AN EMPIRICAL STUDY OF THE EXCHANGE RATE VOLATILITY REGIME FOR CARRY TRADE INVESTORS

by

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DECLARATION

I declare that the thesis "**An Empirical study of the exchange rate volatility regime for carry trade investors"** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. This research has not been previously accepted for any degree and is not being currently submitted in candidature for any degree.

Signed…….....

Date……

ABSTRACT

The main objective of the study was to determine the exchange rate volatility regime for carry trade profitability when using the South African Rand as the target currency.

The study used the Logistic Smooth Transition Regression (LSTR) model to test the uncovered interest rate parity (UIP). The Sharpe ratio and the risk adjusted forward premium were used as the transition variables. The transition variable is a function of the transition function, which is used to determine the regime for the UIP. The LSTR model is characterised by three regimes, i.e. the lower regime, the middle regime and the upper regime. The LSTR model was tested for the short-term forward rate maturity of less than one year.

The results show that the UIP hypothesis holds in the middle regime for the Rand/USD and the Rand/GBP when using the Sharpe ratio as the transition variable. Meanwhile, the UIP hypothesis does not hold for the Rand/Yen when using the Sharpe ratio as the transition variable for the forward rate maturity of one month, and it does hold for other short-term forward rate maturity of less than one year. The results for the risk adjusted forward premium as the transition variable show that the UIP hypothesis does not hold for all three currencies at various short-term forward rate maturities of less than one year.

The research provides the following contributions to new knowledge:

(1) Uncovered interest parity hypothesis holds in the middle regime for all periods for the Rand/USD and the Rand/GBP when using the Sharpe ratio as the transition variable with a short-term forward rate maturity of less than one year.
(2) Currency carry trade profit taking for the Rand/USD and the Rand/GBP can be achieved in the upper regime.
(3) The results for the Rand/Yen are mixed, in that the UIP hypothesis does not hold for other crisis periods as a result of negative Sharpe ratios. However, for the calm periods, UIP hypothesis holds in the middle regime for the Rand/Yen for short-term forward rate maturity of more than one month but less than one year when using the Sharpe ratio as the transition variable.

The overall contribution of this study is that for the South African Rand as the target currency, the UIP hypothesis holds for the short-term horizon when using the Sharpe ratio as the transition variable and that this mostly depends more on currency than on horizon.

Contrary to other researchers who found that the UIP holds in the long-term maturity with higher Sharpe ratios in the upper regime, this study proved that the UIP holds in the short-term maturity horizon.

Key terms:

Carry trade; Uncovered Interest Parity; Exchange rate volatility regime, Logistic smooth transition variable; Risk-adjusted forward premium; Sharpe ratio; short-tem forward rate maturity; long-term forward rate maturity; target currency; funding currency

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To the end, I believe that "it is not what happens that determines my life; instead, it is what I do about it". I thank you all who touched my life during this period.

TABLE OF CONTENTS

LIST OF EQUATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMNS

CIP	–	Covered Interest Rate Parity
CPI	–	Consumer Price Index
CTC	–	Carry Trade in Currency
CTV	–	Carry Trade in Volatility
FPA	–	Forward Premium Anomaly
FPP	–	Forward Premium Puzzle
FVUH	–	Forward Volatility Unbiasedness Hypothesis
FVA	–	Forward Volatility Agreement.
G10	–	Group of 10 Developed Countries
GNP	–	Gross National Product
LSTR	–	Logistic Smooth Transition Regression
OLS	–	Ordinary Least Squares
OTC	–	Over the Counter
RIP	–	Real Interest Rate Parity
RAFP	–	Risk Adjusted Forward Premium
SUR	–	Seemingly Unrelated Regressions
TED	–	Treasury Eurodollar
UIP	–	Uncovered Interest Rate Parity
VAR	–	Value at Risk
VIX	–	Volatility Index

CHAPTER 1: ORIENTATION

1.1. Introduction

Exchange rate movement affects the way companies conduct their transactions when concluding deals, contracts or any form of payment involving a foreign currency. Companies use their respective treasury departments to make provision for a forward cover when the payment is due in the near future and also to make provision for a spot rate when the payment is immediately due. In providing cover for future payment, the treasury departments consider the interest rate differentials between the domestic currency and the foreign currency.

Carry trade is a form of investment that is affected by movement in the currency exchange rates. According to the web-based Farlex Financial Dictionary, carry trade is "*a position in which a trader borrows money in one currency at a low interest rate and lends the same money in another currency at a higher interest rate. A currency carry trade derives its profit from the exchange rate between the two currencies and the difference in interest rates. The major risk associated with a currency carry trade is that the exchange rate will move in an adverse direction, eliminating the profit from the interest rate difference.*"

It is based on the uncovered interest parity (UIP) which provides a link between the exchange rates and interest rates. The UIP states that the change in exchange rate between domestic and foreign countries is offset by their respective interest rate differential. Thus, according to the UIP theory, carry trade means borrowing money in a low interest rate country (funding currency) and investing it in a high interest rate country (target currency) on condition that the target currency depreciates (Gagnon & Chaboud, 2007; Sy & Tabarraei, 2009). Studies such as Flood & Rose (2012) have found that the UIP theory does not hold in the short-term; instead, the target currency tends to appreciate and this is generally referred to as the Premium Puzzle.

In their study, Chinn & Meredith (2004) found that inflation shock causes the short-term interest rate to rise by roughly the same amount in the first period as a result of an exchange rate market shock. The UIP theory can only hold if this exchange rate market shock is offset by the changes in the interest rate differential between the trading currencies.

This study focusses on the impact of an exchange rate volatility regime on currency carry trade activity for the South African Rand as the target currency.

The implication of currency carry trade activity for the South African Rand as the target currency requires a thorough understanding of the volatilities of both the exchange rates and the interest rates between the trading countries. The magnitude and scale of these volatilities have an impact on the profitability of the carry trade activity. It is also important to determine the exchange rate volatility regimes and their impact on profit taking for the firm investing abroad. This will allow companies and businesses to plan and budget better, especially in the exporting sector of the business.

1.2. Background and Context

Currency carry trade affects investors and companies when making decisions on foreign payments or investments. These decisions are mostly based on the interest rates between two trading countries or countries where investments are held. There are a number of factors that affect the movement of the interest rates. Chinn & Meredith (2004) found that inflation shock causes short-term interest rates to rise, mainly due to exchange rate shocks. However, the impact of exchange rate fluctuations in the short-term due to currency carry trade activity is not clearly understood with regards to the timing and its magnitude. Hence the Forward Premium Puzzle (FPP), which makes carry trade investments more attractive and profitable in the short-term due to the volatility of the exchange rate movement. Exchange rate volatility can either have a positive or a negative impact on carry trade activity. Higher exchange rate volatility leads to losses in carry trade activity (Clarida et al., 2009).

The effect of interest rates on the exchange rate has been investigated by the Fisher relation which found that in the long-term the uncovered interest rate parity holds (Kesriyeli, 1994). This means that in the long-term, the exchange rate volatility should not have a significant effect on interest rate movements. However, Mishkin (1992) found that the short-term Fisher relation does not hold, in that changes in the expected inflation are not reflected in the change in interest rates.

This study endeavours to determine the exchange rate volatility regime for currency carry trade profitability by evaluating the short-term impact of currency carry trade activity on a company or business investing in the South African economy.

1.3. Problem Statement

The volatility of the domestic currency presents challenges for investors and companies trading in a foreign denominated currency. This also affects the balance sheet and income statements of exporting companies. The recent subprime crisis caused the worst kind of recession and this presented challenges for monetary policy for most countries. The movement of exchange rates in the short-term leads to monetary policy responses that result in a negative correlation between exchange rates and interest rates (Chinn & Meredith, 2004). It is these short-term currency volatilities that influence the currency carry trade activity.

This study seeks to determine whether the currency carry trade activity involving the South African Rand (as the target currency) is influenced by the exchange rate volatility regime and if so, how businesses and companies should conduct their planning.

The level of domestic exchange rate volatility and the movement of interest rates have an impact on the way businesses and companies do their planning and budgeting, especially in the short-term. It is therefore important to identify the level of short-term interest rates movement and the change in the exchange rates between the trading countries to be able to plan more effectively. Companies are faced with challenges in determining the level of exchange rate volatilities that will not lead to losses in their foreign investments.

1.4. Research Objectives

The overall aim of this research is to conduct a detailed assessment of the short-term impact of currency carry trade activity for the South African Rand as the target currency with a view to guiding businesses and companies to plan better when trading in a foreign denominated currency.

The following specific objectives are addressed in this research:

- To determine the manageable level of currency carry trade activity in the short-term for the South African Rand as the target currency, and also to guide investors and exporting companies with regards to the timing and unwinding of the currency carry trade activity to be able to minimise losses due to exchange rate volatilities.
- To determine the level of exchange rate movements on carry trade activity.

- To determine the level of domestic interest rate movements on carry trade activity.

The research puts more emphasis on the impact of an exchange rate volatility regime on carry trade activity in the short-term.

1.5. Importance/Significance of the Study

This research focuses on the impact of exchange rate volatilities on currency carry trade investment. The fact that carry trade investors use interest rate differential between the trading countries to speculate profit taking for carry trade is a problem in itself in that the interest rate is not the only determining factor for carry trade investment. This is a risk because exchange rate volatility is not being considered. Carry trade investors must consider both the interest rate differential and changes in the exchange rate movement between the trading countries. The other most important factor is the timing in investing in the carry trade activity and the timing in exiting or unwinding the carry trade investment. The timing in investing in carry trade activity is influenced by the exchange rate volatility regime.

The importance of this research is to determine the link between the level of volatilities (domestic currency and interest rates) and the carry trade activity with a view to developing a model that will help investors and companies on the timing for their investments and to determine whether to withdraw their investments before maturity date or whether to enter into an interest rate swap. The most significant contribution of the study is to determine the validity of the UIP theory in practice and the existence of the (FPP). The existence of the Puzzle is being tested for forward rates of short-term maturity and at various sample periods.

1.6. Ethical Considerations

Time series data were used in this study. The data were legally obtained from DataStream and there were no ethical considerations required. DataStream supply data for research purposes. Furthermore, some of the data, such as exchange rates, were also publicly available from different sources such as the central banks of the countries considered in this study.

1.7. Limitations and Delimitations

The following limitations to the research were identified:

- The distinction between unwinding of the currency carry trade which leads to the depreciation of the domestic currency and the weakening of the domestic currency due to certain events such as political instability or any form of risk, might not be clearly identified or defined.
- The distinction between momentum strategy or investment and carry trade activity might not be clearly distinguished.
- The distinction between currency carry trade activity and the monetary policy interventions that lead to the strengthening of the domestic currency might not be clearly identified.
- This research only focusses on the impact of currency and interest rate volatilities on carry trade activity in the short-term for the South African Rand as the target currency.
- Transaction costs for carry trade activity will not be taken into account (assumed to be constant). Transaction costs vary across currency pairs and time (need to consider both new and rollover transactions).

1.8. Summary

Carry trade activity is profitable in the short-term due to exchange rate volatility. However, higher exchange rate volatilities result in carry trade losses. Carry trade is based on the assumption of the UIP and this hypothesis holds in the long-term only.

The failure of the UIP hypothesis in the short-term remains a puzzle. It is this puzzle that initiated the interest to research the impact of carry trade activity on the South African economy as a target currency.

1.9. Thesis Layout

The remainder of the thesis is structured as follows:

Chapter 2 discusses the theoretical foundation relating to the carry trade activity. It covers background theory on interest rate parity.

Chapter 3 provides a detailed literature review on carry trade activity and why the UIP hypothesis does not hold in the short-term. It also provides a detailed analysis of the impact of exchange rate volatility on carry trade activity.

Chapter 4 discusses the problem statement, research questions, and the hypothesis development for this research on carry trade activity.

Chapter 5 deals with research design and analysis and provides a detailed discussion on model selection, model specification, and data sources.

Chapter 6 provides a summary and analysis of the results.

Chapter 7 presents the summary, conclusions, and recommendations for this research.

CHAPTER 2: THEORETICAL FOUNDATION

2.1. Introduction

Carry trade activity is based on the uncovered interest rate parity (UIP) whereby the risk associated with the exchange rate is not covered (Chinn & Meredith, 2004). It is used by speculative investors to exploit the interest rate differential between two trading countries with the ultimate aim of making a profit. However, this is very risky because the risk associated with the exchange rate volatility is often not taken into account. Studies have shown that moderate or lower currency volatility leads to a profitable carry trade activity while higher currency volatility leads to losses in carry trade activity (Christiansen &Ranaldo, 2010; Clarida et al., 2009).

The exchange rate volatility is one of the reasons why the UIP theory does not hold in the short-term; the target currency tends to appreciate instead of depreciating and this is what is generally referred to as the Premium Puzzle (see Flood & Rose, 2002; Ichiue & Koyama, 2010; Kozak, 2011; Beyaert et al., 2007; Ding & To, 2010; Kellard & Sarantis, 2008; Bai & Mollick, 2010). Therefore, there is no tight relationship between the exchange rate changes and the interest rate differential (Flood & Rose, 2002).

To be able to maximise their profit takings, investors need to fully understand the impact of the exchange rate volatility path on the UIP.

2.2. Interest Rate Parity

Interest rate parity is a condition whereby international financial markets are in equillibrium (Eun & Resnick, 2009). Eun & Resnick (2009:134) define an arbitrage as "*the act of simultaneously buying and selling the same or equivalent assets or commodities for the purpose of making certain, guaranteed profit*". Profit can only be guaranteed if the risk associated with the exchange rate volatility is taken into consideration. In other words, the exchange rate risk will be hedged, given the information currently available on the future exchange rate movement. This is what the covered interest rate parity (CIP) is all about. On the other hand, the UIP condition does not take exchange rate risk into consideration. Therefore there can never be a guaranteed profit under the the UIP condition.

The theory of the UIP requires the covered interest parity (CIP) to hold (Ito, 2005). The CIP theory states that the difference between the forward exchange rate and the spot rate should be equal to the interest rate differential (Ito, 2005; Saatcioglu & Korap, 2007; Coakley & Fuertes, 2001; Chinn, 2006) such that:

Equation 2:1 $$\textbf{CIP: } f_{t,k} - s_t = i_{t,k} - i^*_{t,k}$$

where

$f_{t,k}$ is the log of the forward rate for the domestic currency with maturity of k-periods ahead,

s_t is the log of the spot rate,

$i_{t,k}$ is the domestic interest rate for k periods, and

$i^*_{t,k}$ is the foreign interest rate for k periods.

Equation 2.1 is valid such that the interest rate differential between two identical risk-free securities denominated in different currencies should be equal to zero (Fong et al., 2010). This is consistent with the definition provided by Akram (2008) that the condition for CIP is that the net returns on an investment that borrows at home and lends abroad in similar interest bearing assets will be zero when the exchange rate risk is hedged through forward or swap contract, therefore risk is covered through forward contract of equal maturity.

Risk needs to be considered when prices of assets are not to be paid on the spot. Covering for this risk is the essence of the CIP in that frictionless markets tend to offer identical rates of return for identical assets (Suthar, 2010).

After maturity, the returns from investing in money markets after the currency conversion of both the spot and forward markets are completed must be the same (Bhar et al., 2004). This is true for identical goods traded for identical prices across various economies when converted into a common currency, assuming a risk-free world (Suthar, 2010).

The interest parity conditions define the theoretical linkage between interest rates and exchange rates between the trading countries (Chinn, 2009; Saatcioglu & Korap, 2007; Bleaney & Laxton, 2003; Ito, 2005).

The difference between the CIP and the UIP is that for the CIP the exchange rate risk is covered, whereas for the UIP exchange rate risk is not covered. The UIP states that the

expected depreciation of the exchange rate should be equal to the interest rate differential (Ito, 2005; Bleaney & Laxton, 2003; Kirikos, 2002; Ferreira, 2009; Razzak, 2002).

Equation 2:2 $$\mathbf{UIP:}\ \mathbf{s^{e}_{t,k} - s_t = t_{t,k} - i^{*}_{t,k}}$$

where

$s^{e}_{t,k}$ is the future spot rate at t+k being expected at time t.

Considering that the CIP holds, the test for the UIP is conducted to determine whether the forward rate is equal to the expected future rate, i.e. $f_{t,k} = s^{e}_{t,k}$ (Ito, 2005). Substituting equation 2.1 into equation 2.2 leads to the following equation:

Equation2:3 $$\mathbf{f_{t,k} - s_t = s^{e}_{t,k} - s_t}$$

Equation 2.3 assumes that the CIP holds and there is no risk premium. In reality investors are mostly risk averse such that the forward rate differs from the expected future spot rate by a premium that compensates for the risk of holding a domestic asset instead of a foreign asset (Saatcioglu & Korap, 2007; Coakley & Fuertes, 2001; Chinn, 2006). Taking risk premium into account leads to the following equation:

Equation 2:4 $$\mathbf{f_{t,k} - s_t = s^{e}_{t,k} - s_t + R_p}$$

where

Rp is the risk premium.

The UIP condition requires a risk premium to be zero.

George & Mallik (2009) define the UIP as the condition whereby the interest rate differential is equal to the exchange rate difference between the trading countries. Further, they define exchange rate differential as the difference between the expected spot rate in the next period and the current spot rate.

The following equations are used to test the conditions for UIP and CIP respectively (Chinn, 2009; Ito, 2005):

Equation 2:5 $$\mathbf{s_{t+1} - s_t = \alpha + \beta(f_{t+1} - s_t) + \mu_t}$$

Equation 2:6 $$\mathbf{s_{t+1} - s_t = \alpha + \beta(i_i - i_t^*) + \mu_t}$$

where

s_t is the log of the spot rate,

f_t is the log of the forward rate,

i_t is the domestic interest rate

i^*_t is the foreign interest rate, and

u_t is the error term.

Both CIP and UIP tests require $\alpha = 0$ and $\beta = 1$, when using either equation 2.5 or equation 2.6. The difference between the CIP and UIP is that, under the CIP the forward premium is equal to the interest rate differential (Kellard & Sarantis, 2008; George & Mallik, 2009) and the UIP condition requires the CIP conditions to exist such that the exchange rate risk premium is zero (George & Mallik, 2009; Suthar, 2010).

Under CIP conditions, the interest rate differential is used to estimate the forward exchange rate (Suthar, 2010) so that the risk associated with the exchange rate can be covered. Therefore equilibrium prices in forward currency markets are maintained, based on the interest rate differential between the two trading countries (Batten & Szilagyi, 2007). However, it is difficult to test the UIP hypothesis because the exchange rate changes are unobservable (Chinn, 2009). This could be attributed to the volatility of the exchange rates. The volatility of the exchange rates is influenced by the expectation of the inflation difference across two economies that affects the forward exchange rate between two trading countries (Suthar, 2010).

2.3. Summary

Carry trade activity is influenced by speculative investors who want profit from the interest rate differential between the two trading countries. This form of investment is mostly associated with risk and hence investors require a risk premium. Carry trade is based on the UIP hypothesis which requires the interest rate differential to be equal to the change in the exchange rate. In reality the UIP hypothesis does not hold in the short-term and this creates a Puzzle in relation to the profitability of the carry trade.

CHAPTER 3. LITERATURE REVIEW

3.1. Introduction

Investors and companies using currency carry trade forms of investment are often faced with the challenge of exchange rate volatility. Exchange rate volatility can either have a negative or a positive effect on currency carry trade returns, depending on the exchange rate volatility regime. Moderate or lower exchange rate volatility leads to profitable carry trade returns while higher exchange rate volatility leads to losses in carry trade investments (Christiansen & Ranaldo, 2010).

Carry trade investment is based on the assumption of UIP which is a function of the change in the exchange rate and the interest rate differential. The UIP states that the change in the exchange rate and the interest rate differential between domestic and foreign countries is offset by their respective interest rate differential (Flood & Rose, 2002; Gyntelberg & Remolona, 2007; Olmo & Pilbeam, 2009; Clarida et al., 2009; Wagner, 2008; Verdelhan, 2005). However, most of the studies have found that UIP theory does not hold in the short-term, instead the target currency tends to appreciate and this is what is generally referred to as the Premium Puzzle (Flood & Rose, 2002). Hence speculative investors embark on carry trade investment purely based on the interest rate differentials. Essentially, carry trade means borrowing money in a low interest rate country (funding currency) and investing it in a high interest rate country (target currency) which results in the the target currency depreciating, according to UIP theory (Gagnon & Chaboud, 2007; Sy & Tabarraei, 2009).

Studies have found that UIP theory does not hold in the short-term and instead the target currency tends to appreciate: this is what is generally referred to as the Premium Puzzle (see Flood & Rose, 2002; Ichiue & Koyama, 2010; Kozak, 2011; Beyaert et al., 2007; Ding & To, 2010; Kellard & Sarantis, 2008; Bai & Mollick, 2010). However, the strength of the target currency is not permanent: it depends on the exchange rate volatility regime, in that when investors pull out of the carry trade investment, the funding currency appreciates due to the unwinding of the carry trade activity (Clarida et al., 2009; Nishigaki, 2007). As pointed out by Cheung et al. (2012), the buildup and the unwinding of carry trade investment tend to move stock markets into target currency countries. The implication of the buildup of the carry trade investment is the appreciation of the target currency. Meanwhile, the unwinding of the

carry trade investment leads to the depreciation of the target currency. The unwinding of carry trade activity is mostly influenced by conditions of market stress (Melvin & Taylor, 2009; Ichiue & Koyama, 2010). This leads to a reduction of the carry trade profits (James et al., 2009).

The challenge for carry trade investors is the timing and response to the effect of exchange rate volatility on carry trade investments in order to avoid investment losses by promptly pulling out of the investment or prolonging the investment until after the exchange rate volatility regime associated with carry trade losses ceases to exist.

3.2. Carry Trade Activity

Carry trade will prove to be unprofitable if the high interest rate currency depreciates by an amount greater than the interest rate differentials (Olmo & Pilbeam, 2009).

Gagnon & Chabound (2007) identified two types of carry trade activity: canonical carry trade and derivative carry trade. In their definition, canonical carry trade is a form of investment whereby investors borrow money in a low interest rate currency and invest the proceeds in a high interest rate currency. On the other hand, they define derivative carry trade as a form of investment where an investor is taking on leveraged positions in derivative markets through currency futures and forward contracts by borrowing and lending in the interbank market. Gagnon & Chabound (2007) further proved that the realised profit from either channel is identical:

Equation 3:1 $$\textbf{Profit C} = \mathbf{i^F - i^J + e_1 - e_0}$$

Equation 3:2 $$\textbf{Profit D} = \mathbf{e_1 - f}$$

Equation 3:3 $$f = e_0 + i^J - i^F$$

where

i^F is the interest rate earned in a foreign currency (target currency),

i^J is the the Japanese interest rate (funding currency),

e is the appreciation of the foreign currency in terms of the Yen or the funding currency (e_0 is the initiation of the position, e_1 is the closing), and

f is the forward contract.

Substituting equation 3.3 into equation 3.2 theoretically proves that canonical carry trade profit is the same as the derivative carry trade profit.

This research will only focus on the canonical carry trade activity.

Investors engage in carry trade activity mainly because of the FPP. According to Nishigaki (2007), the FPP states that currencies at forward premium that have low interest rates tend to depreciate and not appreciate (a clear violation of the UIP condition).

Sy & Tabarraei (2009) used the following equation to measure the FPP:

Equation 3:4 $$\Delta S_{t+k} = \alpha + \beta(i_t - i_t^*) + \varepsilon_{t+k}$$

where

ΔS_{t+k} is the change in exchange rate over k – periods,

$(i_t - i_t^*)$ is the interest rate differential,

ε_{t+k} is the error term.

Under the UIP, the above equation requires that α=0 and β = 1. Sy & Tabarraei (2009) found a negative β which implies that the high interest rate currency is appreciating. This is a confirmation of the violation of the UIP hypothesis and hence the carry trade strategy is being used to exploit the FPP to maximise investor's profitability.

Carry trade activity is measured by testing the UIP hypothesis. It is based on the Fama equations. The derivation of the Fama equation is adopted from Olmo & Pilbeam (2009, 2011). Their paper assumes that the forward rate corresponds to the rate provided by arbitrage in the covered interest parity condition (CIP). They believe that it has an advantage of eliminating the timing mismatch between interest rates and exchange rates. The CIP is described as follows:

Equation 3:5 $$F_t = \frac{(1+r_t^*)S_t}{(1+r_t)}$$

where

S_t is the spot exchange rate at time t (in units of foreign currency per domestic currency),

F_t is the forward exchange rate at time t,

r_t^* is the foreign interest rate,

r_t is the domestic interest rate.

For the efficient market hypothesis, Olmo & Pilbeam (2009, 2011) state that in the presence of rational expectations and perfect capital mobility the forward rates will coincide with expected future spot rate. This is represented by Equation 3.6 below.

Equation 3:6 $$\mathbf{E(S_{t+1}) = F_t}$$

where

E (S_{t+1}) is the expected spot exchange rate at time t for time t+1.

Taking logs of Equation 3.5 will lead to CIP:

Equation 3:7 $$f_t - s_t = r_t^* - r_t$$

where

f_t is the log of forward exchange rate at time t,

s_t is the log of spot exchange rate at time t.

Olmo & Pilbeam (2009, 2011) used first order Taylor expansion of log S_{t+1} around its expected value to E (S_{t+1}) = f_t. This then leads to the UIP condition:

Equation 3:8 $$\mathbf{E(s_{t+1}) - s_t = r_t^* - r_t}$$

where

E (s_{t+1}) - s_t is the expected rate of depreciation of the currency.

With rational expectations the exchange rate dynamics are expressed as follows:

Equation 3:9 $$\mathbf{s_{t+1} = E(s_{t+1}) + \varepsilon_{t+1}}$$

where,

ε_{t+1} is a random error term with zero mean.

The UIP equation is derived by substituting Equation 3.8 into Equation 3.9 and by using the approximation given by Equation 3.7.

Equation 3:10 $$\mathbf{s_{t+1} - s_t = (f_t - s_t) + \varepsilon_{t+1}}$$

For regression purposes the UIP can be tested by the following regression equation (Fama regression):

Equation 3:11 $$\mathbf{\Delta s_{t+1} = \alpha + \beta(f_t - s_t) + \varepsilon_{t+1}}$$

UIP is tested by proving that α = 0 and ß =1

It must be noted that testing equation 3.11 for ß = 1 through regressions is not sufficient as it does not take into account other factors such as risks or volatility regimes. Therefore this equation only provides a basis for modelling the UIP in different volatility regimes.

3.3. The Forward Premium Puzzle

Carry trade investment is attractive as a result of the FPP, the nature and the existence of which remains an unresolved financial issue.

The FPP implies that currencies with high interest rates tend to appreciate while those with low interest rates tend to depreciate (Chakraborty & Evans, 2008; Sy & Tabarraei, 2009; Della Corte et al., 2011; Serban, 2010; Pippenger, 2011; Olmo & Pilbeam, 2011). This is what makes carry trade investment attractive in that markets are not efficient or rather, if the markets were efficient then according to the UIP theory, investing in carry trade activity should not be profitable since the change in currency movement should be neutralised by interest rate differential (Fong, 2010).

Several studies have been conducted to determine the existence of the Puzzle. The existence of the Puzzle is believed to be due to the omission of risk premium in standard UIP tests (Wagner, 2012; Chang, 2013). This is consistent with Ito (1998), who believes that a test of

UIP is the same as a test of market efficiency without risk premium in a foreign exchange market on condition that the covered interest parity (CIP) holds. In reality, this cannot be achieved unless the exchange rate risk is hedged. According to Wagner (2012), a short-term deviation of UIP and excess returns represent a time-varying risk premium, whereas in the long-term there are no excess returns from carry trade investment. Investor's risk aversion varies and it leads to a time-varying risk premium that is negatively correlated to the movements of exchange rates (Jonen&Scheuring, 2010). This is in line with the work of Francis at al. (2002) who determined that the failure of UIP is due to the existence of time-varying risk premium as a compensation for the speculative position in the foreign currency. The speculative position in the foreign currency could be attributed to (1) inefficient currency forward markets, (2) rational learning about potential changes in currency regimes and (3) speculative bubble (Francis, et al., 2002). These factors were refined by Jonen&Scheuring (2010) to be (1) irrational expectation, (2) market frictions and risk premium. Accordingly, Jonen&Scheuring (2010) used a two-country model under rational expectation without market friction and found that the FPP is due to a large and time-varying risk premium. Sarantis (2006) used General Methods of Moments (GMM) to determine the existence of the Puzzle. In this study, Sarantis (2006) determined that interest rate alone cannot explain the failure of the UIP in the short-term. Sarantis (2006) used traded currency volatility as a measure of expectation about the future volatility of exchange rates.

The overall findings according to the author (Sarantis, 2006) are that time-varying risk premium explains a much greater proportion of the variance in exchange rate change and this amounts to 44% over the five exchange rates investigated.

While most of the studies dwell more on the contribution of time-varying risk premium to the failure of the UIP, there is a need to ascertain what really contributes to the time-varying risk premium or to fully define, if not quantify, the time-varying risk premium. Adrian et al. (2011) established that the time-varying risk premium is composed of two components. These components are (1) macroeconomic state variables, which refer to industrial production and inflation for a particular country, and (2) the balance sheet risk premium that refers to the funding liquidity of a country's financial institutions. According to Adrian et al. (2011), funding liquidity conditions have a significant explanatory power for foreign exchange risk premium as compared to the global macroeconomic factors. This is contrary to

Li et al.(2012), who determined that volatility in the macroeconomic factors is the primary determinant of the exchange rate, which could in turn lead to the Puzzle.

The exchange rate risk premium is influenced by (1) pure currency risk component and (2) the stochastic nature of the interest rates (Sarno et al., 2012). According to Sarno et al. (2012), pure currency risk could either be positive or negative and the compensation for bearing interest rate risk is positive. The uncertainty of pure currency risk (positive or negative) could be largely attributed to its volatility in the market. Meanwhile, the compensation for bearing interest rate risk premium is a significant contribution to the overall risk premium (Sarno et al., 2012).

While time-varying risk premium is considered to be relevant in determining the existence of the FPP, it is not clear if it is influenced by the maturity of the forward rate and the interest rates. Time-varying risk premium, however, does not completely solve the Premium Puzzle (Li et al., 2012).

Kozak (2011) investigated the relationship between foreign bond investments and risk premium and found that the risk premium is high when using forward rate maturity of up to eight years.

Ding & To (2010) examined the Puzzle based on a range of maturities to show a clear pattern of the term structure of the Puzzle. Their overall finding is that the existence of the Puzzle depends on the maturity of forward rates. The Puzzle does not exist for one day maturity but it is significant for medium maturities and disappears for long maturities. This confirms that the Puzzle is a short-term phenomenon. This is also in line with Ahmad et al. (2012) who observed that the FPP does not exist in the long-term. While Ding & To's (2010) research focussed a lot on maturities of the forward rate, it however fails to take into account the existence of the exchange rate volatility regime, which could either be characterised by a linear or a nonlinear pattern. Testing for linearity is very important as it helps in selecting an appropriate model.

The interest rate differential also contributes to the FPP. Sarantis (2006) investigated the effect of the maturity of interest rates on the FPP with maturity of one month and three month interest rates and found that the Puzzle exists irrespective of the interest rate maturity. This was done by modelling the UIP separately for linear and for nonlinear conditions. This cannot be conclusive, considering that the UIP may be characterised by various exchange rate

volatility regimes. The model needs to take into account the transition from linear to nonlinear to be able to fully determine the characteristics of the FPP. In fact, Drakos (2003) determined that the magnitude of the risk premium is not uniform across interest rate maturity.

Since the FPP is also influenced by the change in the movement of the exchange rate, the volatility of the exchange rate needs to be investigated in addition to the time-varying risk premium to determine how influential it is in contributing to the existence of the FPP.

Bansal & Dahlquist (2000) conducted studies on the Premium Puzzle for developed and emerging economies. They established that the difference in the Premium Puzzle across economies relates to per capita GNP, average inflation rates and inflation volatility. Their results indicate that future exchange rates and the current interest rate differential are negatively correlated. Their results imply that the interest rate differential is not a good indicator of future exchange rate movements. They also measured the expected depreciation of the currency by doing regression on the change in the spot prices on forward premium. The negative slope coefficient of the UIP equation in their results indicates that the forward premium is more volatile than the expected depreciation of the exchange rate. They concluded that the Premium Puzzle is not present in the emerging economies. This is contrary to the findings of the work done by Bai & Mollick (2010), whose results point out that for the emerging countries, the forward discount works better during the crisis periods than the non-crisis periods.

Bai & Mollick (2010)'s research focussed on the effect of two financial crises (the 1997 Asian currency crisis and the 2000 Turkish financial crisis) on forward discount bias for 14 emerging market economies using a robust two stage procedure. They used a structural break model or regime shift because the structural breaks affect statistical inferences if they are not accounted for.

Frankel & Poonawala (2010) conducted research to test for the bias in the forward markets in emerging market currencies, and compared this bias to that of major currencies. They used the Seemingly Unrelated Regressions (SUR) to correct for a possible correlation of the error term across currencies. Their results show that the bias in the forward discount for emerging market economies is smaller than the one for the advanced economies. The authors simply concluded that the source of the forward discount bias does not entirely lie in the exchange

risk premia without analysing these results for crisis and non-crisis periods. Compared to other studies which attempted to correct or align the timing mismatch for the spot rate and the forward rate, they used the forward rate and the spot rates from the last day of each month. The problem with this data is that the forward rates and the spot rate might be in different volatility regimes. Therefore the reliability of these results is questionable. Furthermore the linearity test was not conducted.

To be able to qualify and quantify the existence of the FPP, one needs to consider that the exchange rate volatility regime may be characterised by either a linear or nonlinear pattern. It is therefore proposed that the model to determine the existence of the FPP needs to take into account the following (1) the existence of a linear regime, (2) the existence of a nonlinear regime, (3) transition from a linear regime to a nonlinear regime, (4) the maturity of the forward rates; (5) maturity of the interest rates, (6) exchange rate volatities, (7) time-varying risk premium, and (8) the type of currency.

3.4. UIP Horizons for Carry Trade Activity

The profitability of carry trade investment as a result of the existence of the FPP may be influenced by the time horizon within which speculative investors embark on carry trade activity. Chinn & Meredith (2004) were two of the few researchers who tested the UIP hypothesis for short-term horizons and their findings were that the UIP fails for the short-term horizon because the exchange rates move inversely with interest rate differentials. According to Hacker et al. (2010), this negative relationship between the spot exchange rate and the interest rate differential in the short-term is mainly due to the sticky product prices, which are influenced by an increase in the domestic interest rate inducing financial capital flows to the target currency. This puts pressure on the domestic currency to appreciate. This was also confirmed by Lothian & Wu (2011): the short-term interest rates are more volatile than the long-term interest rates. For Gyntelberg & Remolona (2007) the failure of the UIP in the short-term horizon is due to downside risk. Therefore the UIP is most likely to hold in the long-term as a result of stable and less volatile interest rates. This is consistent with Meredith & Yue (2002) who found that the UIP holds in the long-term and that it is an indication that inflation differentials between the countries dominate nominal exchange rate movements over time.

The implication of the failure of the UIP in the short-term is that speculative investors will endeavour to take advantage of interest rate differentials and low exchange rate volatility because the UIP is not expected to hold in the short to medium term (Galati et al., 2007).

Chinn & Meredith (2004) tested the UIP hypothesis for long-term horizons. Their findings are consistent with Kesriyeli (1994), which did not reject the co-integration of domestic and foreign interest rates for the long-term. The co-integration hypothesis was conducted to test whether or not domestic interest rates and foreign exchange rates trend together in a one-on-one relationship. The short-term effect of the interest rate differential on the change in the exchange rate was also investigated by Flood & Rose (2002) for interest rate maturities of one day, one week and one quarter of a year. Their results also confirm that there is no tight relationship between exchange rate changes and interest rate differentials. Therefore interest rate differentials cannot be relied upon to predict future exchange rate changes.

Hacker et al. (2010) investigated the casual relationship between exchange rates and interest rates differential for five major currencies against the Swedish Krona (SEK). Their motivation for using the wavelet analysis is that the time series data can be decomposed into different time scales and the relationship between variables can be analysed into short, medium and long-run. Their results indicate that the casual relationship between two variables is getting stronger as the time scale increases. They found that at the 16th month wavelet, the interest rate differential Granger causes the exchange rate for five out of six countries and for the quarterly period of four and eight wavelet scale, the interest rate Granger causes the exchange rate three times out of six. However, their results show that the Granger causality does not exist at the shorter wavelet scales when using either monthly or quarterly data. These results confirm that the UIP only holds for the long-term.

However these studies (Hacker et al., 2010; Chinn & Meredith,2004; Galati et al., 2007; Gynteberg & Remolona, 2007) failed to take linearity into account. Testing for linearity becomes relevant in that the pattern for the UIP could be developed. In other words, does the UIP hypothesis hold in the exchange rate volatility regime that is either characterised by the linearity or nonlinearity? It also needs to be proven whether linearity is a short-term or long-term phenomenon.

Mehl & Cappiello (2009) and Bekaert et al. (2007) found that the UIP depends more on the currency than on the time horizon. In their research, Mehl & Cappiello (2009) used the USD

against emerging market currencies and found that these currencies are less supportive of the UIP due to political risk.

In determining the profitability of carry trade due to the failure of the UIP in the short-term, the following factors need to be taken into consideration: (1) the type of currencies used in the carry trade investment, which should be investigated through the crisis periods and calm periods (2) the time horizon within which investment is taking place, (3) the interest rate spread between the trading currencies, (4) the exchange rate volatility, and (5) taking linearity tests into consideration.

3.5. Carry Trade Activity and Inflation

Carry trade investment is influenced by the spread of interest rates between the trading currencies. Interest rates are affected by macro-economic factors such as the prevailing inflation in both the domestic country and the foreign country. As such, interest rates in different countries will not necessarily move in the same direction (Mishkin, 1984).

The real interest rate is a function of nominal interest rate and inflation. According to Moosa (2004), if the real interest rates are exogenously determined in the world economy according to the real interest rate parity (RIP), then the nominal interest rate can only be influenced by controlling inflation. However, if the nominal interest rate is beyond the control of the monetary authorities, then the nominal interest rate cannot be influenced, since it will be determined as the difference between exogenous real interest rate and domestic inflation (Moosa, 2004).

Sánchez-Fung & Prazmowski (2004) believe that the most significant driver of aggregate exchange rate expectation is the interest rate differential, followed by the present stance of the exchange rate and the price level differential.

The price level is an indication of the inflation levels for the trading countries. Inflation rates contain information to predict future interest rates (Booth & Ciner, 2001). This information will help investors to determine their level of investment and the timing for pulling out of the market. Nominal interest rates and inflation are deemed to be moving together in a one-on-one relationship in the long-run (Booth & Ciner, 2001).Booth & Ciner (2001) determined a long-run bivariate relationship between the short-run Eurocurrency interest rate and inflation

rate for nine Euro countries and the USA. Using co-integration methods, their results show that there is a one-on-one relationship between Eurocurrency rates and rationally expected inflation. They concluded that nominal interest rates and inflation rates move together in the long-run even though there may not be an exact relationship in the short-run. However, it is not clear from these results whether the nominal interest rates and inflation exhibit a linear or non-linear pattern. These results cannot be conclusive as compared to the work of Lanne (2006) for the non-linear component in the nominal interest rate and inflation.

Chinn & Meredith (2004) found that inflation shock causes the short-term interest rate to rise by roughly the same amount in the first period as an exchange market shock. The exchange rate initially appreciates in response to higher interest rates and it is followed by depreciation in the subsequent periods (Chinn & Meredith, 2004). This could be explained by the unwinding of the carry trade activities whereby traders withdraw their investment in the high interest rate country and pocket their proceeds from the higher short-term interest rates (Brunnermeier et al., 2008).

Lanne (2006) determined that the common non-linear component in the nominal interest rate and inflation is a long-run phenomenon and that variables move together in the long-run. However, this pattern does not exist in the short-run (Lanne, 2006). This is consistent with Fama (1999) who determined that the inflation rate and the real return move opposite to one another over shorter time horizons. This is supported by Mishkin (1992), whose study of the Fisher relation proved that in the short-run a change in expected inflation is not associated with a change in interest rates. However, there is strong evidence that the interest rate and the inflation rate trend together in the long-term (Mishkin, 1992). This supports the view that there is a long-term Fisher relationship between interest rates and inflation (Kesriyeli, 1994).

The short-term effect of inflation and interest rate remains a challenge for businesses and investors in determining the amount of investment and its returns. Therefore, a correct estimate of the real interest rate is important for investment and consumption decisions (Chen, 2001). According to Chen (2001), real interest rate is constant and nominal interest rate reflects a one-on-one variation in the expected inflation.

The following equation provides an explanation of the phenomenon (Chen, 2001):

Equation 3:12 $$\mathbf{I_t = P_t^* + E_t \pi_{t+1}}$$

where

I_t is the nominal interest rate,

P_t* is the real interest rate and

$E_t\ \pi_{t+1}$ is the expected inflation rate.

Interest rates and foreign exchange rates are determined by the two trading countries' inflation risks and money supply (Jylha & Suominen, 2011). The researchers determined that speculators invest in a hedge fund that borrows from a country with a low Sharpe ratio for fixed income securities, and invest in a country with a high Sharpe ratio. They call this strategy a risk-adjusted carry trade as opposed to a simple carry trade strategy, which is based on the long and short portfolio on the basis of interest rate and not on the Sharpe ratio rankings. In their research, Jylha & Suominen (2011) observed that a simple carry trade strategy has a monthly Sharpe ratio of 0.223, whereas the risk adjusted carry trade has a monthly Sharpe ratio of 0.159. The results for the two carry strategies are relatively close except that the risk adjusted carry trade has a lower mean and standard deviation (Jylha & Suominen, 2011). Therefore an investor participating in a carry trade strategy should be indifferent in adopting either a simple carry trade or the risk adjusted carry trade.

Jylha & Suominen (2011) used the following equation to calculate the Sharpe ratio:

Equation 3:13 $$\textbf{Sharpe ratio} = \frac{(\textbf{Nominal interest rate} - \textbf{Expected Inflation})}{\textbf{Standard Deviation of unexpected Inflation}}$$

The returns to carry trade have been observed to have a high Sharpe ratio and to be negatively skewed (Nozaki, 2010). In addition to a high Sharpe ratio, carry trade investment has a lower volatility compared to any other assets investment (Das et al., 2013).

Interest rate differential remains the driving force for speculative carry trade (Nishigaki, 2007). However, studies done by Nishigaki (2007) proved that the interest rate differential between Japan and the USA does not have a significant impact on the movement of the carry trade; instead the USA stock price has a dominant impact on the activity of speculative yen carry trade.

Kesriyeli (1994) adopted the Fisher equation for inflation and interest rates, which states that in the long-term equilibrium a change in the rate of growth of money supply leads to a fully

perceived change in inflation and an adjustment of nominal interest rates. Kesriyeli (1994) unpacked the Fisher statement by assuming that real interest rates will not respond to movements in the expected exchange rate in the long-term, changes in inflation will be absorbed in the nominal interest rates (real rates remain constant).

The log-linear form of Fisher hypothesis is given by:

Equation 3:14 $$\mathbf{i_t = r_t + \Delta p_{te}}$$

where

i_t is the logarithm of one plus nominal interest rate,

r_t is the logarithm of one plus real interest rate,

Δp_{te} is the logarithm of the expected change in the price level.

Assuming the real interest rate to be stationary:

Equation 3:15 $$\mathbf{r_t = r^* + \mu_t}$$

where

r^* is a positive constant

μ_t is normally distributed with zero mean and constant variance

Further assuming that the actual and expected inflation differ by stationary zero mean,

Equation 3:16 $$\mathbf{\Delta p_t = \Delta p_{te} + \upsilon_t}$$

where

Δp_t is actual change in price level

$\upsilon_t$is normally distributed with zero mean and constant variance

Substituting Equation 3.15 and Equation 3.16 into Equation 3.14 leads to the following equation:

Equation 3:17 $$\mathbf{i_t = a + b\Delta p_t + n_t}$$

Equation 3.17 is used to test the Fisher hypothesis by testing the existence of co-integration between nominal interest rates (i_t) and inflation rate (Δp_t).

Kesriyeli (1994) tested the long-term relationship between inflation and interest rates using co-integration and these results indicated that there is a long-term relationship between inflation and nominal interest rates (accepting Fisher hypothesis). The paper also tested the long-term co-integration between the domestic and foreign interest rates and this was accepted. This confirms that the UIP is a long-run phenomenon.

The failure of the Fisher relation in the short-term implies that the nominal interest rates do not trend together with domestic inflation and therefore it becomes a challenge to determine the amount of risk associated with carry trade activity.

3.6. Currency Carry Trade Returns and Exchange Rate Volatility

Exchange rate volatility plays a big role in determining carry trade returns. The profit associated with carry trade is sensitive to exchange rate movements and interest rate differentials (Sy & Tabarraei, 2009). Higher exchange rate volatility results in a stronger correlation between the stock market and carry trade strategy and the risk exposures of the carry trade strategy are much more pronounced during volatile periods than during calm periods (Christiansen et al., 2009).

Therefore, the exchange rate is considered volatile compared with the interest rate differential. This was confirmed by James et al. (2009) who studied the uncovered interest parity and carry trade for the performance of G10 currencies since 1975. The study reveals that foreign exchange rate movement has a greater effect on the profitability of carry trade compared to the interest rate differential.

There are other currencies that are considered to be a safe haven in that they benefit from negative exposure to risk assets and they appreciate when market risk and illiquidity increase (Ranaldo & Soderlind, 2009). These currencies are the exact opposite of the carry trade currencies, although the effect might not necessarily exhibit the same pattern.

Exchange rate risk may also be measured by the skewness and kurtosis: skewness is used to show the risk of currency crash and kurtosis measures whether these crashes are abrupt or not (Sy & Tabarraei, 2009). Wagner (2008) insists that the exchange rate changes consist of time-

varying risk components in addition to the forward premium. The regime switching models will be used to model the transition from one regime to another. The volatility based transition variables will be used to fully capture the UIP condition.

3.6.1. Currency Carry Trade Returns

Investors and companies engage in a carry trade activity to make profit by simply capitalising on the interest rate differentials between two currencies and hoping that the high interest rate currency will appreciate. This is what the Premium Puzzle is all about and it is the very reason for the failure of the UIP in the short-term. According to Gyntelberg & Remolona (2007) carry trade returns: (1) are not normally distributed, (2) have positive kurtosis (have heavier tails than normal distribution), and (3) are negatively skewed, reflecting higher frequency of negative returns.

Skewness and kurtosis are used to measure exchange rate risk whereby skewness is used as an indicator of the risk of currency crash while kurtosis measures whether these crashes are abrupt or not (Sy & Tabarraei, 2009). Accordingly, a big negative skewness implies that the exchange rate has appreciated slowly and crashed suddenly while big positive kurtosis means that the crash is fast (Sy & Tabarraei, 2009).

Gyntelberg & Remolona (2007) used value-at risk (VAR) and expected shortfall as a measure of downside risk. They used volatility, VAR and expected shortfall as a measure of risk. The VAR and shortfall are estimated using extreme value theory. They define VAR as capital needed to cover certain level of losses from financial instruments over a given holding period or for a given confidence level and they define expected shortfall as a potential expected loss in a situation where losses exceed a given VAR.

They found that there is a positive relationship between risks and returns for carry trades. Carry trade returns are characterised by a negatively skewed high Sharpe ratio (Nozaki, 2010).

Fong (2010) conducted a stochastic dominance test on the yen carry trade and determined that carry trade is profitable during the pre-crisis period and is characterised by Sharpe ratios higher than the global stock market. The author used data for one month forward exchange rates for the six target currencies. His results for the pre-crisis period, however, show that the

yen carry trade generated higher average returns with lower volatility than the stock market. His results also shed some light on the impact of the carry trade activity on interest rate differential. His finding was that carry trade returns are positively correlated with interest rate differentials. This correlation is more prominent during the pre-crisis period, presumably because of the low volatility regime. However, during the high volatility regime this correlation is very much reduced (Fong, 2010). This indicates that the high interest rate differential is dependent on currency volatility and that an investor should only use the interest rate differential as a speculator engaging in the carry trade activity.

Figure 3.1 shows the pattern for the carry trade returns for Turkey. There is a correlation between the interest rate differential and the carry trade returns. The higher the interest rate differential, the higher the carry trade returns. However, this pattern or correlation only exists during the normal or calm periods. During the crisis periods, such as 2001, the higher interest rate differential does not translate into positive returns. Instead there are carry trade losses and the depreciation of the domestic or the target currency. It is therefore clear that carry trade returns are influenced by the currency regime.

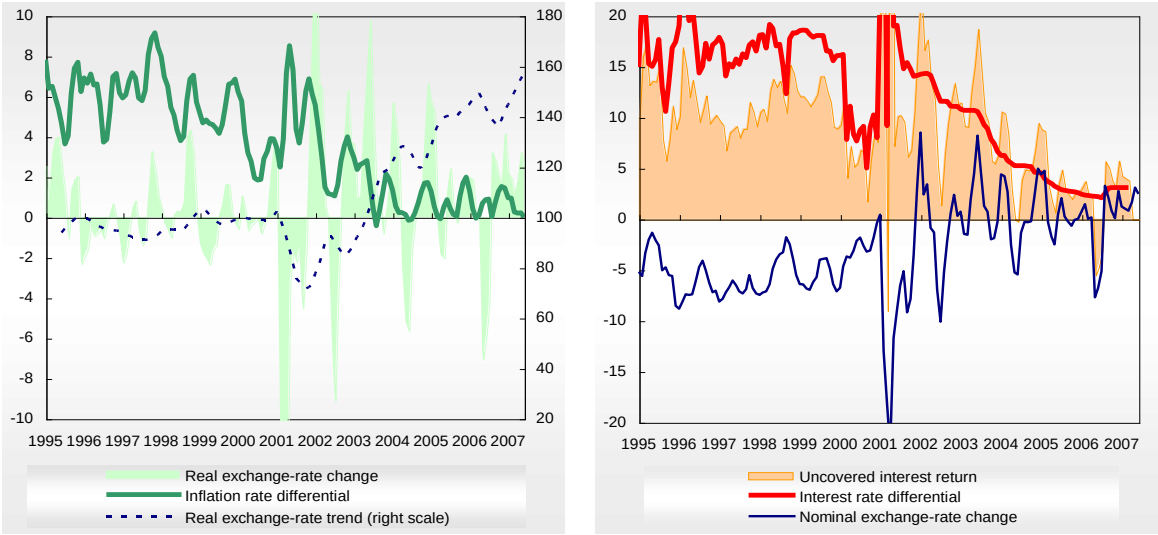

Figure 3:1Uncovered Interest Returns, Exchange Rate Figure Changes, Inflation and Interest Rate Differentials, 1995-2007 Turkey
(*Source*: Flassbeck: *vi.unctad.org/uwist08/sessions/tue0513/ifsflassbeck.ppt)*

These results are also confirmed by the interest rate differential and the excess returns for the South African Rand and the US dollar. Figure 3.2 shows that at a higher exchange rate excess returns could be achieved when the interest rate differential between the US Dollar and the

South African Rand is high. From Figure 3.2 it seems that the high excess returns and the high interest rate differential correlation was during the crisis periods, i.e. 1997/98, 2000/2001 and 2007-2009. However, there were also periods of low interest rate differential and high excess returns. This is also observable for the change in the exchange rate and the interest rate differential as depicted in Figure 3.3 for the British Pound and the South African Rand. Higher interest rate differentials are correlated with high changes in the exchange rate movement for the British Pound and the South African Rand. Both excess returns (Figure 3.2) and the change in exchange rate (Figure 3.3) are very volatile. This shows that the correlation between the interest rate differentials and these variables (excess returns and changes in the exchange rate movement) might not always be one-to-one. This could explain why carry trade investment could either lead to gains or losses.

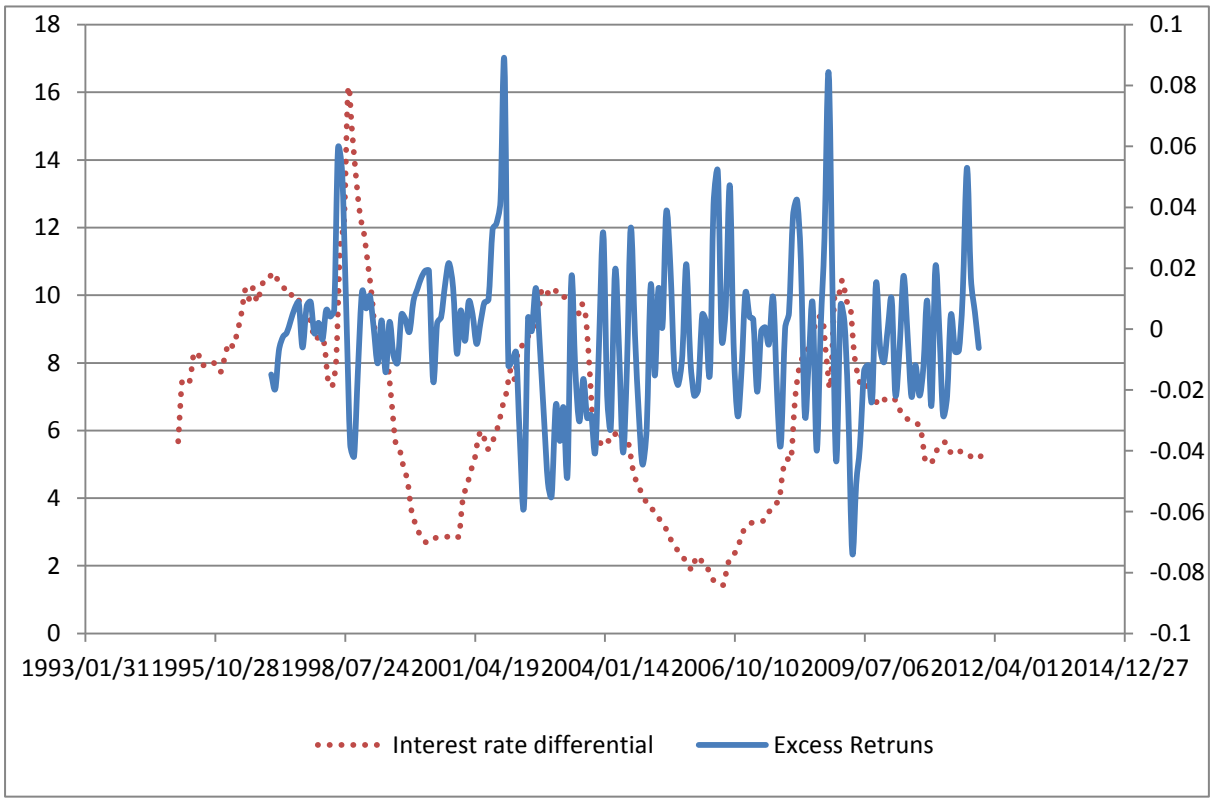

Figure 3:2 Interest Rate Differential and Excess Returns for SA and USA
Source: Author's calculations

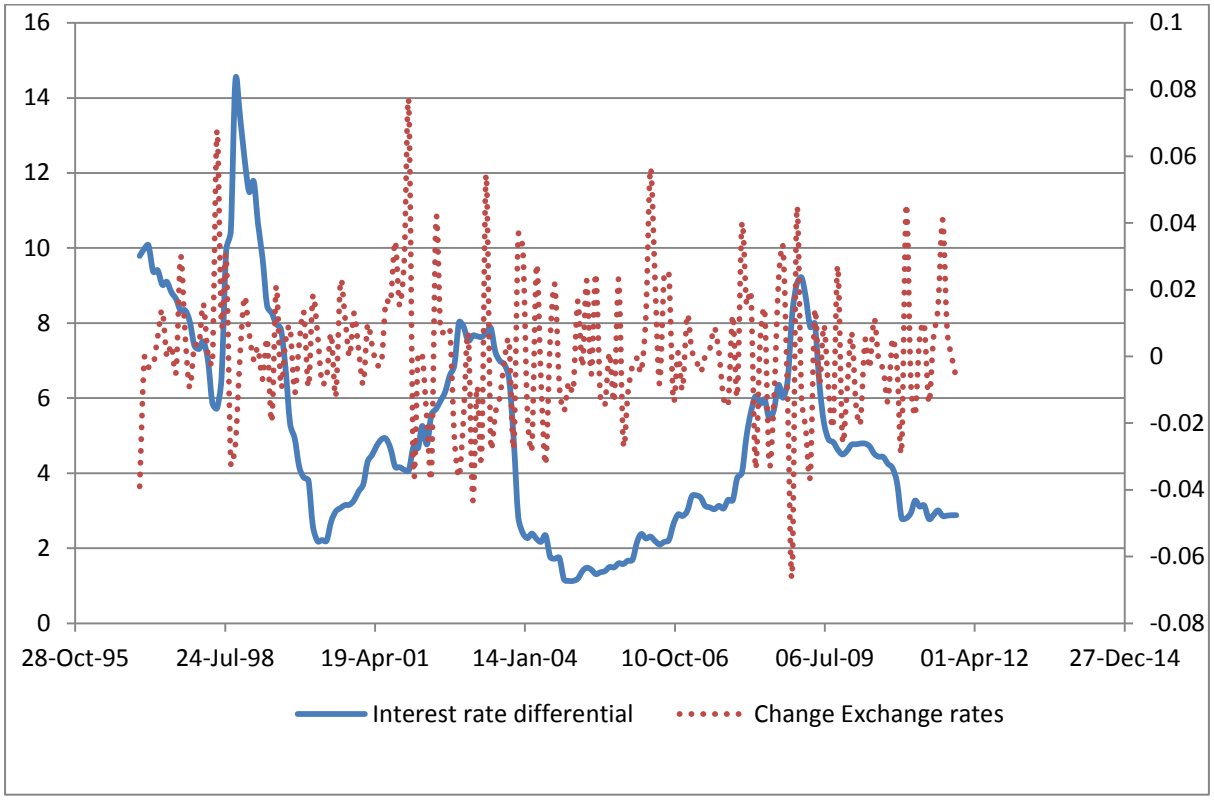

Figure 3:3 Exchange Rate And Interest Rate Differential for SA and UK
Source: Author's calculations

Darvas (2009) did some work on the effect of leverage on forward carry trade positions and he used each of the 11 major currencies as a base currency. He performed a bootstrap test to investigate whether returns are significant or not. His results indicate that when no leverage is used, all individual currency pairs have positive excess returns. When leverage is considered, his results indicate that leverage deteriorates the relationship between returns and risks for all currency pairs and portfolios, that is, the Sharpe ratio is decreasing as a function of leverage. However, his results concluded that with diversification, leverage carry trade portfolio leads to much higher returns and Sharpe ratios than individual currencies. These results do not take into consideration the effect of volatility on carry trade returns.

3.6.2. Exchange Rate Volatility

High exchange rate volatility leads to a violation of the UIP in that low interest rate countries appreciate by more than the interest rate differential compared to high interest rate countries (Clarida et al., 2009). The correlation between the profitability of the carry trade (excess

returns) and the exchange rate volatility is evident from Figure 3.4. A higher volatility index is associated with low exchange rate excess returns. The volatility index (VIX) was used as a proxy to exchange rate market volatility. The volatility index is used to gauge the financial strain as it measures the implied volatility of the S&P 500 (Standard & Poor's 500) index option for the next 30 days (Coudert et al., 2010).

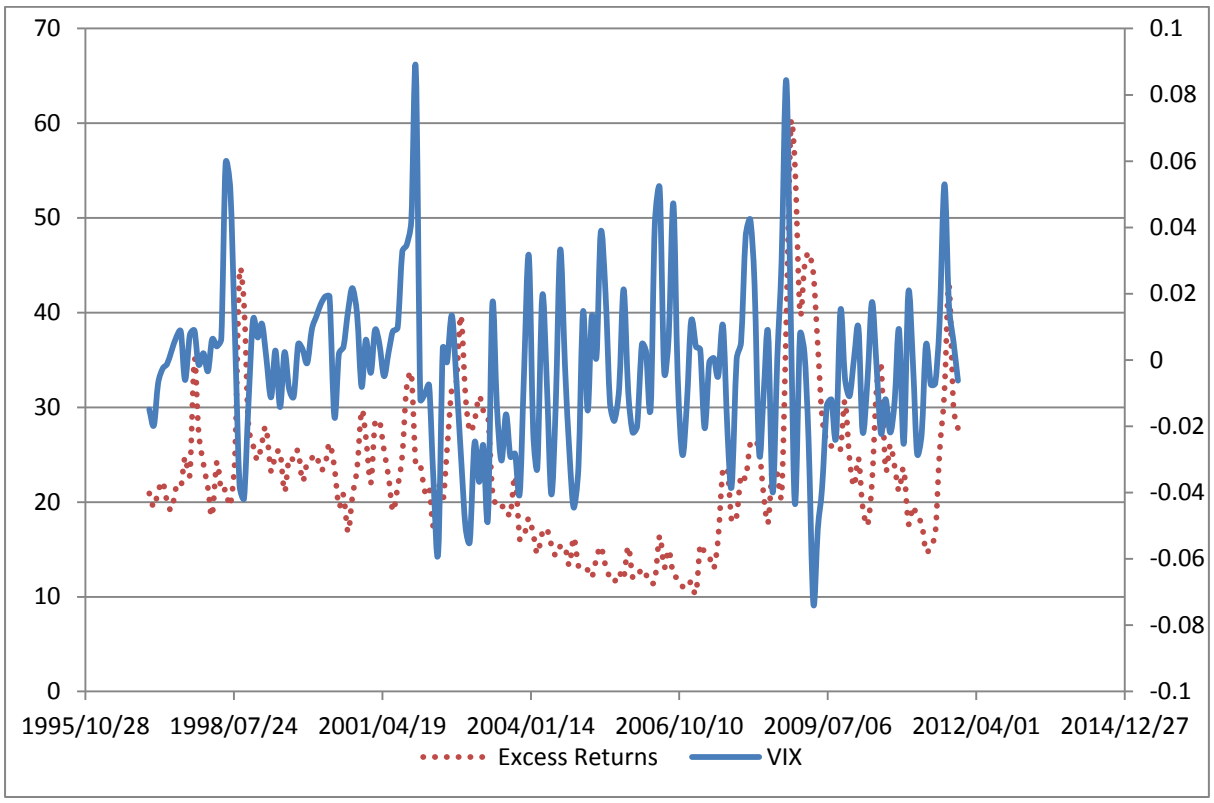

Figure 3:4 Excess Returns and the Volatility Index for the Rand/USD
Source: Author's calculations

Companies and businesses usually use hedging strategies as a defence for exchange rate risk due to currency volatilities. Hedging for exchange rate volatility can be more beneficial for flexible companies when they sell their products in markets where currencies are high and sourcing inputs from countries whose currencies have fallen (Brookes et al., nd). This strategy is similar to the carry trade activity except that it is not motivated by the interest rate differentials.

According to the Reserve Bank of New Zealand, the following instruments can be used to manage currency risk (Brookes et al.,nd):

- **Forward foreign exchange contracts**

This instrument is used when contracting today to buy or sell a foreign currency at a future date at an exchange agreed today. It is used to protect the investor from decreases in the foreign exchange rate market (Fonseca & Rustem, 2012). The forward exchange rate is not the same as the spot rate and this is determined by the interest rate differentials between the two trading countries. The problem with this instrument is that the future rate might be very high probably due to a high projected forward rate and by the time the contract matures the market might be calm compared to the current state of the market. If the market is turbulent, the investor will suffer a loss as result of the exchange rate volatilty. Essentially, the foreign exchange rate is locked at the value of the forward and it is really up to the investor to predict the amount to be gained in the future (Fonseca & Rustem, 2012).

It is therefore important to consider the currency regime before deciding on the forward contract. The carry trade strategy remains superior in that an investor can pull out of the market at any time if the volatility poses a threat to his investment.

- **Structural or balance sheet hedges**

The hedge provided by a forward contract can also be used to borrow or lend in the relevant currency. The forward contracts are mostly favoured for short-term hedging while borrowing and lending in foreign currencies is normally used to establish a long-term structural hedge. A major drawback to balance sheet hedging is that it is limited to large corporations with the financial strength and profile to access offshore debt markets.

- **Invoicing in local currency**

Invoicing in local currency can also be used to manage exchange rate risk by passing it to the trading counterparty. However, this is not sufficient if the selling price is far below the market price. Therefore it is important to negotiate a pricing arrangement in order to benefit from the effect of transferring the exchange rate risk to the trading counterpart. A major drawback to this form of hedging instrument is that it only considers the price and neglects the effect of interest rate differentials between the trading countries.

- **Use of foreign exchange option contracts**

This form of instrument gives the holder the right, not the obligation, to buy or sell one currency in exchange for another at a specified exchange rate at an agreed point in the future. The drawback to this instrument is that the future date might be long to make a decision in

response to exchange rate movements. Compared with the carry trade activity an investor can pull out of the market anytime.

While investors have a choice in using any of the above listed hedging instruments, their drawbacks are outweighed by the benefit of capitalising on the short-term impact of carry trade activity. The profitability of the carry trade is influenced by the exchange rate volatility regime. Christiansen & Ranaldo (2010) used the Logistic Smooth Transition Regression (LSTR) methodology to explain systematic risk associated with carry trade activity for the G10 currencies. They modelled the regimes by adopting proxies used to measure market risk, i.e. foreign exchange volatility and VIX, and the bid-ask spread and the TED (Treasury Euro dollar). They used this to make a distinction between low and high risk environment with a view to fully capturing or understanding the danger associated with carry trade. Their overall findings are that risk exposures of carry trade strategy are much stronger during volatile periods than during calm periods. They concluded that carry trade strategy yields positive and moderately high returns in normal periods and dramatic losses during turbulent periods.

This is confirmed by Menkhoff et al. (2010) who did some work on the relationship between the global foreign exchange volatility risk and the cross-section of excess returns arising from carry trades. Their results indicate that high interest rate countries are negatively related to innovations in global foreign exchange volatility and that carry trade returns are low during times of unexpected high volatility.

Ranaldo & Soderlind (2009) did some work on the safe haven currencies using a factor model that accounts for both linear and non-linear patterns. Their findings indicate that there is a systematic relationship between risk increases, stock market downturns and the appreciation of safe haven currencies. They also did some work on high interest rate currencies to determine whether they exhibit a mirror image of the safe haven currencies. They found that the performance of safe haven currencies mirrors the loss of carry trade speculations and that these currencies are mostly linear. They concluded that safe haven currency effects are systematic and it is not driven by any particular episodes.

The challenge for investors and companies is to determine when to invest in a safe haven currency and when to invest in a carry trade currency. The decision will be based on investment returns and it will be mostly influenced by the risk or the exchange rate volatility

of the market. For a long-term investment it seems that the safe haven investment would be a better option since carry trade is deemed to be unprofitable in the long-term.

Della Corte et al. (2011) brought another dimension to the carry trade strategy by investigating the empirical relationship between spot and forward implied volatility in foreign exchange by testing the forward volatility unbiasedness hypothesis (FVUH). According to their assumptions, the FVUH postulates that forward implied volatility conditional on today's information is an unbiased predictor of the future spot implied volatility. Their work is based on daily implied volatilities for 9 US dollar exchange rates quoted on Over the Counter (OTC) currency options spanning up to fourteen years of data. They formulated the volatility speculation which involves the forward volatility agreement (FVA). They define the FVA as a forward contract on future spot implied volatility. They used the FVA to determine carry trade in volatility (CTV) and compared its performance to carry trade in currency (CTC). Their results show that CTV performs better than CTC. The combination of both CTV and CTC yields significantly more returns. These results indicate that implied volatility plays a significant role in determining carry trade returns. It is therefore important to determine the volatility pattern when adopting carry trade strategy.

3.7. Exchange Rate Volatility Regimes and Carry Trade Activity

Exchange rate movements affect carry trade investment in much the same way as the movement in the nominal interest rates across the trading currencies, even though their magnitude might not necessarily be the same.

Chen (2006) used a Markov-switching model for the nominal exchange rate with time-varying transition probabilities for six developing countries. His motivation for using this model is that it makes it easy to identify how the exchange rate shifts from tranquil to crisis regimes and it also has the ability to identify regimes by data rather than splitting the sample. Further, the model takes into account the linear and non-linear effect for a regime shift. His results show that raising interest rates leads a higher probability of switching to a crisis regime (high exchange rate volatility).

Beyaert et al.(2007) tested the UIP with a two-equation Markov-switching VAR model that links the interest rate differential and the exchange rate variations whereby the autoregressive

coefficients were allowed to vary with the state of the economy. They tested this model for the US Dollar-German Mark and the Spanish Peseta-British Pound data pairs for the period 1973 to 2001. They define state 1 as a regime where the UIP holds and state 2 as regime where the UIP is violated. Their results indicate that for the US Dollar-German Mark pair, the UIP is violated in state 2 which is described as a volatile state. For the Spanish Peseta-British Pound pair the UIP holds regardless of the state. The results for the currencies tested do not provide an explanation for the transition from one state to another, even with the use of the smoothed probabilities, which they claim provide an estimation of the duration of the regime and the intensity of the changes. They do not explain whether these events are abrupt or smooth transitions.

Christiansen et al. (2009) used the logistic smooth transition regression model to describe the systematic risk of carry trade strategies. They modelled regimes by foreign exchange rate volatility, TED (Treasury to Eurodollar) spread, the VIX (volatility index), and bid ask spread. They found that the risk exposures of the carry trade strategy are much stronger during the volatile periods than during the calm periods. They also determined that carry trade strategy yields positive and moderate returns during the calm periods compared to the considerable losses during the periods of turmoil.

In their study Christiansen et al. (2009) found that excess return on carry trade is positively correlated with return on the stock market and negatively correlated with return on the bond market; this is an indication that weak currencies appreciate compared to strong currencies when the stock market booms. Further, weak currencies tend to depreciate against strong currencies when bond prices increase as a result of a decrease in interest rates (Christiansen et al., 2009).

Baillie & Chang (2011) used the logistic smooth transition regression (LSTR) model with transition variables related to the currency carry trading strategies. They believe that the LSTR has an advantage in identifying whether the forward foreign exchange market is in a regime where anomaly is present or whether it is in a regime where the UIP holds. Their paper provides an explanation of the Forward Premium Anomaly (FPA) that is focussed more on trading behaviour than on time dependent risk premia or Peso problems. Momentum traders operate on a positive feedback investment rule, responding to past price movements rather than to expectations about future fundamentals (Baillie & Chang, 2011).

The research by Baillie & Chang (2011) focussed on the combination of carry trade and momentum trading behaviour suggesting that the spot-forward relation might be characterised by two different regimes. In regime one, they say, it is characterised by exchange rate movements that exhibit a persistent deviation from the UIP, and the other regime is characterised by a subsequent reversion to the UIP that is associated with changes in fundamentals.

Their results indicate that the UIP is most likely to hold in low exchange rate volatility regimes and times when carry trade appears attractive on the basis of interest rate differentials and the reversion to the UIP is most likely to be observed during periods of high volatility.

Burnside et al. (2011) investigated the returns of carry trade and momentum strategies for twenty major currencies for the period 1976-2010. They define momentum strategy as going long (short) on currencies for which long positions have yielded (negative) returns in the past. Comparing this strategy to the carry trade strategy, their results indicate that both strategies yield returns of 4.5% (momentum, with standard deviation of 7.3%) and 4.6% (carry trade, with standard deviation of 5.1%). While these two strategies are highly profitable, it must be emphasised that the two strategies cannot be applied in isolation from one another. It is important to identify the transition from one strategy to another and this can be done through examination of the exchange rate volatility regime.

Clarida et al. (2009) did some work on currency carry trade regimes using Kernel regressions which are suitable to model misspecification and potential non-linearities. They estimated a non-parametric relationship between realised volatility and foreign exchange returns using Kernel regressions. Their study only focussed on the G10 low interest rate currencies and G10 high interest rate currencies. Their findings are that carry trade returns are higher in a low currency volatility regime and negative in a high currency volatility regime. Their results are summarised in Table 3.1 below which indicates that a low volatility regime leads to high carry trade returns (13.61% annual average) while a high volatility regime is associated with poor carry trade returns (-9.75% annual average). Therefore the low volatility environment is associated with the appreciation of the high yielding currency which is a clear violation of the UIP (Clarida et al., 2009). However these findings do not indicate or determine the link between the interest rate differential and currency volatilities. This information will help

investors to determine the amount of returns from carry trade activity and also to determine whether to pull out of the market earlier due to volatilities.

Table 3:1 G10 Carry Trade Strategy in high and low volatility states

All currencies			
High Volatility State			
(Above 75th percentile)			
Basket	mean	vol	m/v
1	-9.75	20.72	-0.47
2	-5.01	15.55	-0.32
3	-1.89	12.47	-0.15
4	3.37	10.72	0.31
5	2.34	9.15	0.26
Low Volatility State			
(Below 25th percentile)			
Basket			
1	13.61	10.25	1.33
2	6.06	7.45	0.81
3	6.52	6.21	1.05
4	5.76	5.27	1.09
5	5.97	4.76	1.25
m/v is mean/volatility			

Source: Clarida et al., 2009

Flood & Rose (2002) did a study on 23 developed and developing countries that suffered from crisis in the 1990s. They used standard ordinary least squares regression and the Newey-West standard errors that are robust for both heteroskedasticity and autocorrelation. They found that the UIP works differently for countries in crisis in that both the exchange rate and the interest rate display more volatility. However, their findings point out that there is no tight relationship between the exchange rate changes and the interest rate differential. They concluded therefore, that the interest rate differential is not very useful in predicting exchange rate changes.

Their findings do not make a distinction between the carry trade and momentum trading which was used by Baillie & Chang (2011) in determining whether or not the spot-forward relation is characterised by two different regimes. The results might be misleading if it is not known whether the spot rate and the forward rate are in the same regime or not.

Hai et al. (1997) used parametric models of log spot and forward exchange rates that combine permanent and transitory dynamics. Their model is estimated by the maximum-likelihood using the Kalman filter for the entire sample to obtain an estimate of the expected future spot rate series and these estimated values are subtracted from forward rates to obtain the implied expected excess return series. They concluded that there are positive excess returns during recession. Their results do not take into account the volatility regime pattern for carry trade returns. Further recession is mostly associated with negative returns due to the magnitude of the exchange rate volatility.

3.8. Summary

Investors engage in carry trade activity to exploit the interest rate differentials with a view of making a profit out of this transaction. The UIP theory only restricts them to the short-term period horizons which are regime dependent. An investor would make a significant loss in the currency regime that is highly volatile in the 75th percentile. Therefore the random walk approach based only on interest rate differentials might not be a good move for a carry trade investor. There is a need to precisely establish a regime where the UIP holds and where it does not hold. Some of the studies suggested that the LSTR model is suitable to model both carry trade and momentum trading by identifying the regime where the spot rate and forward rate are located in order to determine the regime where the UIP holds and where it does not hold. In general carry trade returns are associated with a high interest rate differential and a low currency volatility regime. Most of the work has been done for the developed countries and less work has been done for the emerging market economies. It is the intention of this research to determine the impact of currency carry trade activity on an emerging market economy.

CHAPTER 4. PROBLEM STATEMENT AND HYPOTHESES

4.1. Introduction

The preceding chapters have reviewed and discussed the theoretical and empirical issues on carry trade investment and more importantly, the profitability of carry trade in the short-term. Evident from the discussions is that speculative investors only put their bet on currency carry trade investment on the basis of an interest rate differential between two trading currencies. There is no consideration of the risk associated with the movement of the exchange rate. This creates a problem in that volatilities of the exchange rate have a great impact on the profitability of the currency carry trade investment. It is by chance that the speculative investors are able to make a profit.

The objective of this chapter is to unpack the research problem considering the profitability of currency carry trade investment in the short-term and in the long-term, with a view of developing testable hypotheses that will guide the empirical work.

The rest of this chapter is structured as follows: subsection 4.2 discusses the problem statement; subsection 4.3 discusses research questions; subsection 4.4 discusses the hypotheses, and finally, subsection 4.5 summarises the research objectives.

4.2. Problem Statement

This research determines whether the impact of currency carry trade activity for the South African Rand (as the target currency) is influenced by the exchange rate volatility regime and if so, how businesses and companies should do their planning.

The literature review on the subject of currency carry trade activity provided mixed results on the factors that drive or cause the violation of the UIP hypothesis. Some of the studies attribute the short-term failure of the UIP to the exchange rate volatility. (Among authors who tried to address the issue of exchange rate volatility for carry trade activity see Sy & Tabarraei, 2009; Christiansen et al., 2009; James et al., 2009; Ranaldo & Soderlind, 2009; Ichiue & Koyama, 2010).

As pointed out by Clarida et al. (2009), carry trade returns are higher in the low exchange rate volatility regime and negative in the high exchange rate volatility regime. However, their study did not provide guidance on the exchange rate volatility pattern with regards to the conditions or indications of the low and high exchange rate volatility regimes. They used kernel regression to model misspecification and possible nonlinearities. Again, it is not clear from their study how to model the transition from linear to nonlinear for the exchange rate volatility regime.

Peltomaki (2010) determined that carry trade activity is popular during times of low exchange rate implied volatility. This study did not provide the exchange rate implied volatility pattern to quantify the implied volatility regime for maximum profit taking.

Christiansen & Ranaldo (2010) caution that the distinction between low and high risk environments should be taken into account when engaging in carry trade activity. They found that in turbulent times or periods of financial crisis, carry trade's systematic risk tends to increase and exposures to other risky allocations are also affected. This leads to an increase in exchange rate volatility. Higher exchange rate volatility results in a stronger correlation between stock market and carry trade strategy and the risk exposures of the carry trade strategy are much more pronounced during volatile periods than during the calm periods (Christiansen et al., 2009).

Studies by Chinn & Meredith (2004), Gynteberg & Remolona (2007), Galati et al. (2007), Hacker et al. (2010), Bansal & Dahlquist (2000), Beyaert et al. (2007) confirmed that the UIP hypothesis as a framework for carry trade activity does not hold in the short-term because of the inverse relation between the bilateral exchange rates and the interest rate differential. According to Galati et al. (2007), carry trade investment is speculatively used to take advantage of the interest rate differentials and the low exchange rate volatility against the background that the UIP is not expected to hold in the short to medium term.

Drakos (2003) investigated the link between the pattern of the deviation of the UIP and term structure of the cross-currency interest rate spread. The author found that the risk premium is not uniform across maturities. Clearly, the term structure of the interest rate is another pertinent issue to be investigated further. Francis et al. (2002) in their study found that the UIP in emerging markets is systematic in nature and that the significant part of the emerging market currency excess returns is associated with the time-varying risk premium.

Bekaert et al. (2007) studied the UIP and expectation hypotheses of the term structure at long and short horizons. For the UIP and the expectation hypotheses to hold, the following conditions must be met (1) if the UIP holds in the short-term, it should also hold in the long-term provided that the expectation of the term structure of the interest rates holds; and (2) the long-term interest rates must be equal to the average expected future of the short-term interest rates over the life of the bond. The authors found that the UIP and the changes in the exchange rates are weak and negatively correlated with the interest rate differentials and that there is no clear pattern. They concluded that the UIP and expectation hypotheses depend more on currency pair than the horizons.

The following issues have implications for carry trade investment in the South African currency: (1) the deviation pattern of the UIP; (2) the term structure of the interest rates; (3) the UIP and expectation hypotheses for the interest rates; (4) the volatility of the exchange rates, and (5) the currency pairs as opposed to the horizons.

The following section develops the approach to determine the impact of these factors in the context of the South African Rand as the target currency for carry trade activity.

4.3. Research Questions

In order to understand the profitability of currency carry trade investment fully, the following research questions are posed:

A. Does the exchange rate volatility have any impact on currency carry trade investment?

B. Does the profitability of currency carry trade investment depend on the type of currency?

C. Does the profitability of currency carry trade investment depend on time horizon?

D. Does the profitability of currency carry trade investment depend on the interest rate differential between the two trading countries?

E. Is there a link between interest rate differential and the changes in the exchange rate movements?

F. Does the UIP hold in any time horizon?

G. Does the forward rate maturity affect the profitability of currency carry trade investment?

4.4. Hypothesis Development

The UIP hypothesis forms a fundamental approach in testing the profitability of carry trade activity. It has been extensively tested under the linear model. The hypothesis for this research is generalised for testing the UIP under the linear regime, transition regime and nonlinear regime. This research tests the following hypotheses:

H_o: $\alpha = 0$ and $\beta=1$

H_1: $\alpha \neq 0$ and $\beta \neq 1$

This generalised hypothesis for testing the UIP was extended to the development of the following sub-hypotheses:

Hypothesis 1: Exchange rate volatility does not have an impact on the profitability of carry trade investment.

Alternative hypothesis: Exchange rate volatility affects the profitability of carry trade investment.

Hypothesis 1 is tested by considering the Sharpe ratio as the transition variable in the LSTR model. The model is tested for intercept of zero and the slope coefficient of one.

Hypothesis 2: The profitability of carry trade investment does not depend on the type of currency.

Alternative hypothesis: The profitability of carry trade investment depends on the type of currency.

Hypothesis 2 is tested by selecting a different currency as the funding currency. Three currencies are under consideration (British Pound, US Dollar and Japanese Yen).

Hypothesis 3: The profitability of carry trade investment does not depend on the time horizon.

Alternative hypothesis: The profitability of carry trade investment depends on the time horizon.

Hypothesis 3 is tested for the short-term horizon only. The short-term horizon is defined as a maturity period of less than five years. For this research, this hypothesis is tested with forward rate maturities of less than one year.

Hypothesis 4: The profitability of carry trade investment does not depend on the interest rate differential between the two trading countries.

Alternative hypothesis: The profitability of carry trade investment depends on the interest rate differential between the two trading countries.

Hypothesis 4 is as a result of the speculative investors who only focus on the interest rate differential to make a profit out of the carry trade investment. As stated elsewhere in the literature review, interest rates might not necessarily be the only determinant of the profitability of carry trade investment.

Hypothesis 5: There is no link between the interest rate differential and the changes in the exchange rate movements for the two trading countries.

Alternative hypothesis: There is a link between interest rate differential and the changes in exchange rate movements for the two trading countries.

As stipulated by the UIP hypothesis, there is a direct correlation between the interest rate differential and changes in exchange rate movements. It has, however, been proven that the

UIP hypothesis does not hold in the short-term horizon. This research intends to determine if indeed the UIP does or does not hold for the South African Rand as the target currency.

Hypothesis 6: The UIP hypothesis does not hold in the short-term horizon.

Alternative hypothesis: TheUIP hypothesis holds in the short-term horizon.

It has been stated in the preceding chapters that the UIP hypothesis does not hold in the short-term horizon and therefore investors are able to make profit out of the carry trade investment for the short-term horizon. The research intends to prove whether or not this hypothesis is valid. The LSTR model will be tested with the short-term forward rate maturities of up to one year.

Hypothesis 7: Forward rate maturity does not affect the profitability of carry trade investment.

Alternative hypothesis: Forward rate maturity affects the profitability of carry trade investment.

Investors have a choice in deciding on the maturity of the forward rate to invest in. The question that needs to be answered is whether or not the forward rate maturity has any impact on the FPP. The LSTR model will be tested under different forward rate maturities.

4.5. Summary

This chapter discussed the problem statement associated with investment in carry trade. The following issues that have an impact on carry trade investment were identified: (1) thedeviation pattern of the UIP; (2) the term structure of the interest rates; (3) the UIP and expectation hypotheses for the interest rates; (4) the volatility of the exchange rates, and (5) the currency pairs as opposed to the time horizons. Hypotheses were then developed. The following chapter will discuss the research design and it will provide a plan on how to address the research hypotheses.

CHAPTER 5. RESEARCH DESIGN AND ANALYSIS

5.1. Introduction

The previous chapter discussed the research problem and the hypotheses to address it. This chapter discusses the plan for solving the research problem.

The chapter is structured as follows: subsection 5.2 discusses research objectives; subsection 5.3 discusses the research design; subsection 5.4 discusses model selection; subsection 5.5 provides a discussion on the motivation for the selected model; subsection 5.6 discusses model specification; subsection 5.7 discusses the data sources; subsection 5.8 discusses data analysis and finally subsection 5.9 summarises the research design.

5.2. Research Objectives

The overall objective of this research is to investigate currency carry trade profitability using the South African Rand (ZAR) as the target currency. In other words, the study examines whether the UIP holds in the short-term horizon and/or whether exchange rate volatility of the ZAR is favourable for profit taking when investors undertake currency carry trade investments.

5.3. Research Design

The research is based on trading between the South African currency and its three major trading partners (USA, UK, and Japan), according to data provided by the South African Department of Trade and Industry. Their respective currencies are the US Dollar, the British Pound, and the Japanese Yen. The data were collected for the period January 1995 to December 2011 and covered the periods that include major world economic crises. These crisis periods are 1997/1998 (Asian financial crisis), 2000/2001 (Turkish financial crisis) and the 2007/2008 United States subprime financial crisis. These crisis episodes are helpful in determining the exchange rate volatility regime and its impact on currency carry trade investments. Another important factor in the context of the South African economy is that the

data cover the period since the South African markets were liberalised in November 1996 (see Alper et al., 2009; for the discussion on financial liberalisation in emerging markets).

To determine the exchange rate volatility regime on currency carry trade investment, the South African Rand is selected as the target currency.

The exchange rate volatility regime may be characterised by linear and nonlinear patterns. According to Altavilla& De Grauwe (2005), the relation between the exchange rate and its fundamentals is nonlinear, and the nonlinearity is characterised by frequent changes in the regimes linking the exchange rate to the fundamentals.

Therefore choosing a model that only caters for a linear pattern will be misleading because the transition from linear to nonlinear might not be captured. This information is important in explaining the UIP deviation pattern. In this research, a model that caters for the transition between linear and nonlinear is selected.

Baillie & Chang (2011) recommend that the transition variable in this model be specified separately for the interest rate differential and the spot exchange rate returns. In that way, it would be easier to determine whether the exchange rate volatility regime is impacted by the interest rate differential or the spot rate variability.

5.4. Model Selection

The research on the subject of the carry trade and the UIP hypothesis was done using other models that capture either linear or both linear and nonlinear patterns.

These models are being discussed in the context of their strengths and weaknesses, and justification why they were not selected for this research.

Drakos (2003) used a bivariate Vector Auto-Regression (VAR) model. The author used unrestricted VAR parameter estimates to model the term structure of the deviation of the UIP and the cross currency spread pairs of maturities. It was found that the UIP fails for a particular part of maturity due to the presence of different term premiums. This did not explain whether the transition was taken into consideration owing to different maturities.

Meanwhile Bekaert et al. (2007) used a two-equation Markov-Switching VAR model that links the interest rate differential and the exchange rate changes. The autoregressive coefficients were allowed to vary with the state of the economy. Their model defines state (1) as a regime where UIP holds and state (2) as a regime where UIP is violated. The model does not provide any explanation of the transition from one state to another. Even with the use of the smoothed probabilities, which, they claim, provide an estimation of the duration of the regime and the intensity of the changes, they do not explain whether these events are abrupt or smooth transitioning.

Altavilla& De Grauwe (2005) used the Markov-Switching Vector Error Correction Model (MSVECM) to capture different regimes associated with nonlinearity in the relationship between the exchange rate and its fundamentals. They claim that the relation between the exchange rate and its fundamentals is time-varying and constant conditional on the stochastic and unobservable regime shift. They tested the linear part with the VECM with maximum likelihood technique and they then checked for the nonlinearity of the residuals by using a battery of standard tests whereby the shocks to each of the variables in the model were allowed to influence the transition probabilities of moving from one regime to another. The only drawback with this model is that it does not measure the linearity and nonlinearity effects of the exchange rate simultaneously. It also does not provide an explanation on the transitional regime accounting for the magnitude and speed of the regime change from one state to another.

Chen (2006) also used the Markov-Switching specification model of the nominal exchange rate with time-varying transition probabilities. The model was used for the following reasons: (1) it makes it easy to identify how the exchange rate may shift from tranquil to crisis episodes; (2) it assumes that there are only two regimes: low exchange rate volatility regime (tranquil) and high exchange rate volatility regime (crisis); (3) it can model the nonlinearity as part of the time-varying transition probability; and (4) it can identify the regimes by data rather than splitting the sample according to regimes. The author determined that an increase in interest rates leads to a higher probability of switching to a crisis regime. The drawback to this model is that it does not consider the transition from tranquil to crisis episodes and it only identifies the two regimes through a probabilistic determination.

Mylonidis&Paleologou (2011) used the Vector Correction Model (VECM) to test for the co-integration of the real exchange rate with the real interest rate differential in the context of the real interest rate parity (RUIP). The RUIP considers the domestic demand as a possible determinant of the real exchange rate. This model does not take into account the sensitivities associated with the exchange rate fluctuations.

Sarantis (2006) used the Generalised Methods of Moments (GMM) to model the linear and non-linear patterns of the data separately. For the linear part, it was found that the slope of the coefficient of the UIP equation is negative, whereas for the non-linear test it was found that the coefficient is positive and statistically significant. The model explains the structural nonlinear time-varying effect of the foreign exchange risk premium. The only problem with this model is that it does not capture the transition from linear to non-linear.

Clarida et al. (2009) tested the currency carry trade regime using Kernel regressions that are suitable to model misspecification and potential nonlinearities.

They estimated the non-parametric relationship between realised volatility and foreign exchange returns using Kernel regressions to bootstrap standard errors and associated confidence intervals by re-sampling from distribution residuals. Their findings are that carry trade returns are higher in a low currency volatility regime and negative in a high currency volatility regime. However, their model did not capture the transitional currency volatilities from one regime to another.

5.5. Motivation for Using the LSTR Model

The Logistic Smooth Transition Regression (LSTR) model has been selected to model the impact of exchange rate volatility on carry trade activity. The LSTR model has the capability to allow a smooth and continuous shift between two extreme regimes (Lopes & Salazar, 2006; Van Dijk&Terasvirta, 2000; Becker & Osborn, 2010; Davis & Ensor, 2007; Deschamps, 2007; Coudert et al., 2011).

Sarno et al. (2006) studied the deviations from UIP using five major USD exchange rates and forward rates with one- and three-month maturity. Using the LSTR model, they found that the relationship between the spot and forward exchange rate is characterised by significant nonlinearities. They determined that the LSTR model allows for departures at all points and

they chose expected excess returns as the transition variable. They found that a large deviation from the UIP is associated with large effects of speculative forces in generating reversion towards UIP. Lothian & Wu (2011) used the LSTR model to capture the nonlinearity in the UIP by measuring the smooth transition from small to large deviations. They found that the exchange rate movements only respond to large interest rate differential and not the small ones.

McMillan (2009) used the LSTR model to investigate whether the forward premium is able to provide an unbiased estimate of the future spot rate by allowing for asymmetries. The LSTR model was used to capture asymmetric behaviour representing two regimes. One regime is associated with large positive values of forward premium and the other regime is associated with large negative values of forward premium. The model has the ability to detect the middle transition regime whereby the forward premium is small and it is of either sign (positive or negative).

Furthermore, McMillan (2009) compared the performance of the LSTR model with alternative models. The author found that the transition variable in the alternative models is abrupt compared to the LSTR model where it is the continuum of regimes between two extremes. The author concluded that the abruptness is an assumption that the threshold model assumes that all market agents act simultaneously, whereas for the LSTR model the threshold is a smooth adjustment. This view is consistent with Lopes & Salazar (2006) who determined that the LSTR model could allow a smooth and continuous shift between two extremes.

Woodward &Marisetty (2005) used the LSTR model for 50 traded securities in Australia for the period 1986–2001. They found that the LSTR model is suitable for smooth and continuous transition between two regimes and the regimes are nonlinear and smooth rather than abrupt. They determined that the duration of the market condition is an important component to characterise risk as a transition variable.

Baillie &Kiliç (2006) determined that in the LSTR model, the adjustment process occurs in every period and the speed of adjustment is governed by the values of the transition variable, and allows for relatively sharp asymmetries in adjustment process.

Holmes &Maghrebi (2004) used logistic and exponential smooth transition regression models to test for nonlinearities in the real interest rate differential for the South East Asian economies with respect to Japan and the United States of America. These models have the

ability to measure the smoothness of adjustment between two regimes. Therefore, the sharpness of switching from one regime to another can be determined. The difference between logistic and exponential smooth transition models is highlighted by Coudert et al. (2011) who investigated the link between exchange rate volatility and global financial stress during the crisis episodes when using data from twenty-one emerging markets from January 1994 to September 2005. According to the authors (1) for the LSTR model, exchange rate volatility follows two regimes depending on whether the level of global financial stress is low or high. Meanwhile (2) the Exponential Smooth Transition Regression model (ESTR) is designed to deal with situations involving an intermediate regime and it is characterised by the same behaviour or pattern below and above the threshold value.

The LSTR model has the capability to determine the exchange rate volatility pattern, which has an influence on the profitability of currency carry trade investment. The exchange rate volatility pattern is characterised by the low, transitional, and high exchange rate volatility regimes.

5.6. Model Specification

Most of the studies for carry trade activity have assumed that the UIP equation follows the linear pattern (see Chinn & Meredith, 2004; among others). The FPA can also be influenced by the nonlinear pattern, which is governed by the range of transition variables relating to the bands or regimes (Baillie &Kiliç, 2006).

The transition from one regime to another may be characterised by linear and nonlinear patterns. To consider the transition from linear to nonlinear, the regime switching models are recommended.

The fundamental development of the model starts from the CIP condition that is expressed as (Olmo&Pilbeam; 2009, 2011):

Equation 5:1 $$\mathbf{F_t(1 + i_t) = S_t(1 + i_t^*)}$$

where

S_t is the spot of the exchange rate at time t,

F_t is the forward exchange rate at time t,

i_t^* is the foreign interest rate at time t, and

i_t is the domestic interest rate at time t.

Assuming the efficient market hypothesis holds means that the forward rate will coincide with expected spot rate such that (Olmo&Pilbeam; 2009, 2011):

Equation 5:2 $$\mathbf{E(S_{t+1}) = F_t}$$

where $E(S_{t+1})$ is the expected spot exchange rate for time t+1 at time t.

Taking logs of equation (1) leads to an approximation of the CIP:

Equation 5:3 $$\mathbf{f_t - s_t = i_t - i_t^*}$$

where f_t and s_t are the logs of forward exchange rate and spot exchange rate at time t respectively.

Under the UIP condition, the interest rate differential is equal to the expected change in the log of the exchange rate as given by (Olmo&Pilbeam; 2009, 2011):

Equation 5:4 $$\mathbf{E(s_{t+1}) - s_t = i_t - i_t^*}$$

where $E(s_{t+1}) - s_t$ is the expected depreciation of the spot rate.

Under rational expectations, the actual spot exchange rate in period t+1 is given by:

Equation 5:5 $$\mathbf{s_{t+1} = E(s_{t+1}) + \varepsilon_{t+1}}$$

where

s_{t+1} is the log of the spot rate in period t+1,

$E(s_{t+1})$ is the expected spot rate in period t+1 and

ε_{t+1} is the error term and it is serially uncorrelated.

Substituting equation 5.4 into equation 5.5 and taking equation 5.3 into consideration leads to the following equation:

Equation 5:6 $$\mathbf{s_{t+1} - s_t = (f_t - s_t) + \varepsilon_{t+1}}$$

For regression purposes, equation 5.6 can be transformed into equation 5.7 below to test the UIP hypothesis.

Equation 5:7 $$\mathbf{\Delta s_{t+1} = \alpha + \beta(f_t - s_t) + \varepsilon_{t+1}}$$

where the UIP is tested by proving that α= 0 and ß =1.

As elaborated in the sections that deal with the motivation for the LSTR and the selection of the model, it is evident that nonlinearity needs to be taken into account when testing the UIP for the exchange rate volatility regime.

This research adopts the LSTR model from Amri (2008) which alters the above linear equation to include the transition variables to account for the nonlinearity when testing for the UIP as follows:

Equation 5:8 $$\mathbf{\Delta s_{t+1} = [\alpha_1 + \beta_1(f_t - s_t)] + [\alpha_2 + \beta_2(f_t - s_t)]\big(G(z_t, \gamma, c)\big) + \mu_{t+1}}$$

where

$\mu_{t+1}$is a zero mean,

stationary I (0) is a disturbance term and

G (.) is a transition function and it is the logistic function,

which in this model is given by:

Equation 5:9 $$\mathbf{G(z_t, \gamma, c) = (1 + \exp(-\gamma(z_t - c)/\sigma_{zt}))^{-1}, \gamma > 0}$$

where

$z_t$is the transition variable,

σ_{zt} is the standard deviation of z_t,

γ is a slope parameter and

c is a location parameter.

