Bayesian Methods in Analysis of Fund Management Performance

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Declaration

This thesis is composed by me and that the work is my own. No part of it has been submitted to any other institution for another qualification.

Signature:

Date: 24 Apr. 2008

Abstract of Thesis

The measurement of fund management performance is critical to making good decisions in investment. This thesis develops a model of fund management performance that incorporates market behaviour, beliefs, opinions and economic index into measurement. Given that some of the measures will be subjective, it is appropriate to use Bayesian methodology.

Traditionally modelling of fund management performance has been based on the Capital Assets Pricing Model (CAPM), which has been revised and modified overtime. The simple CAPM can be described as a linear regression model of the return of the fund against a benchmark. It can be extended to include other factors to aid modelling. A review of the literature, as well as to interviews and a survey, reveals 12 macro-economic variables as significant in predicting fund performance. Two estimation methods, Ordinary Least Square (OLS) and Bayesian Modelling (BM) were employed on a monthly data for 26 equity funds from the USA market over16 years' period. After several processes of filtering, five factors include Standard & Poor 500 and other four macro-economic factors: US federal funds rate, US federal funds rate target, US monetary base and US money supply 1 were selected. These key variables were then used in subsequent modelling of fund performance.

A range of models were considered for the modelling including: dependent and independent models. Results from different models are consistent. Five factors model consistently score a quite high adjusted R square which proves good tracking ability of the model on fund performance. Overall, funds do not have superior performance compared to the benchmark and do have similar risk preference to the market portfolio. Intermarket effect has been investigated as well in the study and it is shown empirically that no such effects exist. Empirical Bayesian models are explored using Bootstrap re-sampling method and priors elicited from experts' beliefs of interviews. The experts' view will be evaluated by comparing priors with posteriors. Overall, the results obtained are similar previously.

Abbreviations

APT	Arbitrage Pricing Theory
AR	Autoregressive
AS	Averages Style
BtM	Book to Market
BUGS	Bayesian Inference Using Gibbs Sampling
EB	Empirical Bayes
E/P	Earnings/Price
CAPM	Capital Asset Pricing Model
CCAPM	Consumption-based Capital Asset Pricing Model
CEO	Chief Executive Officer
CML	Capital Market Line
CRB	Commodity Research Bureau
CRSP	Center for Research in Security Prices
CS	Characteristic Selectivity
CT	Characteristic Timing
EMH	Efficient Market Hypothesis
I	Integrated (model)
ICAPM	Intertemporal Capital Asset pricing Model
IPOs	Initial Public Offerings
MA	Moving Average (model)
MCMC	Markov Chain Monte Carlo
OLS	Ordinary Least Squares
PPW	Positive Period Weighting
SEOs	Seasoned Equity Offerings
SML	Security Market Line
SR	Sharpe Ratio
TR	Treynor Ratio

Fund abbreviated name in Chapter 4

AMER	Federated American Leaders A
ING	ING GNMA Income A
MAINSTAY	MainStay MAP I
PRINCIPAL	Principal Capital Value A
AXP	AXP DIVR Bond A

Fund abbreviated name in Chapter 5, 6, 7, 8

a1	Alpine International Real Estate
a2	AXA Enterprise Equity Income A
c1	Calvert Social Investment Equity A
c2	CGM Advisor Targeted Equity A
e1	Evergreen Equity Index Instl
e2	Excelsior Blended Equity
f	Federated Equity-Income A
h	Huntington Income-Equity Tr
i	Federated International Equity A
j1	JHancock Large Cap Equity A
j2	JPMorgan Equity Income Select
l1	Legg Mason Partners Social Awareness B
l2	Lord Abbett Global Equity A
m1	MFS Global Equity B
m2	BlackRock Equity Dividend B
m3	BlackRock Equity Dividend I
o1	Old Mutual Analytic Defensive Equity Z
o2	Orbis Leveraged Equity Fund
p	Phoenix Insight Equity N
s1	SM&R Equity Income T
s2	Fidelity Spartan U.S. Equity Index Inv
t1	T. Rowe Price Equity Income

t2	T. Rowe Price Instl Foreign Equity
u	U.S. Global Investors All American Eq
w1	Westwood Equity AAA
w2	Principal Inv West Coast Equity A

Independent factor abbreviated name

cci	US Commercial bank assets – Commercial & Industrial Loans
cll	US Commercial bank assets – Loans & Leases in bank credit
cpi	US Consumer price index all urban
d	US Trade-weighted value of US dollar against major currencies
f	US Federal funds rate
ft	US Federal funds target rate
mb	US Monetary base
m1	US Money supply M1
m2	US Money supply M2
pp	US Personal consumption expenditures
ur	US Unemployment Rate
coci	US Consumer confidence index
sp500	Market Portfolio Standard and Poor's 500
hb	US House Building
td	US Trade Deficit

Abbreviation for interviews and in Chapter 6

min minimum (in percentage)

mos most likely (in percentage)

max maximum (in percentage)

up the scenario a unexpected increase of a quarter percentage point in the leading indicator

down the scenario a unexpected decrease of a quarter percentage point in the leading indicator

BoE Bank of England Base Rate

M0 UK Money Market Base M0

M4 UK Money Supply M4

UE UK Unemployment rate

RPI UK Retail Price Index

CPI UK Consumer Price Index

CCI UK Consumer Confidence Index

HB UK House Building

Frequent Used Symbols

α_i Jensen's Alpha of portfolio i

β ***(beta)*** systematic risk

β_{in} sensitivity of asset i to risk factor n

$cov(R_i, R_m)$ covariance of R_i, R_m

$E(R_i)$ expected return on security or portfolio i

R_f risk free rate

$E(R_m)$ expected return from the market (sector)

ε error term of the regression

h coefficients measure the sensitivity of the high-minus-low factor

HML_t portfolio's return to the high-minus-low factor

λ_n risk premium for factor n

s coefficients measure the sensitivity of the small-minus-big factor

SMB_t portfolio's return to the small-minus-big factor

σ standard deviation

Σ summation sign

$\overline{R_p}$ the average return of the portfolio

R_{pt} return of the portfolio in period t

R_{ft} risk free rate the excess in period t

R_{mt} return of the market portfolio in period t

Abstract of Thesis

Abbreviations

Frequent Used Symbols

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Chapter 1 Introduction

1.1 Introduction

A fund manager is an individual or a firm who provides investment management services. A fund manager is responsible for the performance of the fund and the investment style. It is the decision making of the fund manager which will have an impact on the funds performance. Canadian Financial Publishing Group (2007) indicates that the duties of a fund manager include:

'Establish an investment objective for the fund (and your money), outlining the types of securities held in the fund's prospectus;

Study profitable companies in which to invest;

Track the market, monitor securities' values and indices;

Develop economic analyses by watching industry sectors and the economies of the world;

Work, on your behalf, to make well-timed decisions as to when to buy and when to sell securities held by the fund;

May seek to reduce your tax bill on earnings by minimizing taxable distributions using trading and tax-management strategies;

Make use of numerous in-house resources and computerized analytic tools.'

The two principle decisions made by fund managers are the amount allocated to a class of assets (equity, bonds, cash etc) and the choice of specific items within an asset class. The decisions are often constrained by the investor. Within these constraints the aim of the fund manager is to 'optimise' the return. The nature of the optimisation will be based on the objective set between the fund manager and the investor. The fund manager will usually have greater flexibility over the actual choice of specific investments within an asset class, though, this can also be constrained for some funds such as 'ethical' or 'environmental' funds.

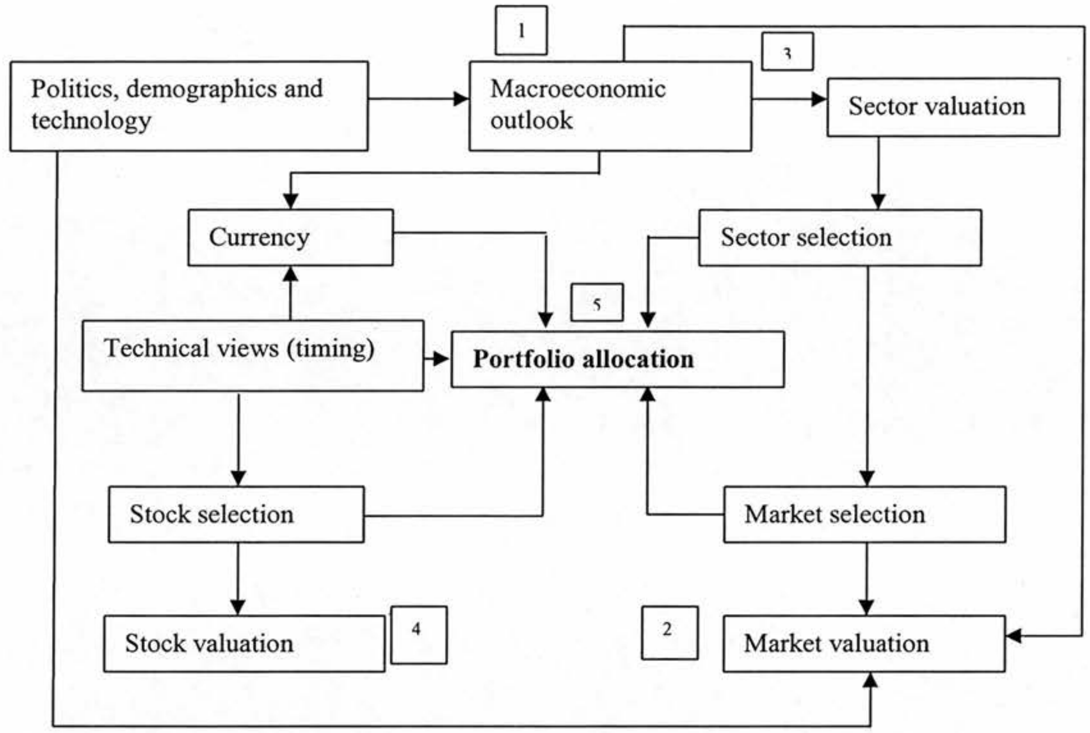
An investor will clearly have a range of potential funds in which to invest. Their choice of fund manager, or fund managers, will be influenced by a number of factors. This will include performance and the attributes of the fund manager(s). Performance is often judged against a specific benchmark. The aim of this thesis is to develop a Bayesian model to assess fund performance allowing for the incorporation of a series of factors which may have impact on fund performance.

1.2 Research Objectives and Audiences

The objective of this study is to develop a Bayesian model measuring performance of fund management. In the development of such a model it is expected further insight into the performance of funds and their managers will be gained. A Bayesian model allows for the combination of raw data and beliefs/opinions of the analyst in assessing fund performance.

A fund or portfolio is the investment vehicle managed by fund managers. The structuring of a portfolio as described by Swiss Bank Corporation is presented in Figure 1.1. Many factors influence the performance of funds. These are not solely economic or market factors. Lots of behavioural finance studies tried to discover factors may influence people in psychological level. For instance, factors include: sunshine (Hirshleifer and Shumway, 2003), daylight (Kamstra et al, 2003), temperature (Cao and Wei, 2005) and lunar cycles (Yuan et al, 2001), clock changes (Kamstra et al, 2000), and non-secular holidays (Freider and Subrahmanyam, 2004). This study mainly concerns impact from macroeconomic and policy factors. Influence from policy set by the trustees of the funds could be determinative. The policy may govern the style of management and the asset allocation requirements. The style will determine the objective of the fund. The basic styles are Money Market, Growth, Aggressive Growth, Income, High Income and Balanced. Details are given in Appendix A. Funds may be actively or passively managed. Active managers think that they can beat the market by timing of actions (purchase or selling) and selection of assets. Passive managers follow the market index and try to copy the asset allocation of a market portfolio due to their belief in market efficiency. Lots of studies have discussions on the contribution of fund's style, manager's skill such as market timing and stock picking (e.g. Daniel and Titman ,1997; Daniel et al., 1997; Fama and French, 1996; Grinblatt, Titman, and Wermers, 1997; Moskowitz and Grinblatt,1999 Graham and Harvey,1996; and Bollen and Busse, 2001).

Figure 1.1: Structuring the portfolio

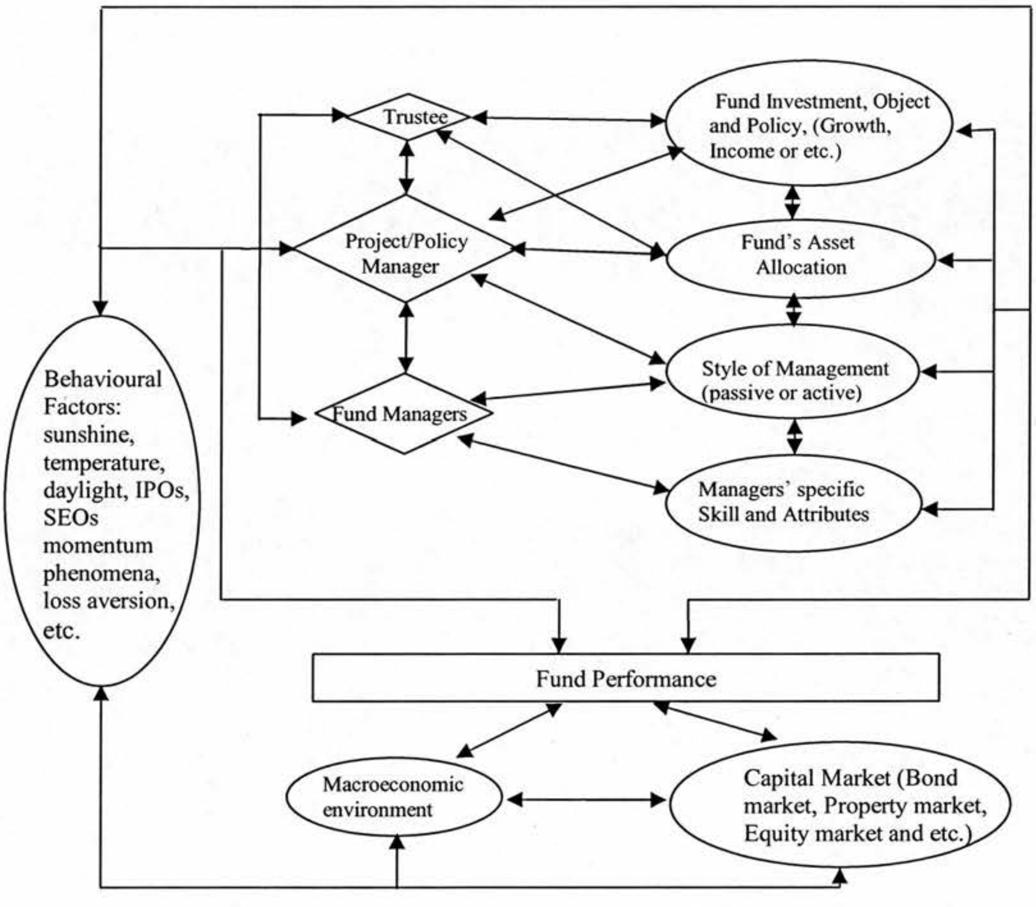


Source: Swiss Bank Corporation, Portfolio Management International Division, London

1. Growth, inflation, interest rates
2. Earnings growth, liquidity pressure, PE, NAV, interest rates. Investor sentiment
3. Exposure to economic cycle (growth, inflation, interest rates), industry risk
4. Production/business risk, management, competitiveness, PE, P/CE, NAV, growth, yield, dividend discount models, discounted cash flow models, balance sheet, currency exposure, liquidity
5. Prospective total return, client aims & constraints, time horizons, risk tolerance, risk control

The asset allocation decision is extremely important, since it dominates the performance of most portfolios. When a fund manager starts to create a portfolio, he will consider the investment objective, risk tolerance and estimates of the risks and returns on shares, bonds and money market securities. Fund manager will allocate portfolio from different aspects which involve factors mentioned in Figure 1.1. They all link to each other. Factors such as politics, demographics and technology, they may influence board environment. When fund manager outlook macroeconomic, he concerns factors such as economic growth, inflation, interest rate etc.. Sector and market valuation happens after over look the broad environment. They evaluate factors such as earning growth, liquidity pressure, price earning, market exposure etc.. Based on the valuations, sector and market are selected. Meanwhile the influence from currency is concerned as well. Fund manager's timing and stock selection skills are heavily involved in the portfolio allocation. The selection of stock is based on the valuation on factors such as production/business risk, currency exposure, liquidity etc.. Finally attributions from all the selection made previous are integrated with prospective total return, client aims and constraints to balance final allocation of the portfolio.

Figure 1.2: Overview of impacts on fund management



A simplified description is given in Figure 1.2. In the left is Behavioural Factors which are considered in the behavioural finance studies. Other elements in Figure 1.2 above 'Fund Performance' represent the internal features whilst those below are the external features. Funds will normally be controlled by Trustees who will determine the policy and strategy of the funds. They will select the fund manager(s). Within the fund managers there will often be a Project or Policy Manager who will interpret the views of the Trustees for the individual fund manager. The Trustees and Project Manager will determine the Object and Policy of the fund. This will establish the Style of Management and also influence the Fund's Asset Allocation. The individual fund manager will have specific skills and attributes which will have an impact on the performance of the fund. Obviously, in Figure 1.2 external factors will play a major part in fund performance as well. The state of the local and global economy will have an impact as will the performance of the market. Behavioural factors are very import as well. They influence fund performance through their influence on both internal and external factors implicitly and explicitly.

Initially it was envisaged that the influences of all of the factors of Figure 1.2 would be examined in the study but it was appreciated this might be too ambitious. Hence primarily the influences that will be examined will be the external factors, macroeconomic environment and capital market. The internal factors will be discussed both in light of the literature survey and the results of the early interviews with those involved in the fund management industry. Using the questionnaires the impact of macroeconomic factors will be explored and used to influence the building of the Bayesian model.

The audience for the research may be those involved with the industry and academics. The research will develop a model which will allow for assessing fund performance. The model will determine whether funds can out-performance the market. It may also allow the assessment of fund managers and their views. This should be of interest to both the industry and academics.

1.3 Research Questions

There is a large volume of literature which addresses different models for assessment of fund performance. Blakie (2000) suggested that the research question can be a device to filter irrelevant literature and save endless hours of directionless activity in libraries.

There has been a debate for sometime over whether fund managers can outperform the market. Lehman and Modest (1987), Ippolito (1989) suggest they can. Studies such as Jensen (1968), Cumby et al (1990) Malkiel (1995), John et al (1997), Miranda (1999), and Quigley and Sinquefield (2000), however, believe that managers have no superior ability in performance. Although there seems to be a number of methodologies and models used by the authors from both sides, most of them are based on the Capital Asset Pricing Model (CAPM). CAPM was developed by William Sharpe (1964). Parallel work was also performed by Treynor (1961) and Lintner (1965). For this reason the Bayesian model developed will be based on the CAPM, but it could be developed for other potential models.

The Bayesian approach allows for greater insight to be built into the model using the prior views and opinions of those involved with the analysis. This may overcome some of the limitations of the normal linear model and provide a better insight into the underlying variability and interaction between factors.

The study can be defined in terms of the following research questions:

- Can Bayesian methods be used to bring further insight into the measurement and performance of fund management?
- Which factors would be appropriate to include into modelling?
- Are there practical limitations to the modelling?

1.4 General Approaches

1.4.1 Data Collection

The U.S. mutual fund market will be used, since it is more complete and easier to access. It has also the advantage of being large enough to provide a sufficient sample across a range of different sectors and styles. It can be regarded as a mature market and so provide a sufficiently long period of historical data to assess aspects of performance.

Monthly data has been chosen because some funds may not be traded frequently during the time period and it is generally smoother than daily data. Short term volatility is not a concern in this current study. Equity funds have been chosen for similar reasons. They tend to be more regularly traded than other mutual funds. Using Datastream 26 funds have been selected over a 16 year period.

1.4.2 Research Scope

1.4.2.1 Research Strategy

A positivist approach has been taken based on the ideas of Auguste Comte. Comte believed that an ordered universe is made up of discrete and observable events, and that order can be generalised from observation. Four research strategies were plausible: the inductive, the deductive, the retroductive and the abductive. The inductive or inductive logic/reasoning approach was felt most appropriate for the current study since it generalises principles from a definite number of observations of experiences.

1.4.2.2 Theory Background

1.4.2.2.1 Capital Asset Pricing Model (CAPM)

A number of models could be considered for assessing fund performance. One of the most established, though not beyond criticisms including: Black, Jensen and Scholes (1972), Blume and Friend (1973), Fama and Macbeth (1973), Basu (1977), Reinganum (1981), Banz (1981), Gibbons (1982), Stambaugh (1982), Chen, Roll and Ross (1986), Fama and French (1992) and Jagannathan and Wang (1996), is the Capital Asset Pricing Model (CAPM). It has a long history, see Sharpe (1964,1966), Treynor (1961,1965) Lintner (1965) and Jensen (1968). It became dominant for a considerable length of time during the late 20th Century. The approach developed within this thesis is not dependent on this model and could be adapted to other more sophisticated models as desired.

The basic CAPM model for a security or portfolio i is

$$E(R_i) = R_f + \beta_i\,(E(R_m) - R_f)$$

where $E(R_i)$ is the expected return on security or portfolio i, $E(R_m)$ is the expected return from the market (sector), R_f is the risk free rate and β_i is the systematic risk for security or portfolio i.

Often the model is presented as

$$E(R_i) - R_f = \alpha_i + \beta_i (E(R_m) - R_f)$$

In this study, though, the model will assumed to be valid for making investment decisions. α and β have been determinants of investment decisions with β seen initially as the more important measure, though, significance is now also associated with α. Focus of the research will therefore be an estimation of α and β using Bayesian techniques.

A multi-factor model will be built. Selection of the factors to include is clearly subjective. A number of authors have advocated specific set of variables such as Basu (1977), Fama and French (1992) and Carhart (1997). The choice is based on the analyst's belief, hence a natural setting for Bayesian analysis. Beliefs from the analysts will be used to determine both factors used and to produce prior beliefs about the effect of the factors on fund performance.

As indicated earlier the focus within the study will be on the external factors. Views have been sought from experts over the development of the model as well as subsequent consultation over the potential impact of factors to derive elicited prior distributions for impact of factors. Modelling has also been used to determine the significant factors, such as stepwise regression and bootstrapping.

1.4.2.2.2 Behavioural Finance

Behavioural finance is becoming mainstream in the recent 10 years. It recognises individual's behaviour in a psychological level since this could be a driven force behind those financial anomalies including calendar effects, loss aversion, momentum effect, etc.. Studies including Barberis, Shleifer, and Vishny (1998) and Daniel, Hirshleifer, and Subramanyam (1997) tried to model fund performance from a behavioural aspect. However, there is still no unified model for behavioural finance. Statman (1999) provides few suggestions on how to improve behavioural finance model without rejecting traditional efficient market theory. In this study human psychological traits will be explored through interviewing fund managers and comparing their beliefs to posteriors generated by Bayesian model constructed in the study. Behavioural factors discussed by other studies such as sunshine (Hirshleifer and Shumway, 2003), daylight (Kamstra et al, 2003), temperature (Cao and Wei, 2005) and lunar cycles (Yuan et al, 2001), clock changes (Kamstra et al, 2000), and non-secular holidays (Freider and Subrahmanyam, 2004) will not be further investigated.

1.4.2.2.3 Bayesian Method

Bayesian Theory is named after Thomas Bayes (1702-1761) who proved a special case of Bayes' Theorem. Bayes' Theorem is a consequence of the probability axioms and the definition of conditional probability:

$$P(S \mid T) = P(T \mid S) \times P(S)/P(T)$$

where P(S) is the probability of event S, P(S | T) is the probability of event S given T has occurred (the conditional probability of S given T) and P(T) is assumed to be greater than zero.

The epistemological significance of Bayes' Theorem is that it provides a corollary to the Simple Principle of Conditionalization. The posterior probability of a hypothesis H is generated by conditioning on observed evidence E. Bayes' Theorem provides a formula for the posterior probability of H in terms of the likelihood of E given H {P(E | H)} and the prior probability of H. The Bayesian method will be employed to estimate fund performance based on the model developed in the study.

1.4.2.3 Research Structure

Following the inductive strategy, a series of Bayesian models will be built from observations of market data and subjective opinion. Figure 1.3 provides a guide to the research structure of this study. The research objective lead to the research questions posed. To gain understanding of the context a literature survey was carried out along with a series of interviews with those involved with the industry. Data was collected on a series of funds and also macroeconomic factors and market benchmark.

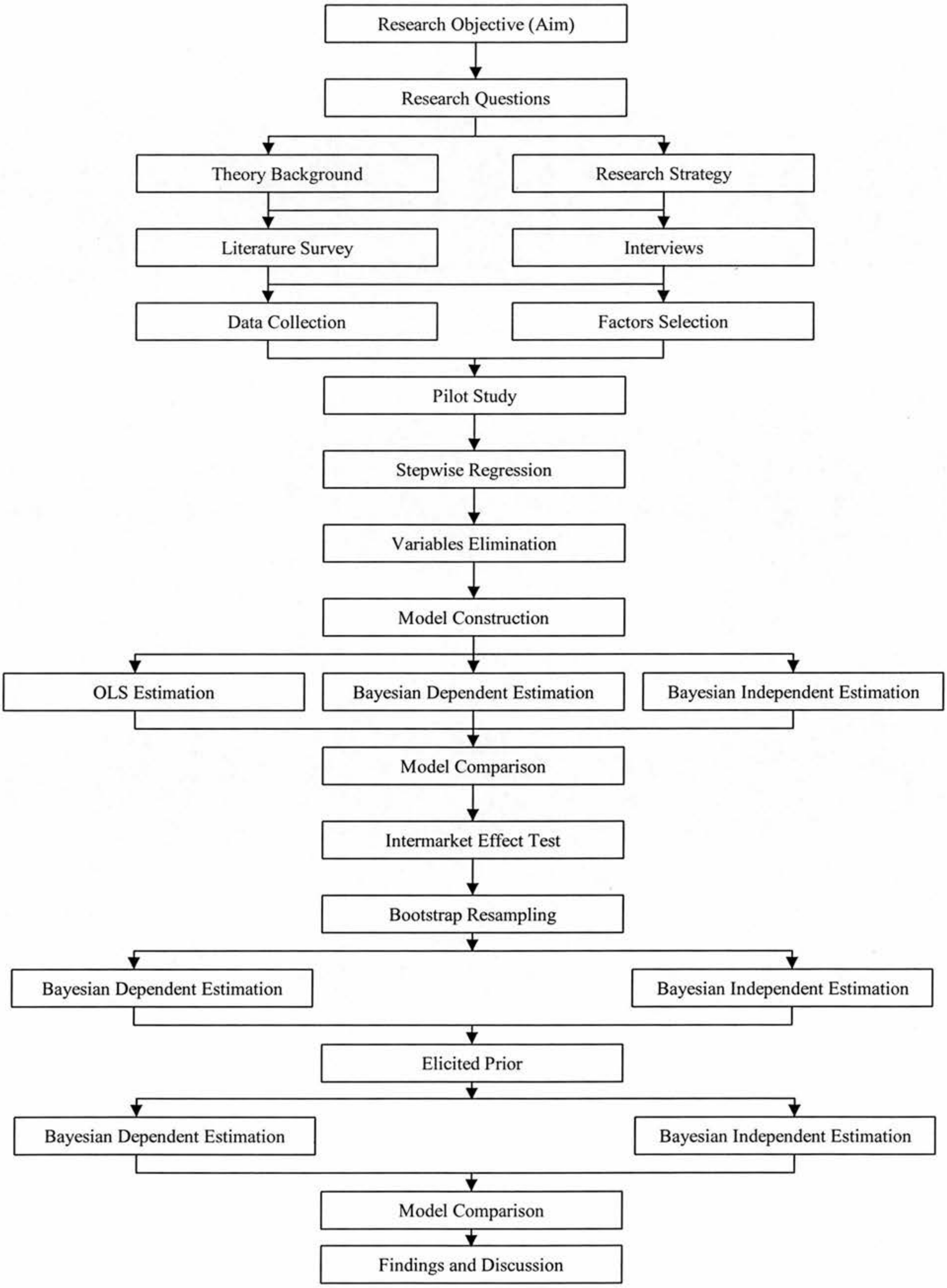
A pilot study on 5 funds was initially carried out. In the pilot study using Ordinary Least Squares (OLS) the significance of the factors were determined using repeated trials of different combinations of factors. Those found to be insignificant were discounted. The significant factors were then employed in Bayesian analysis, with dependent and independent formulations. After the pilot study the full study using 26 funds was carried out following the same pattern.

The priors used could be regarded as theoretical priors in the initial study. To overcome this limitation it was decided to explore both Empirical Bayesian and Elicited Prior Bayesian models. Throughout comparisons of the models were made. Table 1.3 presents the types of data used within the study.

Table 1.3: Combinations of models and data set

Models	**Data**
OLS	Data
Bayes	Data+Theoretical Priors
Empirical Bayes	Data+Bootstrap Prior
Bayes	Data+Elicited Prior

Figure 1.3: Research structure



1.5 Practical Constraints

There have been a number of constraints on development of the current work. Time and budget means that it has not been possible to collect all the data that was original desired. There are limitations to using Datastream as the main source of information on funds. Obviously this could have been overcome if there had been money to purchase more data from financial institutions.

It has not been possible to gain sufficient detail of information to explore the internal factors that may have had an impact on fund performance. In fact it may not always be possible to quantify such measures. Hence this area will be left for future research.

The required subjective data is difficult to collect particularly from busy fund managers. Whilst considerable effort was employed in the collection of such the results were disappointing. Again future effort could be centred on developing elicitation methods within this area.

1.6 Overview of Chapters

Chapter 2 explores the literature on measure of fund performance including behaviour of fund management. It will look at the aspects that may influence fund management performance as well as the established models. It will consider the role of policy with fund management. It will be supported with interviews in type and behaviours of the people involved with fund management.

Methodological issues will be discussed in Chapter 3. This will include the choice of research strategy with its epistemological roots. An outline of the history and theory of the Bayesian approach will be given. The final part of the Chapter will discuss the qualitative methods employed in the thesis.

The pilot study will be described along with results in Chapter 4. The pilot study used five funds from U.S. Market with the benchmark being Standard & Poor's 500 (sp500). OLS and Bayesian models will be compared.

A full study of the 26 funds will be explored in Chapter 5. Comparisons of the models will be considered. It will cover significant macroeconomic factors. This is followed by an examination of the intermarket effect with further investigation of the intermarket index.

Chapter 6 discusses the results from use of the bootstrap and elicited priors. Again comparisons will be made amongst the models. The implications of the elicited model will be explored.

The main conclusions of the research will be given in Chapter 7. Chapter 8 will reflect on further research which could be employed to extend the work of the thesis.

Chapter 2 Literature Survey and Background

2.1 Introduction

The objective of this chapter is to provide an overview of the work that has been done in an important area of financial markets research—modelling the behaviour of fund managers. This is an active area of research and it is impossible within limited space to capture all aspects. The review describes the work most relevant to the current researches. The next section provides an overview of the financial theory that underlies the behaviour of fund managers. This is followed by the results of numerous empirical studies that have been published during the past quarter-century. Time series analysis is an important method for exploring fund performance. This involves autoregressive (AR) models, integrated (I) models, or moving average (MA) models. There is a considerable literature on using time series analysis to measure fund performance, including Bollerslev, Engle and Wooldridge (1988); Bodurtha and Mark (1991); Ng (1991); Bollerslev, Chou and Kroner (1992); Devaney (2001); Copeland and Wang (2000); Specht and Gohout (2003); and Füss, Kaiser and Adams (2007). This study, however, is concerned with general trends in fund performance rather volatilityetc. Therefore literature of finance theory on fund performance measurement will be focus point and reviewed in this Chapter.

Quantitative method can provide insights into the performance of investment funds, but these funds are managed by people, not by machines. There will be information not revealed from the study of historical market data. One way to obtain this information is to use qualitative methods, interviews and surveys of experts. A survey allows one to gather information on the behaviour of the people involved: e.g. trustees, policy managers and fund managers. The questions posed might include: How do trustees and policy managers pick fund managers? What is the relationship among trustees, policy managers and fund managers? In the later part of Chapter, based on the information from literature and initial survey, findings of various aspects of fund management will be reviewed.

2.2 Theoretical Background

2.2.1 The Market Efficiency

Contents in Theoretical Background section are based on the standard text from Fabozzi (1999), Blake (2000), Reilly and Brown (2003), and Brealey and Myers (2003). In reality, there are two types of efficiency – informational efficiency and rational fundamental valuation. Informational efficiency is concerned with how rapidly information is reflected in share prices. Rational fundamental valuation is concerned with whether security prices always reflect 'true' fundamental values. It is possible to test informational efficiency, but literally impossible to test rational fundamental valuation.

The Efficient Markets Hypothesis (EMH) concerns informational efficiency which was developed from the Random Walk Theory. It has very important implications for investors as well as for financial managers. The EMH theory deals with one of the most fundamental and exciting issues in finance – how rapidly new information is impounded in security prices.

2.2.1.1 The Efficient Markets Hypothesis

The term 'efficient market' appeared first in a 1965 paper by Eugene Fama who said that in an efficient market, on the average, competition will cause the full effects of new information on intrinsic values to be reflected "instantaneously" in actual prices. Which means that current stock prices fully reflect available information about the value of the firm, and there is no way to earn excess profits, (more than the market over all), by using this information.

The most crucial implication of the EMH is for stock market pricing. According to the theory, prices of securities in efficient markets will reflect all known information available to investors. Nevertheless this does not mean that securities will all perform similarly, because the expected return from a security is primarily a function of its risk. The rational price of the security will reflect the present value of its expected future cash flows, which incorporates many factors such as volatility, liquidity, and risk of bankruptcy. As indicated by the theory while prices are rationally based, changes in prices are expected to be random and unpredictable, because of new information, by its very nature, is unpredictable. Therefore stock prices follow a random walk.

2.2.1.1.1 Three Versions of the Efficient Markets Hypothesis

The efficient markets hypothesis states that market prices incorporate all available information at any point in time. There are, however, different kinds of information that influence security values. Consequently, financial researchers distinguish between three versions of the Efficient Markets Hypothesis, depending on what is meant by the term 'all available information'.

2.2.1.1.1.1 The Weak Form Efficiency

In Blake (2000), the weak form of the Efficient Markets Hypothesis states that the current price fully incorporates information contained in the past history of prices. Nobody can detect mis-priced securities and "beat" the market by analysing past prices. Thus, no one is able to profit from using something that 'everybody else knows'. Technical analysis is used by many financial analysts. Technical analysis is the study of a security's price action which is defined as movement in a security's price. This technique is used by many financial analysts for the purpose of forecasting profitable price trends and movement of securities. According to EMH, technical analysis has no value.

2.2.1.1.1.2 The Semi-strong Form Efficiency

The semi-strong form of the efficiency market hypothesis states that the current price fully incorporates all publicly available information (Reilly and Brown, 2003). This information includes not only the past sequence of stock prices, but also data reported in a company's financial statements (annual reports, income statements, filings for the Security and Exchange Commission, etc.), earnings and dividend announcements, announced merger plans, the financial situation of company's competitors, expectations regarding macroeconomic factors (such as inflation, unemployment), etc.

The assertion that nobody can consistently achieve superior investment performance using public information is stronger than the weak form efficiency. As will be seen later, empirical evidence is overwhelming consistent with the semi-strong form of the EMH.

