. The International Fisher Effect equation is derived through free capital mobility assumption whereby real interest rate are said to be equal between two countries. The IFE equation as stated above therefore implies that the expected change on the exchange rate is approximately equal to the interest rate differential between the two countries. The enterprising reader can refer to Eun & Resnick (2014), for detailed explanation of the relationship between the UIP, relative PPP and the IFE.

The ensuing discussion of this paper focuses mainly on the Uncovered Interest Parity condition. On the contrary, Covered Interest Rate Parity (CIP) compares the nominal interest rate in any country, like South Africa, to the nominal interest rate in any other country, like the United States, and the forward premium on the nominal exchange rate between the currencies of the two countries: $r_{SA} = r_{USA} + f$. In other words, South Africa's investors who expect return r_{SA} for investing locally will require

return r_{USA} for investing in a foreign country plus a forward premium f to compensate for risk. Therefore, CIP implies that any nominal interest rate gain of the rand cash deposits over dollar cash deposits $(r_{SA} - r_{USA})$ will completely be offset by the depreciation of the rand against the dollar, as captured by the forward premium f. Bansal & Danlquist (2000) have defined the forward premium as: $f = \frac{F_{R/\$} - e_{R/\$}}{e_{R/\$}}$, where $F_{R/\$}$ denotes the nominal forward exchange rate between the rand and the dollar and $e_{R/\$}$ represents the nominal spot exchange rate between the rand and the dollar.

Under the UIP, the assumption that the currency of an economy with a high interest rate is expected to depreciate in order to equalize profit earned from a low interest rate country; the carry through strategy would fail. In international finance, carry trade is a strategy whereby an investor borrows funds at a low interest rate in order to invest in a commodity that is expected to yield a higher return (Burnside et al., 2011). The reasons for the inconsistency between the UIP and carry trade has been explained by various authors (Balassa, 1964; Samuelson, 1964). The work of these authors has led to the formulation of the so-called Balassa-Samuelson effect, used as a reason to explain the inconsistency, arguing that countries with higher economic growth tends to experience currency appreciation, thus the UIP does not necessarily need to hold. Countries with higher consumption also tend to experience currency appreciation (Backus & Smith, 1993).

Despite the theoretical appeal of the Fisher Effect, similarly to the UIP and PPP, research on the Fisher Effect has yielded conflicting econometric evidence. Shapiro (1998) conducted a study for twenty two countries by comparing their nominal interest rate and concluded that generally, economies which have higher inflation often have generally higher nominal interest rates. Aliber and Stickey (1975) conducted research for both developed and developing countries and found that the International Fisher Effect holds in the long run but no sufficient evidence was found to prove that it also holds in the short-run. More support in favour of the International Fisher Effect was further provided by Kane & Rosenthal (1982) for the period 1974-1979 who examined the Euro currency market and concluded that the International Fisher Effect is fulfilled in the long run.

Robinson & Wartburton (1980) were amongst the first group of researchers to dispute the empirical validity of the International Fisher Effect by arguing that the

appreciation of the currency with lower nominal interest rates in relation to the currency with the higher nominal interest rate would in the medium run, erode any possibility of earning higher interest returns. Using residual-based cointregration test methodology by Engle & Granger (1987), Mishkin (1992) argued that in the presence of a common stochastic trend on interest rate and inflation, the International Fischer Effect may hold. Aspects of Mishkin (1992) work on the International Fisher Effect were a review of Mishkin & Huizinga (1984) who found that the US adoption of the monetary targets in 1979 led to the disappearance of the Fisher Effect.

However, Gonzalo (1994) showed that the Engle-Granger test as applied by Mishkin is not sufficiently robust in detecting stochastic trends and argued that the most suitable approach would be the Maximum Likelihood method. Yuhn (1996) found that, notwithstanding the general lack of evidence to back the International Fisher Effect hypothesis in the United Kingdom and Canada, the findings revealed that results for Germany confirmed the validity of the International Fisher Effect. Moreover, similarly to Aliber & Stickey (1975), Yuhn (1996) found that the Fisher Effect is more powerful in the long period horizon but weak during periods of policy regime changes. Coppock & Poitras (1999) found that the Fisher Effect does not hold because interest rates do not fully adjust to inflation.

The overwhelming evidence against the UIP, PPP and the International Fisher Effect may be attributed to errors as a result of overlooking the linkages between and asset and goods markets (Johansen & Juselius, 1992). For instance, Johansen & Juselius (1992), based on a model in which a multivariate cointegration framework was adopted, in which possible linkages between exchange rates, nominal interest rates, and price levels are factored into the model, found evidence in support of the PPP and UIP relations for the United Kingdom. Employing the same econometric multivariate cointegration framework that allows for interactions in the determination of interest rates, prices and exchange rates and different horizon dynamics, in their work, Caporale et al. (2001) have also discovered some evidence in favor of the Uncovered Interest Parity and Purchasing Power Parity. Some more regional studies on the UIP are discussed below:

2.1. US and Europe literature on the UIP

Most of the literature work done on UIP often uses data coming from countries under flexible exchange rate regime with a low-inflationary environment, (Flood and Rose, 1997). The UIP outcome may be different when tested for developing countries with a higher degree of volatility in both the exchange rate and interest rate movement (Sarbapriya, 2012). High volatility of exchange and interest rates increases the risk premium in financial markets and therefore it may also give results with greater statistical significance when testing for the validity of the Uncovered Interest Parity. As financial markets deepen, the UIP hypothesis may also provide different results over time and UIP deviations may also differ through countries.

Work by Bilson (1981) and Fama (1984) arrived at similar inferences whereby they both conceded that UIP results differ significantly over time and regions. Similar results were also found in the work by Macdonald & Taylor (1992).Chinn & Meredith (2004) applied data from 1980-2000 for about six key currencies and found that the interest rate differential had a coefficient of negative 0.8. Most of the estimated coefficients had signs which were contrary to expectation and were significantly different from unity. One other crucial finding of the work was that rendering a clear meaningful interpretation of the estimates from the UIP equations was ambiguous and complicated to such an extent that the hypothesis of unity of coefficients would be rejected even in circumstances where it would not normally be rejected. Using high frequency currency data for Japan, Germany, Switzerland and the US, Chaboud and Wright (2005) ran UIP regression test and found some evidence in support of the uncovered interest parity condition, though only over very short period of data span, especially at discrete interest payment interval. However, the positive UIP evidence is destroyed when adding few hours to the span.

There have been various arguments put forward to try and explain failure of unbiased estimates findings to hold when considering time frame of shorter than a year. These arguments include the possibility of nonlinearities, existence of the risk premium factor, as well as forecast errors. Using panel data estimates to test the UIP at both 5 year and 10 year period for four economies, Meredith & Chinn (1998) and Chinn (2006) found beta coefficients which were close to 1. Lothian and Simaan (1998) made use of long-period analysis and were able to find some evidence in support of the UIP hypothesis for period 1974 to-1994. Comparably, Cheung et al.

(2005) found in their research that the UIP hypothesis holds at long span horizon as opposed to a shorter one.

Keen to test the unbiased expectations theory, Liu and Maddala (1992) found that evidence in favour of uncovered interest parity was untenable. This finding implied that the major currency markets such as Germany, Japan, Switzerland and Great Britain are inefficient. Owing to high interest rate environment that prevailed in some countries through the 1990s, investors were attracted to keep their funds in those countries as net returns were relatively higher. As a result, a study by Bakaert and Hodrick (1993) found that the uncovered interest parity hypothesis did not hold during the early 1990s. This implies that currency values belonging to countries whose interest rate were high failed to depreciate rapid enough to cancel out the yield advantages realized. Summarizing findings of UIP tests done during the mid-1990s, Van Horne (1998) concluded that the interest rate parity evidence was weak.

Varma (1997) conducted an examination of the uncovered interest parity for Indian. He used data prior to and after observed structural breaks in the money market in 1995. He found that while the uncovered interest parity did not hold prior to the money market structural breaks, there was strong supporting evidence of the UIP which commenced in 1995. The differences in the findings were attributed to these structural breaks which are seen as forming an important integral bridging part of the money market and foreign exchange market.

Essentially, the Uncovered Interest Parity (UIP) postulates that the expected changes in currencies can be used to explain interest rates differences between countries. However, assuming rational expectations, empirical studies on the UIP theory have generally refuted the hypothesis. A compelling critique against rational expectation assumption as a basis of most UIP notion was put forward by various researchers including Frankel and Froot (1990) and Mark and Wu (1998) who argue that expectations are irrational. It has also been argued that the UIP condition hypothesis does not necessarily hold, owing to some time-varying risk premium that may be present (Domowitz & Hakkio, 1985) and Nieuwland et al. (1998).

McCallum (1994) notes that after running a change in spot exchange rate regression on the forward premium, the results yield regression parameters which are less than unity (-4 to -3). This finding is contrary to the expected estimates of unity of coefficients (+1). The author argues that when factoring in policy issues and

behaviour, the findings may be in line with the UIP theory. McCallum (1994) backs his argument by presenting significant results under the rational expectation assumption, which were derived from his reduced form equation for the spot exchange rate. The reduced form equation also assumes that in order to keep exchange rates stable, policymakers often adjusts and smooth interest rates so that they are less variable over time. Contrary to the UIP, many researchers demonstrated that higher interest rate countries instead appreciate in relation to lower interest rate countries. Applying policy behaviour and data from 1978:01m-1990:07m, Christensen (2000) find that their results to a great extent confirm those of McCallum (1994). However, Christensen (2000) notes some criticism of McCallum (1994) in that he did not make use of sound econometric analysis of his results. In an attempt to verify the empirical findings of McCallum (1994), Christensen (2000) employed various econometric models and eventually concluded that the beta (β) coefficient is significantly different from unity. Moreover, as pointed out by McCallum (1994) and Nieuwland et al. (1998), many studies have shown that β changes considerably across time intervals. Aggarwal (2013) has noted that β has an approximate value of negative one, indicating a perfect appreciating relationship, thereby leading to rejection of the UIP. The rejection of the UIP has led investors to pursue excess returns in the foreign exchange market through carry trades (Aggarwal, 2013).

Most empirical evidence appears to be overwhelmingly against the UIP hypothesis, especially at horizons less than a year (Hodrick, 1987); (Froot and Thaler, 1990) and Engel (1996). Similar to Nieuwland et al. (1998), Christensen (2000) associates the lack of tenable basis of support which favors the UIP arguments to both the existence of time-varying risk premia and the assumption of rational expectations. Fama (1984) undertook a work to test the UIP, focusing specifically on the statistical properties of the changes in spot exchange rate, interest rate differential and the risk premium relation. His findings showed that the differential component on the exchange risk premium was larger than the differential in the expected future spot rates movements when compared against currencies of ten major trading countries' currencies between 1982 and 1973.

Fama (1984) focused specifically on the distinction between systematic market generated forecast errors and the time-varying risk premium. The failure to accept the UIP based on the time-varying risk premium and forecast errors have fueled

extensive research studies in the past three decades. However, in his evaluation of the different explanations behind the rejection of the UIP, Lewis (1995) notes that considering these different explanations separately might eventually compel the researcher to conclude that foreseeable excess returns remain unexplained, despite the existing solid theoretical framework which suggests otherwise. In his narratives, he argues that the two explanations as advanced by Fama (1984) do not take into account other arguments. For instance, Baillie and Bollerslev (1997) argued that Fama (1984) ignored the autocorrelation present in the forward premium and his relatively small sample which might have led to biased UIP investigation.

Sarno and Taylor (2002) surveyed the UIP literature on developed countries, and noted the significance of expectations, risk premium, and the use of sample data. In his review of the work, Sarno (2005) concentrated on non-linear dynamics of departure from the UIP hypothesis and incorporated term structure models. Chinn (2006) analyses the robustness of the results with respect to the time horizon.

Contrary to Fama (1984), Frankel and Froot (1987) noted that the UIP theory may not hold because of the so-called asymmetries between currencies. In their work, they showed that participants had expected a dollar depreciation of 10% against the Deutsche Mark for period 1981-1985. However, the interest rate differential around the same time horizon was 4%.

In spite of the strong empirical evidence against the UIP hypothesis, most of which were done in the 1980s and 1990s, recent studies have brought much more favourable evidence. Bekaert and Hodrick (2001) and Baillie and Bollerslev (2000) argue that the choice of statistical inference methods may contribute to the rejections of UIP even in cases where it should not normally have been rejected.

Using long term interest rate, a number of researchers, among them DeGennaro et al. (1994) and De Haan et al. (1991), focused on testing for cointegration across five major economies and their results led to them rejecting the IUP hypothesis.

The UIP is believed to hold strongly at long time frequencies (Chinn and Meredith, 2001). The authors make use of longer-term bonds interest rates for Germany, U.S., and Canada Japan to test the hypothesis. After running a long horizon regression, they found that the interest rate differential coefficients were closer to unity and correct in signs. Ravi and Magnus (2000) found that while the UIP does not hold for

most developed countries, the same cannot be said about developing countries. In their conclusion, they note that the often found negative relationship between interest rate differential and the expectation of currency depreciation is not consistent across countries and only applies in developed countries.

Huisman et al. (1998) test the UIP by making use of a panel model that captures time effects and controls for biased factors. They find that while the UIP hypothesis is rejected, the results are not as severely against the UIP and “almost” hold during periods of large forward premiums. Employing an unbalanced panel of weekly data for the time period 1976–1998 for a 1-month horizon, Bansal and Dahlquist (2000) used a sample of 28 emerging and developed economies. In their findings, they reported that the forward premium puzzle only applies to developed countries and that the UIP failure only occurs when the US interest rate rises above the interest rates of the other developed countries. These research findings also indicated that the slope coefficient in equations of the UIP equation rises towards unity with lower credit ratings, higher inflation volatility, lower per capita income, and higher than average inflation. All these attributes characterizes EMs like South Africa (Bansal and Dahlquist, 2000).

Bruggemann and Lutkepohl (2005) carried out an empirical study focusing on the univariate analysis of unit root test on the 10 year bond rate for the horizon 1985-2004. Their finding suggested that the Efficient Market Hypothesis (EMH) and UIP hold for U.S. and Eurozone markets. Meredith and Chinn (2002) find correct sign of beta coefficients, in other words, the slope of the nominal interest rate differentials, leading them to accept the hypothesis that the beta coefficient is closer to unity over longer periods.

