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Determinants of Private Investment in South Africa: Investor Confidence Index Approach

by

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A dissertation submitted in partial fulfilment of the requirements for the degree in

MAGISTER SCIENTIAE:
RISK ANALYSIS (MATHEMATICAL STATISTICS)

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January 2009

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Abstract

The paper aims at formulating an index that captures the investor sentiment in the economy under the prevailing political, economic and capital markets conditions. Before formulating an index, we *first* explore the determinants of investment in its three categories. We do this by employing a multivariate technique known as canonical correlation analysis. The results support a strong relationship between economic markets and private investment, but indicate a lesser contribution from capital markets partly due to lack of data available within such markets. *Secondly*, principal component analysis is also used to formulate an index that captures the confidence of investors, which, on the other hand, reflects on the importance of the capital and foreign markets in explaining investor confidence.

I declare that this research is my own work and has not been submitted in part or in whole to any other academic institution or for any other qualification.

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January 2009

1. INTRODUCTION

1.1 Background

Confidence in the economy and in capital markets is a critical driver of economic and financial fluctuations, and of the business cycle (State Street Corporation, 2008). When confidence increases, consumers and investors want to buy consumer goods, durables, and invest at prevailing prices. When confidence decreases, spending and risk-taking tend to fall. Therefore, it is a worthwhile exercise to attempt to measure confidence in some manner.

Portfolio theory simply states that the greater the proportion of a portfolio that professional investors are willing to devote to riskier investments, the greater their risk appetite or confidence. When risk appetite increases, investors move to increase their holdings of each risky investment in the same proportion by buying appropriate instruments in the marketplace. This process might occur when there is good news and prices are high, but could also happen over a period of bad news and falling prices. As a result, the risk appetite of institutional investors is related to, but not dependent upon, price behaviour. Actual investor holdings and recent purchases can serve as a better indicator of investor confidence.

1.2 Problem Statement

Within the South African context most of the confidence literature available is based on surveys (for example, the FNB/BER consumer confidence issued by FNB, the Purchasing Managers Index by Investec and RMB/BER business confidence index by RMB). Hence, the purpose of this study is to capture the investor sentiment by way of formulating an investor index that sheds light on whether or not investors are bullish enough to take on higher investment given the economic fundamentals and market conditions; put simply, the aim is to formulate an index that explains the investor behaviour given the prevailing socio-political and economic conditions.

1.3 Objectives

In order to capture the investor sentiment in the market, the objectives of the study are two-fold. *Firstly*, to review the macroeconomic determinants of private investment in South African economy, and, *secondly*, and most importantly, to formulate an investor confidence index within the South African context, which is based on historical and current market-related data. This basket consists of items or indicators that explain confidence in the capital market, confidence in the economic market and confidence in the foreign market.

2. LITERATURE REVIEW

2.1 Introduction

Given a lack of relevant academic literature on investor confidence indices, much of the literature in this study analyses investor behaviour (explaining the individual or institutional investor's risk appetite towards certain assets). However, these issues are still relevant to the objective of the study, given the assumption or the view that sentiment measures provide evidence of how investors trade and also which factors influence their expectations. In other words, these measures are closely related to investor confidence.

Section 2.2 discusses empirical studies behind confidence indices. Sections 2.3-2.5 will discuss the role of capital markets, foreign markets and the economic markets respectively, and the ways in which they influence investment levels in the economy.

The role of markets is included because investment on its own is not self-driven, but is rather a function of particular market conditions. Capital markets capture the current information on companies' performance and future expectations, and, hence, affect the investment decisions made by companies and individuals. On the other hand, foreign markets are an important driver of investment as they reflect the country's stability, both political and economic. Direct inflow of investment (either portfolio investment or foreign direct investment) is representative of the soundness of political and economic policies that exist within the country.

2.2 Investor confidence

A good confidence measure should indicate, for a given set of fundamentals, that investors are bullish or bearish on a risky asset. On a daily basis the Chicago Board Options Exchange (CBOT) computes Put-Call Ratio (PCR) and VIX-Investor Fear Gauge (VIX), and these are widely used as a measure of investor sentiment to gauge the prevailing level of bullishness or bearishness in the market (Bandopadhyaya, 2006).

Given the extent to which investor sentiment is an important explanatory variable in analyzing asset prices, which, in turn, indicate the level of investor confidence in the market, Bandopadhyaya (2006) measures the extent to which the two indicators (the PCR and VIX) out-perform each other in different aspects of approximating non-economic factors. Using residuals from a random walk equation to represent variations in asset prices not explained by economic factors, PCR is found to be a better measure of market sentiment.

To test if individual investor sentiment is related to daily stock returns, Schmitz, Glaser, and Weber (2007) employ vector autoregressive models and Granger causality tests on time series data divided into different classes. They show that there exists a mutual influence between sentiment measure and stock market returns, but only in the short-run. In other words, when individual investors are optimistic today, stock prices rise the following day. However, the model's predictive power is very low and therefore cannot be used to predict the future.

Unlike many studies, Schmitz *et al*. (2007) is more concerned with the predictive power of the sentiment in predicting stock returns, rather than investor sentiment as a measure of investor confidence. Sentiment measures should provide evidence on how investors trade and which factors influence their expectations, and, in turn, reflect the level of investor confidence in the market.

In studying the behaviour and decisions of investors (so as to understand the indicators of investor confidence), Burghardt (2007) found that decisions of individual investors in the stock market are usually influenced by the expectations and the behaviour of other investors.

In modelling the index, Burghardt (2007) used two approaches: the Investor Confidence and Expectation index (ICE), which measures the investor confidence, and expectations measured by the ratio of investor-executed buy and sell orders. The ICE index assumes that the higher the risk of the traded security, the higher the investors' confidence in their

market expectations. The Investor Risk Attitude Index (IRA) measures the risk attitude investors show in their trading decisions by assuming that the securities' inherent risks do not differ according to their option type, *i.e.* puts and calls of the same category are assumed to have the same impact on the IRA. The option type variable is therefore omitted.

However, the ICE and IRA indices can be seen as measuring investor confidence and risk attitude based on transactions between retail investors and institutional market makers, and by using market data, not surveys, they can be easily used in the understanding of historical investment trends or patterns.

Alfa Banks' investor confidence index (AB_ICI) methodology combines indicators that reflect confidence levels amongst portfolio and strategic investors, both Russian and foreign, as well as amongst bank depositors. Included in the variables were the foreign-currency corporate bond markets (including spread, duration and diversification), the performance of the stock market (normalized returns and the entry of new companies), the sovereign spread, capital outflows, GDP and sector-based growth, and the composition of retail banking deposits. The Index also takes into account foreign direct investment and the share of foreign banks in Russia's banking sector (Alfa Bank, 2003).

The AB_ICI follows the approach of Stock and Watson (1989), which assumes that each variable is based on the common factor, confidence, as well as an idiosyncratic component with a certain degree of independence. Both the common factor and the idiosyncratic component are characterized by inertia (in econometric terms, both follow certain auto-correlated processes). An estimate using the Kalman filter then determines the best statistical decomposition of the joint behaviour of the selected variables as expressed by a common factor (the confidence index) and the idiosyncratic part. Further, the AB_IC index is calculated based on three main components with different respective weights; an indicator reflecting capital markets confidence (20%), an indicator reflecting foreign confidence (37%), and an indicator reflecting confidence it the economy (43%).

An approach by State Street Corporation (2003) measures confidence directly and quantitatively by assessing investor holdings of risky assets. That is, their index sheds light on whether or not institutional investors are bullish enough to take on higher risk investments given economic fundamentals and market conditions, similar to the way consumer confidence surveys aim to determine whether or not consumers are willing to spend money.

Another interesting confidence index measure that has gained much attention recently is the Barron's confidence index, which is the ratio of high grade bound price to intermediate grade bound price (Investopedia, 2008). The index is supposed to indicate the general faith in corporations, by showing concerns with default on their debt.

2.3 Capital markets

Capital markets are places where investors buy and sell company and government securities. Their trading decisions reflect information on company performance provided by financial statements and financial analysis, dividend announcements by companies, market expectations on the future levels of interest rates and inflation, and investment decisions made by companies.

The good functioning of the capital market is vital in the economy, in order to achieve an efficient transfer of monetary resources from those who save money toward those who need capital and who succeed in offering a superior utilization. The capital market can have a significant influence on the quality of investment decisions (Stoica, 2002).

Capital markets with adequate depth play an essential role in economic development by mobilizing funds to finance longer-term projects. Within the South African context capital markets typically consists of three main components: long term bank loans and deposits, the bond market and the equity market.

In his address of 7 November 2006, Governor Mboweni (2006) pointed out that in an environment where all three components of capital markets are adequately efficient, bank loans would generally provide bridging finance or be used for smaller amounts of funding. When larger projects are to be funded, and as credit ratings improve, it makes more sense to issue bonds, because of the lower and fixed funding costs. However, maintaining a good credit rating implies that an acceptable debt/equity ratio has to be maintained, which in turn requires funding in the form of equity. In this regard, the equity market plays an essential role.

Again, good primary market functioning depends also on the credibility, attractiveness and efficiency of the secondary market. The stock exchange inspires trust to participants, confers legality to operations and instils trust to obtain the best price at the moment. The stock exchange is labelled as a "resonance box" for economic, political and social events, both internal and international, and reflects the state of the economy. Necessary conditions for the securities markets to operate with some degree of efficiency are: a stable macro-economic environment, an appropriate capital market infrastructure, and an adequate regulatory, legal and supervisory framework in order to protect investors, promote public confidence, and guarantee market discipline.

2.3.1 The bond and equity market

The equity (or stock) market is defined as a private or public market for the trading of company stock (and derivatives of company stock) at an agreed price. Both of these are securities that may be listed on a stock exchange or only traded privately. This market has an important role in the allocation of resources, both directly as a source of funds and as a determinant of firms' value and borrowing capacity.

In examining the relationship between equity prices and investment that is specifically addressing the question of whether investment is influenced by inefficient pricing in equity markets, Tease (1993) found that, while there is a significant relationship between share prices and business investment in some countries (the United States, Japan, the

United Kingdom and Canada), this largely reflects stock price correlation with, and anticipation of, other macroeconomic developments. This simply reflects the importance of considering other macroeconomic factors in determining the level of investment.

On the other hand, the bond market is a financial market where participants buy and sell debt securities, usually in the form of bonds. References to the "bond market" usually refer to the government bond market, because of its size, liquidity, lack of credit risk and, therefore, sensitivity to interest rates. Because of the inverse relationship between bond valuation and interest rates, the bond market is often used to indicate changes in interest rates or the shape of the yield curve.

Andritzky, Bannister and Tamiris (2007) examined the impact of macroeconomic announcements on emerging market bonds, and found that global emerging bond markets appear to respond mainly to announcements of changes in international ratings, which are designed to serve as composite forward-looking indicators of domestic fundamentals and policy developments and a broad measure of country risk. Changes in global interest rates also tend to affect the level of spreads, possibly because they lower the cost of funding for international bond investors and the cost of financing for emerging market sovereigns.

Moreover, sustaining a stable macroeconomic environment enhances the development of bond markets in general. In a volatile macroeconomic environment characterized by volatile inflation and interest rates, companies are likely to make short-run investment decisions. On the demand side, institutional or individual investors in financial markets develop a preference for assets with shorter maturities such as bank deposits and government treasury bills and hence starving the bond market from funds.

2.4 Economic markets

The good overall microeconomic and macroeconomic fundamentals inspire confidence and optimism in the economy. Aggregate output is a common indicator used to predict the future growth or market potential of a country. At the microeconomic level aggregate

output is a helpful measure used in estimating the future profitability of an investment. For instance, if aggregate output is expected to grow in the future the firm will view this as an increase in demand for their own products.

In assessing economic markets, selected key macro-economic variables (which have direct or indirect relationships with investment) were investigated. Jorgenson (1971) pointed out, in his accelerator theory, that macroeconomic policy can affect private investment by affecting domestic demand directly. For example, a contractionary monetary policy that raises interest rates and/or constrains credit expansion will reduce aggregate demand which will, in turn, reduce private investment; therefore, the country's growth is vitally important in this analysis since monetary policy adjustments are often implemented to respond to growth.

Movement in the exchange rates, say devaluation or depreciation, boosts the export sector of the economy, and will also be favourable to the acquisition of local assets by foreign companies (Froot and Stain, 1991). In other words, real exchange rate depreciation increases profitability in export-oriented sectors and, therefore, promotes investment in those sectors. Conversely, the volatility and the unpredictability of exchange rates increases uncertainty, which discourages long term investment in capital stock in favour of short run speculative activities.

One of the main questions debated by policy makers and researchers is whether public investment stimulates private sector productivity, thereby increasing economic growth. This is because, while public investment may be considered a factor input that contributes positively to economic growth, the way public investment is financed may crowd out private investment, as argued by Mittnik and Neumann (2001). Public sector investment has also been suggested to affect private investment, although its impact remains ambiguous. In other words, public investment can also improve or boost private investment by increasing private returns through the provision of infrastructure.

Many firms in developing countries rate skills shortages and labour regulations as major constraints on their operations. Government policies in both areas have a wide ranging impact on the investment climate. Shortage of skilled labour prevents firms from entering new markets or adopting more advanced technologies. Regulations can restrict the ability to adjust the organization of work, reducing incentives to pursue new opportunities (World Bank Investment Climate Surveys, 2001).

In addition, the monetary policy indicators will be used to assess the overall tightness or looseness of reserve bank policy. High interest rates, *ceteris paribus*, are an indicator of tight monetary policy, while low rates reflect a loose monetary policy stance. Moreover, both theory and empirical evidence suggest that there exists a negative relationship between interest rates and investment, since higher real interest rates causes borrowing of capital to be more costly, thus discouraging investment. Growth in broadly defined money supply is indicative of the current direction of the reserve bank policy: strong growth may be a result of a resilient domestic economic activity and the increase in the level of interest rates which raised the return on holding monetary assets relative to other asset classes.

2.5 Foreign markets

At the country level, macroeconomic and political stability, appropriate regulatory policies, and infrastructure development are needed to increase Foreign Direct Investment (FDI). Hence, the FDI offers a rich laboratory in which a level of confidence in one country can be measured. The FDI inflows to and outflows from a country may be useful indicators of economic health and investment appeal. Countries with major inflows probably represent growth opportunities. Countries with major outflows probably represent created wealth, or strategic positioning, or less appealing home country investments. Inflows are probably clearer indicators of the economic position than outflows.

Johnson (2006) examined the impacts of FDI inflows on the host country's economic growth and found that FDI inflows enhance economic growth in developing economies but not in developed economies. This may be attributed to the fact that in a mature market economy the state of technology is advanced, hence there is no marked difference between domestic and trans-border investment.

Sovereign ratings increasingly influence investment decisions in both developed and developing countries (Ratha, Prabal De and Mohapatra, 2007). As a result, they are widely employed by investors to determine prices and to take decisions regarding buying and selling public external debt securities. Moreover, rated government bonds are preferred by lenders to those of governments which are not risk-rated. Canuto (2004) maintains that the fairly widespread use of the risk ratings to manage risk exposure is a sign that investors consider them to be appropriate indicators of the probability of default.

