

# **DETERMINING THE EFFICIENCY OF THE FOREIGN EXCHANGE MARKET IN KENYA**

By **MUHORU JUDITH, W**

**UNIVERSITY OF NAIROBI  
LOWER KABETE LIBRARY**

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DECLARATION

This research project is my original work and has not been presented for award in any other university or college.

Signed Judith Wanjiru Muhoro ..... Date 17<sup>TH</sup> OCTOBER 2005 .....

Judith Wanjiru Muhoro

Registration Number.....8538101.....

This project has been submitted for examination with my approval as university supervisor.

Signed W Nyamute ..... Date 17<sup>th</sup> October, 2005 .....

Mrs Nyamute,  
Lecturer,  
Accounting Department.

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**To my family.**

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## ABSTRACT

The repealing of the Exchange Control Act in 1995 was the first step towards a liberalized foreign exchange market. This also saw the entry of foreign exchange Bureaus in the market.

This study was carried out to determine the efficiency of the foreign exchange market in Kenya which is dominated by banks and bureaus. The main objective was to find out whether it was possible for an arbitrageur to make profits through locational and triangular arbitrage. Secondary data in the form of daily closing counter foreign exchange rates for six banks and fifty seven bureaus were obtained from the Central Bank of Kenya and analyzed using chi-square and line graphs.

To determine locational arbitrage the highest buying price of the particular currency was obtained and from it the lowest selling price was deducted. To determine triangular arbitrage, the cross rate between the Euro and the Dollar was computed. The computed cross rate was then compared with the actual exchange rate of the two currencies. If the computed cross rate is greater than the actual exchange rate, then there was an opportunity for triangular arbitrage.

Having identified the opportunity for triangular arbitrage, one thousand Kenya shilling was used to purchase the overvalued currency, which was then used to purchase the undervalued currency. Finally the undervalued currency was converted back to Kenya shilling. The difference between the final amount of Kenya shillings and the amount at the beginning of the transaction represented arbitrage profits.

The research concludes that the foreign exchange market is generally inefficient due to the existence of arbitrage opportunities for both bureaus and banks. Higher arbitrage profits could be obtained among bureaus than banks. This could be due to the fact that banks may be able to better disseminate information amongst themselves than bureaus may.

1.1 Background

The foreign exchange market is defined as a market where individuals, institutions, governments and other participants buy and sell foreign currencies. It is a market of exchange which allows for the exchange of one currency for another. The market is significant in that it allows for the exchange of currencies and is a key component of the global economy. The market is also a key component of the global financial system.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background

The foreign exchange (forex) market can be defined as a market where individuals, businesses, governments and other participants buy and sell foreign currencies. It is primarily a set-up without which no cross border transactions would take place. It is significant to note that foreign exchange earnings are a major contributor to the Gross Domestic Product (GDP) of most economies (Ramaphele, 2002).

Ramaphele (2002), further notes that in a universe with a single currency, there would be no forex market, no forex rates and no forex. However, in our world of many national currencies, the forex market plays the indispensable role of providing the essential machinery for making payments across borders, transferring funds and purchasing power from one currency to another and determining the forex rate.

Following the repeal of the Exchange Control Act in 1995 and the licensing of foreign exchange bureaus, there has been witnessed some vibrancy in Kenya's foreign exchange market (Kurgat, 1998). In the period prior to 1995, Kenya maintained restrictions on foreign exchange currency transactions.



Part 2 of the Exchange Control Act Cap 113(now repealed) clearly prohibited the handling of foreign currency transactions by individuals. The statute empowered the Minister of Finance to apply discretion in the licensing of foreign exchange dealers; this inhibited a free enterprise system in currencies resulting in trade inefficiencies. Owing to these trade restrictions in the foreign exchange market, a black market for foreign exchange quickly developed within Kenya. Indeed by the late 1970's virtually all major international currencies were readily available in vast quantities in the black market (Kiprotich, 1995).

Following liberalization in 1995, the government of Kenya decided to license individuals, companies and financial institutions to open foreign exchange bureaus where the general public could buy and sell foreign currencies. This therefore meant that major international currencies became available to individuals via a legal channel and the "eating up" into the volume of trade hitherto undertaken by the black market. The introduction of foreign exchange bureaus in the country improved the convertibility of the Kenya shilling in relation to other currencies. McKinnon (1979), by Kurgat (1998) defines a currency to be convertible if:

*“Domestic residents wishing to buy foreign goods and services, not specifically restricted, can freely sell domestic for foreign currency in a unified market at a single but possibly variable exchange rate covering all current transactions inclusive of normal trade credit, whereas non-residents with balances in domestic currency arising from current transaction can sell them at the same foreign exchange rate or purchase domestic goods freely at prevailing domestic-currency prices.”*

Kenya pursues a floating exchange rate regime, in which market forces of demand and supply interplay to determine the exchange value of currencies. Indeed as proposed by Friedman (1953), because speculators buy low and sell high, their activities ensure that exchange rates reflect the fundamental determinants of currency values.

In an efficient market, opportunities to make arbitrage profits slim out. An efficient market exists where currency prices quickly adjust to reflect all publicly available (past, present and future) information; transactions are cost-free; a large pool of willing buyers and sellers exist as well as a definite class and quantity of currencies to be traded is available. In developing countries, foreign exchange markets are weak form efficient.(Kurgat, 1998)

## **1.2 The Research Problem**

Studies regarding the efficiency in foreign exchange markets have been carried out extensively. Solnik (1983), sets out the minimum requirement for an efficient market: the fizzling out of all arbitrage opportunities. Consistent deviations from that rule, after accounting for market imperfections such as trading costs can be interpreted as evidence of market inefficiency in allowing such profit opportunities to go unexploited. Empirical studies (Levich et al,1993 and Frenkel, 1975) have clearly established the strong roles that arbitrage plays in international financial markets. They demonstrate that arbitrage opportunities are available.

A study carried out on the Kenyan foreign exchange market by Kurgat (1998), pointed out the inefficiency of the Kenyan foreign exchange market due to the existence of arbitrage opportunities. He showed that there was an opportunity to make instantaneous risk free profits through locational arbitrage. However, the study is not current as it was done over five years ago. In addition, he did not address the issue of triangular arbitrage.

This study endeavored to determine the efficiency of the Kenyan foreign exchange market as evidenced by the existence or non-existence of both locational and triangular arbitrage opportunities for both bureaus and banks.

## LITERATURE REVIEW

### 1.3 Objective of the Study

To determine the efficiency of the foreign exchange market using locational and triangular arbitrage models.

### 1.4 Importance of the Study

- It would benefit participants in the foreign exchange market by advising them on whether or not they can take advantage of the inefficiency in the foreign exchange market to make arbitrage profits.
- It would benefit other academicians who may want to pursue studies relating to the foreign exchange market.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 The Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) has been consented as one of the cornerstones of modern financial economics. The voluminous publications and research by financial scholars and experts centering on the subject attest to this assertion (Frank R, et al, 1998).

The classic definition of an efficient market is due to Fama (1970), and is a market where prices fully reflect the information available, such that an unusual profit cannot be earned through exploiting this information set (informational efficiency); puts available funds to their best possible uses (allocative efficiency) and undertakes transactions at the least unavoidable cost (operational efficiency).

The market is efficient if the reaction of market prices to the arrival of new information is instantaneous and unbiased. Efficient Market Hypothesis (EMH) is the idea that new information is quickly and efficiently incorporated into asset prices at any point in time, so that old information cannot be used to foretell future price movements. Fama (1970) identified three forms of efficiency being - weak form efficiency, semi-strong form efficiency and strong form efficiency, each of which have different implications of how markets work.

The weak form EMH stipulates that current asset prices already reflect past price and volume information. The information contained in the past sequence of prices of a security is fully reflected in the current market price of that security. It is named weak form because the security prices are the most publicly and easily accessible pieces of information. It essentially implies that:

- ◆ No excess returns can be earned by using investment strategies based on historical share prices or other financial data
- ◆ The use of technical analysis will not be able to produce excess returns. It is sufficient to use statistical investigations on time series data of prices for test purposes. Current share prices are the best, unbiased, estimate of the value of the security. The only factor that affects these prices is the introduction of previously unknown news. News is generally assumed to occur randomly, so share price changes must also therefore be random.

The semi strong form EMH states that all past and present information is similarly already incorporated into asset prices. The publicly available information includes not only past prices but also data reported in a company's financial statements, company's announcement of dividend payouts and key managerial changes and economic factors.

It essentially implies that :

- ◆ Share prices adjust instantaneously and in an unbiased fashion to publicly available new information, so that no excess returns can be earned by trading on that information.
- ◆ The use of fundamental analysis will not be able to produce excess returns. This indicates that a company's financial statements are of no help in forecasting future price movements and securing high investment returns.
- ◆ To test for semi-strong-form efficiency, the adjustments to previously unknown news must be of a reasonable size and must be instantaneous. To test for this, consistent upward or downward adjustments after the initial change must be looked for. If there are any such adjustments it would suggest that investors had interpreted the information in a biased fashion and hence in an inefficient way.

The strong form EMH stipulates that private information (or insider information) too, is quickly incorporated into market prices and therefore cannot be used to reap abnormal trading profits. Thus, all information, whether public or private, is fully reflected in a security's current market price. The rationale behind it is that the market anticipates in an unbiased manner, future development and therefore information has been incorporated and evaluated into the market price in a much more objective and informative way than insiders. It essentially implies that share prices reflect all information and no one can earn excess returns.

◆ Even the company's management is not able to make gains from core private information it holds. It is not able to take the advantages to profit from information such as a takeover decision made ten minutes ago.

◆ If there are fund managers who have consistently beaten the market, then it cannot be described as being strong-form efficient. Research by Cornell and Dietrich (1978) suggest that foreign exchange markets appear to be weak form and semi strong form efficient.

## **2.2 Arguments Concerning the Validity of the EMH**

This theory has been met with a lot of opposition, especially from the technical analysts, Goodman (1979). Their argument against the efficient market theory is that many investors base their expectations on past prices, past earnings, track records, and other indicators. Since currency prices (exchange rates) are largely based on buyer expectation, many believe it only makes sense to believe that past prices do influence future prices

Further to this evidence that the UK stock market is weak form efficient, other studies of capital markets have pointed toward them being semi strong-form efficient. Studies by Firth (1980) in the United Kingdom have compared the share prices existing after a takeover announcement with the bid offer. Firth found that the share prices were fully and instantaneously adjusted to their correct levels, thus concluding that the UK stock market was semi strong-form efficient. Within the financial markets there is knowledge of features of the markets that can be exploited e.g. seasonal tendencies and divergent returns to assets with various characteristics e.g. factor analysis and studies of returns to different types of investment strategies suggest that some types of stocks consistently outperform the market.

Grossman and Stiglitz (1980), identified a major theoretical problem with the hypothesis termed the paradox of efficient markets, which they developed in the context of equity markets. As applied to foreign exchange market, the argument starts by noting that exchange rate returns are determined by fundamentals like national price levels, interest rates, and public debt levels and that information about these variables is costly for traders to gather and analyse.

The traders must be able to make some excess returns by trading on this analysis, or they will not do it. But if markets were perfectly efficient, the traders would not be able to make excess returns on any available information. Therefore, markets cannot be perfectly efficient in the sense of exchange rates always being exactly where fundamentals can recover the costs of fundamental research by profiting from having marginally better information than the rest of the market on where the exchange rate should be. In this case, the exchange rate remains close enough to its fundamental value to prevent less informed people from profiting from the difference. Partly for these reasons, Campbell, Lo and Mackinlay (1997) suggest that the debate about perfect efficiency is pointless and that it is more sensible to evaluate the degree of inefficiency than to test for absolute efficiency.

The poor empirical performance of standard exchange rate models is another reason to suspect the failure of the efficient market hypothesis. Meese and Rogoff (1983), persuasively showed that no existing exchange rates models could forecast exchange rates changes better than a “no change” guess at forecast horizons of up to one year. This was true even when the exchange rate models were given true values of future fundamentals like output and money. Although Mark (1995), and others have demonstrated some forecasting ability for these models at forecasting horizons greater than three years no one has been able to convincingly overturn the Meese and Rogoff (1983) result.

### **2.3 Arbitrage**

Arbitrage is a fundamental mechanism for achieving efficiency in the financial markets (Ross 1976). An arbitrage opportunity occurs when a price discrepancy exists between two or more highly related assets. The opportunity can be exploited by buying the under priced asset and selling the over priced asset, producing a profit without incurring any risk. Since mispricing is rapidly corrected in highly competitive markets (Frenkel et al, 1975), arbitrage opportunities need rapid identification, fast transactions and low transaction costs.

Arbitrage, in this respect, refers to the simultaneous purchase of currencies in one bureau/bank and sale in another bureau/bank in order to take advantage of the price (currency) differentials. It exists in two forms:

#### **a ) Locational Arbitrage:**

This is an attempt to exploit discrepancies in exchange rates between forex bureaus/banks. It refers to the purchase of a currency in a lowly-priced market and the subsequent sale in a highly-priced market made possible by the ability to contain seepage of information, in the short-run, between the two markets. It is a classical case of geographical profiteering i.e. buy in the lowly priced NorthWest and sell in the highly-priced South-East (Aiba et al, 2003).



## **b) Triangular Arbitrage:**

This involves striking offsetting deals among three markets simultaneously to obtain an arbitrage profit. It is a financial activity that takes advantage of exchange rate differentials among three currencies, say Kshs, US dollars and Euros.

We may wish to establish the resultant net position from a scenario of this kind: exchange one US dollar to some amount of Kenya shilling, then exchange the amount of Kenya shilling to some amount of Euro, and finally exchange the amount of Euro back to US dollar. There are opportunities that we have more than one US dollar in the final conversion. The triangular arbitrage transaction is the trade that takes advantage of these types of opportunities.

Studies by Aiba et al (2003) have indicated that arbitrage opportunities do exist in foreign exchange markets and they provide an interaction amongst foreign exchange rates.

## **2.4 Foreign exchange market efficiency**

Numerous empirical studies, (Fama (1970), Clendenning (1970) and Aliber (1973)) have been carried out on the efficiency of international foreign exchange markets. Such studies came about with the establishment of floating exchange rates in most countries of the world. Levich (1979) 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 the equilibrium value is. According to Fama (1970), equity markets and foreign exchange markets differ as firms might be characterized by their consistency in terms of products, directors, 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.

