

**AN EMPIRICAL STUDY OF FOREIGN EXCHANGE
MARKET ARBITRAGE OPPORTUNITIES AFTER
LIBERALIZATION –THE CASE OF COMMERCIAL
BANKS IN KENYA**

BY

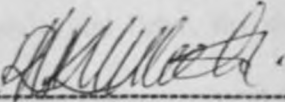
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Requirements for the Award of the Master of Business Administration
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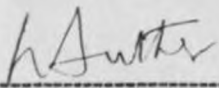
DECLARATION

This management research project is my original work and has not been presented for a degree award in any other University.

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LIST OF DEDICATIONS

To My Parents, Mr. James Mule Musembi and Mrs. Annastacia Mueni Mule, my brothers Samson and Peter, my sisters Jane, Grace, and late Penina for their inspiring support, love and encouragement throughout my academic life. May the Almighty God bless them.

EMBI – Effluent Market Institute

CVPM – Central Vision Printing Machine

EPF – Environmental Protection Fund

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LIST OF ABBREVIATIONS

KCCT	Kenya College of Communications and Technology
IMF	International Monetary Fund
SDR	Special Drawings Rights
USA	United States of America
IRPT	Interest Rate Parity Theorem
EMH	Efficient Market Hypothesis
CAPM	Capital Asset Pricing Model
S & P	Standard and Poors
PPP	Purchasing Power Parity
SPMM	Sticky-Price Monetary Model
SAPs	Structural Adjustment Programmes
UIP	Uncovered Interest Parity
MFM	Mundell- Fleming
PBA	Portfolio Balance Approach
UK	United Kingdom
CHIPS	Clearing House Interbank Payments System
CBK	Central Bank of Kenya
ANOVA	Analysis of Variance
FR	Frequency
EU	Euro
USD	United States Dollar
MBA	Master of Business Administration

ACKNOWLEDGMENT

GBP	Great Britain Pound
SW FR	Swiss Franc
SW KR	Swedish Kroner
CAN S	Canadian Dollar
IRP	Indian Rupee
JPN	Japanese Yen
ZR	South African Rand
TS	Tanzanian Shilling
UG	Ugandan Shilling
NK	Norwegian Kroner
DK	Danish Kroner
AUST S	Australian Dollar
D.F	Degrees of Freedom
S.D	Standard Deviation
NARC	National Rainbow Coalition

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ABSTRACT

Since independence, Kenya maintained restriction on foreign exchange currency transaction including amount of foreign currency that could be purchased. In 1995, Kenya repealed the Exchange Control Act, an important feature in the liberalization of trade and foreign exchange regimes. This paved way for a legalization of the hitherto “non-existent market” into the commercial banks foreign exchange market.

This paper looks at the existence of arbitrage opportunities of commercial banks foreign exchange market in Kenya.

The intention is to ascertain whether information is widely and cheaply available to the market participants. Secondary data was obtained from commercial banks under study and analyzed using chi-square distribution, F-distribution and line graphs. The results obtained are analyzed in this report. The paper mainly found that the foreign exchange market is generally inefficient as evidenced by the number of arbitrage opportunities that exist. However, possible benefits to Kenya from the liberalization of the foreign exchange market included increased availability of foreign currency and reduced inconveniences, which foreign currency buyers formerly experienced in the previous control regime. The most important development is the increased level of economic activity in the country due to easy access to foreign currency.

A key indicator of financial performance and efficiency is the spread between the selling and buying rates. If this spread is large, it indicates the existence of arbitrage opportunities. This is because it encourages speculators to buy currencies cheaply and sell them dearly. But in Kenya, foreign exchange liberalization seems to have led to a widening foreign exchange rate spread.

1.0 INTRODUCTION

1.1 BACKGROUND

The existence of arbitrage profit is evidence of a market that is not efficient. This is because it implies existence of different prices for the same asset in different markets; a situation that factor an unnecessary cost in product pricing. Roll and Ross (1984) defines arbitrage as buying an asset in one market at a lower price and simultaneously selling an identical asset in another market at a higher price with no cost or risk. Arbitrage profit can be used as a measure of the efficiency of the foreign exchange market and is defined as the process of taking advantage of existence of different prices for the same product (or substitute) at the same time but in different markets (Riehl and Rodriguez, 1977). If the market were efficient, one would expect absence of arbitrage profits while in an inefficient market, cases of arbitrage profits can be obtained. It is therefore not surprising that most economies strive for efficient foreign exchange markets.

With globalization has come increased emphasis on outward looking and a market-oriented economy. Consequently, the 1990's were associated with a greater degree of liberalization of the financial, foreign exchange and domestic markets in Africa. Liberalization of the foreign exchange market in Kenya was gradual from a fixed exchange rates regime to crawling peg before a flexible or floating exchange rate regime was adopted in the 1990's (Were *et al*, 2001).

High and sustainable economic growth is one of the key economic goals in many countries but attaining it is likely to be influenced by, inter alia; appropriate macroeconomic policies aimed at general macroeconomic stability (Dlamini, 1987).

Among the instruments that are crucial in economic management and stability of basic prices is the exchange rate. As a relative price, the exchange rate is important in making spending and investment decisions (Marrinan, 1989).

Over the past two decades, the trade and foreign exchange policies followed by Kenya have been restrictive. In 1971, for instance, a system of import licensing was introduced to control foreign exchange (Ndung'u, *et al*, 1999). Studies have shown that exchange control as a means to regulate capital was never a solution as capital found its way out of the country because of lack of security for investment or limited investment channels (Killick, 1981). The bureaucratic red tape involved in obtaining foreign exchange approval raised the cost of doing business, which was subsequently passed on to the customer.

In the 1990's, prices in the goods market were decontrolled; interest rates were liberalized, foreign exchange controls were gradually relaxed. In fact, the exchange rate regime operated under a dual system in 1992 since there was an 'official' exchange rate and a 'market' rate which operated on the basis of the foreign exchange bearer certificates (Ndung'u and Ngugi, 1999). When the certificates were suspended in January 1993, exporters were allowed to retain specified proportions of their foreign exchange earnings, while importers were required to purchase the foreign exchange from the

commercial banks (Ndung'u, 2000). In April 1993, both import and foreign exchange licensing were eliminated and 100 percent retention accounts introduced. However, the supply and demand for foreign exchange in the trade account did not immediately respond to market forces as would have been expected (Ndung'u and Ngugi, 1999).

Despite the assumed benefits of financial liberalization (McKinnon 1973; Shaw 1973) financial sectors in most developing countries are characterized by fragility, volatile interest rates, high- risk investment and inefficiencies in the intermediation process. These threaten stability of the financial sector as the system experiences banking crises, misallocation of resources, high levels of non-performing loans and high costs of intermediation (Ndung'u and Ngugi, 1999).

Empirical studies based on developed countries (Levich, 1979a, Frenkel and Levich, 1975) have clearly established the strong roles that arbitrage plays in international financial markets. These empirical tests of spot market and forward market efficiency have been based on small samples using statistical techniques. Rigorously tested academic models and performance studies of professional forecasters clearly demonstrated that arbitrage profit opportunities are available (Levich, 1979a).

An inefficient foreign exchange market can be costly. For example, Grossman and Stiglitz (1980) concludes that profits cannot perfectly be eliminated when arbitrage is costly, but it should be noted that the existence of investors who choose to pay in order to acquire

and process information can be due to point that the necessary conditions for efficiency are far less stringent. Studies done on the foreign exchange market in Kenya to date (Kurgat, 1998; Dlamini, 1987; Sharpley, 1984; Ndung'u and Ngugi, 1999, Were *et al*, 2001) are not conclusive on the existence or absence of arbitrage opportunities. For example, Dlamini (1987) focused on foreign exchange management through quantitative controls, Sharpley (1984) examined the foreign exchange content of Kenyan agriculture, and Kurgat (1998) tested spot market efficiency on Kenya's foreign exchange bureaux using daily exchange rates for the 1997 and concludes that the foreign exchange market is inefficient.

The liberalization of foreign exchange markets gave rise to numerous advantages such as the ability of the government to receive tax revenues on the transactions in the market. It also instilled confidence in the foreign exchange market in general, which is necessary for a faster economic development in the country. One view by Friedman (1953) is that because speculators buy low and sell high, their activity ensures that exchange rates reflect the fundamental determinants of currency values.

1.2 STATEMENT OF THE PROBLEM

Market efficiency has been and is likely to continue to be a matter of intense debate in the investment community (Sharpe, 2001). Economists agree that it is desirable to see that capital is channeled to places where it will do most good, in which case a reasonable goal is to encourage the establishment of allocatively efficient markets in which the firms with the most promising investment opportunities have access to needed funds at affordable costs.

With establishment of floating exchange rates in most countries of the world, it was natural to begin the investigation of foreign exchange markets efficiency. Studies by Frenkel and Levich (1975) relied heavily on stock markets techniques to test foreign exchange market efficiency. Levich (1979a) argued that it is difficult to test whether investors' efficiency set and the actual spot exchange rate is equal to its equilibrium value unless there is some agreement on what equilibrium value is.

In the foreign exchange market, spatial, triangular and covered arbitrages are elementary investment opportunities that promise certain return with no exposure to risk (Buiter, 1983). Poole (1967) tested market efficiency in spot speculation and analyzed the performance of investment strategies that use filter rules as guides for picking speculative positions. He reports filter profits for the Canadian Dollar during the floating rate period 1950-1962, and for nine other series of flexible exchange rates in the post-first war period.

In an efficient foreign market, prices of foreign currency should be set so that "unusual profits" from arbitrage are quickly eliminated so that the participants are unable to take advantage of the market.

Since efficient market, means that it should not be possible for market participant to make instantaneous risk-free profits, any participant regardless of speculators in the market should be able to buy or sell to any market participant since the rates available in the markets are the same. If the Efficient Market Hypothesis (EMH) governs foreign exchange markets, then arbitrage should be continually equal to zero.

On the other hand, if the market is inefficient then there will be arbitrage cases occurring at short intervals and participants in the market can take advantage of the inefficient market by buying at a lower price in one bank and selling to another bank at a higher price. In an inefficient market, arbitrageurs will be the main actors in the foreign market. In theory, arbitrage profit is essentially risk free and can be completed in a matter of seconds, so any profit in excess of the transaction cost is arbitrage profits (Riehl and Rodriquez, 1977).

When licensing, commercial banks, the government needs to know the type of participants in the market for efficient allocation of resources. Overall, it is not clear whether agents who pursue profitable trading opportunities in the market are irrationally wasting their resources. The minimum requirement a market must satisfy if it is to be efficient is that no arbitrage possibilities must exist. In Kenya, though foreign exchange

markets have been liberalized, the evidence that efficiency has been attained is lacking. An attempt is made to look at level of foreign market efficiency after liberalization.

Although the weight from evidence from markets worldwide seems to lean toward market inefficiency, it is equally not clear if the agents could systematically exploit these apparent inefficiencies. The major participants in the foreign exchange market plays a role in the Kenyan economy, hence two questions are clear; who are the participants in the Kenyan foreign exchange market? And does the market have arbitrage opportunities?

1.6 IMPORTANCE OF THE STUDY

The findings of the study will

1. Provide a comprehensive background material on the operations of the Kenyan foreign exchange market

2. Provide a basis for measuring policy changes necessary for the Kenyan foreign exchange market

3. Serve as a vital source of information to the regulatory authorities (Central Bank of Kenya/CBK)

4. Provide valuable information to the International and Development institutions such as International Monetary Fund, World Bank, Non governmental organizations (NGOs), learning institutions and research institutions, journals and magazines.

1.3 OBJECTIVE OF THE STUDY

The study seeks to determine whether there exists arbitrage opportunities between commercial banks in Kenya after liberalization.

1.4 HYPOTHESIS TESTING

In order to study this problem, the following hypotheses will be tested:

H₀: The market is efficient so arbitrage will be equal to zero.

H_A: The market is inefficient and that arbitrage is greater than zero.

1.5 IMPORTANCE OF THE STUDY

The findings of this study will:

1. Provide a comprehensive background material on the performance of the Kenyan currency against other currencies in Kenyan foreign exchange market and help to:
 - Form a basis for suggesting policy changes necessary for the Kenyan foreign exchange market,
 - Serve as a vital source of information to the regulatory authorities notably Central Bank of Kenya (CBK),
 - Provide guideline information to the International and Development institutions such as International Monetary Fund, World Bank, Non governmental organizations (NGOs), learning institutions, academicians, researchers, exporters and importers.

2. Provide a useful guide to the existing and upcoming consultants in the analysis of the foreign exchange market.
3. Provide knowledge to international investors on the effect of exchange rates' fluctuations on their investments.
4. Guide heads of trade finance of commercial banks and other dealers on the analysis of Kenyan shilling against other currencies.
5. Become a valuable addition to the existing body of knowledge on foreign exchange market. In addition, the study will be useful to scholars and academicians who may wish to use the findings of this study as the basis for further research on this subject.

1.6 ORGANIZATION OF THE STUDY

The research is organized into five chapters. Chapter one covers the background of the study, the research problem, the objectives, hypothesis testing and importance of the study. Chapter two covers literature review on liberalization of the foreign exchange market, Efficient Market Hypothesis (E.M.H), studies done on foreign exchange market efficiency, currency arbitrage in spot market and approaches to testing foreign exchange market efficiency.

Finally the chapter reviews determination of the spot rate exchange, theoretical and empirical models of exchange rate and international foreign exchange markets.

Chapter three is the research design. The analysis and findings of the study are in chapter four, while chapter five covers summary, conclusions, limitations of the study, policy recommendations and suggestions for further research.

2.0 LITERATURE REVIEW

2.1 LIBERALIZATION OF THE FOREIGN EXCHANGE MARKET

Michaely *et al* (1991) defines trade liberalization as a change in a country's trade policy, which moves the country's trade system closer to neutrality. Thus, trade liberalization moves the economy closer to the situation that would prevail if there were no government interference in trade system. Trade liberalization includes relaxation of quantitative restrictions; tariff rate reductions; tariff rate rationalization; exchange rate changes and bias in correcting export promotion. Each of these forms of trade liberalization has been implemented in Kenya at different times.

Financial liberalization entails a variety of measures such as liberalization of interest rates, establishing freedom of entry into and procedures for orderly exit from the banking industry, reducing reserves and liquidity requirements, eliminating or minimizing credit allocation directives, eliminating preferential credit at concessional interest rates and removing controls in the capital account of the balance of payments (Montiel, 1995).

Foreign exchange is the process according to which the currency of one country is exchanged into currencies of the other countries. Exchange rate is the price of domestic currency in terms of a foreign currency (Exchange Control Act, 1967). Eiteman *et al* (1998) notes that the foreign exchange markets provides the physical and institutional structure through which the money of one country is exchanged for that of another country, the rate of exchange is determined, and foreign exchange transaction are

physically completed. It is an over-the-counter market and does not denote a particular place or floor where dealers assemble and transact foreign currencies. Rather, it consists of trading desks at major agencies dealing with foreign exchange throughout the world that are connected by telephone, telex and so on (Sharan, 2001).

Melvin (1989) gives three reasons why foreign exchange markets exist:

The first explanation of why foreign exchange markets exist is that they provide power from individual who normally deal in one currency to other people who generally transact business using different monetary units. Importing and exporting goods and services are facilitated by this conversion and can deal in terms of medium of exchange rather than having to rely on bartering.

A second reason why efficient markets have developed is that they provide means for passing the risks associated with changes in exchange rate to professional risk takers. This "Hedging" function is particularly important to corporation in the present era of floating exchange rate. The last important reason for continuing prosperity of foreign exchange market is the provision of credit for international trade transactions.

Since independence, Kenya maintained restriction on foreign exchange currency transaction including amount of foreign currency that could be purchased (Ndung'u, 1999). The shift from a fixed to a flexible exchange of the regime has been gradual in many developing countries including those in Africa. Although such a shifts in the developed countries date back to the early 1970's when the Bretton Woods System

collapsed, most developing countries continued pegging their exchange rates, either to a single key currency (especially the United States of America Dollar or the French Franc) or to a basket of currencies (such as the IMF's Special Drawings Rights).