2.2. East Asian UIP studies

Making use of quarterly data which ranged dating back to 1998 through 2010, Lily et al. (2011) ran traditional regressions (OLS) and conducted a Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) analysis on Uncovered Interest Parity for Malaysia-Singapore, Malaysia-United Kingdom, and Malaysia-Japan. Their empirical findings showed that the findings to back that the UIP hold were insignificant to suggest that the hypothesis holds for all the UIP cases considered. As result, they were led to agree with the findings of most previous researches, effectively rejecting the UIP. Moreover, they found that the regression

results obtained for the Malaysia-UK, Malaysia-Japan and the Malaysia-Indonesia cases had positive estimates of slope coefficients.

The general expectation for the UIP to hold is for the beta sign to be positive, implying that an increase in domestic in interest rates is accompanied by a depreciation of the domestic currency. The findings also showed that the UIP deviation for the case of Malaysia-Singapore had a standard deviation which was smaller than was the case for the other cases. Moreover, using simple GARCH to conduct volatility analysis on the Uncovered Interest Parity deviation, their analysis showed that there were considerable ARCH and GARCH effects, particularly for the Malaysia-Singapore case. However, the deviation appeared to be consistent and persistent in the long period horizon. The foremost problem with the GARCH methods is their failure to explain economic determinants of the risk premium, Bui (2010).

2.3. Latin American Studies

To investigate the UIP hypothesis, Carvalho et al. (2004) make use of monthly data sampled from Brazil, Argentina, Mexico and Chile, focusing on period 1990–2001 and incorporate the use of the rational expectation hypothesis. These countries were chosen because of their relatively larger size of their economies in the Latin American region. In their study, they also analyze the extent of foreign capital mobility in these economies. To achieve this they make use of panel data estimation method, in line with unit root analysis which was proposed by Levin and Lin (1992), and subsequently applied by Im et al. (1997). Their essential findings suggested the rejection of UIP for the period under review in the study, for the group of countries consisting of Brazil, Argentina, Mexico and Chile. However, results based on a slightly different time span (January 1991– December 2000) revealed that the UIP hypothesis could not be rejected for the group of countries consisting of Chile, Mexico and Argentina. The findings of this later group also indicated that there is an existence of a relatively high degree of capital mobility between those economies.

2.4. Oceania

Using both short- and long-horizon monthly data from 1985-2009 for New Zealand and Australia, Bui (2010) carried out an empirical test of UIP model in which a Generalized Methods of Moments (GMM) model that aligns the risk premium to underlying economic variables is applied. To estimate the UIP condition, he first runs the OLS with Heteroskedasticity and Autocovariance Consistent (HAC) estimators, a method which was developed by Newey and West (1987). As noted by the author, the GMM differs from previous studies that had made use of OLS estimates that yielded inconsistent and biased parameter estimates owing to omitted risk premium. The findings of Bui (2010) are in many respects the same as in other previously conducted empirical studies (as those in the US and Latin America). The main finding of his paper showed that short-term horizon regression yielded negative coefficient estimates of approximately (-1). However, also noted in the study is that three of the four coefficient estimates yielded positive values in the long-term-horizon regression analysis.

Specifically, Bui (2010) found a significant compelling evidence for New Zealand and Australia showing that there is a short-run negative relationship between interest rate differentials and exchange rate depreciation. Consistent with most previous studies, the findings showed that the average slope coefficient estimate was approximately -0.90. The author notes however that, in the long-horizon period, the coefficients estimates significantly differ from short-run horizon whereby Interest rate differentials coefficients become near zero. This is especially the case for Australia. Therefore, the study was unable to reject the null hypothesis that the beta is equal to unity. These results were in line with Froot and Thaler (1990) and Chinn and Meredith (2004), positing that the UIP works better in the longer horizons period. However, the R^2 and adjusted R^2 were low in all regressions conducted. The low R^2 suggests that interest rate differential accounts for small proportion in explaining the variation in exchange rates.

2.5. South African studies

While there has been extensive research done on the UIP in many regions around the world, the focus on emerging African economies like South Africa has been scarce and limited. The availability of credible data sources has contributed to

limitations associated with conducting quantitative research on the African continent. As the African economies begin to modernize their institutions, the challenge pertaining to data availability and accessibility is gradual diminishing. Crucial investigation on the UIP for South Africa was conducted by Lacerda et al. (2010), who in an attempt to circumvent modelling which previously ignored shifts in policy regimes and the concomitant distortions on the PPP and UIP relations, constructed a vector error correction model (VECM) which is based on a Markov-switching vector. This model incorporates shifts exchange rate and monetary regimes in which the UIP and PPP is tested as a joint long-run relationship in the presence of shifts in both the political and economic regimes. Their standard linear VECM results reveal weak evidence in favour of the UIP and PPP, despite some residual indications that the functional form is inappropriate. However, the constructed Markov-switching VECM gives compelling strong evidence in support of the PPP and UIP as well as an improved distribution of the residuals. The next chapter turns the attention to the methodological approach employed in the research, as well as important data description.

CHAPTER 3

3. DATA AND METHODOLOGY

3.1. Data

The study will make use of the ZAR/USD, ZAR/YEN, ZAR/YUAN, ZAR/RUPEE and ZAR/EURO spot exchange rates and nominal interest rates for South Africa as the domestic country and the U.S, Japan, China, India and the Euro area respectively. The nominal interest rate is determined by central banks of the respective countries and is readily available. To incorporate the Purchasing Power Parity (PPP) and the International Fischer effect, the research also makes use of consumer price inflation (CPI) data from these countries, as well as the real interest rate data. Though at first glance CPI and GDP deflator seem to be similar, GDP deflator only includes domestically produced goods and excludes those that are imported. The CPI is therefore preferred in this paper as it includes both domestic and foreign prices and therefore makes it the most reliable measure for the research on PPP. The data frequency is monthly and covers the period 1999-2014. Most of the used data is obtained from the South African Reserve Bank and the Federal Reserve Bank of Saint Louis (2015). The table below provides descriptive statistics for the data used in the research.

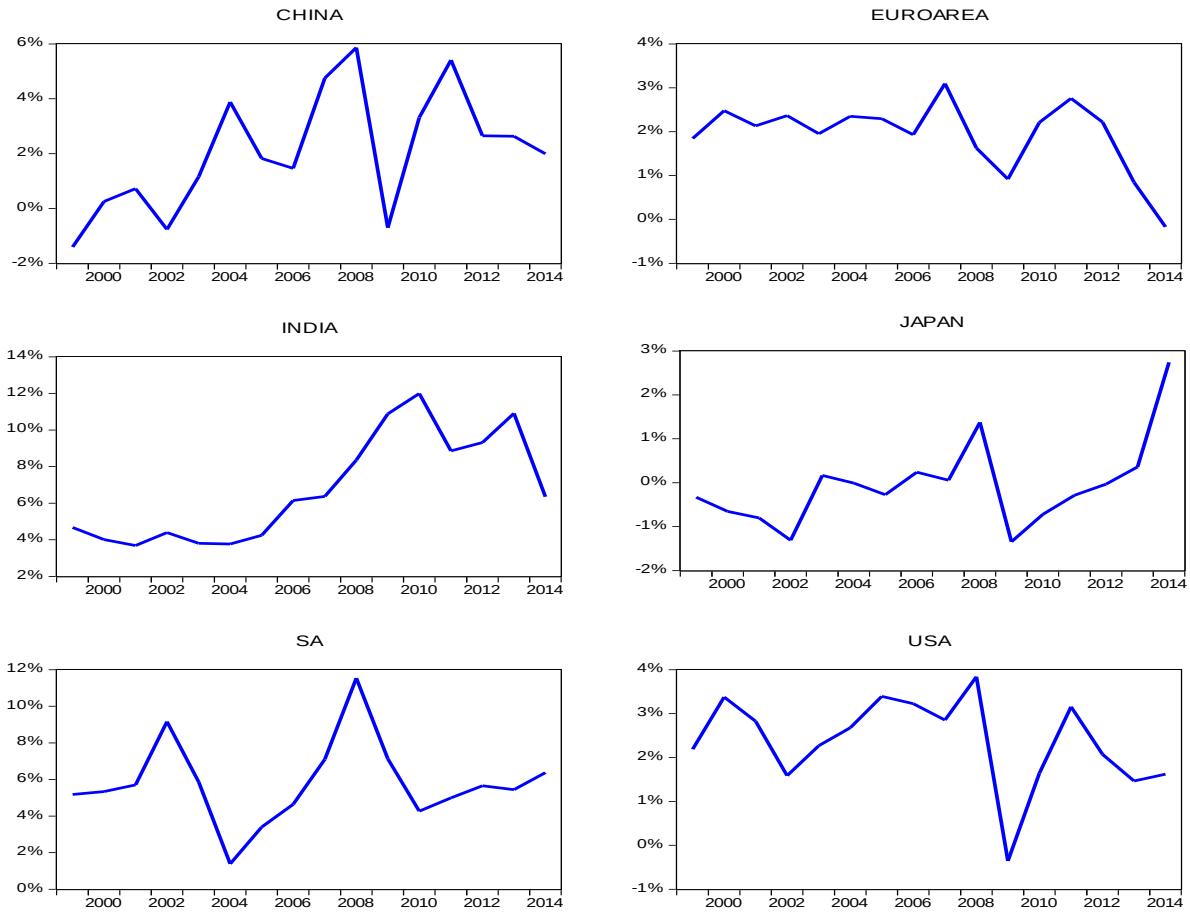
Table 1: Descriptive Statistics-1999-2014

Monthly Nominal Interest Rates (%)						
	South Africa	**United States**	**Japan**	**India**	**Euro-Area**	**China**
Mean	0.09	0.03	0.00	0.07	0.03	0.03
Median	0.08	0.02	0.00	0.06	0.03	0.03
Maximum	0.19	0.06	0.01	0.10	0.06	0.05
Minimum	0.05	0.01	0.00	0.06	0.00	0.03
Std. Dev.	0.03	0.02	0.00	0.01	0.02	0.00
Skewness	0.59	0.61	0.83	0.91	-0.06	1.31
Jarque-Bera	13.07	23.79	22.29	31.59	9.50	122.15
Monthly Real Interest Rates (%)						
Mean	0.03	0.00	0.00	0.00	0.01	0.01
Median	0.02	-0.00	0.00	0.00	0.01	0.01
Maximum	0.13	0.03	0.01	0.04	0.03	0.07
Minimum	0.01	-0.02	-0.01	-0.06	-0.06	-0.02
Std. Dev.	0.02	0.01	0.00	0.03	0.01	0.02
Skewness	0.70	0.26	-0.13	-0.52	0.02	0.15
Kurtosis	3.19	1.98	2.63	2.17	2.15	2.44
Jarque-Bera	15.49	9.86	1.592786	13.35	5.44	3.02
Monthly Inflation Rates (%)						
Mean	0.06	0.02	0.01	0.06	0.02	0.02
Median	0.05	0.02	0.06	0.06	0.02	0.02
Maximum	0.11	0.04	0.12	0.12	0.03	0.06
Minimum	0.01	-0.07	0.03	0.03	0.02	-0.02
Std. Dev.	0.02	0.01	0.02	0.02	0.06	0.02
Skewness	0.69	-1.01	0.47	0.47	-0.77	0.16
Jarque-Bera	19.56	39.73	19.41	19.41	18.95	6.77

Source: author's own calculations (2015)

Table 1 depicts the nominal interest rates, real interest rates and inflation statistics for the sampled countries. Of these countries, South Africa has the highest average nominal and real interest rates (9% and 3% respectively) while Japan has the lowest real and nominal interest rates. Contrary to observed inflation trends in developed countries, the relatively high inflation environment in South Africa necessitates commensurate high interest rates by monetary authorities. In his work on the long horizon relationship between interest rates and inflation, Mishkin (1992) finds that a 1% increase in the rate of inflation leads to a 1.34% increase in the nominal interest rate. The highest nominal interest rate period for South Africa was 1999 when the interest rate reached 19%, coinciding with inflation rate of approximately 6%. South Africa recorded its highest inflation rate for the period under review in 2008 as the globe slumped into a financial meltdown emanating from developed countries. The Inflation trend across the selected countries for the period under review is depicted in the figure below:

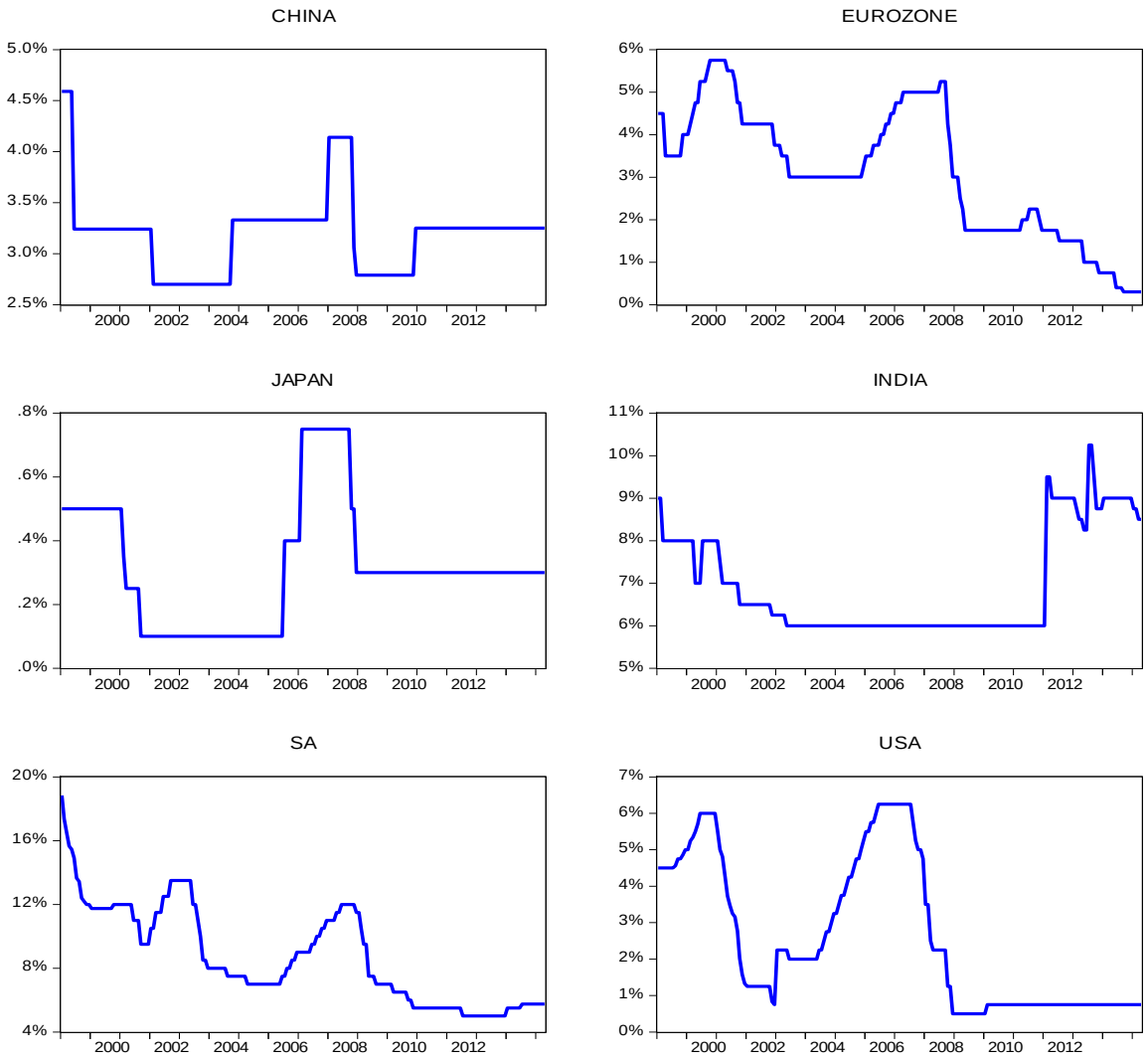
Figure 1: Monthly Inflation rate-1999-2015