2.6 Conclusion

Capital, economic and foreign markets influence private investment differently with varying intensities. The selection of variables from these markets and the weighting of such variables in explaining the levels of investment in South Africa are of critical importance in this study. Informed by the basics and the findings of the above literature, a number of key variables will be used in the analysis by employing two important multivariate techniques, the canonical correlation analysis (CCA) and the principal component analysis (PCA) as detailed in Section 3.

3. METHODOLOGY

3.1 Introduction

Since this research is based on the view that investment return is dependent on returns available in the financial markets, together with the economic or political environment in which the markets operate, the index should be constructed using carefully selected variables that reflect the level of confidence among domestic and foreign investors (in terms of the capital markets, foreign markets and economic markets).

The performance of individual indicators in this case will depend on the causes behind a specific economic cycle. Some indicators may perform better in one cycle and others better in a different cycle, hence it is necessary to have signals for many possible causes of cyclical change and to use all possible indicators as a group.

The methodology in this study is a two step procedure. *Firstly, to* capture the determinants of private investment in South African economy, canonical correlation analysis, proposed by Hottelling (1939), will be employed. *Secondly*, to formulate the investor confidence index principal component analysis (PCA) will be employed.

3.1.1 Canonical Correlation Analysis

Canonical correlation analysis measures the strength of the overall relationships between the linear composites (*canonical variates*) for the independent and dependent variables. The correlations of interest will be the strongest correlations between any linear combination of dependent variables with any linear combination of independent variables.

The simple logic behind canonical analysis is to determine the vectors from the linear combinations of variables X_i and Y_i, Such that the canonical variates U_α and V_β are maximally correlated and defined by:

$$(\alpha, \beta) = \text{argmax}|\text{corr}(\alpha^T X, \beta^T Y)|$$

Hair *et al.* (1998) argues that the objectives behind canonical correlation analysis are three-fold:

- Determining whether two sets of variables are independent of one another or, conversely, determining the magnitude of the relationships that may exist between the two sets.
- Deriving a set of weights for each set of dependent and independent variables so that the linear combinations of each set are maximally correlated.
- Explaining the nature of whatever relationships exist between the sets of dependent and independent variables, generally by measuring the relative contribution of each variable to the canonical functions (relationships) that are extracted.

For the focus area of this study we use canonical analysis to derive a set of weights for each of the dependent and independent variables so that the linear combinations (using these weights) of each variable set are maximally correlated. We will then use the canonical correlation coefficients as a measure of association between the two sets of variables. For this analysis the first set of variables (our dependent measures) consists of total gross fixed capital formation ($GFCF_t$), *i.e.*, the three respective investment categories; and the second set of variables (our independent measures) consist of variables representing various aspects of the economic markets, capital markets and the foreign markets.

One of the most powerful advantages of the canonical analysis technique is that, unlike regression analysis, where one of the networks must be uniplex, here both the "predictor" and the "criterion" networks can be multiplex. That is, in canonical correlation analysis most causes have multiple effects and most effects are multiply caused.

3.1.2 Principal Component Analysis

The second part of the analysis is to formulate the investor confidence index using principal component analysis (PCA). Recent interest among academics has been in the construction of an asset index that measures poverty, using PCA (Sricharoen and Buchenrieder, 2005, Filmer and Pritchett, 2001, Vyas and Kumaranayake, 2006) (World Development) or MCA, multiple correspondence analysis (Booysen *et al.*, 2008).

PCA is a multivariate data analysis procedure that involves a transformation of a number of possibly correlated variables into smaller number of uncorrelated variables along axes known as principal components. Mishra (2007) upholds the excellence in the mathematical properties that lie behind PCA. That is, given $X = (X_1, X_2, \dots, X_n)$ one may obtain *n* indices that are orthogonal with each other and explain all variation within the original variables. Additionally, the first principle component, that is a candidate for making a single index, explains the largest proportion of the variation in the variables $X = (X_1, X_2, \dots, X_n)$.

This approach develops a composite index by defining a real valued function over the relevant variables objectively. This approach is useful given a set of explanatory variables upon which the selection of the most important variables or a limited number of variables from a set has to be made. Moreover the Indian Department of Information Technology (2005) claims that the principal of this method lies in the fact that when different characteristics are observed about a set of events, a characteristic with higher variation explains a higher proportion of the variation in the dependent variable compared to a variable with lesser variation.

3.2 Data Diagnostics

Time series data was obtained from the South African Reserve Bank on 16 variables computed on a quarterly basis, with the total number of observations at 152. One of the inherent challenges experienced in data collection was lack of lengthy data on capital market indicators; however, in this analysis we use the yield on loan government stock traded on the bond exchange for 10 years or more to capture movements in bond markets and the total value of shares traded, *i.e.* the stock exchange transactions, represents secondary market movements.

3.2.1 Descriptive Analysis

According to Table 1 below, the Jarque-Bera test for Normality rejects the hypothesis that the individual samples are Normally distributed. By the same token, the canonical correlation and the principal component analysis are based on the assumption that the data is multivariate Normal, which is another reason the two methods would not work on the original data as it does not follow Normality.

Table 1: Descriptive Statistics of Individual Samples

	Domestic credit	Domestic deposit	Exchange rates	Foreign assets	Foreign deposits	GDP	Gov Investment	M3
Mean	308534	909	0	59776	186	191838	7814	282612
Median	124815	14	0	8345	60	185630	7434	118793
Maximum	1708747	13138	24	510042	1321	321018	13611	1653244
Minimum	7004	-2	-16	781	3	112611	4155	7281
Std. Dev.	392734	2957	5	111303	331	47080	2173	370053
Skewness	2	3	0	2	2	1	1	2
Kurtosis	5	12	8	8	6	3	2	6
Jarque-Bera	91	720	148	270	199	11	10	126
Probability	0	0	0	0	0	0	0	0

	M labour cost	credit extension	Prime	Private Invest	Public Invest	Shares	Terms of trade	Yield on Gov
Mean	51	275486	15	20459	4459	25289	113	12
Median	35	111963	15	18431	4241	1544	107	13
Maximum	129	1622453	25	49873	9205	282668	152	18
Minimum	4	5346	8	9428	1640	39	89	7
Std. Dev.	43	360596	4	8196	1517	52540	14	3
Skewness	0	2	0	1	1	3	1	0
Kurtosis	2	6	2	5	3	12	3	2
Jarque-Bera	16	123	7	78	11	678	34	13
Probability	0	0	0	0	0	0	0	0

3.2.2 Test for Stationarity

Before exploring the univariate properties of the data the graphical representation shows (in Appendix A) a non-stationary pattern for all the variables except for the exchange rate variable. The log-transform technique is applied on the data converting the exponential trends to linear patterns. Only the non-negative variables were converted (the prime lending rate was left unchanged). After the transformations some variables (as shown in Appendix B) did have an upward trend and were not completely stationary; hence, these necessitated a need to conduct formal Augmented Dickey Fuller and Phillips-Perron tests for stationarity.

As the results in Table 2 show, the two tests confirm the presence of stationarity for variables such as exchange rates, foreign deposit and public investment. While for yield on government loan stock, domestic deposit, foreign assets, GDP, government investment, M3, private credit extension, private investment, shares, and domestic credit variables became stationary upon first differencing. The only conflicting results came from variables such as the manufacturing labour cost, and in this case we take the Phillips-Perron as it is consistent with the findings from the graphical analysis reported in Appendix B. The same argument holds for the prime rate variable, but for the terms of trade we will use the results of the ADF test.

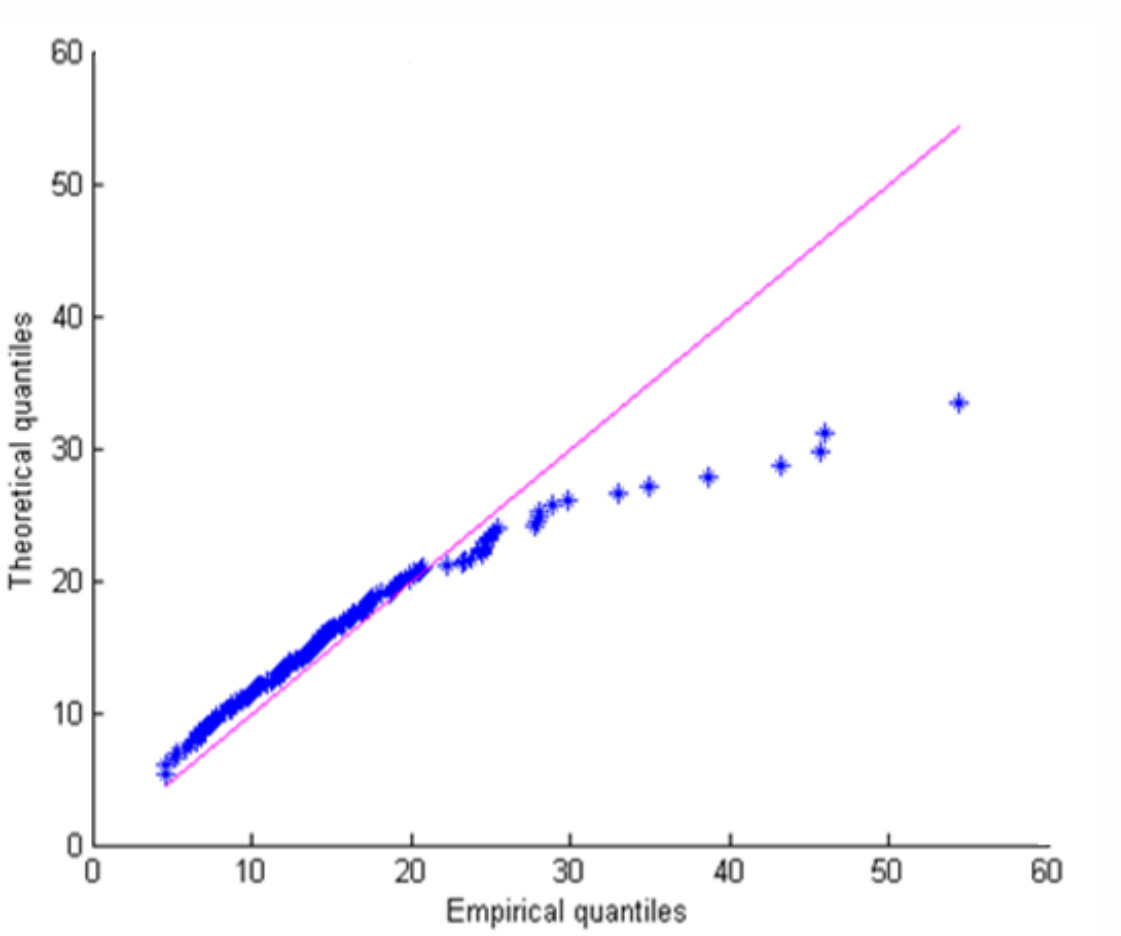
Table 2: Augmented Dickey fuller Test (1970–2007)

	ADF		Phillips-Perron	
	I(0)	I(1)	I(0)	I(1)
Domestic credit		-6.77192***		-8.961804***
Domestic deposit		-3.568027***		-7.029763***
Exchange rates	-11.90643***		-11.90298***	
Foreign assets		-5.531592***		-9.87683***
Foreign deposits	-3.518603***		-3.518603***	
GDP		-4.321765***		-20.42982***
Gov Investment		-5.743336***		-19.86956***
M3		-8.634878***		-8.969093***
Manu labour cost	-3.052699**			-10.08651***
Private credit extension		-4.303018***		-6.927129***
Private Investment		-4.4429***		-17.36625***
Prime	-3.006406**			-6.990860***
Public Investment	-2.726587*		-3.138881**	
Shares		-14.58155***		-14.59285***
Terms of trade		-16.96682***	-2.769786*	
Yield on GOV		-9.754266***		-9.585131***

N.B. ***, (**), (*) denotes significance at one (five) and ten percent levels respectively.

After making all the data roughly stationary it was found that about 91% of the data is multivariate Normal, and hence the remaining 9% can be considered extreme outliers, as shown individually in Appendix D. The Chi-square qq-plot of transformed observations below indicates linearity at a lower quantiles but diverging at the upper quantiles. Appendix E contains the Normal qq-plots for the individual stationary variables.

Figure 1: Chi-square qq-plot for transformed observations



With the transformation of the variables, the interpretation of results based on those variables are changed as well. The variables with their original descriptions, along with their descriptions after they have been logged and differenced, are given in Table 3 below. This table will aid in the interpretation of the results considered in the following section.

Table 3: Data description

Short variable name	Original data description	Transformation style	Short transformed description (used in text)
Domestic credit	All monetary institutions: Total domestic credit extension	Logged and then differenced once.	Change in relative change in domestic credit
Domestic deposit	South African Reserve Bank liabilities: other domestic deposits	Differenced once	Change in domestic deposit
Exchange rates	1 Term percentage change in the real effective exchange rate of the rand against 15 trading partners.	Original data	Percentage change in exchange rates
Foreign assets	Monetary sector assets: Total foreign assets	Logged and then differenced once.	Change in relative change in foreign assets
Foreign deposits	South African Reserve Bank liabilities: other foreign deposits	Expressed as a logarithms	Foreign deposits
GDP	Gross domestic product at market prices	Logged and then differenced once.	Change in relative change in GDP
Gov Investment	Gross fixed capital formation: General government	Logged and then differenced once.	Change in relative change in Government investment
M3	Monetary aggregates: M3	Logged and then differenced once.	Change in relative change in M3
Manu labour cost	Manufacturing: Unit labour costs	Logged and then differenced once.	Change in relative change in manufacturing labour costs
Private credit extension	All monetary institutions: Credit extended to the domestic private sector: Total loans and advances	Logged and then differenced once.	Change in relative change in private credit extension
Private Investment	Gross fixed capital formation: Private business enterprises	Logged and then differenced once.	Change in relative change in private investment
Prime	Prime overdraft rate	Differenced once	Change in prime rates
Public Investment	Gross fixed capital formation: Public corporations	Logged	Relative change in public investment
Shares	Secondary market - Stock exchange transactions: Total value of shares traded	Logged and then differenced once.	Change in relative change in total value of shares traded
Terms of trade	Terms of trade excluding gold	Logged and then differenced once.	Change in relative change in terms of trade
Yield on GOV	Yield on loan stock traded on the bond exchange: Government stock - 10 years and over	Logged and then differenced once.	Change in relative change in yield on government loan stock

4. RESULTS AND INTERPRETATION

4.1 Introduction

The first section of this analysis, Section 4.1, will report the findings of canonical correlation analysis and the interpretations thereof, while Section 4.2 will reveal the findings resulting from the principal component analysis.