It was not until the early 1980's that developing countries started moving explicitly towards more flexible exchange rate arrangements.

By 1996, countries that pegged exchange rate accounted for only about 20 percent of the developing worlds trade, from 70 percent in 1975 (Ndung'u, 1999).

Increased flexibility in the exchange rates has been greatly associated with a general shift towards increased openness, outward looking policies of trade and increased emphasis on markets determined exchange and interest rates. In particular, the general increase in international, capital flows to developing countries and to globalization of the financial markets has played an important role (IMF, 2000).

In Kenya, exchange rates regimes have evolved along the general macroeconomic policies adopted since independence. Kenya's economy in the 1960's and 1970's was predominantly characterized by controls in virtually all key sectors. There were controls on domestic prices, foreign exchange transactions, interest rates and import licensing, among others (Were *et al.*, 2001).

However, when a series of external shocks emerged, this approach to macroeconomic management proved inadequate. For example, in 1973/74's oil price hike, which saw the economy so hard hit that signs of instability were quite evident (Ndung'u, 1993). Consequently, the government of Kenya started to liberalize the economy, following

typical structural adjustment policies (SAPs). As an intermediate step the exchange rate policy was changed to a crawling one.

In the 1990s, liberalization was intensified in both financial and goods markets. Prices in the goods markets were decontrolled; interest rates were liberalized, foreign exchange controls were gradually relaxed. In fact, the exchange rate regime operated under a dual system in 1992 since there was an 'official' exchange rate and a 'market' rate. The latter operated on the basis of the foreign exchange bearer certificate, which could be purchased at the official exchange rate from the Central Bank of Kenya, without having to declare the source of the foreign exchange, and then marketed as any other paper asset (Ndung'u and Ngugi 1999).

This facility was a major relief in the foreign exchange market as it entitled the bearer to some amount of foreign exchange without going through the tedious and time consuming foreign exchange licensing process. When the certificates were suspended in January 1993, exporters were allowed to retain specified proportions of their foreign earnings, while importers were required to purchase their foreign exchange from commercial banks (Ndung'u, 2000).

The liberalization period is thus characterized by a shift in attention a way from the real economy to trade in financial assets (Were *et al.*, 2001). Other liberalization measures undertaken in subsequent years included complete liberalization of offshore borrowing in May 1994 and elimination of the remaining restrictions on inward portfolio investment in January 1995. Were *et al.* (2001) investigates some of the key factors that are likely to

have influenced the foreign exchange rate movements since the foreign exchange market was liberalized in 1993. They conclude that exchange rate appreciates with an increase in the short-term nominal interest rate differential and increases in the price differential.

2.2 EFFICIENT MARKET HYPOTHESIS (E.M.H)

An efficient market is where prices “fully reflect” all available information, when this conditions is met, investors, cannot earn an unusual profit by exploiting available information (Fama, 1970; Brealy and Myers, 2001). Gitman (2001) defines an efficient market as one where it is not possible for market participants to make instantaneous risk-free profits. The Efficient Market Hypothesis (EMH) states that at any given time, security prices fully reflect all available information. But most individuals who buy and sell securities (stocks in particular) do so under the assumption that securities they are buying are worth more than the price that they are paying (undervalued), while the securities they are selling are less that the selling price (overvalued). However, if markets are efficient and current prices fully reflect all information, then buying and selling securities in an attempt to outperform the market will effectively be a game of chance rather than skill (Fama, 1970).

Grossman and Stigliz (1980) argue that a precondition for EMH is that information and trading costs, that is, the costs of getting prices to reflect information are always zero. In an efficient market, competition among the many intelligent participants leads to a situation where at any point in time, actual prices of individual securities already reflects

the effects of information based both on events that have already occurred and on events which as of now the market expects to take place in future.

Thus, in an efficient market at any point in time the actual price of a security will be a good estimate of the intrinsic value (Fama, 1995). Copeland *et al* (1993) argue that, in an efficient capital market, prices fully and, instantaneously reflect all available relevant information hence when assets are traded, prices are accurate signals for capital allocation. Cornell and Roll (1981) concludes that, it is reasonable to have efficient markets where people earn different gross rates of return because they pay differing costs for information. However, net costs of their abnormal rates of return will be equal (to zero).

The market efficiency hypothesis suggests that the foreign exchange market is efficient meaning that the exchange rate reflects all available information. If it is so, then speculators will not benefit from trading in currencies. However in the real world, they do benefit. Borrowing from Fama's (1970) Classification of efficiency in the security market, the efficiency in the foreign exchange market is classified as weak, semi-strong and strong.

In a market with weak efficiency, the series of historical exchange rates contain no information that can be used for forecast of future spot exchange rates. This means that in a weak-efficient market, forecasts can be generated. On the other hand, if efficiency is semi-strong, it is believed that there is a large and competitive group of market participants who have access to publicly available information for the purpose of forming

an expectation about future spot rates. In this case, the above hypothesis suggests forecast is not required. If the market is efficient in strong form, not only public but also private information is available which can tell about the future spot rates and which rules out any need for forecast.

The empirical findings differ on the issue of weak efficiency. Dooley and Shafer (1976) cover a two and a half-year period from March 1973 and find no support for the concept of weak efficiency. On the other hand, Logue and Sweeney (1977) find significant evidence for the weak efficiency hypothesis in the context of changes in the French franc-US dollar rates. The semi-strong hypothesis is so general that it is difficult to test it empirically (Copeland *et al.*, 1993). In practice, foreign exchange markets are normally found to be at least semi-strong form efficient. In general, the efficient studies suggest that the major foreign exchange markets exhibit behavior that is characteristic of other assets markets.

The speed with which information is exchanged between market participants provides the opportunity for quick and efficient arbitrage between foreign exchange centers and between currencies (Murphy, 1992).

2.3 FOREIGN EXCHANGE MARKET EFFICIENCY

Market efficiency is a major theme that has motivated numerous empirical studies of international financial markets like Fama (1970), Clendenning (1970), Aliber (1973) and Frenkel and Levich (1975). Tests of assets market efficiency (on domestic equity and bond market) began in the 1950s and gained increasing popularity and significance during 1970s. With establishment of floating exchange rate in most countries of the world, it was natural to begin the investigation of foreign exchange market efficiency.

Studies done by Frenkel and Levich (1975) relied heavily on stock market techniques to test the foreign exchange efficiency. Levich (1979a) argued that it is difficult to test whether investor's efficiency set and the actual spot exchange rate is equal to its equilibrium value unless there is some agreement on what equilibrium value is.

Fama (1970) notes that equity market and foreign exchange market differ as firms might be characterized by their consistency in terms of directors, product line, financial strategy and customers. He suggests that, for firms operating in a stable environment with mature products investors can learn the risk / return properties of equities. In the foreign exchange, spatial, triangular and covered arbitrages are elementary investment opportunities that promise a certain return with no exposure to risk (Buiters, 1983).

Several approaches have been put forward to test for spot market efficiency. One popular null hypothesis was that, under a regime of freely floating exchange rates, changes in spot exchange rates should be serially uncorrelated. Poole (1967) and Burt, Kaen and Booth

(1977) reported empirical tests of this hypothesis. In general these researches concluded that spot market was not efficient. Poole (1967) tested that market efficiency in spot speculation and analyzed the performance of investment strategies that use filter rules as guides for picking speculative positions. A filter rule produces profits when momentum or "band wagon" effects carry the exchange rate further in the direction indicated by the initial movement.

Dooley and Shafer (1983) reports filter rule profits for nine currencies using daily spot rates over the 1970s floating exchange rate period. Dooley and Shafer hypothesized that if market is efficient the filter rule profit adjusted to reflect the above costs should be a "fair game" process. Gross profits from filter rule strategies imply abnormal profits and therefore reflect market inefficiency. Since filter rule trading involves risk, the key question is whether unusual profits are available ex-ante to spot speculators.

Levich (1979b) suggests performance tests based on a means- variance model, but these raise further problems concerning the appropriate market portfolio and risk aversion measure. Good man (1981) examined the performance of professional foreign exchange advisors that issue buy and sell signals based on technical analysis. He reports large profits in excess of the risk-free rate are generally available to users of these professional signals. He suggests that these risks are small for investors who have enough capital to withstand big losses and who use professionals on a regular basis.

The growth of the literature on efficient market is motivated by the search for alternative formulation of market efficiency, and in particular for those formulations aimed at directly testing for existence of profitable trading opportunities. For example, Bilson (1981), Dooley and Shafer (1983), and Hodrick and Srivastava (1984).

There is growing evidence, mostly from stock market studies (Harris and Gurel, 1986; French and Roll, 1986; and Roll, 1988) that news alone do not move asset prices; but also informed changes in demand move asset prices. Grossman and Stiglitz (1980) points out that if asset prices do fully and instantly reflect all available information, then presumably there will be incentive for individuals to collect and process information, since this will already have been reflected in market prices.

As applied to foreign exchange market, Grossman and Stiglitz suggested that the EMH might be described as a joint hypothesis consisting of how equilibrium returns are determined, with the view that agents rapidly arbitrage away any profitable opportunities that may arise using the available information at their disposal.

Murphy (1977) argues that efficiency is not an accurate description of the capital market and may not even be a very good description of the capital markets and that there are serious problems with the risk/return relationship.

Grossman and Stiglitz (1980) concluded that arbitrage profits cannot be perfectly eliminated when arbitrage is costly, but it should be noted that the existence of investors who choose to pay in order to acquire and process information may not be due to the fact that they can consistently obtain a return on this outlay. Rather it can be due to the point that necessary conditions for efficiency are far less stringent and are thereby that

information be readily available to a sufficient "number of investors, that transaction costs be reasonable", and that, in the absence of agreement about the implication of current information and expectation regarding price movements, there can be no evidence of consistent superiority or inferiority by significant participants in the market.

2.4 CURRENCY ARBITRAGE IN SPOT MARKET

Arbitrage is a trading strategy based on a purchase of a commodity, including foreign exchange, in one market at one price while simultaneously selling it in another market at a more advantageous price in order to obtain a risk free profit on the price differential (Logue *et al.*, 1977). With vast development in the telecommunication system, rates are expected to be uniform in different foreign exchange market. Nevertheless inconsistency exists at times.

The arbitrageurs take advantage of the inconsistency and garner profits by buying and selling currencies. They buy a particular currency at a cheaper rate in one market and sell it at a higher rate in the other. This process is known as currency arbitrage (Grossman *et al.*, 1980). Where two currencies and two markets are involved, it is known as two-point arbitrage (Logue *et al.*, 1977). There are also examples of three-point arbitrage/triangular arbitrage where three currencies and three markets are involved (Sharan V, 2001).

According to Roll & Ross (1984) triangular arbitrage is the striking offsetting deals among the three markets simultaneously to obtain profit. Another category of arbitrage is covered interest arbitrage. Grossman *et al* (1980) defines it as swapping one currency into another on a hedged basis to benefit from interest differential. This arbitrage involves two steps: Firstly, buying foreign currency spot (transfer purchasing power). And secondly, selling foreign currency forward (Hedged position). Without hedging the position, the investor could take a substantial loss if the foreign currency depreciates in value against the investor's home currency (Eiteman *et al* 1998).

Logue *et al* (1977) defines covered interest arbitrage as the process whereby an investor earns a risk free profit by: borrowing funds in another currency; exchanging those in the spot market for a foreign currency; investing the foreign currency at interest rates in a foreign country; selling forward at a time of original investment, the investment proceeds to be received at maturity; using the original loan, and having a remaining profit balance.

2.5 APPROACHES TO TESTING EFFICIENCY OF THE FOREIGN EXCHANGE

MARKET

According to Copeland *et al* (1993) five approaches to testing foreign exchange market efficiency can be identified:

TESTING ARBITRAGE RELATIONSHIPS

The minimum requirement a market must satisfy if it's to be said to be efficient is that no arbitrage possibilities must exist. For example, Interest Rate Parity Theorem (IRPT) is one such arbitrage relationship that must hold in international financial markets. Consistent and systematic deviations from IRPT outside the bounds of transactions costs may be interpreted as evidence of inefficiency. Frenkel and Levich (1977) conclude that - after allowing for transactions costs and ensuring that the arbitrated assets are comparable - covered interest arbitrage does not seem to entail unexploited opportunities for profit.

EQUILIBRIUM PRICING MODELS

Another approach to testing the efficiency of foreign exchange market, but without confining the test to arbitrage relationships between assets of "equal risk" is to, develop a model for the pricing of risky assets and test whether financial markets price assets accordingly. In this study, tests of Capital Asset Pricing Model (CAPM) in domestic markets can be construed to be joint tests of market efficiency and of the model itself.

But a rejection of the model in empirical testing would be a rejection of the notion of efficiency of the market in which the assets are traded (Copeland *et al.*, 1993).

TRADING RULE TESTS

Another approach is to examine the profitability of simple trading rules like filters. One such study is by Cornell and Dietrich (1978), using daily exchange rate for the period March 1973 to September 1975, for a sample of currencies of major industrialized nations, they set up some simple filter rule –based trading strategies, taking transaction costs into account in the moving average filter, when the exchange rate moves x percent above the moving average for a pre-specified interval the rule calls for the investor to move into the foreign currency; when it falls x percent below the moving average the investor moves back into dollars.

Moving averages of 10, 25 and 50 days were tried. None of these filter rules produced a profit of more than 4 percent per annum for the British pound, Canadian Dollar, or Japanese yen. However, the situation was quite different with the German Mark, the Dutch guilder, and Swiss Franc. The 25-day moving average rule consistently produced profits of more than 15 percent per annum for all three currencies, with filters ranging from 0.2 percent to 2.0 percent.

They concluded that the three currencies with the high trading-rule profits were also the three with the highest variance. Hence the “profit” observed might well be merely compensation for the greater risk of trading in these currencies. They attempted to

separate the systematic from unsystematic portion of total variation. Exchange rate variations were correlated with the S&P 500 index as the "market". The result were to eliminate almost entirely the risk of these currencies, casting doubt on the proposition that the "excess profit" was a risk premium".

As with all filter tests, the main problem in interpretation of the results seems to be that we do not know how to adjust for the different risks of the alternative strategies. Also, it does not appear in any way to determine, *ex ante*, the appropriate size of filter to test. They depend on historical relationships- that are likely to be unstable over time (Burt *et al.* 1977).

FORWARD SPECULATION

A fourth approach to testing the efficiency of foreign exchange markets is to examine the returns to forward speculation. The basic assumption underlying the simpler versions of this class of efficiency tests is that the forward rate should be an unbiased forecaster of the future spot rate. But there may be good theoretical reasons for the forward rate to be systematically different from the expected (corresponding) future spot rate. For example, Stockman (1978) developed a simple model with only money supply uncertainty that shows that the forward rate may have a risk premium associated with it, which would lead it to be a biased estimator of the future spot rate.

A forward bias can also come from the "real" exchange risk. Stockman (1978) found that the risk premium is significant only for a couple of currencies (the British pound and

the Swiss franc). He interpreted it was not important to mean that the risk premium, when significant was not stable across sub periods. Cornell (1978) used monthly data on exchange rates for eight industrialized countries and concluded that the market prices forward exchange contracts as if a stochastic process with a constant term and a random noise term generates the exchange rates.

PERFORMANCE OF FORECASTING SERVICES

A final way to test for efficiency of the exchange market is to study whether forecasting services can "beat" the market. This is a test of efficiency in semi -strong form. Levich (1979) analyses the currency forecasts made by forecasting service. He found that the particular service studied yielded profits consistently and significantly for some currencies. For other currencies, it lost. The results of such studies have been mixed and generally hard to interpret. On the whole the literature on the market efficiency seem to suggest that international market are weak form and semi – strong efficient.

2.6 DETERMINATION OF THE SPOT RATE EXCHANGE

Three models of exchange rate determination are reviewed as under:

FREELY FLOATING RATES

In a free market, in the absence of government stabilization, the exchange rate is determined by the supply and demand for foreign exchange. Melvin (1989) concludes that the amount of foreign exchange demanded at any time will depend on the volume of international transfer requiring payments to non-residents.

