

**RELATIONSHIP BETWEEN THE MOVEMENT IN THE FOREIGN
EXCHANGE RATE AND POSSIBLE ARBITRAGE PROFITS IN
KENYA**

BY

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DECLARATION

I hereby declare that this research project is my original work and has not been presented for award in any other university or college. Where other sources of information have been used, they have been acknowledged.

Signed.....Date.....

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This project has been submitted for examination with my approval as University Supervisor.

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DEDICATION

I dedicate this project to my wife, Mercy Kweyu and my parents, Johnstone and Hellen Kweyu for their steadfast prayers, unwavering support and words of encouragement throughout my study. I will always be grateful.

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ABBREVIATIONS

ATP	–	Arbitrage Pricing Theory
BOP	–	Balance of Payment
CBK	–	Central Bank of Kenya
CIP	–	Covered Interest Rate Parity
CLRM	–	Classical Linear Regression Model
CMA	–	Capital Markets Authority
EMH	–	Efficient Market Hypothesis
EUR	–	Euro
FE	–	Fisher Effect
FX	–	Foreign Exchange
GDP	–	Gross domestic Product
IFE	–	International Fisher Effect
KES	–	Kenya shilling
LOP	–	Law of One Price
MNCs	–	Multi National Corporations
PPP	–	Purchasing Power Parity
VIF	–	Variance Inflation Factor
USD	–	United States Dollar

ABSTRACT

This study examined the relationship between movement in the Foreign Exchange rate and possible Arbitrage Profits in Kenya, covering a ten year period from January 2007 to December 2016. The study used secondary data from Central Bank of Kenya (CBK). In determining arbitrage profits, the researcher computed Triangular Arbitrage. Movement in foreign exchange rate was computed as well by getting the end month closing rate of the KES/USD and KES/EUR and subtracting the previous month's rate. The other explanatory variables were CBK rate and Inflation rate. Descriptive analysis was done on the variables. It was established, over the research period, changes in the CBK Rate was minimal, as compared to changes in inflation. The Mean and Standard deviations of arbitrage profit, change in Euro value, and change in Dollar value was measured. It was found that over the ten year research period, the standard deviation of the change in the value of Euro was twice of the change in the value of the Dollar. Pearson correlation was employed to analyze the level of association between the arbitrage profit and the explanatory variables and the results shows a significant weak positive correlation between arbitrage profit and change in dollar value. CBK rate have significant weak negative correlation with change in euro value and change in dollar values. Arbitrage profit was regressed against change in dollar value, change in euro value, central bank rate as well as inflation. It was found that there is a low degree of correlation between the arbitrage profits and the explanatory variables. R squared, being the coefficient of determination indicates the deviations in the response variable that is as a result of changes in the predictor variables. The R^2 indicates that only 8% of the variation in arbitrage profit is explained by change in dollar value, change in euro value, central bank rate and inflation rate. This means there are other micro and macro-economic factors, such as Balance of Payment, Country's Debt level, Banks Interest rates, other investment opportunities available in the market, which could explain the variation in arbitrage profits. A one unit increase in the dollar value increases the arbitrage profit by three hundred and twenty units while a unit increase in the rate of inflation increases the arbitrage profit by one hundred and seven units. However, changes in euro value has no significant effect on the arbitrage profit. The results of this study suggest that arbitrageurs may monitor the movement of the Kshs/USD exchange rates to identify arbitrage opportunities and make profits. The level of inflation rate in the country could also be a guide to arbitrageurs in identifying triangular arbitrage opportunities in the foreign exchange market.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The foreign exchange (FX) trade involves buying and selling of currencies with a view of making a profit. The FX market presents many opportunities to make profit and one of the ways is through exchange rate arbitrage. Sharpe and Alexander (1990) described arbitrage as the concurrent purchase and sale of two or more currencies so as to make a profit from the disparity in prices.

Madura (2008) defined FX rate as the price at which the domestic currency will exchange for another country's currency. Exchange rate structures can either be fixed, free floating, managed float or pegged. The context of this study is the Kenyan FX market, which has adopted the free floating system. Under this system, the currency value is dictated by the market dynamics.

This study sought to determine the relationship between the movement in the exchange rate of the Kenya Shilling (KES) and the exchange rate arbitrage profits over a 10-year period, 2007 to 2016. The study strived to answer the question "What is the relationship between movement of the KES/USD and KES/EUR exchange rate and possible currency arbitrage profits?" The researcher used Triangular Arbitrage approach in determining arbitrage opportunities. The Kenya Shilling (KES), the United States Dollar (USD) and the Euro (EUR) was used in the computation of arbitrage profits and changes in the

exchange rate of the KES. The researcher computed cross rates between the KES/USD and KES/EUR exchange rates and compared with the actual USD/EUR exchange rates. Difference between the cross rate and actual exchange rate, positive or negative, presented an opportunity for Triangular Arbitrage Profits.

This study made reference to The Efficient Market Hypothesis (Fama, 1965), which states that prices will be a reflection of all the obtainable facts and figures as long as the market is efficient. Presence of exchange arbitrage opportunities therefore is an indicator of market inefficiency. Purchasing Power Parity (PPP) theory also informed this study. It states that “the ratio of the prices of a similar commodity in two different countries is the same as the exchange rate of the two countries. An opportunity for arbitrage profit arises if PPP is different from the prevailing exchange rate. (Cheol and Bruce, 2012).

This study also borrowed from the Interest rate theories of Fisher Effect (FE) and International Fisher Effect (IFE). Under these theories, exchange rates are determined by inflation. Variances in real interest rate, which is arrived at using inflation rate factor, is greatly correlated with the exchange rate of a currency. The IFE ties the FE and PPP to determine the influence of comparative changes in interest rates between nations on their FX prices.

1.1.1 Movement in Foreign Exchange Rate

Movement in FX rate is the adjustment in price of a currency as dictated by FX market dynamics. In a free floating system like Kenya, the price adjusts frequently as the market dictates. However, in a fixed exchange rate structure, the government controls the price

of the currency at a constant rate or oscillates within thin margins. A managed float is a hybrid between fixed and freely floating. Currency rates fluctuate without formal limits. However, interventions from the Government can be made to prevent the currency from moving in a certain direction continuously. In a Pegged structure, the home currency's price is attached to a foreign stable currency but its value changes as per the stable currency. (Madura, 2008).

Sissoko (2012) studied sources of Real Exchange Rate (RER) fluctuations in Sub Saharan Africa and found that change in economic fundamentals is the main source of variation in exchange rates in both Francophone and Anglophone countries in the Long run. It was also found that Economic Fundamentals are key in explaining RER fluctuations in the short term and long term projections in Anglophone Countries. Free Floating exchange structure and varied fiscal and monetary policies in Anglophone Countries could explain the relative significance of economic fundamentals in these countries.

1.1.2 Possible Arbitrage Profits

Foreign currency arbitrage can be defined as simultaneous purchase and sale of two or more currencies so as to make a profit from differences in price. According to (Sharpe and Alexander, 1990), arbitrage is the purchase and immediate sale of the identical assets located in diverse markets and profit from the different prices. It exploits the price differences in currencies on different markets or in different forms. Existence of arbitrage (locational or triangular) in currency markets is attributed to market inefficiencies.

Cheol and Bruce (2012) defined Triangular Arbitrage as buying of an overpriced currency, then exchange it for an underpriced third currency, which is in turn exchanged for the original currency. The objective is to make an arbitrage profit which is attributable to the overpricing of a currency and underpricing of another. It involves striking offsetting deals among three currencies simultaneously to earn arbitrage profit. It takes advantage of exchange rate variances among three currencies.

In their study of Arbitrage in FX market, Akram, Rime and Sarno (2007) delivered real-time proof on the rate of recurrence, extent and time interval of arbitrage opportunities and economically significant violations of the law of one price (LOP) covered interest rate parity (CIP) condition in the FX market. The opportunities lasted to allow arbitrageurs to take advantage of them but were also short enough to justify why such opportunities went unnoticed in past researches.

Ohemke (2009) argues that mispricing that leads to arbitrage profits are usually rectified gradually rather than instantly because capital often moves gradually from one market to another in reaction to buying prospects. Ohemke (2009) terms this as “gradual arbitrage”. The pace of arbitrage is decreasing in price effect costs and increasing in the level of competition among arbitrageurs. Arbitrage is therefore slower in more illiquid markets.

1.1.3 Movement in Exchange Rate and Possible Arbitrage Profits

Foreign exchange rate can be defined as the price at which the domestic currency will exchange for another country’s currency. Cheol and Bruce (2012) described foreign

exchange as change of buying power from one currency into another. Sharpe and Alexander (1990) stated that arbitrage is purchase and immediate sale of identical assets located in diverse markets and profit from the different prices.

Movement in exchange rates is affected by, among other factors, changes in inflation rates and interest rates. Piet and Raman (1995) explained that lower inflation rate could lead to an increase of the price of the currency of a country. McKenzie (1999) stated that Interest rates and price of a currency have a strong correlation. When the rates of interest in a country are higher than those of other countries, then, *ceteris paribus*, an inflow of currency into banks and other financial institutions is expected. This would cause an appreciation of the exchange rate thereby determining whether arbitrage profits exist. While changes in interest rates and inflation rates affect the movement in the exchange rate, arbitrage profits are influenced by movement in exchange rates. These three variables therefore determine the existence of arbitrage profits.

1.1.4 Foreign Exchange Rates and Possible Arbitrage Profits in Kenya

According Ndung'u (2001), Kenya has adopted a free floating rate system of foreign exchange. There is no preset rate at which the shilling exchanges with other currencies but market dictates the value of the shilling. The CBK may make periodic interventions to avert adverse fluctuations. The CBK releases indicative foreign exchange rate on a daily basis, providing a good indicator of the value of the Shilling on any particular day for the use by the public. However, foreign exchange dealers may apply different rates

for their transactions. It is expected that as the market dictates the level of foreign exchange rate, foreign exchange arbitrage opportunities would also be affected.

