AN EMPIRICAL TEST OF THE INTERNATIONAL FISHER EFFECT BETWEEN NAMIBIA AND HER MAJOR TRADE PARTNERS

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ALPHEUS KAMUTUSHI

200505955

SUPERVISOR: PROF: E. ZIRAMBA (UNIVERSITY OF NAMIBIA)

ABSTRACT

The international Fisher effect (IFE) is a theory in international finance that can be used to predict or estimate the movement in the bilateral exchange rate between any two currencies using nominal interest rate differentials. IFE states that the spot exchange rate between two currencies should move in the opposite direction with the interest rate differential between those countries. The aim of this study is to examine whether the IFE holds between Namibia and each of its five trading partners. In order to test for the direction of the parity, each of the five trading partners was considered as home countries and Namibia as the foreign country. The study used historic nominal interest rates and bilateral exchange rates for the period 2010 first quarter to f 2018 fourth quarter for Namibia, China, Netherland and India. However, data for the United Kingdom and the United States of America were only available for the first quarter of 2010 to second quarter of 2018 and first quarter of 2010 to second quarter of 2017 respectively.

A regression analysis was employed to test the validity of the IFE between Namibia and the following countries: China, the United Kingdom, Netherland, the United States of America and India. The outcomes were mixed in both scenarios, where Namibia was the home country, results showed that the IFE does not hold. However, when Namibia was used as a foreign country, the IFE holds for the case of the United States of America versus Namibia even though the correlation was not one to one. The results also indicated that the IFE theory could not be relied upon to predict the changes in bilateral exchange rates for the chosen countries from 2010 to 2018.

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Finally, I would like to thank my father for stressing the importance of school and ensuring that I get an opportunity to attend school.

DEDICATION

I dedicate this thesis to my father, without your constant reminder on the importance of being educated I would have given up. Continue resting in eternal peace.

DECLARATION

I, Alpheus Kamutushi, hereby declare that this study is my own work and is a true reflection of my research and that this work or any part thereof has not been submitted for a degree at any other institution.

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Alpheus Kamutushi	Signature	Date

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller
APPP	Absolute Purchasing Power Parity
ARDL	Autoregressive Distributed Lag
ASEAN	Association of South-east Asian Nations
ECM	Error Correction Model
FM-OLS	Fully Modified Ordinary Least Square
IFE	International Fisher Effect
IMF	International Monetary Fund
IRP	Interest Rate Parity
IFS	International Finance Statistics
KPSS	Kwiatowski Philips Schmidt Shin
OLS	Ordinary Least Square
PPP	Purchasing Power Parity
SDR	Special Drawing Rights
SUR	Seemingly Unrelated Regression
UP	Uncovered Parity
USA	United States of America
USD	United States of American Dollar
VAR	Vector Auto Regression
VD	Variance Decomposition
WAMZ	West African Monetary Zone
ZAR	South African Rand

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

The International Fisher Effect (IFE) is a parity used to explain the changes in exchange rates between countries' currencies using the nominal interest rates of the relevant countries. According to Salas-Ortiz and Gomez-Monge (2015), an exchange rate is the price of a currency in terms of another and it is expressed as the number of units in the domestic currency that will be exchanged for one unit of a foreign currency. The IFE is a theory in international finance which asserts that the spot exchange rate between countries should move in the opposite direction from the interest rate differential between these countries (Ersan, 2008). Other theoretical perspectives used to explain movements in exchange rates are Purchasing Power Parity (PPP), interest rate parity (IRP) and uncovered parity (UP). The present study tests the movements in the exchange rate of the South African Rand (ZAR) against the currencies of the following countries – the Netherlands, the United Kingdom, the United States of America, India, and China – in relation to the interest rate differential of the above countries to determine if the IFE holds in the case of Namibia and its five trading partners. This study will also illustrate the degree to which the IFE holds if it does do so. It is of the utmost importance to note that the Namibian interest rates were used. The countries listed above were chosen because Namibia imports and exports most of its products from and to these countries. According to the International Monetary Fund (IMF) the following countries are Namibia's major trade partners: the Netherlands, the United Kingdom, India, the United

States of America, and Canada for both imports and exports. As Namibia is part of the international market, it is important to test if the IFE theory holds for Namibia. This information helps appraise the price competitiveness of foreign imports and exploring export opportunities for countries (Shalishali, 2012).

1.2 Statement of the Problem

The IFE suggests that countries with high nominal interest rates are expected to have a higher inflation rate than countries with lower nominal interest rates and that countries with higher inflation rates are expected to experience depreciation in their currencies when compared to those with lower inflation rates. Therefore, when dealing in international markets, it is important to compare the real interest rate (nominal interest rate – inflation rate) between countries as opposed to comparing only the nominal interest rates. Namibia is a developing country and, as such, depends heavily on imports from the global market for its domestic consumption, while its exports are primarily raw materials. As part of the global market, the Namibian business community and the Namibian government are exposed to exchange rate risk. With this in mind, the IFE can be used to predict the future spot rate using the interest rate differential between the home country and foreign countries and so reduce such a risk. The findings of this study will show whether the IFE theory can be used to focus future spot rates in the case of Namibia and five of her trading partners. The outcomes of this study could be of vital importance in assisting the Namibian business community in deciding whether they can make use of the IFE theory to predict the future bilateral exchange rates between Namibia and its five trading partners.

Empirical evidence on the subject is mixed. A study by Alam, Alam and Shuvo (2011) that examined the empirical evidence of the IFE between Bangladesh and its two major trading partners, China and India, concluded that the IFE did not hold between the three Asian countries during the investigated period. However, a study by Alizadeth, Nassir and Masoudi (2014) that investigated the empirical evidence of the IFE among member countries of the Association of South-East Asian Nations (ASEAN) suggests that the theory partially held in the case of Malaysia and Indonesia during the investigated period. Similarly, a study by Shalishali (2012), where a test of the IFE was conducted for eight industrialized Asian countries, namely China, India, Japan, South Korea, Malaysia, Thailand, Vietnam, and Indonesia, concluded that the theory holds for most of the countries. Because results tend to vary from country to country, it is necessary to test the theory in the case of Namibia.

1.3 Research Objectives

The main objective of the study is to test the empirical evidence of International Fisher Effect between Namibia and five of its major trading partners for the period first quarter of 2010 to the fourth quarter of 2018 and the specific objective are:

(a) To examine whether the IFE holds between Namibia and each trading partner (India, China, the Netherlands, the United Kingdom and the United States of America), with Namibia as the home country.

(b) To determine if the IFE folds when each of the trading partners is taken as the home country and Namibia as the foreign country.

1.4 Research Hypotheses

(a) H_0: The IFE does not hold for all trading partners when Namibia is treated as the home country.

H_1: The IFE holds for each trading partner when Namibia is treated as the home country.

(b) H_0: The IFE does not hold for all trading partners when Namibia is treated as a foreign country.

H_1: The IFE holds for each trading partner when Namibia is treated as a foreign country.

1.5 Significance of the Study

Namibia is a developing country, rich in mineral resources and, as such, attracts investors from all over the world. Namibia exports raw materials such as uranium and diamonds traded in foreign currency, but imports most of its finished products for domestic consumption; this makes Namibia a net importer (meaning the value of imported goods and services exceeds the goods and services the country exports). Because the IFE is one of the theories that can be used to estimate or predict future movements of the bilateral exchange rate between countries, this study will be significant for potential or existing investors. The findings of the study will assist both

current and potential investors to estimate the possible direction of exchange rate movements between countries using interest rate differentials. The findings will also enable investors to predict the possible future spot rate. Furthermore, it will also be important to know whether the IFE theory is reliable, and to what degree, when estimating future spot rates.

1.6 Limitations of the Study

As the IFE theory uses the interest rate differential to explain movement in the exchange rates, and other factors can cause a change in future exchange rates, the IFE may not explain the total movement in exchange rates but only a part of the total movement in the exchange rates.

1.7 Delimitation of the Study

This study compared the South African Rand to the currencies of the following countries: The United States of America, the United Kingdom, China, India, and the Netherlands, and their nominal interest rates. The data were collected between the first quarter of 2010 to the fourth quarter of 2018.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The primary purpose of this chapter is to review the empirical evidence of the International Fisher Effect. The chapter compares the different methods employed by each scholar and interprets the different outcomes of various studies. However, in order to fully understand the IFE theory, this chapter first discusses the theories which are the building blocks of the IFE, namely the Fisher effect and the PPP (both in its absolute and relative form).

2.2 Theoretical Literature

In the 1930s, the economist, Irving Fisher, developed a theory (now referred to as the Fisher effect) that defines the relationship between the nominal (quoted) interest rate and the expected inflation rate (Madura, 2016). The foundation of the Fisher effect assumes that potential savers in a country require a return from their local savings and will only be willing to save money if their savings grow at a faster rate than the prices of the products that they may buy in the future (Madura, 2016). The theories of the Fisher effect and PPP are the building blocks of the evolution of the IFE (Khawaga, Esam, & Hammam, 2013).