2.2.1.1.1.3 The Strong Form Efficiency

The strong form of the efficiency market hypothesis states that the current price fully incorporates all existing information, not only public, but also private information. The main difference between semi-strong and strong form efficiency is that nobody can benefit from trading on inside information. Empirical research in finance, however, has found evidence that is inconsistent with the strong forms of the EMH.

2.2.1.1.2 Evidence of the Efficient Markets Hypothesis

Since introduction of EMH into the financial economics literature around40 years ago, it has been examined extensively in numerous studies. The vast majority of this research indicates that developed stock markets are indeed efficient. In this section, the evidence regarding the Efficient Market Hypothesis will be briefly discussed, splitting the tests into the different forms of efficiency.

2.2.1.1.2.1 Evidence on the Weak Form of Market Efficiency

The most important early test of the weak-form EMH conducted by Alexander (1961) and Fama and Blume (1966) was the examination of a particular technical trading rule called the k% filter rule. The result of the examination was consistent with the US stock market being weak form efficient and the trading rule based on the movement of past prices was not profitable. Other research examines whether investors can gain from technical analysis. Evidence shows that technical analysis cannot provide sufficient return to cover trading costs. Lakonishok and LeBaron (1992) found following a relatively simple technical trading rule leads to successful prediction of results of the Dow Jones Industrial Average. Nevertheless these gains are insufficient to cover their transaction costs. Consequently, the findings are consistent with weak-form market efficiency.

If a market is efficiency in the weak sense then security prices follow a random walk. The random walk hypothesis implies that successive price movements are independent of each other. Fama (1965) found that the serial correlation coefficients for a sample of 30 Dow Jones Industrial stocks are statistically significant, but too small to cover transaction costs of trading.

2.2.1.1.2.2 Evidence on the Semi-strong Form of Market Efficiency

People pay the most attention to the semi-strong form of the EMH because of its significant implication. According to the EMH, if a market is semi-strong form efficient, all publicly available information is reflected in the stock price, which implies that no method based on public information can consistently beat the market. This is because new information is rapidly converted into price changes instantly.

The evidence from tests of the semi-strong EMH is mixed. Studies on a range of events have results are consistent with efficient market hypothesis. Fama, Fisher, Jensen, and Roll (1969) examined the stock price reaction around stock splits. They observed no evidence of abnormal stock price performance following the split. This evidence is consistent with the efficient markets hypothesis.

Ball and Brown (1968) tested whether the information contained in company reports (particularly earnings announcements contained in company reports) leads to significant changes in security price following the public release of the reports. They found no trading rule based on the announcements can lead to positive excess returns after adjusting for risk and transaction costs.

Event studies on initial public offerings by Ritter (1991), Carter, Dark and Singh (1998), and Loughran and Ritter (1995), accounting changes by Bernard and Thomas (1990), and a variety of corporate finance events by Smith (1986) and Jensen and Warner (1988) support the semi-strong form of EMH.

Studies on returns prediction presented evidence against the semi-strong efficiency. Studies on the calendar effects including January effect by Rozeff and Kinney (1976), the turn of the month effect by Ariel (1987) and Lakonishok and Smidt (1988), the Monday (or weekend) effect by French (1980) and Gibbons and Hess (1981), the day-end effect by Harris (1986,1989), and holiday effect by Ariel (1990) found significant excess returns associated with specific times of the day, days of the week, or month of the year. Time-series studies on quarterly earnings surprises by Rendleman, Jones, and Latane (1982), and Jones, Rendleman and Latane (1985) found market does not adjust stock prices to reflect the information released by the announcement as fast as expected by the semi-strong EMH.

Similarly, studies of cross-sectional predictors such as size by Banz (1981), market to book ratio and earnings-price ratio by Fama and French (1992) indicated semi-strong EMH is not true.

2.2.1.1.2.3 Evidence on the Strong Form of Market Efficiency

Empirical tests of the strong-form version of the efficient markets hypothesis have typically focused on the profitability of insider trading. If the strong-form efficiency hypothesis is correct, then insiders should not be able to profit by trading on their private information. Jaffe (1974) found considerable evidence that insider trades are profitable. A paper by Rozeff and Zaman (1988) discovered that insider profits, after deducting an assumed 2 percent transactions cost, are 3% per year. This is not appear to be consistent with the strong-form of the EMH. However, insider trading is illegal behaviour. There is different evidence, which is based on legal use of information rather on the legal acquisition and use of information. Jensen (1968) and Ippolito (1989) tested the unit trusts performance in the US market base on company information which is generated by fund mangers. Although this kind of information is not public, it is legal inside information. The results show that unit trusts, on average, make the same return adjusted for the risk and costs as a buy-and-hold strategy.

2.2.1.1.3 The Implication of EMH on Fund Performance Measure

If the market is efficient, funds will not have ability persistently to achieve superior performance. On other hand, if the market is not consistent with the EMH, funds may have the ability persistently to outperform the market. Most of the empirical evidence supports the EMH. In one of the first studies of its kind, Jensen (1969) found that over the period 1955 to 1964 mutual funds achieved a risk-adjusted performance of approximately zero percent per year. In other words, mutual fund managers exhibited no special stock picking ability. Furthermore, this return fell to –0.9% per year after taking into consideration commissions and expenses. Burton Malkiel (1999) compared the performance of managed general portfolio funds to the performance of the S&P 500 Index. During 1984-1994, the S&P 500 gained 281.65%, while the equity funds on average appreciated only by 214.80%.

The overwhelming majority of empirical evidence supports the Efficient Market Hypothesis. The opponents of the Efficient Markets Hypothesis point to some evidence, such as DeBondt and Thaler (1985) suggesting that there is under- and over-reaction in security markets.

2.2.1.1.4 Rational Fundamental Valuation

Despite informational efficiency, another form of efficiency exists. Summers (1986) did not dispute the conclusion that it is very difficult to earn abnormal returns making use only of publicly available information. The paper, however, debated that market prices may not represent rational assessment of fundamental values. On Monday 19th October 1987, the Dow Jones Industrial Average fell by 23% followed by the prices fell by 24% in London, 32% in New York, and 20% in Tokyo. People will ask what new information caused such a sharp fall? and Do prices reflect fundamental values? In the view of rational fundamental valuation, market is efficient in the sense that shares are approximately ‘correctly’ valued most of the time. It is extreme difficulty of testing the rational fundamental valuation because the intrinsic value of stock need to be calculated by referring the price which comes out regarding to yesterday’s price or relating to today’s price of comparable securities. Brealey and Myers (2003) mentioned that if investors lose confidence on these benchmarks, there may be a period of confused trading and volatile prices before a new benchmark is established. This makes find true value of share prices become extremely difficult.

2.2.1.2 Behavioural Finance

Behavioural finance is psychology applied to the financial behaviour of market practitioners. It seeks to understand and predict systematic financial market implications of psychological decision processes. It focuses on the psychological dimensions that underlie and drive investors' actual behaviour and judgement on an individual level. A basic precept of behavioural finance is that market participants do not make choices on a purely rational basis. It is accepted by many as a legitimate area for academic research in the 1990s.

DeBondt and Thaler (1985) is the first attempt to use a behavioural principle to predict a market anomaly. They suggest that most people tend to 'overreact' to unexpected and dramatic news events which may lead to an under- and over-reaction in security markets. Several studies tried to use behavioural finance to explain market anomalies including: noise trader by Shleifer and Summers (1990), momentum phenomena by Jagadeesh and Titman (1993), and loss aversion by Kahneman and Tversky (1979), Thaler and Johnson (1990), and Barberis , Huang and Santos (2001).

Fama (1998) summarised several reported long-term return anomalies. He concluded that stock prices over-react to anomalies including long-term return reversals, ratios as a proxy for past performance, Initial Public Offerings (IPOs) and Seasoned Equity Offerings (SEOs) and under-react to earnings announcement, stock splits, repurchase tender offers and dividend omission.

Statman (1999) gave the direction of development in behavioural finance. He mentioned that people would benefit from the insights of behavioural finance by accepting market efficiency in the (not) beat the market sense but not in the rational sense. People could develop a behavioural asset pricing model that includes 'value-expressive' as well as 'utilitarian' characteristics.

People are keeping searching factors may influence share prices in the behavioural finance area. Studies are about continuous variables including sunshine (Hirshleifer and Shumway, 2003), daylight (Kamstra et al, 2003), temperature (Cao and Wei, 2005) and lunar cycles (Yuan et al, 2001), and event studies including: clock changes (Kamstra et al, 2000), and non-secular holidays (Freider and Subrahmanyam, 2004). Behavioural finance provides plausible explanations for the existence of anomalies within financial markets. It is becoming much more mainstream recently.

2.2.2 Theory Review of CAPM

2.2.2.1 Markowitz Portfolio Selection

The development of the theoretical relationship between risk and expected return is built on two economic theories: portfolio theory and capital market theory. Portfolio theory deals with the selection of portfolios that maximize expected returns consistent with individually acceptable levels of risk. Capital market theory deals with the effects of investor decisions on security prices. More specially, it shows the relationship that should exist between security return and risk, if investors construct portfolios as indicated by portfolio theory.

Together, portfolio and capital market theories provide framework to specify and measure investment risk and to develop relationship between risk and expected return. These theories have revolutionalised the world of finance, by allowing portfolio managers to quantify the cost of capital and risk of a proposed investment.

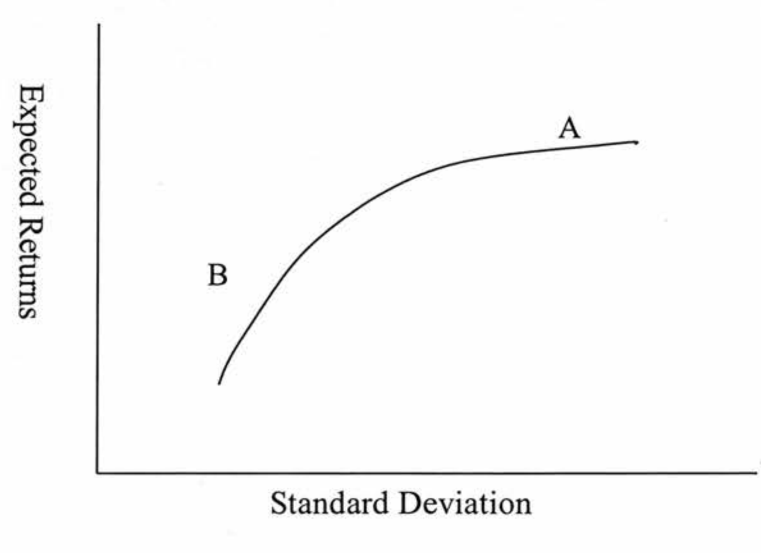
Theories are an abstraction of the real world and, as such, are based upon some simplifying assumptions. Portfolio theory and capital market theory require the following assumptions (Blake, 2000; Reilly and Brown, 2003):

(1) All investors are single-period expected utility of terminal wealth maximizers who choose among alternative portfolios on the basis of mean and variance of return.
(2) All investors can borrow or lend an unlimited amount at an exogenously given risk-free rate of interest R_F, and there are no restrictions on short sales of any asset.

(3) All investors have identical subjective estimates of the means, variance, and covariances of return among all assets.
(4) All assets are perfectly divisible and perfectly liquid, i.e., all assets are marketable and there are no transactions costs.
(5) There are no taxes.
(6) All investors are price takers.
(7) The quantities of all assets are given.

The work of Markowitz on portfolio selection resulted in a revolution in the theory of finance and laid the foundations for modern capital market theory. In his study (1952) and (1959), Markowitz constituted the Modern Portfolio Theory. The Markowitz model is a single-period model, where an investor forms a portfolio at the beginning of the period. It assumes that subject to an acceptable level of risk investors can maximize their expected return by diversification. According to the theory, risk is measured by the variance of return and diversification can reduce portfolio variance. Markowitz set forth the theory for the construction of an efficient portfolio, called a Markowitz efficient portfolio which is a portfolio with the highest expected return of all feasible portfolios with the same level of risk. The collection of all Markowitz efficient portfolios is called the efficient frontier. It is shown in Figure 2.1

Figure 2.1: Markowitz portfolio selection



Source: Adapted from Blake (2000)

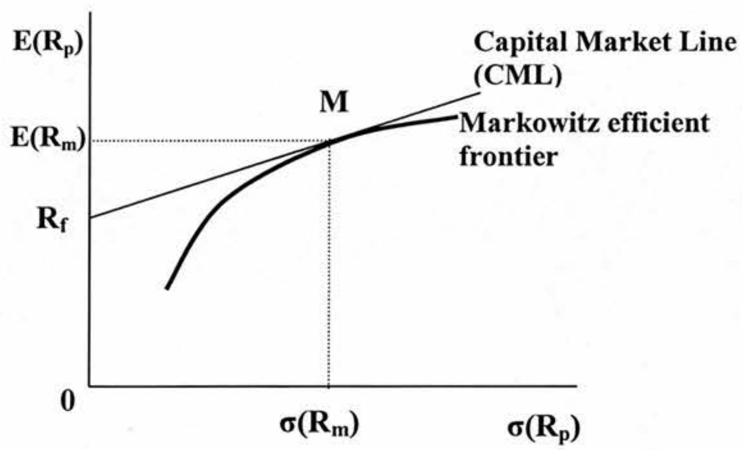
Investors can select any portfolios along curve AB, according to their tolerance for risk. A risk-lover might choose portfolio A and a risk-averse investor would be more likely to choose portfolio B.

2.2.2.2 Capital Asset Pricing Model

The Markowtiz two-factor did not include the ability of the investors to borrow and lend at the risk-free rate. William Sharpe (1964), John Linter (1965), Jack Treynor (1961), and Jan Mossin (1966) demonstrated that the opportunity to borrow and lend implies a capital market where risk-averse investors will prefer to hold portfolios consisting of combinations of the risk-free asset and some portfolio M on the Markowitz efficient frontier. The line from the risk-free rate to portfolio M on the efficient frontier is called Capital Market Line (CML). It is illustrated in Figure 2.2. The following equation yields the capital market line

$$E(Rp) = Rf + \frac{E(Rm) - Rf}{\sigma(Rm)} \sigma(Rp)$$

Figure 2.2: Capital Market Line



Source: Adapted from Blake (2000)

where $E(R_p)$ = portfolio excepted return

$E(R_m)$ = market portfolio excepted return

$\sigma(R_p)$ = standard deviation of portfolio return

$\sigma(R_m)$ = standard deviation of market portfolio return

R_f = risk-free rate

M = market portfolio

Capital market theory assumes that all investors hold the same expectations for the inputs into the model. $\sigma(R_p)$ and $\sigma(R_m)$ are the market's consensus for the standard deviation of return for the market portfolio and portfolio p. The slope of the CML measures the reward per unit of the market risk and it determines the additional return needed to compensate for a unit change in risk. For this reason, the slope of the CML is also referred to as the market price of risk.

The capital market line represents an equilibrium condition in which the expected return on a portfolio of assets is a linear function of the expected return on the market portfolio. This model assumes that investors use the logic of Markowitz in forming portfolios. It further assumes that there is an asset (the risk-free asset) that has a certain return. With a risk-free asset, the efficient frontier in Figure 2.1 is no longer the best that investors can do. The straight line in Figure 2.2, which has the risk-free rate as its intercept and is tangent to the efficient frontier, is now the up left boundary of the investment opportunity set. Investors choose portfolios along the capital market line, which shows combinations of the risk-free asset and the risky portfolio M. In order for markets to be in equilibrium, the portfolio M must be the market portfolio of all risky assets. So, all investors combine the market portfolio and the risk-free asset, and the only risk that investors are paid for bearing is the risk associated with the market portfolio. Please see Blake (2000) p489-491 for detail of mathematical calculation. The CAPM equation is:

$$\boldsymbol{E(R_i) = Rf + \beta_i(E(Rm) - Rf))}$$

where $\beta_i = \dfrac{\sigma_{im}}{\sigma^2_m} = \dfrac{cov(R_i, R_m)}{\sigma^2(R_m)}$

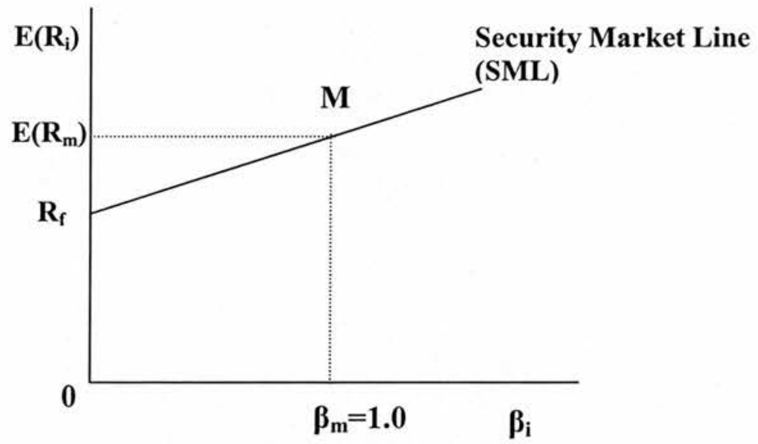
and $E(R_i)$ = the expected return on security i

β_i= the systematic risk for security i and

σ_{im}= the covariance between the security's return and the market return

It is referred to as the Capital Asset Pricing Model (CAPM), the general equilibrium models of asset price derived by Sharpe (1964) and Lintner (1965). Where they describe the expected return on the security, *i* is equal to the return on the risk free rate (price of time; real rate of interest; inflation premium; liquidity premium) plus the amount of market risk times the quantity of risk, beta (β_i). The CAPM equation uses the covariance of the i^{th} security with the market, relative to the total risk of the market (measured by the variance, and is diversifiable and non-diversifiable risk). It is possible to plot the relationship between expected return and the relative risk of the asset in E(R*i*)- β_i space. This is the Security Market Line (SML):

Figure 2.3: Security Market Line



Source: Adapted from Blake (2000)

In equilibrium, the excepted return of individual securities will lie on the SML and not on the CML because of the high degree of unsystematic risk that remains in the individual securities that can be diversified out of portfolios of securities. The only risk that investors will pay a premium to avoid is market risk.

The CAPM can be used to evaluate the investment performance of the individual assets, like mutual funds, in the portfolio. If β equals to 1, the portfolio expected return is same as the market portfolio. If β is larger than 1 we have an aggressive fund whose price is more volatile than that of the market i.e. more undiversifiable risk and a higher return will be demanded. Similarly, with a defensive fund, its β is less than 1and it has less undiversifiable risk than the market as a whole. Beta provides investors with an easy way to compare investment performance of individual securities with the benchmark. The CAPM equation says that the expected return of any risky asset is a linear function of its tendency to vary jointly with the market portfolio. So, if the CAPM is an accurate description of the way assets are priced, this positive linear relation should be observed when average portfolio returns are compared to portfolio betas. Further, when beta is included as an explanatory variable, no other variable should be able to explain cross-sectional differences in average returns. Beta should be all that matters in a CAPM world.

The CAPM just described assumes that the only risk that investors are concerned with is uncertainty about the future price of the investment. So the CAPM model is known as a single-factor model. Investors, however, usually are concerned with other risks that will affect their ability to consume goods and services in the future. Recognizing these other risks that investors face, Merton (1973) extended the CAPM based on the consumers deriving their optimal lifetime consumption when they face these "extra-market" sources of risk. An alternative model to the CAPM and the multifactor CAPM was developed by Ross (1976). This model is based purely on arbitrage arguments, and hence is called the Arbitrage Pricing Theory (APT) model. Compared with CAPM, they are both equilibrium pricing models, because when arbitrage transactions are available, the economy is not in equilibrium. Thus, the APT investigates the market equilibrium prices when all arbitrage transactions are eliminated. The APT model will be discussed in section 2.3.3.1.

2.2.2.3 Some Early Measures on Performance Measurement and Evaluation

2.2.2.3.1 Sharpe Ratio

The Sharpe Ratio (Sharpe, 1966), also known as Reward-to-Volatility-Ratio, indicates the excess return per unit of risk associated with the excess return. The higher the Sharpe Ratio, the better the performance.

$$SR_p = \frac{\overline{R_p} - \overline{R_f}}{\sigma_p}$$

where $\overline{R_p}$= the average return of the portfolio

$\overline{R_f}$= the average risk-free rate

Graphically, the Sharpe Ratio is the slope of a line between the risk-free rate and the portfolio in the mean/volatility space. Actually, the task of finding the efficient portfolio in the Markowitz' mean-variance framework with a risk-free asset is equal to maximizing the Sharpe Ratio of the portfolio.

The Sharpe Ratio does not refer to the market portfolio or any other benchmark. The implicit benchmark is the risk-free rate of return. The excess return can be interpreted as a zero-investment strategy: It can be obtained by taking a long position in the portfolio and a short position in the risk-free rate, with the funds from the latter used to finance the purchase of the former.

The total risk of a portfolio (its standard deviation) is used in the Sharpe Ratio, so that diversification does not play any role in performance analysis. The Sharpe Ratio is a useful measure for an investor which puts all his money in one fund; in this situation, only total risk matters. It measures a manager's ability not only to pick winners but also to diversify efficiently.

2.2.2.3.2 Treynor Ratio

Like the Sharpe Ratio, the Treynor Ratio (Treynor 1965), sometimes called Reward-to-Variability-Ratio, also relates excess return to risk; but systematic risk instead of total risk is used. It measures a manager's ability to choose investment with higher rates of return than others with similar beta values. The higher the Treynor Ratio, the better the performance under analysis.

$$\boldsymbol{TR_p} = \frac{\overline{\boldsymbol{R_p}} - \overline{\boldsymbol{R_f}}}{\boldsymbol{\beta_p}}$$

In mean and beta-space, the Treynor Ratio is graphically represented by the line between the risk-free rate and the portfolio.

A ranking of portfolios based on the Treynor Ratio measure is only useful if the funds under consideration are well-diversified or are sub-funds of a broader, fully diversified portfolio. If this is not the case, portfolios with identical systematic risk, but different total risk, will be rated the same, but the portfolio with a higher total risk is less diversified and therefore has a higher unsystematic risk which is not priced in the market.

2.2.2.3.3 Jensen Alpha

The Sharpe and Treynor Ratios discussed above can only be used in relative performance comparison between portfolios and between a portfolio and a benchmark. Jensen's Alpha (Jensen 1969) measures the value added by selection activities. Alpha can be estimated together with Beta by introducing a constant in a linear regression between portfolio and benchmark excess returns:

$$\boldsymbol{R_{pt} - R_{ft}} = \alpha + \boldsymbol{\beta} \, (\boldsymbol{R_{mt} - R_{ft}}) + \varepsilon$$

where R_{pt}-R_{ft}= the excess return of the portfolio in period t

α= the constant in the times series regression

R_{mt} - R_{ft}= the excess return of the market portfolio in period t

ε= the error term of the regression

Graphically, an Alpha shifts the Security Market line up or down in mean/beta-space. The statistical significance of Alpha can be measured with the usual t-tests for the parameters of a linear regression. More powerful statistical tests to identify the significant superior performance have been developed. A direct comparison of Alphas between different portfolios is only valid when they have equal systematic risk (equal beta).

It is not clear which of these performance indicators represents the best performance measure, as each of them may inferior to one of the other indicators in a different context, or even for different investors. Often Sharpe and Treynor measures contradict. For instance, an asset often beats the SML but not the CML, usually because it is not diversified enough to be held alone. When the portfolios are well diversified, these two measures will have consistent ranks.

Jensen alpha is more appropriate for fund measurement, because it evaluates the outperforming market ability of the funds. It provides a clear view of the fund's performance and it is considered in this thesis. Also the Jensen ratio uses Ordinary Least Squares regression (OLS) to check whether the alpha is significantly different from zero. Using historical data, the alpha can be derived easily and the hypothesis of its difference from zero can be analysed statistically. The Jensen ratio, however, relies on the assumptions of the CAPM being valid. So if CAPM is invalid, Jensen measure will also lose its validity. In earlier studies, Black et al. (1972), Fama and MacBeth (1973) and Sharpe and Cooper (1972) used different analytical methods but essentially used the same data for US equities and their results are all supported the CAPM. A number of later studies, though, Basu (1977), Banz (1981), Corhay et al (1987) and Friend et al. (1988), have come to an alternative conclusion about the CAPM. Among these studies, there is one controversial paper. It is generally known as Roll's critique. In Roll (1977), he criticized the previously published tests of the CAPM. He argued that the CAPM is not testable unless the exact composition of the true market portfolio is known, and the only valid test of the CAPM is to observe whether the ex ante true market portfolio is mean-variance efficient. As the market portfolio cannot be determined, this test is impossible.

2.3 Debates around CAPM

The cross-section of expected returns in the CAPM should be linearly related to the cross-section of betas. In other words, the slope in a cross-sectional regression of expected returns on betas equals the expected return on the market in excess of the risk-free or zero beta return. After the seminal papers by Black, Jensen, and Scholes (1972) and Fama and MacBeth (1973), this implication of the CAPM has been the hot topic of decades of literature in the empirical asset pricing area. Some more recent paper by Fama and French (1992) and Jagannathan and Wang (1996) suggest that the CAPM is dead because there is no significant and even negative relation between realized (ex-post) return and beta.

2.3.1 Is Beta the only Factor to have Explanatory Power of Risk?

Theoretically, there should be an exact linear relation between expected returns and true 'beta' when the market portfolio is ex ante mean-variance efficient, but empirical research contradicts to the predictions of the Sharpe (1965), Linter (1965), and Black (1972) Capital Asset Pricing Model. Hundreds of investigations in the empirical asset pricing have not reported much evidence of a significant cross-sectional relation between expected returns and betas. Not finding a positive cross-sectional relation may suggest that the index proxies used in empirical testing are not ex ante mean-variance efficient and the beta could not be the only factor that has explanatory power of risk.

2.3.1.1 The Univariate Relations

Fama and French (1992) found no cross-sectional mean-beta relation after controlling for size and the ratio of book-to-market value. Similar findings are reported by others, for a variety of different explanatory variables. For instance, Chen, Roll and Ross (1986) conclude that betas of market indices do not explain cross-sectional difference in average returns after the betas of the economic state variables have been included. Fama and French's paper made people doubt the existence of beta as the only explanatory independent variable and CAPM as a proper fund performance measure model.

Black (1993) reviewed the early study by Black, Jensen, and Scholes (1972). He suggests the 'announcements of the death of beta seem premature' after he confirmed the superior performance of low-beta stocks relative to high-beta stocks in a CAPM context. Chan and Lakonishok (1993) argued that additional data would be needed before the CAPM can be rejected with statistical confidence. In fact, typical statistical results are often so weak and confidence intervals so wide that people cannot reject anything and, thus, cannot conclude whether beta is dead or alive.

Some of the empirical studies have uncovered variables other than beta that have power in explaining the sample cross-sectional variation in mean returns. Banz (1981) found that size adds to the explanation of average return provided by β. Moreover, size is no longer the prime embarrassment of the CAPM. Variables that do not seem to be correlated with β (such as earnings/price, cashflow/price, book equity/market equity, and past sales growth) add even more significantly to the explanation of average return provided by β (Basu (1983), Chan, Hamao, and Lakonishok (1991), Fama and French (1992, 1993, 1996), and Lakonishok, Shleifer, and Vishny (1994)).

2.3.1.1.1 Variables that have the Power of Explaination

The failure of beta prompted people to search for factors which do have explanatory power. Among the most prominent are book-to-market equity (Stattman, 1980), market capitalization (size) (Banz, 1981; Reinganum, 1981), earnings-to-price (Basu, 1983), and leverage (Bhandari, 1988).

Book-to-Market Equity

BtM (Book to Market) effect has been confirmed by Rosenberg, Reid and Lanstein (1985). They discovered that stocks with high ratios of book value of common equity to market value of common equity (also known as book-to-market equity, or BtM) have significantly higher returns than stocks with low BtM. Later on Chan, Hamao and Lakonishok (1991) confirmed similar results in the Japanese market. BtM is another variable which has also explanatory power.

Firm Size

Banz (1981) confirmed that the stocks of firms with low market capitalizations have higher average returns than large capital stocks. Basu (1983) found that the size effect is distinct from the Earnings/Price (E/P) effect which will be discussed below. He claimed that small firms tend to have higher returns, even after controlling for E/P. Although small firms tend to have higher betas than large firms, based on those studies the return differences are far larger than the beta differences. That can be only explained by the firm size effect and it is another explanatory variable.

Earnings / Price

Basu (1977) conducted one of the earliest examinations which contradicted CAPM. Basu concluded that stocks with high Earnings/Price ratios earned significantly higher returns than stocks with low Earnings/Price ratios from sample period during April 1957 and March 1971. In his later study, Basu (1983) confirmed his "E/P effect" finding based on the test on US stocks along with size and market β. The E/P effect proved that beta is not all that matters.

Leverage

Leverage effect has been discovered by Bhandari (1988) study. Basically, he found that firms with high leverage (high debt/equity ratios) normally have higher average returns than firms with low leverage for the 1948-1979 period. After including both size and beta as explanatory variables, Bhandari found leverage effect still hold.

The studies discussed in this section cast doubts on the ability of the CAPM to explain equilibrium relationships in the financial markets. These variables should not be able to explain average returns better than beta. Stocks with high E/P, high BtM, high leverage, etc. should not outperform other stocks to the extent that they have. Reinganum (1981) made matters worse by showing that the positive relation between beta and return that was observed in earlier studies (e.g., Fama and MacBeth, 1973) has weakened in more recent years. In spite of all this negative evidence, the CAPM was still the default view for most financial economists and practitioners going into the 1990s.

2.3.2 A New Milestone

In 1992, Fama and French (1992) tested explanatory power of size, leverage, E/P, BtM and beta together in a single cross-sectional study. It is an influential paper which firstly pulls different factors together which were discovered in the earlier empirical work. Fama and French performed a double sort, first on size, then on market beta. Their evidence show that the relation between beta and size effect cause a artificial positive relation between beta and average return. When the correlation between size and beta is accounted for, the relation between beta and average return is flat, even when beta is only explanatory variable. As Fama and French (1992) said, evidence on the robustness of the size effect and the absence of a relation between beta and average return is so contrary to the Sharpe-Lintner-Black (SLB) model. Then they compared the explanatory power of size, leverage, E/P, Book to Market Equity (BtM), and beta in cross-sectional regressions that spanned the 1963-1990 period. Their results indicate that BtM and size are the variables that have the strongest relation to returns. The explanatory power of the other variables vanishes when these two variables are included in the regressions. They believe those two variables combine to capture the cross-sectional variation and suggest that stock risk is proxied by size and BtM.

2.3.2.1 The Risk-Based Models

After results of Fama and French (1992) had been published. It was the centre of intensive investigation because of its controversial nature. Fama and French (1993)'s research shows that factors related to size and BtM are able to explain a significant amount of the common variation in stock returns during the 1963-1991 period. A three-factor regression of the form has been run.

Fama and French 3-factor

$$R_{it} - R_{ft} = a + b\,(R_{mt} - R_{ft}) + s\,SMB_t + h\,HML_t + e_{it}$$

where R_{it} is the return to portfolio i for month t, R_{ft} is the T-Bill return for month t, and R_{mt} is the return to the Center for Research in Security Prices (CRSP) value weighted index for month t. SMB_t is the realisation on a capitalisation-based factor portfolio that buys small cap stocks and sells large capital stocks. Similarly, HML_t is the realization on a factor portfolio that buys high BtM stocks and sells low BtM stocks. The s_j and h_j coefficients measure the sensitivity of the portfolio's return to the small-minus-big and high-minus-low factors, respectively. The coefficients of SMB and HML could be interpred as the coefficients of risk factors from the APT or

ICAPM. The evidence of Fama/French (1993) support that size and BtM do have statistically significant coefficient on them. The three-factor regressions also produced the regression R Squared values close to 1 for most portfolios, which indicates that the three factors are able to capture much of the common variation in portfolio returns. Therefore, it indicates that SMB and HML have significant explanatory power on systematic risk.

The risk-based story has been confirmed by several following papers. Fama and French (1995) provided support for the risk hypothesis by showing that there are size and value factors in earnings as well as returns. This suggests that systematic variation in firms' cash flow streams may be associated with systematic variation in stock returns. Also, Fama and French (1996) show that the three-factor model can explain most of the departures from the CAPM predictions discussed in the recent financial literature, including the two-way sorts of Lakonishok, Shleifer and Vishny (1994). Liew and Vassalou (2000) supported the risk-based story by showing that SMB and HML are able to predict future GDP growth in some countries. The relation between these variables and GDP growth, however, is weak in several countries, and it is nonexistent in the US for the 1957-1998 period. Moreover, the three-factor model could not explain the short-term momentum in stock prices. The ability of the three-factor model to explain most of the observed cross-sectional empirical results supports a multi-factor risk model of expected returns. Still, it is not clear why the three-factor model cannot explain momentum.

2.3.2.2 The Criticism

Fama and French (1992) and other literature established the ground of risk-based theory and discovered several risk factors which have explanatory power other than beta. Several papers argued about their results have biases by selection, survivorship, missing information and other issues that potentially lead to biases in the sample concluded.

The enormous amount of discussion that Fama and French (1992) has generated proved their unparalleled success. One of the first replies was from Black (1993a, 1993b). He suggested the results from Fama and French paper are likely the matter of one possible draw from the distribution, which could be interpreted as data mining. Other hundreds of unsuccessful tests are likely results in different draws from the same distribution. All the variables that show a significantly statistical relation to returns are discovered just by chance. Black (1993a, 1993b) finally concluded that risk factors in Fama and French paper are purely based on massive data mining and they are improperly specified statistical discovery. Black (1993a, 1993b) also mentioned that, the relations between returns and size, BtM, etc. could be time sensitive. MacKinlay (1995) also suggested data mining as a potential cause of the observed results.

The other main criticism of Fama and French (1992) put forth by Kothari, Shanken and Sloan (1995) is related to the frequency of data used. Levhari and Levy (1977) show that beta coefficients estimated with monthly returns are not the same as betas estimated with annual returns. The results of empirical studies will be different based on different data frequency used. They show that the relation between beta and return is stronger when betas are estimated using annual returns. Although Kothari, Shanken and Sloan argued that annual betas are more appropriate than monthly betas. Definitely yearly data is not likely be suitable to funds with a relative short history.

Kothari, Shanken, and Sloan (1995) suggested selection bias is potentially present in studies that use the intersection of CRSP and Standard & Poor's COMPUSTAT data also to gain information on accounting variables. Historically, companies need to have positive performance before being eligible for inclusion in COMPUSTAT Therefore returns of companies included in the COMPUSTAT database are dramatically higher than those of companies that are not. Kothari, Shanken, and Sloan (1995) suggested that this could be explanation of the size effect as well. Banz and Breen (1986) and Breen and Korajczyk (1994) demonstrated that this selection bias may also explain the book-to-market effect.

Survivorship bias arises when a certain minimum history of data is needed to set up the empirical tests. Companies whose history, for reasons typically related to poor performance, is shorter than the minimum are excluded from the analysis. Obviously, surviving companies do better on average than dying companies. Furthermore, the likelihood of being delisted is naturally related to several of the size and accounting variables presented above.

Based on the criticisms of Fama and French (1992), many researchers in the early-to-mid 1990s believed that the explanatory power of BtM should not be taken seriously. A number of authors argued that the CAPM was still the best model of expected returns, claiming that the empirical results contradicting the CAPM are unreliable.