The logistic function for equation 5.8 is bounded between 0 and 1 and depends on the transition variablez_t. The logistic function is governed by the following conditions (Baillie & Chang, 2011; Baillie &Kiliç, 2006; Deschamps, 2007; Davis & Ensor, 2005; Eklund, 2003; Pascalau, 2007; Coudertet al., 2011; Strikholm&Tarasvisrta, 2006 and Amri (2008):

- When $\gamma \rightarrow \infty$, G ($z_t$; γ, c) becomes a step function and the smooth transition model becomes a discrete switching model.
- When $\gamma = 0$, G (z_t; γ, c) = 0.5 for all z_t and the model reduces to a linear regression model with parameters $\alpha = \alpha_1 + 0.5\ \alpha_2$, and $\beta = \beta_1 + 0.5\ \beta_2$

Baillie & Chang (2011) normalised the exponent in equation 5.9 by dividing by σ_{zt}, to make the parameter γ to be scale free to facilitate the convergence of the nonlinear least squares estimation.

The LSTR model can be specified for different transition functions. Equation 5.9 is an example of an LSTR1 model. The transition function is monotonically increasing from 0 to 1 as a result of an increase in the z_t, the transition variable (Kavkler et al., nd; Weng et al., nd).

Another form of the LSTR model is called LSTR2. This model is due to the fact that the transition function does not always follow a monotonic pattern like LSTR1. Instead it is non-monotonous and it is useful for identifying a reswitching such that the transition function is symmetric around the midpoint, i.e. the values lies between 0 and 0.5 (Kavkler et al., nd; Weng et al., nd). To use the LSTR2 model the transition function, G is depicted as follows (Kavkler et al., nd; Weng et al., nd).

Equation 5:10 $$\mathbf{G(z_t\gamma, c) = \left[1 + \exp(-\gamma^{\frac{(z_t - c_1)(z_t - c_2)}{\sigma_{zt}}}\right]^{-1}\ , \gamma > 0}$$

The time series data for each particular country will dictate which the LSTR model is suitable for testing the profitability of carry trade investment when using various transition variables.

5.7. Data Sources

The exchange rate data (spot rate and the forward rate) were collected from DataStream. The interest rate data were collected from the Central Banks of the trading currencies.

The research uses time series data for the following data: spot exchange rates, forward rates, and interest rates.

The South African Rand is used as the target currency for modelling the impact of exchange rate volatility on currency carry trade activity. The base currency for the target currency is the South African Rand (ZAR) per unit of the funding currency.

The data were collected for the following currencies trading against the South African Rand as a base currency: US Dollar (USD), Japanese Yen (JPY), and the British Pound (GBP).

The data were collected for the period January 1995 to December 2011. These data periods cover important information that affected the South African markets, i.e. January 1995–October 1996 cover the period prior to market liberalisation for South Africa; from 1997/1998 Asian financial crisis data were used to assess the impact of this crisis on the carry trade investment for the South African currency; likewise the 2000/2001 Turkish financial crisis and 2007/2008 United States subprime crisis data were used to assess the implication for the carry trade investment for the South African currency.

The data analysis is composed of a sample size of 576 monthly data (16 years for the three currencies). This represents 192 monthly observations for each of the other currencies.

5.8. Data Analysis

Data analysis captures the characteristics of the UIP equation specified in the LSTR model.

Equation 5.8 was used to test the UIP hypothesis by specifying: (1) change in the spot rate depreciation will be regressed against the forward premium ($f_t - s_t$); (2) the Sharpe ratio as the transition variable; (3) the adjusted forward risk premium as the transition variable; (4) the logistic function to be bounded between 0 and 1, and (5) the slope parameter (γ) of the logistic function for $-\infty$ and $+\infty$.

The data analysis was conducted under the following scenarios:

- The whole sample period (1 January 1995–31 December 2011)
- Pre-Asian Crisis (1 January 1995–30 June 1997)
- Asian Crisis (1 July 1997–31 December 1998)
- Post-Asian Crisis (1 January 1999–31 December 2000)
- Asian Crisis including all periods (1 January 1995–31 December 2000)
- Pre-subprime Crisis (1 July 2005–31 December 2007)
- Subprime Crisis (1 January 2008–31 December 2009)
- Post-subprime Crisis (1 January 2010–31 December 2011)
- Subprime Crisis including all periods ((1 July 2005–31 December 2011)
- Pre-Turkish Crisis (1 January 2001–31 December 2001)
- Turkish Crisis (1 January 2002–31 December 2002)
- Post-Turkish Crisis (1 January 2003–31 December 2004)
- Turkish Crisis including all periods (1 January 2001–31 December 2004)

Splitting the sample in this way will allow one to determine the impact of exchange rate volatility for the tranquil periods and for the crisis periods. The sample includes periods of low exchange rate volatility and periods of high exchange rate volatility.

The following variables will be used as transition variables:

- Sharpe ratio: Excess returns/standard deviation of the excess returns. Excess returns can be expressed as s_{t+1} - f_t

- Adjusted Forward rate premium: (f_t – s_t)/standard deviation of the forward premium

5.9. Econometric and Statistical Issues

Time series data are often characterised by a unit root which may deem the data non-stationary. Should a unit root be detected, the data will need to be transformed to make it stationary. Analysing data that are not stationary may give results that are misleading and one

cannot fully rely on those results. An exchange rate volatility regime is characterised by linear and nonlinear patterns. The first requirement of the LSTR model is to conduct a linearity test on the data.

5.9.1. Unit Root Tests

Before testing the model, it is important to conduct unit root and co-integration tests. A non-stationary time series is said to be integrated to order one or I (1) if the series is integrated to order d or I (d), if it must be differenced d times before achieving I(0) series (Davidson & Mackinnon, 2009). Using standard regression methods with variables that are I (1) can yield highly misleading results and it is therefore important to test for the hypothesis that the time series has a unit root (Davidson & Mackinnon, 2009). The null hypothesis is that time series data has a unit root and the alternative hypothesis is that the time series does not have a unit root such that I(0).

According to Davidson & Mackinnon (2009), a regression model is said to be spurious when it finds a relation that does not really exist. According to the authors, a spurious regression involves two different phenomena: (1) testing false null hypothesis, and (2) standard asymptotic results do not hold whenever at least one of the repressors is I (0), even when a model is correctly specified. There are various methods used to test for a unit root, among others are Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP).

5.9.2. Linearity Tests

Linearity tests may be conducted once the unit root tests are done. Since the LSTR model is governed by various regimes (linear, transition and nonlinear) it is imperative to conduct a linearity test before analysing the data. To test for linearity, the following hypothesis is relevant for Equation 5.8:

Null Hypothesis: The LSTR model follows a linear pattern.

Alternative Hypothesis: The LSTR model does not follow a linear pattern.

For the null hypothesis to be true requires that $\gamma = 0$ in equation 5.8 and the alternative hypothesis will require $\gamma > 0$.

5.10. Summary

This chapter examined the important issues that have an implication for the research on carry trade activity for the South African currency as the target currency. These issues are fundamentally based on the UIP and forward unbiasedness hypothesis (FRUH). FRUH states that the forward rate should be an unbiased predictor of the future spot rate, meanwhile the UIP states that the expected future change in the spot rate is determined by the interest rate differential between the two trading countries (Bai&Mollick, 2010). Different models were used to test these hypotheses and the results were mixed. This could be attributed to the deviation pattern of the UIP and the exchange rate volatility regime. The LSTR model was selected for this research because of its strength to measure the transition from linear to nonlinear regime owing to the exchange rate volatility regime.

Briefly the research addresses the following: (1) the term structure of the UIP with respect to the time horizon, (2) the interest rate maturities and their link to the UIP, (3) forward rate unbiasedness hypothesis and its impact on the UIP, (4) the implied exchange rate volatility and the carry trade returns, and (5) the currency pairs with respect to the interest rate differential and the time horizon.

The econometric and statistical issues were also discussed in this chapter. The next chapter discusses the results.

CHAPTER 6. DISCUSSION OF THE RESULTS

6.1. Introduction

This chapter provides the summary and discussion of the results for the LSTR model. Unit root tests were conducted before doing any analysis on the LSTR model. This chapter only provides results for a one month forward rate for the transition variables. The transition variables considered are the Sharpe ratio, the risk adjusted forward premium and the delay parameter. Detailed results are in the appendices. The results will form the basis for hypothesis testing. The results will further confirm if the UIP hypothesis holds or not for the currency selected and for each of the periods under consideration. The rest of this chapter is organised as follows: (6.2) the Unit root test, (6.3) the Sharpe ratio as the transition variable, (6.4) the Risk Adjusted Forward Premium (RAFP) as the transition variable, (6.5) the Delay parameter as the transition variable, and (6.6) a summary of this chapter.

6.2. Unit Root Test

Table 6:1Unit Root Tests for Rand/GBP

Variable	Test statistic (*t*)	Significance levels and Critical values			Comment
		1%	5%	10%	
ΔS_{t+1}	-7.1938	-2.56	-1.94	-1.62	Significant at all levels
f_{t+1}-s_t	-5.5651	-2.56	-1.94	-1.62	Significant at all levels
f_{t+2}-s_t	-4.4840	-2.56	-1.94	-1.62	Significant at all levels
f_{t+3}-s_t	-3.7097	-2.56	-1.94	-1.62	Significant at all levels
f_{t+6}-s_t	-2.4975	-2.56	-1.94	-1.62	Significant at 5% level
f_{t+12}-s_t	-1.7362	-2.56	-1.94	-1.62	Significant at 10% level

Table 6.1 above provides a summary of the unit root test results (Rand/GBP) for ΔS_{t+1} and the forward premium at different forward rates. The results show that both ΔS_{t+1} and the forward premium at different forward rates do not have the unit root at 5% significant level (except 12 month forward premium, which is only significant at 10%). Therefore, these variables are stationary.

Table 6:2 Unit Root Tests for Rand/USD

Variable	Test statistic (*t*)	Significance levels and Critical values			Comment
		1%	5%	10%	
ΔS_{t+1}	-7.9197	-2.56	-1.94	-1.62	Significant at all levels
f_{t+1}-s_t	-5.9062	-2.56	-1.94	-1.62	Significant at all levels
f_{t+2}-s_t	-4.9865	-2.56	-1.94	-1.62	Significant at all levels
f_{t+3}-s_t	-4.2433	-2.56	-1.94	-1.62	Significant at all levels
f_{t+6}-s_t	-2.9629	-2.56	-1.94	-1.62	Significant at all levels
f_{t+12}-s_t	-2.0628	-2.56	-1.94	-1.62	Not Significant at 1% level

Table 6.2 above shows the unit root test results for the Rand/USD. The results show that ΔS_{t+1} is significant at all levels. The forward rate premium is significant at all levels for the forward rates up to six months (and stationary). The 12 month forward is not significant at 1% level.

Table 6:3Unit Root Tests for Rand/Yen

Variable	Test statistic (*t*)	Significance levels and Critical values			Comment
		1%	5%	10%	
$\mathbf{\Delta S_{t+1}}$	-6.5372	-2.56	-1.94	-1.62	Significant at all levels
$\mathbf{f_{t+1}}$-$\mathbf{s_t}$	-1.4045	-2.56	-1.94	-1.62	Not Significant at all levels
$\mathbf{f_{t+2}}$-$\mathbf{s_t}$	-1.2703	-2.56	-1.94	-1.62	Not Significant at all levels
$\mathbf{f_{t+3}}$-$\mathbf{s_t}$	-1.3781	-2.56	-1.94	-1.62	Not Significant at all levels
$\mathbf{f_{t+6}}$-$\mathbf{s_t}$	-1.5197	-2.56	-1.94	-1.62	Not Significant at all levels
$\mathbf{f_{t+12}}$-$\mathbf{s_t}$	-1.4540	-2.56	-1.94	-1.62	Not Significant at all levels

Table 6.3 above shows the unit root test results for the Rand/Yen. The endogenous variable ΔS_{t+1} is stationary but the predictors are not stationary. Since no distributional assumptions on the predictors are necessary in regression modelling the predictors can be used to build the LSTR model without any violation of any prerequisite assumptions. Only the endogenous variable ΔS_{t+1} needs to meet distributional assumptions of stationarity or must be transformed to meet the assumptions before model building can commence.

6.3. Results for Using the Sharpe Ratio as the Transition Variable

This section provides the summary results for the LSTR model when using the Sharpe ratio as the transition variable. The results are mainly for a one month forward rate. Detailed results including other forward rates are in Appendix1, Appendix 2, and Appendix 3.

6.3.1. Long-Term Periods

The following section provides an interpretation of the results for the following long-term periods: December 1996–December 2011 and July 2005–December 2011.

Period: December 1996–December 2011

Table 6.4 and Figure 6.1 (below) provide a summary of the results for the Rand/GBP for a one month forward rate. The Rand/GBP is linear with $\gamma = 0$. The linearity is also confirmed by Figure 6.1, which shows that the Rand/GBP follows a linear trend. In terms of the transition function graph, the linearity is at G (.) = 0.5 (as confirmed by Figure 6.1). The lower regime is when G (.) < 0.5, the middle regime is when G (.) = 0.5 and the upper regime is when G (.) >0.5. The UIP hypothesis holds in the middle regime such that $\alpha = 0$ and $\beta = 1$.

The Sharpe ratio at the lower regime is -2.5 and the Sharpe ratio at the upper regime is 3. The threshold from the lower regime to the upper regime is located at the Sharpe ratio of 0.361.

The maximum profit taking for the Rand/GBP carry trade could be achieved in the upper regime.

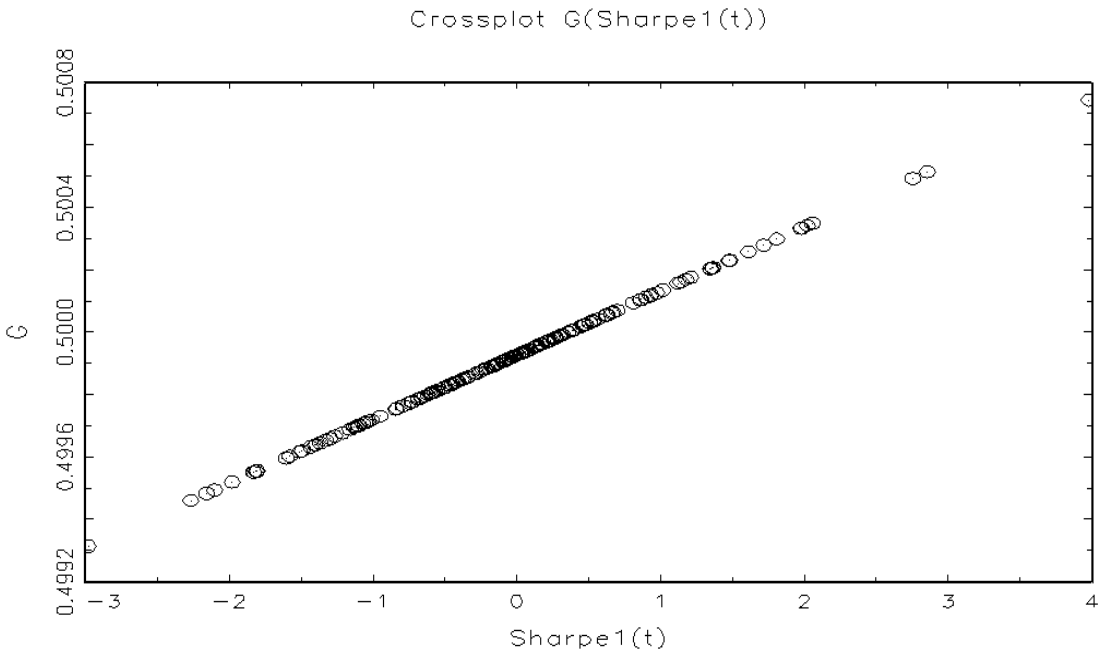

Figure 6:1Rand/GBP Sharpe ratio (1996–2011) One month forward

Table 6:4Sharpe Ratio as Transition variable for period Dec 1996–Nov 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-7.171	0.5654	14.457	0.873	0.00675	2.357
British Pound	-57.864	1.000	115.747	-0.00013	0.00082	0.36123
Japanese Yen	-0.1845	23.508	0.1669	-17.495	2.997	-3.847

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix1 for the results). The results confirm that Rand/GBP is linear at these forward rates and therefore the UIP hypothesis holds in the middle regime. The maximum profit taking for the Rand/GBP carry trade investor could be achieved with Sharpe ratio ranging from threshold to the maximum possible Sharpe ratio in the upper regime.

Table 6.4 and Figure 6.2 (below) provide the summary of results for the Rand/USD for a one month forward rate. These results are almost similar to the Rand/GBP results. UIP hypothesis holds in the middle regime where G (.) = 0.5, α =0 and β = 1 for a one month forward rate when using the Sharpe ratio as the transition variable. The threshold from the lower regime to

the upper regime is occurring at the Sharpe ratio of 2.35. Therefore the maximum possible profit taking for the Rand/USD carry trade investment could be achieved in the upper regime.

The same results are achieved for two months, three months, six months and twelve months forward rates when using the Sharpe ratio as the transition variable (see Appendix 2 for the results). Therefore profitability of the Rand/USD carry trade investment at these forward rates could be achieved from the threshold Sharpe ratio to the maximum possible Sharpe ratio in the upper regime.

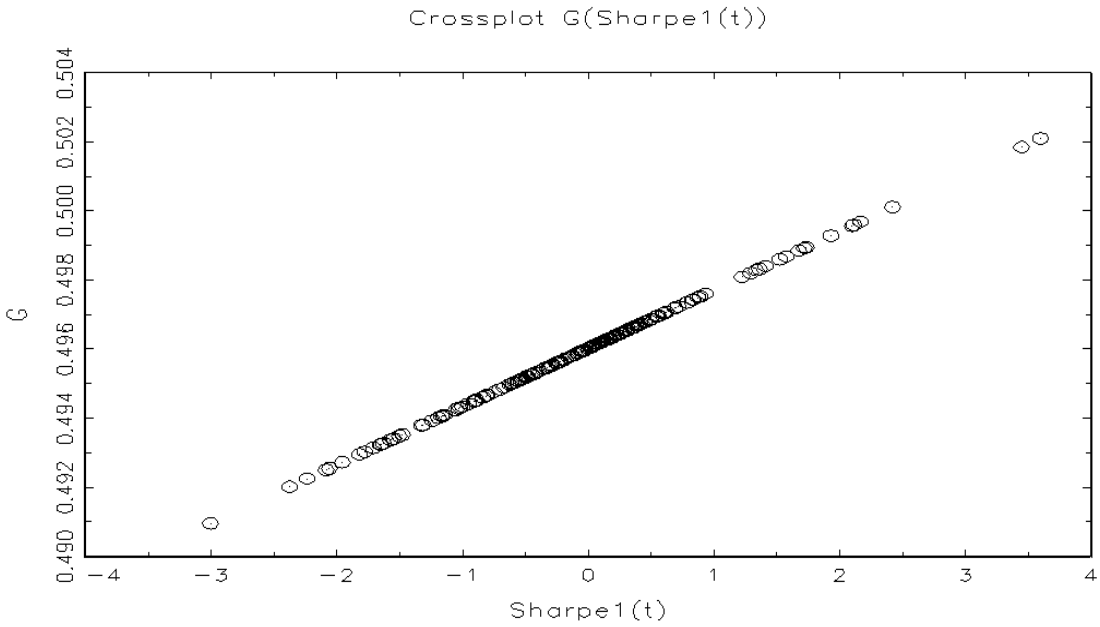

Figure 6:2Rand/USD Sharpe ratio (1996–2011) One month forward

The results for the Rand/Yen are summarised in Table 6.4 and Figure 6.3. The Rand/Yen shows a nonlinear smooth transition from the lower regime to the upper regime with $\gamma > 0$. The transition function is bounded between 0 and 1. The Sharpe ratio at the lower regime is -6 and at the upper regime is -2. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.85. The Rand/Yen carry trade investment is not profitable due to the negative Sharpe ratios. The maximum possible profit could be achieved in the upper regime if the Sharpe ratios are much higher than the prevailing Sharpe ratios.

The results for the two months, three months, six months and twelve months forward rates show that the Rand/Yen is linear with $\gamma = 0$. The UIP hypothesis holds in the middle regime such that $\alpha = 0$ and $\beta = 1$.

The maximum profit taking for the Rand/Yen could be achieved in the upper regime at these forward rates when using the Sharpe ratio as the transition variable.

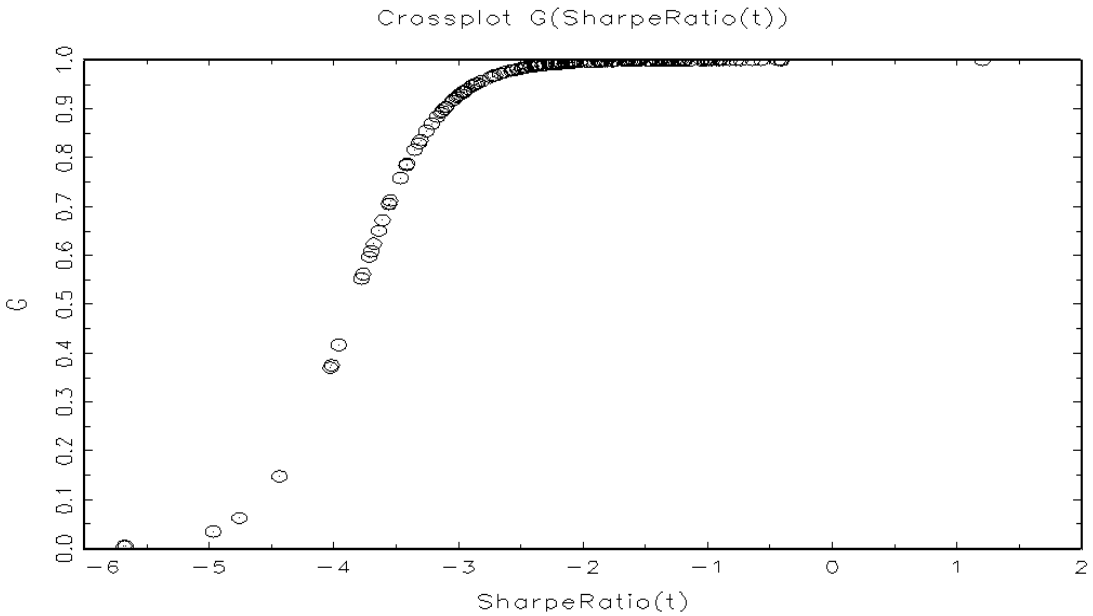

Figure 6:3Rand/Yen Sharpe ratio (1996–2011) One month forward

Period: July 2005–December 2011

Table 6.5 and Figure 6.4 show the results for the Rand/GBP for a one month forward rate when using the Sharpe ratio as the transition variable. The results show that Rand/GBP is linear, $\gamma = 0$, $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore, the UIP hypothesis holds for the middle regime when the Sharpe ratio is used as the transition variable. The minimum Sharpe ratio to be achieved is -3 and the maximum Sharpe ratio to be achieved is 3. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -0.235. The maximum profit taking for the Rand/GBP carry trade investment could be achieved in the upper regime.

Table 6:5Sharpe Ratio as Transition variable for period Jul 2005–Dec 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-40.78357	0.99944	81.58734	0.00112	0.00123	0.41318
British Pound	-35.13977	1.00043	70.26838	-0.00087	0.00132	-0.23450
Japanese Yen	-0.04977	8.42066	0.02038	3.15730	158.45946	-3.08215

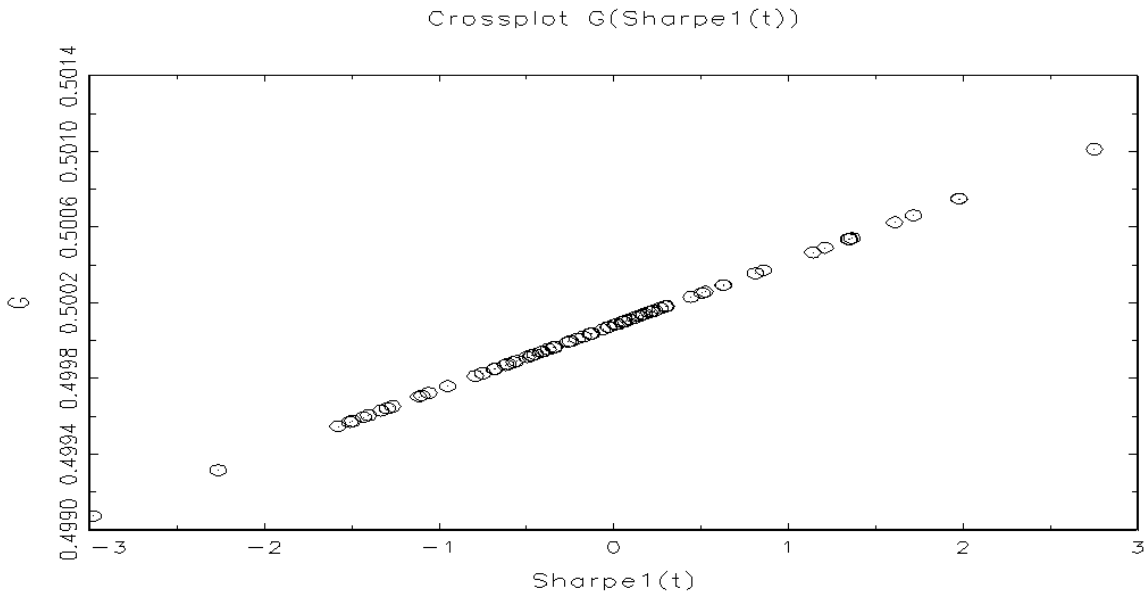

Figure 6:4Rand/GBP Sharpe ratio (2005-2011) One month forward

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore, the UIP hypothesis holds for the Rand/GBP when using the Sharpe ratio as the transition variable for these periods. The maximum profit taking for the Rand/GBP at these forward rates could be achieved in the upper regime.

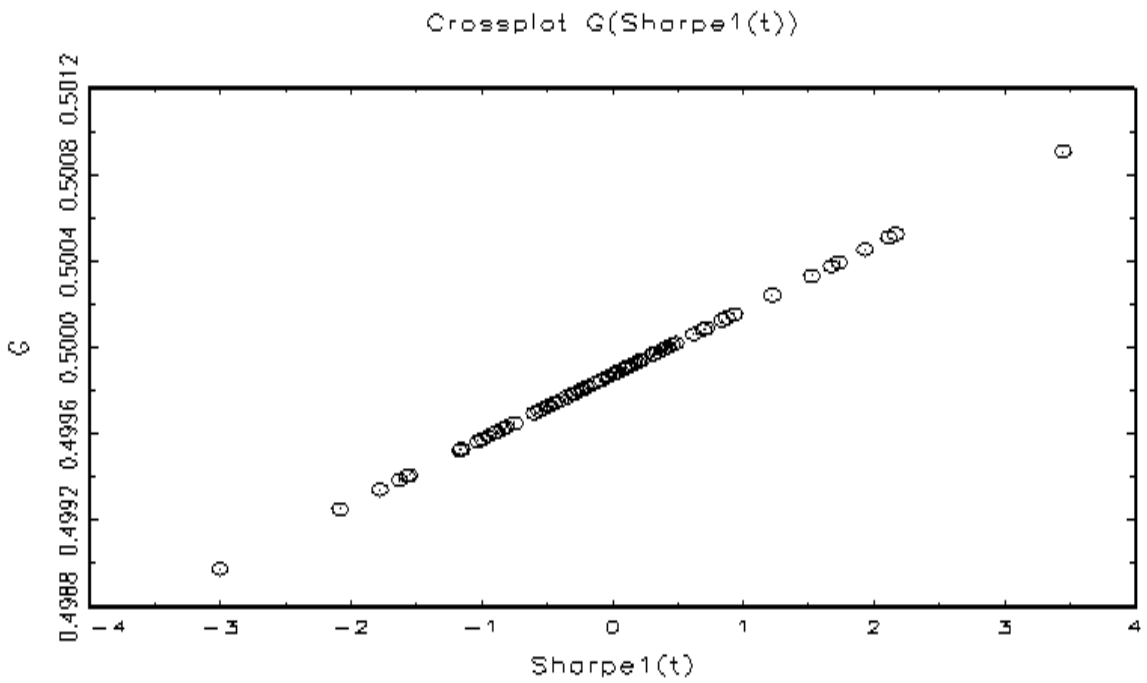

Figure 6:5Rand/USD Sharpe ratio (2005–2011) One month forward

Table 6.5 and Figure 6.5 show the results for the Rand/USD for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/USD is linear with $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore, the UIP hypothesis holds for the middle regime when using the Sharpe ratio as the transition variable. This regime has a minimum Sharpe ratio of -4 and a maximum Sharpe ratio of 4. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of 0.413. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) =0.5. Therefore the UIP hypothesis holds for the Rand/USD when using the Sharpe ratio as the transition variable for these periods. The maximum profit taking for the Rand/USD carry trade activity at these forward rates could be achieved in the upper regime.

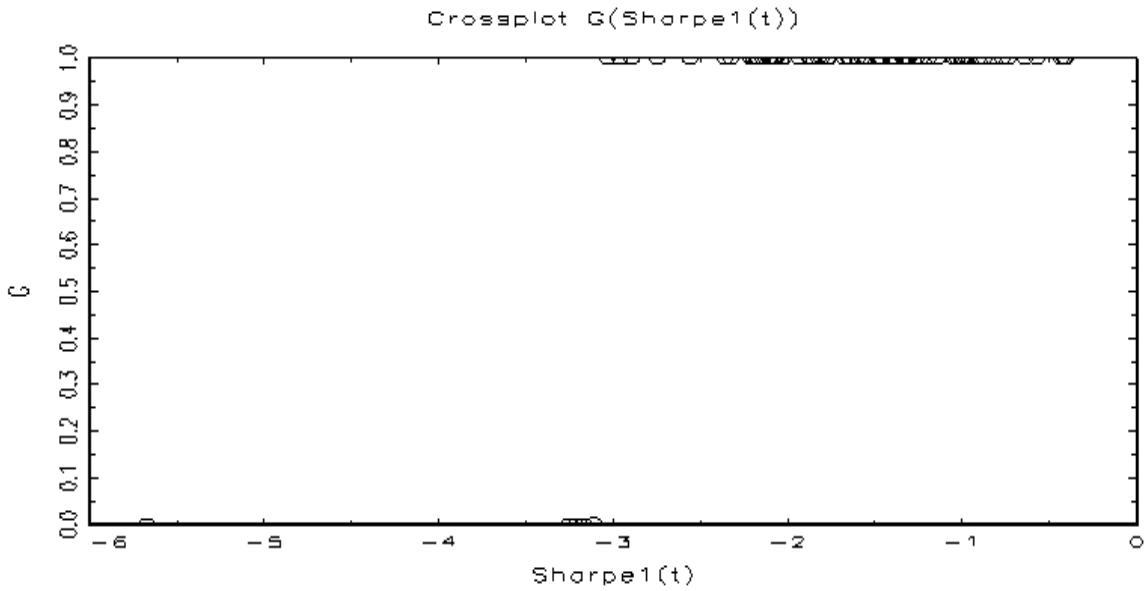

Figure 6:6Rand/Yen Sharpe ratio (2005–2011) One month forward

Table 6.5 and Figure 6.6 show the results for the Rand/Yen when the Sharpe ratio is used as a transition variable for a one month forward rate. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and abrupt from the lower regime to the upper regime. The UIP hypothesis does not hold for one month forward when the Sharpe ratio is used as the transition variable.

The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.08. Since most of the data are concentrated in the upper regime, the maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime when using the Sharpe ratio as the transition variable.

Further tests were conducted for two months, three months, and twelve months forwards (see Appendix 3 for the results).

The results for two months forward rates show that the Rand/Yen is nonlinear and the transition function is mostly abrupt with the Sharpe ratio of -0.6 for the lower regime and 0.2 for the upper regime. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. Therefore carry trade investment is profitable only in the upper regime. UIP hypothesis does not hold for two months forward rate.

Three months forward results show that the Rand/Yen is nonlinear and the transition function is mostly abrupt with the Sharpe ratio of -0.5 for the lower regime and 0.2 for the upper

regime. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. Therefore carry trade investment is profitable only in the upper regime. UIP hypothesis does not hold for three months forward rate.

Twelve months forward rate results show that the Rand/Yen is nonlinear and the transition function is mostly smooth with a Sharpe ratio of -1 for the lower regime and -0.2 for the upper regime. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. UIP does not hold for the twelve months forward rate when using the Sharpe ratio as the transition variable. The maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime.

6.3.2. Short-Term Periods

The following section provides the interpretation of the results for the following short-term periods: December 1996–December 2000, July 1997–December 1998, July 1999–December 2000, January 2001–December 2004, January 2003–December 2004, July 2005–December 2007 and January 2010–December 2011.

Period: December 1996–December 2000

Table 6.6 and Figure 6.7 show the results for the Rand/GBP for a one month forward rate when using the Sharpe ratio as the transition variable. The results show that the Rand/GBP is linear with $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds for the middle regime when using the Sharpe ratio as the transition variable. The Sharpe ratio ranges from -2 (in the lower regime) to 3 (in the upper regime). The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.485. Therefore the maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

Table 6:6Sharpe Ratio as Transition variable for period Dec 1996–Dec 2000

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-27.28485	0.99985	54.58852	0.0029	0.00124	0.38477
British Pound	-31.396	0.9997	62.8167	0.00050	0.00124	0.48512
Japanese Yen	-0.27984	34.65984	0.26854	-30.94688	2.66722	-4.28249

Figure 6:7Rand/GBP Sharpe ratio (1996–2000) One month forward

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/GBP when using the Sharpe ratio as the transition variable for these periods.

The maximum profit taking for the Rand/GBP carry trade activity at these forward rates could be achieved in the upper regime.

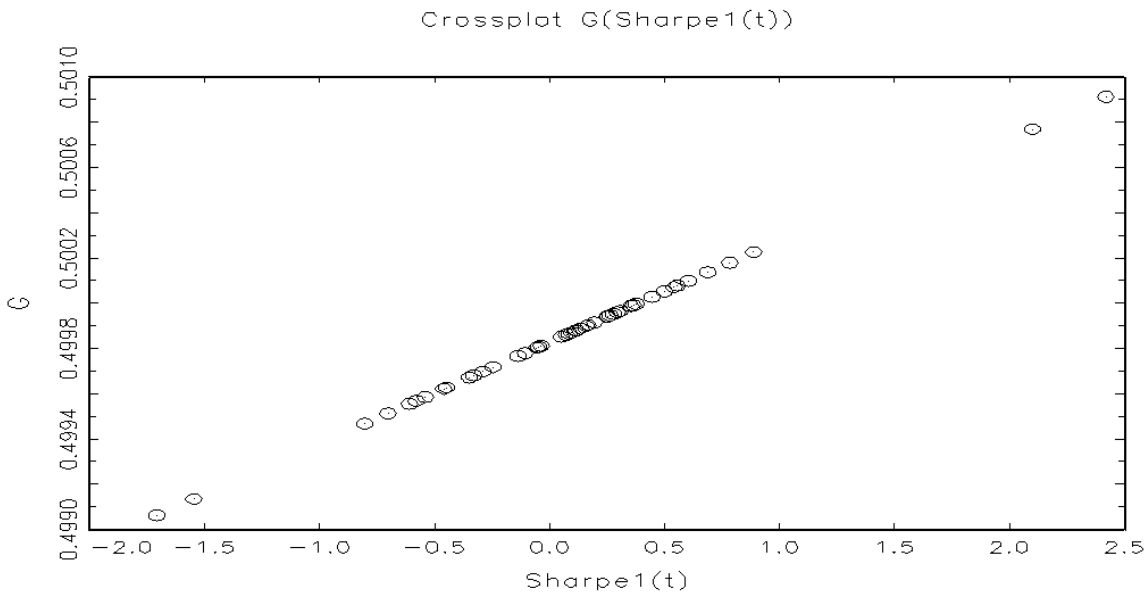

Figure 6:8Rand/USD Sharpe ratio (1996–2000) One month forward

Table 6.6 and Figure 6.8 show the results for the Rand/USD for one month forward when using the Sharpe ratio as the transition variable. The results show that the Rand/USD is linear with $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when using the Sharpe ratio as the transition variable. The Sharpe ratio varies between -2.5 for the lower regime and 2.5 for the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.385. Therefore the maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/USD when using the Sharpe ratio as the transition variable for these periods. The maximum profit taking for the Rand/USD carry trade activity at these forward rates could be achieved in the upper regime.

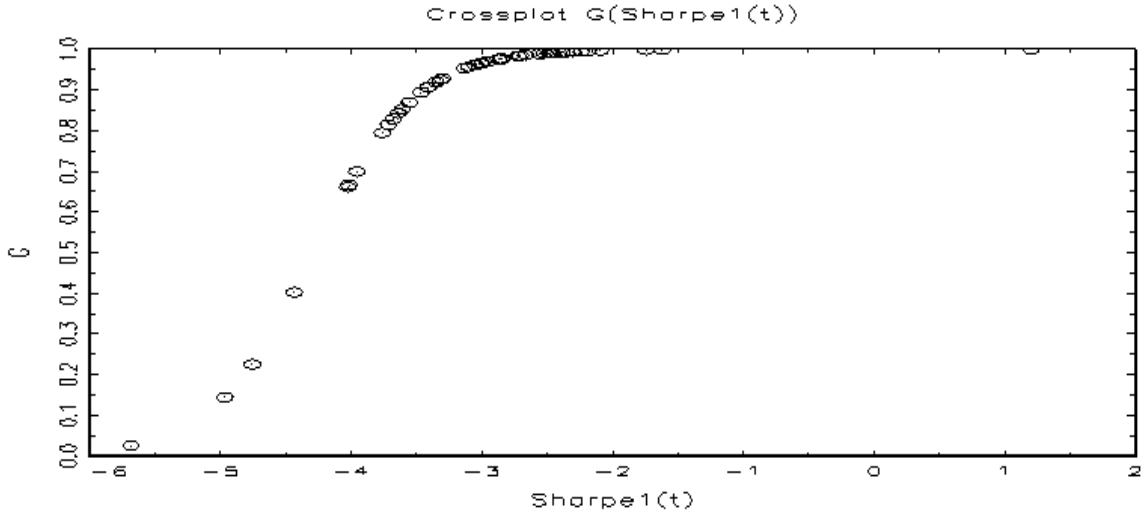

Figure 6:9Rand/Yen Sharpe ratio (1996–2000) One month forward

Table 6.6 and Figure 6.9 show the results for the Rand/Yen for a one month forward rate when using the Sharpe ratio as the transition variable. The transition function is smooth and it is bounded between 0 and 1. The Sharpe ratio ranges from -6 in the lower regime to -2 in the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -4.28. The maximum profit taking for the Rand/Yen could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as the transition variable for these periods. The maximum profit taking for the Rand/Yen carry trade activity at these forward rates could be achieved in the upper regime.

Period: July 1997–December 1998

Table 6.7 and Figure 6.10 show the results for the Rand/GBP for one month forward when using the Sharpe ratio as the transition variable. The results show that the Rand/GBP is linear, $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when using the Sharpe ratio as the transition variable. The Sharpe ratio ranges from -2 in the lower regime to 4 in the upper regime. The threshold from the lower regime to the

upper regime is occurring at the Sharpe ratio of 0.591. Maximum profit taking for the Rand/GBP could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/GBP when using the Sharpe ratio as the transition variable for these forward rates.

The maximum profit taking for the Rand/GBP carry trade activity at these forward rates could be achieved in the upper regime.

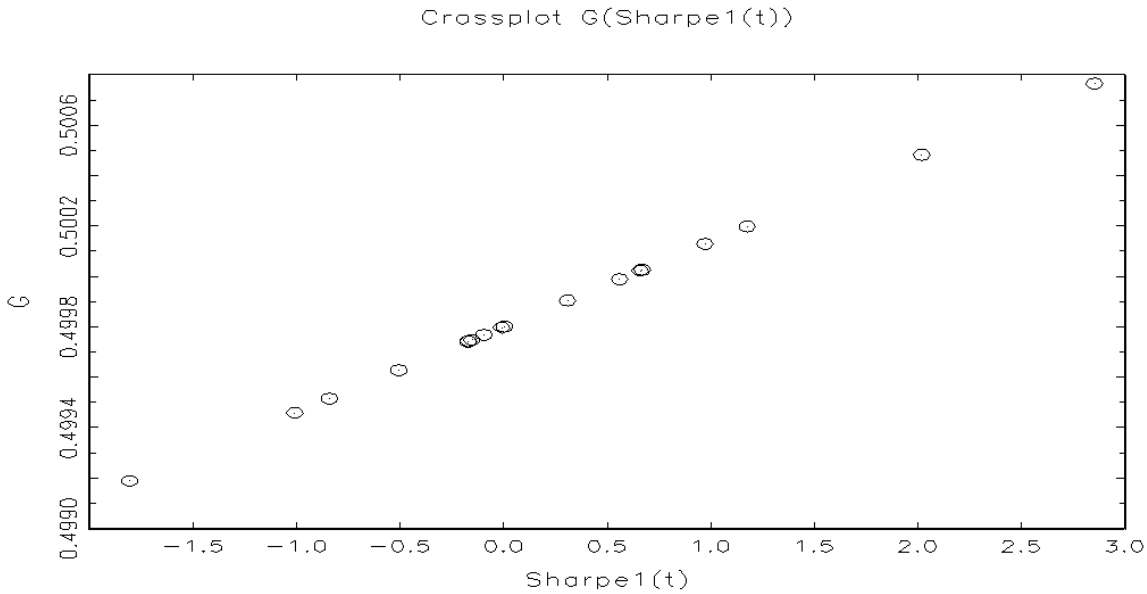

Figure 6:10Rand/GBP Sharpe ratio (1997–1998) One month forward

Table 6:7Sharpe Ratio as Transition variable for period July 1997–Dec 1998

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-28.27956	0.99987	56.57581	0.00027	0.00170	0.34132
British Pound	-35.16380	0.99966	70.35577	0.00069	0.00147	0.59184
Japanese Yen	-0.26201	32.78847	0.22966	-26.75941	325.49116	-4.02719

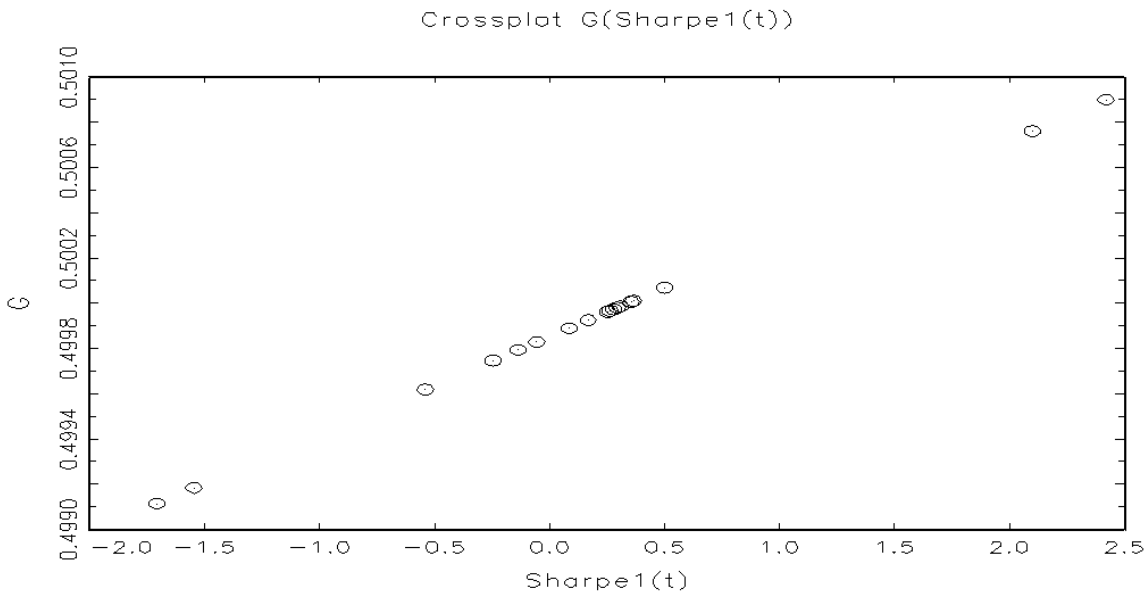

Figure 6:11Rand/USD Sharpe ratio (1997–1998) One month forward

Table 6.7 and Figure 6.11 show the results for the Rand/USD for one month forward when using the Sharpe ratio as the transition variable. The results show that the Rand/USD is linear, $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The Sharpe ratio ranges from -2 in the lower regime to 2.5 in the upper regime. The threshold from the lower regime to the upper regime is occurring at 0.341. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 2 for the results). The results show that theRand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for theRand/USD when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking at these forward rates for the Rand/USD could be achieved in the upper regime.

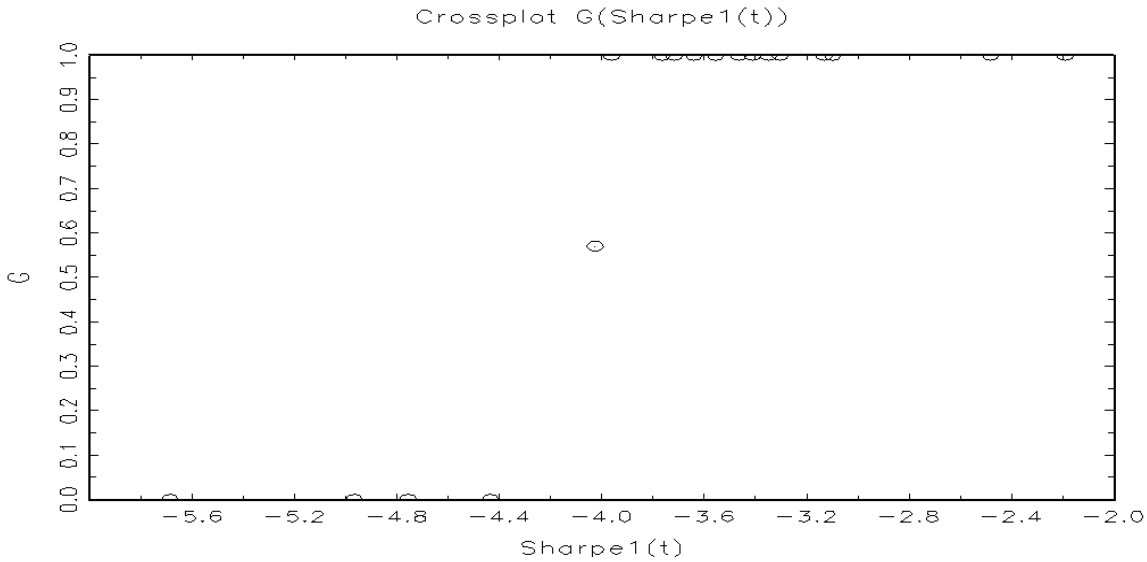

Figure 6:12Rand/Yen Sharpe ratio (1997–1998) One month forward

Table 6.7 and Figure 6.12 show the results for the Rand/Yen when using the Sharpe ratio as the transition variable for a one month forward rate. The results show that Rand/Yen is nonlinear ($\gamma>0$) and the transition from lower regime to the upper regime is very abrupt. The lower regime has a Sharpe ratio of -4 and the upper regime has a Sharpe ratio of -5.6. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -4.03.

The UIP hypothesis does not hold for one month forward when the Sharpe ratio is used as the transition variable. The maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime provided that the Sharpe ratios are improved.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking at these forward rates for the Rand/Yen could be achieved in the upper regime.

Period: July 1999–December 2000

Table 6.8 and Figure 6.13 show the results for the Rand/GBP for a one month forward rate when using the Sharpe ratio as the transition variable. The results show that the Rand/GBP is

linear with $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The Sharpe ratio ranges from -1 in the lower regime to 1.2 in the upper regime. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -0.12. The maximum profit taking for the Rand/GBP could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for Rand/British Pound when using the Sharpe ratio as the transition variable for these forward rates.

The maximum profit taking for the Rand/GBP carry trade activity at these forward rates could be achieved in the upper regime.

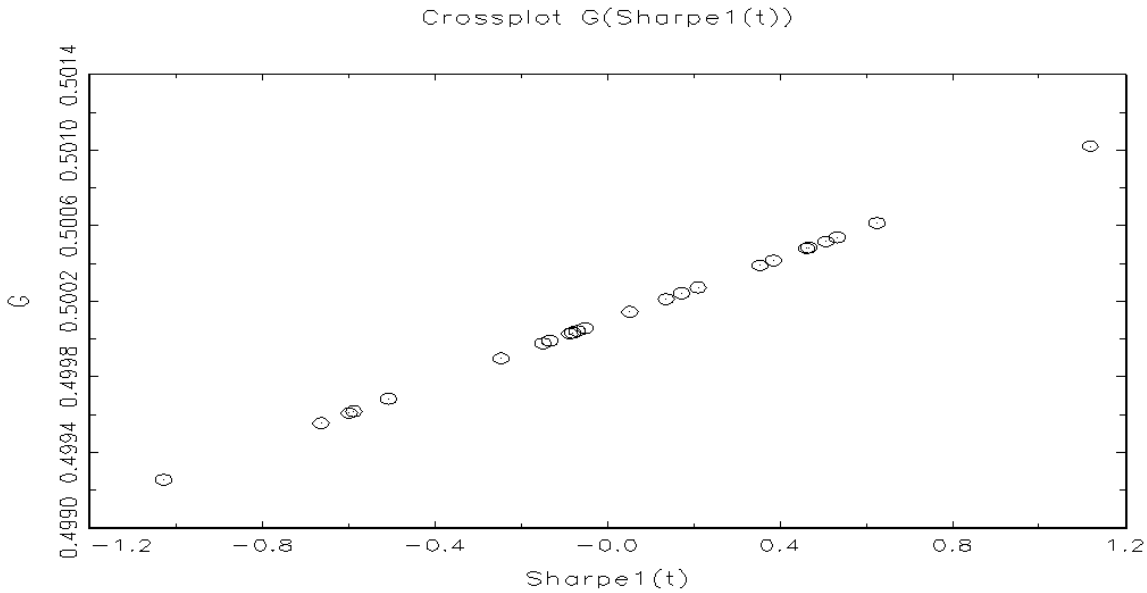

Figure 6:13Rand/GBP Sharpe ratio (1999–2000) One month forward

Table 6:8 Sharpe Ratio as Transition variable for period July 1999–December 2000

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-13.01925	0.99991	26.04441	0.00018	0.00172	0.12103
British Pound	-14.45495	1.00072	28.90417	-0.00143	0.00162	-0.12044
Japanese Yen	-0.00464	1.81082	-1.37062	476.88005	205436.2280	-1.72884

Table 6.8 and Figure 6.14 show the results for the Rand/USD for one month forward when using the Sharpe ratio as the transition variable. The results show that the Rand/USD is linear with $\gamma = 0$, $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when using the Sharpe ratio as the transition variable. The Sharpe ratio ranges from -0.80 in the lower regime to 1.0 in the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.12. Maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

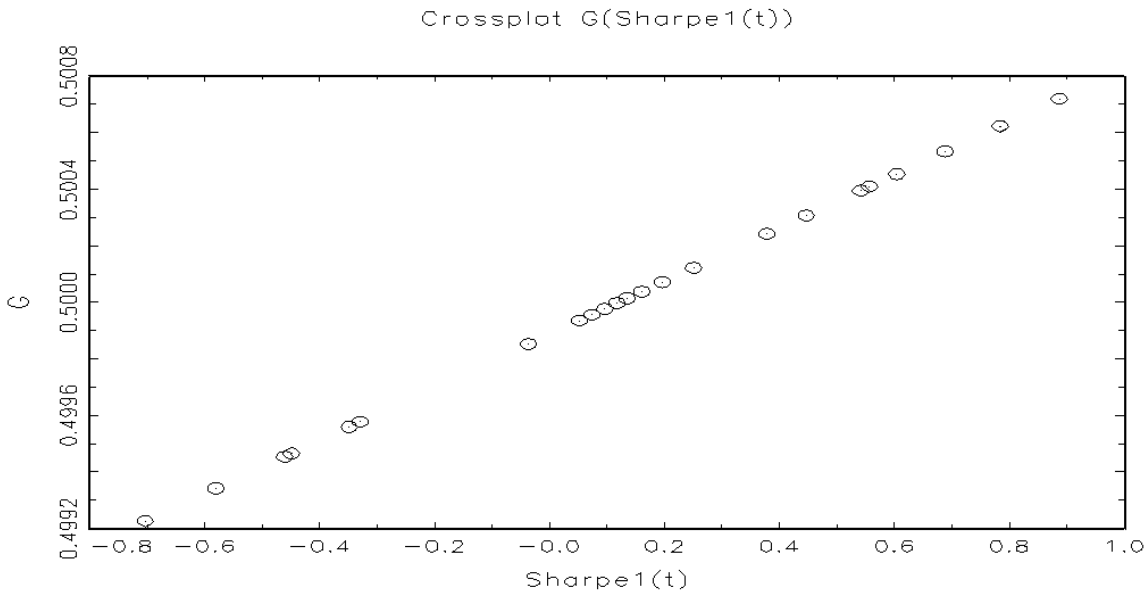

Figure 6:14Rand/USD Sharpe ratio (1999–2000) One month forward

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/USD when using the Sharpe ratio as the transition variable for these forward

rates. The maximum profit taking for the Rand/USD carry trade activity at these forward rates could be achieved in the upper regime.

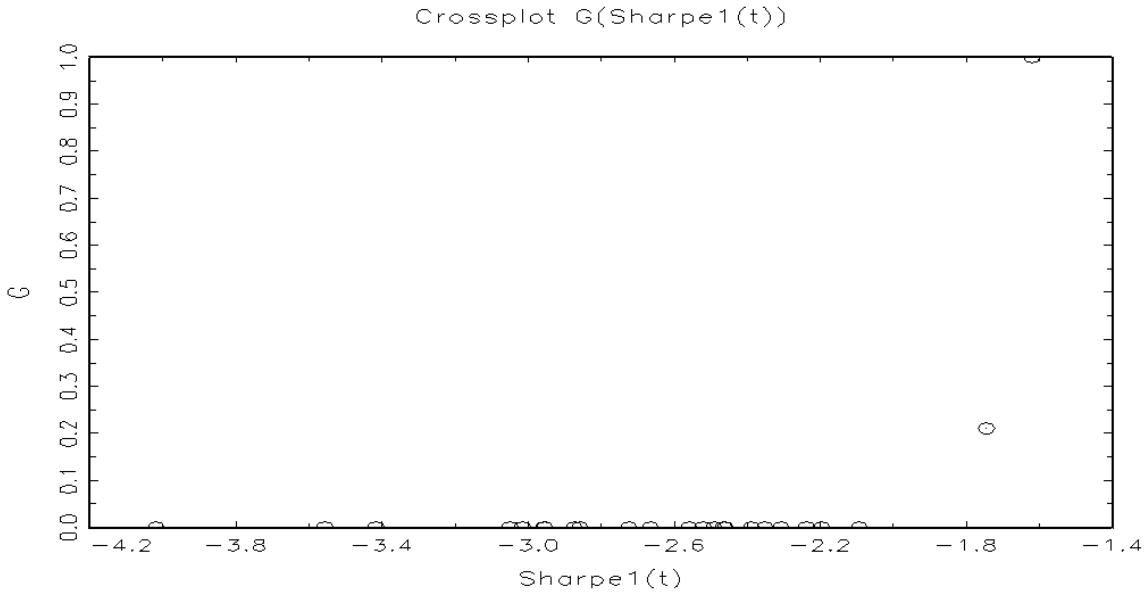

Figure 6:15Rand/Yen Sharpe ratio (1999–2000) One month forward

Table 6.8 and Figure 6.15 show the results for the Rand/Yen when using the Sharpe ratio as the transition variable for a one month forward rate. The results show that Rand/Yen is nonlinear ($\gamma>0$) and there is no transition from the lower regime to the upper regime. The Sharpe ratio is mostly concentrated in the lower regime with a Sharpe ratio of -4.2. Therefore carry trade is not profitable during this period for the Rand/Yen when the Sharpe ratio is used as the transition variable for one month forward. The UIP hypothesis does not hold for a one month forward when the Sharpe ratio is used as the transition variable.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with α = zero, β = one and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/Yen carry trade activity at these forward rates could be achieved in the upper regime.

Period: January 2001–December 2004

Table 6.9 and Figure 6.16 show the results for the Rand/GBP when the Sharpe ratio is used as the transition variable for one month forward. The Rand/GBP exhibits a smooth transition from the lower regime to the upper regime. The results show that the Rand/GBP is nonlinear ($\gamma>0$) and the transition function is slightly smooth from the lower regime to the upper regime. The transition function G (.) is bounded between 0.2 and 0.8. The Sharpe ratio ranges from -2.5 in the lower regime to 4 in the upper regime. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of 0.80. The maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime.

Table 6:9Sharpe Ratio as Transition variable for period Jan 2001–Dec 2004

	α_1	β_1	α_2	β_2	γ	c
US Dollar	-47.01971	1.00012	94.06014	-0.00024	0.00123	0.42374
British Pound	-0.10393	0.93418	0.24728	0.11956	0.52030	0.79925
Japanese Yen	1.64721	-250.22855	-1.66129	253.58524	43.97037	-3.56757

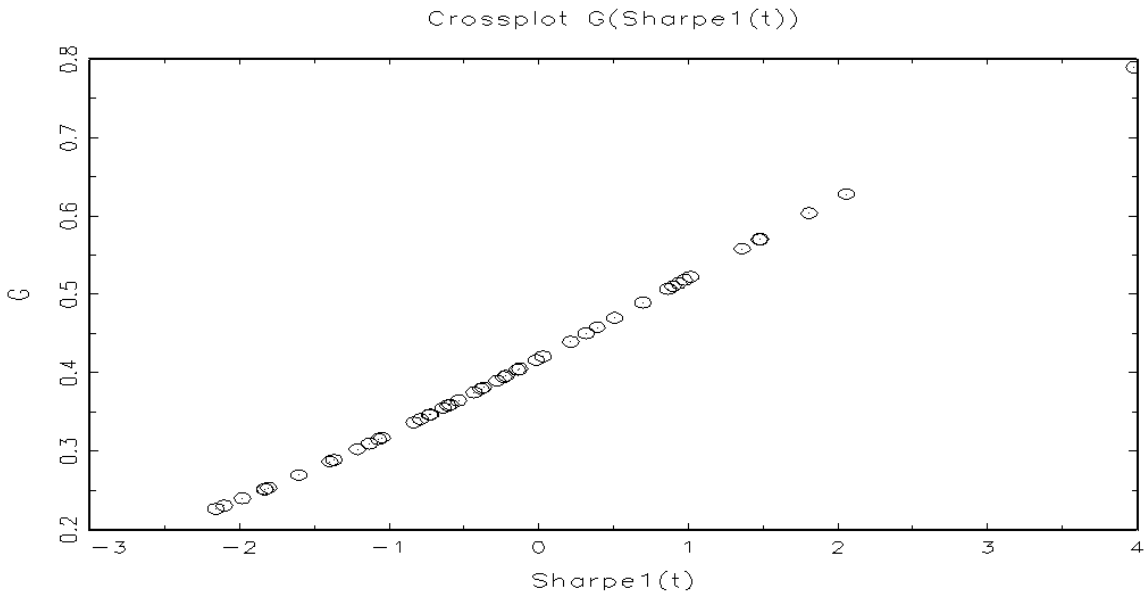

Figure 6:16 Rand/GBP Sharpe ratio (2001–2004) One month forward

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 1 for the results).

Two months forward results show that the Rand/GBP is nonlinear ($\gamma>0$) and the transition function is smooth from the lower regime to the upper regime. The Sharpe ratio for the lower regime is at -1 and for the upper regime it is at 1. The lower regime is at G (.) = 0.2 and the upper regime is at G (.) = 0.8. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.8. Therefore maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime. The UIP hypothesis does not hold for the two months forward rate.

Nine months forward results show that the Rand/GBP is nonlinear ($\gamma>0$) and the transition function is smooth from the lower regime to the upper regime. The Sharpe ratio for the lower regime is at -6 and for the upper regime is at 6. The lower regime is at G (.) =0.2 and the upper regime is at G (.) = 0.8. Therefore the Rand/GBP carry trade activity is profitable in the upper regime. The UIP hypothesis does not hold for two months forward rate.

For three months and six months forward, the results show that the Rand/GBP is linear at these forward rates with α =0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds for

the Rand/GBP when using the Sharpe ratio as the transition variable for three and nine month forward rates.

The maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

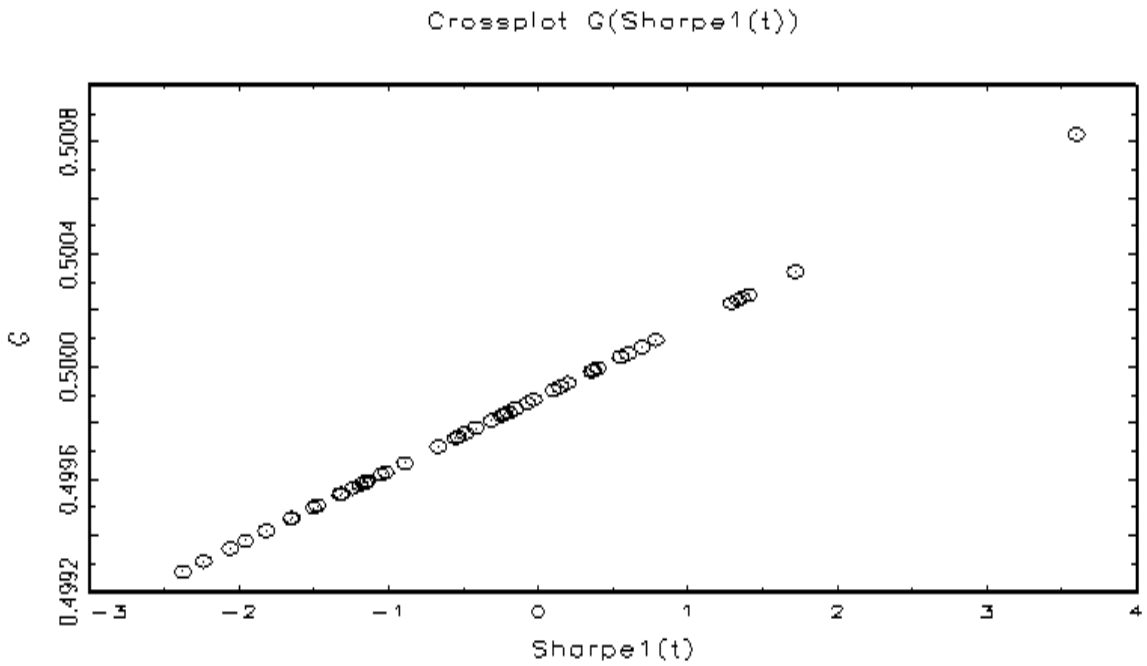

Figure 6:17Rand/USD Sharpe ratio (2001–2004) One month forward

Table 6.9 and Figure 6.17 show the results for the Rand/USD for one month forward when using the Sharpe ratio as the transition variable. The results show that the Rand/USD is linear with $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. On average the Rand/USD should not yield any profit. The profit made when the Sharpe ratio is slightly above the middle regime will be offset by the loss made when the Sharpe ratio is slightly below the middle regime. Therefore the maximum profit taking could be achieved when the Sharpe ratio is in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for

the Rand/USD when using the Sharpe ratio as a transition variable for these forward rates. The maximum profit taking for the Rand/USD carry trade at these forward rates could be achieved in the upper regime.

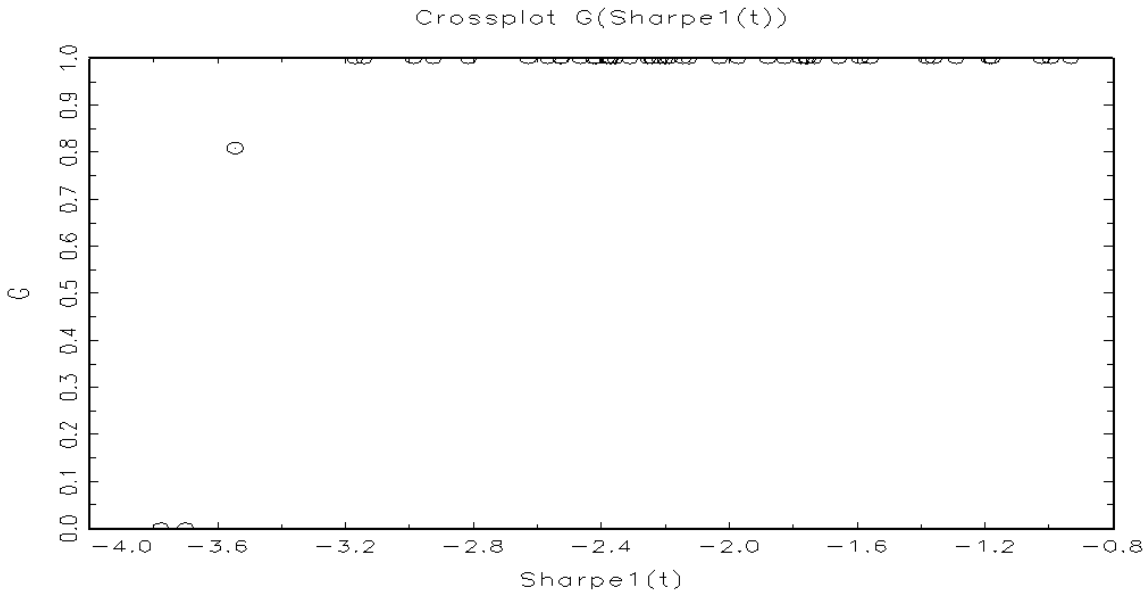

Figure 6:18Rand/Yen Sharpe ratio (2001–2004) One month forward

Table 6.9 and Figure 6.18 show the results for the Rand/Yen when using the Sharpe ratio as a transition variable for a one month forward rate. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and there is no transition from the lower regime to the upper regime. The Sharpe ratio is mostly concentrated in the upper regime with a Sharpe ratio of -3.2. Carry trade was not profitable during this period. The UIP hypothesis does not hold for a one month forward when Sharpe ratio is used as the transition variable.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 3 for the results).

Two months forward rate results show that the Rand/Yen is nonlinear ($\gamma>0$) and transition function is smooth from the lower regime to the upper regime. The Sharpe ratio for the lower regime is at -0.8 and for the upper regime is at 0.6. The lower regime is at G (.) = 0.2 and the upper regime is at G (.) = 0.8. Therefore the Rand/Yen carry trade activity is mostly

profitable in the upper regime. The UIP hypothesis does not hold for a two months forward rate.

For three months, six months and 12 months forwards, the results show that the Rand/Yen is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/Yen carry trade at these forward rates could be achieved in the upper regime.

Period: January 2003–December 2004

Table 6.10 and Figure 6.19 show the results for the Rand/GBP for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/GBP is linear with $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -0.115. The maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

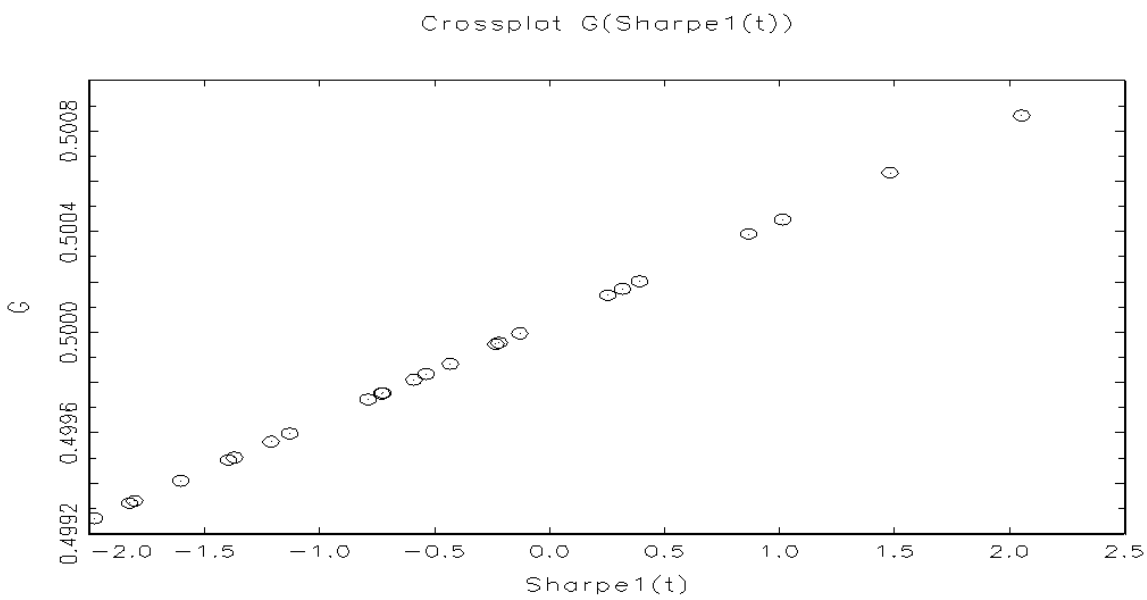

Figure 6:19Rand/GBP Sharpe ratio (2003–2004) One month forward

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with α = 0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/GBP when using the Sharpe ratio as a transition variable for these forward rates. The maximum profit taking for the Rand/GBP at these forward rates could be achieved in the upper regime.

Table 6:10Sharpe Ratio as Transition variable for period Jan 2003– Dec 2004

	α_1	β_1	α_2	β_2	γ	c
US Dollar	-25.10664	1.00034	50.19253	-0.00069	0.00191	-0.42420
British Pound	-29.97879	1.00024	59.95206	-0.00048	0.00170	-0.11592
Japanese Yen	0.24008	-45.42141	-0.24870	46.21408	152.44646	-2.53043

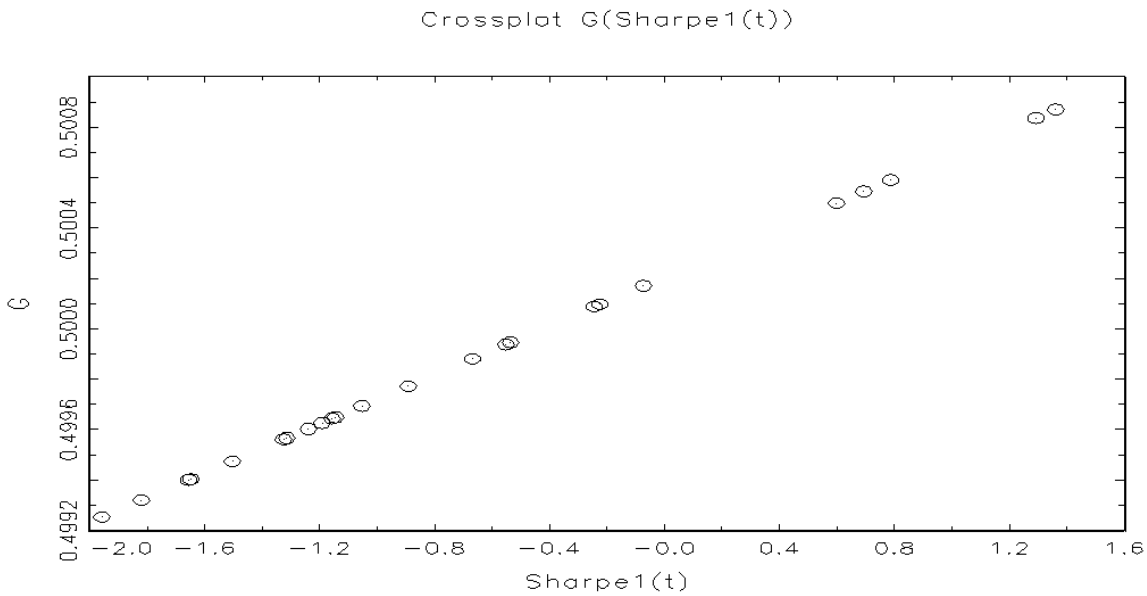

Figure 6:20 Rand/USD Sharpe ratio (2003–2004) One month forward

Table 6.10 and Figure 6.20 show the results for the Rand/USD for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/USD is linear with γ = 0. α = 0, β = 1, G (.) = 0.5. Therefore the UIP hypothesis holds for the

middleregime when the Sharpe ratio is used as the transition variable. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with α = 0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/USD when using the Sharpe ratio as the transition variable for these forward rates. The Rand/USD carry trade activity is profitable at these forward rates when the Sharpe ratio is in the upper regime.

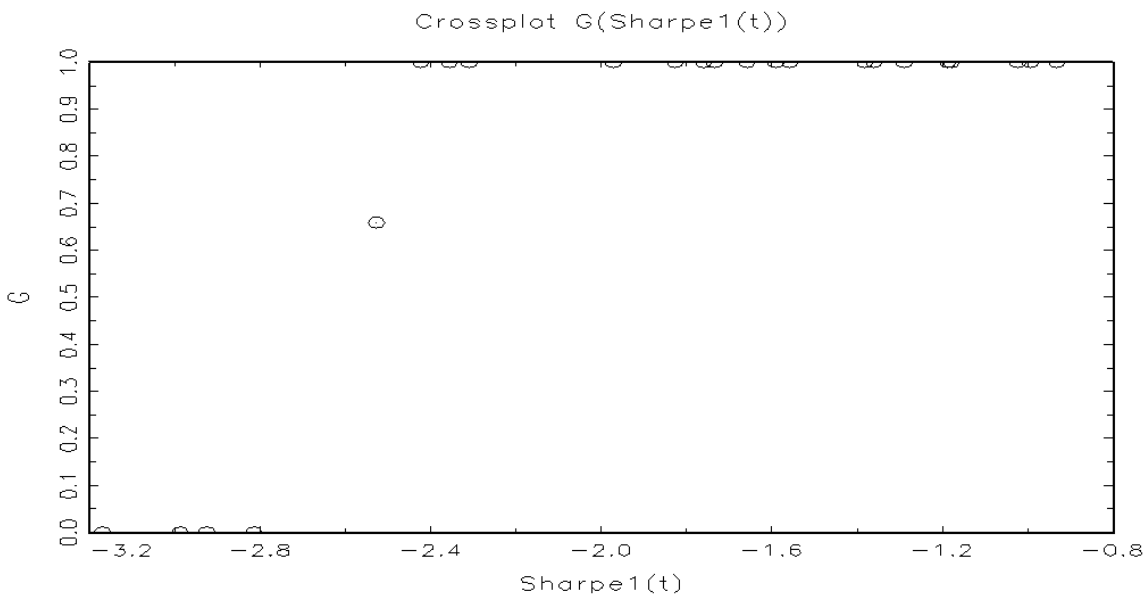

Figure 6:21Rand/Yen Sharpe ratio (2003–2004) One month forward

Table 6.10 and Figure 6.21 show the results for the Rand/Yen when the Sharpe ratio is used as a transition variable for a one month forward rate. The results show that the Rand/Yen is nonlinear (γ>0) and there is no transition from lower regime to the upper regime. Sharpe ratio is mostly concentrated in the upper regime with a Sharpe ratio of -2.4. Carry trade was not profitable during this period. The UIP hypothesis does not hold for one month forward when the Sharpe ratio is used as the transition variable.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with α = 0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as a transition variable for these forward rates. The

Rand/Yen carry trade is profitable at these forward rates when the Sharpe ratio is in the upper regime.

Period: January 2010–December 2011

Table 6.11 and Figure 6.22 show the results for the Rand/GBP for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/GBP is linear with $\gamma = 0$, $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -0.028. The maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

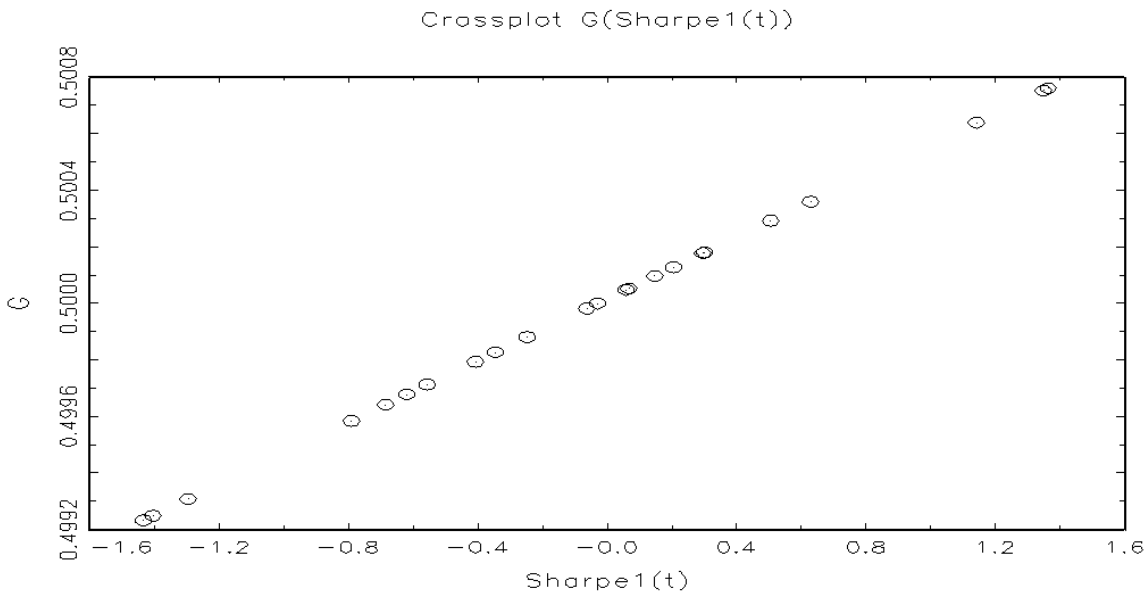

Figure 6:22Rand/GBP Sharpe ratio (2010–2011) One month forward

Table 6:11Sharpe Ratio as Transition variable for period Jan 2010–Dec 2011

	α_1	β_1	α_2	β_2	γ	c
US Dollar	-25.27531	0.99982	50.57273	0.00036	0.00150	0.01105
British Pound	-21.78393	0.99977	43.56654	0.00046	0.00172	-0.02798
Japanese Yen	66.17301	-11865.51141	-66.18356	11871.47142	50.25451	-2.44661

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with α = 0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/GBP when using a Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/GBP carry trade at these forward rates could be achieved in the upper regime.

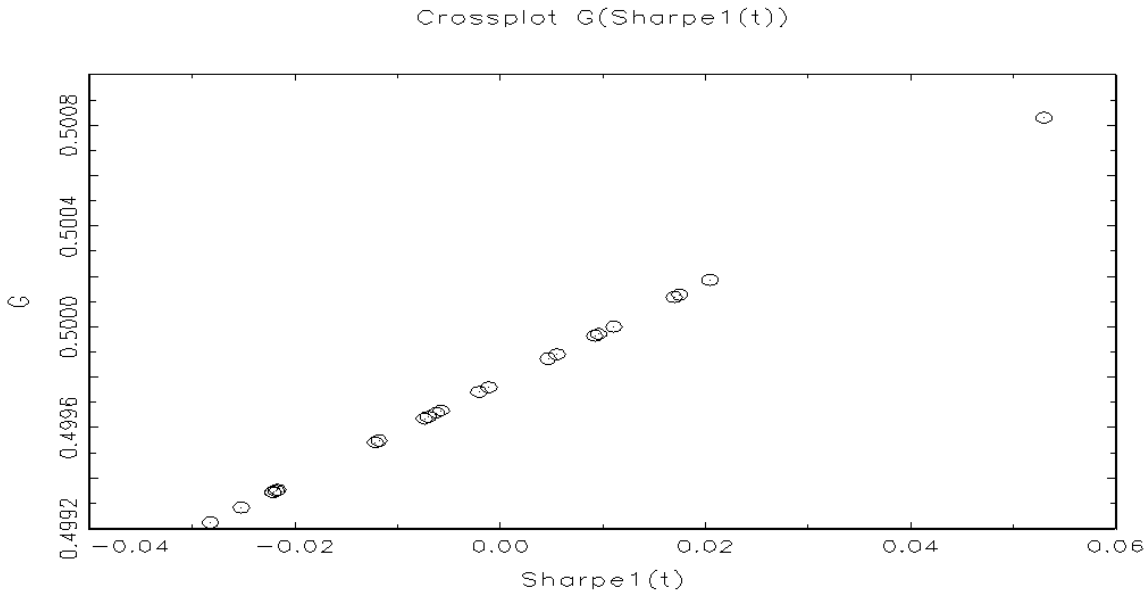

Figure 6:23Rand/USD Sharpe ratio (2010–2011) One month forward

Table 6.11 and Figure 6.23 show the results for the Rand/USD for one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/USD is linear, γ = 0. α = 0, β = 1, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of 0.011. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with α = 0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds

for the Rand/USD when using the Sharpe ratio as the transition variable for these forward rates. The Rand/USD carry trade activity is profitable at these forward rates when the Sharpe ratio is in the upper regime.

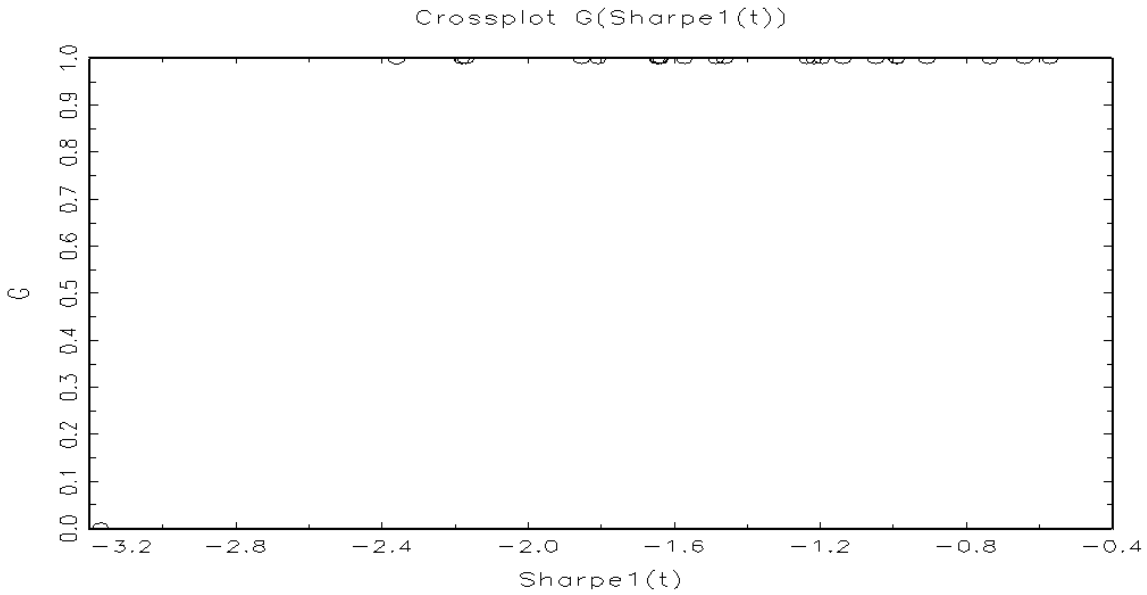

Figure 6:24Rand/Yen Sharpe ratio (2010–2011) One month forward

Table 6.11 and Figure 6.24 show the results for the Rand/Yen when the Sharpe ratio is used as the transition variable for a one month forward rate. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and the transition function is abrupt and mostly in the upper regime with a Sharpe ratio of -2.4. The UIP hypothesis does not hold for one month forward when the Sharpe ratio is used as the transition variable. The maximum profit taking for the Rand/Yen could be achieved in the upper regime provided that the Sharpe ratios increase.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The Rand/Yen carry trade is profitable at these forward rates when the Sharpe ratio is in the upper regime.

Period: July 2005–December 2007

Table 6.12 and Figure 6.25 show the results for the Rand/GBP for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/GBP is linear with $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.817. The maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/GBP when using the Sharpe ratio as the transition variable for these forward rates. The Rand/GBP is profitable at these forward rates when the Sharpe ratio is in the upper regime.

Table 6:12Sharpe Ratio as Transition variable for period Jul 2005–Dec 2007

	α_1	β_1	α_2	β_2	γ	c
US Dollar	-12.03611	1.00065	24.07981	-0.00129	0.00362	0.15491
British Pound	-27.37534	0.99955	54.78959	0.00090	0.00150	0.81743
Japanese Yen	0.03528	-5.63698	-0.05992	13.25671	18.14224	-1.84923

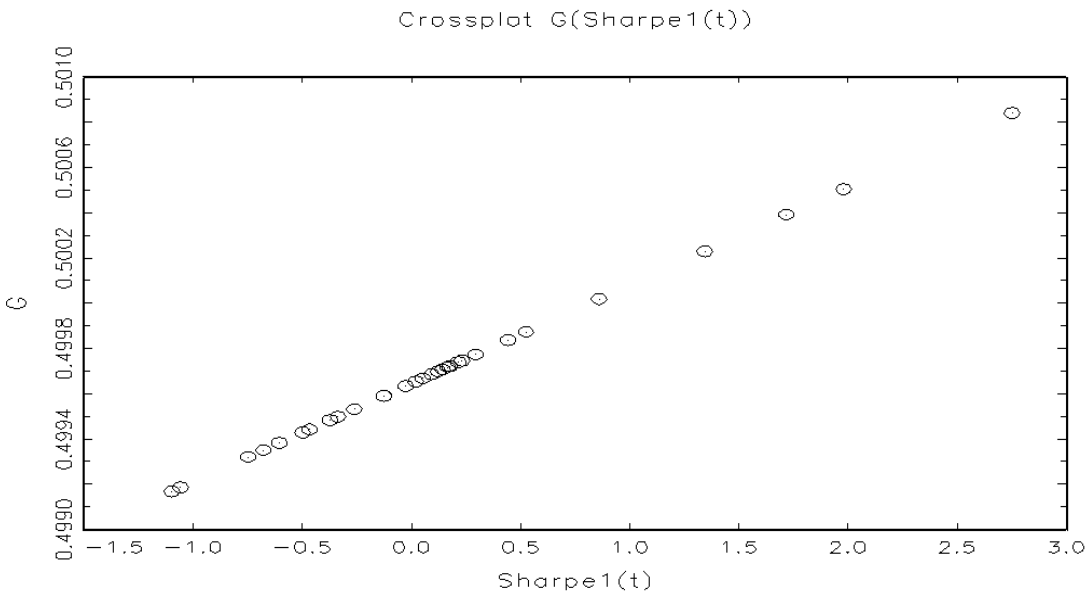

Figure 6:25Rand/GBP Sharpe ratio (2005–2007) One month forward

Table 6.12 and Figure 6.26 show the results for the Rand/USD for a one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/USD is linear, $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of 0.154. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds for the Rand/USD when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/USD carry trade activity at these forward rates could be achieved in the upper regime.

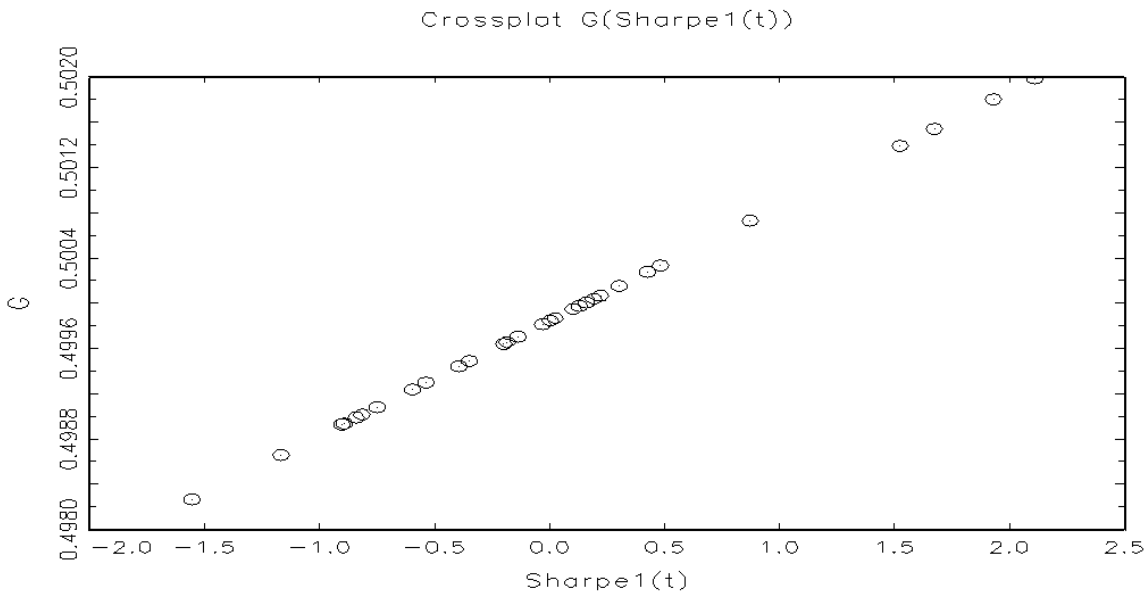

Figure 6:26Rand/USD Sharpe ratio (2005–2007) One month forward

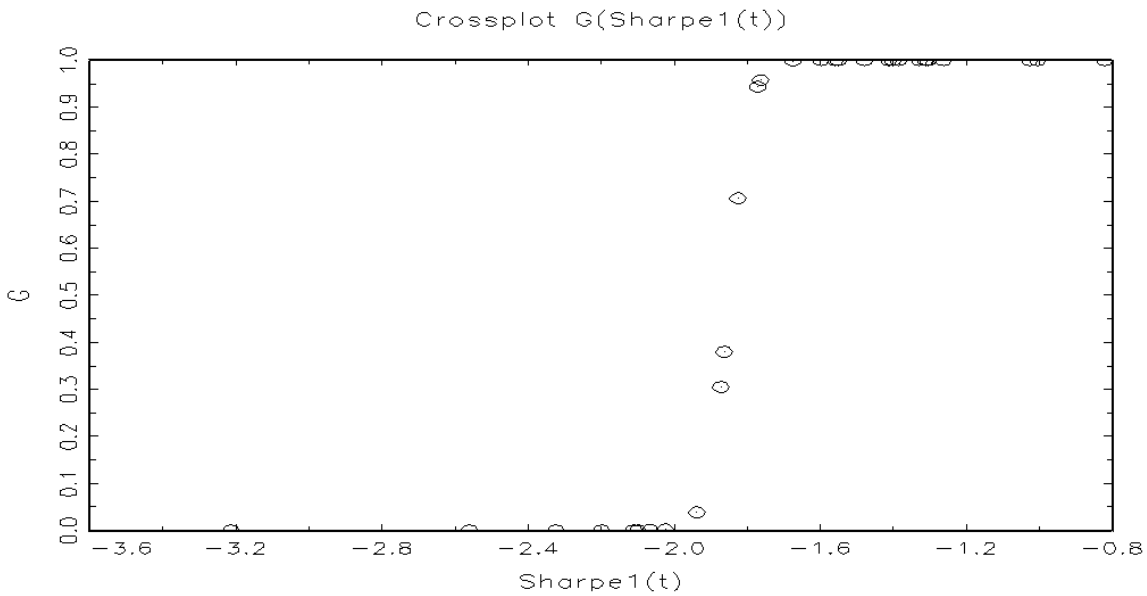

Figure 6:27Rand/Yen Sharpe ratio (2005–2007) One month forward

Table 6.12 and Figure 6.27 show results for the Rand/Yen when the Sharpe ratio is used as the transition variable for a one month forward rate. The results show a smooth transition from the lower regime to the upper regime and that the Rand/Yen is nonlinear ($\gamma>0$). The

threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -1.84. The maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime if the Sharpe ratios improve. UIP hypothesis does not hold for a one month forward when the Sharpe ratio is used as the transition variable.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime for Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/Yen carry trade activity at these forward rates could be achieved in the upper regime.

Period: January 2008 - December 2009

Table 6:13Sharpe Ratio as Transition variable for period Jan 2008–Dec 2009

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-48.58409	0.99923	97.19650	0.00155	0.00137	0.57893
British Pound	-33.43669	1.00082	66.83577	-0.00164	0.00168	-0.79024
Japanese Yen	-0.08530	12.02652	0.04775	1.71585	66.00136	-3.10046

Table 6.13 and Figure 6.28 show the results for the Rand/GBP for one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/GBP is linear with $\gamma = 0$, $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -0.79. The maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forward rates (see Appendix 1 for the results). The results show that the Rand/GBP is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime for the Rand/GBP when using the Sharpe ratio as the transition variable for these forward rates.

The maximum profit taking for the Rand/GBP at these forward rates could be achieved in the upper regime.

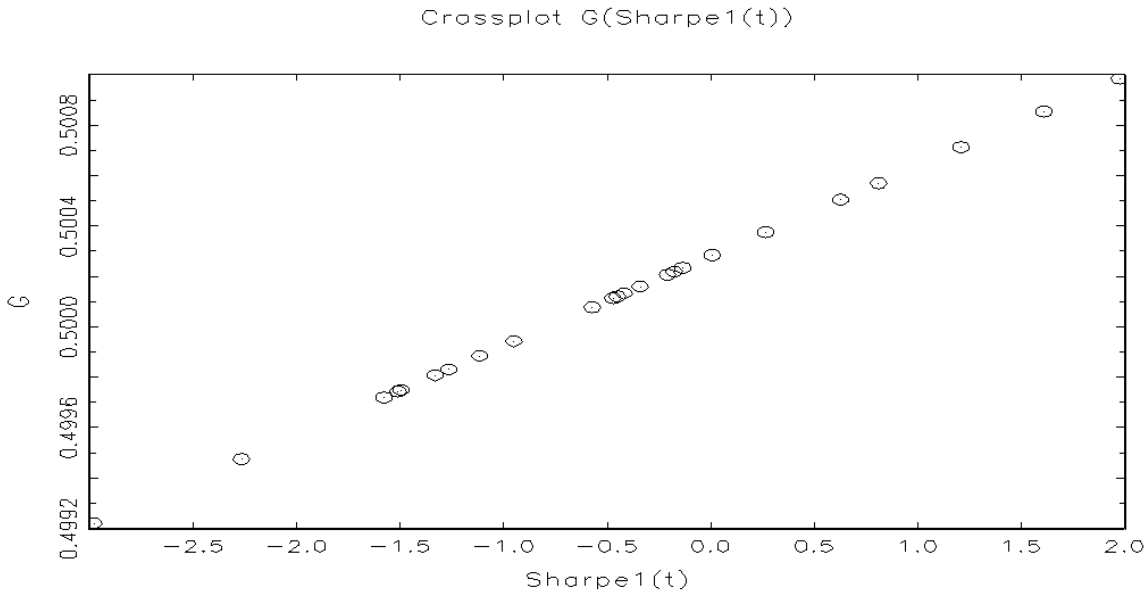

Figure 6:28Rand/GBP Sharpe ratio (2008–2009) One month forward

Table 6.13 and Figure 6.29 show the results for the Rand/USD for one month forward when the Sharpe ratio is used as the transition variable. The results show that the Rand/USD is linear with $\gamma = 0$. $\alpha = 0$, $\beta = 1$, G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime when the Sharpe ratio is used as the transition variable. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.58. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 2 for the results). The results show that the Rand/USD is linear at these forward rates with $\alpha = 0$, $\beta = 1$ and G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime for the Rand/USD when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/USD carry trade activity at these forward rates could be achieved in the upper regime.