The IFE is the counterpart of the Fisher effect (Khawaga, Esam, & Hammam, 2013). It outlines how each country's nominal interest rate can be used to derive its expected inflation rate and how the difference in inflation rates between two countries signals an

expected change in the exchange rate (Madura, 2016). It further explains that the currency of foreign countries with a relatively high-interest rate will tend to depreciate because the high nominal interest rates reflect the expected rate of inflation (Madura, 2016).

The IFE is a theory in international finance which asserts that the spot exchange rate between two countries should move in the opposite direction against the interest rate differential between these countries. The IFE offers a specific relationship between the differential in nominal interest rates of two countries and the exchange rate movement; it suggests (1) how each country's nominal interest rate can be used to derive its expected inflation rates, and (2) how the difference in inflation rates between two countries signals an expected change in the exchange rate (Madura, 2016).

2.2.1 Fisher Effect

The famous Fisher hypothesis is the starting point in the attempt to understand the link between nominal interest rates and inflation (Nemushungwa, 2016). The relationship between interest rates and inflation postulates that the ex-ante nominal interest rate should fully anticipate movements in expected inflation, therefore leading to a one-to-one relationship between the expected inflation rate and the nominal interest rate (Madhyereh & Al-Zoubi, 2006). Fisher (1930) asserts that a permanent change in the rate of inflation will cause an equal change in the nominal interest rate so that the real interest rate is not affected by monetary shocks in the long run. That said, countries with high-interest rates expect to experience higher inflation rates than countries with lower

interest rates. The Fisher theory suggests that real interest rates are the same between countries.

As usually interpreted, the Fisher equation treats the real rate of interest as exogenously determined by the "fundamental" factors of productivity and time preference as laid out in Fisher's canonical treatment of the subject (Glasner, 2018). Following Ersan (2008), the Fisher equation can be written as follows:

$$i_t = \alpha + \beta\pi_t^e$$

In this equation, i_t is the nominal interest rate, $\alpha$is the real interest rate and $\beta\pi_t^e$ is the expected inflation for the period t. By definition, β is expected to be equal to 1in order to conclude for a strong Fisher effect. If β is positive but not equal to 1, then there is evidence of the weaker form of the Fisher effect. From the above equation, it is evident that nominal interest rates are made up of two components: the real interest rate, and inflation. The real interest rate is constant, while the inflation rate varies and therefore, any change in the nominal interest rate is a change in the inflation rate.

Many scholars have tested the validity of the Fisher effect both in the long run and short-term; however, results are mixed.

2.2.2 Purchasing Power Parity

This part of the thesis explains the PPP and illustrates how it is linked to the IFE and the Fisher hypothesis. Purchasing Power Parity is an equilibrium condition equating the nominal exchange rate between two countries with the relative price of an identical

bundle of goods in each country (Crownover, Pippenger, & Steigerwald, 1996). The concept of PPP was first developed by Swedish economist Gustav Cassel in the 1920s to examine the relationship of the exchange rates for different countries (Ersan, 2008). Purchasing Power Parity is an international finance theory which attempts to quantify the relationship between inflation and exchange rate (Madura, 2016). According to Coakley, Flood, Fuertes and Taylor (2005), PPP involves a relationship between a country's foreign exchange rate and the level of movement of its national price level relative to that of a foreign country. The strictest version of PPP is the law of one price, which states that, after converting prices to one common currency, any good should have the same price across countries (Findreng, 2014). Voinea (2013) formally defined the law of one price between two countries as in the following scenario:

In this scenario, the Euro is regarded as the domestic currency and the United States currency, the USD, as the foreign currency. In this example, we have: P_{EU}^{i}, the price of good i when sold in the Eurozone, and $P_{US}^{i}$the corresponding price in USD. The law of one price implies that the Euro price of the good i is the same wherever it is sold. Thus the law of one price postulates purchasing power parity, which leads to two types of PPP. There are two types of purchasing power parities: absolute PPP, and relative PPP. This paper first discusses absolute PPP, and then relative PPP.

2.2.2.1 Absolute Purchasing Power Parity

Absolute Purchasing Power Parity states that the purchasing power of a unit of domestic currency is the same in the foreign economy once it is converted into foreign currency at

the absolute PPP exchange rate (Coakley, Flood, Fuertes & Taylor, 2005). To test the validity of the absolute PPP, researchers use price level instead of the price indices.

2.2.2.2 Relative Purchasing Power Parity

Both absolute PPP and relative PPP take exchange rates into account; however, it is relative PPP that forms the basis of the IFE. The theory of PPP states that the difference in inflation rates equals the expected changes in the spot rate.

2.2.3 International Fisher Effect

Following scholars such as Khubchandani and Abrol (2017), and Ersan (2008), this study illustrates how the Fisher effect and the relative PPP are linked to the IFE. The Fisher effect is the first theoretical construct of the IFE and suggests that the nominal interest rate i is a determinant of real interest rates r and the expected inflation rate π^e, which then means that the nominal interest rate is made up of the real interest rate and the expected inflation rate:

$$(1 + i) = (1 + r)(1 + \pi^e)$$

The Fisher hypothesis is the starting point in an attempt to understand the link between nominal interest rates and inflation (Nemushungwa, 2016). The hypothesis suggests that a 1% change in the nominal interest rate is caused by a 1% change in the inflation rate.

The second theoretical construct of the IFE is the PPP in its relative form. Relative PPP uses inflation rate differentials to estimate the bilateral exchange rate changes. The PPP can be described using the following formula, where s_t is the value of one unit of

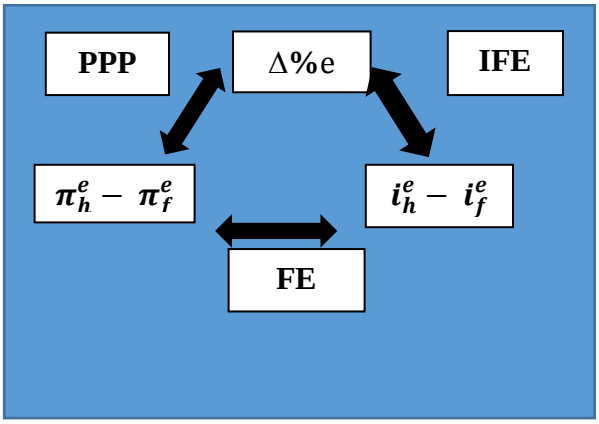
foreign currency in domestic currency at time t, and s_{t+1} is the spot exchange rate for time $t+1$.

$$\frac{s_{t+1} - s_t}{s_t} = \frac{\pi_{h,t} - \pi_{f,t}}{1 + \pi_{f,t}}$$

The IFE uses nominal interest rate differentials to estimate the movements in bilateral exchange rates. The above can be summarized as follows: the Fisher effect estimates the expected inflation rates by analyzing the movements in nominal interest rates; the relative PPP uses the inflation rate differentials to estimate the expected changes in nominal exchange rates, and the IFE uses the nominal interest rate differentials to explain the movements in exchange rates. Figure 2.1 demonstrates the relationship between the three theories. In the figure, Δ%e denotes the change in spot rate;$\pi_h^e - \pi_f^e$ is the difference in inflation expectations between the home country and the foreign country, and $i_h^e - i_f^e$ is the difference in nominal interest rate between the home country and foreign country. An extended version of the Fisher effect is the Generalized Fisher effect (GFE) which considers the interactions between countries and states that real returns are equalized across countries through arbitrage. Within the context of the GFE, the nominal interest rate differential between two countries is equal to their anticipated inflation differential. According to Ersan, the Generalized Fisher effect asserts that differences in inflation expectations cause nominal interest rate differences. Ersan (2008) went on to say if the PPP holds, then the inflation differentials should be offset by exchange rate changes. Ersan (2008) concluded that, according to the IFE hypothesis,

if real interest rates are equal across countries, the interest rate differential between two countries is an unbiased predictor of the future changes in spot exchange rates.

Figure 2.1 1 *(Ersan, 2008)*



Accordingly, this study investigates the empirical findings of the Fisher effect, PPP, and IFE.

2.3 Empirical Literature

In this section of the thesis, a review of the empirical literature for the following theories, Fisher effect, PPP and the IFE is undertaken.

2.3.1 Fisher Effect

A study by Maghyereh and Al-Zoubi (2006), "Does the Fisher effect apply in developing countries: Evidence from a nonlinear co-trending test applied to Argentina, Brazil, Malaysia, Mexico, South Korea, and Turkey", aimed to examine the possible existence of a relationship between the nominal interest rate and the inflation rate in developing countries (Argentina, Brazil, Malaysia, Mexico, Korea, and Turkey).

Evidence is first presented that the null hypothesis of the unit root with drift (constant or linear trend) was rejected in favour of nonlinear trend stationarity. The paper also found a robust nonlinear co-trending relationship between the interest rate and the inflation rate; thus, the hypothesis of the full Fisher effect is accepted.

By contrast, a study by Sheefeni (2013), "Testing for the Fisher Hypothesis in Namibia", that analyzed the relationship between the nominal interest rate and inflation in Namibia rejected the Fisher hypothesis in the Namibian context. The objective of the article was to test whether the Fisher hypothesis holds in the long run. The author used monthly data for the period 1992:01–2011:12; the paper employed time-series techniques, namely, unit root tests and co-integration test.