4.2 Canonical correlation analysis

Here the analysis was done using the `canoncorr` function in Matlab 7.1 (The Mathworks), with two sets of variables split into set *X* and *Y* being the dependent and independent variables respectively, *i.e.* to model the relationship between investment and the markets and given as:

```
X = data(:,[1:3]);
Y = data(:,[4:16]);
[A,B] = canoncorr(X,Y);
U = (X-repmat(mean(X),size(X,1),1))*A;
V = (Y-repmat(mean(Y),size(Y,1),1))*B;
[A,B,r,U,V,stats] = canoncorr(X,Y);
```

Where *U* and *V* return the scores from two respective groups depicting a strong positive relationship amongst the sets, as shown by the scatter plot in Figure 2 (below):

Figure 2: Scatter Plot

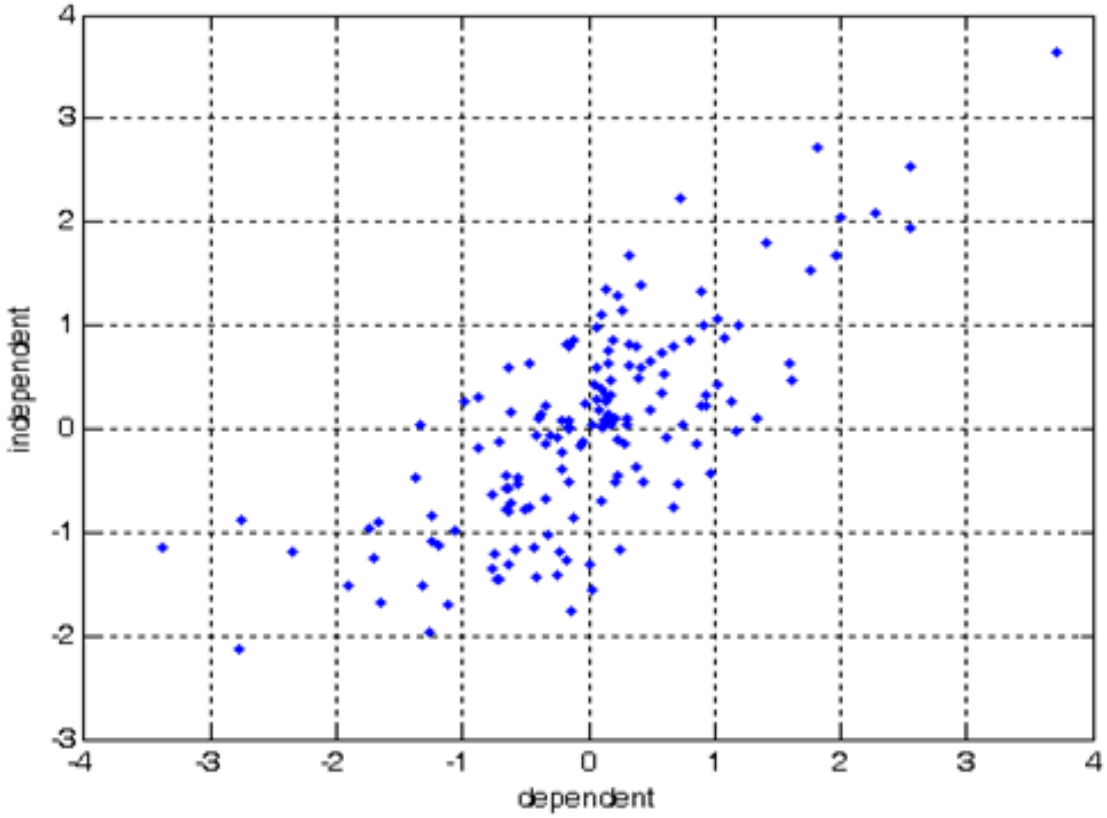


Table 3 (below) contains the canonical analysis for the two sets of data. The first three sets of coefficients are shown below, with the first two being statistically significant canonical variates at the 0.05 significance level. The canonical correlation coefficients show strong correlations of 0.74 for the first set and 0.44 for the second.

Statistical tests show that the first set of canonical coefficients is statistically significant given all tests. Wilks' statistic is a well-known statistic used to test the independence between two sets of jointly Normally distributed variables (Wilks, 1932, 1935) *i.e.* to test the null hypothesis of independence of the two sets of variables which in this case is rejected and we conclude that the two sets are dependent. According to Snedecor and William (1989), Bartlett's approximate Chi-squared statistic is used to test if *k* samples have equal variances, the null hypothesis is to test for homogeneity of variances and we reject the null hypothesis for this test.

Table 4: Statistical Analysis

	1st	2nd	3rd
Wilks	0.34	0.75	0.93
df1	39.00	24.00	11.00
df2	400.51	272.00	137.00
F	4.52	1.78	1.00
pF	0.00	0.02	0.45
Chi-square	152.87	41.59	11.36
pChi-square	0.00	0.01	0.41
dfe	39.00	24.00	11.00
P	0.00	0.01	0.41
r	0.74	0.44	0.27

The overall statistical tests for this model are highly supportive of the first set and the second set of results and proving their statistical significance over the third set. However, the result will only be analysed for the first pair as it has proven to be highly significant.

Table 5: Canonical Coefficients

	1st	2nd	3rd
ΔLOG Gov Investment	-0.8929	-1.5197	9.2029
ΔLOG Private Investment	13.1808	-1.3353	5.5817
Δ Public Investment	-0.3166	-2.864	-0.2469
ΔLOG Domestic credit	5.8252	-0.3607	-2.5778
Δ Domestic deposit	0.0001	-0.0003	0.0004
ΔLOG Foreign assets	0.7366	-2.5081	0.7048
ΔLOG GDP	25.6145	-3.3436	-5.0673
ΔLOG M3	8.6597	-20.6269	8.3608
ΔLOG Manu labour cost	-6.2277	-7.8011	-6.3371
ΔLOG Private credit extension	-12.6224	-29.8927	29.332
ΔPrime	0.1055	0.0516	-0.1478
ΔLOG Shares	-0.2313	0.1607	0.1188
ΔLOG Terms of trade	-0.8118	0.5649	3.0978
ΔLOG Yield on GOV	-1.1087	1.9247	0.8922
Exchange rates	0.0103	0.0083	-0.0887
LOG Foreign deposits	-0.0917	-0.3947	-0.5513

The result re-iterates the importance of growth in driving private investment as is stated in the theory of Jorgenson (1971). Overall, the performance of the "economic market" variables indicates a strong relationship with private investment, either positive or negative. The small magnitude of the exchange rate variable indicates certainty and the predictability of the currency movements, which is a conducive environment for long term investment; hence discouraging short run speculative activities.

Moreover, for variables such as manufacturing labour cost, we have an inverse relationship with private investment, as expected, since lower labour manufacturing costs lead to more profitable businesses. Additionally, an inverse association with government and public investment can be explained as well, for example a flight of skilled labour resources experienced within Eskom was one of the causes of power shortages around the country; hence, a decline in labour costs will result in a decline in public investment.

The results seems to communicate efficient transfer of monetary resources, in the sense that declining private credit extension in terms of loans and advances implies increased savings which translate into capital to offer it a superior utilization; hence, investment in this case is savings-driven.

Lastly, the foreign sector as represented by foreign assets by all monetary institutions with the country indicates a positive relationship with private investment, inferring a confidence in the market by the foreign sector.

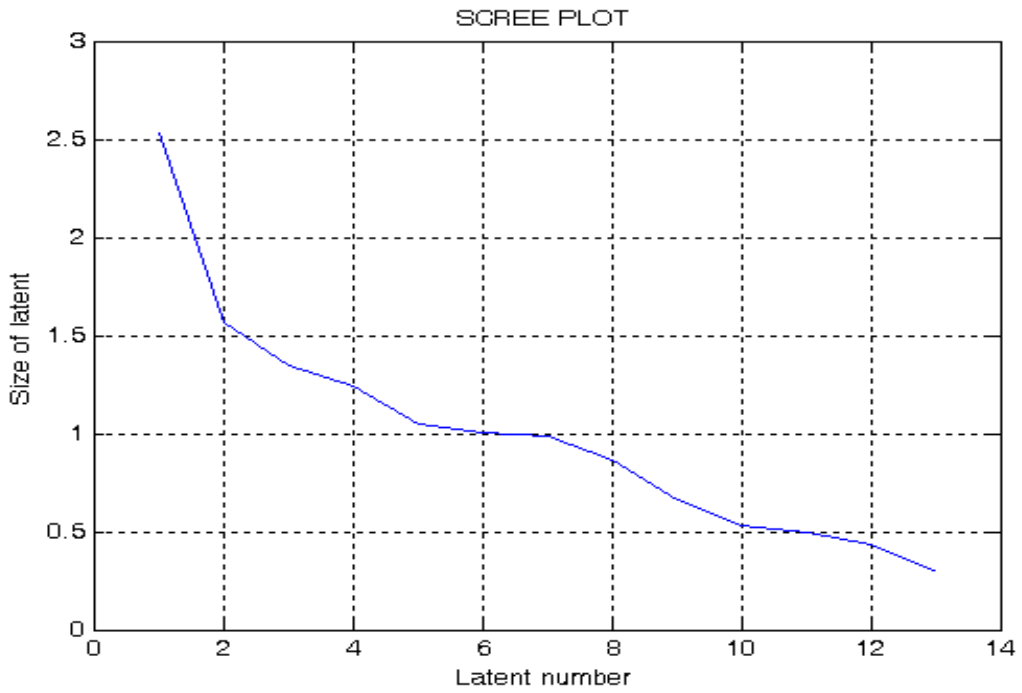
4.2 Principal component analysis

The function `Princomp` in Matlab 7.1 (The Mathworks) was used to extract the principal components from the matrix of size 151 by 13, note should be taken that only independent variables (as indicated in the canonical correlation analysis) will be used for this part of analysis. The data was first standardized by subtracting the mean of each variable and then dividing by its standard deviation as follows:

```
data = xlsread ('data1.xls');
sdata = (data - repmat(mean(data),151,1))./repmat(std(data),151,1);
[COEFF, SCORE, LATENT, TSQUARED] = princomp(sdata)
```

On deciding how many principal components to retain we use the scree plot, which effectively is a plot of eigenvalue numbers against their size. A plot of the principal components indicates a clear change in direction between the second and the third principal component. It therefore appears that the first two principal components contain most of the information about investment levels.

Figure 3: Scree Plot



The results of the estimation are shown in Table 5 and hence the interpretation will be based on the first index thereof. It is seen that most of the variables have the expected signs; however, the manufacturing labour cost and domestic deposit variables indicate weak linkages with the investor confidence index. Improvement in terms of trade (in this case a unit price of exports divided by the unit price of imports excluding gold) can increase investment by increasing real income, making capital goods (mostly imported goods) cheaper relative to domestic goods.

The depreciation (a rise) in real effective exchange rates inspires investor confidence by decreasing the cost of investing in domestic assets by foreign parties. In contrast, both the domestic and private credit extension variables are inversely associated with investor confidence as a faster increase or slowing decrease in debt could unsettle investors. In particular, if credit extension is increasing at an increasing rate it can have a destabilizing effect on the economy.

With a negative weight on the change in prime, it means that decreasing prime rates would lead to an increase in investor confidence, an entirely believable situation, given that investment is stimulated in an economy with declining lending rates. Similarly, decreasing yields on government bonds indicate a stronger capital market, allowing investors to obtain financing more easily. This, again, would raise investor confidence.

Table 6: Principal component

	1st	2nd
ΔLOG Domestic credit	-0.47	0.28
Δ Domestic deposit	0.01	0.20
ΔLOG Foreign assets	0.20	0.08
ΔLOG GDP	-0.12	-0.36
ΔLOG M3	-0.30	0.40
ΔLOG Manual labour cost	0.00	0.08
ΔLOG Private credit extension	-0.47	0.35
Δ Prime	-0.41	-0.10
ΔLOG Shares	0.29	0.35
ΔLOG Terms of trade	0.11	0.21
ΔLOG Yield on GOV	-0.38	-0.40
Exchange rates	0.11	0.32
LOG Foreign deposits	0.03	0.13

Since we are working with a change in relative change in M3, a drop implies increased stability and possibly lower inflation, which promotes investment by lowering the risk to price stability. In contrast, a positive value in the total value of shares traded is indicative

of a slower fall or faster rise in share prices, which promotes the levels of confidence among the investors.

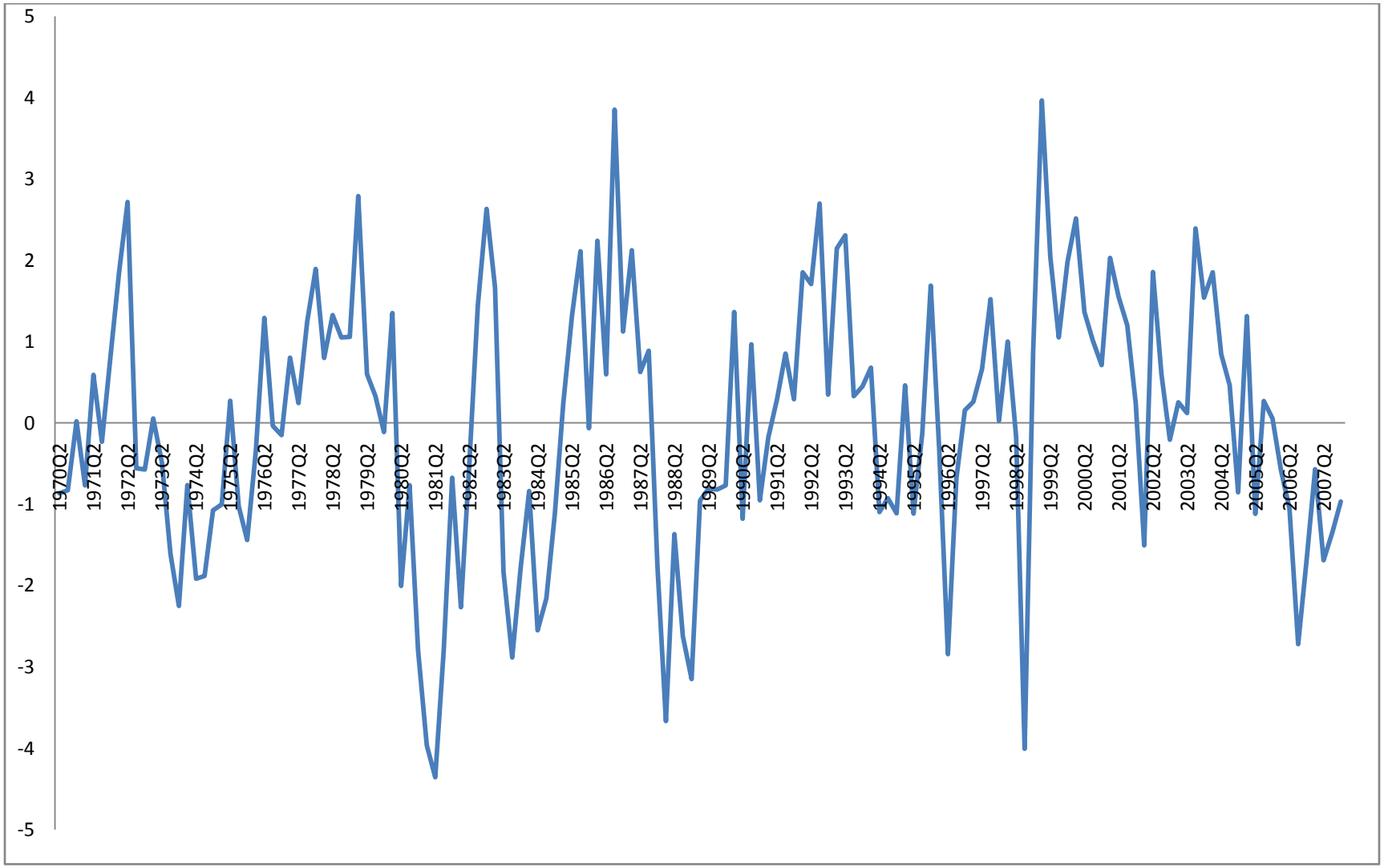
The signs of the foreign assets and foreign deposits variables are what we would expect, as these variables are directly related to the levels of confidence of foreign investors in the South African economy. However, the trends in GDP growth and investment are contrary to each other according to the findings of both empirical and theoretical literature. For example, consider Jorgenson's accelerator theory of demand which suggests that that investment responds to changes in demand for output. However, similar findings of failing to link investment with the growth variable were reported in the study undertaken by the TIPS (2000).