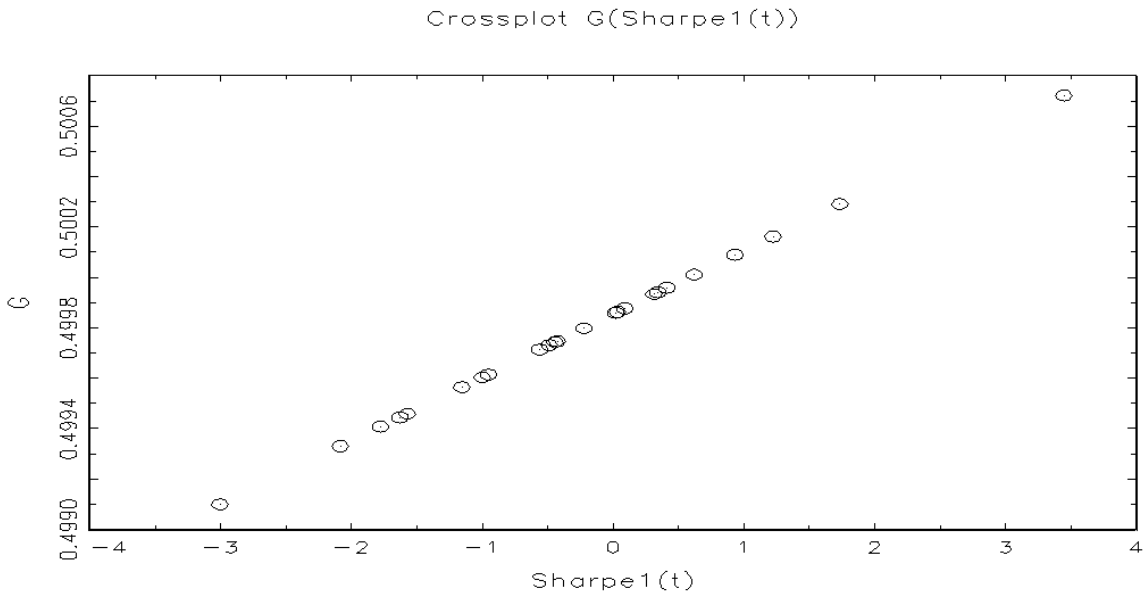

Figure 6:29Rand/USD Sharpe ratio (2008–2009) One month forward

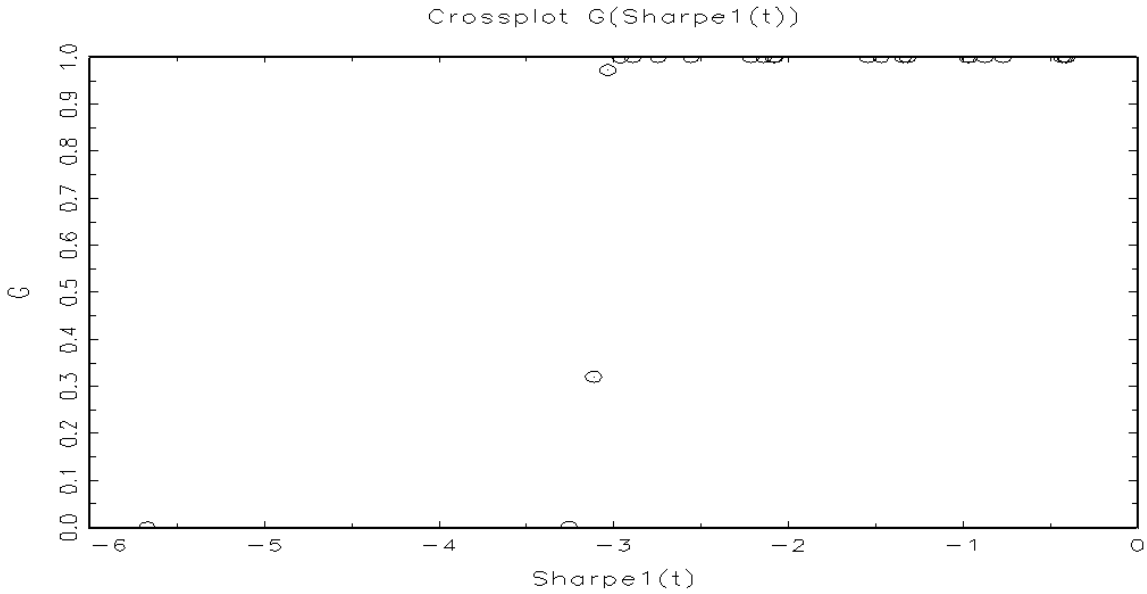

Figure 6:30 Rand/Yen Sharpe ratio (2008–2009) One month forward

Table 6.13 and Figure 6.30 show the results for the Rand/Yen when the Sharpe ratio is used as a transition variable for a one month forward rate. The results show that the Rand/Yen is

nonlinear (γ>0) and the smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.10.

The UIP hypothesis does not hold for one month forward when the Sharpe ratio is used as the transition variable. The maximum possible profit for the Rand/Yen carry trade activity could be achieved in the upper regime if the Sharpe ratios increase.

Further tests were conducted for two months, three months, six months, and twelve months forwards (see Appendix 3 for the results). The results show that the Rand/Yen is linear at these forward rates with α =0, β = 1 and G (.) = 0.5. Therefore the UIP hypothesis holds in the middle regime for the Rand/Yen when using the Sharpe ratio as the transition variable for these forward rates. The maximum profit taking for the Rand/Yen carry trade activity at these forward rates could be achieved in the upper regime.

6.4. Risk Adjusted Forward Rate as the Transition Variable

Risk adjusted forward rate premium is the forward premium divided by the standard deviation of the forward premium. This section only reports the results for the two months adjusted risk forward premium. Detailed results for the other forwards are documented in Appendices 4-6, and in Appendix 9 for the transition functions for the other risk adjusted forward premium results.

6.4.1. Long-Term Periods

The following section provides an interpretation of the results for the following long-term periods: December 1996–December 2011 and July 2005–December 2011.

Period: December 1996–December 2011

Table 6.14 and Figure 6.31 provide summary results for the Rand/GBP. The results show that the Rand/GBP follows a nonlinear (γ>0) smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0.35 and the upper regime is at G (.) = 0.70. The FPA is detected at the risk adjusted forward premium of -0.4% at the lower

regime and at the risk adjusted forward premium of 3% for the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of -0.69%. Profitability of carry trade investment can only be achieved in the upper regime. The results for the three months, six months and twelve months risk adjusted forward premium show that the UIP hypothesis does not hold and it is mostly concentrated in the lower regime where G(.) <0.5. Therefore there is no possibility of making a profit in this regime and the investor is, on the whole, better off in concentrating on an effort with a risk adjusted forward premium of less than two months forwards.

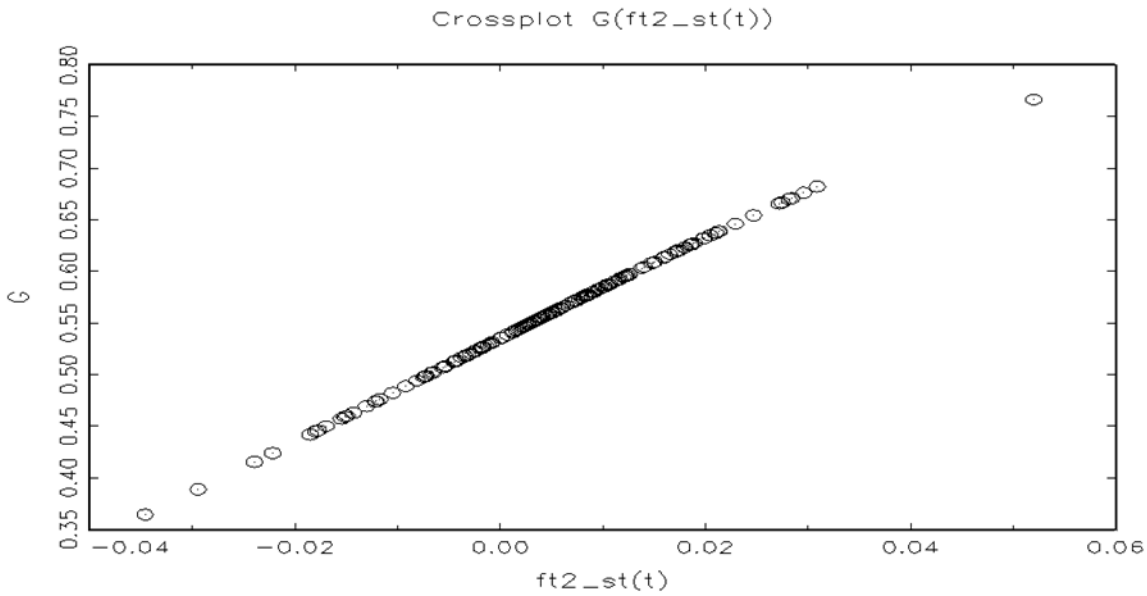

Figure 6:31Rand/GBP Forward Premium (1996–2011) Two Months Forward

Table 6:14Forward Premium as the transition variable for period Dec 1996–Nov 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00973	0.25896	-0.15938	5.34353	1.57689	0.02605
British Pound	0.48733	3.41693	-0.89401	1.78412	0.23979	-0.00697
Japanese Yen	-0.02001	8.87800	-0.07166	4.22357	1.65904	0.01007

Table 6.14 and Figure 6.32 provide summary results for the Rand/USD. The results show that the Rand/USD follows a nonlinear (γ>0) smooth transition from the lower regime to the

upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 0.70. The risk adjusted FPA is detected at -1% at the lower regime and at 3.5% for the upper regime. The threshold from the lower regime to the upper regime is occurring at a risk adjusted forward premium of 2.60%. Profitability of carry trade investment could be achieved in the upper regime. The three, six and twelve months risk adjusted forward premium exhibits a similar trend to the one month forward premium. For the three months risk adjusted forward premium, FPA is detected at -1% for the lower regime and at 4% for the upper regime. For the six months risk adjusted forward premium, the results show that the FPA is detected at 0% in the lower regime and at 5% for the upper regime. The results for the 12 months risk adjusted forward premium show that the FPA is detected at 0% in the lower regime and at 7% in the upper regime. Overall, the investor could be making a substantial amount of profit if more effort is concentrated in the risk adjusted forward premium higher than the two months forward premium.

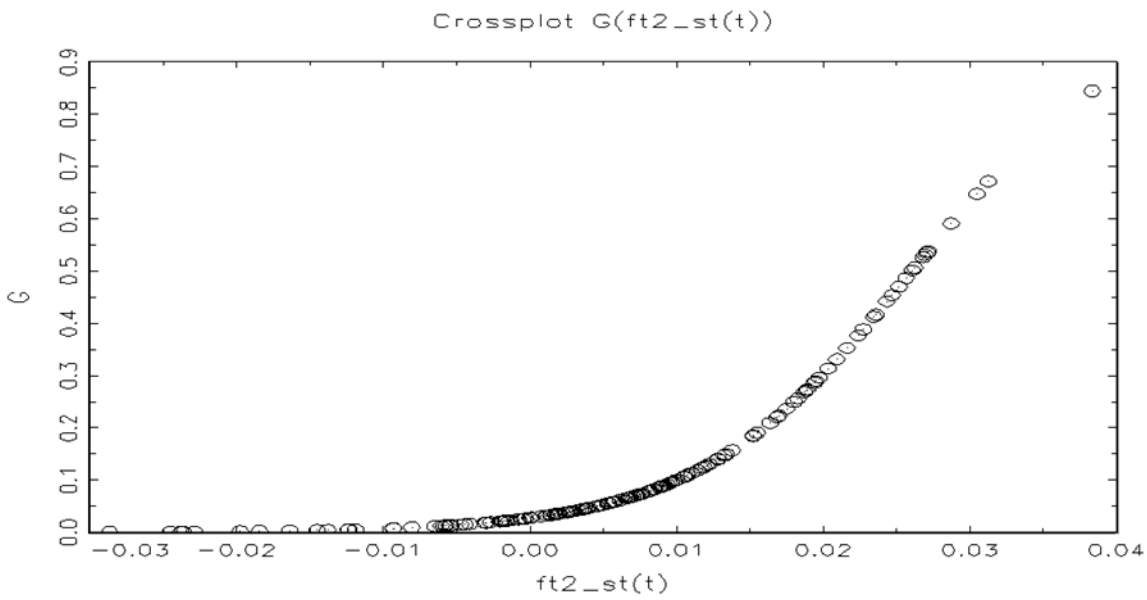

Figure 6:32Rand/USD Forward Premium (1996–2011) Two Months Forward

Table 6.14 and Figure 6.33 provide summary results for the Rand/Yen. The results show that the Rand/Yen follows a nonlinear (γ>0) smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this

currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is detected at 0.4% at the lower regime and at 1.6% at the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 1%. Profitability of carry trade investment could be achieved in the upper regime. The results for the three months risk adjusted forward premium show that the FPA is detected at 0.4% in the lower regime and at 2.2% for the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 1.5%. The profitability of the Rand/Yen carry trade activity could be achieved in the upper regime.

The results for the six months risk adjusted forward premium exhibit a rapid smooth transition from the lower regime to the upper regime. The FPA in the lower regime is detected at 2.4% and at 2.8% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 2.6%. The profitability of the Rand/Yen carry trade activity could be marginally achieved in the upper regime.

The results for the twelve months forward premium also exhibit a rapid smooth transition from the lower regime to the upper regime. The FPA in the lower regime is detected at the risk adjusted forward premium of 4.8% and at the risk adjusted forward premium of 5.2% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 5%. Therefore the profitability of the Rand/Yen carry trade activity could be marginally achieved in the upper regime.

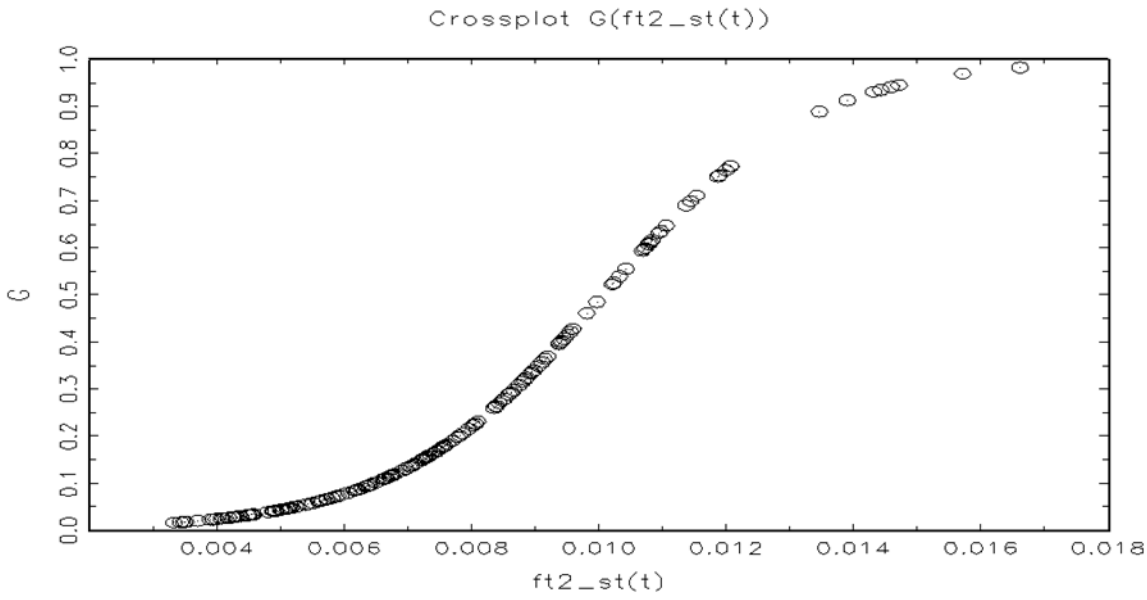

Figure 6:33Rand/Yen Forward Premium (1996–2011) Two Months Forward

Period: July 2005–November 2011

Table 6.15 and Figure 6.34 provide summary results for the Rand/GBP. The results show that the Rand/GBP follows a nonlinear (γ>0) and slightly smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0.35 and the upper regime is at G (.) = 0.65. The FPA is detected at the risk adjusted forward premium of -4% at the lower regime and at the risk adjusted forward premium of 3% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 0.22%. Therefore the profitability of the Rand/GBP carry trade activity could be achieved in the upper regime.

The results for the three months forward premium show that the FPA is detected at the risk adjusted forward premium of -4% in the lower regime and at the risk adjusted forward premium of 4% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 1.5%. The lower regime is at G (.) = 0.3 and the upper regime is at G (.) = 0.65. Therefore the profitability of the Rand/GBP carry trade activity could be achieved in the upper regime.

The results for the six months, nine months and twelve months forward premium show that the FPA is only occurring in the lower regime, G (.) < 0.5, and this regime is not profitable since the UIP hypothesis does not hold at all. The subprime crisis was only profitable for the two months and three months forward premium for the Rand/GBP carry trade activity.

Table 6:15Forward Premium as Transition variable for period Jul 2005– Dec 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00173	-0.04678	-0.27818	9.12410	243.51115	0.02600
British Pound	0.76978	6.16748	-1.55001	2.76334	0.24221	0.00229
Japanese Yen	-0.02387	4.31588	2612.70825	-29780.64982	0.51212	0.05189

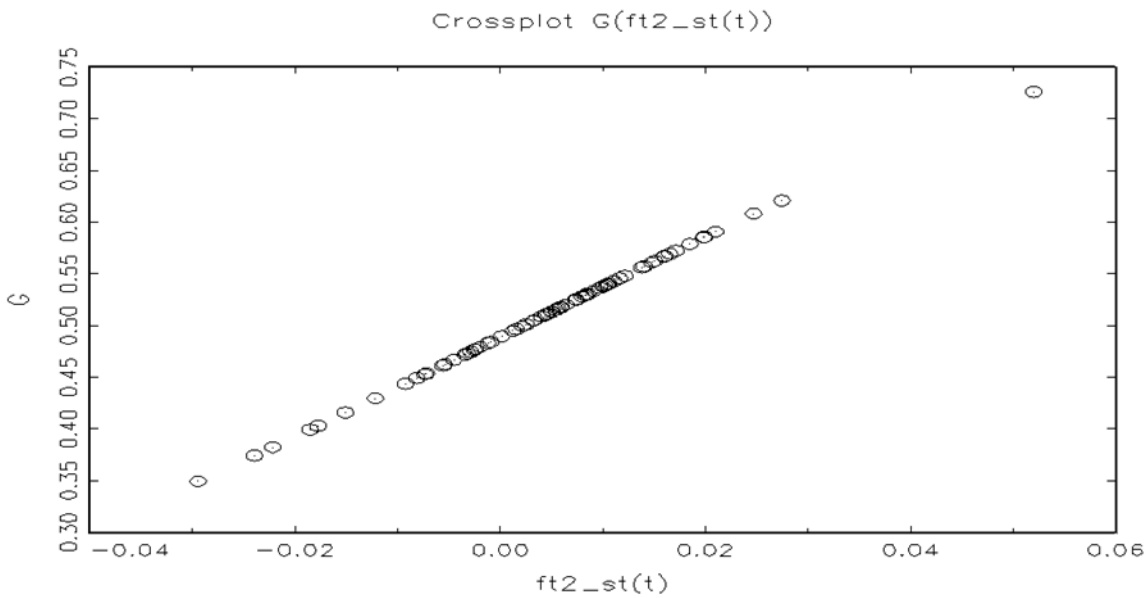

Figure 6:34Rand/GBP Forward Premium (2005–2011) Two Months Forward

Table 6.15 and Figure 6.35 provide summary results for the Rand/USD. The results show that the Rand/USD follows a nonlinear (γ>0). The transition from the lower regime to the upper

regime is very abrupt. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is detected at the risk adjusted forward premium of -3% at the lower regime and at the risk adjusted forward premium of 3% for the upper regime.

However, most of the data are concentrated in the lower regime, which makes it very difficult for the investor to predict the profitability of carry trade investment.

The other results (three, six, nine and twelve months forward premium) show that the forward premium is mainly concentrated in the lower regime. This regime is not profitable and the UIP hypothesis does not hold at all. Overall, the subprime crisis period was not profitable for the Rand/USD carry trade activity.

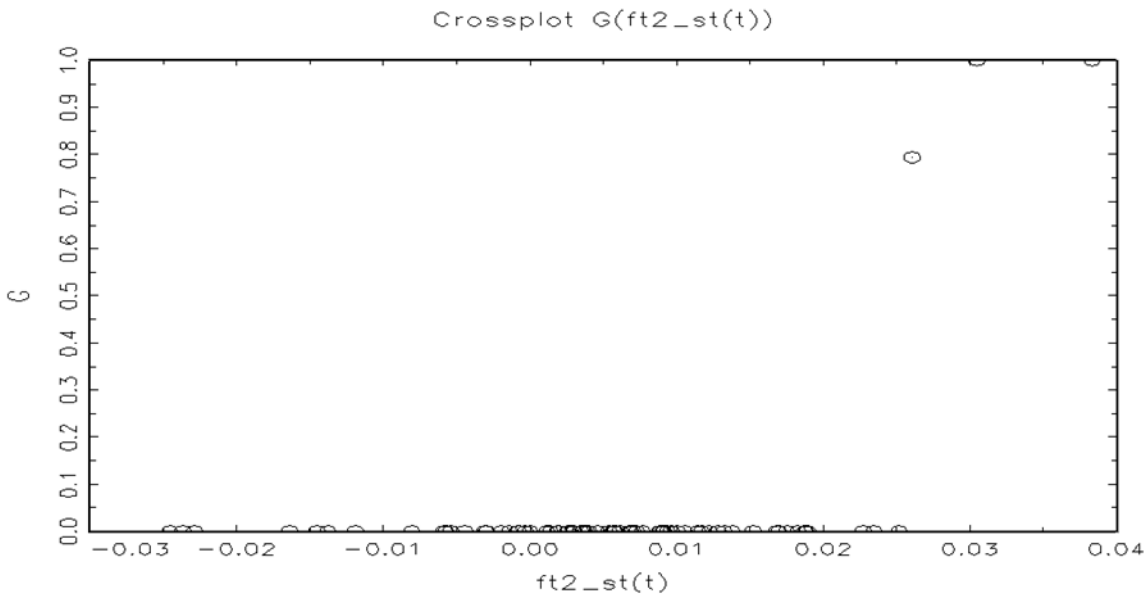

Figure 6:35Rand/USD Forward Premium (2005–2011) Two Months Forward

Table 6.15 and Figure 6.36 provide summary results for the Rand/Yen. The results show that the Rand/Yen follows a nonlinear (γ>0) and the smooth transition within the lower regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading.

The results for the three months forward premium show that the Rand/Yen follows a nonlinear pattern but is mostly concentrated in the lower regime where the UIP hypothesis does not hold.

The results for the six months risk adjusted forward premium show that the Rand/Yen follows a very rapid smooth transition from the lower regime to the upper regime. The FPA in the lower regime is detected at the risk adjusted forward premium of 2.2% and at the risk adjusted forward premium of 2.8% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 2.5%. Therefore the Rand/Yen carry trade activity is marginally profitable in the upper regime.

The results for the twelve months forward premium show a very smooth transition from the lower regime to the upper regime. The FPA in the lower regime is detected at the risk adjusted forward premium of 4.4% and at the risk adjusted forward premium of 5.4% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 5%. Therefore the Rand/Yen carry trade activity is marginally profitable in the upper regime.

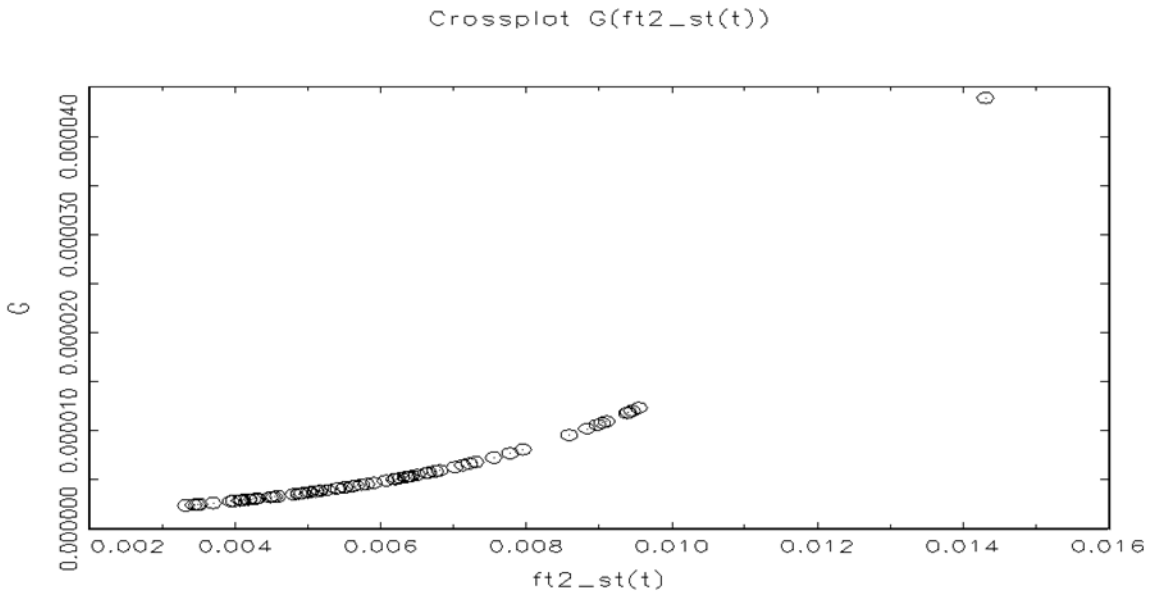

Figure 6:36Rand/Yen Forward Premium (2005–2011) Two Months Forward

6.4.2. Short-Term Periods

The following section provides an interpretation of the results for the following periods: December 1996–December 2000 and January 2001–December 2004.

Period: December 1996–December 2000

Table 6.16 and Figure 6.37 provide summary results for the Rand/GBP. The results show that the Rand/GBP follows a nonlinear (γ>0). The transition from the lower regime to the upper regime is very abrupt and mostly in the lower regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is detected at the risk adjusted forward premium of -1% in the lower regime and at the risk adjusted forward premium of 2% in the upper regime. Since most of the data are concentrated in the lower regime, the profitability of carry trade investment can only be achieved at the lower regime.

The three months forward premium shows that the transition from the lower regime to the upper regime is very abrupt. Most of the data are concentrated in the lower regime and the UIP hypothesis does not hold in this regime. The results for the six months forward premium show that the UIP does not hold and it is in the lower regime. The FPA is detected at the risk adjusted forward premium of -2% in the lower regime and at the risk adjusted forward premium of 5% in the upper regime. The lower regime is not profitable at all.

The results for the twelve months forward premium show that the UIP hypothesis does not hold and that it is in the lower regime. The minimum FPA is detected at the risk adjusted forward premium of -1% and the maximum forward anomaly is detected at the risk adjusted forward premium of 7%. Overall, the Rand/GBP was not profitable during this period (the Asian financial crisis), since most of the data are in the lower regime for most of the risk adjusted forward premium considered.

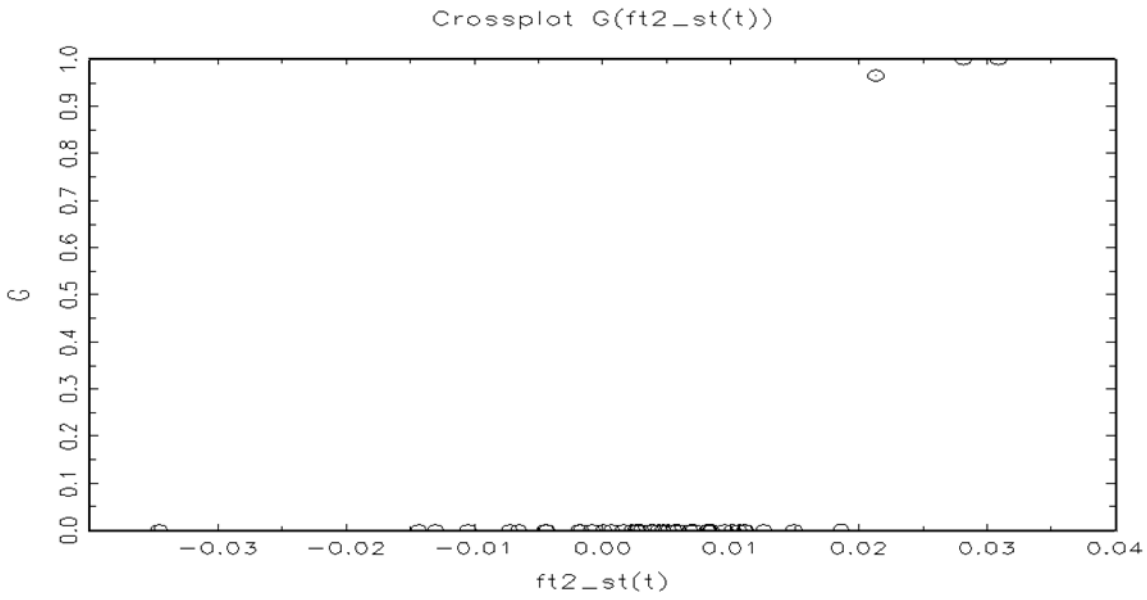

Figure 6:37Rand/GBP Forward Premium (1996–2000) Two Months Forward

Table 6:16Forward Premium as Transition variable for period Dec 1996–Dec 2000

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00493	-0.35668	0.25826	-12.89776	71.49847	0.01818
British Pound	0.00387	0.24956	-0.07677	2.56190	44.65502	0.02052
Japanese Yen	-0.01295	3.99729	-0.08262	10.18899	13.23751	0.01116

Table 6.16 and Figure 6.38 provide summary results for the Rand/USD. The results show that the Rand/USD follows a nonlinear (γ>0). The transition from the lower regime to the upper regime is very abrupt and mostly in the lower regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is mostly detected at the risk adjusted forward premium of -1% at the lower regime. This is not a profitable regime and therefore it is not worth investing in this currency during periods of volatility.

The results for the three months risk adjusted forward premium and six months risk adjusted forward premium show a very abrupt transition from the lower regime to the upper regime.

Most of the data are concentrated in the lower regime and the UIP hypothesis is not profitable in this regime.

The twelve months forward premium shows the smooth transition within the lower regime and that the UIP hypothesis does not hold. The minimum risk adjusted forward premium was detected at 1% and the maximum risk adjusted forward premium was detected at 8%.

Overall results indicate that the Rand/USD was not profitable during the Asian financial crisis.

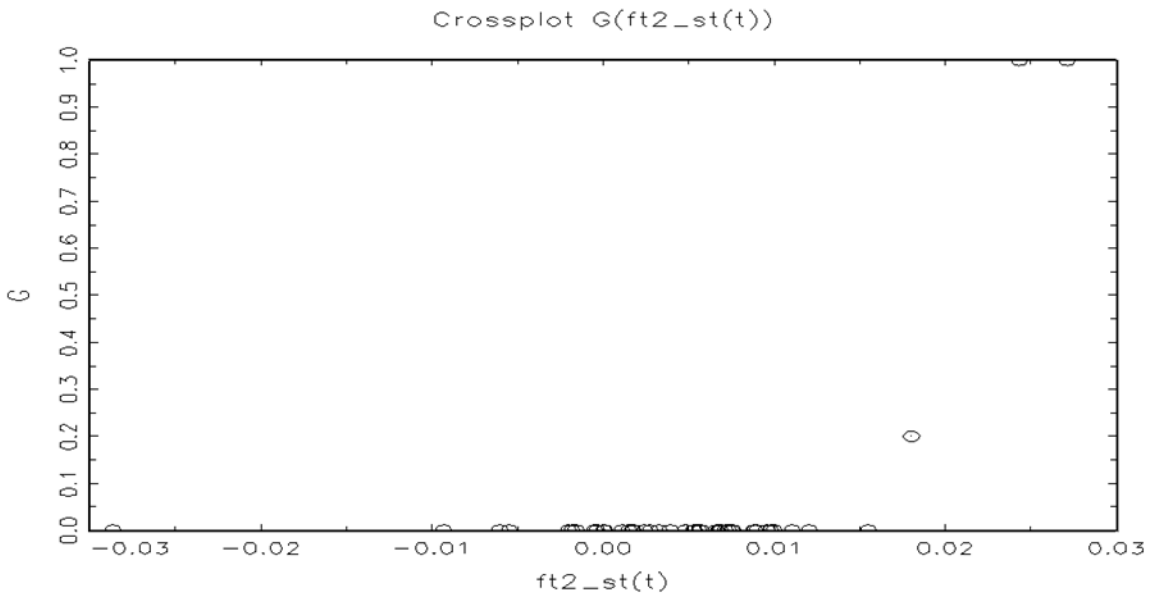

Figure 6:38Rand/USD Forward Premium (1996–2000) Two Months Forward

Table 6.16 and Figure 6.39 provide summary results for the Rand/Yen. The results show that the Rand/Yen follows a nonlinear ($\gamma>0$) rapid smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is detected at the risk adjusted forward premium of 1% in the lower regime and at the risk adjusted forward premium of 1.2% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 1.1%. The profitability of the Rand/Yen carry trade activity was marginally in the upper regime.

The results for the three months forward premium show a rapid transition from the lower regime to the upper regime. The FPA is detected at 1.6% at both the lower regime and the upper regime.

The six months forward premium results show an abrupt transition from the lower regime to the upper regime. The FPA in the lower regime is detected at the risk adjusted forward premium of 3.2% and at the risk adjusted forward premium of 3.5% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 3.4%. The profitability of the Rand/Yen carry trade activity was marginally profitable in the upper regime.

The results for the twelve months forward premium show a very rapid transition from the lower regime to the upper regime. The forward risk anomaly in the lower regime is detected at the risk adjusted forward premium of 6% and at the risk adjusted forward premium of 6.5% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 6.3%. The Rand/Yen carry trade activity was marginally profitable in the upper regime.

Overall, the Rand/Yen carry trade activity was marginally profitable in the upper regime during the Asian financial crisis.

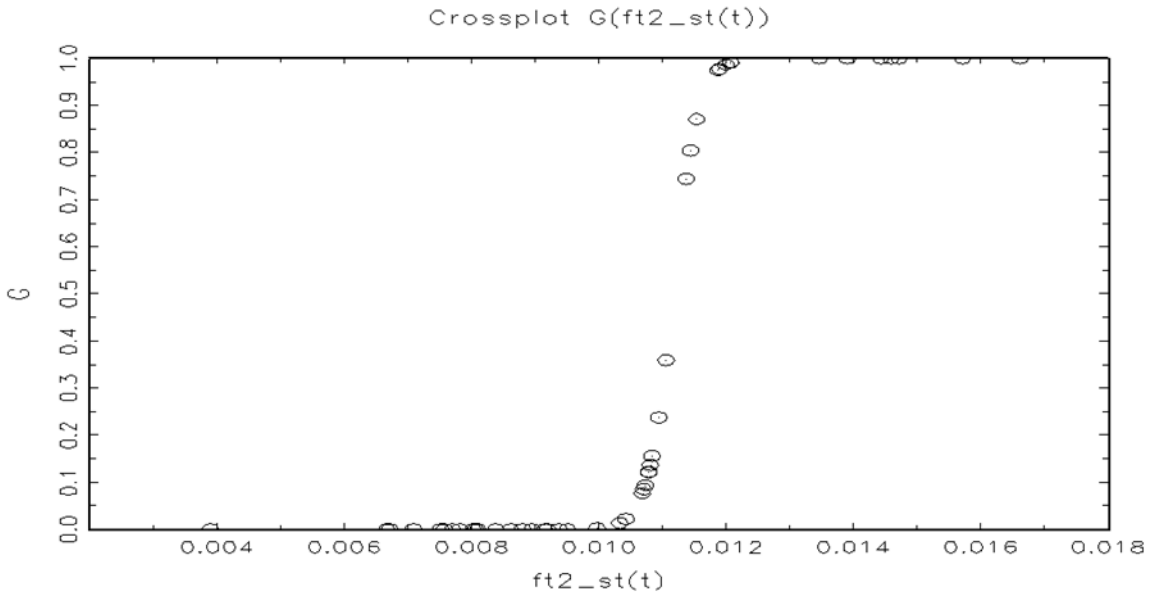

Figure 6:39Rand/Yen Forward Premium (1996–2000) Two Months Forward

Period: January 2001–December 2004

Table 6.17 and Figure 6.40 provide summary results for the Rand/GBP. The results show that the Rand/GBP follows a nonlinear (γ>0) and rapid smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1. The FPA is detected at the risk adjusted forward premium of 1.5% at the lower regime and at the risk adjusted forward premium of 2.5% in the upper regime.

The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 2%. The profitability of Rand/GBP carry trade activity can only be achieved in the upper regime.

The three months forward premium results show that the transition from the lower regime to the upper regime is abrupt. The FPA is detected at the risk adjusted forward premium of 2% for both the lower regime and the upper regime. The UIP hypothesis does not hold at all. The Rand/GBP carry trade activity is marginally profitable, most probably in the upper regime.

The six months forward premium results show a rapid smooth transition within the upper regime. The minimum FPA is detected at the risk adjusted forward premium of -1% and the maximum FPA is detected at the risk adjusted forward premium of -0.5%. The UIP hypothesis holds in the upper regime.

The results for the nine months forward premium show a rapid smooth transition within the upper regime. The minimum FPA is detected at the risk adjusted forward premium of -1% and the maximum FPA is detected at the risk adjusted forward premium of 0%. The UIP hypothesis seems to be holding in the upper regime where G (.) = 1 and that the maximum profit taking could only be achieved in the upper regime.

The results for the twelve months forward premium show a rapid transition within the upper regime. The minimum forward premium is detected at the risk adjusted forward premium of -0.5% and the maximum forward premium is detected at the risk adjusted forward premium of 0.5%. The results show the UIP hypothesis holds in the upper regime when G (.) = 1. Therefore carry trade activity is profitable in the upper regime.

The overall results show that the Rand/GBP was profitable during the Turkish financial crisis mainly for the six months, nine months, and 12 months forward premium and that the UIP hypothesis holds at the upper regime.

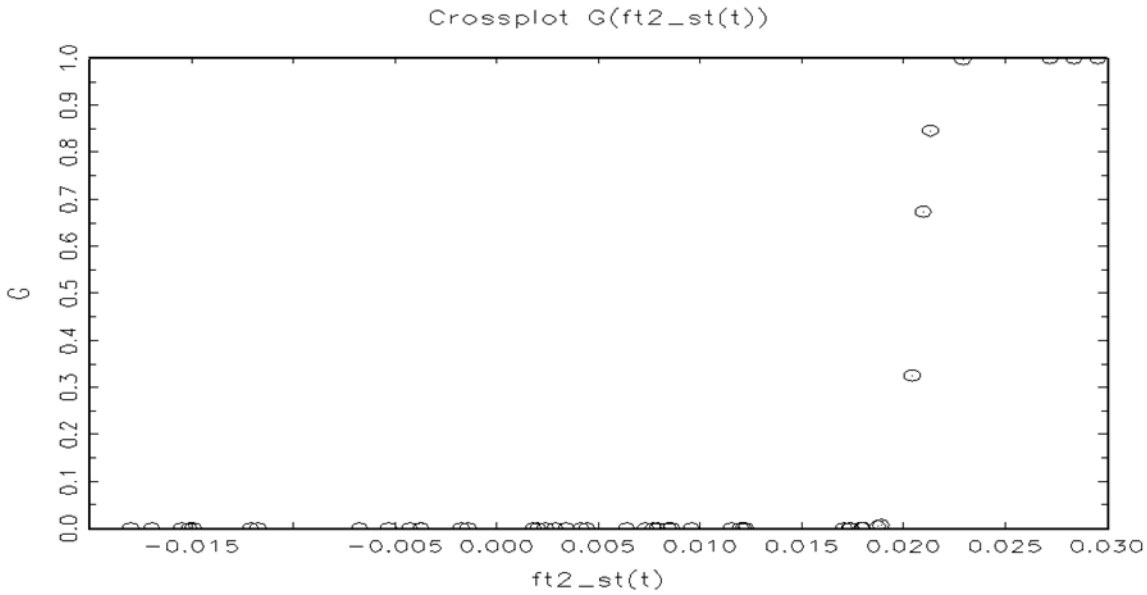

Figure 6:40Rand/GBP Forward Premium (2001–2004) Two Months Forward

Table 6:17Forward Premium as Transition variable for period Jan 2001–Dec 2004

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.05223	1.61988	-6299.037	210890.807	1.13646	0.13832
British Pound	-0.00178	-0.69620	0.25516	-9.97949	35.32648	0.02070
Japanese Yen	-0.03770	12.29560	-0.00681	-4.58601	30.57719	0.00834

Table 6.17 and Figure 6.41 provide summary results for the Rand/USD. The results show that the Rand/USD follows a nonlinear (γ>0) and smooth transition within the lower regime and the lower regime is at G (.) = 0. The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The FPA detection within the lower regime ranges from the risk adjusted forward premium of -2% to 3%. Profitability of carry trade investment can only be achieved within the lower range.

The results for the three months forward premium show a smooth transition in the lower regime. The minimum FPA is detected at the risk adjusted forward premium of -1% and the maximum FPA is detected at the risk adjusted forward premium of 3.5%. The UIP hypothesis does not hold within this lower regime.

The results for the six months forward premium show a smooth transition within the lower regime. The minimum FPA is detected at the risk adjusted forward premium of 0% and the maximum FPA is detected at the risk adjusted forward premium of 5%. The UIP hypothesis does not hold within this lower regime.

The results for the nine months forward show a smooth transition within the lower regime. The minimum FPA is detected at the risk adjusted forward premium of 1% and the maximum FPA is detected at the risk adjusted forward premium of 6%. The UIP hypothesis does not hold within this lower regime.

The results for the twelve months forward premium show a smooth transition within the upper regime. The minimum FPA is detected at the risk adjusted forward premium of 0% and the maximum FPA is detected at the risk adjusted forward premium of 4%. The UIP hypothesis holds in the upper regime when G (.) = 1. Therefore the maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

Overall results indicate that an investor could make a substantial amount of profit when considering the 12 month risk adjusted forward premium.

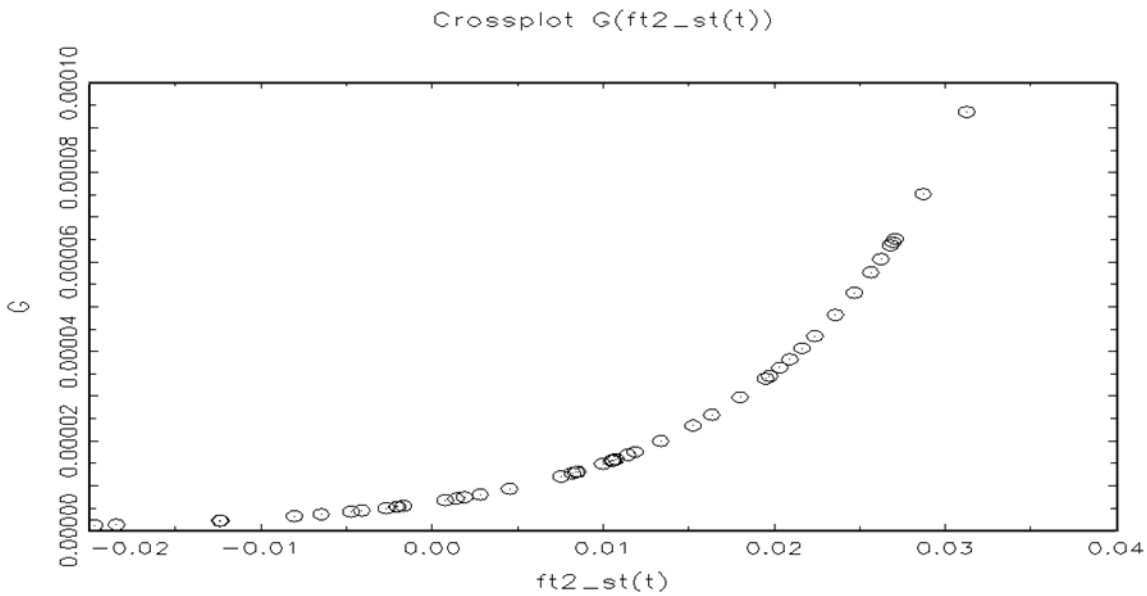

Figure 6:41Rand/USD Forward Premium (2001–2004) Two Months Forward

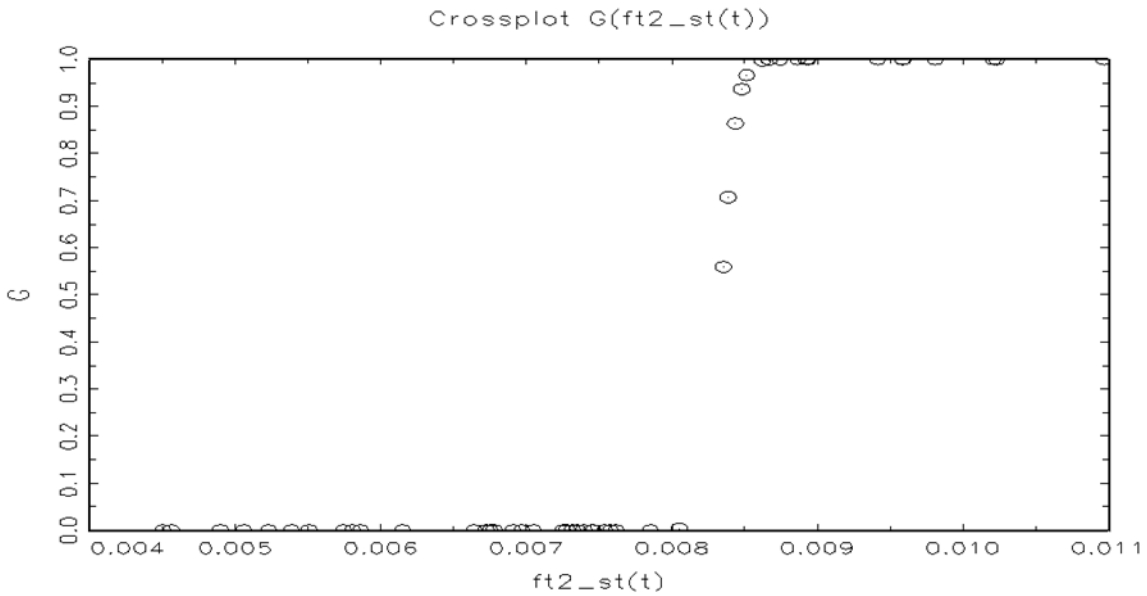

Figure 6:42Rand/Yen Forward Premium (2001–2004) Two Months Forward

Table 6.17 and Figure 6.42 provide summary results for the Rand/Yen. The results show that the Rand/Yen follows a nonlinear ($\gamma>0$) and rapid transition from the lower regime to the upper regime. The lower regime is at G (.) = 0 and the upper regime is at G (.) = 1.

The UIP hypothesis does not hold and therefore a profit could be exploited for this currency trading. The FPA is detected at the risk adjusted forward premium of 0.8% at the lower regime and at the risk adjusted forward premium of 0.85% in the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 0.83%. The Rand/Yen carry trade activity is marginally profitable in the upper regime.

The three months forward premium results show an abrupt transition from the lower regime to the upper regime. The Rand/Yen carry trade is likely to be profitable in the upper regime and likely to be unprofitable in the lower regime.

The results for the six months forward premium show a smooth transition from the lower regime to the upper regime. The FPA is detected at the risk adjusted forward premium of 1.6% in the lower regime and at the risk adjusted forward premium of 2.6% at the upper regime. The threshold from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 2.1%. The Rand/Yen carry trade activity is marginally profitable in the upper regime.

The results for the twelve months forward premium show a smooth transition from the lower regime to the upper regime. The FPA at the lower regime is detected at the risk adjusted forward premium of 3.4% and the risk adjusted forward premium of 4.6% in the upper regime. The transition from the lower regime to the upper regime is occurring at the risk adjusted forward premium of 4%. The Rand/Yen carry trade activity is marginally profitable in the upper regime.

Overall, the results indicate that the maximum profit taking for the Rand/Yen carry trade activity during the Turkish financial crisis could only be achieved at the higher forward premium maturity.

6.5. Delay Parameter for the Transition Variable

The purpose of the Delay parameter is to check the effect of the lag of the transition variable on the LSTR model with regard to the profitability of carry trade investment. For this work the transition variable lag will only be taken up to two periods (two months lag). Testing for the maximum lag period is beyond the scope of this research. The idea behind the Delay parameter is to determine if an investor should consider the forward looking approach (forecasting) or the backward looking approach (historical) to make a decision in carry trade investment. The tests will be conducted for long-term and short-term periods.

The current work will only focus on the lag of the Sharpe ratio as the transition variable. The choice of the Sharpe ratio is purely based on the risk allocation and profit taking. These results will be compared against the transition variable without a lag.

6.5.1. Long-Term Periods

The following section provides the interpretation of the results for the following long-term periods: December 1996–November 2011 and July 2005–December 2011**.**

Period: December 1996–November 2011

Table 6:18One Month Lag Sharpe Ratio for the period November 1996–December 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-0.02845	1.43064	0.03066	-1.70274	149.19524	-1.04385
British Pound	0.16591	-1.08043	-0.16626	0.77384	1.77150	-3.14298
Japanese Yen	-0.01580	4.25041	-0.00149	2.90530	51.80269	-1.58278

Table 6:19Two Months Lag Sharpe Ratio for the period November 1996–December 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00257	-0.18943	-0.10467	10.40055	5.65207	2.28002
British Pound	0.00009	0.60302	0.00189	-1.00053	1503.408	-0.52163
Japanese Yen	-0.01638	4.10200	-0.00236	3.06828	1291.36470	-1.99965

Table 6.18 and Figure 6.43 provide summary results for the Rand/GBP for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear (γ>0) and the smooth transition from the middle regime to the upper regime. The transition occurs from G (.) = 0.5 for the middle regime and G (.) = 1 for the upper regime. The UIP hypothesis does not hold within this regime and there is also a possibility of carry trade profitability within this regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.14. The upper regime has a Sharpe ratio of 1 and it could be as high as 3. However, the UIP hypothesis holds in the upper regime with a minimum Sharpe ratio of 1.

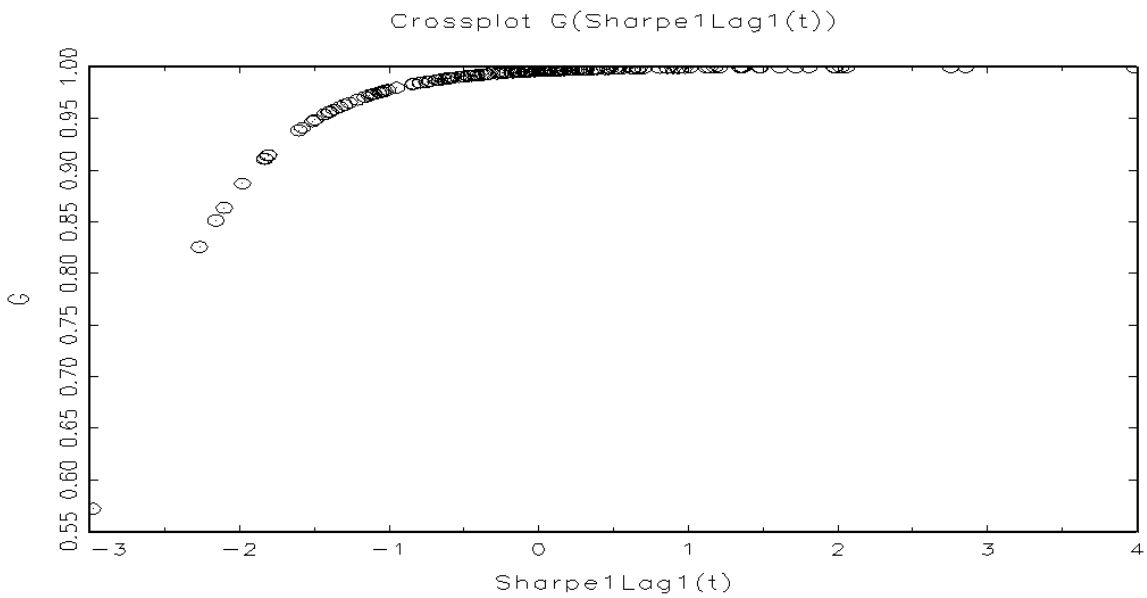

Figure 6:43Rand/GBP One Month Lag Sharpe Ratio (Nov 1996–Dec 2011)

Table 6.19 and Figure 6.44 provide the summary results for the Rand/GBP for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear (γ>0) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -0.52. The maximum possible Sharpe ratio to be achieved in the upper regime is 3. This means that the profitability of carry trade could only be achieved at the upper regime. This can also switch to the lower regime that is associated with negative Sharpe ratios.

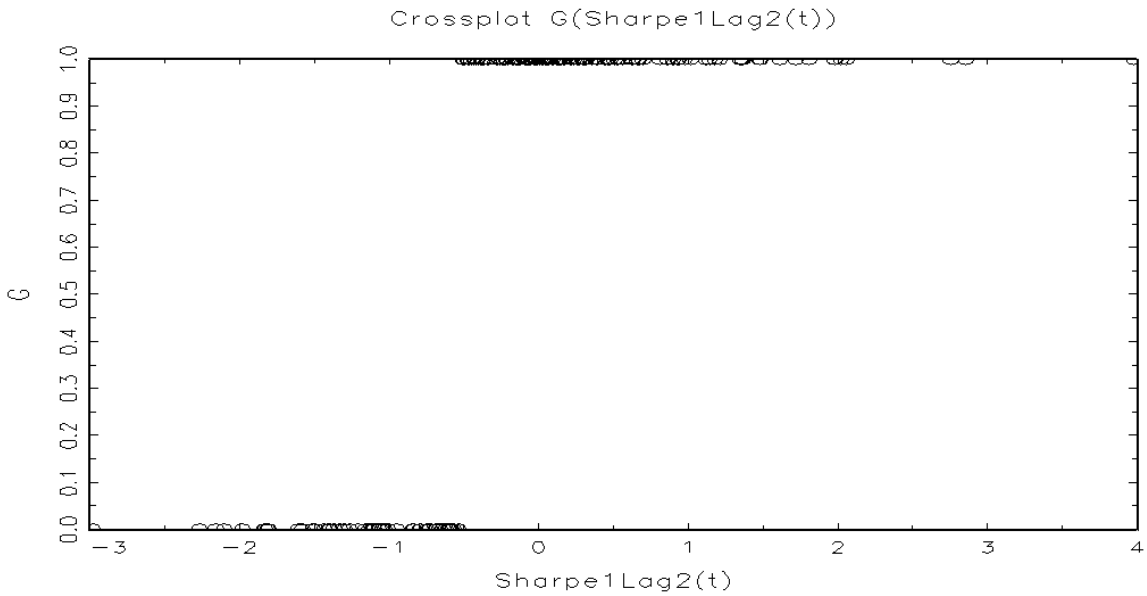

Figure 6:44 Rand/GBP Two Month Lag Sharpe Ratio (Nov 1996–Dec 2011)

Table 6.18 and Figure 6.45 provide summary results for the Rand/USD for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear ($\gamma>0$) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -1.04. This means that the maximum profit taking for the Rand/USD could only be achieved in the upper regime.

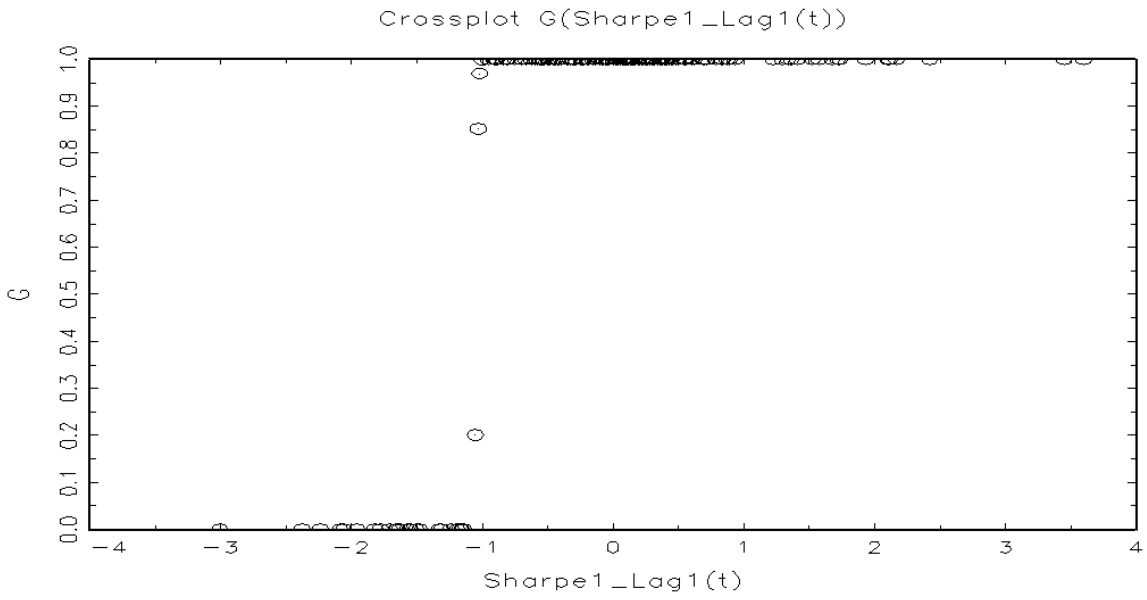

Figure 6:45Rand/USD One Month Lag Sharpe Ratio (Nov 1996– Dec 2011)

Table 6.19 and Figure 6.46 provide summary results for the Rand/USD for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear ($\gamma>0$) and smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 2.28. The maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime with a Sharpe ratio of 3.5.

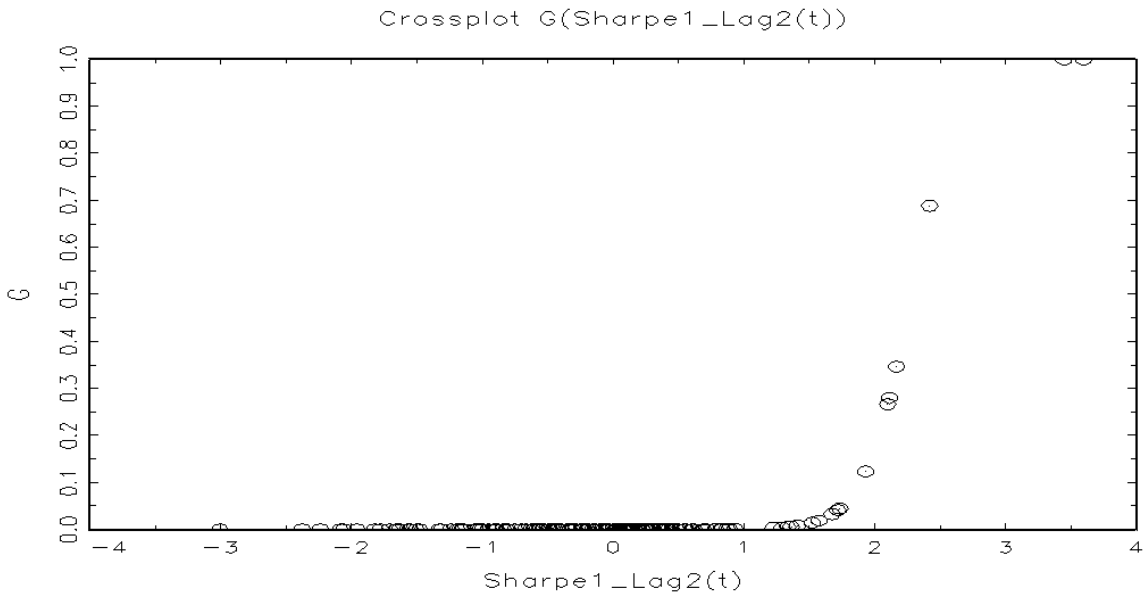

Figure 6:46Rand/USD Two Month Lag Sharpe Ratio (Nov 1996–Dec 2011)

Table 6.18 and Figure 6.47 provide summary results for the Rand/Yen for the one month lag in the Sharpe ratio as the transition variable. The results show that Rand/Yen is nonlinear (γ>0) and the smooth transition from the lower regime to the upper regime. The transition occurs from G (.) = 0 for the lower regime and G (.) = 1 for the upper regime. The threshold from the lower regime to the upper regime is occurring at a Sharpe ratio of -1.58. The maximum profit taking for the Rand/Yen could only be achieved in the upper regime with a minimum Sharpe ratio of 0.5.

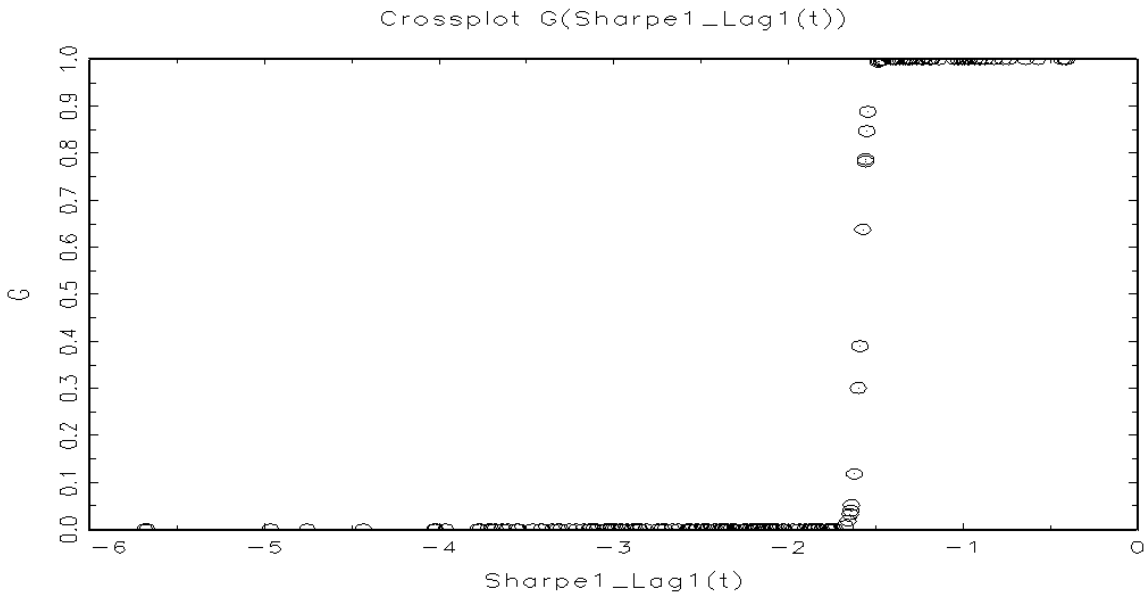

Figure 6:47Rand/Yen One Month Lag Sharpe Ratio (Nov 1996–Dec 2011)

Table 6.19 and Figure 6.48 provide the summary results for the Rand/Yen for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -2. The maximum profit taking for the Rand/Yen could only be achieved in the upper regime when the Sharpe ratio is much more than the threshold Sharpe ratio.

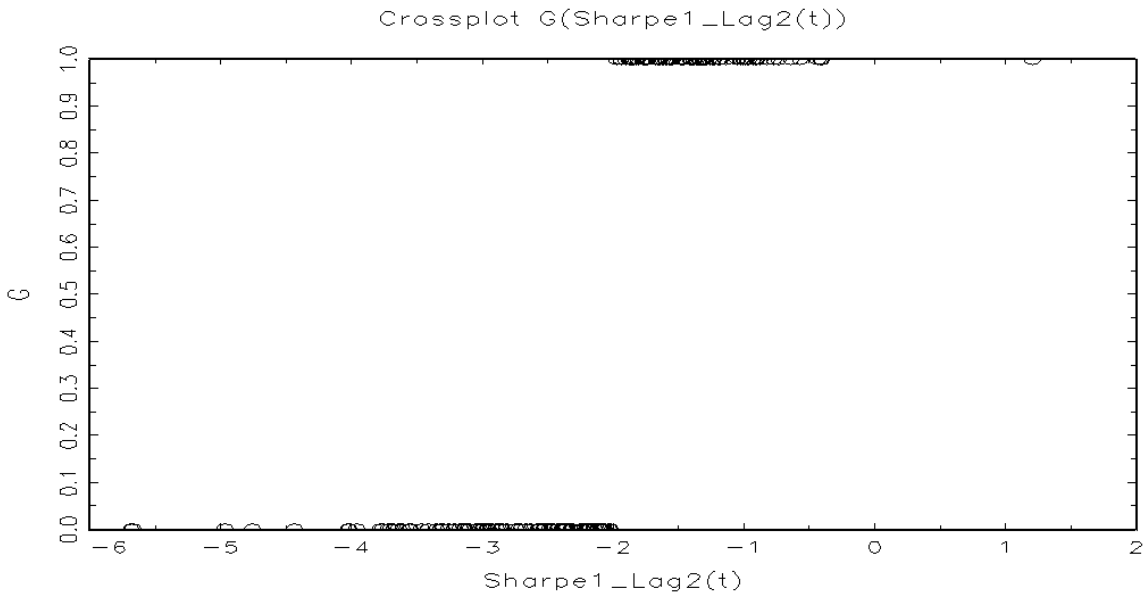

Figure 6:48Rand/Yen Two Month Lag Sharpe Ratio (Nov 1996–Dec 2011)

Period: July 2005–November 2011

Table 6:20One Month Lag Sharpe Ratio for the period July 2005–November 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-0.66390	22.98006	0.66584	-22.94789	5.52064	-2.48148
British Pound	0.01220	0.42483	-0.01343	-0.74181	81.10657	-1.33393
Japanese Yen	-0.01615	6.68281	-0.04980	11.00637	136.84090	-0.49841

Table 6:21Two Months Lag Sharpe Ratio for the period July 2005–November 2011

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00441	-0.53663	-0.01077	1.25885	131.92073	0.23985
British Pound	0.00158	0.84157	-0.00082	-1.34895	1121.932	-0.47141
Japanese Yen	-0.02951	7.45673	0.00860	1.27847	208.62473	-2.45521

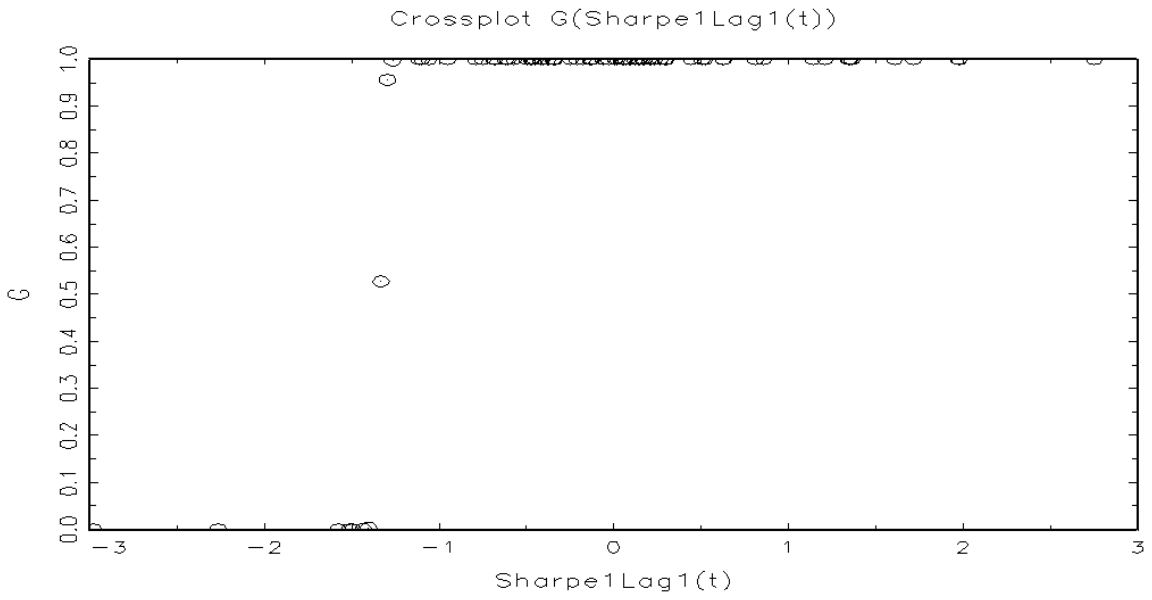

Figure 6:49Rand/GBP One Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.20 and Figure 6.49 provide summary results for the Rand/GBP for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear ($\gamma>0$) and very abrupt from the lower regime to the upper regime. The threshold Sharpe ratio from the lower regime to the upper regime is occurring at a Sharpe ratio of -1.3. Most of the Sharpe ratios are concentrated in the upper regime. Therefore the maximum profit taking for the Rand/GBP could be achieved in the upper regime.

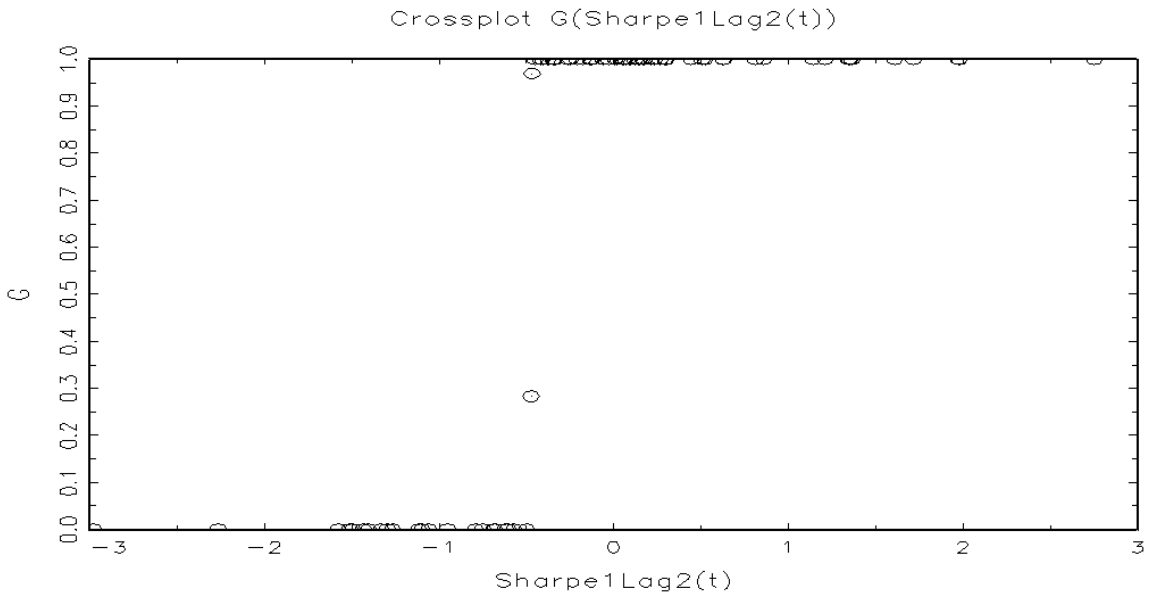

Figure 6:50Rand/GBP Two Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.21 and Figure 6.50 provide summary results for the Rand/GBP for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear (γ>0) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -0.47. This means that the maximum profit taking for the Rand/GBP could be achieved in the upper regime.

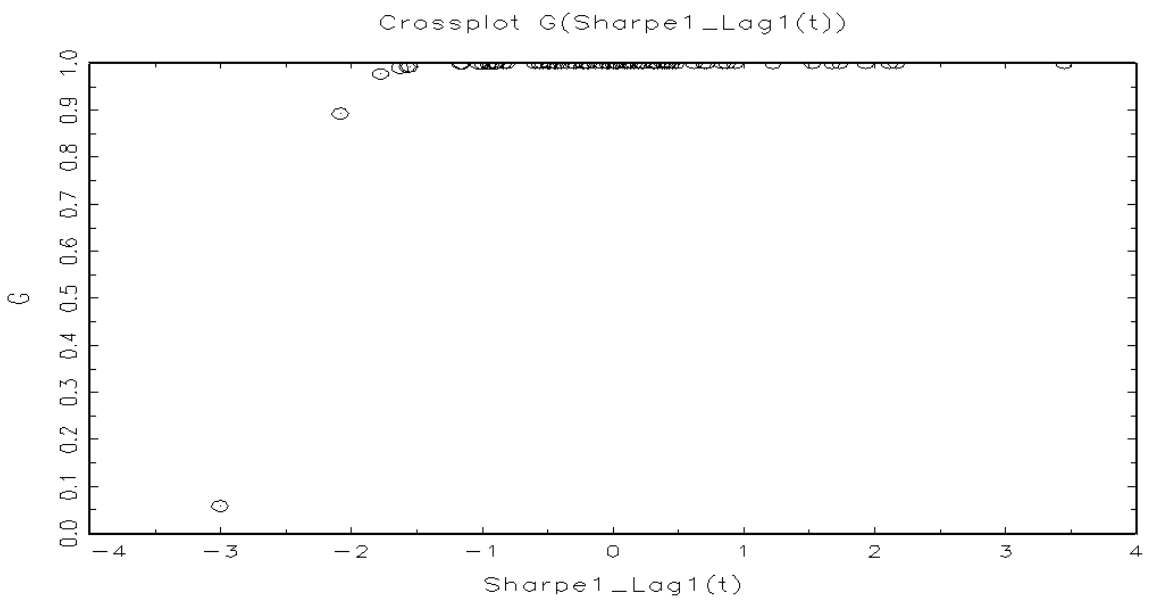

Figure 6:51Rand/USD One Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.20 and Figure 6.51 provide summary results for the Rand/USD for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear (γ>0) and a smooth transition from the lower regime to the upper regime. The transition occurs from G (.) = 0 for the lower regime and G (.) = 1 for the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -2.28. This means that the maximum profit taking for the Rand/USD could be achieved in the upper regime.

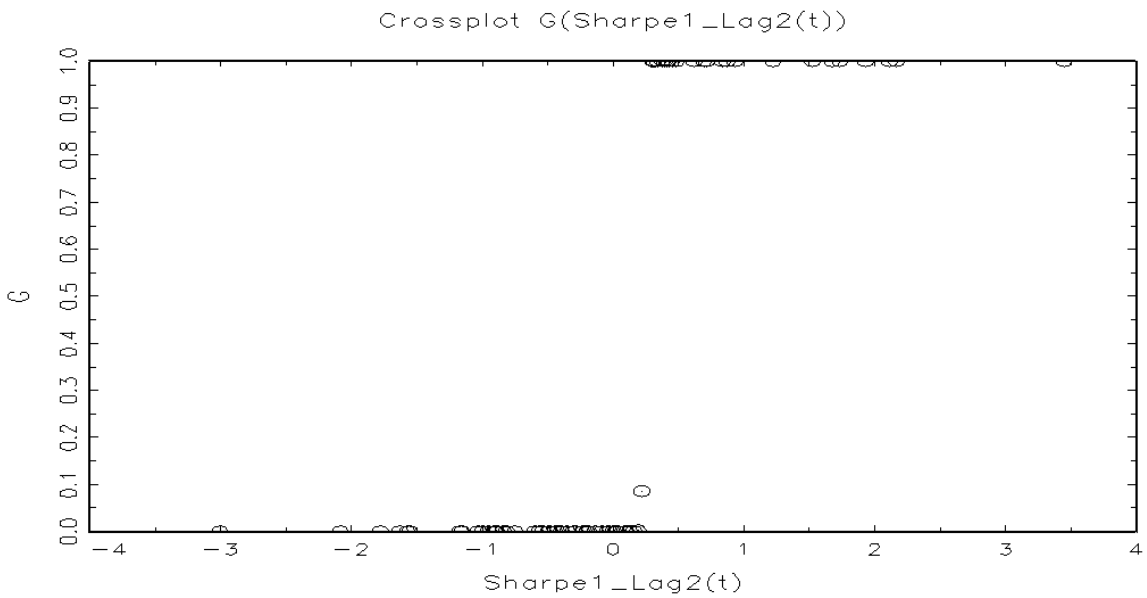

Figure 6:52 Rand/USD Two Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.21 and Figure 6.52 provide summary results for the Rand/USD for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear (γ>0) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.24. This means that the maximum profit taking for the Rand/USD could only be achieved in the upper regime.

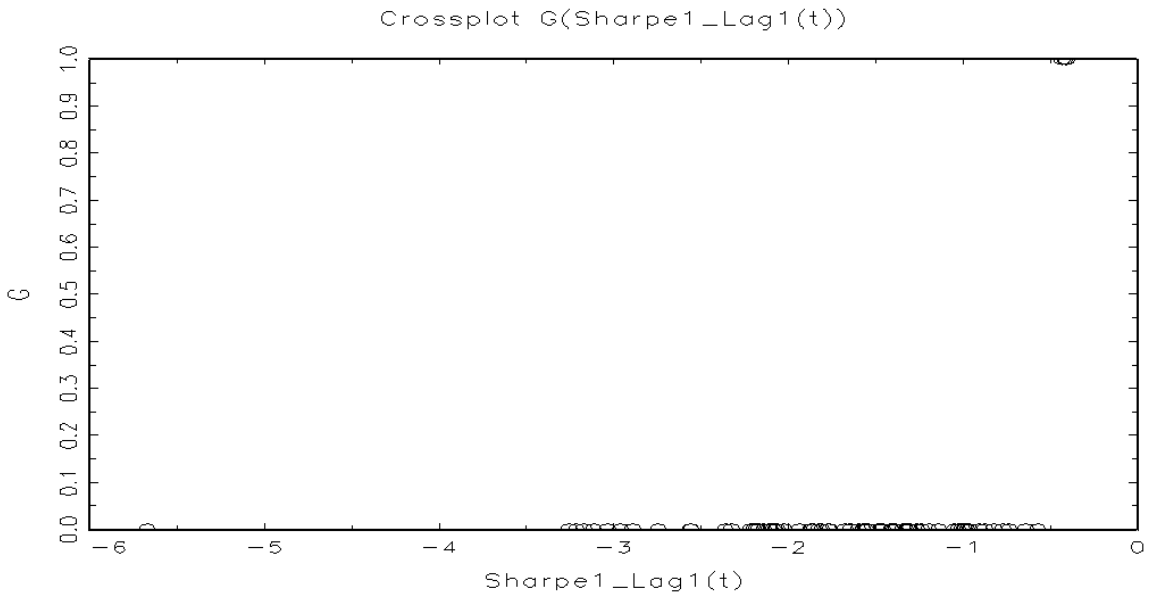

Figure 6:53Rand/Yen One Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.20 and Figure 6.53 provide summary results for the Rand/Yen for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/Yen is nonlinear (γ>0) and concentrated in the lower regime. The lower regime is at G (.) = 0. The lower regime has negative Sharpe ratios. The Yen was not profitable during this period.

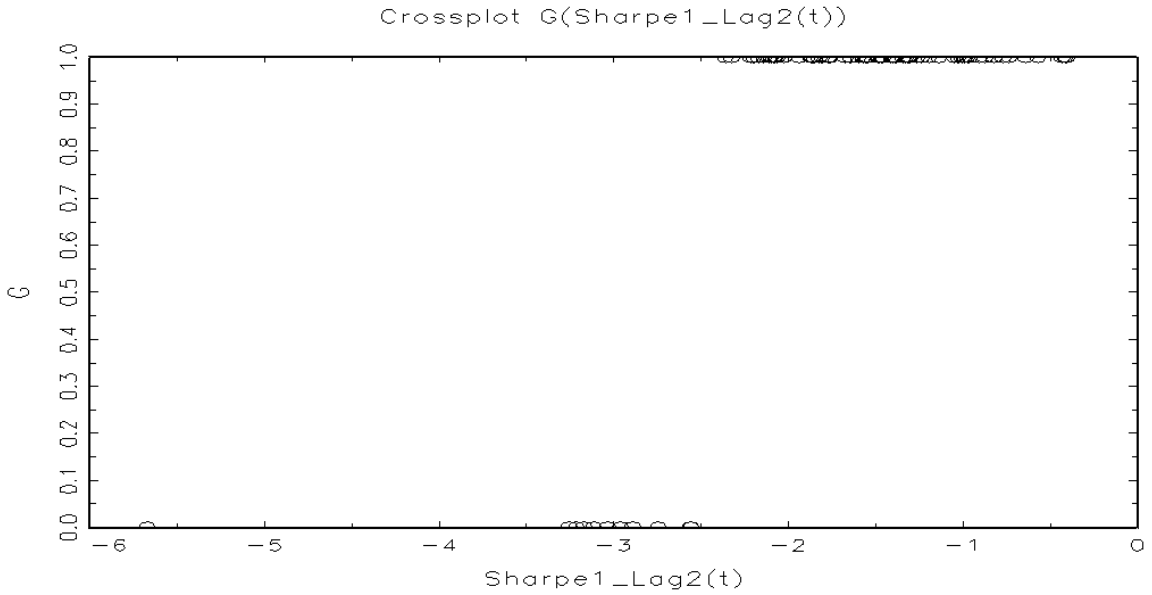

Figure 6:54Rand/Yen Two Month Lag Sharpe Ratio (Jul 2005–Nov 2011)

Table 6.21 and Figure 6.54 provide the summary results for the Rand/Yen for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -2.45. This means that maximum profit taking in the Rand/Yen carry trade activity could be achieved in the upper regime.

6.5.2. Short-Term Periods

The following section provides interpretation of the results for the following periods: January 2001–December 2004 and December 1996–December 2000.

Period: December 1996–December 2000

Table 6:22One Month Lag Sharpe Ratio for the period November 1996–December 2000

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.58665	-29.91121	-0.58091	29.73507	10.56245	-1.57330
British Pound	0.01618	-1.00588	-0.01449	1.15897	53.80255	-0.11214
Japanese Yen	-0.05153	9.32555	0.05614	-9.50337	15.87857	-3.56146

Table 6:23Two Months Lag Sharpe Ratio for the period November 1996–December 2000

	α_1	β_1	α_2	β_2	γ	C
US Dollar	0.00681	-0.44283	-0.04229	4.83615	10.42045	0.92367
British Pound	0.00452	-0.08456	-82.62487	6365.65741	2.94332	4.38448
Japanese Yen	-0.05173	8.93183	0.05323	-8.19983	60.29974	-3.40741

Table 6.22 and Figure 6.55 provide summary results for the Rand/GBP for the one month lag in the Sharpe ratio as the transition variable. The results show that theRand/GBP is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold

from the lower regime to the upper regime is occurring at the Sharpe ratio of -0.11. This means that the maximum profit taking for the Rand/GBP carry trade could be achieved in the upper regime.

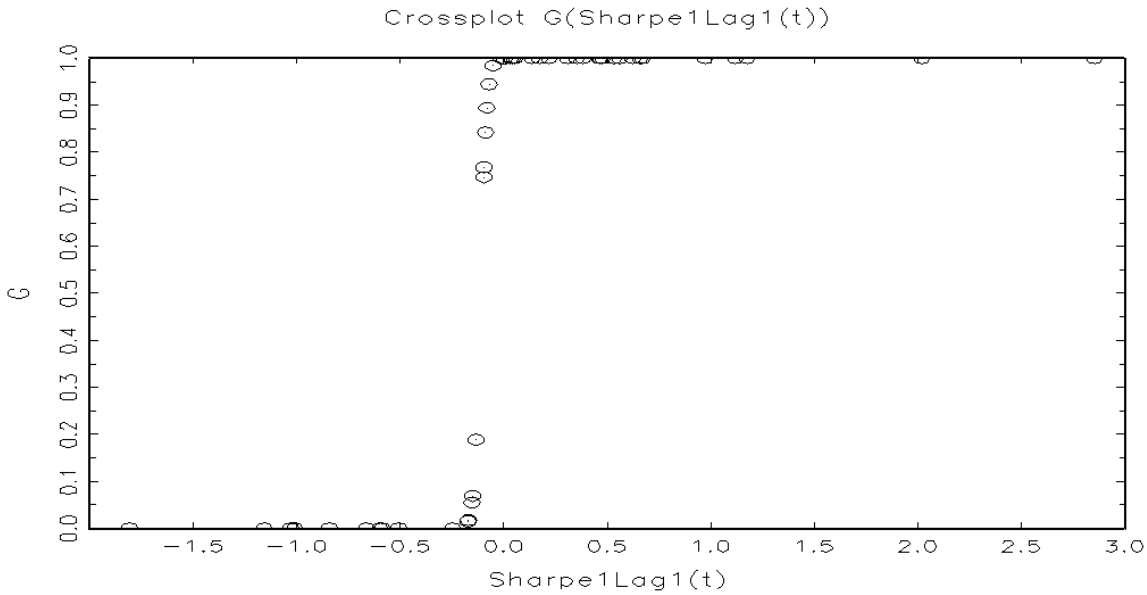

Figure 6:55 Rand/GBP One Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Table 6.23 and Figure 6.56 provide summary results for the Rand/GBP for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear ($\gamma>0$) and mostly concentrated at the lower regime. The maximum possible profit for the Rand/GBP carry trade could only be achieved in the lower regime. However, this could be very marginal as it is determined by the level of the forward premium.

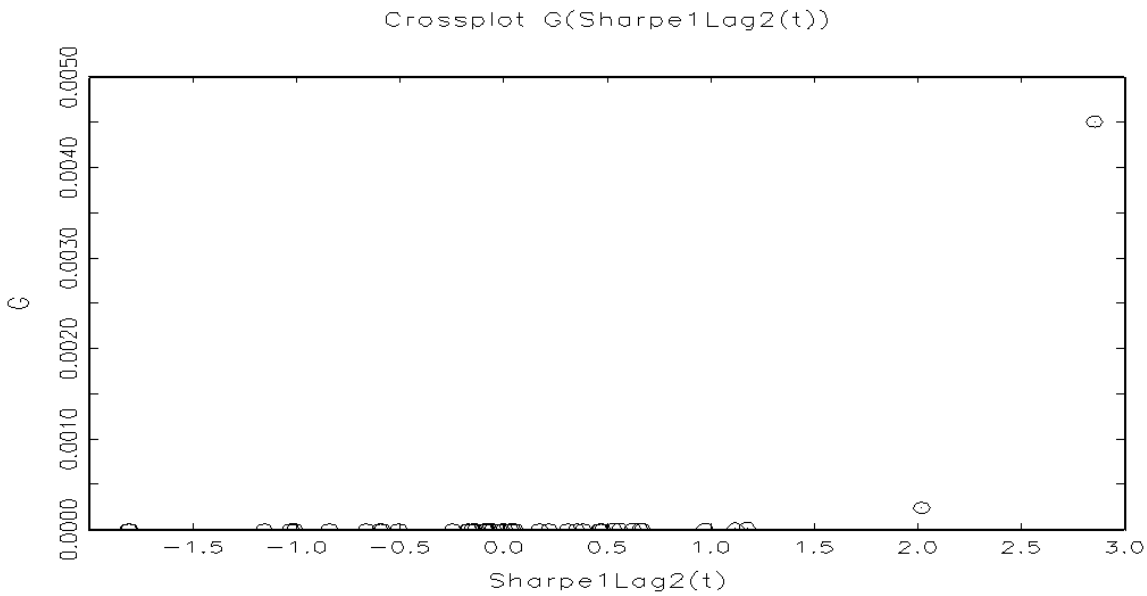

Figure 6:56 Rand/GBP Two Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Table 6.22 and Figure 6.57 provide summary results for the Rand/USD for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -1.57. This means that maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

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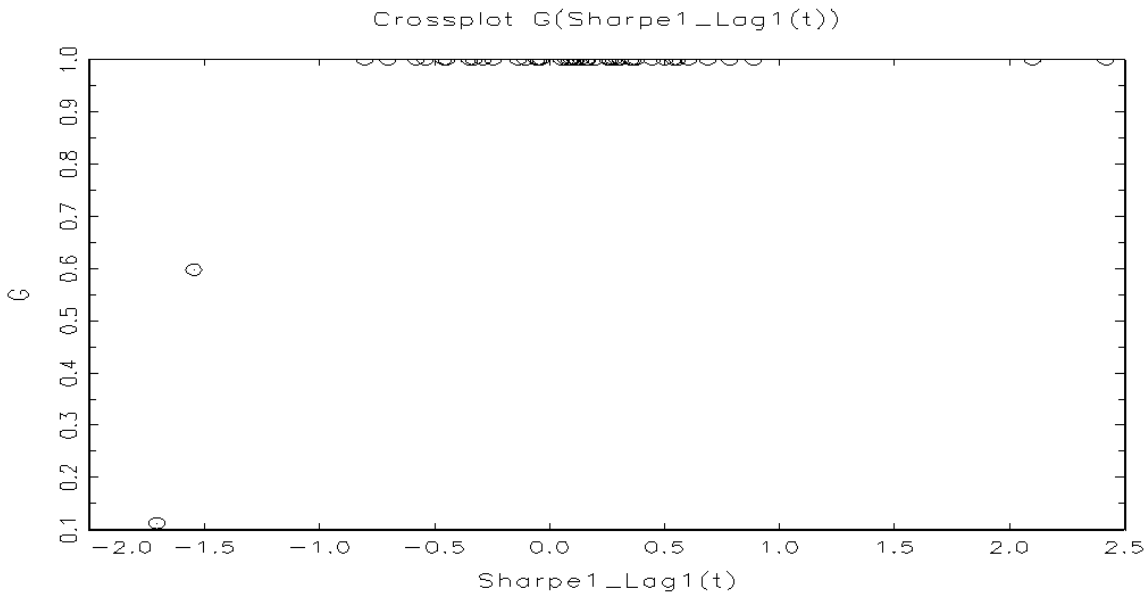

Figure 6:57Rand/USD One Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Table 6.23 and Figure 6.58 provide summary results for the Rand/USD for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.92. Therefore the maximum profit taking for the Rand/USD carry trade activity could be achieved in the upper regime.

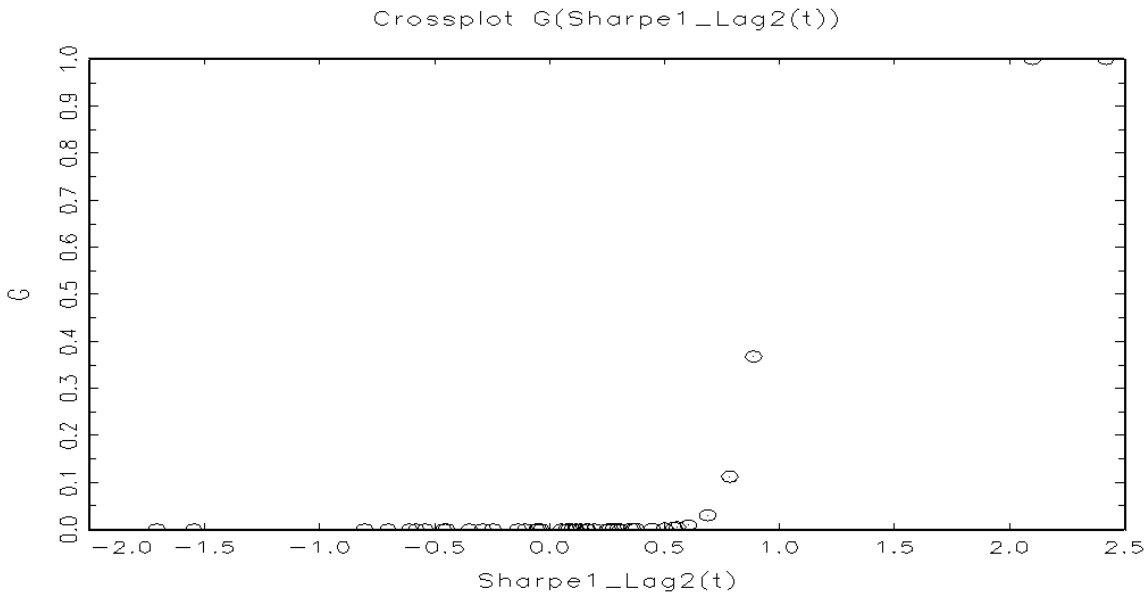

Figure 6:58 Rand/USD Two Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Table 6.22 and Figure 6.59 provide summary results for the Rand/Yen for the one month lag in the Sharpe ratio as the transition variable. The results show that Rand/Yen is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.56. This means that the maximum profit taking for the Rand/Yen carry trade could be achieved in the upper regime. However, most of data indicates that the Rand/Yen carry trade activity is still making a loss in the upper regime. This could be attributed to the very low forward premium and the lower Sharpe ratios experienced during this period.

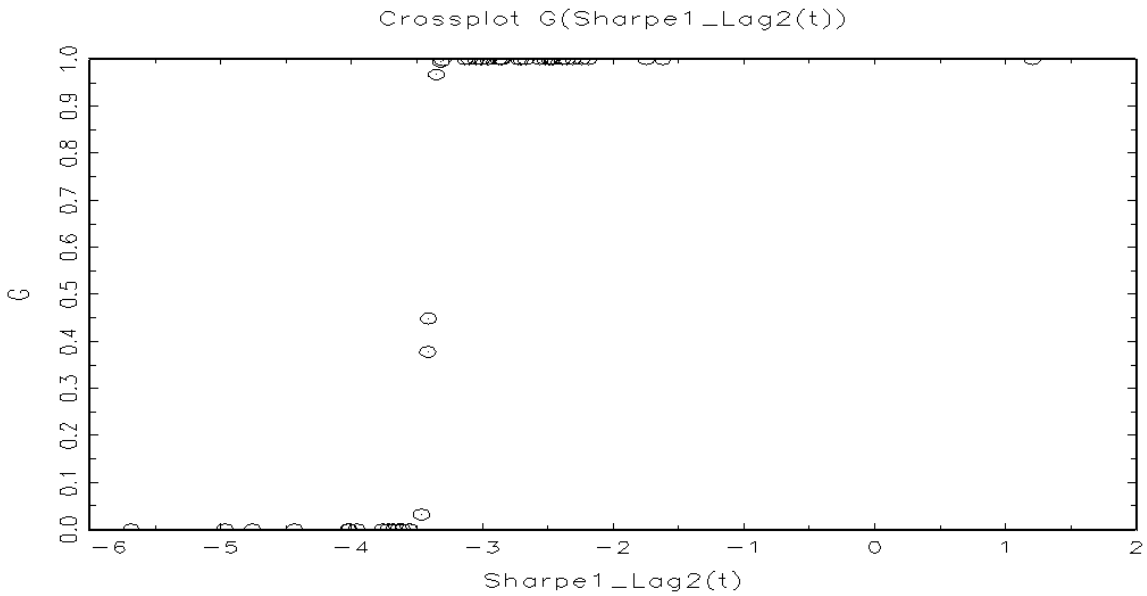

Figure 6:59Rand/Yen One Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Table 6.23 and Figure 6.60 provide summary results for the Rand/Yen for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -3.4. The maximum profit taking for the Rand/Yen carry trade could be achieved in the upper one month regime. However, the data shows a Rand/Yen carry trade loss in the upper regime. This could be attributed to the lower forward premium and the lower Sharpe ratios experienced during this period.