These transactions may include purchases (or imports) of goods and services, and purchases (capital outflows) of financial assets. The quantity of foreign exchange demanded will vary inversely with its price. MacDonald (1988) argues that a high exchange rate makes foreign goods and services more expensive, and quantity demanded of these items will be lower. By contrast a low exchange rate tends to increase the amount of foreign exchange demanded. This study examines arbitrage in a freely floating rate environment.

FIXED EXCHANGE RATES

Sharan (2001) defines this model as where government establishes par value for currency and actively intervenes in market to maintain this valuation. He further notes that for a fixed exchange rate system to work well, it is necessary for government to maintain financial policies that promote stable exchange rates. McKinnon (1979) argue that extreme differences in monetary and fiscal policies will result in greater discrepancies between inflation rates and interest rates, and places heavy pressure on exchange rates. Also, these differences in policies will lead to shifts in the demand and supply schedules of the respective currencies (McKinnon, 1979; Marrinan, 1989).

CONTROLLED EXCHANGE RATES

Exchange rate controls have been dominant in most African Countries. These exchange rate controls policies seem to have been adopted on the basis of arguments that it ensured the stability of currencies (Dlamini, 1987). Under an exchange control system, the

government authority enjoys exclusive powers to determine the allocation and use of available foreign exchange. Residents of exchange control systems are not free to engage in foreign exchange transactions. Capital inflows and export of merchandise generate available foreign exchange (Isard, 1995).

Todaro (1977) argued that given the structure of less developed Countries' economies, the optimal exchange rate policy is a fixed rather than a flexible rate regime. The proponents of flexible exchange rate deny the propositions that fixed regimes generate stability and economic benefits. Quirk (1987) argued that a fixed exchange rate regime couldn't guarantee stability since the rates must be adjusted from time to time. He asserts that the cost of controls and the rules governing foreign exchange allocation generate very high inefficiencies in the foreign exchange market hence; a flexible regime is seen to generate efficient resource allocation.

The historical experience of countries shows that some economies have at given points adopted more than one exchange rate regime (Todaro, 1977). An efficient exchange rate regime may among other things, depend on the character of the institutions, particularly their operational efficiency and credibility (Dornbusch, 1976). Todaro (1977) argues that the shift in exchange rate policy from controls to deregulation has made the market mechanisms dominant in the management of foreign exchange in most African countries today.

2.7 AN OVERVIEW OF THEORETICAL MODELS OF EXCHANGE RATE

Traditionally, two views of exchange rates have been predominant. One regards the exchange rate as the relative price of two monies, in the other; the exchange rate is viewed as the relative price of domestic and foreign goods. A third view takes into account portfolio consideration and regards the exchange rate as the relative price of nominal assets. Recently some interest in the portfolio approach has emerged in the form of an exchange rate theory oriented to the current account (Dornbusch, 1980).

The flexible price monetary approach regards the exchange rates as an asset price. It assumes continuous price flexibility maintains the money market in equilibrium. It also assumes that purchasing power parity (PPP) holds continuously.

Given the equilibrium condition in the domestic and foreign money markets, the equilibrium national price levels are then solved by equating real money supply to money demands in each of two countries. In this approach, therefore nominal exchange rate is explicitly expressed in current relative money supplies and factors affecting money demand (Marrinan, 1989; MacDonald, 1988; Isard, 1995).

A key limitation of the simple monetary model is its failure to recognize the factors affecting demand for money have repercussions in the product market (Marrinan, 1989). Further more, extensive empirical evidence has revealed significant violations of the PPP hypothesis (Marrinan, 1989; Isard, 1995).

An alternative to the simple monetary model is a disequilibrium microeconomic model that considers the differential speeds of adjustments in assets and goods markets. This leads to the sticky-price monetary approach to the exchange rate. The most common sticky-price monetary model (SPMM) is the Dornbusch (1976) Over-Shooting Model, which is an extension of the Mundell-Fleming Model (Obstfeld *et al.*, 1996; MacDonald, 1988). In it, the nominal output prices are assumed to be sticky—they adjust slowly over time. On the other hand, asset markets continuously change in response to new information or changes in expectation (Marrinan, 1989). The model thus adopts the principle of the uncovered interest parity (UIP), but PPP need not hold. A small country with an open economy is faced with a foreign interest, which is assumed to be constant.

With open capital markets and perfect foresight, UIP is assumed to hold continuously because of the sluggish adjustments of the national price level a purely nominal shock or disturbance can cause short-run deviations from PPP and over shooting of the nominal exchange rate (Marrinan, 1989). Hence the model is popularly known for its demonstration of overshooting / and undershooting behavior in exchange rates (Dornbusch, 1976; Marrinan, 1989; Obstfeld and Rogoff, 1996).

Despite its popularity, the Dornbusch model has methodological limitation when examined from a micro-foundation perspective. First the model lacks explicit choice-theoretical foundations, particularly concerning micro-foundations of aggregate supply (Obstfeld and Rogoff, 1996). Its specification of the price determination process is ad hoc.

Another strand of the literature is the portfolio balance approach (PBA). It focuses on the link between balance of payments and adjustments in asset stock. It also emphasizes that models of capital account should be rooted in behavioural models of supplies of and demands for portfolio stocks (Isard, 1995). The portfolio balance model has, since its emergence in the late 1960's undergone several changes. Until the early 1980's, attempts to explain the behaviour of exchange rates with the approach were based on ad hoc assumptions about exchange rates expectations. In addition, early empirical applications of these models were often based on the valiant assumption that currency composition of financial portfolio could be measured simply by calculating current account flows (Isard, 1995).

2.8 AN OVERVIEW OF EMPIRICAL MODELS OF EXCHANGE RATE

Studies indicate that the reduced- form single equations models, which are based on the theoretical insights above, have performed poorly empirically (Isard, 1995; Obstfeld and Rogoff, 1996; Marrinan, 1989). Exchange rate movements have not been consistent with the prediction of the economic models. Instead, exchange rate, have been found to be more volatile under floating regimes than had been anticipated, with frequently large month-to-month variability. One of the likely explanations is linked to the markets expectation about the future exchange rate (Marrinan, 1989).

Recently the growing number of exchange rate studies in Africa, most of which tend to focus on exchange rates management and policy issues (Ogiogio, 1996, Barungi, 1997; Odbogun, 1995; Atta *et al*, 1999; Njinkeu and Bamou, 2000) conclude that, first, there is

a strong relationship between prices (both domestic and imported) and exchange rate movements (Atta *et al.*, 1999; Ndung'u, 1997; Aja kaiye and Ojowu, 1994).

Secondly, most studies found the movement of exchange rate is strictly linked to both fiscal and monetary policy discipline, in particular monetization of the fiscal deficit (Njinkeu and Bamou, 2000, 1997; Ogiogio, 1996; Barungi, 1997). Finally in most of these studies, the institutional aspect of managing exchange rate as well as real sector performance is emphasized as long-run solution to sustain ability of a stable exchange rate system. (Ogiogio, 1996; Bamou, 2000; Barungi, 1997).

EMPIRICAL EVIDENCE ON EXCHANGE RATE MARKETS

Applied studies in Kenya have tended to adopt the SPM by using the UIP specification. For example Ndung'u (2000) and Ndung'u and Ngugi, (1999) used modified UIP in which the exchange rate is specified as a function of price differential and real interest rate differential. Ndung'u (1999) analyzed the effects of expansionary monetary policy on real and nominal exchange rates by specifying the equation that encompasses real income, price and money supply and concluded that the real income drives appreciation of the nominal exchange rate while money supply growth and inflation leads to its depreciation.

In general, empirical models based on Kenya include the short-term nominal interest rate differential as one of the explanatory variables. In Kenya, exchange rate movements also tend to be associated with both inflows of external donor funds and their expectation (Ndung'u, 2000). Traditionally, interest rate and price differentials have been known to be among the determinants of changes in the exchange rate (Ndung'u *et al.*, 1999).

In addition, improvements in the current account balance and net external inflows leads to exchange rate appreciation, key events and expectations associated with key announcements particularly donor funding, also influence exchange movements (Were, *et al.*, 2001). These empirical results are consistent with policy outcome that shows that the interest rate (mainly the Treasury bill rate) is used to stabilize the exchange rate. This has resulted in a high interest rate regime with a stable nominal exchange rate (Ndung'u 2000).

2.9 INTERNATIONAL FOREIGN EXCHANGE MARKETS

Conversion of one currency into another takes place in foreign exchange markets. Such markets are located worldwide and consist largely of banks and specialized dealers linked together by a communication system (Sharan, 2001). Thus the extent to which a country's currency is traded in the worldwide markets depends to some measure on local regulations that vary from country to country (McKinnon, 1979). The major participants in the international foreign exchange markets are the large multinational Commercial Banks. McKinnon (1979) reports that, the United States of America (USA) market is dominated by 25 large banks with half of them located in New York and the remainder in major financial centers.

These banks operate at two levels in the foreign exchange market. First, at the retail level, banks deal with individuals and corporations. Second, at the wholesale level, banks operate in the inter bank market. Major banks transact directly with foreign institutions

involved. Hence, these banks maintain market in various currencies, offering to buy and sell them in much the same way as markets are made in over the counter financial securities (Copeland, T.E. *et al.*, 1993).

Returns to the bank from making markets consist of the spread between bid and ask prices set by banks as well as any gains or losses from appreciation of some currencies relative to others (Buckley, 1996). The other major participants in the foreign exchange markets are the Central Banks of the various countries. Central banks typically intervene in foreign exchange markets to smooth out fluctuations in a country's currency rate. Additional participants are non-financial businesses and individuals who enter the market by means of banks for various commercial reasons. Most payments are made by telephone or cable. The Society World-wide International Financial Telecommunication (SWIFT) and the Clearing House Inter bank Payments System (CHIPS) have added a new dimension to the speed and efficiency with which the payment transfer and clearing process works (Melvin, M, 1989).

With advent of free-floating currencies, multinational corporations engaged in international trade and investors have become increasingly concerned with minimizing exchange rate risks (Ike, 1991). In the UK, residents have been able to invest freely abroad since October 1979 when foreign exchange control restrictions were fully lifted. Foreign currency is traded in electronic information screens such as Reuter's link banks. In total there are 300 participants including 50 large international banks in the foreign exchange market (Longworth, 1981).

The integration of financial center implies that there can be no significant difference between the Dollar / Deutsche mark exchange rate quoted in New York at 9.00am and the Dollar / Deutsche mark exchange rate quoted in New York at 9.00am and the Dollar / Deutsche mark exchange rate quoted in London time. If the Deutsche mark were selling for \$0.30 in New York and \$0.35 in London, profits could be made through arbitrage, the process of buying a currency cheap and selling it dear. If all traders tried to cash in on the opportunity, however, their demand for Deutsche marks in New York would drive up the Dollar price of deutsche marks there. Very quickly, the difference between the New York and London exchange rates would disappear in the efficient market (Levich D, 1979a).

Since foreign exchange traders carefully watch their computer screens for arbitrage opportunities, the few that arise are small and very short-lived (Melvin M, 1989).

3.0 RESEARCH METHODOLOGY

3.1 POPULATION OF THE STUDY

The population of interest in this study comprised of all the 43 commercial banks in Kenya. Commercial Banks were chosen because they are well organized and they file their returns to Central Banks of Kenya regularly. In addition they control a significant proportion of the entire foreign exchange market and forms the basis upon which Central Bank of Kenya (CBK) computes both daily and monthly indicative exchange rates.

3.2 SAMPLING DESIGN

The sample of the study was chosen from the population .Out of 43 commercial bank, 5 were under receivership/liquidation hence excluded from the sample of the study. Out of the remaining 38, 9 did not consistently trade in the currencies of interest.

More so, the years 2002 and 2003 were the most current years during the research period with all available data. Hence the information that was generated from the data was to be timely for the users of this information. The study used a sample of 27 commercial banks since these were the only operational banks in terms of currency dealing.

3.3 DATA COLLECTION

The study entailed mainly use of secondary data, which was obtained from respective banks in the sample. The data that was collected was the commercial banks' closing buying and selling exchange rates for the fourteen currencies from January 2002 to

December 2003 (Appendix III). Osei (1996) selected dates (data points) at two weekly intervals to get 83 data points from 1988 to 1992 (5years). Ayogu (1997) used 208 data points in testing for speculative efficiency and noisy trading from the period 1990 to 1993. Kurgat (1998) used 292 data points for the period January to December 1997 to test spot market efficiency on Kenya's foreign exchange bureaux from January 1997 to December 1997. The above studies justify this research using 504 data points for the period January 2002 to December 2003. Due to bulkiness of the data required, 2 years were sufficient for the researcher to generate the commercial banks' foreign exchange rates from respective banks.

3.4 TECHNIQUES OF ANALYSIS AND PRESENTATION

The possible arbitrage profits were analyzed between commercial banks in the sample.

The number of cases the condition of arbitrage is satisfied is given as:

$$S_i - B_j > 0 \text{ or } S_j - B_i > 0$$

Where:

B_i = the buying rate for Bank I in time t

B_j = the buying rate for Bank j in time t

S_i = the selling rate for Bank I in time t

S_j = the selling rate for Bank j in time t

The main costs encountered in arbitrage analysis are transport and telephone costs. For arbitrage analysis in two locations (towns), the transport and telephone costs are substantial because of the long distance involved.

In this research the analysis of arbitrage is between commercial banks' branches based in Nairobi hence the cost of transport and telephone is assumed to be zero.

In the arbitrage analysis the researcher analyzed the highest arbitrage obtained on each of 14 currencies for all operating dates (Days) $t_1, t_2 \dots t_n$ between 2002 and 2003 and obtained 504 points in each of the 14 currencies (Table 4.1.0).

The null hypothesis of this study is that the market is efficient so arbitrage will be equal to zero. Research hypothesis in contrast holds that the market is inefficient and that arbitrage is greater than zero.

That is;

$$H_0: \mu = 0$$

$$H_1: \mu > 0$$

Chi-square (X^2) was used to test for the similarity ("goodness of fit") between the observed proportions and the expected proportion of case for each type of currencies.

The goodness of fit was done to determine how closely a set of observed frequencies corresponds to a given set of expected frequencies. Chi-Square tests how well the sample result fit the population by matching the observed and the expected frequencies to ensure that the variation is not significant. When the chi-square test statistic is small compared to chi-square critical value (tabulated critical value), then the fit is said to be good.

The Chi-square test statistic in the form:

$$X^2 = \sum \frac{(F_o - F_e)^2}{F_e}$$

$$= \frac{\text{The sum (observed - expected frequencies)}^2}{\text{Expected frequencies}}$$

A fundamental assumption in the application of chi-square is that no systematic biases exist in the selection of subject. More generally it's assumed that the sample is representative of the population from which it's drawn. Any systematic selection will certainly distort the conclusions drawn in the study. Also chi-square assumes that the outcome of an observation doesn't affect the likelihood of the outcome. Using the chi-square test statistic has some limitation. When there is one degree of freedom, the expected frequencies for every cell should be at least ten (10) and the true distribution of the chi-square test statistic is an approximation. However it is adequate if the sample frequencies are sufficiently large enough (at least five observations).

After analysis arbitrage opportunities on the foreign exchange market the researcher probed further to see if there was any difference in the mean arbitrage derived from each currency in the 27 commercial banks in the sample.

Thus testing the null hypothesis

$$H_0: \bar{\mu}_{\$} = \bar{\mu}_{\pounds} = \bar{\mu}_{\text{€}} = \bar{\mu}_{\text{Zr}} = \bar{\mu}_{\text{Ugshs}} = \bar{\mu}_{\text{Tshs}} = \bar{\mu}_{\text{CAN\$}} = \bar{\mu}_{\text{SF}} = \bar{\mu}_{\text{JPN}} = \bar{\mu}_{\text{Sk}} = \\ \bar{\mu}_{\text{NORKR}} = \bar{\mu}_{\text{DANKR}} = \bar{\mu}_{\text{IRP}} = \bar{\mu}_{\text{AUST\$}}$$

Where:

$\bar{\mu}_{\$}$ = arbitrage mean for United States of America Dollar.

$\bar{\mu}_{\pounds}$ = arbitrage mean for Great Britain Sterling Pound.