The results simply communicate that a linear combination of all these variables with their respective weights gives an index as follows:

$$
\begin{aligned}
Investor\ confidence\ index_{2007\,(Q4)} \\
&= -0.47(domestic\ credit) + 0.2(foreign\ assets) - 0.12(GDP) - 0.3(M3) \\
&- 0.47(private\ credit\ extention) - 0.41(prime) + 0.29(shares) \\
&+ 0.11(terms\ of\ trade) - 0.38(yield\ on\ government\ stock) \\
&+ 0.11(exchange\ rates) + 0.03(foreign\ deposit)
\end{aligned}
$$

The maximum value reached by the investor confidence index is 3.964756 in the first quarter of 1999 and the lowest is -4.3555 in the second quarter of 1981. From the investor confidence trends in Figure 4 below, the slowdown experienced in early 80's reflects the impact of dept crisis caused by liberalization of financial markets causing uncertainty amongst investors. However, the peak period was heavily driven by President Mbeki's reaffirming of the privatization policy with complete or partial sales of parastatals in the media, telecommunications, and aviation industries, which spurred high levels of confidence. Similar associations with global and local events can be made for most rises and falls in the index, validating the calculated index.

Figure 4: Investor Confidence index



5. CONCLUSIONS

The establishment of an investor confidence index requires detailed analysis of the theory, both theoretical and empirical, so as to draw meaningful conclusions in explaining the behaviour of a rational investor. In view of this analysis, the most important variables were selected to produce the investor confidence index through principal component analysis; and the extent of the relationship between the variables and investment was investigated using the canonical correlation analysis.

The result from canonical correlation analysis favours strong linkages for the economic markets variables with respect to their influence in investment in its three categories, more importantly, the variables seems to have powerful relation with private investment. Whilst the spill over effects of public investment and government investment do not seem to support private investment.

The result, as presented in the principal component analysis, shows that most of the variation in investor confidence is captured by movements in foreign markets with expected signs. Moreover, the index captures variation in capital markets and economic markets, although with unexpected direction of the GDP variable.

This analysis has placed much attention in the determinants of investment and the construction of an index which can be used to trace the confidence of the investors in the markets over the past, be it the capital markets, economic markets and the foreign markets. Therefore, a useful extension would be to empirically formulate an index that can be used to predict future levels of private investment.

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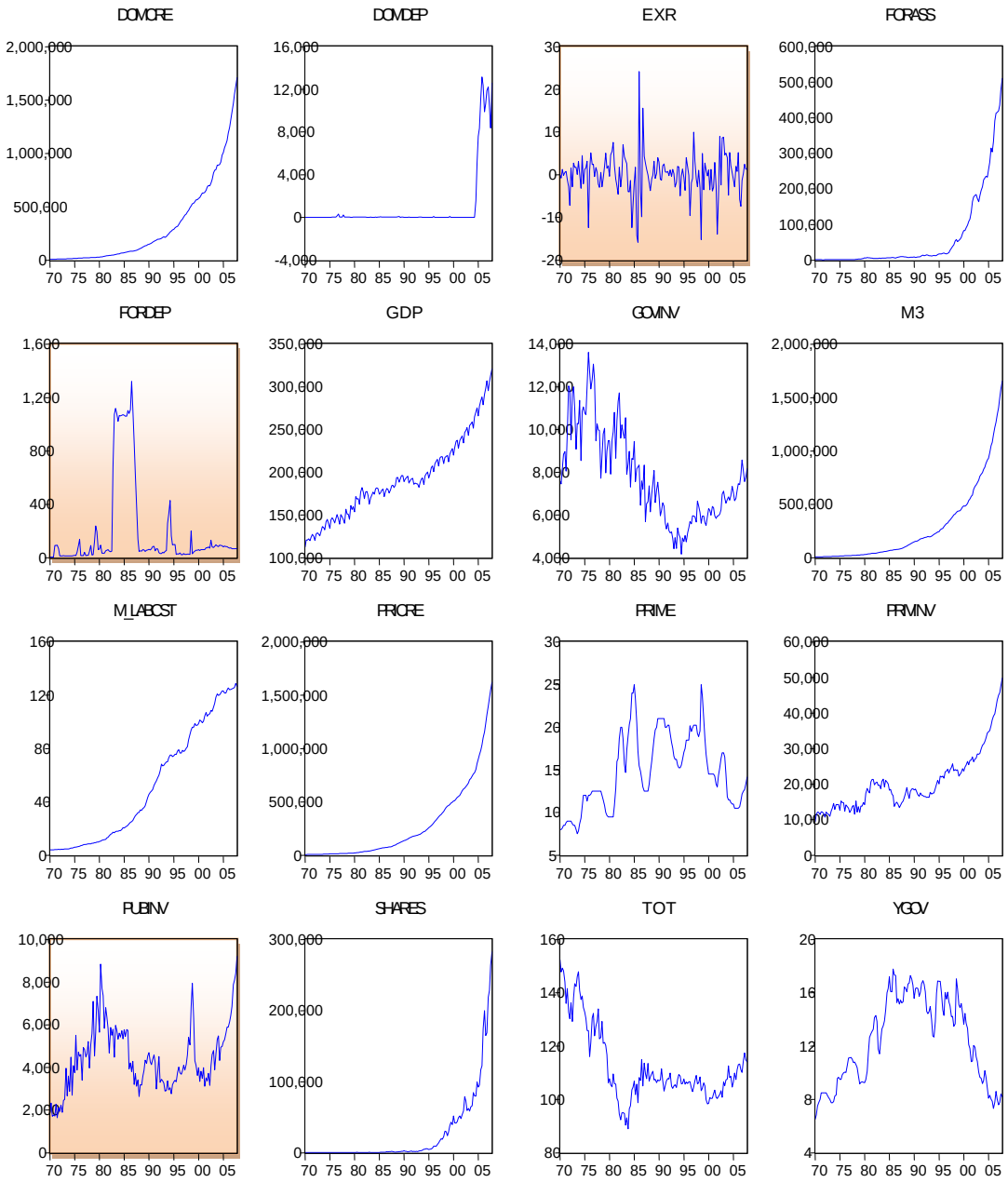
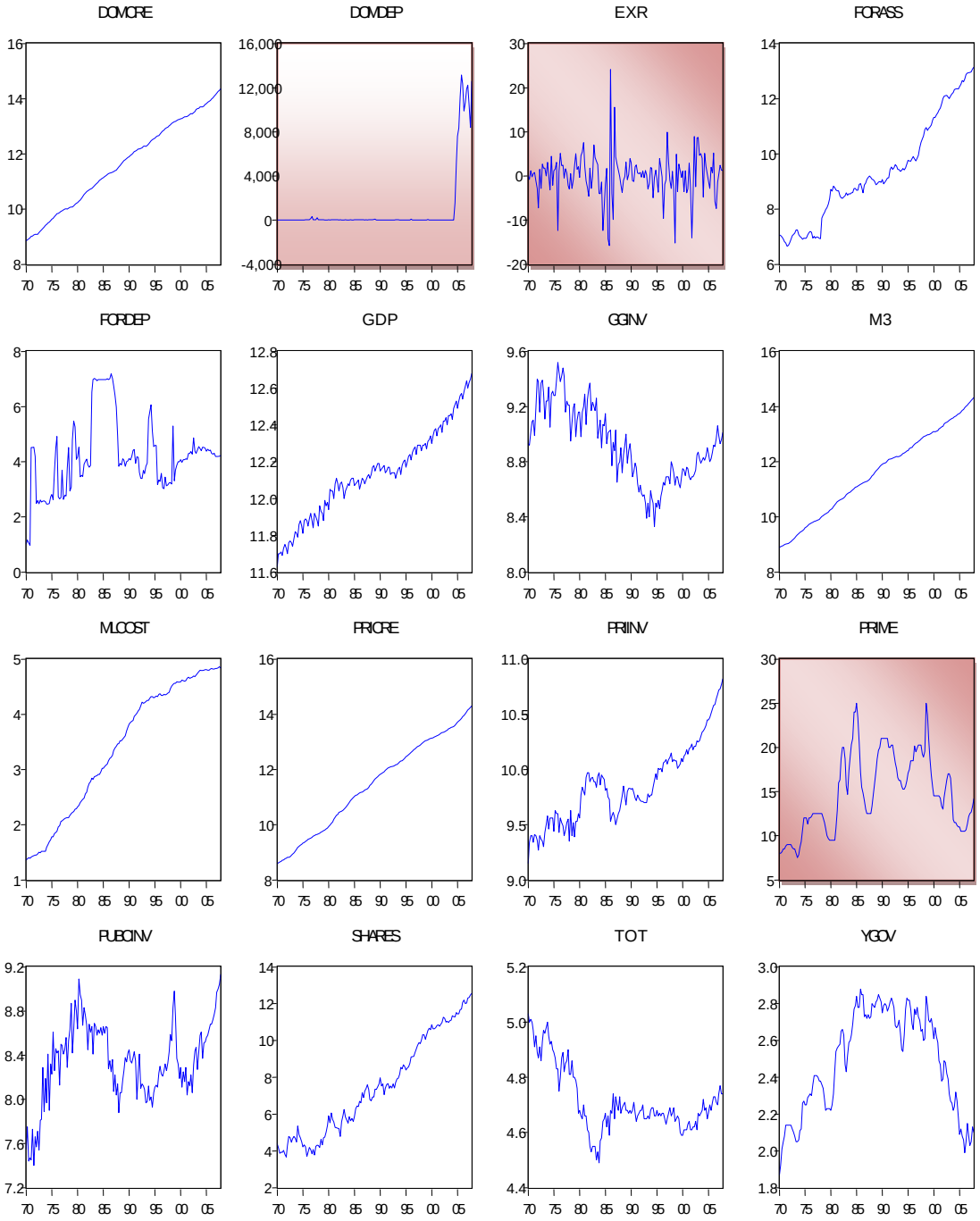
APPENDIX A: Original data,

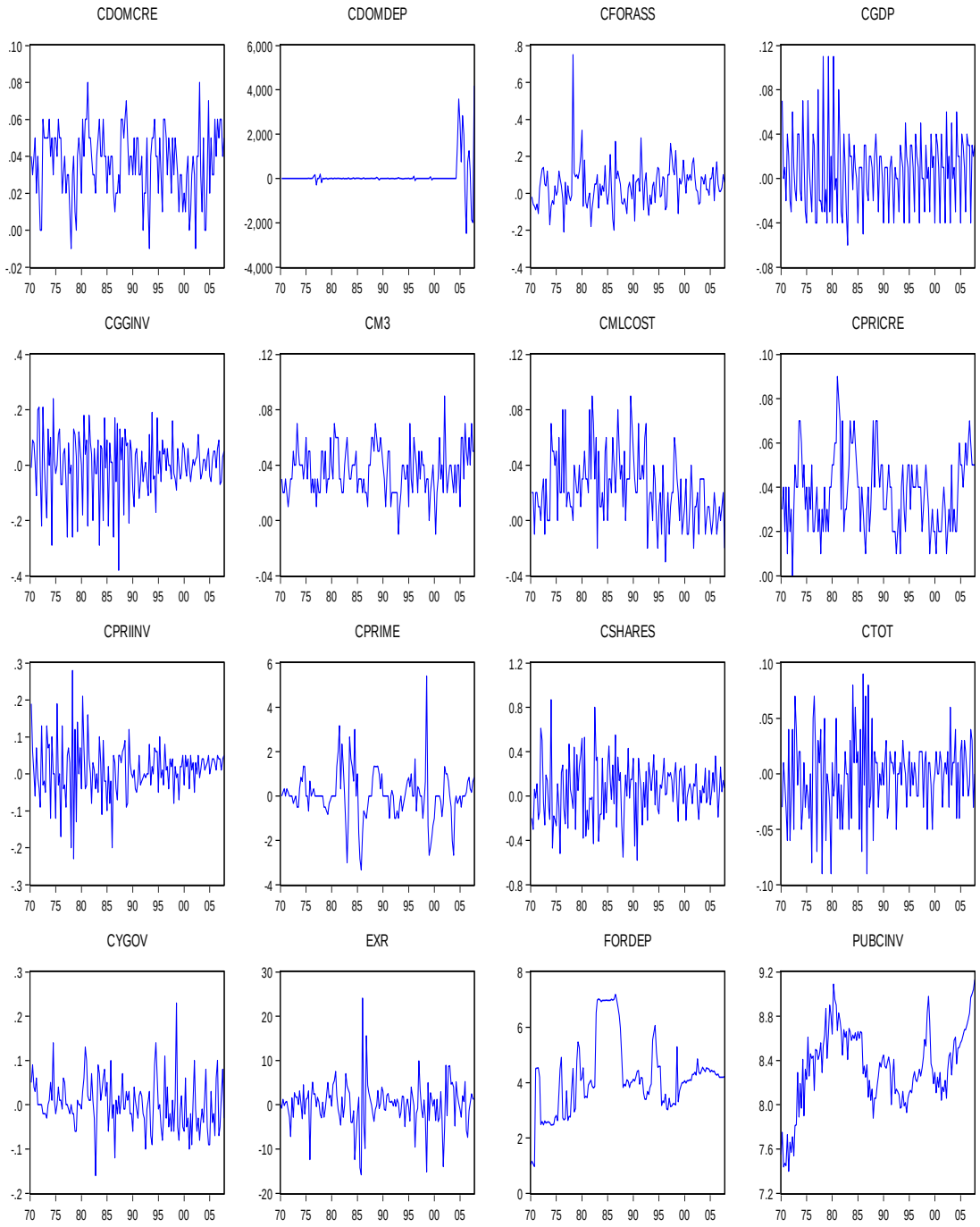
With exchange rate, foreign deposit, and public investment variables stationary