Source: Federal Reserve Bank of St. Louis (2015)

The scale of the financial distress of the Japanese economy beginning in the early 1990s was unprecedented amongst the developed world in the post War era, characterized by a deflationary spiral in which prices plummeted steadily (Cargill, 2001). As can be seen in the table above, Japan's average inflation for the period is 1% while the average nominal interest rate is zero percent. The nominal interest rates in the United States and Euro Area are also low, both averaging 3% for the period. Following the 2008 Great Recession and the European Sovereign debt crisis, the US Federal Reserve Bank and the European Central Bank have both embarked on a series of monetary stimulus efforts and interest rates cuts in an attempt to stimulate demand. Typical of most emerging countries, similar to South Africa, India's average interest rates and inflation are also relatively high (7% and 6% respectively). China had average nominal interest rates similar to the US and Euro Area average rates for the period (3%) while average inflation was moderate at 2%.

Figure 2: Percentage nominal interest rate (1999-2015)



Source: Federal Reserve Bank of St. Louis (2015)

Historical nominal interest rates analysis shows that starting in the mid-1970s; US interest rate generally increased significantly and reached a high of 14 percent in 1982. The relatively low interest rate environment of the early 1970s led inflation to rise and prompted the Federal Reserve Bank to hike interest rate sharply during the late 1970s and early 1980s (Cogley and Sargent, 2005). From 1983, US interest rates continued to decline and were at 1 percent in 2003. After rising from 1 percent to approximately 7 percent in 2007, the US interest rate began falling as a result of the 2008 Financial Crisis. The Federal Reserve Bank has ever since kept interest rate at near zero. In the recent periods, US interest rates have declined significantly.

This study also makes use of India, China, Japan, and Euro-area; which have reduced their nominal interest rates to match the general global trend in effort to stimulate economic growth. Japan enjoyed rapid economic growth, especially from

mid-1960s through the 1970s. The rapid economic expansion was as a result of a large-consumption society, as technological progress stimulated the growth of manufacturing facilities, thereby increasing the sale of consumer durables (Koo, 2011).

The resilience of the Japanese economy which was built in the 1960s shielded the country against the effects of the two oil crises of the 1970s. However, the housing market bubble that began in the 1990s had tremendous negative impact on the general economy and led to a decade of weak growth and deflationary spiral (Ito & Mishkin, 2006). In an effort to restore economic growth, the Bank of Japan began aggressively reducing interest rates. From 1972 to 2014, interest rates in Japan averaged 3.04 percent and reached record low in 1999 (Koo, 2011).

Unlike in South Africa, the US, India, Japan and the Euro-area, monetary policy in China has in recent years been conducted under difficult limitations, including a relatively underdeveloped financial system, fixed exchange rate regime and many institutional challenges (Goodfriend & Prasad, 2006). Interest rates in China have averaged 3.2% for 1999-2014 and were reduced significantly in 2002 and 2010 respectively. A desire to enhance trade led to liberalization efforts as authorities began a move towards a flexible exchange rate regime. These considerations have led the authorities to initiate a move towards a more flexible exchange rate regime. However, despite the intention to allow for greater flexibility, the renminbi remain pegged to the dollar. The weak economic growth in the Euro-area, compounded more by the recent Greece severe debt crisis, has prompted the European Central Bank (ECB) to reduce interest rates. The bank began a series of aggressive interest rate cuts following the 2009-2010 Financial Crisis which saw most Euro member countries affected severely and sliding into recession (Martin & Phillippon, 2014). In India, interest rates have also tended to decline over the span.

Table 2: Exchange rate descriptive statistics- 1999-2014

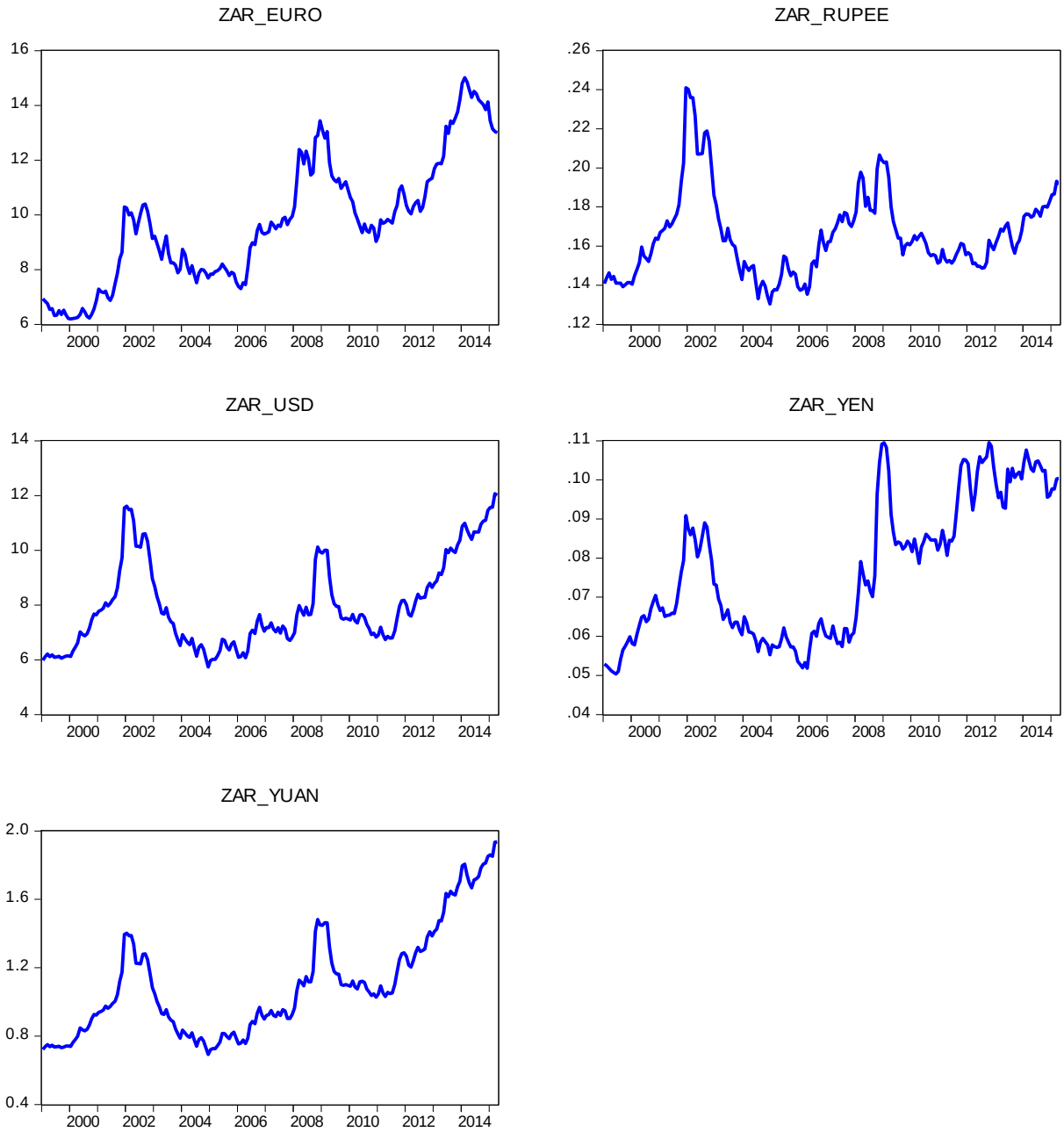
Monthly Exchange rates					
	ZAR_EURO	**ZAR_RUPEE**	**ZAR_USD**	**ZAR_YEN**	**ZAR_YUAN**
Mean	9.73	0.17	7.98	0.08	1.10
Median	9.63	0.16	7.57	0.07	1.05
Maximum	15.01	0.24	12.06	0.11	1.94
Minimum	6.20	0.13	5.73	0.05	0.69
Std. Dev.	2.29	0.02	1.60	0.02	0.32
Skewness	0.42	1.18	0.84	0.31	0.85
Kurtosis	2.39	4.60	2.65	1.70	2.86
Jarque-Bera	8.84	66.37	24.05	16.96	24.01

Notes: South African Rand/Euro (**ZAR_EURO),** South African Rand/Rupee **(ZAR_RUPEE)**, South African Rand/USD **(ZAR_USD),** South African Rand/Yen (**ZAR_YEN),** South African Rand/Yuan (**ZAR_YUAN).**
Source: author's own calculations (2015)

Table 2 lays out crucial summarized statistics of rand and the selected currencies. The Rand has averaged R9.70 against the Euro, R0.17 against the Rupee, R7.9 against the USD, R0.08 against the Japanese Yen, and R1.10 against the renminbi. South Africa uses a free floating exchange rate which is determined by the market forces of supply and demand. The rand fluctuation for the time horizon under review, against a basket of the selected currencies is depicted in figure 3. The forward exchange rate movement closely mirrors the spot exchange rate trend. South Africa's rand has tended to depreciate against the selected countries' currencies in the study.

In the figure below, the ZAR_EURO denotes the relationship between the Rand and the Euro, ZAR_RUPEE represents the relationship between the Rand and the Rupee, ZAR_USD to capture the relationship between the Rand and the American dollar, ZAR_YEN denotes the relationship between the Rand and the Japanese Yen, and ZAR_YUAN to denote the relationship between the Rand and the renminbi. The South African rand has weakened against the selected currencies counterparts to reflect a number of factors, among them the weak economic fundamentals and low investor sentiments, (Zouaoui et.al, 2011), lower yields compared to those in the US, compounded by several downgrades of the country's sovereign bond ratings by rating agencies (Block & Vaaler, 2004). As shown in the figure below, the rand has in general depreciated against a basket of the selected currencies.

Figure 3: Exchange Rate Movement: South African Rand against selected currencies (1999-2015)



Source: South African Reserve Bank, Online Statistical Query (2015)

3.2. Methodology

3.2.1. UIP

With free capital mobility and capital markets which are assumed to be perfect, the relationship of the change in exchange rate and interest rate differential between the domestic (SA) and foreign country (U.S.) is defined below:

$$r_t - r_t^* = f_t - e_t \quad (1)$$

where r_t is the domestic (SA) interest rate, r_t^* is the foreign interest rate and f_t is the forward rate and e_t is the domestic spot exchange rate. However, testing the UIP comes with a number of challenges because according to Isard (1996), expectations regarding the future exchange rates are not directly observable. Therefore, the current forward rate is taken to be equivalent to the expected exchange rate $E(e_{t+1})$ as well a forecast error term. The above relation assumes that investors are risk neutral. Factoring in expectations about future exchange rate, we have:

$$r_t - r_t^* = E(e_{t+1}) - e_t \quad (2)$$

Assuming the UIP hypothesis holds, capital moves freely across borders and investors are indifferent between investing in South African or U.S. assets because return between the two countries is the same. Capital market imperfections under a flexible exchange rate regime lead to interest differences between the two countries. The simplest version of the uncovered interest parity condition is stated as:

$$r_{t+n} - r_{t+n}^* = [E(e_{t+n}) - e_t]/e_t \quad (3)$$

r_{t+n} and r_{t+n}^* are the domestic and foreign nominal interest rates respectively. F_{t+n} is the n-horizon forward rate.

Under the Uncovered Interest Rate Parity (UIP) condition, there are no arbitrage opportunities as the local South Africa's interest rate (r_t) and international interest rate (r_t^*) is assumed to be equivalent to the yield spread in the exchange rate. When investors are risk neutral, the UIP condition is simplified as:

$$\Delta e^e_{t,t+k} = (r_{t,k} - r_{t,k}^*) \quad (4)$$

$\Delta e^e_{t,t+k}$ denotes the percentage change in the expected spot exchange rate, t denotes the spot exchange rate period and k is the future exchange rate period, (r_t)

and (r_t^*) defines domestic (South African) and foreign (US) interest rate respectively. Equation (4) assumes that there are no arbitrage opportunities between South Africa and the US, implying the change in the exchange rate and the interest rate differential are in equilibrium. This implies that investors cannot earn extra return by moving funds between countries. When investors are risk averse, equation (4) becomes:

$$\Delta e^{e}_{t,t+k} = (r_{t,k} - r_{t,k}{}^{*}) + \delta_{t,t+k} \quad (5)$$

where $\delta_{t,t+k}$ represents the risk premium needed by investors who are risk averse who would demand to be compensated for assuming risk associated with holding securities. The caveat of equation (5) is that the expected exchange rate cannot be observed. Engel (1996) attempted to circumvent this caveat by formulating that the market movement at period t+k, with information efficiently utilized at time t, can be determined as:

$$e_{t,t+k} = e^{e}_{t,t+k} + \mu_{t,t+k} \quad (6)$$

The term $e^{e}_{t,t+k}$ denotes the expected future exchange rate under the assumption of rational expectation. The term $\mu_{t,t+k}$ defines the white-noise stochastic process which is not correlated with the exchange rate spread at period t. This equation shows that the exchange rate at period t in the future is explained by the expected exchange rate ($e^{e}_{t,t+k}$) plus the white noise variable ($e^{e}_{t,t+k}$) which represents all the other factors which can affect the exchange rate at time t. Combining equation (5) and (6), we get:

$$\Delta e_{t,t+k} = (r_{t,k} - r_{t,k}{}^{*}) + \delta_{t,t+k} - \mu_{t,t+k} \quad (7)$$

Assuming that the terms $\delta_{t,t+k}$ and $\mu_{t,t+k}$ are statistically independent of the interest rate differential, equation (7) can be re-written in a testable form of the Uncovered Interest Parity (UIP) hypothesis (see Chin and Meredith, 2005):

$$\Delta e_{t,t+k} = \alpha + \beta(r_{t,k} - r_{t,k}{}^{*}) + \varepsilon_{t,t+k} \quad (8)$$

The term $\varepsilon_{t,t+k}$ represents the white noise and assuming rational expectations in exchange markets and risk-neutrality amongst investors, α should equal zero to reflect the absence of a constant risk premium and β should be equal to one to capture a complete depreciating relation as posited according to the UIP. The UIP

requires that as the interest-rate differential widens, the exchange rate should equally adjust through depreciation. For instance, if the foreign currency is two percent higher than the rand, the dollar is expected to depreciate by two percent after the two year period. Interest rate parity reinforces the balance between exchange rates and preventing arbitrage opportunities. The absence of the balance between the two currencies implies that both the foreign and domestic investors would not prefer to hold lower interest rate bonds.