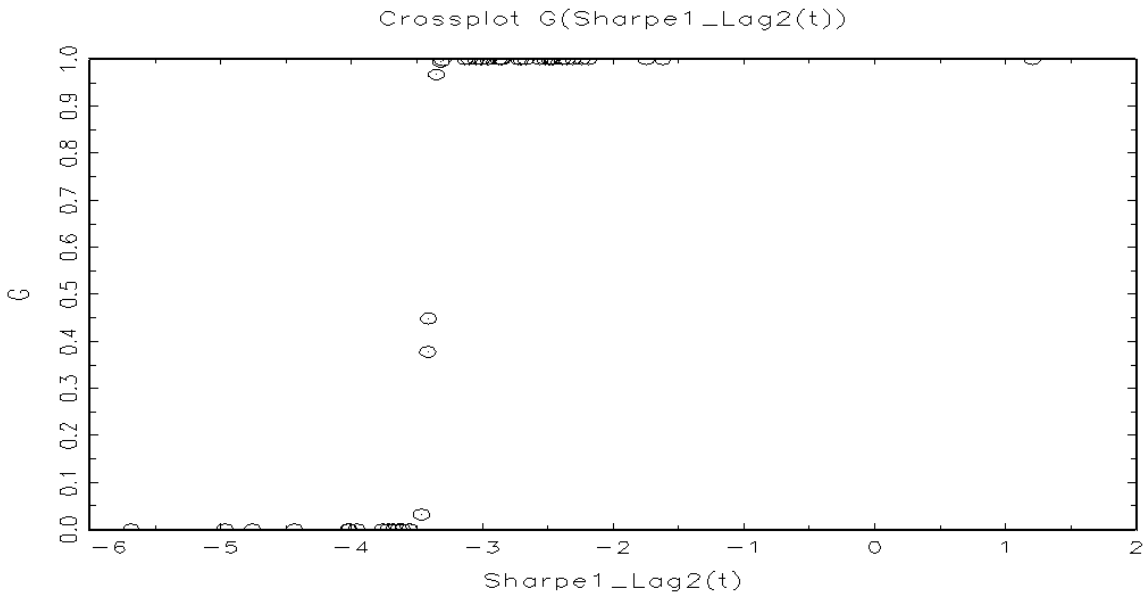

Figure 6:60Rand/Yen Two Month Lag Sharpe Ratio (Dec 1996–Dec 2000)

Period: January 2001–December 2004

Table 6:24One Month Lag Sharpe Ratio for the period January 2001–December 2004

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-0.00354	-0.05533	-200.65169	21393.13390	87.56449	1.83175
British Pound	0.03418	-1.12798	-0.03754	0.27797	9.98430	-1.33078
Japanese Yen	-0.01580	4.25041	-0.00149	2.90530	51.80269	-1.58278

Table 6:25Two Month Lag Sharpe Ratio for the period January 2001–December 2004

	α_1	β_1	α_2	β_2	γ	C
US Dollar	-0.00882	0.56970	0.01265	-2.05307	10.15936	-0.37970
British Pound	0.00003	0.30164	0.00008	-1.33636	9.66793	-0.24394
Japanese Yen	-0.01638	4.10200	-0.00236	3.06828	1291.36470	-1.99965

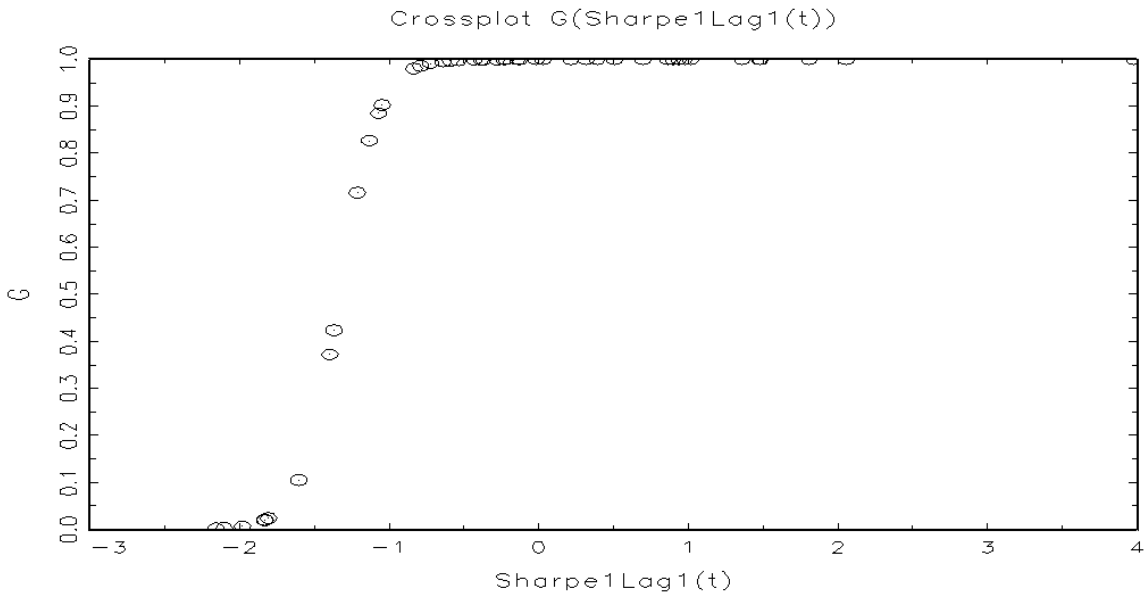

Figure 6:61 Rand/GBP One Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.24 and Figure 6.61 provide summary results for the Rand/GBP for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear ($\gamma>0$) and a smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -1.33. This means that the maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

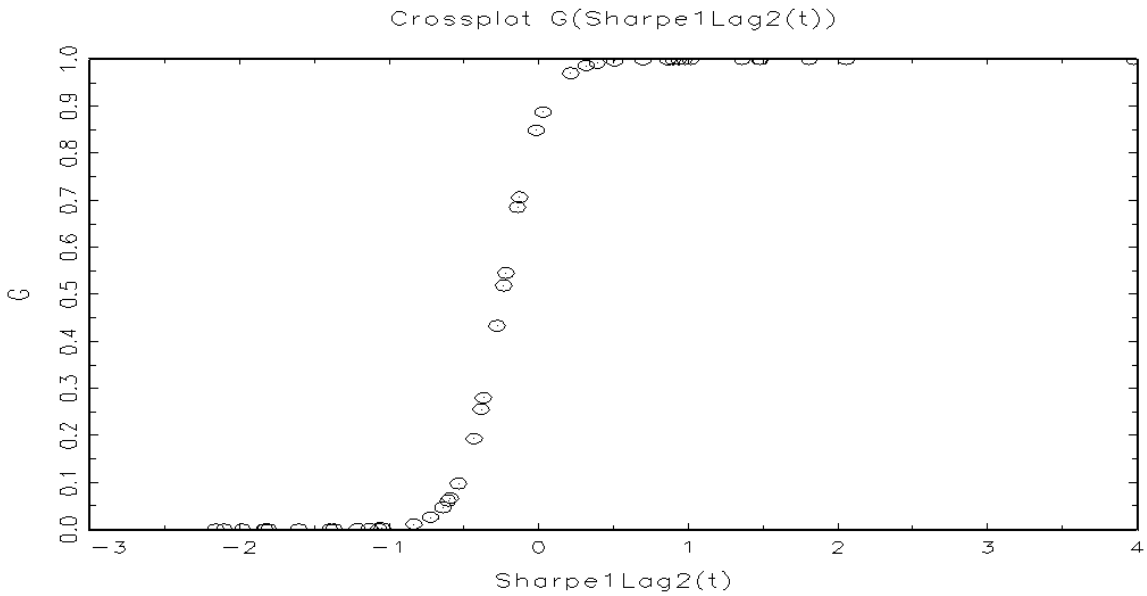

Figure 6:62Rand/GBP Two Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.25 and Figure 6.62 provide summary results for the Rand/GBP for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/GBP is nonlinear ($\gamma>0$) and a smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -0.24. This means that the maximum profit taking for the Rand/GBP carry trade activity could be achieved in the upper regime.

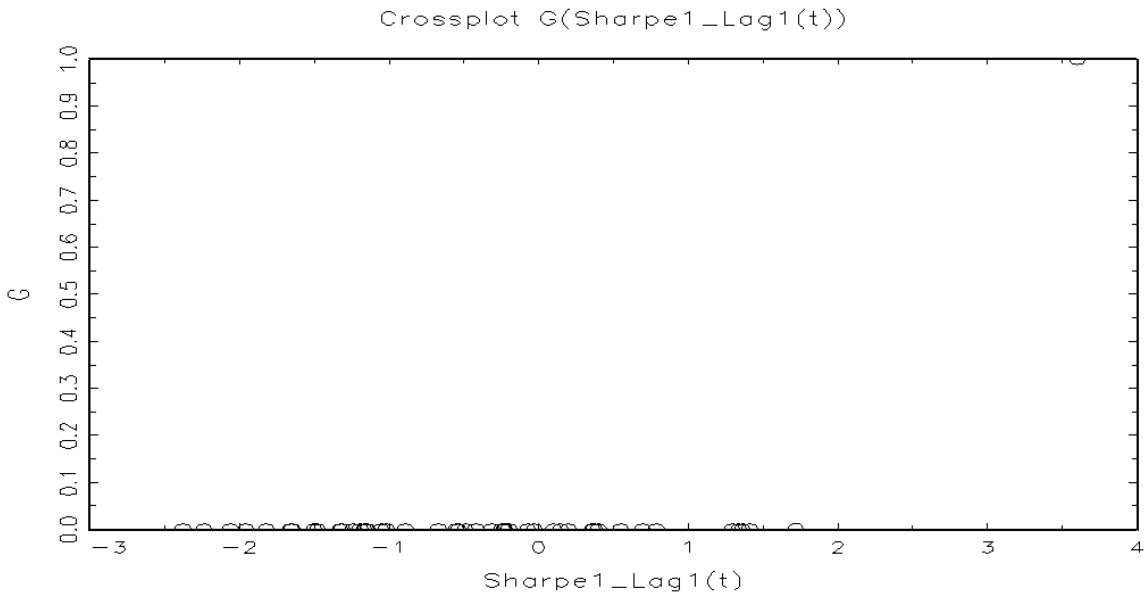

Figure 6:63 Rand/USD One Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.24 and Figure 6.63 provide summary results for the Rand/USD for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear (γ>0) and mostly concentrated in the lower regime. This means that the Rand/USD carry trade activity is not profitable in the lower regime.

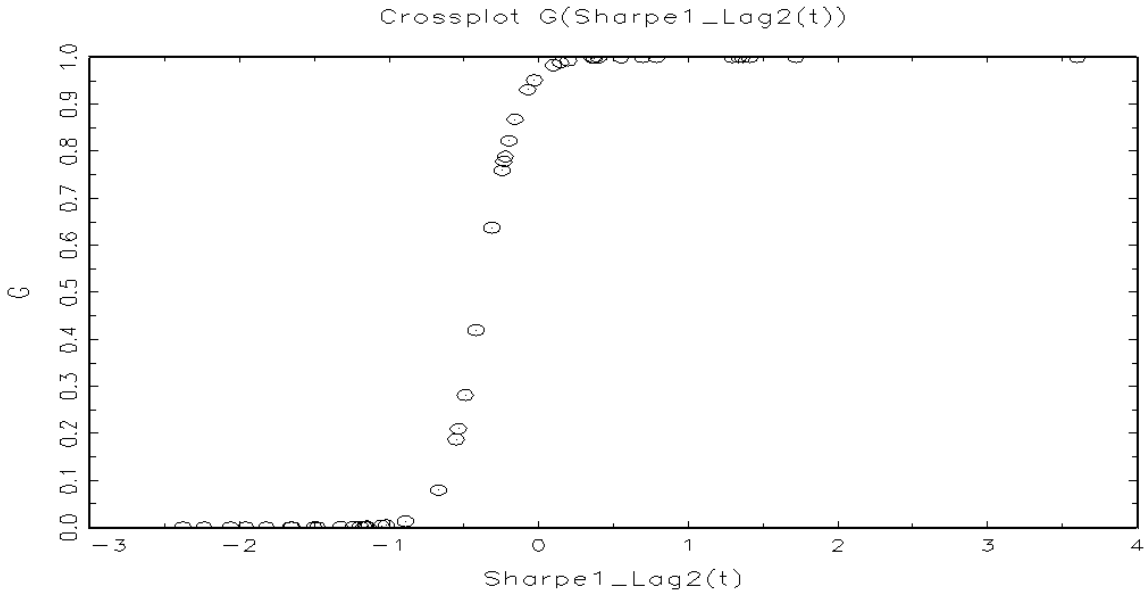

Figure 6:64 Rand/USD Two Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.25 and Figure 6.64 provide summary results for the Rand/USD for the two months lag in the Sharpe ratio as the transition variable. The results show that the Rand/USD is nonlinear ($\gamma>0$) and a smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of 0.26. This means that the Rand/USD carry trade activity is mostly profitable in the upper regime.

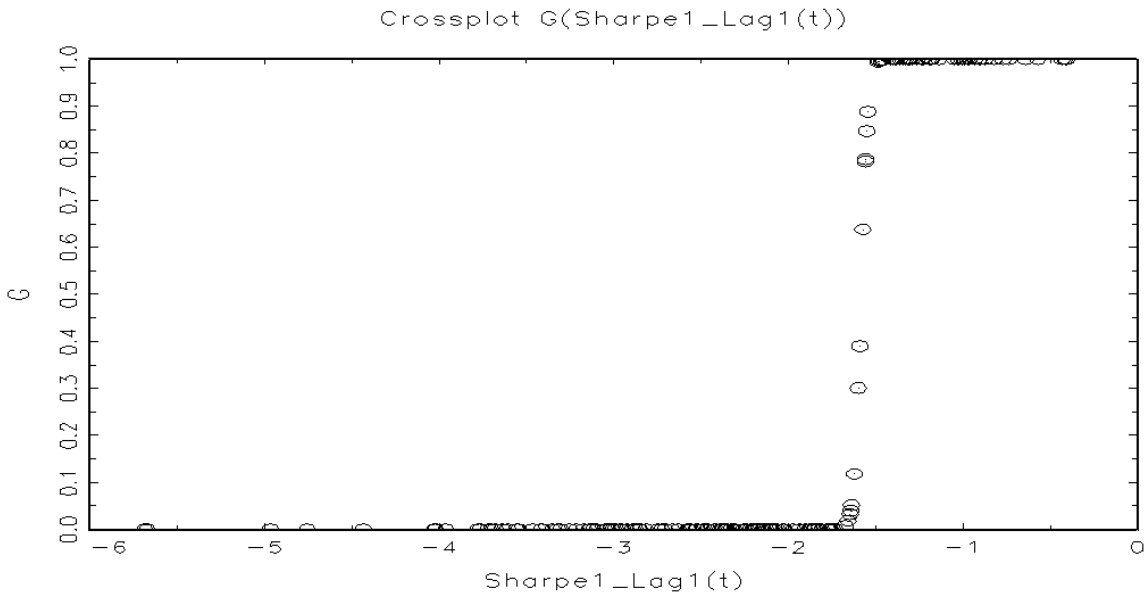

Figure 6:65Rand/Yen One Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.24 and Figure 6.65 provide summary results for the Rand/Yen for the one month lag in the Sharpe ratio as the transition variable. The results show that the Rand/Yen is nonlinear ($\gamma>0$) and a rapid smooth transition from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -1.58. This means that the maximum profit taking for the Rand/Yen carry trade activity could be achieved in the upper regime. The Rand/Yen carry trade activity was marginally profitable during this period.

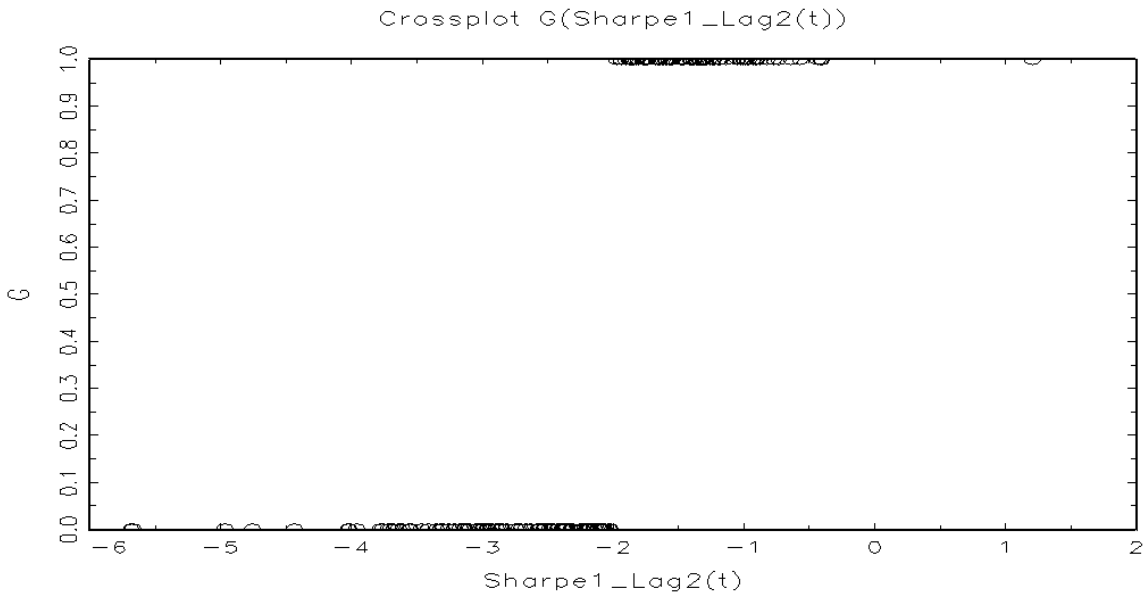

Figure 6:66 Rand/Yen Two Month Lag Sharpe Ratio (Jan 2001–Dec 2004)

Table 6.25 and Figure 6.66 provide summary results for the Rand/Yen for the two months lag in the Sharpe ratio as the transition variable. The results show that Rand/Yen is nonlinear ($\gamma>0$) and very abrupt from the lower regime to the upper regime. The threshold from the lower regime to the upper regime is occurring at the Sharpe ratio of -2. This means that the maximum profit taking for the Rand/Yen could be achieved in the upper regime. However, the Rand/Yen carry trade activity was generally not profitable during this period. This could be attributed to the lower forward premium and the negative Sharpe ratios experienced during this period.

6.6. Robustness Checks

This section provides brief analysis of robustness checks to evaluate the sensitivity of the empirical results reported in this chapter. The robustness is assessed based on the calm periods (pre-crisis and post-crisis) and also on the choice of the forward rate maturity.

The core results are based on a one month forward rate maturity. The results of the pre-crisis periods and post-crisis periods were individually assessed to determine if there is a pattern in the results. The results considered are mainly for the Sharpe ratios and for the three currencies considered in this research. The pre-crisis period is for July 2005–December 2007

(subprime crisis) and the post-crisis periods are for January 2010–December 2011 (subprime), January 2003–December 2004 (Turkish crisis), and January 1999–December 2000 (Asian crisis).

For one month forward rates for the calm periods, the results show that for both the Rand/GBP and the Rand/USD, the UIP hypothesis holds in the middle regime. Meanwhile the results for the Rand/Yen show that UIP hypothesis does not hold and that the transition from the lower regime to the upper regime is smooth.

The robustness of the maturity of the forward rates was tested for the same pre-crisis and post-crisis periods. The core results are based on a one month forward rate with the Sharpe ratio as the transition variable. The forward rates considered are two months, three months, six months, nine months, and twelve months. For the Rand/GBP and the Rand/USD, the results show that the UIP hypothesis holds for all forward rates considered and it is in the middle regime.

For the Rand/Yen, the results show that a one month forward is a nonlinear smooth transitioning from the lower regime to the upper regime. For the other forward rates, the results show that UIP hypothesis holds in the middle regime.

6.7. Summary

This chapter provided a summary of the results. The results include the following: unit root tests, the LSTR results with the Sharpe ratio as the transition variable for a one month forward rate, the LSTR results with risk adjusted forward premium as the transition variable for a two month forward rate and the delay parameter for the lag of the Sharpe ratio as the transition variable.

The LSTR results with the Sharpe ratio as the transition variable show that the Rand/GBP and the Rand/USD are mostly linear for all short-term forward rate maturities considered.

The results for the Rand/Yen show a smooth transition from the lower regime to the upper regime when using the Sharpe ratio as the transition variable for a one month forward rate maturity. For the other short-term forward rate maturities, the Rand/Yen exhibits a linear pattern.

The only exceptions are the Turkish financial crisis, which affected the results for the Rand/GBP in that the UIP hypothesis only holds for the three and six months forward rates.

The results for the risk adjusted forward premium generally show that carry trade activity is profitable in the upper regime for most of the currencies considered in this research. The UIP hypothesis is likely to hold in the upper regime when the Sharpe ratios are substantially high to attract the speculative investors. The profit margin depends on the forward premium.

The results for the delay parameter as the transition variable with the maximum of two months lag for the Sharpe ratio show that the maximum profit taking for the carry trade activity could be achieved in the upper regime for the currencies considered in this research.

The robustness checks were conducted for the pre-crisis and post-crisis periods to determine the sensitivity of the empirical results reported in this research. In addition, the forward rate maturity was tested for the same periods.

The pre-crisis and post-crisis results with a one month forward rate maturity as the core results show that UIP hypothesis holds for the Rand/GBP and the Rand/USD. The UIP hypothesis does not hold for the Rand/Yen for a one month forward rate maturity.

The results for the other forward rate maturities show that the UIP hypothesis holds for all currencies considered with forward rate maturities up to one year.

Overall, the maximum profit taking for carry trade activity could be achieved in the upper regime for all the currencies considered in this research. The risk adjusted forward premium provided an indication of the profit margin to be achieved for the carry trade activity. Of the three currencies considered in this research, the Rand/Yen carry trade activity has a small forward premium, which could result in a very little profit margin. The profitability of the carry trade activity is mostly in the upper regime.

CHAPTER 7. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

The previous chapters provided a summary and discussion of the results. The results were analysed for each of the three currencies under consideration. These results were interpreted for each of the periods considered, taking into account crisis periods that occurred during the sample period. The Sharpe ratio and the risk adjusted forward premium were used as the transition variables. The delay parameter was done by lagging the Sharpe ratio as the transition variable for a two periods lag. The results show that for a one month Sharpe ratio, the UIP hypothesis holds for the Rand/USD and the Rand/GBP for most of the periods. The Rand/Yen results consistently show that the UIP does not hold and in most of the cases the Sharpe ratios were consistently negative, implying that the Rand/Yen is not profitable. The profitability of carry trade investment requires the Sharpe ratio to be in the upper regime.

The results for the risk adjusted forward premium as the transition variable consistently show nonlinearity for all currencies and for all the periods considered. The Rand/GBP and the Rand/USD results show that a significant amount of profit could be made in the upper regime. This translates into an average of more than 2% risk adjusted forward premium for these currencies. However, the Rand/Yen results show some considerable losses and if a profit is to be made, it could not exceed 0.05% (the risk adjusted forward premium). The Rand/Yen is therefore not profitable for currency carry trade investment.

The results for the Delay parameter as the transition variable display nonlinearity. The Rand/GBP and the Rand/USD results for both the one month lag and the two months lag show that carry trade investment is profitable in the upper regime. The results further show that the UIP hypothesis does not hold when considering the Delay parameter as the transition variable with a maximum of two lags. The results for the Rand/Yen show that carry trade investment is not profitable and in most of the cases this is occurring in the lower regime. The UIP hypothesis does not hold for the Rand/Yen currency when considering the Delay parameter as the transition variable with a maximum of two periods lag.

The rest of this chapter is organised as follows (7.2) summary of the results in relation to literature, (7.3) hypothesis tests, (7.4) contribution to body of knowledge, (7.5) limitations and (7.6) recommendation for future work.

7.2. Summary

Currency carry activity remains an interesting subject for speculative investors who mainly focus on the interest rate differential between two trading countries of interest. The observation made, therefore, is that the interest differential should reasonably determine the profit margin in this type of investment. This can only be true if the exchange rate risk is covered. However, the exchange rate risk is not covered under the currency carry trade investment. Hence it is fundamentally based on the uncovered interest rate parity (UIP) condition. In most of the cases the UIP does hold. There are many reasons attributed to the failure of the UIP condition: amongst others, it is the choice of the currency or currency pairs, the assumption of linearity throughout and the choice of transition variable (should nonlinearity be considered).

7.2.1. The Time Horizon for UIP

Studies such as Chinn & Meredith (2004) tested the UIP hypothesis using interest rates of short and long maturities of 5–10 years. This was done mostly on the OLS regressions and the results confirm that the UIP hypothesis holds for longer maturities. These findings are slightly different to Snaith et al. (2013), who also used OLS regressions for forward rate maturities ranging from one month to 10 years. Their results indicate that the UIP hypothesis holds for maturities from three years onwards. In other words, the FPP does not exist for longer maturities. These results are mainly for five heavily traded US dollar currency pairs for the period 1980–2006. They are only applicable to the developed currencies and they cannot be fully compared to the research currently undertaken. The exchange rate volatility regime involves nonlinearities. This research proved that UIP hypothesis holds for forward maturities ranging from one month to one year for the Rand/USD and the Rand/GBP when using the Sharpe ratio as the transition variable in the LSTR model. The results for the Rand/Yen show that the UIP hypothesis does not hold for a one month forward maturity and

only holds from two months to one year forward rate maturities when using the Sharpe ratio as the transition variable. The results further show that the UIP hypothesis holds in the middle regime and investors can make profit when the Sharpe ratio is in the upper regime. The results for the risk adjusted forward premium as the transition variable did not yield any favourable results and therefore the UIP hypothesis did not hold for all currencies and the periods considered.

Lee (2013) used OLS regressions to prove that the UIP holds best for shorter maturity forward premium and the relationship becomes weaker when maturity extends. The author found that UIP holds much better between developed and developing countries and the relationship is weaker between developing countries. This is in line with Frankel &Poonawala (2010) who found that the acceptance rate of the UIP is weaker between developed countries. The developing countries have less sophisticated financial markets and their currencies are convertible for international arbitrage (Frankel &Poonawala, 2010).

Mehl&Cappiello (2009) found that the UIP hypothesis depends more on currency than on the time horizon, and that political risk and exchange rate risk premia explain the failure of the UIP.

Kozak (2011) found that risk premium is high when using a long-horizon forward rate of up to eight years. The slope coefficient is close to one for a seven year horizon.

The results documented in this thesis clearly show that the UIP hypothesis depends more on currency than on time horizon. The results for the Rand/USD and the Rand/GBP proved that the UIP hypothesis holds for forward rate maturities ranging from one month up to one year when using the Sharpe ratio as the transition variable. The results for the Rand/Yen show that the UIP hypothesis holds only for forward rate maturities ranging from two months to one year when using the Sharpe ratio as the transition variable. These results are mostly not affected by the crisis periods experienced during the sample period. The only exception is the Rand/Yen for the period July 2005–December 2011 where the UIP hypothesis did not hold at all for all forward rates considered. Also, the Rand/GBP during the period January 2001–December 2004, where the results show that only three months and six months forward rate proved that UIP holds and the rest of the forward rates maturity results exhibit some form of nonlinearity.

The results for the risk adjusted forward premium and the delay parameter as the transition variables mostly show that the UIP hypothesis does not hold regardless of the currency or the maturity of the forward rate.

7.2.2. Transition Variables

Currency carry trade activity is mostly characterised by transition from one regime to another. The transition is mostly influenced by the choice of the transition variable.

This study adopted the risk related transition variables and these variables are the Sharpe ratio and the risk adjusted forward premium. The Sharpe ratio is associated with excess returns and this will help investors in determining the maximum possible profit to be achieved when considering the currency carry trade investment. Meanwhile, the risk adjusted forward premium is used to determine the profit margin or the size of the forward premium.

The results for the Sharpe ratio as the transition variable show that the UIP hypothesis holds in the middle regime for both the Rand/USD and the Rand/GBP for a one month forward rate. However, the UIP hypothesis does not hold for the Rand/Yen for a one month forward rate when using the Sharpe ratio as the transition variable. For the other forward rates, the UIP hypothesis holds for all currencies considered. The data used in this study is mostly associated with lower Sharpe ratios, hence the UIP hypothesis holds mostly in the middle regime. This is contrary to Li et al. (2013) who found that the UIP only holds in the upper regime and this regime is mostly associated with higher Sharpe ratios. Their study mainly used four advanced currencies (UK, Australia, Japan, and Switzerland) and four emerging currencies (Brazil, Mexico, Thailand, and Russia) against the USD with the data spanning 1990–2009 (for the emerging currencies) and 1986-2009 (for the advanced currencies). The other finding from Li et al. (2013) is that the UIP hypothesis holds better during the crisis period with transition function close to unity.

Sarno et al. (2006) studied the deviation for the UIP using five major USD exchange rates and forward rates with 1– and 3–month maturity. They used the LSTR model with the Sharpe ratio as the transition variable. They found that the UIP holds in the upper regime and this occurs when the Sharpe ratio is high. Their results also point out that the deviation of the UIP occurs in the lower regime and this is mostly caused by the lower Sharpe ratios.

This is contrary to this research in that the UIP holds irrespective of the crisis period or calm period, with the exception of the Rand/GBP during the Turkish crisis and the Rand/USD during the subprime crisis. The Rand/GBP during the period 2001–2004 (Turkish financial crisis) showed that the UIP hypothesis only holds for three months and six months forward rates. Meanwhile for the Rand/USD, UIP hypothesis did not hold at all. The reason why the UIP hypothesis did not hold for these specific crises is that these currencies had lower Sharpe ratios during these respective crisis periods.

This research found that the UIP hypothesis is dependent on the type of currency rather than periods of volatility.

The adjusted risk forward premium did not yield favourable results for the UIP hypothesis. The results for all currencies and all periods considered show that the UIP does not hold. The results further show that the exchange rate volatility regime is mostly characterised by the smooth transition from the lower regime to the upper regime. This is contrary to Baillie &Kilic (2006) who found that the UIP holds in the upper regime when a risk adjusted forward premium is used as the transition variable. The authors found that when the risk adjusted forward premium is high enough the transition function takes the values closer to one. They also found that when the risk adjusted forward premium is low, the transition function is in the lower regime, and that the UIP does not hold. These results were also consistent with McMillan (2008) who examined the ability of the forward premium to provide an unbiased estimate of future spot rate allowing for potential asymmetries. McMillan (2008) found that the larger the forward premium, the better a predictor for future spot rate it is.

This research concludes that the risk related transition variables are more appropriate in determining the maximum possible profit taking in currency carry trade investment. Higher Sharpe ratios and higher forward premium leads to maximum profit taking.

7.2.3. Carry Trade Returns

The results for the Rand/USD and the Rand/GBP generally show that excess returns are achieved in the upper regime when using the Sharpe ratio as the transition variable in the LSTR model. This is achieved for all forward rates considered (the short-term forward rates).

The results for the Rand/Yen only show that the excess returns could be achieved from two months forward rates onwards.

This is consistent with Li et al. (2013) who found that excess returns could be achieved in the upper regime, which has higher Sharpe ratios. Li et al. (2013) determined that the volatility based transition variables are useful in determining the carry trade returns. The volatility based transition variables are the Sharpe ratio and exchange rate volatility. The authors found that other transition variables, such as the interest rate differential, are not useful in determining the transition from the lower regime to the upper regime. Li et al. (2013) concluded that it is the risk and not a pure return that determines the transition from one regime to another. This is contrary to Baillie & Chang (2011) who found that UIP holds in the upper regime when interest rate differentials are high and the exchange rate volatility is also high.

This research concludes that maximum possible excess returns could be achieved in the upper regime when the forward premium is high.

7.3. Hypothesis Tests

Hypothesis 1: Exchange rate volatility does not have an impact on the profitability of carry trade investment.

Alternative hypothesis: Exchange rate volatility affects the profitability of carry trade investment.

Hypothesis 1 is tested by considering the Sharpe ratio as the transition variable in the LSTR model. The model is tested for intercept of zero and the slope coefficient of one.

Long-term Period:

The long-term period means the period including some major crisis episodes that occurred during the sampling period. It is still being tested with short-term forward rate maturity.

Only the British Pound and the USD as the funding currencies against the South African Rand are linear with $\alpha = 0$ and $\beta = 1$. Therefore the UIP hypothesis holds for these currencies.

For the Rand/USD, all parameters are significant ($P<0.05$). The null hypothesis is therefore rejected. It can be concluded that in the long-term period, the Rand/USD exchange rate volatility affects the profitability of carry trade investment.

For the Rand/GBP, all parameters are are significant ($P<0.05$) with the exception of $\beta_{2,}$ which is not significant ($P>0.05$). However, β_1 is more significant and it has more influence than β_2 (β_2 is almost zero). Therefore, overall β is significant. The null hypothesis is therefore rejected. It can be concluded that in the long-term period, the Rand/GBP exchange rate volatility affects the profitability of carry trade investment.

The Yen as the funding currency against the South African Rand is nonlinear and mostly abrupt if there is no smooth transition from the lower regime to the upper regime. The UIP hypothesis does not hold. All parameters are not significant ($P>0.05$). Therefore the null hypothesis is accepted. It can be concluded that exchange rate volatility does not have an impact on the profitability of carry trade investment for the Rand/Yen carry trade investment in the long-term period.

Short-term Period:

The short-term period means the pre-crisis and the crisis periods. This is also being tested for forward rate maturity of the short-term horizon.

The British Pound as the funding currency against the South African Rand is linear for all short-term periods considered with the exception of the period January 2001–December 2004.

For all other short-term periods all parameters are significant ($P<0.05$). Therefore the null hypothesis is rejected. It can be concluded that in the short-term period the Rand/GBP exchange rate volatility affects the profitability of carry trade investment.

For the period 2001–2004, the Rand/GBP is nonlinear ($\gamma>0$). All other parameters are significant ($P<0.05$) except $\beta_{2,}$ which is not significant ($P>0.05$). The UIP hypothesis does not hold during this period. Therefore the null hypothesis is rejected. It can be concluded that in the short-term period, exchange rate volatility affects the profitability of the Rand/GBP carry trade investment for the period January 2001– December 2004.

The USD as the funding currency against the South African Rand is linear for all periods considered. The UIP hypothesis holds for all short-term periods considered.

For all other short-term periods all parameters are significant ($P<0.05$). Therefore the null hypothesis is rejected. It can be concluded that for the short-term periods the Rand/USD exchange rate volatility affects the profitability of carry trade investment.

The Yen as the funding currency against the South African Rand is nonlinear and the UIP hypothesis does not hold for all periods considered. All parameters are not significant ($P>0.05$).The null hypothesis is accepted. It can be concluded that the volatility of the Yen as the funding currency againt the South African Rand does not have an impact on the profitability of carry trade investment.

Hypothesis 2: The profitability of carry trade investment does not depend on the type of currency.

Alternative hypothesis: The profitability of carry trade investment is dependent on the type of currency.

Hypothesis 2 follows exactly from hypothesis 1. In hypothesis 1 different currencies were tested to determine the profitability of carry trade investment.

From hypothesis 1 it was concluded that the Yen as the funding currency is nonlinear and that the UIP hypothesis does not hold, compared to other currencies (the British Pound and the USD). Therefore the null hypothesis is rejected. It can be concluded that the profitability of carry trade investment is dependent on the type of currency.

Hypothesis 3: The profitability of carry trade investment does not depend on a time horizon.

Alternative hypothesis: The profitability of carry trade investment depends on the time horizon.

The limitation of this hypothesis is that only short-term maturities of less than one year are being considered. Lack of data for the forward maturities of more than one year is the limitation to testing this hypothesis.

For British Pound as the funding currency:

With the exception of the period January 2001– December 2004 (where the UIP hypothesis only holds for three months and six months forward rates), the UIP hypothesis holds for all short-term forward rate maturities considered. The null hypothesis is accepted. It can be concluded that the profitability of carry trade investment does not depend on the time horizon, when using the Sharpe ratio as the transition variable in the LSTR model.

For the USD as the funding currency:

The UIP hypothesis holds for all short-term forward rate maturities considered. Therefore the null hypothesis is accepted. It can be concluded that profitability of carry trade investment for the USD as the funding currency does not depend on the time horizon when using the Sharpe ratio as the transition variable in the LSTR model.

For the Yen as the funding currency:

With the exception of the period July 2005–December 2007 (where the UIP hypothesis did not hold for all short-term forward rates maturities), the UIP hypothesis does not hold for the one month forward rate maturity but it holds for other short-term forward rate maturities.

It can be concluded that profitability of carry trade investment for Yen as the funding currency depends on the time horizon when using the Sharpe ratio as the transition variable in the LSTR model.

Hypothesis 4: The profitability of carry trade investment does not depend on the interest rate differential between the two trading countries.

Alternative hypothesis: The profitability of carry trade investment depends on the interest rate differential between the two trading countries.

Since a CIP condition requires the interest rate differential to be equal to the forward premium, the results of the forward premium will be used to prove Hypothesis 4. For Hypothesis 4 to be accepted requires the UIP hypothesis to hold. Under the UIP there should

be no profit as a result of carry trade investment. This hypothesis is testing by using the risk adjusted forward premium.

For British Pound as the funding currency:

UIP hypothesis does not hold for all periods considered. All parameters are not significant (P>0.05) Therefore the null hypothesis is accepted. It can be concluded that profitability of carry trade investment does not depend on the interest rate differential between the two trading countries. This is only true when forward premium with a two months forward is used as the transition variable in the LSTR model.

The results for this currency were not consistent when considering the transition from the lower regime to the upper regime. The lower regime is mostly characterised by a negative forward premium.

For the USD as the funding currency:

The UIP hypothesis does not hold for all periods considered. All parameters are not significant (P>0.05) Therefore the null hypothesis is accepted. It can be concluded that profitability of carry trade investment does not depend on the interest rate differential between the two trading countries. This is only true when the forward premium with a two months forward is used as the transition variable in the LSTR model.

The results for this currency were mostly affected by the crisis period and the forward premium was mostly concentrated in the lower regime. This regime is not profitable.

For the Yen as the funding currency:

UIP hypothesis does not hold for all periods considered. All parameters are not significant (P>0.05) Therefore the null hypothesis is accepted. It can be concluded that profitability of carry trade investment does not depend on the interest rate differential between the two trading countries. This is only true when a forward premium with a two months forward is used as the transition variable in the LSTR model.

This currency showed a very positive forward premium from the lower regime to the upper regime. It was only affected by the subprime crisis (2005–2011) whereby the forward premium was still positive but in the lower regime.

Hypothesis 5: There is no link between interest rate differential and the changes in the exchange rate movements for the two trading countries.

Alternative hypothesis: There is a link between interest rate differential and the changes in exchange rate movements for the two trading countries.

Hypothesis 5 follows from Hypothesis 4. For all currencies considered, it was established that the UIP does not hold when an adjusted forward premium is used as the transition variable in the LSTR model. For hypothesis 5 to be true requires the UIP not to hold. Therefore the null hypothesis is accepted. It can be concluded that there is no link between interest rate differential and the changes in the exchange rate movements for the currencies considered (Rand/Pound, Rand/USD and Rand/Yen).

Hypothesis 6: TheUIP hypothesis does not hold in the short-term horizon.

Alternative hypothesis: TheUIP hypothesis holds in the short-term horizon**.**

This hypothesis was only tested with the forward rate maturities of up to one year.

For the British Pound and the USD, it has been proven that the UIP hypothesis holds for a one month forward maturity when using the Sharpe ratio as the transition variable. This has also been proven for the other forward rates maturities up to one year. This was tested for all sample periods considered in this study. The only exception is the period January 2001–December 2004 where the UIP hypothesis does not hold for the Rand/GBP. This is primarily due to the lower Sharpe ratios experienced during this crisis period.

The Rand/Yen results show that the UIP hypothesis does not hold for a month forward maturity when using the Sharpe ratio as the transition variable. However, the other forward rate maturieties (up to one year) show that the UIP hypothesis holds for the Yen. The only exception is the period July 2005–December 2011 where the UIP hypothesis did not hold for

all short-term forward rate matutities considered. This is due to the lower Sharpe ratio for the Rand/Yen experienced during this period.

Overall, the results indicate that the UIP hypothesis holds for the short-term maturities.

Hypothesis 7: Forward rate maturity does not affect the profitability of carry trade investment.

Alternative hypothesis: Forward rate maturity affects the profitability of carry trade investment.

The maturity of forward rates was tested for all periods when the Sharpe ratio was used as the transition model in the LSTR model.

Long-term period:

The British Pound and the USD as the funding currencies against South African Rand show that the UIP holds for all short-term forward rate maturities considered. Therefore carry trade investment is not profitable in all short-term forward rate maturities considered. The null hypothesis is accepted. It can be concluded that the forward rate maturity does not affect the profitability of carry trade investment for the British Pound and the USD as the funding currencies against the South African Rand when the Sharpe ratio is used as the transition variable in the LSTR model.

The Yen as the funding currency against the South African Rand shows that the UIP does not hold for a one month forward rate maturity for all periods considered. For the period July 2005–November 2011, the UIP does not hold for all forward rate maturities considered. For the other periods, the UIP holds for other forward rate maturities considered. The null hypothesis is rejected. It can be concluded that the forward rate maturity affects the profitability of carry trade investment when the Yen is used as the funding currency against the South African Rand.

Short-term period:

The British Pound provides mixed results. For the period January 2001–December 2004, the UIP does not hold for one month, two months and nine months forwardrates. The null hypothesis is rejected for the period January 2001–December 2004. It can be concluded that forward rate maturity affects the profitability of carry trade investment when the British Pound is used as the funding currency against the South African Rand for the period January 2001–December 2004.

For the other short-term periods considered, the forward rate maturity is not profitable for all forward rates and the UIP hypothesis holds. The null hypothesis is accepted. It can be concluded that carry trade investment is not profitable for all forward rates considered.

The USD as the funding currency against the South African Rand shows that the UIP holds for all forward rates considered. Therefore carry trade investment is not profitable for all forward rates considered. The null hypothesis is accepted. It can be concluded that the forward rate maturity does not affect the profitability of carry trade investment for the USD as the funding currency against the South African Rand when the Sharpe ratio is used as the transition variable in the LSTR model.

The Yen as the funding currency against the South African Rand shows that the UIP does not hold for the one month forward rate for all short-term periods considered. For the other periods, the UIP holds for other forward rate maturities considered (with the exception of two months forward for the period 2001–2004). The null hypothesis is rejected. It can be concluded that the forward rate maturity affects the profitability of carry trade investment when the Yen is used as the funding currency against the South African Rand.

7.4. Contribution to the Body of Knowledge

This research provided some insight into currency carry trade investment and its association with the UIP theory. As stated in the literature section, most of the studies have focussed too much attention on the negative slope coefficient of the UIP and the fact that it does not hold at all, particularly for the short-term horizon. The majority of these studies assumed that the data is linear (Snaith et al., 2013; Chinn & Meredith, 2004; Lee, 2013; Mehl & Cappiello, 2009 and Bekaert et al., 2007).

The current research did an in-depth analysis of the data, starting by testing the stationarity of the data and then testing for the linearity. Linearity needs to be tested for each of the transition variables used. A series of transition variables was tested to check their suitability for the LSTR model. To be relevant to the current work, only the risk related transition variables were used as the transition variables. The Sharpe ratio and the RAFP were selected as the transition variables. Financial institutions allocate capital according to the Sharpe ratio. Therefore the Sharpe ratio is taken as a proxy for exchange rate risk.

Three currencies (USD, GBP and Yen) were used as the funding currencies against the South African Rand (the target currency). The data were separated into various periods, which included some major crisis episodes such as the Asian crisis. The data were analysed for short-term maturities up to one year. The LSTR model was used and each of the currencies displays different characteristics.

The results for the Rand/USD and the Rand/GBP proved that in most of the cases the UIP hypothesis holds for all short-term forward rate maturities when using the Sharpe ratio as the transition variable. The UIP hypothesis only holds in the middle regime as result of the lower Sharpe ratios. The maximum profit taking for carry trade activity for these currencies at the short-term forward rate maturities of less than one year could be achieved in the upper regime.

The results for the Rand/Yen proved that the UIP hypothesis does not hold for the one month forward maturity when using the Sharpe ratio as the transition variable. However, for the other short-term forward rate maturities, the Rand/Yen results show that the UIP hypothesis holds in the middle regime. The one month forward rate maturity is mostly characterised by high negative Sharpe ratios, meanwhile, the other short-term forward rate maturities have

favourable Sharpe ratios. The maximum profit taking for the Rand/Yen could be achieved in the upper regime.

To validate the profitability of carry trade investment as a result of the Sharpe ratios, the risk adjusted forward premium was selected as the transition variable. The motivation for this was to determine the anomaly at the lower regime and at the upper regime. This will be used in conjunction with the Sharpe ratio for an investor to determine when to pull out of the carry trade investment.

For the curencies considered, only the Rand/Yen provided consistent positive FPA in both the lower and the upper regimes. FPA should be used to determine whether an investor would be able to make a profit in a particular exchange rate volatility regime.

This research has used both the Sharpe ratio and the RAFP as the transition variables. These two transition variables will help investors in determing the maximum profit taking for carry trade investment. Further, they will provide proper guidance in determing the predictability of the forward rate. Using the Sharpe ratio as a transition variable one would determine the regime where most of the profit could be made and then using RAFP as the transition variable, one would determine the profit margin. The analysis of the combination of the two results will help investors in maximising their profit taking.

The first step that needs to be done is to check the pattern of the FPA through the RAFP as the transition variable and the second step would be to check the Sharpe ratios. The results for the Sharpe ratio as the transition variable show that the UIP hypothesis holds in the middle regime and that maximum profit taking could be achieved in the upper regime. The results for the FPA show that in some periods the anomaly is bigger and transitioning from the lower regime to the upper regime, thereby encouraging an investment in carry trade activity. However, some of the results show that the anomaly is mostly concentrated in the lower regime with the UIP hypothesis only holding in the middle regime. This scenario is not profitable because maximum profit could only be achieved with the threshold Sharpe ratio and in most of the cases the threshold is very low if not negative.

The overall contribution of this study is that for the South African currency as the target currency, the UIP hypothesis holds for the short-term horizon and mostly depends more on currency than on horizon. Contrary to other researchers, who found that the UIP holds in the

long-term maturity with higher Sharpe ratios in the upper regime, this study proved that UIP holds in the short-term maturity horizon.

This is the first South African study to comprehensively analyse the currency carry trade activity specific to the South African economy. This research further determined the impact of the financial crisis on the carry trade activity. For the US subprime crisis and the Asian financial crisis, the results indicate that the Rand/GBP and the Rand/USD were not profitable during these periods as a result of the lower RAFP and the lower Sharpe ratios. The carry trade activity for these currencies was mostly concentrated in the lower regime. The Rand/Yen carry trade activity is mostly marginally profitable with the higher forward rate maturities as a result of slightly higher risk adjusted forward premium and the relatively lower Sharpe ratios.

The Turkish financial crisis shows that all three currencies are mostly profitable in the upper regime with a much higher forward rate maturity (12 months). This is due to the moderate Sharpe ratios and the high RAFP.

The contribution to the literature on the UIP hypothesis is that the UIP hypothesis holds for non-crisis and crisis periods when using the Sharpe ratio as the transition variable specifically for the Rand/GBP and the Rand/USD carry trade with forward rate maturities of less than one year. For the Rand/Yen carry trade activity, the UIP hypothesis holds for the other short-term forward maturity other than the one month forward rate.

The results for the RAFP show that UIP hypothesis holds in the upper regime with slightly higher forward rate maturity. This is applicable for the crisis periods.

A combination of the Sharpe ratio and the RAFP will be beneficial in determining the maximum profit taking for currency carry trade investment.

7.5. Limitations of the Study

The following are the limitations to this research:

- The data was tested for short-term maturity of up to one year, thus proving that the UIP holds for the short-term maturities mostly for the Rand/USD and the Rand/GBP currencies. The data for the long-term maturities were not available. This was required to compare the overwhelming conclusion from various empirical studies that the UIP hypothesis only holds for the long-term maturities.
- Lack of data for various interest rate maturities made it difficult to conclusively determine the effect of interest rate differential on carry trade profitability. An assumption was therefore made that the CIP hypothesis holds.
- The types of currencies selected for this research were mostly associated with lower Sharpe ratios and sometimes negative Sharpe ratios. This made it difficult to compare these results with some of the empirical studies that determined that the UIP hypothesis holds in the upper regime when using the Sharpe ratio as the transition variable in the LSTR model. Further, a mixture of lower to higher Sharpe ratios would have been very interesting in fully capturing the exchange rate volatility regime.
- The effect of the unwinding of currency carry trade activity was not fully captured in this study. Mostly this was due to the lower Sharpe ratios associated with the Rand/USD and the Rand/GBP currencies, and also due to the negative Sharpe ratios associated with the Rand/Yen currency.
- The inconsistent results for the UIP hypothesis for the Rand/Yen for the forward rates from two months to one year make it very difficult for the investor to fully benefit from currency carry trade investment. The UIP hypothesis holds, even though the profit margins are very tight. The profit margin due to the FPA is mostly 0.05% for the Rand/Yen.
- The delay parameter for the lag of the Sharpe ratio as the transition variable was only done up to two lags. This restriction made it difficult to conclusively determine the UIP hypothesis under these conditions. Normally one should allow the model to determine the maximum lag.

7.6. Recommendations/Implications

The following recommendation for future research is proposed:

- This research used the Sharpe ratio as the transition variable in the LSTR model to determine the profitability of carry trade investment. It also used the RAFP to determine the profit margin due to the FPA. Future research should focus on simultaneously determining the effect of these transition variables on the profitability of carry trade investment.
- Future work should also focus on the effect of the transaction costs on currency carry trade activity when using these risk related transition variables.
- The study should also focus on the effect of the rollover transactions due to the maturity of the forward rates. This study assumed no rollover for the forward rates.
- The effect of inflation on the currency carry trade activity should also be considered. However, care should be taken, considering that monetary policies for various countries differ, in that some countries use floating exchange rates while others use a fixed exchange rate. The floating exchange rate regime allows the value of the currency to be determined by the markets while the fixed exchange rate regime has its currencies pegged against another currency. The other problem is that countries do not react simultaneously when faced with monetary challenges that might prompt an adjustment in the interest rate: this might have different impact on inflation.

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APPENDIX 1: DETAILED FORWARD RATES RESULTS FOR RAND/POUND

Table A1.1 Forward rates results for Dec 1996–Nov 2011

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-57.86497	0.0000	-39.86663	0.0000	-13.97521	0.0000	-46.89749	0.0000	-45.25731	0.0000
Std(α1)	0		0.0146		0.0128		0.0181		0.0265	
β_1	1.00007	0.0000	1.00007	0.0000	1.00013	0.0000	0.99997	0.0000	0.99981	0.0000
Std(β1)	0.0001		0.0001		0.0004		0.0001		0.0001	
α_2	115.74714	0.0000	79.7456	0.0000	27.95813	0.0000	93.78975	0.0000	90.48694	0.0000
Std(α2)	0		0.0292		0.0253		0.0363		0.0531	
β2	-0.00013	0.4262	-0.00015	0.5600	-0.00026	0.7167	0.00006	0.7897	0.00038	0.0896
Std(β_2)	0.0002		0.0003		0.0007		0.0002		0.0002	
γ	0.00082	0.0000	0.00121	0.0000	0.00349	0.0000	0.00108	0.0000	0.0012	0.0000
Std(γ)	0		0.0000		0		0		0	
C	0.36123	0.0000	0.07203	0.0003	0.04493	0.0253	-0.03039	0.1628	-0.16043	0.0000
Std(C)	0.0673		0.0194		0.0199		0.0217		0.0243	
AIC	-38.213		-3.67E+01		-3.24E+01		-37.085		-36.637	
SC	-38.107		-3.66E+01		-3.23E+01		-36.979		-36.53	
HQ	-38.17		-3.66E+01		-3.24E+01		-37.042		-36.594	
Adj R2	1		1.0000		1		1		1	
SD of transition variable	1.0028		0.2812		0.2843		0.2942		0.3151	
SD of residuals	0		0.0000		0		0		0	

Table A1.2 Forward rates results for Dec 1996–Dec 2000

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-31.3968	0.0000	-31.7987	0.0000	-32.6224	0.0000	-36.0812	0.0000	-38.4293	0.0000
Std(α1)	0.0234		0.028		0.0531		0.0365		0.0337	
β_1	0.99975	0.0000	0.9997	0.0000	0.99967	0.0000	0.99961	0.0000	0.99949	0.0000
Std(β1)	0.0001		0.0001		0.0001		0.0001		0.0001	
α_2	62.81671	0.0000	63.61403	0.0000	65.25547	0.0000	72.15632	0.0000	76.82244	0.0000
Std(α2)	0.0468		0.056		0.1062		0.0729		0.0672	
β2	0.0005	0.068	0.0006	0.0356	0.00066	0.0234	0.00078	0.0077	0.00102	0.0013
Std(β_2)	0.0003		0.0003		0.0003		0.0003		0.0003	
γ	0.00124	0.0000	0.00124	0.0000	0.00124	0.0000	0.0012	0.0000	0.00127	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.48512	0.0000	0.0977	0.0000	0.06219	0.0062	-0.03522	0.1619	-0.20994	0.0000
Std(C)	0.0714		0.0206		0.0216		0.0247		0.0315	
AIC	-3.72E+01		-3.72E+01		-3.72E+01		-3.72E+01		-3.69E+01	
SC	-3.70E+01		-3.70E+01		-3.69E+01		-3.70E+01		-3.67E+01	
HQ	-3.71E+01		-3.71E+01		-3.71E+01		-3.72E+01		-3.68E+01	
Adj R2	1.000		1.00E+00		1.000		1.000			
SD of transition variable	0.8185		0.2307		0.2357		0.2511			
SD of residuals	0.0000		0.0000		0.0000		0.0000			

Table A1.3 Forward rates results for Jan 2001–Dec 2004

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	9Month	P-values	12Month	P-values
α_1	-0.10393	0.0000	-0.11193	0.0000	-44.0775	0.0000	-45.5091	0.0000	-0.12641	0.0000	-52.4452	0.0000
Std(α1)	0.0088		0.0093		0.0353		0.0334		0.0107		0.0458	
β_1	0.93418	0.0000	0.9225	0.0000	0.99979	0.0000	0.99964	0.0000	0.8313	0.0000	0.99947	0.0000
Std(β1)	0.0851		0.0809		0.0003		0.0003		0.079		0.0002	
α_2	0.24728	0.0000	0.25895	0.0000	88.18414	0.0000	91.03713	0.0000	0.26322	0.0000	104.8904	0.0000
Std(α2)	0.0174		0.018		0.0701		0.0662		0.019		0.0912	
β2	0.11956	0.5521	0.14491	0.4489	0.00042	0.4295	0.00072	0.1703	0.35342	0.0804	0.00105	0.0275
Std(β_2)	0.1994		0.1895		0.0005		0.0005		0.1971		0.0005	
γ	0.5203	0.0000	0.49742	0.0000	0.00137	0.0000	0.00137	0.0000	0.51796	0.0000	0.00127	0.0000
Std(γ)	0.0415		0.0391		0.0000		0.0000		0.0411		0.0000	
C	0.79925	0.0000	0.19696	0.0001	0.16953	0.0005	0.11031	0.0276	0.30538	0.3737	0.00019	0.9972
Std(C)	0.1661		0.047		0.0448		0.0483		0.3396		0.0543	
AIC	-1.30E+01		-1.31E+01		-3.65E+01		-3.65E+01		-1.29E+01		-3.68E+01	
SC	-1.28E+01		-1.29E+01		-3.63E+01		-3.63E+01		-1.27E+01		-3.66E+01	
HQ	-1.29E+01		-1.31E+01		-3.64E+01		-3.64E+01		-1.29E+01		-3.67E+01	
Adj R2	0.9973		0.9976		1.0000		1.0000		0.9971		1.0000	
SD of transition variable	1.2512		0.3506		0.3537		0.3641		2.2545		0.3847	
SD of residuals	0.0014		0.0013		0.0000		0.0000		0.0015		0.0000	

Table A1.4 Forward rates results for July 2005–November 2011

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	9Month	P-values	12Month	P-values
α_1	-35.13977	0.0000	-33.90059	0.0000	-35.07124	0.0000	-36.708	0.0000	-36.8496	0.0000	-40.3819	0.0000
Std(α1)	0.0182		0.0274		0.025		0.0242		0.0419		0.0252	
β_1	1.00043	0.0000	1.00046	0.0000	1.00046	0.0000	1.00048	0.0000	1.00053	0.0000	1.00053	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	70.26838	0.0000	67.78529	0.0000	70.12195	0.0000	73.38228	0.0000	1.00053	0.0000	80.70628	0.0000
Std(α2)	0.0363		0.0546		0.0498		0.0483		0.0004		0.0501	
β2	-0.00087	0.0088	-0.00092	0.0101	-0.00092	0.0112	-0.00096	0.012	0.00135	0.0100	-0.00106	0.0071
Std(β_2)	0.0003				0.0004		0.0004		0.0000		0.0004	
γ	0.00132	0.0000	0.00138	0.0000	0.00135	0.0000	0.00132	0.0000	0.00135	0.0000	0.00126	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
C	-0.2345	0.0044	-0.09279	0.0002	-0.11975	0.0000	-0.19578	0.0000	-1.6014	0.0000	-0.33291	0.0000
Std(C)	0.0797		0.0233		0.0245		0.0276		0.1841		0.0333	
AIC	-3.68E+01		-3.66E+01		-3.66E+01		-3.66E+01		-3.64E+01		-3.65E+01	
SC	-3.67E+01		-3.64E+01		-3.64E+01		-3.64E+01		-3.62E+01		-3.64E+01	
HQ	-3.68E+01		-3.65E+01		-3.66E+01		-3.65E+01		-3.63E+01		-3.65E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.9734		0.2731		0.2755		0.2821		1.7339		0.2944	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

Table A1.5 Forward rates results for Jan 1999–Dec 2000

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-14.45495	0.0000	-0.05599	0.0000	-0.0618	0.0000	-16.70499	0.0000	-19.03583	0.0000
Std(α1)	0.0171		0.0055		0.0058		0.0178		0.0233	
β_1	1.00072	0.0000	1.25171	0.0000	1.23588	0.0000	1.00075	0.0000	1.00066	0.0000
Std(β1)	0.0002		0.0946		0.0929		0.0002		0.0002	
α_2	28.9042	0	0.0999	0.0000	0.10681	0.0000	33.37881	0.0000	38.01426	0.0000
Std(α2)	0.0341		0.0101		0.0106		0.0354		0.0462	
β2	-0.00143	0.003	-0.45512	0.0064	-0.42884	0.0090	-0.00149	0.0035	-0.00131	0.0049
Std(β_2)	0.0004		0.1475		0.1464		0.0004		0.0004	
γ	0.00162	0.0000	0.51382	0.0000	0.49394	0.0000	0.00158	0.0000	0.0016	0.0000
Std(γ)	0		0.0592		0.0564		0.0000		0	
C	-0.12044	0.0657	-0.06763	0.0022	-0.09462	0.0002	-0.18155	0.0000	-0.33254	0.0000
Std(C)	0.0615		0.019		0.0202		0.0229		0.0000	
AIC	-3.85E+01		-1.55E+01		-1.56E+01		-3.83E+01		-3.82E+01	
SC	-3.83E+01		-1.52E+01		-1.53E+01		-3.80E+01		-3.79E+01	
HQ	-3.85E+01		-1.54E+01		-1.55E+01		-3.82E+01		-3.81E+01	
Adj R2	1.0000		0.9991		0.9992		1.0000		1.0000	
SD of transition variable	0.4907		0.1392		0.1425		0.1533		0.176	
SD of residuals	0.0000		0.0004		0.0004		0.0000		0.0000	

Table A1.6 Forward rates results for Jul 2005–Dec 2007

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-27.37534	0.0000	-27.77005	0.0000	-27.41138	0.0000	-27.52775	0.0000	-27.50683	0.0000
Std(α1)	0.0284		0.0277		0.0259		0.028		0.0244	
β_1	0.99955	0.0000	0.99955	0.0000	0.99954	0.0000	0.99952	0.0000	0.99943	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	54.78959	0.0000	55.57693	0.0000	54.85751	0.0000	55.08387	0.0000	55.02921	0.0000
Std(α2)	0.0566		0.0553		0.0517		0.0559		0.0487	
β2	0.0009	0.0268	0.0009	0.0258	0.00092	0.0254	0.00096	0.0204	0.00115	0.0077
Std(β_2)	0.0004		0.0004		0.0004		0.0004		0.0004	
γ	0.0015	0.0000	0.00148	0.0000	0.0015	0.0000	0.0015	0.0000	0.00153	0.0000
Std(γ)	0		0.0000		0.0000		0.0000		0.0000	
C	0.81743	0.0000	0.21497	0.0000	0.20281	0.0000	0.16515	0.0000	0.09013	0.0018
Std(C)	0.0851		0.0000		0.024		0.0000		0.0256	
AIC	-3.75E+01		-3.76E+01		-3.75E+01		-3.75E+01		-3.74E+01	
SC	-3.72E+01		-3.73E+01		-3.72E+01		-3.72E+01		-3.71E+01	
HQ	-3.74E+01		-3.75E+01		-3.74E+01		-3.74E+01		-3.73E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.8621		0.2397		0.2399		0.2403		0.2439	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A1.7 Forward rates results for Jan 2008–Dec 2009

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-33.43669	0.0000	-33.35071	0.0000	-33.67914	0.0000	-33.6537	0.0000	-34.09119	0.0000
Std(α1)	0.0363		0.0000		0.0419		0.0428		0.0365	
β_1	1.00082	0.0000	1.00085	0.0000	1.00086	0.0000	1.00092	0.0000	1.00096	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	66.83577	0.0000	66.65753	0.0000	67.30826	0.0000	67.24028	0.0000	68.08541	0.0000
Std(α2)	0.0723		0.0000		0.0836		0.0854		0.0729	
β2	-0.00164	0.0002	-0.0017	0.0002	-0.00172	0.0002	-0.00184	0.0002	-0.00193	0.0003
Std(β_2)	0.0004		0.0004		0.0004		0.0004		0.0004	
γ	0.00168	0.0000	0.00169	0.0000	0.00168	0.0000	0.0017	0.0000	0.00168	0.0000
Std(γ)	0.0000		0.0000		0.0000		0		0.0000	
C	-0.79024	0.0000	-0.25615	0.0000	-0.29181	0.0000	-0.39078	0.0000	-0.56183	0.0000
Std(C)	0.0981		0.028		0.0286		0.0303		0.0322	
AIC	-3.72E+01		-3.71E+01		-3.71E+01		-3.70E+01		-3.69E+01	
SC	-3.69E+01		-3.68E+01		-3.68E+01		-3.67E+01		-3.66E+01	
HQ	-3.71E+01		-3.70E+01		-3.70E+01		-3.69E+01		-3.68E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.1787		0.3293		0.3306		0.3324		0.3309	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A1.8 Forward rates results for Jan 2010–Dec 2011

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-21.78393	0.0000	-21.60238	0.0000	-22.5326	0.0000	-23.2112	0.0000	-21.47139	0.0000
Std(α1)	0.0264		0.0346		0.0000		0.0385		0.0000	
β_1	0.99977	0.0000	0.99975	0.0000	0.99976	0.0000	0.99974	0.0000	0.99967	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	43.56654	0.0000	43.19968	0.0000	45.0565	0.0000	46.40301	0.0000	42.90217	0.0000
Std(α2)	0.0528		0.0692		0.0000		0.0771		0.0000	
β2	0.00046	0.1834	0.00049	0.1588	0.00048	0.1504	0.00052	0.1157	0.00066	0.0773
Std(β_2)	0.0003		0.0003		0.0003		0.0003		0.0003	
γ	0.00172	0.0000	0.00174	0.0000	0.00168	0.0000	0.00166	0.0000	0.00185	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	-0.02798	0.6159	-0.02967	0.0709	-0.0508	0.0046	-0.11288	0.0000	-0.23526	0.0000
Std(C)	0.0548		0.0154		0.0156		0.0163		0.0183	
AIC	-3.81E+01		-3.81E+01		-3.82E+01		-3.82E+01		-3.76E+01	
SC	-3.78E+01		-3.78E+01		-3.79E+01		-3.79E+01		-3.73E+01	
HQ	-3.81E+01		-3.80E+01		-3.81E+01		-3.81E+01		-3.75E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.7861		0.2196		0.2205		0.2236		0.2304	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A1.9 Forward rates results for Jan 2003–Dec 2004

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-29.97879	0.0000	-30.68498	0.0000	-30.3149	0.0000	-0.12806	0.0000	-34.19733	0.0000
Std(α1)	0.0288		0.0344		0.0362		0.0128		0.0000	
β_1	1.00024	0.0000	1.00023	0.0000	1.00023	0.0000	1.06084	0.0000	1.0002	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0563		0.0002	
α_2	59.95206	0.0000	61.35934	0.0000	60.61422	0.0000	0.22474	0.0000	68.342	0.0000
Std(α2)	0.0576		0.0687		0.0721		0.0235		0.0000	
β2	-0.00048	0.1269	-0.00047	0.1429	-0.00047	0.1607	-0.1486	0.1596	-0.0004	0.3206
Std(β_2)	0.0003		0.0003		0.0003		0.1013		0.0004	
γ	0.0017	0.0000	0.00168	0.0000	0.00172	0.0000	0.5107	0.0000	0.0017	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.059		0.0000	
C	-0.11592	0.2127	-0.06193	0.0319	-0.09093	0.0050	-0.18517	0.0001	-0.30514	0.0000
Std(C)	0.0897		0.0266		0.0285		0.0353		0.0438	
AIC	-3.73E+01		-3.73E+01		-3.71E+01		-1.43E+01		-3.67E+01	
SC	-3.70E+01		-3.70E+01		-3.68E+01		-1.40E+01		-3.65E+01	
HQ	-3.72E+01		-3.72E+01		-3.70E+01		-1.42E+01		-3.67E+01	
Adj R2	1.0000		1.0000		1.0000		0.9994		1.0000	
SD of transition variable	1.0705		0.3008		0.3044		0.3158		0.3357	
SD of residuals	0.0000		0.3008		0.0000		0.0007		0.0000	

Table A1.10 Forward rates results for July 1997–December 1998

Rand/Pound	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-35.1638	0.0000	-32.94716	0.0000	-34.01376	0.0000	-38.4672	0.0000	-38.6923	0.0000
Std(α1)	0.045		0.0000		0.0000		0.0534		0.1090	
β_1	0.99966	0.0000	0.99959	0.0000	0.99957	0.0000	0.9996	0.0000	0.99946	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	70.35577	0.0000	65.91591	0.0000	68.043	0.0000	76.9329	0.0000	77.3511	0.0000
Std(α2)	0.0899		0.0000		0.0000		0.1066		0.2180	
β2	0.00069	0.0918	0.00083	0.0711	0.00086	0.0632	0.0009	0.0494	0.00107	0.0522
Std(β_2)	0.0004		0.0004		0.0004		0.0004		0.0005	
γ	0.00147	0.0000	0.00159	0.0000	0.00157	0.0000	0.0015	0.0000	0.00166	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.59184	0.0004	0.12601	0.0032	0.0903	0.0261	-0.00855	0.8370	-0.19407	0.0039
Std(C)	0.1203		0.0343		0.0356		0.0406		0.0545	
AIC	-3.70E+01		-3.67E+01		-3.67E+01		-3.68E+01		-3.62E+01	
SC	-3.67E+01		-3.64E+01		-3.64E+01		-3.65E+01		-3.59E+01	
HQ	-3.70E+01		-3.66E+01		-3.66E+01		-3.68E+01		-3.61E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.0875		0.3063		0.3125		0.3309		0.3714	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

APPENDIX 2: DETAILED FORWARD RATES RESULTS FOR USD/RAND

Table A2.1 Forward rates results for Dec1996–Nov 2011

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-7.17108	0.4291	-7.7499		-4.21228		-2.68959		-2.01031	
Std(α1)	9.0485		0		0		0		0.8784	
β_1	0.56547	0.7246	0.6647		0.9266		1.12336		1.14763	
Std(β1)	1.6027		0		0.9024		0.4614		0.3708	
α_2	14.45739	0.3886	15.356		8.24491		5.13801		3.79476	
Std(α2)	16.7255		8.1933		0		0		1.4945	
β2	0.87267	0.8046	0.6631		0.14429		-0.23313		-0.27683	
Std(β_2)	3.5229		0		1.7939		0.8703		0.676	
γ	0.00675	0.3885	0.0064		0.01212		0.02027		0.02991	
Std(γ)	0.0078		0.0035		0		0		0.0117	
C	2.35713	0.9877	-2.9184		-3.59901		-4.63619		-3.98408	
Std(C)	152.6187		0		44.2671		9.6564		10.0764	
AIC	-14.26		-14.26		-14.26		-14.262		-14.266	
SC	-14.154		-14.154		-14.154		-14.156		-14.16	
HQ	-14.217		-14.217		-14.217		-14.219		-14.223	
Adj R2	0.9986		0.9986		0.9986		0.9986		0.9986	
SD of transition variable	1		1		1		1		1	
SD of residuals	0.0008		0.0008		0.0008		0.0008		0.0008	

Table A2.2 Forward rates results for Dec 1996–Dec 2000

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-27.2849	0.0000	-29.4838	0.0000	-28.6155	0.0000	-31.0833	0.0000	-33.7244	0.0000
Std(α1)	0.0259		0.024		0.0287		0.024		0.0329	
β_1	0.99985	0.0000	0.99977	0.0000	0.99969	0.0000	0.9995	0.0000	0.99939	0.0000
Std(β1)	0.0001		0.0001		0.0002		0.0002		0.0001	
α_2	54.58852	0.0000	58.9786	0.0000	57.23472	0.0000	62.1508	0.0000	67.3967	0.0000
Std(α2)	0.0516		0.048		0.0573		0.0477		0.0656	
β2	0.00029	0.331	0.00046	0.1295	0.00063	0.0610	0.00099	0.0029	0.00123	0.0001
Std(β_2)	0.0003		0.0003		0.0003		0.0003		0.0003	
γ	0.00124	0.0000	0.00118	0.0000	0.00125	0.0000	0.00127	0.0000	0.0014	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.38477	0.0000	0.22469	0.0033	0.07434	0.3378	-0.30445	0.0007	-0.91957	0.0000
Std(C)	0.0676		0.0722		0.0767		0.0835		0.0902	
AIC	-3.73E+01		-3.75E+01		-3.72E+01		-3.72E+01		-3.71E+01	
SC	-3.71E+01		-3.72E+01		-3.70E+01		-3.70E+01		-3.69E+01	
HQ	-3.72E+01		-3.74E+01		-3.71E+01		-3.71E+01		-3.70E+01	
Adj R2			1.0000		1.0000		1.0000		1.0000	
SD of transition variable			0.7013		0.7163		0.7586		0.8329	
SD of residuals			0.0000		0.0000		0.0000		0.0000	

Table A2.3 Forward rates results for Jan 2001–Dec 2004

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	9Month	P-values	12Month	P-values
α_1	-47.01971	0.0000	-46.4104	0.0000	-42.7721	0.0000	-51.6277	0.0000	-52.2984	0.0000	-51.8593	0.0000
Std(α1)	0.0303		0.0448		0.0379		0		0.0353		0.0334	
β_1	1.00012	0.0000	1.00005	0.0000	0.99997	0.0000	0.99972	0.0000	0.99947	0.0000	0.99927	0.0000
Std(β1)	0.0003		0.0003		0.0004		0.0003		0.0003		0.0003	
α_2	94.06014	0.0000	92.83706	0.0000	85.55638	0.0000	103.2574	0.0000	104.59	0.0000	103.7028	0.0000
Std(α2)	0.0595		0.0891		0.0748		0.0000		0.0691		0.0655	
β2	-0.00024	0.7112	-0.0001	0.8794	0.00006	0.9315	0.00057	0.3815	0.00106	0.1125	0.00146	0.0325
Std(β_2)	0.0007		0.0007		0.0007		0.0006		0.0007		0.0007	
γ	0.00123	0.0000	-0.0001	0.8794	0.00139	0.0000	0.0012	0.0000	0.00123	0.0000	0.00128	0.0000
Std(γ)	0.0000		0.0007		0.0000		0.0000		0.0000		0.0000	
C	0.42374	0.0435	0.00127	0.0000	0.24299	0.2624	0.0391	0.8639	-0.12191	0.6036	-0.27841	0.2504
Std(C)	0.2036		0.0000		0.2139		0.2266		0.233		0.2389	
AIC	-3.70E+01		-3.69E+01		-3.65E+01		-3.70E+01		-3.69E+01		-3.67E+01	
SC	-3.68E+01		-3.67E+01		-3.63E+01		-3.68E+01		-3.67E+01		-3.65E+01	
HQ	-3.69E+01		-3.68E+01		-3.64E+01		-3.69E+01		-3.68E+01		-3.66E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.1872		1.1894		1.1899		1.1888		1.1595		1.1757	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.4 Forward rates results for July 2005–November 2011

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	9Month	P-values	12Month	P-values
α_1	-40.78357	0.0000	-40.53618	0.0000	-40.07198	0.0000	-39.3206	0.0000	-40.994	0.0000
Std(α1)	0.0276		0.0245		0.0294		0.0218		0	
β_1	0.99944	0.0000	0.99943	0.0000	0.99943	0.0000	0.99972	0.0000	0.99989	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0001	
α_2	81.58734	0.0000	81.08717	0.0000	80.15335	0.0000	78.61775	0.0000	81.94939	0.0000
Std(α2)	0.055		0.0487		0.0584		0.0434		0.0000	
β2	0.00112	0.0112	0.00114	0.0076	0.00114	0.0066	0.00055	0.0925	0.00022	0.4401
Std(β_2)	0.0004		0.0004		0.0004		0.0003		0.0003	
γ	0.00123	0.0000	0.00124	0.0000	0.00126	0.0000	0.00131	0.0000	0.00128	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.41318	0.0004	0.29991	0.0071	0.18767	0.0768	-0.42249	0.0000	-0.68107	0.0000
Std(C)	0.1122		0.1082		0.1045		0.0819		0.0772	
AIC	-3.66E+01		-3.66E+01		-3.66E+01		-3.67E+01		-3.69E+01	
SC	-3.64E+01		-3.64E+01		-3.64E+01		-3.65E+00		-3.68E+01	
HQ	-3.65E+01		-3.65E+01		-3.65E+01		-3.67E+01		-3.69E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.024		1.017		1.0082		1.0000		0.929	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.5 Forward rates results for July 1997–December 1998

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-28.27956	0.0000	-28.84107	0.0000	-26.50171	0.0000	-31.95635	0.0000	-35.404	0.0000
Std(α1)	0.0348		0.0396		0.0822		0.0663		0.0548	
β_1	0.99987	0.0000	0.99983	0.0000	0.9998	0.0000	0.99976	0.0000	0.99963	0.0000
Std(β1)	0.0001		0.0001		0.0002		0.0002		0.0002	
α_2	56.57581	0.0000	57.6908	0.0000	53.00436	0.0000	63.89283	0.0000	70.75139	0.0000
Std(α2)	0.0695		0.0792		0.1642		0.1326		0.1095	
β2	0.00027	0.3391	0.00034	0.2457	0.0004	0.2266	0.00049	0.1347	0.00074	0.0665
Std(β_2)	0.0003		0.0003		0.0003		0.0003		0.0004	
γ	0.0017	0.0000	0.00169	0.0000	0.00189	0.0000	0.00167	0.0000	0.00172	0.0000
Std(γ)	0		0.0000		0.0000		0.0000		0.0000	
C	0.34132	0.0002	0.17546	0.0207	0.0188	0.7900	-0.38226	0.0004		0.0000
Std(C)	0.0642		0.0659		0.069		0.0795			
AIC	-3.75E+01		-3.75E+01		-3.70E+01		-3.74E+01		-3.69E+01	
SC	-3.72E+01		-3.72E+01		-3.67E+01		-3.71E+01		-3.66E+01	
HQ	-3.75E+01		-3.75E+01		-3.70E+01		-3.73E+01		-3.69E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.9806		0.9875		0.9999		1.0275		1.0000	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.6 Forward rates results for January 1999–December 2000

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-13.01925	0.0000	-12.78631	0.0000	-12.59058	0.0000	-15.1406	0.0000	-17.80254	0.0000
Std(α1)	0.0116		0.0183		0.0148		0.0135		0.0147	
β_1	0.99991	0.0000	0.99995	0.0000	0.99994	0.0000	0.99989	0.0000	0.99991	0.0000
Std(β1)	0.0002		0.0002		0.0002		0.0002		0.0002	
α_2	26.04441	0.0000	25.57485	0.0000	25.17978	0.0000	30.26884	0.0000	35.56927	0.0000
Std(α2)	0.0231		0.0366		0.0295		0.0268		0.0293	
β2	0.00018	0.6281	0.00011	0.7723	0.00012	0.7513	0.00021	0.5507	0.00019	0.6238
Std(β_2)	0.0004		0.0004		0.0004		0.0003		0.0004	
γ	0.00172	0.0000	0.00181	0.0000	0.00189	0.0000	0.00172	0.0000	0.00171	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.12103	0.0062	0.0451	0.2589	-0.02746	0.4988	-0.23745	0.0001	-0.11813	0.0000
Std(C)	0.039		0.0387		0.0398		0.049		0.0122	
AIC	-3.94E+01		-3.93E+01		-3.91E+01		-3.92E+01		-3.89E+01	
SC	-3.91E+01		-3.90E+01		-3.88E+01		-3.89E+01		-3.86E+01	
HQ	-3.93E+01		-3.92E+01		-3.90E+01		-3.91E+01		-3.88E+01	
Adj R2	1.0000		1.0000		1.000		1.0000		1.0000	
SD of transition variable	0.4587		0.468		0.4770		0.501		0.1000	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.7 Forward rates results for July 2005–December 2007

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-12.03611	0.0000	-30.66922	0.0000	-29.97037	0.0000	-27.37161	0.0000	-30.45303	0.0000
Std(α1)	0.0204		0.0335		0.0258		0.0254		0.0301	
β_1	1.00065	0.0000	1.00027	0.0000	1.00029	0.0000	1.00036	0.0000	1.00035	0.0000
Std(β1)	0.0004		0.0002		0.0002		0.0002		0.0002	
α_2	24.07981	0.0000	61.34279	0.0000	59.94186	0.0000	54.7345	0.0000	60.87752	0.0000
Std(α2)	0.0405		0.0669		0.0515		0.0506		0.06	
β2	-0.00129	0.0994	-0.00054	0.0861	-0.00059	0.0792	-0.00072	0.0764	-0.00071	0.1285
Std(β_2)	0.0008		0.0003		0.0003		0.0004		0.0004	
γ	0.00362	0.0000	0.00143	0.0000	0.00146	0.0000	0.00162	0.0000	0.0015	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.15491	0.0867	0.08812	0.332	0.02252	0.8081	-0.16768	0.1100	-0.62193	0.0005
Std(C)	0.0867		0.089		0.0917		0.101		0.1538	
AIC	-3.47E+01		-3.83E+01		-3.82E+01		-3.75E+01		-3.74E+01	
SC	-3.44E+01		-3.81E+01		-3.79E+01		-3.73E+01		-3.71E+01	
HQ	-3.46E+01		-3.83E+01		-3.81E+01		-3.75E+01		-3.73E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.8915		0.8848		0.8768		0.8521		1.0000	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.8 Forward rates results for January 2008–December 2009

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-48.58409	0.0000	-47.54756	0.0000	-44.94465	0.0000	-45.48049	0.0000	-48.06261	0.0000
Std(α1)	0.0514		0.0506		0.076		0.057		0.0000	
β_1	0.99923	0.0000	0.99922	0.0000	0.99918	0.0000	0.99927	0.0000	0.99957	0.0000
Std(β1)	0.0004		0.0004		0.0004		0.0004		0.0004	
α_2	97.1965	0.0000	95.11727	0.0000	89.9055	0.0000	90.9591	0.0000	96.08818	0.0000
Std(α2)	0.1024		0.101		0.1518		0.1137		0.0000	
β2	0.00155	0.0547	0.00157	0.0548	0.00164	0.0563	0.00147	0.0812	0.00086	0.2475
Std(β_2)	0.0008		0.0008		0.0008		0.0008		0.0007	
γ	0.00137	0.0000	0.00139	0.0000	0.00147	0.0000	0.00143	0.0000	0.0013	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	0.57893	0.0123	0.44817	0.0398	0.32403	0.1162	-0.03626	0.8390	-0.59123	0.0001
Std(C)	0.208		0.2022		0.1963		0.1759		0.1226	
AIC	-3.64E+01		-3.64E+01		-3.62E+01		-3.64E+01		-3.68E+01	
SC	-3.61E+01		-3.61E+01		-3.59E+01		-3.61E+01		-3.66E+01	
HQ	-3.63E+01		-3.63E+01		-3.61E+01		-3.63E+01		-3.68E+01	
Adj R2	1.0000		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.3567		1.3396		1.3187		1.2472		1.000	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0000	

Table A2.9 Forward rates results for January 2010–December 2011

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-25.27531	0.0000	-0.07617	0.0759	-25.74478	0.0000	-26.12484	0.0000	-25.24749	0.0000
Std(α1)	0.0279		0.0403		0.0262		0.0285		0.0483	
β_1	0.99982	0.0000	0.00762	0.3157	0.99984	0.0000	0.99984	0.0000	0.9998	0.0000
Std(β1)	0.0002		0.0074		0.0002		0.0002		0.0002	
α_2	50.57273	0.0000	2906.5663	0.9693	51.50376	0.0000	52.25229		50.47411	0.0000
Std(α2)	0.0558		74452.489		0.0523		0.0569	0.0000	0.0966	
β2	0.00036	0.3712	-407.45162	0.9693	0.00032	0.4120	0.00032	0.4051	0.00041	0.2832
Std(β_2)	0.0004		10437.607		0.0004		0.0004		0.0004	
γ	0.0015	0.0000	0.32516	0.0534	0.00148	0.0000	0.00147	0.0000	0.00156	0.0000
Std(γ)	0		0.1566		0.0000		0.0000		0.0000	
C	0.01105	0.0000	24.42606	0.6977	0.28407	0.0002	0.05033	0.3865	-0.52913	0.0000
Std(C)	0.0015		61.8221		0.0593		0.0566		0.0759	
AIC	-3.78E+01		-9.39E+00		-3.78E+01		-3.79E+01		-3.76E+01	
SC	-3.75E+01		-9.09E+00		-3.75E+01		-3.76E+01		-3.73E+01	
HQ	-3.77E+01		-9.32E+00		-3.77E+01		-3.78E+01		-3.75E+01	
Adj R2	1.0000		0.8775		1.0000		1.0000		1.0000	
SD of transition variable	0.019		0.7701		0.763		0.7406		1.0000	
SD of residuals	0.0000		0.0082		0.0000		0.0000		0.0000	

Table A2.10 Forward rates results for January 2003 − December 2004

Rand/USD	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-25.10664	0.0000	-25.81029	0.0000	-25.69748	0.0000	-28.33662	0.0000	-0.14718	0.0000
Std(α1)	0.0322		0.0288		0.041		0.1115		0.0129	
β_1	1.00034	0.0000	1.00035	0.0000	1.00035	0.0000	1.00028	0.0000	1.0403	0.0000
Std(β1)	0.0001		0.0001		0.0002		0.0002		0.0689	
α_2	50.19253	0.0000	51.59358	0.0000	51.36172	0.0000	56.62171	0.0000	0.21102	0.0000
Std(α2)	0.0645		0.0576		0.0819		0.2225		0.0224	
β2	-0.00069	0.0233	-0.0007	0.0244	-0.0007	0.0339	-0.00056	0.127	-0.09741	0.4426
Std(β_2)	0.0003		0.0003		0.0003		0.0003		0.1241	
γ	0.00191	0.0000	0.00187	0.0000	0.0019	0.0000	0.00177	0.0000	0.53323	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0613	
C	-0.4242	0.0000	-0.54646	0.0000	-0.66486	0.0000	-0.99074	0.0000	-1.60078	0.0000
Std(C)	0.0719		0.0752		0.0804		0.099		0.1345	
AIC	-3.77E+01		-3.77E+01		-3.75E+01		-3.74E+01		-1.43E+01	
SC	-3.74E+01		-3.74E+01		-3.72E+01		-3.71E+01		-1.40E+01	
HQ	-3.76E+01		-3.76E+01		-3.75E+01		-3.73E+01		-1.42E+01	
Adj R2	1.0000		1.0000		1.0000		1.000		0.9994	
SD of transition variable	0.9787		0.9765		0.9735		0.9613		1.000	
SD of residuals	0.0000		0.0000		0.0000		0.0000		0.0007	

APPENDIX 3: DETAILED FORWARD RATES RESULTS FOR RAND/YEN

Table A3.1 Forward rates results for Nov 1996–Dec 2011

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.18458		-33.0669		-35.02617		-31.82495		-37.13649	
Std(α1)	0.1122		0.0137		0.0135		0.0199		0.0144	
β_1	23.50838		0.9999		0.99932		0.99881		0.99904	
Std(β1)	12.0493		0.0005		0.0004		0.0002		0.0001	
α_2	0.16696		66.1722		70.08157		63.65447		74.23008	
Std(α2)	0.1115		0.0273		0.0269		0.0397		0.0288	
β2	-17.49524		0.0001		0.00136		0.00238		0.00193	
Std(β_2)	11.7251		0.001		0.0007		0.0004		0.0002	
γ	2.99778		0.0011		0.00107		0.00122		0.00118	
Std(γ)	1.7642		0		0		0		0	
C	-3.84779		0.2553		0.19432		0.03022		-0.27871	
Std(C)	0.4497		0.0158		0.0156		0.0151		0.0154	
AIC	-8.0602		-36.61		-36.83		-36.454		-36.961	
SC	-7.9538		-36.504		-36.723		-36.348		-36.854	
HQ	-8.0171		-36.567		-36.787		-36.411		-36.918	
Adj R2	0.1855		1		1		1		1	
SD of transition variable	1.0021		0.2475		0.2489		0.2569		0.2845	
SD of residuals	0.0175		0		0.2489		0		0	

Table A3.2 Forward rates results for Nov 1996–Dec 2000

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.27984	0.0387	-24.578	0.0000	-24.8787	0.0000	-26.0869	0.0000	-27.6232	0.0000
Std(α1)	0.1312		0.022		0.0195		0.0377		0.0229	
β_1	34.65984	0.0193	0.99671	0.0000	0.99754	0.0000	0.99857	0.0000	0.99925	0.0000
Std(β1)	14.2586		0.0006		0.0004		0.0003		0.0002	
α_2	0.26854	0.0461	49.14665	0.0000	49.74014	0.0000	52.12779	0.0000	55.14249	0.0000
Std(α2)	0.1307		0.0439		0.0389		0.0753		0.0457	
β2	-30.9469	0.0306	0.00658	0.0000	0.00491	0.0000	0.00286	0.0000	0.00151	0.0001
Std(β_2)	13.8388		0.0011		0.0009		0.0005		0.0003	
γ	2.66722	0.1724	0.0013	0.0000	0.00126	0.0000	0.00126	0.0000	0.00133	0.0000
Std(γ)	1.9223		0.0000		0.0000		0.0000		0.0000	
C	-4.28249	0.0000	-0.06271	0.0052	-0.11499	0.0000	-0.30395	0.0000	-0.67467	0.0000
Std(C)	0.5156		0.0213		0.0197		0.0186		0.0192	
AIC	-8.53E+00		-3.75E+01		-3.74E+01		-3.75E+01		-3.75E+01	
SC	-8.30E+00		-3.73E+01		-3.72E+01		-3.73E+01		-3.72E+01	
HQ	-8.44E+00		-3.74E+01		-3.74E+01		-3.74E+01		-3.74E+01	
Adj R2	0.4092		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.0213		0.2076		0.2092		0.2161		0.0564	
SD of residuals	0.0133		0.0000		0.0000		0.0000		0.0000	

Table A3.3 Forward rates results for Jan 2001–Dec 2004

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	1.64721	0.5271	-0.06624	0.0000	-26.5517	0.0000	-28.6822	0.0000	-29.5048	0.0000
	2.5831		0.0063		0.0211		0.0217		0.0322	
β_1	-250.22855	0.5244	0.24593	0.4364	0.9974	0.0000	0.9978	0.0000	0.99811	0.0000
Std(β1)	389.7575		0.3129		0.0009		0.0005		0.0003	
α_2	-1.66129	0.5236	0.14326	0.0554	53.10765	0.0000	57.35109	0.0000	58.95833	0.0000
Std(α2)	2.5831		0.0128		0.0421		0.0432		0.0641	
β2	253.58524	0.5188	1.54853	0.0554	0.00521	0.0039	0.00441	0.0001	0.00377	0.0000
Std(β_2)	389.7664		0.786		0.0017		0.001		0.0007	
γ	43.97037	0.9997	0.49154	0.0000	0.00135	0.0000	0.00131	0.0000	0.00141	0.0000
Std(γ)	109262.1519		0.0387		0.0000		0.0000		0.0000	
C	-3.56757	0.9488	0.06973	0.0009	0.02791	0.1553	-0.08725	0.0005	-0.33264	0.0000
Std(C)	55.2489		0.0195		0.0193		0.0232		0.0274	
AIC	-7.96E+00		-1.42E+01		-3.77E+01		-3.78E+01		-3.76E+01	
SC	-7.72E+00		-1.40E+01		-3.74E+01		-3.75E+01		-3.73E+01	
HQ	-7.87E+00		-1.41E+01		-3.76E+01		-3.77E+01		-3.75E+01	
Adj R2	0.1302		0.9984		1.0000		1.0000		1.0000	
SD of transition variable	0.6787		0.236		0.2389		0.249		0.2693	
SD of residuals	0.0177		0.0008		0.0000		0.0000		0.0000	

Table A3.4 Forward rates results for July 2005–November 2011

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	12Month	P-values
α_1	-0.04977	0.1184	-0.02477	0.0048	-0.02275	0.0291	-0.0399	0.1036
Std(α1)	0.0315		0.0085		0.0102		0.0242	
β_1	8.42066	0.0756	4.40705	0.0041	2.68752	0.0276	0.95824	0.1166
Std(β1)	4.6688		1.4833		1.1944		0.6031	
α_2	0.02038	0.5266	-0.02955	0.0550	-0.03103	0.0810	0.01135	0.7104
Std(α2)	0.032		0.0151		0.0175		0.0304	
β2	3.1573	0.5345	5.22126	0.0235	4.01423	0.0301	0.18754	0.8132
Std(β_2)	5.0572		2.2542		1.8137		0.7906	
γ	158.45946	0.9146	146.4387	0.9967	137.56057	0.9940	4.84567	0.4428
Std(γ)	1472.6325		35396.6281		18080.4855		6.2784	
C	-3.08215	0.0000	0.1249	0.9164	0.07065	0.9357	-0.48667	0.0000
Std(C)	0.3471		1.1859		0.8721		0.0935	
AIC		-7.94E+00		-8.06E+00	-7.95E+00		-7.73E+00	
SC		-7.76E+00		-7.88E+00	-7.77E+00		-7.54E+00	
HQ		-7.87E+00		-7.99E+00	-7.88E+00		-7.65E+00	
Adj R2		0.3644		0.4376	0.3705		0.2141	
SD of transition variable		0.8454		0.2806	0.2789		0.2726	
SD of residuals		0.0182		0.0171	0.0181		0.0202	

Table A3.5 Forward rates results for July 1997–December 1998

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.26201	0.0012	-20.94788	0.0000	-22.63587	0.0000	-19.82136	0.0000	-24.94946	0.0000
Std(α1)	-0.26201		0.0281		0.0445		0.0284		0.0311	
β_1	32.78847	0.0006	0.99849	0.0000	0.99912	0.0000	0.99895	0.0000	0.99907	0.0000
Std(β1)	7.0535		0.0013		0.0008		0.0005		0.0004	
α_2	0.22966	0.0044	41.91375	0.0000	45.27951	0.0000	39.6171	0.0000	49.8126	0.0000
Std(α2)	0.0656		0.0559		0.0889		0.0567		0.0621	
β2	-26.75941	0.0057	0.00302	0.2605	0.00175	0.3079	0.00211	0.07	0.00187	0.0224
Std(β_2)	7.9795		0.0026		0.0016		0.0011		0.0007	
γ	325.49116	0.9999	0.00171	0.0000	0.00157	0.0000	0.00176	0.0000	0.00144	0.0000
Std(γ)	1719454.228		0.0000		0.0000		0.0000		0.0000	
C	-4.02719	0.322	0.11987	0.0009	0.05162	0.0162	-0.1693	0.0000	-0.56087	0.0000
Std(C)	3.899		0.0275		0.0185		0.0134		0.0178	
AIC	-8.69E+00		-3.82E+01		-3.85E+01		-3.79E+01		-3.81E+01	
SC	-8.39E+00		-3.79E+01		-3.82E+01		-3.76E+01		-3.78E+01	
HQ	-8.65E+00		-3.81E+01		-3.85E+01		-3.79E+01		-3.81E+01	
Adj R2	0.7663		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.8496		0.2393		0.2366		0.2303		0.2329	
SD of residuals	0.0114		0.0000		0.0000		0.0000		0.0000	

Table A3.6 Forward rates results for January 1999–December 2000

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.00464	0.7587	-12.70573	0.0000	-12.71802	0.0000	-12.56077	0.0000	-13.61326	0.0000
Std(α1)	0.0149		0.0144		0.0124		0.0189		0.019	
β_1	1.81082	0.5598	1.00004	0.0000	1.00001	0.0000	0.99986	0.0000	0.99956	0.0000
Std(β1)	3.0478		0.0004		0.0003		0.0002		0.0002	
α_2	-1.37062	0.9999	25.40471	0.0000	25.42181	0.0000	25.08385	0.0000	27.14144	0.0000
Std(α2)	0.0000		0.0289		0.0247		0.0378		0.038	
β2	476.88005	0.9999	-0.00007	0.9272	-0.00001	0.9871	0.00029	0.4448	0.00088	0.0153
Std(β_2)	0.0000		0.0008		0.0006		0.0004		0.0003	
γ	43.99506	0.9998	0.00182	0.0000	0.00185	0.0000	0.00198	0.0000	0.00205	0.0000
Std(γ)	205436.228		0.0000		0.0000		0.0000		0.0000	
C	-1.72884	0.9812	-0.04497	0.0003	-0.09466	0.0000	-0.24897	0.0000	-0.55291	0.0000
Std(C)	72.3719		0.0102		0.0098		0.0098		0.0131	
AIC	-8.68E+00		-3.94E+01		-3.94E+01		-3.94E+01		-3.90E+01	
SC	-8.39E+00		-3.91E+01		-3.92E+01		-3.91E+01		-3.87E+01	
HQ	-8.60E+00		-3.93E+01		-3.94E+01		-3.93E+01		-3.90E+01	
Adj R2	0.2134		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.5445		0.1542		0.1566		0.1641		0.1805	
SD of residuals	0.0117		0.0000		0.0000		0.0000		0.0000	

Table A3.7 Forward rates results for July 2005–December 2007

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.03528	0.2593	-18.90589	0.0000	-20.25563	0.0000	-19.76923	0.0000	-21.30043	0.0000
Std(α1)	0.0305		0.0164		0.0304		0.0182		0.0227	
β_1	-5.63698	0.4628	0.99768	0.0000	0.99913	0.0000	0.99998	0.0000	1.00019	0.0000
Std(β1)	7.5543		0.0014		0.0009		0.0005		0.0004	
α_2	-0.05992	0.1162	37.80936	0.0000	40.50366	0.0000	39.51302	0.0000	42.53954	0.0000
Std(α2)	0.0368		0.0327		0.0606		0.0364		0.0453	
β2	13.25671	0.2527	0.00463	0.101	0.00173	0.3706	0.00004	0.9746	-0.00039	0.6123
Std(β_2)	11.3105		0.0027		0.0019		0.0011		0.0008	
γ	18.14224	0.5568	0.00175	0.0000	0.00163	0.0000	0.00167	0.0000	0.00158	0.0000
Std(γ)	30.4416		0.0000		0.0000		0.0000		0.0000	
C	-1.84923	0.0000	-0.01609	0.2643	-0.05062	0.0018	-0.16805	0.0000	-0.39846	0.0000
Std(C)	0.0645		0.0141		0.0144		0.0161		0.0216	
AIC	-8.20E+00		-3.83E+01		-3.85E+01		-3.81E+01		-3.79E+01	
SC	-7.92E+00		-3.81E+01		-3.82E+01		-3.79E+01		-3.76E+01	
HQ	-8.11E+00		-3.82E+01		-3.84E+01		-3.80E+01		-3.78E+01	
Adj R2	0.3606		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.4997		0.2207		0.22		0.2181		0.2189	
SD of residuals	0.0152		0.0000		0.0000		0.0000		0.0000	

Table A3.8 Forward rates results for January 2008–December 2009

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.0853	0.2110	-40.90901	0.0000	-39.48943	0.0000	-39.18726	0.0000	-36.8002	0.0000
Std(α1)	0.0658		0.0488		0.0452		0.0442		0.0359	
β_1	12.02652	0.1567	1.00565	0.0000	1.00463	0.0000	1.00273	0.0000	1.00098	0.0000
Std(β1)	8.1372		0.0021		0.0018		0.0009		0.0004	
α_2	0.04775	0.4838	81.87061	0.0000	79.02518	0.0000	78.40146	0.0000	73.58512	0.0000
Std(α2)	0.0668		0.0973		0.0901		0.0882		0.0717	
β2	1.71585	0.8483	-0.01131	0.0158	-0.00927	0.0171	-0.00546	0.0101	-0.00197	0.0359
Std(β_2)	8.8415		0.0042		0.0035		0.0019		0.0009	
γ	66.00136	0.5634	0.00146	0.0000	0.00149	0.0000	0.00146	0.0000	0.00149	0.0000
Std(γ)	112.1279		0.0000		0.0000		0.0000		0.0000	
C	-3.10046	0.0000	0.35032	0.0000	0.308	0.0000	0.17805	0.0002	-0.09924	0.0031
Std(C)	0.0437		0.0445		0.0443		0.0385		0.0291	
AIC	-7.18E+00		-3.64E+01		-3.63E+01		-3.66E+01		-3.69E+01	
SC	-6.89E+00		-3.61E+01		-3.60E+01		-3.63E+01		-3.66E+01	
HQ	-7.10E+00		-3.63E+01		-3.62E+01		-3.65E+01		-3.68E+01	
Adj R2	0.5271		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	1.2295		0.3972		0.3923		0.3789		0.3573	
SD of residuals	0.0248		0.0000		0.0000		0.0000		0.0000	