Other studies that support the Fisher effect hypothesis are studies by Guris, Guris and Un (2016), "Interest rates, Fisher Effect and Economic Development in Turkey". The paper investigates the validity of the Fisher hypothesis in Turkey covering the period 2003 to 2012. To test the validity of the Fisher hypothesis, the authors employed the autoregressive distributed lag test for threshold co-integration. Guris, Guris and Un (2016) found that the Fisher hypothesis is valid for Turkey.

In conclusion, the Fisher hypothesis is an important theory in finance. Some scholars support the theory while others oppose it. However, the link between the Fisher hypothesis and IFE is a crucial one in international finance, as becomes evident in the detailed discussion of the IFE. It must be borne in mind is that the IFE uses nominal interest rate differentials to predict or focus the exchange rate changes and that these nominal interest rate differentials are computed using nominal interest rates. The Fisher

hypothesis states that nominal interest equals real interest rates plus expected inflation. The Fisher hypothesis also suggests that real interest rates do not change; the only thing that fluctuates is the inflation rate. Hence the nominal interest rate will fluctuate to the same extent as the inflation rate.

With the above points in mind, the discussion moves to PPP, which is another building block of the IFE. This paper also discusses the link between the Fisher hypothesis and PPP and how both theories contribute to the IFE.

2.3.2 Purchasing Power Parity

This section reviews the empirical literature of PPP, which comes in two forms: absolute PPP and relative PPP. The discussion focuses first on the absolute form of PPP and then shifts to the relative form of PPP.

2.3.2.1 Absolute Purchasing Power Parity

A study by Crownover, Pippenger and Steigerwald (1996), "Testing for absolute PPP", tested the validity of absolute PPP for the following countries: Germany, Canada, France, Italy, the UK and the USA. The article collected data from 1927 to 1992 for a total of sixty-six observations. Since the primary purpose of the information was to adjust salaries of German diplomats and the Foreign Service personnel stationed outside Germany, the price levels are cost-of-living measures primarily for the capital city of each country. To test for absolute PPP, Crownover, Pippenger and Steigerwald (1996)

used nominal exchange rates and price levels directly rather than the real exchange rate. The real exchange rate is determined by dividing the nominal exchange rate by the ratio of the price level between pairs of countries. To test the presence of unit root in the data, the authors performed augmented Dickey-Fuller tests and found that each reported value exceeded the critical value of -2.92; therefore, the unit root test could not be rejected.

The researchers also investigated the possibility of thick tails in the distribution for the logarithm of the nominal exchange rate by estimating the tail-thickness parameter. To account for the possible presence of unit roots and the joint endogeneity of nominal exchange rates and the ratios of price levels, Crownover, Pippenger and Steigerwald (1996) constructed fully modified ordinary least squares (OLS) estimators. These tests revealed that the estimated test statistic of five of the fifteen country pairs exceeded the critical value of -2.92, and therefore, the unit root in the residual series could not be rejected. However, the estimated test statistic for the other ten country pairs was less than the critical value, and the unit root in the residual series was rejected.

The study had two components for testing APPP; firstly, the researchers tested for a unit root in the residuals from the fully modified OLS estimate of β. The logic was that if APPP holds, there is an equilibrium relation between nominal exchange rates and the ratio of price levels. Secondly, Crownover, Pippenger and Steigerwald carried out a test for the joint null hypothesis that $\beta = 0$ and $\beta = 1$ for the country pairs in which the unit root in the FM-OLS residuals was rejected.

The researchers concluded that eight of the fifteen country pairs could not reject relative PPP, and four of those eight-country pairs could not reject APPP. The results suggest that APPP may indeed hold, in the sense that deviations from APPP do not persist indefinitely.

A similar study by Zhang and Bian (2015), "Absolute Purchasing Power Parity in industrial countries", tested APPP for 21 industrial countries for the period 1950 to 2013. The article used data between 1950 to 2011 from the Penn World Table and data for 1990 to 2013 from the World Development indicator. The scholars concluded that, if the p-value for the Chi-squared statistic in the Wald test is greater than a usual significant level (1%, 5%, or 10%), then the test accepts the null hypothesis C = 1 and APPP holds. If the p-value is less than a usual significant level, then the test rejects the null hypothesis, and APPP does not hold.

For the sub-period analysis, the authors employed the least squares with breakpoints by Bai and Perron. The Bai and Perron method not only identifies the breakpoints but also estimates the coefficient in all sub-periods. In order to achieve the above, three tests were conducted following Zhang and Bian (2015): the SupFT(k), the double maximum statistics (UDmax and WDmax), and the sequential SupFT (l + 1/l). The SupFT (k) tests the null hypothesis of no structural breaks (m = 0) against the alternative hypothesis that there are m = k breaks.

The double maximum test considers the null hypothesis of no structural breaks (m = 0) against the alternative hypothesis of at least 1 through to M structural breaks. The double

maximum test takes two forms: UDmax and WDmax. The UDmax statistic is the maximum value of the SupFT(k) statistic, while the WDmax statistic weights the individual statistics. The sequential SupFT(l + 1/l) procedure tests the null hypothesis of l breaks against the alternative hypothesis of (l + 1) breaks. The method is as follows: the researchers first conduct the double maximum test to examine whether or not the breaks exist. If the double maximum test (UDmax and/or WDmax) confirms that at least one break exists, we examine the actual, fitted, and residual graphs in the three tests and choose the test whose result seems to be most reasonable. When results were analyzed for both periods (whole period using PWT and sub-period using WDI), Zhang and Bian (2015) concluded that the empirical proof shows that the phenomenon that APPP holds is common, and the phenomenon that APPP does not hold is also common. In addition, most country pairs and the pooled country data indicate that the nearer the GDPPs of two countries are, the more valid APPP between the two countries is.

2.3.2.2 Relative Purchasing Power Parity

A study by Coakley, Flood, Fuertes and Taylor (2005), "Purchasing Power Parity and the theory of general relativity: the first tests", tested the validity of relative PPP for industrialized and developing economies on the exchange rate of the national currency against the US dollar and two price measures: the consumer price index and the producer price index, with 1995 as the base year. The data were collected every month for the period 1970:01 to 1998:12.

To test the validity of the relative PPP, the authors proposed and implemented the first test of the general relative PPP hypothesis, which proposes a long-run unit elasticity of the nominal exchange rate with respect to price differentials. The work of Coakley, Flood, Fuertes and Taylor (2005) also builds on panel estimators that have been shown to be able to identify the true long-run relationship between non-stationary variables, even if they do not co-integrate.

The article used the finite-sample properties of the estimators to analyze through Monte Carlo analysis, allowing for country heterogeneity, cross-sectional dependence, and non-stationary disturbances. The application of the estimators to panel data sets of industrialized and developing economies reveals that inflation differentials are, on average, reflected one-for-one in long-run nominal exchange rate depreciation, that is, that general relative PPP holds.

Correspondingly, a study by Findreng (2014), "Relative Purchasing Power Parity and the European Monetary Union: Evidence from Eastern Europe", examines the validity of the relative PPP between Eastern European countries (Albania, Bulgaria, Croatia, FYR Macedonia, Romania and Turkey) and Germany. The above study was conducted for the period of January 1999 to May 2013.

In order to test the validity of relative PPP, Findreng investigated the real exchange rate, using a Dickey-Fuller test. According to the findings, if the null hypothesis for a unit root is rejected, then it can be stated that the real exchange rate is stationary, which implies that the real exchange is mean reverting and that the hypothesis of relative purchasing power holds in the long run. Even though none of the real exchange rates are

able to reject the null hypothesis of a unit root, Findreng was able to estimate the speed of how fast a deviation from the equilibrium is adjusted back to the equilibrium level. Furthermore, the author investigated the real exchange rate by allowing for a trend with the origin in the Balassa-Samuelson effect. According to Findreng, scholars such as Balassa and Samuelson argue that rich countries tend to have higher price levels than poor countries, which means there can be long-term deviations from PPP. Findreng noted that, if the nominal exchange rate and the price differential follow a random walk, a regular OLS regression of the nominal exchange rate on the price differential can produce spurious regression results. Findreng avoided the above by using the Engle-Granger co-integration test to test for any linear combination of the two-time series. The Engle-Granger test for co-integration was employed to test the weaker form of relative PPP. However, for the Engle-Granger co-integration test, four of the pairs are excluded as the nominal exchange rate and the same order does not integrate the price differential. Thereafter Findreng investigated the half-life of each pair in each of the three approaches.

Findreng (2014) found that by using a Dickey-Fuller test on the real exchange rate between the pairs, results indicate that the relative PPP does not hold for the investigated period for those chosen countries. However, results were different when Findreng allowed for the real exchange rate to follow a trend; the outcomes show that the real exchange rate is mean-reverting for the following country pairs: Croatia-Germany, FYR Macedonia-Germany, and Turkey-Germany, which means that the hypothesis of relative PPP holds in the long run for the above country pairs. In addition to the above, Findreng found ambiguous results both regarding relative PPP and the speed of adjustment

towards the PPP equilibrium. The article uses the results to investigate whether the Albanian, Bulgarian, Croatian, FYR Macedonian, Romanian and Turkish economies are synchronized with the German economy and if they are ready to enter the European Monetary Union.