Poole (1967) and Booth (1977) carried out empirical studies on the efficiency of the foreign exchange market. They tested the null hypothesis that under a freely floating exchange rate regime, changes in spot exchange rates should be serially correlated. They concluded that there are significant departures from random behaviour under floating exchange rates and therefore the spot market was not efficient. Poole (1967) further analysed the investment strategies that use filter rules as guides for picking speculative positions. A filter rule is a mathematical rule that can be applied mechanically to produce buy and sell signals. An x per cent filter rule indicates; "buy a currency whenever it rises x per cent above its most recent trough; sell the currency whenever it falls x percent below its most recent peak."

## **2.5 Liberalization of the Foreign Exchange Market in Africa**

In most of sub saharan africa, the introduction of floating exchange rates has lagged behind the floating of major currencies by almost two decades. During the 1970s, exchange rates were mostly held fixed, with infrequent adjustments and following severe terms of trade shocks in the mid-1970's, overvalued exchange rates were sustained by more stringent rationing of foreign exchange. Therefore, grey (or parallel) markets consequently flourished throughout sub saharan Africa.

The adverse macroeconomic consequences of large parallel markets are by now well documented (Kiguel et al, 1997), and by the mid-1980s, encouraged by the Bretton Woods institutions, many countries had adopted transitional systems toward unified, market-determined and convertible exchange rates. With varying degrees of success, interbank markets for foreign exchange now operate in several sub saharan africa countries.

The prospect of fully floating and convertible currencies introduces new policy dilemmas for sub saharan africa economies, already complicated by thin financial markets, rudimentary financial and regulatory institutions, the typical absence of forward markets, and low foreign exchange reserves. By contrast with a system where exchange rates change as infrequent step adjustments in a direction predictable from the balance of payments constraint and the size of reserves, and where the timing of these changes lies at the behest of policy-makers, there is potentially a large increase in exchange rate volatility under full floating regimes (Kiguel et al, 1997).

The role of the exchange rate is crucial in sub saharan africa's small import-dependent economies with highly concentrated export sectors. Policy concerns include the extent of allocation efficiency in thin markets with a volatile exchange rate, whether volatility deters investment or renders it inefficient, and whether the exchange rate can, or should be, smoothed through intervention mechanisms.

Researchers have attempted to determine whether or not foreign exchange markets are "efficient": that is, whether frequent changes in exchange rates are attributable to stabilizing speculation which reflects changes in the fundamentals or long-run determinants of currencies; or proponents of the efficient markets view hold that destabilizing speculation could not flourish because it would be unprofitable for investors (Friedman, 1953). The potential costs of instability have been documented by Krugman (1989), and include the possibility that investors will adopt a wait-and-see attitude in the face of uncertain future exchange rates (Dixit and Pindyk, 1994). If indeed foreign exchange markets were inefficient, and the source of efficiency understood, there could be a case for intervention.

## 2.6 Liberalization in Kenya

Liberalization of various economic sectors in Kenya began in 1990, when interest rates were liberalized. The shift from a flexible exchange rate regime has been gradual in Kenya as it has been for many other developing countries (Ndung'u, 1999). Prior to the early 1980's most developing countries pegged their exchange rates, either to a single key currency (such as the US dollar or the French franc or the British pound) or to a basket of currencies (such as IMF's special drawing rights). Afterwards these countries started moving explicitly towards more flexible exchange rate arrangements.

In Kenya, exchange rate regimes have evolved along the general macro economic policies adopted since independence. In the 1960's and 1970's, Kenya's economy was predominantly characterized by controls in many sectors. There were controls in domestic prices, foreign exchange transactions, interest rates and import licensing. These controls were appropriate as was evidenced by the economic growth at that time. The average GDP growth rate was 6.6% during 1964 to 1973. However a series of external shocks to the economy meant that this approach was inadequate. Most notable of this shocks include the oil crisis that hit the economy (one in 1973/1974 and the other in 1978/1979). Even though this crisis were shadowed by the commodity boom in 1975, the trade and current accounts deficit that had remained relatively low in the 1960's and 1970's reached unprecedented levels during 1978 to 1981(Kwame,2001).

By 1982, the government realized that its macro economic policies were inappropriate and as such began liberalization of the economy. The government's efforts regarding liberalization intensified in the 1990's. Prices in the goods market were decontrolled, interest rates liberalized and foreign exchange controls relaxed.

In 1992, Kenya introduced the foreign exchange bearer certificates (commonly known as forex C's), which marked the beginning of liberalization of the foreign exchange market. These forex C's were purchased at the official exchange rate from the central bank of Kenya in a "no questions asked basis". These certificates, which bore an interest rate were then marketable as any other paper (Ndung'u and Ngug'i, 1999). This meant that Kenya effectively had a dual exchange rate regime, the official exchange rate and a market rate. In January 1993, the forex C's were suspended by the government meaning that the only existing exchange rate was the official one. However exporters were allowed to retain specified proportions of their foreign exchange earnings, while importers were required to purchase their foreign exchange from commercial banks.

Ndung'u (1999) further notes that following the recall of forex C's, speculation in the market grew. As a result, the official exchange rate was devalued three times in the first half of 1993. This persuaded the government to eliminate foreign exchange regulation hence liberalizing the foreign exchange market.

## **CHAPTER THREE**

### **RESEARCH DESIGN**

#### **3.1 The Population**

The population of the study consisted of all foreign exchange bureaus and banks that were in operation in the year 2003. Fifty-seven bureaus were in operation during this period.

The year 2003 was selected being the most recent year with fully available data as well as capturing the latest market sentiments. Thus the results of the study are timely.

#### **3.2 Data Collection Method**

The study used secondary data obtained from the Central Bank of Kenya (CBK) for all the bureaus and banks under study. The data collected were the banks and foreign exchange bureaux closing counter rates of the Kenya Shilling against two major currencies (Euro, US Dollar)

### **3.3 Data Analysis**

#### **Triangular arbitrage**

Possible arbitrage profits arising from the trade interplay of the Kenya shilling, US dollar and Euro currencies was analyzed among bureaus and banks.

#### **Determination of triangular arbitrage**

The cross rate between the Euro and the Dollar was computed. The computed cross rate was then compared with the actual exchange rate of the two currencies. If the computed cross rate is greater than the actual exchange rate, then there was an opportunity for triangular arbitrage.

Having identified the opportunity for triangular arbitrage, one thousand Kenya shilling was used to purchase the overvalued currency, which was then used to purchase the undervalued currency. Finally the undervalued currency was converted back to Kenya shilling. The difference between the final amount of Kenya shillings and the amount at the beginning of the transaction represented arbitrage profits.

## **Locational arbitrage**

The possible arbitrage profits were analyzed between bureaus in the sample. The number of cases the condition for arbitrage is satisfied as;

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

Where:

$B_i$  = the buying rate for Bureau  $i$  in time  $t$

$B_j$  = the buying rate for Bureau  $j$  in time  $t$

$S_i$  = the selling rate for Bureau  $i$  in time  $t$

$S_j$  = the selling rate for Bureau  $j$  in time  $t$

Since arbitrageurs are risk neutral and are only concerned about the highest expected return of their investment, they will go for the highest available arbitrage. As such, the researcher took the highest available arbitrage each day in each currency for analysis and ignored the other available arbitrage opportunities.

The research concentrated on pure arbitrage profits and for purposes of this research associated costs, such as transport and telephone, were assumed to be zero.

## **Statement of hypothesis**

The null hypothesis ( $H_0$ ) of the study was that the market is efficient so arbitrage profits will be equal to zero.

The research hypothesis ( $H_\mu$ ) in contrast was that the market is inefficient therefore arbitrage is greater than zero.

That is:-

$H_0: \mu = 0$

$H_i: \mu > 0$



Chi-square was used as a test of goodness of fit between the observed proportions and the expected proportion of cases for each type of currencies. The goodness of fit test determines how closely a set of observed frequencies corresponds to a given set of expected frequencies. It tests how closely the sample resembles the population by matching the observed and the expected frequencies to ensure that the variation is not significant. When chi-square test statistic is small compared to chi-square tabulated critical value, then the fit is said to be good. The chi-square statistic is in the form:

$$X^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

$$= \frac{\text{The sum of } (\text{Observed frequency} - \text{Expected frequency})^2}{\text{Expected frequency}}$$

The application of chi-square rests on a fundamental assumption that no systematic bias exists in the selection of subjects. It is assumed that the sample is representative of the population from which it is drawn, an outcome of an observation does not affect the likelihood of the other outcomes and the categories of the independent variable must be exhaustive and exclusive.

## CHAPTER FOUR

### DATA ANALYSIS AND FINDINGS

#### 4.1 Locational arbitrage

The number of cases the condition for arbitrage was satisfied was given as;  $B_i - S_j > 0$  or  $B_j - S_i > 0$ . If the difference between Bureau and Bank buying rates and selling rates were greater than zero, only the highest arbitrage on that day was recorded. On the other hand, if the difference between bureau and bank buying rates and selling rates were less than zero or equal to zero, zero was recorded.

This procedure was done for all the three currencies as shown in appendix 1.

After obtaining the possible arbitrage profits, they were grouped into two: those that had greater than zero arbitrage and those with zero arbitrage.

Using chi square, these arbitrage opportunities frequencies were all subjected to the goodness of fit test.

## Banks Locational Arbitrage

The number of frequencies a zero and a greater than zero occurred for banks is given as below:

Arbitrage Observed	Frequency Arbitrage Dollar	Frequency Arbitrage GBP	Frequency Arbitrage EURO	Total
Zero (0)	122	140	144	406
Greater than Zero	93	75	71	239
Totals	215	215	215	645

The results showed the chi-square test statistic at 5% significance level with 2 degrees of freedom to be 5.4745 (Chi-Square=5.4745, D.F= 2). Since the obtained chi-square statistic of 5.4735 is less than the critical value of 5.991 alpha 5% level, it leads to acceptance of null hypothesis that the arbitrage opportunities are equal to Zero this seems to be inconsistent with other researches carried out in this area (kurgat, 1998) and with the rest of the literature. This shows that the market has information about the prices of currencies offered by banks more than bureaus. Indeed this could hold true since foreign exchange rates for major banks in the country are usually published in the daily newspapers.

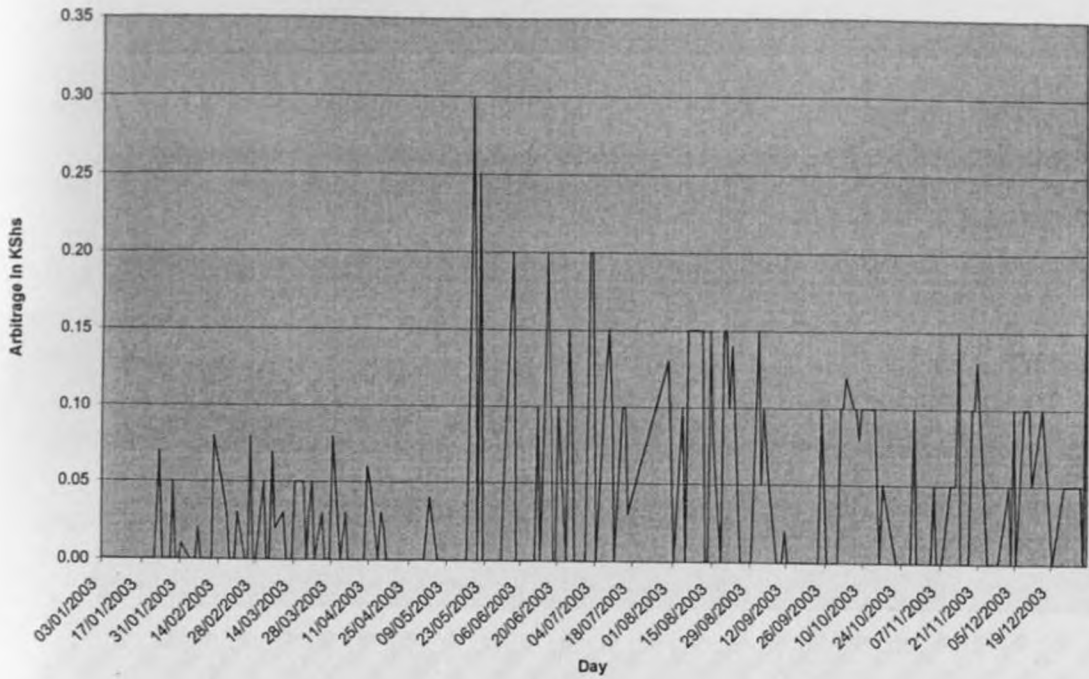
The table below shows the possible arbitrage for the Dollar, Pound and Euro.