Before estimating equation 8, it is important to examine the series $\Delta e_{t,t+k}$ and $(r_{t,k} - r_{t,k}{}^{*})$ for the presence of unit root to test whether the series are stationary. Running a regression in the case where two or more series are non-stationary yields spurious regression results (Kao, 1999). A spurious regression is a situation whereby two unrelated series are treated as related. In this case, the R-square may turn out to be high, thereby producing misleading results (Granger & Newbold, 1974). Based on the unit root analysis, the interest rate differential series $(r_{t,k} - r_{t,k}{}^{*})$ exhibit non-stationarity but can be made stationary by taking the first difference. However, for the purpose of UIP regression test, the interest rates differential$(r_{t,k} - r_{t,k}{}^{*})$ is conducted in level form. The interest rate differential is therefore integrated of I(1). However, $\Delta e_{t,t+k}$ portrays a random walk pattern and tests indicate that the series is stationary and integrated of order I (0).

While regressing two or more time series against each other yields spurious results, exception is made in the event that that the series exhibit evidence for cointegration (Kao, 1999). Cointegration is a phenomenon whereby there is a long run relationship between two series which individually are not in equilibrium (Johansen, 1988). Analyzing the two time series, we do not reject the econometric evidence that the two series are cointegrated and thus there is a long- run equilibrium relationship between them. Therefore, equation 5 will be tested as Ordinary Least Square (OLS).

3.2.2. The Purchasing Power Parity

As outlined in the preceding chapter, purchasing power parity (PPP) is one of the most crucial theoretical notions in international finance. Purchasing power parity describes the quantity of baskets of goods and services that can be bought as defined by a representative bundle of goods. The absolute version of the PPP

compares the absolute price level between two countries against the level of the exchange rate in the respective countries. The PPP relation i is defined below:

$$(e_{t+1} - e_t)/e_t = (\pi^d - \pi^f)/(1 + \pi^f) \quad (9)$$

where π^d and π^f represents domestic and foreign inflation rate respectively. Equation (9) implies the domestic and foreign prices and the changes on the exchange rate should equalize over time, whereby increase in domestic inflation is accompanied by domestic currency depreciation. However, in most observable cases, the channel of cause-and-effect between the two variables has tended to begin with currency depreciation, leading to domestic inflationary pressures. The relative PPP postulates that the differences in inflation between countries (local and international), reflected by the change on the exchange rate, implying for instance that if inflation in South Africa is higher than in the United States by a particular percentage, the US dollar must appreciate by the percentage by which South Africa's inflation exceed that of the US. The linear relation of the relative PPP is shown:

$$\Delta e_t = \emptyset + \rho(\pi^d - \pi^f) + \varepsilon \quad (10)$$

3.2.3. The International Fisher Effect

The International Fisher Effect hypothesis is a generalized relative version of the PPP positing that the possibility of arbitrage opportunities will ensure that real interest rates are equalized across economies. If real interest rates are equal between two countries, the observed differences in nominal interest rates are owed to differences in expected inflation. Equalization of real interest rates across countries requires perfect markets with free capital mobility (Taylor, 1988). In equilibrium, the differential in expected inflation rate is equal to the nominal interest rate differential (Demirag & Goddard, 1994). This relation is represented in equation (11) in which $r_{d,t}$ and $r_{f,t}$ are the domestic and foreign interest rate respectively; $E(\pi^d)$ and $E(\pi^f)$ denote the domestic and foreign country expected inflation rate.

$$\frac{(1+r_{d,t})}{(1+r_{f,t})} = \frac{(1+E(\pi^d))}{(1+E(\pi^f))} \quad (11)$$

Combining equation (10) and (11) yields the International Fisher relation:

$$\frac{((e_{t+1}-e_t)}{e_t} = \frac{(1+r_{d,t})}{(1+r_{f,t})} \quad (12)$$

The international Fisher Effect captured in equation (12) states that worldwide real interest rates are made equal across boarders through arbitrage. In this process, the demand and supply of funds determines the real interest rate. This process comes about as a result of investors chasing investment opportunities in countries where real interest rates are higher. Interest rate differences between two integrated capital markets can be attributed to factors such as psychological barriers, political risk, and inflation (Solnik & Roulet, 2000), legal constraints, transaction costs, and currency risks (Taylor, 1988). However, if the absence of capital market imperfections and free capital mobility, interest rate differentials between markets is eliminated.

The International Fisher relation regression model discussed below is similar with that of Sundqvist (2002). When a market is efficient, the exchange rate makes an immediate adjustment to reflect the new information on which all rational market participants make their decisions (Cheung et al., 2005). Given a certain set of information,φ_t at time t, the expected future spot exchange rate can be represented:

$$E(e_{t+1}, \varphi_t) \quad (13)$$

Given all the readily available information that is accessible to the trading public at time t, the expected future spot on average, rate is approximately equal to the future spot rate (Hansen & Hodrick, 1980):

$$e_{t+1} = E(e_{t+1}, \varphi_t) \quad (14)$$

In order to capture the differential between the expected future spot rate and the real future spot rate realized, an error term ϑ_{t+1} is added to equation (14). The assumption that all market participants are rational implies that the error term is not correlated with the available information at time t.

$$e_{t+1} = E(e_{t+1}, \varphi_t) + \vartheta_{t+1} \quad (15)$$

The International Fisher Effect regression model to be estimated takes the form below:

$$(e_{t+1} - e_t)/e_t = \alpha + \gamma((r^d - r^f)/(1 + r^f)) + \vartheta_{t+1} \quad (16)$$

The coefficient α captures the value by which the exchange rate changes when the nominal interest rate differential is equal to zero. The null hypothesis for the International Fisher is that $\alpha = 0$ and $\gamma = 1$. Just like the UIP and PPP regression models discussed above, equation (16) coefficients will be estimated using Ordinary Least Squares.

CHAPTER 4

EMPIRICAL ANALYSIS

4. INTRODUCTION TO ANALYSIS

The preceding chapters have laid an important introductory aspect of the focus of the research. Past studies related to the research topic were considered and discussed with emphasis on their critical findings and shortcomings. The selected literature review included cross continental studies in Europe and North, Oceana and Latin America, as well as few other South African based work done on the topic. The methodological approach which the research work employs was discussed in detail in chapter 3. In particular, chapter 3 presented the data and models to be utilized and the various tests to be conducted in the research.

This chapter builds on the foundation which has already been established in the previous chapters. The chapter begins by carrying out a series of econometric tests and discusses the significance of the results. The ensuing sections deal with stationarity and cointegration before delving into more formal tests of the UIP, PPP, and the International Fisher Effect. Results from Impulse responses following shocks to variables in the models are also presented. The chapter relates the findings of the research to historical and current capital market developments for a better comprehension. In particular, the movements in bond purchases and sales following changes in interest rates as well as the impact on the rand are discussed. Thus, for the cases where the theoretical expectations and posited hypotheses do not hold, an attempt is made to explain possible reasons for the result. The chapter concludes with an explanation of the findings and their implication on the capital markets, especially in emerging market context like South Africa.

4.1. Unit Root test

The first procedure is to use the Augmented Dickey Fuller (ADF) to conduct unit root tests for the interest rate, interest rate differential between the domestic and foreign country, and exchange rate series with the null hypothesis being that of the presence of unit root. The null hypothesis (H_o) is that the series has unit root and the alternative hypothesis (H_1) is that the series is trend stationary. The ADF output

displayed in panel (a) of table 3 below suggest that the level series of the nominal domestic (South Africa) and foreign interest rate are non-stationary. We therefore accept the results indicating presence of unit root at 1%, 5% and 10% critical values for all nominal interest rates series for the countries in the study. The domestic and foreign interest rate is I (1).

Table 3: ADF Test on Nominal Interest Rate and Exchange Rate

(a) ADF Nominal Interest Rate												
Countries	**Levels**						**First Differences**					
	Intercept			**Intercept & Trend**			**Intercept**			**Intercept & Trend**		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2
South Africa (Home country)	-3.781	-2.712	-2.152	-3.290	-2.628	-2.799	-11.63	-3.673	-4.625	-11.724	-6.366	-4.566
United States	-0.835	-1.128	-1.453	-1.004	-1.374	-1.795	-10.243	-6.269	-4.827	-10.224	-6.272	-4.811
China	-3.934	-3.935	-3.94	-3.924	-3.921	-3.913	-13.034	-13.038	-13.039	-13.090	-13.098	-13.096
Euroarea	-0.104	-0.483	-0.836	-1.336	-1.686	-2.064	-11.045	-7.074	-7.076	-11.065	-7.084	-7.085
India	-2.078	-2.075	-2.074	-2.563	-2.564	-2.563	-13.314	-11.583	-11.585	-13.406	-11.665	-11.664
Japan	-1.707	-1.701	-1.703	-1.72	-1.7201	-1.720	-13.310	-13.310	-13.310	-13.293	-13.293	-13.293
Critical Values												
1%			-3.463			-4.005			-3.464			-4.006
5%			-2.876			-3.433			-2.876			-3.433
10%			-2.574			-3.140			-2.574			-3.140

(b) ADF Exchange Rate												
Countries	**Levels**						**First Differences**					
	Intercept			**Intercept & Trend**			**Intercept**			**Intercept & Trend**		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2
R/¥ (Yuan)	0.501	-0.364	-0.364	-0.661	-1.526	-1.524	-9.677	-9.677	-9.677	-9.713	-9.713	-9.713
R/$	-0.508	-1.365	-1.364	-0.941	-1.783	-1.785	-9.761	-9.761	-9.761	-9.776	-9.776	-9.776
R/¥ (Yen)	-1.354	-1.928	-1.926	-2.048	-2.913	-2.914	-9.870	-9.870	-9.870	-9.845	-9.845	-9.845
R/€	-0.935	-1.253	-1.253	-1.977	-2.442	-2.442	-11.214	-11.214	-11.214	-11.191	-11.191	-11.191
R /₹	-1.912	-2.554	-2.557	-1.917	-2.552	-2.557	-10.458	-10.458	-10.458	-10.424	-10.424	-10.424
Critical Values												
1%			-3.463			-4.006			-3.464			-4.006
5%			-2.876			-3.433			-2.876			-3.433
10%			-2.574			-3.140			-2.574			-3.140

Source: Author's own calculations (2015)

Panel (b) of table 3 tests the exchange rate series for the respective countries in order to check for the presence of unit root. The evidence presented in the model shows that the hypothesis of unit root cannot be rejected.

The focus now turns to the analysis of the variables which enters directly in the UIP models outlined in the methodology. The interest rate differential $(r_{t,k} - r_{t,k}^{*})$ is

tested for presence of unit root using the ADF procedure as the one followed above. The results are presented in panel (d) of table 4, showing that the interest rate differential consists of a unit root which is made stationary by taking the first difference (please note that the first difference is performed for demonstrative purpose only. For the UIP, the regressions are conducted on interest rate differential in level form). The dependent variable ($\Delta e_{t,t+k}$)is also tested for stationarity in similar fashion as the interest rate differential and the results are presented in panel (d) of the table 4, showing a stationary process of I(0).

Table 4: ADF on Interest rate differential

(d) ADF Interest rate differential												
Countries	Levels						First Differences					
	Intercept			Intercept & Trend			Intercept			Intercept & Trend		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2
SA-CHN	-2.942	-2.943	-1.873	-2.718	-2.719	-2.658	-12.220	-6.970	-6.970	-12.263	-6.952	-6.953
SA-USA	-3.018	-2.339	-2.310	-2.407	-2.048	-2.310	-10.90	-6.21	-4.38	-10.96	-6.20	-4.32
SA-IND	-2.077	-2.077	-2.077	-2.561	-2.561	-2.561	-13.318	-11.587	-11.587	-13.409	-11.669	-11.669
SA-JAP	-3.730	-2.681	-2.143	-3.352	-2.682	-2.881	-11.705	-6.461	-4.744	-11.800	-6.463	-4.681
SA-EUR	-4.780	-4.785	-2.933	-3.814	-3.814	-2.713	-12.354	-7.243	-4.852	-12.600	-7.335	-4.934
Critical Values												
1%	-3.463			-4.005			-3.464			-4.006		
5%	-2.876			-3.433			-2.876			-3.433		
10%	-2.574			-3.140			-2.574			-3.140		

Source: Author's own calculations (2015)

The ADF test for the percentage change in the exchange rate series reveals a stationary process in level form. This implies that the exchange rate variable is not tested for stationarity in differenced form as the test statistics as displayed in table 5 are more negative than their corresponding critical values at the three levels of significance. Therefore, the exchange rate data will be used in level form in the model.

Table 5: ADF Test on Expected Percentage Exchange rate

(e) ADF Percentage Exchange rate						
Countries	Levels					
	Intercept			Intercept & Trend		
	Lag0	Lag1	Lag2	Lag0	Lag1	Lag2
SA-CHN	-9.762	-9.762	-9.762	-9.762	-9.762	-9.762
SA-USA	-9.891	-9.891	-9.891	-9.881	-9.881	-9.881
SA-IND	-10.624	-10.624	-10.624	-10.600	-10.600	-10.600
SA-JAP	-10.163	-10.163	-10.163	-10.142	-10.142	-10.142
SA-EUR	-11.011	-11.011	-11.011	-10.981	-10.981	-10.981
Critical Values						
1%	-3.464			-4.006		
5%	-2.876			-3.433		
10%	-2.574			-3.140		

Source: Author's own calculations (2015)

4.2. Cointegration test

As described in the methodology, regression of non-stationary series ordinarily yields a spurious regression results (Engel & Granger, 1987). The authors have also demonstrated how using the R^2 test for relationship for series with trends may yield misleading results. The only way to avoid a spurious regression results in OLS is to test whether the linear combination of the individually integrated series contains some lower order of integration. This implies testing for cointegration between the series to determine the presence of long run relationship. If $(r_{t,k} - r_{t,k}^{*})$ and $(\Delta e_{t,t+k})$ are cointegrated, the linear combination of the two series is stationary (Phillips & Perron, 1988).