2.3.3 International Fisher Effect

A study by Singh (2001), "An Empirical Study of the International Fisher Effect", tested the validity of the IFE between South Africa and the UK in the long run, with South Africa as the home country. Daily nominal interest rates and exchange rates were collected for a sampling period beginning in July 1995 and ending April 2001. The article defined the South African nominal interest rates as prime overdraft rates and those of the United Kingdom as their commercial banks base rates. In his efforts to test the validity of the IFE, Singh ran a simulating investment in which he took GBP100, converted it into ZAR at the prevailing spot rate and then invested those rands in South African banks offering the prevailing floating prime rate. Singh compared the above exercise to investing GBP100 in a UK bank for the same period. He argued that the investment in South Africa must be equal to the investment in the United Kingdom once the investment in South Africa is withdrawn and converted back into GBP.

Singh employed a statistical test chosen as a measure of association, the parametric correlation test, and Pearson's product-moment correlation coefficient to test the validity of the IFE. The formula for Pearson's is

$$\mathrm{r} = SUM(\frac{(X - x)(Y - y)}{(N - 1)S_y S_x})$$

Where X is the UK daily balance

Y is the South African daily balance

x is the mean

y is the mean

N is the number of pairs of cases

S_x and S_y are the standard deviations of $X$and Y

Singh found that the output from the parametric correlation test is $r = 0.998$. He also found the simulated arbitrage to be profitless and the balances of the two simulated investment accounts were found to be statistically similar, which implies that the IFE holds for the case of South Africa versus the United Kingdom during the chosen period. However, there were some short-term deviations from the theory. The value of the South African account was lowest during times of high-interest rates in South Africa, when the foreign exchange market was volatile and when the exchange rate was at peaks in the cycle. Nevertheless, the exchange rate-interest rate relationship always returned to equilibrium.

Similarly, a study by Sundqvist (2002), "An Empirical Investigation of the International Fisher Effect", investigated relationship of the USD to the currencies of the following countries: Sweden, Japan, UK, Canada and Germany in the long run, with the USA as the home country. The data consist of quarterly nominal interest rates for six (6) countries and quarterly exchange rates for the USD and five other currencies between the years 1993 to 2000, except for Germany which contains data for the years 1993 to 1998. Sundqvist used quarterly nominal interest rates, averages of monthly figures and monthly data averages of daily rates. Nominal interest rates are defined as certificates of deposit for the USA and Canada, three-month interbank rates for Japan, the UK and Germany, and three-month Treasury discount notes for Sweden. Sundqvist computed nominal interest rate differentials and exchange rate changes for the different country pairs using the data as defined above. In addition to the above, Sundqvist applied t-tests to alpha and beta and the OLS was used to estimate alpha and beta.

Sundqvist employed regression analysis to quarterly nominal interest rate differentials and quarterly nominal exchange rate changes to determine the validity of the IFE. Furthermore, Sundqvist interpreted the significance of the R-squared, together with the coefficient of alpha and beta, to determine the level of significance for each country pair. The acceptable level was set at 5% level of significance for both alpha and beta. The outcomes of this study are as follows: the case of the USA versus Sweden had an R-squared value of 11.5%, which implies that the quarterly nominal interest rate differentials for the case of the USA versus Sweden only explains 11.5% of the total movement in the quarterly nominal exchange rate changes in the SKr/$ and the remaining 88.5% is explained by other factors. However, Sundqvist found that both

alpha and beta are significant within the 5% level of significance, and as such, the IFE holds in the long run for the case of the USA versus Sweden. Sundqvist also found the outcome for the case of the USA versus Japan to support the IFE, even though it had a low R-squared value of 8.9%. Both alpha and beta lie within their acceptance regions at 5% significance and therefore $null\ hy; pothesis$ cannot be rejected. The case of the USA versus the United Kingdom had an extremely low R-squared value of only 3.6%.Sundqvist found that both alpha and beta were significant at 5% level of significance and therefore the hypothesis that $\alpha = 0$ and $\beta = 1$ cannot be rejected, even though the nominal interest rate differential could only explain 3.6% of the total movement of the nominal exchange rate changes, leaving 96.4% explained by other factors.

The study by Sundqvist (2002) had two outcomes which were rejected due to the fact that beta was outside the 5% region of significance. The outcomes were for the case of the USA versus Canada, and the USA versus Germany.

The outcomes from the study by Sundqvist show that, even though the R-squared value is extremely low, the outcomes were accepted since they were significant at the set percentage level of significance. It is also very important to note that one cannot entirely rely on the IFE to predict the future exchange rate between country pairs. However, the IFE may provide a guideline to the possible direction of the movement in the spot rate.

A study by Ersan (2008), "International Fisher Effect: A Re-examination within the co-integration and DSUR frameworks", analyzed whether the differences in nominal interest rates between countries and their currencies tend to move together over the long

run. The study tested for the presence of the IFE among the G-5 countries and Turkey for the period from 1985:01 to 2007:12. In his study, Ersan used Treasury bill rates for the interest rate data and analyzed the data as follows.

Augmented Dickey-Fuller (ADF) and Kwiatkowski Phillips Schmidt Shin (KPSS) unit root tests were applied to exchange rate and interest rate differentials to determine whether the data exhibit non-stationarity. The Johansen co-integration test was applied to those series that are shown to be non-stationary. Co-integration tests were performed to test whether residuals of linearly combined exchange rates and interest rate differentials are stationary over time. Stationary residuals are an indication of the existence of a long-run relationship between exchange and interest rate differentials. Individually modelled regressions are tested together to analyze cross-sectional dependencies. Panel data for exchange and interest rate differentials are examined for the existence of a panel unit root. If evidence of a panel unit root is found, then a panel co-integration test is performed in order to utilize the additional information that is assumed to be contained in the panel data. As the last step, individually modelled regressions are estimated as a system by applying the Dynamic SUR method proposed by Mark et al. (2005). Three leads and three lags of the independent variable are used in each equation within the system.

Ersan found that there were supportive results for the 1999–2007 period where Turkey was the home country. The calculated p-values indicate that, at the 5% significance level, changes in exchange rates can be explained by interest rate differentials. The direction of the effect was found as expected and implied that positive interest rate differentials in favour of Turkey caused the depreciation of the Turkish currency against

the other currencies in the sample. Similarly, Ersan found supportive results for the 1985–1998 period, but only between the exchange rates of France and Germany.

The above study tested if the IFE holds in the long run; however, the data collected and analyzed was on a monthly basis. Ideally, the data should have been tested on a quarterly basis and not on a monthly basis.

Scholars such as Alam, Alam and Shuvo (2011) also tested the validity of the IFE in their study, "An Empirical Evidence of the International Fisher Effect in Bangladesh with India and China: a time-series approach", that examined the empirical evidence of IFE between Bangladesh and two of her major trading partners, China and India, in the long run, with Bangladesh as the home country. The article consists of quarterly nominal interest rates for Bangladesh, India, and China, and quarterly bilateral exchange rates between the Bangladeshi Taka and two other currencies, the Indian Rupee and Chinese Yen for the years 1995–2008. The nominal interest rates for the three countries were defined as follows: Bangladesh, three months scheduled bank deposit rate; China, three months deposit rate; India, three months bank rate. Alam, Alam and Shuvo (2011) used the above nominal interest rates to compute the interest rate differentials; exchange rates were used to calculate the exchange rate changes for each country pair. The researchers regressed the above data using the OLS to estimate alpha and beta. To analyze the outcome for each country pair, they interpreted the level of significance for the R-squared and found that the R-squared value for each country pair was extremely low. The outcome for the case of Bangladesh versus China had an R-squared value of 0.08%, implying that interest rate differentials for the case of Bangladesh versus China could

only explain 0.08% of the total movement in the exchange rate changes for the Yen/TK. Similar results were found when the article tested the validity of the IFE in the case of Bangladesh versus India where the R-squared value was 0.59%, which can be interpreted as follows: the nominal interest rate differentials for the case of Bangladesh versus India only explain 0.59% of the total movement in the exchange rate changes of Rupee/TK.

The article concludes that empirical results suggest that there is little correlation between the exchange rate and interest rate differential for Bangladesh with China, and Bangladesh with India and the relationship between the variables is also not noteworthy for Bangladesh. Furthermore, the trends advocate that the forecasting of exchange rates with the hypothesis of IFE is not realistic for these countries.

A study by Shalishali (2012), "A test of the International Fisher Effect in Selected Asian Countries", tested the validity of the IFE for the following Asian countries, China, India, Japan, South Korea, Malaysia, Thailand, Vietnam and Indonesia, in the long run with each of the above countries interchangeably used as the home country and foreign country to test the direction of the parity. The article used quarterly money market interest rates to determine the nominal interest rate differentials. The data ranged from the first quarter of 1990 to the fourth quarter of 2009.