$\bar{\mu}_{\text{€}}$ = arbitrage mean for Euro.

$\bar{\mu}_{\text{Zr}}$ = arbitrage mean for South African Rand.

$\bar{\mu}_{\text{Ugshs}}$ = arbitrage mean for Ugandan shillings.

$\bar{\mu}_{\text{Tshs}}$ = arbitrage mean for Tanzanian shillings.

$\bar{\mu}_{\text{CAN\$}}$ = arbitrage mean for Canadian Dollar.

$\bar{\mu}_{\text{SW}}$ = arbitrage mean for Swiss franc.

$\bar{\mu}_{\text{JPN}}$ = arbitrage mean for Japanese Yen (100).

$\bar{\mu}_{\text{Sk}}$ = arbitrage mean for Swedish Kroner.

$\bar{\mu}_{\text{NORKR}}$ = arbitrage mean for Norwegian Kroner.

$\bar{\mu}_{\text{DANKR}}$ = arbitrage mean for Danish Kroner.

$\bar{\mu}_{\text{IRP}}$ = arbitrage mean for Indian Rupee

$\bar{\mu}_{\text{AUST\$}}$ = arbitrage mean for Australian Dollar.

Using statistical test of analysis of variance (ANOVA), the exchange rates of 27 commercial banks were compared. Descriptive statistics were used to show possible arbitrage opportunities in years 2002 and 2003.

4.0 DATA ANALYSIS AND FINDINGS

The aim of this study was to determine whether it is possible to obtain arbitrage profits between commercial banks in the sample. All the 504 data points were analyzed to see if arbitrage existed in each of the fourteen currencies. The number of cases the condition for arbitrage was satisfied was given as, $S_j - B_i > 0$ or $S_i - B_j < 0$. If the difference between banks' selling and buying rates were greater than zero, only the highest difference (arbitrage) was on that day recorded.

On the other hand, if the difference between banks' selling and buying rates were less than zero or equal to zero, a zero (0) was recorded. This procedure was done for the fourteen currencies (Table 4.1.0).

After obtaining the possible arbitrage profits, they were grouped into two; those that had greater than zero arbitrage and those with zero arbitrage. The number of frequencies a zero and greater than zero occurred was tabulated as shown in the table 4.1.0 below:

TABLE 4.1.0 POSSIBLE ARBITRAGE PROFITS FREQUENCY TABLE

Observed Arbitrage	Fr. EU	Fr. USD	Fr. GBP	Fr. C\$	Fr. SF	Fr. IRP	Fr. JP	Fr. ZR	Fr. SK	Fr. TS	Fr. US	Fr. NK	Fr. DK	Fr. A\$	Sum
= 0	158	181	188	204	170	276	206	211	216	216	229	239	225	244	2963
> 0	346	323	316	300	334	228	298	293	288	288	275	265	279	260	4093
Sum	504	504	504	504	504	504	504	504	504	504	504	504	504	504	7056

Source: Research data

Using chi-square, these arbitrage opportunities frequencies were all subjected to the goodness of fit test. The results showed the chi - square - test statistic at 5% significance level with 13 degrees of freedom to be 22.36 ($X^2 = 22.36$, D.F = 13). Since the obtained chi square statistic of 102.26 exceeds the critical value of 22.36 at alpha 5% level, it leads to a rejection of the null hypothesis that the arbitrage opportunities are equal to zero. It would be concluded that there is very significant differences between zero arbitrage opportunities and greater than zero. This is consistent with some researches that have shown that arbitrage opportunities are available in the foreign exchange market (Kurgat 1998, Ayogu 1997, Osei 1996).

This shows that information of commercial banks pricing is not readily available hence those with such information will beat the market consistently in making arbitrage profits.

The analysis of variance (ANOVA) was used to compare the mean arbitrage opportunities available in the fourteen currencies. The observed variance ratio (F^*) was 50.46 and the theoretical value of $F_{0.05}$ at the 5% level of significance with 2 degrees of freedom in numerator and 13 degrees of freedom in denominator. Since $F^* > F_{0.05}$, the null hypothesis is rejected, that is we accept that there is a significant difference in the mean arbitrage of the fourteen currencies. We may therefore infer that arbitrage opportunities amongst commercial banks are actually different, that is, the alternative hypothesis (H_1) is true at 5% level of significance.

This is also consistent with the findings of Kurgat (1998) that Bureau pricing in Kenya is actually different and it was possible to obtain arbitrage.

For the Indian Rupee, Australian Dollar, Norwegian Kroner, Ugandan shilling, Danish Kroner, Tanzanian shilling, and South African Rand, it was harder to obtain arbitrage from the market as compared to Euro, United States Dollar, Great Britain pound, Canadian Dollar Swiss Franc and Japanese Yen. The currency with more occurrences of arbitrage was Euro followed by Swiss Franc, United States Dollar, Great Britain Pound Canadian Dollar, Japanese Yen, South African Rand, Swiss Franc, Tanzanian shilling, Danish Kroner, Ugandan Shilling, Norwegian Kroner, Australian Dollar and finally the Indian rupee.

The table 4.1.1 below shows the descriptive statistics on arbitrage opportunities from the fourteen currencies:

TABLE 4.1.1 SUMMARY OF DESCRIPTIVE STATISTICS ON ARBITRAGE OPPORTUNITIES

Mean	.732	.636	.707	.539	.537	.358	.521	.56	.579	.583	.538	.498	.524	.411
S.D.	.763	.676	.799	.688	.603	.515	.667	.72	.737	.894	.679	.635	.676	.595
Kurtosis	.125	-.15	.335	2.294	1.5	1.02	1.79	1.07	.791	3.419	.34	.167	1.125	3.343
Skewness	.969	.874	1.063	1.555	1.344	1.392	1.503	1.37	1.289	2.011	1.155	1.117	1.361	1.906
Range	2.97	2.89	3.46	3.46	2.89	2.38	3.10	2.97	2.95	4.27	2.89	2.81	2.81	2.70
Min.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Max.	2.97	2.89	3.46	3.49	2.89	2.38	3.10	2.97	2.95	4.27	2.89	2.81	2.81	2.70
Sum	368.7	320.6	356.3	271.7	270.3	180.6	261	284	291.8	293.6	271.1	251.2	263.9	207.0
Confidence level 95%	0.069	.059	.07	.06	.052	.045	.058	.06	.065	.079	.059	.056	.059	.052

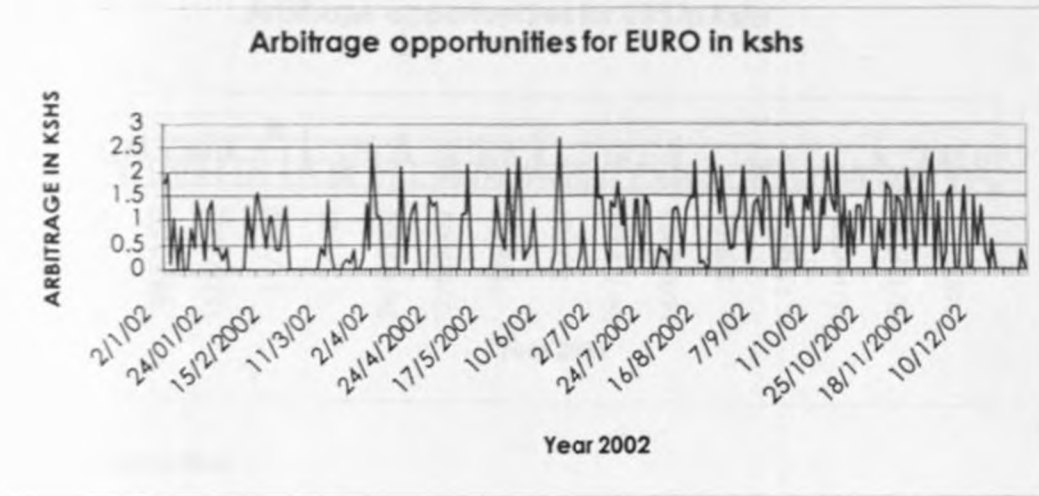
Source: Research data

From the descriptive statistics above, it was found that the currency with the highest arbitrage that can be obtained from the market is the Euro with arbitrage profits of Kshs 368.71 followed by Great Britain Pound with Kshs 356.30, US Dollar with Kshs 320.60, Tanzania shilling with 293.60, Swedish Kroner with Kshs 291.77, South African Rand with Kshs 284.00, Canadian Dollar with Kshs 271.10, Swiss Franc with Kshs 270.33, Danish Kroner with Kshs 263.97, Norwegian Kroner with Kshs 251.17, Australian Dollar with Kshs 207.02 and Indian Rupee with Kshs 180.60.

From the table above, the results show that at a 95 percent confidence level, the populations mean arbitrage lies between Kshs 0.73 and Kshs 0.069 for the Euro. For the United States Dollar, 95 times out of 100 mean arbitrage will be between Kshs 0.636 and Kshs 0.059, between Kshs 0.707 and Kshs 0.07 for the Great Britain Pound between Kshs 0.539 and Kshs 0.06 for the Canadian Dollar, between Kshs 0.537 and 0.0524 for Swiss Franc between Kshs 0.358 and Kshs 0.045 for Indian Rupee, between Kshs 0.52 and Kshs 0.058 for Japanese Yen, between Kshs 0.56 and Kshs 0.06 for South African Rand between Kshs 0.579 and Kshs 0.045 for Swedish Kroner between Kshs 0.583 and Kshs 0.079 for Tanzanian shilling, between Kshs 0.538 and 0.059 for Ugandan shilling between Kshs 0.498 and Kshs 0.056 for Norwegian Kroner, between Kshs 0.524 and Kshs 0.05.94 for Danish Kroner and finally between Kshs 0.411 and Kshs 0.0524 for Australian Dollar.

The results in both cases of analysis are as expected and indicate that information is not widely and cheaply available on the foreign exchange market, hence the existence of arbitrage opportunities in the market.

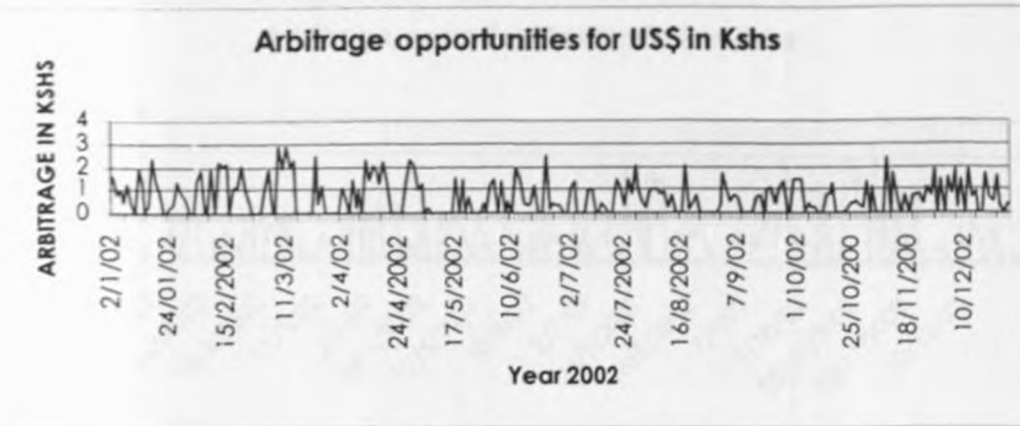
Graph 4.1.1



Source: Research data

The Euro in 2002 could fetch arbitrage profits as high as Kshs 2.97 in the month of June. In January, Kshs 2.00 profits could be obtained within a short period until mid February. Thereafter, it was not possible to get any profits through arbitraging until early March 2002. In mid March, arbitrage profits rose very sharply then decreased again to zero. The only months arbitrageurs could make gain of more than Kshs 2.00 were April, May, June, July, August, September, October and part of November. In the month of January, February, March and December arbitrage profits that could be obtained were very low. Looking at the nature of arbitrage opportunities, it is clearly seen that when there is fluctuations in exchange rates, speculators take advantage to make profits.

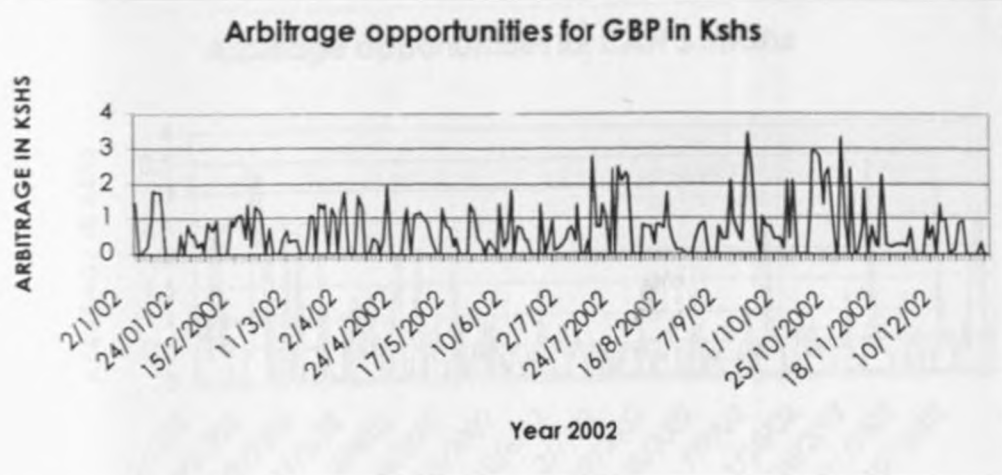
Graph 4.1.2



Source: Research data

The United States Dollar was a fairly volatile currency as can be seen above. The amount of arbitrage that could be obtained was as high as Kshs 2.89 but this was not occasionally experienced. In January at least Kshs 1.50 profits could be obtained within a short period until the end of February. Thereafter, in mid March, arbitrage profits rose rapidly and then declined to settle at zero arbitrage profits by the turn of month of March 2002 before assuming an upward trend in the month of April. From the beginning of May 2002, the arbitrage profit fluctuated wildly as seen from the above graph. It can be concluded from the United states dollar currency that less arbitrage profits could be obtained from arbitraging with this currency consistently because the opportunities of getting profits is inconsistent over time.

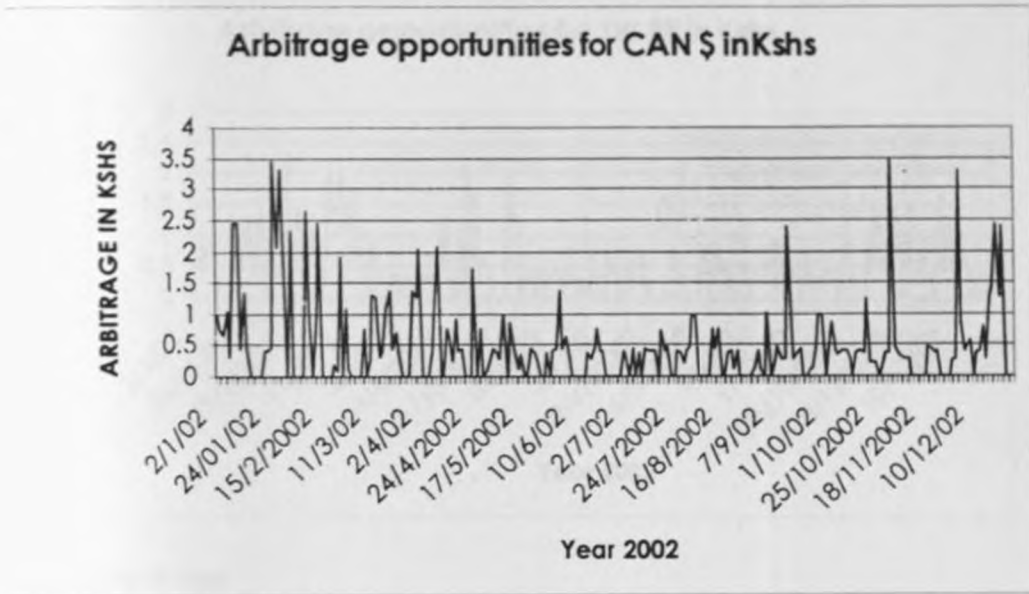
Graph 4.1.3



Source: Research data

The Great Britain Sterling Pound has more constant arbitrage opportunities compared to the Euro and the US dollar. From the above graph, it is clearly shown that daily arbitrage opportunity on average amounts to Kshs 1.00. An arbitrageur venturing in this currency can be sure of getting at least a profit on a daily basis unlike the Euro and United States dollar.