Table 6: Test for cointegration

Included observations: 190 after adjustments.						
Trend assumption: Linear deterministic trend						
Lags interval (in first differences): 1 to 4						
	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	No. of Cointegrating eqn(s)
SA-CHN	None *	0.162	38.213	15.494	0.000	2
	At most 1 *	0.036	6.140	3.848	0.010	
SA-USA	None *	0.168	39.757	15.491	0.000	2
	At most 1 *	0.046	7.540	3.84	0.010	
SA-IND	None *	0.217	45.324	15.494	0.000	1
	At most 1 *	0.012	1.485	3.841	0.220	
SA-JAP	None *	0.222	51.572	15.492	0.000	2
	At most 1 *	0.034	5.565	3.844	0.020	
SA-EUR	None *	0.205	55.013	15.495	0.000	2
	At most 1 *	0.063	12.635	3.846	0.000	

Source: Author's own calculations (2015)

By looking at the eigenvalues and the trace statistics for the respective critical values and corresponding probabilities, as provided in table 6, for all the cases, there is at least one cointegrating equation, implying a long run relationship between $(r_{t,k} - r_{t,k}{}^{*})$ and $(\Delta e_{t,t+k})$. The assumption of no cointegration in the series can therefore be rejected. Thus, despite the possibility that the interest rate differential and the expected percentage change in the exchange rate can diverge substantially in the short-run, they will obey a long-run equilibrium relationship.

4.3. Long run UIP

The findings in section 4.2 form a fundamental basis for running the two series for each of the five UIP test cases as Ordinary Least Squares to yield unbiased non-spurious regression results. The analysis relies primarily on the t-statistic and p-values reported in column five and six respectively. The t-statistic was determined by taking the estimated value of the coefficient and dividing by its standard error. The t-statistic captures the likelihood that the estimated parameter is not statistically different from zero (Naylor & Wichern, 1972). The lower the value of the t-statistic in the regression output, the higher the likelihood that the estimated parameter is not different from zero.

The generally accepted thumb-rule for a statistically significant t-statistic value is a value of at least two in absolute value. Based on the probability value, a smaller value, at most 0.05 would support the likelihood of the estimated parameter being different from zero. The R^2 as reported in column 7 also provides crucial information in respect of the degree to which the explanatory variable such as $(r_{t,k} - r_{t,k}{}^*)$, which is the interest rate differential between the domestic and foreign country, can be used to explain the depended variable ($\Delta e_{t,t+k}$) in the UIP model. Low R^2 suggests poor fit and weak relationship between the variables in question. Table 7 provides the long-horizon OLS results for the UIP model:

Table 7: UIP long horizon (1999-2014)

$\Delta e_{t,t+k} = \alpha + \beta(r_{t,k} - r_{t,k}{}^*) + \varepsilon_{t,t+k}$						
Variable	**Coefficient**		**Std. Error**	**t-Statistic**	**Prob.**	R^2
$(r_{SA} - r_{CHN}{}^*)$	B	0.125	0.089	1.403	0.162	0.010
	α	-0.011	0.005	-2.017**	0.0451	
$(r_{SA} - r_{USA}{}^*)$	B	0.144	0.094	1.524	0.128	0.011
	α	-0.011	0.006	-1.845*	0.066	
$(r_{SA} - r_{IND}{}^*)$	B	-0.202	0.189	-1.067	0.287	0.005
	α	0.012	0.013	0.972	0.331	
$(r_{SA} - r_{JAP}{}^*)$	B	-0.011	0.100	-0.118	0.905	0.000
	α	-0.001	0.008	-0.160	0.872	
$(r_{SA} - r_{EUR}{}^*)$	B	0.282	0.118	2.372**	0.018	0.028
	α	-0.018	0.007	-2.598**	0.010	

Notes: ** and * indicates significance at 5% and 10% levels respectively.
Source: Author's own calculations (2015)

In their UIP tests, Chinn & Meredith (2001) found that the UIP holds only at long horizons. Therefore the analysis begins with testing for the UIP in the long horizon. Examining the results from the UIP tests as depicted in table 7, for each of the five domestic-foreign cases, we get interesting results. Starting with the β coefficient, the t-statistics and probability values suggest that the hypothesized UIP relation is insignificant for four out of the five cases (SA-CHN, SA-USA, SA-IND and SA-JAP). The t-statistic is small for each of these four cases (1.4, 1.5, -1.1, and -0.12). Similarly to the findings of Lily et al. (2011), the β coefficient for the SA-IND and SA-JAP has wrong signs, opposed to the expectation of a positive slope coefficient. The UIP results for the SA-EUR zone however, seems to suggest that the hypothesized UIP relation between the euro-area and South Africa exists. However, the relatively

low R^2 force us to reject the UIP for the SA-EUR case, though not as strongly as we do for the other cases. In other words, the results for the SA-EUR case support the UIP which emphasizes the efficiency of the forward market, indicating the that the rand will likely depreciate against the euro if for instance, the South Africa's interest rates rises above those in the Euro-area. This implies that South Africa's rand is expected to depreciate against the euro when South Africa's interest rate rises higher than those prevailing in the euro-area. However, this SA-EUR exception does not hold for the other cases, as presented in table 5. The R^2 values portrayed in the table are very low, especially for the first four cases (SA-CHN, SA-USA, SA-IND and SA-JAP), suggesting that the interest rate differential between South Africa and the respective countries in the study are poor predictors of movements in the exchange rate. The value of the R^2 shows some minor negligible improvement for the SA-EUR case (0.03), though still insufficient to consider the interest rate differential as a good variable in explaining the variation in $\Delta e_{t,t+k}$. Having tested the UIP at long horizon, we now turn to consider how the results differ when testing the UIP in the short run.

4.4. Short run UIP

Table 8 shows the regression results from testing the UIP at short-term horizon: 12 months, 16 months and 19 months. As it can be seen in the table, the 12 months results reflect a definitive failure of the UIP, with very small t-statistics, wrong signs and too large coefficients. The signs and magnitude of the parameters seems to improve as we move from 12 month horizon to the 19 months horizon. In the 16 months and 19 month short-term horizon, two cases are observed in support of the UIP, namely the SA-IND and SA-JAP. However, the reduced degree of freedom associated with conducting UIP for short term horizon presents a number of challenges and caution with which the interpretation of the findings must be rendered, which could lead to distorted regression results.

Table 8: UIP Short Horizon (2013-2014)

$\Delta e_{t,t+k} = \alpha + \beta(r_{t,k} - r_{t,k}^{*}) + \varepsilon_{t,t+k}$						
	12 Months		16 Months		19 Months	
	B	t-Statistic	β	t-Statistic	B	t-Statistic
$(r_{SA} - r_{CHN}^{*})$	-5.075	-0.881	-0.392	-0.194	0.833	0.439
$(r_{SA} - r_{USA}^{*})$	-2.853**	-0.560	-0.572	1.768	0.600	0.345
$(r_{SA} - r_{IND}^{*})$	-0.300	-0.739	1.044	2.672**	3.322***	4.381***
$(r_{SA} - r_{JAP}^{*})$	8.621	1.298	0.79	0.338	2.890**	1.139
$(r_{SA} - r_{EUR}^{*})$	0.700	0.396	1.118	1.246	1.803	1.777

Notes:*** , ** and * indicates significance at 1%, 5% and 10% levels respectively.
Source: Author's own calculations (2015)

4.5. The Purchasing Power Parity (PPP) and the International Fisher effect

The focus now turns to the related hypothesis of testing the validity of the Purchasing Power Parity (PPP) and the international fisher effect. As already discussed in the preceding chapter, the International Fisher Effect can be summarized as predicting that the domestic currency will depreciate against that of a foreign trading partner as a result of an increase in the domestic real interest rates above those of the foreign counterpart. On the other hand, the PPP relates the changes between currencies of two countries over a period of time to changes in the price levels between the two countries (Dornbusch, 1985). The PPP and the International Fisher Effect are therefore in many aspects comparable with the UIP. Table 7 shows the results of the OLS results of both the International Fisher Effect and the PPP. Except for the SA-EUR case under the International Fisher Effect which seems to reflect a significant relationship between the real interest rate differential on the real foreign rate against the expected percentage change in exchange rate, the rest of the cases do not seem to display any evidence to suggest any statistically significant relationship between the interest rate differential, inflation and the changes in the domestic exchange rate. Nor does the value of the R^2 across all the International Fisher and PPP cases indicate any explanatory power of the interest rate differential or inflationary differences to explain variations in the expected percentage exchange rate. The findings from the UIP tests regarding the SA-EUR case which suggested that the UIP could hold between South Africa and the Euro-area is confirmed in the International Fisher Effect but not in the PPP results displayed in table 9.

Table 9: The International Fisher Effect & PPP

(a) $(e_{t+1} - e_t)/e_t = \delta + \gamma((r^d - r^f)/(1 + r^f)) + \vartheta_{t+1}$

Variable	Coefficient		Std. Error	t-Statistic	Prob.	R^2
$(r^{SA} - r^{CHN})/(1 + r^{CHN})$	γ	-0.066	0.115	-0.576	0.564	0.001
	δ	0.007	0.003	1.900*	0.058	
$(r^{SA} - r^{USA})/(1 + r^{USA})$	γ	-0.117	0.123	-0.952	0.342	0.005
	δ	0.007	0.004	1.622	0.106	
$(r^{SA} - r^{IND})/(1 + r^{IND})$	γ	-0.203	0.112	-1.799	0.073	0.017
	δ	0.008	0.004	1.873*	0.062	
$(r^{SA} - r^{JAP})/(1 + r^{JAP})$	γ	-0.093	0.119	-0.783	0.434	0.003
	δ	0.007	0.004	1.576018	0.116	
$(r^{SA} - r^{EUR})/(1 + r^{EUR})$	γ	-0.314	0.105	-2.988**	0.003	0.047
	δ	0.010	0.003	3.245***	0.001	

(b) PPP

$$\Delta e_t = \emptyset + \rho(\pi^d - \pi^f) + \varepsilon$$

Variable	Coefficient		Std. Error	t-Statistic	Prob.	R^2
$(\pi^{SA} - \pi^{CHN})$	P	-0.069	0.093	-0.748245	0.455	0.003
	$\emptyset$	0.008	0.004	1.853529*	0.065	
$(\pi^{SA} - \pi^{USA})$	P	-0.053	0.111	-0.479	0.632	0.001
	$\emptyset$	0.005	0.004	1.229	0.220	
$(\pi^{SA} - \pi^{IND})$	P	-0.054	0.088	-0.613	0.540	0.002
	$\emptyset$	0.005	0.006	0.838	0.402	
$(\pi^{SA} - \pi^{JAP})$	P	0.145	0.142	1.023	0.307	0.005
	$\emptyset$	-0.004	0.009	-0.439	0.660	
$(\pi^{SA} - \pi^{EUR})$	P	0.118	0.107	1.096	0.274	0.006
	$\emptyset$	0.000	0.004	0.097	0.922	

Notes:*** , ** and * indicates significance at 1%, 5% and 10% levels respectively.
Source: Author's own calculations (2015)

Table 9 shows the statistical findings from testing both the International Effect (panel a) and the Purchasing Power Parity (panel b). Evidence in support of the International Fisher Effect is found for the SA-EUR case, with significant values of both the beta an intercept coefficients reported as shown in the table. This finding is similar to the results in table 7 which also suggested some evidence in support of the UIP for the case of SA-EUR. However, neither the PPP nor the International Fisher

Effect holds for the other four cases, as the t-statistics yields insignificant results, as was found when testing for the validity of the UIP in the foregoing sections. The implication for the failure of the International Fisher Effect to hold is that a country with higher interest rates need not necessarily be matched by higher inflation. This also implies that an increase in inflation may not necessarily be accompanied by a depreciation of the currency.