A statistical test among selected countries was conducted by Shalishali (2012) who ran an OLS regression on the historical nominal exchange rate changes and nominal interest rate differential. Their search regressed the percentage change in currency against the

nominal interest rate differentials among the selected countries and produced the following regression analysis:

$$e_f = a_0 + a_1\left(\left(\frac{1+i_h}{1+i_f}\right) - 1\right) + \mu$$

Wherea_0 = constant

a_1 = slope coefficient, and

μ = error term

According to Shalishali (2012), the hypothesized values of a_0 and a_1 are 0 and 1 respectively, which implies an equal offsetting average percentage change in the exchange rate of a given interest rate differential. The researcher then computed t-values to compare each regression coefficient to its hypothesized values and found that, when Indonesia is used as the home country, the IFE holds for the case of Indonesia versus the Philippines, Indonesia versus China, Indonesia versus South Korea, Indonesia versus Singapore, Indonesia versus India, Indonesia versus Vietnam, Indonesia versus Malaysia, and Indonesia versus Thailand. However, the IFE was refuted for the case of Indonesia versus Japan. Furthermore, when the Philippines was used as the home country, the article found that the IFE holds for the following country pairs: the Philippines versus China, Philippines versus South Korea, the Philippines versus Singapore, the Philippines versus Malaysia, but does not hold for the case of Philippines versus India, and the Philippines versus Indonesia. On the other hand, Shalishali also found that when China was made the home country, the hypothesized values were rejected for the following country pairs: China versus Indonesia, China versus Japan,

and China versus India, but the hypothesized values were not rejected for the remaining country pairs.

Similarly, when Japan was the home country, Shalishali found the IFE holds for the selected country pairs, except for the case of Japan versus India, and Japan versus Indonesia. Shalishali also found that the IFE holds when South Korea is the home country for the following country pairs: South Korea versus the Philippines, South Korea versus China, South Korea versus Japan, South Korea versus Vietnam, South Korea versus Malaysia, South Korea versus India, with the exceptions of South Korea versus Indonesia, and South Korea versus Singapore. However, when Singapore is the home country, Shalishali's findings for the IFE do not hold for the case of Singapore versus Indonesia, Singapore versus Malaysia, and Singapore versus India, but did hold for these countries: the Philippines, China, Japan and South Korea. The article also found mixed results when the IFE was tested for Malaysia as the home country where the IFE was refuted for the case of Malaysia versus Indonesia, and Malaysia versus India. However, the IFE was not rejected for the other five-country pairs.

The above results are mixed. While the IFE was found to hold for some country pairs, it did not hold for others. The theory held when some country pairs were used as the home country but were refuted when they were used as foreign countries. This suggests that there may be some impediments to foreign trade that may affect exchange rate adjustment, apart from interest and inflation rate differentials. While caution must be exercised in applying or interpreting the theory, this information is useful in international business in terms of export opportunities and price competitiveness of

imports. Shalishali (2012) further states that the IFE model may not be realistic in practice in daily currency transactions, but its value lies in its ability to illustrate the expected relationship between interest rates, inflation, and exchange rates.

A single two case study by Khawaga, Esam and Hammam (2013), "Exchange Rates and Interest Rates: An Empirical Investigation of International Fisher Effect Theory – The Case of Egypt (2003–2012)" examined the validity of the IFE theory for the Egyptian economy, and investigated Egypt versus the USA, and Egypt versus Germany during the period 2003–2012. The study used quarterly Treasury bill rates for the nominal interest rate as the independent variable. For the dependent variable, the researchers used quarterly data for the rate of change in the Egyptian pound per USD spot exchange rate, and the rate of change in the Egyptian pound per Euro spot exchange rate. To test the above dependent and independent variables, the researchers employed the following research methodologies: Unit root test, Autoregressive Distributed Lag (ARDL), bounds test approach to co-integration, and Error Correction Model (ECM), Granger Causality test, impulse response function and variance decomposition (VD). The ADF unit root test was employed to check for the stationarity of the nominal interest rates and nominal exchange rates. In the case of the ARDL and ECM, the methodology addresses both the long-run and the short-run relationships between nominal exchange rate changes and the nominal interest rate differentials under the IFE theory. Khawaga, Esam and Hammam (2013) undertook the ARDL bounds test approach to the co-integration and ECM. To test the direction of the relationship between nominal exchange rate changes and nominal interest rate differentials, they employed the Granger causality test. The researchers established that it was necessary to study the dynamics of the long-run and

short-run relationships between nominal exchange rate changes and nominal interest rate differentials through the ECM. Therefore, a VAR model was used to estimate and interpret through impulse response function and variance decomposition.

The outcomes of the above research methodologies used are discussed below. The ADF test was employed to test for the stationarity of the nominal exchange rate changes and nominal interest rate differentials. Khawaga, Esam and Hammam (2013) found that the nominal exchange rate changes are stationary series, while the nominal interest rate differentials are first-order homogenous. According to Khawaga, Esam and Hammam (2013), the preceding ADF unit root test results support the choice of the ARDL approach to co-integration due to the fact that the variables under study have different orders of integration. The researchers found that the null hypothesis of no co-integration is rejected, supporting the existence of a long-run relationship between nominal exchange rate changes and nominal interest rate differentials for both cases.

The empirical findings reveal the partial significance of the IFE in the case of the Egyptian pound and USD. However, the IFE did not hold in the case of the Egyptian pound and the Euro. Even in the case where the IFE holds, it is not a one-to-one relationship. This is an indication that the theory partially explains the change in the spot rate. Scholars such as Khawaga, Esam and Hammam argue that, for the IFE to hold, the PPP needs to hold as well. If the PPP does not hold, then the IFE will not hold.

This thesis discusses several research approaches to test the argument of Khawaga, Esam and Hammam (2013) to determine its validity and to what extent it is valid.

A study by Kulkarni (1991), "A test of Purchasing Power Parity theory and the International Fisher Effect: A case of the US dollar and the Japanese Yen", tested the validity of PPP and the IFE for the time period 1980 to 1988 in the long run, with the USA as the home country for both theories. The research used monthly data for the USA and Japan to test the validity of the purchasing power and the IFE theories. Kulkarni (1991) analyzed the outcomes of the PPP and the IFE by interpreting the R-squared values together with the Durbin-Watson statistic. Kulkarni found that both the PPP and IFE hold for the case of the USA versus Japan. The significance of the outcomes was determined by analyzing the R-squared values for both scenarios, when the monthly data was used to test the validity of the PPP and IFE, and when quarterly data were used to test the validity of the PPP and IFE theories.

What is interesting to note is that, even though both theories held, it was not to the same extent. Kulkarni found that the PPP had a higher R-squared value than that of the IFE, which implies that inflation rate differentials could explain most of the exchange rate changes between the USD dollar and the Japanese Yen for the selected time period.

Moreover, when Kulkarni tested the PPP and the IFE using monthly data, the R-squared values were lower for both theories than the R-squared results when the theories were tested using quarterly data. This implies that both the PPP and IFE theories are most evident in the long run and can be used when making long-term foreign investments.

A similar study by Mionel (2012), "The Influence of International Parity on the Exchange Rate: Purchasing Power Parity and International Fisher Effect", tested the

validity of PPP and the IFE for the same country pairs during the same period to determine if the PPP and the IFE hold in the long run. In order to test the PPP, Mionel (2012) took into account the period of 1990–2009, and the following countries: The United States of America, Germany, the United Kingdom, Switzerland, Canada, Japan, and China. Testing the IFE theory used the same period as that for the PPP, but the countries were slightly different: The United States of America, Germany, the United Kingdom, Switzerland, Canada, Australia, and New Zealand. Both theories analyze the data with the United States of America as a home country.

In order to validate the point made by Khawaga, Esam and Hammam (2013), "that for the IFE theory to hold, the PPP also needs to hold", this study only concentrates on the outcomes for the following countries: Germany, the United Kingdom, Switzerland, and Canada as these were the only countries tested for both theories. Mionel (2012) used annual inflation rates between 1999 and 2009 and, for the IFE, short-term nominal interest rates. Mionel considered the United States of America as the home country when testing the PPP and the IFE. Statistical tests were carried out on inflation rate differentials, interest rate differentials, and exchange rate changes taking the PPP theory and IFE into account. Mionel (2012) analyzed the outcomes of the PPP by comparing them to the PPP line. As per Mionel (2012), the points which are above the PPP line present the relation where the inflation rate differential is greater than the exchange rate changes, which describes the situation where foreign goods become cheaper for the home country and the points which are below the PPP line present the relationship where the inflation rate differential is less than the exchange rate changes, which describes the situation where foreign goods become more expensive than those in the

home country. Moreover, Mionel (2012) stated that if the points are extremely distant from the PPP line, then the percentage change for the currency value is not influenced by the inflation rate differential, as the PPP theory says.

For the IFE, Mionel (2012) analyzed the IFE outcomes by comparing them to the IFE line. According to Mionel (2012), all the points situated on the IFE line show that the investors get the same yield, no matter whether they invest in the home country or abroad. However, the points which are above the IFE line confirm the related interest rate differentials are greater than percentage changes in the exchange rates, which then implies that the investment yield in the home country is higher than the one abroad. Similarly, the points which are below the IFE line confirm the relation interest rate differentials are less than percentage changes in the exchange rates and therefore can be interpreted as the investment yield in the home country being lower than the yield abroad. On the other hand, if the points significantly deviate from the IFE line, then the percentage change of the currency value is not influenced by the inflation rate differential as the IFE theory suggests. The above outcomes, both for the PPP and the IFE were also analyzed by interpreting the significance of the R-squared results.