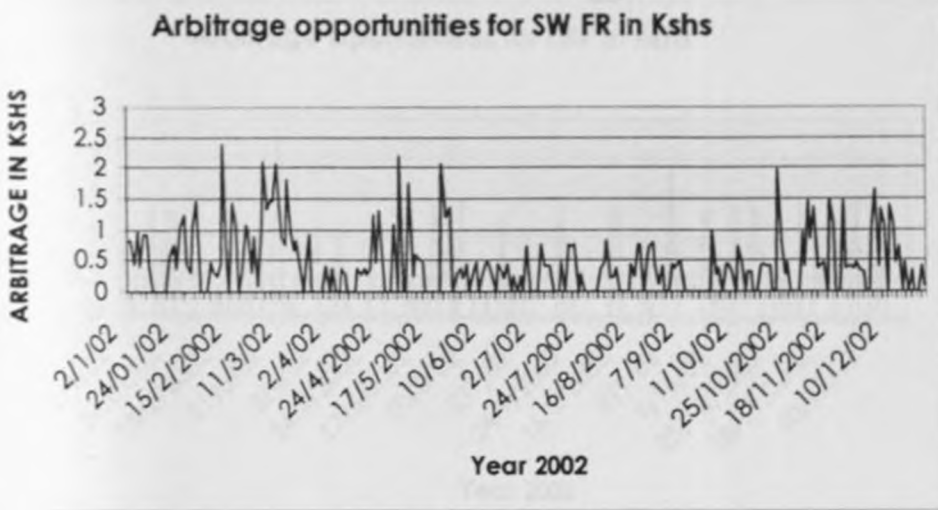
Graph 4.1.4



Source: Research data

Canadian dollar was one of the least profitable currencies among the fourteen currencies. From the above graph, it is shown that on average, the arbitrage opportunities were between Kshs 1.00 and Kshs 1.50. On daily arbitraging, there was at least a profit of between Kshs 0.50 and Kshs 3.49.

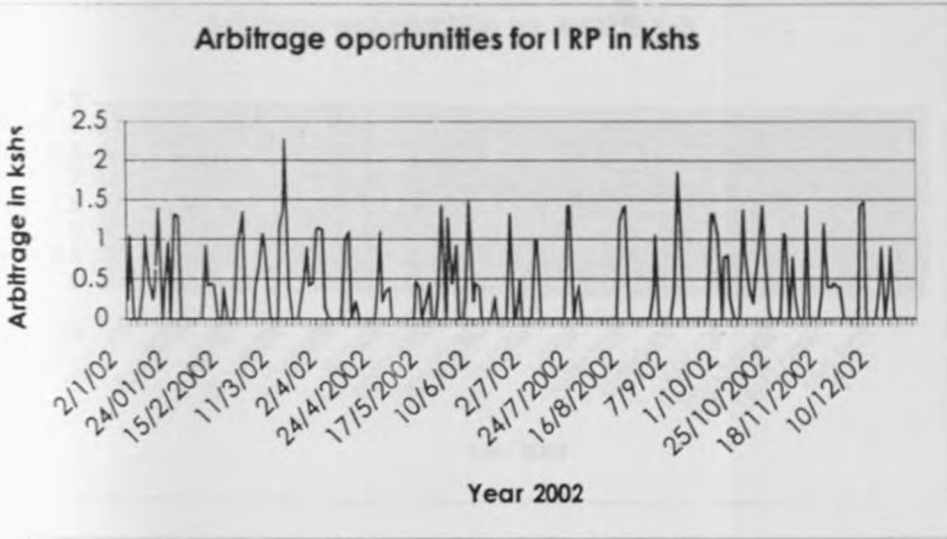
Graph 4.1.5



Source: Research data

Swiss Franc was one of the moderately profitable currencies among the fourteen currencies. From the above graph, it is shown that on average, the arbitrage opportunities were between Kshs 0.5 and Kshs 2.00 but this was occasionally experienced. The highest arbitrage profit that could be obtained from the market was Kshs 2.28 in the month of February.

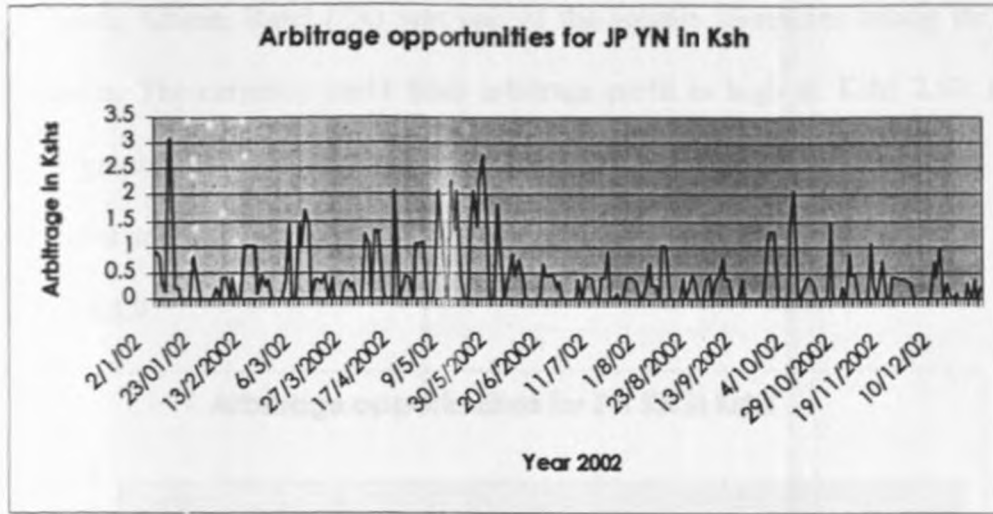
Graph 4.1.6



Source: Research data

Indian rupee was the least profitable currency. From the above graph it is shown that on average, the arbitrage profits was between Kshs 0.50 and Kshs 1.00. This means that an arbitrageur venturing in this currency can be sure of getting at least a profit on a daily basis. The highest arbitrage that could be obtained from the market was 2.34 in the month of April 2002.

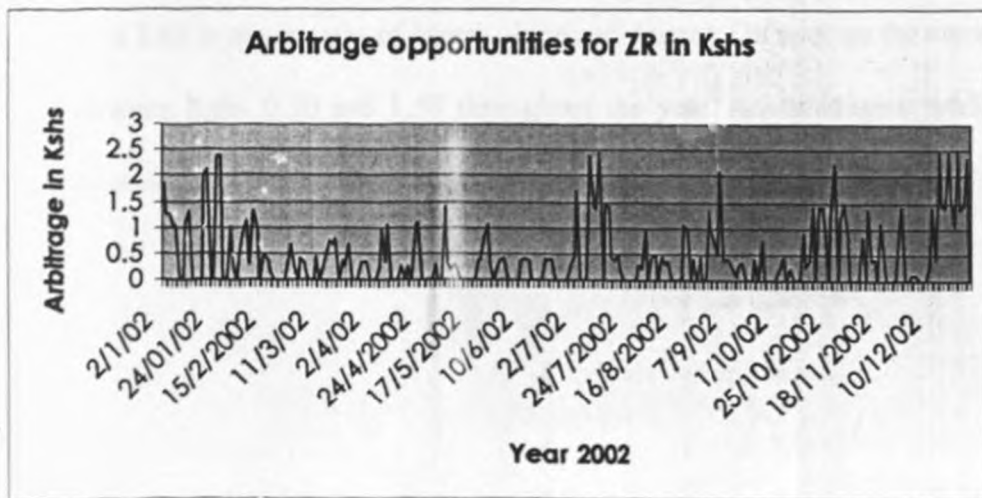
Graph 4.1.7



Source: Research data

Japanese Yen was a fairly volatile currency as shown above. It would fetch arbitrage profits as high as Kshs 3.10 in the month of January 2002. The currency fluctuated rapidly in the month of April and May. Thereafter it remained relatively stable and arbitrage profits were between Kshs 0.50 and Kshs 2.00.

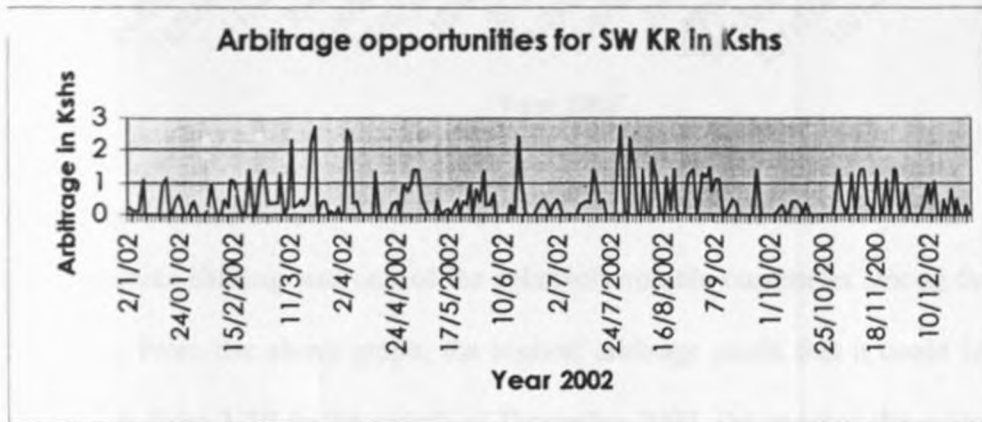
Graph 4.1.8



Source: Research data

The South African Rand (ZR) was one of the volatile currencies among the fourteen currencies. The currency could fetch arbitrage profit as high as Kshs 2.50. From the above graph, the currency was volatile in the months of January, July, October, November and December 2002.

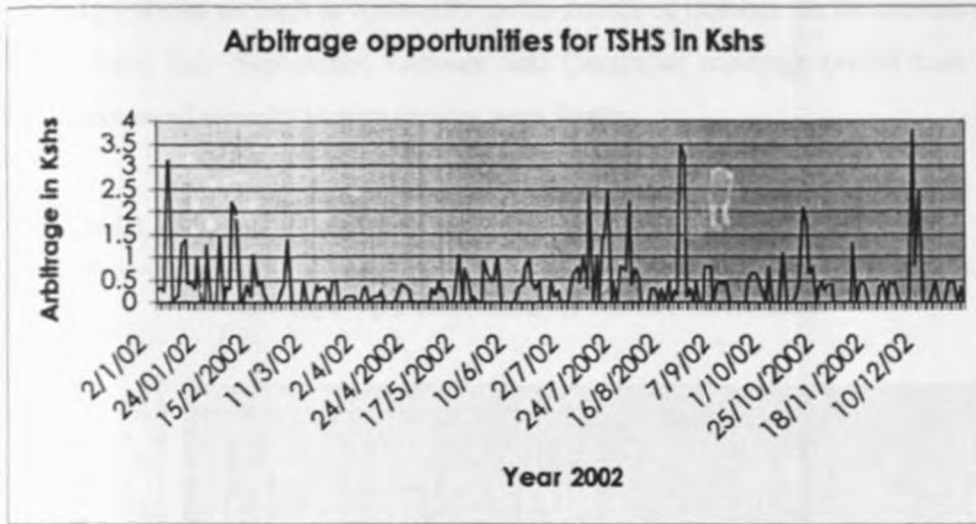
Graph 4.1.9



Source: Research data

The Swedish Kroner was a fairly volatile currency as shown above. The currency could fetch Kshs 2.60 in the months of March, June and August. On average the currency could fetch between Kshs 0.50 and 1.50 throughout the year. An arbitrageur trading in this currency could be sure of getting daily arbitrage profits.

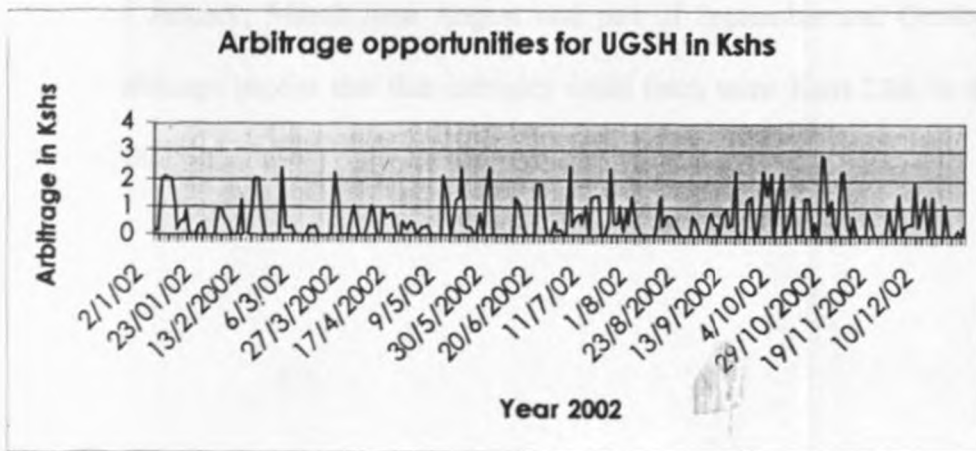
Graph 4.1.10



Source: Research data

The Tanzanian shilling was one of the relatively volatile currencies among the regional currencies. From the above graph, the highest arbitrage profit that it could fetch in the market was Kshs 3.70 in the month of December 2002. On average the arbitrage gains that could be obtained in the were between Kshs 0.50 and Kshs 1.00

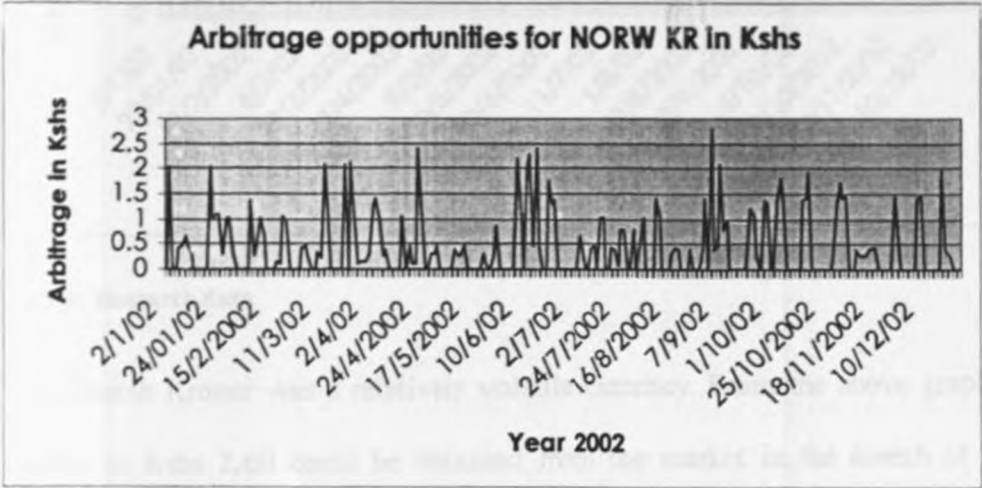
Graph 4.1.11



Source: Research data

The Ugandan shilling was one of the most volatile currencies. The currency could fetch arbitrage profits as high as Kshs 2.80 in the month of October. In the months of February, May, June, July September, October and December arbitrage profits rose sharply and then decreased sharply to zero or near zero levels.