**BANKS - LOCATIONAL ARBITRAGES**

<b>Descriptive Statistics</b>	<b>Dollar</b>	<b>Pound</b>	<b>Euro</b>
Mean	0.04	0.06	0.03
Standard Deviation	0.0567206	0.10678	0.069692
Sample Variance	0.0032172	0.011402	0.004857
Kurtosis	2.5247309	5.616101	8.450314
Skewness	1.5952261	2.301004	2.770063
Maximum	0.30	0.61	0.43
Minimum	0.00	0.00	0.00
Range	0.30	0.61	0.43
Sum	8.34	12.17	7.12
Count	215	215	215

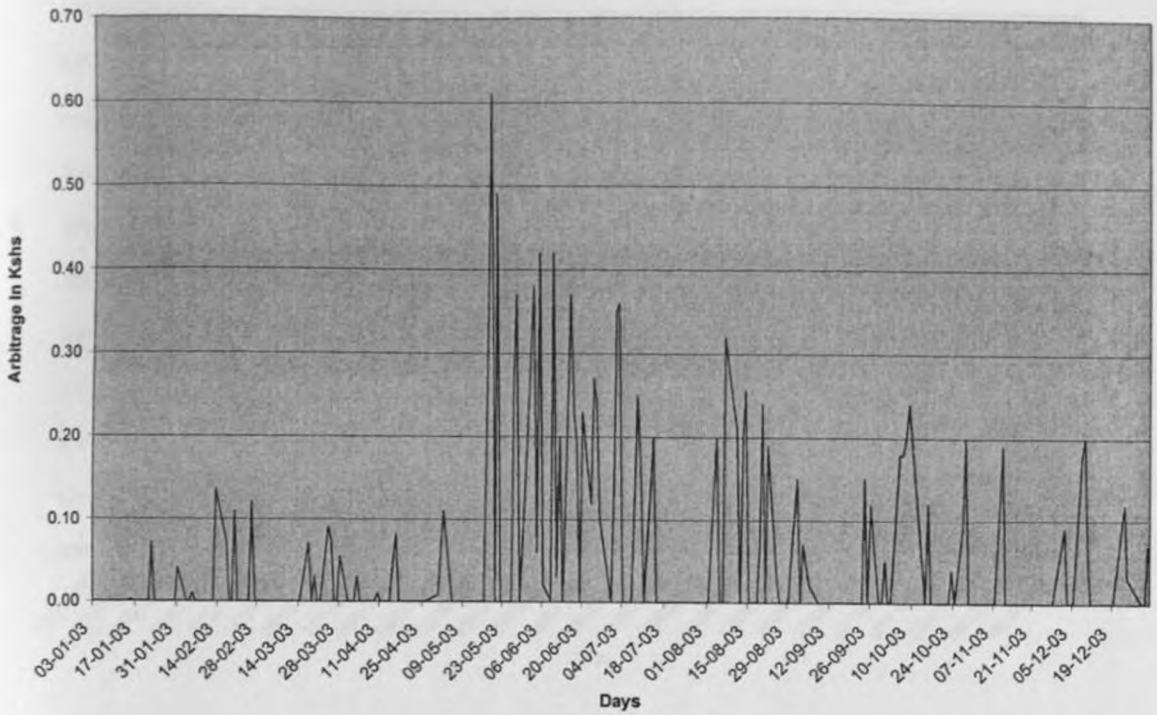
From the descriptive statistics above, the currency with the highest arbitrage profits is the pound (KShs 12.17), followed by the dollar (KShs 8.34) and finally the euro (KShs 7.12). This could mean that among the three currencies, the dollar was the most efficiently priced. The mean profits that could be obtained for the dollar, pound and euro was KShs .04, KShs .06 and KShs .03 respectively. From the above it can be inferred that the arbitrage profits are too small to encourage an arbitrageur to take advantage of the arbitrage opportunities.

### Arbitrage Dollar



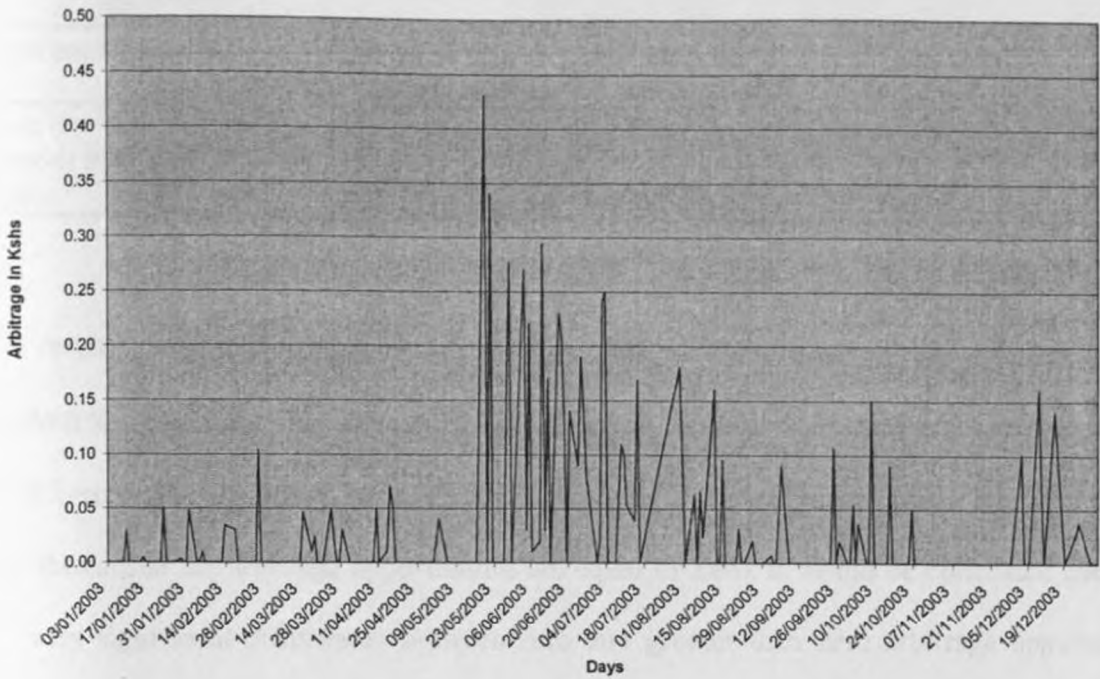
Locational arbitrage profits for the dollar were below Kshs. 0.10 for the first half of the year. This increased slightly during May and June with the highest arbitrage profits occurring in may of Kshs 0.20. The other months arbitrage profits were mainly between Kshs 0.05 and Kshs 0.15.

### Arbitrage GBP



The highest arbitrage profits seem to be obtained between May and June. Profits within this period ranged from Kshs 0.60 and Kshs 0.40. For the rest of the year profits were mainly below Kshs 0.30. These profits were too low and many arbitrageurs were unlikely to exploit the arbitrage opportunities.

### Arbitrage EURO



Slightly higher arbitrage profits could be obtained for the euro than the dollar. The highest profits of Kshs 0.425 occurred in the month of May. Arbitrage profits of less than Kshs .05 could be made in the first four months of the year. Such profits would be negligible such that an arbitrageur would be unlikely to exploit such opportunities.

## Bureau Locational Arbitrage

Arbitrage Observed	Frequency Arbitrage Dollar	Frequency Arbitrage GBP	Frequency Arbitrage Euro	Total
Zero (0)	11	1	6	18
Greater than Zero	169	179	174	522
Totals	180	180	180	540

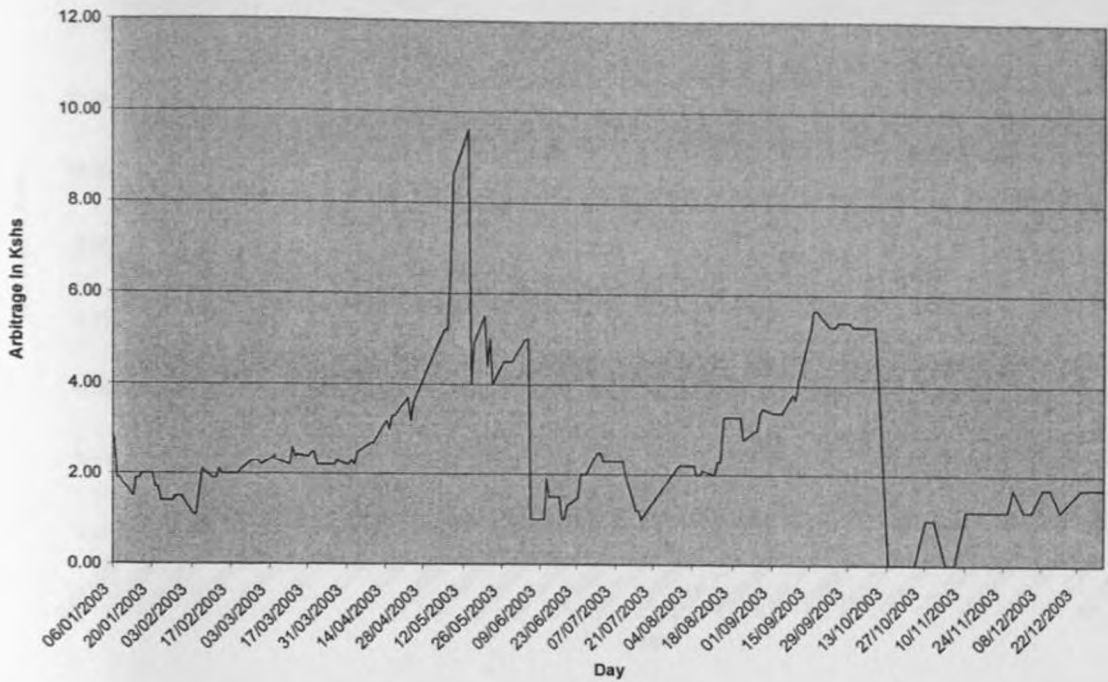
The results showed the chi-square test statistic at 5% significance level with 2 degrees of freedom to be 8.6207 (Chi -Square =8.6207, D.F= 2). Since the obtained chi-square statistic of 8.6207 exceeds the critical value of 5.991 at alpha 5% level, it leads to a rejection of null hypothesis that the arbitrage opportunities are equal to Zero. It would be concluded that there are very significant differences between zero and greater than zero arbitrage opportunities. This is consistent with some researches that have shown that arbitrage opportunities are available in the forex market. This shows that information of bureau pricing is not readily available hence those with such information will beat the market consistently in making arbitrage profits.



<b>Descriptive Statistics</b>	<b>Dollar</b>	<b>Pound</b>	<b>Euro</b>
Mean	2.5	7.7	4.04
Standard Deviation	1.5961535	4.17028	2.270997
Sample Variance	2.547706	17.39123	5.157425
Kurtosis	2.3972837	-1.40182	1.574224
Skewness	1.2385713	-0.04725	1.054193
Maximum	9.6	14	11.5
Minimum	0	0	0
Range	9.6	14	11.5
Sum	450.75	1385.1	727.6
Count	180	180	180

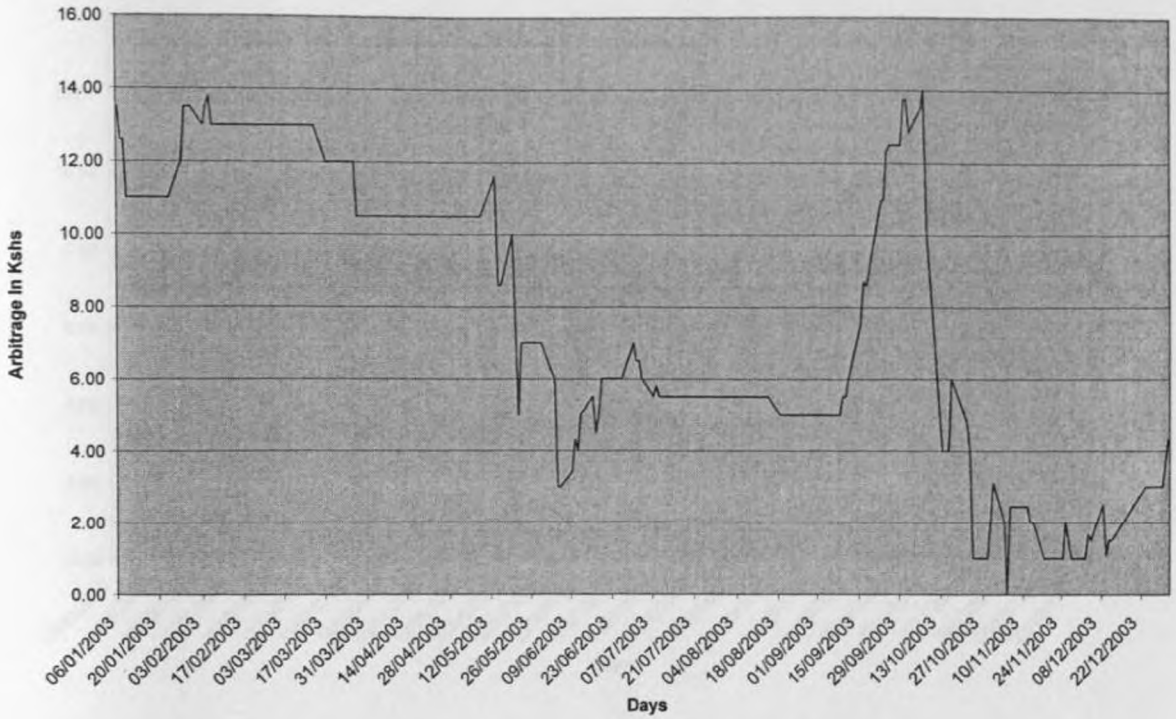
From the descriptive statistics above, the currency with the highest arbitrage profits is the pound, followed by the euro and finally the dollar. This could mean that among the three currencies the dollar was the most efficiently priced. The mean profits that could be obtained for the dollar, pound and euro were Kshs 2.5, Kshs 7.7 and Kshs 4.04 respectively.

Arbitrage Dollar



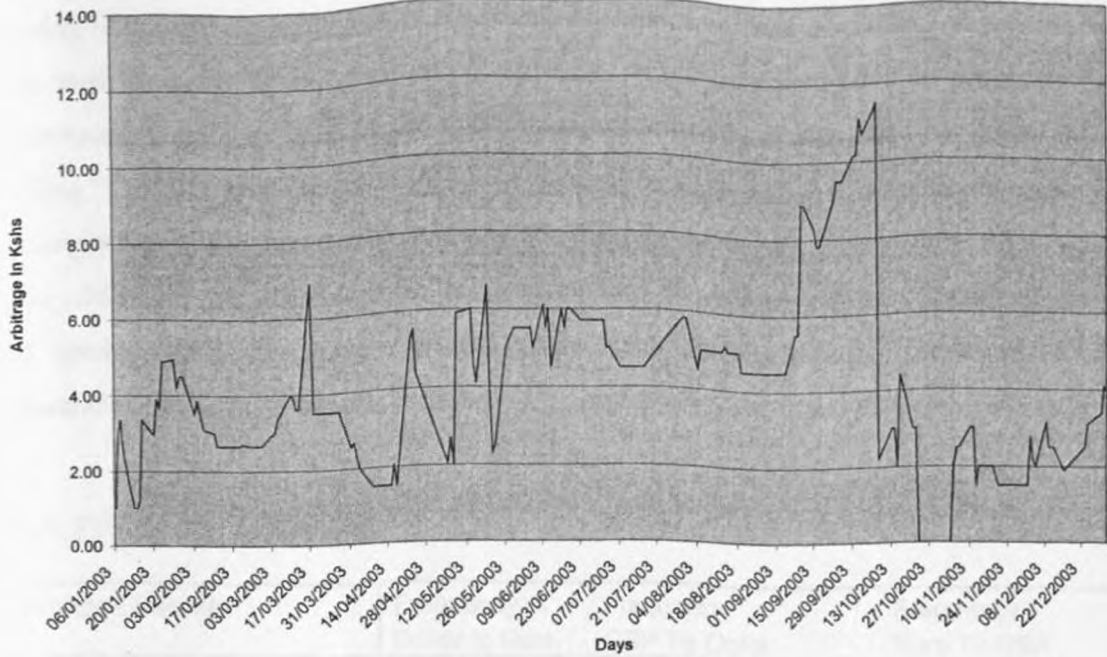
The profits to be made through locational arbitrage for bureaus appear to be significantly less than those that can be made in triangular arbitrage. During the year, the arbitrage profits were less than Kshs 4.00. The only months arbitrageurs could make more than Kshs 4.00 were in the months of May, June and September.