In Kenya, it is possible to make Triangular Arbitrage profits by dealing in three different currencies concurrently and gaining from the price differences. It is also possible to make Locational arbitrage profits by buying currencies from lowly priced forex bureaus/banks and selling at other forex bureaus/banks at a higher price (Mwangi and Duncun, 2012). It is expected that these opportunities would be influenced by various factors such as movement in exchange rate, CBK rate and inflation rate. This study intends to look at the effects of these factors.

1.2 Research Problem

Movement in exchange rates is affected by, among other factors, changes in inflation rates and interest rates. Studies have confirmed that lower inflation rate could lead to an increase of the price of a currency and that Interest rates and price of a currency have a strong correlation. When the rates of interest in a country are higher than those of other countries, then, *ceteris paribus*, an inflow of currency into banks and other financial institutions is expected. This would cause an appreciation of the exchange rate thereby determining whether arbitrage profits exist. While changes in interest rates and inflation rates affect the movement in the exchange rate, arbitrage profits are influenced by movement in exchange rates.

Players in the foreign exchange market trade in various financial products with the aim of making profit. One of them is Triangular Arbitrage, which involves dealing in three different currencies concurrently by taking advantage of the price differences to make a profit. In Kenya, the FX Market provide an institutional structure through which currencies are traded and the market determines the rate of exchange between currencies once the FX transactions are completed.

Various global studies have established that major FX markets have some element of inefficiency due to existence of opportunities to make arbitrage profits. However, these profits are short-lived and are soon wiped out as soon as more investors take advantage of these opportunities, (Arnott and Pham, 1993). Garbade and Silber (1978) found that technology has minimized arbitrage opportunities. Technological inventions have led to quick reduction of differences in the market prices and increased market efficiency while reducing arbitrage

Akram, Rime and Sarno (2007) delivered real-time proof on the rate of recurrence, extent and time interval of arbitrage opportunities and economically significant violations of the law of one price (LOP) covered interest rate parity (CIP) condition in the FX market. The opportunities lasted to allow arbitrageurs to take advantage of them but were also short enough to justify why such opportunities went unnoticed in past researches.

Ohemke (2009) argued that mispricing that leads to arbitrage profits are usually rectified gradually rather than instantly because capital often moves gradually from one market to

another in reaction to buying prospects. (Ohemke, 2009) terms this as “gradual arbitrage”. The pace of arbitrage is decreasing in price effect costs and increasing in the level of competition among arbitrageurs. Arbitrage is therefore slower in more illiquid markets.

Locally, a number of studies have been done of the efficiency of the FX market and found that the market is inefficient due to existence of arbitrage opportunities, both locational and Triangular. Kurgat (1998) studied the efficiency of Foreign Exchange Bureaus in Kenya and established that locational arbitrage opportunities were prevalent due to informational inefficiencies. Muhoro (2005) found that both locational and triangular arbitrage opportunities existed in both Banks and Forex Bureaus in Kenya.

Figondo (2013) found borrowers arbitrage opportunities between Kenya Shilling denominated loans and US dollar denominated loans at different banks depending on the time of the year. Mwangi and Odhiambo (2012) studied the Mombasa spot market, it was found that there were more triangular arbitrage opportunities as compared to locational arbitrage in the FX market. Finally, it was found that Forex dealers in various currencies can capitalize on the inefficiencies and gain by buying currencies from one forex bureau and sell in another (locational arbitrage) before the equilibrium is restored.

It is expected that movement in exchange rate could lead to overvaluation or undervaluation of a currency thereby creating an opportunity of an arbitrage profit. However, the relationship between these two variables has not been established. This

study intended to fill this gap. The findings will assist arbitrageurs in telling arbitrage opportunities based on the direction/movement the KES takes against USD or EUR.

This study used Triangular Arbitrage between the KES, USD and the EUR to determine the relationship between this established arbitrage and the movement in the KES exchange rate against the USD and EUR. Triangular arbitrage was determined by computing the USD/EUR cross rate from the KES/USD and KES/EUR exchange rates. Any difference between the derived cross rate and the prevailing market USD/EUR exchange rate represented an opportunity for an arbitrageur to make profit.

1.3 Research Objective

To determine the relationship between the movement in KES/USD and KES/EUR exchange rates and possible exchange rate arbitrage profits in Kenya over a ten-year period, from January 2007 to December 2016.

1.4 Value of the Study

This study intended to determine the relationship between movement in the prevailing exchange rate and possible arbitrage profits. Several studies have been done of existence of arbitrage opportunities. This was a further study to these researches and intended to determine the existence or not of the relationship between these arbitrage profits and the movement in the exchange rate.

The Kenya Money and Capital Market is experiencing growth in terms of increased investments and deepening of financial products. There is need for increased research on these markets so as to broaden the portfolio of financial products available for investors.

This study will give a clear picture of the FX market movements to the market players since it's more guided by actual market trends. The study will help commercial banks, investment banks and investors identify arbitrage profit opportunities through the movement in the exchange rates.

This study is will advise/guide arbitrageurs and speculators determining the presence or lack of arbitrage profits in the FX Market, depending on the currency exchange movement. They could therefore take advantage of the price movement to strike arbitrage profits. This Study would also be useful to policy makers and market players in coming up with effective policies and strategies that will support continual growth of the FX market in Kenya as well as guide the CBK in making appropriate interventions as need arises. The determination of the relation between changes in the exchange rate and arbitrage profits will add knowledge in the academic studies of the Foreign Exchange Market thereby relating the actual practical operations in the stock market with the academic work.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This is a review earlier studies and examines theories relating to exchange rate arbitrage and foreign exchange rates. This chapter examines the arbitrage pricing theory, Purchasing Power Parity, Interest Rate theories, Empirical studies, the Conceptual framework and a summary of the literature review.

2.2 Theoretical Review

Below is a review of theories that informed this study:

2.2.1 Efficient Market Hypothesis

Fama (1965) explained that The Efficient market hypothesis (EMH) postulates that prices will be a reflection of all the obtainable facts and figures as long as the market is efficient. In the context of this study, this means the foreign exchange prices is optimal and there is not opportunity for arbitrage profits. Under EMH, markets can be strong, semi-strong or weak all dependent on the amount of information reflected in the prices.

Bodie, Kane and Marcus (2014) state that analysis of historical price statistics is not worthwhile since all these information is available at no cost. As long as a market is efficient, investors would profit by use of historical price statistics, freely available facts and figures or that which can only be accessed by market players. In an efficient market,

investors cannot use past prices, public available information or information available to the insiders of the market to plan ways to beat the market consistently.

Ryoo (2006) explains that an inefficient market gives rise to untapped arbitrage profitability. Bid-ask spreads can be an indicator of the level of market inefficiency. Banks operating in financial markets with potentially huge arbitrage returns due to market illiquidity may opt for a wider bid-ask spread, which will eventually reduce the number of arbitrage opportunities.

2.2.2 Purchasing Power Parity

According to Cheol and Bruce (2012), Purchasing Power Parity (PPP) states that the ratio of the prices of a similar commodity in two different countries is similar to the exchange rate of the two countries. An opportunity for arbitrage profit arises if PPP is different from the prevailing exchange rate. Due to the difference in values, a country's currency may be viewed as overpriced or underpriced. Cheol and Bruce (2012). Law of One Price (LOP) is therefore akin to PPP. International trade is impacted whether PPP holds or not. Under PPP exchange rate changes between two countries is counterbalanced by difference in inflation rates between the same countries. The countries' will therefore remain competitive against their trading partners. However, if PPP does not hold, the competitiveness of these countries would be affected.

Richardson (1978) subjected PPP to a test of commodity arbitrage between the United States and Canada but arbitrage was not established in most of the commodities

categories. The researcher held that PPP may not hold for other sets of countries if it could not hold between bordering countries.

Stockman (1980) developed the model of arriving at rates of exchange and prices of commodities. With a deviation from PPP, price changes due to market dynamics would affect changes exchange rates. The changes in exchange rates would not match changes in commodity prices because exchange rates more fluid than prices levels and inflation rates. Deviation from PPP means variation of exchange rates is more than ratios of price indexes. It was found that changes in exchange rates affect terms of trade because commodity prices do not adjust to clear market mispricing. Inflation would therefore influence exchange rates thereby determining existence of arbitrage opportunities.

2.2.3 Interest Rate Theories: Fisher Effect and International Fisher Effect

Cheol and Bruce (2012) state that under these theories, FX rates are arrived at through use of inflation rates. Under Fisher Effect (FE), nominal interest rate is a sum of real interest rate and inflation rate. Exchange rates is affected by both inflation rates and interest rates and therefore real interest rate is used to assess exchange rate movements. Holding all other parameters constant, changes in real interest rate highly affects the country's exchange rate. The International Fisher Effect (IFE) combines the PPP and FE to determine the effect of interest rate change on FX prices. A rise in a country's inflation rate compared to other countries would lead to a drop in its currency's exchange price. This is the IFE which states that variances in interest rates results in changes in exchange rates. The exchange rate of Country with high interest rates compared to another will fall

because this is a reflection of likely inflation. Differences in interest rates two countries can be used to calculate future variations in the exchange rate. The level of inflation therefore has an influence of the existence or lack of arbitrage profits in the FX market.

2.3 Determinants of Foreign Exchange Arbitrage Profits

There are several factors that determine existence of arbitrage profits in the FX market, including a country's exchange rate, prevailing interest rates and inflation rates.

2.3.1 Net Capital Inflows

Zhou, (1997) states that in a free-floating exchange rate system, currency prices are dictated by the market, as well as trade and investment decisions. Monetary inflows from exports and investment income would lead to current account surpluses (*ceteris paribus*) thereby increasing demand for the country's currency hence appreciation of its value. This movement in currency value would determine whether opportunities for arbitrage profits exist or not.