2.3.2.3 Characteristic Model

Daniel, Grinblatt, Titman and Wermers (1997) used characteristic based approach to examine whether mutual funds can systematically pick stocks that allow them to compensate the fees and expenses charged. They built a dataset which is almost ten times the number in the dataset used by Grinblatt and Titman (1989a, 1993) and the time period for this study is twice as long. This database includes portfolio holding of over 2500 equity mutual funds from 1975 to 1994. The characteristic model also has a very unique way to create benchmark. It forms benchmarks by directly matching the characteristics of the component stocks of the portfolio being evaluated. Although their characteristics could fail without fund holdings, it is superior for several reasons when holdings are available.

Firstly, characteristics provide better ex-ante forecasts of the cross-sectional patterns of future returns. Secondly, characteristic matching should have more statistical power to detect abnormal performance than factor models and characteristics approach provide insights into decomposition of fund returns which can be divided into: Averages Style (AS), Characteristic Selectivity (CS) and Characteristic Timing (CT). The sum of these measures is the overall hypothetical return of a fund. The performance (CS+CT) is added by fund managers by their stock selection and timing ability. For companies, they also include other performance measures, such as GT measure (Grinblatt and Titman, 1993), Jensen measure using the Carhart (1997) four factor portfolios as benchmarks and Jensen measure using the CRSP value-weighted index as a benchmark. After constructing the data, they find that mutual funds, particularly aggressive- growth funds exhibit some selectivity ability, but that funds exhibit no characteristic timing ability. The evidence suggests that fund managers show ability to beat a mechanical strategy, but it is approximately equal to the average management fee. Aggressive-growth funds, however, have outstanding performance compared to others. It also generates the largest costs. Therefore, most aggressive-growth funds are able to outperform the market, which is just enough to earn back their fees.

Finally, Danniel, Grinblatt, Titman and Wermers (1997) conclude fund managers do have selective ability, but not timing ability. Aggressive-growth and growth funds outperform growth- income and income fund, due to momentum investing it, however doesn't entirely explain whole story because the residual performance of growth category fund after controlling for momentum is still higher that the returns of average fund. Although fund managers exhibit the ability to beat the market, it is still relatively small and compensated by management fees.

Daniel and Titman (1997) doubt the risk-based explanation. They contend that it is 'characteristics, not covariances, 'that produce return dispersion. For example, the risk-based story says that high BtM stocks have high average returns because they are sensitive to common variation in stock returns. In other words, the high returns are due to a high sensitivity to HML. In contrast, Daniel and Titman argue that high BtM stocks have high returns due to some other reason (possibly overreaction), so that the high returns have nothing to do with systematic risk. In their opinion, it is the characteristic rather than the covariance that is associated with high returns.

Daniel and Titman provide results suggesting that the characteristics-based story is more plausible for the 1973-1993 period. However, Davis, Fama and French (2000) show that the Daniel and Titman results are confined to their relatively short sample period. When the longer 1929-1997 period is examined, covariances show more explanatory power than characteristics. It is not sure why the shorter period produces different results. It may be due to economy effect over time, change in nature and impact of driving characteristics.

Davis, Fama and French (2000) agreed entirely with Daniel and Titman (1997) about the rejection of risk models. They found a flat relation between average return and univariate market β which is also observed in earlier studies, such as Black, Jensen and Scholes(1972). Fama and Macbeth (1973) and Fama and French (1992) which perform a cross-sectional on the CAPM. This result shows that the three-factor model is just an incomplete description of expected return, but it is still explain the value premium better than the characteristic model which shows a irrespective of the risk loading only in a rather short sample period.

2.3.2.4 Risk Based Model Resurgent

People should always bear in mind the robustness of the empirical results is likely to vary with different groupings of portfolios formed based on the same population of individual stocks. For instance, Fama and MacBeth (1973) created portfolio based on sorting entirely on beta, which confirms the validity of the CAPM. Fama and French (1992), however, strongly reject the CAPM, when they sort their portfolio first on size and then on beta using the same method. Moreover, the evidence confirming the validity, which could be interpreted as one possible draw from the distribution of the ex-post market risk premium which itself is a random variable with a mean and a standard deviation. Other combination of stock could only be the result of different draws from the distribution of that random variable, even if the CAPM holds perfectly.

Although Fama and French (1992) is criticised by a range of people, it is still believed by many people that support the theory. One of the early responses to the criticisms of Fama and French (1992) was Davis (1994), who constructed a database of book values for large US industrial firms for the 1940-1963 period, a period for which the COMPUSTAT coverage is either poor or nonexistent. This database was constructed to be free of survivorship bias, and it covers a period that precedes the period studied by Fama and French. If the Fama and French results are a result of data mining, this independent time period should produce different results. A spurious relation in one period is not likely to carry over different periods. Also, the beta coefficients in this study were estimated using annual returns to address one of Kothari, Shanken and Sloan's (1995) main criticisms.

Further independent evidence came from Fama and French (1998), who found a reliable BtM effect in several developed countries for the 1975-1995 period. They also found a reliable value premium in several emerging markets. Capaul, Rowley and Sharpe (1993) also found evidence of a BtM effect in the US and five other developed countries for the 1981-1992 period. This international evidence casts even more doubt on the data mining criticisms of the US results.

2.3.3 The Improvements and Alternations

After CAPM became the centre of the controversy, some improved CAPM and alternations were made such as Merton's (1973) interemporal CAPM (ICAPM), Ross' (1976) Arbitrage Pricing Theory (APT) which is believed can provide a better description of average returns and consumption-based capital asset pricing model (CCAPM) is developed by Breeden (1979). All these are believed as a successor of CAPM and they can provide a better description of capital market. In the following section, they will be discussed.

2.3.3.1 Arbitrage Pricing Theory

CAPM is a simple model that is based on some unrealistic assumptions Some extensions of the basic CAPM were proposed that relaxed one or more of these assumptions. Instead of simply extending an existing theory, Ross (1976a, 1976b) suggested rather developing a completely different model than extending the existing one. Arbitrage Pricing Theory (APT) unlike the CAPM, which is a model of financial market equilibrium, the APT starts with the premise that arbitrage opportunities should not be present in efficient financial markets. This assumption is much less restrictive than those required to derive the CAPM.

The APT starts by assuming that there are n factors which cause asset returns to systematically deviate from their expected values. The theory does not specify how large the number n is, nor does it identify the factors. It simply assumes that these n factors cause returns to vary together. Based on these assumptions, Ross shows that, in order to prevent arbitrage, an asset's expected return must be a linear function of its sensitivity to the n common factors:

Arbitrage Pricing Theory (APT)

$$E(R_i) = R_f + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 + \ldots + \beta_{in}\lambda_n$$

$E(R_i)$ and R_f are defined as before. Each β_{in} coefficient represents the sensitivity of asset i to risk factor n, and λ_n represents the risk premium for factor n. As with the CAPM, we have an expression for expected return that is a linear function of the asset's sensitivity to systematic risk. Under the assumptions of APT, there are n sources of systematic risk, where there is only one in a CAPM world.

2.3.3.2 Intertemporal Capital Asset Pricing Model

Merton (1973) developed a multi-period financial model called Intertemporal Capital Asset pricing Model (ICAPM). It is a linear factor model used to capture the equilibrium price for the security. The main difference between ICAPM and single-period models such as CAPM and APT, is recognising state variables that account for the fact that future investment opportunity set may shift over time and investors may hedge against it. ICAPM can reflect this hedging demand in the asset pricing equation.

Intertemporal Capital Asset Pricing Model (ICAPM)

$$E(R_j) = \beta_{im}\, E(R_m) + \beta_{ih}\, E(R_h)$$

where $E(R_j)$ is the excepted excess return on asset i. $E(R_m)$ and $E(R_h)$ are the excepted excess return of market portfolio and hedging portfolio, respectively.

β is the coefficient.

2.3.3.3 Consumption-Oriented Capital Asset Pricing Model

The Consumption-based Capital Asset Pricing Model (CCAPM) is developed by Breeden (1979). CCAPM is used as an expansion of the CAPM and includes the amount that investor wishes to consume in the future. CCAPM is measured by diminishing marginal utility of consumption and consumption beta measures the covariance between the amount of investors' consumption from investment and return from market index.

Consumption-based Capital Asset Pricing Model (CCAPM)

$$E(R_i) = R_f + \beta_{iC} [E(R_m) - R_f]$$

In this model, β_{iC} measures the sensitivity of the return of asset j to changes in aggregate consumption. β_{iC} is referred to as the consumption beta of asset i, and the CCAPM's main result is that expected returns should be a linear function of consumption betas.

2.3.3.4 Literatures of the Improvements and Alternations

In spite of the unrealistic assumptions underlying the single-period CAPM, it still became the most widely used asset pricing model within a few years after its development. Its simplicity, coupled with empirical tests that supported most of its predictions, made it the most widely taught asset pricing model in business schools. The APT was tested in a number of empirical studies, but the CAPM received most of the financial world's attention.

In an interesting recent study, Lettau and Ludvigson (2001) show that a consumption-oriented capital asset pricing model (CCAPM) that allows expected returns to vary over time, provides a good cross-sectional explanation of equity returns. They use the ratio of aggregate consumption to wealth as a 'conditioning variable' to model the evolution of expected returns over time. The relation between the consumption/wealth ratio and expected returns is straightforward. If investors expect returns to be high in the future, they would be more likely to raise their consumption level (relative to their level of wealth). So, an increase in the consumption/wealth ratio would signal high expected returns. Lettau and Ludvigson also found that the variation in returns that is picked up by the Fama and French three-factor model appears to be related to the changing risk premium from the CCAPM. It may be difficult, though, to prove this.

2.3.4 Recent Literatures on Asset Pricing

The research into stock price behaviour and asset pricing continues, and a number of interesting results have surfaced recently. Perez-Quiros and Timmermann (2000) provide evidence that small firms have high average returns due to restrictions of credit market conditions. They explain the tight credit market condition that small firms do not have the same access to domestic and international bond markets that are enjoyed by large firms. Since the availability of credit is tied to economic conditions, so that a credit contraction typically occurs near a recession, small firms would be very sensitive to systematic variation in credit market conditions. Thus, the high returns of small firms might be compensation for the high sensitivity to a credit-related risk factor.

A study by Elton, Gruber, Agrawal and Mann (2001) reports a potentially important link between the equity and fixed income markets. If certain risk factors are pervasive enough to explain common variation in stock returns, it is reasonable to expect that these same risk factors would be at work in the bond market as well. Elton, et al. provide evidence that SMB and HML do just that.

Pastor and Stambaugh (2001) provide evidence that sensitivity to market-wide shifts in liquidity might be a priced risk factor. Stocks that are highly sensitive to shifts in market liquidity have higher average returns. This liquidity factor appears to be distinct from SMB and HML, suggesting an independent source of risk. While it is too early to conclude that there is a systematic liquidity factor in stock returns, more research is likely to be forthcoming in this area.

Finally, an indication of the acceptance of the three-factor model is the frequency with which it is now used as a benchmark for performance measurement. For example, Quigley and Sinquefield (2000) use a three-factor benchmark to analyze the performance of UK unit trusts, and Carhart (1997) and Davis (2001) use the Fama and French modelplus the monmentum factor in studies of US mutual fund performance.

2.4 Studies on Fund Performance Measure

2.4.1 The Theoretical Studies Review

Most of these studies employed a method developed by early studies Treynor (1965), Sharp (1966) and Jensen (1968). They are three earliest studies for funds performance and they also provided the popular and basic measure.

In Treynor and Mazuy (1966) studies, they mainly used the excess return to beta measure to measure the market timing ability of 57 managed funds over the period of 1953-1962. A successful market timer increases the beta of his portfolio prior to market rise and vice versa. With the help of the F test, in 57 managed funds, only one displayed the ability to outguess the market. They concluded an investor in mutual funds is completely dependent on fluctuations in the general market.

Sharpe (1966) presented the excess return to volatility measure to test the 34 open-end mutual funds during the period 1954-1963. The empirical results showed that the excess return to volatility ratio for the benchmark Dow-Jones is bigger than the ratio for the mostly funds. In the sample of 34 mutual funds, only 11 funds did better than the Dow-Jones portfolio, while 23 did worse. Also the studies compared the gross performance (before deducting investment expenses) with that of the market portfolio.

In 1968 Jensen collected a sample of 115 open-end mutual funds, in which 59 funds had 10 years of data from 1955 to 1964 and the rest 56 had additional observations in the period 1945-1964. The Security Market Line is set as the basis for a comparison. Jensen estimated the position of the SML using the S&P500 as a proxy for the market portfolio, the beta for each fund and examined the abnormal return for each fund net of expenses. He found that the average abnormal return across funds was approx -1% per annum. If expenses were added back into the gross return, average abnormal return was approximately zero. The author concluded that the evidence on mutual fund performance indicates not only that these 115 mutual funds on average were not able to predict security price well enough to outperform a buy-the-market-and-hold policy, but also that there is very little evidence that any individual fund was able to do significantly better than that which people expected from mere random chance.

2.4.1.1 The Evidence on Lack of Ability to Beat the Market

Due to the detection of statistical biases when the Jensen evaluation technique was used in the presence of market timing ability, alternative measures such as the positive period weighting measure of Grinblatt and Titman (1989b) were developed. The positive period weighting measure is an alternative performance measure to recent fund performance measure such as Jensen measure. In their study, they announced that positive period weighting measure can correctly identified informed investors as positive performers. In Cumby et al (1990), two performance measures are used, the Jensen measure and the positive period weighting measure, to examine the performance of a sample of fifteen US-based internationally diversified mutual funds between 1982 and 1988. The authors found no evidence that the funds, either individually or as a whole, provide investors with performance that surpasses that of a broad, international equity index over this sample period.

Malkiel (1995) utilizes a unique data set including returns from all equity mutual funds from 1971 to 1994. These data enables the author to more precisely examine performance and the extent of survivorship bias. In the aggregate, funds have underperformed benchmark portfolios both after management expenses and even gross of expenses.

Gruber (1996) found that the average mutual fund underperforms passive market indexes by about 65 basis points per year from 1985 to 1994. Also, Carhart (1997) found that net returns are negatively correlated with expense levels, which are generally much higher for actively managed funds.

John et al (1997) evaluated the performance of US based international bond mutual funds over the November 1988-March 1994 period. The performance evaluation is conducted using the Sharpe (1966) and Jensen (1969) performance measures. The authors derived the Jensen index using both an international single-index model and a multi-index model that separates interest rate returns and currency returns. The empirical result indicated that the funds, in general, were unable to outperform either the multi-index benchmark or the single-index benchmark during the sample period.

In 1999, Miranda's paper studies the risk and return characteristics of global bond mutual funds during 1988–1995. These actively managed funds did not demonstrate superior performance, net of expenses, against a wide range of benchmarks.

In the Quigley and Sinquefield (2000) study, they examined the performance of all UK unit trusts that concentrate their investment in UK equities. This study covers the period from January 1978 to December 1997. They compared the returns of these unit trusts with a three-factor model which takes into account their exposure to market, value and size risk. They found that managers, net of expenses, reliably underperform the market.

Overall, these studies find that active managers fail to outperform passive benchmark portfolios and in many cases underperform passive indices, even before expenses.

2.4.1.2 The Contradictory Studies

Most tests of performance evaluation do not support the hypothesis that managers have superior ability and performance. Lehman and Modest (1987) found evidence against it. The main goal of their study is to gauge the sensitivity of conventional measures of abnormal mutual-fund performance to the benchmark chosen to measure normal performance. The authors employed standard CAPM benchmarks and a variety of APT benchmarks to investigate this question and found little similarity between the absolute and relative rankings implied by them. Finally, the authors found statistically significant measured abnormal performance using all benchmarks.

Ippolito (1989) provides evidence to the contrary. They found that mutual funds, net of all fees and expenses, except load charges, outperformed index funds on a risk-adjusted basis.

In Grinblatt and Titman (1994), the study examined a sample of 279 mutual funds and 109 passive portfolios, using a variety of benchmark portfolios. They found abnormal performance by measuring actual returns net of transaction costs.

Some studies (e.g. Fama and French ,1992, 1996; Jegadeesh and Titman ,1993; Grinblatt, Titman, and Wermers, 1995; Daniel and Titman ,1997; and Moskowitz and Grinblatt,1999) found very different results that active managers can outperform the market, at least before trading costs are deducted. Wermers (2000) has more exciting results and prove the value of the active fund management. He found that funds pick stocks well enough to cover their costs.

2.4.1.3 Market Timing, Stock Picking and Style, Do They Add Value on Fund?

The timing ability of fund managers is to increase a fund's exposure to the market index prior to market advances and to decrease exposure prior to market declines. Most existing studies find little evidence that fund managers possess market timing ability including: Treynor and Mazuy (1966), Henriksson (1984), and Graham and Harvey (1996). Goetzmann, Ingersoll, and Ivkovic (2000), however, argued that a monthly frequency might fail to capture the contribution of a manager's timing activities to fund returns, because decisions regarding market exposure are likely made more frequently than monthly for most funds. Bollen and Busse (2001) used daily data and they found that funds may possess more timing ability than previously documented.

Another strand of the literature, however, finds that active managers do exhibit some stock-picking talent. For instance, Grinblatt and Titman (1989, 1993), and Wermers (1997) conclude that mutual fund managers have the ability to choose stocks that outperform their benchmarks, before any expenses are deducted. Daniel et al. (1997) and Grinblatt, Titman, and Wermers (1995) attributed much of outperformance to the characteristics of the stocks held by funds as well.

Funds tend to systematically follow certain 'styles', such as holding small stocks or high past-return stocks (see, e.g., Chen et al., 2000). Studies including: Fama and French (1992, 1996), Jegadeesh and Titman (1993), Grinblatt, Titman, and Wermers (1995), Daniel and Titman (1997), and Moskowitz and Grinblatt (1999) provide evidence that stocks with certain characteristics (e.g., high book-to-market or momentum stocks) outperform other stocks, before trading costs are deducted. These funds, however, might not deliver superior net returns due to the possibly high costs of analysing and implementing these styles. Wermers (2000) find that funds hold stocks that outperform the market by 1.3percent per year, but their net returns underperform by one percent. There is a 2.3 percent difference between fund's performance and net return. Most of them are due to expenses and transactions costs. Evidence from their paper supports the value of active mutual fund management.

2.4.1.4 Benchmark and Fund Performance Measure

Earlier studies indicated that the choice of the benchmark would not be crucial. The results, however, found by Lehman and Modest (1987) is contrary. Benchmark selection will lead to bias in fund performance measure. Inappropriate benchmark will lead to managers behave in short-term fashion. This will be discussed in the later part of paper. Ansell, Moles, and Smart (2003) also concluded that inappropriate benchmarks are likely to either under-state or over-state the existence of superior performance. For example, when an average performance fund measured by a relative low return benchmark, it can be concluded that average return fund outperform benchmark and has abnormal return. In the contrary side, fund with abnormal return can be defined as normal return fund measured by relative high return benchmark.

In Grinblatt and Titman (1994), the study empirically contrasted the Jensen Measure, the Positive Period Weighting Measure (performance measure without benchmark), and Treynor and Mazuy total performance measure. Four different benchmarks are used in this study. They found that the measures generally yield similar inferences when using the same benchmark and that inferences can vary, even from the same measure, when using different benchmarks.

This paper gives us some new sights on benchmark selection and provides a reasonable way to measure fund performance without benchmark. Contrasted to other performance measures and employed four different benchmarks, it presented a clear view of how benchmark works in the process of performance measure.

Bailey (1992a) provided some criteria for benchmark choosing: 1) Unambiguous-the components and constituents of the benchmark need to be clearly delineated. 2) Investable-it should be open to managers to forego active management and simply hold the benchmark portfolio. 3) Measurable-the benchmark's return can be calculated on a reasonably frequent basis. 4) Appropriate-the benchmark is consistent with the manager's investment style and objectives. 5) Reflective of current investment opinion-the manger has current knowledge of the constituents of the benchmark. 6) Specified in advance-the benchmark is constructed at the start of the assessment period and is observable by all participants and Ansell, Moles, and Smart (2003) add one more point 7) Observable-managers can observe the evolution of the benchmark across time and how their investment decisions relate to benchmark performance.

2.4.1.5 Performance Persistence

In fund performance measurement literatures, a large number of studies talk about fund performance persistence phenomena. Papers completed in the 1990s claim to have isolated a 'hot hand' phenomenon. For example, Grinblatt and Titman (1992) found evidence that differences in performance between funds persist over time and this persistence is consistent with the ability of fund managers to earn abnormal returns. Hendricks, Patel, and Zeckhauser (1993) and Goetzmann and Ibbotson

(1994) argue that past mutual fund returns predict future returns. Brown and Goetzmann (1995) found evidence that risk-adjusted performance of fund persists. These results of persistent performance of fund suggest that some fund managers do have ability to outperform the market consistently. Hence investors can pursue these relative successful managers and earn significant excess (risk-adjusted) returns.

The persistent performance may suggest that some individual fund manager have outstanding ability in asset allocation, but Grinblatt, Titman, and Wermers (1995) examined the momentum phenomena which may be the one of reasons for fund persistent performance. Their results suggested that relationship between funds performance and invested on momentum is positive. It implies that the positive performance may have been at least partially generated by a simple trading rule rather than by superior information.

Mutual funds may purchase stocks based on their past returns as well as their tendency to exhibit 'herding' behaviour. There is a common strategy among fund managers. Grinblatt, Titman, and Wermers (1995) found that the behaviour of the 'momentum' investors buying stocks that were past winners is more significant than the behaviour of selling past losers. In some level buying past winner can guarantee persistent fund performance. It is assumed that whilst herd may move, they make different choices "different" winners, otherwise price of winners would get too high.

Recently, Droms and Walker (2001) found short-term performance persists and it has been confirmed by Jan and Hung (2004). They also confirmed the long-term performance persists. Bollen and Busse (2004) agreed on existence of the short-term performance, but they concluded such persistence may not be economically significant. Carhart, Carpenter, Lynch, and Musto (2002) have different opinion and concluded that persistence exists but mainly due to expenses.

2.4.1.6 Bayesian Alphas

In recent year, a new technique is introduced to test persistent fund performance. Pastor and Stambangh (2002) suggest that a more precise estimate can be obtained using historical returns on more than just the fund. A longer-history can provide more precise estimate. They decompose the alpha of the fund performance measure model into two parts. One part is alpha from regression of fund returns on market portfolio and unrelated portfolio. Another part is coefficient of unrelated portfolio in previous regression times alpha from regression of unrelated returns on passive assets. The principle of getting a more precise estimator of alpha for funds is attempting to obtain a more precise estimator of both parts by using a longer sample period. Normally, the longer history of historical data you get the more precise estimated alpha you can obtain. A more precise estimated alpha as prior belief of under Bayesian framework can give you a better measure of fund performance. The longer histories of those assets also can provide information about the volatility of the funds return beyond what is provided by the fund's shorter return history.

Eight benchmark and nonbenchmark assets are applied in their study. Three of them come from Fama and French three factors model, CMS is payoff on a characteristic-matched spread from Pastor and Stambangh (2000), MOM is momentum factor constructed by Carhart (1997) and IP1, IP2, IP3 are portfolios constructed from a universe of 20 value-weighted industry portfolio.

A Center for Research in Security Prices (CRSP) survivor bias free mutual fund database is used in their study. Their sample contains 2609 domestic equity mutual funds with more than a year of available returns. They compared the posterior mean of alpha with, OLS estimator which is estimated without using seemingly unrelated nonbenchmark assets. The empirical results show that by increasing the duration of the funds, the difference between OLS estimator and posterior mean become smaller and smaller, which implies with a longer history, the sample size increases and so OLS methods and Bayesian methods will be dominated by the data. The evidence also shows that Sharpe ratios estimated using seemingly unrelated assets have a precision four to five times higher on average than the precision of the usual estimates. The relative precision of Sharp ratio also increases incorporating with increasing of the funds' history. Moreover, they also discovered that fund rankings based on the improved Sharp-ratio estimates differ substantially from those based on the usual estimates. It implies that the information in return on seemingly unrelated assets could have an important impact on fund ranking. They also found that across different beliefs about pricing, most funds have underperformed the CAPM and Fama Franch benchmarks.

There have been a number of papers that have explored the use of Bayesian methodology within fund management performance. Irvine and Busse (2006) implement Pastor and Stambaugh (2002a) Bayesian α approach, which not only used passive asset returns from periods of time that precede the mutual fund returns, but in addition, the Bayesian measure incorporates a flexible set of prior beliefs about managerial skill and about the validity of an asset pricing model. Irvine and Busse (2006) discovered Bayesian αs based on the CAPM are particularly useful for predicting future standard CAPM alphas.

Irvine and Busse (2006) contrast Bayesian estimates of alphas for mutual fund with standard frequentist measures basing on mutual fund daily returns. They first create

$$r_{A,t} = \alpha_A + \beta'_A r_{B,t} + \varepsilon_{A,t} \qquad (1),$$

where $r_{A,t}$ is the excess return of fund A at time t, $r_{B,t}$ is the excess return of the passive asset(s) at time t, and α_A is the fund's alpha, and

$$r_{N,t} = \alpha_N + \beta'_N r\, B,\, t + \varepsilon_{N,t} \qquad (2)$$

where $r_{N,t}$ are the nonbenchmark assets, $r\ B,\ t$ are the excess returns of the benchmark
asset(s), and α_N are the nonbenchmark alphas.
Then

$$r_{A,t} = \delta_A + c'_{A,N} r_{N,t} + c'_{A,B} r_{B,t} + u_{A,t} \qquad (3)$$

where δ_A, as fund A's stock selection skill, and $c'_{A,N}$ are the fund's exposures to the nonbenchmark assets.
Put equation (2) into (3) and we can get

$$\boldsymbol{\alpha_A = \delta_A + c'_{A,N}\alpha_N} \tag{4}$$

They follow Pastor and Stambaugh, (2002) to calculate Bayesian alphas. To estimate the posterior distributions of the elements of equation (4), first they specify a conditional prior distribution of α_N, the nonbenchmark abnormal return. Conditional on Σ, the covariance matrix for $\varepsilon_{N,t}$, the prior distribution for α_N as

$$\boldsymbol{\alpha_N|\Sigma \sim N\left(0, \sigma^2\alpha_N\left(\Sigma/s^2\right)\right)} \tag{5}$$

the priors for the estimation of the skill and benchmark and nonbenchmark asset loadings in equation (3) are conditional on $\sigma^2 u$, the variance of $u_{A,t}$ and $\sigma^2 u$ is independent normal distributions:

$$\boldsymbol{\delta_A\,|\sigma u^2 \sim N(\delta 0, (\sigma u^2/\,E(\sigma u^2))\,\sigma\delta^2)} \tag{6}$$

and

$$\boldsymbol{c_A\,|\sigma u^2 \sim N(c\,0, (\sigma u^2/\,E(\sigma u^2))\,\Phi c)} \tag{7}$$

Following an empirical Bayes approach, $E(\sigma u^2)$ is set to equal to the cross-sectional mean of $\hat{\sigma} u^2$ from OLS regressions of equation (3) and c_0 and Φc equal to the OLS estimate of the sample cross-sectional moments of $\hat{c}_A$. Finally, combine the priors specified in equations (5), (6), and (7)

Huij and Verbeek (2003) evaluate the usefulness of shrinkage estimation in analyzing mutual fund performance and its persistence. They believe shrinkage estimators, which include the Stein-rule, iterative empirical Bayes and Gibbs sampling, can exploit information contained in the cross-section of mutual fund returns and enable a more accurate estimation of mutual fund αs. They investigated three alternative shrinkage estimators in a simulated sample of mutual funds in comparison with standard OLS estimators. Their results show that Bayesian αs are substantially more accurate than OLS in realistic settings. Huij and Verbeek (2004) also employ Bayesian alphas for fund performance measurement, because standard OLS alphas are typically not very accurate based on short measure horizons. Their evidence indicate that using a measurement horizon of one year when funds are ranked on Bayesian alphas, highest ranked funds have sharp ratios significantly higher than median over the next 12 to 21 months.

Bayesian alpha may explore a new method in fund performance measure. Yet it is still involved in survivorship bias, benchmark bias, CAPM pitfall. Actually, Bayesian model is only an alternative method to calculate parameter, such as alpha or beta. It still cannot provide a totally new measure for fund performance which encapsulates all desire features. How to reduce bias and build an accurately model will still be main debates in fund performance research for next few years.

2.5. Reviews of Fund Performance Policy Studies and Initial Survey

2.5.1 Policy Studies

Policy studies are another substantial part of fund performance research. A policy study reviews fund performance from a totally different prospective. Surz (1996) noticed that current performance evaluation practices continue to focus on manager results and ignore the effects of policy and policy management.

Couple studies sought a different angle to gain insights into fund management. Golec (1996) conducted research on fund performance which relates the effects to fund managers' characteristics. The purpose of the study was to test whether mutual fund managers' characteristics help to explain fund performance, risk and fees. A three-stage least squares model with several determined variables are applied on the data sample which spans 1988-1990 and is composed of 530 mutual funds. Overall, Golec concluded investors can expect better alpha from a young manager (less than 46 years old, yet who have managed a fund for more than 7 years) and if he/she has a MBA degree.

Chevalier and Ellison (1999) tested whether some mutual fund managers are better than others by looking at the relationship between performance and manager characteristics rather than only fund performance. The data base contains 492 managers who have sole responsibility for a growth or growth and income fund for at least some part of the 1988-1994 period. The characteristics data included managers' age, the place they got an undergraduate degree, whether they had an MBA degree and their tenure as a fund manager.

Finally, Chevalier and Ellison concluded that there are some systematic cross-sectional differences in fund performance that cannot easily be attributed to differences in managerial characterises. In particular, they found fund managers with MBAs or from higher SAT scored schools normally have superior performance. They conclude that a good education directly benefits a good stock-picking ability. They also mentioned another very interesting explanation of MBA and SAT effects; the difference in value of the social network that different schools provide. Chevalier and Ellison also found younger managers have better performance than older managers. Both conclusions are consistent with previous findings from Golec (1996)

Other studies tried to make discover from trustees and policy managers. Trustees and Policy managers (or Project managers) are the governors of fund managers. Figure 1.2 in Chapter 1 shows how both of them relate to the fund. Trustees, using a listed company analogy, are shareholders of the company. Normally they pick the policy manager. Sometime they maybe involved in selecting fund managers, laying down investment guidelines and appraising past performance which are the jobs of policy managers. Policy managers act as Chief Executive Officer (CEO) within a listed company and they report to Trustees. As Surz (1996) said, policy managers are the mangers of mangers. They play a very important role in the fund decision-making. Their main role is picking fund managers, making investment policy and evaluating past performance of fund management. They are the mentors of the fund managers. The policy manager is also involved with the allocation of assets among alternative asset classes, the division of assets between different fund managers, and the provision of information to the trustee. In other words, the crucial role of the policy manager is making investment decisions.

Trustees come from a wide variety of industrial backgrounds. Regardless of where they come from, trustees with accounting and finance background will normally be necessary members of the board of trustees. According a survey in Brown, Davies and Draper (1992), more than two-thirds of all the pension funds included accountants on the trustee body. Nonetheless, one-sixth of all trustees appear to have little in the way of relevant skills and experience. Trustees without financial or accounting background are often representatives of the employees. They should be capable of taking an independent view and must fulfil their obligations to be a qualified trustee. Some trustees may be without prior experience, so it is important for them to take professional training, however, not all comply with this desired requirement.

Several literatures are about performance assessing bias and relationship between trustees and fund managers. Surz (1996) discussed that bias results are obtained from forcing every manager into some pre-specified group, such as growth or value. Actually, most managers are a blend of styles, so such classification will misrepresent peers. A contemporary approach known as Portfolio Opportunity Distribution, which can eliminate these biases was introduced in Surz (1996). The problem between governors and fund managers is due to many reasons, some of which come from governors while some are to do with balancing their portfolio to be close to a particular benchmark. For example, inappropriate benchmarks, misinterpretation of performance measurement statistics, and unachievable investment objectives will lead to problems between the fund managers and governors.

The performance figures are seen as a warning signal that can be used to alert fund managers to the governors' concern about performance. Is it true that governors use performance measures to decide which funds managers should stay or leave? Table 2.1 from Brown, Davies and Draper (1992) indicates that 70 per cent of funds in their sample have not changed any of their investment managers for at least two years and that 44 per cent are unchanged for four or more years. This does not indicate a particularly short-term approach to pension fund management. They also note that the 30 per cent of funds that made a change in 1992 or 1991 may have only altered one of their investment management firm and so these figures would in fact seem to under-estimate the stability of the main arrangements.

Table 2.1: Last change made to investment management arrangements

	% of pension funds in sample
1992	18.7
1991	11.7
2 or 3 years ago	25.7
4 or more years ago	28.3
No recent changes	15.7

Source: Adapted from Brown, Davies and Draper (1992)

Brown, Davies and Draper (1992) indicated that terminating a long-standing personal relationship with fund managers was described as a fairly traumatic experience and a task not to be undertaken lightly. They also give an example of one manager that was changed because of weaknesses in administration and the failure to provide timely information even though investment performance was perhaps adequate. It could be concluded that investment managers may be changed for reasons other than their investment performance.

Tierney and Winston (1990) provide some more practical advice. They examined how the plan governor can evaluate its managers' specialized skills; how the governor can best use these skills in its total portfolio; and how the governor can use a dynamic completeness fund to complement its managers' skills and to diversify its total portfolio efficiently. They also believe that the governor can sharply reduce or eliminate the risk by using a dynamic completeness fund. Thus, a misfit-correcting portfolio is used under the situation when fund management goes wrong.

2.5.2 Initial Interview Results

Two surveys have been carried out in this thesis. As part of the pilot study, an initial questionnaire based on various questions about trustee, policy managers and fund managers was implemented and it will be discussed in this Chapter. The second survey regards elicit priors based on the respondents' opinion. It will be discussed in Chapter 6.

Two interviews have been carried out for the initial survey. See Appendix B for the questionnaire and transcripts of the interviews. Based on the interview, several important issues about relationships between trustees, policy managers and fund managers are explored in the following part and cited with the policy literature. All the information is summarised from the transcript of experts and literature.

The survey is to gain insights into a broad range of issues surrounding fund management. Interviews were conducted with a number of people involved with fund management. Due to the fund managers' commitments, only two of them were interviewed. Although the number of respondents is low, they produce a good insight into the relationship between people working in the industry.

2.5.2.1 Who are Fund Managers?

What sort of people make good fund manager is another question within the initial survey carried out in this study? It is hard to answer, but this question can be viewed from another prospective. What is essential for a fund manager? Education, work experience or personality, can all be the part of the answer, but this is not the whole story. During the initial survey, respondents suggested that flair and intuition are good attributes contributing towards a good fund manager..

Flair and intuition are very difficult to measure. They are probably intuitive and can not be learned through practice. There is no certain definition for flair. It can be anticipating the market, not following the herd, having a different view of the market, etc.. It is a feeling which is built in and not the same as experience. Intuition is the same as flair. People may improve their intuition with experience of winning and losing money. It is particularly difficult to justify before the event. Some people regard intuition as 'one of the keys to successful trading is to know when you are not.', however, some people disagree. From their point of view intuition can be result of 'illusion of control' or 'hyper rationality'. Both flair and intuition cannot be explained by statistics and econometrics whatsoever.