### Arbitrage Pound



The locational arbitrage opportunities for the sterling pound appear to be the least erratic of all arbitrage opportunities in the year 2003. For the first six months of the year arbitrage profits were ranging between Kshs 10.00 and Kshs 14.00. From mid June to mid September there was a lull in profits only for them to peak in October, November and December represented the least profits of below Kshs 4.50.

### Arbitrage EURO



Arbitrage opportunities existed throughout the year for the euro, except for a brief period in November when no profits could be made. Arbitrage profits ranged between Kshs 1.00 to Kshs 11.50. The only months an arbitrageur could make profits over Kshs 8.00 were in September and October.

## 4.2 Triangular Arbitrage

Having identified the opportunity for triangular arbitrage, one thousand Kenya shilling was used to purchase the overvalued currency, which was then used to purchase the undervalued currency. Finally the undervalued currency was converted back to Kenya shilling. The difference between the final amount of Kenya shillings and the amount at the beginning of the transaction represented arbitrage profits.

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 of zero and greater than zero arbitrage profits are in the following table:-

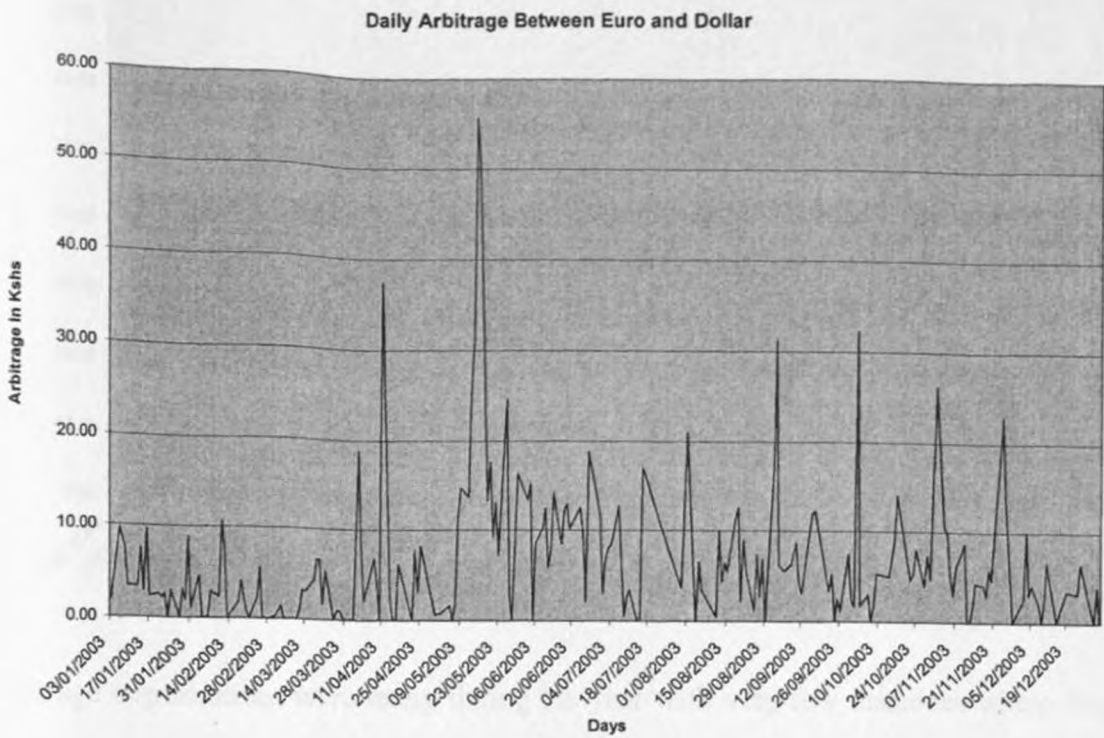
### Bank Triangular Arbitrage

Arbitrage Observed	Frequency Dollar to Euro	Frequency GBP To Dollar	Frequency Euro To GBP	Total
Zero (0)	35	8	19	62
Greater than Zero	180	207	196	583
Totals	215	215	215	645

The results showed the chi-square test statistic at 5% significance level with 2 degrees of freedom to be 19.4735 (Chi -Square =19.4735, D.F= 2). Since the obtained chi-square statistic of 19.47 exceeds the critical value of 5.991 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 are very significant differences between zero and greater than zero arbitrage opportunities. Previous research carried out in this area show that foreign exchange markets are not efficient (Kurgat, 1998)

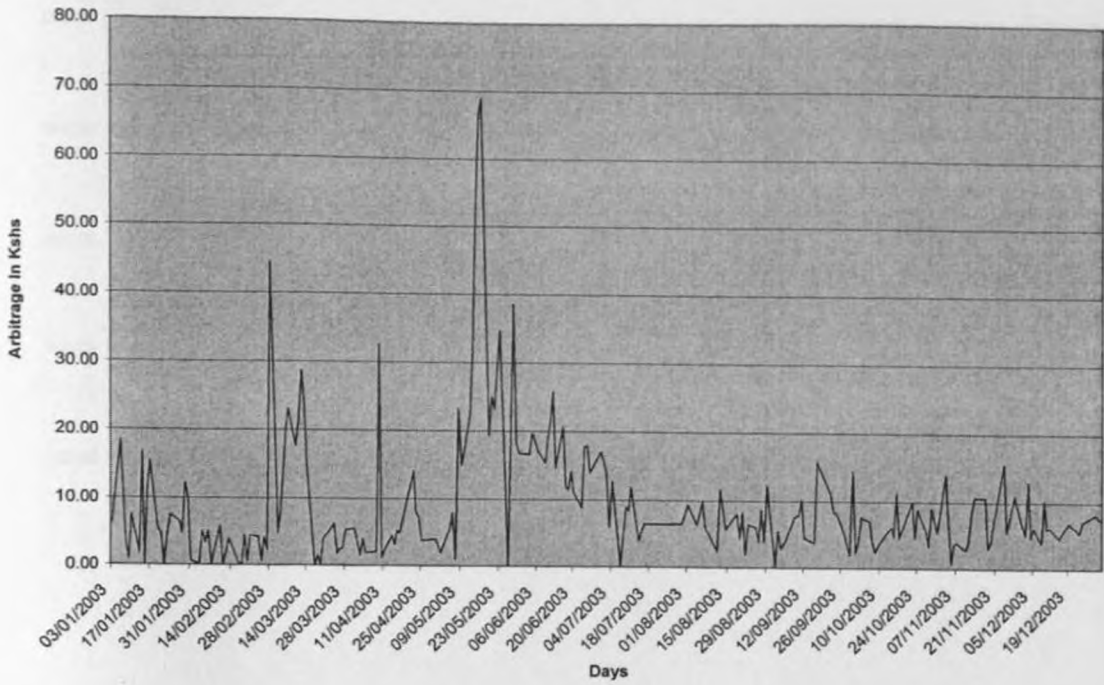
<b>Descriptive Statistics</b>	<b>Dollar To Euro</b>	<b>Pound To Dollar</b>	<b>Euro To Pound</b>
Mean	6.44	9.57	8.30
Standard Deviation	7.97416	9.944798	18.72978
Sample Variance	63.58723	98.899	350.8045
Kurtosis	12.2109	12.02987	77.02932
Skewness	2.937125	2.892853	8.103298
Maximum	55.64	68.96	210.04
Minimum	0.00	0.00	0.00
Range	55.64	68.96	210.04
Sum	1385.15	2058.01	1783.78
Count	215	215	215

From the descriptive statistics above, the currency with the highest arbitrage profits is the pound, followed by the euro and finally the dollar. This could mean that among the three currencies, the dollar was the most efficiently priced. The mean profits that could be obtained for the dollar pound and euro were Kshs 9.57, Kshs 8.30 and Kshs 6.44 respectively.



Triangular arbitrage profits in the year mainly fluctuated between zero and Kshs 55.00. The only months that arbitrageurs could obtain profits greater than Kshs 20.00 were in April, and May.

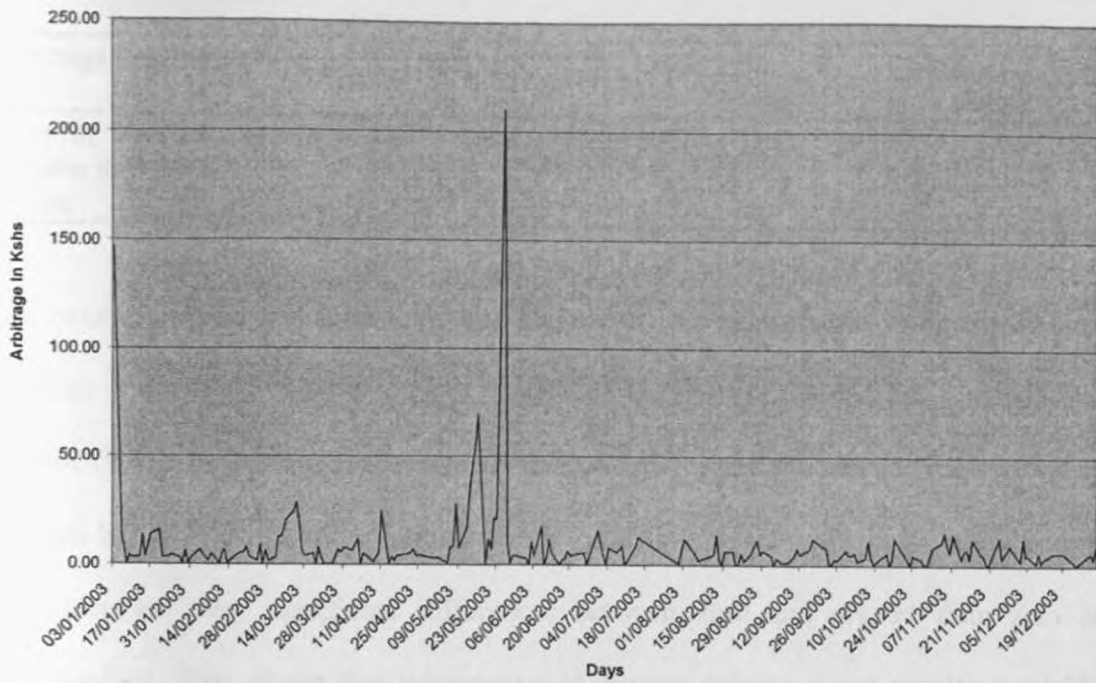
Daily Arbitrage Between GBP and Dollar



Arbitrage opportunities were many during the year with very few instances where they were zero. However, most of the time an arbitrageur would make less than twenty shillings. The highest profit occurred in March and May. It appears that even though these two instances had very high profit, it would be difficult to identify them as they seem to occur at random.



### Daily Arbitrage Between EURO and GBP



Arbitrage profits between the euro and sterling pound were generally below the fifty shilling mark, apart from three instances in January and in May of Kshs 110.00, Kshs 65.00 and Kshs 242.00 respectively. However, the high profits of Kshs 110 and Kshs 242.00 seem to be one off outliers.

## Bureau Triangular Arbitrage

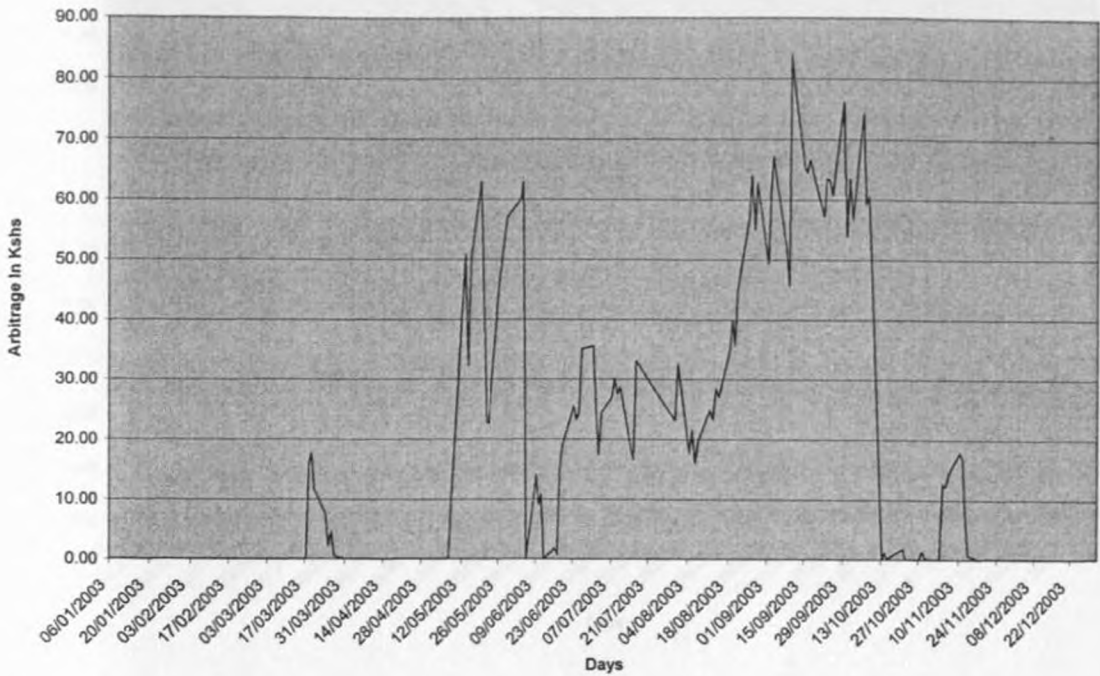
Arbitrage Observed	Frequency Dollar To Euro	Frequency GBP To Dollar	Frequency Euro To GBP	Total
Zero (0)	87	5	5	97
Greater than Zero	93	175	175	443
Totals	180	180	180	540