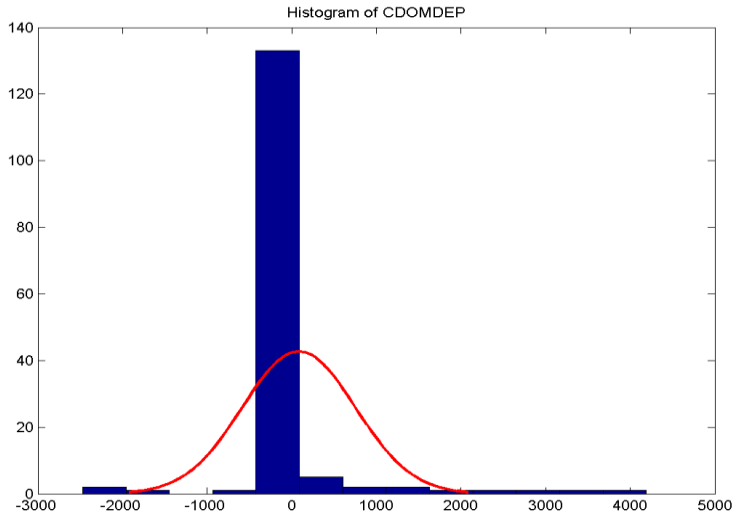
APPENDIX B: Logarithms

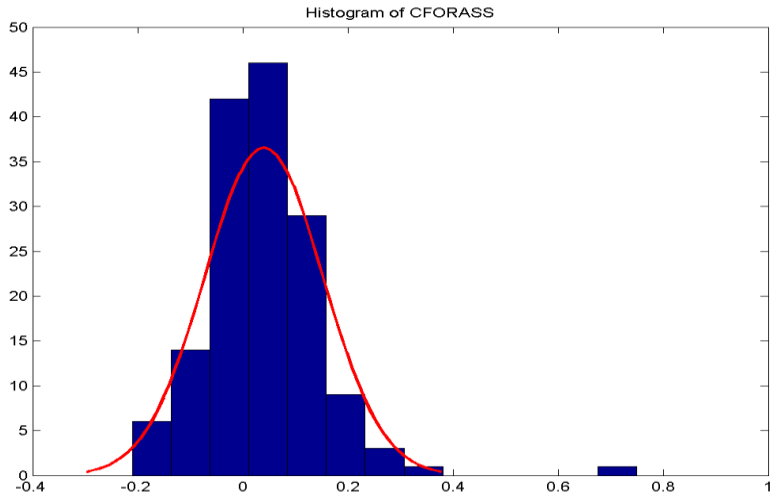


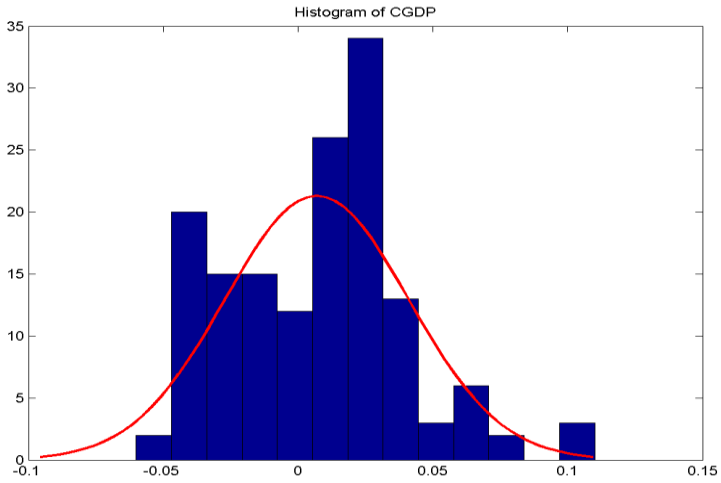
APPENDIX C: Stationary data

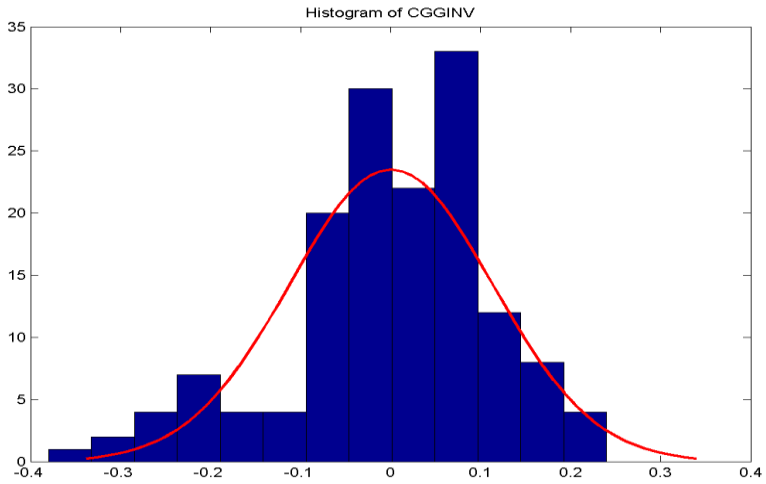


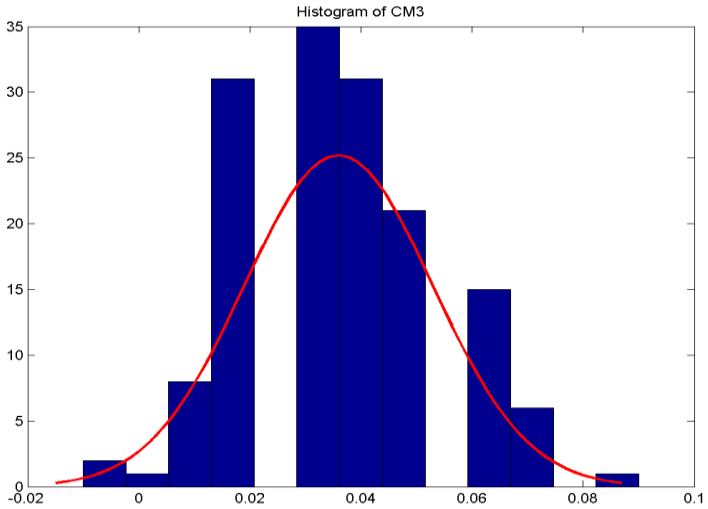
APPENDIX D: Normality tests







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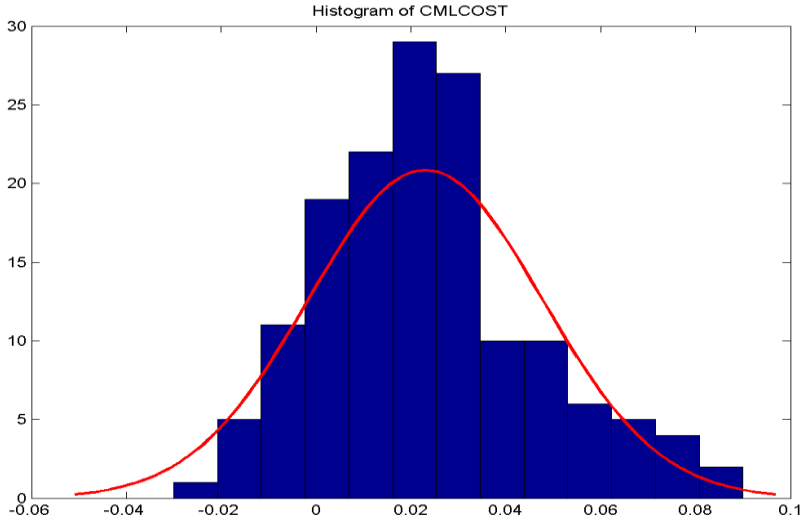
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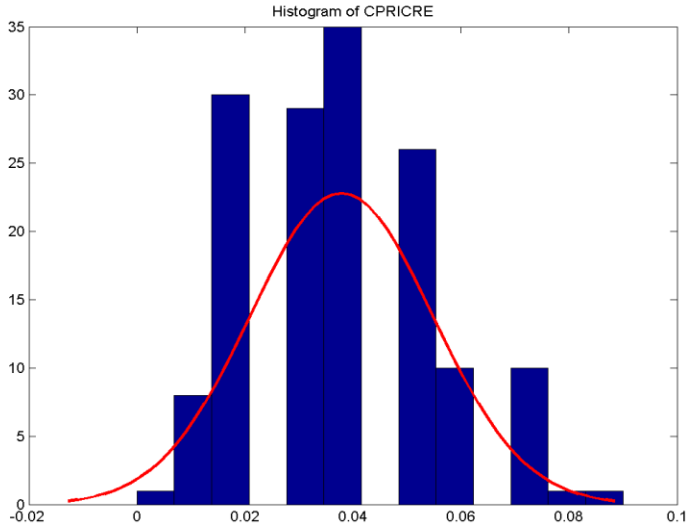
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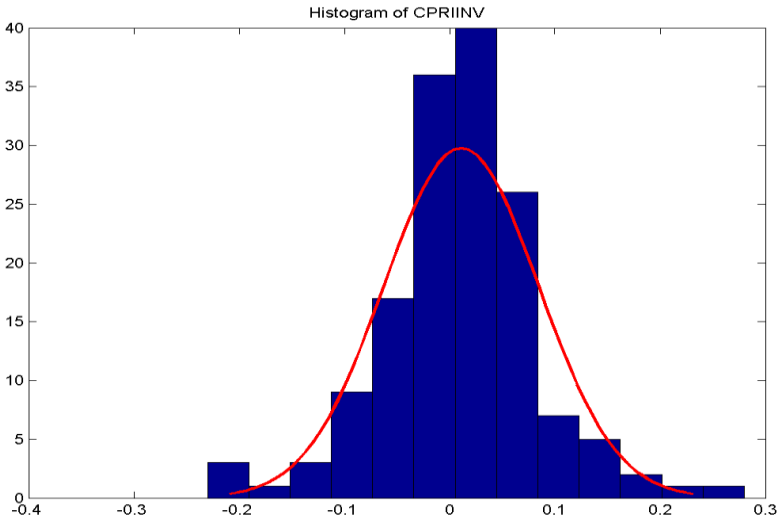
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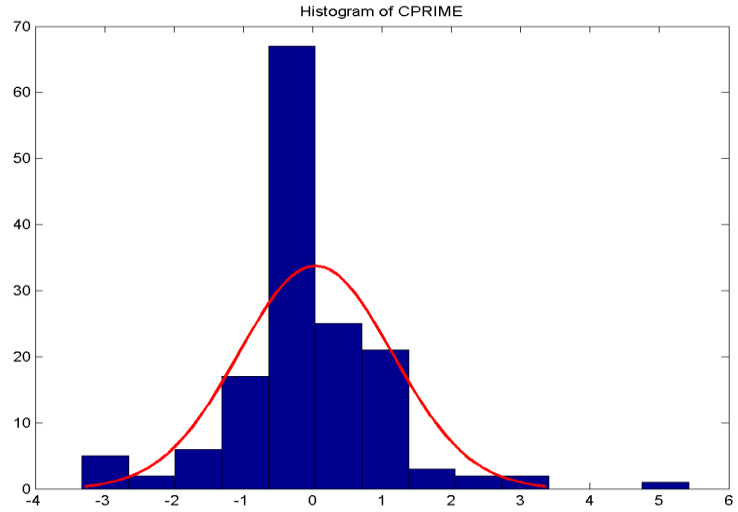
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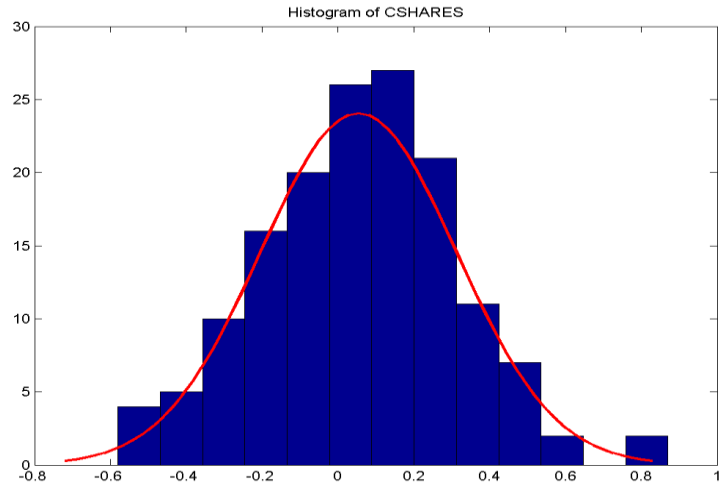
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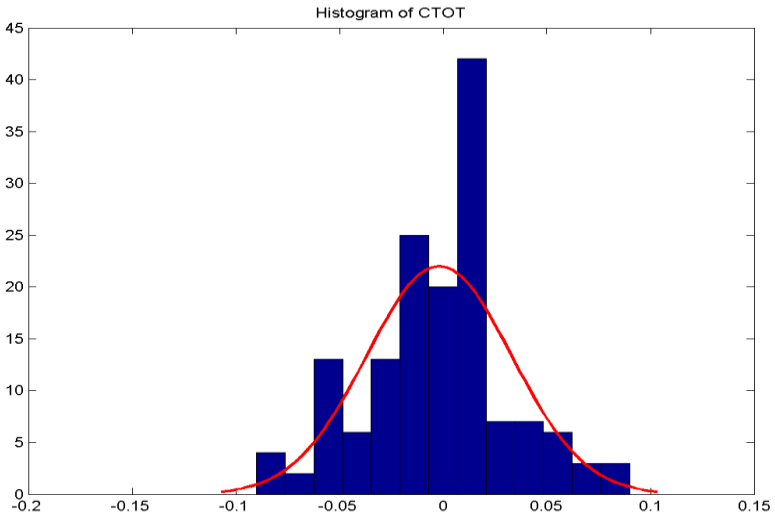
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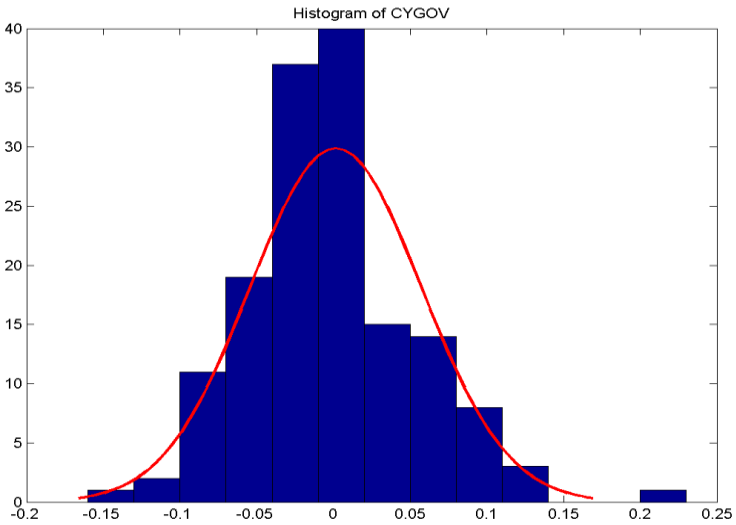
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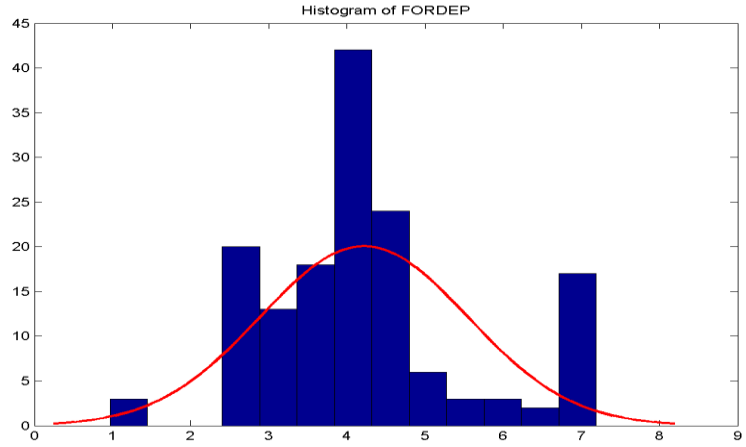