Pareshkumar, Narendra and Ashok (2014) explain that countries world over, the current account deficit point to higher amounts of imports of goods and services as compared to the amount of exports. A country benefits more when a country has a surplus rather than a deficit. Such countries can attract more capital inflows through Direct Foreign Investment and increased exports leading to appreciation in the currency value as compared to the countries with capital account deficit

2.3.2 Prevailing Interest Rate

Prevailing rate of interest would also determine existence of arbitrage profit. There is a strong correlation between Interest rates and exchange rates. A country with higher interest rates compared to others, then, *ceteris paribus*, an inflow of currency into banks and other financial institutions is expected. This would cause an appreciation of the exchange rate thereby determining whether arbitrage profits exist (McKenzie, 1999).

If rate of interest of a country increases as compared to other, Investors will be attracted to the country because they will get a higher return from saving in the country's banks. The demand for the country's currency will eventually increase, hence the exchange rate. Higher interest rate therefore leads to net monetary inflows. Higher interest rate reduces purchase power of the consumer while the loan borrowers have to pay more interest. (Pareshkumar, Narendra and Ashok, 2014)

2.3.3 Inflation Rate

Inflation also influences arbitrage profits. High inflation reduces purchasing power of a country hence weakening the local currency. At times the relationship between inflation and foreign exchange may be inverse. This may be caused by speculation from the players in the forex market. (Zhao, 1985). (Piet and Raman, 1995) explained that country than maintains lower inflation rate will result in an increase in the value of its currency.

Public debt or external debt also influence exchange rate hence arbitrage profits. (Piet and Raman, 1995) stated that countries with huge deficit budgets with public projects to

finance and government expenditure are less attractive to foreign and local investors leading to high inflation and thus loss in the value of local currency. Large debt encourages inflation.

2.3.4 Balance of Payment

Balance of Payments (BOP) method was the first approach used in exchange rate modeling. This approach tracks all the monetary inflows and outflows across a country's borders over a given period. If a country's value of exports are higher than that of its imports, then it has favorable terms of trade. This will lead to an increase in the demand of the country's currency as well as its value. Foreign Direct Investment (FDI) also leads to increase in currency demand and a rising exchange rate. Capital inflows into a country play a role in the determination of a country's exchange rate. (Solnik, 2000)

2.4 Empirical Studies

Kurgat (1998) studied the spot market efficiency of the Foreign Exchange Bureaux in Kenya with a view to establishing whether market information is readily available at affordable prices to the market. The researcher used secondary data CBK, and analyzed using chi-square distribution, F-distribution and line graphs and found that the Foreign Exchange Bureaux market is generally inefficient as evidenced by the number of arbitrage opportunities. Unlike Muhoro (2005) who studied both locational and triangular arbitrage, Kurgat studied locational arbitrage. The study also noted that the introduction of the Forex Bureaux in Kenya increased availability of foreign currency and reduced inconveniences experienced by small-scale foreign currency buyers under the expunged

exchange control regime. The study covered the period when Kenya was transiting from the fixed exchange regime to the free floating system and therefore the findings would not represent the current market trends.

Muhoro (2005) carried out a study to determine the efficiency of the FX market in Kenya which is dominated by banks and bureaus, the main objective being to find out whether it was possible for an arbitrageur to make profits through locational and triangular arbitrage. Secondary data in the form of daily closing counter foreign exchange rates for six banks and fifty-seven bureaus were obtained from CBK and analyzed using chi square and line graphs. The researcher found out that the FX market is generally inefficient due to the existence of arbitrage opportunities for both bureaus and banks. This study covered both triangular and locational arbitrage. However, the one-year period covered was quite short. A longer period would have given a better reflection of the market trends.

Figondo (2013) carried out a study to establish the existence or absence of foreign exchange rate arbitrage (borrowers' arbitrage) opportunities between Kenya Shilling denominated loans and US dollar denominated loans. The specific objectives of the study were to establish the existence of individual currency arbitrage on USD, GBP and EUR in the commercial banks in Kenya and to establish the significance of the arbitrage in selected banks in Kenya. Secondary data that were obtained from CBK and selected Commercial Banks in Kenya. Data was then analyzed using descriptive statistics where mean and mode were used to give the central tendency of the forex prices on whether it is

uniformly distributed or not uniformly distributed. Inferential statistic was also used where paired t-test was used to give significance of the performance. Arbitrage opportunities were found with some currencies at different banks depending on the time of the year. The studied covered arbitrage in two commercial banks which may not a large enough sample for the sector. The study should have covered slightly more banks.

Mwangi and Duncan (2012) sought to find out if there were arbitrage opportunities in the Mombasa spot market. Chi-square was used to test goodness of fit on the frequencies of the expected zero and observed values. It was found that both triangular and locational arbitrage opportunities existed in the market. It was further found that there were more triangular arbitrage opportunities as compared to locational arbitrage and that frequently traded hard currencies like USD, Sterling Pound and EUR were more efficiently valued compared to other hard currencies that were not traded much for example the Yen, Canadian and Australian Dollars. This was a comprehensive study on arbitrage opportunities in the Mombasa Spot Market. However, a longer study period would have given a wider perspective of the market.

Wekesa (2006) also carried out a study to establish whether arbitrage opportunities in foreign exchange market, with a focus on Forex Bureaus operating in Nairobi. The study picked thirty forex bureaus operating in Nairobi, sampled out of the ninety-four Forex Bureaus operating in Kenya. Secondary data that was collected from these Forex Bureaus and it was found that arbitrage opportunities. Forex dealers in various currencies can capitalize on the inefficiencies and gain by buying currencies from one forex bureau and

sell in another (locational arbitrage) before the equilibrium is restored. The study covered 305 data points from January – December 2005 but was limited to forex bureaus. Inclusion of banks in the study over the same study period

Akram, Rime and Sarno (2007) in their study of arbitrage in the FX market provided evidence that in major FX markets, brief arbitrage opportunities exist by way of deviation from the Covered Interest Rate Parity (CIP) rule. The market swiftly exploit these opportunities because they exist briefly.

Osu (2010) found out that currency arbitrage exists in the Aba Foreign Exchange Market, Nigeria, with the arbitrageurs profiting when an opportunity arises, indicating the distribution of wealth of arbitrageurs. The study further shows the existence of cross rate and triangular arbitrage opportunities in the Nigerian exchange markets.

Aiba et al (2005) established that there are triangular arbitrage prospects in the FX markets upon analyzing the Japanese Yen/ United States Dollar rate, the United States Dollar/ Euro rate and the Japanese Yen / Euro rate. The researchers offered an interactive model of FX rates that includes effects of triangular arbitrage transactions in the three countries. Since the opportunities exist briefly, profits can be realized by arbitrageurs who swiftly recognize the arbitrage opportunity and take advantage of it.

Grossman & Stiglitz (1980) pointed out that “arbitrage paradox” arise from lack of exchange rate arbitrage prospects. If there are no arbitrage opportunities, the market

players may not be keen in seeking these opportunities as a result arbitrage prospects could arise. Traders would be invited to exploit the opportunities which will be eliminated quickly.

Jecheche (2011) investigated the APT for the case of Zimbabwe covering the period 1980 to 2005. Tests were done to establish the existence of a relationship among the variables like Gross Domestic Product (GDP), FX rate and inflation rate. The researcher found that there is no clear direction in the causality from Consumer Price Index (CPI) to Stock Prices.

2.5 Conceptual Framework

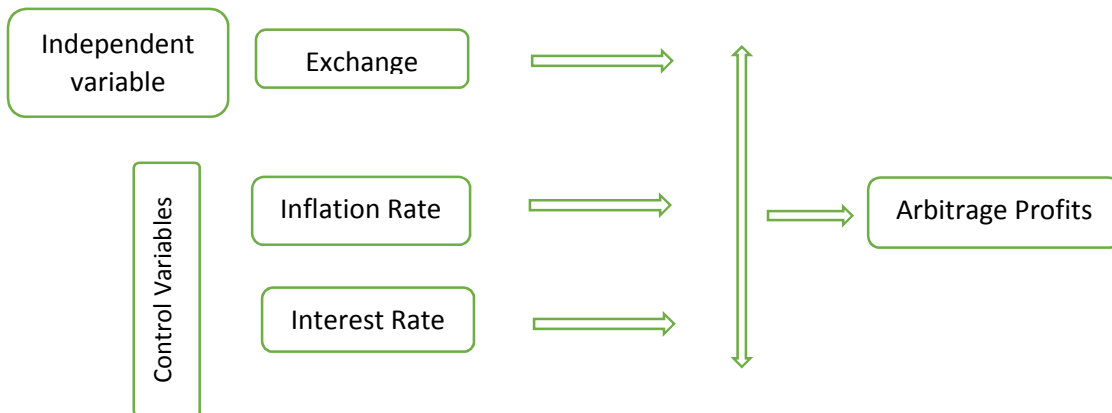
Exchange rates are affected by both changes in inflation rates and interest rates. Piet and Raman (1995) explained that if a country maintains lower inflation, its currency value will rise. McKenzie (1999) stated that there is a high correlation between Interest rates and exchange rates. A country with higher interest rates than those of other countries, then, *ceteris paribus*, an inflow of currency into banks and other financial institutions is expected. This would cause an appreciation of the exchange rate thereby determining whether arbitrage profits exist.

While changes in interest rates and inflation rates affect the movement in the exchange rate, arbitrage profits are influenced by movement in exchange rates. These three variables therefore determine the existence of arbitrage profits, exchange rate being the

significant independent variable whereas interest rate and inflation rate being less significant variable.