Mionel (2012) found that the inflation rate differentials explain most of the exchange rate changes for the following country pairs: the USA versus Germany with an R-squared value of 0.989; the USA versus the United Kingdom with an R-squared value of 0.996, and the USA versus Switzerland with an R-squared value of 0.9969. Similarly, when the IFE was tested, Mionel found that interest rate differentials explain most of the exchange rate changes for the following country pairs: the USA versus Germany with an R-squared result of 0.9956, and the USA versus the United Kingdom with an R-squared

value of 0.9981. The above outcomes support the statement made by Khawaga, Esam, and Hammam (2013). However, Mionel found that results were different when the IFE was tested for the case of the USA versus Switzerland with an R-squared value of 0.152. The outcomes suggest that the interest rate differentials only explain 15% of the changes in the exchange rate, as opposed to the inflation rate differentials that explain 99% of the percentage changes in the exchange rate when the PPP was tested. The case of the USA versus Switzerland also suggests that even if the PPP holds, it does not necessarily mean that the IFE will hold as well and, as such, does not support the statement made by Khawaga, Esam, and Hammam (2013).

A study by Alizadeth, Nassir and Masoudi (2014), "An Empirical Investigation of the International Fisher Effect on ten (10) ASEAN Countries", provides empirical evidence of the IFE as investigated among ASEAN member countries, assuming Malaysia as the home country. Historical interest rates and exchange rates were collected from 2002 to 2012. To test the validity of the IFE for the selected countries, Alizadeth, Nassir and Masoudi (2014) employed a statistical test to check the relationship between nominal interest rates and exchange rate changes. The researchers measured the nominal interest rate differentials and exchange rate changes relative to Malaysia as the home country for 2002 to 2012. In order to determine if the IFE holds, they analyzed the nominal interest rate differentials and exchange rate changes by employing a regression model by applying the OLS.

The study aimed to investigate the empirical validity of the IFE among ASEAN members over a period of ten years by analyzing the relationship of nominal interest rate

differentials and the exchange rate changes between each country with Malaysia as the home country in the long run.

A regression method was used for this analysis, and the outcomes were analyzed by analyzing the R-squared results and the significance of alpha at 5% level of significance. According to the statistical method used, as well as revealed results, this theory shows a partially significant relationship between the nominal interest rate differential and the exchange rate changes only for the Malaysia-Indonesia case, even though the nominal interest rates only explain 34.1%. The above results for the case of Malaysia versus Indonesia mean that nominal interest rate differentials explain 34.1% of the total movement in the exchange rate change for the Indonesian rupiah/MR. Furthermore, an alpha of 1.258 was significant in 5% acceptance level. By contrast, Alizadeth, Nassir and Masoudi found that the R-squared values for the other eight-country pairs had extremely low R-squared and alpha results, being above the level of significance, with Malaysia versus Vietnam having the lowest R-squared value of 0.2%. The researchers also found that three of the eight country pairs had an R-squared result of 12.2% for Malaysia versus Brunei, 23% for Malaysia versus Laos, and 40.6% for Malaysia versus Singapore. However, the null hypothesis for these country pairs was rejected owing to the amounts of the constant and the coefficient not being significant within the 5% level of significance. The outcomes of the eight-country pairs suggest that the IFE does not hold for the eight cases during the selected period. Therefore, the changes in exchange rate movements are not explained by the nominal interest rate differentials. For the case of Malaysia versus Indonesia, the nominal interest rate differential could only explain 34.1% of the total movement in the exchange rate changes. Therefore other factors

influence the exchange rate between Malaysia and Indonesia. These factors could be changes in government policies, changes in income, and so forth. Alizadeth, Nassir and Masoudi (2014) concluded that, considering the results and statistical outcomes, it is evident that one cannot merely rely on a few macroeconomic figures to predict the exchange rate fluctuations between countries.

A similar study by Puci and Mansaku (2016), "Empirical Evidence of the International Fisher Effect on the USD to CNY Exchange Rate", analyzed the IFE for the USD and Chinese Yuan. The article used the monthly consumer price index value and monthly interest rates of the USA and China to test the validity of the IFE in the long run. Monthly data were collected for the period from January 2002 to December 2014. The phenomenon which this research aimed to address was whether nominal short-term interest for the USA and that of China affected the exchange rates between the USA and China from January 2002 to December 2014.

In order to investigate the above case, Puci and Mansaku (2016) employed the following research methods: first, the researchers used Augmented Dickey-Fuller and Philips-Perron unit root tests of level and first difference to check if the time series were stationary or not. Secondly, they used Engle-Granger and Johansen co-integration techniques to check for long-run relationships between non-stationary variables. According to the authors, the primary reason for using co-integration techniques was to evade "spurious" regression results, meaning that the co-integration of two-time series, or more than two, shows that, in the long run, they have a relation, which in the short run, might deviate from its equilibrium, but in the long run, will always return to.

Furthermore, Puci and Mansaku (2016) maintain that a necessary condition for the co-integration technique is that the order of integration of all the elements, in the long run, must be the same, and the time series should be non-stationary in levels. Puci and Mansaku stress that the order of integration is the number of times the data should be differentiated in order to become stationary.

The main objective of Puci and Mansaku (2016) article was to define the validity of the IFE for the USD and CNY exchange rates from 2002 to 2014. The authors employed Augmented Dickey-Fuller and Phillips-Perron unit root tests to check the stationarity of the time series; the results of these tests led to the application of co-integration techniques such as Engle-Granger and Johansen. According to Johansen, evidence was found in favor of the theory at 1% level of confidence.

Similarly, a study by Khubchandani and Abrol (2017), "The International Fisher Effect and Japan: An Empirical Analysis" tested the validity of the IFE between Japan and six other countries in the long run, with Japan as the home country. The study used quarterly nominal interest rate differentials and exchange rate changes data from 2002 to 2017 to test the validity between Japan and the USA, the United Kingdom, Canada, Australia, South Korea, and the Eurozone. The article defined the nominal interest rates as follows: certificates of deposit for Japan, USA and South Korea, three-month Treasury securities for the United Kingdom, bank bills for Australia, and 90-day corporate papers for Canada and three-month lender's rate for the Eurozone.

Khubchandani and Abrol (2017) employed Z-tests to test the validity of the IFE, and OLS estimates were made for alpha and beta. Khubchandani and Abrol (2017) tested the

error term by calculating the Durbin-Watson statistic to identify the possible autocorrelations in the residuals, and Z-tests were employed to calculate p-values; residual terms were tested using the Durbin-Watson statistic. When analyzing the outcomes, the researchers found that the IFE held for some country pairs, but not for others. As such results were mixed, the outcomes are discussed in detail below. The outcomes for the case of Japan versus the USA, Japan versus the United Kingdom, Japan versus the Eurozone, and Japan versus Australia suggest that the IFE does not hold. This conclusion was based on the fact that the R-squared values for the these country pairs were extremely low, with 1.15% in the case of Japan versus the USA, 1.8% in the case of Japan versus the United Kingdom, 5.25% in the case of Japan versus the Eurozone, and 5.25% in the case of Japan versus Australia. The above R-squared values can be interpreted as follows: the nominal interest rate differentials can only explain 1.15% of the total movement in the exchange rate changes for the case of the Japanese Yen versus USD, 1.8% of the total movement in the exchange rate changes for the case of the Japanese Yen and the British pound, 5.25% of the total movement in the exchange rate changes for the case of the Japanese Yen versus the Euro, and 5.25% in the total movement in the exchange rate for the case of Japanese Yen versus the Australian Dollar. Khubchandani and Abrol also found that for the cases of Japan versus the USA, Japan versus the United Kingdom, Japan versus the Eurozone and Japan versus Australia, the null hypothesis was rejected for alpha, but it was not rejected for beta, and therefore the IFE does not hold for the above country pairs. By contrast, Khubchandani and Abrol (2017)found that the analysis failed to reject the null hypothesis in the case of Canada, as the p-values of both coefficients exceed the significance level of 0.05, implying that the IFE is likely to have held in the case of the

Japanese Yen and Canadian Dollar and that nominal interest rate differentials may appropriately predict exchange rate changes, but only to an extent of 0.02% as the outcome only had an R-squared value of 0.02%. Like other scholars, Khubchandani and Abrol concluded that differences in nominal interest rates are not significant predictors of exchange rates.

A study by Adam and Ofori (2017), "Validity of International Fisher Effect in the West African Monetary Zone", investigated the validity if the IFE in the West African Monetary Zone (WAMZ) in the long run. The West African Monetary Zone includes countries such as Cape Verde, the Gambia, Nigeria, Sierra Leone, Liberia and Guinea. However, Adam and Ofori excluded Liberia and Guinea from the study because the required data were unavailable. The article followed an approach similar to that of Shalishali (2012), where each country was used as the home and foreign country interchangeably. The study used monthly cross exchange rates and nominal interest rates for the period 1998:02 to 2012:08, and the nominal interest rates were defined as Treasury bill rates.