The results showed the chi-square test statistic at 5% significance level with 2 degrees of freedom to be 170.3843 (Chi -Square =170.3843, D.F= 2). Since the obtained chi-square statistic of 170.3843 exceeds the critical value of 5.991 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 are very significant differences between zero and greater than zero arbitrage opportunities. This shows that information of Bureau pricing is not readily available hence those with such information will beat the market consistently in making arbitrage profits

<b>Descriptive Statistics</b>	<b>Dollar To Euro</b>	<b>Pound To Dollar</b>	<b>Euro To Pound</b>
Mean	17.47	78.99	63.9
Standard Deviation	23.65	41.27	30.64
Sample Variance	559.36	1703.07	938.91
Kurtosis	-0.08	-1.11	0.78
Skewness	1.13	0.15	0.5
Maximum	83.92	177.73	167.81
Minimum	0	0	0
Range	83.92	177.73	167.81
Sum	3143.95	14218.17	11501.6
Count	180	180	180

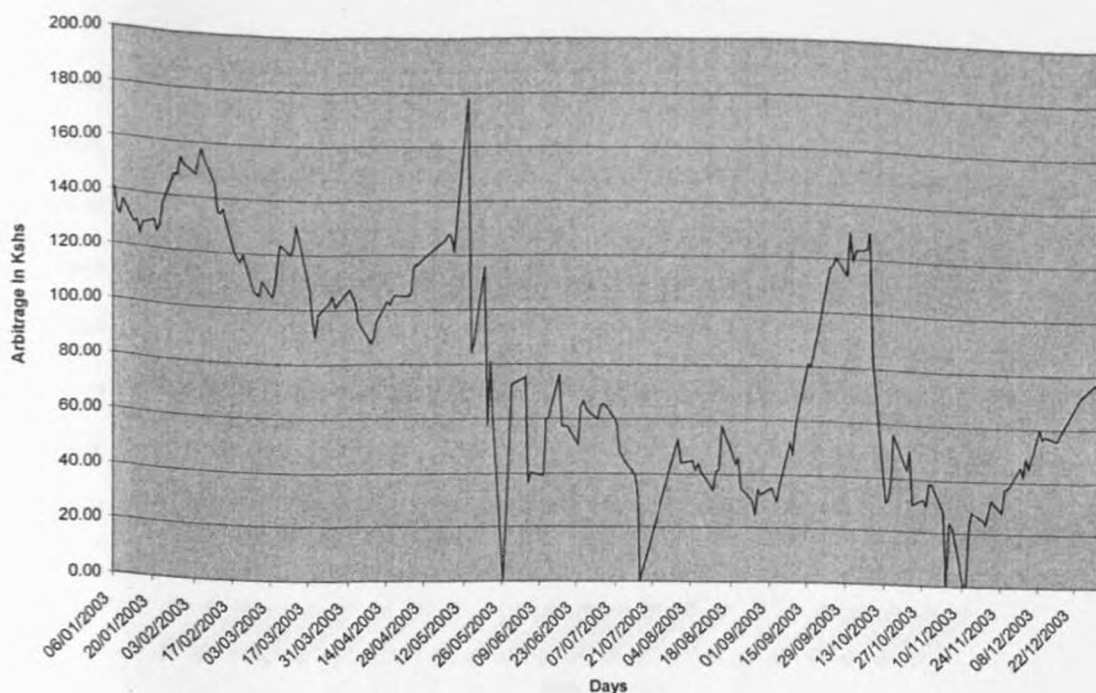
From the descriptive statistics above, this was the most profitable of the arbitrage opportunities that existed in 2003. The total arbitrage profits were as high as Kshs 14,218 for the pound, Kshs 11,501 for the euro and Kshs 3,143 for the dollar. The mean profits that could be obtained for the dollar, pound and euro were Kshs 17.47, Kshs 78.99 and Kshs 63.9 respectively.

Daily Arbitrage Between Dollar and Euro



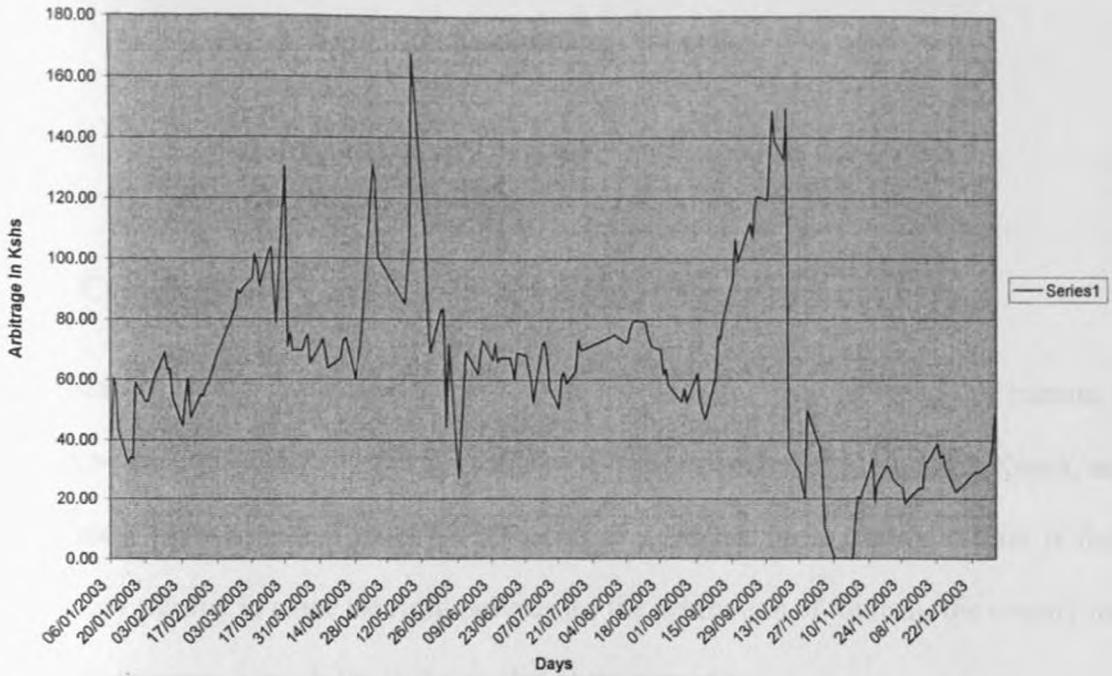
For the first almost five months, it was impossible to make any arbitrage profits except for a short period in March where an arbitrageur could make profits of Kshs 18.00. Arbitrage profits rose sharply in May for a short period before falling in June. However, within the same month the profits began a steady increase to peak at Kshs 83.00 before starting to decline. However, in the month of December, there were no arbitrage opportunities.

Daily Arbitrage Between GBP and USD



For the sterling pound and the dollar, arbitrage opportunities abounded in plenty. With three highs amidst lows in February, May and October of Kshs 97.00, Kshs 169.00 and Kshs 125.00 respectively. This appears to be the most volatile of all arbitrage profits as evidenced by the steepness of the curve as the profits escalate from very high to very low.

Daily Arbitrage Between Euro and GBP



During the year, opportunities existed for an arbitrageur to make profits in excess of Kshs 40.00 except for brief periods in January, February, June, November and December. There was a brief period in November where no profits could be made at all. The highest profits were made in May.

## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

Liberalization of the foreign exchange market in 1995 saw the emergence of bureaus in the Kenyan economy. This saw an improvement of foreign exchange sourcing in Kenya, and one of the most important sources of foreign currency on the forex bureau market is from the tourists. By putting in place the right policies for the promotion of tourism, the country has also improved currency availability in the market at the same time.

The forex bureau market has helped small scale users of foreign currency, since 85.6% of the number of transactions on the market are below US\$ 1000 (Kurgat, 1998). Trade of high volume currency has also benefited, although large volume purchases are difficult to execute because of the constant unavailability of currency. Thus, even though Forex Bureaus offer competition to banks in foreign exchange transactions, banks have the upper hand when it comes to high volume transactions that would ordinarily be carried out by multi-national companies.

In a regulated market, a currency's value is only changed through revaluation or devaluation. However, this does not mean that in a liberalized market devaluation becomes a thing of the past, as authorities will tend to influence currency trend through purchase or sale of currency in the open market place. This method tends to cause less uncertainty and results in less considerable commercial loss.

In terms of efficiency, the market seems to be inefficient due to the many cases that arbitrage opportunities occur in the market. There were arbitrage profits for both banks and bureaus. However, the arbitrage profits that could be obtained by an arbitrageur were higher in bureaus than in banks. This could be due to the fact that banks may be able to more easily disseminate information at a cheaper cost amongst themselves unlike bureaus. It however, becomes difficult for an arbitrageur to exploit this higher profits as bureaus only deal with physical cash transactions (unlike banks where transactions could be done over a computer network), thus buying from low priced bureaus is not easily achieved even if minimum distances separate the bureaus due to risks involved in transporting cash.

Higher profits could be made by carrying out a triangular arbitrage transaction rather than carrying out a locational arbitrage transaction in both banks and bureaus. It therefore appears that currencies are not efficiently priced against one another.



## 5.2 Limitations of the study

This study set out to determine the efficiency of the foreign exchange market in Kenya. However it was only possible to study the formal market with licensed players, that is banks and bureaus. The black market which is prevalent in Kenya could not be studied as it was difficult to obtain any records of their activities during the year as they are not regulated by Central Bank of Kenya.

The efficient market hypothesis is a concept that is being currently challenged. This research has been conducted based on the efficient market hypothesis concept. Efforts should be made to redefine the indicators of market efficiency applicable to both emerging and advanced markets.

This research is based on data for the period 2003. Any interpretations deviating from the findings of this research as regards the efficiency of foreign exchange market may occur if the period is outside the study period.

### 5.3 Recommendations for future research

This research was conducted to determine whether there existed any arbitrage opportunities in the forex market. The results conclude that such opportunities do exist. A further investigation can be done to determine the factors which can lead to fluctuations on the possible arbitrage profits over time.

In addition, research can be done to establish the relationship between the exchange rate prevailing in the country and possible arbitrage profits.

## REFERENCES

Aiba ,H (2002): "Triangular Arbitrage as an Interaction Among Foreign Exchange Rates", Physica A 310 467-479.

----- (2003): "Triangular Arbitrage and Negative Autocorrelation of Foreign Exchange Rates", Physica A 324 (2003) 253-257.

Aiba, O and Takayasu, H (2004): "The Application of Econophysics", Springer-Verlag Tokyo, pp.18-23.

Campbell, J and Lo, A (1997): "The Econometrics of Financial Markets", Princeton University Press.

Cornell, B and Dietrich, K (1978): "The Efficiency of the Market for Foreign Exchange Under Floating Exchange Rates", Review of economics and statistics pages 111-120.

Dixit, A and Pindyk (1994): "Investment Under Uncertainty", Princeton university press, Princeton. New Jersey.

Fama, E F (1969): "The Adjustment of Stock Prices to New Information," International Economic Review, vol. 10(1), pages 1-21.

-----, (1970): "Efficient Capital Markets: A review of Theory and Empirical Work", Journal of Finance, vol 25,pages 383-417,1970.

Fama, Eugene, F and French, Kenneth R, (1988): "Permanent and Temporary Components of Stock Prices," Journal of Political Economy, University of Chicago Press, vol. 96(2), pages 246-73.

Firth, M (1980): "Take overs, Shareholders Returns, and the Theory of the Firm", Quarterly Journal of Economics, 235-260.

Frank, R (1998): "Efficient Market Hypothesis" Investment Analysis and Portfolio Management, pp 108-114.

Frenkel, J (1975): "Covered Interest Arbitrage: Unexploited Profit?", Journal of political economics, page 325-338.

Friedman, M (1953): "The Case For Flexible Exchange Rates" Essays in positive economics, University of Chicago Press, Chicago.

Goodman, S H, (1979): "Foreign Exchange Rate Forecasting Techniques: Implications for Business and Policy", Journal of Finance, pages 415-427.

Grossman, Sanford J and Stiglitz, Joseph E (1980): "On the Impossibility of Informationally Efficient Markets," American Economic Review, American Economic Association, vol. 70(3), pages 393-408.

Moosa, I (2001): "Triangular Arbitrage in the Spot and Forward Foreign Exchange Markets," quant. Finance 1, 253-257.

Kiprotich, K (1995): "Key Success Parameters in the Foreign Exchange Market" Investment Promotion Center (IPC) Journal, pp. 34-35.

Krugman, P, (1993): "What Do We Need to Know About the International Monetary System?" Princeton Studies in International Economics 190, International Economics Section, Department of Economics Princeton University.

Kurgat, P (1998): "An Empirical Study of Spot Market Efficiency on Kenya's Foreign Exchange Bureaus" University of Nairobi.

Kwame, O "Economic Resuscitations in Highly Indebted Countries", Institute of Economic Affairs, Trade Notes Issue No 2, pp.46-51.

Levich, Richard M. and Thomas, Lee III, (1993): "The Significance of Technical Trading-Rule Profits in the Foreign Exchange Market: A Bootstrap Approach," *Journal of International Money and Finance*, Elsevier, vol. 12(5), pages 451-474, 10 .

Meese, R and Rogoff K, (1983): "Empirical Exchange Rate Models of the Seventies: Do they Fit out of Sample?" *Journal of International Economics*, page 3-24.

Ndung'u N. S (1999): "Monetary and Exchange Rate Policy in Kenya," African Research Consortium, Working Papers.

Ramaphele, M K (2002): "Comparative Analyses and Indices of Currency Strengths", *Johannesburg Stock Exchange Quarterly Bull*, Issue No 3, pp.56-58.

Ross A, (1976): "The Valuation Options for Alternative Stochastic Processes," *Journal of Financial economics*, vol 3, page 145-166.

Sanford J and Joseph E (1980): " On the Impossibility of Informational Efficient Markets," NBER Reprints 0121, National Bureau of Economic Research, Inc.