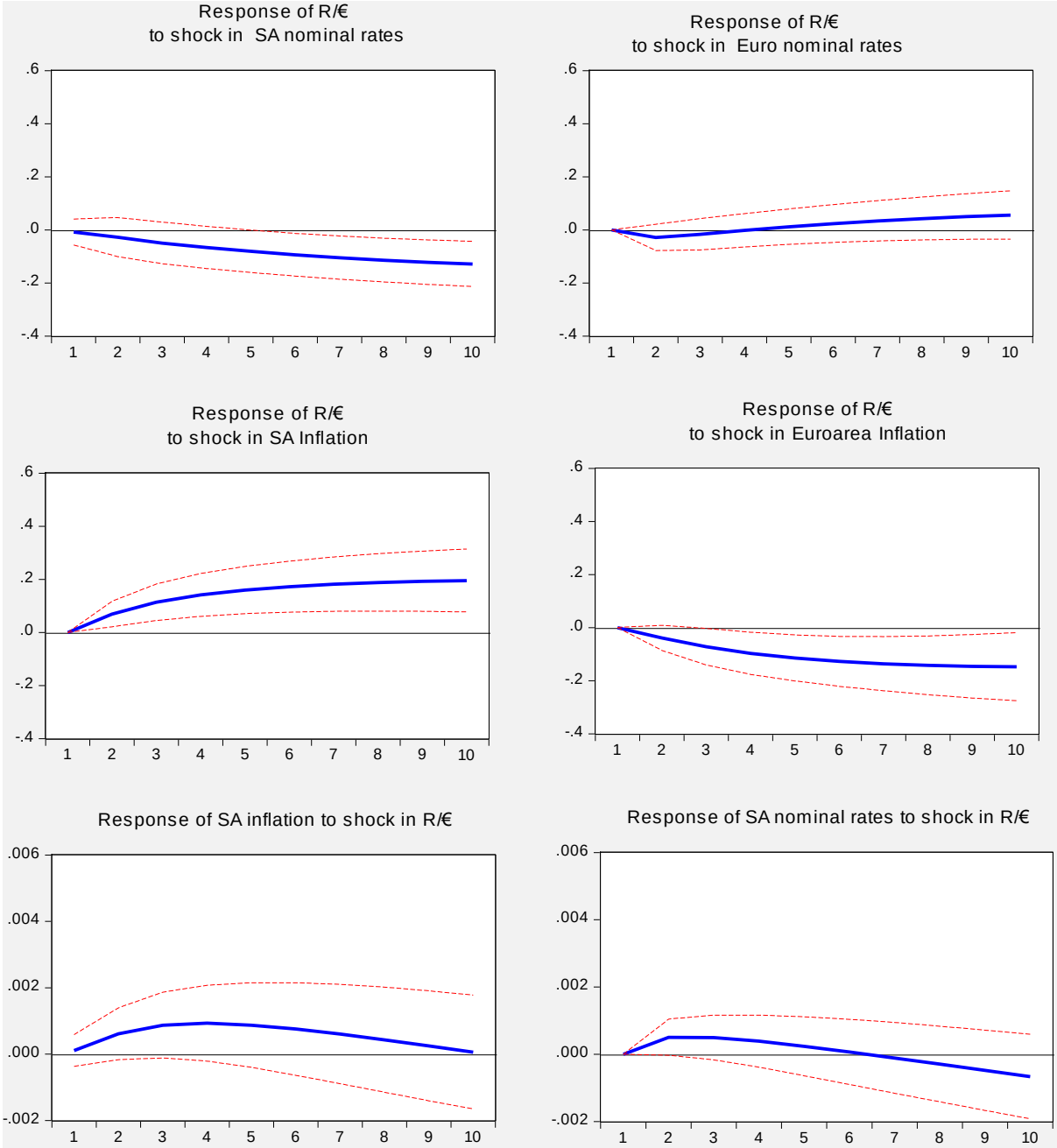
4.6. Impulse responses

The evidence in favour of the UIP and the International Fisher hypothesis necessitates some more scrutiny on the response of the exchange rate to shocks in the economy due to nominal interest rates and inflation. In this section, we closely examine the dynamic reaction of the models to changes in external factors. An impulse response is used to investigate these reactions as function of time and other variables which are object of our interest in the dynamic models. The impulses are generated though vector autoregressive systems whereby we attempt to establish linear interdependencies among the various time series utilized in the models. The response of inflation and nominal interest rate to shocks in the exchange rate is also shown in figure 5. In the event of shock in the economy due to nominal interest rate increase, the rand will appreciate by approximately 2% against the euro in the first period. An external shock due to increase in nominal interest rate in the euro-area leads initially to a transient 0.02% appreciation of the rand in the first period, before it depreciates against the euro by approximately 0.5%. However, this rather erratic path of response does not appear to be consistent with the UIP prediction, supporting the generally accepted previous literature that the UIP in most cases fail to hold.

Following a domestic inflationary shock, the rand will adjust to the shock by depreciating against the euro by 1.8%, in line with the PPP and Fisher hypothesis. This behaviour could be attributed to a wide variety of factors. An increase in domestic inflation generally reduces the competitiveness of a country's currency in relation to that of the trading partner. These findings are related with Mishkin's (1992) evidence in favour of the long-run Fisher Effect which showed how inflation has an effect on the exchange rate through the effects on interest rates, as they both have a common stochastic trend. The opposite happens when there are positive inflationary shocks in the euro-area, leading to a 1.9% appreciation in the rand,

attributed to improving domestic competitiveness. A sudden exchange rate shock has an effect of increasing domestic inflation to 0.5% in the first period, before it eventually dampens to 0%.

Figure 4: Impulse Response Functions to shocks



Source: Author's own calculations (2015)

4.7. Causality test: UIP, PPP and the International Fisher Effect

The next step involves looking at Granger Causality tests as initially proposed by Granger (1969). This method generally attempts to determine whether one variable can be used to explain another. For instance, the UIP hypothesis surmises that the interest rate differential between domestic and foreign country can be used to explain the expected percentage change in the exchange rate. The Granger Causality test therefore is interested in testing the validity of such hypothesis. Correlation is characterized by a tendency of variables to move together whether in positive or negative direction. In the case of UIP for instance, the variables $(r_{t,k} - r_{t,k}^{*})$ and $\Delta e_{t,t+k}$ appear to exhibit a correlated pattern in which the increase in the domestic interest rate occurs at the same time at which the rand depreciates. However, it cannot necessarily be the case that the depreciation was caused by the increase in the domestic interest rate. The significance of the Granger test lies in separating relationships which are merely due to statistical correlation from those that are causal in nature.

The time series $(r_{t,k} - r_{t,k}^{*})$ is considered to Granger-cause $\Delta e_{t,t+k}$ if it can be proved, usually through F-tests and probability values on the lagged values of $(r_{t,k} - r_{t,k}^{*})$, that those $(r_{t,k} - r_{t,k}^{*})$ values yields information in respect of future values of $\Delta e_{t,t+k}$ that is statistically significant. Table 10 provides such information, where column one shows the null hypothesis to be tested for each of the series. Column 2 and column 3 provide the F-tests and probability values respectively. Starting with the UIP examination for any causality in the series, the table displays the results for the PPP and the International Fisher.

The UIP tests for each of the five cases shows that the interest rate differential series between South Africa and China does not Granger cause movements in the expected percentage exchange rate. Instead, it is the exchange rate movement which seems to have causal effect on the interest rate differential. The results are the same for the SA-USA case which show that the interest rate differential does not cause changes in the rand/dollar exchange rate. The SA-IND and SA-JAP cases show that neither the interest rate differential nor the exchange rate has any causal effect on each other. The evidence in favour of the UIP for the SA-EUR case as displayed in table 7 is confirmed in the Granger Causality test, as the information in table 7 shows that the hypothesis positing that the series $(r_{t,k} - r_{t,k}^{*})$, can be used to

predict movements in the rand/euro exchange rate cannot be rejected, with the F-test value of 2.97.

Most of the evidence from the PPP also shows that with the exception of the SA-EUR case, the inflation rate differential series $(\pi^{d} - \pi^{f})$ cannot be attributed to cause changes in the exchange rate. The null hypothesis of no causal relationship between the series in the International Fisher effect model is amplified across all tested cases.

Table 10: Granger Causality

Null Hypothesis:	F-Statistic	Prob.
UIP		
$(r_{SA} - r_{CHN}{}^{*})$does not Granger Cause Percentage change **R/¥ (Yuan)**	1.161	0.313
Percentage Change R/¥ (Yuan) does not Granger Cause $(r_{SA} - r_{CHN}{}^{*})$	4.864	0.01
$(r_{SA} - r_{USA}{}^{*})$ does not Granger Cause Percentage change **R/$**	2.704	0.080
Percentage change **R/$** does not Granger Cause $(r_{SA} - r_{USA}{}^{*})$	4.752	0.012
$(r_{SA} - r_{IND}{}^{*})$ does not Granger Cause Percentage change **R /₹**	1.992	0.143
Percentage change **R /₹** does not Granger Cause $(r_{SA} - r_{IND}{}^{*})$	0.114	0.905
$(r_{SA} - r_{JAP}{}^{*})$ does not Granger Cause Percentage change **R/¥ (Yen)**	0.284	0.768
Cause Percentage change **R/¥ (Yen)** does not Granger Cause $(r_{SA} - r_{JAP}{}^{*})$	1.154	0.323
$(r_{SA} - r_{EUR}{}^{*})$ does not Granger Cause Percentage change **R/€**	2.978	0.051
Percentage change **R/€** does not Granger Cause $(r_{SA} - r_{EUR}{}^{*})$	3.340	0.047
PPP		
$(\pi^{SA} - \pi^{CHN})$does not Granger Cause Percentage change **R/¥ (Yuan)**	2.336	0.106
Percentage change **R/¥ (Yuan)** does not Granger Cause $(\pi^{SA} - \pi^{CHN})$	6.525	0.000
$(\pi^{SA} - \pi^{USA})$ does not Granger Cause Percentage change **R/$**	3.070	0.056
Percentage change **R/$** does not Granger Cause $(\pi^{SA} - \pi^{USA})$	9.70	0.00

$(\pi^{SA} - \pi^{IND})$ does not Granger Cause Percentage change **R /₹**	0.106	0.90
Percentage change **R /₹** does not Granger Cause $(\pi^{SA} - \pi^{IND})$	0.73	0.485
$(\pi^{SA} - \pi^{JAP})$ does not Granger Cause Percentage change **R/¥ (Yen)**	1.873	0.163
Percentage change **R/¥ (Yen)** does not Granger Cause $(\pi^{SA} - \pi^{JAP})$	4.543	0.015
$(\pi^{SA} - \pi^{EUR})$ does not Granger Cause Percentage change **R/€**	6.995	0.001
Percentage change **R/€** does not Granger Cause$(\pi^{SA} - \pi^{EUR})$	3.805	0.023
International Fisher Effect		
SA-CHN Real Interest differential factor does not Granger Cause Percentage change **R/¥ (Yuan)**	0.853	0.432
Percentage change **R/¥ (Yuan)** does not Granger Cause SA-CHN Real Interest differential factor	1.212	0.307
SA-US Real Interest differential factor does not Granger Cause Percentage change **R/$**	0.723	0.498
Percentage change **R/$** does not Granger Cause SA-US Real Interest differential factor	0.206	0.824
SA-IND Real Interest differential factor does not Granger Cause Percentage change **R /₹**	1.674	0.195
Percentage change **R /₹** does not Granger SA-IND Real Interest differential factor	0.535	0.592
SA-JAP Real Interest differential factor does not Granger Cause Percentage change **R/¥ (Yen)**	0.500	0.616
Percentage change **R/¥ (Yen)** does not Granger Cause SA-JAP Real Interest differential factor	0.955	0.395
SA-EUR Real Interest differential does not Granger Cause Percentage change **R/€**	5.493	0.002
Percentage change **R/€** does not Granger Cause SA-EUR Real Interest differential	1.455	0.248

Source: Author's own calculations (2015)

4.8. Why the UIP, PPP and International Fisher Effect Fail?

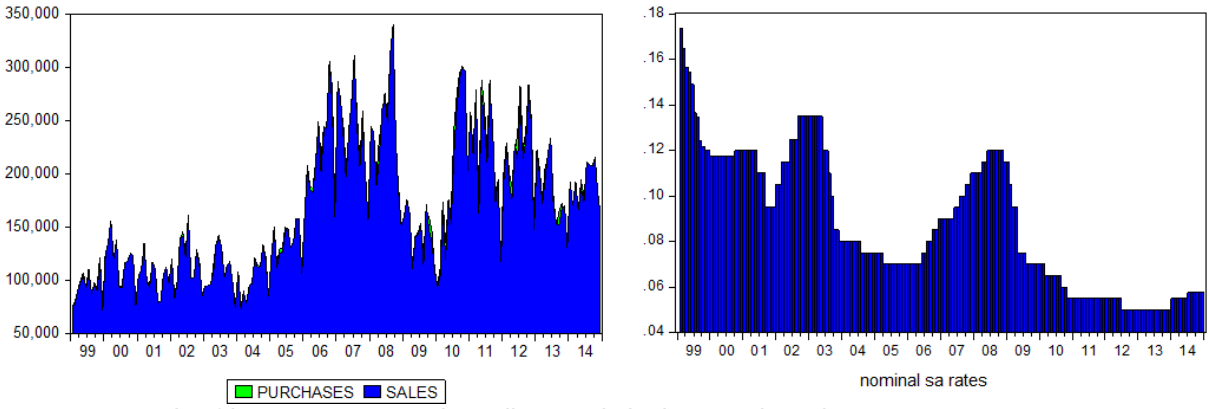
The theoretical UIP hypothesis that an increase in domestic interest rate should be accompanied by a depreciation of the rand against that of the trading partner is violated for a number of reasons. The failure of these related three hypothesis is that the capital markets are inefficient, attributed mainly to adverse selection and moral hazard (Stiglitz & Weiss, 1981). Specifically, other factors closely associated with inefficient capital markets include the presence of transaction costs, taxes,

differences in borrowing costs across countries and the existence of asymmetric information (Modigliani & Miller, 1958). When the borrowing costs are not the same, investors will always choose to borrow from low interest countries and this may prevent the UIP and International Fisher from being fulfilled.

However, the other reason concerns short-term investors chasing higher yields. Contrary to the UIP and the International Fisher Effect, an increase in interest rate differential as a result of an increase in domestic interest rates may cause the rand to appreciate. This phenomenon has been observed in the South African economy in which interest rates hikes in the United States has often led to capital flight out of the South African economy, resulting in currency depreciation. A decrease in returns due to a decrease in nominal interest rates following a monetary contraction action by the South African Reserve Bank, will lead to foreign investors seeking higher return on their holdings to sell the rand in exchange for a foreign currency whose return is higher. This action leads to an increase in the supply of rand, thereby causing a depreciation of the rand.

The scenario described above is depicted in figure 6 in which the plot on the left shows the volume of bonds purchases and sales by non-residents while the plot on the right shows the nominal interest rates over the time period under review. The figure shows that between 2003 and 2006 when interest rates were falling, the purchases of bonds by non-resident investors were also falling. The period 2006-2008 was marked by a sharp increase in interest rate, coinciding with a sharp increase in the purchases of bonds by non-residents. The period 2009-2010 was a repeat of the 2006-2008 cycle in which an interest rate fall was also followed by a decline in bond purchases. The movements in bond purchases which follow changes in nominal interest rate implies changes in the spot exchange rate which is not consistent with the UIP and the International Fisher relation. The forward market is therefore inefficient in predicting the expected exchange rate.