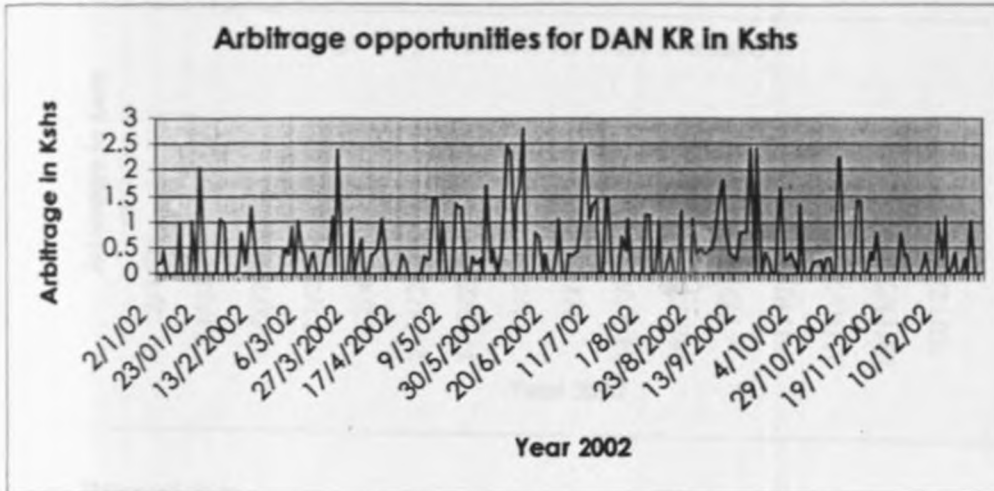
Graph 4.1.12



Source: Research data

The Norwegian Kroner was one of the least profitable currencies. From the above graph, the currency could only fetch arbitrage profits of between Kshs 0.50 and Kshs 1.50 in the month of January, March June August and part of September and October 2002. The highest arbitrage profits that this currency could fetch were Kshs 2.86 in the month of August 2002.

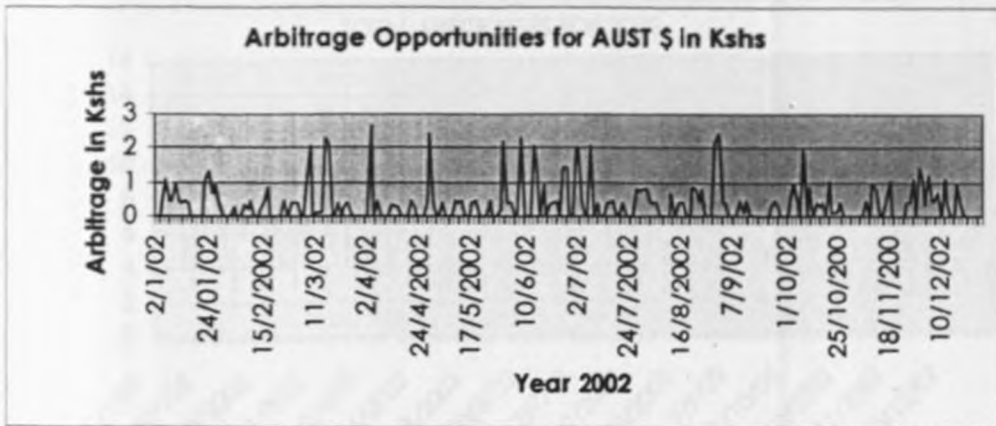
Graph 4.1.13



Source: Research data

The Danish Kroner was a relatively volatile currency. From the above graph, arbitrage profits of Kshs 2.60 could be obtained from the market in the month of May 2002. Thereafter in the months of July, August, September, October and November, arbitrage profits fluctuated rapidly for the rest of year and settled at zero level by the end of December 2002.

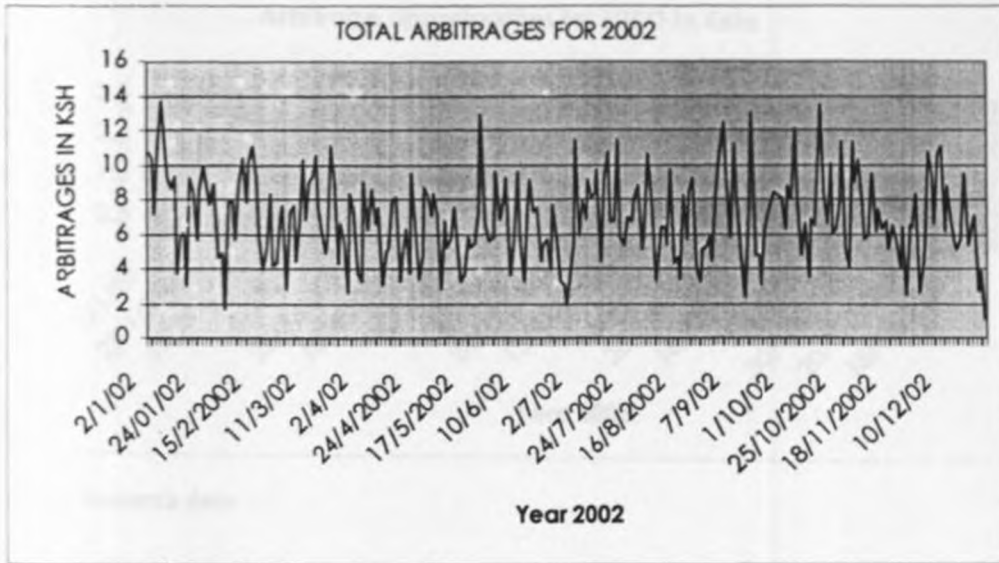
Graph 4.1.14



Source: Research data

The Australian dollar in 2002 could fetch arbitrage profits as high as Kshs 2.50 in the month of April. In the month of May, less than Kshs 1.00 arbitrage profits could be obtained within a short interval. Thereafter, from the month of June through December arbitrage gains fluctuated rapidly before settling at zero arbitrage profit in the mid December.

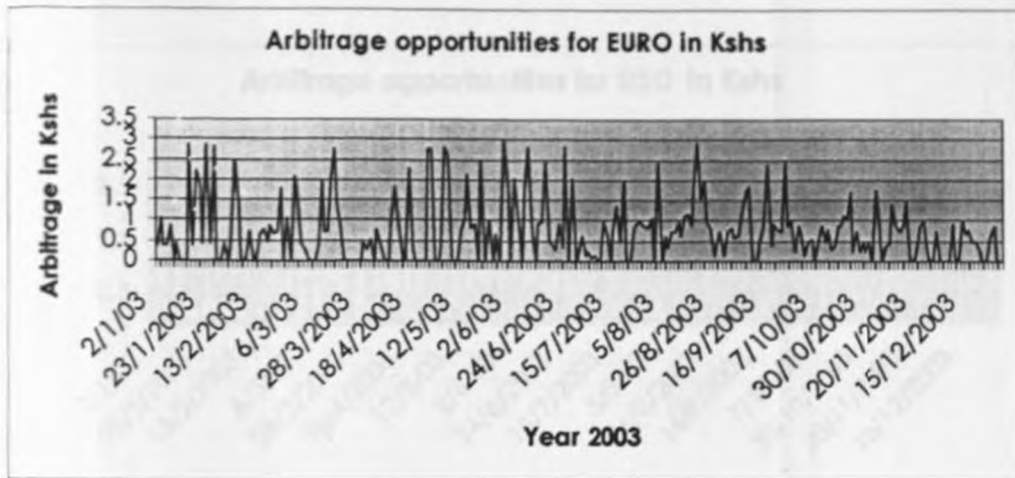
Graph 4.1.15



Source: Research data

The above graph shows the total arbitrage that was possible to obtain in the foreign exchange market in the year 2002. It is clearly depicted from the above graph that the highest arbitrage profits could be obtained between the months of January, February, June, August, October and November 2002. For all the currencies, the arbitrage was high between this months. This is a clear indication that the volatility of the exchange affects the possible arbitrage profits in the foreign exchange market. There were a lot of political activities (politicking) between August and December 2002, which led to the volatility of the exchange rate hence arbitrageurs made arbitrage profits.

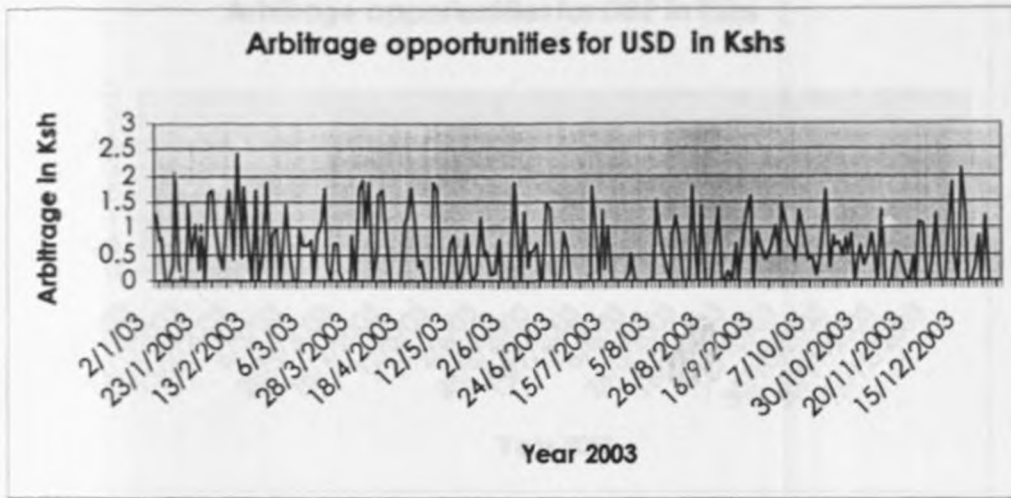
Graph 4.1.16



Source: Research data

The Euro in 2003 could fetch arbitrage profits as high as Kshs 3.00 in the month of June. In the months of January and February 2003, at least Kshs 1.50 arbitrage profits could be obtained within a short period as depicted by the graph above. Between the months of April and October 2003, arbitrage profits rose and declined sharply. Thereafter in the months of November and December, arbitrage profits moderately rose and decreased to zero by the end of December. Looking at the nature of arbitrage opportunities, it is clearly seen that when there are fluctuations in exchange rates arbitrageurs take advantage to make profits.

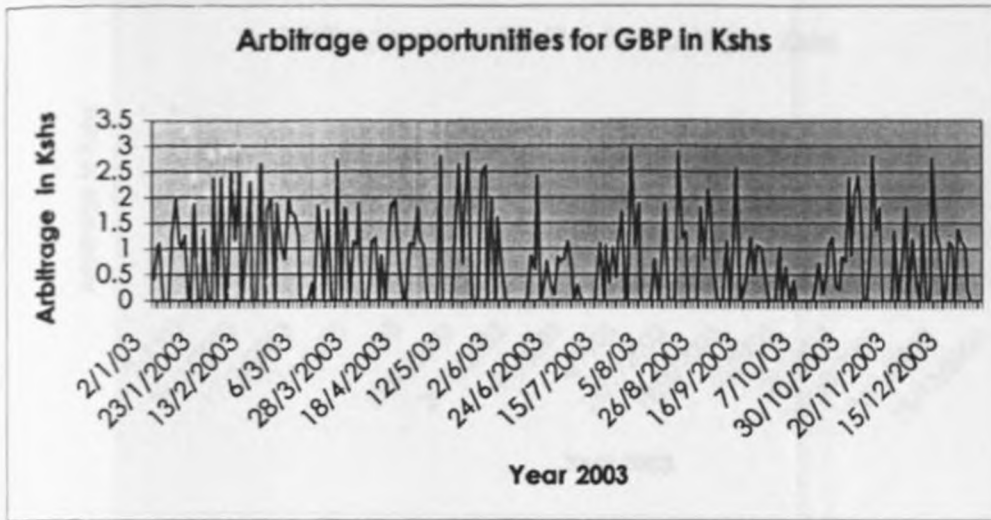
Graph 4.1.17



Source: Research data

In the year 2003, the United States Dollar was amongst the most volatile currencies as seen above. The amount of arbitrage profit that could be obtained was as high as Kshs 2.43 but this was not occasionally experienced. Between January and June 2003, the arbitrage profits that could be obtained in the market fluctuated wildly as depicted by the above line graph. It can be concluded from the United States Dollar currency that less arbitrage could be obtained from arbitraging with this currency consistently because the opportunities of getting profits is inconsistent over time.

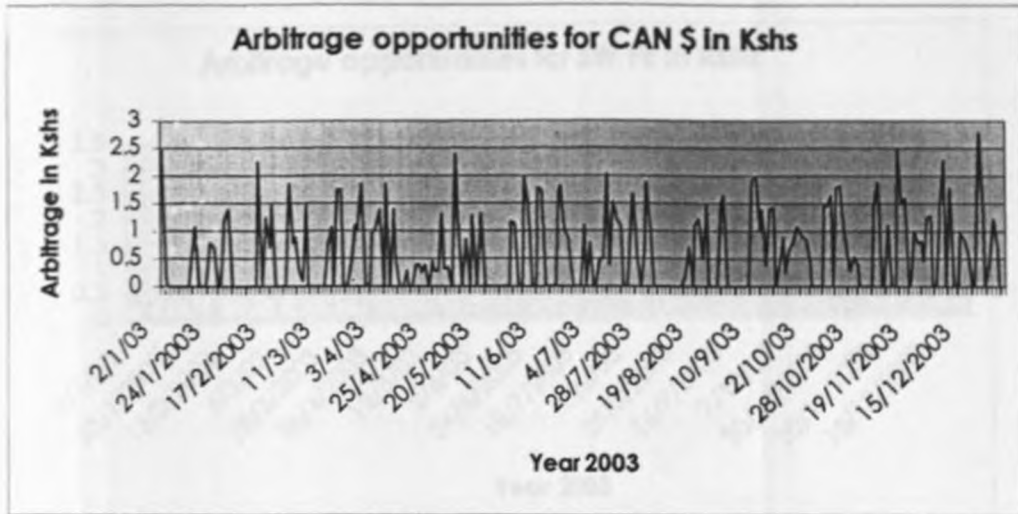
Graph 4.1.18



Source: Research data

The Great Britain Sterling Pound was the most volatile currency among the major currencies as shown above. The amount of arbitrage profits that could be obtained was as high as Kshs 2.96 in the month of August 2003. The currency arbitrage profits rose and then declined rapidly throughout the year hence less arbitrage profits could be obtained from arbitraging with this currency consistently because the opportunities of getting gains is inconsistent over time.

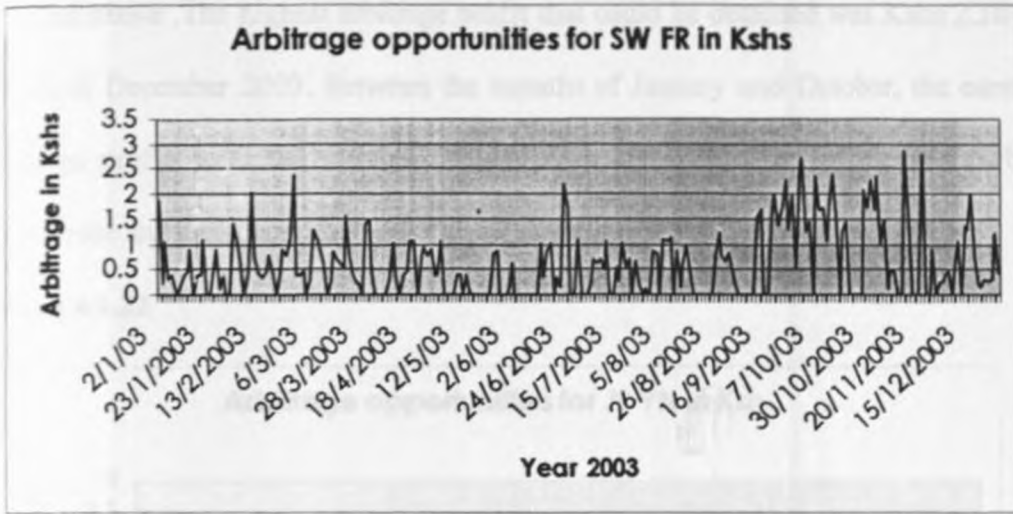
Graph 4.1.19



Source: Research data

The Canadian Dollar was moderately volatile as shown above. This currency had more constant arbitrages compared to the Euro, United States Dollar and Great Britain pound. From the above line graph, it is clearly shown that daily arbitrage profits on average amounts to Kshs 1.00. An arbitrageur venturing in this currency can be sure of obtaining at least a profit on a daily basis, unlike the Great Britain Pound and United States Dollar.