The researcher used secondary data collected from CBK covering a ten year period, January 2007 to December 2016. The exchange rates used were the closing end month indicative exchange rates issued by the CBK. The interest rate will be the CBK rate while Inflation rate will be the rate issued by CBK monthly. The relationship between the dependent variable and the independent variables is as illustrated in the following diagram:

Figure 1: Conceptual Framework



2.6 Summary of Literature Review

Both local and global studies found the existence of exchange rate arbitrage prospects in the FX market. This confirms that the markets are inefficient. However, these opportunities are quickly wiped out and parity restored as aptly captured in the PPP theory. However APT postulates the possibility of getting something for nothing while having no possibility of loss. Local studies to determine the efficiency of Kenya FX

Market found that arbitrage profits exist, thereby confirming the inefficiency of the market.

Internationally, several studies on foreign exchange arbitrage opportunities have been done and found that arbitrage prospects exist in major FX markets by deviation from the Covered Interest Rate Parity (CIP) rule. It was also noted that use of telecommunication is minimizing arbitrage opportunities. Triangular arbitrage opportunities in the spot FX markets were found upon analyzing the Japanese Yen/ US Dollar rate, the US Dollar/ Euro rate and the Japanese Yen / Euro rate. It was pointed out that if there are not arbitrage opportunities, the market players may not be keen in seeking these opportunities as a result arbitrage prospects could arise. Traders would be invited to exploit the opportunity which will be eliminated quickly.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This study intended to establish the relationship between the movement in the prevailing exchange rate and possible arbitrage profits in Kenya. Research Methodology describes the design of the research, the nature of data used, data collection and analysis methods adopted by the Researcher. This chapter further explains and justifies the diagnostics tests used in determining the significance of the data collected.

3.2 Research Design

This is a hypothesis testing study of aimed at determining the relationship between the movement in the prevailing exchange rate and possible arbitrage profits in FX market in Kenya. The study was a time series analysis whereby a linear regression analysis of the variables was done to establish the nature and the extent of the relationship between exchange rate movement and arbitrage profits in Kenya. The researcher employed secondary quantitative data, consisting of KES/USD, KES/EUR and USD/EUR monthly closing exchange rates, inflation and interest rates that prevailed over a ten-year period, from January 2007 to December 2016. The period was selected being wide enough and was expected to depict accurate trends in the Kenyan FX market. The three exchange rates were chosen because Kenya is the location of study and the USD and EUR are the most actively traded currencies in the Kenyan Forex Market. All these data was collected from the CBK.

3.3 Population

This study has no population since the data will consist of end month exchange rates, inflation rates, interest rates over a ten-year period.

3.4 Sample Design

The study has no sample as well because the data will consist of end month exchange rates over a ten year period.

3.5 Data Collection

Secondary data was used in this study. The buying and selling closing indicative rates of the KES/USD, KES/EUR, and USD/EUR exchange rates from January 2007 to December 2016 was collected from CBK. Inflation and Interest rates that prevailed over the research period was also collected from CBK. The cross rates between the selected currencies and the exchange arbitrage profits was computed from the collected data.

3.6 Diagnostic Tests

The study period was appropriate since it covered a period long enough to reflect the exchange rate trends and patterns in the Kenyan FX market. This study employed the use of Classical Linear Regression Model (CLRM). In order to make sure that the CLRM rules are met, diagnostic tests were performed before the data is analyzed. These tests included Normality test on whether the residual is normally distributed, Multicollinearity test to determine whether there exists any relationships between the explanatory variables. In order to test for Multicollinearity, Variance Inflation Factor (VIF) will be

used. Finally Heteroscedasticity test was done on constant in variance of the error term. Breusch-Pagan & White test was used to test for Heteroscedasticity while Jarque-Bera test was used to test for normality.

3.7 Data Analysis

Multiple Linear regression analysis was used to analyze the relationship movement in exchange rate and possible arbitrage profits in Kenya. The objective of linear regression analysis was to project the value of the dependent variable using the known values of the independent variable. The researcher constructed a regression model to analyze the dependence of arbitrage profits (the dependent variable) on movement in exchange rates, CBK rate and Inflation rate (independent variables).

3.7.1 Research Model

Linear regression model was used in this study. This model allowed the analysis of the independent variables to determine its effect on the dependent variable. The analysis was aimed at explaining the type and strength of relationship between changes exchange rates, inflation rates and interest rates (independent variable) and arbitrage profits (dependent variable). The regression model adopted was;

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + e_t$$

Where:

Y = Exchange Arbitrage Profits

- Constant

β_1 , β_2 and β_3 – Regression Coefficients indicating presence of relationship or not between arbitrage profits and movement in exchange rate.

X_1 – Movement in Exchange Rate

X_2 – Interest Rate

X_3 – Inflation Rate

e_t – Error Term/Disturbance Term

X_1 , X_2 , and X_3 was obtained from the CBK data

Y was measured as follows:

3.7.2 Measurement of variables

The Dependent Variable, Y , is the Foreign Exchange Arbitrage profits, which was arrived at through the computation of Triangular Arbitrage. The Kenya Shilling (KES), the United States Dollar (USD) and the Euro (EUR) was used in the computation of arbitrage profits and changes in the exchange rate of the KES. Cross rates between the KES/USD and KES/EUR exchange rates was computed and compared with the actual USD/EUR exchange rates. Any variance between the computed cross rate and the prevailing exchange rate was an opportunity to strike triangular arbitrage profits. An arbitrageur would quickly seize this opportunity by moving to purchase the overpriced currency, then in turn purchase the underpriced currency and finally, purchase back the original currency using the underpriced currency. The final amount of was expected to be higher than the amount at the beginning of the transaction, the difference being arbitrage profits as illustrated below:

If the KES/USD exchange rate is KES100/\$, KES/EUR is KES120/€ then the cross rate between USD/EUR is \$1.2/€ If the prevailing market exchange rate between the USD/EUR is \$1.3/€ then the USD is undervalued therefore is an opportunity for arbitrage profit.

If an arbitrageur has KES 1,200,000.00 he will buy the overvalued EUR at KES120/€ and get EUR 10,000.00 then buy undervalued USD at market price \$1.3/€ and get USD 13,000.00 then buy back KES at market price KES100/\$ and get KES 1,300,000.00. The arbitrage profit, Y , will be KES 100,000.00.

X_1 represented movement in the exchange rate. The movement was measured using the monthly closing exchange rates over the ten-year period, January 2007 to December 2016. It was the difference between the end month's closing KES/USD exchange rate and the previous month's closing exchange rate. Movement was also measured monthly between the day's KES/EUR exchange rate and the previous month's exchange rate.

X_2 and X_3 represented the prevailing CBK interest rates and inflation rates respectively, issued on a monthly basis by the CBK over the research period January 2007 to December 2016. A test of significance of the model in measuring the relationship between independent and dependent variable was done. The study will test at 95% confidence level and 5% significant level to establish whether the model is significant in explaining the relationship.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter details the analysis of the foreign exchange data collected from the Central Bank of Kenya (CBK). Triangular arbitrage was computed to establish the effect of changes in euro value, changes in dollar value, CBK rate and inflation on the arbitrage profit. Using descriptive statistics, correlation analysis and regression analysis, the results of the study were presented in table forms as shown in the following sections.

4.2 Diagnostic Tests

Before further analysis could be carried out, the data was first subjected to some diagnostic tests. This was to ensure that the classical linear regression model (CLRM) assumptions were all met, as that would give the best linear unbiased estimator. Some of the diagnostic tests that were carried out include test for heteroskedasticity, multicollinearity and normality.

Table 4.1: Diagnostic Results

Test	Test Statistics	p-value	Conclusion
Normality test (Jarque–Bera)	33.42	0.0000	Reject the null hypothesis
Heteroskedasticity test	5.62	0.0178	Reject the null hypothesis

From the results of the diagnostic tests in Table 4.1, the normality test conducted using the Jarque-Bera (J.B.) test show that the error terms are not normally distributed. This is

due to very low significance level ($p=0.000$) which is lower than critical value of 0.05 and relatively high t-statistic of 33.42. Based on the argument of (Agung, 2009), normality tests are applicable to specific cases and are not to be used for all selected models. The reason is that the statistics used for normality test is presumed to have its own precise distribution function. This leads to testing the assumption of the specific distribution function resulting to circular problem. It therefore becomes difficult to give a conclusive result for the normal distribution of the residual series using the normality test. The normality results as presented in table 4.1 does not automatically mean that estimation errors are not normally distributed with zero mean.

Multicollinearity test was done in order to determine whether there exists any relationship between the explanatory variables. To test for Multicollinearity, the variance inflation factor was used. The rule of the thumb is that when the VIF value is more than 10 then Multicollinearity is a problem. From the VIF output of the analysis, we have a mean VIF of 1.39, therefore Multicollinearity is not a problem.

Heteroskedasticity test of the null hypothesis that there is constant variance of some unknown residuals. Results in Table 4.1 show that the p-value ($p=0.0178$) is less than the critical value of 0.05. Therefore, we reject the null hypothesis and conclude that the variance is not homogenous. To correct for heteroskedasticity, the regression was run with a robust standard error and the results discussed.

4.3 Descriptive Analysis

Descriptive statistics gives a presentation of the average, maximum and minimum values of variables applied together with their standard deviations in this study are as shown in Table 4.2.

Table 4.2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CBK Rate (%)	120	5.75	18.00	9.4708	2.9211
Inflation Rate (%)	120	1.85	19.72	8.2948	4.7870
Arbitrage Profit	120	0.00	12911.90	2287.705	2659.6967
Change in Euro	120	-20.355	15.097	.09291	3.6487
Change in Dollar	120	-10.2362	8.0422	.19562	1.8128

From the data, CBK Rate had a mean of 9.47 with a standard deviation of 2.92, while inflation had a mean of 8.295 with a standard deviation of 4.787. Arbitrage profit recorded a mean of 2287.71 with a standard deviation of 2659.6967. Change in euro value recorded a mean of 0.0929 and a standard deviation of 3.64875 while change in dollar value recorded a mean of 0.19562 and a standard deviation of 1.8128.