Table A3.9 Forward rates results for January 2010–December 2011

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	66.17301	0.9997	-16.37118	0.0000	-16.98385	0.0000	-17.11213	0.0000	-17.41819	0.0000
Std(α1)	0.0000		0.0333		0.1101		0.034		0.0298	
β_1	-11865.511	0.9997	1.00016	0.0000	1.00015	0.0000	0.99992	0.0000	0.99963	0.0000
Std(β1)	0.0000		0.0008		0.0008		0.0006		0.0004	
α_2	-66.18356	0.9997	32.74275	0.0000	33.96372	0.0000	34.20709	0.0000	34.7925	0.0000
Std(α2)	0.0000		0.0665		0.22		0.068		0.0596	
β2	11871.4714	0.9997	-0.00032	0.8526	-0.0003	0.8481	0.00015	0.9077	0.00074	0.3915
Std(β_2)	0.0000		0.0017		0.0015		0.0013		0.0008	
γ	50.25451	0.9987	0.00179	0.0000	0.00173	0.0000	0.00174	0.0000	0.00176	0.0000
Std(γ)	29809.4453		0.0000		0.0000		0.0000		0.0000	
C	-2.44661	0.952	0.00261	0.8409	-0.02644	0.0528	-0.1135	0.0000	-0.28519	0.0000
Std(C)	40.0462		0.0128		0.0127		0.0127		0.0136	
AIC	-8.18E+00		-3.87E+01		-3.89E+01		-3.88E+01		-3.87E+01	
SC	-7.89E+00		-3.84E+01		-3.86E+01		-3.85E+01		-3.84E+01	
HQ	-8.11E+00		-3.87E+01		-3.88E+01		-3.87E+01		-3.87E+01	
Adj R2	0.26		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.6155		0.1954		0.1957		0.1969		0.199	
SD of residuals	0.015		0.0000		0.0000		0.0000		0.0000	

Table A3.10 Forward rates results for January 2003–December 2004

Rand/Yen	1 Month	P-values	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.24008	0.1868	-16.28361	0.0000	-17.37104	0.0000	-18.76335	0.0000	-21.25736	0.0000
Std(α1)	0.1749		0.0289		0.0388		0.0251		0.0227	
β_1	-45.42141	0.1906	0.99809	0.0000	0.99843	0.0000	0.99862	0.0000	0.99882	0.0000
Std(β1)	33.3983		0.0007		0.0005		0.0004		0.0003	
α_2	-0.2487	0.1733	32.55798	0.0000	34.72756	0.0000	37.49462	0.0000	42.44591	0.0000
Std(α2)	0.1754		0.0578		0.0776		0.0501		0.0454	
β2	46.21408	0.1869	0.00383	0.0111	0.00314	0.0079	0.00276	0.0016	0.00237	0.0012
Std(β_2)	33.6858		0.0014		0.0011		0.0007		0.0006	
γ	152.44646	0.9999	0.00181	0.0000	0.00173	0.0000	0.00169	0.0000	0.00163	0.0000
Std(γ)	0.0000		0.0000		0.0000		0.0000		0.0000	
C	-2.53043	0.884	-0.06157	0.0003	-0.09648	0.0000	-0.21197	0.0000	-0.44709	0.0000
Std(C)	0		0.0136		0.0144		0.0178		0.0242	
AIC	-8.17E+00		-3.83E+01		-3.85E+01		-3.85E+01		-3.83E+01	
SC	-7.88E+00		-3.80E+01		-3.82E+01		-3.82E+01		-3.80E+01	
HQ	-8.09E+00		-3.82E+01		-3.84E+01		-3.84E+01		1.00E+00	
Adj R2	0.2117		1.0000		1.0000		1.0000		1.0000	
SD of transition variable	0.6768		0.1966		0.1999		0.2089		0.2241	
SD of residuals	0.0151		0.0000		0.0000		0.0000		0.0000	

APPENDIX 4: DETAILED FORWARD PREMIUM RESULTS POUND/RAND

Table A4.1 RAFP for Dec 1996–Nov 2011

Rand/Pound	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.48733	0.6783	0.15714	0.1362	0.05714	0.6167	0.0271	0.5649
Std(α1)	1.1731		0.105		0.0000		0.0000	
β_1	3.41693	0.7391	0.5459	0.5068	-0.04382	0.9754	-0.22036	0.7991
Std(β1)	10.2423		0.8207		0.0000		0.0000	
α_2	-0.89401	0.2387	-1.1496	0.5213	-0.50283	0.5731	-0.47788	0.2541
Std(α2)	0.7562		0.0000		0.0000		0.0000	
β2	1.78412	0.9304	12.91785	0.6177	9.18588	0.31	12.56788	0.0962
Std(β_2)	20.3847		0.0000		0.0000		7.5147	
γ	0.23979	0.2341	0.21359	0.0922	0.27814	0.6142	0.34427	0.5359
Std(γ)	0.2008		0.1261		0.0000		0.0000	
C	-0.00697	0.9753	0.10908	0.3646	0.10756	0.5472	0.14916	0.4301
Std(C)	0.2244		0.0000		0.0000		0.0000	
AIC	-7.76E+00		-7.76E+00		-7.77E+00		-7.77E+00	
SC	-7.65E+00		-7.66E+00		-7.66E+00		-7.67E+00	
HQ	-7.71E+00		-7.72E+00		-7.73E+00		-7.73E+00	
Adj R2	0.0617		0.0689		0.0736		0.0755	
SD of transition variable	0.0119		0.0122		0.0132		0.0156	
SD of residuals	0.0203		0.0203		0.0202		0.0202	

Table A4.2 RAFPfor Nov 1996–Dec 2000

Rand/Pound	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.00387	0.1349	0.00385	0.1370	0.06929	0.2188	0.01952	0.3991
Std(α1)	0.0025		0.0025		0.0000		0.0000	
β_1	0.24956	0.3811	0.24488	0.3900	0.53324	0.4147	0.38742	0.2797
Std(β1)	0.2819		0.2819		0.6473		0.3538	
α_2	-0.07677	0.3862	-0.07683	0.3851	-0.31372	0.0016	-0.46623	0.5075
Std(α2)	0.0877		0.0875		0.0000		0.6974	
β2	2.5619	0.4737	2.56743	0.4722	3.74472	0.5338	10.58458	0.6158
Std(β_2)	3.5439		3.539		5.9692		20.9369	
γ	44.65502	0.8102	31.46742	0.7787	0.27022	0.3839	0.57663	0.4243
Std(γ)	184.7831		111.2715		0.0000		0.0000	
C	0.02052	0.0001	0.02515	0.0001	0.07237	0.2623	0.11648	0.1298
Std(C)	0.0047		0.0057		0.0637		0.0000	
AIC	-8.03E+00		-8.03E+00		-8.04E+00		-8.07E+00	
SC	-7.80E+00		-7.80E+00		-7.81E+00		-7.84E+00	
HQ	-7.94E+00		-7.94E+00		-7.96E+00		-7.98E+00	
Adj R2	0.1033		0.1032		0.1131		0.1361	
SD of transition variable	0.0106		0.0109		0.0123		0.0155	
SD of residuals	0.0170		0.0170		0.0169		0.0167	

Table A4.3 RAFP**for Jan 2001–Dec 2004**

Rand/Pound	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.00178	0.6271	-0.00203	0.5841	-0.76178	0.5152	-2.39837	0.6987
Std(α1)	0.0036		0.0037		1.1603		6.1526	
β_1	-0.6962	0.0459	-0.71873	0.0427	-50.68385	0.4928	-148.9566	0.6991
Std(β1)	0.3382		0.3437		73.2417		382.6463	
α_2	0.25516	0.0181	0.20817	0.0033	0.75703	0.5179	2.39391	0.6993
Std(α2)	0.1036		0.0667		1.1606		6.1532	
β2	-9.97949	0.0274	-8.04637	0.0109	50.90146	0.4909	149.14357	0.6987
Std(β_2)	4.3627		3.0186		73.2291		382.6171	
γ	35.32648	0.4403	117.0017	0.6035	11.2562	0.3207	13.23503	0.5612
Std(γ)	45.3352		223.51		11.1983		22.5928	
C	0.0207	0.0000	0.02198	0.0000	-0.0109	0.0008	-0.00262	0.7002
Std(C)	0.0005		0.0003		0.003		0.0068	
AIC	-7.44E+00		-7.44E+00		-7.39E+00		-7.41E+00	
SC	-7.20E+00		-7.20E+00		-7.15E+00		-7.17E+00	
HQ	-7.35E+00		-7.35E+00		-7.30E+00		-7.32E+00	
Adj R2	0.2939		0.2927		0.2563		0.2716	
SD of transition variable	0.0128		0.0131		0.0142		0.0165	
SD of residuals	0.0228		0.0229		0.0234		0.0232	

Table A4.4 RAFP**for July 2005–November 2011**

Rand/Pound	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.76978	0.0424	0.61176	0.3547	0.11499	0.5245	0.03389	0.8695
Std(α1)	0.3725		0.6567		0.0000		0.2056	
β_1	6.16748	0.0149	3.58792	0.0057	0.49019	0.6964	0.16421	0.9564
Std(β1)	2.4718		0.0000		0.0000		2.9898	
α_2	-1.55001	0.0083	-1.3652	0.4412	-9.45927	0.6040	-0.58707	0.8955
Std(α2)	0.571		1.7628		18.1561		4.4542	
β2	2.76334	0.1701	4.90093	0.2575	135.92643	0.6578	12.21641	0.8874
Std(β_2)	1.9938		4.2934		305.533		85.964	
γ	0.24221	0.0137	0.21432	0.4310	0.25214	0.4970	0.42381	0.8591
Std(γ)	0.0958		0.2706		0.0000		2.3793	
C	0.0023	0.8560	0.0155	0.7759	0.2389	0.4284	0.11501	0.8436
Std(C)	0.0000		0.0000		0.0000		0.5807	
AIC	-7.81E+00		-7.82E+00		-7.81E+00		-7.79E+00	
SC	-7.62E+00		-7.64E+00		-7.62E+00		-7.60E+00	
HQ	-7.73E+00		-7.75E+00		-7.73E+00		-7.71E+00	
Adj R2	0.1564		0.1667		0.1556		0.1380	
SD of transition variable	0.0123		0.0125		0.0132		0.0146	
SD of residuals	0.0194		0.0193		0.0194		0.0196	

APPENDIX 5: DETAILED FORWARD PREMIUM RESULTS USD/RAND

Table A5.1 RAFP for Dec 1996–Nov 2011

Rand/USD	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.00973	0.511	0.00785	0.2544	0.00455	0.1243	0.0031	0.1008
Std(α1)	0.0148		0.0069		0.0029		0.0019	
β_1	0.25896	0.6747	0.18378	0.6144	-0.08328	0.6915	-0.21085	0.1684
Std(β1)	0.6159		0.3642		0.2095		0.1524	
α_2	-0.15938	0.488	-0.11994	0.2272	-0.1189	0.2209	-0.26244	0.5083
Std(α2)	0.2294		0.099		0.0968		0.3959	
β2	5.34353	0.4166	4.24086	0.1959	4.82654	0.2005	11.92325	0.5091
Std(β_2)	6.5618		3.2667		3.7562		18.0217	
γ	1.57689	0.2708	1.90115	0.1037	2.19974	0.0812	2.8038	0.0803
Std(γ)	1.4273		1.1624		1.2540		1.5939	
C	0.02605	0.1133	0.02591	0.0105	0.03873	0.0011	0.06631	0.0001
Std(C)	0.0164		0.01		0.0117		0.0165	
AIC	-7.75E+00		-7.76E+00		-7.77E+00		-7.78E+00	
SC	-7.64E+00		-7.65E+00		-7.66E+00		-7.68E+00	
HQ	-7.71E+00		-7.71E+00		-7.72E+00		-7.74E+00	
Adj R2	0.0626		0.0711		0.0785		0.0934	
SD of transition variable	0.0115		0.0119		0.0132		0.0164	
SD of residuals	0.0204		0.0203		0.0203		0.0200	

Table A5.2 RAFP for Nov 1996–Dec 2000

Rand/USD	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.00493	0.0159	0.00493	0.0159	0.00493	0.0159	0.01049	0.0972
Std(α1)	0.002		0.002		0.002		0.0062	
β_1	-0.35668	0.2238	-0.35668	0.2238	-0.35668	0.2238	-0.02988	0.9224
Std(β1)	0.289		0.002		0.289		0.305	
α_2	0.25826	0.1822	0.25826	0.1822	0.25826	0.1822	-14496.16868	0.9858
Std(α2)	0.1905		0.1905		0.1905		31012902.19	
β2	-12.89776	0.1741	-12.89776	0.1741	-12.89776	0.1741	556017.812	0.9858
Std(β_2)	9.332		9.332		9.332		31012902.19	
γ	71.49847	0.9996	67.57694	0.9995	64.70528	0.9996	1.0219	0.2377
Std(γ)	130026.3099		0.0000		0.0000		0.8534	
C	0.01818	0.9507	0.02284		0.03497	0.9414	0.25909	0.7685
Std(C)	0.2921		0.0000		0.000		0.8748	
AIC	-8.54E+00		-8.54E+00		-8.54E+00		-8.54E+00	
SC	-8.30E+00		-8.30E+00		-8.30E+00		-8.31E+00	
HQ	-8.45E+00		-8.45E+00		-8.45E+00		-8.45E+00	
Adj R2	0.1477		0.1477		0.1477		0.1488	
SD of transition variable	0.0083		0.0089		0.0111		0.0157	
SD of residuals	0.0132		0.0132		0.0132		0.0132	

Table A5.3 RAFP **for Jan 2001–Dec 2004**

Rand/USD	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.05223	0.2829	0.02407	0.2459	0.01189	0.2733	2.96119	0.6026
Std(α1)	0.048		0.0205		0.0107		5.6444	
β_1	1.61988	0.2681	0.55994	0.4566	-0.10224	0.8114	90.91243	0.6101
Std(β1)	1.4434		0.7452		0.4258		176.937	
α_2	-6299.03736	0.9458	-6714.20433	0.9671	-6664.5488	0.9735	-2.98489	0.5998
Std(α2)	92120.8924		161929.4437		199257.54		5.645	
β2	210890.8075	0.9458	249620.4976	0.9671	271306.68	0.9735	-90.00568	0.6137
Std(β_2)	3084223.12		6020213.011		8111542.5		176.9846	
γ	1.13646	0.0049	1.34209	0.0035	1.39137	0.0106	1.9654	0.0569
Std(γ)	0.3830		0.4331		0.5200		1.0036	
C	0.13832	0.4279	0.13184	0.5924	0.15258	0.6334	-0.019	0.4508
Std(C)	0.1728		0.2444		0.3176		0.025	
AIC	-7.53E+00		-7.52E+00		-7.50E+00		-7.50E+00	
SC	-7.29E+00		-7.29E+00		-7.27E+00		-7.27E+00	
HQ	-7.44E+00		-7.43E+00		-7.41E+00		-7.41E+00	
Adj R2	0.2910		0.2867		0.2744		0.2732	
SD of transition variable	0.0131		0.0135		0.0146		0.0171	
SD of residuals	0.0219		0.0220		0.0222		0.0222	

Table A5.4 RAFP **for July 2005–November 2011**

Rand/USD	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	0.00173	0.4922	0.00174	0.5314	0.00124	0.6364	0.00112	0.6660
Std(α1)	0.0025		0.0028		0.0026		0.0026	
β_1	-0.04678	0.8442	-0.08651	0.7755	-0.25562	0.2948	-0.28646	0.2282
Std(β1)	0.2372		0.3022		0.2422		0.2356	
α_2	-0.27818	0.0359	-9723.8211	0.9899	0.87266	0.7924	810807.0202	0.9998
Std(α2)	0.13		766332.09		3.3029		4034247832	
β2	9.1241	0.0293	282695.05	0.9899	-23.36187	0.8042	-21018982.04	0.9998
Std(β_2)	4.1022		22279809		93.8973		1.04581E+11	
γ	243.51115	0.9909	3.81828	0.3395	19.87886	0.5976	9.1749	0.7982
Std(γ)	21353.7491		3.9710		0.0000		35.7535	
C	0.026	0.0000	0.0676	0.7843	0.04087	0.0000	0.084	0.9915
Std(C)	0.0056		0.246		0.0000		7.8877	
AIC	-7.65E+00		-7.58E+00		-7.57E+00		-7.59E+00	
SC	-7.47E+00		-7.40E+00		-7.39E+00		-7.40E+00	
HQ	-7.58E+00		-7.51E+00		-7.50E+00		-7.51E+00	
Adj R2	0.1480		0.0879		0.0811		0.0924	
SD of transition variable	0.0116		0.0118		0.0126		0.0145	
SD of residuals	0.0210		0.0217		0.0218		0.0217	

APPENDIX 6: DETAILED FORWARD PREMIUM RESULTS YEN/RAND

Table A6.1 RAFP for Dec 1996–Nov 2011

Rand/Yen	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.02001	0.0005	-0.01861	0.0002	-0.01787	0.0000	-0.01848	0.0000
Std(α1)	0.0056		0.0048		0.0042		0.0042	
β_1	8.878	0.0003	7.36777	0.0000	6.25329	0.0000	6.57719	0.0000
Std(β1)	2.409		1.7378		1.2239		1.2014	
α_2	-0.07166	0.1373	-0.05239	0.1458	-0.01372	0.1715	-0.01312	0.1569
Std(α2)	0.048		0.0359		0.01		0.0092	
β2	4.22357	0.487	3.44423	0.4782	-0.56163	0.7672	-0.98919	0.5867
Std(β_2)	6.0629		4.8461		1.8943		1.8164	
γ	1.65904	0.0361	2.2279	0.0557	21.7546	0.3697	34.9796	0.6524
Std(γ)	0.7854		1.1565		24.1868		77.5229	
C	0.01007	0.0000	0.01445	0.0000	0.02651	0.0000	0.05065	0.0000
Std(C)	0.0015		0.0018		0.0007		0.0007	
AIC	-8.08E+00		-8.08E+00		-8.08E+00		-8.10E+00	
SC	-7.97E+00		-7.97E+00		-7.97E+00		-8.00E+00	
HQ	-8.03E+00		-8.03E+00		-8.03E+00		-8.06E+00	
Adj R2	0.1983		0.1995		0.1997		0.2203	
SD of transition variable	0.0027		0.0038		0.0069		0.0125	
SD of residuals	0.0173		0.0173		0.0173		0.0171	

Table A6.2 RAFP for Nov 1996–Dec 2000

Rand/Yen	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.01295	0.1196	-0.01109	0.1534	-0.00531	0.4904	-0.00136	0.9006
Std(α1)	0.0082		0.0076		0.0076		0.0108	
β_1	3.99729	0.0376	3.47665	0.0358	1.63529	0.2837	0.98514	0.6399
Std(β1)	1.8626		1.6039		1.5063		2.0907	
α_2	-0.08262	0.0028	-0.08142	0.0009	-0.10346	0.0033	-0.08991	0.0061
Std(α2)	0.0261		0.0228		0.0332		0.0312	
β2	10.18899	0.011	10.31753	0.0041	14.20044	0.0025	12.80051	0.0053
Std(β_2)	3.8325		3.4049		4.4183		4.3615	
γ	13.23751	0.2662	394.99345	0.5605	169.57642	0.9998	18.90224	0.2893
Std(γ)	11.7509		673.2323		0.0000		17.6173	
C	0.01116	0.0000			0.03451	0.8605	0.06353	0.0000
Std(C)	0.0003				0.0000		0.0011	
AIC	-8.49E+00		-8.52E+00		-8.40E+00		-8.40E+00	
SC	-8.26E+00		-8.29E+00		-8.16E+00		-8.17E+00	
HQ	-8.40E+00		-8.43E+00		-8.31E+00		-8.31E+00	
Adj R2	0.3848		0.4026		0.3253		0.3281	
SD of transition variable	0.0026		0.0034		0.0059		0.0101	
SD of residuals	0.0135		0.0134		0.0142		0.0142	

Table A6.3 RAFP **for Jan 2001–Dec 2004**

Rand/Yen	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.0377	0.0016	-0.04221	0.0007	-0.0367	0.0140	-0.03765	0.0118
Std(α1)	0.0111		0.0116		0.0143		0.0143	
β_1	12.2956	0.0008	14.60868	0.0002	13.10206	0.0152	13.68583	0.0089
Std(β1)	3.3968		3.5528		5.1763		4.9907	
α_2	-0.00681	0.7922	0.02405	0.1641	0.01956	0.3649	0.02513	0.2259
Std(α2)	0.0257		0.017		0.0214		0.0204	
β2	-4.58601	0.4214	-11.68427	0.0128	-11.08859	0.0888	-12.3507	0.0477
Std(β_2)	5.6483		4.4945		6.3649		6.0545	
γ	30.57719	0.6250	1170.79264	1.0000	4.11276	0.2042	5.24582	0.3308
Std(γ)	62.0922		68284513728.4		3.1889		5.3319	
C	0.00834	0.0000	0.01099	1.0000	0.02165	0.0000	0.04034	0.0000
Std(C)	0.0001		4473.7177		0.0012		0.0015	
AIC	-8.20E+00		-8.26E+00		-8.20E+00		-8.19E+00	
SC	-7.97E+00		-8.03E+00		-7.96E+00		-7.95E+00	
HQ	-8.12E+00		-8.17E+00		-8.11E+00		-8.10E+00	
Adj R2	0.3216		0.3590		0.3166		0.3100	
SD of transition variable	0.0016		0.0021		0.004		0.0072	
SD of residuals	0.0156		0.0152		0.0157		0.0157	

Table A6.4 RAFP **for July 2005–November 2011**

Rand/Yen	2Month	P-values	3Month	P-values	6Month	P-values	12Month	P-values
α_1	-0.02387	0.0109	-0.01442	0.0056	-0.01271	0.0139	-0.01461	0.0027
Std(α1)	0.0091		0.005		0.005		0.0047	
β_1	4.31588	0.1255	4.80695	0.0054	4.63144	0.0056	5.43277	0.0004
Std(β1)	2.7832		1.6754		1.6213		1.4673	
α_2	2612.7083	0.9811	0.13139	0.2401	-0.18191	0.0085	-0.301	0.6102
Std(α2)	109807.21		0.1109		0.0671		0.5877	
β2	-29780.65	0.9819	-6.72204	0.7559	52.97278	0.0006	85.3995	0.6119
Std(β_2)	1305082.6		21.5408		14.8284		167.5828	
γ	0.51212	0.0047	3.31395	0.4414	11.38389	0.0788	5.68872	0.3739
Std(γ)	0.1752		4.2801		6.3816		6.3571	
C	0.05189	0.7437	0.01451	0.0000	0.02542	0.0000	0.05181	0.0000
Std(C)	0.1581		0.0016		0.0004		0.0066	
AIC	-8.25E+00		-8.19E+00		-8.16E+00		-8.12E+00	
SC	-8.07E+00		-8.00E+00		-7.98E+00		-7.94E+00	
HQ	-8.18E+00		-8.11E+00		-8.09E+00		-8.05E+00	
Adj R2	0.5355		0.5039		0.4913		0.4710	
SD of transition variable	0.0019		0.0025		0.0043		0.0076	
SD of residuals	0.0155		0.0161		0.0163		0.0166	

APPENDIX 7: DETAILED DELAYED PARAMETER

Table A7.1 Rand/GBP Delay Parameter for Dec 1996–Nov 2011

Rand/Pound	One Month Lag	P-values	Two Months Lag	P-values
α_1	0.16591	0.6291	0.00009	0.9742
Std(α1)	0.3429		0.0029	
β_1	-1.08043	0.8571	0.60302	0.005
Std(β1)	5.9923		0.2123	
α_2	-0.16626	0.6285	0.0019	0.5781
Std(α2)	0.343		0.0034	
β2	0.77384	0.8986	-1.00053	0.0003
Std(β_2)	6.0652		0.2686	
γ	1.7715	0.3775	1503.40856	0.9998
Std(γ)	2.002		6945704.05	
C	-3.14298	0.0995	-0.52163	0.9941
Std(C)	1.8977		70.2168	
AIC	-7.76E+00		-7.79E+00	
SC	-7.65E+00		-7.68E+00	
HQ	-7.72E+00		-7.74E+00	
Adj R2	0.0577		0.0805	
SD of transition variable	0.9992		1.0076	
SD of residuals	0.0203		0.0200	

Table A7.2 Rand/GBP Delay Parameter for Dec 1996–Dec 2000

Rand/Pound	One Month Lag	P-values	Two Months Lag	P-values
α_1	0.01618	0.023	0.00452	0.0706
Std(α1)	0.0068		0.0024	
β_1	-1.00588	0.1398	-0.08456	0.7274
Std(β1)	0.6676		0.2409	
α_2	-0.01449	0.0576	-82.62487	0.9805
Std(α2)	0.0074		3367.3289	
β2	1.15897	0.1257	6365.65741	0.9805
Std(β_2)	0.741		259368.1424	
γ	53.80255	0.635	2.94332	0.7196
Std(γ)	112.4765		8.141	
C	-0.11214	0.1075	4.38448	0.7432
Std(C)	0.0681		13.2926	
AIC	-8.16E+00		-8.2337	
SC	-7.92E+00		-7.9952	
HQ	-8.07E+00		-8.1444	
Adj R2	0.1325		0.194	
SD of transition variable	0.7852		0.8337	
SD of residuals	0.0159		0.0153	

Table A7.3 Rand/GBP Delay Parameter for July 2005–Nov 2011

Rand/Pound	One Month Lag	P-values	Two Months Lag	P-values
α_1	0.0122	0.3475	0.00158	0.7068
Std(α1)	0.0129		0.0042	
β_1	0.42483	0.4324	0.84157	0.0042
Std(β1)	0.538		0.2843	
α_2	-0.01343	0.3095	-0.0008	0.8717
Std(α2)	0.0131		0.0051	
β2	-0.74181	0.2099	-1.34895	0.0010
Std(β_2)	0.5861		0.3936	
γ	81.10657	0.7102	1121.93209	0.8068
Std(γ)	217.4044		4570.7716	
C	-1.33393	0.0000	-0.47141	0.0000
Std(C)	0.0412		0.0043	
AIC	-7.77E+00		-7.81E+00	
SC	-7.58E+00		-7.62E+00	
HQ	-7.69E+00		-7.74E+00	
Adj R2	0.1423		0.1784	
SD of transition variable	0.9848		0.9844	
SD of residuals	0.0198		0.0194	

Table A7.4 Rand/GBP Delay Parameter for Jan 2001–Dec 2004

Rand/Pound	One Month Lag	P-values	Two Months Lag	P-values
α_1	0.03418	0.5739	0.00003	0.9967
Std(α1)	0.0603		0.0062	
β_1	-1.12798	0.7037	0.30164	0.5136
Std(β1)	2.9441		0.4575	
α_2	-0.03754	0.5377	0.0001	0.9933
Std(α2)	0.0604		0.0092	
β2	0.27797	0.9266	-1.33636	0.0592
Std(β_2)	2.9993		0.6876	
γ	9.9843	0.4658	9.66793	0.6621
Std(γ)	13.5556		21.9571	
C	-1.33078	0.0001	-0.24394	0.522
Std(C)	0.315		0.3775	
AIC	-7.22E+00		-7.18E+00	
SC	-6.98E+00		-6.94E+00	
HQ	-7.13E+00		-7.09E+00	
Adj R2	0.1635		0.1315	
SD of transition variable	1.2751		1.2734	
SD of residuals	0.0254		0.0259	

Table A7.5 Rand/USD Delay Parameter for Dec 1996–Nov 2011

Rand/USD	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.02845	0.0251	0.00257	0.1258
Std(α1)	0.0126		0.0017	
β_1	1.43064	0.0233	-0.18943	0.1797
Std(β1)	0.625		0.1406	
α_2	0.03066	0.0171	-0.10467	0.0838
Std(α2)	0.0127		0.0602	
β2	-1.70274	0.0093	10.40055	0.1012
Std(β_2)	0.647		6.3108	
γ	149.19524	0.8231	5.65207	0.0674
Std(γ)	666.4155		3.0709	
C	-1.04385	0	2.28002	0.0000
Std(C)	0.0343		0.2585	
AIC	-7.72E+00		-7.73E+00	
SC	-7.62E+00		-7.62E+00	
HQ	-7.68E+00		-7.68E+00	
Adj R2	0.0492		0.0517	
SD of transition variable	1.0048		1.0053	
SD of residuals	0.0207		0.0207	

Table A7.6 Rand/USD Delay Parameter for Dec 1996–Dec 2000

Rand/USD	One Month Lag	P-values	Two Months Lag	P-values
α_1	0.58665	0.9288	0.00681	0.0005
Std(α1)	6.5228		0.0018	
β_1	-29.91121	0.9294	-0.44283	0.0528
Std(β1)	335.4281		0.2221	
α_2	-0.58091	0.9295	-0.04229	0.0004
Std(α2)	6.5228		0.011	
β2	29.73507	0.9298	4.83615	0.0004
Std(β_2)	335.4244		1.2413	
γ	10.56245	0.9291	10.42045	0.3972
Std(γ)	117.9846		12.1799	
C	-1.5733	0.3044	0.92367	0.0000
Std(C)	1.5126		0.0889	
AIC	-8.48E+00		-8.83E+00	
SC	-8.25E+00		-8.59E+00	
HQ	-8.40E+00		-8.74E+00	
Adj R2	0.1079		0.3690	
SD of transition variable	0.6977		0.7028	
SD of residuals	0.0135		0.0114	

Table A7.7 Rand/USD Delay Parameter for July 2005–Nov 2011

Rand/USD	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.6639	0.7956	0.00441	0.1675
Std(α1)	2.5535		0.0032	
β_1	22.98006	0.8009	-0.53663	0.0813
Std(β1)	90.7607		0.3033	
α_2	0.66584	0.7951	-0.01077	0.0697
Std(α2)	2.554		0.0058	
β2	-22.94789	0.8011	1.25885	0.0085
Std(β_2)	90.7501		0.465	
γ	5.52064	0.7437	131.92073	0.9491
Std(γ)	16.8197		2058.9698	
C	-2.48148	0.1902	0.23985	0.4104
Std(C)	1.8755		0.2896	
AIC	-7.51E+00		-7.59E+00	
SC	-7.32E+00		-7.41E+00	
HQ	-7.43E+00		-7.52E+00	
Adj R2	0.0431		0.1232	
SD of transition variable	1.0347		1.0369	
SD of residuals	0.0226		0.0216	

Table A7.8 Rand/USD Delay Parameter for Jan 2001–Dec 2004

Rand/USD	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.00354	0.4021	-0.00882	0.1455
Std(α1)	0.0042		0.0059	
β_1	-0.05533	0.8494	0.5697	0.1261
Std(β1)	0.2895		0.3646	
α_2	-200.65169	0.9998	0.01265	0.1388
Std(α2)	0		0.0084	
β2	-21393.1339	0.9998	-2.05307	0.0018
Std(β_2)	0		0.6149	
γ	87.56449	0.999	10.15936	0.4257
Std(γ)	72076.4621		12.6231	
C	1.83175	0.9842	-0.3797	0.1523
Std(C)	91.6967		0.2602	
AIC	-7.38E+00		-7.46E+00	
SC	-7.14E+00		-7.22E+00	
HQ	-7.29E+00		-7.37E+00	
Adj R2	0.2102		0.2746	
SD of transition variable	1.2042		1.1965	
SD of residuals	0.0236		0.0226	

Table A7.9 Rand/Yen Delay Parameter for Dec 1996–Nov 2011

Rand/Yen	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.0158	0.0002	-0.01638	0.0008
Std(α1)	0.0041		0.0048	
β_1	4.25041	0.0000	4.102	0.0001
Std(β1)	0.8852		0.9886	
α_2	-0.00149	0.8741	-0.00236	0.7424
Std(α2)	0.0094		0.0072	
β2	2.9053	0.3359	3.06828	0.1079
Std(β_2)	3.0104		1.8986	
γ	51.80269	0.7867	1291.3647	1.0000
Std(γ)	191.1335		2946672857.0868	
C	-1.58278	0.0000	-1.99965	1.0000
Std(C)	0.0837		60671.9674	
AIC	-8.05E+00		-8.07E+00	
SC	-7.95E+00		-7.97E+00	
HQ	-8.01E+00		-8.03E+00	
Adj R2	0.1638		0.1815	
SD of transition variable	0.9717		1.0042	
SD of residuals	0.0175		0.0174	

Table A7.10 Rand/Yen Delay Parameter for Dec 1996–Dec 2000

Rand/Yen	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.05153	0.0077	-0.05173	0.0042
Std(α1)	0.0184		0.0171	
β_1	9.32555	0.0015	8.93183	0.0009
Std(β1)	2.7475		2.4912	
α_2	0.05614	0.0132	0.05323	0.0149
Std(α2)	0.0217		0.0209	
β2	-9.50337	0.011	-8.19983	0.023
Std(β_2)	3.568		3.4716	
γ	15.87857	0.5129	60.29974	0.4521
Std(γ)	24.0545		79.4371	
C	-3.56146	0.0000	-3.40741	0.0000
Std(C)	0.1072		0.0436	
AIC	-8.51E+00		-8.51E+00	
SC	-8.28E+00		-8.27E+00	
HQ	-8.42E+00		-8.42E+00	
Adj R2	0.3032		0.3021	
SD of transition variable	0.817		1.0261	
SD of residuals	0.0134		0.0134	

Table A7.11 Rand/Yen Delay Parameter for July 2005–Nov 2011

Rand/Yen	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.01615	0.0032	-0.02951	0.0177
Std(α1)	0.0053		0.0121	
β_1	6.68281	0.0000	7.45673	0.004
Std(β1)	1.5407		2.5001	
α_2	-0.0498	0.1271	0.0086	0.5353
Std(α2)	0.0322		0.0138	
β2	11.00637	0.3068	1.27847	0.6995
Std(β_2)	10.6879		3.298	
γ	136.8409	0.9623	208.62473	0.9999
Std(γ)	2886.4972		3303880.4846	
C	-0.49841	0.7330	-2.45521	0.9988
Std(C)	1.4552		1570.0273	
AIC	-7.79E+00		-7.80E+00	
SC	-7.60E+00		-7.61E+00	
HQ	-7.71E+00		-7.72E+00	
Adj R2	0.2769		0.2820	
SD of transition variable	0.8563		0.8552	
SD of residuals	0.0196		0.0195	

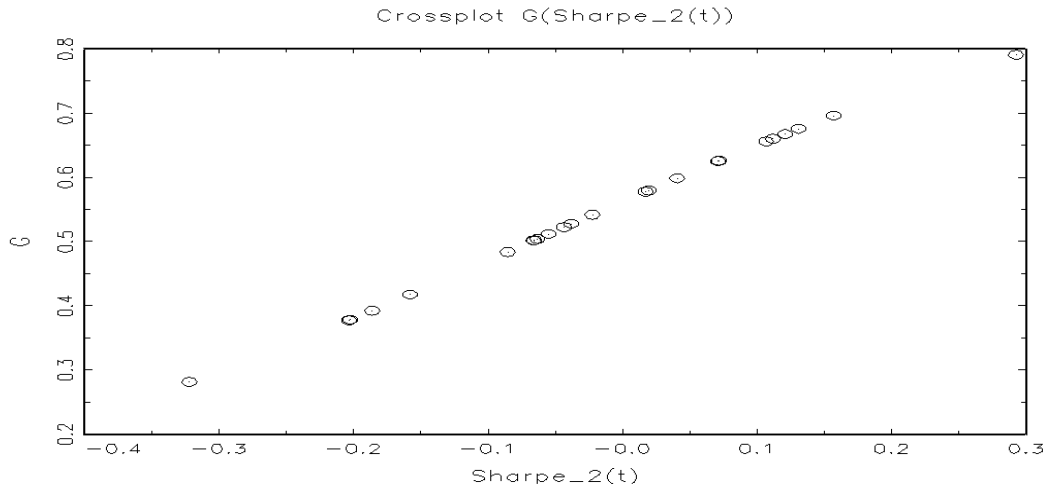
Table A7.12 Rand/Yen Delay Parameter for Jan 2001–Dec 2004

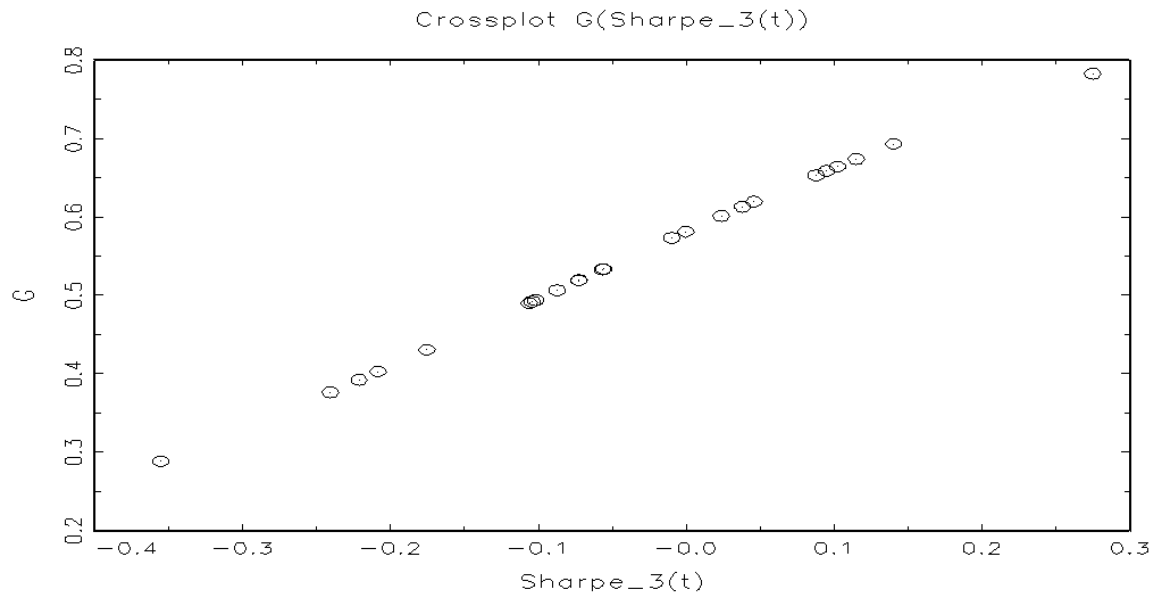
Rand/Yen	One Month Lag	P-values	Two Months Lag	P-values
α_1	-0.0158	0.0002	-0.01638	0.0008
Std(α1)	0.0041		0.0048	
β_1	4.25041	0.0000	4.102	0.0001
Std(β1)	0.8852		0.9886	
α_2	-0.00149	0.8741	-0.00236	0.7424
Std(α2)	0.0094		0.0072	
β2	2.9053	0.3359	3.06828	0.1079
Std(β_2)	3.0104		1.8986	
γ	51.80269	0.7867	1291.3647	1.0000
Std(γ)	191.1335		2946672857.0868	
C	-1.58278	0.0000	-1.99965	1.0000
Std(C)	0.0837		60671.9674	
AIC	-8.05E+00		-8.07E+00	
SC	-7.95E+00		-7.97E+00	
HQ	-8.01E+00		-8.03E+00	
Adj R2	0.1638		0.1815	
SD of transition variable	0.9717		1.0042	
SD of residuals	0.0175		0.0174	

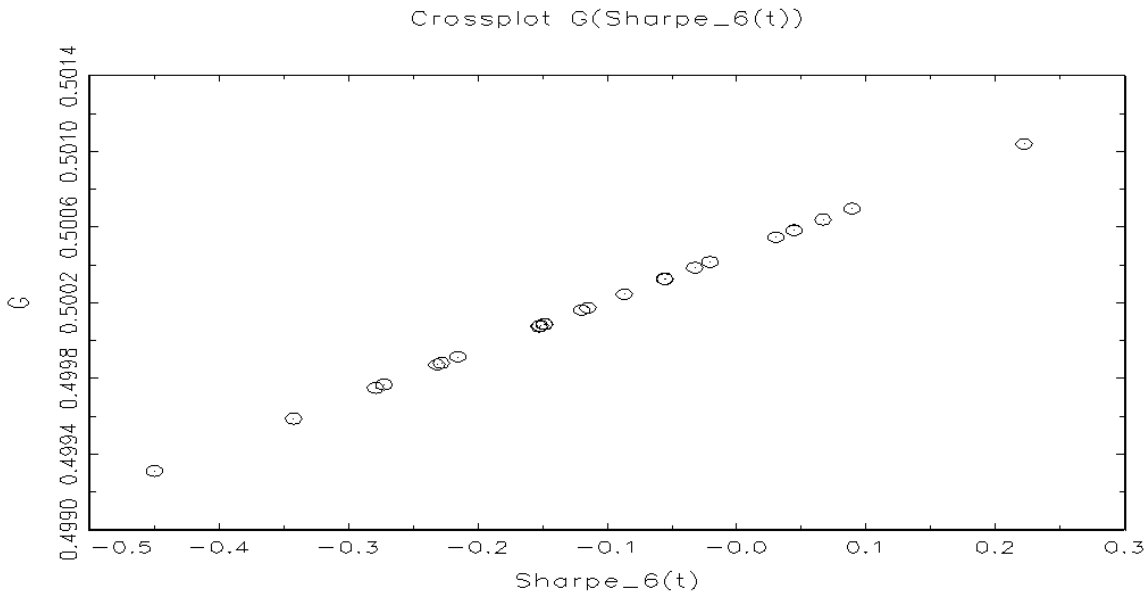
APPENDIX 8: TRANSITION FUNCTION FOR THE SHARPE RATIO AS THE TRANSITION VARIABLE

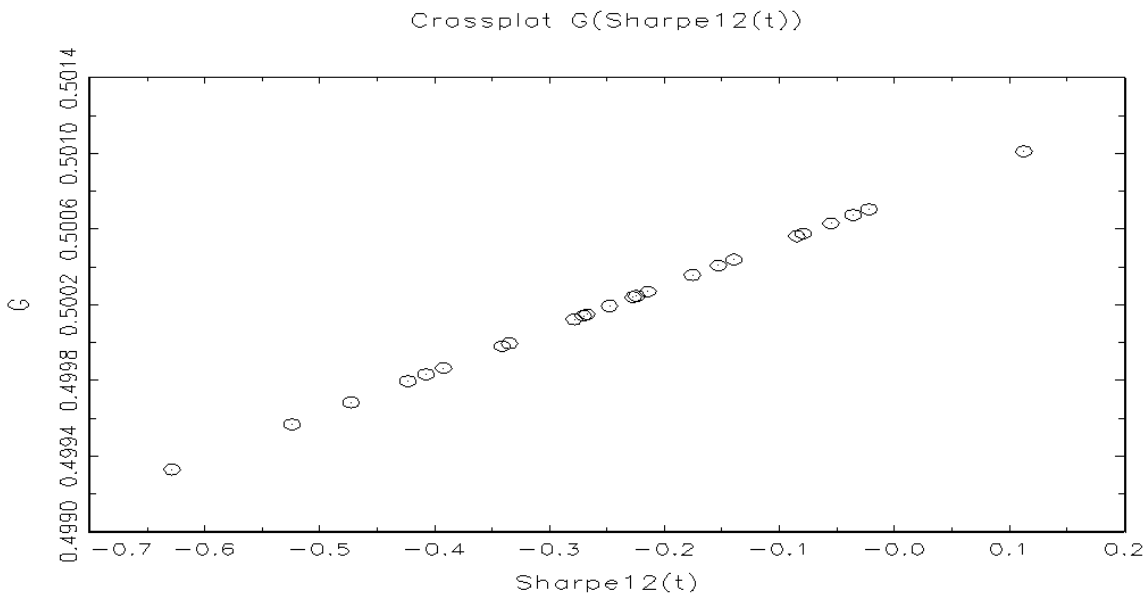
GBP

GBP/RAND Jan 1999–Dec 2000

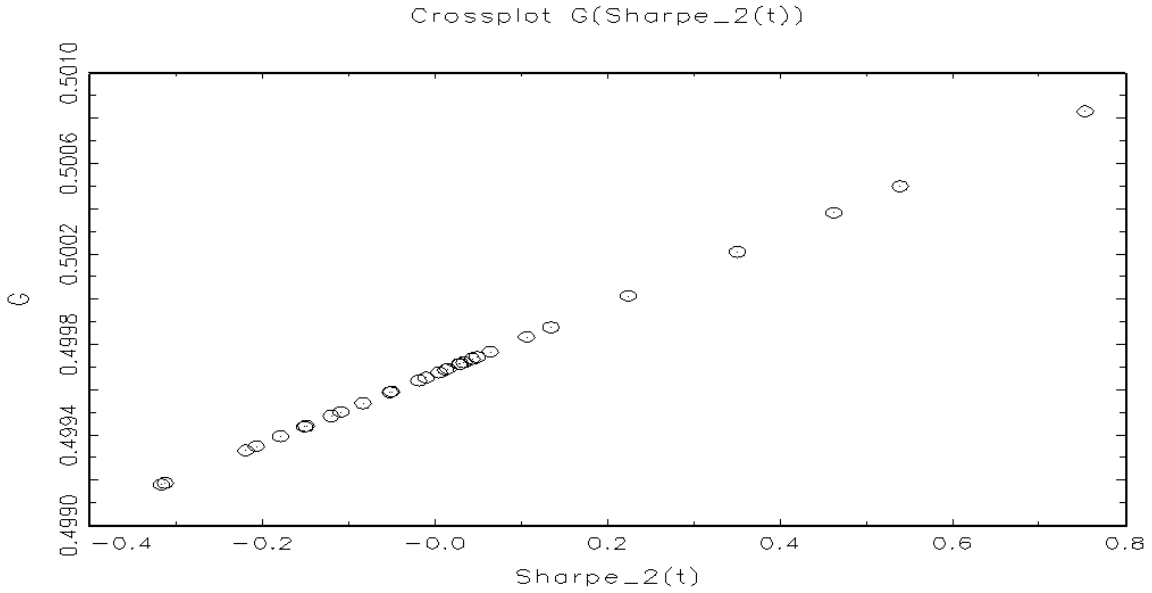


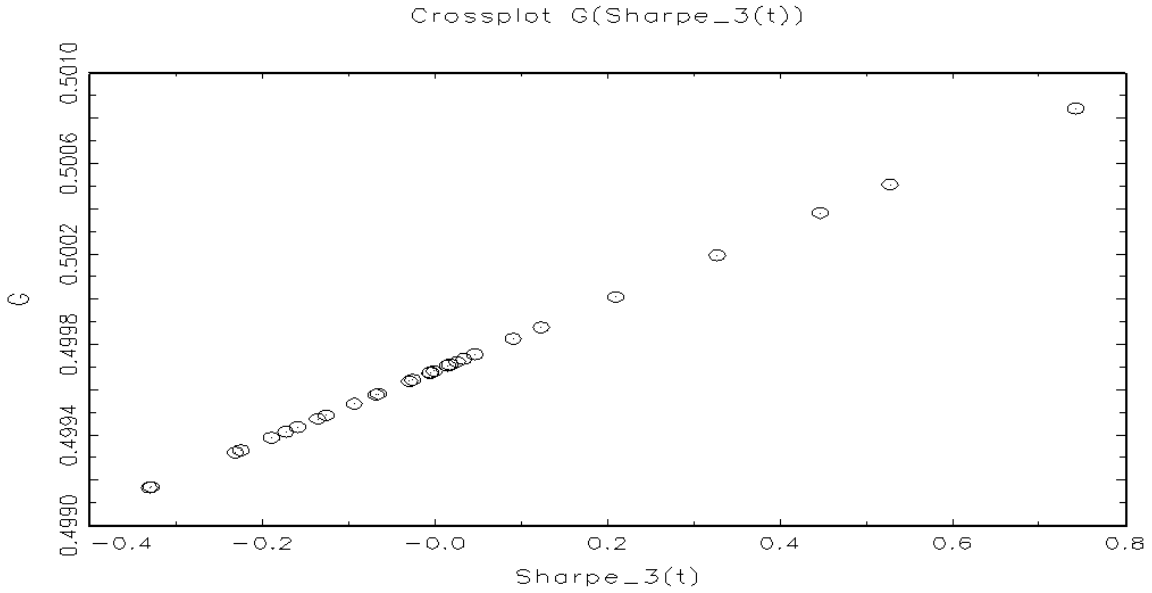


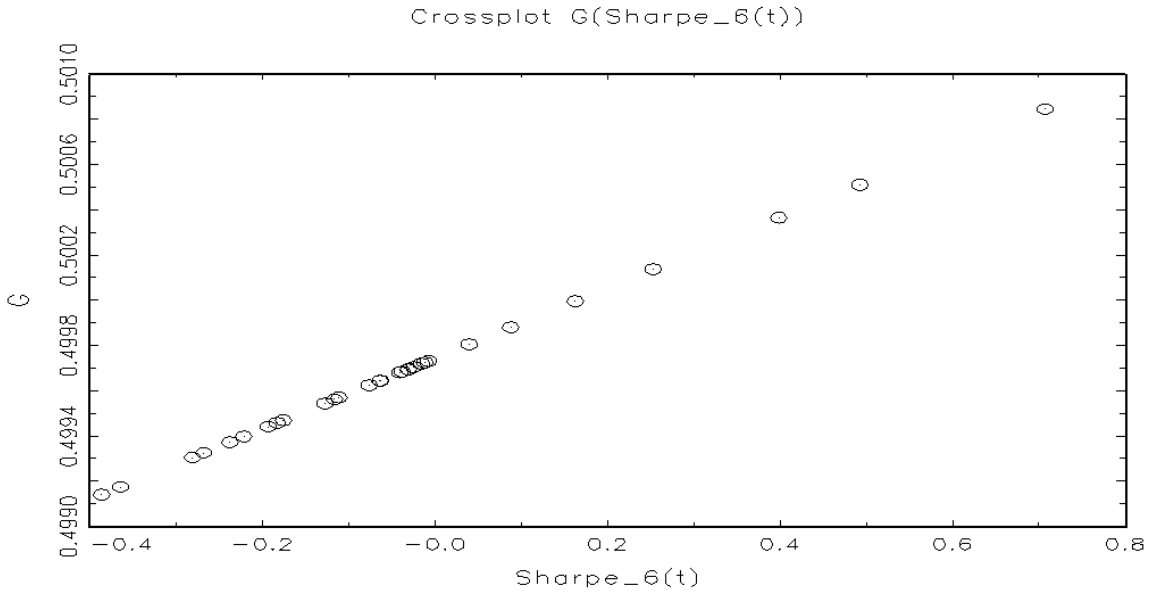

Crossplot G(Sharpe_6(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−0.5 −0.4 −0.3 −0.2 −0.1 −0.0 0.1 0.2 0.3
Sharpe_6(t)

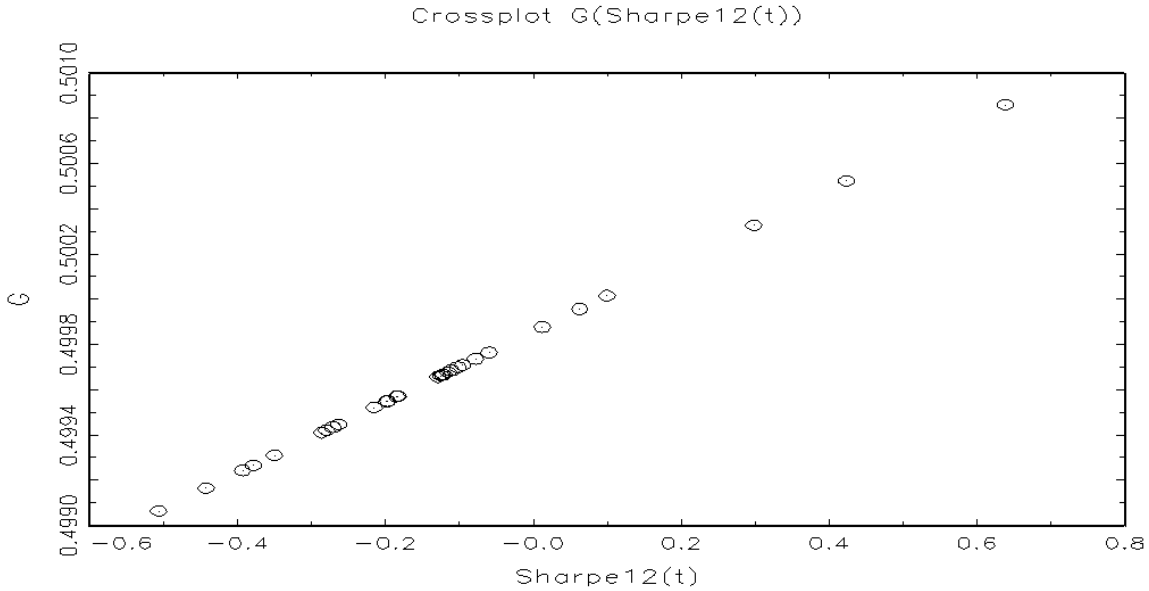

Crossplot G(Sharpe12(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−0.7 −0.6 −0.5 −0.4 −0.3 −0.2 −0.1 −0.0 0.1 0.2
Sharpe12(t)

GBP/RAND July 2005–Dec2007

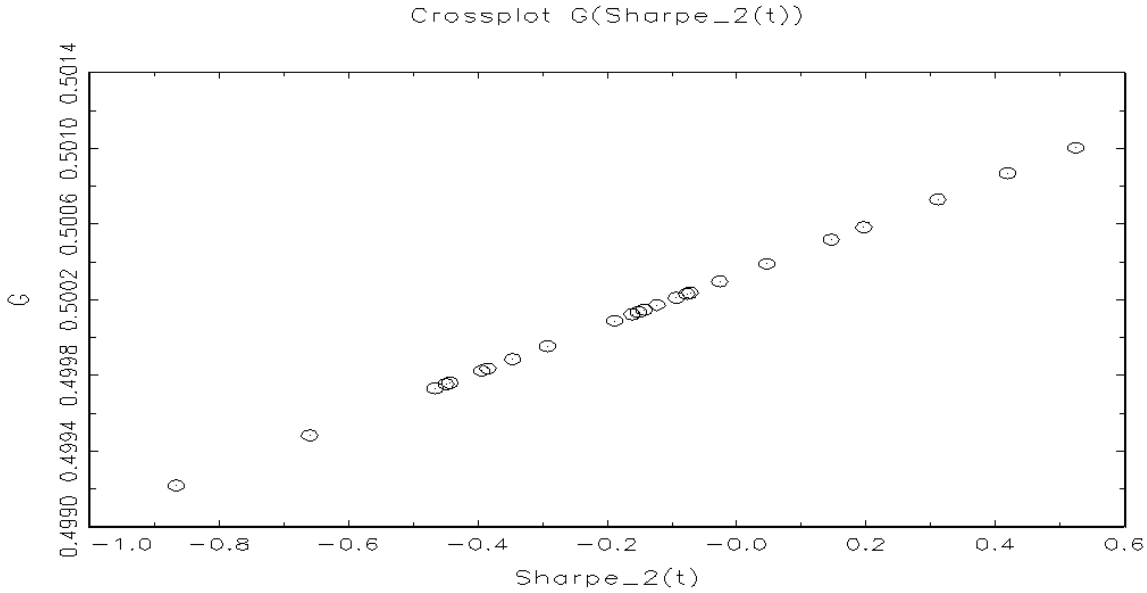


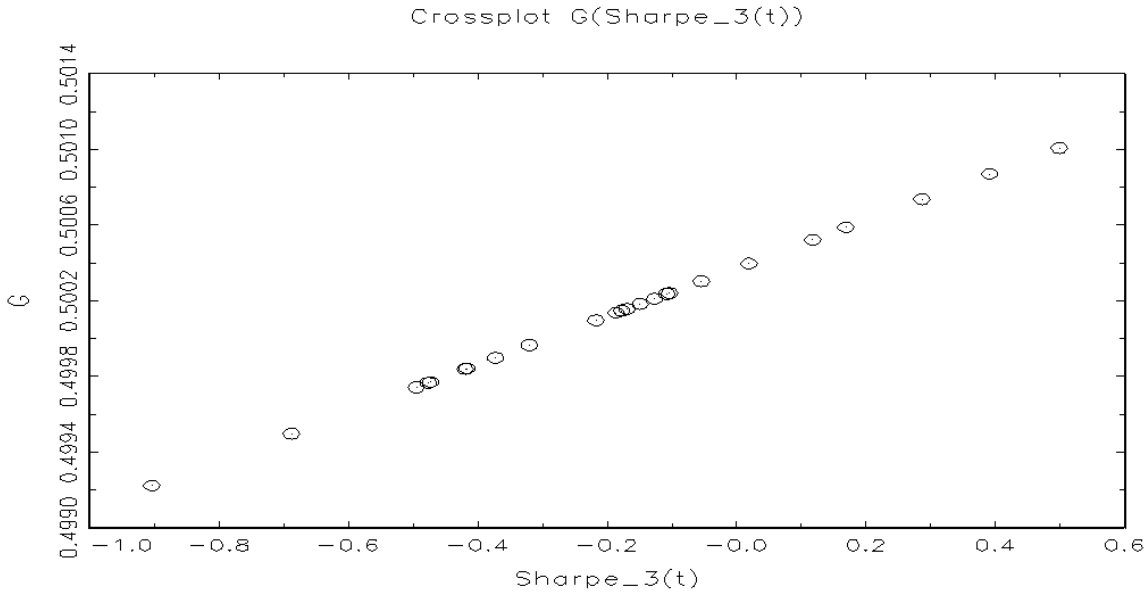


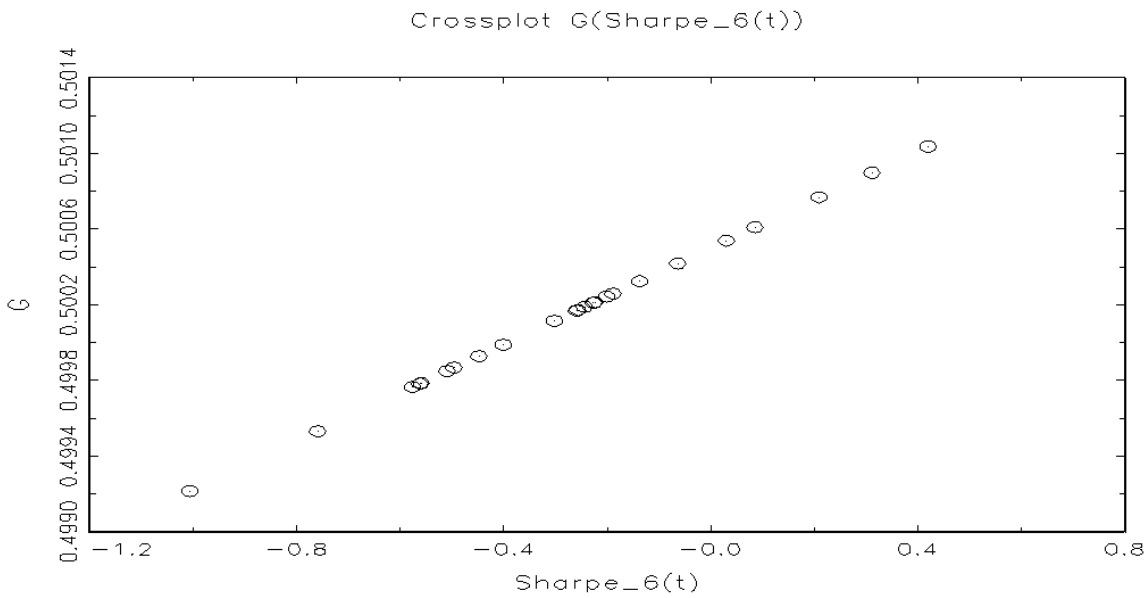

Crossplot G(Sharpe_6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.4
−0.2
−0.0
0.2
0.4
0.6
0.8
Sharpe_6(t)

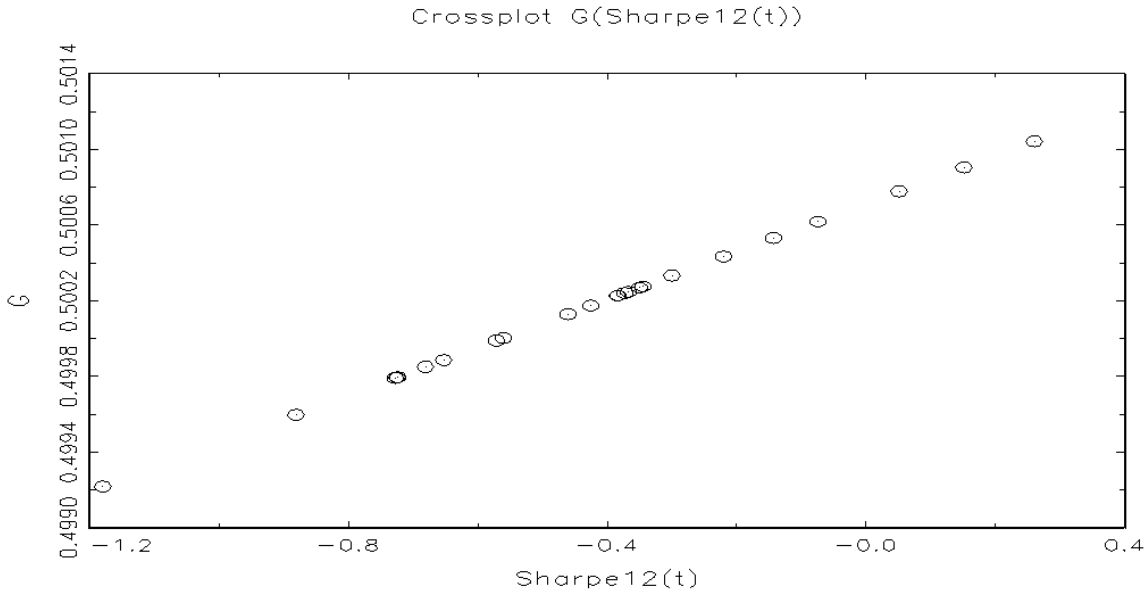

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
0.8
Sharpe12(t)

GBP/RAND Jan 2008-Dec2009

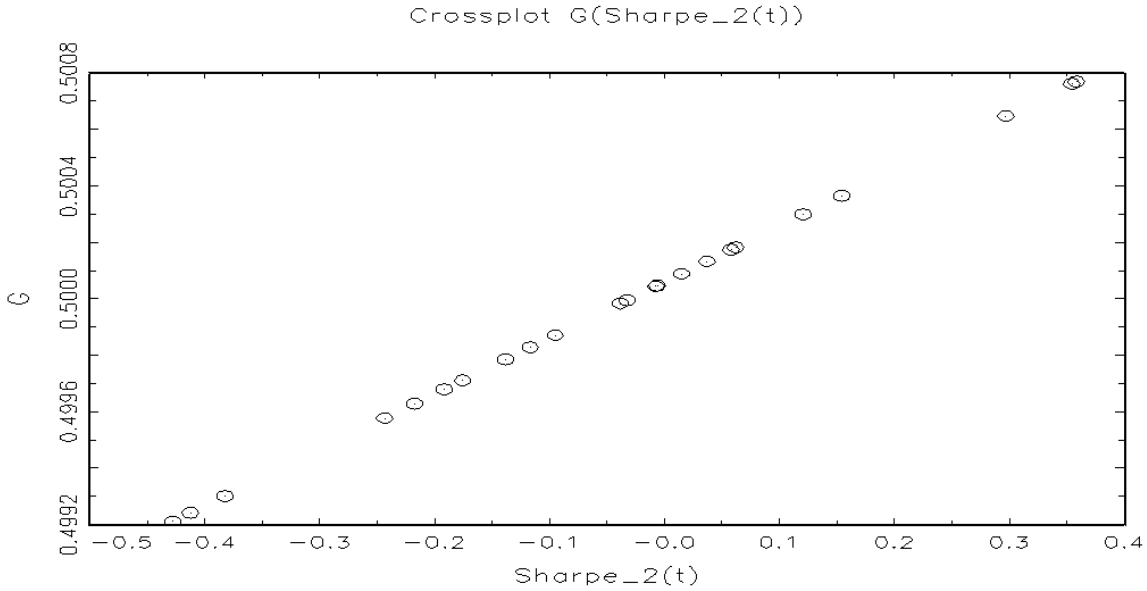


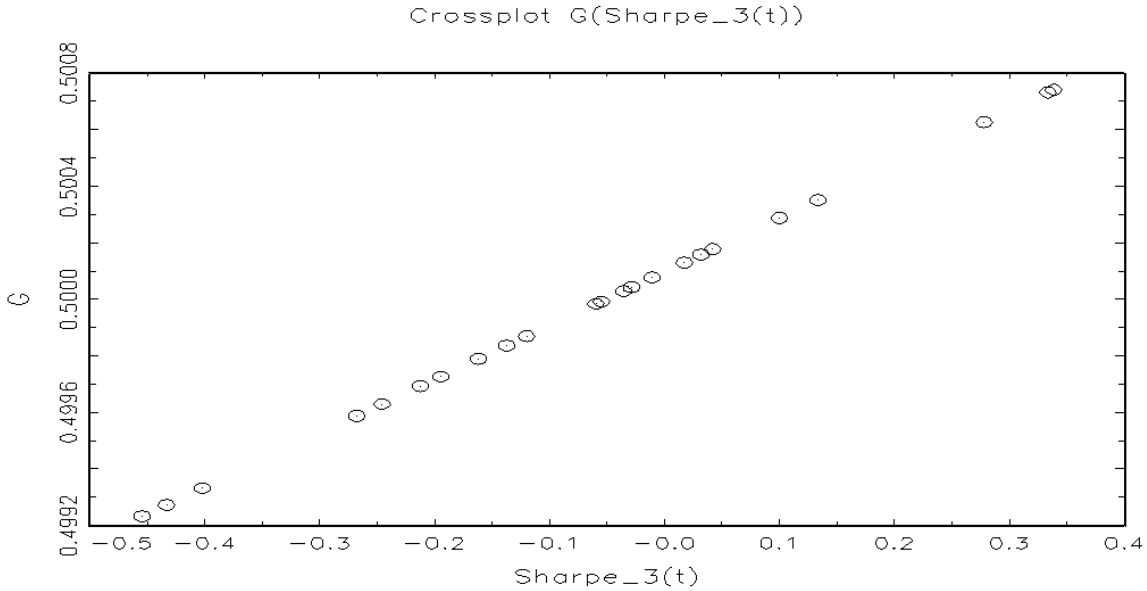


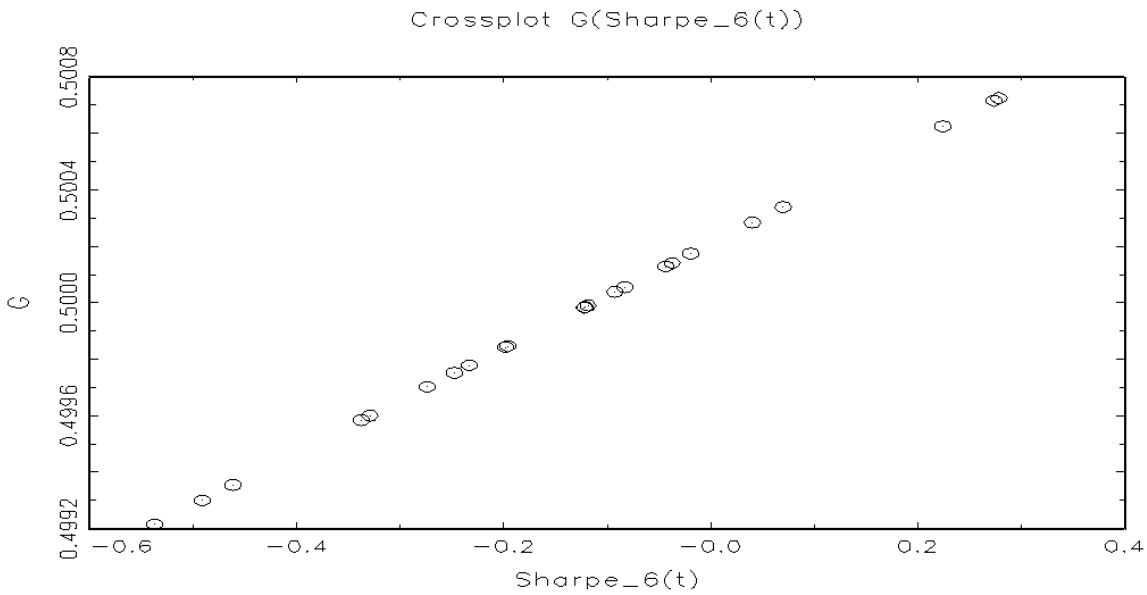

Crossplot G(Sharpe_6(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−1.2 −0.8 −0.4 −0.0 0.4 0.8
Sharpe_6(t)

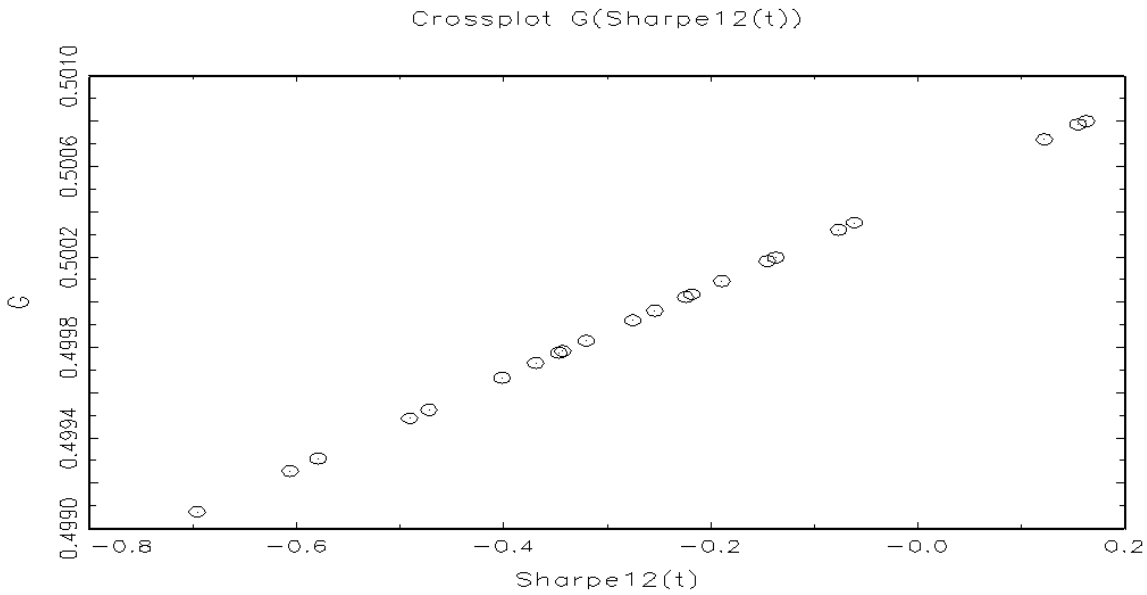

Crossplot G(Sharpe12(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−1.2 −0.8 −0.4 −0.0 0.4
Sharpe12(t)

GBP/RAND Jan2010-Dec2011

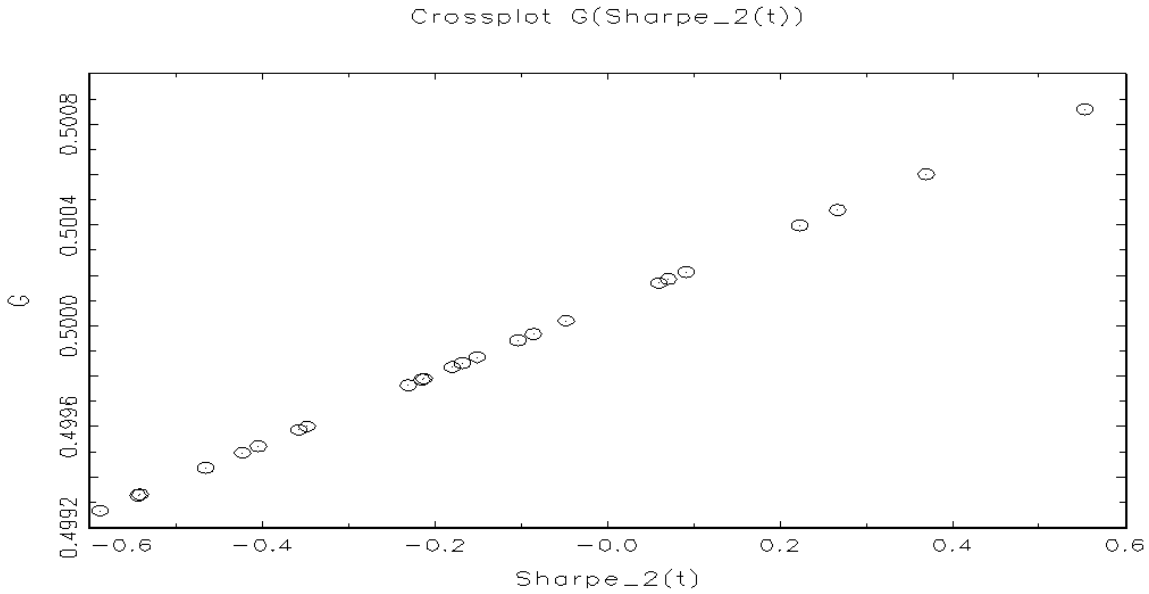


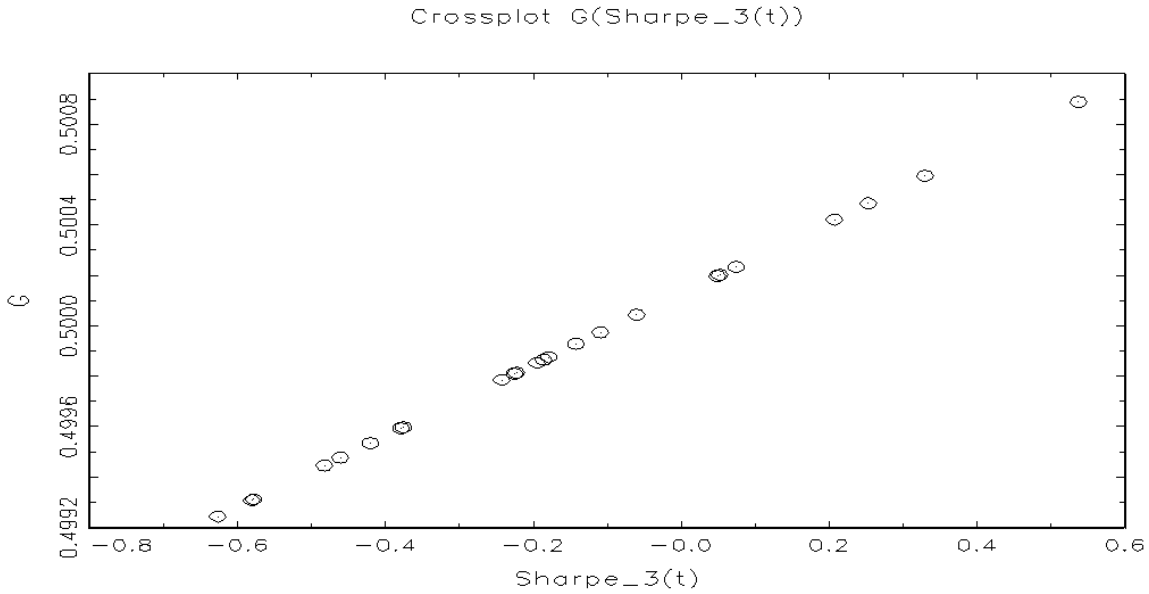


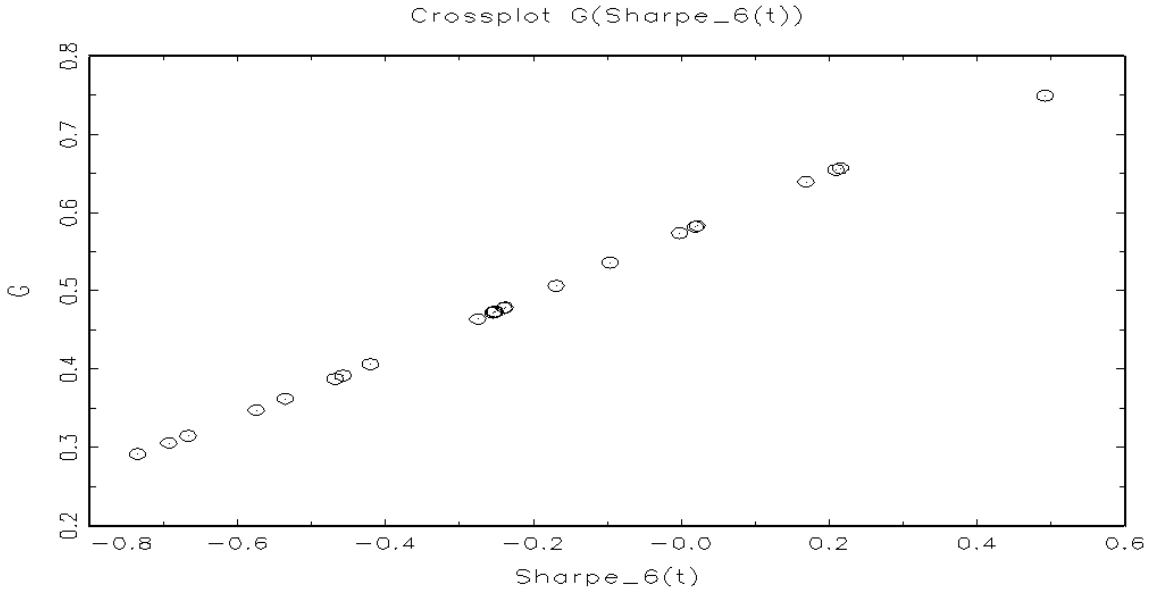

Crossplot G(Sharpe_6(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−0.6
−0.4
−0.2
−0.0
0.2
0.4
Sharpe_6(t)

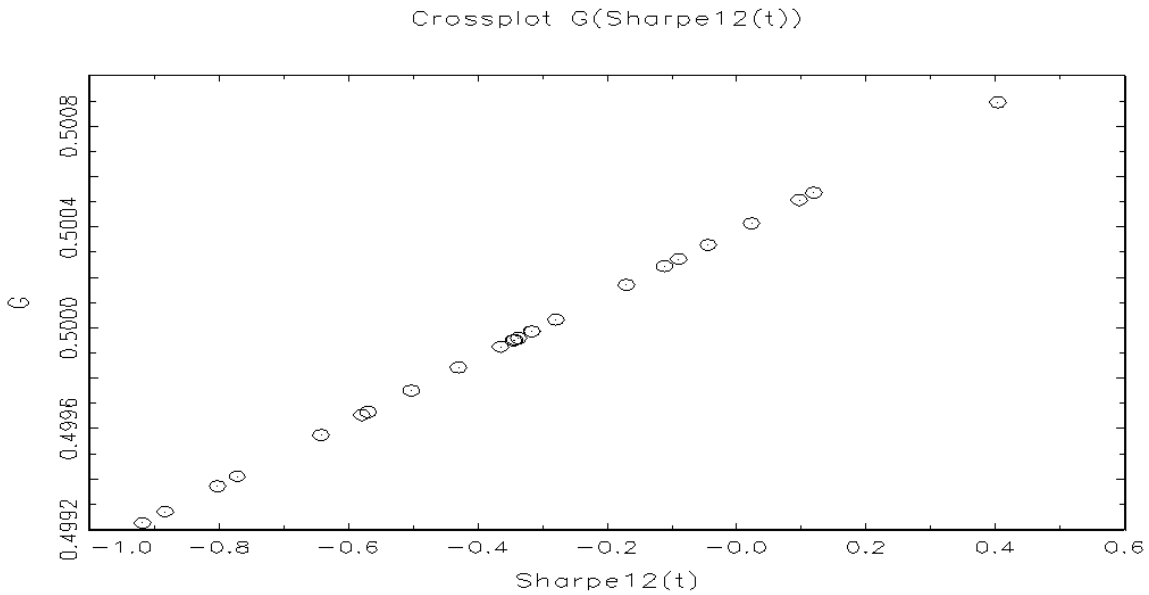

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
Sharpe12(t)

GBP/RAND Jan 2003-Dec 2004

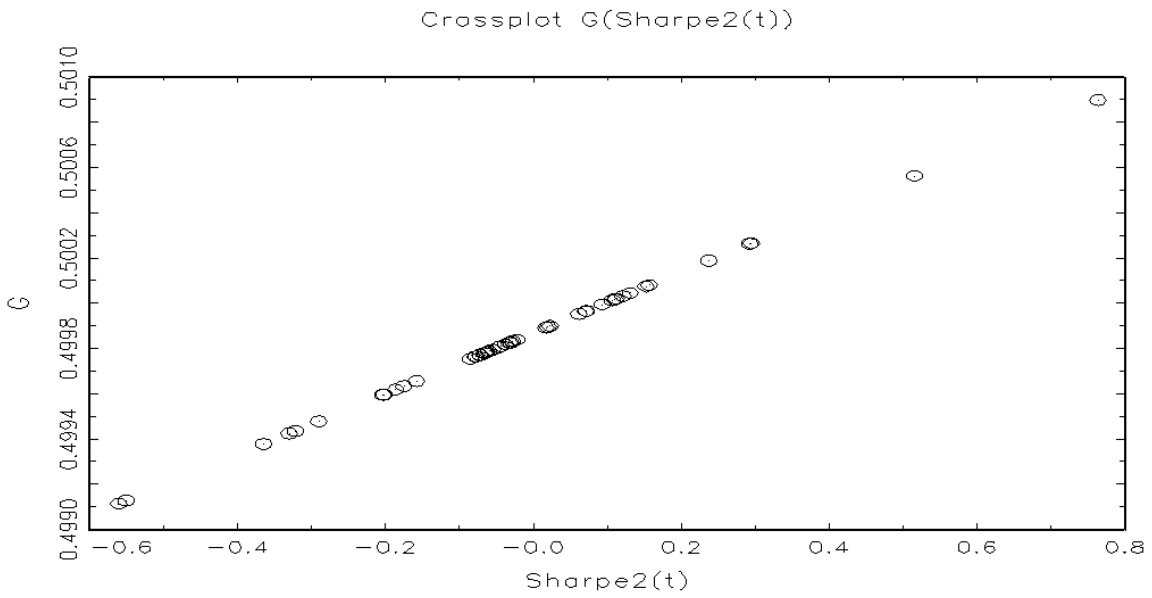


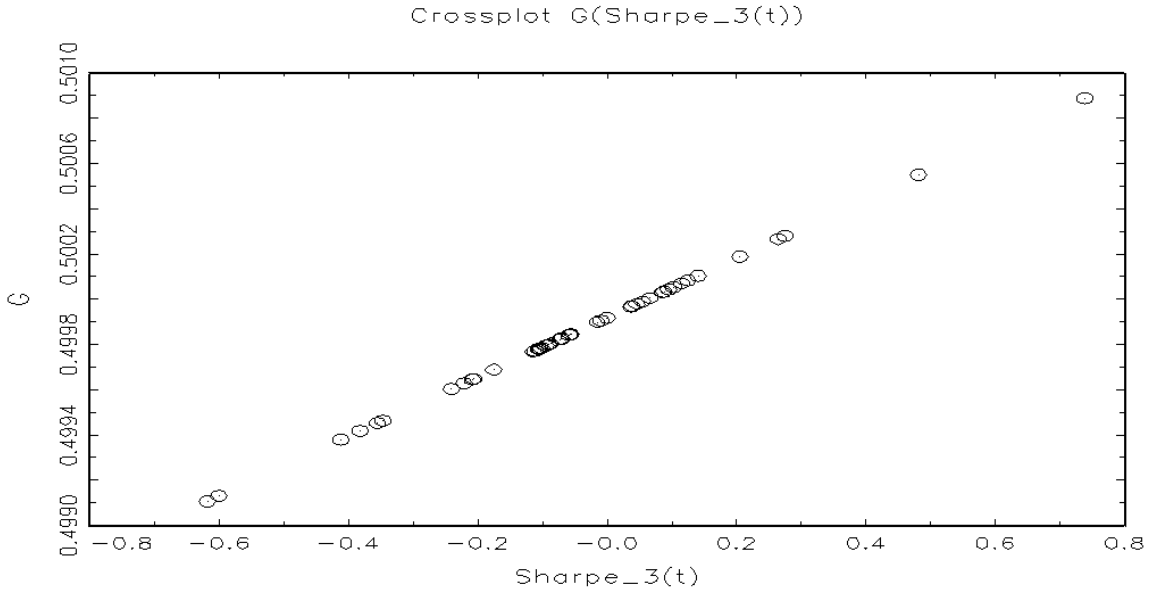


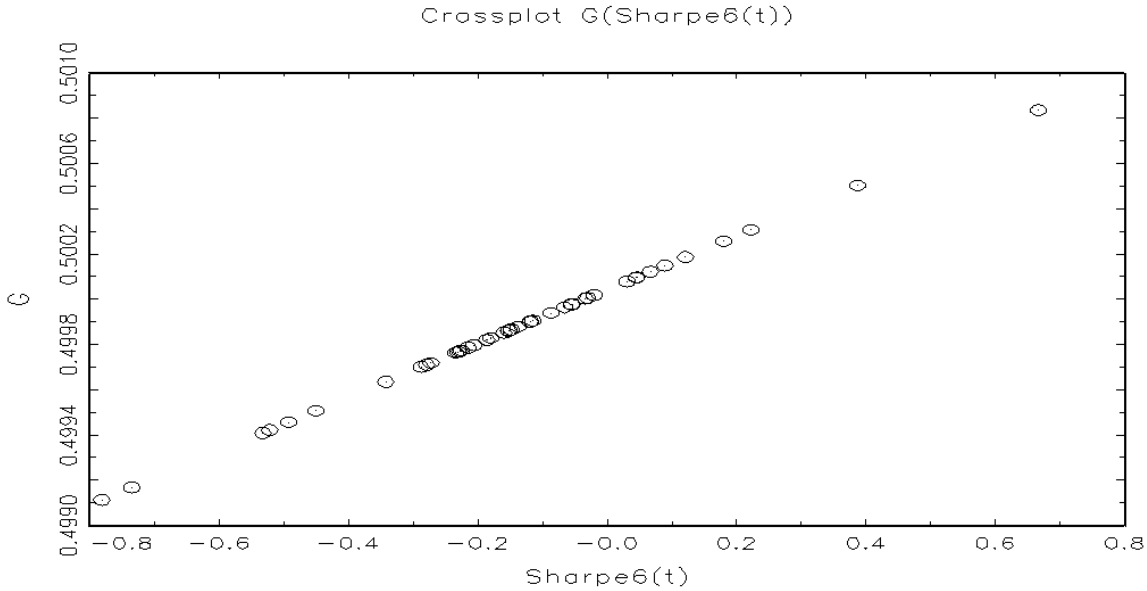

Crossplot G(Sharpe_6(t))
G
0.2
0.3
0.4
0.5
0.6
0.7
0.8
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
Sharpe_6(t)

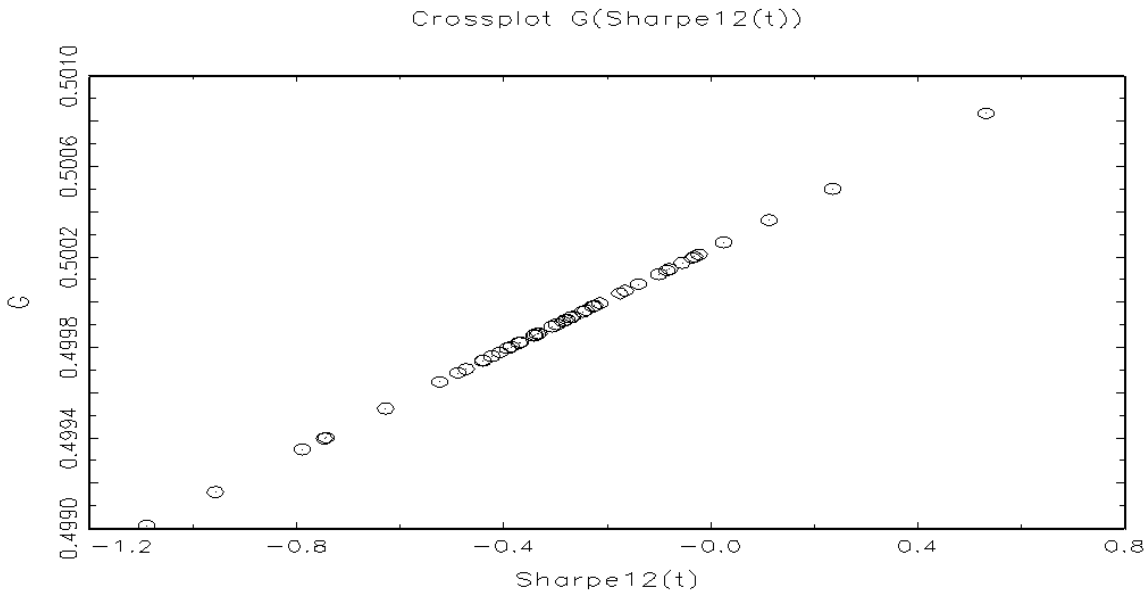

Crossplot G(Sharpe12(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
Sharpe12(t)

RAND/GBP Jan 1995-Dec 2000

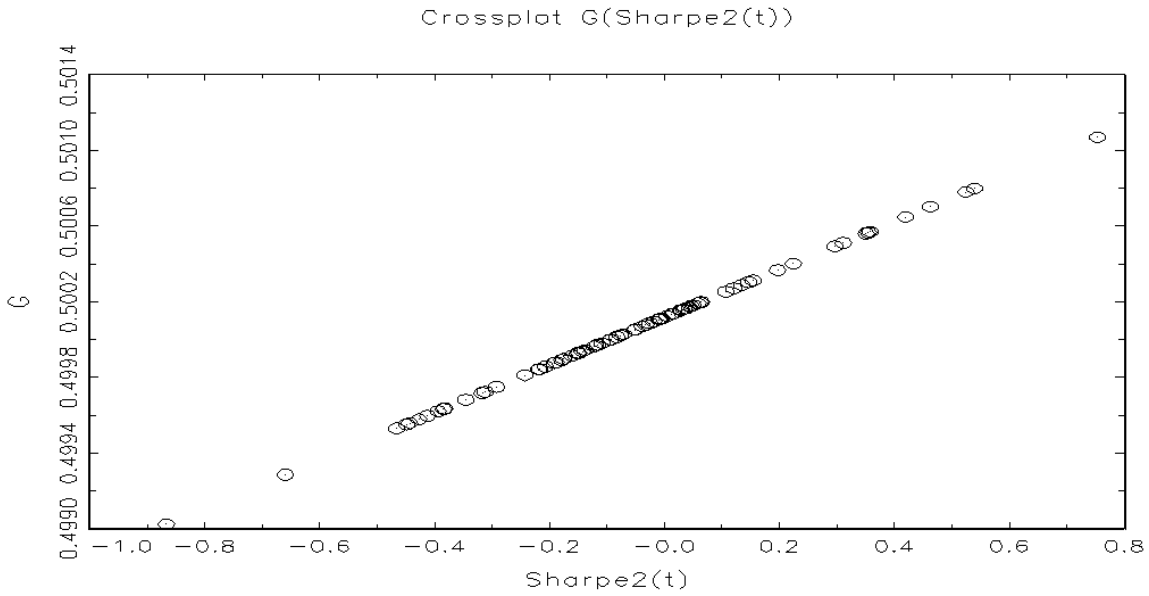


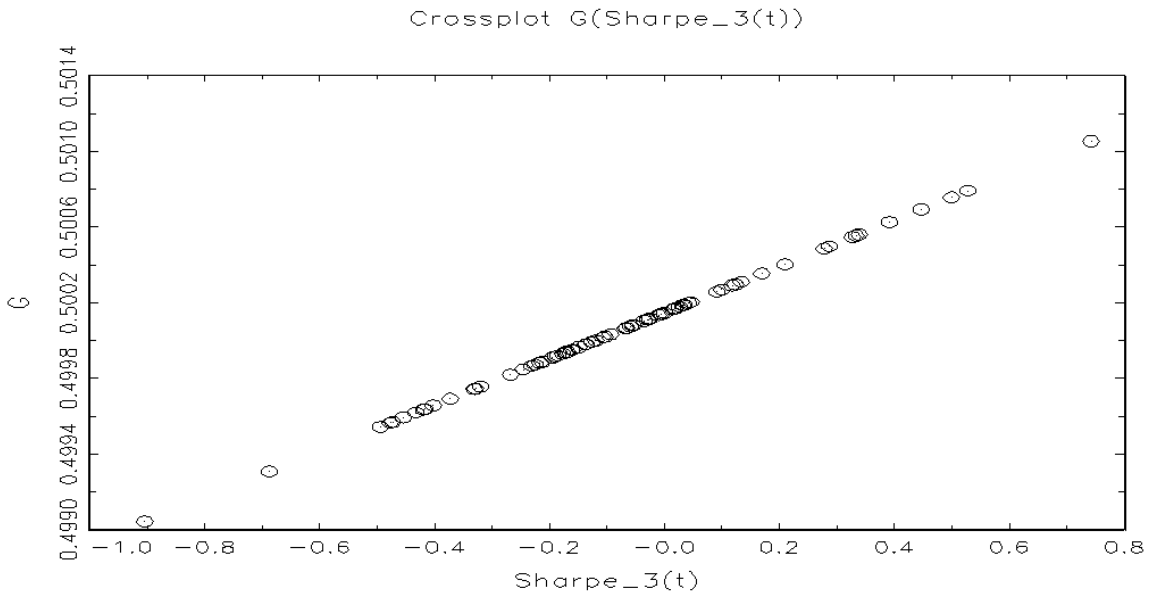


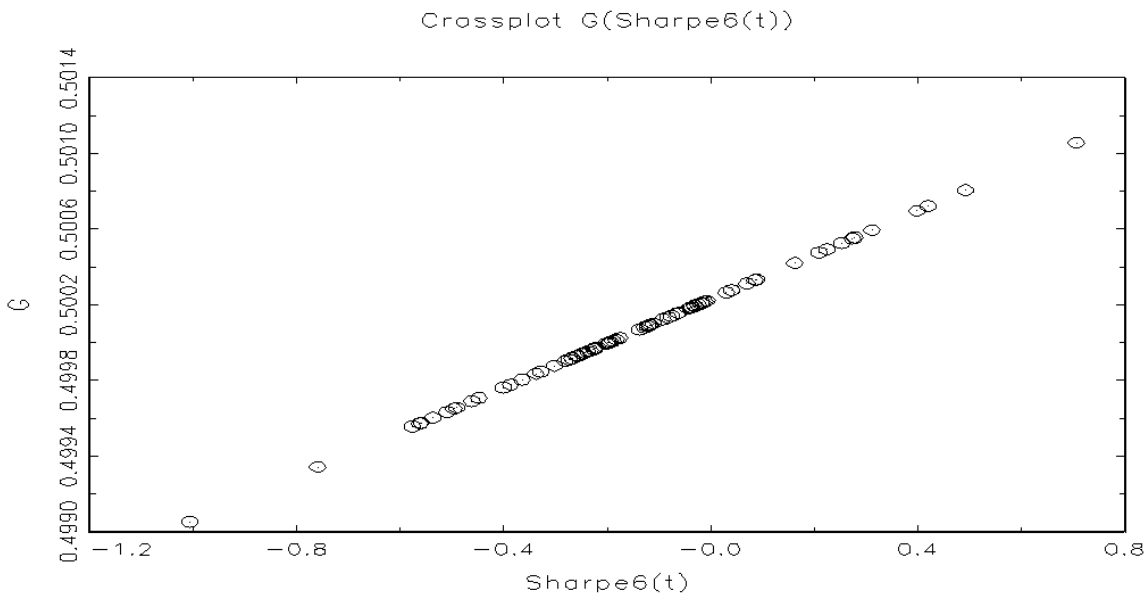

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
0.8
Sharpe6(t)