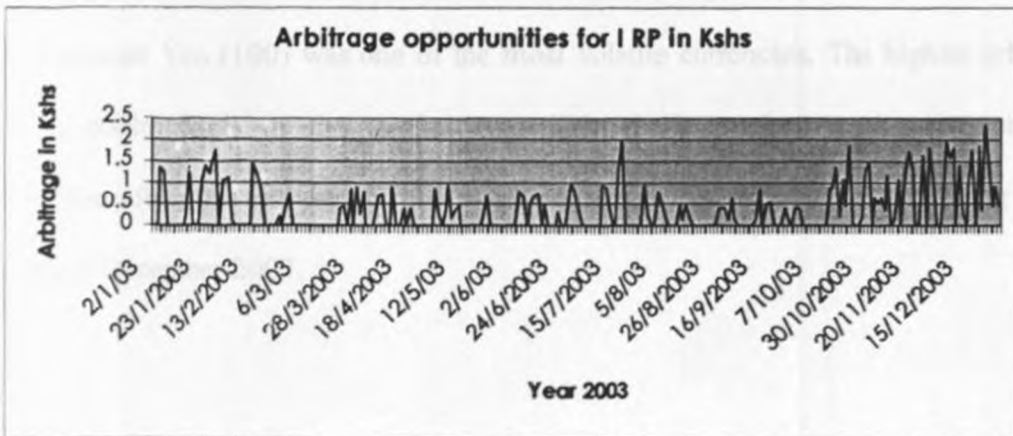
Graph 4.1.20



Source: Research data

Swiss franc was a fairly stable currency as depicted by the graph above. The highest arbitrage profits that could be obtained in the market were Kshs 2.47 in the month of November 2003. However in the last quarter of the year, arbitrage profits rose and declined sharply before closing the year at Kshs 0.50 level.

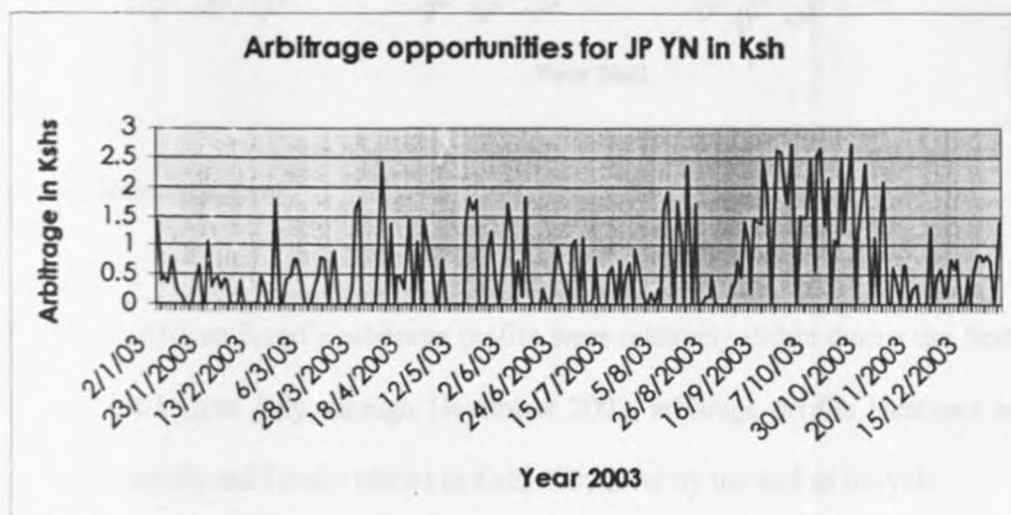
Graph 4.1.21



Source: Research data

The Indian Rupee was the least volatile currency in terms of arbitrage opportunities as depicted above. The highest arbitrage profit that could be obtained was Kshs 2.38 in the month of December 2003. Between the months of January and October, the currency's arbitrage profits were fairly stable. However, in the last quarter of the year, arbitrage profits rose and then decreased rapidly before settling at Kshs 0.50 level.

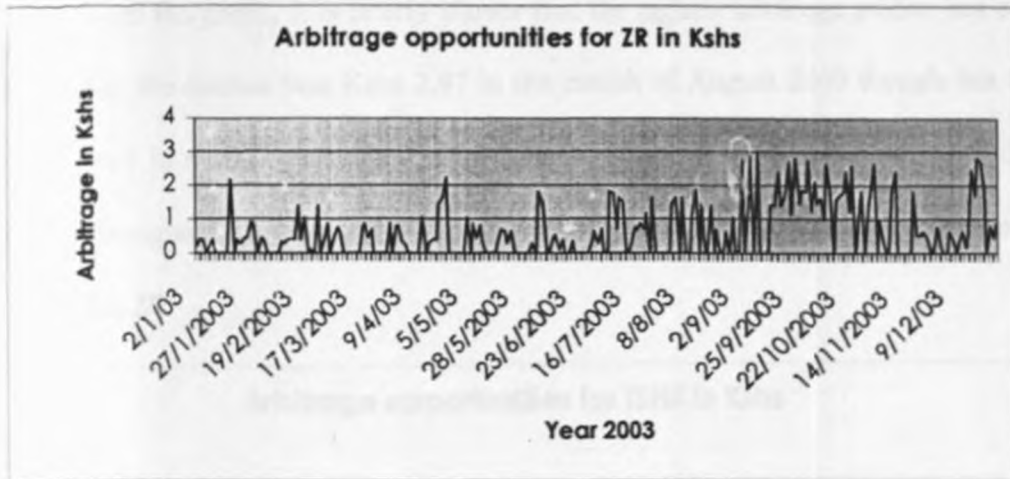
Graph 4.1.22



Source: Research data

The Japanese Yen (100) was one of the most volatile currencies. The highest arbitrage that it could fetch in the market was Kshs 2.62 in the month of September 2003. Thereafter; the arbitrage profits rose and declined rapidly before stabilizing in the month of December 2003.

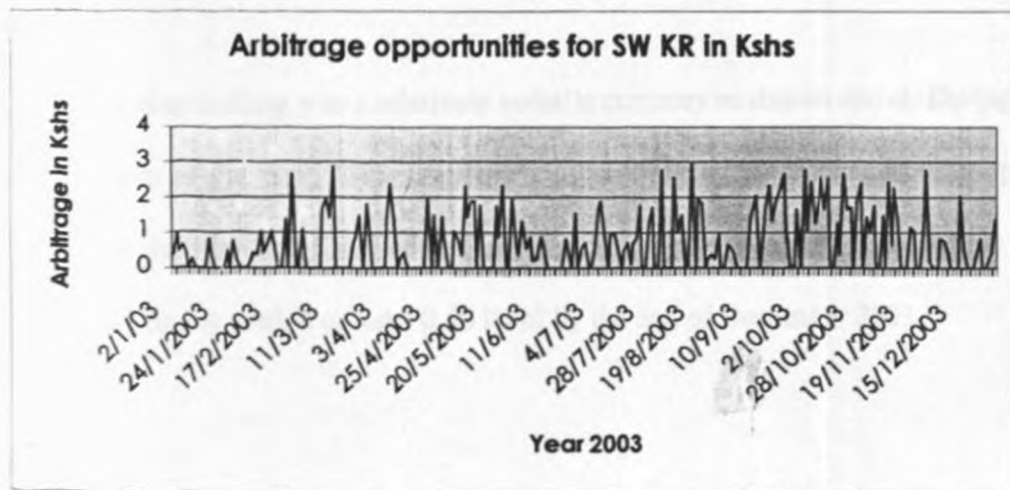
Graph 4.1.23



Source: Research data

The South African Rand's arbitrage profits were relatively stable during the first half of the year 2003. From July through December 2003, arbitrage profits increased and then decreased rapidly and finally settled at Kshs 1.00 level by the end of the year.

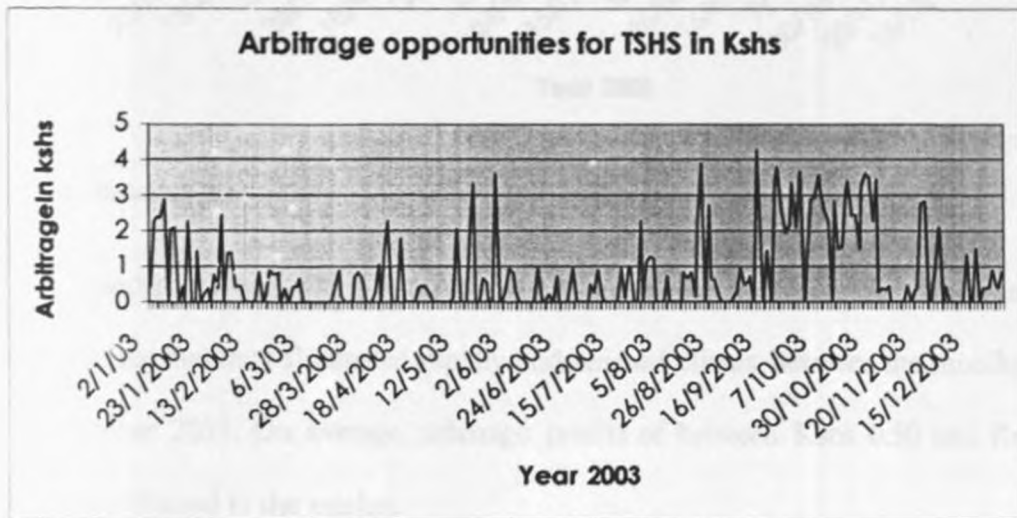
Graph 4.1.24



Source: Research data

Swedish Kroner was among the most volatile currencies as shown by the line graph above. From the graph, it is clearly shown that the highest arbitrage profits that could be obtained in the market was Kshs 2.97 in the month of August 2003 though this was not experienced in many occasions. Thereafter, the arbitrage profits rose and then declined rapidly throughout the year and finally settled at Kshs 1.00 level by the end of year.

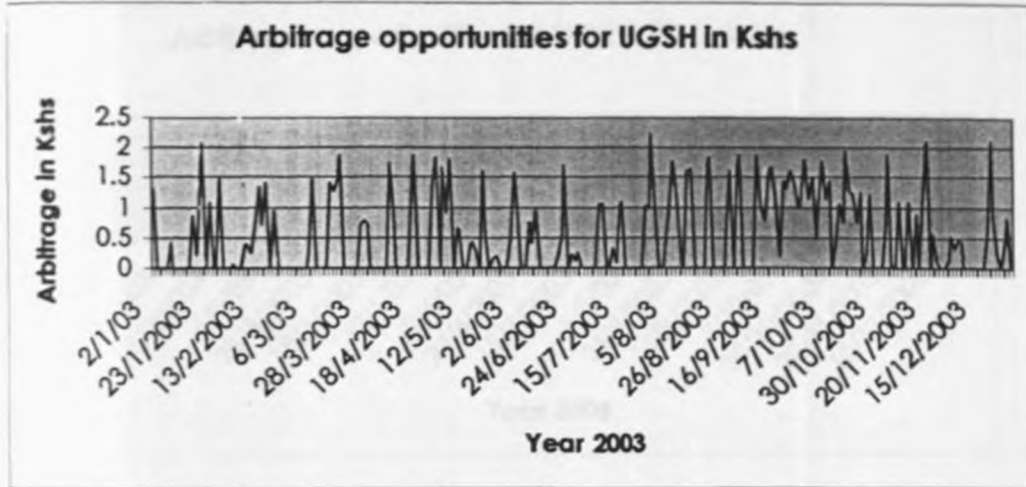
Graph 4.1.25



Source: Research data

The Tanzanian shilling was a relatively volatile currency as shown above. During the first two quarters of the year 2003, the currency could on average fetch arbitrage profits of between Kshs 1.00 and Kshs 1.50. Thereafter the arbitrage profits rose and then declined wildly and finally settled at Kshs 0.50 level by the end of December 2003.

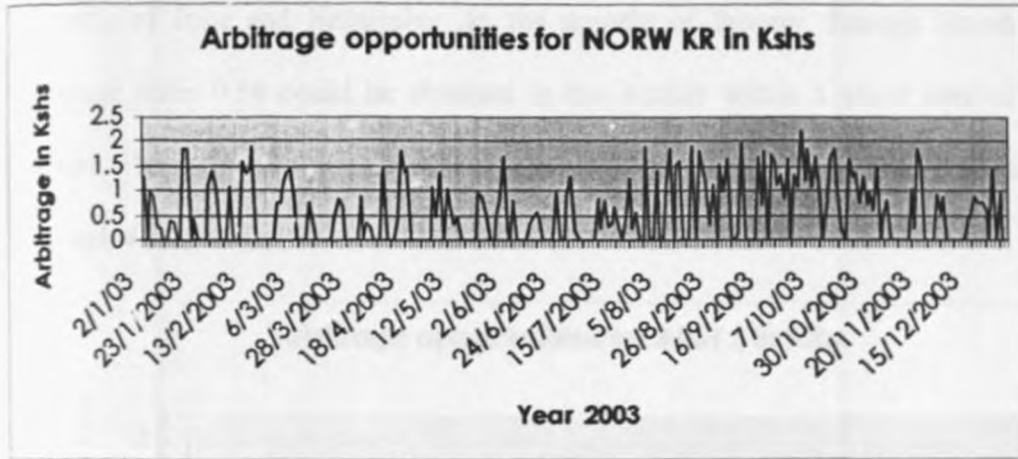
Graph 4.1.26



Source: Research data

The Ugandan shilling was a relatively volatile currency as depicted above. Throughout the year, the currency fluctuated rapidly and reached climax between the months of July and October 2003. On average, arbitrage profits of between Kshs 0.50 and Kshs 1.50 could be obtained in the market.

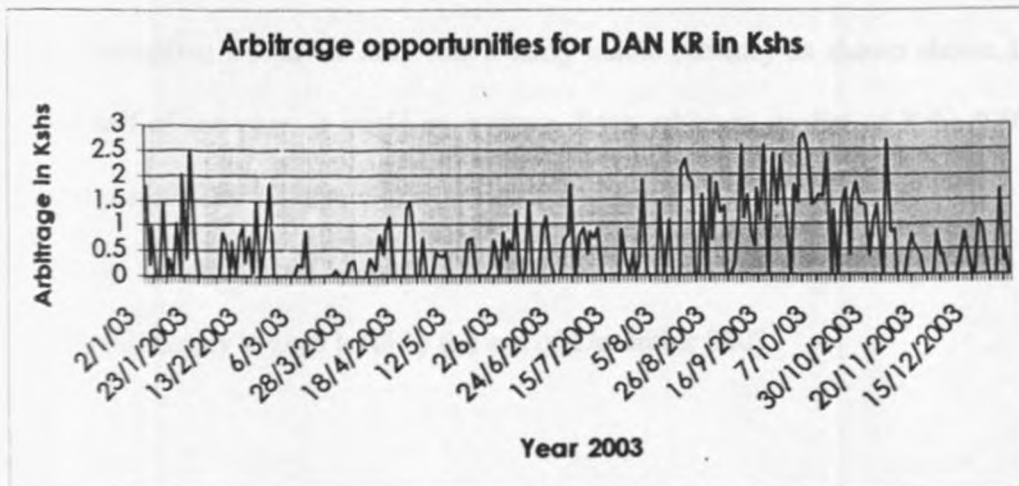
Graph 4.1.27



Source: Research data

The Norwegian Kroner was a stable currency during the first half of the year as shown above. Thereafter, the arbitrage profits rose and then declined rapidly through the months of July, August, and November 2003 before stabilizing in the month of December.