4.4 Correlation Analysis

Correlation analysis is used to establish whether there exists a relationship between two variables. The correlation lies between (-) strong negative correlation and (+) perfect positive correlation. Pearson correlation was employed to analyze the level of association

between the arbitrage profit and the explanatory variables. The results are as shown in Table 4.3 below

Table 4.3: Correlation Analysis

		CBK Rate (%)	Inflation Rate (%)	ArbitrageProfit1	Change in Euro	Change in Dollar
CBK Rate (%)	Pearson Corr	1	.254**	.040	-.242**	-.334**
	Sig. (2-tailed)		.005	.661	.008	.000
Inflation Rate (%)	Pearson Corr	.254**	1	.213*	-.007	.023
	Sig. (2-tailed)	.005		.019	.935	.801
ArbitragePr ofit1	Pearson Corr	.040	.213*	1	.080	.183*
	Sig. (2-tailed)	.661	.019		.383	.046
Change in Euro	Pearson Corr	-.242**	-.007	.080	1	.601**
	Sig. (2-tailed)	.008	.935	.383		.000
Change in Dollar	Pearson Corr	-.334**	.023	.183*	.601**	1
	Sig. (2-tailed)	.000	.801	.046	.000	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

From Table 4.3, the results shows a significant weak positive correlation between arbitrage profit and change in dollar value. CBK rate have significant weak negative correlation with change in euro value and change in dollar values.

4.5 Regression Analysis and Hypothesis Testing

Arbitrage profit was regressed against change in dollar value, change in euro value, central bank rate as well as inflation. The regression analysis was undertaken at 5% significance level. The critical value obtained from the F – table was compared with the one obtained from the regression analysis. The study obtained the model summary statistics as shown in table 4.4 below.

Table 4.4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.284 ^a	.080	.048	2594.5305	.080	2.513	4	115	.045	1.954
a. Predictors: (Constant), Change in Dollar, Inflation Rate (%), CBK Rate (%), Change in Euro										
b. Dependent Variable: ArbitrageProfit1										

The results show that there is a low degree of correlation between the arbitrage profits and the explanatory variables. R squared, being the coefficient of determination indicates the deviations in the response variable that is as a result of changes in the predictor variables. The R^2 indicates that only 8% of the variation in arbitrage profit is explained by change in dollar value, change in euro value, central bank rate and inflation rate.

Table 4.5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	67671706.180	4	16917926.545	2.513	.045 ^b
	Residual	774132671.714	115	6731588.450		
	Total	841804377.894	119			
a. Dependent Variable: ArbitrageProfit1						
b. Predictors: (Constant), Change in Dollar, Inflation Rate (%), CBK Rate (%), Change in Euro						

The results show that there is a statistically significant difference between the means of regression and the residual, this is depicted by the ANOVA ($F(4,115) = 2.513, p=0.045$).

Table 4.6: Model Coefficients

Arbitrage Profit	Robust		T	P>t	[95% Conf.	Interval]
	Coef.	Std. Err.				
Change in Euro	-26.0711	88.79113	-0.29	0.77	-201.949	149.807
Change in Dollar	319.8285	196.4607	1.63	0.10	-69.3223	708.9792
CBK Rate	50.4178	124.0543	0.41	0.685	-195.31	296.1454
Inflation Rate	107.5669	55.53113	1.94	0.055	-2.42959	217.5634
_constant	857.8148	1110.16	0.77	0.441	-1341.2	3056.829

4.6 Discussion of Research Findings

The descriptive statistics indicate a CBK Rate had a mean of 9.47 with a standard deviation of 2.92, while inflation had a mean of 8.295 with a standard deviation of 4.787. Arbitrage profit recorded a mean of 2287.71 with a standard deviation of 2659.6967.

Change in euro value recorded a mean of 0.0929 and a standard deviation of 3.64875 while change in dollar value recorded a mean of 0.19562 and a standard deviation of 1.8128.

The findings show that the changes in dollar value had a significant effect on the arbitrage profit at 10% significance. A one unit increase in the Dollar value increases the arbitrage profit by 320 (units). It is important to note that the effect of changes in euro value and the CBK rate had no significant effect on the arbitrage profit. Inflation also had a significant effect on the arbitrage profit, a one-unit increase in the rate of inflation increases the arbitrage profit by 107.567 units. Had the data consisted of exchange rates charged by Commercial Banks and Forex Bureaus, the Change in exchange rates would have had a greater impact on arbitrage profits as compared with the indicative rates issued by CBK.

The significance of the movement of the Dollar on presence of arbitrage profits could be due to the fact that it's the most traded foreign currency in the country. The exchange rate of the Kenya Shilling with the Dollar is important for arbitrageurs in decision making and enable one seize arbitrage opportunities as they arise. The level of inflation of a country is key in determining the foreign exchange rate. This will in turn the existence and the level of arbitrage in the market. Inflation trends are therefore important in helping arbitrageurs in striking arbitrage opportunities.

The R^2 indicates that only 8% of the variation in arbitrage profit is explained by change in dollar value, change in euro value, central bank rate and inflation rate. This means there are other micro and macro-economic factors, such as Balance of Payment, Country's Debt level, Banks Interest rates, demand and supply of the Kenya Shilling, other investment opportunities available in the market, which could explain the variation in arbitrage profits

Mwangi and Duncan (2012), studied the existence of exchange rate arbitrage in the Mombasa Spot Market and concluded that arbitrage opportunities, occasioned by market inefficiencies, existed. The study also sought to find out, comparatively, if arbitrage opportunities existed given growth in information efficiencies, lower information costs and emergence of vibrant markets. The study supports the predictions that arbitrage opportunities will decline and eventually eliminated under perfect market conditions. It was also found that there were more triangular arbitrage opportunities as compared to locational arbitrage, meaning that exchange rates were priced more efficiently than cross rates.

Muhoro (2005) in her study of efficiency of the Foreign Exchange Market in Kenya found that greater gains could be made through triangular arbitrage opportunities rather than locational arbitrage trade in both banks and bureaus. This implies that currencies are not efficiently priced against one another. Other studies, Kurgat (1998) and Wekesa (2006) also established arbitrage opportunities in the Kenyan Financial market.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter five gives a summary of the findings of the analysis of the relationship movement in foreign exchange rates and arbitrage profits. Conclusions of the study and recommendations based on the findings are made in this chapter. Highlights of the limitations of the study and suggestions of further research are made

5.2 Summary of Findings

The objective of this research was to find out the relationship between movement in the foreign exchange rate and possible arbitrage profits. To this end, the closing monthly indicative exchange rates between Kshs/USD and Kshs/EUR for the period January 2007 to December 2016 was used to compute the USD/EUR cross rate. The USD/EUR cross rate was compared with the USD/EUR market rate and where there was a difference, arbitrage profit existed.

Movement in exchange rate was arrived at by computed the difference between month's closing exchange rate and the previous month's closing rate. This was done for each of the month in the study period. The period was chosen because it was considered that it will give adequate representation of the state of the forex market in Kenya

A descriptive statistics analysis was conducted on all the variables to give the general behavior of the arbitrage profits, movement in the exchange rates, CBK rates and Inflation rates. CBK Rate had a mean of 9.47 with a standard deviation of 2.92, while inflation had a mean of 8.295 with a standard deviation of 4.787. Arbitrage profit recorded a mean of 2287.71 with a standard deviation of 2659.6967. Change in euro value recorded a mean of 0.0929 and a standard deviation of 3.64875 while change in dollar value recorded a mean of 0.19562 and a standard deviation of 1.8128.

To establish the relationship among variables, Pearson correlation coefficient analysis was conducted. The analysis showed a significant weak positive correlation between arbitrage profit and change in dollar value. CBK rate have significant weak negative correlation with change in euro value and change in dollar values.

Changes in USD value had a significant effect on the arbitrage profit. A one-unit increase in the USD value increases the arbitrage profit by 320 (units). Inflation also had a significant effect on the arbitrage profit, a one-unit increase in the rate of inflation increases the arbitrage profit by 107.567 units. Change in USD values and Change in Inflation rate have a statistical relationship with arbitrage profits. However, changes in EUR value and CBK rate have no significant effect on the arbitrage profit.

Arbitrage profit was regressed against change in dollar value, change in euro value, central bank rate as well as inflation. The regression analysis was undertaken at 5% significance level. The critical value obtained from the F – table was compared with the

one obtained from the regression analysis. The results show that there is a low degree of correlation between the arbitrage profits and the explanatory variables. The R^2 indicates that only 8% of the variation in arbitrage profit is explained by change in dollar value, change in euro value, central bank rate and inflation rate.

5.3 Conclusions

The findings show that the changes in USD value had a significant effect on the arbitrage profit. A one unit increase in the USD value increases the arbitrage profit by 320 (units). Inflation also had a significant effect on the arbitrage profit, a one unit increase in the rate of inflation increases the arbitrage profit by 107.567 units. There is a statistical relationship between change in USD values and arbitrage profits. Inflation also has a statistical relationship with arbitrage profits. However, changes in EUR value and CBK rate have no significant effect on the arbitrage profit.

The significance of the movement of the Dollar on presence of arbitrage profits could be due to the fact that it's the most traded foreign currency in the country. The exchange rate of the Kenya Shilling with the Dollar is important for arbitrageurs in decision making and enable one seize arbitrage opportunities as they arise. The level of inflation of a country is key in determining the foreign exchange rate. This will in turn the existence and the level of arbitrage in the market. Inflation trends are therefore important in helping arbitrageurs in striking arbitrage opportunities.