Figure 5: Bond Purchases/Sales by non-residents (Rm) and nominal interest rates

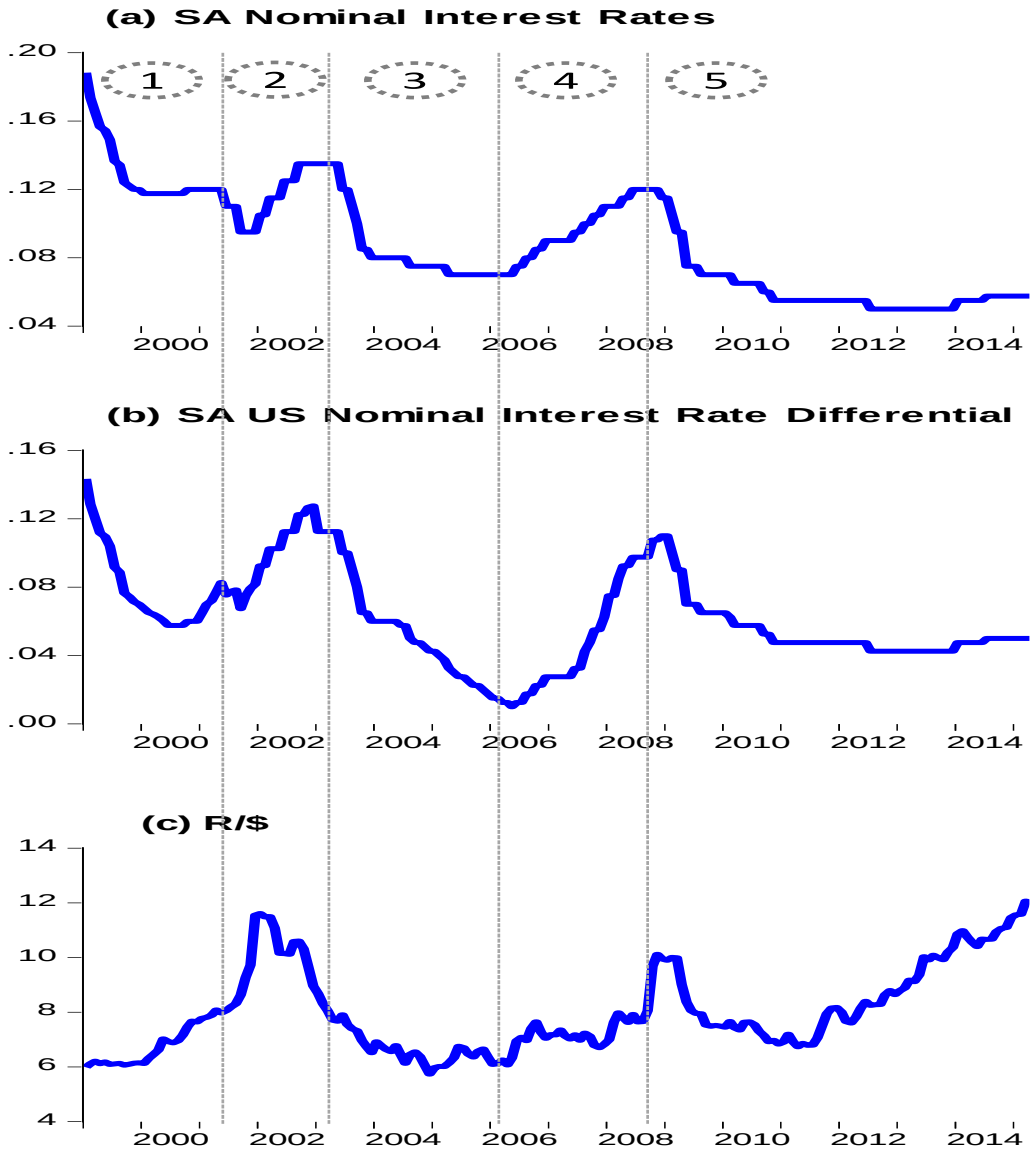


Source: South African Reserve Bank, Online Statistical Query (2015)

These results are supported by Taylor & Sarno (1997) who found that other things equal, a reduction in US interest rates tended to increase capital inflows in developing countries. These findings were consistent with those of Calvo et al. (1993) who showed that an increase in US interest rate could lead to a reversal of capital flows out of developing markets like South Africa, thus emphasizing the finding that interest rate are the most fundamental determinant of portfolio flows, especially bond flow dynamics in emerging markets. However, Taylor & Sarno (1997) also found that the impact of short-term interest rate on bond flow dynamics differs significantly across Latin American, Asian and African emerging markets, with the effect of interest rate changes on bond flows being stronger in Latin America than in most African economies.

In order to closely examine the relationship between the nominal interest rate and the exchange rate, figure 6 expands on the analysis ensuing from section 4.8 to depict some interesting trends between the two variables. Panel (a) depicts South Africa's nominal interest rate trend, panel (b) shows the interest rate differential trend between South Africa and the United States, and the last panel (c) shows the rand/dollar exchange rate trend. Note that the interest rate differential has mirrored the pattern of the nominal interest rate differential, especially owing to the tendency of the South African Reserve Bank (SARB) to adjust rates in tandem with the monetary policy decision of the Federal Reserve Bank. Coincidentally, in order to stimulate domestic demand, both South Africa and the United States have cut rates aggressively following the 2008 financial crisis.

Figure 6: Nominal Interest rate, Interest rate differential and Rand/dollar relationship



Source: South African Reserve Bank, Online Statistical Query (2015)**.**

Figure 6 divides South Africa's nominal interest trend from 1999-2015 into 5 phases. Period 1999-2000 marks the first phase characterized by interest rate decline. The second phase begins in 2001 with a moderate rise in interest rates until 2002. Interest rates began falling again from 2003 through 2005, denoted as the third phase. Period 2006-2007 represents the fourth phase in which in which SARB aggressively hiked interest rate to curb inflation (Rangasamy, 2009). The 2008 financial crisis prompted SARB to begin a series of interest rate cuts beginning late in 2008. The unprecedented reduction in interest rates was compounded by the Eurozone 2011-2013 sovereign debt crisis which resulted in a significant decline in global aggregate demand, marking the fifth phase in our study (2008-2015).

Turning to the analysis of these five phases, when interest rates were falling from 1999-2000, the South Africa rand depreciated from R6 per dollar to R8 per dollar, peaking at R12 per dollar in late 2000. The second phase (2001-2002) was characterized by a general increase in interest rates, coinciding with a period of appreciation of the rand against the America dollar. The third phase (2003-2005) mimicked the first phase as interest rates began falling again. However, contrary to the first phase in which the fall in interest rate appeared to coincide with the rand depreciation, the rand does not spontaneously react to the decrease in interest rate until 2004 after which the transition towards depreciation begins. As the interest rate began rising sharply in efforts to curtail inflation by the monetary authority, the rand/dollar exchange rate became more volatile, though the rand generally depreciated. As the interest rates began falling in the fifth phase amid fears of recession, the rand was appreciating against the dollar until 2011, from which it reversed into a major depreciating trajectory.

The patterns observed above reveal that the periods of decline in South Africa's interest rates are associated with periods of depreciation of the rand. Conversely, a general increase in South Africa's interest rates tends to elicit an appreciation of the rand against the American dollar. This has been found to be the case for all the phases except the fourth phase in which the rand depreciated in spite of the increase in interest rates during 2006-2007. These results support the evidence in favour of the rejection of the UPI and to a broader extent, the rejection of the associated PPP and the International Fisher Effect. The relationship between the interest rate and the rand/dollar exchange rate seems plausible with the notion that investors tend to chase higher yields, leading to currency depreciation when the domestic interest rates fall.

The phenomenon outlined in the preceding paragraph explains the major part concerning the failure of the UIP to hold. In their research done for emerging markets, Bosworth et al. (1999) acknowledge that in order to quell capital outflows, emerging markets may be forced to raise interest rates. The authors also indicated that portfolio flows are more sensitive to changes in interest rate than Foreign Direct Investment (FDI). While this research does not delve into a detailed examination of the possible causes of the failure of the PPP, the existence of transportation costs and trade barriers and the lack of competition in the goods market are understood as reasons behind the failure of the PPP to hold (Aizenman, 1984, 1985; Rogers &

Jenkins, 1995). The difference in taste between countries and non-tradable goods has also frequently been cited as reasons behind the failure of the PPP (Warnock, 1998).

CONCLUSION

In the foregoing chapter, the Uncovered Interest Parity (UIP), the International Fisher Effect (IFE) and the Purchasing Power Parity (PPP) hypothesis were tested in the context of South Africa as an emerging economy. Similar to Chinn & Meredith (2001), the Uncovered Interest Parity was tested at both long and short-term horizon to establish whether the claim advanced by some authors that the UIP holds only in the long run applies in emerging market context like South Africa. The first step entailed an analysis of the data to determine any possible presence of unit root, by means of applying the Augmented Dickey Fuller method. With the exception of the expected percentage exchange rate variable, the other time series in the data were found to be nonstationary. First difference procedure was performed to ensure the time series are stationary in order to avoid spurious regression. The first-difference procedure sufficed to ensure that all the nonstationary series were converted into stationary series of order I(1). The Johansen cointegration test was employed to ascertain whether exists a long run relationship between the variables in question. The cointegration result support the existence of long term relationship between the variables in question. The cointegration findings formed an important basis for testing for the UIP, UIP and the PPP.

The research did not find any evidence in support of the UIP in the long-term horizon for all the cases except for the SA-EUR. The OLS results did not provide any strong support of the UIP in the short-term horizon, except for the case of SA-IND. Like many other research works in the past, the UIP is therefore generally rejected. The results from the International Fisher Effect were also predominantly insignificant, though consistent with the UIP test, there seems to be some moderate evidence in support of the International Fisher Effect for the case of the SA-EUR. The PPP is also rejected for all the cases as the t-statistics all yield insignificant results. The R-squares for all the cases were found to be low, suggesting the exchange rate is instead explained by many other factors, not just the changes in nominal and real interest rates and the rate of inflation. Impulse response functions were used to determine the effect of shocks in interest rates and inflation on the exchange rate in a dynamic system. The results from the impulse response functions provide more evidence for the rejection of the UIP, IFE and PPP. Contrary to the UIP hypothesis, the impulse response functions showed that In the event of shock in the economy

due to nominal interest rate increase, the rand will generally appreciate by approximately 2% against the foreign country currency in the first period. Moreover, an external shock due to increase in nominal interest rate in the euro-area leads initially to a transient 0.02% appreciation of the rand in the first period, before it depreciates against the euro by approximately 0.5%

Granger causality technique was employed in the research to determine whether one variable can be used to explain another, such as that posited by the UIP that the interest rate differential between domestic and foreign country can be used to explain the expected percentage change in the exchange rate. The UIP tests for each of the five cases shows that the interest rate differential series does not Granger cause movements in the expected percentage exchange rate. Instead, it is the exchange rate movement which seems to have causal effect on the interest rate differential. Most of the evidence from the PPP also showed that with the exception of the SA-EUR case, the inflation rate differential series cannot be attributed to cause changes in the exchange rate. The same results were found for the IFE case.

An attempt to explain why the UIP, IFE and the PPP fail to hold were made by providing a dozen of reasons possibly explaining why these hypotheses are rejected. These factors could include the existence of transaction costs and taxes between countries. In addition, investors also tend to chase higher returns for their assets, a phenomenon recently seen across emerging markets including South Africa. Interest rates hikes in the trading partner countries have often led to capital flight out of the South Africa, resulting in rand depreciation. A decrease in returns due to a decrease in nominal interest rates following a monetary contraction action by the South African Reserve Bank, will lead to foreign investors seeking higher return on their holdings to sell the rand in exchange for a foreign currency whose return is higher. This action leads to an increase in the supply of rand, thereby causing a depreciation of the rand. Movements in purchase and sale purchase of treasury bonds have also mirrored trends in interest rates as set by the Monetary Policy Committee.

By dividing South Africa’s interest rate trends into five phases between 1999 and 2015 and analyzing the movements in exchange rate following changes to interest rate and the interest rate differential, it was shown that the adjustment of the rand to changes in levels of interest rate is not consistent with the UIP. This more pragmatic

analysis suggests that an increase in South Africa's interest rates prompts more capital inflows from foreign investors, leading to currency appreciation. The implication of these results is that the movements in the rand are influenced primarily by investor's actions in pursuit of higher yields, withdrawing funds when the interest rate fall and conversely supplying more capital when interest rates increase, leading the currency to appreciate. These results imply that capital markets may still be inefficient, justifying more government intervention to eliminate inefficiencies. These interventions could include implementing capital controls to avoid excessive outflows during periods of economic slumps. Future research in relation to the effectiveness of such capital controls should explore each of the different controls alternatives to investigate the extent to which each alternative would be the most effective. A limitation of the models used in this research is that it does not fully capture the dynamic trends in capital markets, especially as the markets become even more sophisticated. The OLS method also does not most accurately capture the time-varying risk premium required by investors, which could potential affect the findings of the research. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models could be used in future to study the validity of the UIP, PPP and IEF in emerging market context as the capital markets become more dynamic and integrated.

REFERENCES

Adler, M., & Lehmann, B. (1983). Deviations from purchasing power parity in the long run. *Journal of Finance,* 38 (22), pp. 1471 – 1487.

Aggarwal, S. (2013). The Uncovered Interest Rate Parity Puzzle in the Foreign Exchange Market. *New York University Press* 101 (2), pp. 23-44.

Alper, C. E., Ardic, O. P., & Fendoglu, S. (2009). The economics of the uncovered interest parity condition for emerging markets. *Journal of Economic Surveys, 23*(1), pp. 115-138.

Aizenman, J., (1984). Modelling deviations from PPP, *International Economic Review,* 25 (4), pp.175-190.

Backus, D. K., & Smith, G. W. (1993). Consumption and real exchange rates in dynamic economies with non-traded goods. *Journal of International Economics*, *35*(3), pp. 297-316.

Baillie, R.T., & Bollerslev, T. (2000). The Forward Premium Anomaly Is Not as Bad as You Think, *Journal of International Money and Finance 19*(4), pp. 471-488.

Bansal, R. and Dahlquist, M. (2000). The forward premium puzzle: different tales from developed and emerging economies*. Journal of International Economics, 5* (11), pp. 115–144.

Bakaert, G. & Hodrick, R. (1993). On Biases in the Measurement of Foreign Exchange Risk Premiums, *The Journal of International Money and Finance*, *12*(3), pp. 3-39.

Baillie, R.T., Bollerslev, T., (1997). The forward premium anomaly is not as bad as you think. *IMF Working Paper.*

Balassa, B.(1964). The purchasing-power parity doctrine: a reappraisal. *The Journal of Political Economy 05*(7), pp. 584-596.

Bilson, John F.O.(1981). The 'speculative efficiency' hypothesis, *Journal of Business*, *54*(4), pp. 435-51.

Block, S. A., & Vaaler, P. M. (2004). The price of democracy: sovereign risk ratings, bond spreads and political business cycles in developing countries. *Journal of International Money and Finance*, *23*(6), pp. 917-946.

Bosworth, B. P., Collins, S. M., & Reinhart, C. M. (1999). Capital flows to developing economies: implications for saving and investment. *Brookings Papers on Economic Activity 40(2)*, pp.143-180.

Bui, A. T. (2010). Test of the uncovered interest parity: evidence from Australia and New Zealand. *The Economic Journal,* 113 (23), pp. 34-52.

Burnside, C., Eichenbaum, M., Kleshchelski, I., & Rebelo, S. (2011). Do peso problems explain the returns to the carry trade?. *Review of Financial Studies*, *24*(3), pp. 853-891.