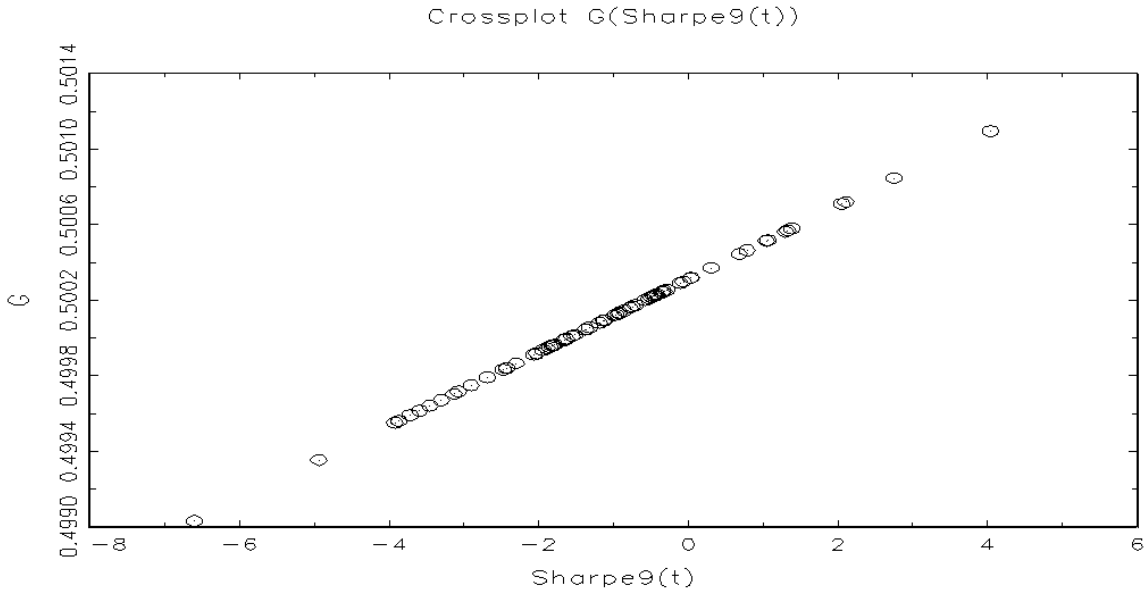

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.2
−0.8
−0.4
−0.0
0.4
0.8
Sharpe12(t)

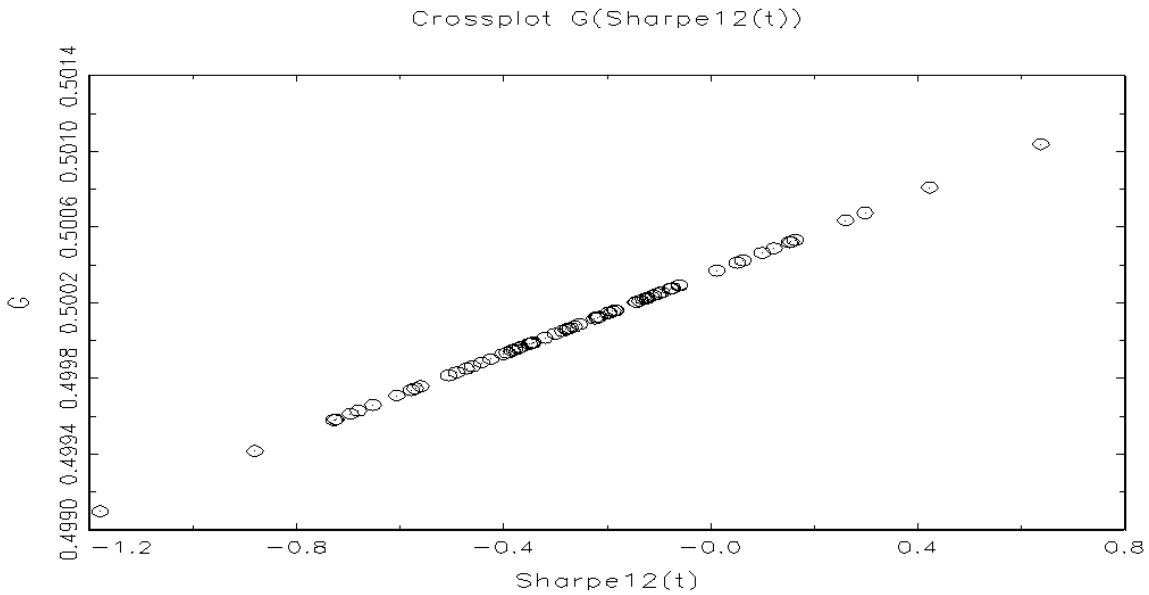
RAND/GBP July 2005 – Dec 2011



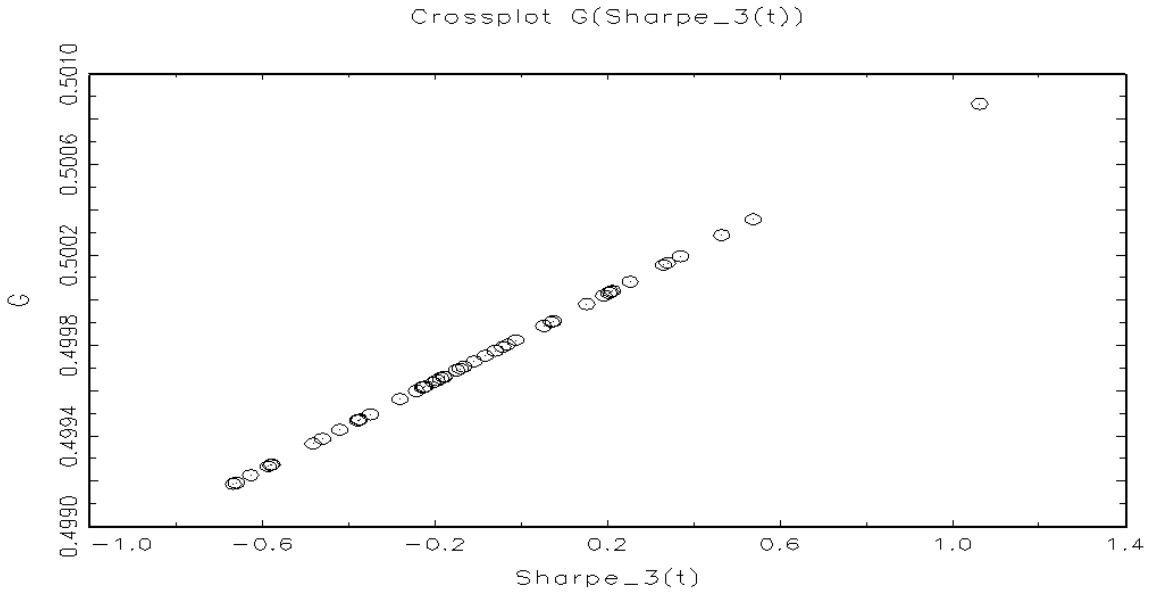


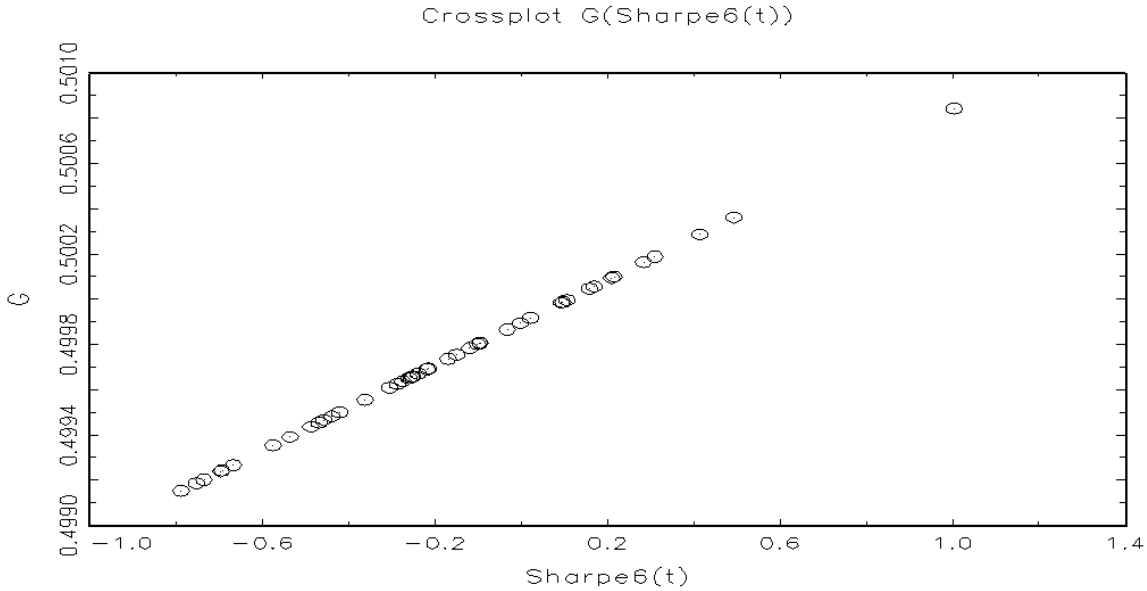

Crossplot G(Sharpe6(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−1.2 −0.8 −0.4 −0.0 0.4 0.8
Sharpe6(t)

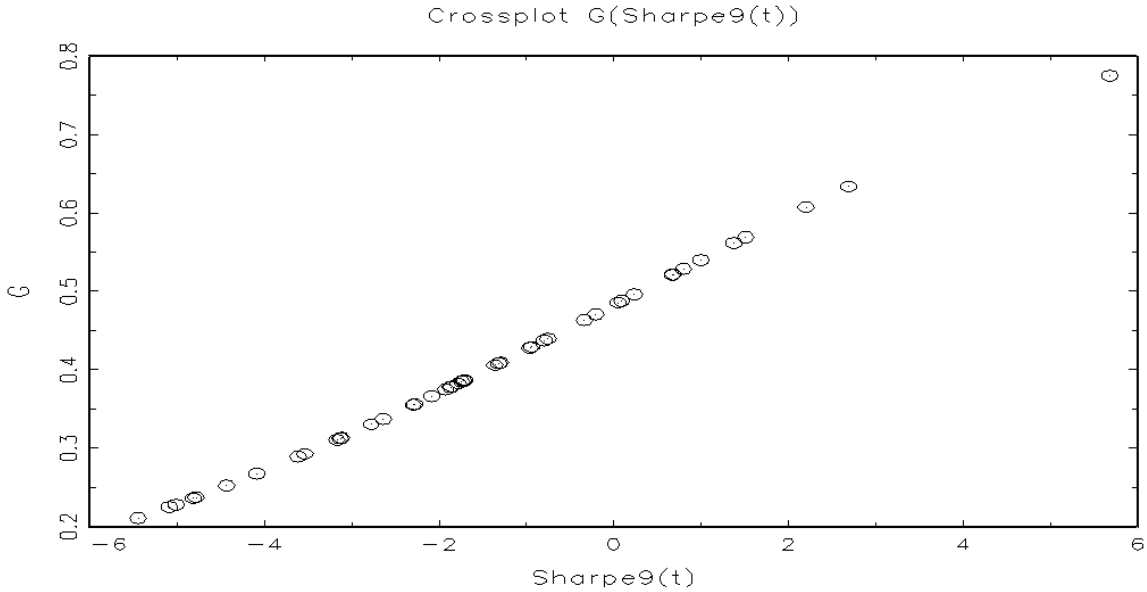

Crossplot G(Sharpe9(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−8 −6 −4 −2 0 2 4 6
Sharpe9(t)

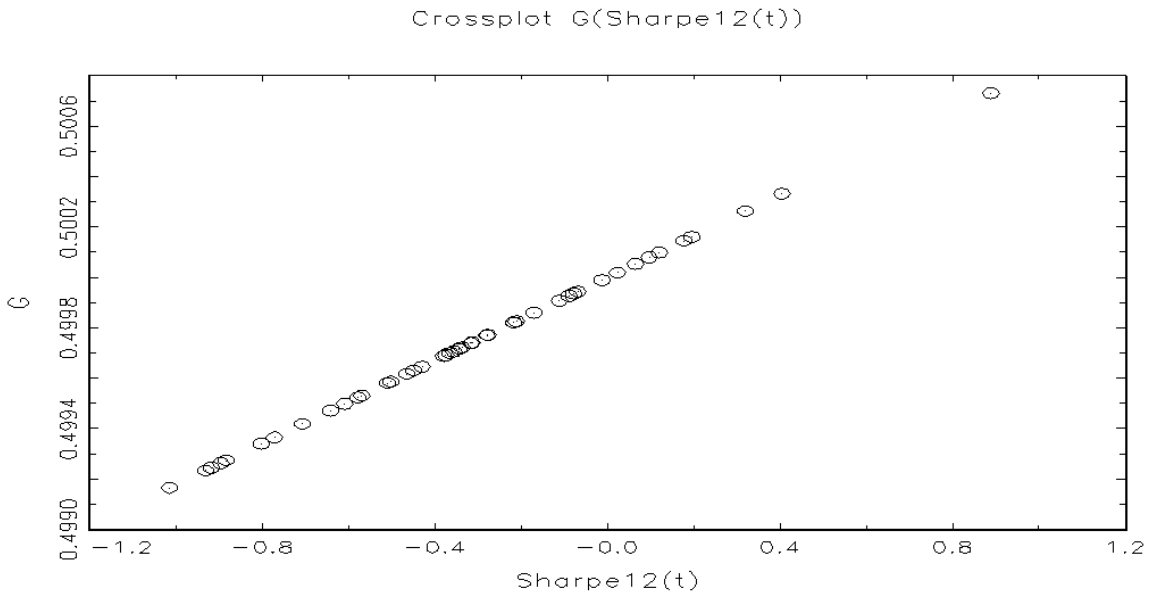

Crossplot G(Sharpe12(t))
G
0.4990 0.4994 0.4998 0.5002 0.5006 0.5010 0.5014
−1.2 −0.8 −0.4 −0.0 0.4 0.8
Sharpe12(t)

RAND/GBP Jan 2001 – Dec 2004



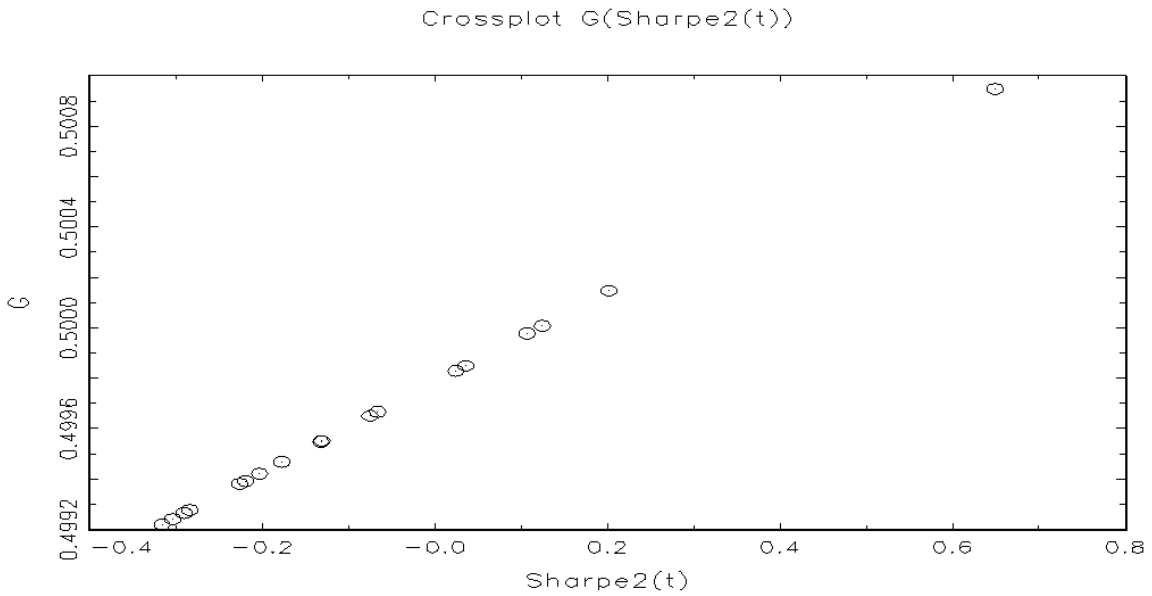

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.0
−0.6
−0.2
0.2
0.6
1.0
1.4
Sharpe6(t)

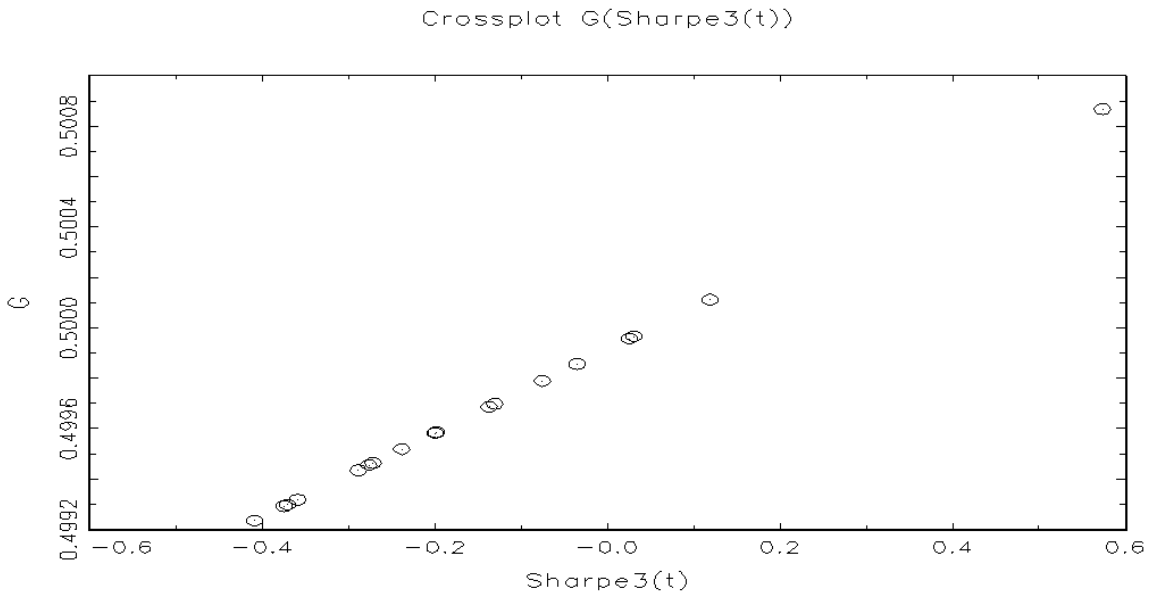

Crossplot G(Sharpe9(t))
G
0.2
0.3
0.4
0.5
0.6
0.7
0.8
−6
−4
−2
0
2
4
6
Sharpe9(t)

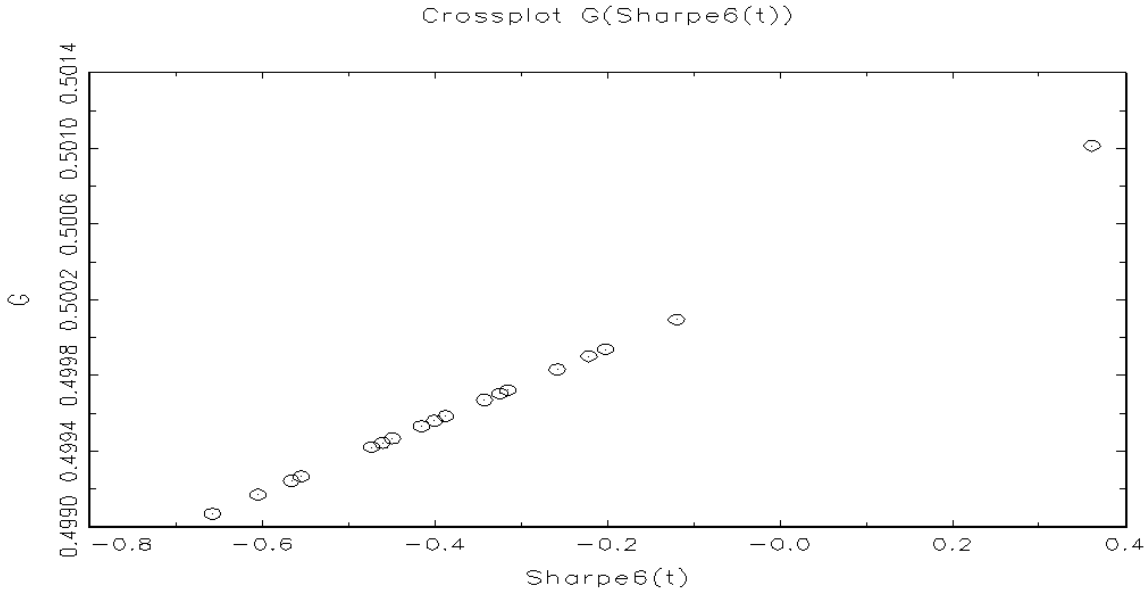

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−1.2
−0.8
−0.4
−0.0
0.4
0.8
1.2
Sharpe12(t)

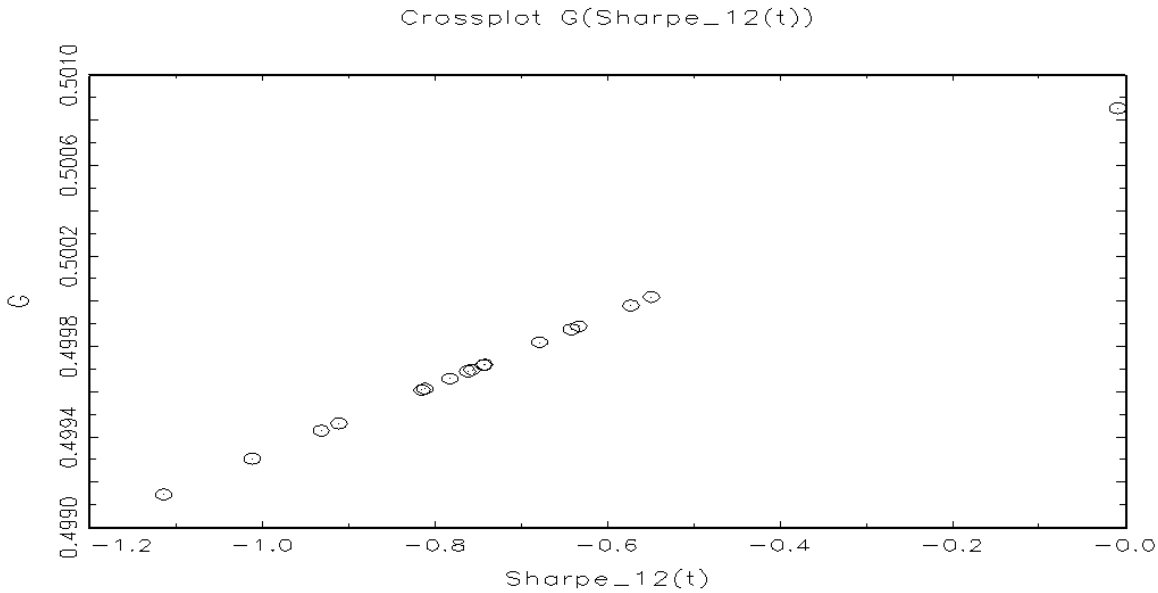
USD

USD/RAND July 1997 – Dec 1998

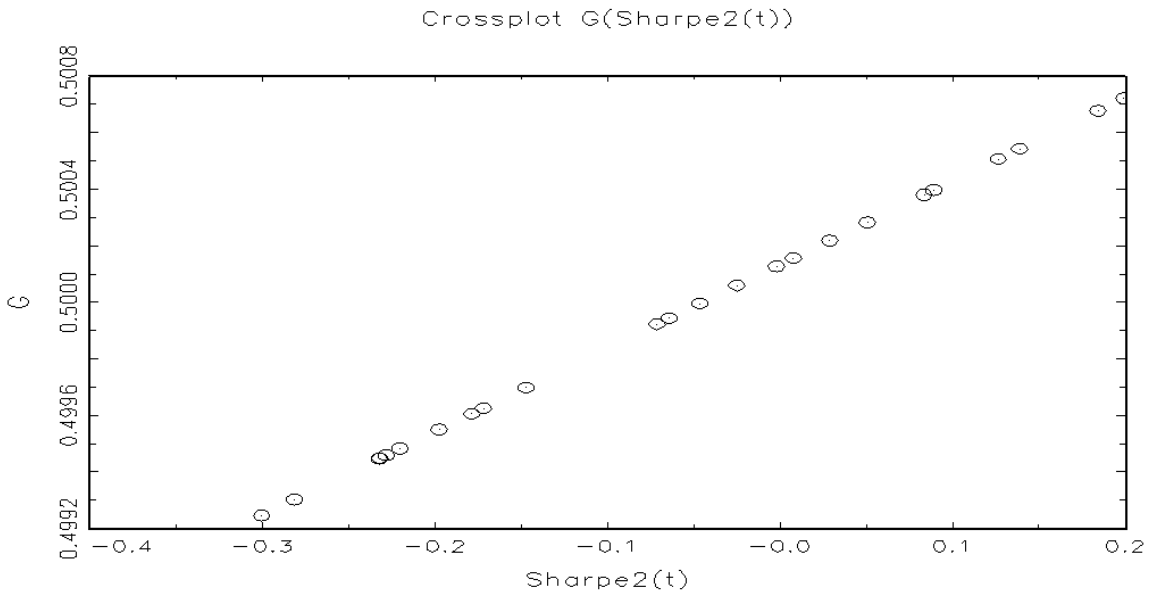


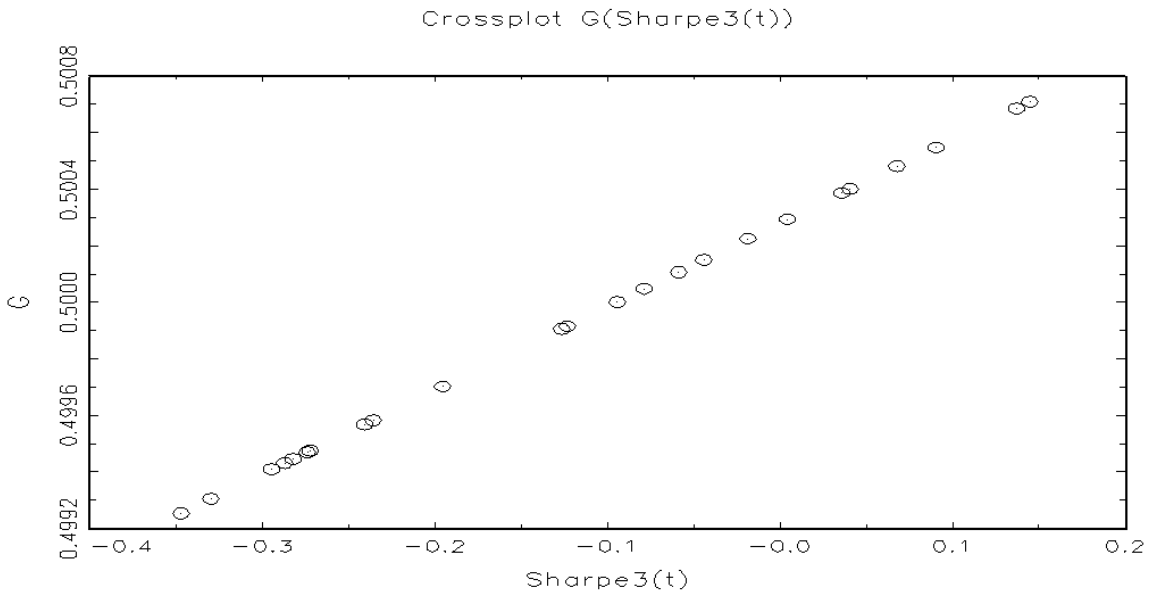


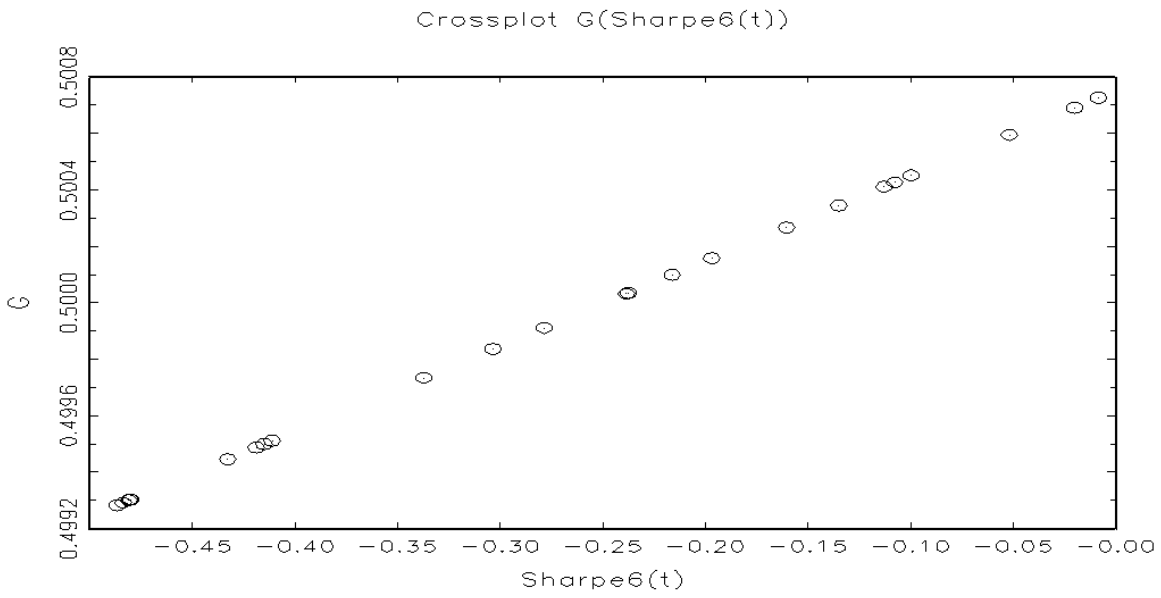

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
0.5014
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
Sharpe6(t)

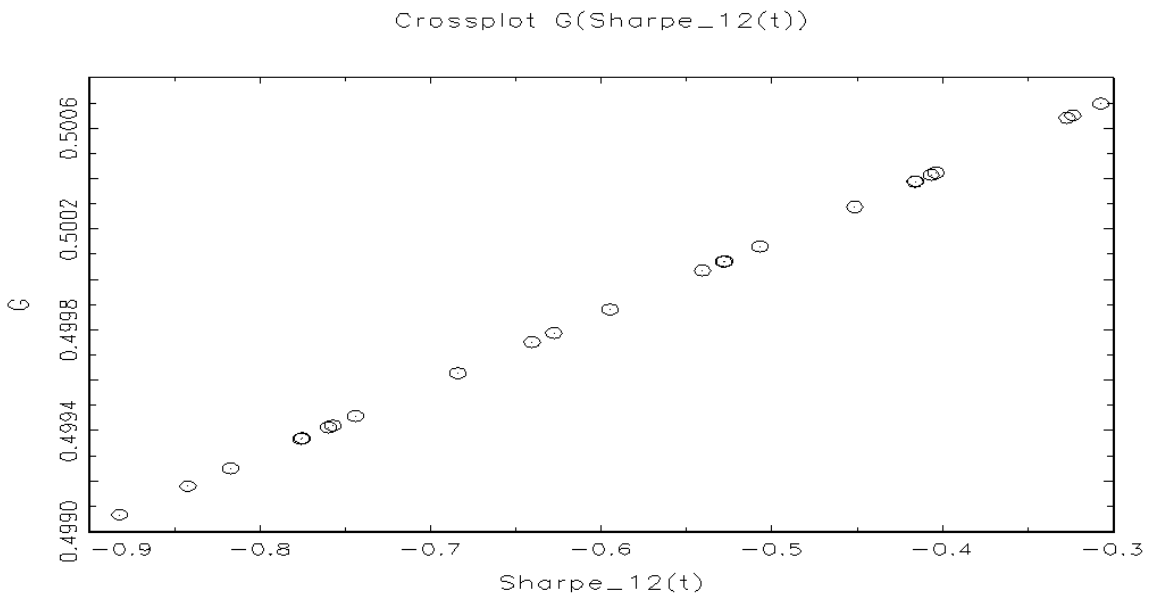

Crossplot G(Sharpe_12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
Sharpe_12(t)

USD/RAND Jan 1999 – Dec 2000

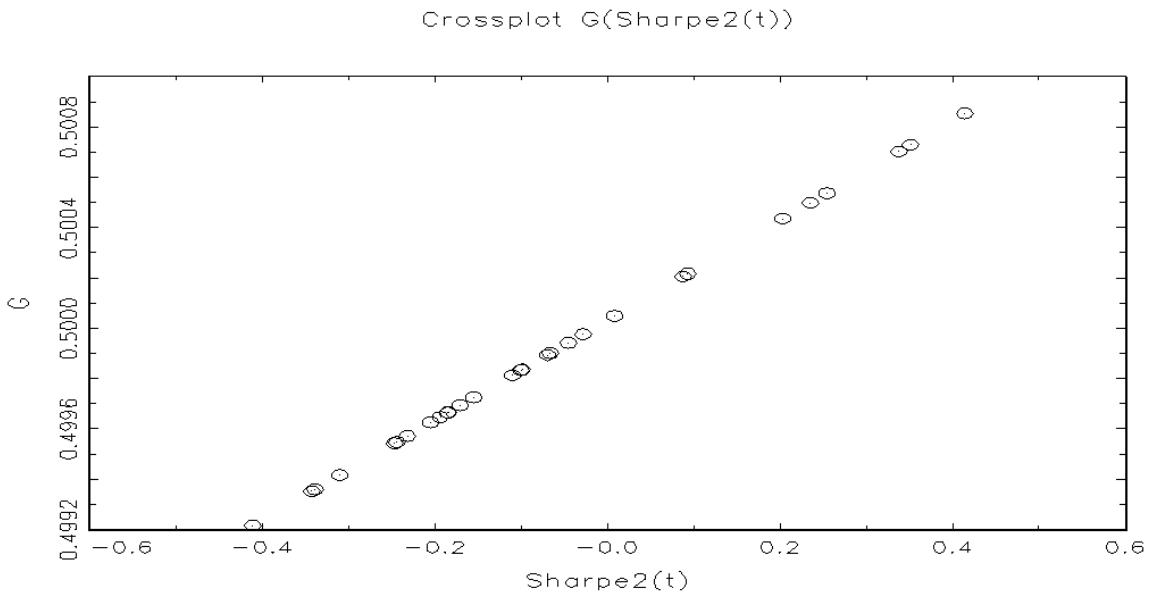


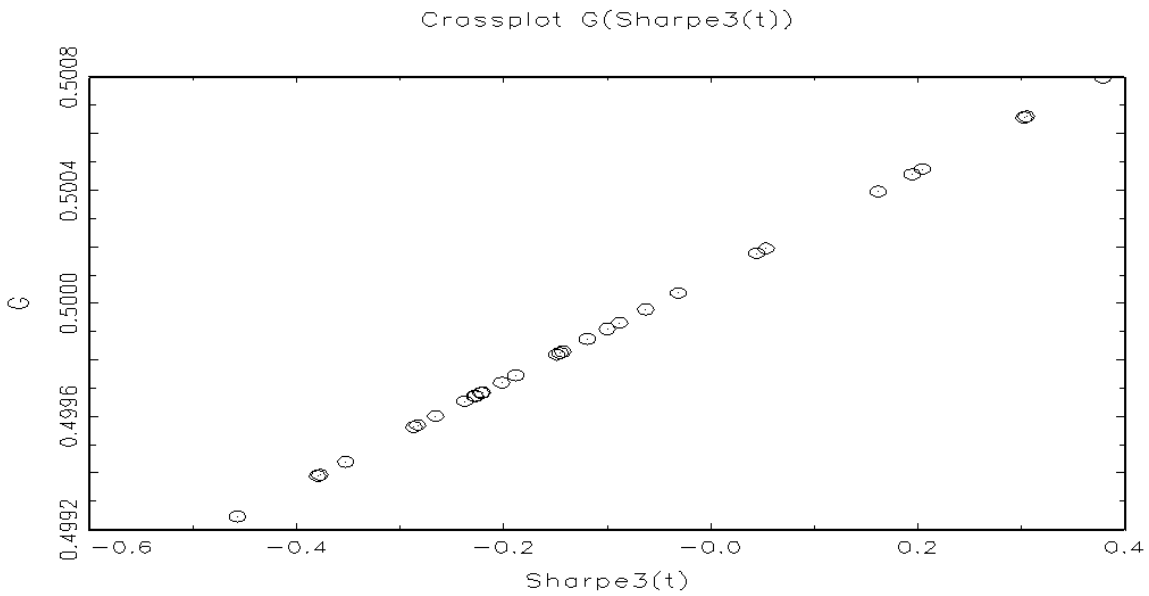


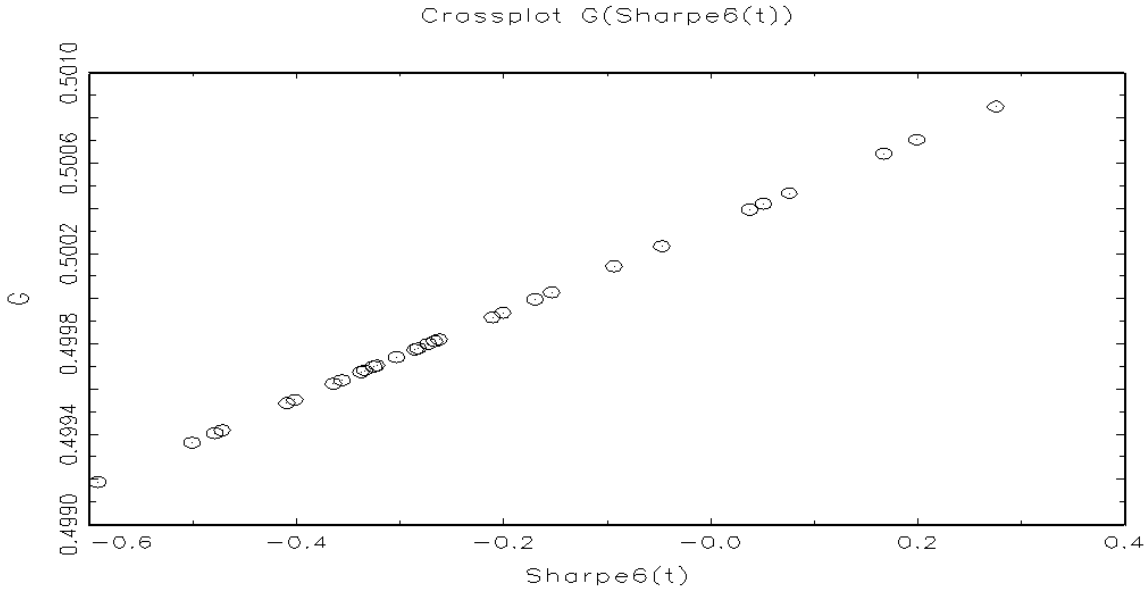

Crossplot G(Sharpe6(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−0.45
−0.40
−0.35
−0.30
−0.25
−0.20
−0.15
−0.10
−0.05
−0.00
Sharpe6(t)

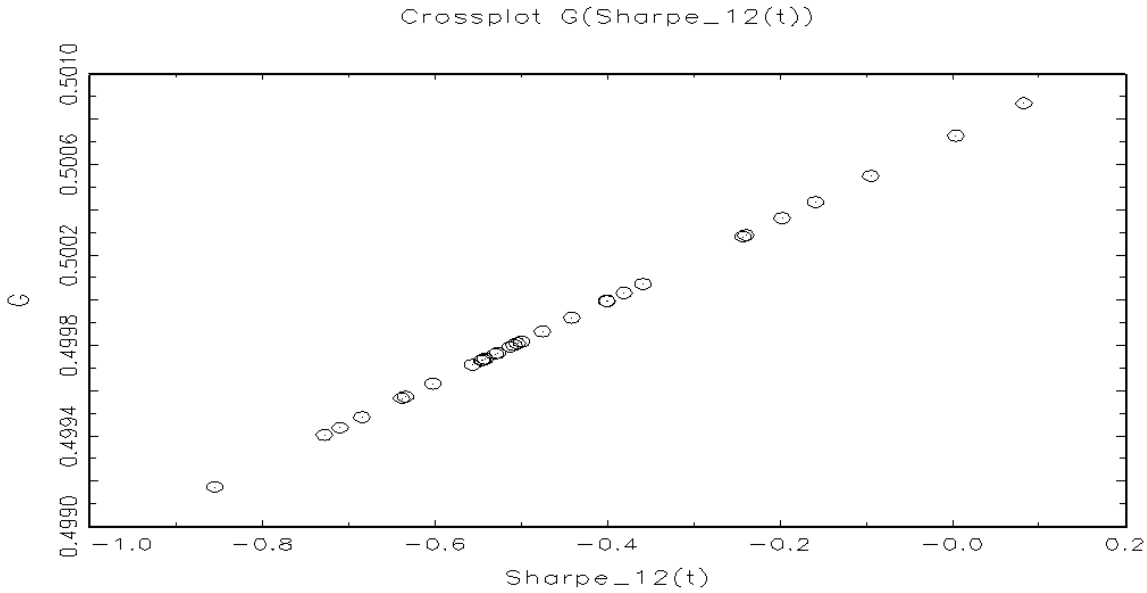

Crossplot G(Sharpe_12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−0.9
−0.8
−0.7
−0.6
−0.5
−0.4
−0.3
Sharpe_12(t)

USD/RAND July 2005 – Dec 2007

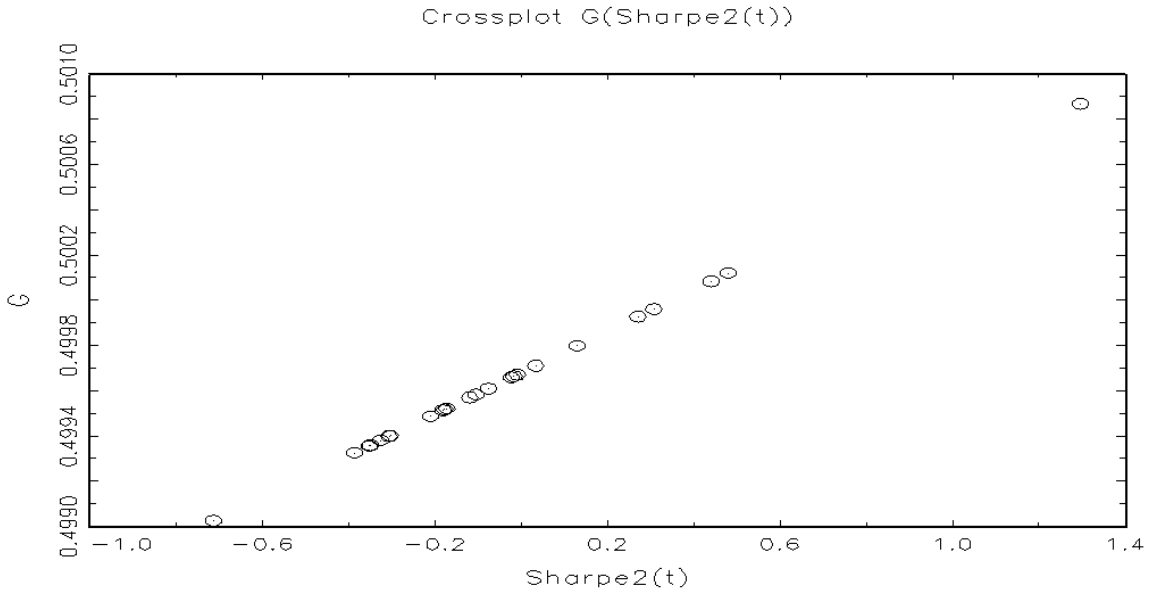


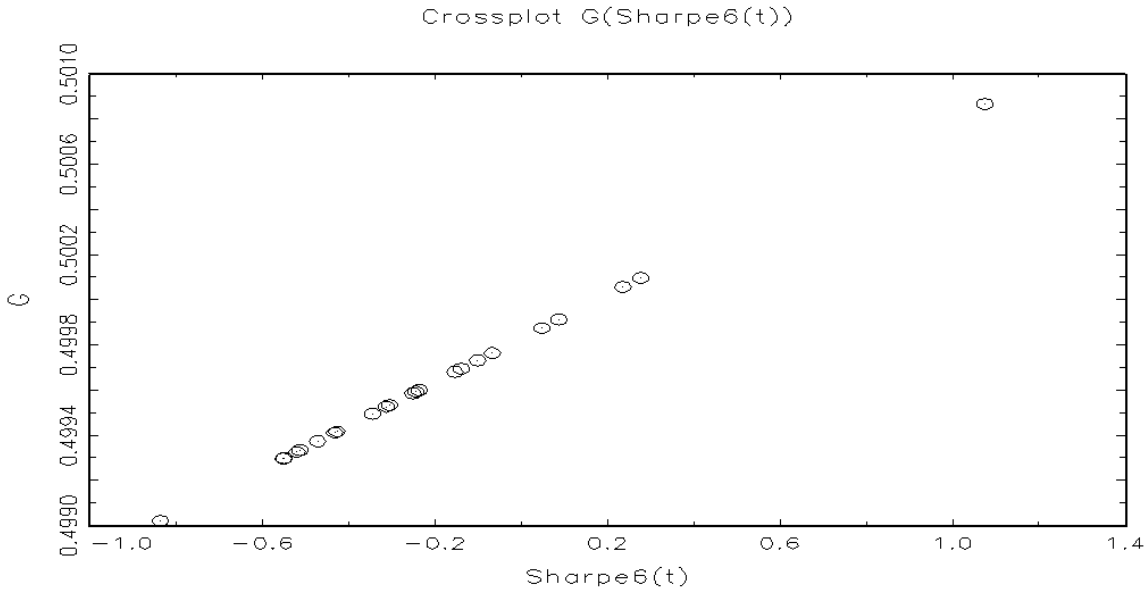


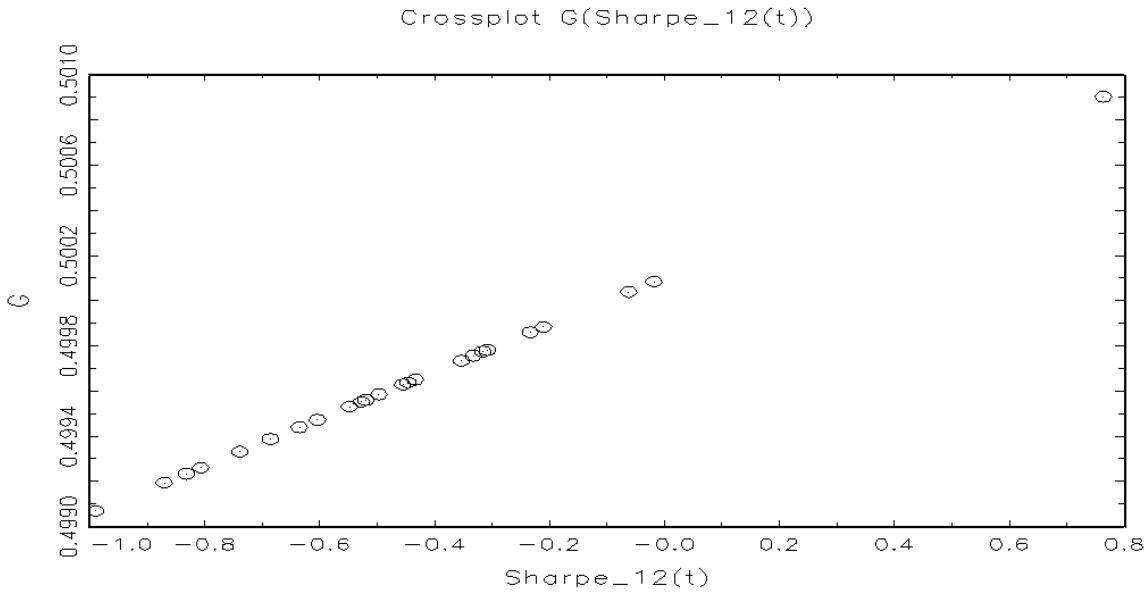

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.6
−0.4
−0.2
−0.0
0.2
0.4
Sharpe6(t)


Crossplot G(Sharpe_12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
Sharpe_12(t)

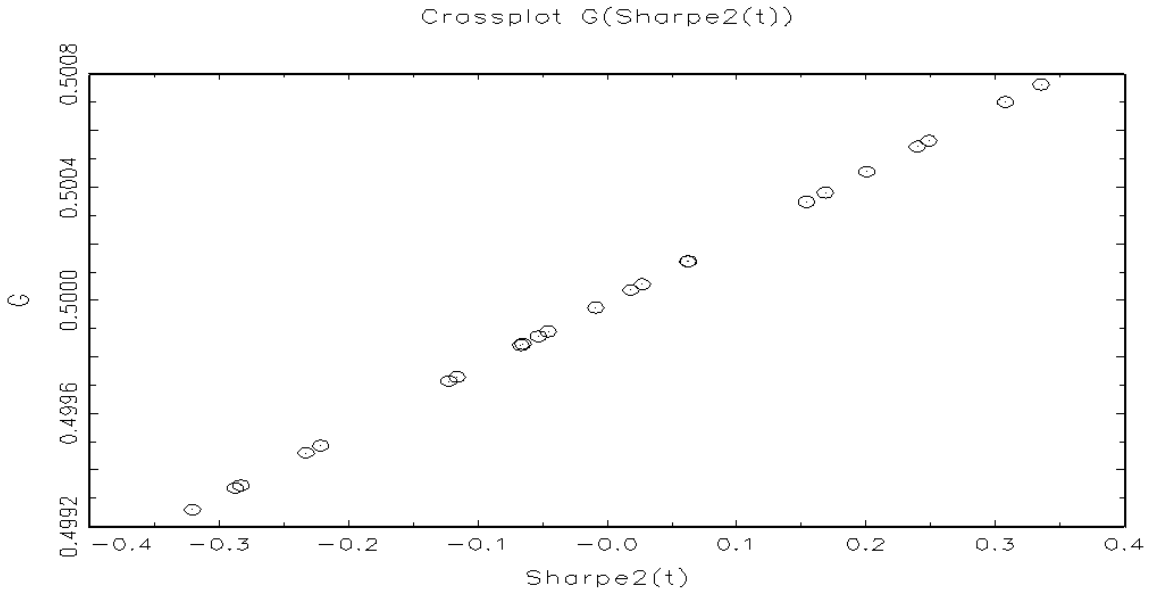
USD/RAND Jan 2008 – Dec 2009

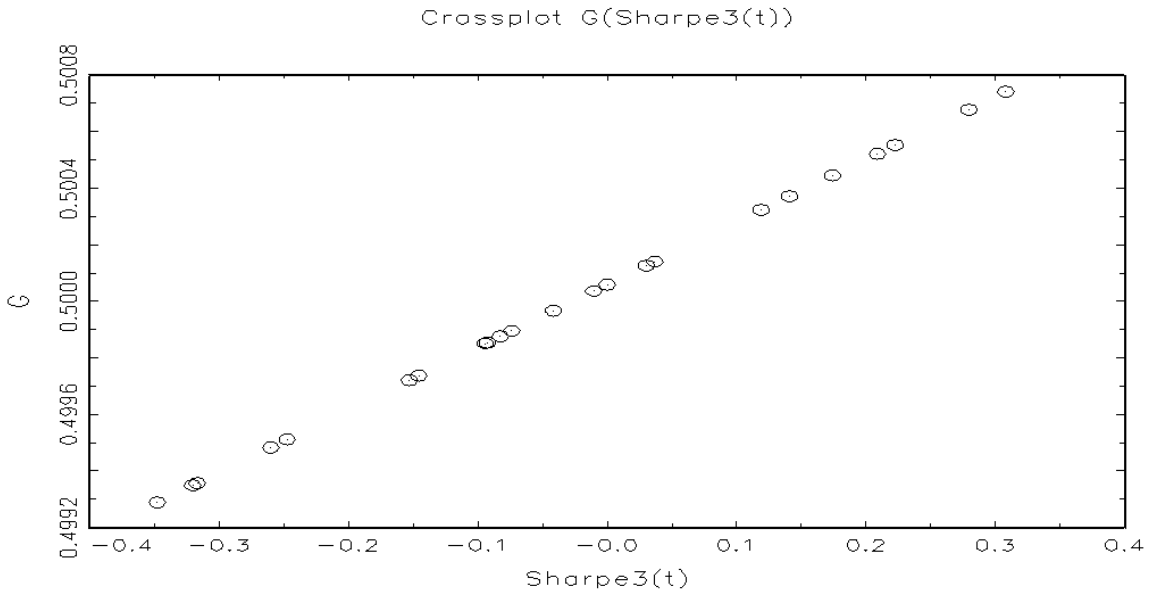


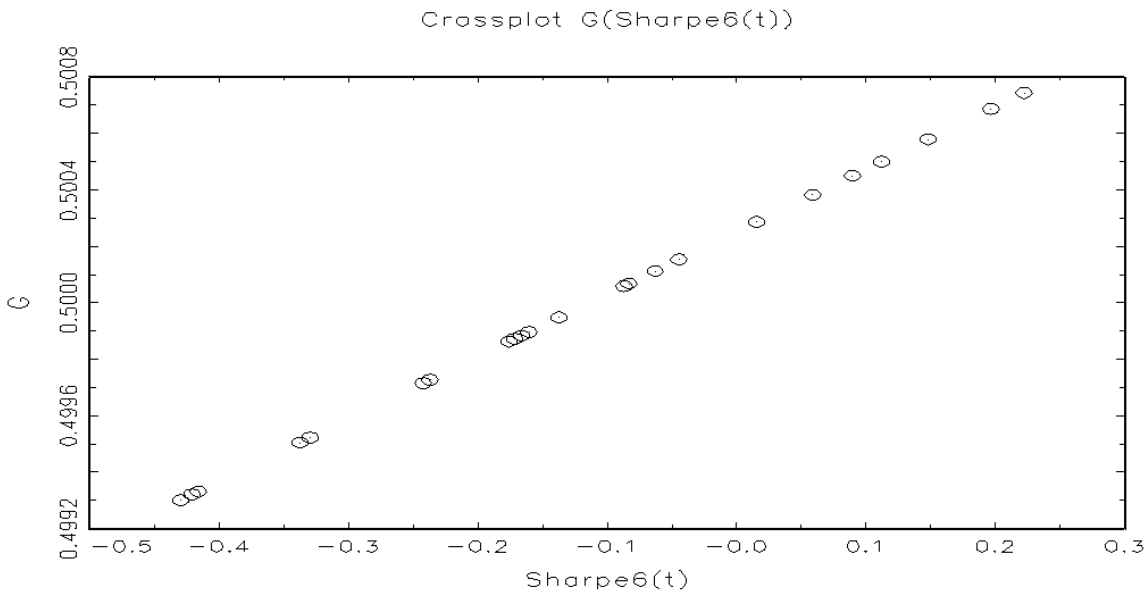

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.0
−0.6
−0.2
0.2
0.6
1.0
1.4
Sharpe6(t)

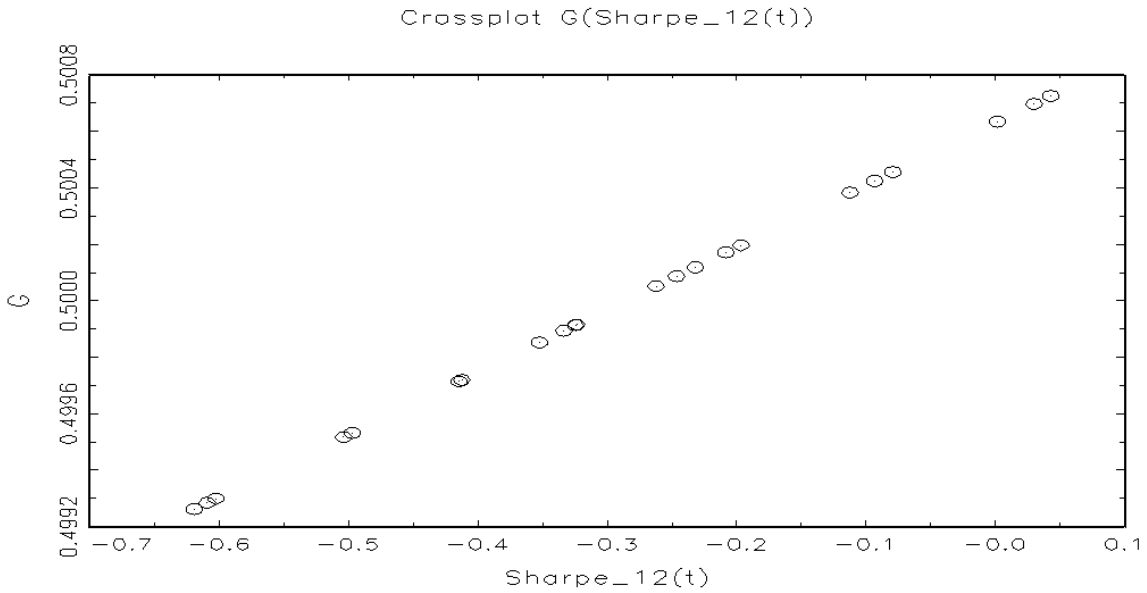

Crossplot G(Sharpe_12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
0.8
Sharpe_12(t)

USD/RAND Jan 2010 – Dec 2011

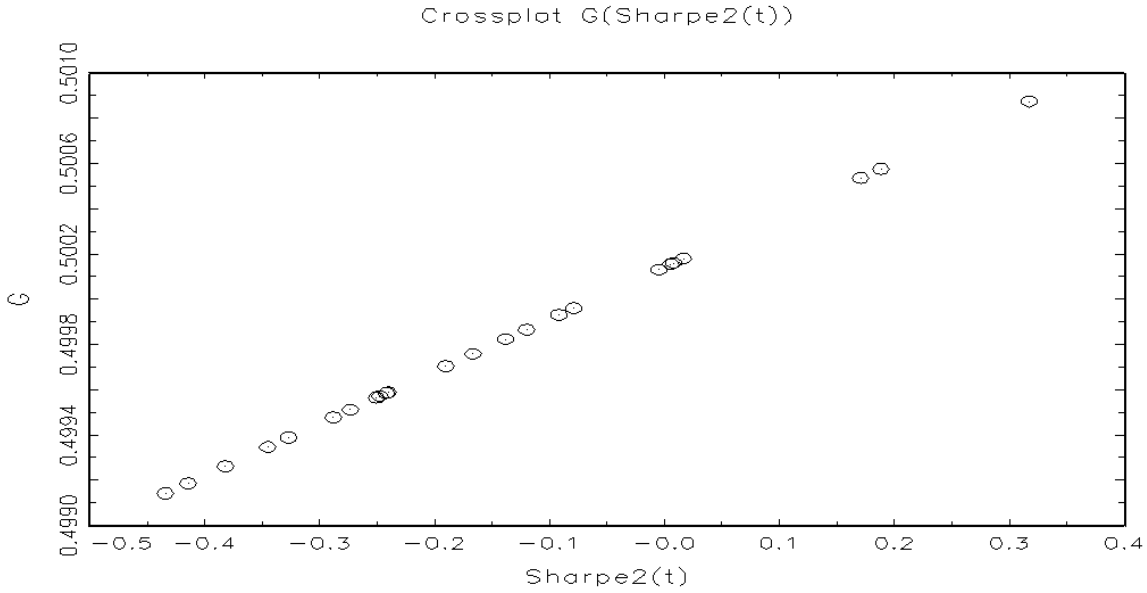


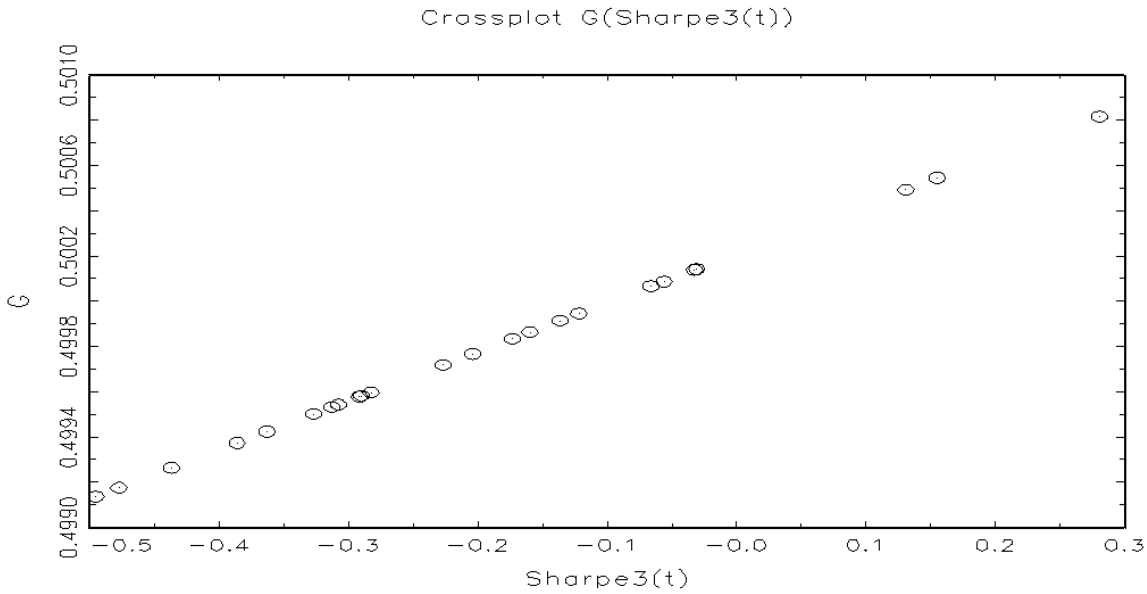


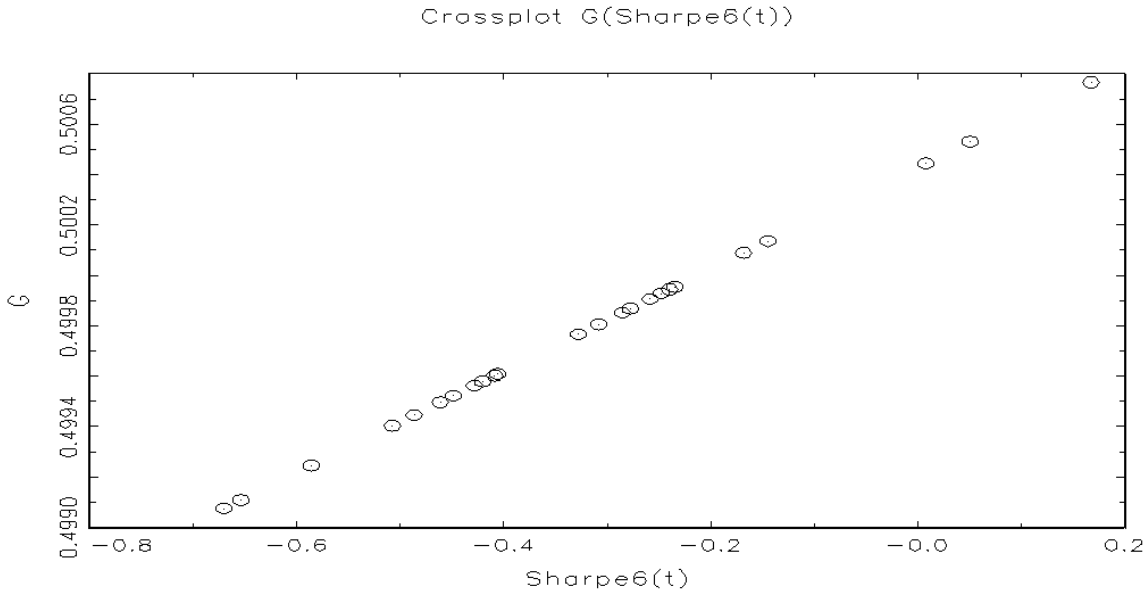

Crossplot G(Sharpe6(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−0.5
−0.4
−0.3
−0.2
−0.1
−0.0
0.1
0.2
0.3
Sharpe6(t)

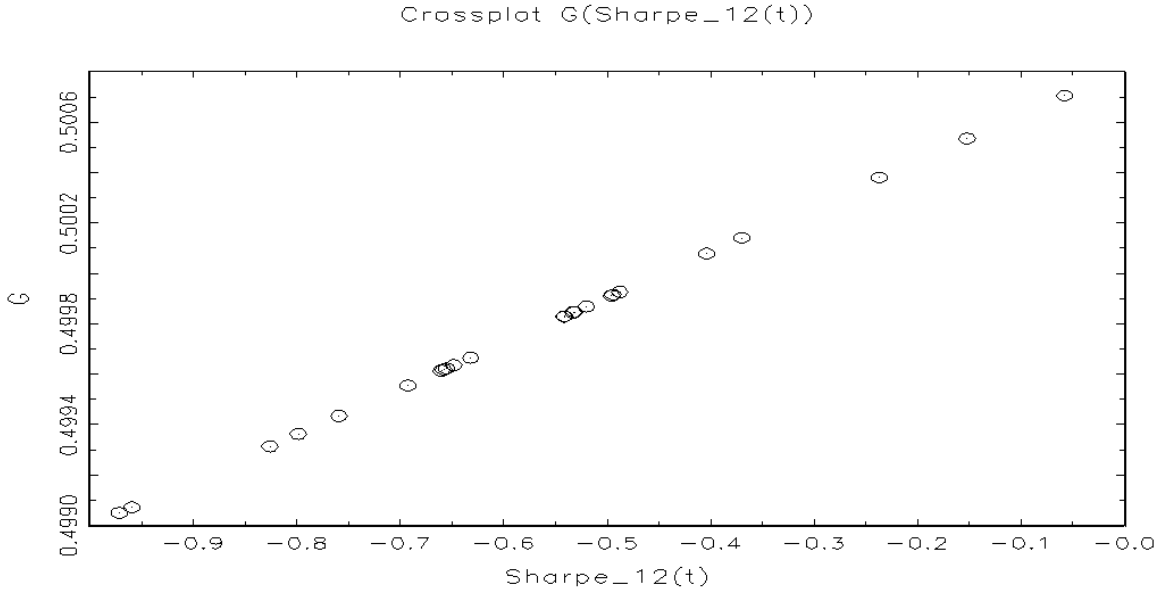

Crossplot G(Sharpe_12(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−0.7
−0.6
−0.5
−0.4
−0.3
−0.2
−0.1
−0.0
0.1
Sharpe_12(t)

USD/RAND Jan 2003 – Dec 2004

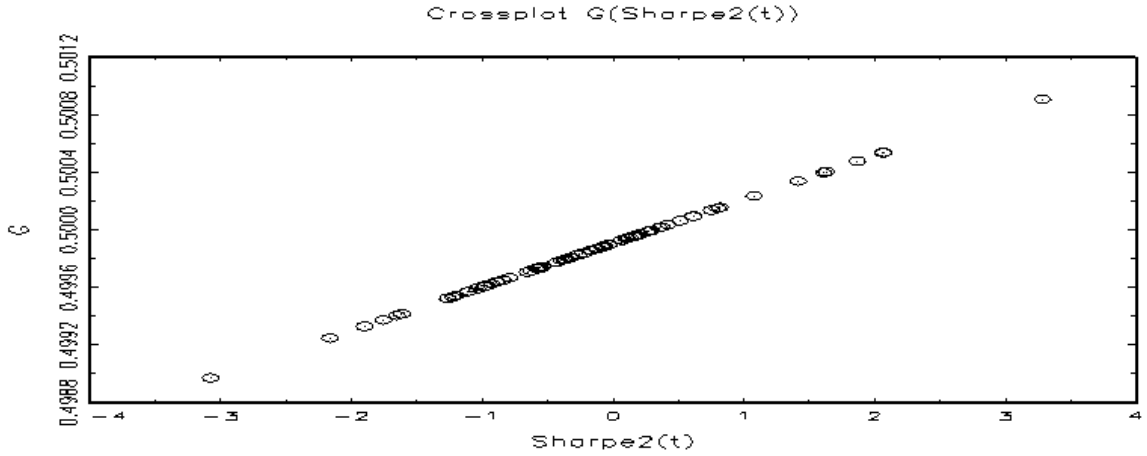


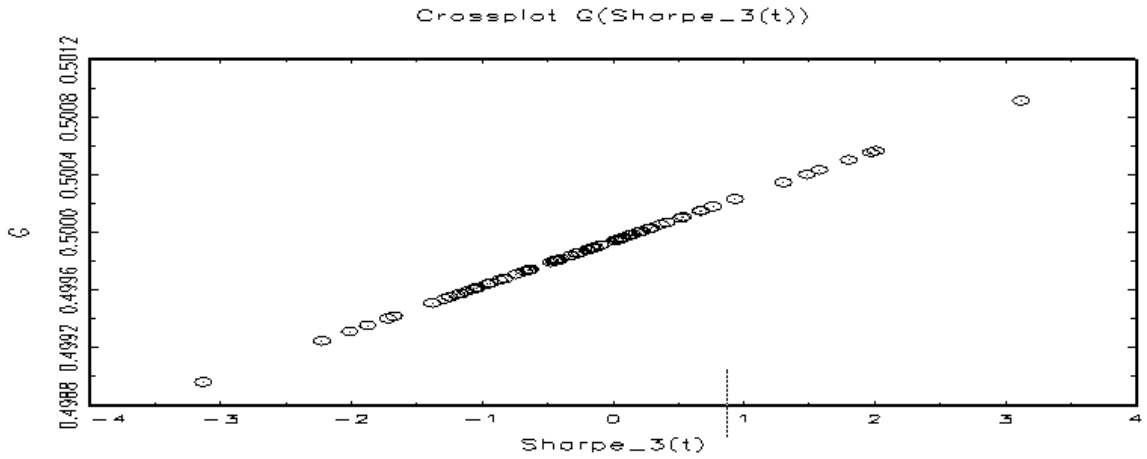


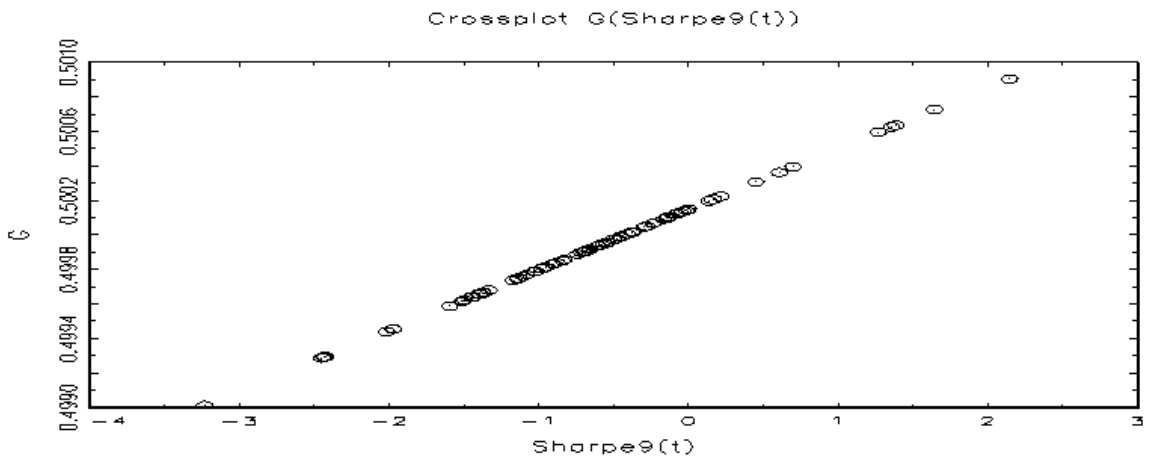

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
Sharpe6(t)

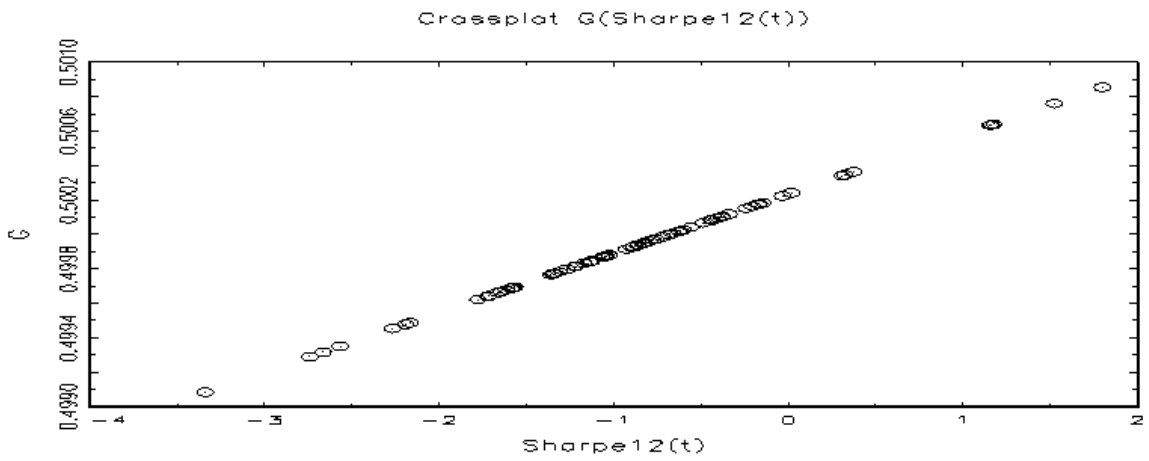

Crossplot G(Sharpe_12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−0.9
−0.8
−0.7
−0.6
−0.5
−0.4
−0.3
−0.2
−0.1
−0.0
Sharpe_12(t)

RAND/USD July 2005 – November 2011

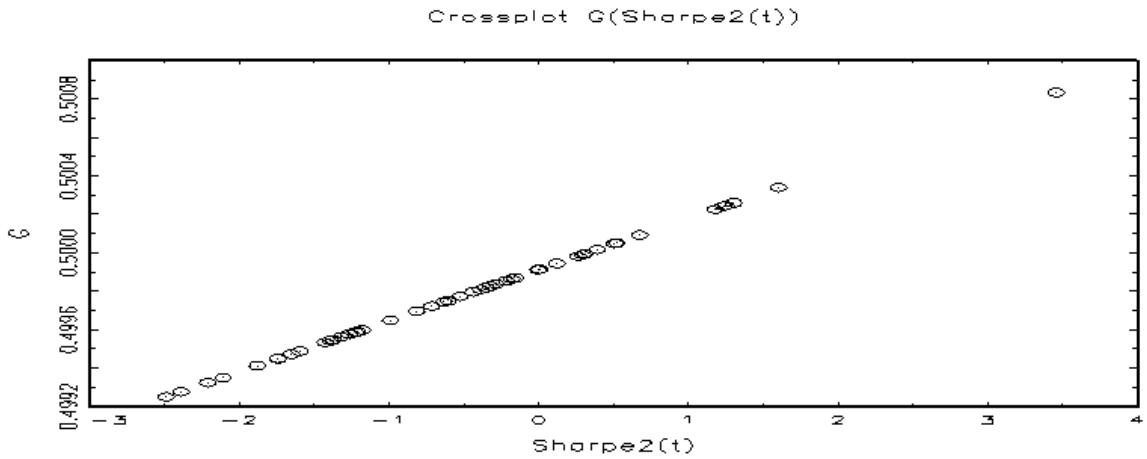


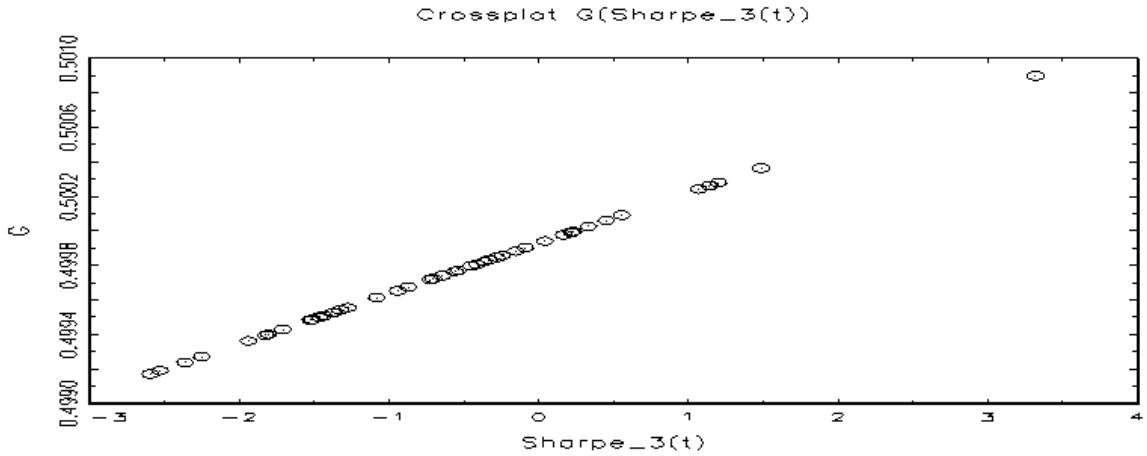


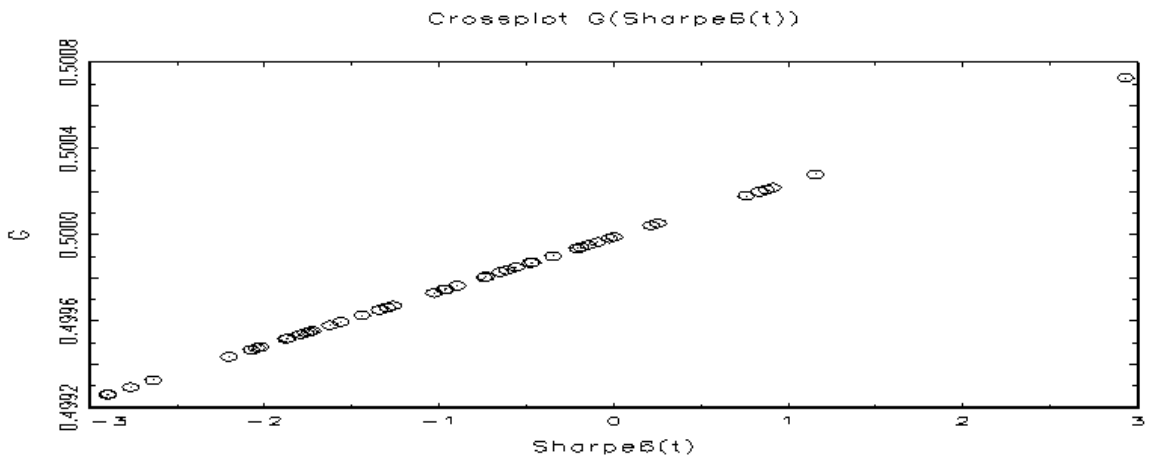

Crossplot G(Sharpe9(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
-4
-3
-2
-1
0
1
2
3
Sharpe9(t)

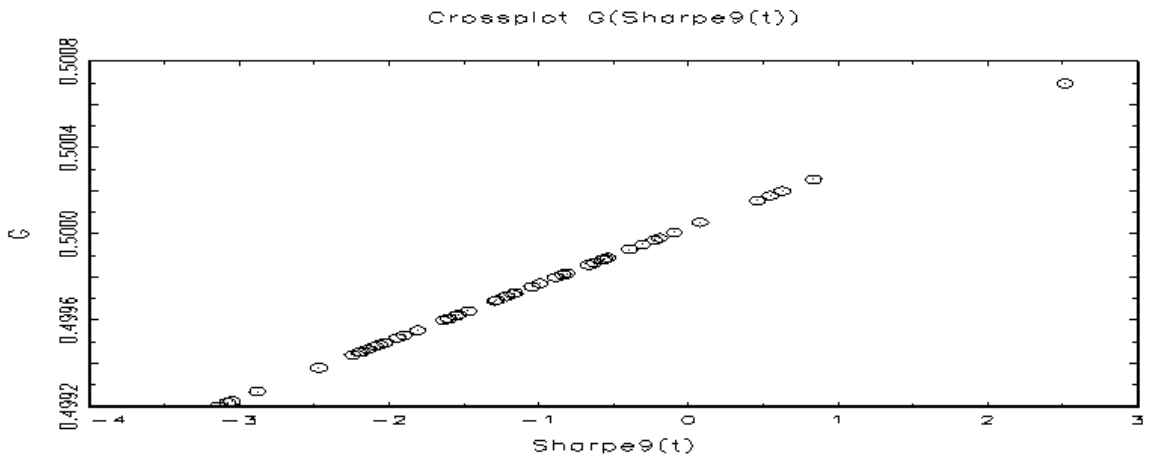

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
-4
-3
-2
-1
0
1
2
Sharpe12(t)

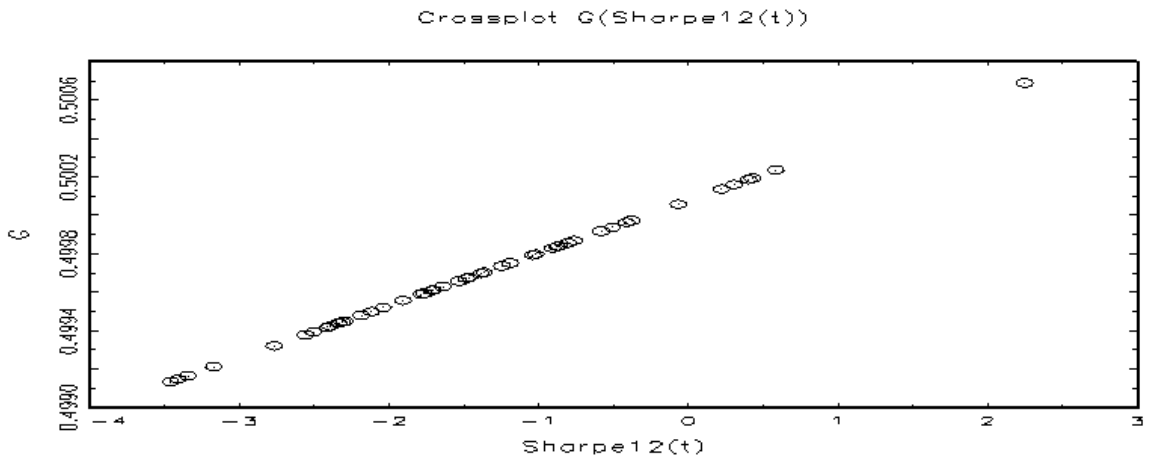
RAND/USD Jan 2001 – Dec 2004



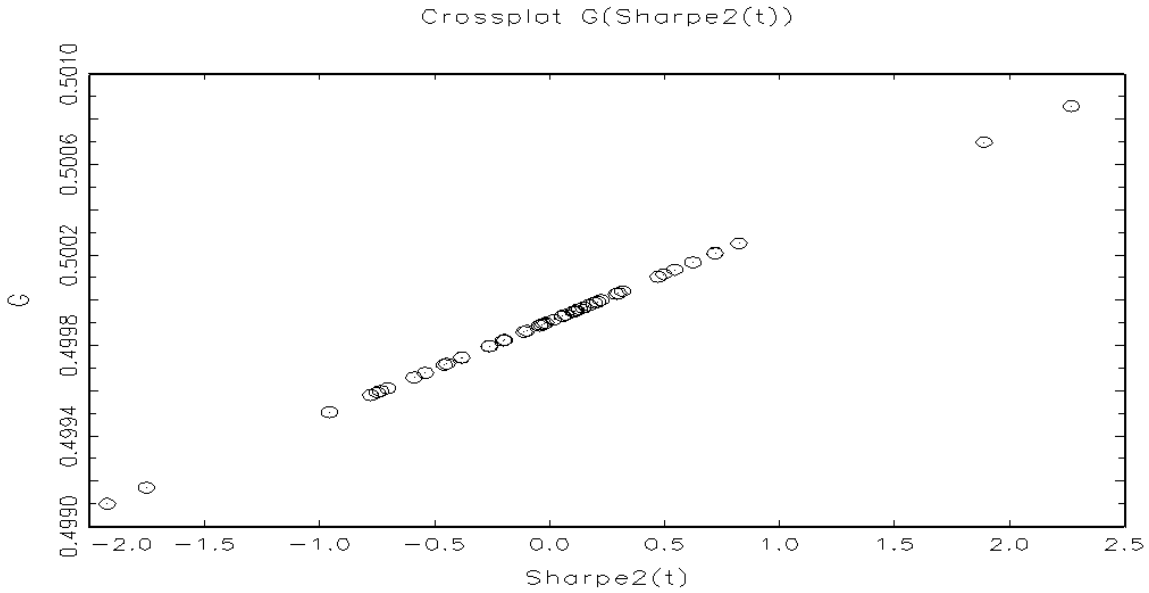


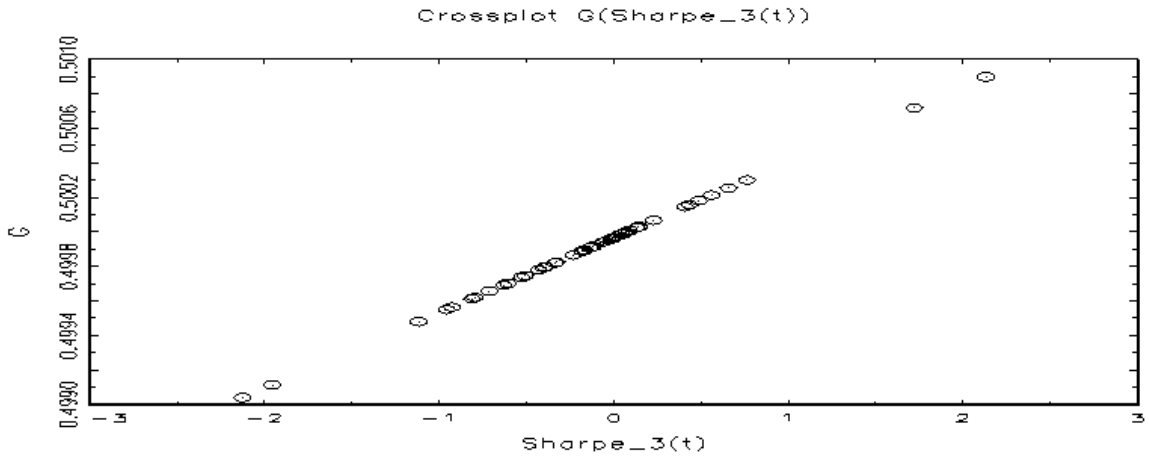

Crossplot G(Sharpe6(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−3
−2
−1
0
1
2
3
Sharpe6(t)

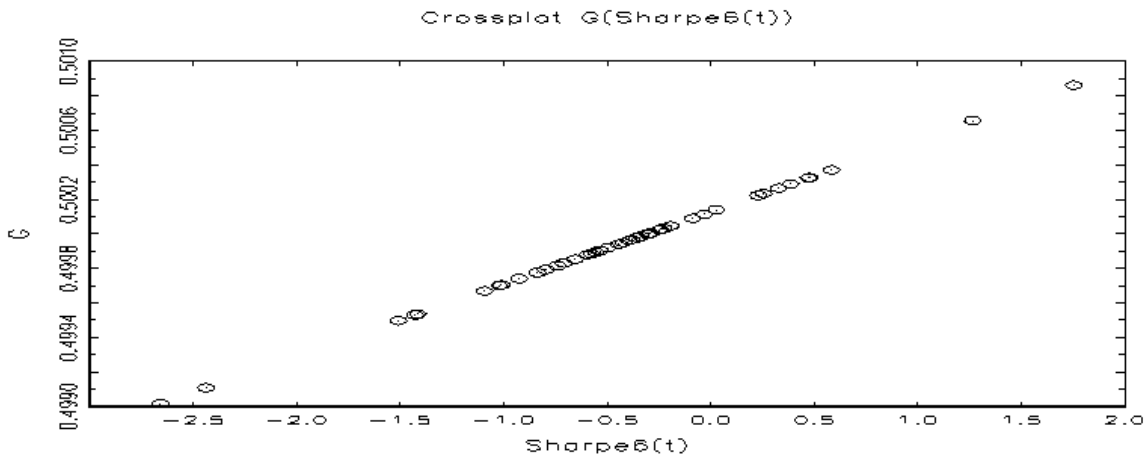

Crossplot G(Sharpe9(t))
G
0.4992
0.4996
0.5000
0.5004
0.5008
−4
−3
−2
−1
0
1
2
3
Sharpe9(t)

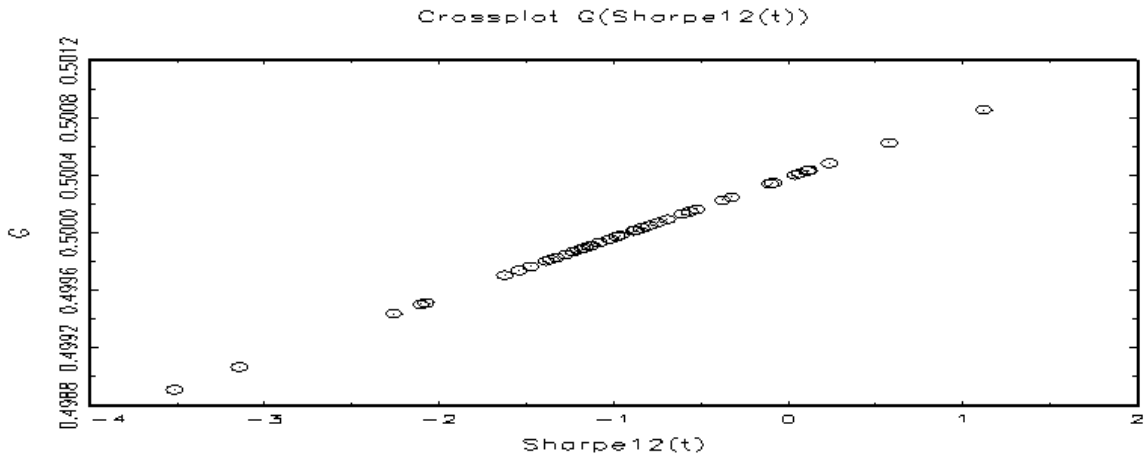

Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−4
−3
−2
−1
0
1
2
3
Sharpe12(t)

RAND/USD Dec 1996 – Dec 2000



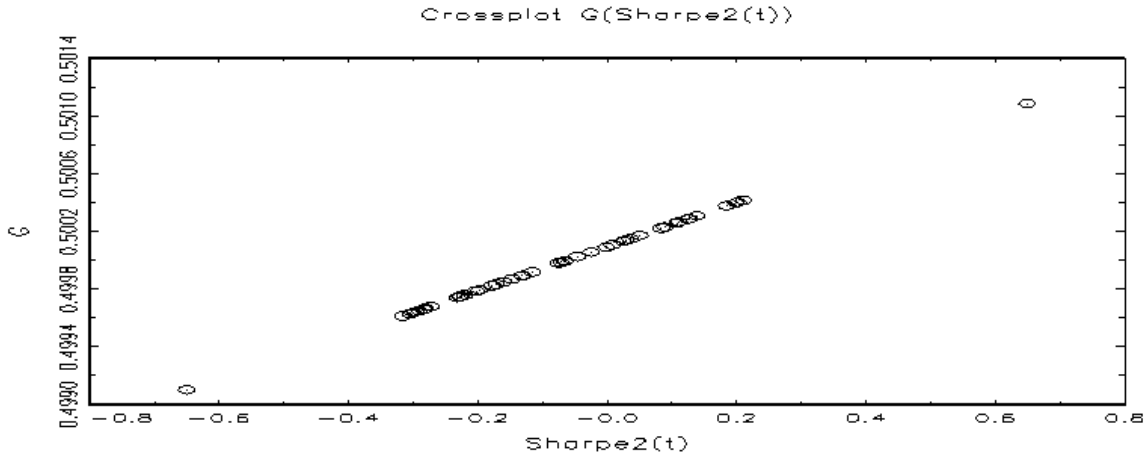


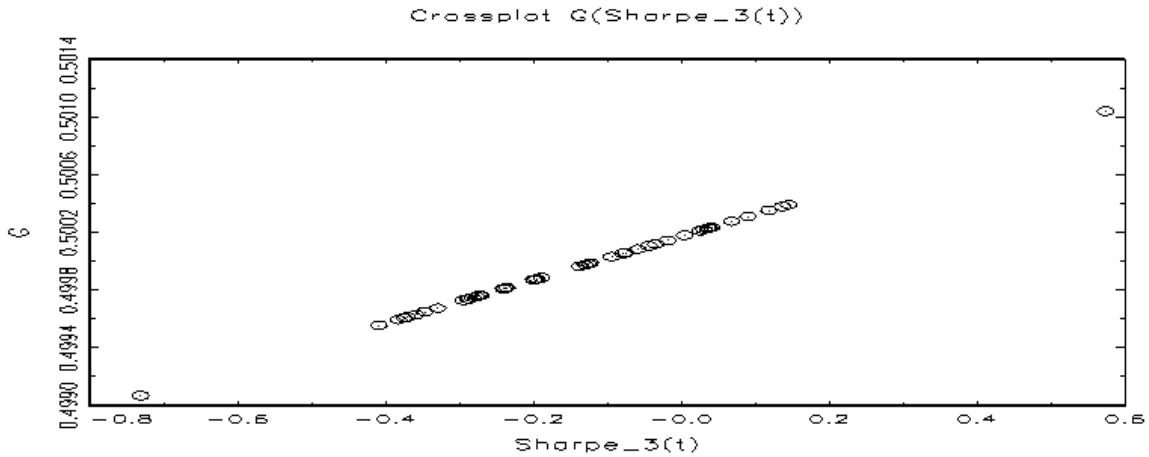

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−2.5
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
Sharpe6(t)

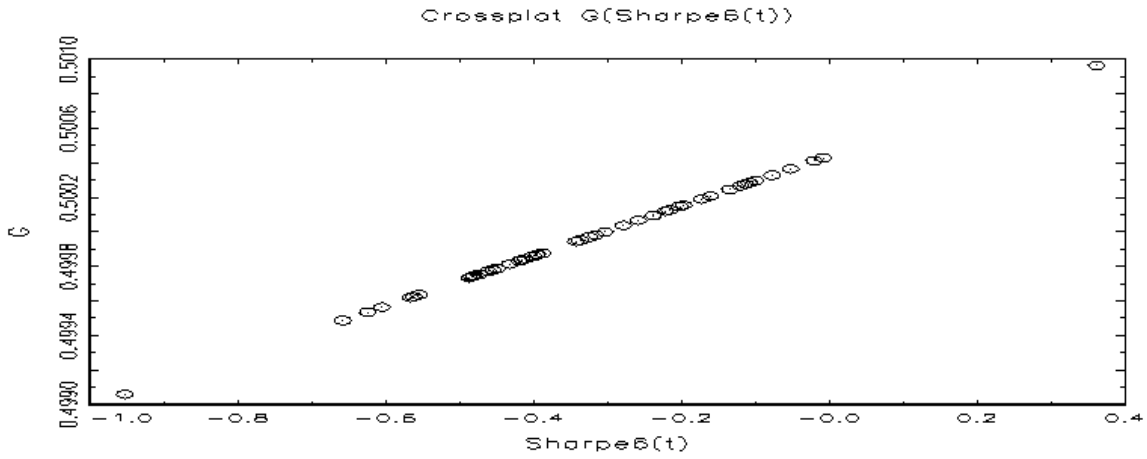

Crossplot G(Sharpe12(t))
G
0.4988
0.4992
0.4996
0.5000
0.5004
0.5008
0.5012
−4
−3
−2
−1
0
1
2
Sharpe12(t)