Solnik, B (1983): "The Relationship Between Stock Prices and Inflationary Expectations," *Journal of Finance*, vol 38(1) page 35-48.

## APPENDICES

### APPENDIX ONE

#### POPULATION OF THE RESEARCH STUDY

1. ABC Forex Bureau
2. Afro Forex Bureau
3. Amex Forex Bureau
4. Aristocrats Forex Bureau
5. Bay Foreign Exchange Bureau
6. Blue Nile Forex Bureau
7. Blues Seas Forex Bureau
8. Chinese Forex Bureau De Exchange
9. Brisky Forex Bureau
10. Capital Bureau De Change
11. Cent4ral Forex Bureau De Change
12. Chase Forex Bureau De Change
13. Chief Forex Bureau
14. Coast Forex Bureau
15. Continental Forex Bureau
16. Cosmos Forex Bureau
17. Crater Forex Bureau
18. Crown Bureau De Change
19. Diani Forex Bureau
20. Dollar Forex Bureau
21. Down Town Cambio Forex Bureau
22. Finerate Forex Bureau
23. Fort Jesus Forex Bureau
24. Giant Forex Bureau
25. Glory Forewign Exchange Bureau
26. GnK Forex Bureau
27. Goldfield Exchange Bureau
28. Green Land Forex Bureau
29. Jodeci Bureau De Change
30. Jorg's Forex Bureau
31. Karen Bureau De Change
32. Leo Forex Bureau
33. Link Forex Bureau
34. Maasai Mara Forex Bureau
35. Maritime Forex Bureau
36. Maxfair Forex Bureau
37. Metropolitan Bureau De Change
38. Middle Town Forex Bureau
39. Muthaiga Forex Bureau
40. Nairobi Buereua De Change Ltd
41. Nairobi Forex Bureau

42. Nile Forex Bureau
43. Nippon Forex Bureau
44. Overseas Forex Bureau
45. Pearl Forex Bureau
46. Pinnacle Forex Bureau
47. Planet Connection Ltd
48. Solid Exchange Bureau
49. Speedy Exchange Bureau
50. Sterling Forex Bureau
51. Taipan Forex Bureau
52. Trade Bureau De Change
53. Travelers Forex Bureau
54. Union Forex Bureau
55. Village Market Forex Bureau
56. Warwick Forex Bureau
57. Yaya Centre Exchange Bureau

APPENDIX III  
FOREIGN EXCHANGE BUREAUS

No.	Name	Address	Telephone
42	Nile Forex Bureau	100, ...	...
43	Nippon Forex Bureau	100, ...	...
44	Overseas Forex Bureau	100, ...	...
45	Pearl Forex Bureau	100, ...	...
46	Pinnacle Forex Bureau	100, ...	...
47	Planet Connection Ltd	100, ...	...
48	Solid Exchange Bureau	100, ...	...
49	Speedy Exchange Bureau	100, ...	...
50	Sterling Forex Bureau	100, ...	...
51	Taipan Forex Bureau	100, ...	...
52	Trade Bureau De Change	100, ...	...
53	Travelers Forex Bureau	100, ...	...
54	Union Forex Bureau	100, ...	...
55	Village Market Forex Bureau	100, ...	...
56	Warwick Forex Bureau	100, ...	...
57	Yaya Centre Exchange Bureau	100, ...	...

## APPENDIX TWO

**BANK DAILY POSSIBLE LOCATIONAL ARBITRAGES**

Date	Arbitrage Dollar (KShs)	Arbitrage Pound (KShs)	Arbitrage Euro (KShs)
03-01-03	0.00	0.00	0.00
06-01-03	0.00	0.00	0.00
08-01-03	0.00	0.00	0.00
09-01-03	0.00	0.00	0.03
10-01-03	0.00	0.00	0.00
13-01-03	0.00	0.00	0.00
14-01-03	0.00	0.00	0.00
15-01-03	0.00	0.00	0.00
16-01-03	0.00	0.00	0.00
17-01-03	0.00	0.00	0.00
20-01-03	0.00	0.00	0.00
21-01-03	0.00	0.00	0.00
22-01-03	0.03	0.07	0.05
23-01-03	0.07	0.00	0.00
24-01-03	0.00	0.00	0.00
27-01-03	0.00	0.00	0.00
28-01-03	0.05	0.00	0.00
29-01-03	0.00	0.00	0.00
30-01-03	0.00	0.00	0.00
31-01-03	0.01	0.04	0.05
03-02-03	0.00	0.00	0.00
04-02-03	0.00	0.00	0.00
05-02-03	0.00	0.01	0.01
06-02-03	0.02	0.00	0.00
07-02-03	0.00	0.00	0.00
10-02-03	0.00	0.00	0.00
11-02-03	0.00	0.00	0.00
12-02-03	0.08	0.00	0.00
13-02-03	0.07	0.14	0.03
17-02-03	0.03	0.07	0.03
18-02-03	0.00	0.00	0.00
19-02-03	0.00	0.00	0.00
20-02-03	0.00	0.11	0.00
21-02-03	0.03	0.00	0.00
24-02-03	0.00	0.00	0.00
25-02-03	0.00	0.00	0.00
26-02-03	0.08	0.12	0.10
27-02-03	0.00	0.00	0.00
28-02-03	0.00	0.00	0.00



03-03-03	0.05	0.00	0.00
04-03-03	0.00	0.00	0.00
05-03-03	0.00	0.00	0.00
06-03-03	0.07	0.00	0.00
07-03-03	0.02	0.00	0.00
10-03-03	0.03	0.00	0.00
11-03-03	0.00	0.00	0.00
12-03-03	0.00	0.00	0.00
13-03-03	0.00	0.00	0.00
14-03-03	0.05	0.00	0.05
17-03-03	0.05	0.07	0.01
18-03-03	0.00	0.00	0.02
19-03-03	0.03	0.03	0.00
20-03-03	0.05	0.00	0.00
21-03-03	0.00	0.00	0.00
24-03-03	0.03	0.09	0.05
25-03-03	0.00	0.07	0.02
26-03-03	0.00	0.00	0.00
27-03-03	0.00	0.00	0.00
28-03-03	0.08	0.05	0.03
31-03-03	0.00	0.00	0.00
02-04-03	0.03	0.00	0.00
03-04-03	0.00	0.03	0.00
04-04-03	0.00	0.00	0.00
08-04-03	0.00	0.00	0.00
09-04-03	0.00	0.00	0.00
10-04-03	0.06	0.01	0.05
11-04-03	0.05	0.00	0.00
14-04-03	0.00	0.00	0.01
15-04-03	0.03	0.04	0.07
16-04-03	0.02	0.08	0.05
17-04-03	0.00	0.00	0.00
22-04-03	0.00	0.00	0.00
23-04-03	0.00	0.00	0.00
24-04-03	0.00	0.00	0.00
25-04-03	0.00	0.00	0.00
30-04-03	0.00	0.01	0.00
02-05-03	0.04	0.11	0.04
05-05-03	0.00	0.00	0.00
06-05-03	0.00	0.00	0.00
07-05-03	0.00	0.00	0.00
08-05-03	0.00	0.00	0.00
09-05-03	0.00	0.00	0.00
12-05-03	0.00	0.00	0.00
13-05-03	0.00	0.00	0.00

14-05-03	0.00	0.00	0.00
15-05-03	0.00	0.00	0.00
16-05-03	0.00	0.00	0.00
19-05-03	0.30	0.61	0.43
20-05-03	0.00	0.00	0.00
21-05-03	0.25	0.49	0.34
22-05-03	0.00	0.00	0.00
23-05-03	0.00	0.00	0.00
26-05-03	0.00	0.00	0.00
27-05-03	0.00	0.27	0.16
28-05-03	0.00	0.37	0.28
29-05-03	0.00	0.00	0.00
30-05-03	0.05	0.07	0.06
03-06-03	0.20	0.38	0.27
04-06-03	0.00	0.06	0.03
05-06-03	0.00	0.42	0.22
06-06-03	0.00	0.02	0.01
09-06-03	0.00	0.00	0.02
10-06-03	0.00	0.42	0.29
11-06-03	0.00	0.03	0.03
12-06-03	0.10	0.20	0.17
13-06-03	0.00	0.00	0.00
16-06-03	0.20	0.37	0.23
17-06-03	0.10	0.23	0.21
18-06-03	0.00	0.19	0.14
19-06-03	0.00	0.00	0.00
20-06-03	0.10	0.23	0.14
23-06-03	0.00	0.12	0.09
24-06-03	0.15	0.27	0.19
25-06-03	0.10	0.24	0.14
26-06-03	0.00	0.10	0.08
30-06-03	0.00	0.00	0.00
01-07-03	0.10	0.15	0.02
02-07-03	0.20	0.35	0.24
03-07-03	0.20	0.36	0.25
04-07-03	0.00	0.00	0.00
07-07-03	0.10	0.00	0.00
09-07-03	0.15	0.25	0.11
10-07-03	0.10	0.16	0.10
11-07-03	0.00	0.00	0.05
14-07-03	0.10	0.20	0.04
15-07-03	0.10	0.00	0.17
16-07-03	0.03	0.00	0.00
30-07-03	0.13	0.00	0.18
01-08-03	0.00	0.00	0.00

04-08-03	0.10	0.20	0.06
05-08-03	0.00	0.00	0.00
06-08-03	0.15	0.00	0.07
07-08-03	0.15	0.32	0.02
11-08-03	0.15	0.21	0.16
12-08-03	0.00	0.00	0.00
13-08-03	0.00	0.20	0.00
14-08-03	0.15	0.26	0.10
15-08-03	0.08	0.00	0.00
18-08-03	0.00	0.00	0.00
19-08-03	0.15	0.07	0.00
20-08-03	0.15	0.24	0.03
21-08-03	0.10	0.00	0.00
22-08-03	0.14	0.19	0.00
25-08-03	0.00	0.03	0.02
26-08-03	0.00	0.00	0.00
27-08-03	0.00	0.00	0.00
28-08-03	0.00	0.00	0.00
29-08-03	0.00	0.00	0.00
01-09-03	0.15	0.15	0.01
02-09-03	0.05	0.00	0.00
03-09-03	0.10	0.07	0.00
05-09-03	0.05	0.02	0.09
08-09-03	0.00	0.00	0.00
10-09-03	0.00	0.00	0.00
11-09-03	0.02	0.00	0.00
12-09-03	0.00	0.00	0.00
16-09-03	0.00	0.00	0.00
17-09-03	0.00	0.00	0.00
22-09-03	0.00	0.00	0.00
23-09-03	0.00	0.00	0.00
24-09-03	0.10	0.15	0.11
25-09-03	0.05	0.00	0.00
26-09-03	0.00	0.12	0.02
29-09-03	0.00	0.00	0.00
30-09-03	0.00	0.00	0.00
01-10-03	0.10	0.05	0.05
02-10-03	0.10	0.00	0.00
03-10-03	0.12	0.00	0.04
06-10-03	0.10	0.18	0.00
07-10-03	0.10	0.18	0.00
08-10-03	0.08	0.20	0.15
09-10-03	0.10	0.24	0.00
14-10-03	0.10	0.00	0.00
15-10-03	0.05	0.12	0.09

16-10-03	0.00	0.00	0.00
17-10-03	0.05	0.00	0.00
22-10-03	0.00	0.00	0.00
23-10-03	0.00	0.04	0.05
24-10-03	0.00	0.00	0.00
27-10-03	0.00	0.09	0.00
28-10-03	0.10	0.20	0.00
29-10-03	0.00	0.00	0.00
31-10-03	0.00	0.00	0.00
03-11-03	0.00	0.00	0.00
04-11-03	0.05	0.00	0.00
05-11-03	0.00	0.00	0.00
06-11-03	0.00	0.00	0.00
07-11-03	0.00	0.00	0.00
10-11-03	0.05	0.19	0.00
11-11-03	0.05	0.00	0.00
12-11-03	0.05	0.00	0.00
13-11-03	0.15	0.00	0.00
14-11-03	0.00	0.00	0.00
17-11-03	0.00	0.00	0.00
18-11-03	0.10	0.00	0.00
19-11-03	0.10	0.00	0.00
20-11-03	0.13	0.00	0.00
24-11-03	0.00	0.00	0.00
25-11-03	0.00	0.00	0.00
28-11-03	0.00	0.00	0.00
02-12-03	0.05	0.09	0.10
03-12-03	0.00	0.00	0.00
04-12-03	0.10	0.00	0.00
05-12-03	0.00	0.00	0.00
08-12-03	0.10	0.18	0.12
09-12-03	0.10	0.20	0.16
10-12-03	0.10	0.06	0.06
11-12-03	0.05	0.00	0.00
15-12-03	0.10	0.00	0.14
19-12-03	0.00	0.00	0.00
23-12-03	0.05	0.12	0.03
24-12-03	0.05	0.03	0.04
29-12-03	0.05	0.00	0.00
30-12-03	0.00	0.00	0.00
31-12-03	0.15	0.07	0.00

## BUREAU DAILY POSSIBLE LOCATIONAL ARBITRAGES

	Arbitrage Dollar	Arbitrage Pound	Arbitrage Euro
Date	(KShs)	(KShs)	(KShs)
23-10-03	0.00	1.00	0.00
27-10-03	1.00	1.00	0.00
28-10-03	1.00	1.00	0.00
03-11-03	0.00	2.00	0.00
29-10-03	1.00	2.00	0.00
30-10-03	1.00	3.10	0.00
13-01-03	1.50	11.00	1.00
14-01-03	1.90	11.00	1.00
06-01-03	2.80	13.50	1.00
15-01-03	1.90	11.00	1.20
20-11-03	1.20	1.00	1.50
24-11-03	1.20	1.00	1.50
01-12-03	1.20	1.00	1.50
27-11-03	1.70	1.00	1.50
12-11-03	1.20	2.00	1.50
25-11-03	1.20	2.00	1.50
08-04-03	2.70	10.50	1.50
09-04-03	2.70	10.50	1.50
10-04-03	2.80	10.50	1.50
15-04-03	3.00	10.50	1.50
14-04-03	3.20	10.50	1.50
17-04-03	3.30	10.50	1.50
15-12-03	1.20	2.00	1.90
04-11-03	0.00	0.00	2.00
17-11-03	1.20	1.00	2.00
18-11-03	1.20	1.00	2.00
04-12-03	1.20	1.50	2.00
13-11-03	1.20	2.00	2.00
15-10-03	0.00	4.00	2.00
03-04-03	2.50	10.50	2.00
07-05-03	6.60	10.50	2.00
16-04-03	3.30	10.50	2.05
05-05-03	5.20	10.50	2.05
03-12-03	1.20	1.65	2.15
08-10-03	5.30	10.00	2.20
21-05-03	5.00	5.00	2.30
02-04-03	2.20	10.50	2.30
09-12-03	1.70	1.10	2.50