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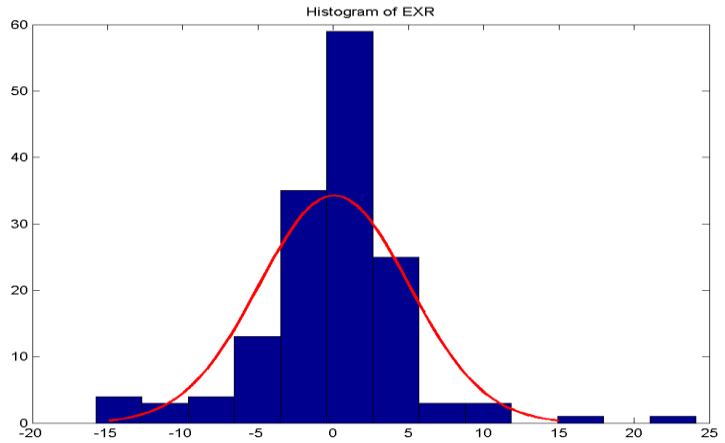
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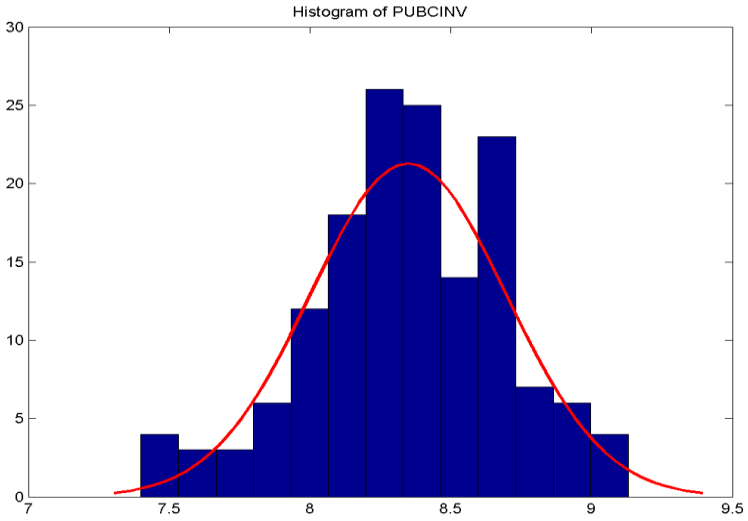
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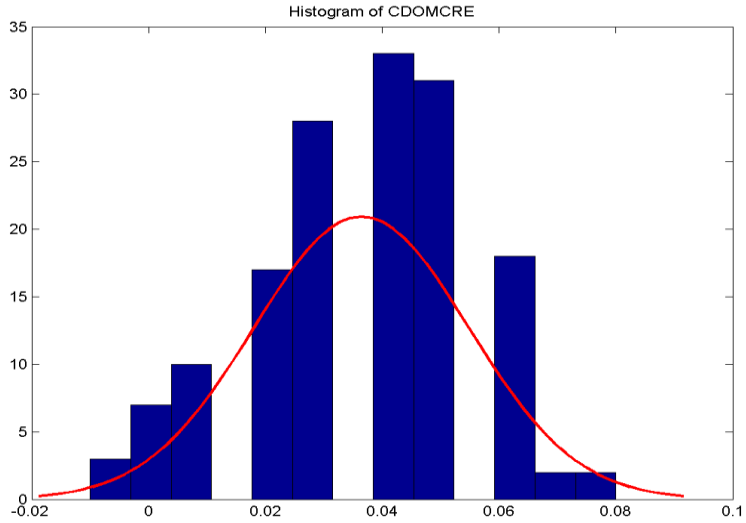
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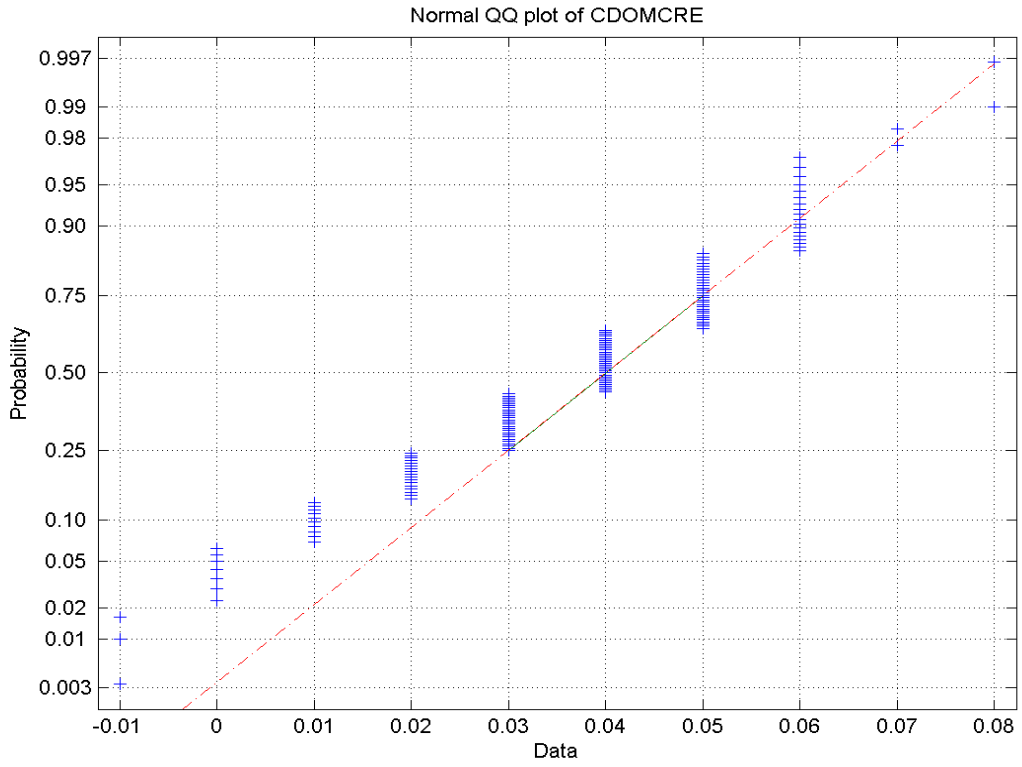
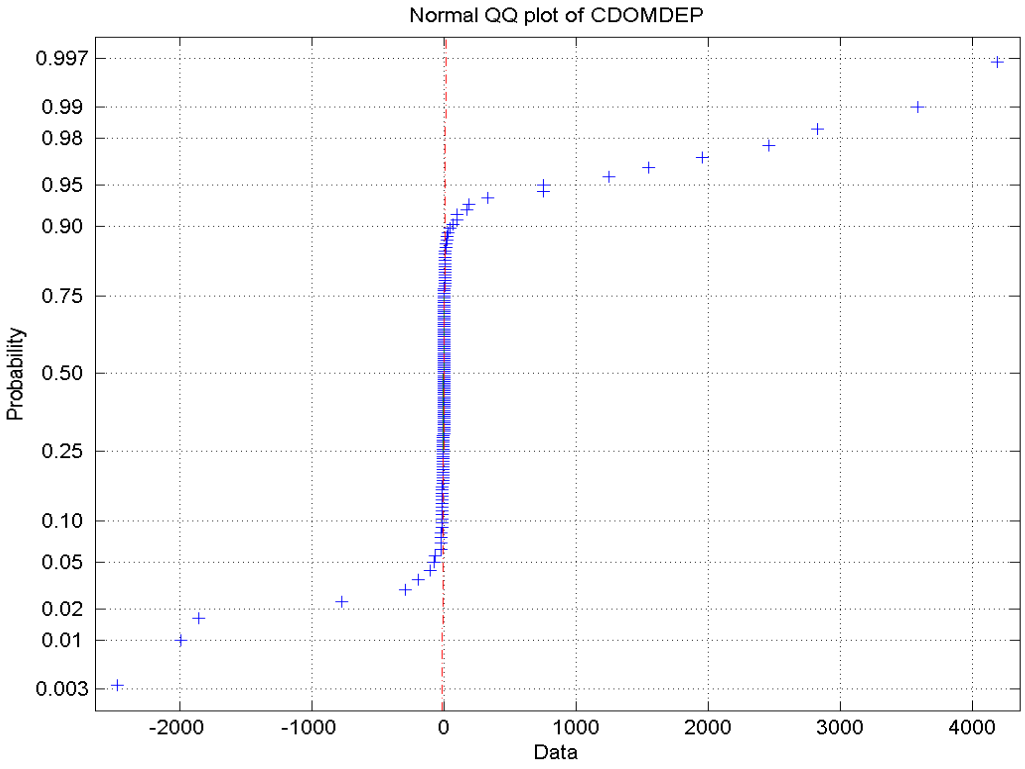
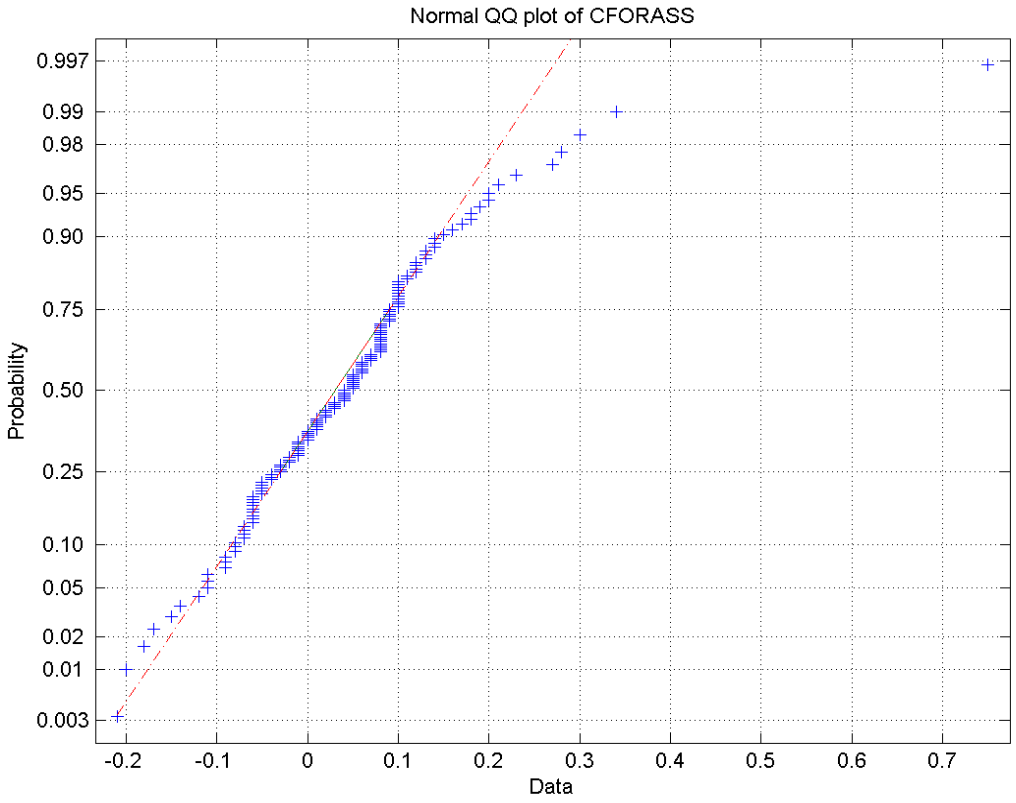
APPENDIX E: Normal QQ Plots






Normal QQ plot of CFORASS
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0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
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0.6
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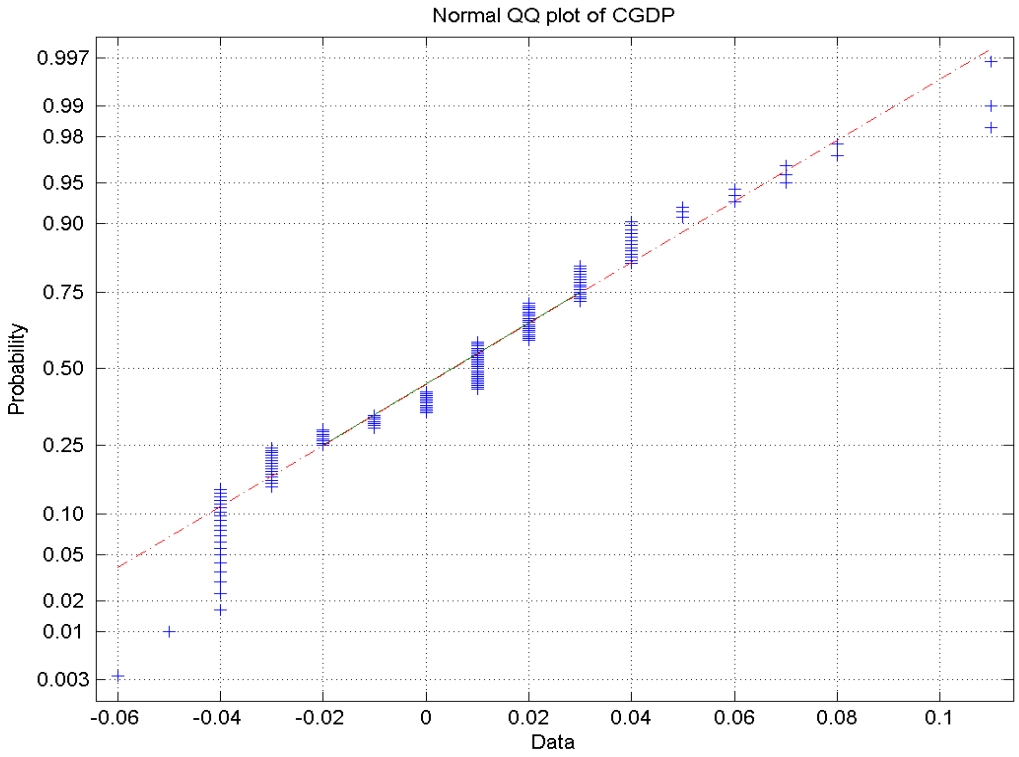
Data


Normal QQ plot of CGDP
Probability
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0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
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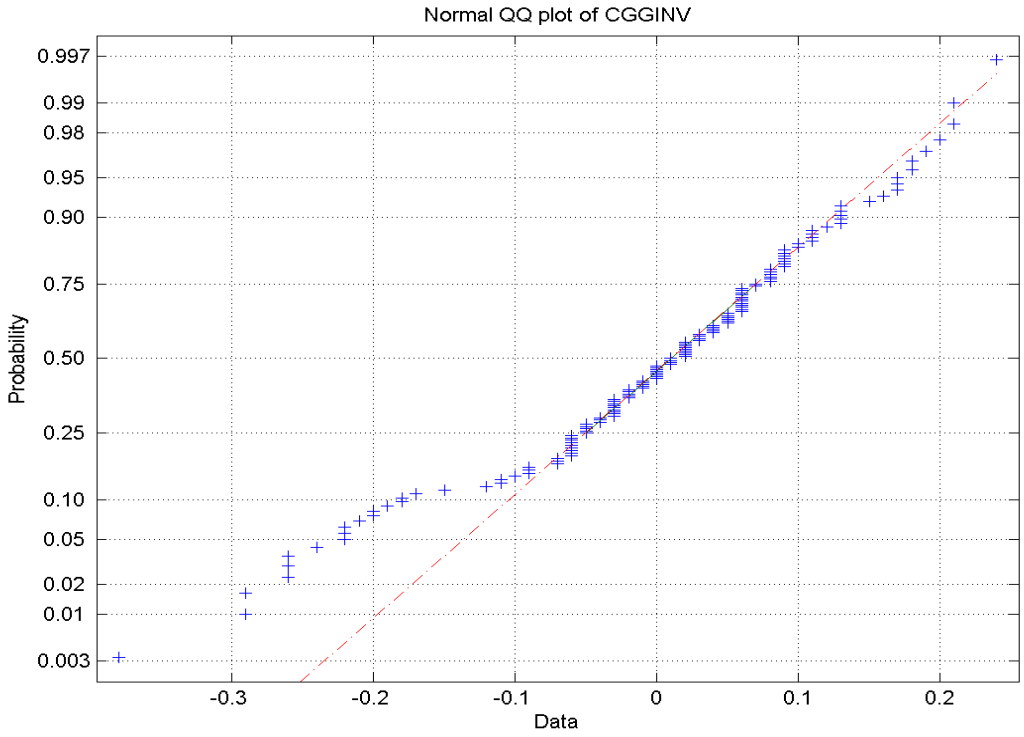
0.1
Data