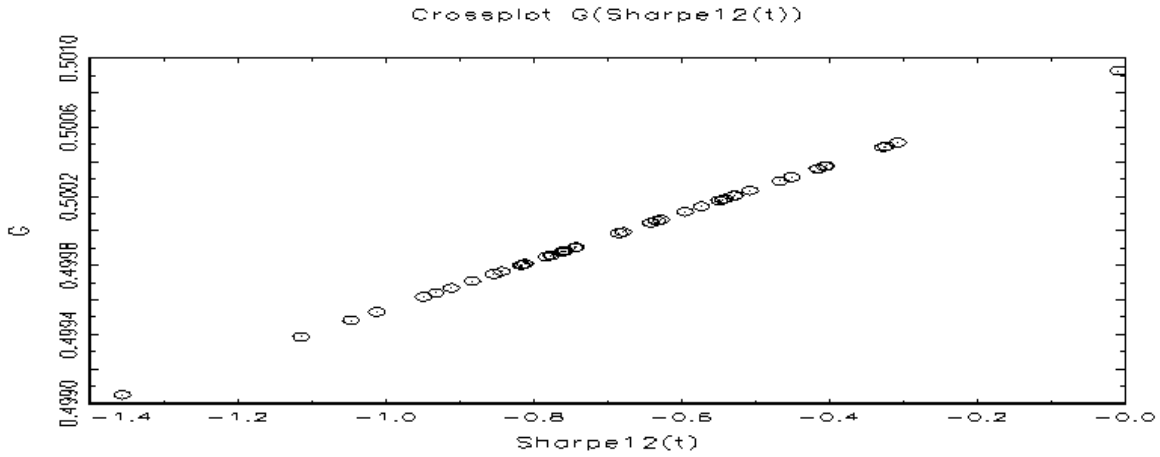
YEN

RAND/YEN Dec 1996 – Dec 2000

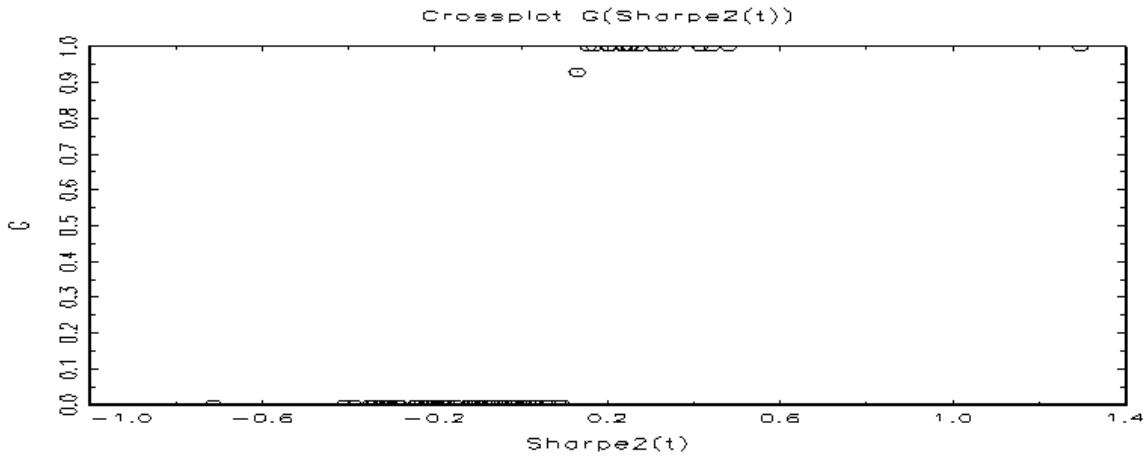


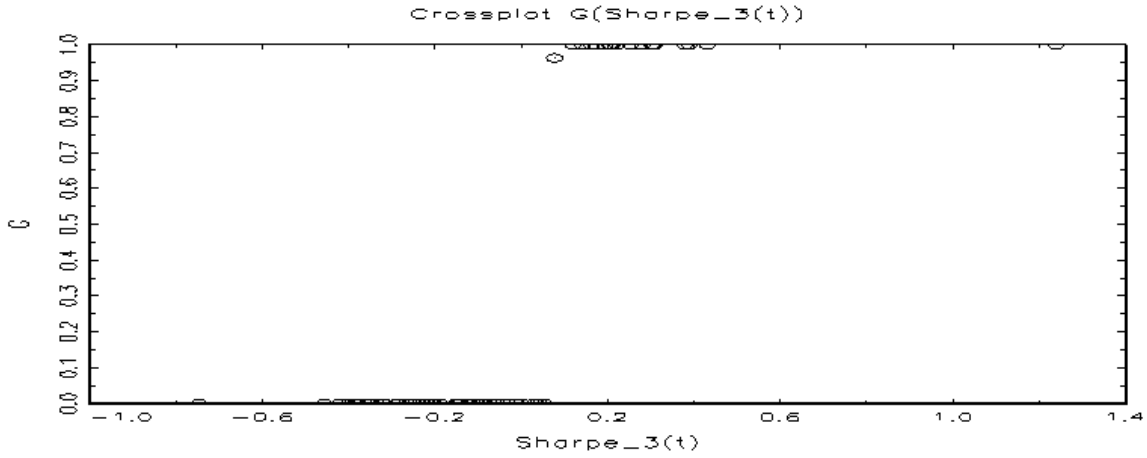


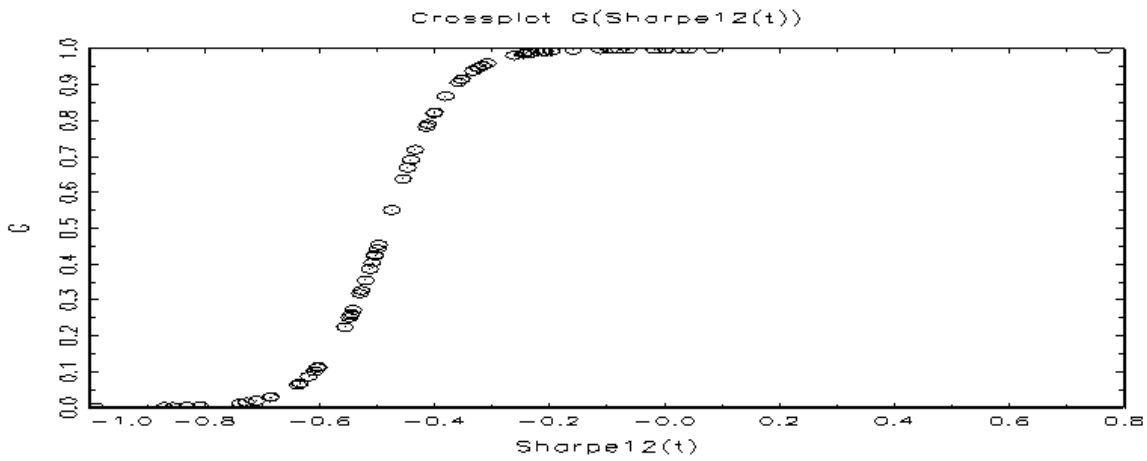

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
Sharpe6(t)


Crossplot G(Sharpe12(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−1.4
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
Sharpe12(t)

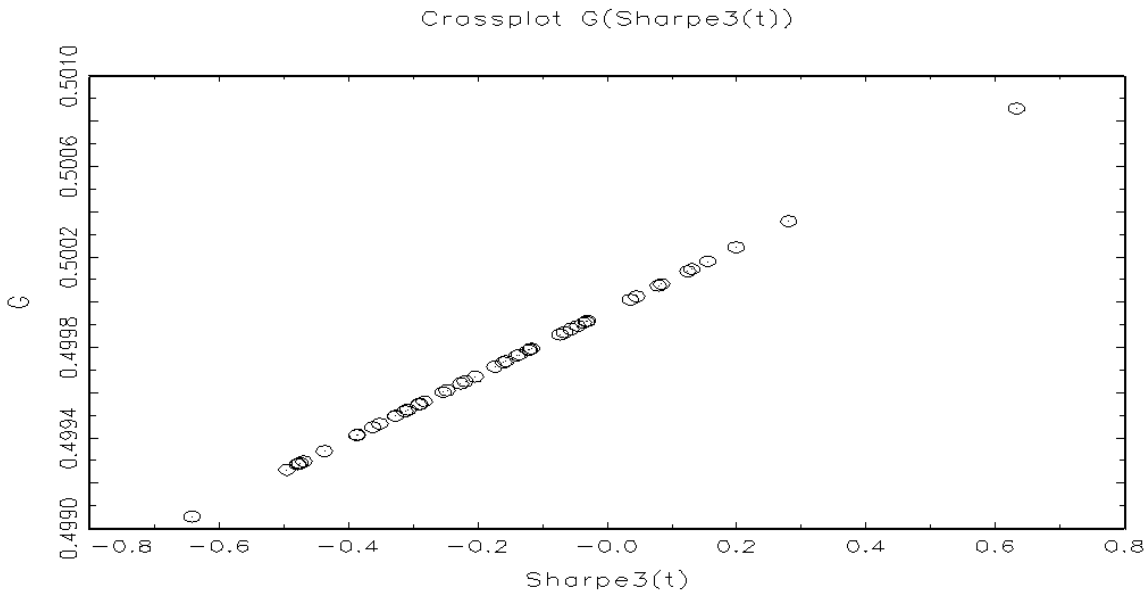
RAND/YEN July 2005 – Dec 2011

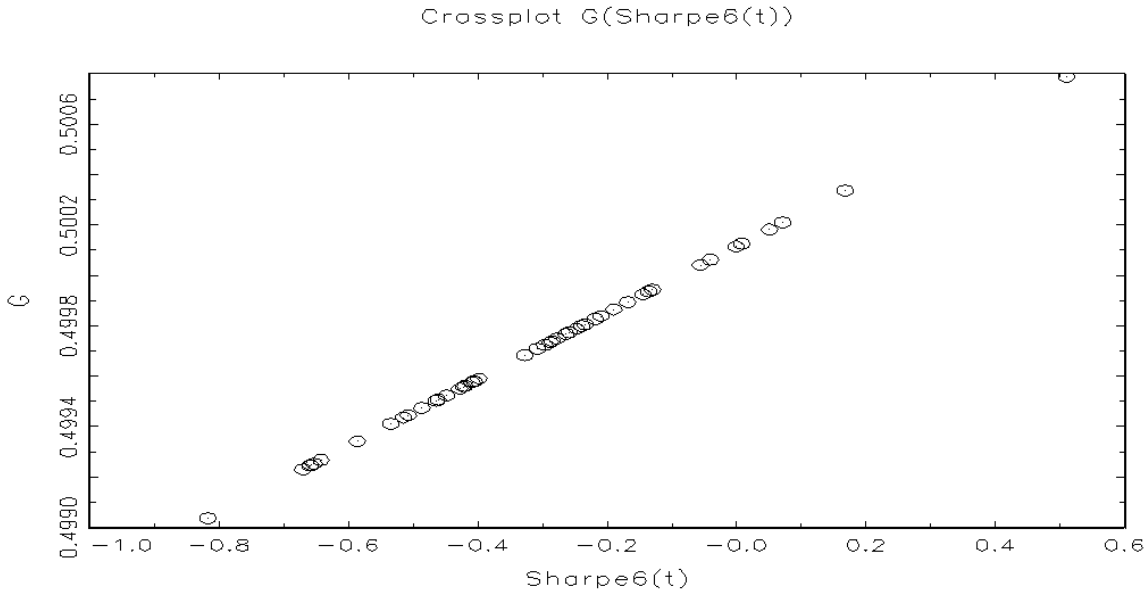


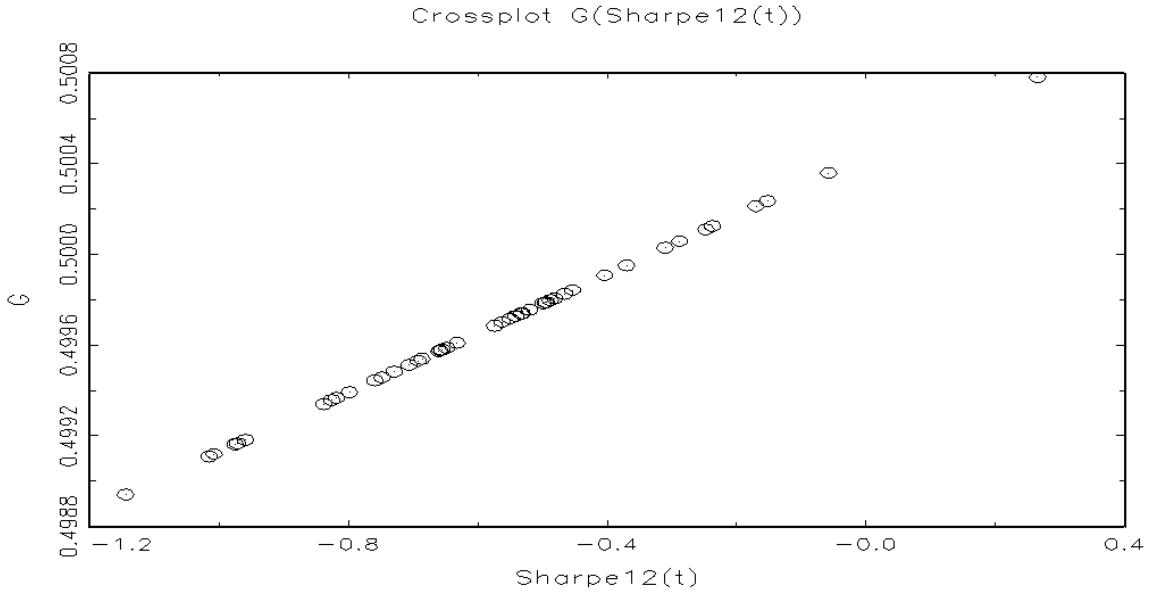




RAND/YEN Jan 2001 – Dec 2004

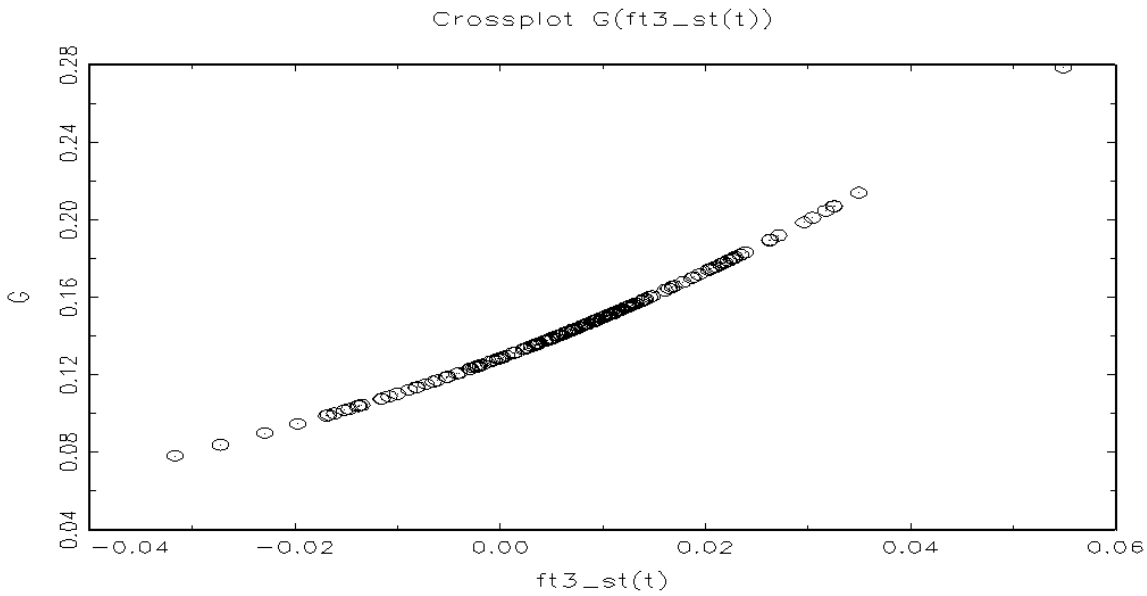

Crossplot G(Sharpe3(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
0.5010
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
0.8
Sharpe3(t)

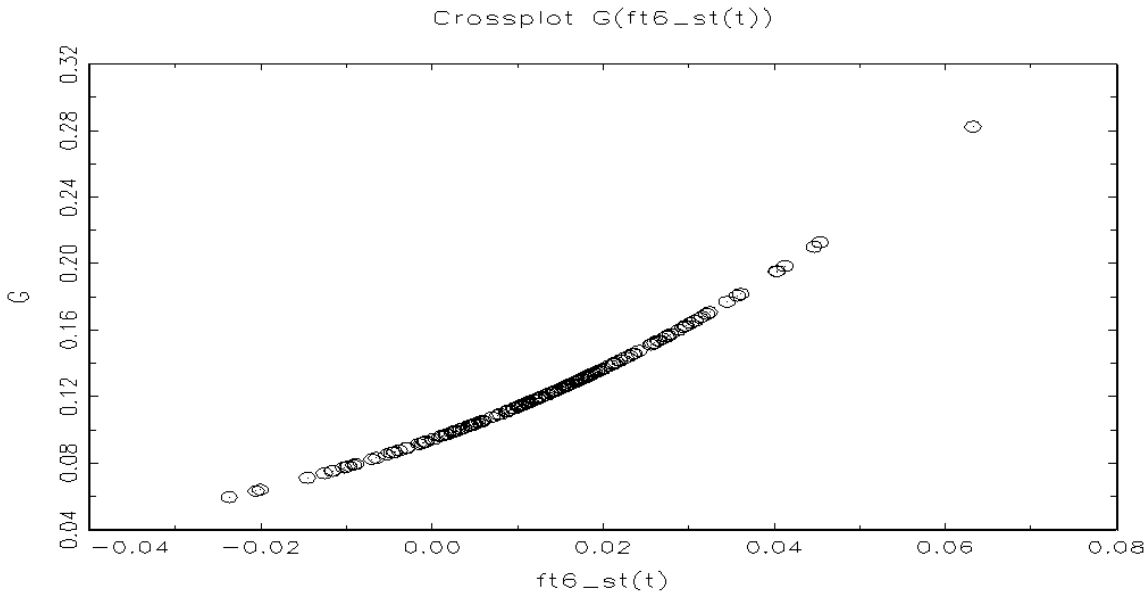

Crossplot G(Sharpe6(t))
G
0.4990
0.4994
0.4998
0.5002
0.5006
−1.0
−0.8
−0.6
−0.4
−0.2
−0.0
0.2
0.4
0.6
Sharpe6(t)

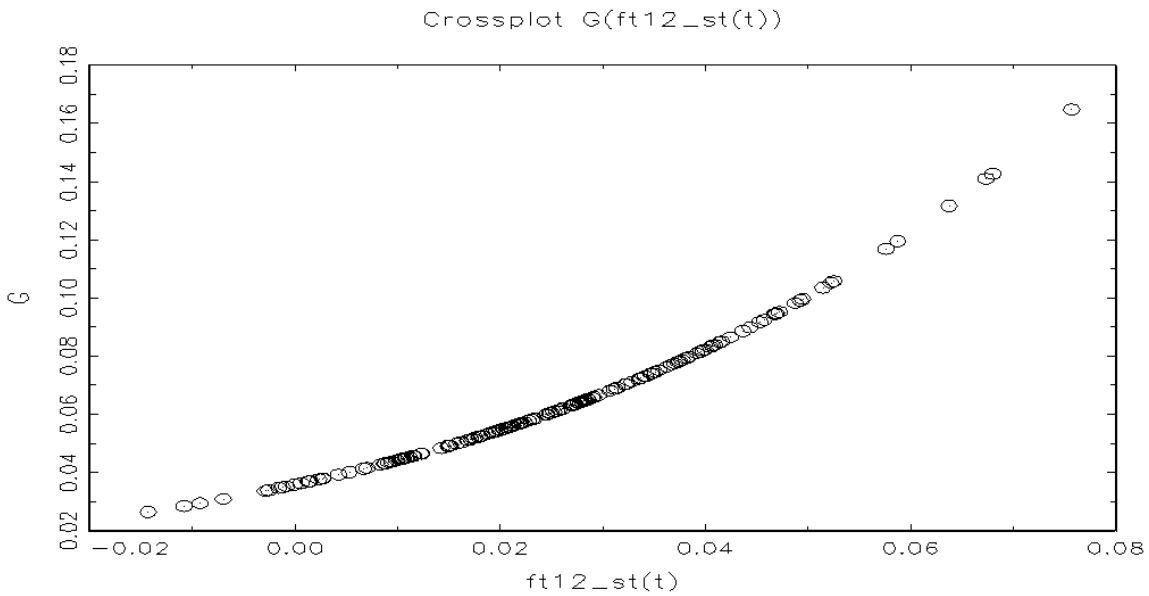

Crossplot G(Sharpe12(t))
G
0.4988
0.4992
0.4996
0.5000
0.5004
0.5008
−1.2
−0.8
−0.4
−0.0
0.4
Sharpe12(t)

APPENDIX 9: FORWARD PREMIUM AS THE TRANSITION VARIABLE

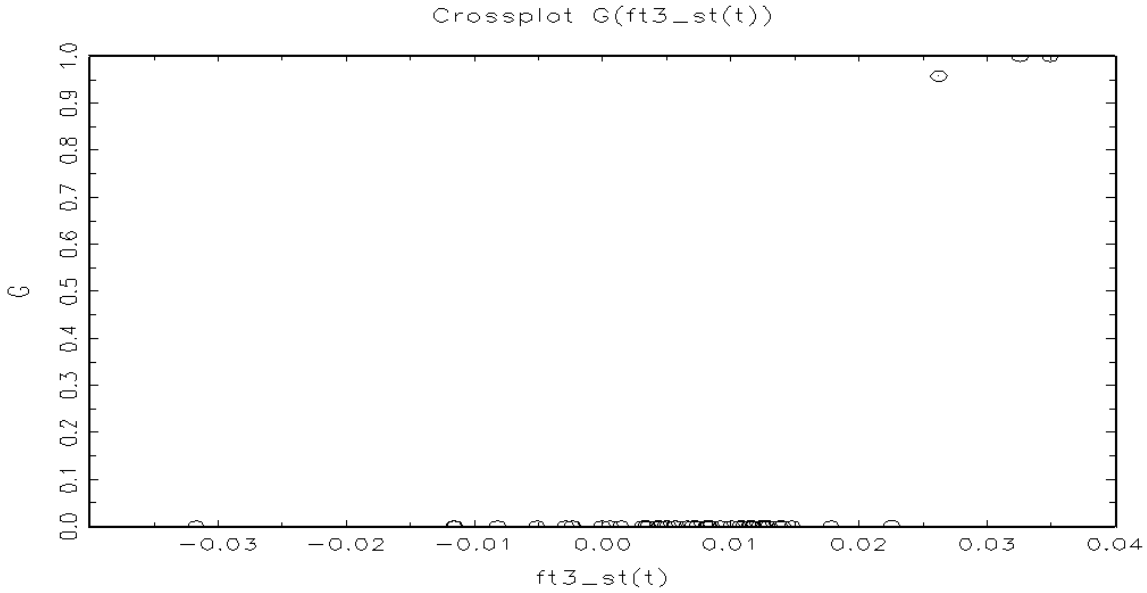
Rand/GBP Dec 1996–Dec 2011

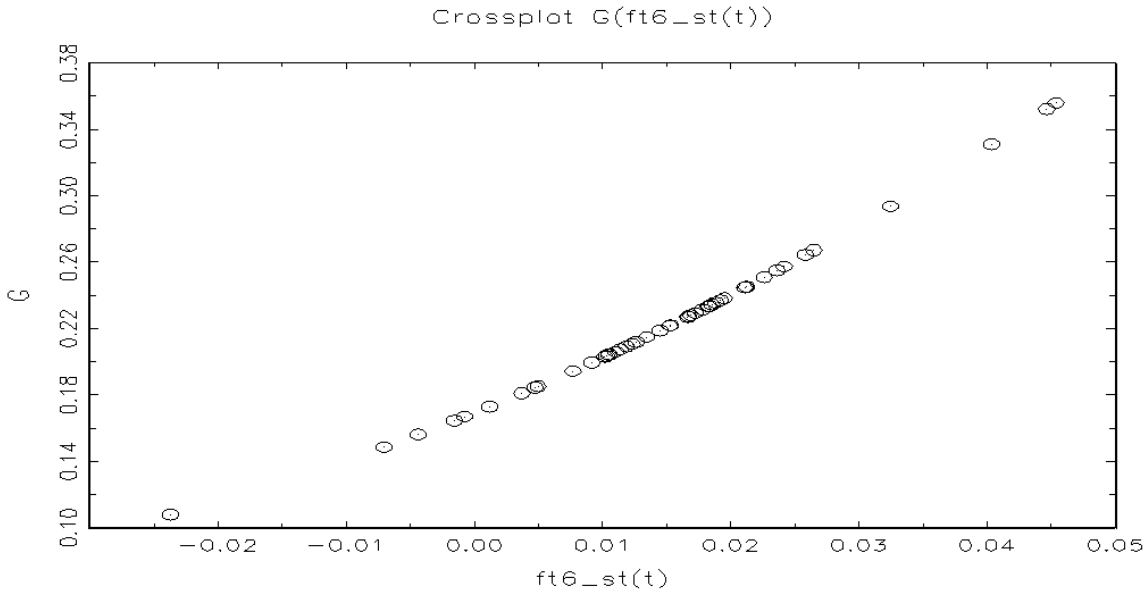


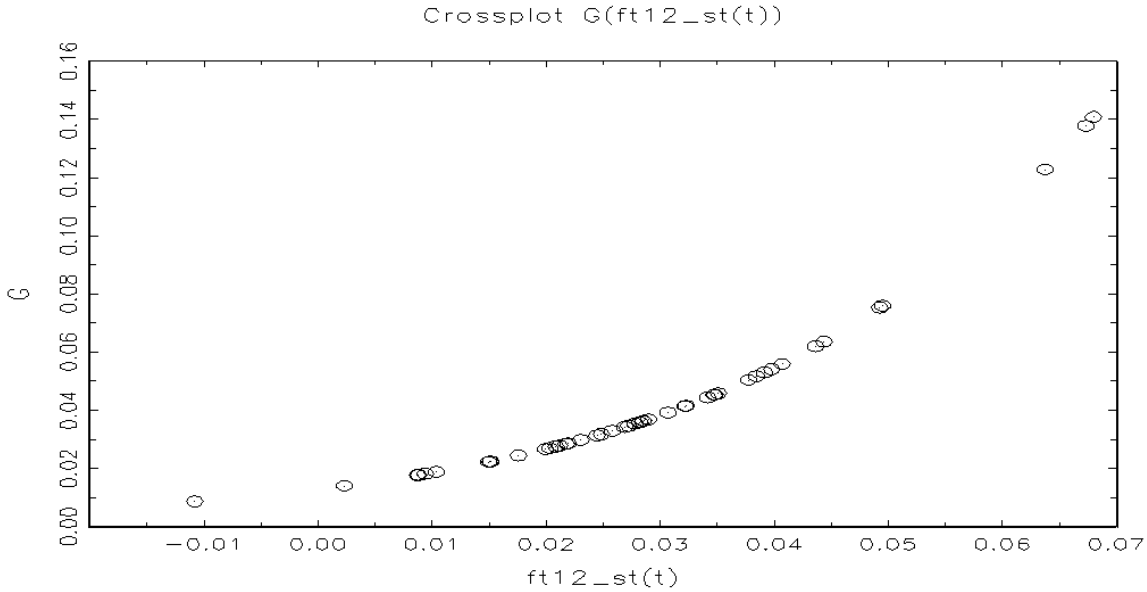



Crossplot G(ft12_st(t))
G
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

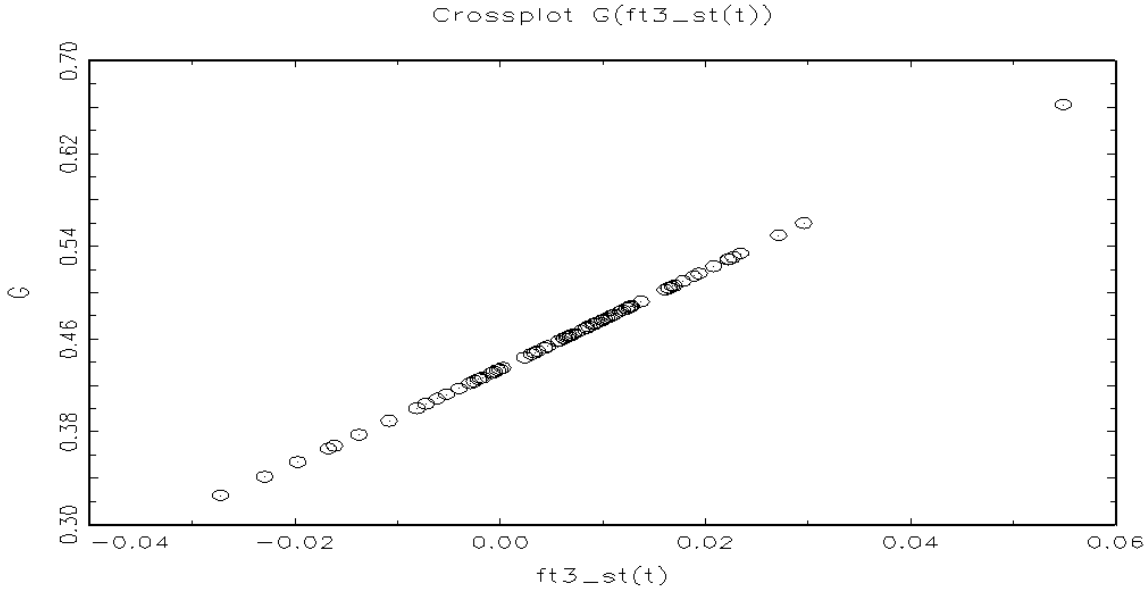
Rand/GBP Dec 1996–Nov 2000

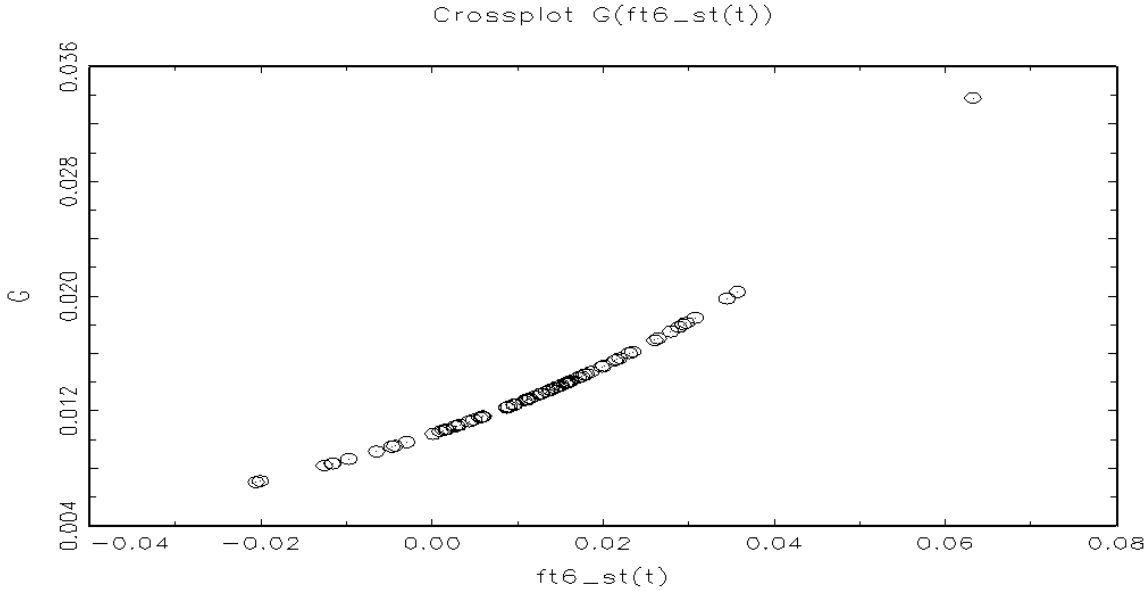


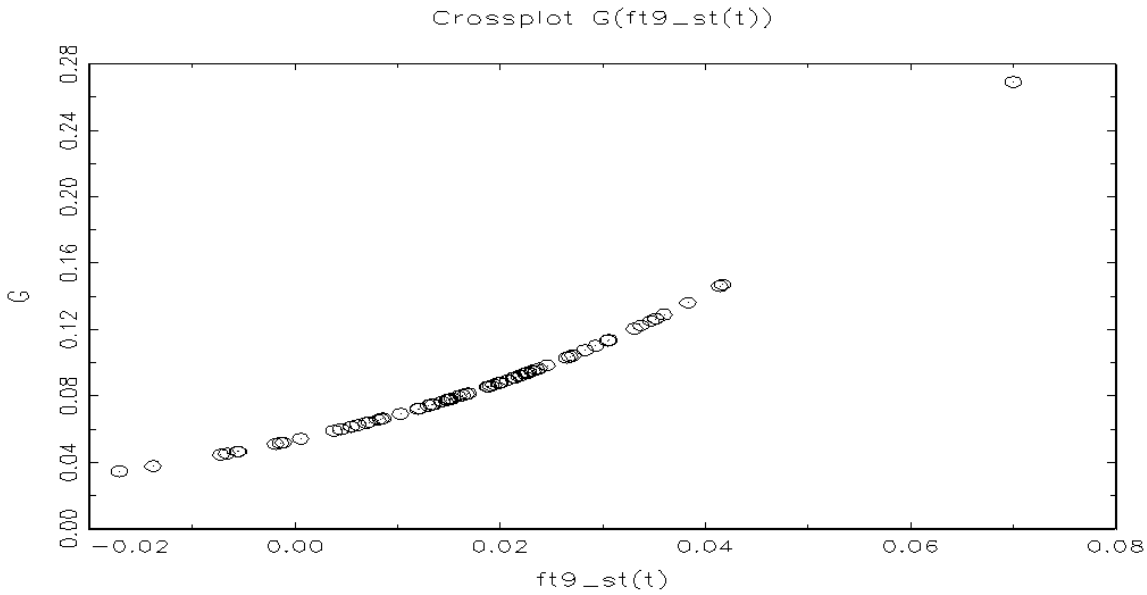


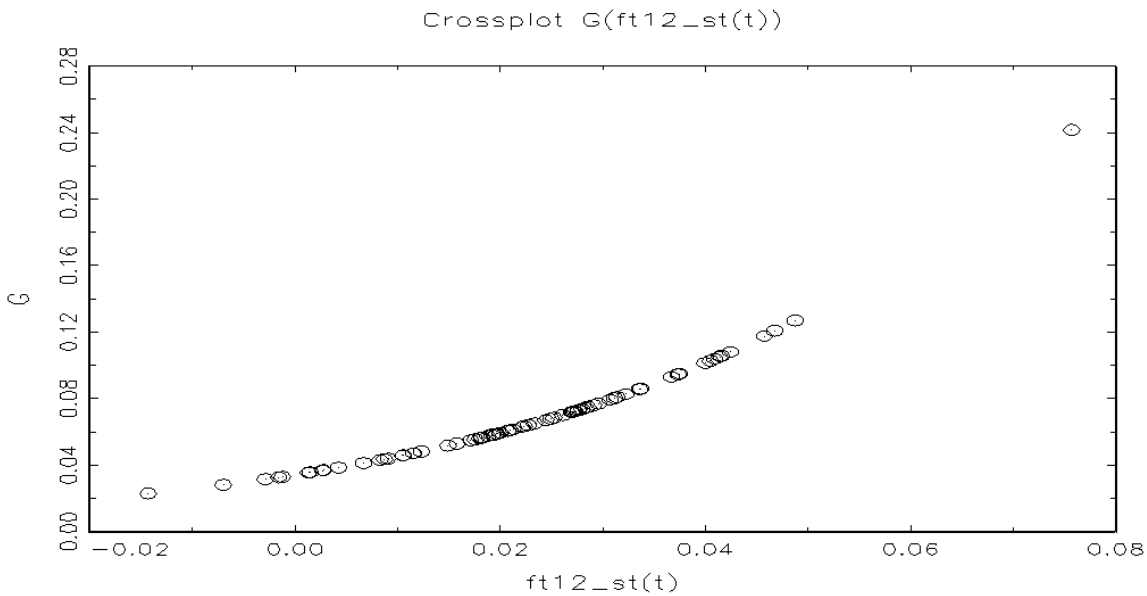

Crossplot G(ft12_st(t))
G
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
ft12_st(t)

Rand/GBP July 2005 – Nov 2011

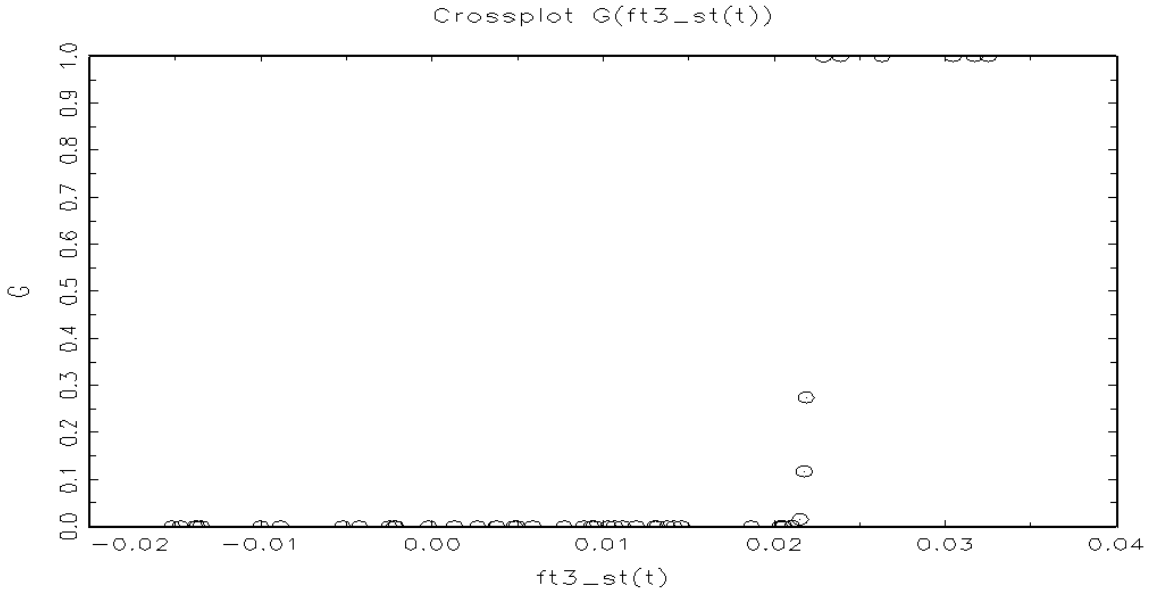


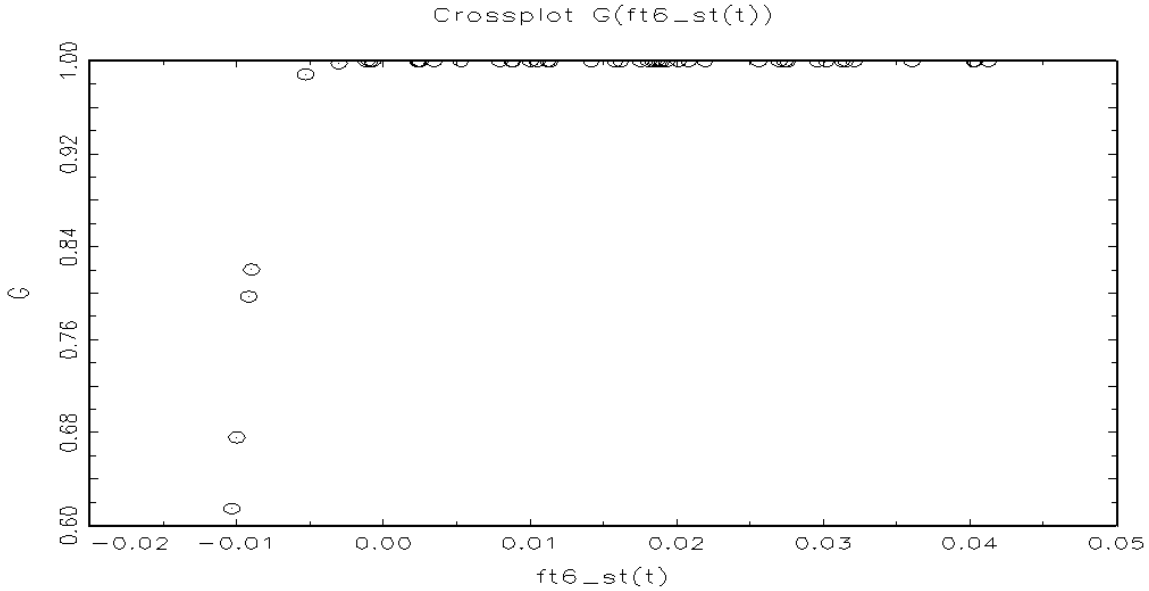


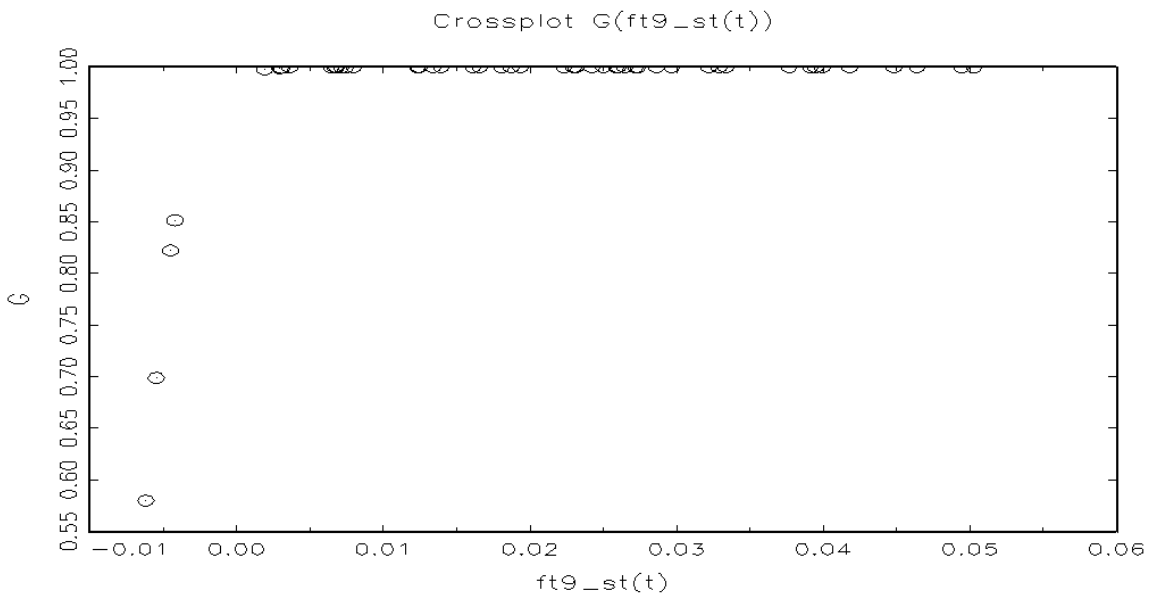

Crossplot G(ft9_st(t))
G
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
−0.02
0.00
0.02
0.04
0.06
0.08
ft9_st(t)

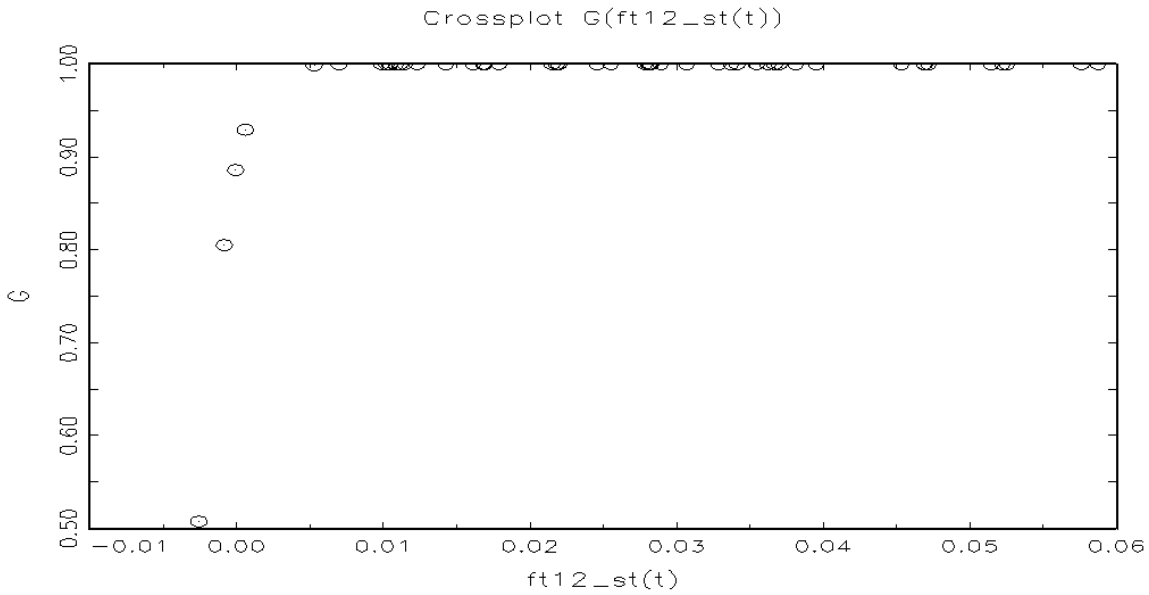

Crossplot G(ft12_st(t))
G
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

Rand/USD Jan 2001–Nov 2004

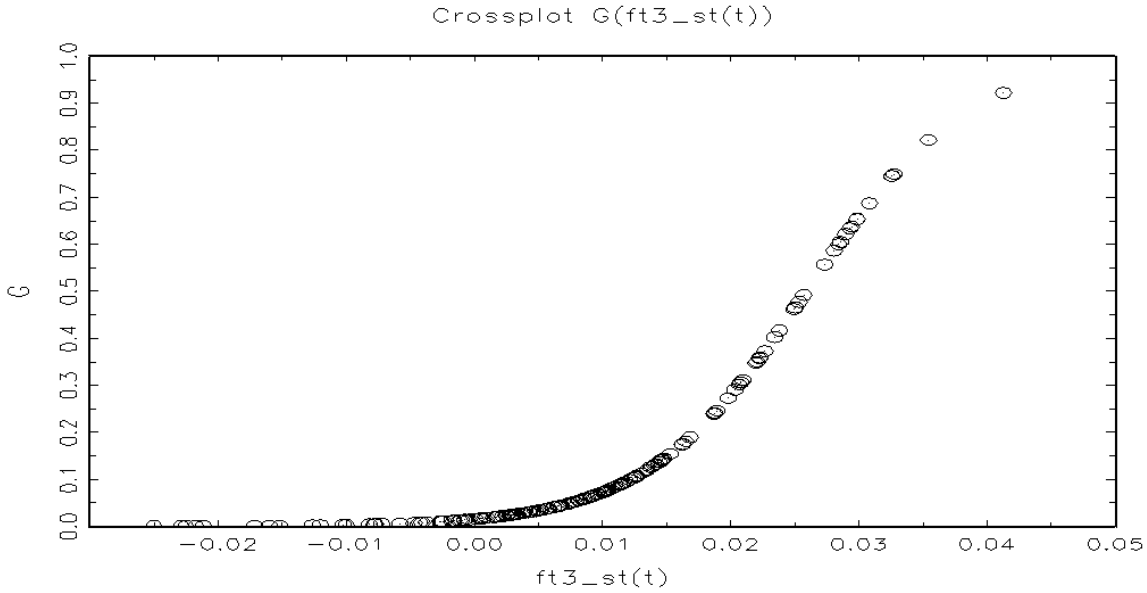


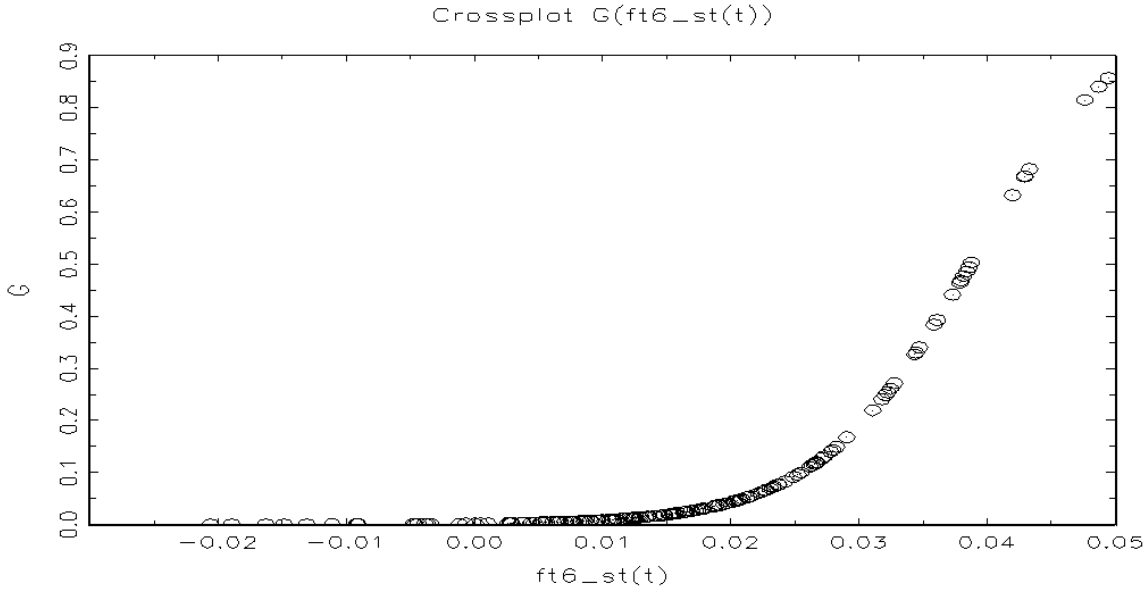


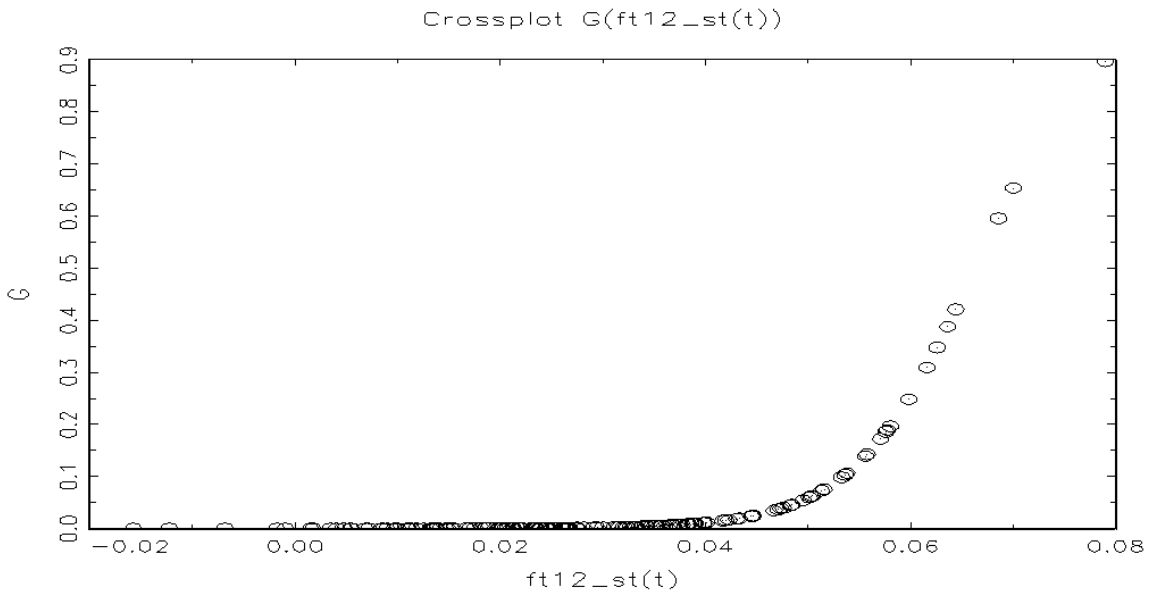

Crossplot G(ft9_st(t))
G
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft9_st(t)


Crossplot G(ft12_st(t))
G
1.00
0.90
0.80
0.70
0.60
0.50
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft12_st(t)

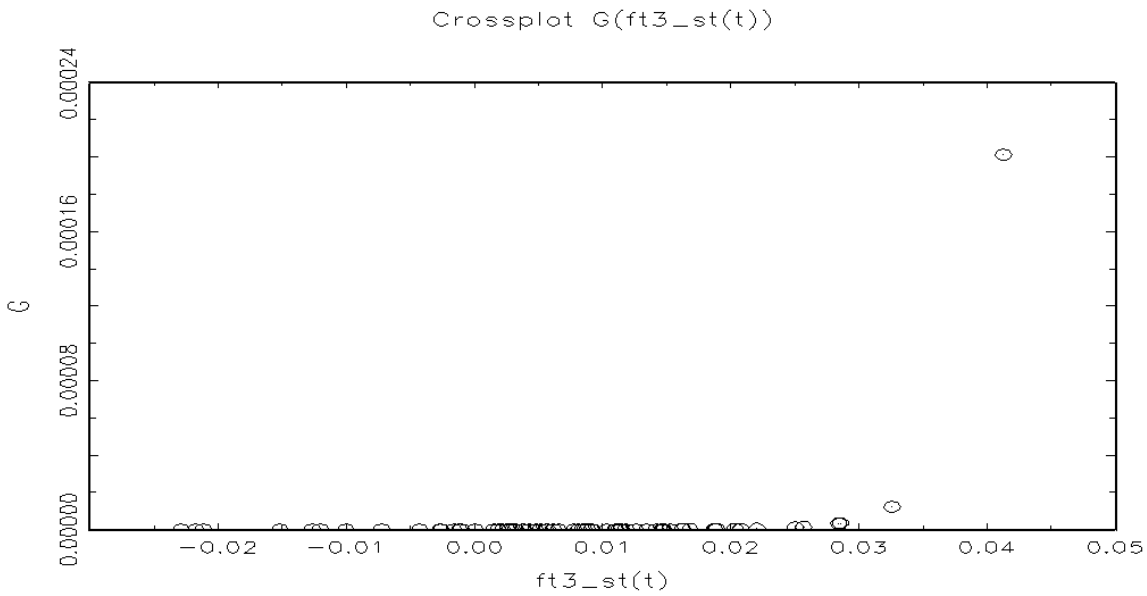
Rand/USD Dec 1996–Dec 2011

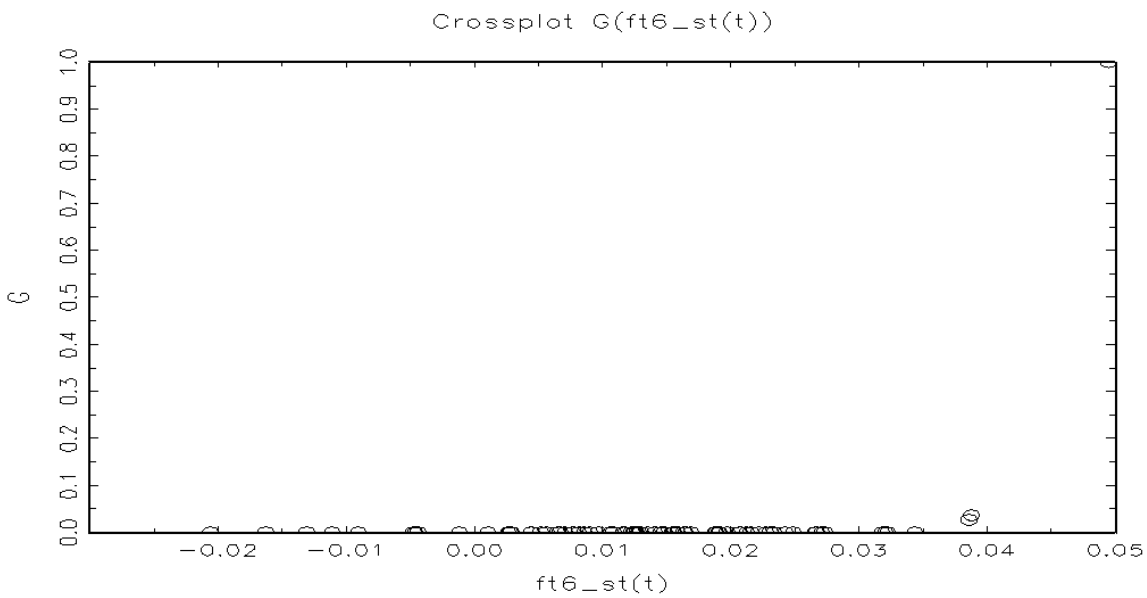


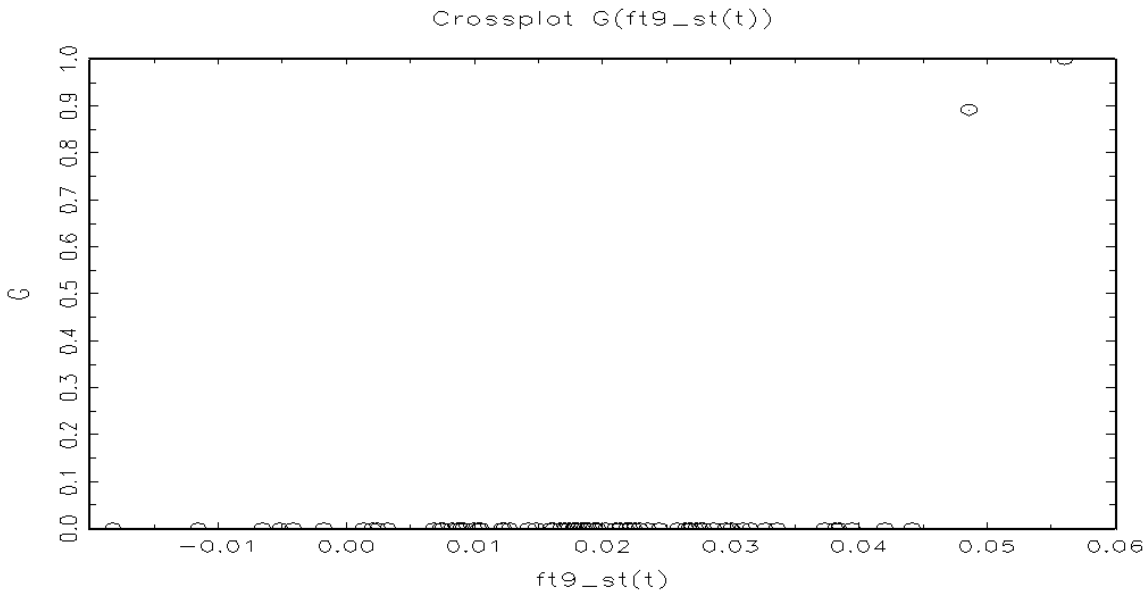


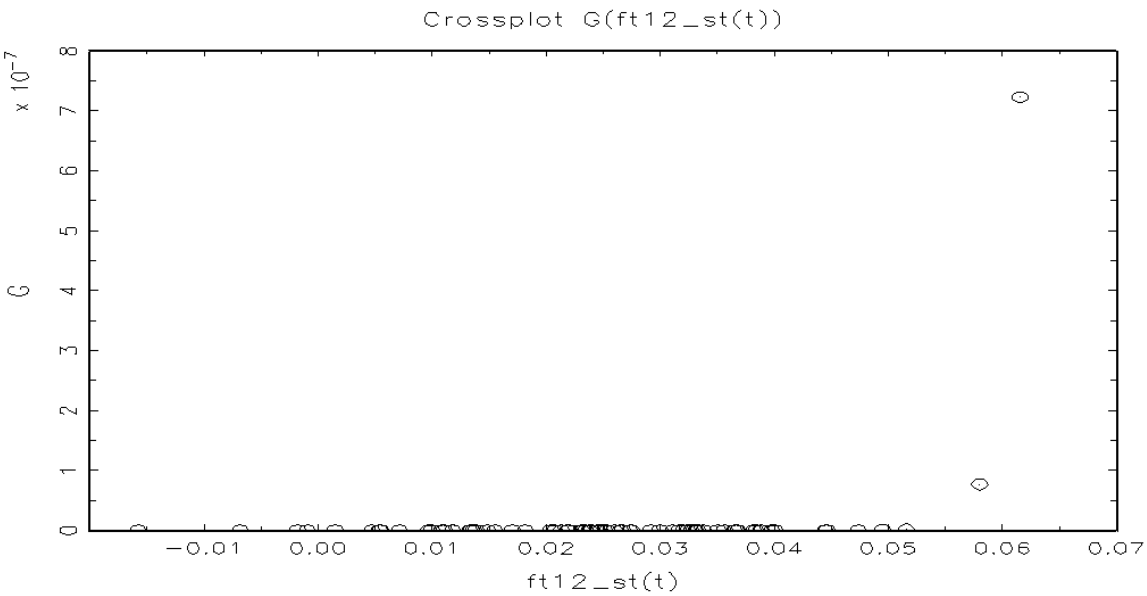

Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

Rand/USD July 2005 – Nov 2011

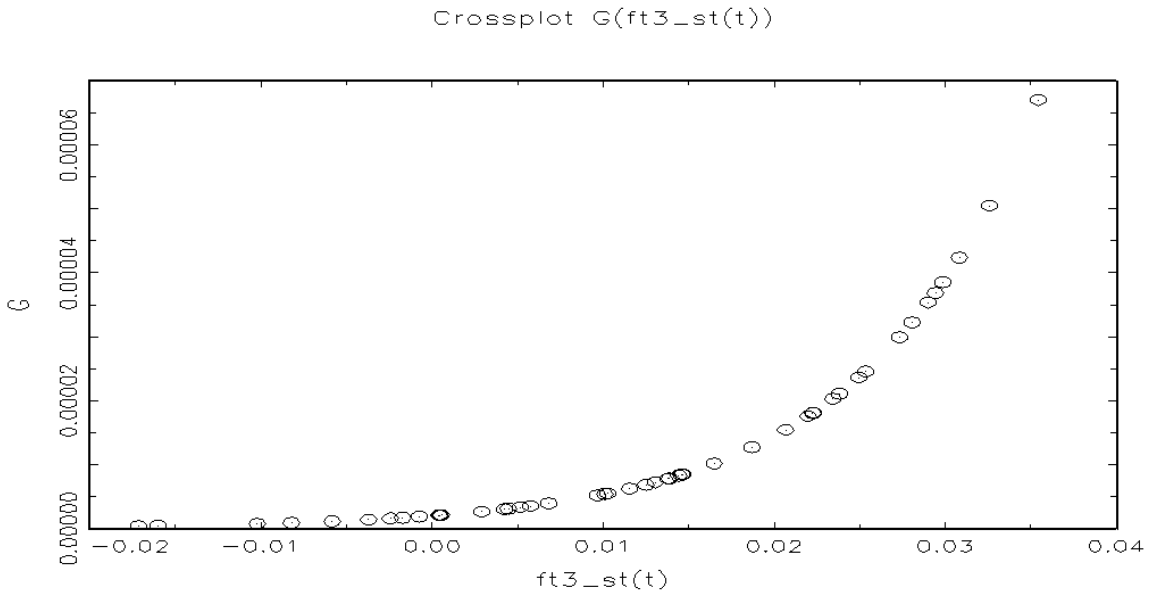


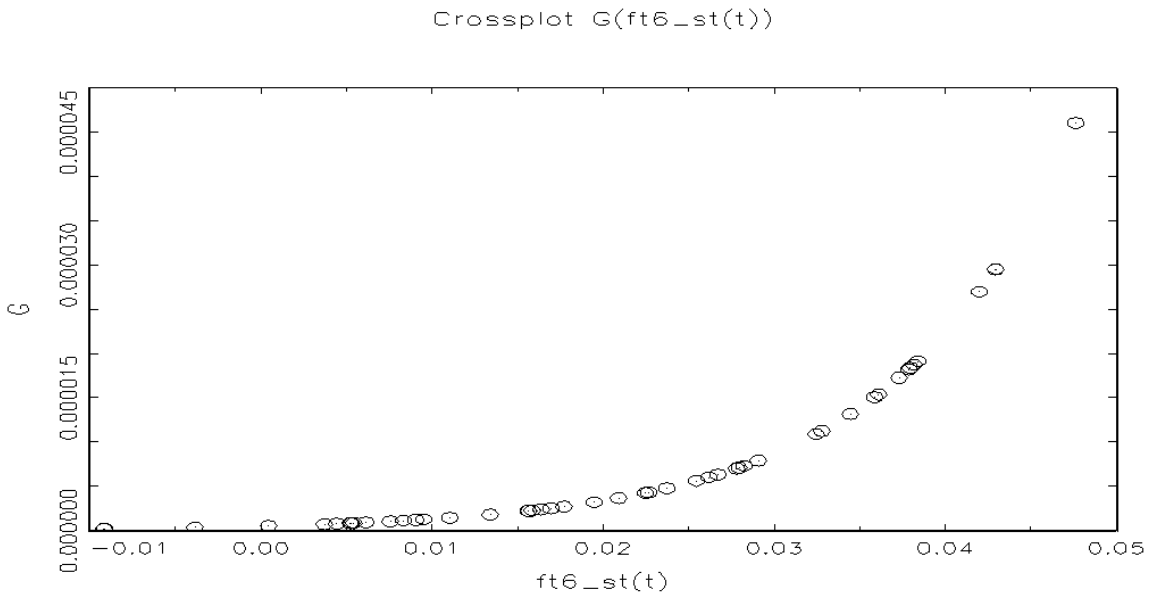


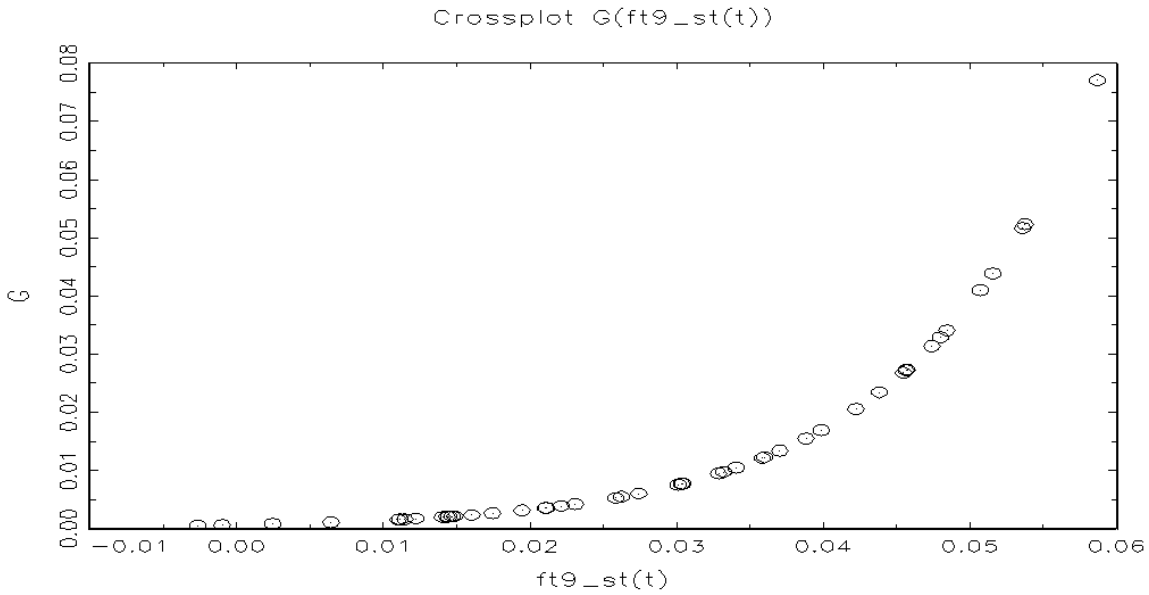

Crossplot G(ft9_st(t))
G
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
−0.01 0.00 0.01 0.02 0.03 0.04 0.05 0.06
ft9_st(t)

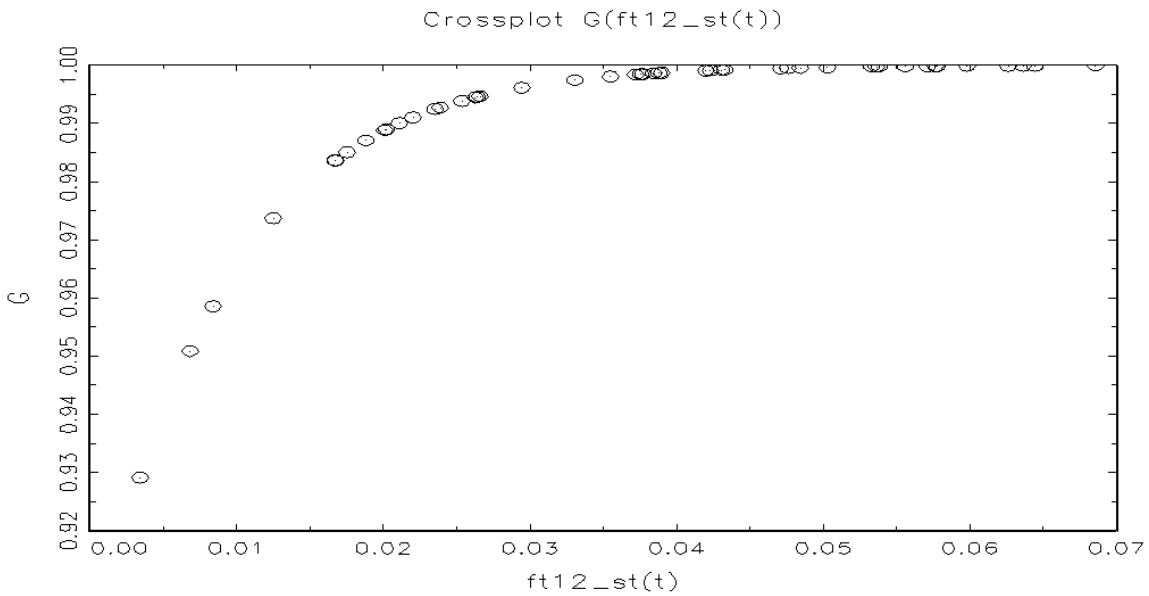

Crossplot G(ft12_st(t))
G
x 10^-7
0 1 2 3 4 5 6 7 8
−0.01 0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07
ft12_st(t)

Rand/USD Jan 2001–Dec 2004

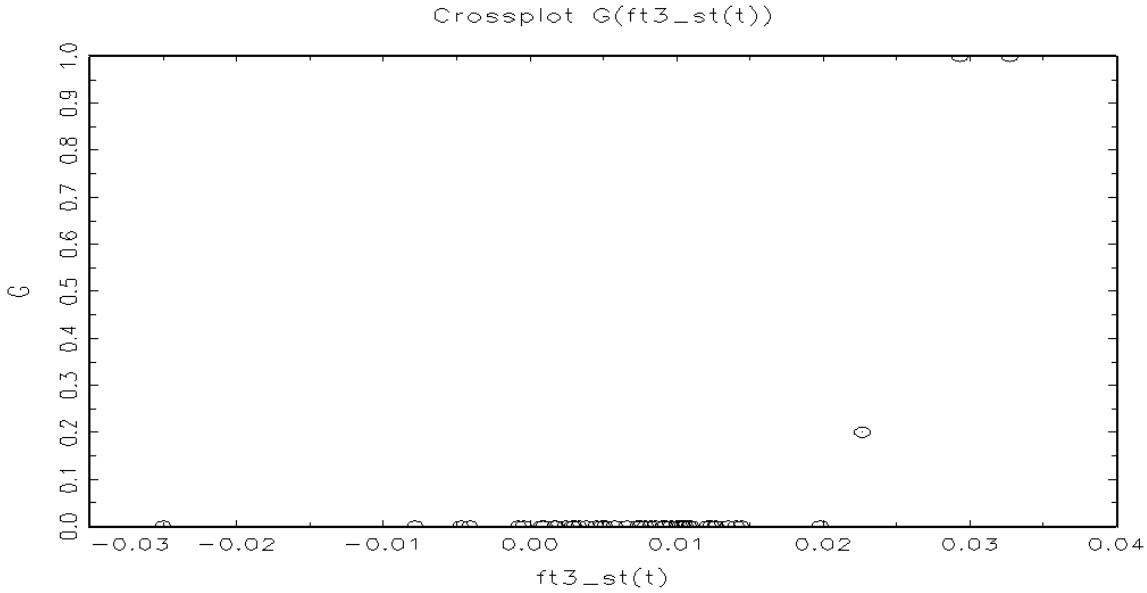


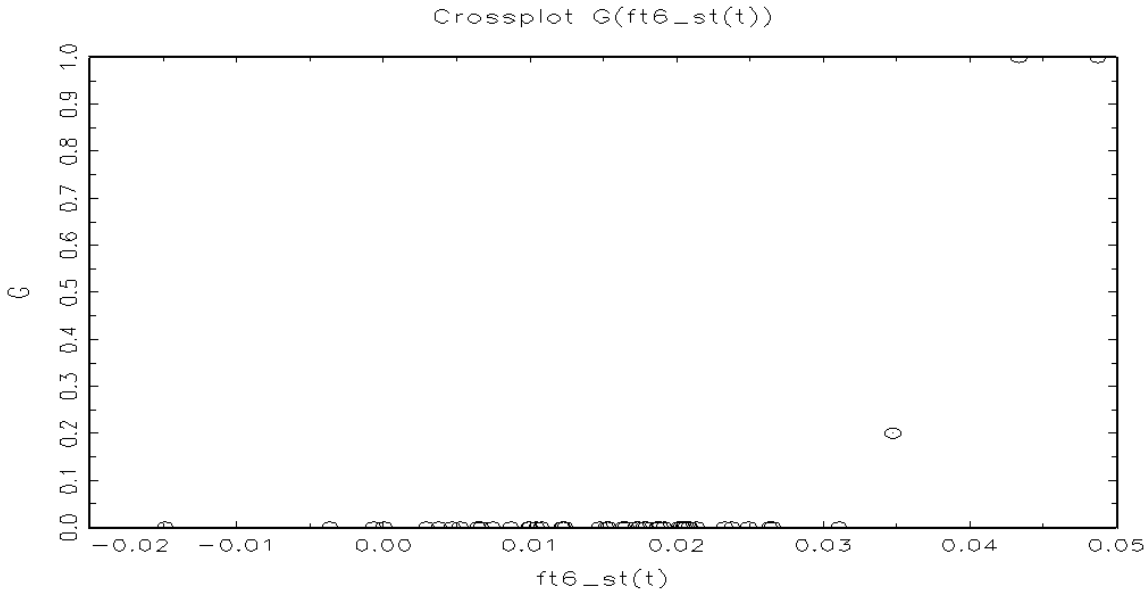


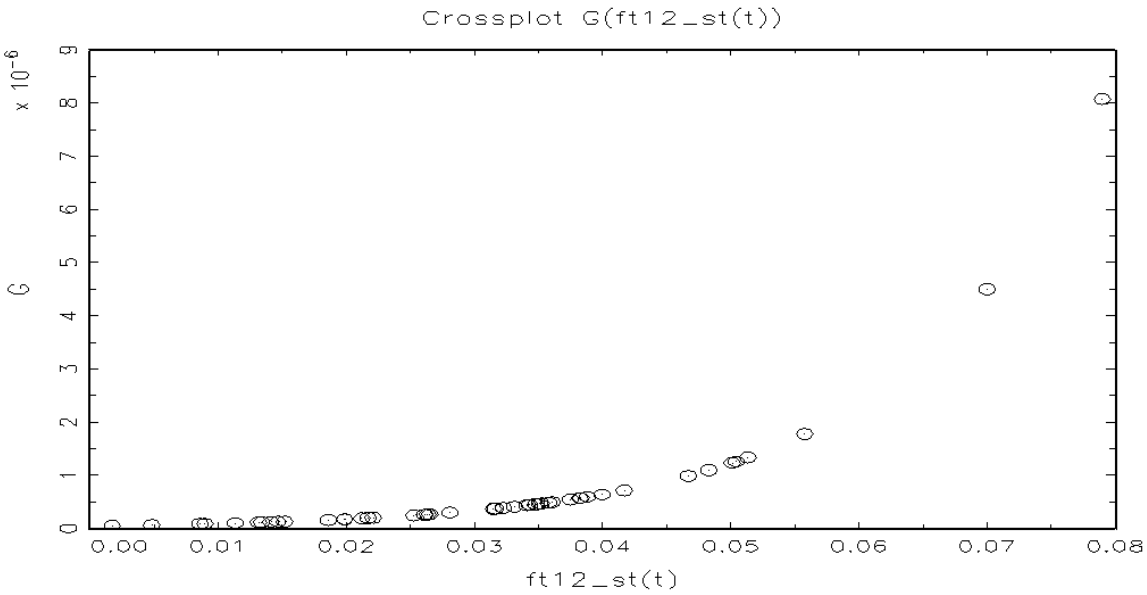

Crossplot G(ft9_st(t))
G
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft9_st(t)


Crossplot G(ft12_st(t))
G
0.92
0.93
0.94
0.95
0.96
0.97
0.98
0.99
1.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
ft12_st(t)

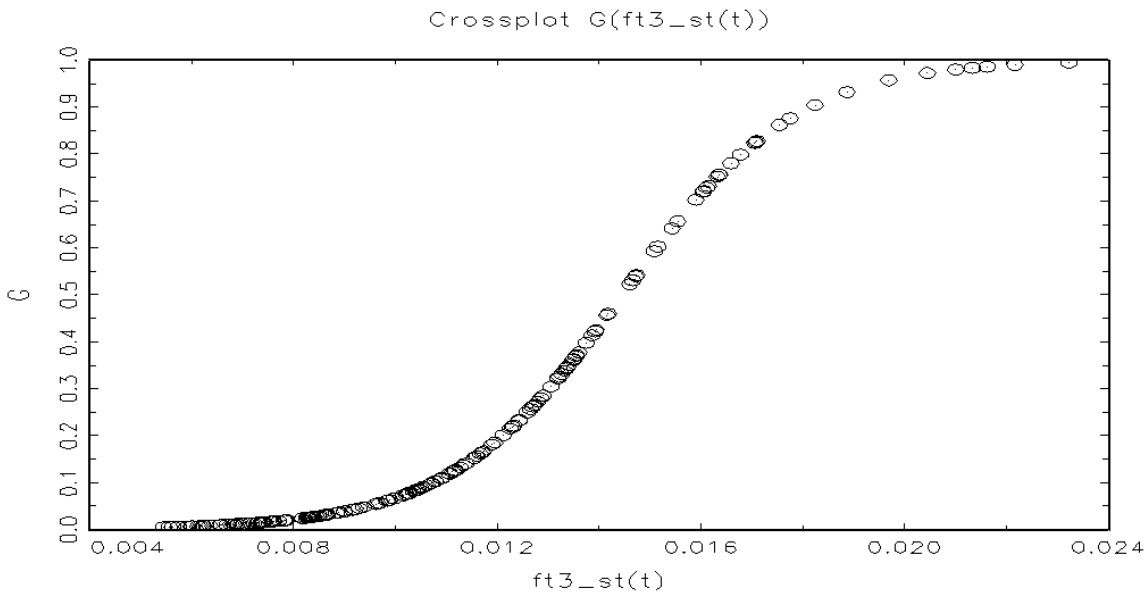
Rand/Yen Dec 1996–Nov 2000

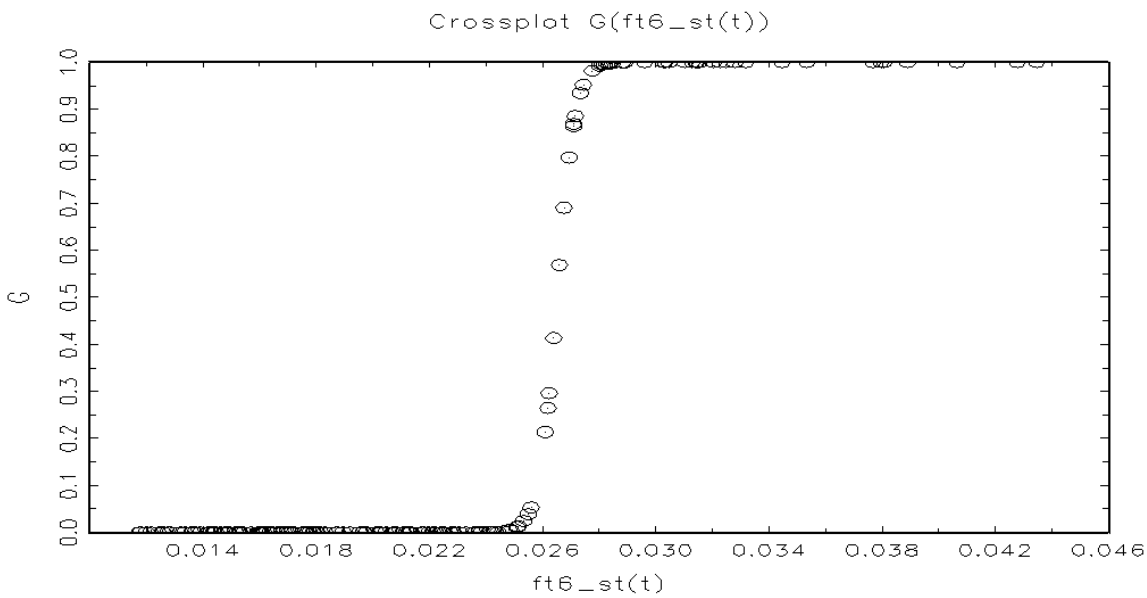


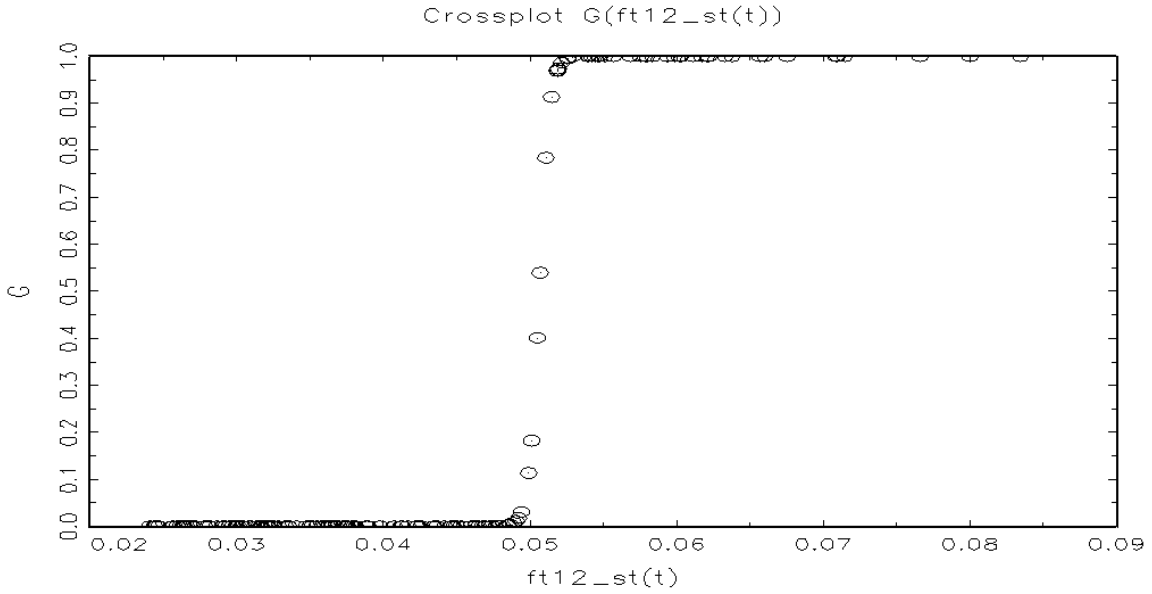



Crossplot G(ft12_st(t))
G
x 10^-6
0
1
2
3
4
5
6
7
8
9
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
ft12_st(t)

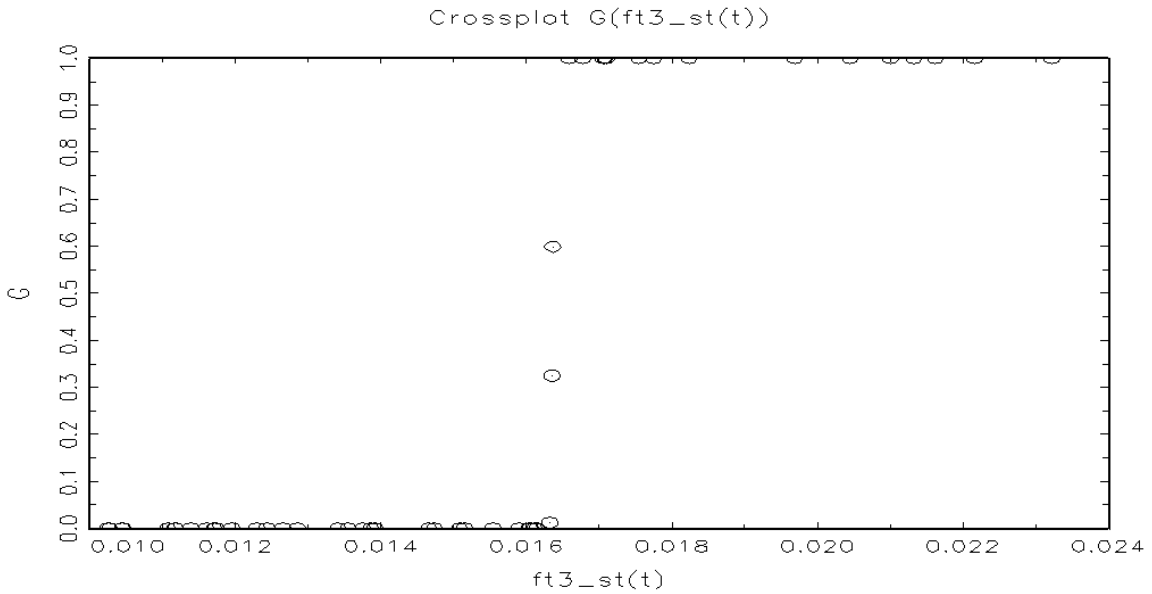
Rand/Yen Dec 1996–Dec 2011

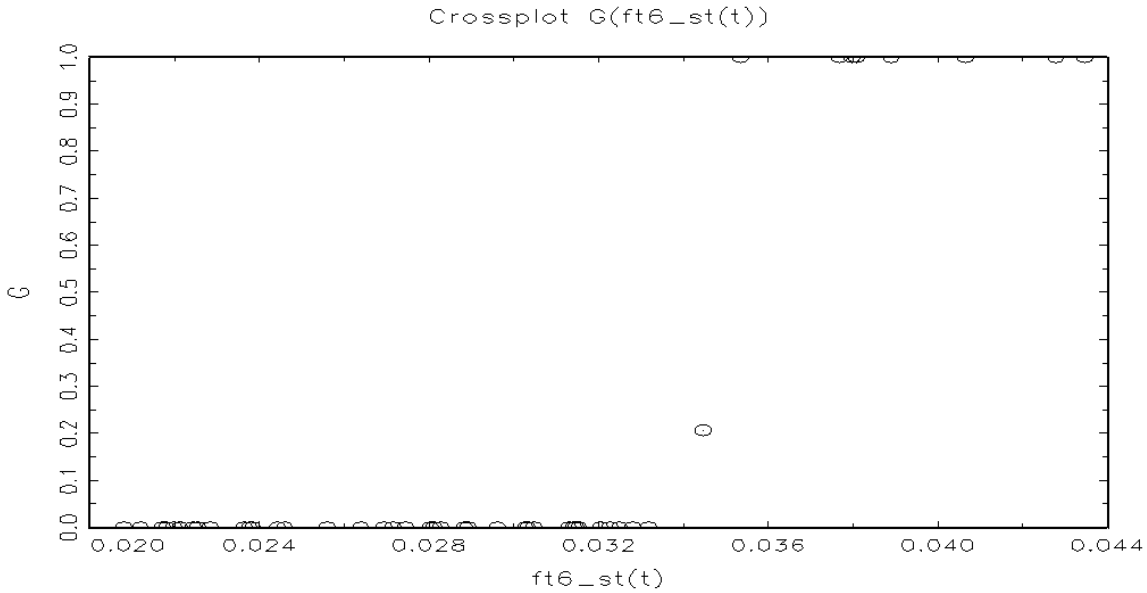


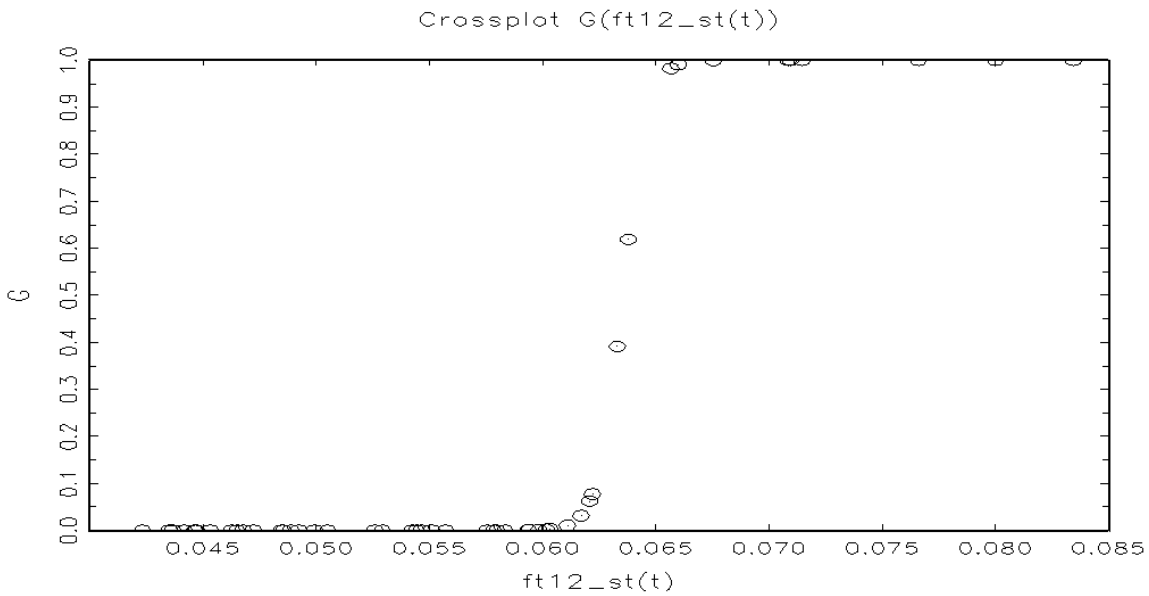




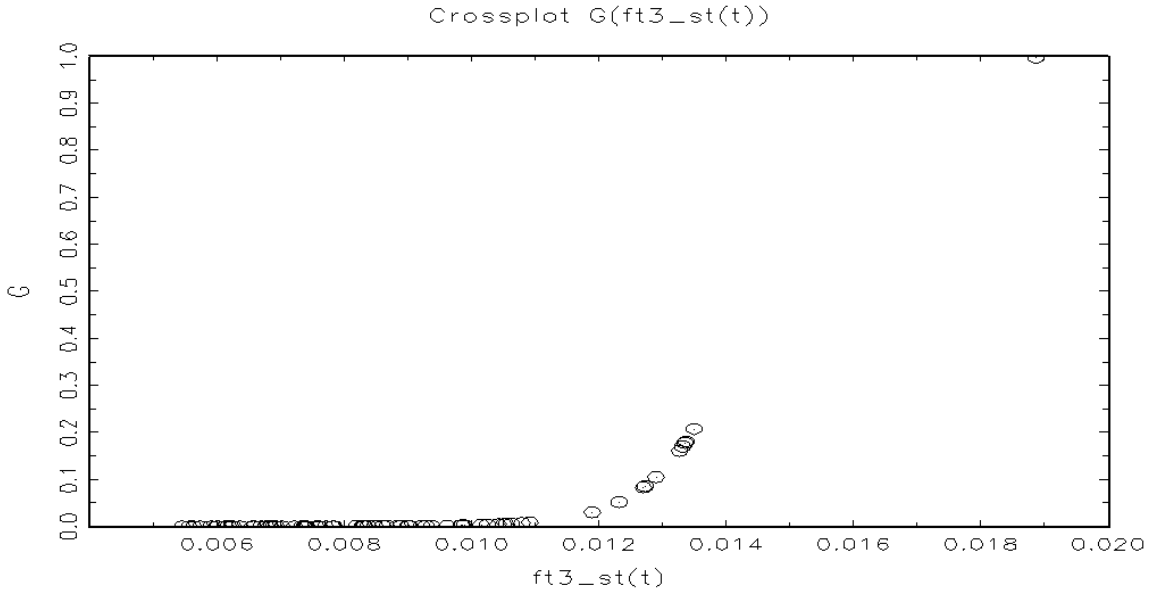
Rand/Yen Dec 1996 – Nov 2000

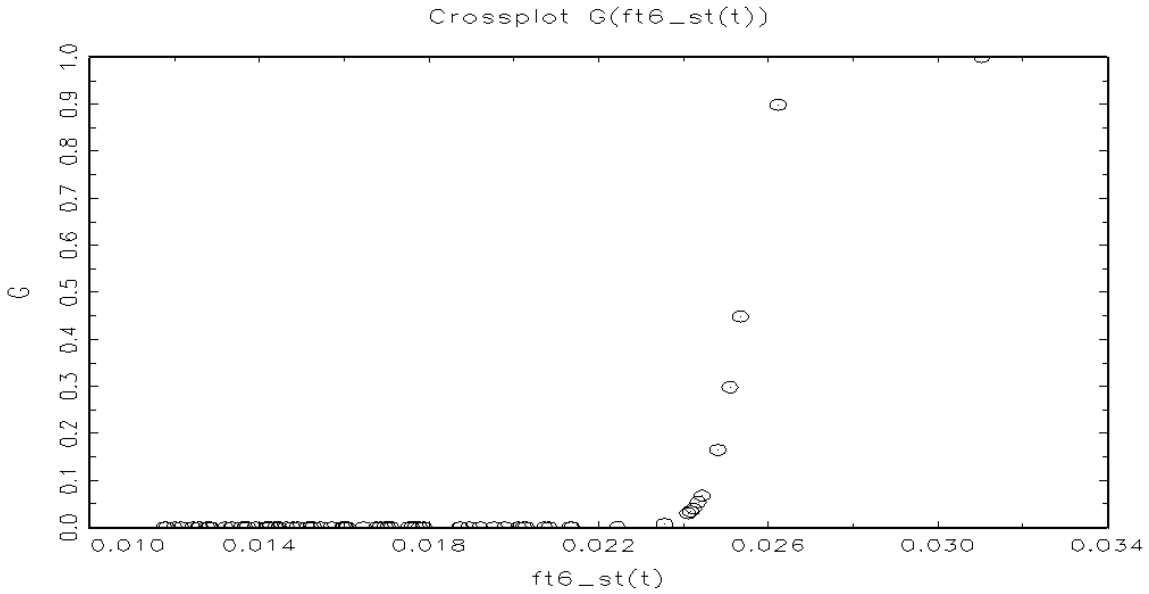


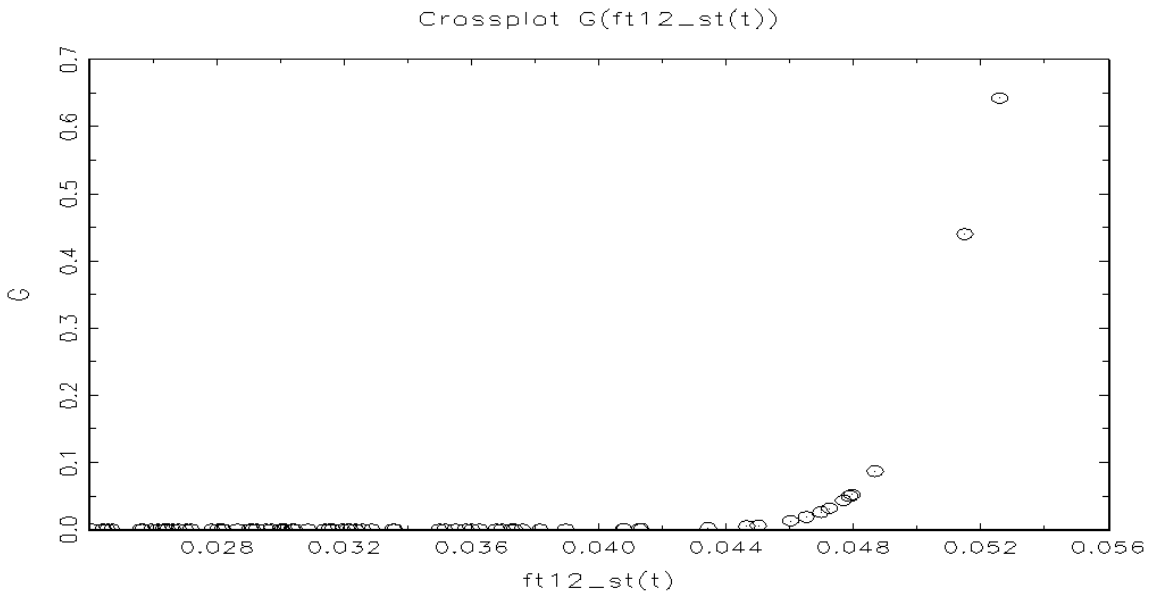

Crossplot G(ft6_st(t))
G
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
0.020 0.024 0.028 0.032 0.036 0.040 0.044
ft6_st(t)