2.5.2.2 Who Governs Fund Manager?

As mentioned in the introduction policy manager is normally in charge of fund managers. In the initial survey carried out by this study, respondents mentioned that policy managers have normally been fund managers in the past. This allows them to fully understand what fund managers are doing and the techniques they use. The experience of an ex-fund manager can also give them the ability to empathise with the stress and complexity of the fund managers' role. Promoting a good fund manager to a policy manager is always painful for companies and it will lead to a dilemma. An initial concern is the opportunity costs involved in the promotion of a highly capable fund manager. In practice, most policy managers will give up their trading role and put much more time into management of the whole fund project.

Secondly, there is no guarantee you will get a good policy manager from losing a capable fund manager. The assumption that a good fund manager will be a good mentor does not always apply. Many people cannot make the adjustment in roles. From another angle, outstanding fund managers may have great talent in portfolio trading, but that does not necessarily mean they have good management skills as well. It may depend on personal individual experience; which possibly employment history, education level or even personal characteristics.

2.5.2.3 Relationships between Governors and Fund Managers

2.5.2.3.1 How Fund Managers are Hired and Fired?

According to the initial survey, when trustees or policy managers want to pick fund managers for their fund, they will arrange and hold a 'beauty parade' where potential fund managers provide presentations of their skills and services. Governors will analyse historical performance, say over a five year period of fund management, on top of this they also note the fund managers' investment style, stability and risk attitude. Past performance is often an important factor which influences the governors' choice of fund managers, though, sometimes it may not be the only factor which influence the decision making.

One or more managers may be chosen by governors. After the governor sets the investment policy, which includes investment aims, it will become a guideline for the fund manager. Fund managers will be asked to hand over a report every 3 months which includes market environment, fund asset allocation and the achievements of fund for the last 3 months, and future plan or aims for the fund. Governors are entitled to ask the fund manager about recent performance of the fund at only time.

Most trustees and policy managers use a benchmark as a reference to decide whether to continue or terminate the relationship with the fund manager. A benchmark is an easy way to measure fund performance, but it does not account for the practice. Governors set benchmark for assessing, however, fund managers would preferably not be assessed in this way. During the survey, respondents mentioned that selection bias is a big problem. Nevertheless, there is no better and easier way for governors to conduct such performance assessment.

Since inappropriate benchmarks are sometimes applied, fund managers may behave in a short-term manner. Misunderstanding of fund performance may let governors feel unsatisfied with managers' achievement. Fund managers may try to invest in riskier assets, particularly equities in order to get a short-term higher return and fulfil governors' requirement, but how long will the good performance last? Over any long period of time, returns will tend to match the risks being taken. Over time, market conditions may move against them.

Another cause of short-termism is due to unachievable objectives, which is more or less related to the benchmark selection bias. Many funds want to consistently achieve above average returns using a low risk strategy. Unfortunately, such goals may often be unachievable. A high return, low risk strategy is unlikely to be achieved. If the market is reasonably efficient, and return is related to risk over time, the only strategy which can be expected to increase returns is one involving more risk exposure. Normally, governors may not find this an acceptable price to pay for enhanced performance. Generally higher average returns can only be achieved by accepting more volatile returns. Although fund managers may feel forced to adopt a short-term perspective, it is rare for governors to sack fund managers without allowing them several years to show what they can do.

Governors, though, are willing to maintain a long-term relationship with fund managers and so do not simply use the benchmark as a guide. It is confirmed by the respondents from the initial survey. It is expensive to fire and hire fund managers because of the relatively high transaction cost involved, so governors always want to maintain the relationship with a manager who has at least an adequate performance. Poorly performing managers, however, will not be retained by governors. From the survey, interviewees suggested that governors allowed fund managers a certain trial period. If the fund managers suffer cataclysmic loss then they would be sacked.

2.5.2.3.2 How do Governors Manage Fund Managers?

Based on the findings from the survey, the ethos of autonomy and responsibility is both inevitable and considerable. Fund managers want autonomy so they can have more room to create their own portfolio. In practice, every project is the responsibility of the policy managers and fund managers are responsible for their own portfolio. In general, there is no micro management from trustees or even from policy managers. Trustees only set broad aims for the investment. A relaxed environment can give fund managers more confidence and freedom to perform their talent. Policy is a central tool and it sets a space in which mangers are allowed to operate and the areas in which they cannot.

From the initial survey of this study, respondents suggested that policy managers normally set some broad goals, such as risk tolerance, error tracking limits, a time table. Everything else is left to fund managers. A no-intervention management style and trust is important for the relationship between the policy manager and the fund manager. Generally, it is impossible for policy managers to know every detail of the fund managers action or positions they are taking, but there are no conflicts between close knowledge and understanding or openness by asking questions about the position which fund managers are taking and their risk tolerance.

Autonomy is still conditional on avoiding significant losses. Upside risk can be lightly managed, but downside risk need to be actively controlled. When losses are incurred, there tends to be a rapid shift in management style. Both policy managers and fund managers acknowledge the importance of managerial interventions when losses are occurring. It is fine to let fund managers have enough freedom when performance is up, but when downside performance occurs, policy managers' intervention is necessary. Fund managers do know their risk limits and they need support from their boss when negative events occur.

Sometimes fund managers will need more than support. Policy managers may facilitate fund managers and let them stop trading or have a couple days break which can give fund managers time to think what may be going wrong and what position they have taken. There is also a role for policy managers after the loss has stopped. They should help fund managers to gear up their abilities and tutor them to improve risk preference in the long term. Controlling loss aversion is not only cutting losing money and getting fund managers back on track, but should also include re-establishing fund managers' self-confidence when they are losing money.

2.5.2.4 Persistence

Both respondents strongly believe that there is little performance persistent amongst fund managers. Even though some funds may appear persistent in the long term is not necessarily true in the short-term. A fund manager maybe consistent in their style, however, the market is difficult to predict. The same style may not work in all environments. Both respondents suggest that keeping an open mind and adapting various strategies maybe a persistent way to survive in the market.

2.6 Conclusion

Theoretical and policy studies provide two different insights into fund performance research. Theoretic studies concentrate on model building and explaining phenomena. Policy studies care more about practical issues. There have been over six decades of development starting with the Modern Portfolio Theory, followed by the CAPM model and movement to multi-factor models. There is still no ultimate solution for fund performance measuring and there will not be any one solution likely in the near future. The statistical methods used on fund performance become more and more sophisticated such as the implementation of the Bayesian method. The quest for a general and accurate measuring model on fund performance will probably never end.

Based on information from literature surveys and initial surveys in this Chapter, benchmark selection is the most important issue, being backed-up by theoretical and policy studies as well as the respondents of the survey. They all suggest an inappropriate benchmark will over- or under-state the fund performance. Choosing a median fund as a benchmark is obviously not a good idea. In the dynamic fund universe, Bailey (1992a) and Ansell, Moles, and Smart (2003) provided some advice on benchmark selection.

From policy literature and initial survey, the relationship between trustees and managers is concluded as being more complex and profound than people often think. Although trustees and fund managers should not base actions on the short-term. Under pressure managers sometimes may behave as short-term investors. Some evidence shows that managers' performance may not be the only criteria in manager selection. Performance measurement is widely used by trustees, although fund managers do not appreciate it. Moreover, trustees intend to have a long-term relationship with fund manager, if they perform adequately. Tight control of fund management is generally not the aim of governors. They are more willing to give fund managers more space to operate. Trustees and policy manager, however, may interfere when losses occur. Finally, both interviewees concluded that the likelihood of persistence for funds in the short term is small.

Chapter 3 Research Methodology

3.1 Introduction

The research strategy employed is important for the development of a thesis. In this Chapter, the choice of research strategy will be discussed and traced back to its epistemological root. Then two research paradigms will be explored: the quantitative and the qualitative. The historical background and basic theory of linear regression and Bayesian modelling will be discussed in the quantitative methodology section, as they will be used in the quantitative investigation of later Chapter. The final part of the Chapter focuses on the qualitative methodology employed in this study, since the survey based approach will be used to elicit the views of the experts in later Chapters.

3.2 Research Strategy

3.2.1 Choice of Research Strategy

The choice of methodological approach taken is dependent on the starting point the researcher agrees on followed by the steps from that point to the conclusion reached. In social science research, a logical framework is often quoted as the basis for a study. Within social science, authors often refer to the following strategies: inductive, deductive, retroductive and abductive. Each has it own initial starting point and manner of proceeding to reach a conclusion.

The inductive strategy starts with the collection of data and then proceeds to derive generalizations using so-called inductive logic. It formulates laws based on limited observations of experience in social life.

The deductive research strategy has a different starting point. Some laws have been formulated and the strategy tries to seek explanations from them. The researchers test the theory by deducing one or more hypotheses from it and then collects appropriate data. If the result corroborates the hypotheses, the theory will continue to be used. On the other hand, if a hypotheses is initially rejected, the theory will either be modified or rejected completely. Following the deductive strategy, laws of the social world will be advanced by process of trail and error.

The retroductive research strategy has a starting-point similar to the deductive strategy. It starts with an established law, but the strategy delves much deeper into structures and mechanisms underlying the law. If those structures and mechanism are unknown, researchers will construct a hypothetical model and then test its existence. Blaikie (2000) described retroduction as 'uses creative imagination and analogy to work back from data to an explanation'.

The abductive research strategy is also known as involving induction. The abductivers believe that in order to discover the motives and reasons that accompany social activities, researchers should discover what social actors provide. Researchers using abductive strategy will abstract individual behaviour into typical behaviour or formulate a law. Those laws will be used to understand and explain social life. Table 3.1 lists four different strategies, their nature of theory and uses of the models.

Table 3.1: Research strategies, theory and models

Research Strategy		Nature of theory	Use of models
Inductive	From:	Generalization/laws Networks of propositions	Abstract Descriptions Mathematical representation
	Process:	Generated by induction from data	Conceptual frameworks
Deductive	From:	Deductive argument produce hypotheses	Theorectical models Diagrammatic representation Mathematical representation
	Process:	Hypotheses tested by matching against data	
Retroductive	From:	Generative structres or mechanisms	Abstract description of e[isodes (homeomorphs)
	Process:	Moddelling mechanisms Establishing their existence	May involve use of analogies (paramorphs)
Abductive	From:	Social scientific accounts Ideal types	Abstract descriptions (ideal types)
	Process:	Generated from everyday concepts/meanings/accounts	

Source: Adapted from Blaikie (2000)

Blaikie (2000) states that 'each strategy has a philosophical and theoretical ancestry and foundation, and includes ontological assumptions about the nature of reality and epistemological assumptions about how that reality can be known'.

Induction is the strategy which will be used in this study and so only its theoretical ancestry and foundation that will be discussed in this Chapter.

Mill (1865) believed that the purpose of science was to establish general laws. He proposed an elementary experimental method to identify possible causes and effects. Such purpose can be achieved by meticulous and objective observation and measurement, and the careful and accurate analysis of data. As the inductive strategy derives generalizations from collection data, it follows the logic of positivism. Positivism is a philosophy developed by Auguste Comte in the mid 19th century. It is a system that denies the validity of metaphysical speculations, and place science, especially natural science, in pride of place, adopting the methods of science as a model for all theoretical and practical activity. Positivism states knowledge can only come from positive affirmation of theories through strict scientific methods. This view is sometimes referred to as the scientist ideology.

In a positivist view of the world, science was seen as the way to get at truth; to understand the world well enough so that people might predict and control it. The world and the universe are deterministic, they operate by laws of cause and effect that could be discerned using the unique approach of the scientific method. The positivist believes in empiricism, the idea that observation and measurement was the core of the scientific endeavour. The key approach of the scientific method is the experiment, the attempt to discern natural laws through direct manipulation and observation.

3.2.2 Positivism

Auguste Comte believed that an ordered universe made up of discrete and observable events and order can be generalized from observations. This system of thought has been influenced various philosophical system such as the Empiricism and the Scepticism. Auguste Comte asserts that every science must pass through three successive stages; the theological, the metaphysical, and the positive. Sauvage (1911) states that 'the positive stage, which rejects the validity of metaphysical speculation, the existence of final causes, and the knowableness of the absolute, and confines itself to the study of experimental facts and their relations, represents the perfection of human knowledge. Classifying the sciences according to their degree of increasing complexity, he reduces them to six in the following order: mathematics, astronomy, physics, chemistry, biology, and sociology'.

The first Positivist was Auguste Comte. Other pioneers of the first Positivism were E. Littré and P. Laffitte in France, John Stuart Mill and Herbert Spencer in England. The second Positivism rise was in the 1860s and 1870s and is associated with Ernst Mach, though Avenarius, Poincaré and others also made significant contributions. A third Positivism, or "neo-positivism" emerged in 1920. The Vienna Circle is widely recognised as its exponent. Neo-positivisms also linked with the activity of the Berlin Society for Scientific Philosophy (Reichenbach and others).

3.2.3 Inductive Reasoning

3.2.3.1 Induction

Induction or inductive reasoning is also known as inductive logic. It sums-up and generalizes principles based on definite numbers of observations or experience; for example, ice is cold, or a billiard ball moves when struck with a cue. They are infered from general propositions such as: All ice is cold, anything struck with a cue moves. The premises of induction only support the conclusion, but is not certain.

The inductive strategy has also been characterized as consisting of four main stages by Wolfe (1924):

1 All facts are observed and recorded without selection or guesses as to their relative importance.

2 These facts are analysed, compared and classified, without using hypotheses.

3 From this analysis, generalizations are inductively drawn as to relations between the facts.

4 These generalizations are subjected to further testing.

There are two main types of inductions: Strong and weak induction.

For example, all observed crows are black. Therefore, all crows are black. The logic in the example give us a strong inductively reasoned statement and it is called strong induction. It inducts the universal from the particular. Only after observing all the crows in the universe could one conclude the crows are black can be drawn and its certainty ensured. Nevertheless, observing all the crow in the universe would be impossible.

An example of weak induction would be: 'I always go to school by bus.' Therefore, all people go to school by bus. Using induction, this example can lead to a conclusion that 'All people go to school by bus.' Normally built on the certainty of premise, a generalized conclusion can be formulated. The link between premise and inductive conclusion here, however, is weak. The statement only tell us that one person goes first to school by bus. It does not state that there are no other way to go to school. People can go to school by car, bicycle or by walking. Using common sense, it is easy to see that induction of this example would lead people to a clearly false conclusion. The inductive logic does not give us a strong conclusion. In other words, the logical means between premise and conclusion is weak and conclusions drawn in such manner are usually overgeneralizations.

3.2.3.2 Bayesian Inference

Bayesian inference is one of the most influential systems for an inductive logic. Given new information and using probability theory framework, Bayesian method can evaluate the strength of a belief for certain hypothesis. With the new update, a prior belief can be updated with the addition of new infomration (data) to produce a posterior belief, by the use of Bayes Theorm. It follows inductive logic. More evidence can give people a stronger belief to agree or disagree with a hypothesis. One of the most important uses of Bayesian inference is to help people solve the very famous induction problem; the Raven paradox.

The Raven paradox, also known as Hempel's paradox or Hempel's ravens is a paradox proposed by the German logician Carl Gustav Hempel in the 1940s to illustrate a problem where inductive logic violates intuition. It reveals the problem of induction.

Hempel describes the paradox in terms of a statement that all ravens are black. This statement is equivalent, in logical terms, to the statement that all non-black things are non-ravens. If one were to observe many ravens and find that they were all black, one's belief in the statement that all ravens are black would increase. But if one were to observe many red apples, and concur that all non-black things are non-ravens, one would still not be any more sure that all ravens are black.

A commonly accepted solution is presented by Bayes' theorem, which relates the conditional and marginal probabilities of stochastic events. Using Bayesian principle, when a person see a non-black non-raven, it will not change his belief about whether all ravens are black. Therefore, the paradox does not arise.

3.2.3.3 The Validity of Induction

The problem of induction is the philosophical issue involved in deciding the place of induction in determining empirical truth. The problem of induction is its validity. Does inductive reasoning really work? In fact, most people learn formal logic from deductive rather than inductive reasoning. Although some philosophers claim to have created systems of inductive logic, the problem of induction is whether inductive reasoning works. Unlike deductive reasoning, conclusions of inductive reasoning do not need the same degree of certainty about initial premises. Actually, inductive reasoning is deductively invalid. For example, a conclusion that 'All swans we have seen are white, and therefore all swans are white' had been drawn in 18th Century. However, it may have been believed as a truth in Europe until the discovery of black swans in Australia. How can you justify it? Hume (1748) resolved that people either formulate laws based on finite observations of particular instances or speculate the sequence of events in the future will occur as it always has happened in the past. Nonetheless, it is nearly impossible to observe all the objects and there is no guarantee that things will repeat in the future. Where is the justification for inductive reasoning? More observations could increase people's belief on conclusion, but they do not establish the reliability of induction. If induction doesn't work, the whole system of reasoning will collapse. The Scottish philosopher David Hume (1748) asserted that there is no logical necessity that the future will resemble the past. Even the largest series of observations consistent with a universal generalization can be logically negated by just one observation in which it is false. Hume advocated that the treatment of the problem of induction is that instead of unproductive radical scepticism about everything, people can take a partial scepticism based on common sense, where the inevitability of induction is accepted. Hume noted the fact that our everyday reasoning depends on patterns of repeated experience rather than deductively valid arguments. For example, people eat bread because it previously nourished them and these inductions would likely continue to hold true, but this is not a guarantee. As Hume said, someone who insisted on sound deductive justifications for everything would starve to death.

Francis Bacon, Isaac Newton, and numerous others up until at least the late 19th century have considered inductive reasoning as the basis of scientific method—indeed inductive reasoning is used today, though in a more balanced interaction with deductive reasoning and abductive reasoning.

Twentieth-century philosophy has approached induction very differently. Rather than a choice about what predictions to make about the future, induction can be seen as a choice of what concepts to fit to observations or of how to graph or represent a set of observed data. Goodman (1955) posed a 'new riddle of induction' by inventing the property 'grue' to which induction does not apply.

3.2.4 Why Positivism and Induction

Positivism, on which the inductive strategy is based, assumes that laws or principles of the ordered universe can be formulated by those observable events. In the ontological level, society is regarded as being made up of complex of causal relationships between events. The assumption made by positivists asserts that those observable relationships between concepts can be experienced by senses. In epistemological assumptions, knowledge is considered to be produced through the use of human experiences, experiment or analysis. The whole procedure starts from producing 'observation' or data collection. Then concepts or generalizations about their relationship will be summarised based on a number of observations. In this study in order to explain phenomena that have happened in the fund market, historical market data of 26 funds have been collected. The study intends to formulate a new model, or law, principal in philosophy terms, to generalize the relationships between funds' performance and independent factors. Based on 16 years' data of 26 funds, those particular observations will inductively form a general model which can explain the insights of fund market in advanced aspects. The model can also be used to prudently predict the sequence of events happening in the fund market.

The aim of the study is to build a new, better fund performance model. The model will be developed from observations without assumption of the nature or types of relationship. Thus deductive and retroductive research strategy cannot be adapted in this study. The abductive research strategy is concerned with the best explanation of phenomena rather than inferring generalizations. As a research strategy, induction begins with data collection and proceeds to derive generalizations inductively. It can be used as a method to determine the nature of the regularities. Therefore inductive strategy suits the task to derive a general model from observing multiple consequents which are the historical market data in the study.

3.3 Research Paradigms

There are two main paradigms: quantitative and qualitative. They are also referred to as positivistic and phenomenological paradigms by Collis and Hussey (2003). In their book they gave out the assumptions of the two main paradigms. Table 3.2 lists assumptions and questions for both paradigms in various levels.

Table 3.2: Assumptions of the two main paradigms

Assumption	Question	Quantitative	Qualitative
Ontological	What is the nature of reality?	Reality is objective and singular, apart from the research	Reality is subjective and multiple as seen by participants in a study
Epistemological	What is the relationship of the researcher to that researched?	Researcher is independent from that being researched	Researcher interacts with that being researched
Axiological	What is the role of values?	Value-free and unbiased	Value-laden and biased
Rhetorical	What is the language of research?	Formal	Informal
		Based on set definitions	Evolving decisions
		Impersonal voice	Personal voice
		Use of accepted quantitative words	Use of accepted qualitative words
Methodological	What is the process of research?	Deductive process	Inductive process
		Cause and effect	Mutual simultaneous shaping of factors
		Static design - categories isolated before study	Emerging design - categories identified during research process
		Context-free	Context-bound
		Generalisations leading to prediction, explanation and understanding	Patterns, theories developed for understanding
		Accurate and reliable through validity and reliability	Accurate and reliable through verification

Source: Adapted from Creswell (1994)

Quantitative approach involves collecting objective data and applying statistical test on them. A qualitative approach starts with subjective data which are collected using interviews, focus groups or questionnaires. Although research can be differentiated by different approaches used in the study, it does not mean that one approach is superior to another. Both research approaches have their own strengths and weaknesses. Table 3.3 gives a very brief comparison between quantitative and qualitative approach regarding their advantages and disadvantages.

Table 3.3: Strength and weakness of quantitative and qualitative approach

	Quantitative	Qualitative
Strength	Some subjects may be previously influenced and affect the outcome of the study.	Awareness of time and history
	Quantitative data analysis is less time-consuming than qualitative	It is also sensitive to the influence of context
	Easy to access large samples	Useful for studying a limited number of cases in-depth
	The results are statistically reliable.	Useful for describing complex phenomena
	The results are able to be projected to the population.	Provides understanding and description of people's personal experiences of phenomena
Weakness	Quantitative research is ineffective at understanding processes	Knowledge produced might not generalize to other people or other settings.
	Quantitative research may be accursed as results of artificial data mining	It might have lower credibility.
	Research bias may caused by data bias	Data analysis is often time consuming.
		The results are more easily influenced by the researcher's personal biases and idiosyncrasies
		Study group may not be representative of the larger population.

Source: Table summarised from Day (1998), Edwards (1998), Urban Wallace & Associates (1995), McCullough (1995), Huysamen (1997), Johnson (1997), and Jason & Nyasha (2005)

3.3.1 Quantitative Paradigms

Collis and Hussey (2003) mentioned that a quantitative approach is objective in nature and concentrates on developing and employing mathematical models, theories and hypotheses to measure phenomena. It uses systematic scientific methods to investigate properties and phenomena. In social sciences particularly, quantitative paradigm is often contrasted with qualitative paradigm. Collis and Hussey (2003) refer to the quantitative approach as positivistic paradigm. They stated that 'the positivistic approach seeks the facts or causes of social phenomena, with little regard to the subjective state of the individual'. The modern idea of quantitative processes have their roots in Auguste Comte's positivist framework.

Statistics is the most widely used branch of mathematics in quantitative research. In this study, the quantitative research section begins with the collection of historical market data, followed by the application of descriptive statistical methods which are Ordinary Linear Squares (OLS) and Bayes. Relationships between fund performance and various macroeconomic factors are studied by eliciting significant factors and examining their influence on fund.

3.3.1.1 Ordinary Linear Squares

In regression, Least Squares Regression is also known as Ordinary Least Squares (OLS) Regression. DeFusco, McLeavey, Pinto and Runkle (2004) define OLS based on the least squares method which determines the values of unknown quantities in a statistical model by fitting a straight line through a set of points and minimizing the sum of the squared vertical distances from the observed points to the fitted line. Least Squares Method was introduced by Carl Friedrich Gauss in the 19th century. The Least Squares Method is widely used in building estimators and in regression analysis. The major limitation of least squares estimation for linear models is bias due to outliers. For instance, if a set of data has several outliers, so the distribution is skewed, and the estimates generated by OLS will be biased.

OLS regression will be used in the study for three reasons. Firstly, stepwise regression will be implemented on 12 macroeconomic factors and market portfolio to elicit significant factors which affect fund performance. Secondly, after significant factors have been elicited, OLS regression will be applied to provide guidance for the prior distribution for Bayesian models used later. The last reason for use of OLS regression is as a benchmark. Comparison between conventional OLS results and Bayesian results will indicate whether new insights are created by the Bayesian model..

3.3.1.2 Bayesian Estimation

Bayesian Epistemology is named after Thomas Bayes (1702 - 1761), who proved a special case of what is now called Bayes' theorem. 'Bayesian epistemology' did not emerge as a philosophical program until the first formal axiomatizations of the probability theory in the first half of the 20th century.

One important application of Bayesian epistemology has been the analysis of scientific practice in Bayesian Confirmation Theory. In addition, a major branch of statistics, Bayesian statistics, is based on Bayesian principles. Finally, the idea of analyzing rational degrees of belief in terms of rational betting behaviour led to the 20th century development of a new kind of decision theory - Bayesian decision theory - which is now the dominant theoretical model for the both the descriptive and normative analysis of decisions.

Gelman, Clarin, Stern, and Rubin (1997) described the Bayes' theorem as relating the conditional and marginal probabilities of stochastic events A and B:

$$\begin{aligned} P(A|B) &= \frac{P(B|A)\,P(A)}{P(B)} \\ &\propto L(A|B)\,P(A) \end{aligned}$$

where P(A) is the prior probability of A. It is "prior" in the sense that it does not take into account any information about B.

P(A|B) is the conditional probability of A, given B. It is also called the posterior probability.

P(B|A) is the conditional probability of B given A.

P(B) is the prior or marginal probability of B, and the sum of over all possible values of A.

L(A|B) is the likelihood of A given fixed B.

According to the Bayes theorem, posterior probability is equal to the prior probability multiplied by the likelihood.

3.3.1.2.1 Gibbs Sampling

A major limitation towards more widespread implementation of Bayesian approaches is that obtaining the posterior distribution often requires the integration of high-dimensional functions. This can be computationally very difficult. Markov Chain Monte Carlo (MCMC) methods attempts to simulate direct draws from some complex distribution of interest. One particular MCMC method, the Gibbs sampler, is very widely applicable to a broad class of Bayesian problems. Gibbs sampling is a special case of the Metropolis-Hastings algorithm, and thus an example of a Markov chain Monte Carlo algorithm. The algorithm is named after the physicist J. W. Gibbs. and was devised in study of Geman and Geman (1984).

Gibbs sampling is a general method for probabilistic inference. It is an important method used to estimate the posterior distribution of the coefficients in a Bayesian model and will be implemented as a simulation method in this thesis. Gibbs sampling is a specific type of Bayesian approach, whereby draws are simulated from a distribution to generate an empirical distribution rather than deriving it analytically. It generates an instance from the distribution of each variable in turn, conditional on the current values of the other variables. The purpose of such a sequence is to approximate the joint distribution. Markov chain theory tells us that repeated application of these conditional densities to an arbitrary density will converge to the density function of the posterior distribution. If the number of iterations is sufficiently large, the impact of initialization is negligibly small. With prior distribution derived from OLS estimates and experts' beliefs, Gibbs sampling will be used on Bayesian models which follow Bayes theorem to generate posterior.

3.3.1.2.2 Empirical Bayes and Bootstrap Sample

Empirical Bayes methods are a class of method which apply empirical prior under Bayes' theorem in order to estimate posterior distribution. Empirical Bayes (EB) combines Bayesianism and frequentist approaches to estimation. Gelman, Clarin, Stern and Rubin (1997) stated that EB is used for methods which estimate the prior distribution from the same data set as in the main analyses. The reason of using such method is mentioned by Carlin and Louis (2000). They said that 'when a prior is postulated, its distribution often has one or more unknown parameters, called hyperparameters. One can posit a hyperprior for these second-stage unknowns, and each of these may have their own priors, etc…An alternative strategy is to use the data to provide estimates of the hyperparameters at some reasonable stage, and to use the estimates in deriving a posterior distribution'. Overall, Empirical Bayes generally refers to using Bayes methods and empirical data to approximate the conditional probability distributions. EB takes several forms, including non-parametric and parametric forms.

In statistics, bootstrapping is resampling methods. It estimates properties of an estimator by measuring those properties when sampling from an approximating distribution which is the empirical distribution of the observed data. The advantage of bootstrap re-sampling is its great simplicity. It is straightforward to apply the bootstrap to derive estimates of standard errors and confidence intervals for complex estimators of complex parameters of the distribution. The disadvantage of bootstrapping is that it may be asymptotically consistent, it does not provide general finite sample, and has a tendency to be overly optimistic.

The empirical Bayes and bootstrap re-sampling will be used together. First bootstrap re-sampling will be carried out, in order to obtain empirical prior distribution. The original data set contains monthly data of 26 funds over a 16 year time period which is 192 data points in total. 40 points of data will be randomly extracted from the original data set. Such process will be repeated 100 times, in order to construct an empirical data set which has 4000 data points for each fund. In the mean time, 12 macroeconomic factors and Standard and Poor's 500 (sp500), the market portfolio, will be given bootstrap re-sampling following the same procedures. All re-sampling data are date synchronised. Then each time after the data has been re-sampled, correlations among fund and factors will be created. After 100 draws, a distribution can be created between funds and the factors. Finally, those distributions are used as priors employed into the five-factor Bayesian model.

3.3.2 Qualitative Paradigms

Qualitative research is one of the two major approaches to research methodology in social sciences. It is also known as phenomenological paradigm. It was not long before researchers began to criticise positivism. They pointed out people's actions and behaviour is generated from human mind. Positivistic approach may suit physical sciences, but when dealing with social sciences, it is not adequate for the job. During the 1970s and 1980s qualitative research started to emerge. It was widely used in the fields such as education studies, social work studies, information studies, management studies and others. Qualitative research involves an in-depth understanding of human behaviour from a participant's own frame. Allan (1991) said, 'data from qualitative methods typically require a different mode of exposition.' Qualitative research methods take into account the 'world-views' of interviewee. Burgess (1984) said, 'understanding the actions of participants on the basis of their active experience of the world and the ways in which their actions arise from and reflect back on experience'. Evered and Lewis (1981) regard qualitative method as like an 'inquiry from the inside' rather than an 'inquiry from the outside'. Allan (1991) agreed with those views and concluded that 'thus within these approaches the researched are not seen as objects with given properties – attitudes, norms, behavioural characteristics – which can be readily measured given due care, but as actors whose own frame of reference needs detailed investigation before their actions can be adequately interpreted and explained'.

A researcher does not need to decide which method to use. The choice of research method depends more on the research question and how that question will be expanded. Eventually after the blue print of the whole research has been decided, the choice of the research method may be very obvious.

In this research, the analysis of the historical market data of fund collected from a database is subject to the quantitative method. It, however, has to be informed by an understanding of the content and this will be based on qualitative research. Some subject views of the impacts are qualitatively collected from the fund managers. There are three important reasons for using qualitative method in this thesis: First, to measure the performance of a certain fund, the choice of explanatory factors will be important. Choosing such factors can be approached either from past literature or peoples' beliefs. It is straightforward to summarise those factors by carrying out a literature review. Collecting peoples' opinion, however will involve a qualitative method such as an interview or questionnaire. Therefore, the qualitative method becomes a crucial part of the study.

Secondly, the models used in the study also decide the choice of research method. Both qualitative and quantitative methods will be applied in the study. The Bayesian model is able to combine both subjective and objective information together to implement analysis on funds. Not only historical market data, the quantitative part, but fund managers' opinion will be put into the Bayesian model to measure performance of funds.

Thirdly, a qualitative method is often concerned with peoples' interaction and relationship with each other, since funds are trading in an open public environment and will be influenced not only by changes of economics, but also peoples' reactions on such changes. The historical quantitative data shows properties of funds. They are more like snapshots of funds and only provide information about what has happened. Qualitative surveys provide some insight into peoples' belief and opinion. Thus, using both methods collectively can compensate the biases and obtain more accurate results.

3.3.2.1 Questionnaire

Quantitative methods can provide insights into funds based on their market performance, but those funds are managed by people. There exists information which will not be revealed by merely studying historical market data. One way to obtain this information is to use qualitative methods; interviews and surveys from experts. Two surveys have been carried out for this study. Initially, a pilot questionnaire was conducted. It includes a list of questions about fund performance measurement such as how trustees pick fund managers; relationship among trustees, policy managers and fund managers, etc.. The target group is fund managers or people used to working in the fund industry. It was distributed among fund managers and with the hope of a snow-ball effect. Given the commitments of fund managers, only two fund managers have been interviewed using the initial questionnaire. Based on the information from this initial survey, findings of various aspects of fund management are reviewed and concluded in Chapter 2 Literature Survey and Background.

The second questionnaire is designed to collect experts' views about impacts of macroeconomic factors and capital market on fund performance. The questionnaire includes three sections: introduction, questions on factors and their potential impacts, and finally personal information about the respondents. The questionnaire will gather empirical data to construct prior for Bayesian model. The questionnaire was introduced to staff, undergraduate and postgraduate students in the Management School of the University of Edinburgh. Since the questionnaire is tailored for fund managers, other people who do not have sufficient finance or investment background may find difficulty in completion of the questionnaire. Therefore although many responses have been received, unfortunately many of them were invalid. Later in Chapter 6, results gathered from the survey will be analysed.

3.4 Triangulation

Triangulation is the application and combination of several research methodologies in the study of the same phenomena. It could be the combining of research approaches, method theories and techniques. The reason is that researchers hope to overcome the weakness or biases by using only single method, single-observer or single-theory studies. Jick (1979) contends that triangulation has its vital strengths, encourages productive research, enhances qualitative methods and allows the complementary use of quantities methods. The modern tendency using triangulation such as both quantitative and qualitative is becoming more common. For example, qualitative methods might be used to gain in-depth understanding the meaning of the results produced by quantitative methods.

In this study, there is a need to understand the nature of and influences on fund management. This can be obtained by interviews with those experts in fund management and information derived from surveys will be employed into a quantitative model. Therefore, both objective and subjective information will be used to measure the likely impact of factors which may influence fund performance.

3.5 Conclusion

Inductive research strategies used in the study and its epistemological ancestor, positivism, have been discussed in the first part of the Chapter, followed by the background information of two paradigms which are the quantitative and qualitative approach. They are also known as positivistic and phenomenologist paradigm. Methods of both research approaches used in this study have been discussed as well.

Chapter 4 Pilot Study

4.1 Introduction

In this chapter the pilot study will be described. The aim is to build a series of Bayesian models to model fund performance based on CAPM. These will be compared with the traditional Ordinary Least Squares model. The data comprises five funds from US fund market are analysed, see Table 4.1 for their name. These funds were chosen randomly from Datastream mutual fund database. Data consists of daily historical market data of funds between October 19, 1990, and October 19, 2005. The benchmark is Standard & Poor's 500 (sp500) and its daily market return price is also collected from DataStream database for the same period.

Table 4.1: Funds name abbreviation

AMER	Federated American Leaders A
ING	ING GNMA Income A
MAINSTAY	MainStay MAP I
PRINCIPAL	Principal Capital Value A
AXP	AXP DIVR Bond A

Both the Ordinary Least Squares (OLS) and the Bayesian method will be applied to these five funds. The Bayesian approach model is characterised by the use of both data and prior beliefs about the model which are used to derive a posterior distribution. This allows statements to be made about the quantities of interest. Three Bayesian models will be used. They are: a dependent model, an independent model and a model where β is held constant. The dependent model assumes that α and β of each fund will influence each other, and a change of any one parameter will lead to a chain reaction influencing the others and eventually feedback towards itself. α and β share a common distribution together. The independent model assumes that all the coefficients of variables are independent. All of them have their own separate distributions. The constant β model assumes a common β exists. It is the average of all five funds' β across all five funds with a simple distribution.

After the models have been constructed, the Gibbs sampler produces a series of values using a Markov Chain Monte Carlo (MCMC) method. Since the initial value will have an effect for some-time, it is customary practice to wait until convergence has been established. In current work about 10000 iterations are found sufficient.