10-12-03	1.70	1.50	2.50
11-12-03	1.70	1.50	2.50
05-11-03	0.00	2.45	2.50
06-11-03	0.00	2.45	2.50
23-12-03	1.70	3.00	2.50
22-05-03	4.00	7.00	2.50
31-03-03	2.20	10.50	2.55
09-01-03	1.80	11.00	2.55
01-04-03	2.30	10.50	2.65
11-02-03	1.90	13.00	2.65
13-02-03	2.00	13.00	2.65
17-02-03	2.00	13.00	2.65
18-02-03	2.00	13.00	2.65
19-02-03	2.00	13.00	2.65
12-02-03	2.10	13.00	2.65
27-02-03	2.20	13.00	2.65
24-02-03	2.30	13.00	2.65
25-02-03	2.30	13.00	2.65
26-02-03	2.30	13.00	2.65
06-05-03	5.20	10.50	2.70
20-02-03	2.10	13.00	2.70
02-12-03	1.20	1.00	2.75
20-01-03	2.00	11.00	2.95
03-03-03	2.35	13.00	2.95
10-11-03	1.20	2.45	3.00
11-11-03	1.20	2.45	3.00
13-10-03	0.00	4.00	3.00
14-10-03	0.00	4.00	3.00
22-10-03	0.00	4.00	3.00
21-10-03	0.00	4.80	3.00
07-01-03	1.90	12.60	3.00
10-02-03	1.90	13.00	3.00
04-03-03	2.40	13.00	3.00
24-12-03	1.70	3.00	3.10
06-02-03	2.10	13.00	3.10
08-12-03	1.70	2.50	3.15
16-01-03	2.00	11.00	3.35
08-01-03	1.90	12.60	3.35
05-03-03	2.30	13.00	3.35
29-12-03	1.70	3.00	3.40
06-03-03	2.30	13.00	3.45
27-03-03	2.30	10.50	3.50
20-03-03	2.20	12.00	3.50
24-03-03	2.20	12.00	3.50
25-03-03	2.20	12.00	3.50

26-03-03	2.20	12.00	3.50
18-03-03	2.50	12.00	3.50
19-03-03	2.50	12.00	3.50
03-02-03	1.10	13.00	3.50
05-02-03	1.60	13.80	3.50
12-03-03	2.40	13.00	3.60
13-03-03	2.45	13.00	3.60
22-01-03	1.70	11.00	3.65
04-02-03	1.10	13.50	3.85
21-01-03	1.70	11.00	3.90
11-03-03	2.60	13.00	3.90
31-12-03	1.70	4.30	4.00
20-05-03	4.40	7.50	4.00
10-03-03	2.20	13.00	4.00
30-12-03	1.70	3.65	4.10
15-05-03	4.90	8.60	4.10
28-01-03	1.50	13.50	4.20
16-10-03	0.00	6.00	4.40
24-04-03	3.60	10.50	4.40
12-06-03	1.50	5.00	4.50
21-08-03	2.80	5.00	4.50
25-08-03	3.00	5.00	4.50
26-08-03	3.00	5.00	4.50
19-08-03	3.30	5.00	4.50
20-08-03	3.30	5.00	4.50
27-08-03	3.40	5.00	4.50
01-09-03	3.40	5.00	4.50
02-09-03	3.40	5.00	4.50
03-09-03	3.40	5.00	4.50
04-09-03	3.40	5.00	4.50
28-08-03	3.50	5.00	4.50
16-07-03	1.00	5.50	4.50
14-07-03	1.20	5.50	4.50
15-07-03	1.20	5.50	4.50
10-07-03	2.00	5.50	4.50
04-08-03	2.20	5.50	4.50
07-07-03	2.30	5.50	4.50
09-07-03	2.30	5.50	4.50
08-07-03	2.30	5.80	4.50
29-01-03	1.50	13.50	4.50
30-01-03	1.50	13.50	4.50
14-05-03	4.00	8.60	4.60
23-01-03	1.40	11.00	4.90
27-01-03	1.40	12.00	4.95
05-06-03	1.00	3.00	5.00

18-08-03	3.30	5.00	5.00
05-08-03	2.00	5.50	5.00
06-08-03	2.00	5.50	5.00
11-08-03	2.00	5.50	5.00
07-08-03	2.10	5.50	5.00
12-08-03	2.30	5.50	5.00
14-08-03	3.30	5.50	5.00
03-07-03	2.30	6.00	5.00
02-07-03	2.30	6.50	5.00
26-05-03	4.50	7.00	5.00
13-08-03	2.30	5.50	5.15
22-04-03	3.70	10.50	5.25
04-06-03	5.00	3.00	5.50
10-06-03	1.00	4.30	5.50
17-06-03	1.00	4.50	5.50
08-09-03	3.80	5.00	5.50
09-09-03	3.70	5.50	5.50
03-06-03	5.00	6.00	5.50
29-05-03	4.50	7.00	5.50
23-04-03	3.20	10.50	5.50
23-06-03	1.50	6.00	5.70
24-06-03	2.00	6.00	5.70
25-06-03	2.00	6.00	5.70
26-06-03	2.00	6.00	5.70
01-07-03	2.50	6.50	5.70
30-06-03	2.50	7.00	5.70
30-07-03	2.20	5.50	5.80
31-07-03	2.20	5.50	5.80
08-05-03	8.60	10.50	5.90
11-06-03	1.90	4.00	6.00
18-06-03	1.00	5.00	6.00
16-06-03	1.50	5.50	6.00
19-06-03	1.30	6.00	6.00
13-05-03	9.60	11.60	6.00
09-06-03	1.00	3.40	6.10
19-05-03	5.50	10.00	6.60
17-03-03	2.40	12.00	6.90
17-09-03	5.65	8.60	7.80
16-09-03	5.65	8.70	7.80
15-09-03	5.25	7.50	8.25
10-09-03	4.10	5.50	8.90
11-09-03	4.30	6.00	8.90
22-09-03	5.30	10.95	9.00
23-09-03	5.30	11.00	9.50
24-09-03	5.30	12.30	9.50



25-09-03	5.40	12.50	9.50
29-09-03	5.40	12.50	10.15
30-09-03	5.30	13.75	10.15
02-10-03	5.30	12.85	10.70
01-10-03	5.30	13.75	11.10
06-10-03	5.30	13.50	11.30
07-10-03	5.30	14.00	11.50

08-10-03	5.30	14.00	11.50
09-10-03	5.30	14.00	11.50
10-10-03	5.30	14.00	11.50
11-10-03	5.30	14.00	11.50
12-10-03	5.30	14.00	11.50
13-10-03	5.30	14.00	11.50
14-10-03	5.30	14.00	11.50
15-10-03	5.30	14.00	11.50
16-10-03	5.30	14.00	11.50
17-10-03	5.30	14.00	11.50
18-10-03	5.30	14.00	11.50
19-10-03	5.30	14.00	11.50
20-10-03	5.30	14.00	11.50
21-10-03	5.30	14.00	11.50
22-10-03	5.30	14.00	11.50
23-10-03	5.30	14.00	11.50
24-10-03	5.30	14.00	11.50
25-10-03	5.30	14.00	11.50
26-10-03	5.30	14.00	11.50
27-10-03	5.30	14.00	11.50
28-10-03	5.30	14.00	11.50
29-10-03	5.30	14.00	11.50
30-10-03	5.30	14.00	11.50
31-10-03	5.30	14.00	11.50
01-11-03	5.30	14.00	11.50
02-11-03	5.30	14.00	11.50
03-11-03	5.30	14.00	11.50
04-11-03	5.30	14.00	11.50
05-11-03	5.30	14.00	11.50
06-11-03	5.30	14.00	11.50
07-11-03	5.30	14.00	11.50
08-11-03	5.30	14.00	11.50
09-11-03	5.30	14.00	11.50
10-11-03	5.30	14.00	11.50
11-11-03	5.30	14.00	11.50
12-11-03	5.30	14.00	11.50
13-11-03	5.30	14.00	11.50
14-11-03	5.30	14.00	11.50
15-11-03	5.30	14.00	11.50
16-11-03	5.30	14.00	11.50
17-11-03	5.30	14.00	11.50
18-11-03	5.30	14.00	11.50
19-11-03	5.30	14.00	11.50
20-11-03	5.30	14.00	11.50
21-11-03	5.30	14.00	11.50
22-11-03	5.30	14.00	11.50
23-11-03	5.30	14.00	11.50
24-11-03	5.30	14.00	11.50
25-11-03	5.30	14.00	11.50
26-11-03	5.30	14.00	11.50
27-11-03	5.30	14.00	11.50
28-11-03	5.30	14.00	11.50
29-11-03	5.30	14.00	11.50
30-11-03	5.30	14.00	11.50
01-12-03	5.30	14.00	11.50
02-12-03	5.30	14.00	11.50
03-12-03	5.30	14.00	11.50
04-12-03	5.30	14.00	11.50
05-12-03	5.30	14.00	11.50
06-12-03	5.30	14.00	11.50
07-12-03	5.30	14.00	11.50
08-12-03	5.30	14.00	11.50
09-12-03	5.30	14.00	11.50
10-12-03	5.30	14.00	11.50
11-12-03	5.30	14.00	11.50
12-12-03	5.30	14.00	11.50
13-12-03	5.30	14.00	11.50
14-12-03	5.30	14.00	11.50
15-12-03	5.30	14.00	11.50
16-12-03	5.30	14.00	11.50
17-12-03	5.30	14.00	11.50
18-12-03	5.30	14.00	11.50
19-12-03	5.30	14.00	11.50
20-12-03	5.30	14.00	11.50
21-12-03	5.30	14.00	11.50
22-12-03	5.30	14.00	11.50
23-12-03	5.30	14.00	11.50
24-12-03	5.30	14.00	11.50
25-12-03	5.30	14.00	11.50
26-12-03	5.30	14.00	11.50
27-12-03	5.30	14.00	11.50
28-12-03	5.30	14.00	11.50
29-12-03	5.30	14.00	11.50
30-12-03	5.30	14.00	11.50
31-12-03	5.30	14.00	11.50

### DAILY BANK POSSIBLE TRIANGULAR ARBITRAGES

	Dollar To Euro	Pound To Dollar	Euro To Pound
Date	(KShs)	(KShs)	(KShs)
03-01-03	1.91	6.33	147.22
06-01-03	9.66	18.40	13.85
08-01-03	7.56	3.42	0.00
09-01-03	3.36	0.86	3.96
10-01-03	3.51	7.53	3.16
13-01-03	3.36	1.74	3.10
14-01-03	7.59	16.75	13.62
15-01-03	2.92	0.00	3.40
16-01-03	9.57	11.56	8.24
17-01-03	2.34	15.35	13.73
20-01-03	2.61	5.42	16.01
21-01-03	2.19	4.76	3.22
22-01-03	2.62	0.00	3.57
23-01-03	0.00	4.73	3.31
24-01-03	2.97	7.55	4.42
27-01-03	0.00	6.60	3.18
28-01-03	3.10	4.87	0.00
29-01-03	1.91	12.17	6.30
30-01-03	8.85	9.80	0.00
31-01-03	1.09	0.62	2.87
03-02-03	4.60	0.09	6.69
04-02-03	0.00	5.05	4.75
05-02-03	0.00	3.22	3.08
06-02-03	0.00	5.06	1.46
07-02-03	2.99	0.00	4.93
10-02-03	2.33	5.86	0.36
11-02-03	10.66	0.00	5.52
12-02-03	7.70	1.69	6.64
13-02-03	0.00	3.85	0.43
17-02-03	1.68	0.00	4.73
18-02-03	4.12	0.08	5.34
19-02-03	2.34	4.55	5.34
20-02-03	0.70	0.49	7.89
21-02-03	0.00	4.48	3.61
24-02-03	2.22	4.10	1.81
25-02-03	5.58	0.60	9.07
26-02-03	0.00	4.01	0.00
27-02-03	0.00	2.24	6.36

28-02-03	0.00	44.38	1.55
03-03-03	0.34	4.82	3.30
04-03-03	0.85	7.62	12.99
05-03-03	1.41	14.10	12.58
06-03-03	0.22	20.39	14.82
07-03-03	0.00	23.09	20.41
10-03-03	0.00	17.68	24.43
11-03-03	0.00	21.27	28.43
12-03-03	1.15	28.60	18.53
13-03-03	3.22	24.27	6.48
14-03-03	3.07	15.02	3.98
17-03-03	4.23	0.00	5.09
18-03-03	6.63	1.41	0.00
19-03-03	6.64	0.00	7.89
20-03-03	1.68	3.89	3.22
21-03-03	5.36	4.41	0.00
24-03-03	0.00	6.25	0.00
25-03-03	0.98	1.69	3.09
26-03-03	1.02	2.40	6.95
27-03-03	0.32	2.55	5.49
28-03-03	0.00	5.37	7.75
31-03-03	0.00	5.65	6.44
02-04-03	18.84	1.47	11.56
03-04-03	7.95	3.88	0.00
04-04-03	2.14	1.91	5.26
08-04-03	6.81	2.03	1.12
09-04-03	4.00	32.42	3.30
10-04-03	0.00	1.12	5.42
11-04-03	37.37	2.06	24.66
14-04-03	2.32	4.37	0.55
15-04-03	0.00	3.03	3.40
16-04-03	0.00	5.30	1.65
17-04-03	6.18	5.03	4.18
22-04-03	0.00	14.00	5.40
23-04-03	7.67	8.00	7.01
24-04-03	3.07	7.37	3.77
25-04-03	8.12	3.71	4.47
30-04-03	0.63	3.94	3.06
02-05-03	0.86	1.89	3.09
05-05-03	1.65	5.57	0.76
06-05-03	0.00	7.93	8.03
07-05-03	1.92	1.01	8.77
08-05-03	11.18	23.12	27.90
09-05-03	14.61	14.92	7.55
12-05-03	13.67	22.38	17.03