The R^2 indicates that only 8% of the variation in arbitrage profit is explained by change in dollar value, change in euro value, central bank rate and inflation rate. This means there

are other micro and macro-economic factors that affect the presence of arbitrage profits in the Foreign Exchange market. These could include Balance of Payment, Country's Debt level, Banks Interest rates, other investment opportunities available in the market, which could explain the variation in arbitrage profits.

5.4 Recommendations

The results of this study suggest that arbitrageurs may monitor the movement of the Kshs/USD exchange rates to identify arbitrage opportunities and make profits. The level of inflation rate in the country could also be a guide to arbitrageurs in identifying triangular arbitrage opportunities in the foreign exchange market. Existence of these arbitrage opportunities are an indicator of market inefficiencies. Movement in foreign exchange and change inflation rates have an effect on arbitrage profits.

I recommend that CBK periodically takes intervening measures in the foreign exchange market to address adverse movement of the Kenya Shilling which leads to creation of arbitrage opportunities in the market. Similar measures can as well be taken periodically to contain inflation rate movements that lead to creation of arbitrage opportunities.

Finally, there is also need to invest in Information Technology in the foreign exchange market so as to create efficiencies that will reduce and eventually wipe out arbitrage opportunities in the Kenyan Foreign Exchange market.

5.5 Limitations of Study

The study used mean indicative rates issued by CBK to compute arbitrage profits could have affected the results of both the amount of computed arbitrage profits and the magnitude of the movement in exchange rates. Actual exchange rates transacted by Commercial Banks and Forex Bureaus would have depicted a different scenario in terms of level of arbitrage profits and the relationship between arbitrage profits and movement in exchange rates.

The study focused on three explanatory variables, which are; movement in foreign exchange rate, CBK rate and Inflation rate. There are other explanatory variables that could have an effect on the level of arbitrage profits. These include, Country's Debt level, Demand and Supply of the Kenya Shilling, Balance of Payment, and other macro-economic factors such as rate of growth of the country.

The study period included two election periods, 2007/08 and 2013, which may have distorted the foreign exchange market trends during those periods. Data from these periods may have affected the findings differently. A continuous ten-year period without intense political campaign periods would have given different arbitrage profits hence varied findings.

5.6 Suggestions for Further Research

The study used three explanatory variables, that is movement in exchange rates, inflation and CBK rates in determining their effect on arbitrage profits. It was found that 8% in the

changes in arbitrage profits can be explained by these factors. I suggest that a further study on arbitrage profits using other possible explanatory variables such as country's growth rate, Balance of Payment and Country's Debt level.

In this study, the movement in foreign exchange was measured on a monthly basis, that is the difference between the end month closing rate that the closing rate of the previous month. A future study could be conducted using the weekly or daily movement in exchange rates as one of the dependent variable. In this case, the period covered could be shorter, say a five-year period.

The KES/USD and KES/EUR exchange rates collected from CBK were used in this study. These currencies were chosen given that they are the most traded currencies in the Kenyan exchange market. A further study could be done using other active currencies, such as the British Pound, French Franc, South African Rand and so on. The exchange rates could also be sourced from Commercial Banks and Forex Bureaus rather than the CBK indicative rates.

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APPENDICES

APPENDIX 1: Data Collection Form

Date	KES/\$ Rate	KES/€ Rate	\$/€ Rate	Inflation Rate	Interest Rate	Arbitrage	Change in KES/\$	Change in KES/€

APPENDIX 2: Arbitrage Profit Computation

Date	Kshs/€	Kshs/\$	Cross Rate (\$/€)	Mkt Rate (\$/€)	C/rate - M/rate	Arbitrage Computation	Arbitrage Profit
29/12/2016	91.4872	69.4633				1,000,000.00	
31/01/2007	91.5247	70.5978	1.2964	1.2961	0.0003	1,000,250.17	250.17
28/02/2007	92.2914	69.8167	1.3219	1.3242	-0.0023	1,001,732.28	1,732.28
30/03/2007	91.8667	68.8478	1.3343	1.334	0.0003	1,000,258.43	258.43
30/04/2007	93.1374	68.3667	1.3623	1.3654	-0.0031	1,002,260.02	2,260.02
31/05/2007	90.0767	67.0378	1.3437	1.3421	0.0016	1,001,170.02	1,170.02
29/06/2007	89.6346	66.6422	1.3450	1.3484	-0.0034	1,002,518.47	2,518.47
31/07/2007	92.6116	67.5789	1.3704	1.3687	0.0017	1,001,258.01	1,258.01
31/08/2007	91.6671	67.0556	1.3670	1.3655	0.0015	1,001,121.38	1,121.38
28/09/2007	94.9314	67.0322	1.4162	1.4145	0.0017	1,001,206.04	1,206.04
31/10/2007	96.9871	67.1867	1.4435	1.4425	0.0010	1,000,725.21	725.21
30/11/2007	95.0446	64.4911	1.4738	1.4773	-0.0035	1,002,399.95	2,399.95
20/12/2007	89.983	62.6078	1.4372	1.4394	-0.0022	1,001,496.59	1,496.59
31/01/2008	105.08	70.65	1.4873	1.4786	0.0087	1,005,905.53	5,905.53
29/02/2008	104.933	69.1056	1.5184	1.5171	0.0013	1,000,886.06	886.06
31/03/2008	99.3411	62.92	1.5788	1.5798	-0.0010	1,000,603.13	603.13
30/04/2008	97.1337	62.2133	1.5613	1.5586	0.0027	1,001,733.09	1,733.09
30/05/2008	96.273	62.0956	1.5504	1.5507	-0.0003	1,000,193.69	193.69
30/06/2008	102.263	64.7556	1.5792	1.5748	0.0044	1,002,803.38	2,803.38
31/07/2008	105.077	67.3767	1.5595	1.5577	0.0018	1,001,184.48	1,184.48
29/08/2008	101.517	68.8056	1.4754	1.4704	0.0050	1,003,412.47	3,412.47
30/09/2008	105.4	73.2967	1.4380	1.4401	-0.0021		

						1,001,466.58	1,466.58
31/10/2008	102.114	79.7389	1.2806	1.2934	-0.0128	1,009,991.71	9,991.71
28/11/2008	100.538	77.9722	1.2894	1.287	0.0024	1,001,871.23	1,871.23
31/12/2008	109.608	77.7889	1.4090	1.4109	-0.0019	1,001,317.05	1,317.05
30/01/2009	102.668	79.63	1.2893	1.2951	-0.0058	1,004,488.38	4,488.38
27/02/2009	101.571	79.7622	1.2734	1.2748	-0.0014	1,001,081.53	1,081.53
31/03/2009	106.536	80.5111	1.3232	1.3187	0.0045	1,003,447.42	3,447.42
30/04/2009	104.898	78.7256	1.3325	1.3252	0.0073	1,005,471.58	5,471.58
29/05/2009	109.799	78.4133	1.4003	1.3916	0.0087	1,006,222.98	6,222.98
30/06/2009	109.182	77.2411	1.4135	1.4069	0.0066	1,004,706.86	4,706.86
31/07/2009	108.323	76.6744	1.4128	1.4082	0.0046	1,003,242.57	3,242.57
31/08/2009	108.838	76.3156	1.4262	1.4357	-0.0095	1,006,691.66	6,691.66
30/09/2009	109.821	75.0911	1.4625	1.4583	0.0042	1,002,882.50	2,882.50
30/10/2009	111.761	75.3278	1.4837	1.4846	-0.0009	1,000,632.17	632.17
30/11/2009	112.904	75.0183	1.5050	1.4968	0.0082	1,005,491.34	5,491.34
31/12/2009	109.088	75.9206	1.4369	1.4316	0.0053	1,003,680.90	3,680.90
29/01/2010	106.003	75.985	1.3951	1.398	-0.0029	1,002,113.43	2,113.43
26/02/2010	104.611	76.9856	1.3588	1.3477	0.0111	1,008,264.85	8,264.85
31/03/2010	103.84	77.4133	1.3414	1.3421	-0.0007	1,000,543.05	543.05
30/04/2010	102.582	77.3559	1.3261	1.3245	0.0016	1,001,211.33	1,211.33
31/05/2010	98.3141	79.8324	1.2315	1.2368	-0.0053	1,004,298.59	4,298.59
30/06/2010	100.209	82.0167	1.2218	1.2191	0.0027	1,002,224.71	2,224.71
30/07/2010	105.014	80.3228	1.3074	1.3086	-0.0012	1,000,918.13	918.13
31/08/2010	102.644	81.155	1.2648	1.2676	-0.0028	1,002,222.03	2,222.03