The article tested the IFE by regressing the relative exchange rate against the nominal interest differentials among the selected country pairs. Adam and Ofori (2017) also tested whether the relative change in exchange rate and nominal interest rate differential among the selected country pairs were co-integrated. To determine if the select country pairs were co-integrated, the researchers first tested the existence of unit roots in the stochastic process generating the series. They then tested the presence of co-integration between paired countries by employing the Engle-Granger two-step test and fractional

co-integration. The study also used OLS to estimate the values of alpha and beta and interpreted the level of significance at 5% and 10%. Adam and Ofori (2017) acknowledged that none of the country pairs supported the IFE hypothesis of $\beta = 1$ and $\alpha = 0$; however, they found that the hypothesis partially holds for some country pairs. The study found the following pairs to be significant at 5% level of significance: Cape Verde versus Ghana, Ghana versus Cape Verde, Ghana versus Sierra Leone and Sierra Leone versus Ghana. What is notable about the above outcomes is that when the direction of the parity was tested, it was found that the IFE holds to the same extent. The study also found the IFE to partially hold at 10% level of significance for the case of Ghana versus Nigeria, and Sierra Leone versus Cape Verde. Unlike the case of Cape Verde versus Ghana, Ghana versus Cape Verde, Ghana versus Sierra Leone, and Sierra Leone versus Ghana, the IFE did not hold for the case of Ghana versus Nigeria, and Sierra Leone versus Cape Verde when the direction of the parity was tested.

2.4 Conclusion

The International Fisher Effect is a theory in international finance that is used to focus the future exchange rates using nominal interest rate differentials. The IFE states that nominal interest rate differentials between two countries will determine the movement in the nominal exchange rates between those countries.

This chapter aimed to review the literature in respect to the IFE. However, in order to do justice to the subject matter, the chapter also touched on the literature of the Fisher hypothesis and PPP. Empirical literature reveals that, when the IFE is tested, results are

mixed. Some studies support of the IFE theory and those that reject the theory. Most importantly, from those studies that support the theory it is evident that, even though the theory was supported, the nominal interest rate differentials did not offset the movements in the nominal exchange rate on a one-to-one basis. Therefore, the IFE can only be used as a guide by the managers that head multi-international companies. This observation also means that other factors can influence the movement of nominal exchange rates, such as a change in income for individuals, government policies, political issues, and changes in the environment.

CHAPTER 3 RESEARCH METHODS

3.1 Introduction

The following chapter presents the research design, data collection and procedures. The objective of a research design section is to explain the type of research design and approach that was used during the research. The procedure section describes the type of analysis used to analyze the data, the countries used in the study, the data range and the data sources. The section on data explains the different types of the bilateral exchange rate used and defines the exchange rate used in the study. The data section also explains the different types of nominal interest rates used to determine the interest rate differentials for the different countries and provides details of the data range for each country and the type of nominal interest rate used.

3.2 Research Design

According to Okoth (2013), research design helps researchers to lay out the research questions, methodologies, implementation procedures, and data collection and analysis for the conduct of a research project.

The descriptive research design was used in this study by deploying a quantitative research approach to test the validity of IFE for the selected countries (the United Kingdom, China, the USA, India and the Netherlands). The descriptive research design

is suitable for describing the interrelationship between nominal interest rate differentials and bilateral nominal exchange rates between Namibia and its major trading partners.

A quantitative research approach was used to test if the IFE theory holds for the selected countries (United Kingdom, China, USA, India and the Netherlands).

3.3 Procedure

A regression analysis was employed to test the IFE between Namibia and the following countries: China, the United Kingdom, the Netherlands, the USA, and India. The data include quarterly nominal interest rate differentials and percentage changes in the bilateral nominal exchange rates. The bilateral exchange rate data range from the first quarter of 2010 to the fourth quarter of 2018 for all countries. The nominal interest rate data range from the first quarter of 2010 to the last quarter of 2018 for Namibia, China, the Netherlands and India. However, the nominal interest rate data for the United Kingdom were collected from the first quarter of 2010 to the second quarter of 2018 and that of the USA were collected from the first quarter of 2010 up until the second quarter of 2017.

Data on nominal interest rates and bilateral exchange rates for the chosen countries were obtained from the International Financial Statistics database, published by the IMF. Since the Namibian Dollar does not trade on the international market and is pegged to the South African Rand on a one-to-one basis, the South African Rand was used during the study as the home country's currency. When testing for the direction of the parity,

the currencies of China, the United Kingdom, the USA, the Netherlands and India were used as the home currencies, and of the South African rand as the foreign currency.

3.4 Data

Exchange Rate Data

According to Salas-Ortiz and Gomez-Monge (2015), an exchange rate is the price of a currency in terms of another and is expressed as the number of units in the domestic currency that must be exchanged for a unit of a foreign currency. There are two ways to quote a currency pair, either directly or indirectly; a direct currency quote is simply a currency pair in which the domestic currency is the quoted currency e.g. 1USD/14.75ZAR which means 1 USD = 14.75 ZAR, while an indirect quote is a currency pair where the domestic currency is the base currency, for example, the indirect quotation is the inverse of the direct quotation (1/14.75) 0.067 ZAR/USD which means 1 ZAR = 0.067 USD. In Namibia, the exchange rate is defined as the number of units of local currency that can be exchanged for a unit of foreign currency (direct quotation).

For this study, the exchange rate data were collected as Special Drawing Rights (SDR) taken from the International Finance Statistics (IFS) database. The SDR is the unit of account for the IMF and is not a currency per se. The SDRs, instead, represent a claim to currency held by IMF member countries for which they may be exchanged.

In order to convert the SDRs to direct currency quotations, the South African SDR is divided by the SDRs of the following countries; China, the USA, India, the United Kingdom, and the Euro Area (the Netherlands).

Interest Rate Data

In the finance literature, the following nominal interest rates are considered as risk-free investments: money markets, Treasury bills and government bonds. Following Adam and Ofori (2017), Treasury bill rates were used as the nominal interest rates for China, Namibia and the USA. However, government bond rates were used as nominal interest rates for the Netherlands and the United Kingdom, following scholars such as Andrea and Rodrigo (2015). For India, money market rates were used as nominal interest rates, following Shalishali (2012).

The interest rate data for the USA were not available for the last six (6) quarters, and therefore, when analyzing the data between Namibia and the United States of America, the analysis excluded the last six (6) quarters of the study.

It is also important to note that the nominal interest rate data for the United Kingdom were not available for the last two (2) quarters of 2018 and therefore the analysis of the data for Namibia and the United Kingdom excluded the last two (2) quarters of 2018.

3.5 Data Analysis

Following Shalishali (2012), Salas-Ortiz and Gomez-Monge (2015), and Madura, (2016) the study employed OLS regressions to test the interrelationships between the historical bilateral exchange rate changes and the nominal interest rate differentials for each of the trading partners.

The interest rate differential was computed taking the nominal interest rate for the home country, minus the foreign country's nominal interest rate divided by one, plus the foreign country's nominal interest rate.

The formula for the actual or effective return on a foreign bank deposit or any other money market security is

$$r = (1 + i_f)(1 + e_f) - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $i_f$is the foreign interest rate, and $e_f$is the percentage change in the value of the foreign currency denominating that security.

Equation (1) states that the actual or effective return (r) on a foreign money market security depends on the foreign interest rate (i_f), as well as the percentage change in the value of the foreign currency (e_f) denominating the security.

Furthermore, the investors who invest in the money market at home are expected to receive the actual rate of return, which is simply the interest rate offered on those securities.

Following the IFE, the effective return on a home investment (i_h) should be, on average, equal to the effective return on a foreign investment (r), $r = i_h$. Substituting equation (1) for r, the equation becomes:

$$(1 + i_f)(1 + e_f) - 1 = i_h \quad \ldots\ldots (2)$$

Solving for e_f

$$e_f = [(1 + i_h)/(1 + i_f)] - 1 \quad \ldots\ldots (3)$$

Wheni_h>i_f, e_f will be positive, which means that the foreign currency will appreciate when the home interest rate is greater than the foreign interest rate. Conversely, wheni_h<i_f, e_f will be negative; that is, the home currency will appreciate when the home interest rate is smaller than the foreign interest rate.

The difference in the nominal interest rates between countries is due to differences in expected inflation rates, assuming that the real rate of return is equal across countries. Furthermore, it must be borne in mind that the PPP theory suggests that the currency of a country with a higher inflation rate will depreciate by the amount of the inflation differential.

Therefore, the country with a higher interest rate will experience depreciation in the value of its currency by the amount of the interest rate differential, which will consequently negate any gains for investors who invested in the securities of those

countries because of a higher interest rate. Eventually, the return on investment in the respective countries will be similar.

Following Shalishali (2012) and Salas-Ortiz and Gomez-Monge (2015), the IFE was tested by computing the percentage change in the bilateral exchange rate and regressed against the nominal interest differential, as illustrated in the formula below.

The formula below was derived from Equation 3 above:

$$e_f = \alpha + \beta(\frac{i_h - i_f}{1 + i_f}) + \mu \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

Where,

α = constant

β = slope coefficient, and

μ = error term

All the other variables are as previously defined.