Crossplot G(ft12_st(t))
G
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
0.045 0.050 0.055 0.060 0.065 0.070 0.075 0.080 0.085
ft12_st(t)

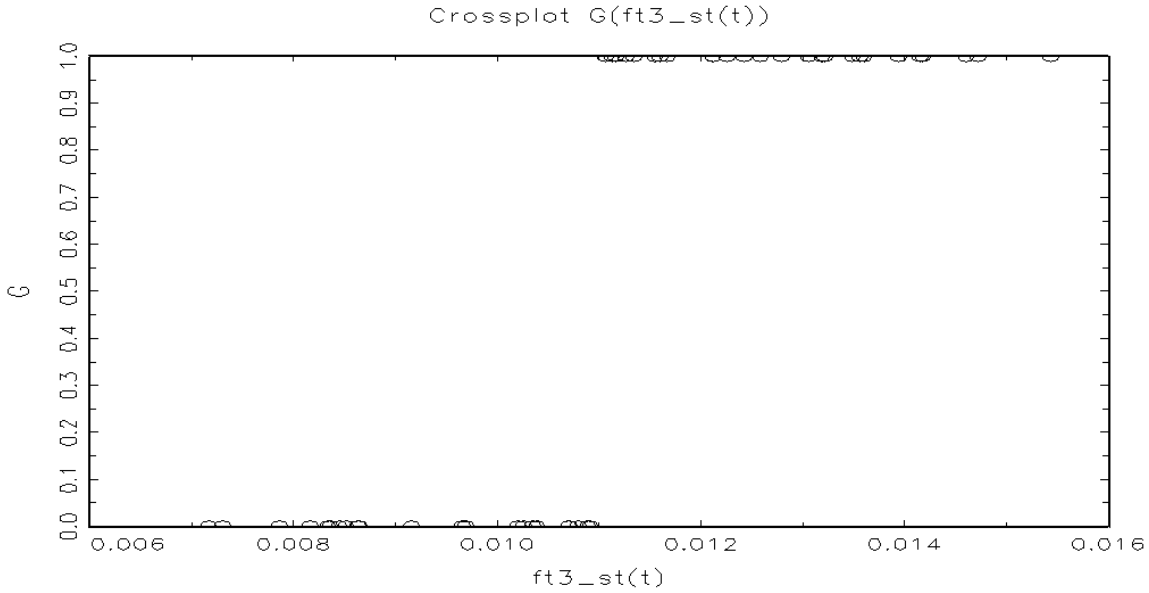
Rand/Yen July 2005 – Nov 2011

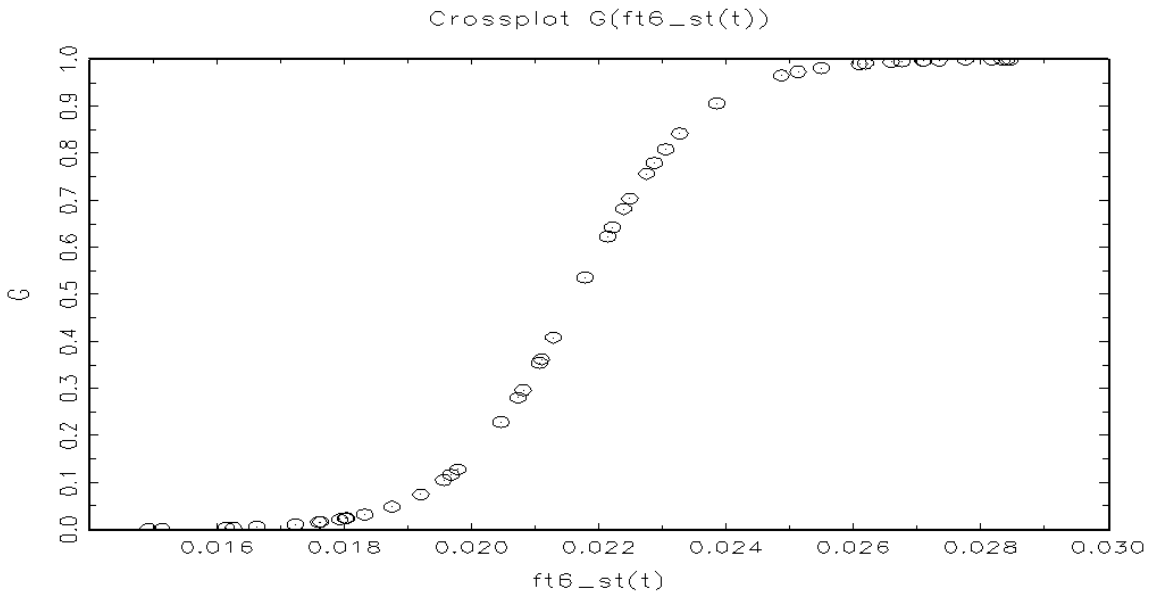


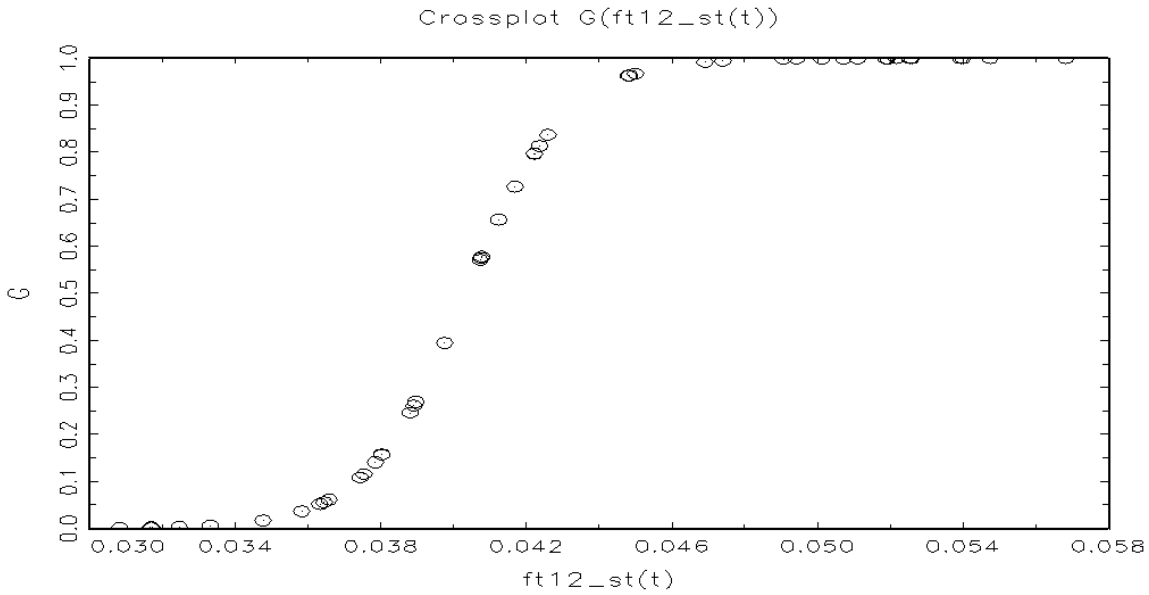



Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.028
0.032
0.036
0.040
0.044
0.048
0.052
0.056
ft12_st(t)

Rand/USD Jan 2001–Dec 2004

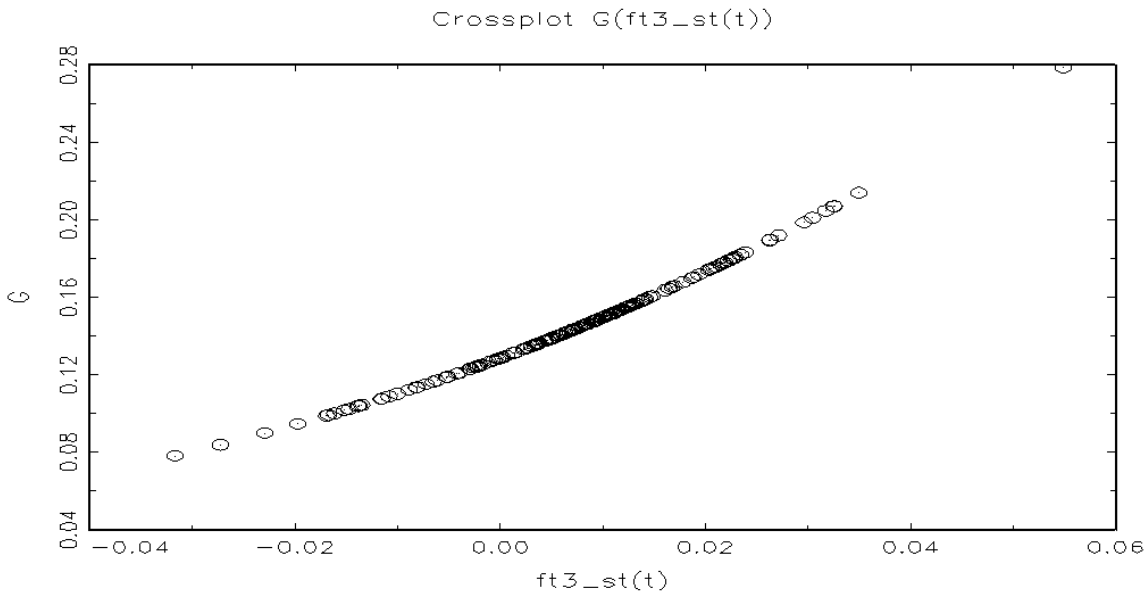


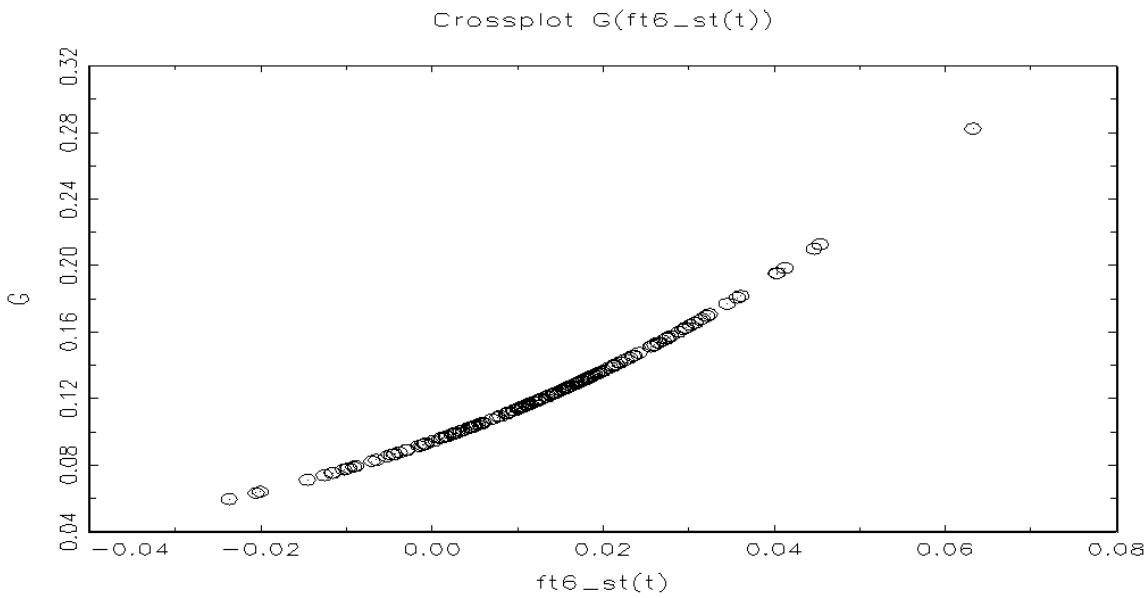


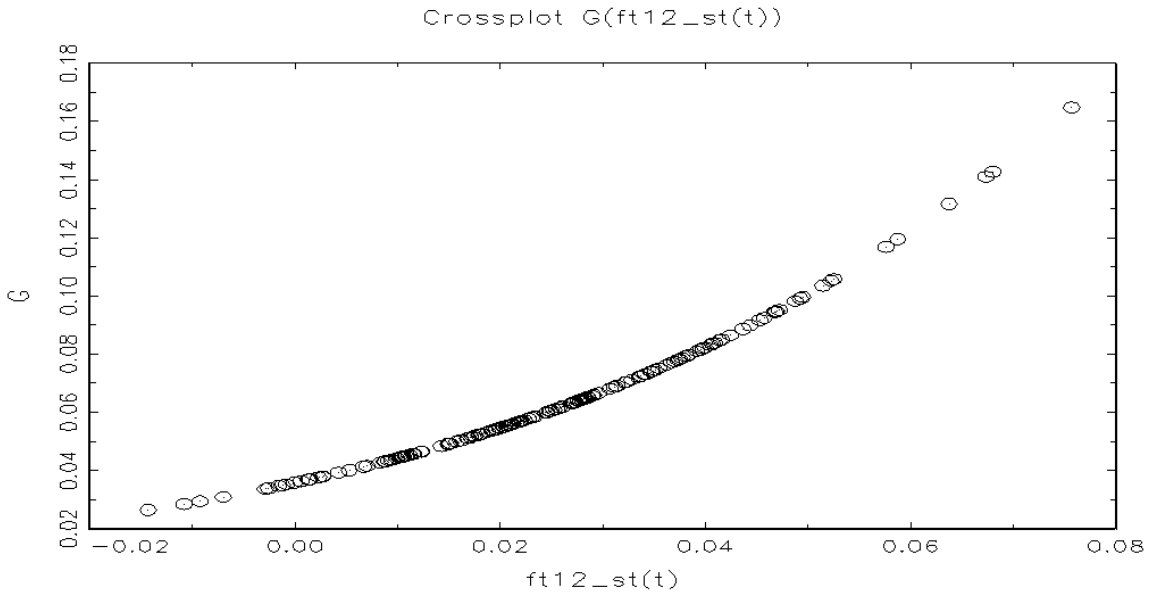

Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.030
0.034
0.038
0.042
0.046
0.050
0.054
0.058
ft12_st(t)

APPENDIX 10: FORWARD PREMIUM AS THE TRANSITION VARIABLE

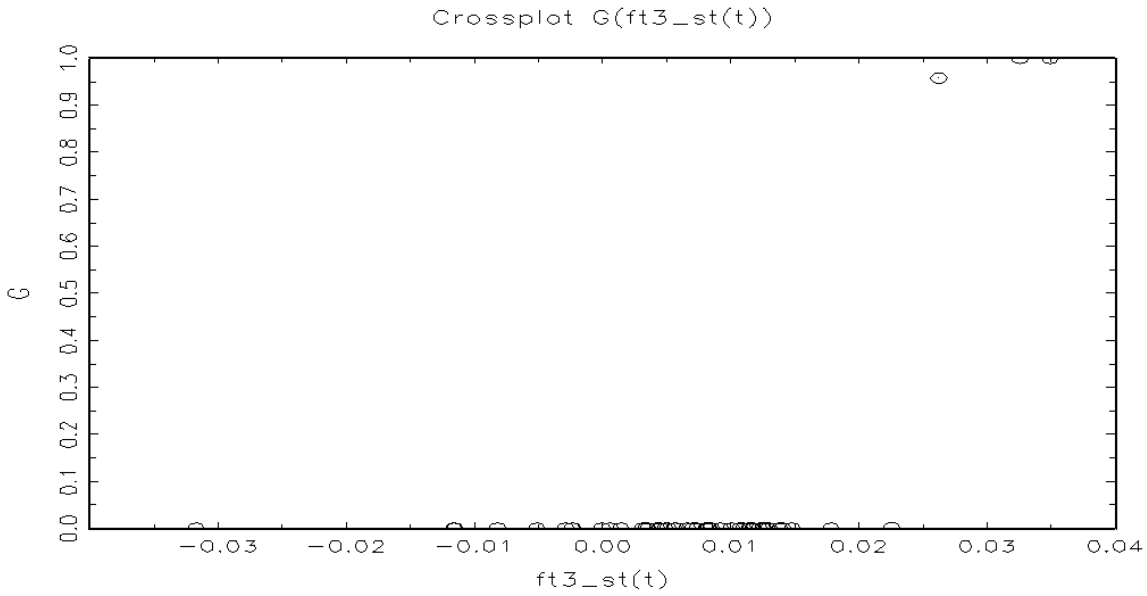
Rand/GBP Dec 1996–Dec2011

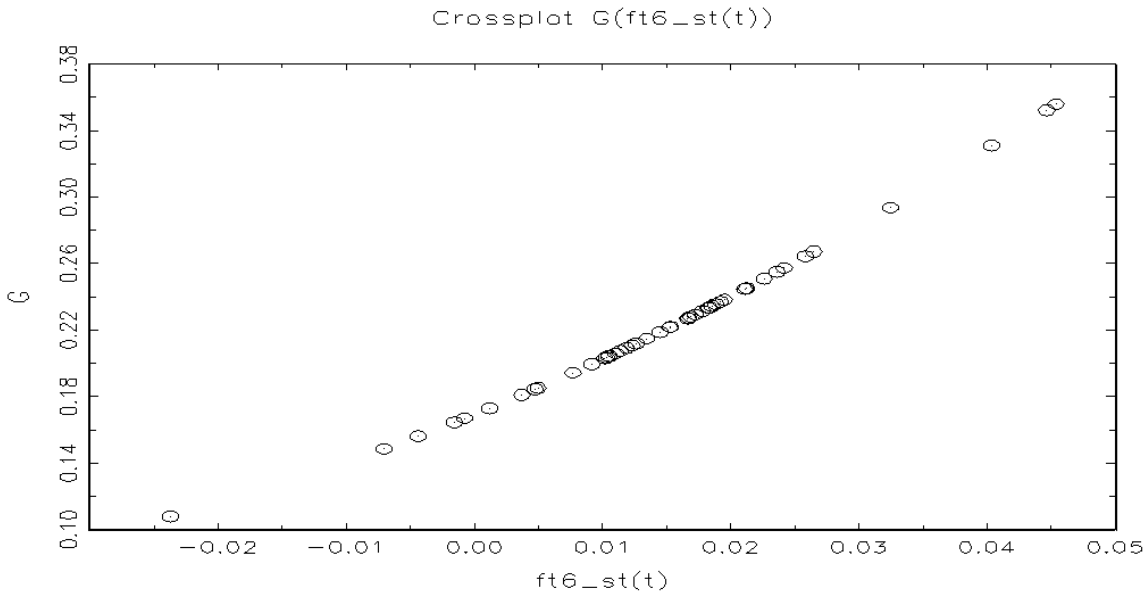


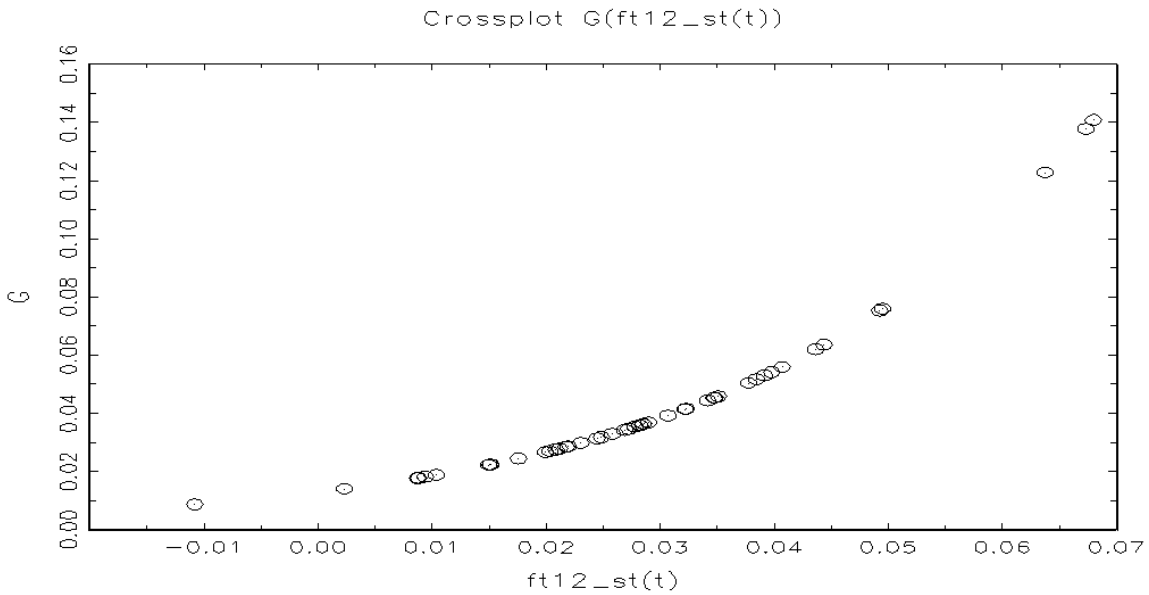



Crossplot G(ft12_st(t))
G
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

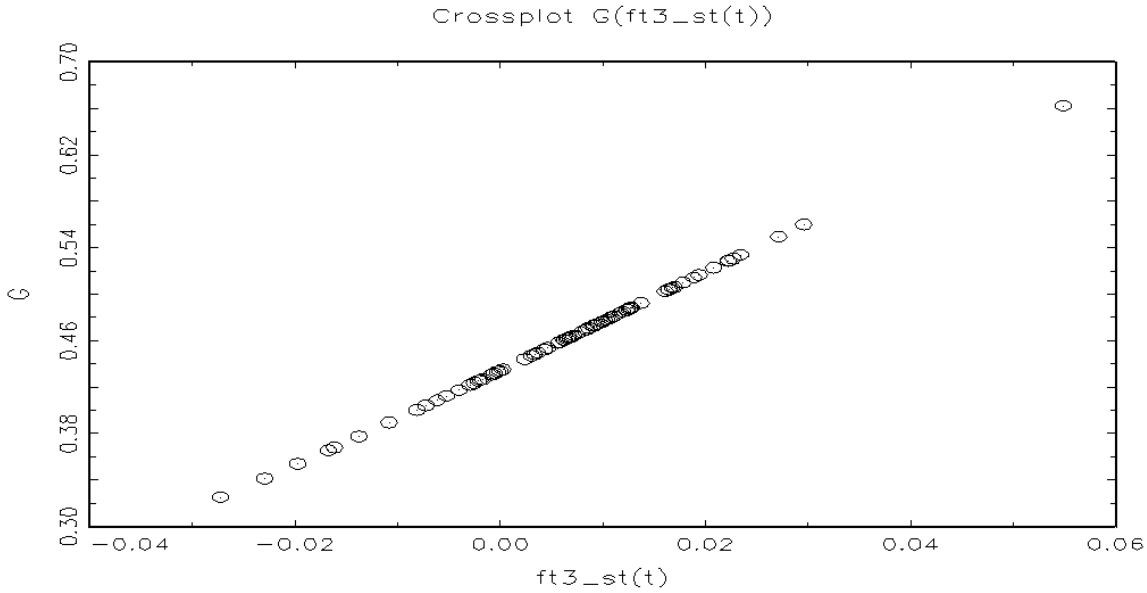
Rand/GBP Dec 1996 – Nov 2000

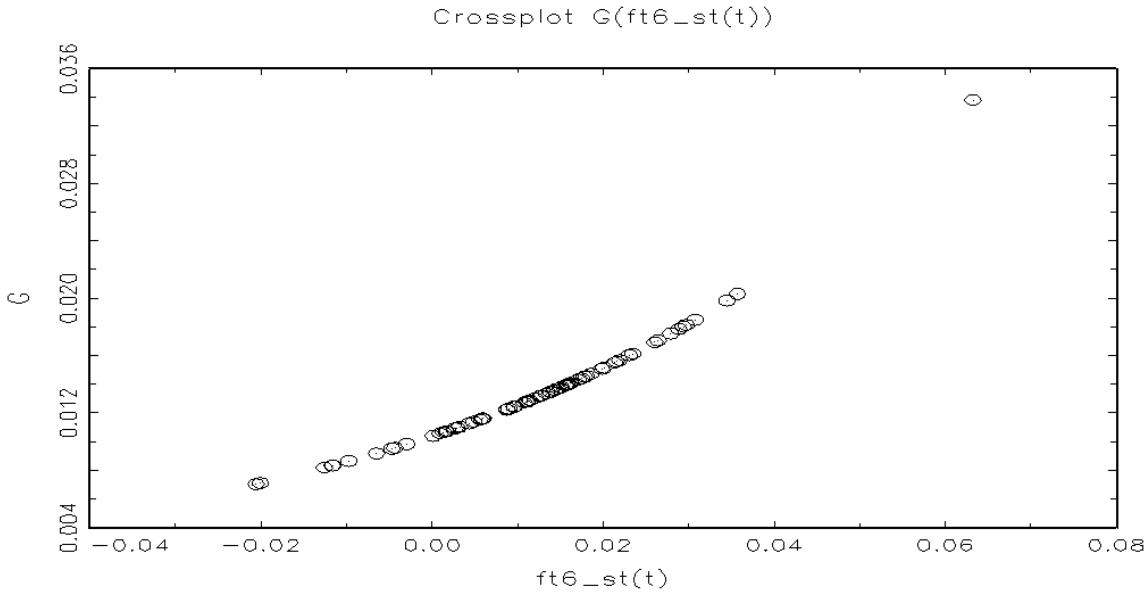


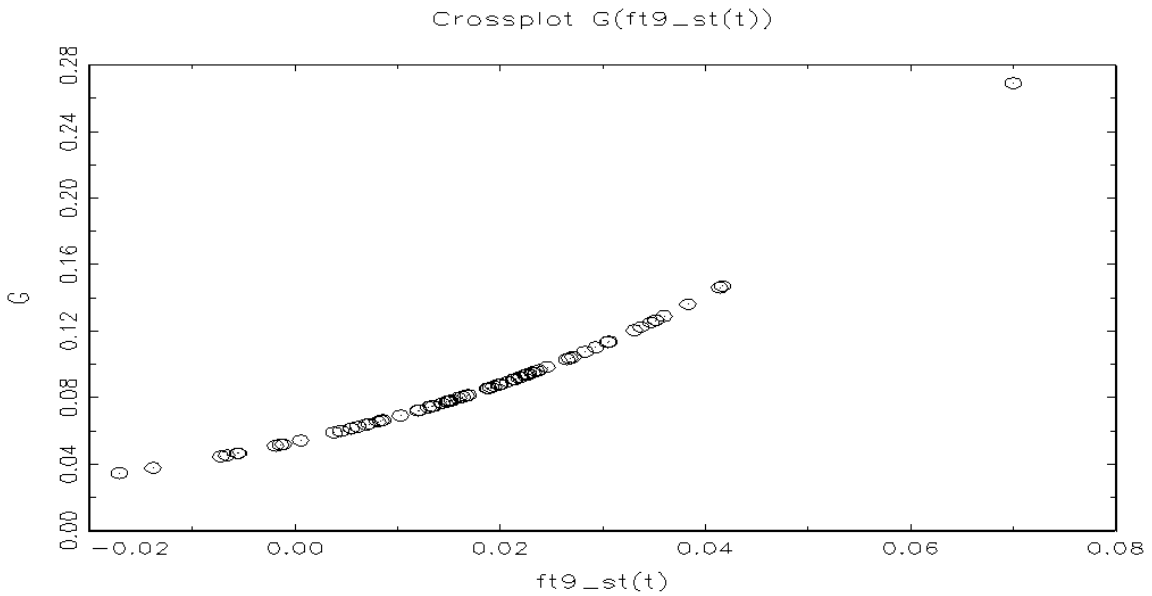


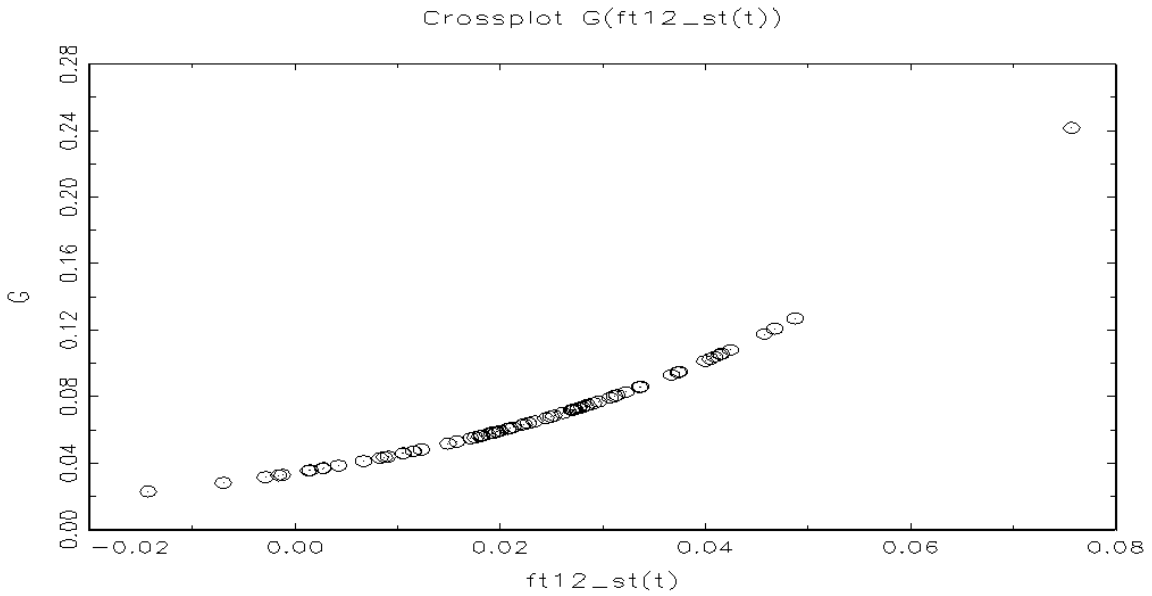

Crossplot G(ft12_st(t))
G
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
ft12_st(t)

Rand/GBP July 2005 – Nov 2011

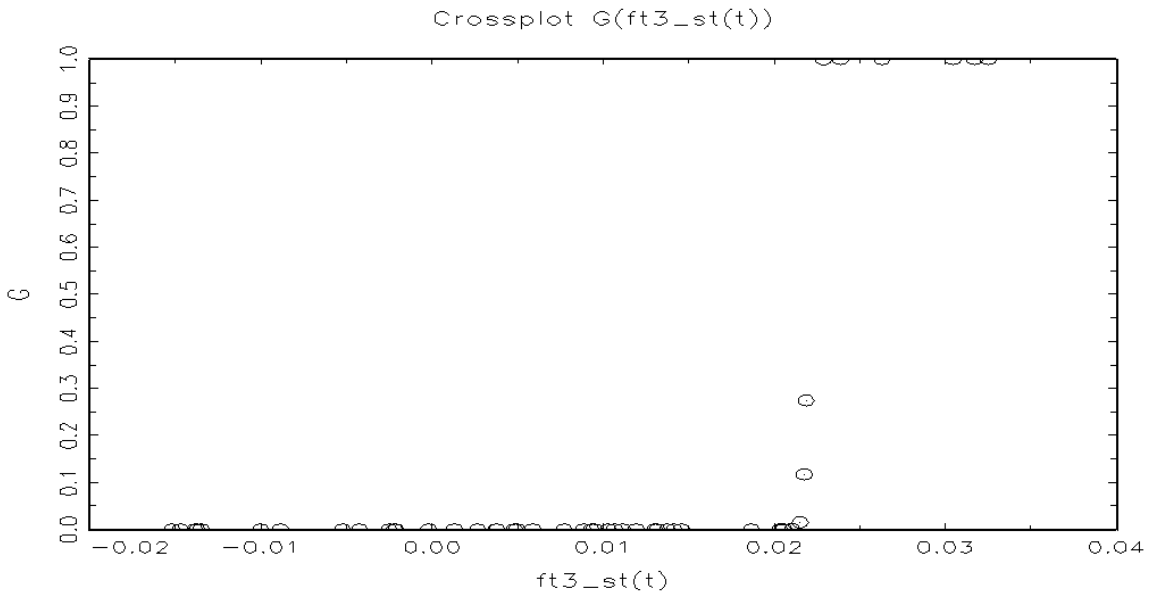


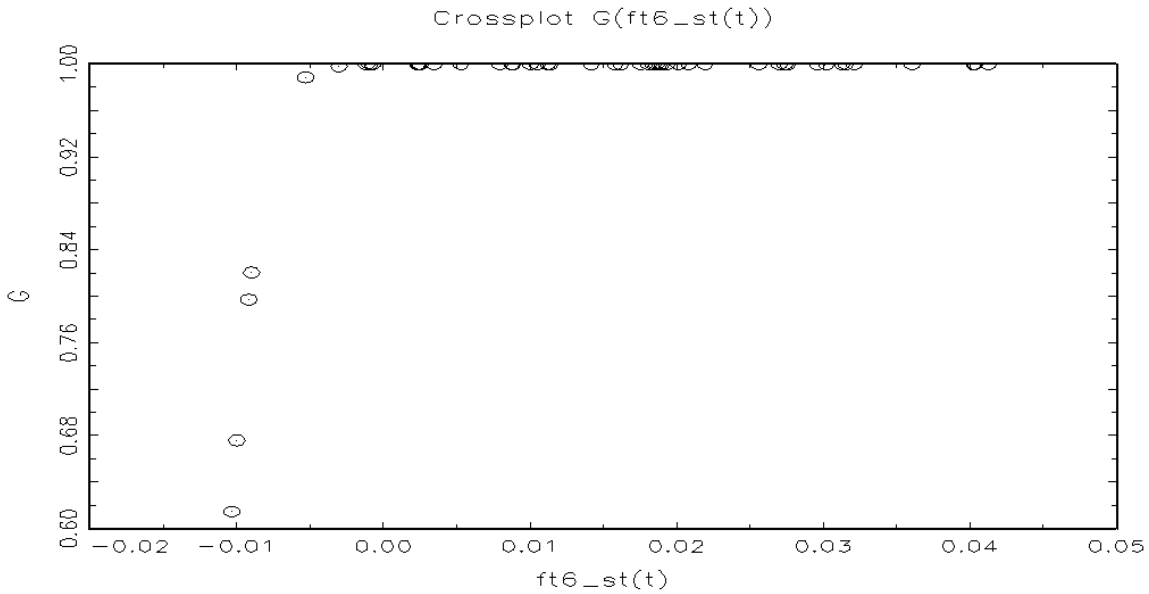


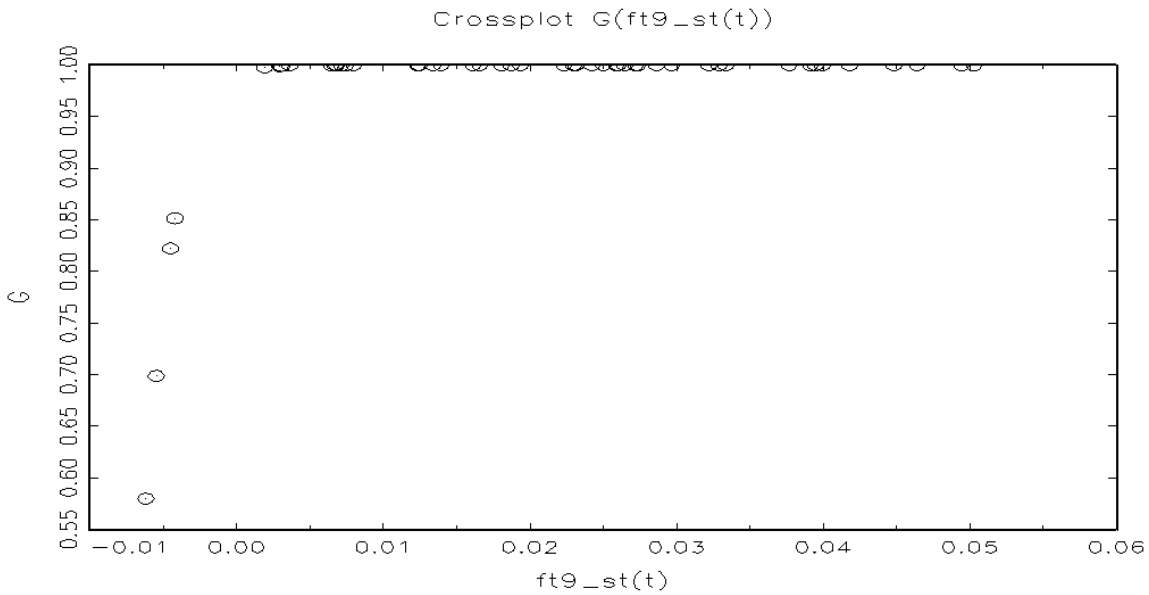

Crossplot G(ft9_st(t))
G
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
−0.02
0.00
0.02
0.04
0.06
0.08
ft9_st(t)

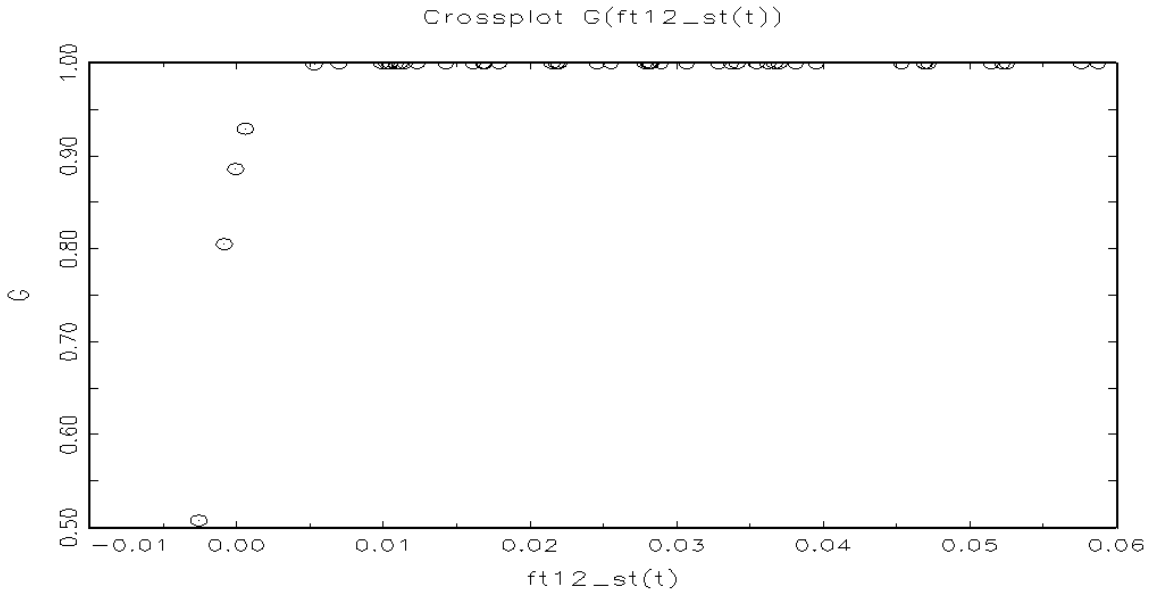

Crossplot G(ft12_st(t))
G
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

Rand/GBP Jan 2001–Nov 2004

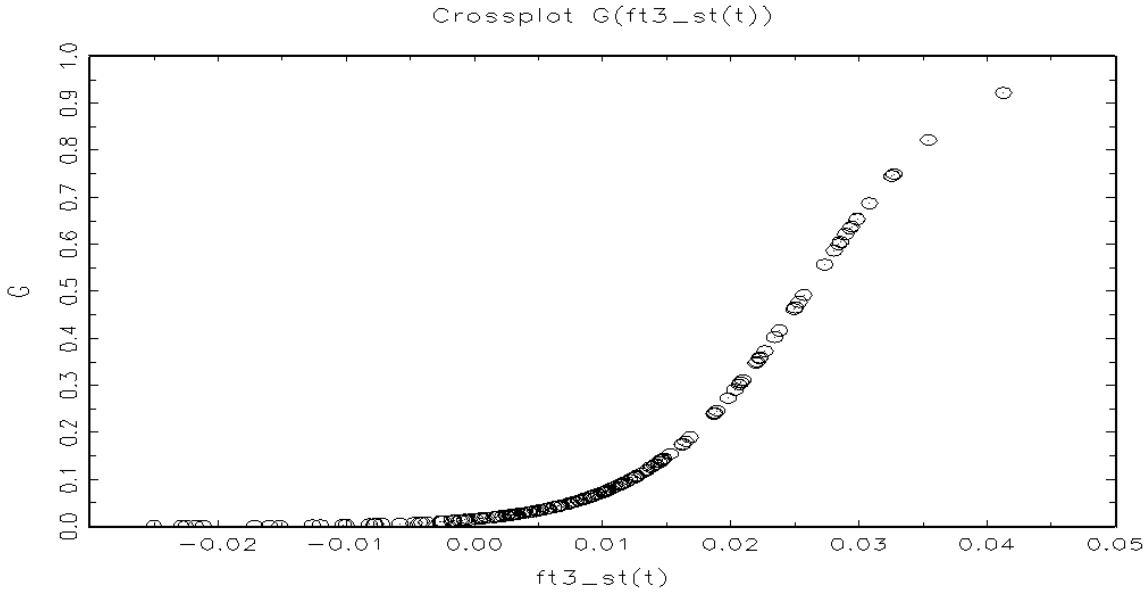


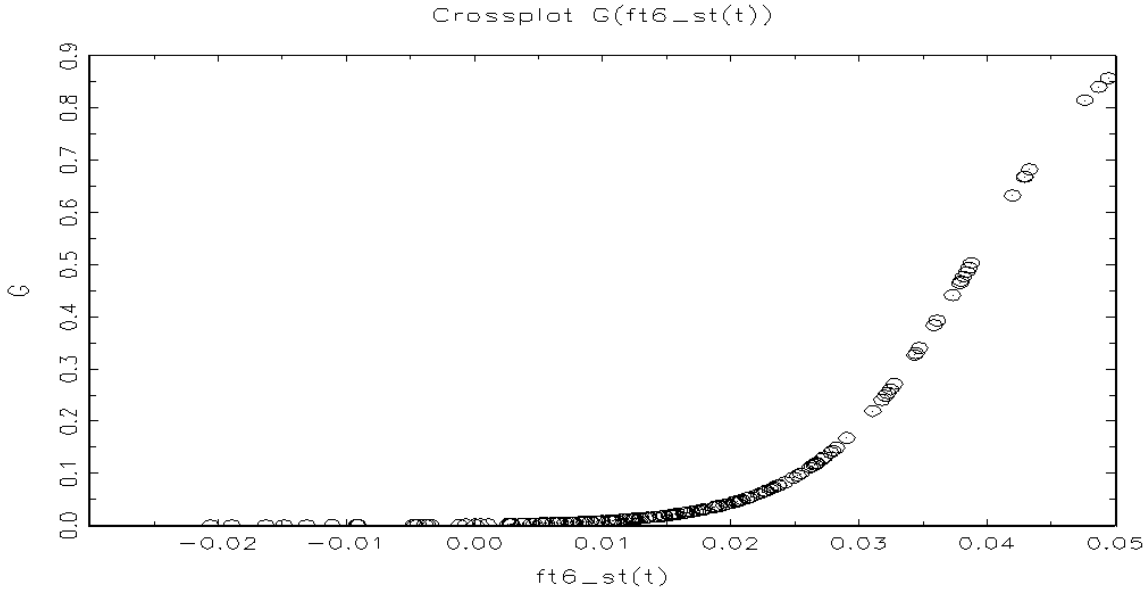


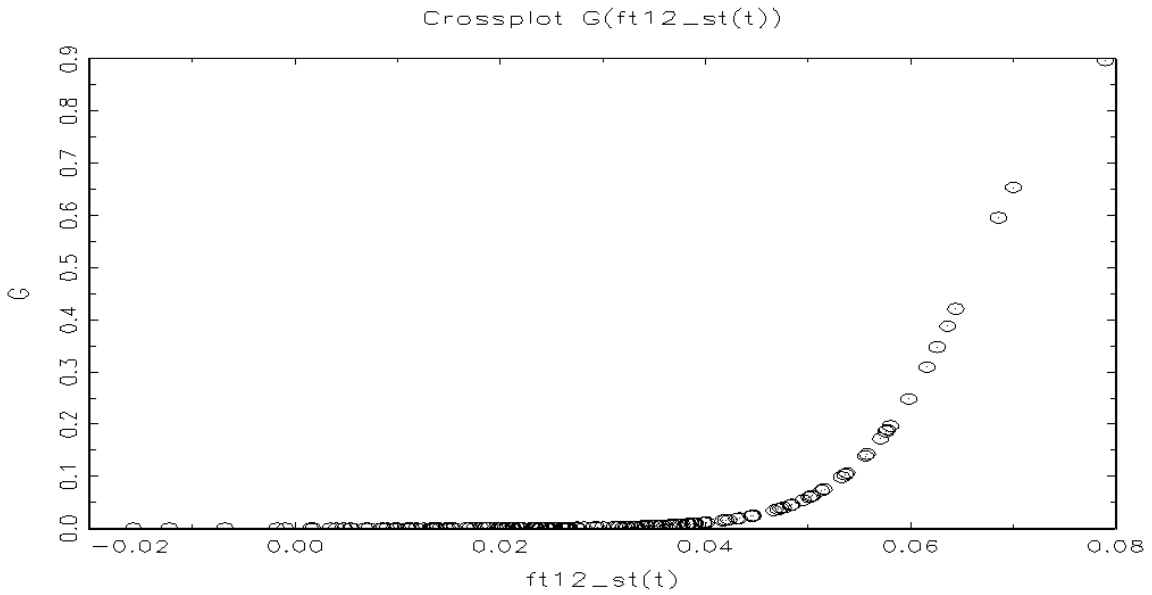

Crossplot G(ft9_st(t))
G
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft9_st(t)


Crossplot G(ft12_st(t))
G
1.00
0.90
0.80
0.70
0.60
0.50
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft12_st(t)

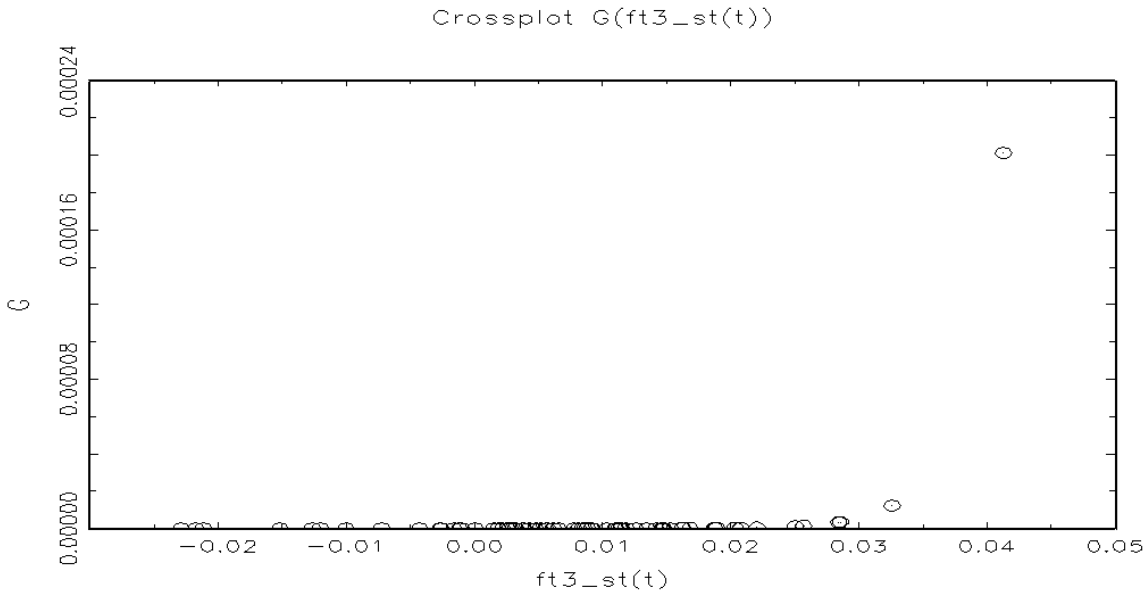
USD/RAND Dec 1996–Dec2011

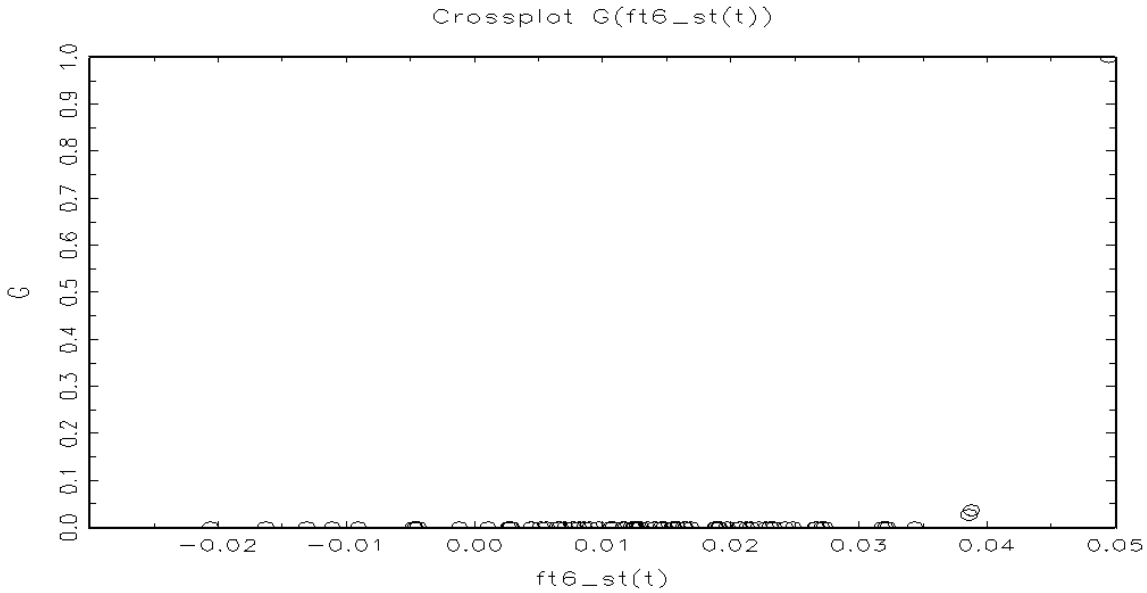


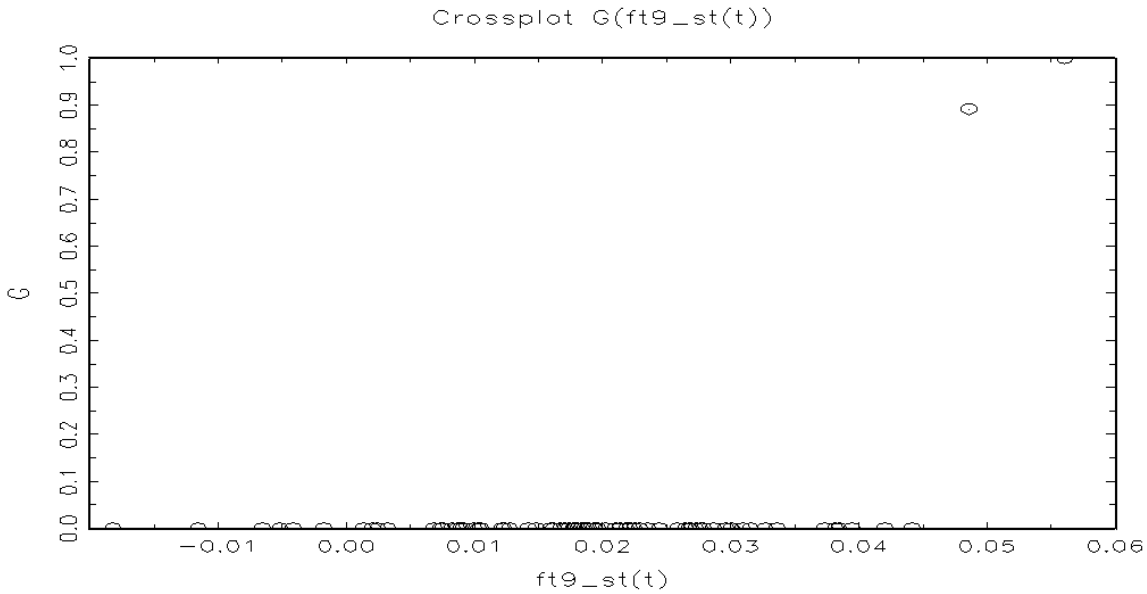


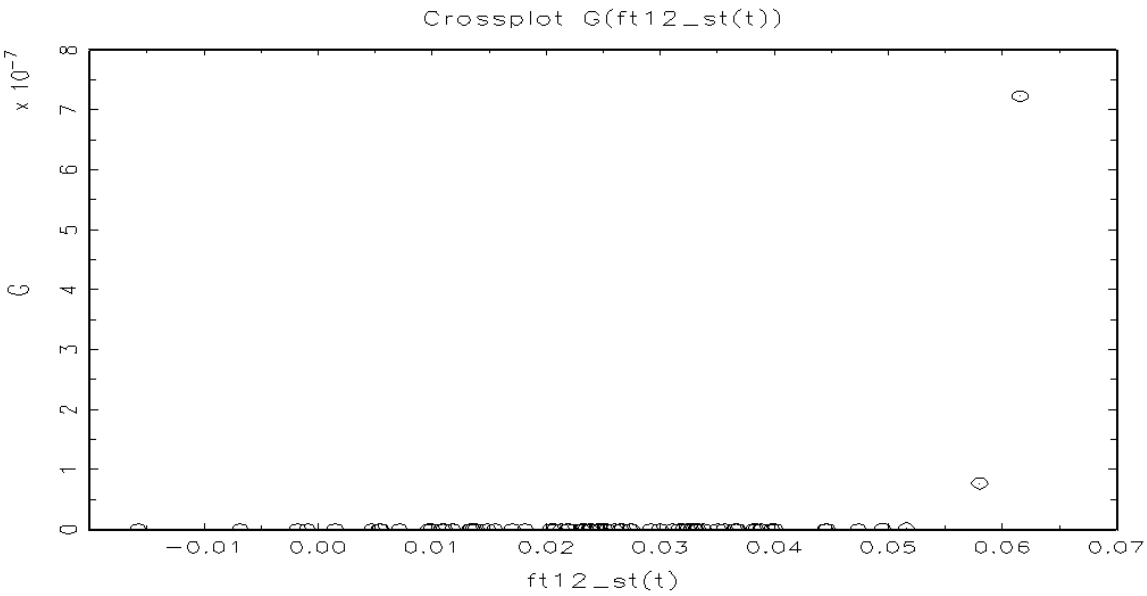

Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
−0.02
0.00
0.02
0.04
0.06
0.08
ft12_st(t)

USD/RAND July 2005–Nov 2011

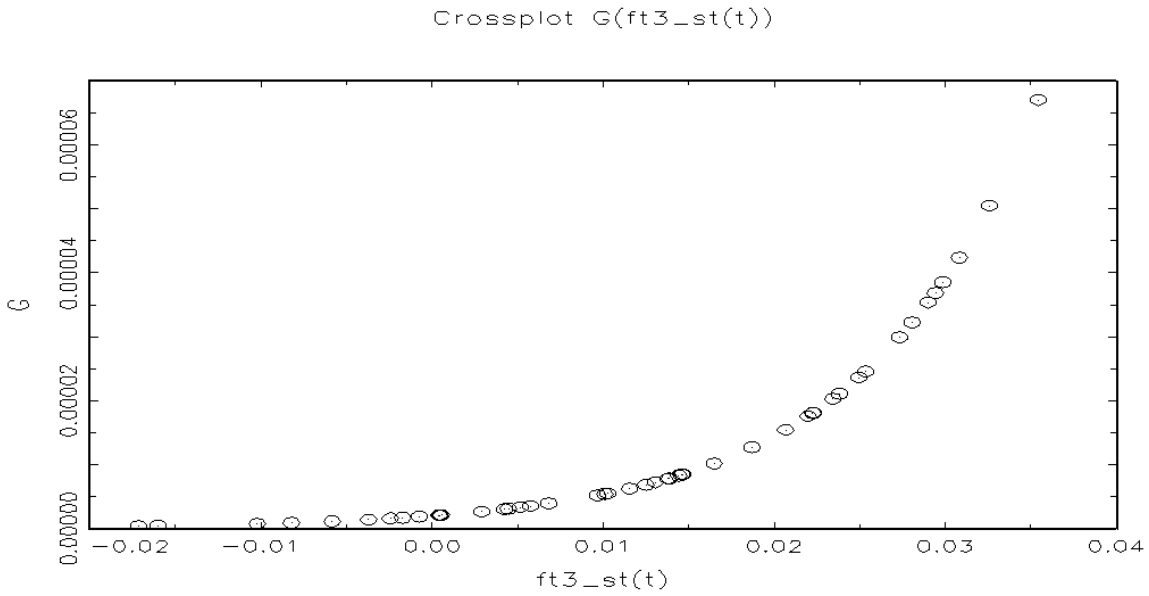


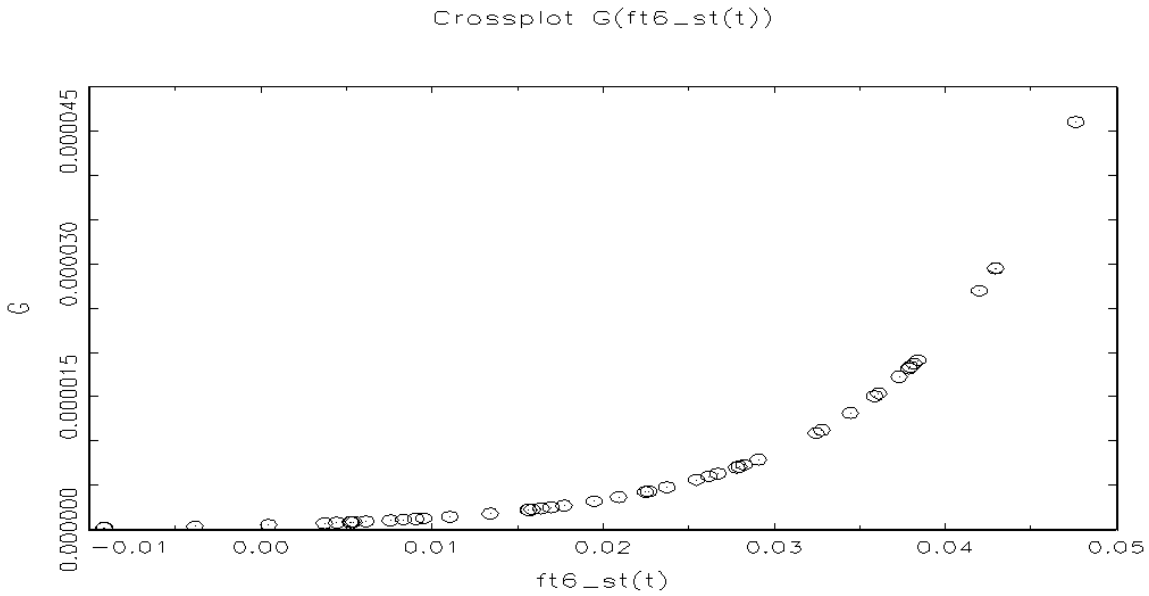


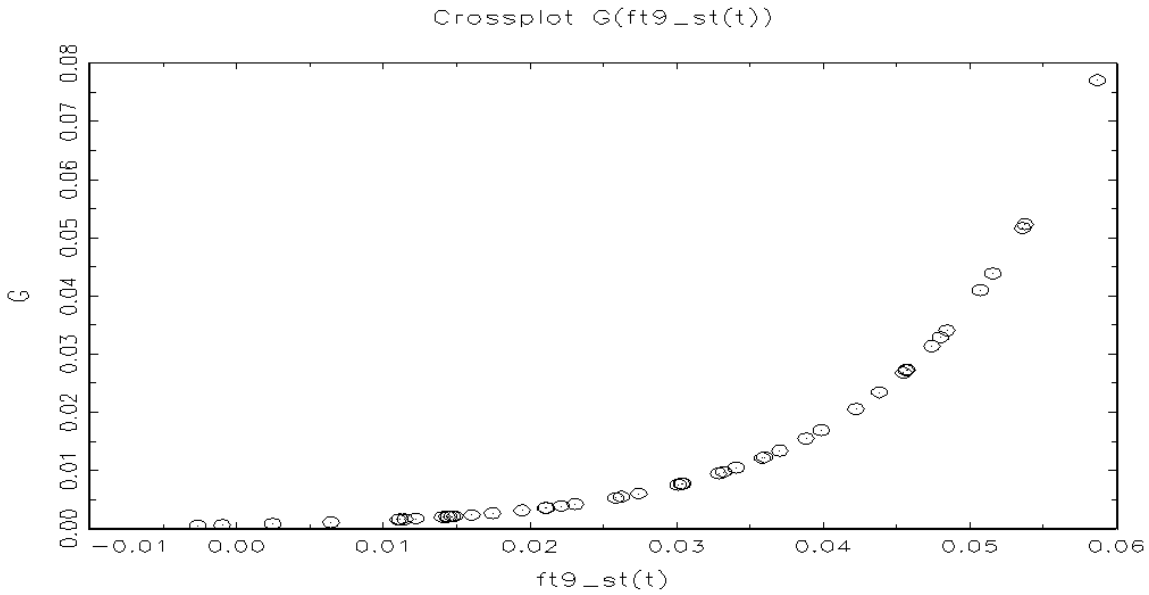

Crossplot G(ft9_st(t))
G
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
−0.01 0.00 0.01 0.02 0.03 0.04 0.05 0.06
ft9_st(t)

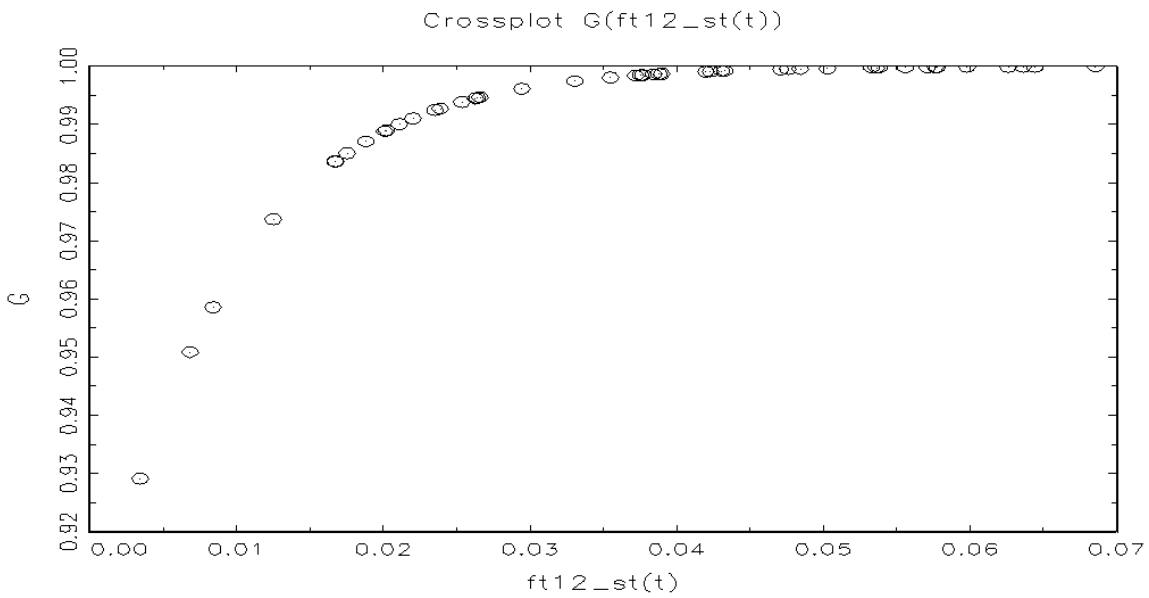

Crossplot G(ft12_st(t))
G
x 10^-7
0 1 2 3 4 5 6 7 8
−0.01 0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07
ft12_st(t)

USD/RAND Jan 2001 – Dec 2004

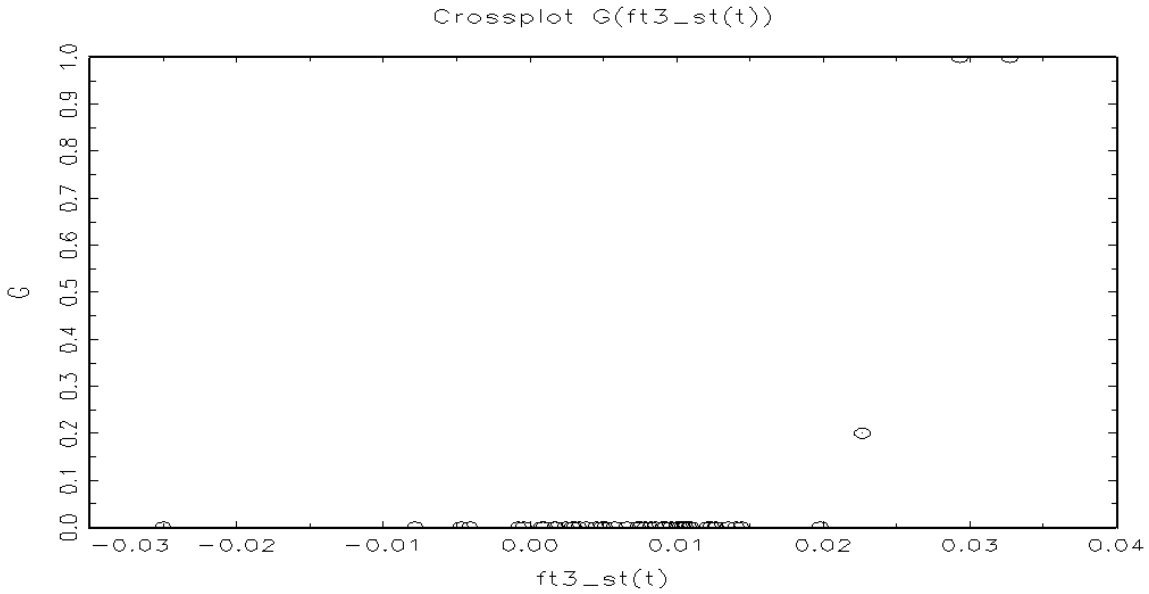


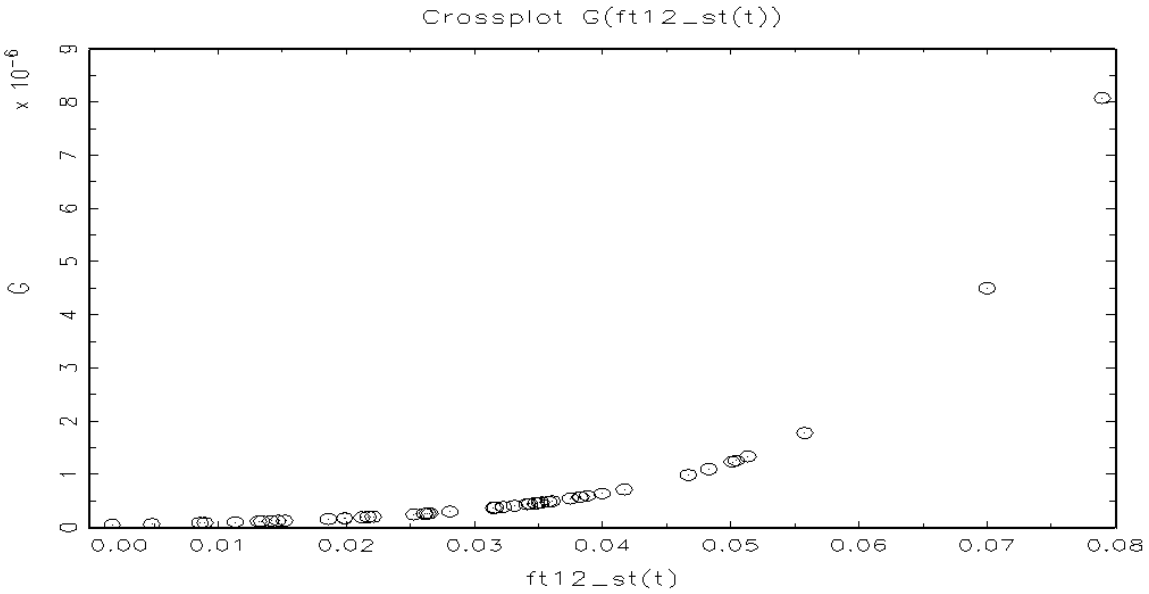



Crossplot G(ft9_st(t))
G
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
−0.01
0.00
0.01
0.02
0.03
0.04
0.05
0.06
ft9_st(t)

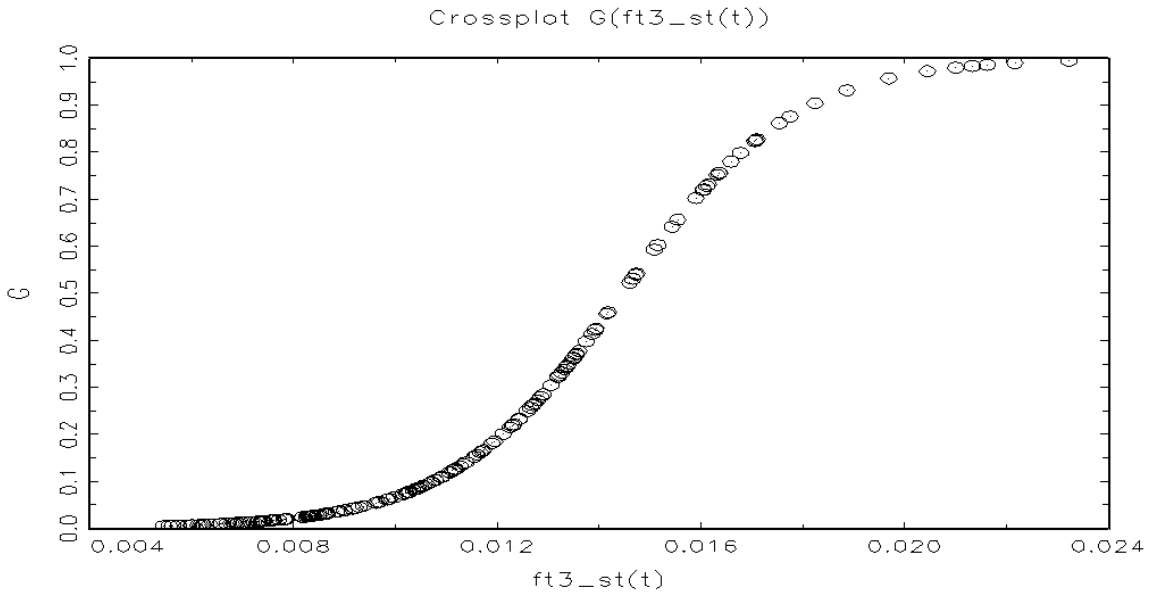

Crossplot G(ft12_st(t))
G
0.92
0.93
0.94
0.95
0.96
0.97
0.98
0.99
1.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
ft12_st(t)

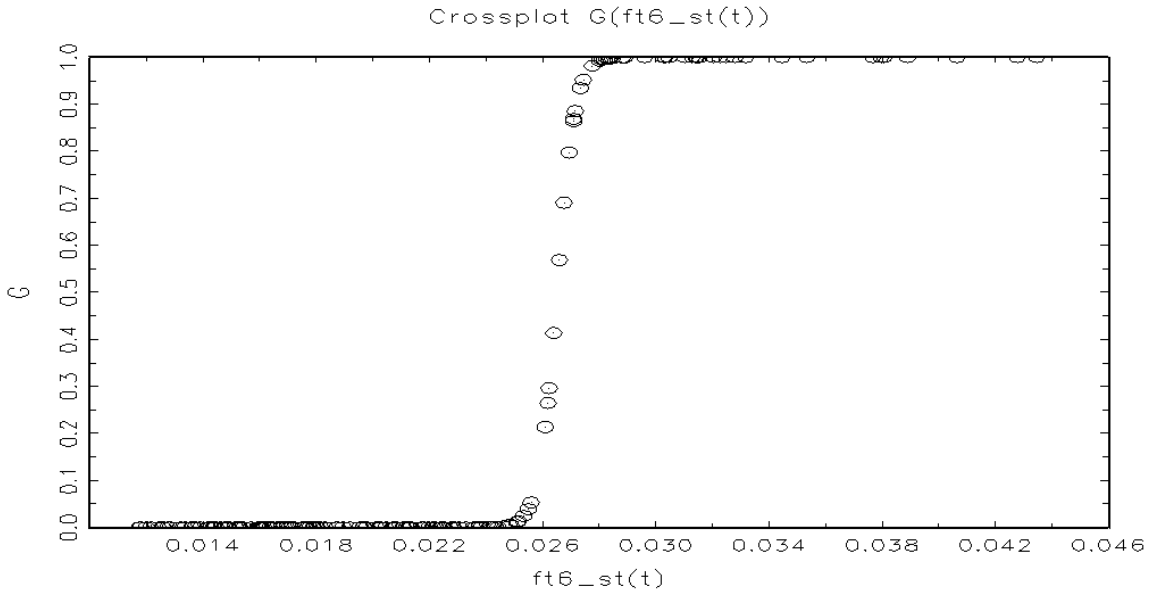
USD/RAND Dec 1996–Nov 2000

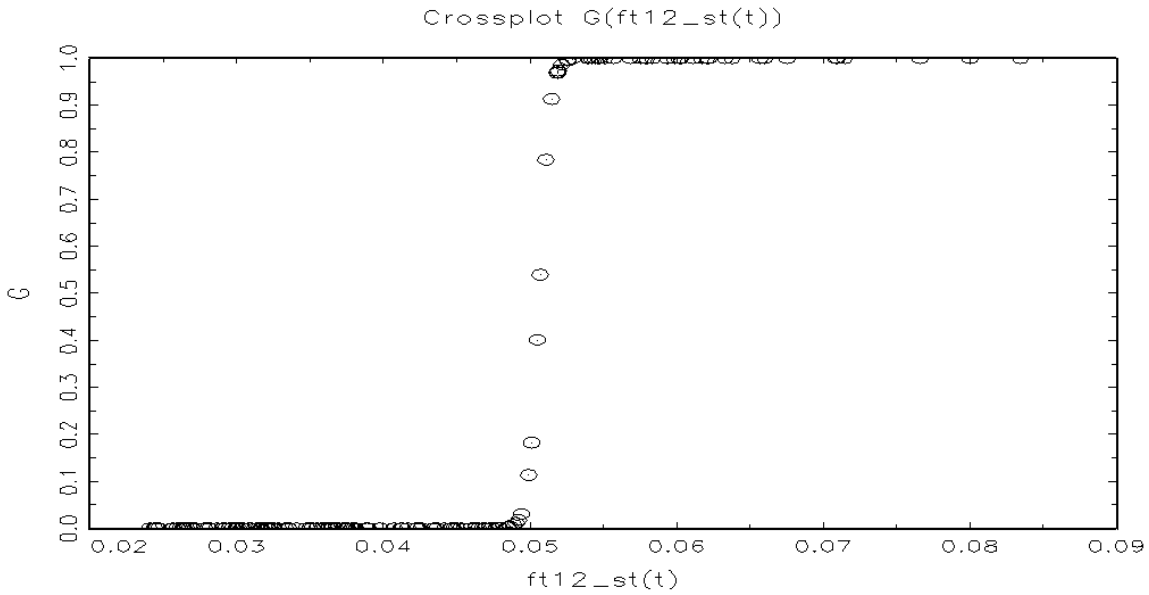




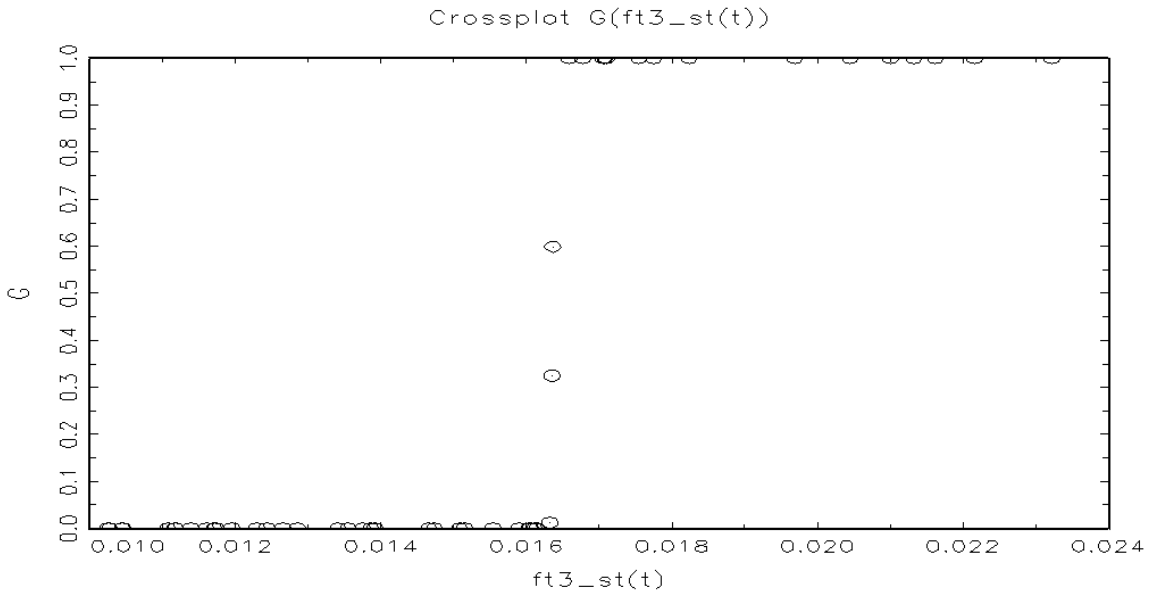
YEN/RAND Dec 1996 – Dec 2011

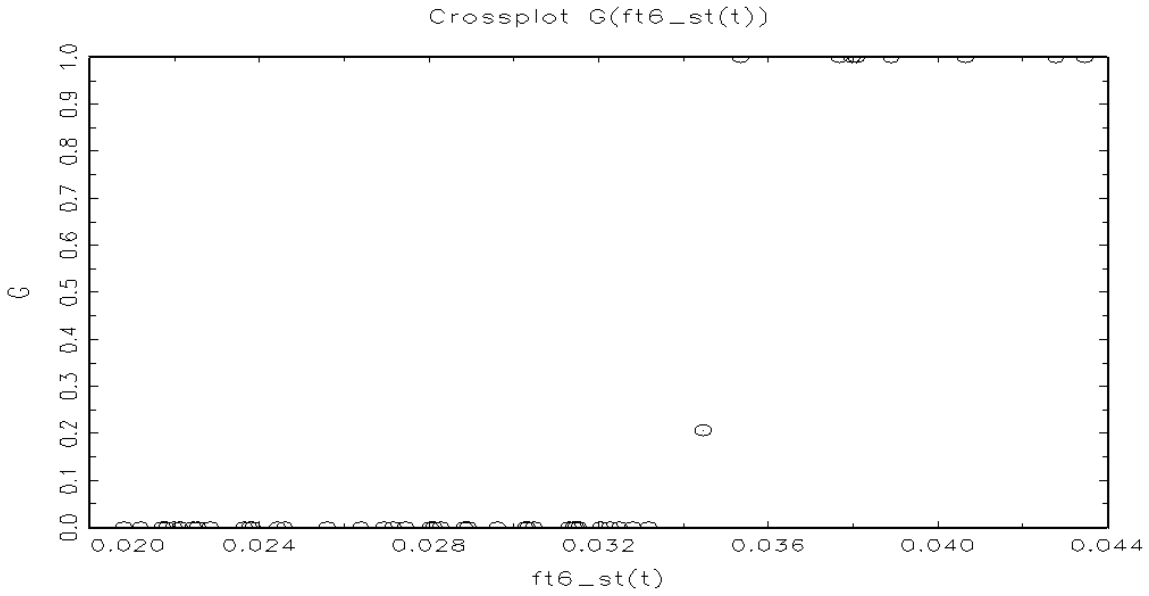


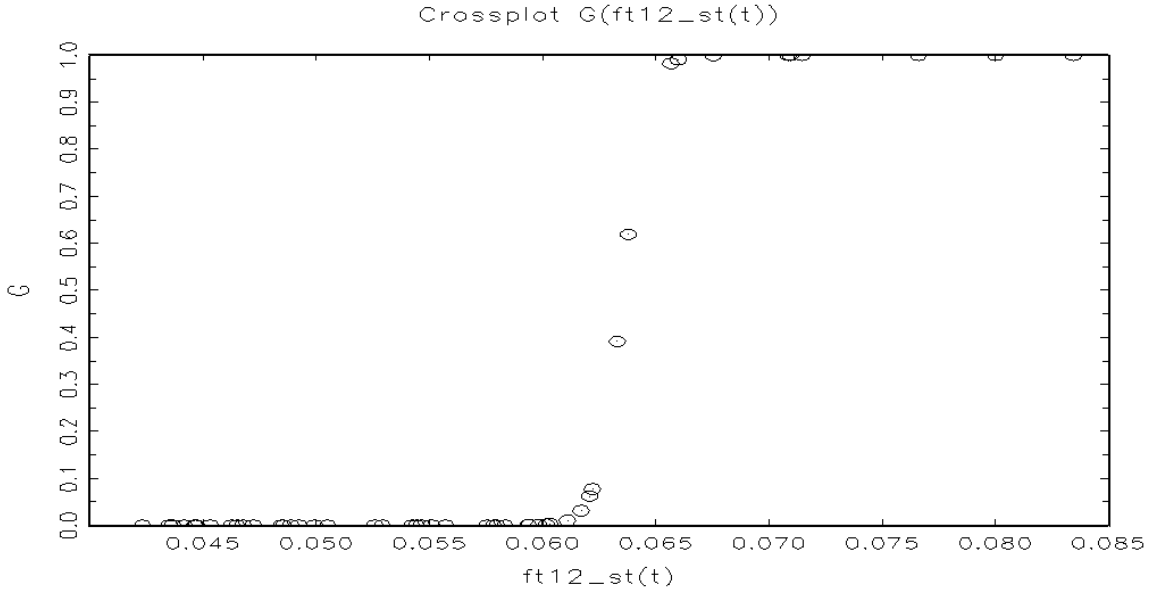



Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
ft12_st(t)

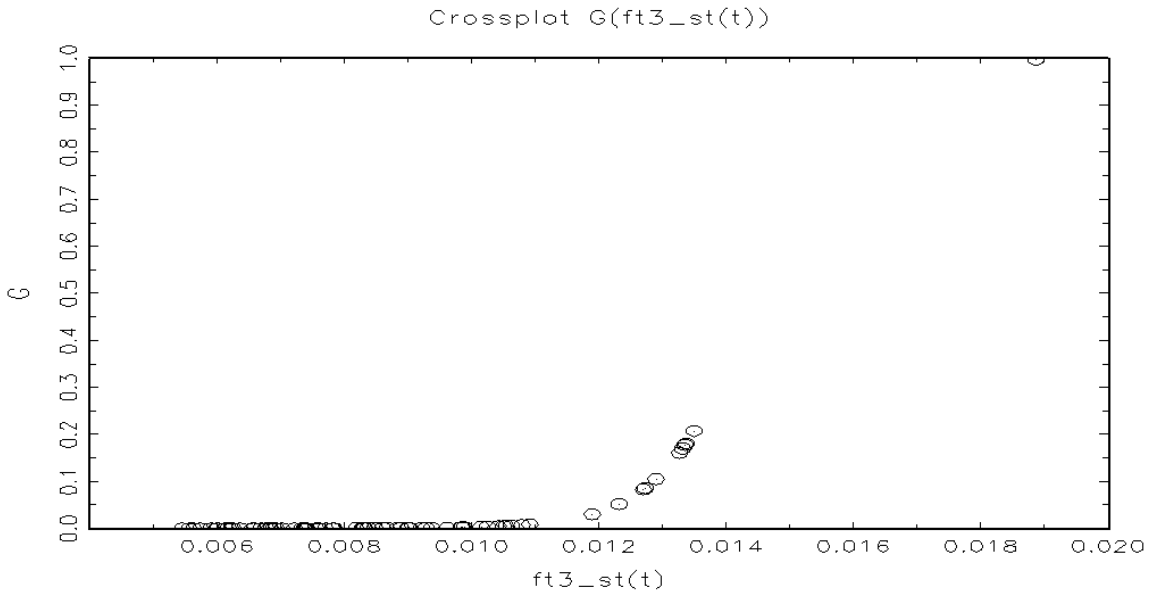
Rand/Yen Dec 1996–Nov 2000

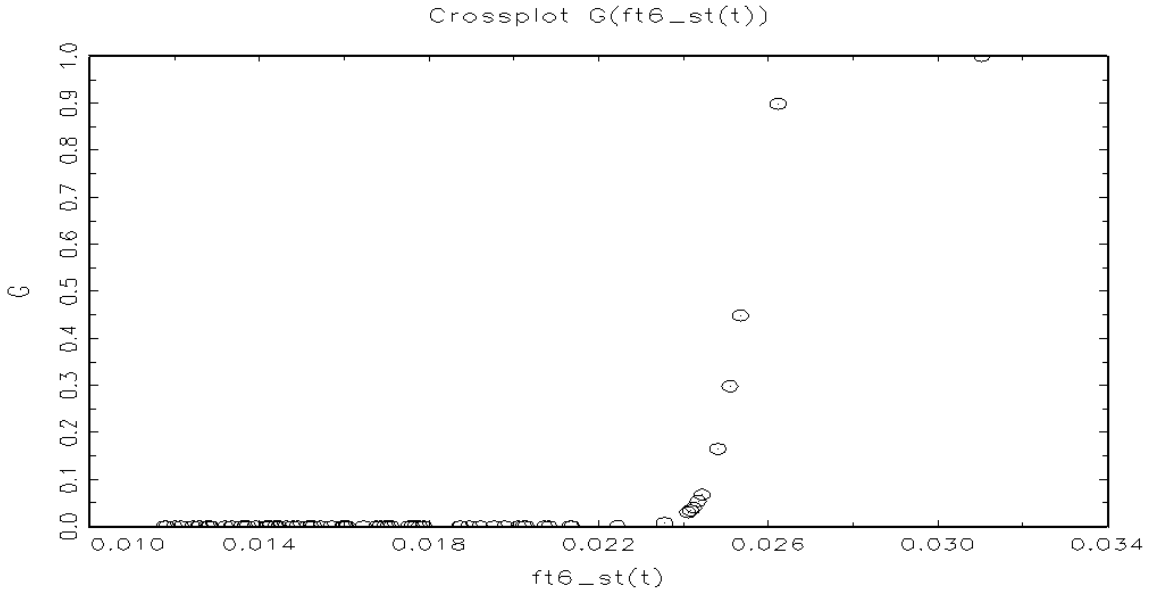


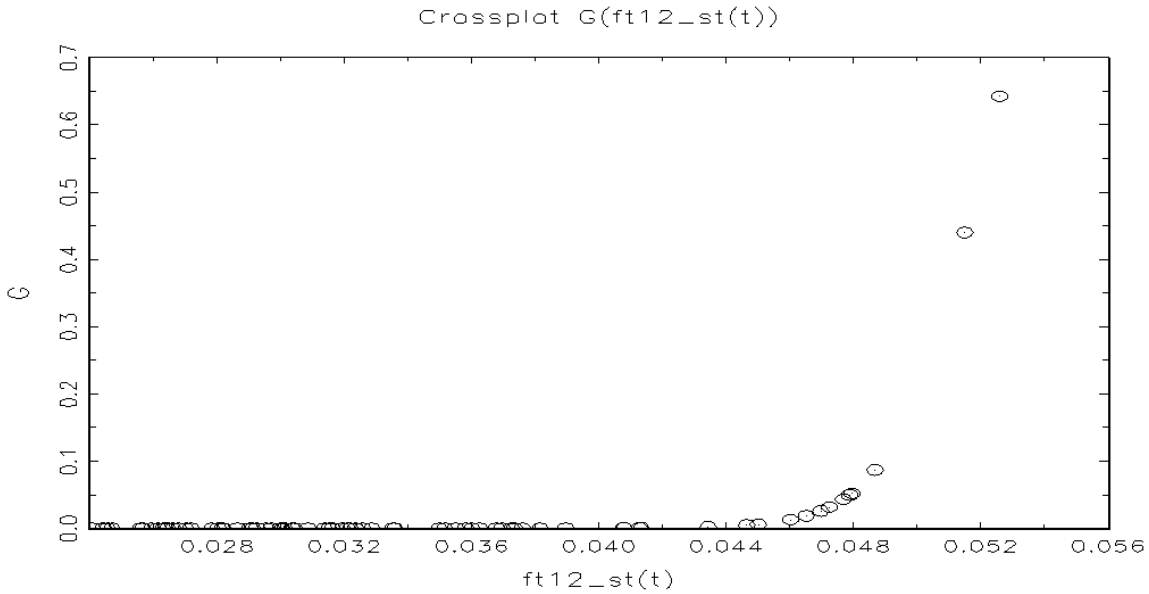



Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.045
0.050
0.055
0.060
0.065
0.070
0.075
0.080
0.085
ft12_st(t)

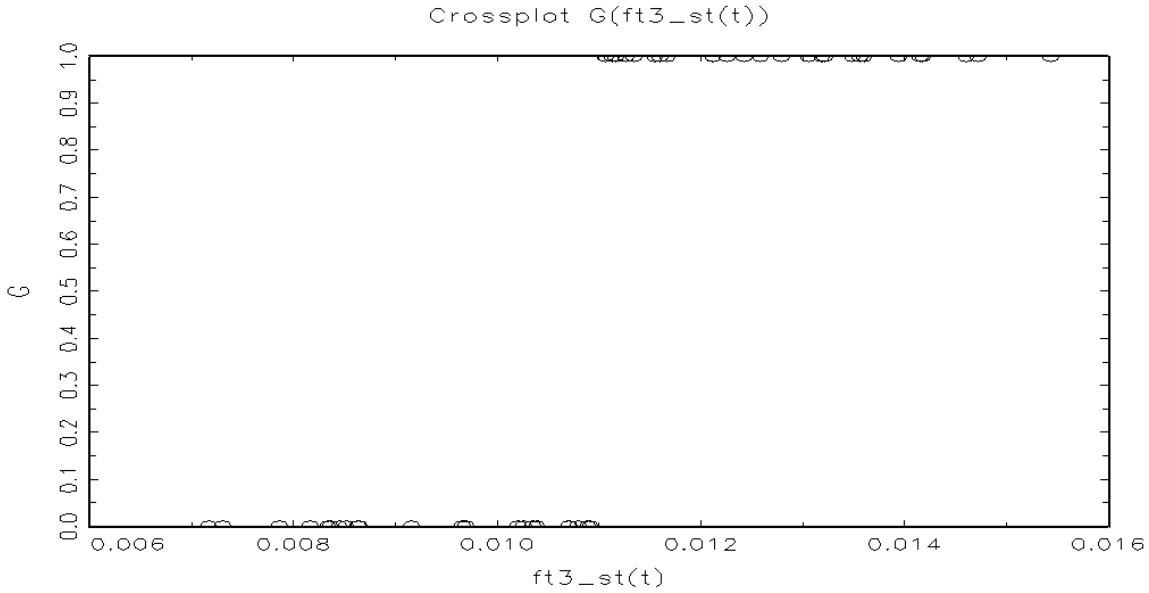
Rand/Yen July 2005–Nov 2011

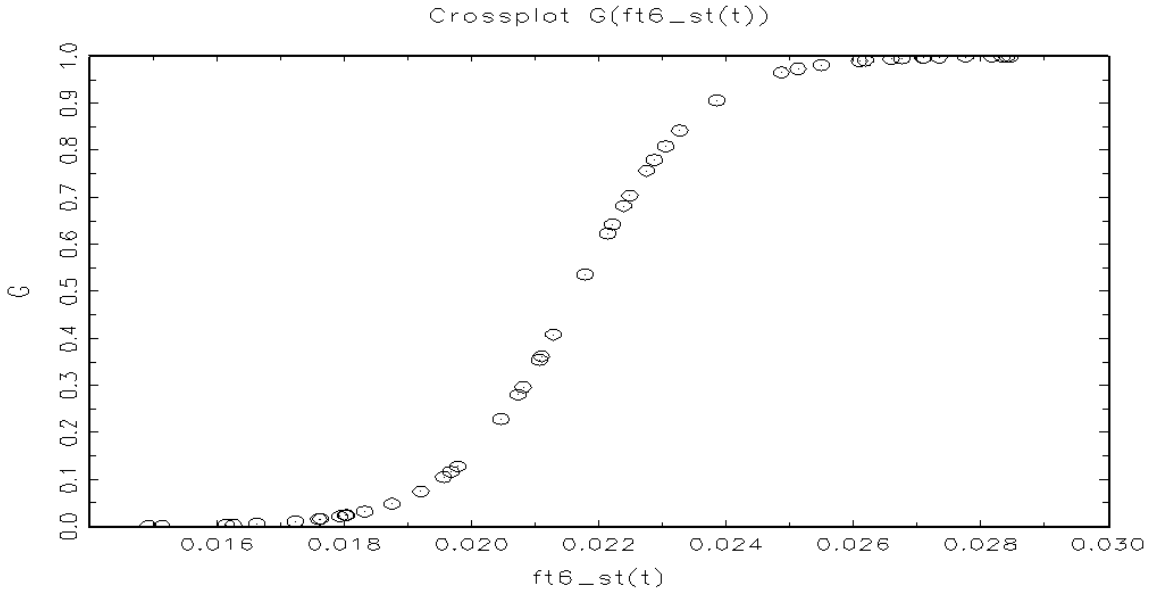


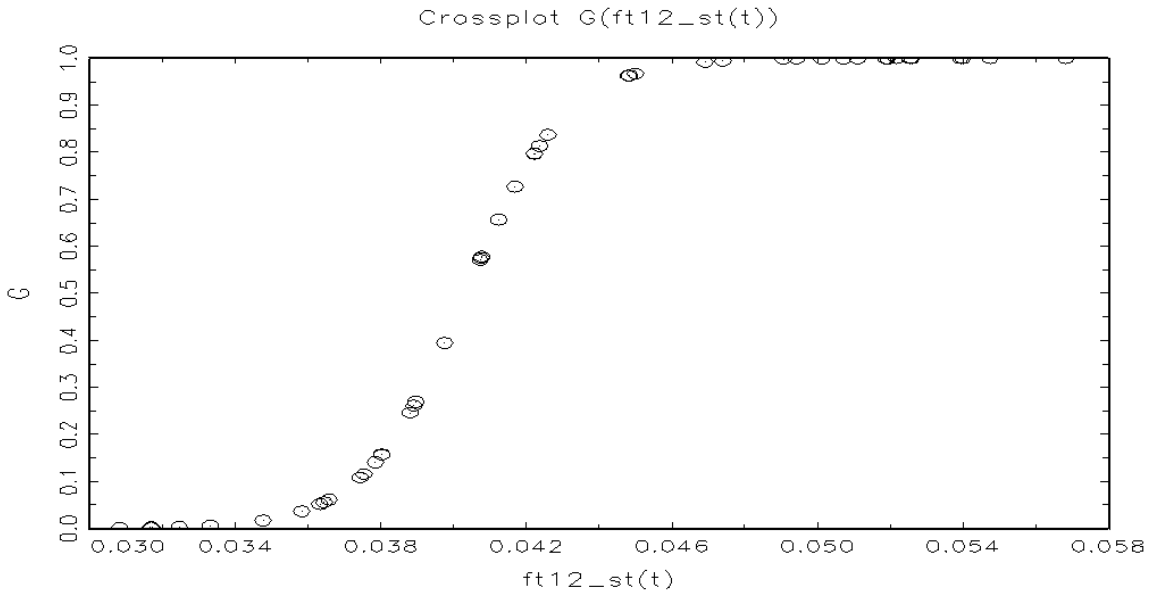



Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.028
0.032
0.036
0.040
0.044
0.048
0.052
0.056
ft12_st(t)

Rand/Yen Jan 2001–Dec 2004






Crossplot G(ft12_st(t))
G
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.030
0.034
0.038
0.042
0.046
0.050
0.054
0.058
ft12_st(t)