30/09/2010	109.825	80.8739	1.3580	1.3634	-0.0054	1,003,992.49	3,992.49
29/10/2010	112.271	80.8772	1.3882	1.3914	-0.0032	1,002,329.51	2,329.51
30/11/2010	106.5	81.0756	1.3136	1.309	0.0046	1,003,505.58	3,505.58
31/12/2010	107.747	80.8272	1.3331	1.3268	0.0063	1,004,713.39	4,713.39
31/01/2011	110.771	81.3639	1.3614	1.3616	-0.0002	1,000,127.17	127.17
28/02/2011	113.512	82.4694	1.3764	1.3756	0.0008	1,000,591.42	591.42
31/03/2011	117.634	83.0722	1.4160	1.4135	0.0025	1,001,800.72	1,800.72
29/04/2011	123.893	83.5389	1.4831	1.4815	0.0016	1,001,051.36	1,051.36
31/05/2011	123.597	85.7767	1.4409	1.4278	0.0131	1,009,186.00	9,186.00
30/06/2011	130.432	90.0083	1.4491	1.443	0.0061	1,004,234.79	4,234.79
29/07/2011	130.324	91.2028	1.4289	1.4322	-0.0033	1,002,276.25	2,276.25
30/08/2011	136.111	93.7278	1.4522	1.4495	0.0027	1,001,858.95	1,858.95
30/09/2011	135.627	99.9778	1.3566	1.3572	-0.0006	1,000,463.55	463.55
31/10/2011	140.08	100.089	1.3996	1.4163	-0.0167	1,011,964.95	11,964.95
30/11/2011	119.725	89.8528	1.3325	1.3341	-0.0016	1,001,233.00	1,233.00
30/12/2011	110.247	85.2083	1.2939	1.2919	0.0020	1,001,511.59	1,511.59
31/01/2012	111.782	84.7139	1.3195	1.3099	0.0096	1,007,346.91	7,346.91
29/02/2012	111.91	83.075	1.3471	1.3456	0.0015	1,001,111.77	1,111.77
30/03/2012	110.995	83.1472	1.3349	1.3269	0.0080	1,006,045.43	6,045.43
30/04/2012	110.426	83.2983	1.3257	1.3254	0.0003	1,000,203.19	203.19
31/05/2012	107.754	86.925	1.2396	1.2395	0.0001	1,000,097.11	97.11
29/06/2012	106.096	84.3278	1.2581	1.2421	0.0160	1,012,911.91	12,911.91
31/07/2012	103.532	84.3	1.2281	1.2255	0.0026	1,002,152.27	2,152.27
31/08/2012	105.566	84.4167	1.2505	1.2498	0.0007		

						1,000,587.73	587.73
28/09/2012	110.2839	85.3806	1.2917	1.2915	0.0002	1,000,134.72	134.72
31/10/2012	110.495	85.2622	1.2959	1.2971	-0.0012	1,000,892.34	892.34
30/11/2012	111.7311	86.0139	1.2990	1.2956	0.0034	1,002,615.69	2,615.69
31/12/2012	113.6906	86.1189	1.3202	1.3217	-0.0015	1,001,167.64	1,167.64
31/01/2013	119.0822	87.7083	1.3577	1.3564	0.0013	1,000,963.81	963.81
28/02/2013	113.5872	86.3417	1.3156	1.3101	0.0055	1,004,163.32	4,163.32
28/03/2013	109.6772	85.7233	1.2794	1.2775	0.0019	1,001,512.94	1,512.94
30/04/2013	110.0811	83.9222	1.3117	1.3095	0.0022	1,001,683.22	1,683.22
31/05/2013	111.0489	85.2111	1.3032	1.3056	-0.0024	1,001,825.43	1,825.43
28/06/2013	112.53	86.1033	1.3069	1.3038	0.0031	1,002,391.89	2,391.89
31/07/2013	115.8988	87.3756	1.3264	1.325	0.0014	1,001,089.46	1,089.46
30/08/2013	116.1867	87.6856	1.3250	1.3245	0.0005	1,000,405.74	405.74
30/09/2013	117.0372	86.75	1.3491	1.3522	-0.0031	1,002,274.06	2,274.06
31/10/2013	116.8335	85.2456	1.3706	1.3767	-0.0061	1,004,486.02	4,486.02
29/11/2013	118.6061	87.0917	1.3619	1.3601	0.0018	1,001,288.94	1,288.94
31/12/2013	119.3287	86.4056	1.3810	1.3815	-0.0005	1,000,340.54	340.54
31/01/2014	116.9811	86.3417	1.3549	1.3546	0.0003	1,000,193.51	193.51
28/02/2014	118.4806	86.4222	1.3710	1.3713	-0.0003	1,000,254.58	254.58
31/03/2014	119.0439	86.5206	1.3759	1.3753	0.0006	1,000,438.00	438.00
30/04/2014	120.1806	86.9628	1.3820	1.381	0.0010	1,000,707.55	707.55
30/05/2014	119.5683	87.8889	1.3604	1.3602	0.0002	1,000,182.51	182.51
30/06/2014	119.6894	87.7217	1.3644	1.3649	-0.0005	1,000,350.48	350.48
31/07/2014	117.7667	87.8861	1.3400	1.338	0.0020	1,001,489.04	1,489.04

29/08/2014	116.6189	88.475	1.3181	1.3181	0.0000	1,000,000.02	0.02
30/09/2014	113.4167	89.3683	1.2691	1.2689	0.0002	1,000,152.24	152.24
31/10/2014	112.4711	89.4339	1.2576	1.2617	-0.0041	1,003,268.85	3,268.85
28/11/2014	112.4006	90.2667	1.2452	1.2476	-0.0024	1,001,922.90	1,922.90
31/12/2014	110.2606	90.6644	1.2161	1.2173	-0.0012	1,000,953.87	953.87
30/01/2015	103.9894	91.7444	1.1335	1.1309	0.0026	1,002,271.32	2,271.32
27/02/2015	102.5978	91.4911	1.1214	1.1217	-0.0003	1,000,270.64	270.64
31/03/2015	99.6139	92.4072	1.0780	1.0823	-0.0043	1,003,999.57	3,999.57
30/04/2015	104.9806	94.6889	1.1087	1.1163	-0.0076	1,006,864.31	6,864.31
29/05/2015	107.1222	97.8676	1.0946	1.0936	0.0010	1,000,880.07	880.07
30/06/2015	110.5089	98.7276	1.1193	1.1256	-0.0063	1,005,600.33	5,600.33
31/07/2015	112.1778	102.6147	1.0932	1.0912	0.0020	1,001,827.58	1,827.58
31/08/2015	116.9228	103.9647	1.1246	1.1181	0.0065	1,005,848.69	5,848.69
30/09/2015	118.4539	105.3912	1.1239	1.1246	-0.0007	1,000,582.87	582.87
30/10/2015	111.7189	101.9	1.0964	1.0964	0.0000	999,961.87	-
30/11/2015	108.275	102.2147	1.0593	1.0592	0.0001	1,000,084.88	84.88
31/12/2015	111.8972	102.4088	1.0927	1.0917	0.0010	1,000,872.21	872.21
29/01/2016	111.8022	102.3829	1.0920	1.0947	-0.0027	1,002,471.87	2,471.87
29/02/2016	111.6	101.7971	1.0963	1.093	0.0033	1,003,017.77	3,017.77
31/03/2016	114.8228	101.4306	1.1320	1.1321	-0.0001	1,000,059.07	59.07
29/04/2016	114.625	101.2353	1.1323	1.1347	-0.0024	1,002,152.19	2,152.19
31/05/2016	112.4794	100.9306	1.1144	1.1139	0.0005	1,000,469.68	469.68
30/06/2016	112.4294	101.1994	1.1110	1.1113	-0.0003	1,000,297.90	297.90
29/07/2016	112.5189	101.4861	1.1087	1.1076	0.0011		

						1,001,004.36	1,004.36
31/08/2016	113.2089	101.4589	1.1158	1.1138	0.0020	1,001,805.03	1,805.03
30/09/2016	113.7761	101.3617	1.1225	1.1208	0.0017	1,001,495.58	1,495.58
31/10/2016	111.2467	101.5572	1.0954	1.0963	-0.0009	1,000,813.13	813.13
30/11/2016	108.1894	101.9728	1.0610	1.0578	0.0032	1,002,990.47	2,990.47
30/12/2016	107.1767	102.5844	1.0448	1.0554	-0.0106	1,010,178.29	10,178.29

APPENDIX 3: Arbitrage Profit, Change in FX, CBK Rate, Inflation Rate

Date	Arbitrage Profit	Δ in Euro Rate(value)	Δ in Euro(%)	Δ in Dollar Rate(value)	Δ in Dollar (%)	CBK Rate (%)	Inflation Rate (%)
31/01/2007	250.17	0.0375	0.06%	1.1345	1.63%	10	4.63
28/02/2007	1,732.28	0.7667	0.77%	-0.7811	-1.11%	10	3.02
30/03/2007	258.43	-0.4247	-0.41%	-0.9689	-1.39%	10	2.19
30/04/2007	2,260.02	1.2707	1.41%	-0.4811	-0.70%	10	1.85
31/05/2007	1,170.02	-3.0607	-3.33%	-1.3289	-1.94%	10	1.96
29/06/2007	2,518.47	-0.4421	-0.52%	-0.3956	-0.59%	8.5	4.07
31/07/2007	1,258.01	2.977	3.30%	0.9367	1.41%	8.5	5.48
31/08/2007	1,121.38	-0.9445	-1.00%	-0.5233	-0.77%	8.75	5.3
28/09/2007	1,206.04	3.2643	3.52%	-0.0234	-0.03%	8.75	5.53
31/10/2007	725.21	2.0557	2.14%	0.1545	0.23%	8.75	5.38
30/11/2007	2,399.95	-1.9425	-1.90%	-2.6956	-4.01%	8.75	6.08
20/12/2007	1,496.59	-5.0616	-5.39%	-1.8833	-2.92%	8.75	5.7
31/01/2008	5,905.53	15.097	16.78%	8.0422	12.85%	8.75	9.4
29/02/2008	886.06	-0.147	-0.25%	-1.5444	-2.19%	8.75	10.58
31/03/2008	603.13	-5.5919	-5.23%	-6.1856	-8.95%	8.75	11.9
30/04/2008	1,733.09	-2.2074	-2.19%	-0.7067	-1.12%	8.75	16.12
30/05/2008	193.69	-0.8607	-0.86%	-0.1177	-0.19%	8.75	18.61
30/06/2008	2,803.38	5.99	6.25%	2.66	4.28%	9	17.87
31/07/2008	1,184.48	2.814	2.78%	2.6211	4.05%	9	17.12
29/08/2008	3,412.47	-3.56	-3.44%	1.4289	2.12%	9	18.33
30/09/2008	1,466.58	3.883	3.83%	4.4911	6.53%	9	18.73
31/10/2008		-3.286	-3.12%	6.4422	8.79%	9	18.74