When the IFE holds, the hypothesized values of parameters of α and β are 0 and 1, respectively, implying an equal offsetting average percentage change in the exchange rate for a given interest rate differential.

In order to test for the direction of parity, each of the trading partners was made a home country and Namibia the foreign country. The analysis was done using the E-Views 7 software.

3.6 Research Ethics

During the research process, credit was given to all resources used by means of referencing and citations.

3.7 Conclusion

The purpose of all the procedures employed in this chapter was to test the IFE to determine if it holds for the selected country pairs. The sample consists of six countries: Namibia and her major trade partners, China, India, the Netherlands, the United Kingdom, and the USA.

Data were collected from the first quarter of 2010 to the fourth quarter of 2018, with the exception of the United Kingdom and the USA. The nominal interest rates for the above countries were collected up until the second quarter of 2018 and 2017, respectively.

The following nominal interest rates were used: Treasury bills, government bonds, and money market rates. It is assumed that the above nominal interest rates are risk-free investments. Ordinary Least Squares regressions were used to test the interrelationships between the historical bilateral exchange rate changes and the nominal interest rate differentials for each of the trading partners.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the empirical results of the validity of IFE between Namibia and her major trading partners (China, UK, USA, India, and the Netherlands) fora period of nine years. Quarterly data on interest rate differentials and exchange rate changes for the period 2010 quarter one to 2018 quarter-four were analyzed using E-Views 7 software.

4.2 Discussion of Results: Namibia as Home Country

The outcome of the data analyzed on E-Views 7 was statistically tested to determine the validity of IFE using statistical tests described below (Madura, 2016).

(a) Test for $\alpha = 0$

$$t = \frac{(\alpha - 0)}{S.E\ of\ \alpha}$$

(b) Test for $\beta = 1$

$$t = \frac{\beta - 1}{S.E\ of\ \beta}$$

The analysis was carried out by analyzing the relationship between nominal interest rate differentials and the exchange rate changes between each country and Namibia as the home country in the long run. As explained in Chapter 3, a regression method was used for this analysis and the results are as follows: the null hypothesis was considered to be $\alpha = 0$ and $\beta = 1$ for the linear regression model. The results of the statistical tests are summarized in Table 1 below.

Table 1: NAMIBIA AS THE HOME COUNTRY 1

		NAMIBIA AS HOME COUNTRY				
		CHINA	UK	INDIA	USA	NETHERLAND
	α	*0.026*	*0.041*	*0.004*	*-0.071*	*0.023*
	Std error	*0.044*	*0.017*	*0.008*	*0.102*	*0.016*
	β	*-0.001*	*-0.019*	*-0.034*	*0.017*	*-0.004*
	Std error	*0.008*	*0.009*	*0.027*	*0.019*	*0.005*
Testing for α = 0	t-values	*0.592*	*2.423*	*0.486*	*-0.694*	*1.417*
Testing for β = 1	t-values	*-118.331*	*-108.662*	*-38.594*	*-52.607*	*-206.741*
R Squared	R Squared	*0.001*	*0.116*	*0.045*	*0.028*	*0.019*

The results were analyzed by interpreting the significance of the t-values for α and β to determine if the IFE holds in the long run and to what extent it holds between the different country pairs.

When interpreting the t-values, it is evident that the outcomes are mixed. There are cases were the $\alpha = 0$ is not rejected and in other cases where it is rejected. By contrast, when testing for $\beta = 1$, all statistical outcomes rejected the null. The t-values had the following outcomes: Namibia versus China $\beta = -118.32$, $\alpha = 0.59221$; Namibia versus India $\beta = -38.594$, $\alpha = 0.486$; Namibia versus USA $\beta = -52.607$, $\alpha = -0.694$, and Namibia versus the Netherlands $\beta = -206.741$, $\alpha = 1.417$. The cases of Namibia versus China, Namibia versus India, and Namibia versus the USA had mixed statistical outcomes, where $\alpha = 0$ was not rejected and $\beta = 1$ was rejected. However, in the case of Namibia versus the United Kingdom, and Namibia versus the Netherlands, both alpha and beta were rejected.

The above outcomes illustrate that IFE does not hold and, as such, the IFE cannot be used to predict currency changes for the above country pairs. This also means that if the

Namibian interest rates are higher than the foreign interest rates, then foreign investors will be attracted to invest in the foreign country and still gain profits as this presents an arbitrage opportunity.

4.3 Discussion of Results: Namibia as Foreign Country

Statistical tests were carried out on the outcomes where Namibia is a foreign country, just as in the case where Namibia is the home country. The results are presented in Table 2 below.

Table 2: NAMIBIA AS THE FOREIGN COUNTRY 1

		NAMIBIA AS FOREIGN COUNTRY				
		CHINA	UK	INDIA	USA	NETHERLAND
	α	*-0.126*	*-0.056*	*0.000*	*0.435*	*-0.023*
	Std error	*0.183*	*0.038*	*0.009*	*0.582*	*0.038*
	β	*-0.133*	*-0.085*	*-0.024*	*0.537*	*-0.021*
	Std error	*0.221*	*0.065*	*0.022*	*0.690*	*0.056*
Testing for α = 0	t-values	*-0.687*	*-1.480*	*-0.016*	*0.747*	*-0.599*
Testing for β = 1	t-values	*-5.126*	*-16.597*	*-45.945*	*-0.671*	*-18.170*
R Squared	R Squared	*0.010*	*0.050*	*0.032*	*0.021*	*0.004*

When the direction of the parity was tested, above results (Table 2) were also analyzed by analyzing the outcomes of the t-values. Just as above, the analysis was carried out by analyzing the relationship of the nominal interest rate differentials and the exchange rate changes between each country with Namibia as the foreign country in the long run. Similarly, when testing for the direction of the parity, the null hypothesis was considered to be $\alpha = 0$ and $\beta = 1$.

Just as in the case where Namibia was the home country, the outcome of the t-values was mixed when Namibia was a foreign country. When conducting a statistical test, both

$\alpha = 0$ and $\beta = 1$ need to be accepted for the IFE to hold. In the case of China versus Namibia, India versus Namibia, and the Netherlands versus Namibia, $\alpha = 0$ was not rejected but $\beta = 1$ was rejected. In the case of the United Kingdom versus Namibia, both $\alpha = 0$ and $\beta = 1$ were rejected. This also means that IFE does not hold for the above country pairs, and the interest rate differentials cannot be used to forecast the exchange rate changes.

On the other hand, the case of the USA versus Namibia had a different outcome when statistically tested to determine if the IFE holds. The case of the USA versus Namibia had a statistical outcome of $\alpha = 0.747$, $\beta = -0.671$ and, as such, the null hypothesis for α and β was not rejected and therefore, in the case of the USA versus Namibia, the IFE holds. Taking into account that the IFE holds, the IFE position is as follows: countries with high-interest rates will experience high expected inflation so that the currencies of these countries with relatively high expectations of inflation will depreciate. The level of expected depreciation is equal to the differential in nominal interest rates, which suggests that the expected depreciation should offset the advantage of investing in securities in the high-interest rate country. This implies that when USA nominal interest rates are relatively low, USA investors would not benefit from investing in interest-bearing securities in Namibia with higher interest rates.

CHAPTER 5: CONCLUSION

5.1 Introduction

The IFE is a theory in international finance that is used to estimate or focus future spot rates using nominal interest rate differentials. This study compared different empirical literature to determine if the IFE can be used to estimate or focus the future spot rates using the nominal interest rate.

Empirical evidence on the subject matter are mixed, scholars such Mionel (2012) found that nominal interest rate differentials explained most of the changes in exchange rate changes, with an R-squared of 0.996 for the case of the USA versus Germany and an R-squared of 0.998 for the case of USA versus the UK. The above R-squared means that 99.6% of the changes in exchange rate for the case of USA versus Germany and 99.8% for the case of USA versus UK is caused by nominal interest rate differentials. However, researchers such as Alizadeth, Nassir, and Masoudi (2014) found that the nominal interest rate differentials have little to do with the changes in exchange rates. Alizadeth, Nassir, and Masoudi (2014) found that the nominal interest rate differentials only explained 34.1% of the changes in exchange rates for the case of Malaysia versus Indonesia.

5.2 Conclusion

The validity of the IFE theory was tested for Namibia and her major trading partners, namely: China, the United Kingdom, the United States of America, India, and the Netherlands. Firstly, when the validity of the IFE was tested, Namibia was the home country, and each of the trading partners was the foreign countries. The direction of the

IFE theory was investigated where Namibia was the foreign country and each of the trading partners was the home country. The results were mixed. The theory was refuted for all country pairs with Namibia as the home country. However, when the direction of parity was tested, the theory held for the case of USA versus Namibia and refuted for all other country pairs. This suggests that other factors affect exchange rate adjustment, apart from nominal interest rates differentials. According to Madura (2016), the other factors that can influence the percentage change in the spot rate are as follow, change in the inflation rate differentials between countries (the relative form of PPP explains this), changes in income differentials between countries, change in government controls and change in expectation of future exchange rates. As this information is essential and useful in international business, it is vital that caution is exercised in applying or interpreting the IFE theory.

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