WinBUGS software is used to perform Gibbs sampling in the thesis. The BUGS (Bayesian Inference Using Gibbs Sampling) project is trying to use flexible software for the Bayesian analysis of complex statistical models using Markov chain Monte Carlo (MCMC) methods. The project began in 1989 in the MRC Biostatistics Unit and led initially to the 'Classic' BUGS program, and then onto the WinBUGS software developed jointly with the Imperial College School of Medicine at St Mary's, London. Development now also includes the OpenBUGS project in the University of Helsinki, Finland. More details can be found on the WinBUGS website: www.mrc-bsu.cam.ac.uk/bugs/

4.2 Model Implementation and Results

4.2.1 Ordinary Least Squares (OLS) Model

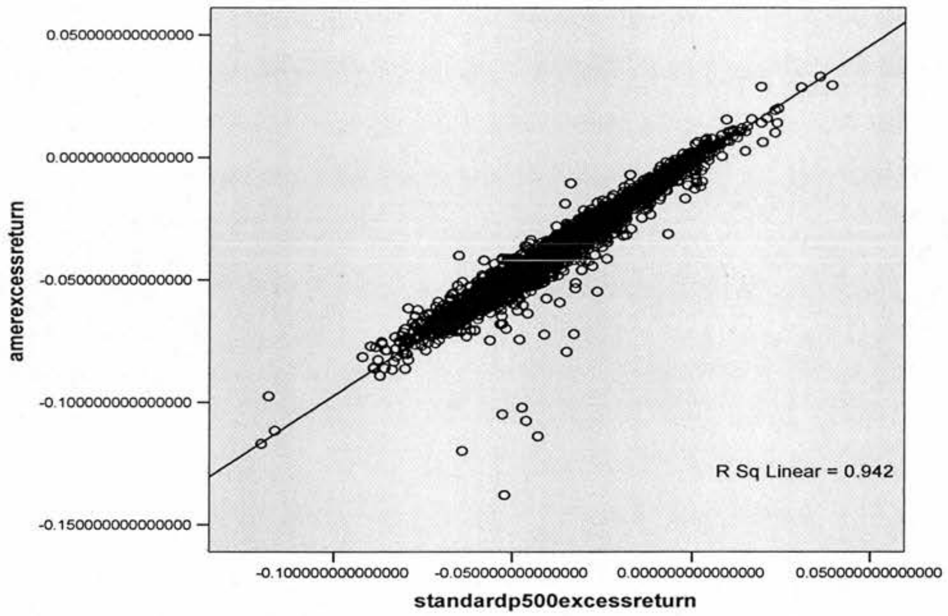
Firstly, an Ordinary Least Squares (OLS) model has been employed, with Standard & Poor's 500 (sp500) as market portfolio and three month Treasury Bill is set as the risk free asset. Using linear regression, estimates of α and β have been obtained and shown in Table 4.2.1. In the Table's first row, the abbreviation name of five funds and last two columns show the mean and the standard deviation of αs and βs of the five funds.

Table 4.2.1: Estimates of αs and βs for the OLS model

Funds		AMER	ING	MAINSTAY	PRINCIPAL	AXP	MEAN	SD
OLS Estimator	α	-0.00186	-0.010835	-0.003158	-0.002701	-0.010556	-0.005822	0.004474257
	β	0.954597	0.725694	0.920891	0.940152	0.732954	0.8548576	0.115246709

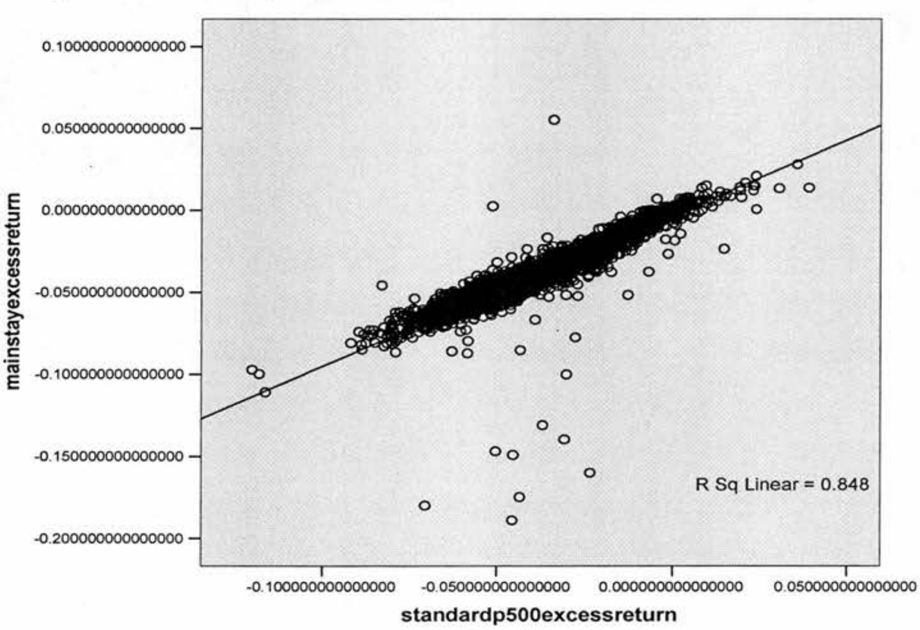
From the results shown in the Table 4.2.1, αs are all negative and close to zero. This can be interpreted as none of the five funds have the ability to 'beat' the market portfolio. All the βs are almost equal to 1 which means all five funds have a similar risk preference to the market portfolio. Scatterplots of two funds are picked to illustrate the fit of the models, the predicted line is shown in the plot. For fund AMER in Figure 4.1, there are a number of outliers, though. Generally the model fits well. The R square (not adjusted) is 0.942, showing a good fit.

Figure 4.1: Scatterplot of fund AMER



For MAINSTAY in Figure 4.2, the fit is not as good as fund AMER with more outliers. The R square is 0.848 and still quite high. So again the fit is good.

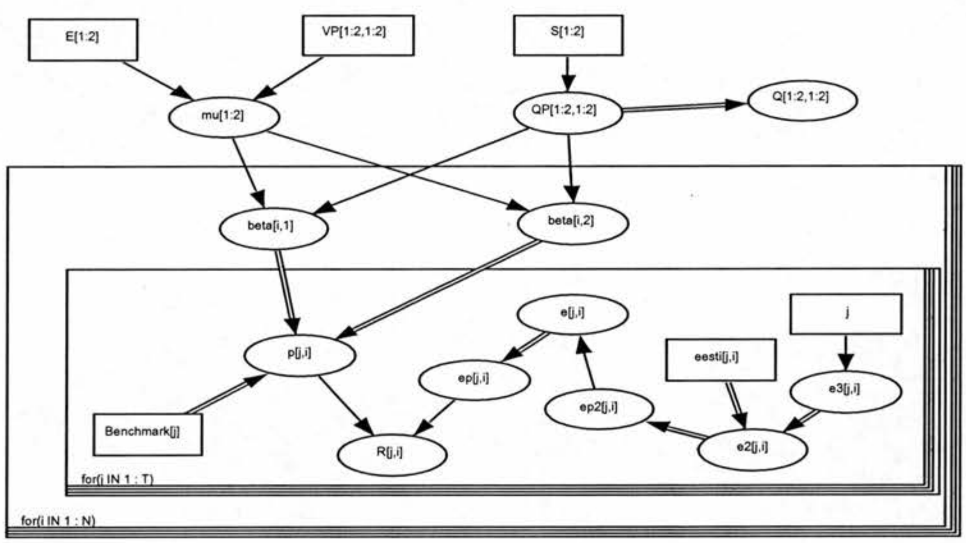
Figure 4.2: Scatterplot of fund MAINSTAY



4.2.2 Dependent Model

The first Bayesian model is the Dependent model which assumes all the αs and βs are derived from the same hyper distribution and so are dependent. This model can be illustrated by the following influence diagram Figure 4.2.1, in which the means and variances are derived from the hyper distribution. It is assumed all αs and βs of funds dependently follow multivariance normal distribution. The multivariance normal distribution has mean mu [1:2] and precision QP [1:2,1:2]. Meanwhile mu has multivariance normal distribution as well. It has hyper prior E [1:2] as mean and VP [1:2,1:2] as precision. The prior of precision of β, QP, follows a wishart distribution with 2 degrees of freedom. Precision of error term has hyper prior, too. The error term e [j,i] is a normal distribution with zero mean and variance e2 [j,i], where e2 [j,i] is simulated from a chi-square distribution.

Figure 4.2.1: Dependent model structure



Benchmark is the market portfolio. R[j,i] is the returns for fund i (i=1, ..., 5) and period j (j=1, ..., 3898). These are historic values. The hyperprior distribution, mu[1:2] and QP[1:2,1:2], are specified initially. In this case the OLS regression results are used to obtain the parameters of these distribution E[1:2] and VP[1:2,1:2] for mu[1:2] and s[1:2] and Q[1:2,1:2] for QP[1:2,1:2]. From these hyperpriors the prior distribution for α, beta[i,1], and β, beta[i,2], are obtained mu[1,2] and QP[1:2,1:2]. The software then using MCMC updates the estimates for α, beta[i,1], and β, beta[i,2]. This provides the estimates of returns p[j,i] which can be compared to R[i,j]. It should be noted also that at each iteration an estimate is provided for the residual term. Again this is derived in similar manner to α and β.

Figure 4.2.1.1 shows the posterior density of α and β for Fund MAINSTAY, which are beta [3,1] as α and beta [3,2] as β in the figure. All figures are based on 1000 samples.

Figure 4.2.1.1: Density of α and β for Fund MAINSTAY from dependent model

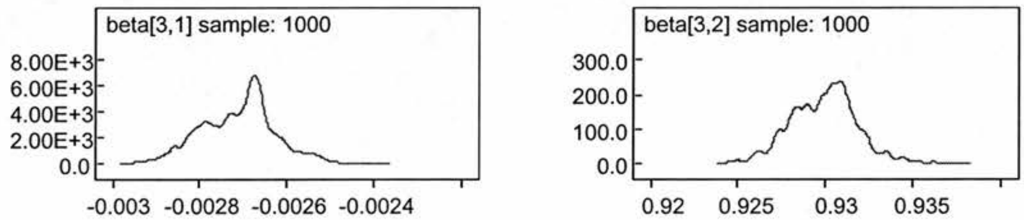
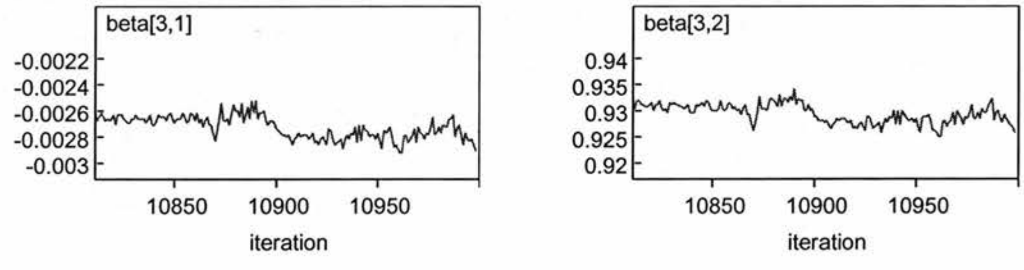


Figure 4.2.1.2 shows the trace of α and β of Fund MAINSTAY. The trace of α (beta [3,1]) shows that they are converging on the values of the mean. This again gives confidence regarding the estimates obtained. The β value has slightly higher variance, but it is insignificant compared to mean. It fluctuates no more than 0.01. The trace looks very stable after 11000 iterations. Both Figure 4.2.1.1 and 4.2.1.2 indicate the Bayesian dependent model is a sound model to track the performance of those funds.

Figure 4.2.1.2: Trace of α and β for Fund MAINSTAY from dependent model



For all funds' density and trace figures please refer Appendix D.

Table 4.2.2 presents the descriptive statistics αs of βs for the dependent model. It includes not only α and β for funds, but standard deviation, MC error and other important measures.

Table 4.2.2: Estimates of αs and βs for the dependent model

Node		Mean	SD	MC error	2.50%	Median	97.50%	Start	Sample
AMER	α	-0.00181	3.83E-05	4.57E-06	-0.00187	-0.00181	-0.00172	10001	1000
	β	0.9558	8.79E-04	1.01E-04	0.9543	0.9558	0.9576	10001	1000
ING	α	-0.0104	1.20E-04	1.25E-05	-0.01063	-0.0104	-0.01017	10001	1000
	β	0.7373	0.002816	2.99E-04	0.7316	0.7375	0.7429	10001	1000
MAINSTAY	α	-0.00271	8.72E-05	1.10E-05	-0.00288	-0.0027	-0.00253	10001	1000
	β	0.93	0.00192	2.32E-04	0.9262	0.9301	0.934	10001	1000
PRINCIPAL	α	-0.00241	7.47E-05	1.03E-05	-0.00256	-0.00241	-0.00226	10001	1000
	β	0.9465	0.001735	2.30E-04	0.9435	0.9465	0.9501	10001	1000
AXP	α	-0.01019	1.26E-04	1.50E-05	-0.01043	-0.0102	-0.00994	10001	1000
	β	0.7418	0.002962	3.68E-04	0.7364	0.7418	0.7475	10001	1000

Table 4.2.2 shows that αs of fund ING and AXP are relative smaller than others. Negative α normally means funds under-perform the market portfolio. All five funds did not beat the benchmark, but they are so close to zero, which shows the performance is similar to the benchmark. For βs of funds, two smaller values stand out from the others. They are 0.7373 of fund ING and 0.7418 of fund AXP. All five βs, however, are less then 1. It also implies that those five funds probably have a similar risk tolerance level. Normally funds with β smaller than 1 have less undiversifiable risk than the market as a whole. The evidence in the Table indicates that all five funds are more passive and less volatile than market portfolio. MC error is batch means standard errors for Markov Chain Monte Carlo (MCMC). Batch means is one of methods used to compute Monte Carlo standard errors. It has the advantage of being easy to implement and appears to work reasonably well in practice. MC error tests the accuracy of the MC estimation. Statistics of β clearly show the MC errors here are all extremely small and under 0.04% which means estimators are likely to be fairly good estimates.

Figure 4.2.1.3 and 4.2.1.4 show the scatterplot of results from the dependent model for fund AMER and MAINSTAY. R square value of the models are 0.94 and 0.86 respectively. Comparing R square from OLS models, both are slightly higher, which may be due to extra parameters for fit due to dependence.

Figure 4.2.1.3: Scatterplot of fund AMER

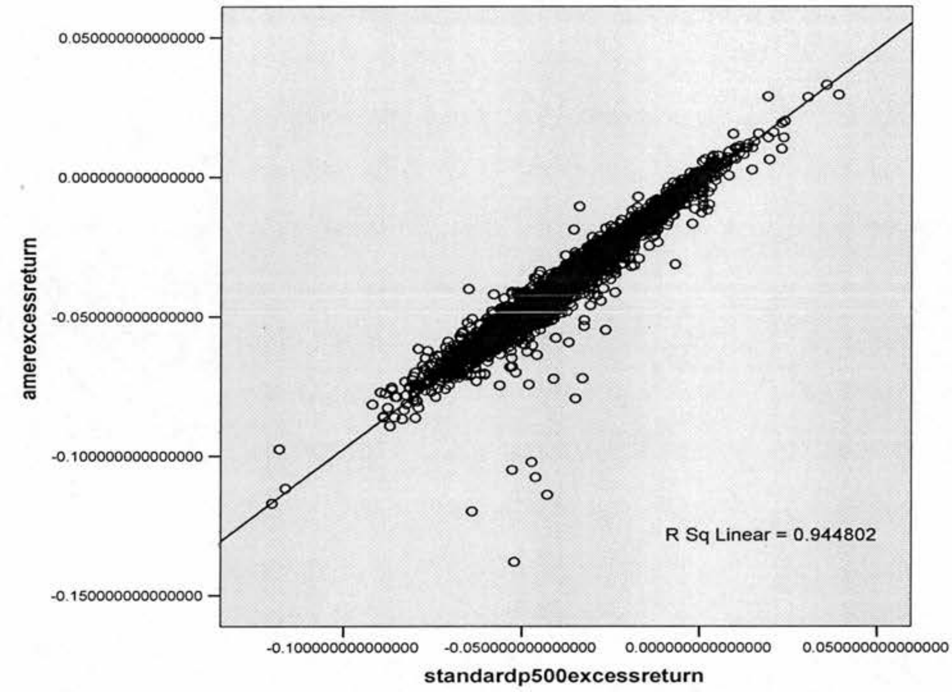
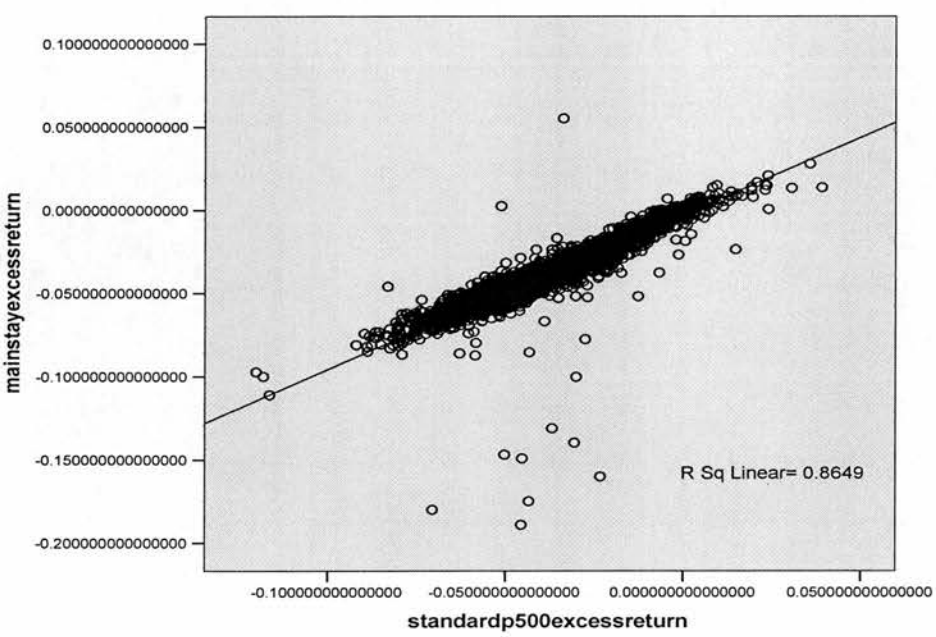


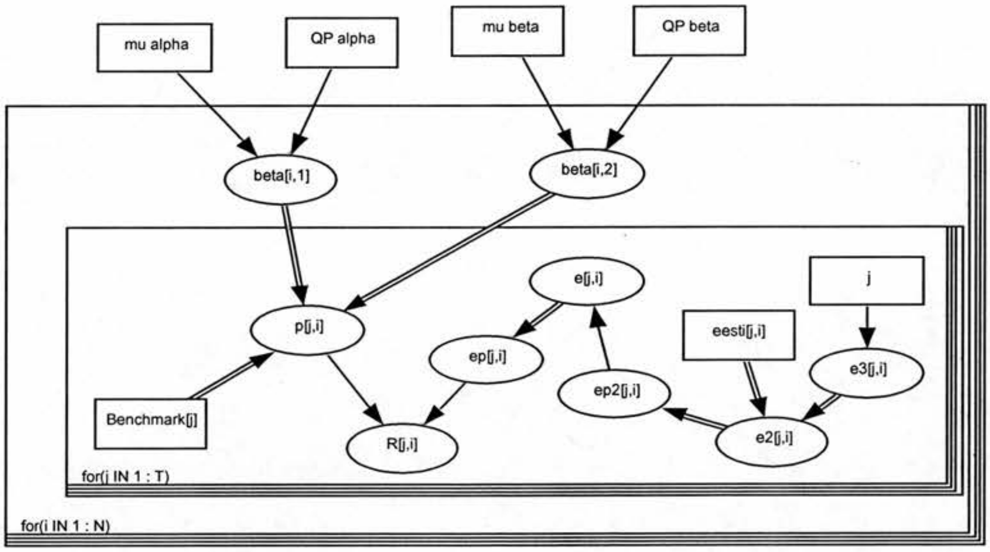
Figure 4.2.1.4: Scatterplot of fund MAINSTAY



4.2.3 Independent Model

The Bayesian independent model assumes that αs and βs are independent. They all have their own distributions. Figure 4.2.2 presents the structure of the independent model. It assumes all αs and βs independently follow normal distribution. The normal distributions have mean mu and precision QP. Meanwhile the priors of mus and QPs are derived from OLS regression estimates. Precision of error term has hyper prior. The error term e [j,i] is a normal distribution with a zero mean and variance e2 [j,i], where e2 [j,i] is simulated from a chi-square distribution. The procedure of calculation of independent model is in similar manner to dependent model.

Figure 4.2.2: Independent model structure



The independent model is also simulated by Gibbs Sampling using WinBUGS. The first 10000 draws are dropped to reduce initial impact and results are all based on next 1000 samples. Table 4.2.3 presents the descriptive statistics of αs and βs.

Figure 4.2.2 presents density α and β for fund AMER. The distributions is close enough to be regarded as normal. The figures of those posterior distributions can be found in Table 4.2.3. Means and medians of them are very close which show at least these distributions are not skewned.

Figure 4.2.2.1: Density of α and β for Fund AMER from independent model

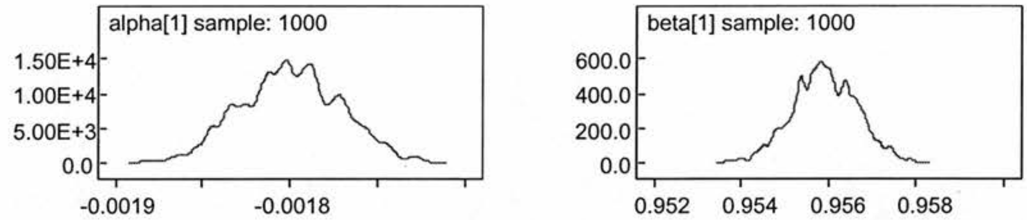


Figure 4.2.2.2 shows the trace of α and β for fund AMER from independent model. whilst in the figure the volatility looks large, if the scale in Figure are considered then it is insignificant given mean of α and β.

Figure 4.2.2.2: Trace of α and β for Fund AMER from independent model

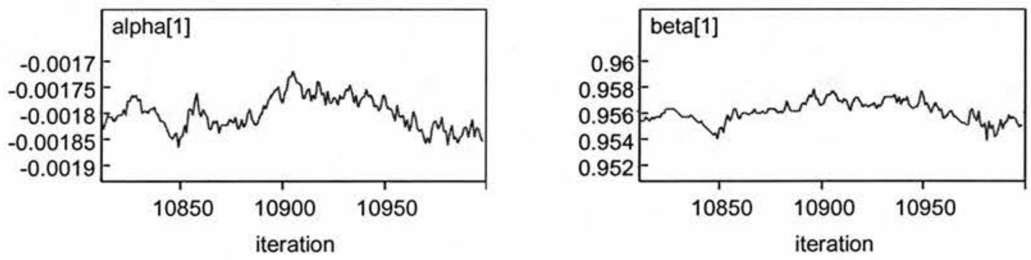


Table 4.2.3 presents the results of the independent model. In the Table estimates of αs and βs of five funds are given. It also shows standard deviation, MC error and other statistic measures.

Table 4.2.3: Estimates of αs and βs in the independent model

Node	Mean	SD	MC error	2.50%	Median	97.50%	Start	Sample
α [1]	-0.0018	2.89E-05	3.14E-06	-0.00185	-0.0018	-0.00174	10001	1000
α [2]	-0.01039	9.36E-05	1.19E-05	-0.0106	-0.01039	-0.01022	10001	1000
α [3]	-0.00273	8.62E-05	1.23E-05	-0.00291	-0.00272	-0.00257	10001	1000
α [4]	-0.00242	4.71E-05	7.23E-06	-0.00251	-0.00242	-0.00232	10001	1000
α [5]	-0.01025	1.30E-04	2.01E-05	-0.0105	-0.01023	-0.01003	10001	1000
β [1]	0.9559	7.40E-04	8.36E-05	0.9545	0.9559	0.9574	10001	1000
β [2]	0.7373	0.002356	2.98E-04	0.7324	0.7373	0.7419	10001	1000
β [3]	0.9295	0.001816	2.55E-04	0.9259	0.9295	0.9331	10001	1000
β [4]	0.9463	0.001214	1.89E-04	0.9438	0.9464	0.9486	10001	1000
β [5]	0.7407	0.003151	4.96E-04	0.7344	0.7411	0.7463	10001	1000

Comparing the results from both the independent and dependent model, the value of both αs and βs are very similar. Some of the figures even correspond. There is not a significant degree of variation over the estimates. When comparing the traces of both the dependent and independent models, it is found that although αs and βs in the different models do have different patterns, their difference are not significant.

Figure 4.2.2.3 and 4.2.2.4 show the scatterplot of Fund AMER and MAINSTAY and the results come from the independent model. R square in the figures indicate both funds can be well tracked. Both R square figures are better than those from the OLS model and similar to the dependent model.

Figure 4.2.2.3: Scatterplot of fund AMER

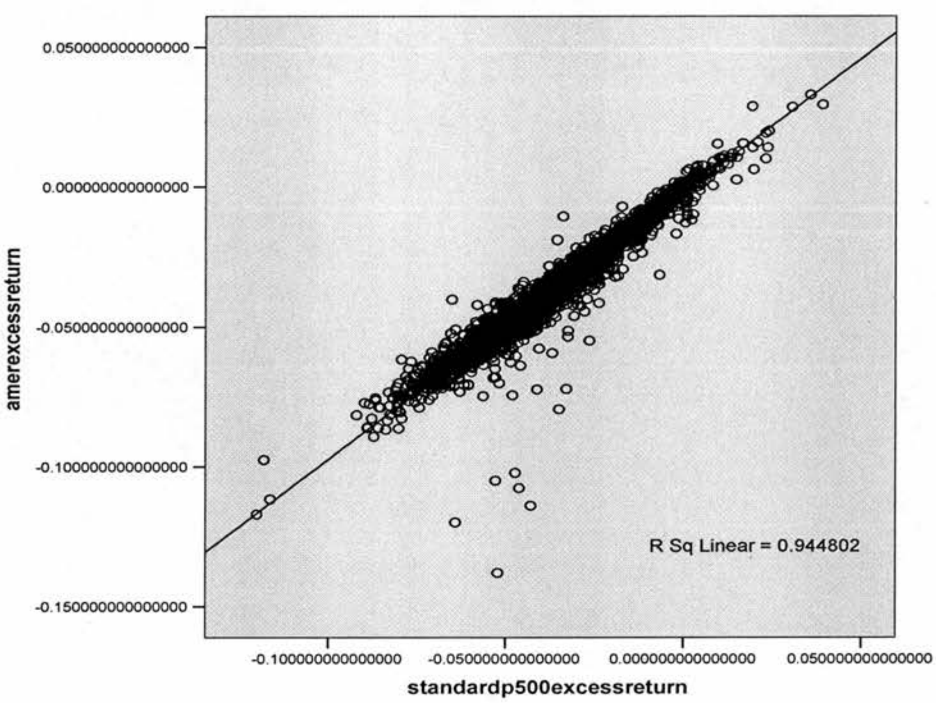
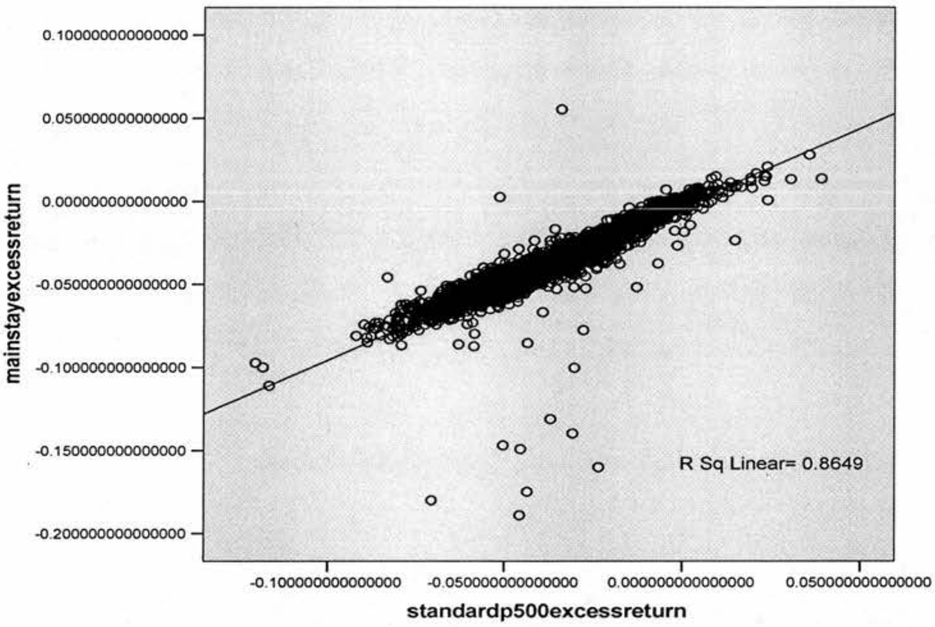


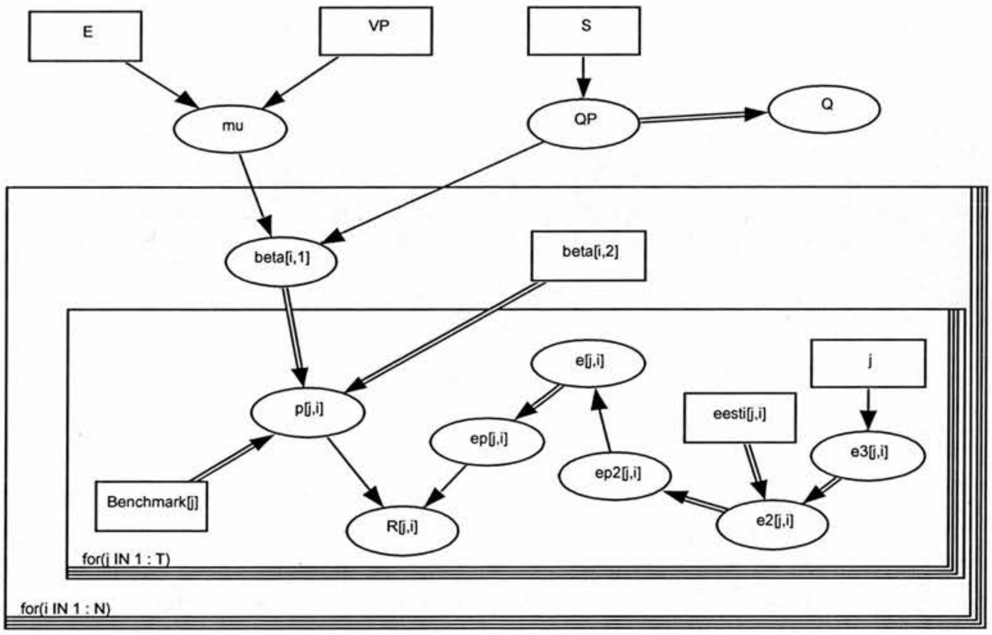
Figure 4.2.2.4: Scatterplot of fund MAINSTAY



4.2.4 Constant β Model

The third model assumes β is constant, which is the average of βs for all five funds. α in the model has its own prior distribution which is estimated from OLS estimators. The purpose of the constant β model is to assess αs of funds without the interference from βs. It asks if different funds have the same risk preference, will they have similar performance? The constant β model is a little bit different from two previous models. A constant is assigned as β's prior, but αs still have their own prior distributions. The constant used as β's prior is the average of βs of all five funds in the OLS model. The normal distribution of beta [i,1], which is αs of the funds, has mean mu and precision QP. Meanwhile mu has a normal distribution, as well. It has hyper prior E as a mean and VP as precision. The prior of precision of αs, QP, follows a wishart distribution. The error term e [j,i] is a normal distribution with zero mean and variance e2 [j,i], where e2 [j,i] is simulated from a chi-square distribution. The procedure of calculation of independent model is in similar manner to dependent model. Relationships between different parameters can be displayed as diagram. Figure 4.2.3 shows the structure of the constant β model.

Figure 4.2.3: Constant β model structure



The Gibbs Sampling process is the same as in the two previous models. First 10000 simulations are removed to improve convergence and then 1000 sample are used to get estimates. Figure 4.2.3.1 shows the density of α for Fund PRINCIPAL from the constant β model. In the Figure, the distribution is very similar to the normal distribution, only with few very insignificant peaks accompanying the main one.

Figure 4.2.3.1: Density of α for Fund PRINCIPAL from the constant β model

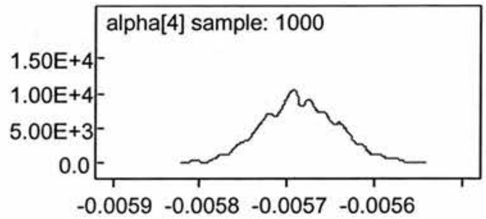


Figure 4.2.3.2 presents the trace of α, which shows the volatilities fluctuate in a very narrow 0.0002 range. It indicates the sampling of α is convergent.

Figure 4.2.3.2: Trace of α for Fund AMER from constant β model

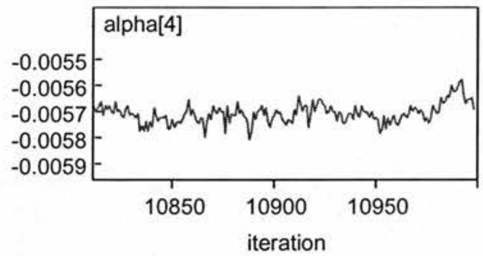


Table 4.2.4 shows the descriptive statistics of αs in the constant β model. It includes not only αs for the five funds of the constant β model, but also standard deviation, MC error and other important statistics.

Table 4.2.4: Estimates of αs in the constant β model

Node	Mean	SD	MC error	2.50%	Median	97.50%	Start	Sample
α [1]	-0.00525	4.88E-05	6.95E-06	-0.00536	-0.00525	-0.00517	10001	1000
α [2]	-0.00587	8.07E-05	1.05E-05	-0.00603	-0.00587	-0.0057	10001	1000
α [3]	-0.00559	5.02E-05	6.66E-06	-0.00568	-0.00559	-0.0055	10001	1000
α [4]	-0.00569	4.32E-05	5.69E-06	-0.00577	-0.00569	-0.0056	10001	1000
α [5]	-0.00567	5.47E-05	6.63E-06	-0.00579	-0.00567	-0.00558	10001	1000

The constant β results are quite unique, when compared with two previous models, although their traces fluctuate in a similar range to αs in the dependent and independent models. It is interesting that with the same β, updating by different excess returns, αs of those five funds are very close to each other.