	9,991.71						
28/11/2008	1,871.23	-1.576	-1.56%	-1.7667	-2.22%	9	19.54
31/12/2008	1,317.05	9.07	9.05%	-0.1833	-0.24%	8.5	17.83
30/01/2009	4,488.38	-6.94	-6.34%	1.8411	2.37%	8.5	13.22
27/02/2009	1,081.53	-1.097	-1.04%	0.1322	0.17%	8.5	14.69
31/03/2009	3,447.42	4.965	4.89%	0.7489	0.94%	8.25	14.6
30/04/2009	5,471.58	-1.638	-1.51%	-1.7855	-2.22%	8.25	12.42
29/05/2009	6,222.98	4.901	4.67%	-0.3123	-0.40%	8	9.61
30/06/2009	4,706.86	-0.617	-0.60%	-1.1722	-1.49%	8	8.6
31/07/2009	3,242.57	-0.859	-0.77%	-0.5667	-0.73%	7.75	8.44
31/08/2009	6,691.66	0.515	0.44%	-0.3588	-0.47%	7.75	7.36
30/09/2009	2,882.50	0.983	0.90%	-1.2245	-1.60%	9	6.74
30/10/2009	632.17	1.94	1.75%	0.2367	0.32%	7.75	6.62
30/11/2009	5,491.34	1.143	0.96%	-0.3095	-0.41%	7	5
31/12/2009	3,680.90	-3.816	-3.34%	0.9023	1.20%	7	5.32
29/01/2010	2,113.43	-3.085	-2.82%	0.0644	0.08%	7	5.95
26/02/2010	8,264.85	-1.392	-1.29%	1.0006	1.32%	7	5.18
31/03/2010	543.05	-0.771	-0.72%	0.4277	0.56%	6.75	3.97
30/04/2010	1,211.33	-1.258	-1.24%	-0.0574	-0.07%	6.75	3.66
31/05/2010	4,298.59	-4.2679	-4.16%	2.4765	3.20%	6.75	3.88
30/06/2010	2,224.71	1.8949	1.88%	2.1843	2.74%	6.75	3.49
30/07/2010	918.13	4.805	4.85%	-1.6939	-2.07%	6	3.57
31/08/2010	2,222.03	-2.37	-2.28%	0.8322	1.04%	6	3.22
30/09/2010	3,992.49	7.181	7.00%	-0.2811	-0.35%	6	3.21

29/10/2010	2,329.51	2.446	2.25%	0.0033	0.00%	6	3.18
30/11/2010	3,505.58	-5.771	-5.21%	0.1984	0.25%	6	3.84
31/12/2010	4,713.39	1.247	1.28%	-0.2484	-0.31%	6	4.51
31/01/2011	127.17	3.024	2.73%	0.5367	0.66%	5.75	5.42
28/02/2011	591.42	2.741	2.52%	1.1055	1.36%	5.75	6.54
31/03/2011	1,800.72	4.122	3.68%	0.6028	0.73%	6	9.19
29/04/2011	1,051.36	6.259	5.28%	0.4667	0.56%	6	12.05
31/05/2011	9,186.00	-0.296	-0.20%	2.2378	2.68%	6	12.95
30/06/2011	4,234.79	6.835	5.39%	4.2316	4.93%	6.25	14.48
29/07/2011	2,276.25	-0.108	0.01%	1.1945	1.33%	6.25	15.53
30/08/2011	1,858.95	5.787	4.44%	2.525	2.77%	6.25	16.67
30/09/2011	463.55	-0.484	-0.47%	6.25	6.67%	7	17.32
31/10/2011	11,964.95	4.453	2.98%	0.1112	0.11%	11	18.91
30/11/2011	1,233.00	-20.355	-14.24%	-10.2362	-10.23%	16.5	19.72
30/12/2011	1,511.59	-9.478	-7.93%	-4.6445	-5.17%	18	18.93
31/01/2012	7,346.91	1.535	1.43%	-0.4944	-0.58%	18	18.31
29/02/2012	1,111.77	0.128	0.14%	-1.6389	-1.93%	18	16.69
30/03/2012	6,045.43	-0.915	-0.78%	0.0722	0.09%	18	15.61
30/04/2012	203.19	-0.569	-0.49%	0.1511	0.18%	18	13.06
31/05/2012	97.11	-2.672	-2.46%	3.6267	4.35%	18	12.22
29/06/2012	12,911.91	-1.658	-1.53%	-2.5972	-2.99%	18	10.05
31/07/2012	2,152.27	-2.564	-2.39%	-0.0278	-0.03%	16.5	7.74
31/08/2012	587.73	2.034	1.94%	0.1167	0.14%	16.5	6.09
28/09/2012		4.7179	4.48%	0.9639	1.14%	13	5.32

	134.72						
31/10/2012	892.34	0.2111	0.21%	-0.1184	-0.14%	13	4.14
30/11/2012	2,615.69	1.2361	1.14%	0.7517	0.88%	11	3.25
31/12/2012	1,167.64	1.9595	1.73%	0.105	0.12%	11	3.2
31/01/2013	963.81	5.3916	4.75%	1.5894	1.85%	9.5	3.67
28/02/2013	4,163.32	-5.495	-4.63%	-1.3666	-1.56%	9.5	4.45
28/03/2013	1,512.94	-3.91	-3.43%	-0.6184	-0.72%	9.5	4.11
30/04/2013	1,683.22	0.4039	0.35%	-1.8011	-2.10%	9.5	4.14
31/05/2013	1,825.43	0.9678	0.89%	1.2889	1.54%	8.5	4.05
28/06/2013	2,391.89	1.4811	1.33%	0.8922	1.05%	8.5	4.91
31/07/2013	1,089.46	3.3688	2.98%	1.2723	1.48%	8.5	6.03
30/08/2013	405.74	0.2879	0.27%	0.31	0.35%	8.5	6.67
30/09/2013	2,274.06	0.8505	0.69%	-0.9356	-1.07%	8.5	8.29
31/10/2013	4,486.02	-0.2037	-0.18%	-1.5044	-1.73%	8.5	7.76
29/11/2013	1,288.94	1.7726	1.55%	1.8461	2.17%	8.5	7.36
31/12/2013	340.54	0.7226	0.67%	-0.6861	-0.79%	8.5	7.15
31/01/2014	193.51	-2.3476	-2.06%	-0.0639	-0.07%	8.5	7.21
28/02/2014	254.58	1.4995	1.31%	0.0805	0.09%	8.5	6.86
31/03/2014	438.00	0.5633	0.51%	0.0984	0.11%	8.5	6.27
30/04/2014	707.55	1.1367	0.90%	0.4422	0.51%	8.5	6.41
30/05/2014	182.51	-0.6123	-0.46%	0.9261	1.06%	8.5	7.3
30/06/2014	350.48	0.1211	0.08%	-0.1672	-0.19%	8.5	7.39
31/07/2014	1,489.04	-1.9227	-1.59%	0.1644	0.19%	8.5	7.67
29/08/2014	0.02	-1.1478	-0.96%	0.5889	0.67%	8.5	8.36

30/09/2014	152.24	-3.2022	-2.77%	0.8933	1.01%	8.5	6.6
31/10/2014	3,268.85	-0.9456	-0.83%	0.0656	0.07%	8.5	6.43
28/11/2014	1,922.90	-0.0705	-0.04%	0.8328	0.93%	8.5	6.09
31/12/2014	953.87	-2.14	-1.86%	0.3977	0.44%	8.5	6.02
30/01/2015	2,271.32	-6.2712	-5.70%	1.08	1.19%	8.5	5.53
27/02/2015	270.64	-1.3916	-1.34%	-0.2533	-0.28%	8.5	5.61
31/03/2015	3,999.57	-2.9839	-2.91%	0.9161	1.00%	8.5	6.31
30/04/2015	6,864.31	5.3667	5.36%	2.2817	2.47%	8.5	7.08
29/05/2015	880.07	2.1416	2.05%	3.1787	3.36%	8.5	6.87
30/06/2015	5,600.33	3.3867	3.15%	0.86	0.88%	10	7.03
31/07/2015	1,827.58	1.6689	1.52%	3.8871	3.94%	11.5	6.62
31/08/2015	5,848.69	4.745	4.22%	1.35	1.32%	11.5	5.84
30/09/2015	582.87	1.5311	1.31%	1.4265	1.37%	11.5	5.97
30/10/2015	-	-6.735	-5.70%	-3.4912	-3.31%	11.5	6.72
30/11/2015	84.88	-3.4439	-3.08%	0.3147	0.31%	11.5	7.32
31/12/2015	872.21	3.6222	3.37%	0.1941	0.19%	11.5	8.01
29/01/2016	2,471.87	-0.095	-0.10%	-0.0259	-0.03%	11.5	7.78
29/02/2016	3,017.77	-0.2022	-0.19%	-0.5858	-0.57%	11.5	6.84
31/03/2016	59.07	3.2228	2.89%	-0.3665	-0.36%	11.5	6.45
29/04/2016	2,152.19	-0.1978	-0.16%	-0.1953	-0.19%	11.5	5.27
31/05/2016	469.68	-2.1456	-1.86%	-0.3047	-0.30%	10.5	5
30/06/2016	297.90	-0.05	-0.07%	0.2688	0.27%	10.5	5.8
29/07/2016	1,004.36	0.0895	0.08%	0.2867	0.28%	10.5	6.4
31/08/2016		0.69	0.61%	-0.0272	-0.03%	10	6.26

	1,805.03						
30/09/2016	1,495.58	0.5672	0.51%	-0.0972	-0.10%	10	6.34
31/10/2016	813.13	-2.5294	-2.22%	0.1955	0.19%	10	6.47
30/11/2016	2,990.47	-3.0573	-2.75%	0.4156	0.41%	10	6.68
30/12/2016	10,178.29	-1.0127	-0.93%	0.6116	0.60%	10	6.35