Calvo, G.A., Leonardo L, & Carmen M.R. (1993). Capital Inflows and the Real Exchange Rate Appreciation in Latin America: The Role of External Factors. *IMF Staff Papers 40(I)*:108-51

Caporale, G. M., Kalyvitis, S., & Pittis, N. (2001). Testing for PPP and UIP in an FIML framework: Some evidence for Germany and Japan. *Journal of Policy Modeling, 23*(6), pp.637-650.

Cargill, T. F. (2001). Monetary policy, deflation, and economic history: lessons for the Bank of Japan. *Monetary and Economic Studies (Special Edition)*, *22*. pp.10-22.

Carvalho, J. V., Sachsida, A., Loureiro, P. R., & Moreira, T. B. S. (2004). Uncovered interest parity in Argentina, Brazil, Chile, and Mexico: a unit root test application with panel data. *Review of Urban & Regional Development Studies, 16*(3),pp. 263-269.

Chaboud, A. P., & Wright, J. H. (2005). Uncovered interest parity: it works, but not for long*. Journal of International Economics, 66*(2), pp.349-362.

Cheung, Y.W., Chinn, M. & Pascual, D.A.(2005). Empirical Exchange Rate Models of The Nineties, Are Any Fit To Survive? *Journal of International Money and Finance, 24*(7), pp.1150-1175.

Chinn, M., & Meredith, G. (2001). Testing Uncovered Interest Parity at Short and Long Horizons, Working Paper No.13560. Retrieved from the *National Bureau of Ecomnomic Research* website:http://www.nber.org/papers/w11077

Chinn, M.(2006). The (Partial) Rehabilitation Of Interest Rate Parity In Floating Rate Era: Longer Horizons, Alternative Expectations And Emerging Markets, *Journal of International Money and Finance, 25 (*9), pp. 7-21.

Chinn, M. (2007). Forward Premium Puzzle, *World Economy –Forward Premium Puzzle (entry written for the Princeton Encyclopedia of the World Economy), 6*(2) pp. 1-8.

Chinn, M., & Meredith, G. (2004). Monetary Policy and Long Horizon Uncovered Interest Parity, *IMF Staff Papers,* 51 (3), pp. 409-430.

Christensen, M. (2000).Uncovered interest parity and policy behavior: New evidence, *Economics Letters 69* (1) pp.81-87.

Cogley, T., & Sargent, T. J. (2005). The conquest of US inflation: learning and robustness to model uncertainty. *Review of Economic dynamics, 8*(2), pp. 528-563.

Cumby, R. E., & Obstfeld, M. (1981). A note on the exchange-rate expectations and nominal interest differentials: a test of the Fisher hypothesis*. Journal of Finance, 36* (2), pp. 697 – 703.

Davidson, J. E. H. (1985). Econometric modelling of the Sterling effective exchange rate. *Review of Economic Studies, 52*, 231 – 250.

DeGennaro, R., Robert, K., & Junsoo, L. (1994). Modelling International Long-Term Interest Rates," *Financial Review 29* (1994), pp.577-597.

De Haan, J., Dirk, P. & Dick, Z. (1991). On the Relationship between Dutch and German Interest Rates*. De Economist 139* (1991), pp. 550-565.

Demirag, I., & Goddard, S. (1994*). Financial management for international business.* Maidenhead,, UK: McGraw-Hill.

Domowitz, I., & Hakkio, C.S.(1985), Conditional variance and the risk premium in the foreign exchange market, *Journal of International Economics,19* (4), pp.47–66.

Dornbusch, R. (1985). *Purchasing power parity* .National Bureau of Economic Research. Working Paper No. w1591.

Dornbusch, R. (1989). Real exchange rates and macroeconomics: a selected survey*. Scandinavian Journal of Economics*, *91 (*12), pp. 401 – 432.

Engel, C. (1996) . The forward discount anomaly and the risk premium: A survey of the recent evidence, *Journal of Empirical Finance*, *3* (2), pp.123-92.

Eun, C.S, and Resnick, B. (2014), "International Finance", Seventh Global Edition.

Fama, E.F. (1984). Forward and spot exchange rates. *Journal of Monetary Economics, 14* (3), pp.319-38.

Fisher, E., & Park, J. Y. (1991). Testing purchasing power parity under the null hypothesis of cointegration. *Economic Journal, 101* (2), pp. 1476 – 1484.

Foy, T.M. (2005). An Empirical Analysis of Uncovered Interest Rate Parity and the Forward Discount Anomaly, *Department of Economics, Queen's University, Ontario,Canada, (3)*6, pp.1-8.

Frankel, J.A., & Froot ,K.A. (1987), Using Survey Data To Test Standard Propositions Regarding Exchange Rate Expectations, *American Economic Review*, *77*(1), pp.133-153.

Frankel, J.A., & Froot, K.A (1990), Exchange rate forecasting techniques, survey data, and implications for the foreign exchange market,' NBER Working paper no.3470.

Froot, K.A., &Thaler, R.H. (1990). Anomalies: Foreign exchange, *Journal of Economic Perspectives, 4* (3), pp.179-92.

Flood, R.P., & Rose, A.K. (1997). Fixes: Of the Forward Discount Puzzle, *IMF research Department, JEL 31(9)*, pp. 1-13.

Flood, R. P., & Rose, A. K. (2002) Uncovered interest parity in crisis, *IMF Staff Papers, 49* (9), pp.252–66.

Fry, M. J. (1997). In favour of financial liberalisation. *The economic journal, 107*(442), pp.754-770.

Gonzalo, J. (1994). Five alternative methods of estimating long-run equilibrium relationships*. Journal of econometrics, 60*(1), pp. 203-233.

Goodfriend, M., & Prasad, E. S. (2006). A framework for independent monetary policy in China. *International Monetary Fund Working Paper,* 06(111), pp.1-52.

Granger, C. W., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of econometrics, 2*(2), pp. 111-120.

Hansen, L. P., & Hodrick, R. J. (1980). Forward exchange rates as optimal predictors of future spot rates: An econometric analysis. *The Journal of Political Economy*, pp. 829-853.

Hodrick, R.J.(1987), The Empirical Evidence On The Efficiency Of Forward And Futures Foreign Exchange Markets. *Journal of Monetary Economics, 18* (3), pp.319-38.

Huisman, R., Koedijk, K., Kool, C., & Nissen, F. (1998). Extreme support for uncovered interest parity. *Journal of International Money and Finance*, 17(1), pp. 211-228.

Huizinga, J., & Mishkin, F. S. (1984). Inflation and real interest rates on assets with different risk characteristics. *The Journal of Finance, 39*(3), pp.699-712.

Huizinga, J. (1987). An empirical investigation of the long-run behaviour of real exchange rates. *Carnegie Rochester Conference Series on Public Policy*, *27* (2), pp. 149 – 214.

Im, K.S., Pesaran, M.H. and Shin, Y. (1997). Testing for unit roots in heterogeneous panel. Unpublished manuscript, *Department of Applied Economics, University of Cambridge.*

Isard, P. (1996). Uncovered Interest Parity. *The Economic Journal,* 113 (23), pp. 34-52.

Ito, T., & Mishkin, F. S. (2006). Two decades of Japanese monetary policy and the deflation problem. In Monetary Policy with Very Low Inflation in the Pacific Rim, NBER-EASE. *University of Chicago Press, 15* (2), pp. 131-202.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control, 12*(2), pp. 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica, 59* (6), pp. 1551 – 1580.

Johansen, S., & Juselius, K. (1992). Testing structural hypotheses in a multivariate cointegration analysis of the PPP and the UIP for UK. *Journal of Econometrics, 53* (3), pp.211 – 244.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of econometrics, 90*(1), pp. 1-44.

Koo, R. (2011). The world in balance sheet recession: causes, cure, and politics. *Real-world economics review, 58*(12), pp. 19-37.

Kool, C., &Hadzi-Vaskov, M. (2006), The Importance of Interest Rate Volatility in Empirical Tests of Uncovered Interest Parity. *Tjalling C. Koopmans Research Institute, Discussion Paper 6(16)*, pp. 3-37.

Kugler, P., & Lenz, C. (1993). Multivariate cointegration analysis and the long-run validity of PPP. *Review of Economics and Statistics, 75* (2), pp. 180 – 187.

Lacerda, M., Fedderke, J. W., & Haines, L. M. (2010). Testing for purchasing power parity and uncovered interest parity in the presence of monetary and exchange rate regime shifts*. South African Journal of Economics, 78*(4), pp.363-382.

Levin, A. and Lin, C.F. 1992. Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties*. University of California at San Diego, Discussion Paper 10*(3) pp.92-93..

Lily, J., Kogid, M., Karim, M. R. A., Asid, R., & Mulok, D. (2011). Empirical testing on uncovered interest rate parity in Malaysia. *Journal of Applied Finance & Banking*, 1(2), pp. 95-114.

Liu, P.,& Maddala, C. (1992). Rationality of Survey Data and Tests for Market Efficiency in the Foreign Exchange Markets*, Journal of International Money and Finance*, *11* (2), pp.366-381.

Mark, N.C., Wu, Y.(1998). Rethinking deviations from uncovered interest parity: the role of covariance risk and noise, *The Economic Journal* , 108(10), pp.1686–1706.

Martin, P., & Philippon, T. (2014). Inspecting the Mechanism: Leverage and the Great Recession in the Eurozone*. National Bureau of Economic Research, 20*(2). pp.23-43.

MacDonald, R. (1985). Do deviations of the real effective exchange rate follow a random walk? *Economic Notes, 14* (1), 63 – 69.

MacDonald, R., & Taylor, M. P. (1990). International parity conditions. In: A. S. Courakis, & M. P. Taylor (Eds*.), Policy issues for interdependent economies* (pp.53-77). Oxford: Oxford University Press.

MacDonald, R., & Taylor, M.P .(1992). Exchange Rate Economics, *A Survey In: IMF Staff Papers*, *39*(1), pp. 1-57.

MacDonald, R., & Marsh, I. W. (1994). On long- and short-run purchasing power parity. In: J. Kaehler, & P. Kugler (Eds*.), Econometric analysis of financial markets* (pp. 23 – 46). Heidelberg, Germany: Physica-Verlag

McCallum, B.T. (1994). A reconsideration of the uncovered interest parity relationship, *Journal of Monetary Economics*, 33(11), pp.105–132.

Meredith, G., & Chinn, M.(1998), Long-Horizon Uncovered Interest Rate Parity. *National Bureau of Economic Research Working Paper 6797.*

Mishkin, F. S. (1992). Is the Fisher effect for real?: A reexamination of the relationship between inflation and interest rates. *Journal of Monetary economics, 30*(2), pp.195-215.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review 3(2)*, 261-297.

Mohamed, S. & Finnoff, K. (2004). In G. A. Epstein (Ed.*), Capital Flight and Capital Controls in Developing Countries* (pp. 85–115). Cheltenham: Edward Elgar.

Naylor, T. H., Seaks, T. G., & Wichern, D. W. (1972). Box-Jenkins methods: An alternative to econometric models. *International Statistical Review/Revue Internationale de Statistique*, pp. 123-137.

Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica (5*)5, 703-708

Nieuwland, F.G.M.C.,& Verschoor,W.F.C. and Wolff, C.C.P(1998). EMS exchange rate expectations and time-varying risk premia, *Economics Letters* ,*60*(3), pp.351–355.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), pp. 335-346.

Rangasamy, L. (2009). Inflation persistence and core inflation: The case of South Africa. *South African Journal of Economics, 77(3*), pp.430-444.

Ravi, B., & Dahlquist, M. (2000). The forward premium puzzle: different tales from developed and emerging economies, *Journal of International Economics, 51*(4), pp.115–144.

Ray, D. S. (2012). Empirical testing of international Fisher effect in United States and selected Asian economies. *Advances in Information Technology and Management*, *2*(1), pp. 216-228.

Rogers, J.H. & Jenkins, M. (1994). Haircuts or hysteresis? Sources of movements in real exchange rates, *Journal of International Economics*, 7(5), pp.55-76.

Roll, R. (1979). Violations of purchasing power parity and their implications for efficient international commodity markets. In: M. Sarnat, & G. Szego (Eds.), *International finance and trade* (pp. 260-282). Cambridge, MA: Ballinger.

Sachsida, A., Ellery Jr., R., & Teixeria, J. R. (2001), Uncovered Interest Rate Parity and the Peso Problem: the Brazilian Case, *Applied Economics Letters*, 8(3), pp.179-181.

Samuelson, P. A. (1964). Theoretical notes on trade problems. *The Review of Economics and Statistics 12 (*3), pp.145-154.

Sarno, L. (2005). Towards a solution to the puzzles in exchange rate economics: where do we stand? *Canadian Journal of Economics 38* (1), pp.673–708

Sarno, L. and Taylor, M.P. (2002) .The Economics of Exchange Rates Cambridge: *Cambridge University Press*

Solnik, B.,& Roulet, J. (2000). Dispersion as cross-sectional correlation.*Financial Analysts Journal, 56*(1), pp. 54-61.

Stigler, G. J. (1957). Perfect competition, historically contemplated, *Journal of Political Economy, 65*(1), pp. 1-17.

Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *American Economic Review 6 (5)*, pp.393-410.

Sundqvist, E. (2002). An empirical investigation of the International Fisher Effect. *Social Science and Business Administration Programmes*, pp. 42, 1-41.

Taylor, M. P. (1987). Risk premia and foreign exchange: a multiple time series approach to testing uncovered interest parity. *Weltwirtschaftliches Archiv, 123* (4), pp. 579 – 591.

Taylor, M. P. (1988). An empirical examination of long-run purchasing power parity using cointegration techniques. *Applied Economics, 20* (2), pp. 1369 – 1382.

Varma, J. R. (1997). Indian money market: Market structure, covered parity and term structure, *The ICFAI Journal of Applied Finance, 3*(2), pp.1-10.

Whitt, J. A. (1992). The long-run behaviour of the real exchange rate: a reconsideration*. Journal of Money Credit and Banking, 24* (1),pp. 72 – 82.

Warnock, F.E., 1998. Idiosyncratic tastes in a two-country optimizing model: implications of a standard presumption, *International Finance Discussion Paper* No. 1998-631, Federal Reserve Board. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=143014

Yuhn, K. H. (1996). Is the Fisher effect robust? Further evidence. *Applied Economics Letters*, 3(1), pp. 41-44.

Zouaoui, M., Nouyrigat, G., & Beer, F. (2011). How does investor sentiment affect stock market crises? Evidence from panel data. *Financial Review*, *46*(4), pp.723-747.