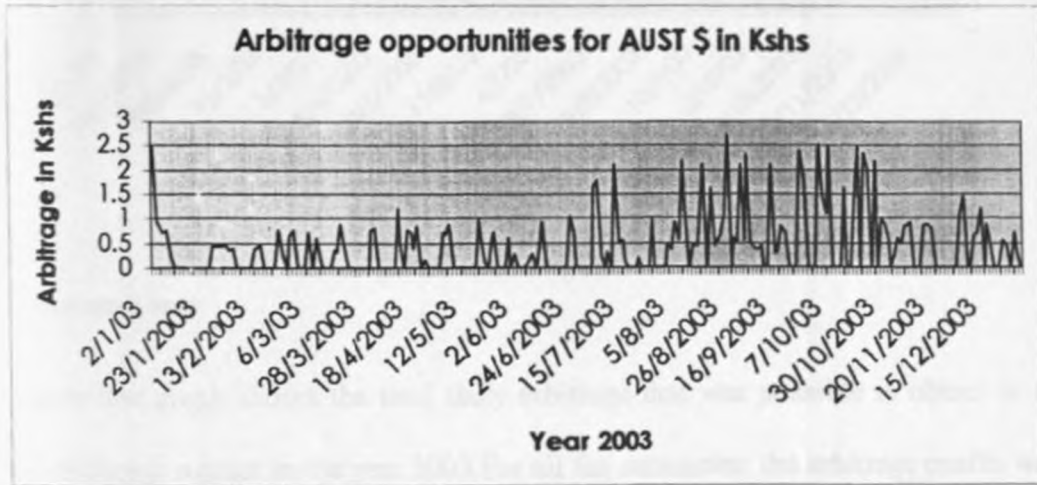
Graph 4.1.28



Source: Research data

The Danish Kroner in 2003 could fetch arbitrage profits as high as Kshs 2.81 in the months of June and September .In the months of January through March 2003, on average Kshs 0.50 could be obtained in the market within a short interval as shown above. Thereafter, arbitrage profits rose sharply, and then decreased sharply to zero.

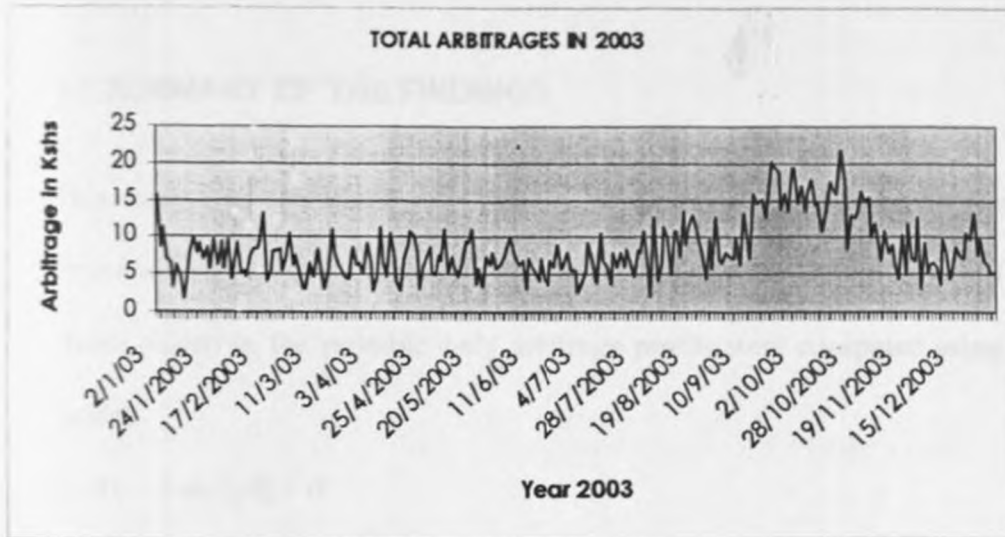
Graph 4.1.29



Source: Research data

The Australian Dollar in 2003 was a fairly stable currency as shown above. During the first half of the year, it could on average fetch arbitrage profits of Kshs 0.50 within a short period. The highest arbitrage profit that could be obtained in the market was Kshs 2.65 in the month of August. Thereafter, the arbitrage gains rose sharply and then declined sharply to zero level by the end of December 2003.

Graph 4.1.30



Source: Research data

The above line graph shows the total daily arbitrage that was possible to obtain in the foreign exchange market in the year 2003. For all the currencies; the arbitrage profits were high between these periods. This is a clear indication that the volatility of the exchange rates affects the possible arbitrage profits in the foreign exchange market. There was a lot of bickering in Kenya between constituent parties of the ruling National Rainbow Coalition (NARC) over the pre-election memorandum of understanding and the stalemate in the constitutional review process to mention just a few which led to the volatility of the exchange rates hence speculators made arbitrage profits.

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE FINDINGS

This study was conducted with the aim of determining whether there exists arbitrage opportunities between commercial banks in Kenya after liberalization. To achieve the above objective, the possible daily arbitrage profits were computed using the following model:

$$S_i - B_j > 0 \text{ or } S_j - B_i > 0$$

Where: B_i = the buying rate for bank I in time t

B_j = the buying rate for bank J in time t

S_i = the selling rate for bank I in time t

S_j = the selling rate for bank J in time t

After obtaining the possible arbitrage profits, they were grouped into two; those that had greater than zero arbitrage and those with zero arbitrage (table 4.1.0). Using chi-square, arbitrage opportunities were all subjected to the goodness of fit test. The results of chi-square test statistic at 5% significance level with 13 degrees of freedom were found to be 22.36. Since the obtained chi-square statistic of 102.26 exceeds the critical value of 22.36 at alpha 5 % level, it led to a rejection of the null hypothesis that arbitrage opportunities are equal to zero. It was thus concluded that there were very significant differences between zero arbitrage opportunities and greater than zero.

Based on descriptive statistics summary (table 4.1.1), the analysis of variance was conducted. The observed F ratio (F^*) was found to be 50.46 and the theoretical value of $F_{0.05}$ at the 5 % level of significance with 2 degrees of freedom in numerator and 13 degrees in denominator. Since $F^* > F_{0.05}$, the null hypothesis was rejected.

From the descriptive statistics, it was found that the currency with the highest arbitrage that could be obtained from the market was the Euro with arbitrage profit of Kshs 368.71, while the currency with the lowest arbitrage profit was Indian Rupee with Kshs 180.60.

The results of the analyses indicate that information is not widely and cheaply available on the foreign exchange market, hence the existence of arbitrage opportunities in the market.

5.2 CONCLUSION

The primary objective of this paper was to investigate whether there exists arbitrage opportunities among commercial banks in Kenya; and it found that they really exist. In general, the results indicate that foreign exchange market is inefficient as evidenced by the numerous arbitrage opportunities that exist. This means that information is not widely and cheaply available to the market participants and hence speculators can benefit from trading in currencies.

Traditionally, interest rates and price differentials have been thought to be among the key determinants of changes in the exchange rate. However, the role of current account balance has become increasingly recognized. Key events and expectations associated with key announcements, particularly donor funding, also influence exchange

movements. Establishment of foreign exchange divisions in commercial banks have improved foreign exchange sourcing in Kenya; and one of the important sources of foreign currency on the foreign exchange market is from the tourists. By putting in place the right policies for the promotion of tourism, the country will be improving currency availability in the market at the same time.

Before the advent of liberalization, a currency's value could only change through revaluation or devaluation. However, a liberalized market does not mean devaluation becomes a thing of the past, as authorities will tend to influence a currency trend through purchase or sale currency in the open market place. The foreign exchange market has helped small-scale users of foreign currency, since 85.6 percent of the number of transactions on the market is below US \$1,000 (Central bank of Kenya, 2004). Big time users have also benefited, although large volume purchases are difficult to execute because of constant unavailability of currency.

In terms of efficiency, the many cases of arbitrage opportunities existing on the foreign exchange market show that the market is inefficient. This situation is easily understood by looking at the communication facilities available in the country and the cost of the information dissemination. More importantly, because commercial banks foreign exchange market deals both in the electronic transfer and physical cash transactions, buying from low priced commercial bank is not easily achieved even if minimum distances separated banks because of the risks involved in transporting large amounts of cash.

This study confirms that Kenyan foreign exchange market is inefficient due to existence of numerous arbitrage opportunities.

5.3 LIMITATIONS OF THE STUDY

The efficient market hypothesis (EMH) is a fairly limited concept, particularly with the assumption that information is costless being untenable in developing countries, Kenya being one of them. This research has attempted to simplify the basic properties of an efficient market. However, future efforts should be directed towards the extension or modification of the EMH concept, which is currently being challenged. Such efforts could be in terms of redefining some generalized form indicators of market efficiency to be applicable both to advanced and emerging markets. Despite the opening up of the foreign market through the commercial banks and bureau system some black market activities are still going on. The survey showed that "black marketing" was still a worry to commercial banks' branches located in the city center where these black marketers are prevalent.

Even though there are problems associated with the commercial banks foreign exchange market, most Kenyans readily admit that they have been removed inconveniences and bureaucracy, which were common in the Exchange Control System.

The results obtained are only based on the data for the period between 2002 and 2003. Any interpretation deviating from the findings of this research as regards the availability of arbitrage opportunities in the commercial banks foreign exchange market may occur if the period is outside the study period (2002 and 2003).

5.4 POLICY RECOMMENDATIONS

From the results, clear pointers in terms of policy emerge. The current effort to lower interest rates is favorable and consistent with maintaining a relatively depreciated currency. This has to be done within a credible policy framework since expectations matter a lot. Measures aimed at improving the current account position, including policies that affect exports and imports of goods and services are also instrumental in stabilizing the exchange rates. Similarly, Kenya's dependence on external financing and expectation regarding donor funds has a bearing on exchange rates movements. Therefore, the government's credibility in the use of external funds and implementation of the related reforms is important.

Liberalization of the foreign exchange market was done hastily but was necessary. Ideally, liberalization should be gradual and progressive. But this is only possible in an environment where government policy is credible and has no risk of reversal. Thus policy makers are well advised not to be overly concerned about the allocation implications of apparent inefficiencies uncovered from the market studies. Therefore, if the characteristics of the new autonomous market are similar to the parallel market it seeks to absorb, then an activist intervention policy, based mainly on market stability imperatives, should be strongly resisted. A major setback of the foreign exchange market is low currency availability hence the Kenyan government can therefore improve on currency availability by encouraging tourism.

In closing, this research deems it necessary to cast a look at the future of the foreign exchange market. With liberalized environment, commercial banks face several challenges. First, decisions must be made quickly on either merger or collaborative prospects with parallel market operatives and foreign exchange bureau.

Second, the commercial banks must confront the challenge of competing on an even playing field with foreign exchange bureaux. Third, all participants face the tasks of contending with the unknown effects of occasional Central Bank of Kenya intervention in the currency market.

It seems inevitable that competitive pressure emanating from foreign exchange bureaux and black market operators will lead commercial banks to cut corners to stay competitive. Economic theory of regulation teaches us that just as financial institutions change in response to regulation, the regulatory authorities change their regulations in response to financial innovation. Both regulators and regulatees thus "continuously adapt to each other much like riders on a seesaw" (Burt, Kaen and Booth, 1977).

Economic analysis predicts, that a change in the economic environment will stimulate a search for innovations that are likely to be profitable. There is need to know that there exist a difference between the exchange rates of different commercial banks hence the best commercial bank to buy and sell the foreign exchange. Participants can exploit the inefficiencies in the market by arbitraging.

5.5 SUGGESTIONS FOR FURTHER RESEARCH

This research was to establish whether there exists any arbitrage opportunities in the foreign exchange market and the findings are that that really exists. A further investigation can be done to establish the factors, which can lead to fluctuation on the possible arbitrage profits over time. In addition, it would be interesting to examine the information concept of the spread in terms of forecasting macroeconomic variables such as investment, inflation and growth. What is the relationship between the banks exchange rate margin and growth of the economy?

Also, research can be done to determine the relationship between the exchange rates prevailing in the country and possible arbitrage profits. This research concentrated on arbitrage opportunities between commercial banks. Further research can be done to investigate whether arbitrage exist between various currencies (triangular arbitrage).

APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION

RE: REQUEST FOR RESEARCH DATA- HISTORICAL DAILY FOREIGN EXCHANGE RATES

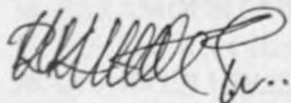
I am a postgraduate student in the Faculty of Commerce, University of Nairobi, pursuing a Master of Business Administration (MBA) degree in Finance. In order to fulfill the degree requirements, I am currently carrying out a research on “ An Empirical Study of Foreign Exchange Market Arbitrage Opportunities after Liberalization: The Case of Commercial Banks in Kenya.”

Your esteemed bank is therefore one of the banks selected and forms part of the sample I would like to use for data collection. Kindly assist me with historical buying and selling spot rates for the years 2002 and 2003 for all the currencies you trade in.

Please be assured that the information you will provide is strictly for academic purposes and the identity of your bank will be treated confidentially.

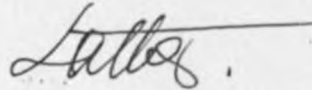
Thank you for your co-operation and assistance in advance.

Yours faithfully,



MULE ROBERT KISAVI

MBA STUDENT



OTIENO LUTHER ODHIAMBO

UNIVERSITY SUPERVISOR

APPENDIX 2: POPULATION OF THE STUDY

1. STANBIC BANK
2. BARCLAYS BANK OF KENYA
3. COOPERATIVE BANK OF KENYA
4. DIAMOND TRUST BANK
5. FIRST AMERICAN BANK
6. COMMERCIAL BANK OF AFRICA
7. NATIONAL INDUSTRIAL CREDIT
8. CFC BANK
9. STANDARD CHARTERED BANK
10. TRANSNATIONAL BANK
11. BANK OF INDIA
12. AFRICAN BANKING CORPORATION
13. CREDIT BANK
14. VICTORIA COMMERCIAL BANK
15. AKIBA BANK
16. DEVELOPMENT BANK
17. KENYA COMMERCIAL BANK
18. CONSOLIDATED BANK OF KENYA
19. DELPHIS BANK
20. BANK OF BARODA
21. CHASE BANK
22. INVESTMENTS AND MORTGAGES BANK
23. FINA BANK
24. CITIBANK N.A
25. GUARDIAN BANK
26. EQUATORIAL COMMERCIAL BANK
27. HABIB A.G ZURICH
28. CITY FINANCE BANK
29. FIDELITY COMMERCIAL BANK
30. PRIME BANK
31. IMPERIAL BANK
32. GIRO COMMERCIAL BANK
33. MIDDLE EAST BANK
34. PARAMOUNT UNIVERSAL BANK
35. SOUTHERN CREDIT BANK
36. CHARTER HOUSE BANK
37. INDUSTRIAL DEVELOPMENT BANK
38. HABIB BANK LTD
39. CREDIT AGRICOLE INDOSUEZ
40. K-REP BANK
41. DAIMA BANK
42. DUBAI BANK
43. NATIONAL BANK OF KENYA

Source: Central Bank of Kenya

APPENDIX 3:LIST OF CURRENCIES UNDER STUDY

1. EURO
2. UNITED STATES DOLLAR
3. GREAT BRITAIN STERLING POUND
4. CANADIAN DOLLAR
5. SWISS FRANC
6. INDIAN RUPEE
7. JAPANESE YEN
8. SOUTH AFRICAN RAND
9. SWEDISH KRONER
10. UGANDAN SHILLING
11. TANZANIAN SHILLING
12. NORWEGIAN KRONER
13. DANISH KRONER
14. AUSTRALIAN DOLLAR

Source: Central Bank of Kenya

APPENDIX 4: LIST OF COMMERCIAL BANKS UNDER STUDY

1. STANBIC BANK
2. BARCLAYS BANK OF KENYA
3. COOPERATIVE BANK OF KENYA
4. FIRST AMERICAN BANK
5. COMMERCIAL BANK OF AFRICA
6. NATIONAL INDUSTRIAL CREDIT BANK
7. CFC BANK
8. STANDARD CHARTERED BANK
9. TRANSNATIONAL BANK
10. BANK OF INDIA
11. AFRICAN BANKING CORPORATION
12. DEVELOPMENT BANK
13. KENYA COMMERCIAL BANK
14. CONSOLIDATED BANK OF KENYA
15. BANK OF BARODA
16. NATIONAL BANK OF KENYA
17. FINA BANK
18. INVESTMENTS & MORTGAGES BANK
19. CITIBANK N.A
20. GUARDIAN BANK
21. HABIB A.G ZURICH
22. PRIME BANK
23. CHASE BANK
24. GIRO COMMERCIAL BANK
25. INDUSTRIAL DEVELOPMENT BANK
26. HABIB BANK LTD
27. CREDIT AGRICOLE INDOSUEZ

Source: Central Bank of Kenya

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