Figure 4.2.3.3 and 4.2.3.4 are the scatterplots for Fund AMER and MAINSTAY from the constant model. R square figures for both funds are at a in reasonable level, but they are relatively poor when compared to previous models. It implies the constant β model fits less well than other models

Figure 4.2.3.3: Scatterplot of fund AMER

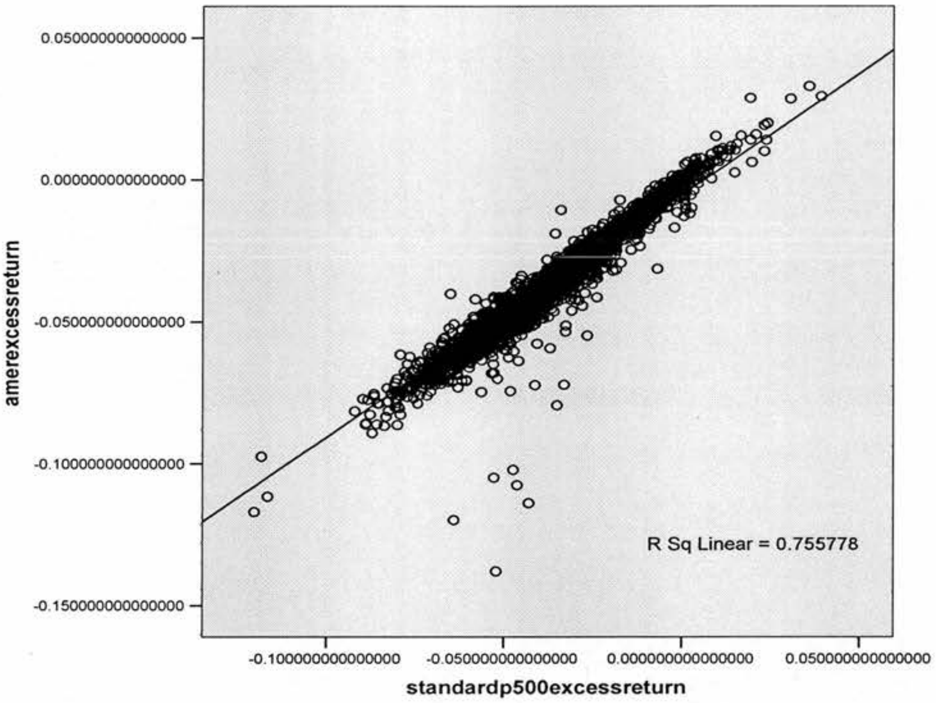
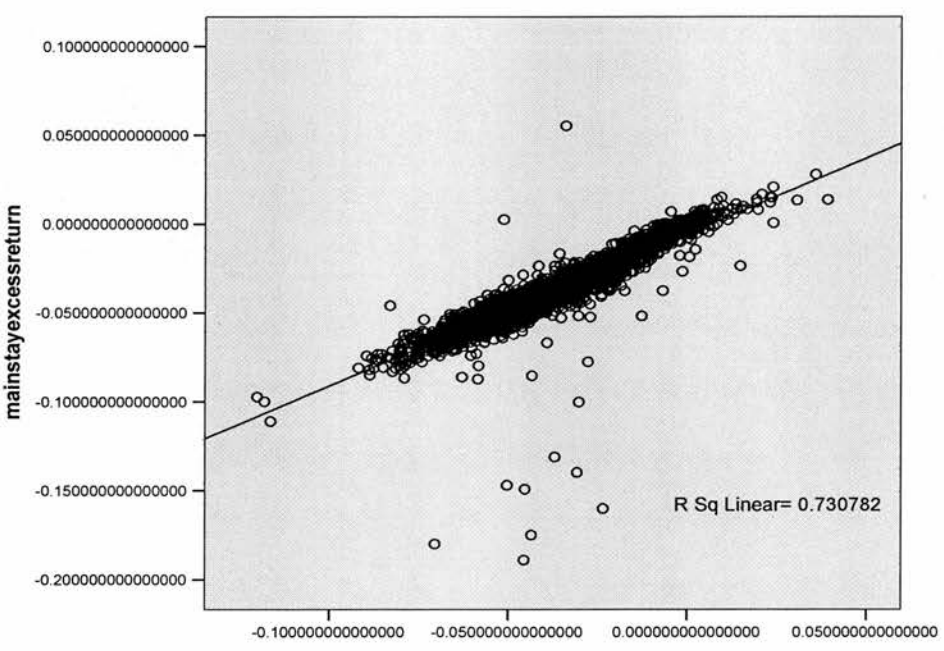


Figure 4.2.3.4: Scatterplot of fund MAINSTAY



4.2.5 Comparison of all Models

Comparing these five funds they have very similar αs and βs. One of reasons is due to their historical performance being similar to each other. Another reason is that they have similar assets composition. The return correlation Table 4.2.5 shows that return of five funds have a very strong correlation with each other.

Table 4.2.5: Correlation among return of five funds

	AMER	ING	MAINSTAY	PRINCIPAL	AXP
AMER	1	0.850241	0.917383	0.794564	0.862773
ING	0.850241	1	0.840054	0.708215	0.984535
MAINSTAY	0.917383	0.840054	1	0.754687	0.85471
PRINCIPAL	0.794564	0.708215	0.754687	1	0.719053
AXP	0.862773	0.984535	0.85471	0.719053	1

The high correlation among return of five funds explains why the five funds have similar performance and risk preference. Similar asset composition may cause high correlation among these funds and give them similar performance and risk level.

Table 4.2.6 compares results from the OLS and Bayesian models. It lists αs and βs for all five funds. The means and standard deviations for all five funds in the same model are included in the table as well.

Table 4.2.6: Comparison among OLS and dependent, independent and constant β Bayesian model

Funds		AMER	ING	MAINSTAY	PRINCIPAL	AXP	MEAN	SD
OLS Estimator	α	-0.00186	-0.010835	-0.003158	-0.002701	-0.010556	-0.005822	0.004474257
	β	0.954597	0.725694	0.920891	0.940152	0.732954	0.8548576	0.115246709
Bayes Estimator (Dependent)	α	-0.001805	-0.0104	-0.002711	-0.00241	-0.01019	-0.0055032	0.004387075
	β	0.9558	0.7373	0.93	0.9465	0.7418	0.86228	0.11242823
Bayes Estimator (Independent)	α	-0.0018	-0.01039	-0.002728	-0.002417	-0.01025	-0.0055168	0.004397711
	β	0.9558	0.7373	0.9295	0.9463	0.7407	0.86192	0.112610976
Bayes Estimator (Constant β)	α	-0.00525	-0.005872	-0.005594	-0.005685	-0.005674	-0.0056156	0.000226888
	β	0.8548576	0.8548576	0.8548576	0.8548576	0.8548576	0.8548576	0

A comparison of the three Bayesian models and the OLS model are made in Table 4.2.6, and it can be seen the values are very close. All five funds cannot beat the market and have lower undiversified risk than the benchmark.

This evidence supports the Efficient Market Hypothesis (EMH) theory stating fund managers cannot outperform the market. From Table 4.2.6, evidence shows that estimators from dependent and independent models are the most similar. Some results are even the identical. For instance, values of β of fund AMER and ING from Bayesian dependent and independent models are the same. Values of estimators in the OLS model are also very close to these in the Bayesian dependent and independent models. In fact, the values of αs in the constant β model are almost the same as the average αs of other models. A constant β leading to a similar α could be explained by β being initially constrained making α closer. It implies when the risk preference of a fund has been chosen, performance of a fund can be predicted.

4.3 Discussion

Historical data of five funds over 15 years have been explored using the CAPM single factor model. Two methods, OLS and Bayesian estimation, are used to estimate α and β for measuring funds' performance. In total four models are considered: OLS, Bayesian dependent, Bayesian independent and Bayesian constant β. Results show the Bayesian dependent and independent models generate the most similar estimators for both α and β. This is followed by standard OLS estimators, which have similar α and β values to Bayesian models. The constant β model has quite different αs from the other models. These values, however, are quite close to the average of αs of other models. This phenomenon can be explained by using the cross-section mean of β and optimum frontier in the modern portfolio theory. When the risk preference is determined, the return of funds can be expected. All the evidence here suggests fund managers have no ability to beat the market and that passive management may be a better way to manage a mutual fund. Consistent with the EMH theory, both OLS and Bayes α indicate negative value of funds' performance.

The methodology seems sound, but it needs to be applied to a larger range of funds. Only five funds have been examined and they only cover a very narrow area. It is hard to provide a full perspective of a whole funds' market. Moreover, CAPM is a very effective but simple model to measure funds' performance. A more complex and sophisticated Baysian model will be developed in the next Chapter based on Figure 1.2 which is mentioned in the introductory chapter and along with experts' opinion collected through interviews.

Chapter 5 Comparison of OLS and Bayesian Models and Intermarket Effect Test

5.1 Introduction

An important issue in performance evaluation of this chapter is whether the macroeconomic factors have influence over the mutual fund performance. This will be examined by fitting 12 macroeconomic factors, to see whether they account for any of the variation in the model.

Choices of macroeconomic factors are based on Figure 1.2 which was mentioned in the introductory Chapter. Figure 1.2 indicates that fund management is not isolated from a wide range of influences. These are not solely economic factors or even market effects, but also the context in which funds are measured. This, to some extent is determined by the views of the trustees who influence policy for the fund, but there are also other aspects such as the style of management, management expertise and asset allocation requirements that will have an impact.

Obviously in any doctoral study it will not be possible to interpret all these aspects. This study will concentrate more on the influence from the external side of funds. The impacts from macroeconomic environment and capital market will be examined rather than funds' internal influence such as funds' asset allocation, style of management, managers' skill etc.. It, however, does not mean that the internal impacts of funds will be totally ignored in this thesis. The policy issues of funds management such relation among trustees, project managers and fund managers have already been investigated in Chapter 2 Literature Survey. The influence from fund mangers on funds will be discussed by using questionnaires as a proxy to collect their beliefs on the macroeconomic impacts.

Based on the models from the pilot study, experts' opinion from pilot interview along with the framework derived from Figure 1.2, stepwise regression is employed to find out the most relevant macroeconomic factors for fund performance. After eliminating the irrelevant factors, the different combinations of the significant factors will be examined. The Ordinary Least Squares (OLS) and Bayesian method will be implemented to explore variable fit. The dependent and independent Bayesian models employed in the pilot study will be applied to 26 funds. Of course, the set of explanatory variables will increase from only one, market portfolio, to 12 macroeconomic factors and market portfolio. The complexity of the models increases as well. The main frames of the dependent and independent Bayesian models, however, are kept, because of the good fit to the funds of the models in the pilot study. The results from the OLS and Bayesian model will be compared in the Chapter.

The performance of the funds is determined by the equities in the portfolio. Some people believe that there is an intermarket relationship which affects the stock market, bond market and commodity market. Murphy (1991) believes that all markets are interrelated—financial and nonfinancial, domestic and international. He suggested that the U.S. stock market does not trade in a vacuum; it is heavily influenced by the bond market. Bond prices are very much affected by the direction of commodity markets, which in turn depend on the trend of the U.S. dollar. He concluded that markets do not move in isolation. Since financial market interact with all kinds of economic and non-economic activities, there are just too many factors that may have direct or indirect impacts on financial market. Therefore, intermarket effects among different securities market would not be surprising. The scale of the effect, however, is the question. The intermarket effects of fund among stock market, bond market and commodity market will be explored.

Fund o2 will be further investigated in the Chapter, since its results have extraordinary performance compared to the rest of funds. Results of Fund o2 from both OLS and Bayesian models will be compared in the Chapter and its relationship with the benchmark will be demonstrated as well. Finally, the assets composition of Fund o2 will be explored in order to explain the unusual performance of Fund o2.

5.2 OLS and Bayesian Models

5.2.1 Data

26 U.S. Equity Mutual Funds are selected from Datastream from these funds with a 16 year span, see Table 5.2.1 for details. The reason for choosing equity funds is that the equity funds are one of the most frequently traded funds among mutual funds. Equity funds have more volatility than others and this characteristic makes analysis easier, because more movements can be observed during the time period. During the 16 years, all funds classified as equity class in the Datastream are chosen and included into the sample. Finally, 26 funds are picked up and monthly data of them start from May 1990 to April 2006. This covers a 16 year period and in total 192 data points for each fund are collected. Since some funds are less volatile than equities, monthly rather than daily data is used in the study. One of the most important reasons to pick equity funds from the U.S. market is information available for the American market is sufficient, available and easy to access. The American market is one of the mature security markets in the world and it is well connected with other markets all over the world. The volume of trade is also an influence in its choice.

Whilst initially it was believed that all funds were equity based, one particular fund was found to be a non-equity fund. This issue will be discussed in the later part of chapter. Composition details of all 26 funds can be found in Appendix E. The name of the funds and their abbreviations which will be used in the rest of the paper are listed in the Table 5.2.1.

Table 5.2.1: Funds' name and abbreviation

Fund Name	Abbreviated Fund Name
Alpine International Real Estate	a1
AXA Enterprise Equity Income A	a2
Calvert Social Investment Equity A	c1
CGM Advisor Targeted Equity A	c2
Evergreen Equity Index Instl	e1
Excelsior Blended Equity	e2
Federated Equity-Income A	f
Huntington Income-Equity Total Return	h
Federated International Equity A	i
John Hancock Large Cap Equity A	j1
JP Morgan Equity Income Select	j2
Legg Mason Partners Social Awareness B	l1
Lord Abbett Global Equity A	l2
MFS Global Equity B	m1
BlackRock Equity Dividend B	m2
BlackRock Equity Dividend I	m3
Old Mutual Analytic Defensive Equity Z	o1
Orbis Leveraged Fund	o2
PHOENIX INSIGHT EQ.FD. CL.N	p
SM&R Equity Income T	s1
Fidelity Spartan U.S. Equity Index Inv	s2
T. Rowe Price Equity Income	t1
T. Rowe Price Instl Foreign Equity	t2
U.S. Global Investors All American Eq	u
Westwood Equity AAA	w1
Principal Inv West Coast Equity A	w2

The US three month treasure bill is regarded as a risk free asset and Standard and Poor's 500 is used as the benchmark. Twelve Macroeconomic indices are included as independent variables. They are from the money market, exchange market, labour market, retail market and the banking industry. All of these variables are collected on a monthly frequency. Please refer Table 5.2.2 for the twelve macroeconomic factors and the benchmark sp500 which are both considered. The abbreviations that will be used in the rest of the paper are listed in the table as well.

Table 5.2.2: Factors' name and their abbreviations

Factors' Name	Abbreviation
US COMMERCIAL BANK ASSETS - COMMERCIAL & INDUSTRIAL LOANS	cci
US COMMERCIAL BANK ASSETS - LOANS & LEASES IN BANK CREDIT	cll
US CPI ALL URBAN	cpi
US TRADE-WEIGHTED VALUE OF US DOLLAR AGAINST MAJOR CURRENCIES	d
US FEDERAL FUND RATE	f
US FEDERALFUND RATE TARGET	ft
US MONETARY BASE	mb
US MONEY SUPPLY M1	m1
US MONEY SUPPLY M2	m2
US PERSONAL CONSUMPTION EXPENDITURES	pp
US UNEMPLOYMENT RATE	ur
US CONSUMER CONFIDENCE INDEX	coci
MARKET PORTFOLIO S&P 500	sp500

5.2.2 OLS Model

5.2.2.1 OLS Model Construction

Table 5.2.2.1 reports the summary details of 26 equity funds as dependent variables with 13 variables. The first column of the table is the funds' abbreviated name, and the first row is the name of the variables. Apart from αs of funds, only significant coefficients are reported here. Note funds coci and ur are not found to be significant for any funds.

Table 5.2.2.1: Stepwise OLS results

	α	sp500	f	ft	mb	m1	d	p	m2	cpi	cci
a1	0.027*	0.621		-0.961							
a2	0.004	0.744	-0.397								
c1	-0.044*	0.963			-1.358	0.984	0				
c2	-0.002	0.872			-1.466						
e1	-0.002*	0.983									
e2	-0.001	1.036									
f	0.004*	0.814		-0.31							
h	0.001	0.692		-0.3				-0.709			
i	0.017*	0.798	-0.531						-1.813		
j1	0.005	0.985			-1.589						
j2	-0.013*	0.786									
l1	-0.002	0.63		-0.384							
l2	0.012*	0.772	-0.492						-1.282		
m1	0.011*	0.754	-0.53								
m2	0.006	0.626	-0.56								
m3	0.006	0.626	-0.561								
o1	0.013	0.635		-0.599	-1.252						
o2	-0.053*				-1.397					-2.431	0.082
p	0.009	0.881	-0.286		-1.651	0.904					
s1	0.001	0.735		-0.238	-1.395	0.722					
s2	-0.001	0.978									
t1	0.006	0.714		-0.375	-0.578						
t2	0.015*	0.795	-0.475						-1.513		
u	-0.005	1.02				0.755					
w1	-0.009	0.851									
w2	0.014	1.077			-2.571	1.042					
Total	26	25	8	7	9	5	1	1	3	1	1
Mean	0.00073	0.8155	-0.479	-0.452	-1.473	0.88	0	-0.709	-1.536	-2.43	0.082
Var	0.00028	0.0205	0.0089	0.0634	0.265	0.019	N/A	N/A	0.0708	N/A	N/A

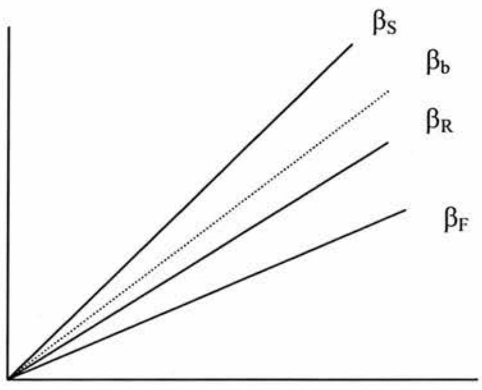
Note: * means coefficient is significant different from zero in 5% level.

Exactly half of the funds here have an α value which is not significantly different from zero. In other words, this means most of them do not outperform the benchmark sp500. In addition, those statistically significant αs reported in Table 5.2.2.1 are just around zero and their variance is no more than 0.01. Funds' performance is therefore very close to the performance of the market portfolio. So no fund outperforming the market, there is only one fund that could be considered exceptional. Nearly all funds, except o2, in this sample have statistical significant coefficient for the market portfolio sp500.

Funds may have a chance to beat the market or have a loss in a certain limited period, but over a sufficiently long period, say more than 20 years, the gain and loss converge towards market norm. This would explain the values of α which are allclose to zero and the same is true of the βs. In different periods, funds' risk preference may be more aggressive or conservative than the market portfolio. In the long term, it will move towards the same risk level of the market. In other words, movement towards the market portfolio means a larger chance of survival for the funds. Eventually, those funds that do not tempt to follow the general trend may be merged or die. This ensures that funds which remain in the market with a long history have similar performance and a risk level similar to the market portfolio.

Survivorship bias occurs when funds with poor performance are either removed or merged while strong performers continue to exist. As illustrated in Figure 5.2.2.1, assuming β_R is the real average market performance without any biases, β_f is the fund which is merged or closed, β_s is the fund success to survive and the dotted line shows the average market performance with bias.

Figure 5.2.2.1: Bias of market



Funds normally exist in the area between lines β_f and β_s. Those failed funds, however, are either closed or merged. That makes it appear as though the poor performers never existed at all. Obviously, such action will move the real average market performance up to the dotted line β_b, which makes the market always looks better than the real performance and makes it harder for funds to outperform the market.

The values of adjusted R square to funds for the OLS model are mainly above 50%. Only five out of the 26 funds have an adjusted R square smaller than 50%, and they are 49.3%, 41.1%, 47.5%, 12.2% and 41.9%. For these funds, it means the variation accounted by the model is not high. For four of them, the amount of variation accounted for can be regarded as reasonable; only one is clearly low. The fourth is fund o2 which is a leveraged fund. It is very reasonable that the value of adjusted R square of a leveraged fund is only 12.2% due to using a model designed for equity fund. Most funds have a relatively high adjusted R square which proves the model can track these funds very well. Figure 5.2.2.2 and 5.2.2.3 show the scatterplot of funds e1 and s2 from stepwise regression. Both funds score very high R Square in the stepwise regression.

Figure 5.2.2.2: Scatterplot of fund e1

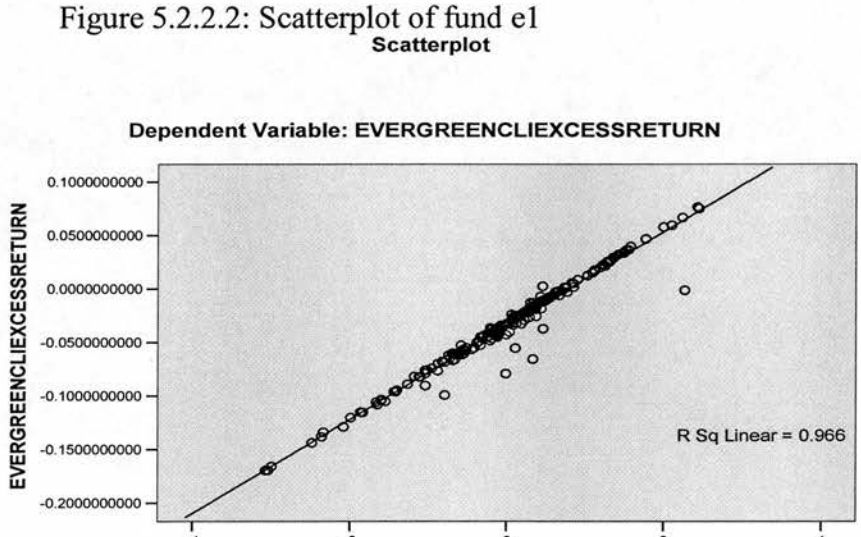
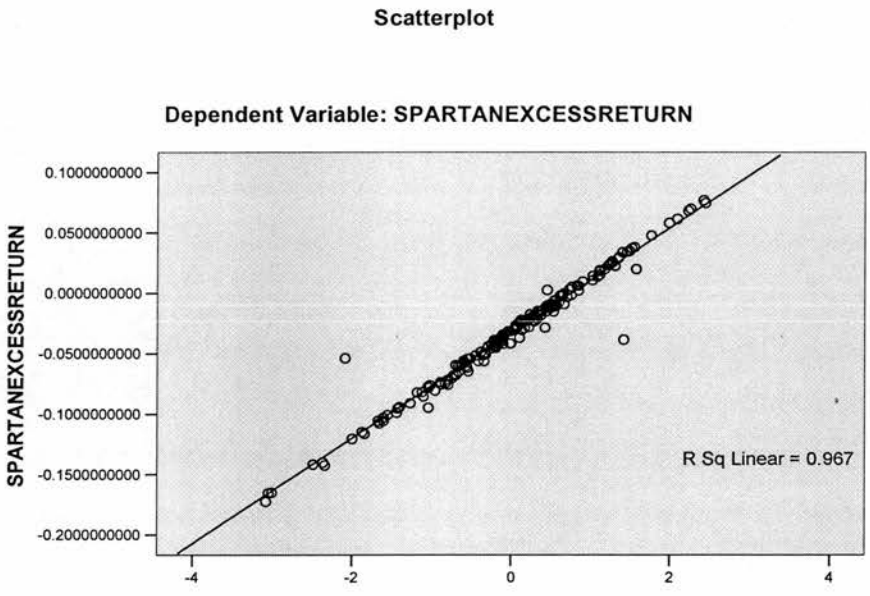


Figure 5.2.2.3: Scatterplot of fund s2



From Table 5.2.2.1 it is apparent there are certain patterns. Almost all the funds have relationship with the market portfolio sp 500. The variable ft appears in 7 out of the 26 funds; f is in 8, mb in 9, m1 in 5 and m2 in 3. The others, cci, cpi, d, pp, each record only one appearance. The conclusion here is that the funds are mainly related to sp500, ft, f, mb and m1. Therefore it is assumed these four macroeconomic variables and market portfolio have the strongest explanatory power among all the other variables.

Table 5.2.2.2 reports the correlation between the fitted variables. There is a significant high correlation of 0.997 between f and ft and so they can act as a substitute for each other, which is apparent in Table 5.2.2.1. It is obvious the Federal Reserve will always try to track the target fund rate.

The correlation between mb and m1 is also unsurprisingly high given their coverage and that m1 includes mb. For coci, some notable positive correlations with cci, cll, cpi, d, f and ft are apparent, and a negative correlation with m1 is seen, though, these correlations are weak.

Table 5.2.2.2: Correlation among 12 macroeconomic factors and market portfolio

	cci	cll	cpi	d	f	ft	mb	m1	m2	pp	ur	coci	sp500
cci	1	0.616703*	0.102113	-0.30608	0.384529	0.408402	-0.1011	-0.27986	0.010961	0.003527	-0.16825	0.450542	-0.03705
cll	0.616703*	1	0.353648	-0.14329	0.042442	0.066284	0.008269	-0.03549	0.313902	-0.0245	-0.15147	0.352572	-0.02089
cpi	0.102113	0.353648	1	0.254055	-0.52543*	-0.50836*	-0.17782	-0.15231	0.332929	0.037027	-0.05863	0.407266	0.150943
d	-0.30608	-0.14329	0.254055	1	-0.06256	-0.06542	0.044779	-0.00246	0.389678	-0.05683	0.163114	0.42858	-0.1395
f	0.384529	0.042442	-0.52543*	-0.06256	1	0.997861*	-0.01563	-0.23414	0.03359	-0.03702	0.07392	0.348824	-0.32295
ft	0.408402	0.066284	-0.50836*	-0.06542	0.997861*	1	-0.01752	-0.24793	0.027988	-0.02577	0.050383	0.373639	-0.32624
mb	-0.1011	0.008269	-0.17782	0.044779	-0.01563	-0.01752	1	0.609319*	0.192764	-0.17121	-0.00534	-0.12768	-0.10316
m1	-0.27986	-0.03549	-0.15231	-0.00246	-0.23414	-0.24793	0.609319*	1	0.319615	-0.3019	0.035209	-0.40265	-0.08189
m2	0.010961	0.313902	0.332929	0.389678	0.03359	0.027988	0.192764	0.319615	1	-0.12773	0.109111	0.3311	-0.07737
pp	0.003527	-0.0245	0.037027	-0.05683	-0.03702	-0.02577	-0.17121	-0.3019	-0.12773	1	0.05255	0.061889	0.130167
ur	-0.16825	-0.15147	-0.05863	0.163114	0.07392	0.050383	-0.00534	0.035209	0.109111	0.05255	1	-0.09042	-0.01186
coci	0.450542	0.352572	0.407266	0.42858	0.348824	0.373639	-0.12768	-0.40265	0.3311	0.061889	-0.09042	1	-0.14372
sp500	-0.03705	-0.02089	0.150943	-0.1395	-0.32295	-0.32624	-0.10316	-0.08189	-0.07737	0.130167	-0.01186	-0.14372	1

* means the correlation is higher than 50%

Considering all the information in Table 5.2.2.1 and 5.2.2.2, there are really only 3 variables rather than 5 which describe most variables, since f and ft, and mb and m1 can be substituted for each other. There seems little benefit for adding both f and ft to a model, but there are circumstances where mb and m1 can be added logically. sp500, f, ft, mb and m1 are the most significant variables in the stepwise models. Based on results from the stepwise results in Table 5.2.2.1 and the correlation analysis in Table 5.2.2.2, nine combinations of various variables have been tested and they are named in roman numerals. For example, II stands for the second modelwhich has sp500, ft, and mb as independent variables. Table 5.2.2.3 shows the number of funds related to those independent variables in different models. For instance, the model I, is a three-factor model with sp500, f and mb. Model I has 25 out of the 26 funds with a significant coefficient with the benchmark sp500; 17 with factor f and 9 with mb.

Table 5.2.2.3: Summary table for the number of funds relative to different factors in different combination

	Model Number	sp500	f	ft	mb	m1
Number of funds relative to	I	25	17		9	
	II	25		16	9	
	III	25	16			1
	IV	25		16		1
	V	25	1	2	9	
	VI	25	1	1		1
	VII	25	16		12	5
	VIII	25		16	12	5
	IX	25	1	0	12	5

From the Table 5.2.2.3, it is noticeable that sp500 has the most significant relationship with almost all the funds in every model. When factors f and ft appear alone, they are the second most significant factor. When both of them, however, appear together, just few funds have a significant relationship with them. Given the high correlation between factor f and ft, the situation can be explained by multicollinearity. Relationship between factors mb and m1 seems interesting as well. There are more causes when both of them appear together than when on their own. Therefore, in order to avoid the multicollinearity problem, models with either f or ft, mb and m1 will be retained in Bayesian methodology. Since the model is used as predication model, as many factors as possible will be included. As both factors f and ft are significant variables, a model with five factors including sp500, f, ft, mb and m1 will be examined in both OLS and Bayesian methods as well.

Figure 5.2.2.4: Summary of Significant Exposures in Nine Different Models

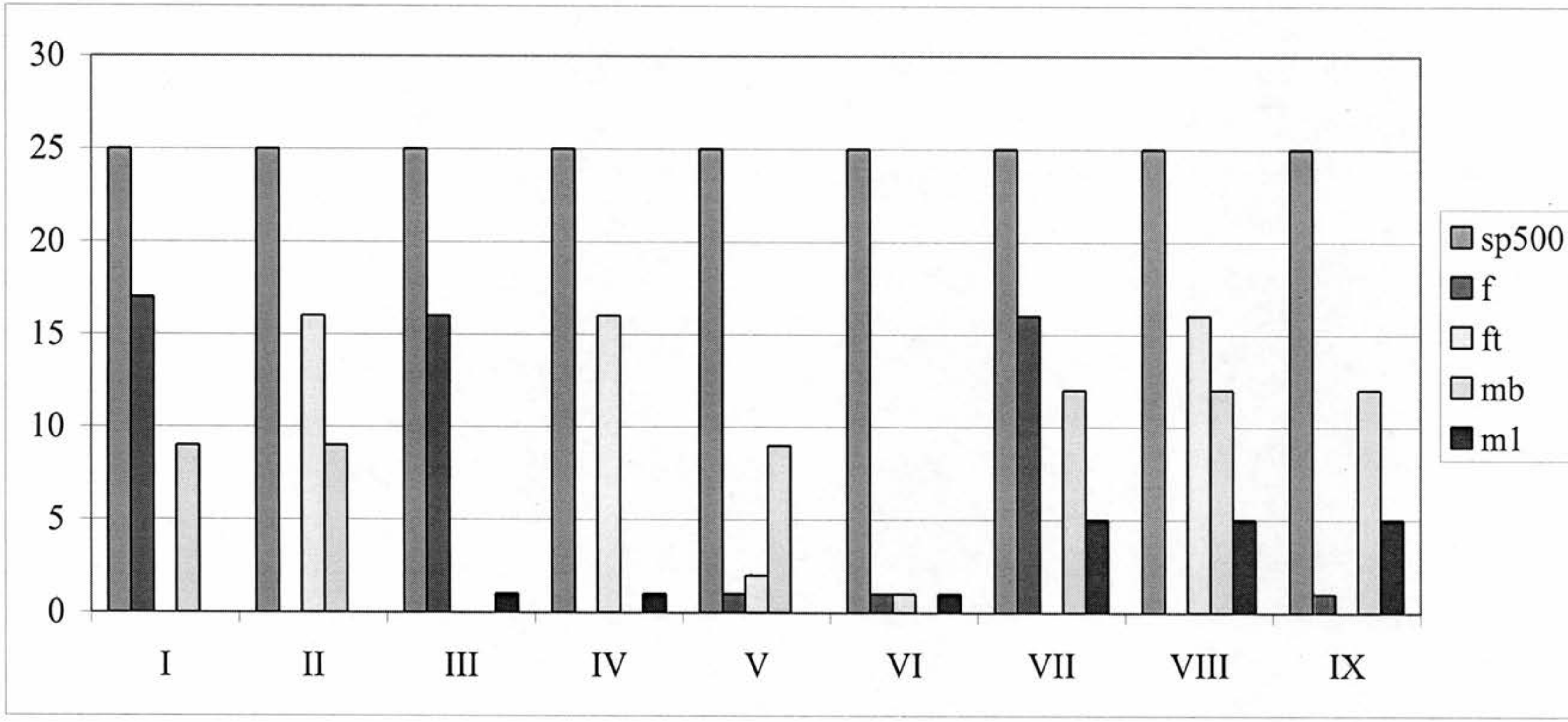


Figure 5.2.2.4 gives a more visual impression of the relationships between funds and five main independent variables. The figure visualises the results from Table 5.2.2.3. Model VII and VIII produce the best fit among all the models. Model IX does not seem to fit as well as model VII and VIII. This is due to multicollinearity.

Table 5.2.2.4: Model comparison between OLS stepwise and five-factor model

	sp500	ft	f	mb	m1
a1	IX				
a2	IX				
c1	IX			IX	IX
c2	IX			IX	
e1	IX				
e2	IX			IX	IX
f	IX			IX	
h	IX				
i	IX				
j1	IX			IX	
j2	IX				
l1	IX				
l2	IX				
m1	IX			IX	
m2	IX				
m3	IX				
o1	IX			IX	
o2		IX		IX	
p	IX			IX	IX
s1	IX			IX	IX
s2	IX				
t1	IX			IX	
t2	IX				
u	IX				IX
w1	IX				
w2	IX			IX	
Total	25	1	0	12	5

In Table 5.2.2.4, the first row is the abbreviated name of all the variables and the first column is the abbreviation of the names of the 26 funds. If for a fund a variable is significant in the stepwise model, the appropriate cell will be shaded and if for a fund variable is significant in the ninth model, for example a roman nine will be put in the appropriate cell where they cross. For example, in the table fund i has significant coefficient with independent variables sp500 and f in the stepwise model, but it is only with sp500 in model IX. In Table 5.2.2.4 most funds are exposed to sp500 except for Fund o2. For stepwise models either ft or f appear in the model; mb occasionally appears and m1 appears only if mb is present except in the case of fund u. Model IX is different with only ft appearing once for Fund o2, while mb appears more often. Again, m1 appears only if mb does also except in the case of fund u.

In Table 5.2.2.5, the first column shows the abbreviated names of funds and the first row shows the model type. For example, sp500, f, ft, mb and m1 indicate the model with five factors. The shaded areas indicate the model with the highest adjusted R Square.

Five variables are chosen in Model IX and they are sp500, f, ft, mb and m1. Although variable f and ft may suffer collinearity, they are both significantly independent variables. Meanwhile multicollinearity does not adversely affect the regression equation if the purpose of research is only to predict the dependent variable from a set of predictor variables. Multicollinearity does not affect the goodness of fit and the goodness of prediction. In this case the predictions in the regression will still be accurate, and the overall R square will give an indication of how well the predictor variables in the model predict the dependent variable. Moreover, evidence from Table 5.2.2.5 shows that the five-factor model has the highest average adjusted R square. It indicates that the five-factor model has the best performance in tracking those funds. Therefore, both of them are kept in consideration. Factors mb and m1 will be considered together as well. This combination will be examined using OLS regression first.

Table 5.2.2.5: Adjusted R square comparison model among four factors and five-factor models

	sp500, f, mb and m1	sp500, ft, mb and m1	sp500, f, ft, mb and m1	sp500-f	sp500-ft
a1	0.495	0.495	0.493	-0.002	-0.002
a2	0.721	0.72	0.72	-0.001	0
c1	0.769	0.769	0.769	0	0
c2	0.42	0.42	0.42	0	0
e1	0.966	0.966	0.966	0	0
e2	0.901	0.901	0.901	0	0
f	0.853	0.852	0.852	-0.001	0
h	0.77	0.771	0.773	0.003	0.002
i	0.498	0.496	0.503	0.005	0.007
j1	0.662	0.661	0.662	0	0.001
j2	0.56	0.56	0.558	-0.002	-0.002
l1	0.777	0.778	0.778	0.001	0
l2	0.64	0.638	0.641	0.001	0.003
m1	0.736	0.735	0.737	0.001	0.002
m2	0.581	0.58	0.581	0	0.001
m3	0.573	0.571	0.573	0	0.002
o1	0.476	0.476	0.473	-0.003	-0.003
o2	0.091	0.096	0.106	0.015	0.01
p	0.693	0.692	0.691	-0.002	-0.001
s1	0.73	0.73	0.73	0	0
s2	0.967	0.967	0.967	0	0
t1	0.708	0.708	0.707	-0.001	-0.001
t2	0.629	0.628	0.628	-0.001	0
u	0.749	0.749	0.75	0.001	0.001
w1	0.422	0.422	0.424	0.002	0.002
w2	0.683	0.683	0.685	0.002	0.002
Mean	0.6565385	0.6563077	0.6572308	0.000692308	0.000923077
Variance	0.0358927	0.0357061	0.035234	1.13415E-05	7.11385E-06

5.2.2.2 OLS Results

Based on the five-factor model developed in previous section, estimates of the coefficients are obtained using the OLS method. Table 5.2.2.6 presents the results of the OLS five-factor model. In the Table, ** means coefficient is significant in 5%

level and first column shows the abbreviated name of all 26 funds while the first row shows the abbreviated names of factors.