Normal QQ plot of CGGINV
Probability
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0.95
0.90
0.75
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0.25
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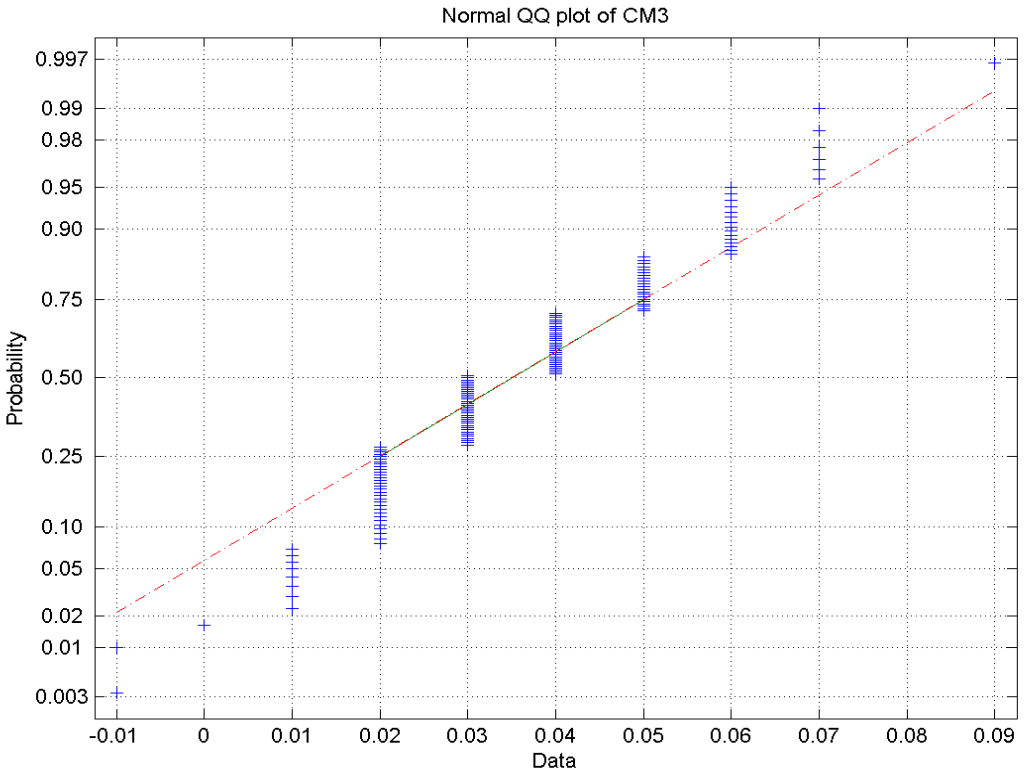
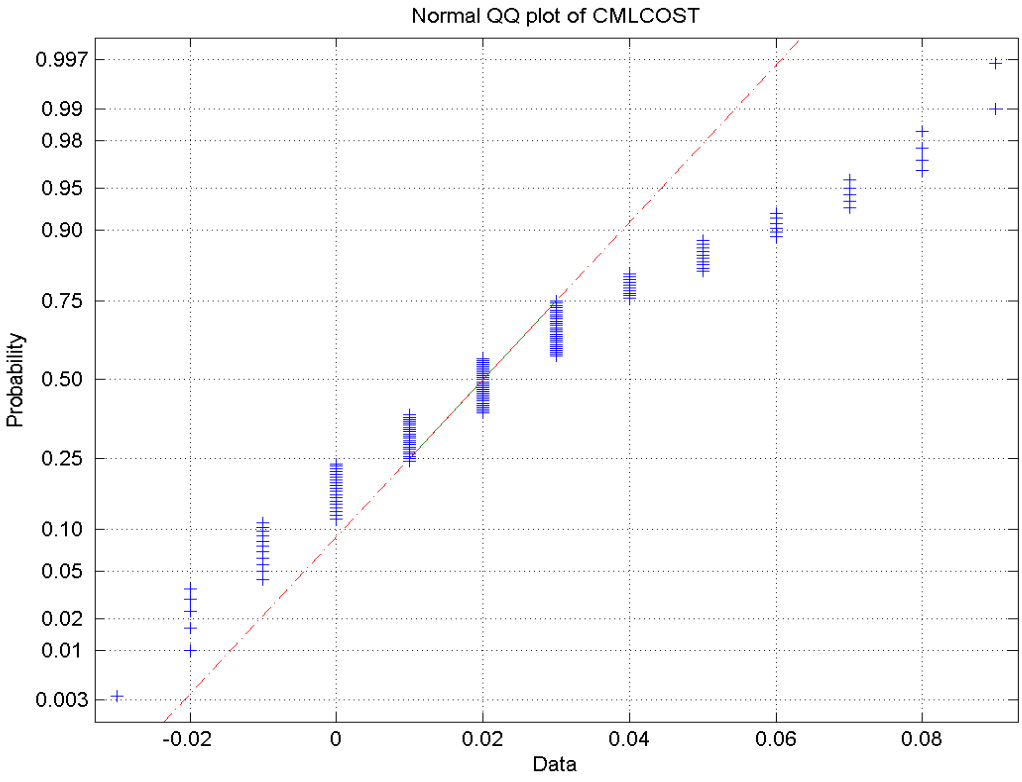
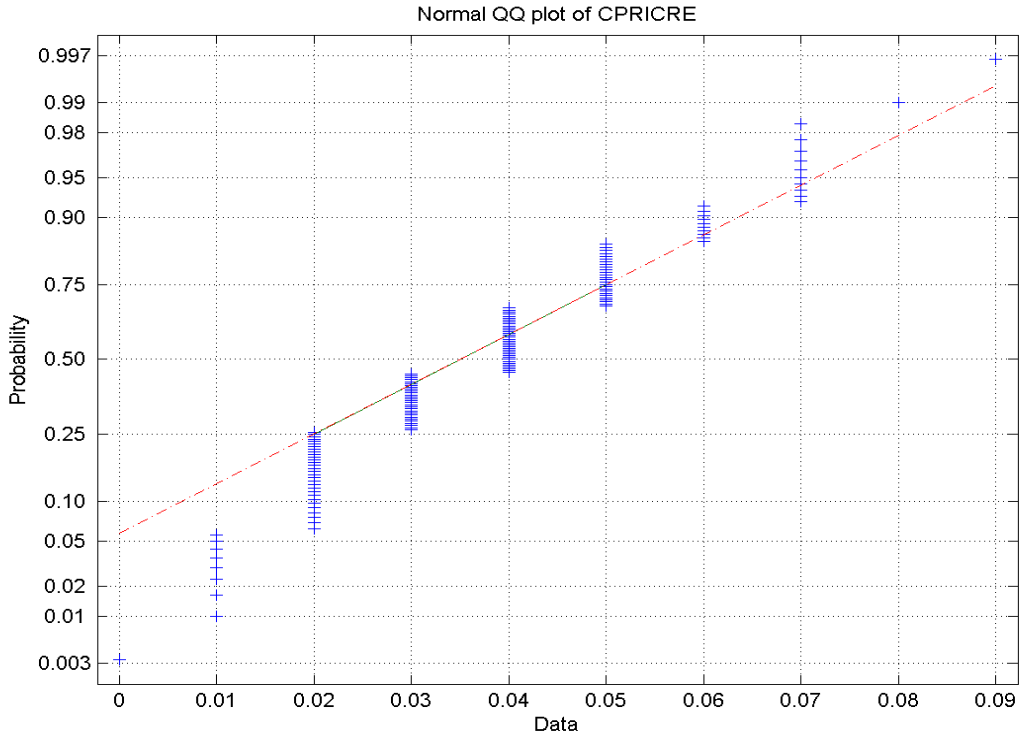
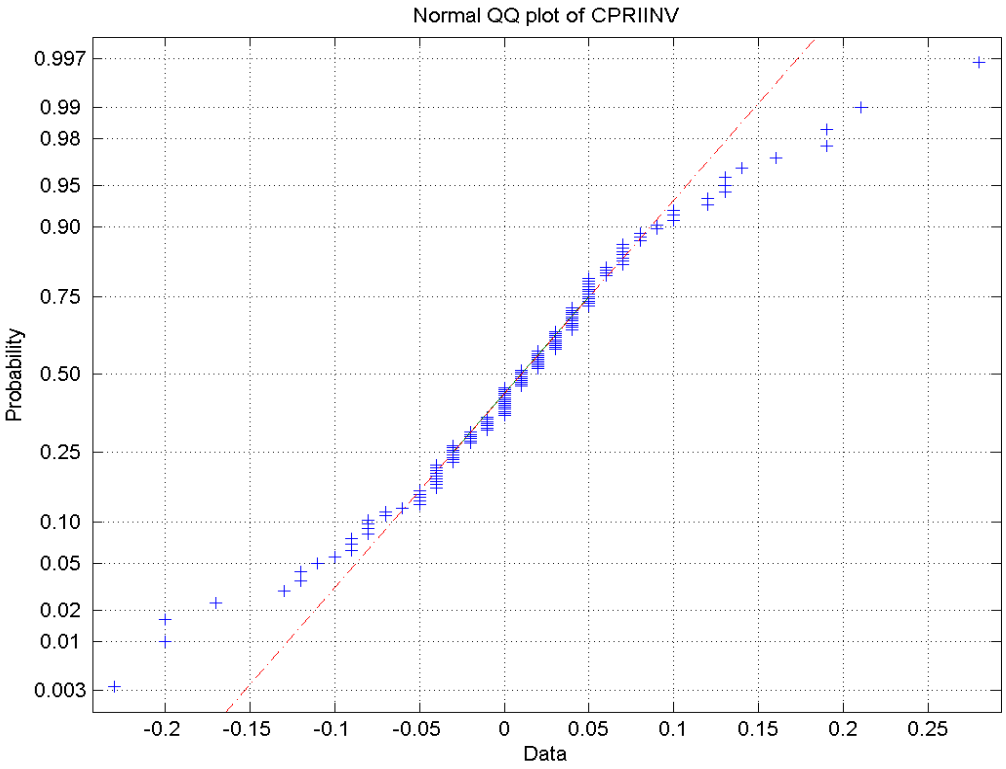
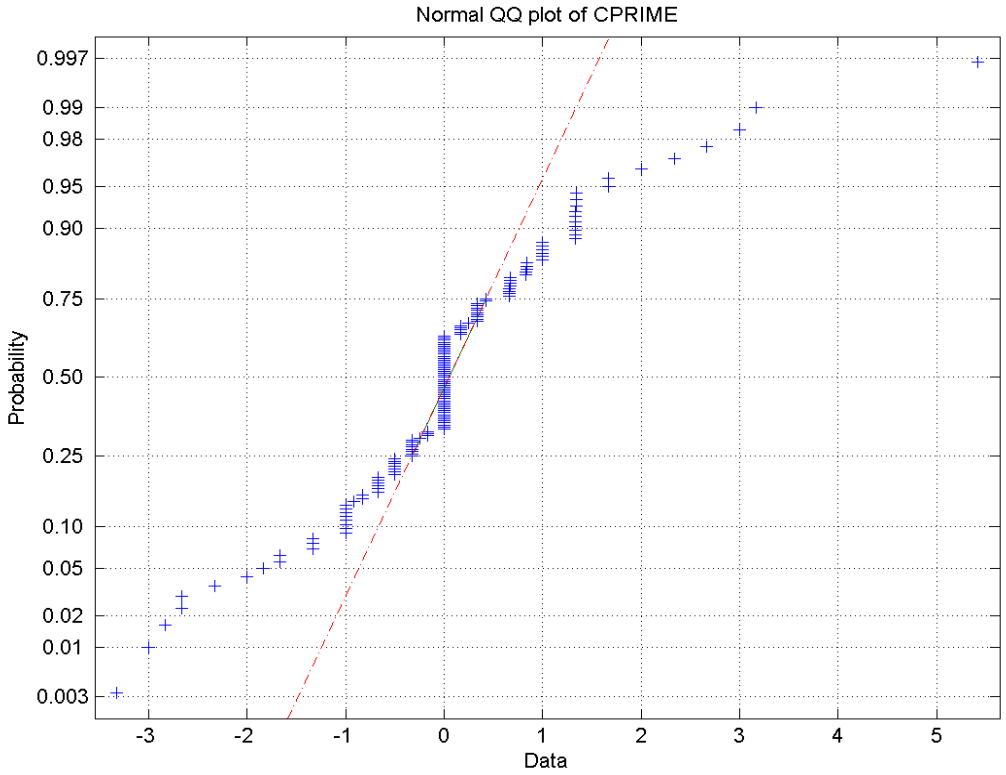
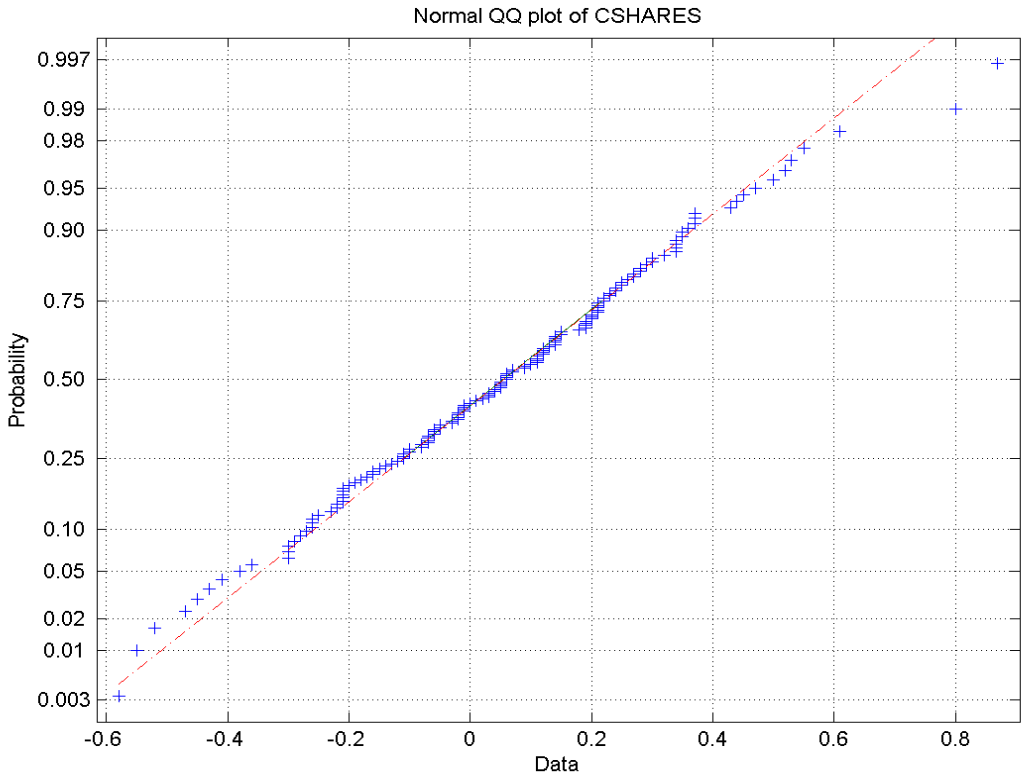