13-05-03	26.27	31.69	33.20
14-05-03	31.31	53.33	45.05
15-05-03	55.64	66.51	54.65
16-05-03	51.42	68.96	69.12
19-05-03	13.25	19.30	0.00
20-05-03	17.61	25.07	11.85
21-05-03	9.13	23.16	7.07
22-05-03	13.04	28.70	21.47
23-05-03	7.23	34.64	20.95
26-05-03	24.59	0.00	210.04
27-05-03	2.74	21.24	10.42
28-05-03	0.00	38.52	0.74
29-05-03	7.73	18.19	4.19
30-05-03	16.23	16.80	4.23
03-06-03	13.35	16.60	2.92
04-06-03	15.15	19.65	0.03
05-06-03	0.00	18.63	10.38
06-06-03	8.48	17.16	4.02
09-06-03	10.19	15.40	17.66
10-06-03	12.36	18.89	0.00
11-06-03	5.92	21.43	3.21
12-06-03	7.81	25.83	11.41
13-06-03	14.11	14.59	5.40
16-06-03	8.50	20.58	0.00
17-06-03	12.21	11.90	2.34
18-06-03	12.88	11.49	2.64
19-06-03	10.21	14.13	5.98
20-06-03	10.69	11.01	4.33
23-06-03	12.48	8.85	5.22
24-06-03	9.38	17.80	5.40
25-06-03	2.13	17.99	5.56
26-06-03	18.83	13.98	0.00
30-06-03	11.72	16.99	15.57
01-07-03	3.05	15.46	9.22
02-07-03	6.61	13.80	4.13
03-07-03	7.97	5.93	0.00
04-07-03	8.32	12.76	7.79
07-07-03	12.69	0.13	5.61
09-07-03	0.53	9.00	8.57
10-07-03	2.66	8.42	0.26
11-07-03	3.36	11.89	1.45
14-07-03	0.00	3.81	8.02
15-07-03	0.00	5.42	12.95
16-07-03	16.99	6.48	11.81
30-07-03	3.66	6.58	0.71

01-08-03	20.95	9.35	11.81
04-08-03	0.00	6.46	5.97
05-08-03	6.52	7.95	4.25
06-08-03	3.40	9.81	1.83
07-08-03	2.83	5.93	2.91
11-08-03	0.50	2.36	4.80
12-08-03	9.99	11.50	13.71
13-08-03	4.34	8.75	2.05
14-08-03	6.42	5.62	0.00
15-08-03	5.40	6.29	6.15
18-08-03	11.31	8.03	6.30
19-08-03	12.56	4.30	0.00
20-08-03	2.20	8.22	0.26
21-08-03	8.92	1.87	5.09
22-08-03	5.50	6.49	1.59
25-08-03	1.15	6.12	5.93
26-08-03	7.35	3.80	9.38
27-08-03	2.63	8.66	11.37
28-08-03	6.76	3.82	4.91
29-08-03	0.00	12.18	6.70
01-09-03	17.00	0.09	4.35
02-09-03	31.22	5.57	0.00
03-09-03	6.22	2.80	3.21
05-09-03	5.50	4.07	1.19
08-09-03	6.32	7.60	1.80
10-09-03	8.66	7.98	4.23
11-09-03	4.26	10.19	7.88
12-09-03	3.02	4.41	4.85
16-09-03	11.88	3.67	7.50
17-09-03	12.25	15.74	12.08
22-09-03	3.21	11.03	7.71
23-09-03	5.23	8.47	0.16
24-09-03	0.03	8.21	0.84
25-09-03	2.49	7.38	2.77
26-09-03	1.08	6.15	2.51
29-09-03	7.40	1.91	6.79
30-09-03	2.21	14.32	4.54
01-10-03	1.66	2.24	4.80
02-10-03	32.23	3.81	5.75
03-10-03	1.73	7.68	1.98
06-10-03	2.94	7.07	3.57
07-10-03	0.00	3.82	10.96
08-10-03	1.74	2.35	3.34
09-10-03	5.30	3.40	0.42
14-10-03	5.02	6.14	5.63

15-10-03	6.78	4.64	0.00
16-10-03	9.02	11.29	2.29
17-10-03	14.03	4.53	12.18
22-10-03	4.64	9.94	2.31
23-10-03	5.38	4.45	0.35
24-10-03	8.00	8.87	4.50
27-10-03	3.94	5.69	2.74
28-10-03	7.34	3.25	0.00
29-10-03	4.68	9.07	0.45
31-10-03	26.26	5.34	8.21
03-11-03	10.41	13.96	10.88
04-11-03	9.94	7.19	15.05
05-11-03	4.89	0.79	8.93
06-11-03	2.94	3.63	6.01
07-11-03	6.05	3.80	14.06
10-11-03	8.65	2.76	2.70
11-11-03	0.00	3.74	6.53
12-11-03	0.00	8.22	7.18
13-11-03	1.80	10.65	3.02
14-11-03	4.33	10.72	11.76
17-11-03	4.09	10.59	5.48
18-11-03	2.91	2.95	4.73
19-11-03	5.80	3.97	1.32
20-11-03	4.69	6.62	0.00
24-11-03	22.87	15.55	12.79
25-11-03	14.64	5.47	3.22
28-11-03	0.00	10.93	9.19
02-12-03	2.56	4.93	2.06
03-12-03	10.04	12.96	12.51
04-12-03	3.05	4.59	4.59
05-12-03	4.03	6.02	4.53
08-12-03	1.84	3.83	1.19
09-12-03	0.00	10.27	5.76
10-12-03	2.04	5.92	0.93
11-12-03	6.59	6.16	3.03
15-12-03	0.00	4.48	6.01
19-12-03	3.51	6.94	5.88
23-12-03	3.18	5.21	1.42
24-12-03	6.44	7.11	0.47
29-12-03	0.00	8.25	5.83
30-12-03	3.91	7.67	3.08
31-12-03	0.00	7.57	8.60

### DAILY BUREAU POSSIBLE TRIANGULAR ARBITRAGES

	Dollar TO Euro	Pound TO Dollar	Euro TO Pound
Date	KShs	KShs	KShs
06-01-03	0.00	140.67	41.04
07-01-03	0.00	132.38	60.49
08-01-03	0.00	131.04	56.86
09-01-03	0.00	136.48	43.28
13-01-03	0.00	128.62	32.16
14-01-03	0.00	129.53	34.07
15-01-03	0.00	124.54	33.65
16-01-03	0.00	128.69	59.03
20-01-03	0.00	130.31	52.78
21-01-03	0.00	126.11	52.71
22-01-03	0.00	128.56	56.83
23-01-03	0.00	136.55	60.00
27-01-03	0.00	148.05	68.97
28-01-03	0.00	147.83	63.49
29-01-03	0.00	154.29	63.41
30-01-03	0.00	151.90	53.85
03-02-03	0.00	148.19	44.57
04-02-03	0.00	153.10	53.30
05-02-03	0.00	157.51	60.33
06-02-03	0.00	154.00	47.44
10-02-03	0.00	145.17	55.03
11-02-03	0.00	134.94	54.49
12-02-03	0.00	134.17	57.67
13-02-03	0.00	135.79	58.83
17-02-03	0.00	120.58	69.01
18-02-03	0.00	118.40	70.88
19-02-03	0.00	116.72	72.80
20-02-03	0.00	119.31	74.91
24-02-03	0.00	106.00	83.61
25-02-03	0.00	105.43	89.52
26-02-03	0.00	104.60	88.21
27-02-03	0.00	109.92	89.95
03-03-03	0.00	104.11	93.46
04-03-03	0.00	108.38	101.25
05-03-03	0.00	116.93	97.52
06-03-03	0.00	123.52	90.79
10-03-03	0.00	119.88	102.22
11-03-03	0.00	122.33	103.60
12-03-03	0.00	130.67	90.32

13-03-03	0.00	125.91	78.64
17-03-03	0.00	107.54	130.16
18-03-03	16.07	96.25	70.91
19-03-03	17.62	90.02	75.40
20-03-03	11.54	98.07	69.73
24-03-03	7.55	102.49	69.67
25-03-03	2.18	105.02	72.95
26-03-03	4.43	100.81	74.63
27-03-03	0.49	102.63	65.54
31-03-03	0.00	107.19	71.39
01-04-03	0.00	104.73	73.39
02-04-03	0.00	102.98	69.07
03-04-03	0.00	95.34	63.81
08-04-03	0.00	87.56	67.21
09-04-03	0.00	90.08	72.93
10-04-03	0.00	95.62	73.77
14-04-03	0.00	102.92	59.96
15-04-03	0.00	101.72	65.75
16-04-03	0.00	104.03	68.64
17-04-03	0.00	105.22	75.77
22-04-03	0.00	105.01	130.78
23-04-03	0.00	106.28	126.71
24-04-03	0.00	115.67	100.59
05-05-03	0.00	125.76	84.96
06-05-03	0.00	127.72	95.24
07-05-03	0.00	126.67	104.28
08-05-03	9.52	121.14	167.81
13-05-03	50.71	177.73	110.38
14-05-03	32.30	84.35	83.88
15-05-03	49.91	88.45	68.91
19-05-03	62.93	115.40	82.94
20-05-03	43.30	57.58	83.48
21-05-03	22.83	80.92	44.27
22-05-03	22.64	59.51	71.73
26-05-03	45.71	0.00	27.15
29-05-03	57.03	72.55	69.34
03-06-03	60.01	75.27	61.89
04-06-03	62.91	36.40	69.55
05-06-03	0.00	40.41	73.09
09-06-03	13.89	39.25	66.43
10-06-03	9.11	39.31	71.93
11-06-03	10.81	59.95	65.80
12-06-03	0.00	60.37	67.18
16-06-03	1.76	75.92	67.33
17-06-03	0.72	57.43	64.16



18-06-03	15.04	57.24	59.89
19-06-03	18.88	57.29	68.94
23-06-03	25.51	50.48	68.08
24-06-03	23.20	64.40	63.68
25-06-03	24.44	66.50	60.30
26-06-03	35.11	63.43	52.40
30-06-03	35.56	59.76	71.42
01-07-03	25.15	64.83	72.76
02-07-03	17.44	65.63	68.34
03-07-03	24.36	64.87	57.55
07-07-03	27.00	58.64	50.43
08-07-03	30.07	48.01	60.53
09-07-03	27.44	46.29	62.38
10-07-03	28.63	44.61	58.56
14-07-03	18.40	39.31	62.79
15-07-03	16.60	31.06	73.19
16-07-03	33.12	0.00	69.77
30-07-03	23.20	52.61	74.90
31-07-03	32.42	44.11	73.97
04-08-03	17.68	44.89	72.12
05-08-03	21.39	41.20	75.52
06-08-03	16.10	43.86	78.38
07-08-03	19.59	40.45	79.64
11-08-03	24.83	34.10	79.28
12-08-03	23.28	40.89	78.15
13-08-03	28.28	41.60	74.08
14-08-03	27.09	57.55	71.27
18-08-03	34.63	46.96	69.81
19-08-03	39.93	43.47	61.59
20-08-03	35.81	45.90	63.34
21-08-03	45.22	34.67	58.22
25-08-03	56.84	30.51	53.58
26-08-03	63.87	24.63	52.63
27-08-03	54.99	34.37	57.03
28-08-03	62.69	32.55	52.58
01-09-03	49.42	35.02	61.97
02-09-03	60.64	32.59	53.22
03-09-03	67.13	30.01	49.42
04-09-03	63.68	35.88	46.87
08-09-03	51.75	51.89	60.56
09-09-03	45.70	47.22	74.48
10-09-03	83.92	57.13	73.51
11-09-03	79.57	62.21	79.90
15-09-03	65.55	81.20	93.38
16-09-03	64.43	79.88	106.47

17-09-03	66.62	84.08	99.04
22-09-03	57.14	111.92	111.69
23-09-03	63.48	116.66	107.03
24-09-03	63.30	117.19	118.01
25-09-03	60.79	120.38	120.64
29-09-03	76.03	113.76	119.45
30-09-03	53.97	129.68	136.29
01-10-03	63.40	119.22	148.78
02-10-03	56.80	123.27	138.74
06-10-03	74.22	123.87	132.82
07-10-03	59.29	129.95	149.53
08-10-03	60.45	83.61	36.20
13-10-03	0.00	30.77	29.26
14-10-03	1.12	31.95	23.33
15-10-03	0.00	38.41	20.02
16-10-03	0.39	56.03	49.85
21-10-03	1.71	43.02	37.45
22-10-03	0.00	50.04	31.74
23-10-03	0.00	30.46	10.23
27-10-03	0.00	32.70	0.00
28-10-03	1.31	30.21	0.00
29-10-03	0.37	38.61	0.00
30-10-03	0.00	38.37	0.00
03-11-03	0.00	28.42	0.00
04-11-03	12.64	0.00	14.14
05-11-03	12.19	23.75	20.75
06-11-03	14.32	22.22	20.13
10-11-03	17.88	0.00	30.33
11-11-03	16.64	0.00	33.81
12-11-03	7.61	21.85	18.75
13-11-03	0.71	28.27	25.16
17-11-03	0.00	24.84	31.28
18-11-03	0.00	23.33	30.71
20-11-03	0.00	32.72	26.85
24-11-03	0.00	28.23	23.89
25-11-03	0.00	37.01	18.23
27-11-03	0.00	38.66	20.38
01-12-03	0.00	45.64	23.54
02-12-03	0.00	41.94	23.41
03-12-03	0.00	48.73	32.71
04-12-03	0.00	45.21	32.60
08-12-03	0.00	59.74	38.64
09-12-03	0.00	56.30	34.14
10-12-03	0.00	57.21	34.83
11-12-03	0.00	57.03	30.60

15-12-03	0.00	55.70	22.19
23-12-03	0.00	70.07	29.63
24-12-03	0.00	71.94	29.06
29-12-03	0.00	76.68	32.14
30-12-03	0.00	76.55	37.09
31-12-03	0.00	81.88	48.16