Table 5.2.2.6: OLS results of model with variables sp500, f, ft, mb and m1

	α	sp500	f	ft	mb	m1
a1	0.028	0.624**	-0.046	-0.854	-1.01	0.664
a2	0.003	0.751**	-1.389	1.055	-0.423	0.451
c1	0.006	0.928**	1.374	-1.556	-1.184**	0.724**
c2	0.009	0.843**	-3.429	3.196	-2.196**	0.975
e1	0	0.974**	-0.307	0.256	-0.048	-0.084
e2	0.003	1.03**	-0.272	0.235	-0.653**	0.616**
f	0.004	0.817**	-0.517	0.257	-0.587**	0.438
h	-0.001	0.682**	1.739	-2.039	-0.443	0.319
i	0.013	0.809**	-4.944	4.518	-1.112	0.362
j1	0.003	0.993**	2.595	-2.557	-1.776**	0.25
j2	-0.008	0.77**	0.727	-0.885	-0.375	0.71
l1	0.001	0.619**	1.076	-1.512	-0.121	-0.278
l2	0.009	0.781**	-3.039	2.629	-0.882	0.428
m1	0.012	0.757**	-2.361	1.905	-0.865**	0.47
m2	0.003	0.64**	-2.138	1.669	-0.274	0.574
m3	0.003	0.641**	-2.233	1.768	-0.294	0.598
o1	0.011	0.646**	-0.332	-0.197	-1.685**	0.613
o2	0.019	-0.135	6.073	-7.141**	-1.99**	0.572
p	0.009	0.884**	-1.148	0.885	-1.683**	0.958**
s1	0.001	0.732**	0.972	-1.23	-1.362**	0.666**
s2	0.001	0.972**	-0.353	0.323	-0.105	-0.016
t1	0.005	0.718**	0.714	-1.069	-0.791**	0.293
t2	0.013	0.794**	-1.697	1.214	-0.391	-0.193
u	-0.001	1.007**	-1.956	1.871	-0.078	0.783**
w1	0.001	0.829**	-3.823	3.753	-1.385	0.644
w2	0.016	1.068**	3.076	-3.16	-2.455**	0.845
Mean	0.006269231	0.775923	-0.44762	0.128231	-0.92954	0.476231
Variance	5.66846E-05	0.05278	5.669191	5.939506	0.495567	0.107924

Figures 5.2.2.5 and 5.2.2.6 show the scatterplot of the five-factor model for fund e1 and s2. Note the few outliers and very high R square showing a good fit. Both R square figures are improved relative to stepwise regression.

Figure 5.2.2.5: Scatterplot for fund e1

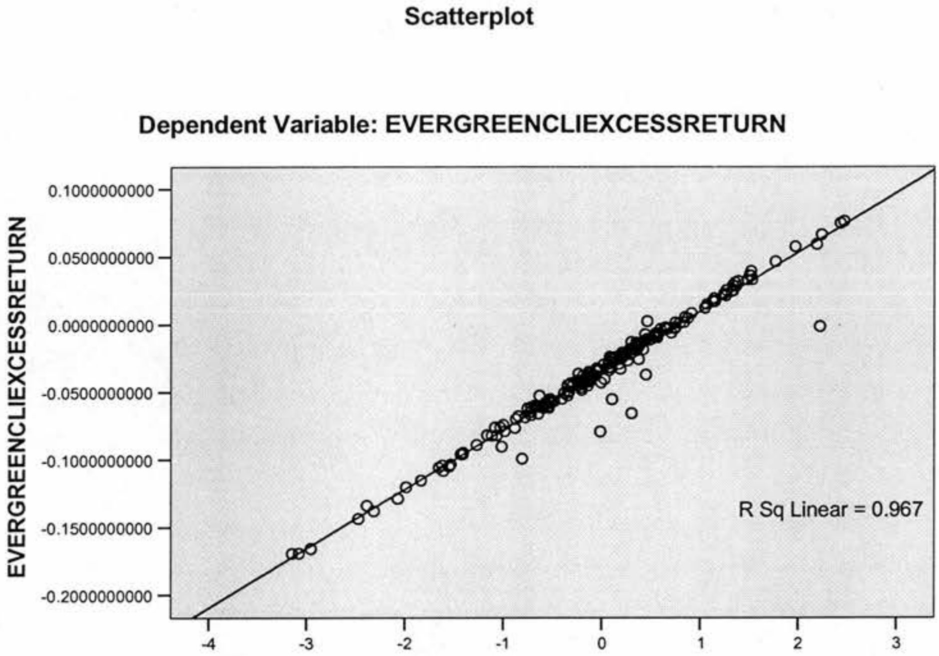
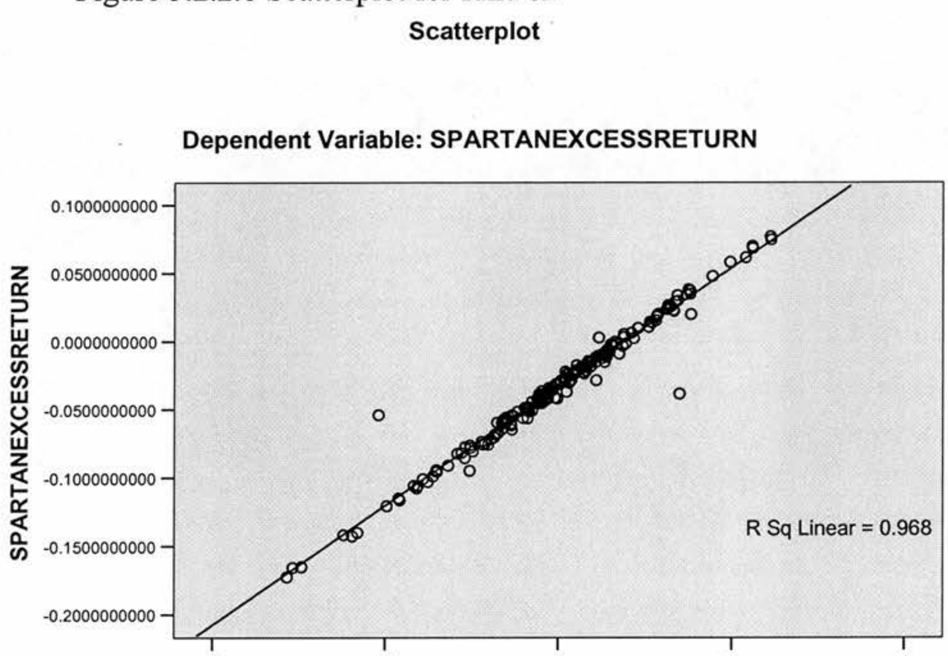


Figure 5.2.2.6 Scatterplot for fund s2



αs and βs seems to be in line with previous findings. The multicolinearity is quite obvious in Table 5.2.2.4 where factors f and ft do not appear together. Variables of mb and m1 once again have similar patterns.

The OLS results of the model with five factors (Table 5.2.2.6) is without any surprises apart from f and ft. They perform as a pair of factors with negative correlation, and such relationship did not appear in the correlation table. For example, fund c2 has a coefficient of -3.429 of f and 3.196 of ft. It shows a strong negative correlation. The variances of both factors f and ft are considerably large. The reason is multicollinearity. It normally happens when 'different' measures quantify the same phenomenon. They are redundant and correlate highly with each other. Multicollinearity, however, does not violate OLS assumptions and they are still unbiased.

5.2.3 Bayesian Model

5.2.3.1 Bayesian Model Construction

The Five-factor OLS model has been shown to have the best fit for the 26 funds. Therefore, the Bayesian method will be applied using the five-factor model. Two Bayesian models will be considered. They are the dependent model, which has assumed α and β, and follows a multivariate normal distribution with a non-diagonal covariance matrix, and the independent model where α and β do not share a common distribution. The method of fitting Bayesian models is to employ the Gibbs sampler.

Figures 5.2.3.1 and 5.2.3.2 present the structure of the dependent and independent models that will be employed. After entering the data and prior, WinBUGS can generate data for the posterior automatically. This model is similar to the previous one in the pilot study, but more independent variables are imported into the model. The main frame of WinBUGS' format CAPM is listed below;

R[j,i] ~ N(p[j,i], ep[j,i])   (1)

where R is the excess return of mutual fund in equation (1); j represents time period of funds' data and i (i=1…N) is the number of funds. Excess return of fund R is normally distributed which has a mean p [j,i] and precision (1/variance) ep [j,i].

The relationship between the excess return of fund and factors is:

P[j,i]=beta [i,1]+beta [i,2]*sp500[j]+beta [i,3]*f[j]+beta [i,4]*ft[j]+beta [i,5]*mb[j]+beta [i,6]*m1[j]

Where sp500 [j], f [j], ft [j], mb [j] and m1 [j] is the excess return of factors; beta [i,1] and beta [i,2] represent α and β in CAPM, respectively. The rest of the βs are coefficients of other factors.

The structure of either dependent or independent models is assumed that all α s and βs either dependently or independently follow multivariate normal distribution.

Figure 5.2.3.1: Dependent model

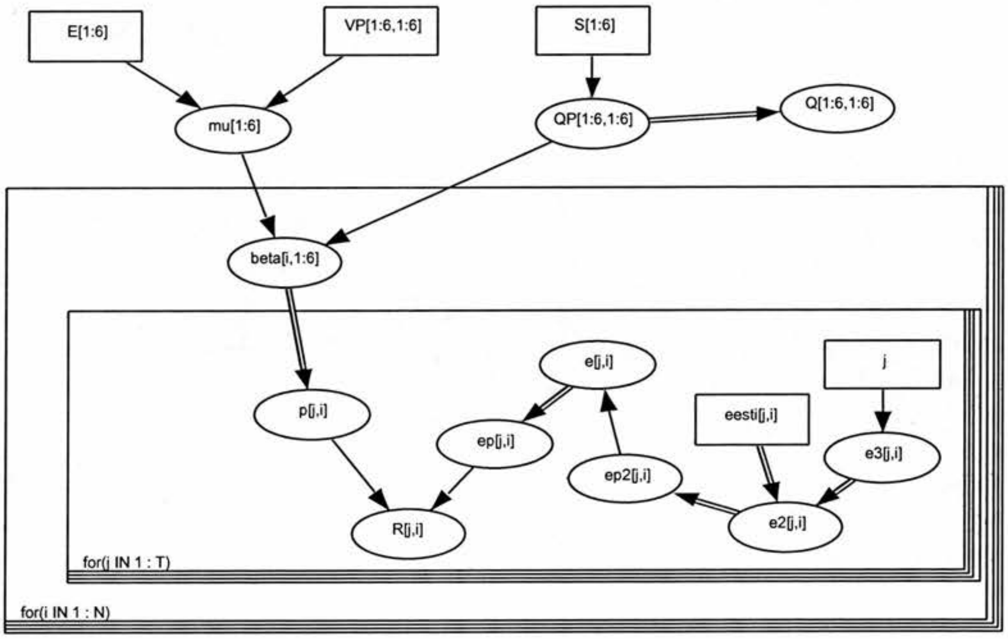


Figure 5.2.3.1 illustrates the structure of the dependent model. In the Figure, multivariate normal distribution has mean mu[1:6] and precision QP[1:6,1:6]. Meanwhile mu has multivariate normal distribution as well. It has hyper prior E[1:6] as mean and VP[1:6,1:6] as precision. The prior of the precision of β, QP, follows a

wishart distribution with 6 degrees of freedom. The precision of the error term has a hyper prior, too. The error term e[j,i] has a normal distribution with a zero mean and variance e2[j,i], where e2[j,i] is simulated from a chi-square distribution.

Figure 5.2.3.2: Independent model

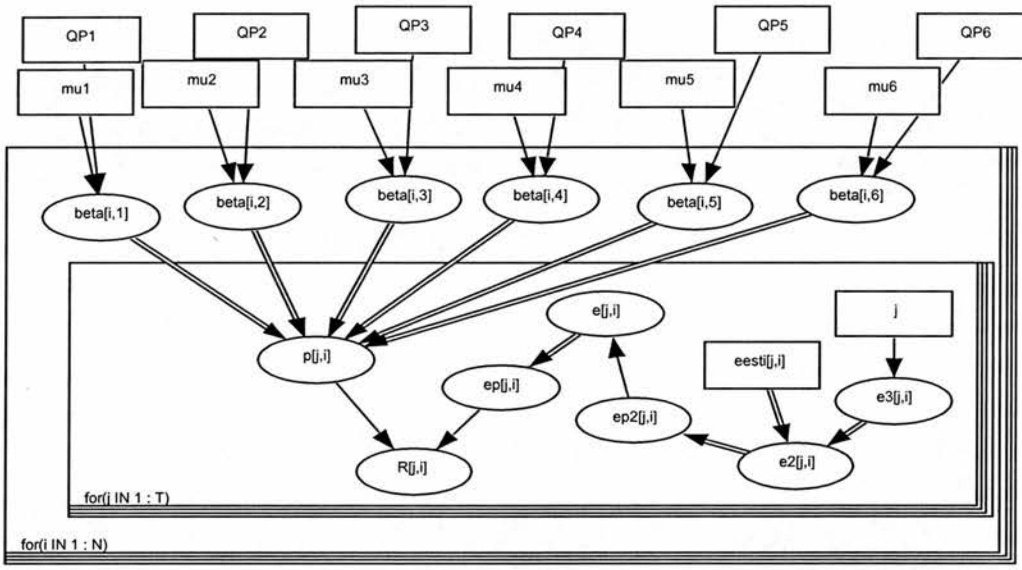


Figure 5.2.3.2 shows the structure of the independent model. Each beta in the model have their own distribution rather than a common distribution as in the dependent model. mus and QPs are the means and precisions for every beta. All the betas relate to the p which has direct relationship with R; the return of funds. The residual of the independent model has the same configuration as the residual of the dependent model.

The initial value is automatically generated by WinBUGS software. The first 10000 draws are dropped in order to reduce the impact of initial values and improve convergence. Then iterative Gibbs sampler estimator is set to iterate 1000 times.

5.2.3.2 Bayesian Results

Tables 5.2.3.2 and 5.2.3.3 show the results from both dependent and independent Bayesian five-factor models. Factors included in the models are based on the factors which are included through out the process of building the OLS five-factor model. These five factors are the most significant independent variables and have significant impacts on the fund performance.

Table 5.2.3.2: Results from dependent Bayesian five-factor model

Dependent	α	sp500	f	ft	mb	ml
a1	0.01714	0.6223	-1.353	0.7179	-1.2	0.817
a2	0.004166	0.754	-1.172	0.8271	-0.382	0.3993
c1	0.006353	0.9118	0.2874	-0.4496	-1.088	0.5556
c2	0.008235	0.9206	-1.843	1.667	-1.585	0.8246
e1	6.95E-05	0.9944	0.02687	-0.03871	-0.06767	0.03383
e2	0.001965	1.008	-0.6484	0.6102	-0.5947	0.4572
f	0.003899	0.8143	-0.2778	0.0323	-0.6173	0.4289
h	0.001968	0.6783	1.123	-1.468	-0.478	0.2572
i	0.007613	0.8502	-3.665	3.306	-0.7441	0.6462
j1	0.002242	0.9574	2.454	-2.445	-1.672	0.395
j2	-7.83E-04	0.7703	-0.1291	-0.1382	-0.1873	0.3043
l1	-1.33E-04	0.6255	0.9563	-1.371	0.04102	-0.1156
l2	0.006491	0.8131	-2.762	2.414	-0.7199	0.5016
m1	0.01094	0.773	-1.943	1.536	-0.9458	0.5654
m2	0.006992	0.6407	-1.87	1.35	-0.521	0.5398
m3	0.007548	0.6585	-1.597	1.104	-0.5622	0.503
o1	0.00632	0.6322	-0.0542	-0.3913	-0.8742	0.4034
o2	0.01837	-0.08075	5.735	-6.829	-1.893	0.4787
p	0.007924	0.8842	-1.106	0.8794	-1.26	0.6648
s1	0.002969	0.7226	0.8475	-1.143	-1.042	0.3442
s2	0.001183	0.9853	-0.1436	0.1222	-0.1077	0.04165
t1	0.00487	0.7258	0.1571	-0.4986	-0.6926	0.3627
t2	0.005481	0.8405	-0.8024	0.5415	-0.5969	0.3028
u	-7.01E-04	1.014	-1.476	1.407	-0.02512	0.508
w1	0.003297	0.8279	-0.6239	0.4356	-0.9886	0.3936
w2	0.0113	1.034	-0.08458	0.04342	-2.193	0.9064
Mean	0.0056045	0.783775	-0.3832235	0.0854312	-0.8075796	0.4430608
Variance	2.4E-05	0.0485864	3.222401	3.52605	0.3334019	0.0551627

Basically, no superior performance over the market portfolio is found for any of the funds and most of them have a near one risk level which is similar to the market portfolio. All of the results from dependent Bayesian model are consistent to the OLS results.

Figures 5.2.3.3 and 5.2.3.4 present scatterplot for funds e1 and s2 based on the dependent model. R square of the OLS stepwise and the five-factor model is found to greatly improve within both funds when used in conjunction with the Bayesian dependent model.

Figure 5.2.3.3: Scatterplot for fund e1

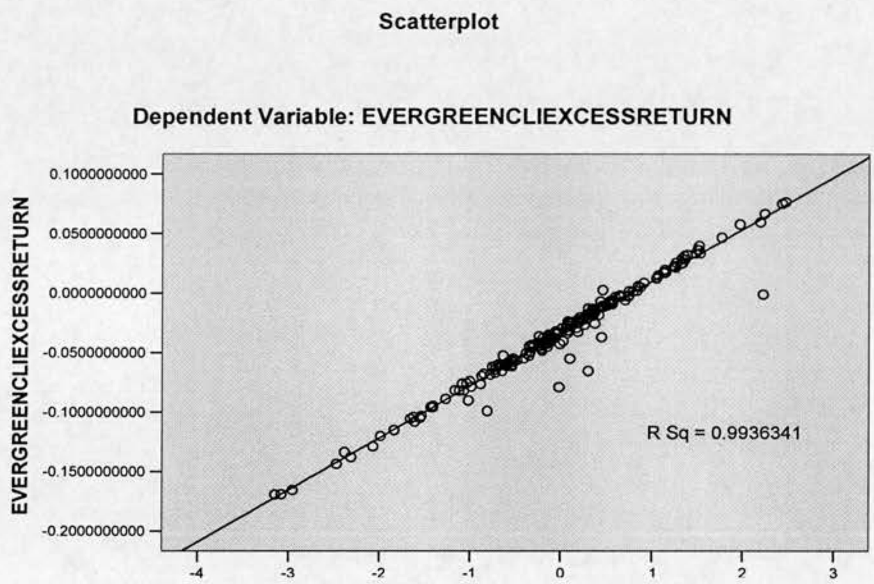
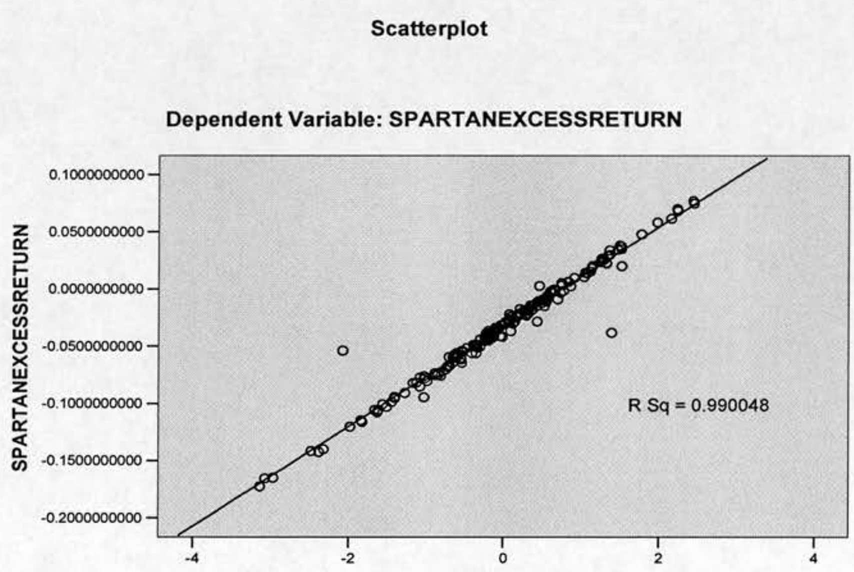


Figure 5.2.3.4: Scatterplot for fund s2



In Table 5.2.3.3, the results of 26 funds using the independent model are shown. The results from the independent model show the similarity with the results from the dependent model. A more detailed comparison will be presented later.

Table 5.2.3.3: Results from independent Bayesian five-factor model

Independent	α	sp500	f	ft	mb	ml
a1	0.02716	0.6262	-0.6489	-0.2236	-1.057	0.7097
a2	0.003567	0.7501	-0.5885	0.2526	-0.3485	0.3816
c1	0.006391	0.9154	-0.1849	0.01234	-0.969	0.5571
c2	0.006388	0.9091	-0.514	0.4157	-2.164	1.193
e1	-2.71E-05	0.9965	-0.1088	0.1049	-0.05616	0.01799
e2	0.00198	1.016	-0.3175	0.2858	-0.6077	0.5299
f	0.003532	0.8159	-0.3786	0.1382	-0.5931	0.4793
h	3.34E-04	0.6881	-0.09996	-0.2074	-0.4284	0.4041
i	0.01255	0.8494	-0.7107	0.182	-0.8847	0.3519
j1	0.003446	0.9577	0.2866	-0.3174	-1.937	0.5128
j2	-0.003606	0.7688	-0.3546	0.1326	-0.1316	0.4544
l1	7.11E-04	0.6151	-0.1581	-0.2778	0.06641	-0.2505
l2	0.008073	0.7871	-0.7788	0.3624	-0.6833	0.31
m1	0.0133	0.7771	-0.7862	0.2896	-0.7434	0.4045
m2	0.006705	0.6329	-0.7832	0.2372	-0.3667	0.4034
m3	0.007034	0.6571	-0.6644	0.1637	-0.4516	0.4889
o1	0.006137	0.6314	-0.5267	0.09655	-0.9065	0.3427
o2	0.01627	-0.1211	-0.5165	-0.4264	-2.031	0.6056
p	0.009438	0.8854	-0.4463	0.1855	-1.332	0.6416
s1	0.004019	0.7228	-0.09906	-0.2065	-1.14	0.3965
s2	0.001148	0.9905	-0.2519	0.2382	-0.06887	0.01464
t1	0.004517	0.7269	-0.349	0.01326	-0.6494	0.3719
t2	0.00998	0.8343	-0.4866	0.07895	-0.3552	-0.1019
u	-0.002145	1.011	-0.4807	0.429	0.04055	0.5314
w1	0.002015	0.8176	-0.5246	0.406	-1.323	0.5064
w2	0.01327	1.053	-0.2776	0.2585	-2.467	0.9923
Mean	0.006238	0.7813192	-0.4134431	0.1009192	-0.8303142	0.4326627
Variance	4.28E-05	0.0520058	0.0665377	0.0580274	0.4867563	0.089315

As shown in the Table 5.2.3.3, funds in the independent model those funds can not beat the market and ended up with an average of 0.006 α and a mean β of 0.78. Those results are consistent to the findings in all the previous models which imply that the funds do not have the ability to beat the market and have a similar risk preference to the market portfolio. Two funds, e1 and s2, are picked to demonstrate the good fit of the independent model. Figures 5.2.3.5 and 5.2.3.6 present the scatterplot of the funds.

Figure 5.2.3.5: Scatterplot for fund e1

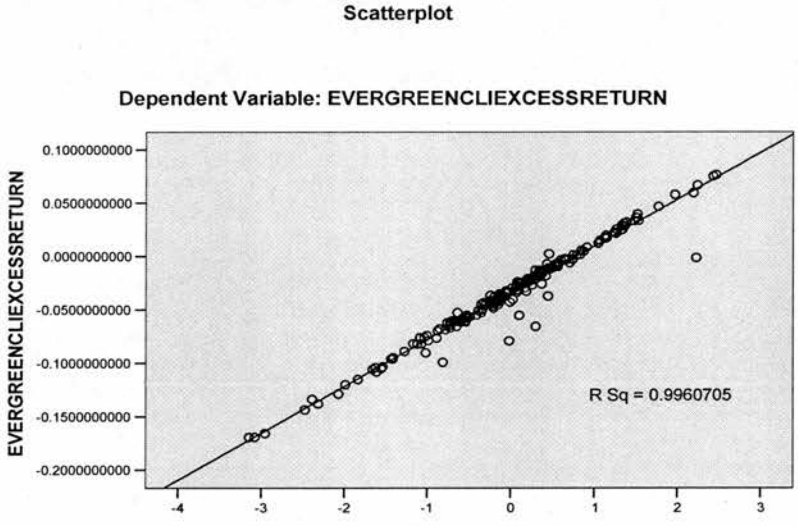
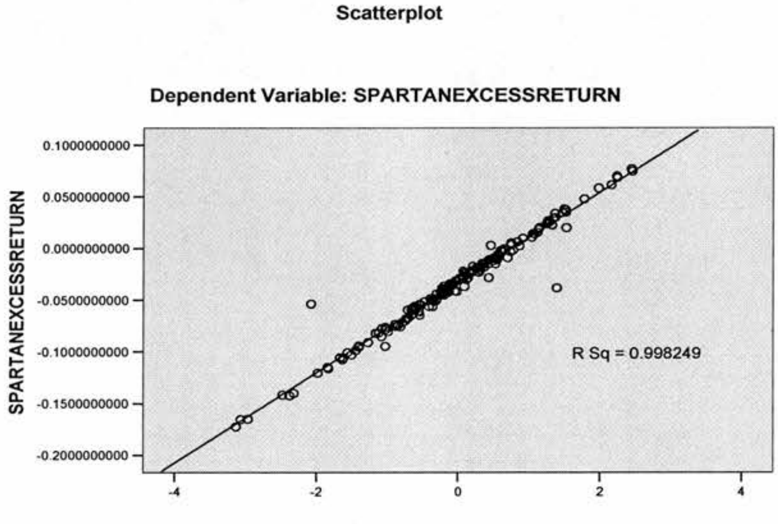


Figure 5.2.3.6: Scatterplot for fund s2



A comparison table has been created, Table 5.2.3.4. The Table presents both the mean and the variance of the models. Five factors including sp500, f, ft, mb and m1 are included for both independent and dependent Bayesian models.

Table 5.2.3.4: Summary results of five-factor Bayesian model

	beta[n,1] α	beta[n,2] sp500	beta[n,3] f	beta[n,4] ft	beta[n,5] mb	beta[n,6] m1
Mean (Dependent)	0.005605	0.783775	-0.38322	0.085431	-0.80758	0.443061
Variance (Dependent)	2.4E-05	0.048586	3.222401	3.52605	0.333402	0.055163
Mean (Independent)	0.006238	0.781319	-0.41344	0.100919	-0.83031	0.432663
Variance (Independent)	4.28E-05	0.052006	0.066538	0.058027	0.486756	0.089315

The results show a similar pattern of α and β of the funds for both models. Evidence from both Bayesian models corroborate these funds having a similar performance to the market portfolio. Factors mb and m1 are not significantly different in dependent and independent models. Although variables f and ft have similar means in both models, they have very different variances. The variance of f in the independent model, compared with the one in the dependent model is very large. It is 3.098 and also quite significant comparing to the value of the mean. The same is true for ft. The difference in variances for factor f and ft is yet again due to multicollinearity. This shows the instability in parameter estimation that may occur. The dependent model clearly is likely to reflect more strongly the interaction between f and ft.

5.2.4 Comparison of Results from OLS and Bayesian Models

5.2.4.1 The Comparison between OLS and Bayesian Four Factors Models

Following findings from Table 5.2.2.3, two different combinations of four factors for both dependent and independent Bayesian models have been set up in order to reduce the multicollinearity. The purpose of these two models is to examine funds without the disturbance of multicollinearity. Table 5.2.4.1 shows the comparison of summary results from the OLS and Bayesian models.

Table 5.2.4.1: Bayesian and OLS results from models with variables sp500, f or ft, mb and m1

		α	β	f		mb	m1
OLS	Mean	0.006346	0.775654	-0.32262		-0.92492	0.468346
	Variance	5.39E-05	0.051443	0.061817		0.536283	0.124203
Dependent	Mean	0.005839	0.783765	-0.30571		-0.78002	0.429396
	Variance	2.48E-05	0.041963	0.052923		0.288553	0.049252
Independent	Mean	0.006348	0.780923	-3.15E-01		-0.83414	0.439948
	Variance	4.45E-05	0.050591	0.062061		0.508725	0.113801
		α	β		ft	mb	m1
OLS	Mean	0.006423	0.774962		-0.32877	-0.91427	0.450346
	Variance	5.52E-05	0.051884		0.064739	0.53223	0.121157
Dependent	Mean	0.005936	0.780332		-0.31065	-0.79061	0.411067
	Variance	2.45E-05	0.048061		0.04969	0.313583	0.045727
Independent	Mean	0.006353	0.779527		-0.31884	-0.816	0.421223
	Variance	4.47E-05	0.052478		0.064639	0.475663	0.097635

It is notable that there exists only slight difference between four and five-factor models with results mostly being identical. Therefore the results prove that multicollinearity among factors does not cause any bias in the five-factor model. The outcomes in terms of performance and risk are the same.

5.2.4.2 Comparison of Results from Five-factor Model (sp500, ft, f, mb and m1)

Table 5.2.4.2 concludes results from the OLS, Bayesian dependent and independent models. Mean and variance of all models are listed in the Table. All these models use five factors: sp500, f, ft, mb and m1 as independent variables.

Table 5.2.4.2: Results from OLS and Bayesian models

	beta[n,1] α	beta[n,2] sp500	beta[n,3] f	beta[n,4] ft	beta[n,5] mb	beta[n,6] m1
Mean (OLS)	0.006269	0.775923	-0.44762	0.128231	-0.92954	0.476231
Variance (OLS)	5.67E-05	0.05278	5.669191	5.939506	0.495567	0.107924
Mean (Dependent)	0.005605	0.783775	-0.38322	0.085431	-0.80758	0.443061
Variance (Dependent)	2.40E-05	0.048586	3.222401	3.52605	0.333402	0.055163
Mean (Independent)	0.006238	0.781319	-0.41344	0.100919	-0.83031	0.432663
Variance (Independent)	4.28E-05	0.052006	0.066538	0.058027	0.486756	0.089315

Results from three different models are consistent. Each factor has similar results in the OLS, independent and dependent models. A near zero α and a β close to 1 have been found in all three models. As concluded before the OLS and dependent models reveal more interaction between factor f and ft through big variance.

5.3 Intermarket Effect

5.3.1 Data

The same 16 year data for the 26 funds will be used as the dependent variable. Standard and Poor's 500 will be used as stock market index, the 30 years treasury bond yields will be regarded as bond market index, and the Commodity Research Bureau (CRB) index will be used as the commodity market index. All data will be collected on a monthly basis over the same time period as the funds data. Then the intermarket index will be calculated from the weight average of all three market indices.

In Table 5.3.1, each column of sp500, CRB and 30yrstbondyield shows the funds' coefficients with the market indices. For example, 0.694 is fund a1's sp500 coefficient. The last row contains the mean coefficients for different market indices.

Table 5.3.1: Coefficients of different market indices

Fund Name Abbr.	SP500	CRB	30yrstbondyield
a1	0.694	-0.04	-0.067
a2	0.78	0.002	-0.016
c1	0.952	-0.049	-0.018
c2	0.874	-4.53E-05	-0.02
e1	0.98	0.002	-0.003
e2	1.042	-0.018	0.003
f	0.845	-0.004	-0.01
h	0.712	-0.008	-0.013
i	0.857	-0.005	-0.024
j1	1	0.025	-0.001
j2	0.798	-0.017	0.01
l1	0.662	-0.017	-0.023
l2	0.829	-0.021	-0.021
m1	0.799	-0.013	-0.029
m2	0.669	0	-0.033
m3	0.669	0	-0.033
o1	0.705	-0.004	-0.026
o2	-0.019	-0.095	-0.064
p	0.916	0.012	-0.011
s1	0.766	-0.008	-0.012
s2	0.976	0.001	-0.002
t1	0.756	-0.006	-0.017
t2	0.844	-0.002	-0.024
u	1.001	0.027	-0.004
w1	0.817	0.021	-0.033
w2	1.1	-0.034	-0.007
Mean	0.808615	-0.00966	-0.01915
Variance	0.0421699	0.000594	0.0003055

Intermarket index are composed using the weighted average of three different market indices. The intermarket portfolio is defined as follow:

$$\text{intermarket portfolio} = \frac{(0.8086)\ \text{sp500} + (-0.00966)\text{CRB} + (-0.01915)\text{30yrstbondyield}}{0.8086 - 0.00966 - 0.01915}$$

5.3.2 Empirical Results

5.3.2.1 Stepwise OLS Results

Table 5.3.2 provides a results summary of the stepwise OLS model. This table reports the summary details of the 26 equity funds as dependent variables with thirteen independent variables including the intermarket portfolio and twelve macroeconomic factors. The first column of the table is the funds' abbreviated name and first row is the name of the variables. The shaded areas indicate the most significant five factors. Apart from αs of funds, only significant coefficients are reported here. Since some factors do not have significant coefficients, they are not shown.

Firstly, the adjusted R Square of the model indicates the stepwise model has considerable explanatory power in measuring fund performance. Moreover, this may be improved while a new model is built based on the significant factors which are extracted from the stepwise OLS model. Secondly, all the funds have a near zero α. It is consistent to the previous finding showing that all funds can not outperform the market portfolio. For the intermarket portfolio, only one fund has an insignificant coefficient. This is Fund o2, and its adjusted R Square is notable lower than others. The rest of the 25 funds all have a similar risk lever to the intermarket portfolio. Finally, the most significant five factors are the intermarket portfolio relates to 25 funds; coci and mb all relate to 8 funds; f and cpi relate to 7 and 4 funds, respectively. Therefore, those five factors including intermarket portfolio will be chosen as significant factors to create a model.