Normal QQ plot of CM3
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Data

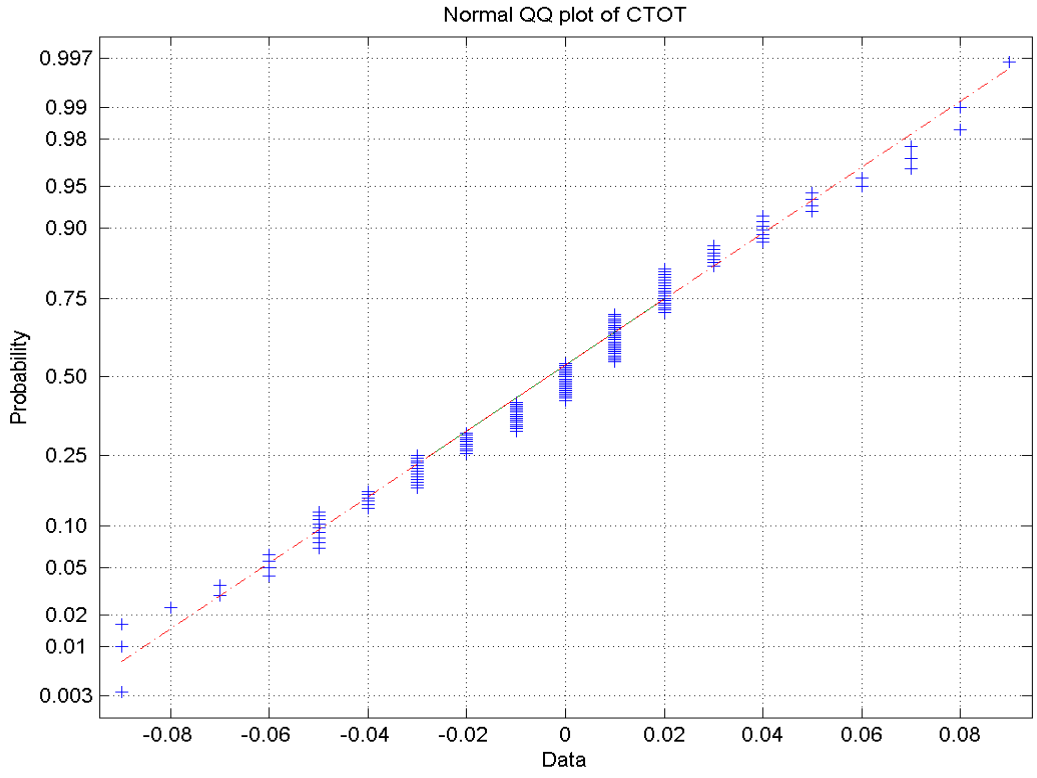

Normal QQ plot of CMLCOST
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.02
0
0.02
0.04
0.06
0.08
Data

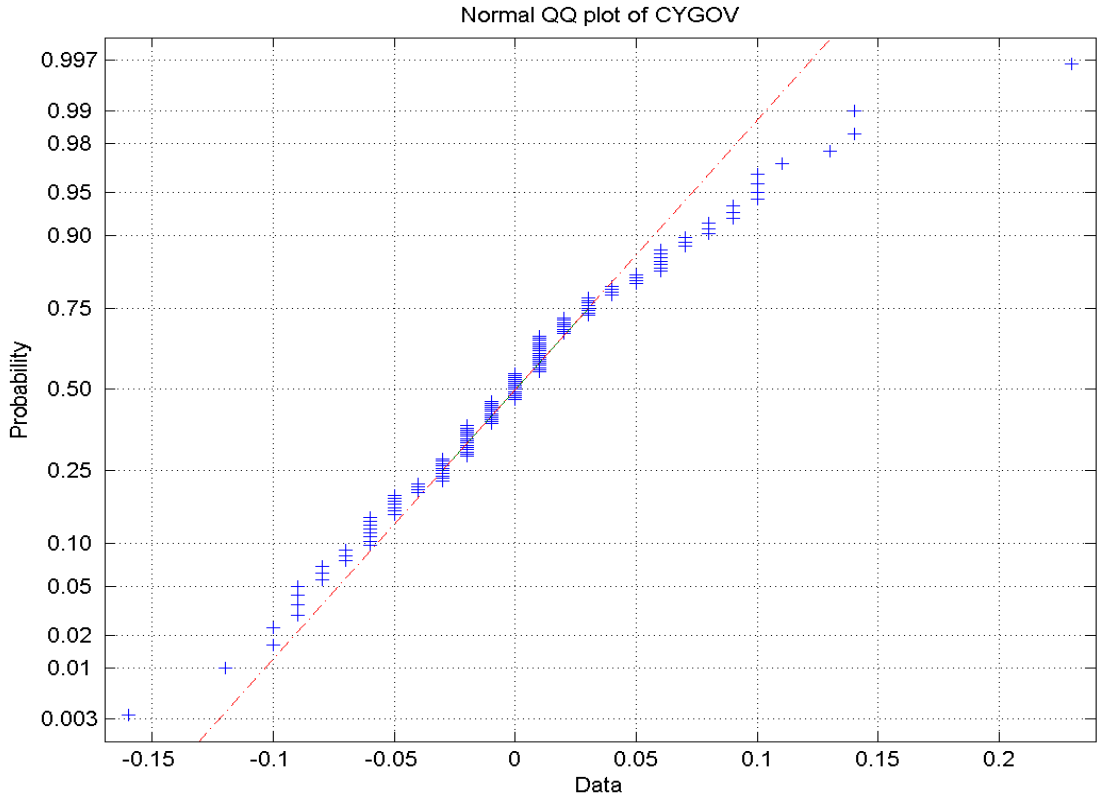

Normal QQ plot of CPRICRE
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Data

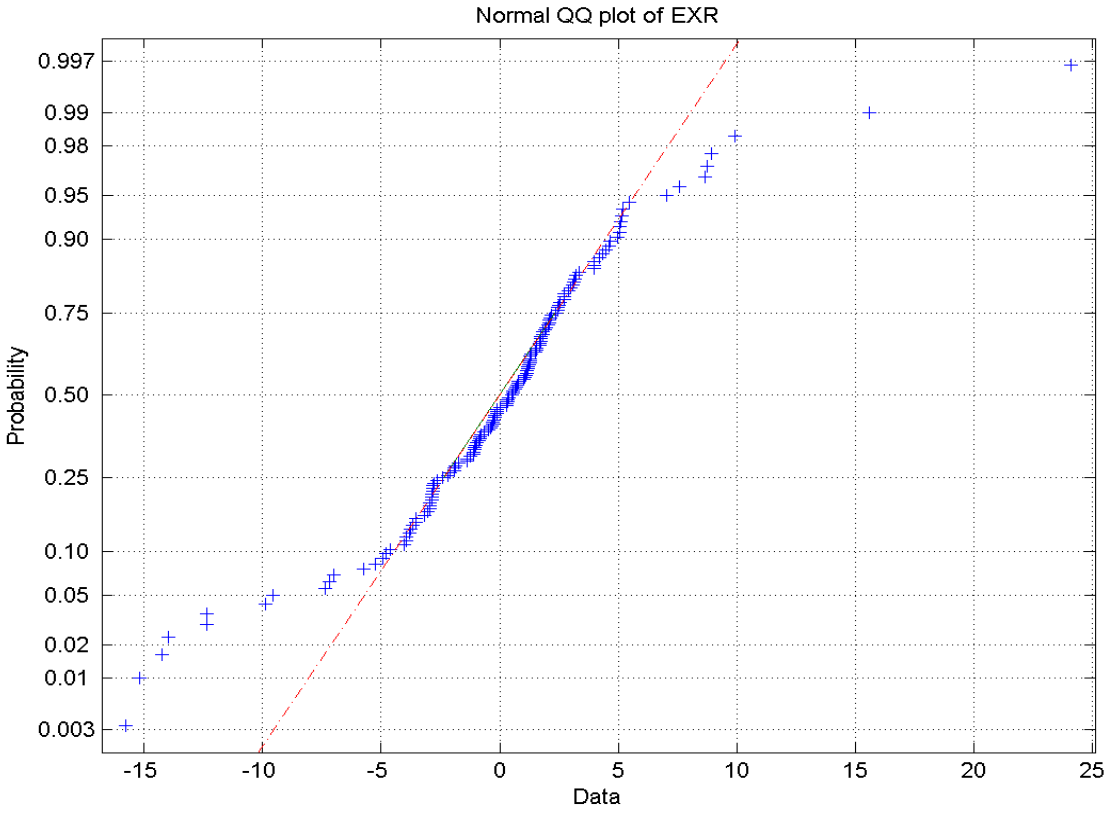

Normal QQ plot of CPRIINV
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
Data

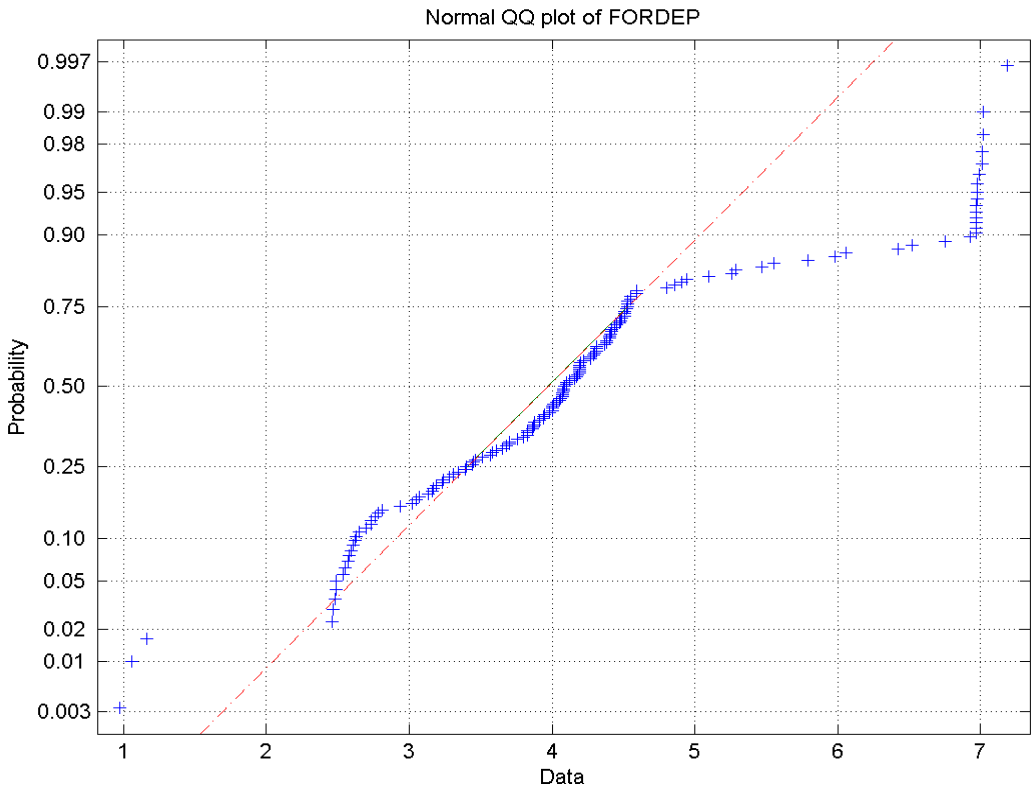

Normal QQ plot of CPRIME
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-3
-2
-1
0
1
2
3
4
5
Data

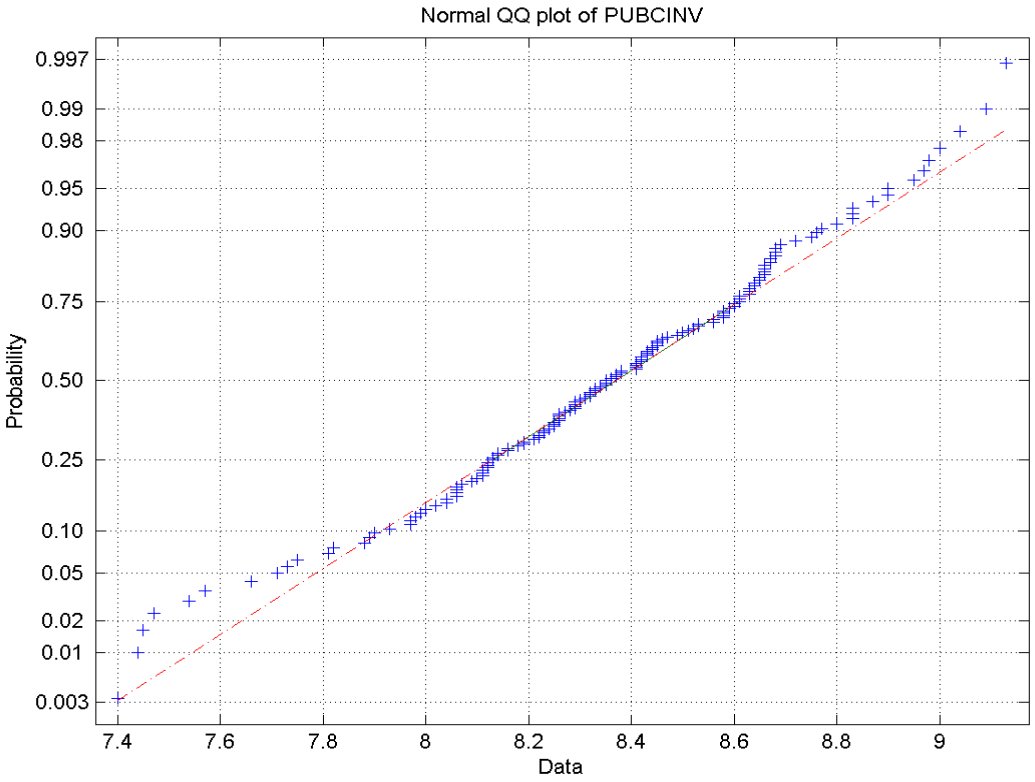

Normal QQ plot of CSHARES
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Data


Normal QQ plot of CTOT
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
Data


Normal QQ plot of CYGOV
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
Data


Normal QQ plot of EXR
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
-15
-10
-5
0
5
10
15
20
25
Data


Normal QQ plot of FORDEP
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
1
2
3
4
5
6
7
Data


Normal QQ plot of PUBCINV
Probability
0.997
0.99
0.98
0.95
0.90
0.75
0.50
0.25
0.10
0.05
0.02
0.01
0.003
7.4
7.6
7.8
8
8.2
8.4
8.6
8.8
9
Data