Table 5.3.2: Stepwise OLS models results summary

Fund Name Abbr.	Adjusted R Square	α	Inter market	coci	ft	f	mb	cpi	pp	m2	d	cll	cci	m1
a1	0.5	-0.012	0.605		-0.861									
a2	0.719	-0.029	0.712	0		-0.215								
c1	0.763	-0.057	0.907											
c2	0.424	-0.019	0.806	0			-1.587							
e1	0.962	-0.044	0.937					-0.025						
e2	0.897	-0.038	0.995					-0.04						
f	0.842	-0.04	0.797	0										
h	0.77	-0.036	0.682	0					-0.692					
i	0.506	-0.03	0.769			-0.409				-2.264				
j1	0.664	0.024	0.911				-1.488				-0.001			
j2	0.557	-0.033	0.722	0										
l1	0.777	-0.04	0.606		-0.29									
l2	0.645	-0.033	0.742			-0.374				-1.718				
m1	0.73	-0.035	0.724			-0.419								
m2	0.581	-0.032	0.602			-0.468								
m3	0.572	-0.032	0.602			-0.468								
o1	0.478	-0.021	0.609		-0.486		-1.184					-1.121		
o2	0.122	-0.053					-1.397	0.082					-2.431	
p	0.691	-0.02	0.841	0			-1.082							
s1	0.731	-0.025	0.715	0			-1.006		-0.803					
s2	0.965	-0.025	0.929					-0.025			0			
t1	0.707	-0.027	0.708	0			-0.599							
t2	0.639	-0.032	0.766			-0.353				-1.962				
u	0.754	0.009	0.945								-0.001			0.74
w1	0.426	-0.055	0.809											
w2	0.681	-0.045	1.013				-2.451							0.976
Total		26	25	8	3	7	8	4	2	3	3	1	1	2

Note: Shaded area means the most significant factors

5.3.2.2 Five-factor Intermarket OLS Model

Five of the most significant factors from the previous analysis are included in the subsequent model. Table 5.3.3 shows the summary results of the five-factor model under OLS regression.

Table 5.3.3: Summary of five-factor model which includes intermarket portfolio, cpi, f, mb and coci.

Fund Name Abbr.	Adjusted R Square	α	Inter market	cpi	f	mb	coci
a1	0.495	-0.011	0.599	0.023	-0.69	-0.464	0
a2	0.716	-0.027	0.71	-0.002	-0.226	-0.132	0
c1	0.765	-0.041	0.889	-0.001	-0.038	-0.624	-9.84E-05
c2	0.419	-0.021	0.787	0.014	-0.075	-1.564	0
e1	0.962	-0.045	0.937	-0.016	0.068	-0.107	-5.35E-05
e2	0.897	-0.023	0.979	-0.057	-0.164	-0.325	2.74E-05
f	0.848	-0.018	0.777	-0.043	-0.351	-0.359	1.93E-05
h	0.766	-0.027	0.654	-0.014	-0.202	-0.236	-7.96E-05
i	0.495	-0.005	0.762	-0.061	-0.718	-0.969	0
j1	0.657	-0.048	0.952	0.011	0.349	-1.562	0
j2	0.557	-0.009	0.725	-0.062	-0.3	-0.052	-3.66E-05
l1	0.779	-0.028	0.604	-0.006	-0.263	-0.315	-8.43E-05
l2	0.635	-0.018	0.738	-0.018	-0.417	-0.637	-7.63E-05
m1	0.733	-0.016	0.717	-0.019	-0.468	-0.573	-5.03E-05
m2	0.578	-0.041	0.604	0.03	-0.289	0.219	0
m3	0.569	-0.041	0.604	0.03	-0.291	0.216	0
o1	0.469	-0.015	0.608	0.005	-0.392	-1.265	0
o2	0.083	0.019	-0.117	0.046	-0.694	-1.513	0
p	0.689	-0.02	0.827	0.005	-0.085	-1.076	0
s1	0.724	-0.026	0.693	-0.002	-0.109	-0.92	0
s2	0.964	-0.041	0.934	-0.022	0.054	-0.134	-5.3.16E-05
t1	0.708	-0.024	0.686	0.002	-0.16	-0.602	0
t2	0.626	-0.014	0.763	-0.028	-0.444	-0.595	-4.57E-05
u	0.74	-0.037	0.948	-0.019	-0.068	0.418	0
w1	0.426	-0.067	0.785	0.058	0.22	-0.767	0
w2	0.676	-0.022	1.02	-0.026	0.02	-1.891	0
Mean	0.652923	-0.025615	0.737884	-0.006615	-0.2205	-0.608807	-1.9985E-05
Var	0.0358686	0.000284	0.047114	0.000927	0.070269	0.360372	1.20948E-09

Neither αs nor βs of any of the funds change a lot. As usual, all αs are close to zero and most βs are nearly 1. Outlier Fund o2 has a -0.117 β and an extremely low adjusted R Square which is only 0.083. The rest of the funds have a high adjusted R square and the mean of the adjusted R Square for all 26 funds is 0.6529 and its variance is 0.0358. Some funds have a remarkably high adjusted R Square such as 0.962 for fund e1 and 0.964 for fund s2. Results of factor coci are very interesting, 15 out of the 26 funds have a zero coefficient for this factor.

Table 5.3.4: Comparison adjusted R Square between five factors using sp500 and intermarket as market portfolio

Fund Name Abbr.	sp500	intermarket	Difference of adjusted R Square between two models
a1	0.493	0.495	-0.002
a2	0.72	0.716	0.004
c1	0.769	0.765	0.004
c2	0.42	0.419	0.001
e1	0.966	0.962	0.004
e2	0.901	0.897	0.004
f	0.852	0.848	0.004
h	0.773	0.766	0.007
i	0.503	0.495	0.008
j1	0.662	0.657	0.005
j2	0.558	0.557	0.001
l1	0.778	0.779	-0.001
l2	0.641	0.635	0.006
m1	0.737	0.733	0.004
m2	0.581	0.578	0.003
m3	0.573	0.569	0.004
o1	0.473	0.469	0.004
o2	0.106	0.083	0.023
p	0.691	0.689	0.002
s1	0.73	0.724	0.006
s2	0.967	0.964	0.003
t1	0.707	0.708	-0.001
t2	0.628	0.626	0.002
u	0.75	0.74	0.01
w1	0.424	0.426	-0.002
w2	0.685	0.676	0.009
Mean	0.657230769	0.652923077	0.004307692
Var	0.035234025	0.035868634	2.41415E-05

Compared with the five-factor OLS model which included sp500, f, ft, mb and m1, the new intermarket five-factor model does not appear to have advantages. Only four of the 26 funds in the intermarket model have a better adjusted R square. Moreover, adjusted R square of those four funds only improve by approximately 0.001 to 0.002. Therefore, the previous five-factor OLS model is slightly better than the intermarket model.

5.3.2.3 Is There Intermarket Effect?

Since the intermarket model has a very similar performance to the previous five-factor model, it raises suspicion that sp500 may have a major role among other intermarket indices and that leads to a similar adjusted R square of the intermarket model to the sp500 five-factor model. Therefore, further investigation has been carried out.

Table 5.3.5: Correlation among three market index

	30yrstbondyield	**CRB**	**SP500**
30yrstbond	1	-0.058	-0.205
CRB	-0.058	1	0.087
SP500	-0.205	0.087	1

As shown in Table 5.3.5, there is a very weak correlation among the three market indices. Then the intermarket portfolio is decomposed back into a three market portfolio: the equity market index sp500, the bond portfolio 30 years Treasury bond yield, and the commodity market index Commodity Research Bureau index.

In Table 5.3.6, "Sig" represents the p value of the coefficients of those three market portfolios. The shaded cells indicate those figures are significant in 5% level. First column shows the abbreviated names of all the funds. The first row shows three different market indices.

Table 5.3.6: Table of significant for three market portfolios

Fund Name Abbr.	SP500 sig	CBR sig	30yrstbondyield sig
a1	0	0.107	0
a2	0	0.875	0.09
c1	0	0.001	0.052
c2	0	0.999	0.292
e1	0	0.699	0.394
e2	0	0.079	0.68
f	0	0.734	0.116
h	0	0.5	0.078
i	0	0.838	0.14
j1	0	0.258	0.957
j2	0	0.393	0.443
l1	0	0.119	0.001
l2	0	0.279	0.08
m1	0	0.407	0.002
m2	0	0.985	0.003
m3	0	0.989	0.004
o1	0	0.873	0.076
o2	0.835	0.008	0.004
p	0	0.539	0.347
s1	0	0.575	0.199
s2	0	0.878	0.549
t1	0	0.705	0.071
t2	0	0.94	0.048
u	0	0.121	0.724
w1	0	0.457	0.059
w2	0	0.148	0.645

The results in the table are very obvious. With only one exception, all of the funds have a significant coefficient of sp500. Only a few funds, however, have significant coefficients with the other two market portfolios. Principle component analysis can be used to determine the significant factor. Nevertheless the evidence is very obvious. Conducting principle component analysis is not necessary. This shows that sp500 is the major component of the effect of the intermarket portfolio.

5.4 Fund o2

Fund o2 seems to be an outlier from the rest of funds in the data set. Table 5.4.1

illustrates the coefficients of Fund o2 to different independent variables in the OLS and Bayesian methods.

Table 5.4.1: Comparison results of Fund o2

Methods \ Factors		α	β	f	ft	mb	ml
OLS		0.019	-0.135	-7.141	6.073	-1.99	0.572
Bayesian	Dependent	0.01837	-0.0808	5.735	-6.829	-1.893	0.4787
	Independent	0.01627	-0.1211	-0.5165	-0.4264	-2.031	0.6056

The results seem consistent in all models apart from factors f and ft which have been found in the previous models. Its relationship to the benchmark makes Fund o2 so distinctive. Normally, other funds have a coefficient which is close to 1, but from Table 5.4.1 an approximate value of -0.1 is found as the coefficient of Fund o2 to market portfolio. A β of less than one suggests the portfolio has a less undiversifiable risk than the market as a whole. Concluding on the evidence from the rest of equity funds, β values should be close to one.

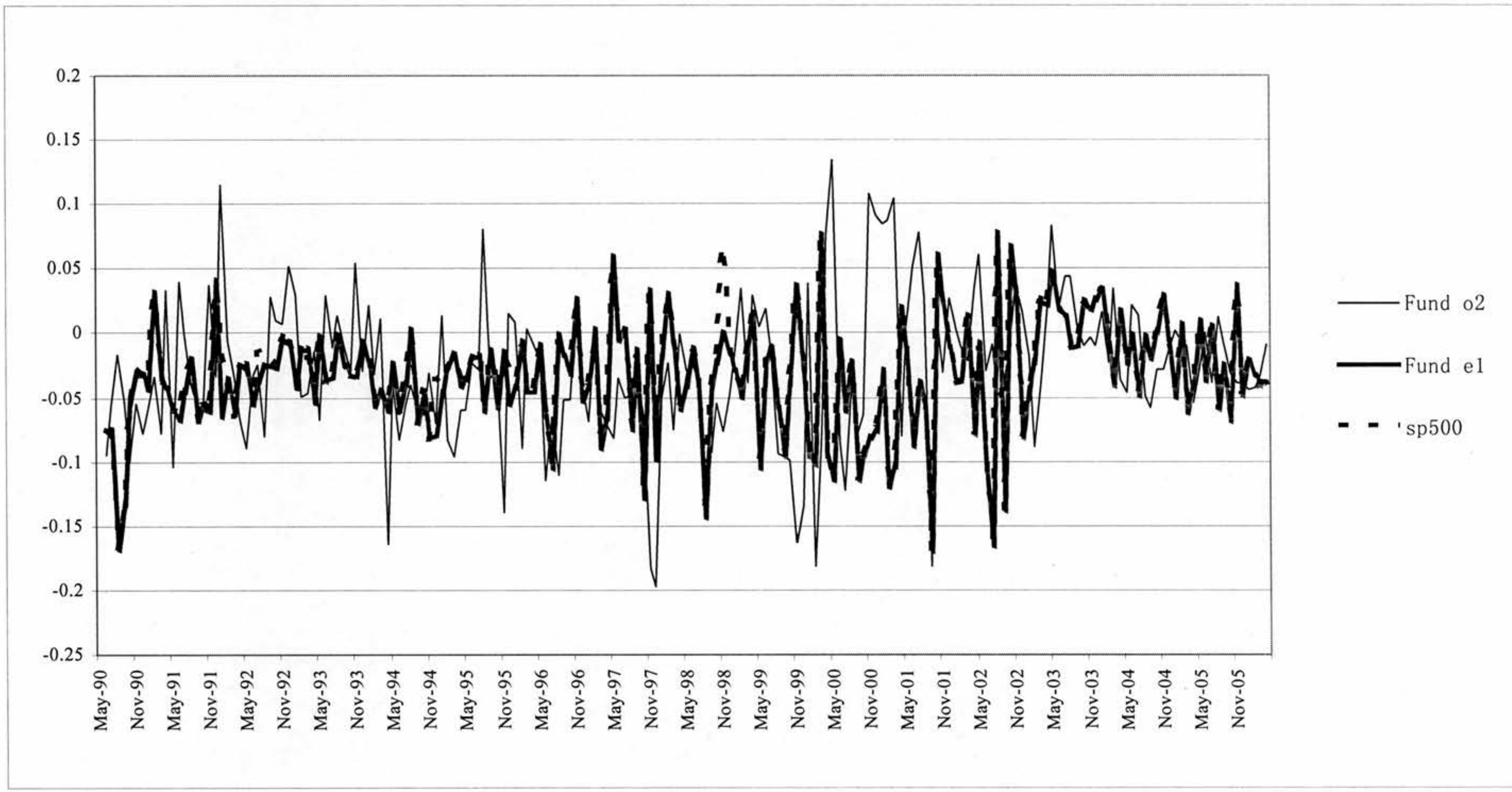
Table 5.4.2: Adjusted R Square of Fund o2 for both sp500 and intermarket five-factor model

	sp500	Intermarket	Difference
o2	0.106	0.083	0.023

Table 5.4.2 shows the adjusted R Square of Fund o2 in both the sp500 and the intermarket five-factor model. Normally, adjusted R squares of funds in both models have been at least more than 45% and some funds have even reached 96%. Nonetheless, Fund o2 is very different. In Table 5.4.2, the adjusted R square of Fund o2 is only 0.106 in the sp500 model and even lower at 0.083 in the intermarket model. This indicates that both models are a poor fit for Fund o2.

In order to find out the reason behind the unusual performance of Fund o2, the historical performance of Fund o2 is shown in Figure 5.4 along with another fund e1, and the benchmark sp500 for comparison.

Figure 5.4: Historical line of Fund o2 and e1 and benchmark sp500



In Figure 5.4 Fund o2 is represented by a solid line; Fund e1 by a thick line and sp500 by a dotted line. Fund e1 has a closer performance to sp500 than Fund o2. Under most circumstances, fund o2 seems to move together with the market portfolio but with a different amplitude. Occasionally it fluctuates in an opposite direction to the sp500. Although conclusions drawn from observation of Figure 5.4 can not be absolute certain that the performance of Fund o2 is totally different from market portfolio, definitely its performance is not as close as fund e1's to sp500.

Table 5.4.3: Correlation between Fund o2 and sp500

	o2	sp500
o2	1	0.011920907
sp500	0.011920907	1

A correlation between Fund o2 and sp500 has been made. Table 5.4.3 shows the result that there is only 0.012 between them. It implies a very weak connection between them which is consistent with the graph illustrated in Figure 5.4.

After an investigation on the overall portfolio composition, it is found that Fund o2 is a leveraged fund rather than an equity fund. Using Standard and Poor's 500 index as a market portfolio may be a proper benchmark rather than on equity fund, but it definitely does not work on a leveraged fund.

5.5 Conclusion

Based on the 26 funds with 16 years of historical market data, along with market portfolio sp500 and twelve macroeconomic factors, an OLS stepwise model has been employed to eliminate insignificant factors. As results, a five-factor model has been selected. It contains sp500, the benchmark, and four macroeconomic factors including f, ft, mb and m1. These factors are basically concerned with interest rate and money supply. The significance of these macroeconomic factors can be easily explained. Price of stocks underlying funds can be regarded as expected discounted dividends which is consistent by the discount factors and expected cash flow. Unanticipated changes in the risk-free interest rate will have an impact on both of them. The discount rate will be influenced through changes of risk premium which is closely connected to basic interest rate. Unexpected changes in the risk-free interest rate will influence the time value of future cash flows and it will reflect on stock return as well. Unexpected changes in money supply will influence inflation level. It will have an influence on pricing and then unanticipated changes in risk premium will show up. Finally it shows up the effects on return.

Based on the five-factor, dependent and independent Bayesian models have been fitted and compared to the OLS model. Evidence shows that besides results of factors f and ft, all the other factors are consistent to those from the OLS model. The distortions of factor f and ft are concluded mainly due to multicolinearity. However, if the purpose of the model is only to predict the dependent variable from a set of predictor variables, multicollinearity does not adversely affect the equation in the aspects of fitness and prediction. The findings from the Bayesian model prove that all 26 funds do not have superior performance over the market portfolio and have a very similar risk preference to the market portfolio.

An investigation of intermarket effect has been carried out in order to find out whether significant interactions among bond, equity and commodity markets exist. All the evidence shows that intermarket effect is likely to be weak among these 26 funds. Although the five-factor intermarket OLS model does not provide a better measurement of funds and shows quite weak intermarket effects, it does confirm the results which were discovered previously by both OLS and Bayesian models that most funds can not beat the market and have a very similar risk level to the market portfolio, sp500. After decomposition of intermarket index, the evidence shows that most of the effect is due to sp500, the equity market benchmark. Hence, the influence of intermarket effect is really only the influence of sp500 itself. Since it is most likely that there are no intermarket effects among those 26 funds, the intermarket model was not be employed in Bayesian method.

As Fund o2 is a leveraged fund rather than an equity fund, using Standard and Poor's 500 index as a market portfolio may not be a appropriate benchmark. This explains why the model fits poorly.

Chapter 6 Bootstrap Re-sampling and Elicited Prior Models

6.1 Introduction

So far in the Bayesian model, priors have been set based on OLS regression estimates. In order to construct more appropriate priors it has been decided that both the Empirical Bayesian approach and the elicited priors approach will be used. Bootstrap re-sampling is used to generate empirical prior distributions for the Bayesian models. Both Bayesian dependent and independent models will be based on the empirical prior.

An alternative approach is to gather information from experts. In this study this was acquired through the use of surveying. A questionnaire on the macroeconomic impact of fund performance has been produced. The questionnaire has been distributed through several channels. The main target group was fund managers. Due to their commitments it is quite difficult to obtain responses from fund managers. The questionnaire was also distributed to both staff, undergraduate and postgraduate students in the Management School of the University of Edinburgh. Since the questionnaire is tailored to fund managers, other people who do not have sufficient finance or an investment background may have found it difficult to complete the questionnaire. Therefore although many responses have been received, some of them were regarded as invalid. In the Chapter the results of the analysis will be discussed and used in Bayesian analysis. Again, both dependent and independent models will be considered.

6.2 Bootstrap Re-sampling

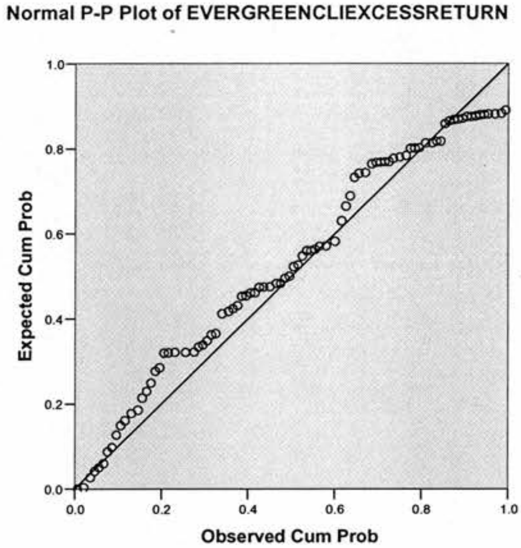
6.2.1 Prior Data Generation

Bootstrap re-sampling has been carried out, in order to obtain empirical prior distributions for the parameters. Based on the original data set which contains monthly data of 26 funds over a 16 year time period, 40 data points have been randomly extracted from the original data set of 192 points. This process has been repeated 100 times in order to construct an empirical data set which has 4000 data points per fund. Also, for each single data point obtained from the funds, 12 macroeconomic factors and Standard and Poor's 500 (sp500) have been re-sampled using bootstrap at the same date. The significant macroeconomic factors are those deduced from previous work reported in Chapter 5, hence there will be a correlation between each of the funds and the macroeconomic factors and benchmark. After 100 draws, empirical distributions have been constructed for the correlation between macroeconomic factors, benchmark, and funds. The constructed distributions will be used as priors for the Bayesian models.

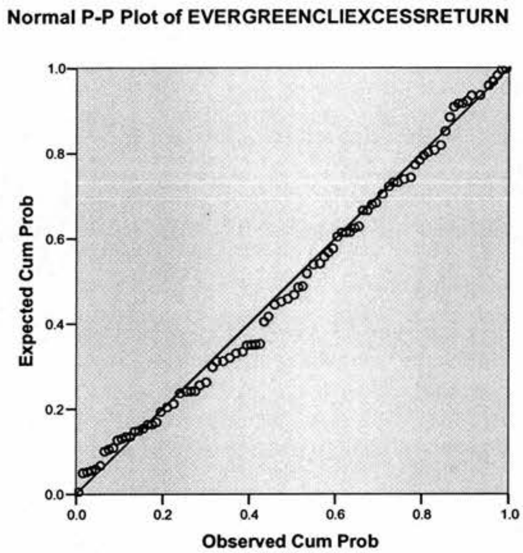
6.2.2 Descriptive Statistics of Bootstrap Re-sampling Data and Results

Most correlation distributions for sp500, f, ft, mb and m1 appear to show a normal distribution. The probability-probability plots (p-p plot) confirm the normality of the distribution. Figure 6.1 presents the p-p plots of sp500, f, ft, mb and m1 for Fund e1. In Appendix E p-p plots of other funds are given.

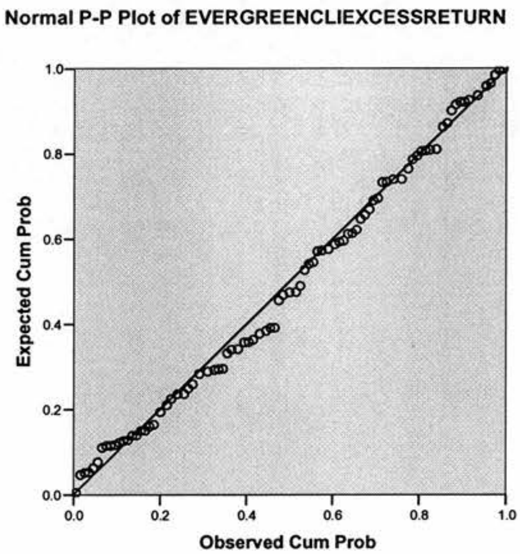
Figure 6.1: P-P Plot of Fund e1 for five independent variables



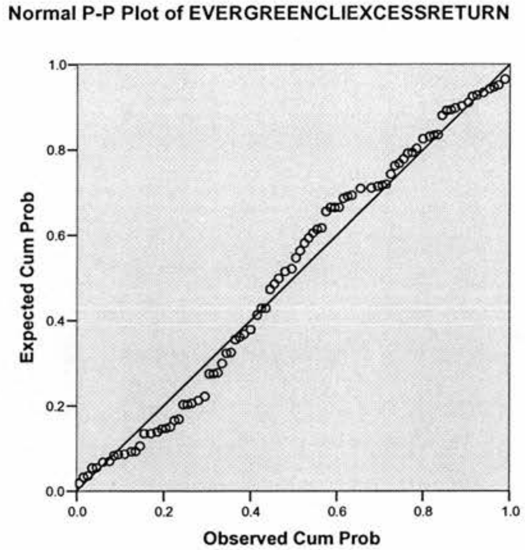
p-p plot of sp500



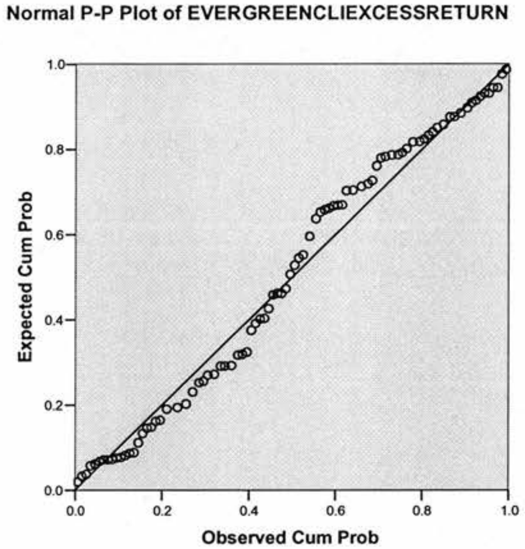
p-p plot of f



p-p plot of ft



p-p plot of mb



p-p plot of m1

Figure 6.1 shows that all plots are very close to the line which implies distribution is very close to the normal. Therefore, correlation distributions for each factor of the 26 funds can be treated as having a normal distribution.

This bootstrap re-sampled data was used for both dependent and independent Bayesian model again as in the previous Chapter. The configurations of both models have not been changed, excepting the priors used. Table 6.2.1 below presents the results of dependent model.

Results in Table 6.2.1 do not show to any surprises. They are consistent with all previous results. Again no funds show any superior performance compared with the market and are in fact they are similar to the market portfolio both in performance and risk preference.

Table 6.2.1: Results of dependent model using Bootstrap Re-sampling data

	α	sp500	f	ft	mb	ml
a1	0.02019	0.635	-0.2885	-0.4373	-1.034	0.5871
a2	0.005382	0.7394	-0.1556	-0.2167	-0.4014	0.2294
c1	0.007035	0.9086	-0.01726	-0.1735	-1.012	0.5288
c2	0.006657	0.9076	0.05365	-0.1923	-1.686	0.7977
e1	6.43E-06	0.9978	0.009318	-0.01349	-0.0653	0.04529
e2	0.002476	1.005	0.0256	-0.07911	-0.5704	0.3686
f	0.004272	0.8026	-0.0826	-0.1771	-0.6071	0.3331
h	0.003454	0.6831	-0.1582	-0.2118	-0.4042	0.1804
i	0.00859	0.8305	-0.1693	-0.2667	-0.6494	0.3546
j1	0.003005	0.9629	0.08191	-0.1519	-1.68	0.6886
j2	5.51E-04	0.7682	-0.1365	-0.1622	-0.1249	0.1141
l1	4.16E-04	0.6186	-0.2275	-0.2042	0.05611	-0.1055
l2	0.007064	0.7912	-0.1588	-0.2429	-0.5767	0.296
m1	0.01153	0.7853	-0.1903	-0.283	-0.6121	0.3527
m2	0.00826	0.6258	-0.2583	-0.3217	-0.4774	0.2516
m3	0.007924	0.6473	-0.2269	-0.2925	-0.4798	0.2557
o1	0.006287	0.6272	-0.1721	-0.2736	-0.8073	0.3225
o2	0.01288	-0.0764	-0.5161	-0.5307	-0.5433	0.01789
p	0.008374	0.8844	-0.03419	-0.2128	-1.208	0.5971
s1	0.003435	0.7252	-0.09164	-0.2202	-0.9917	0.3814
s2	0.001263	0.9878	0.003097	-0.02171	-0.08033	0.05258
t1	0.00493	0.7265	-0.1305	-0.217	-0.6209	0.2895
t2	0.006385	0.8403	-0.1205	-0.19	-0.4697	0.229
u	0.001875	1.008	-0.0625	-0.07346	0.1767	0.1241
w1	0.002552	0.8179	-0.00639	-0.1543	-1.089	0.4304
w2	0.01061	1.042	0.1594	-0.1772	-2.285	1.082
Mean	0.005977067	0.780454	-0.11041	-0.21144	-0.70166	0.338641
Variance	2.04651E-05	0.048384	0.019124	0.012419	0.321079	0.067781

Figure 6.2.1: Results of dependent model using Bootstrap Re-sampling data

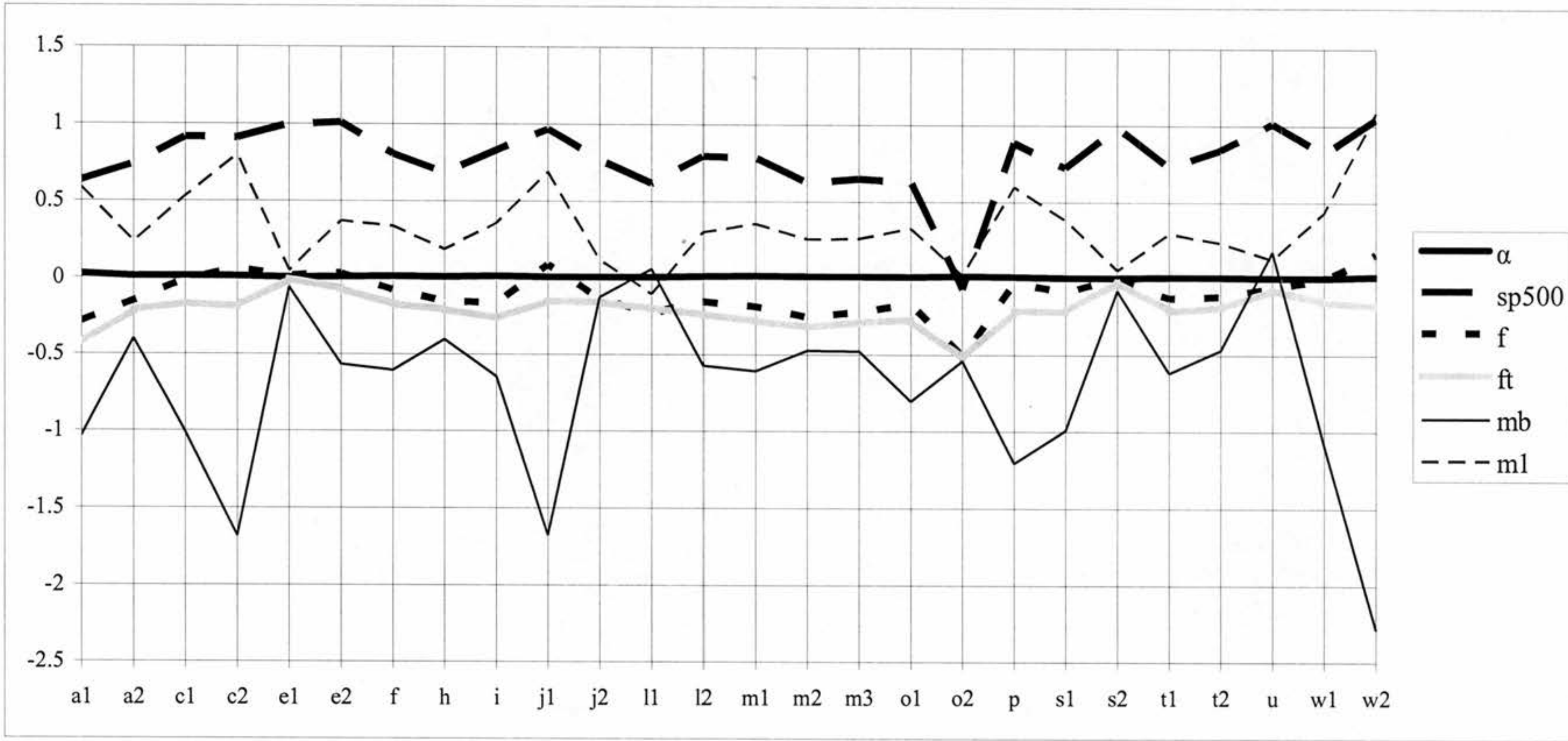
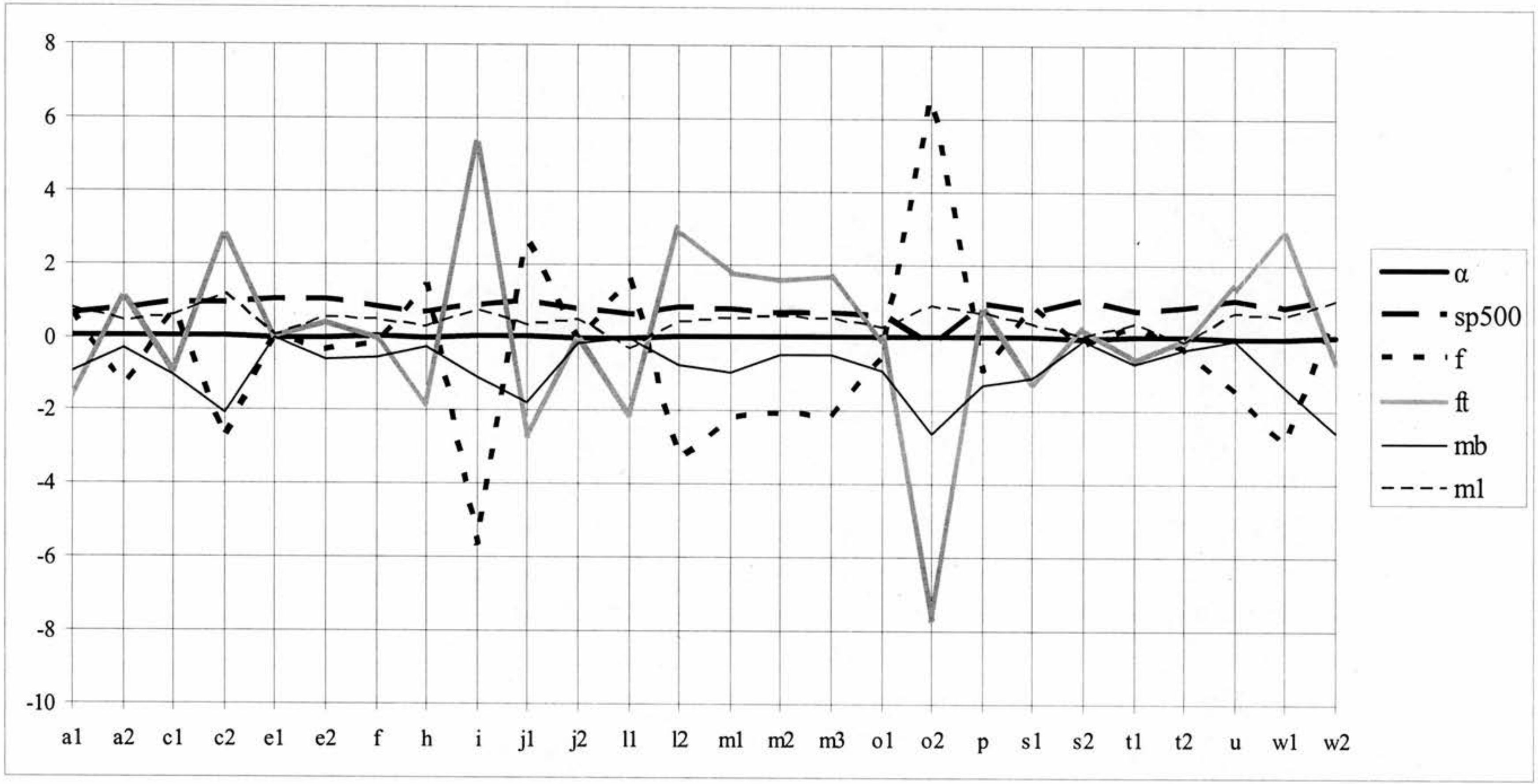


Figure 6.2.1 presents the results graphically. α is the very flat line liying on the x axis. The sp500 line has a intercept of 1 with only one exception, Fund o2. Factors f and ft seem to move together with different interception values. Variable mb and ml always move together in opposite direction which implies the phenomena of multicollinearity. Table 6.2.2 presents the results from the independent model in the same format as Table 6.2.1. Apart from the results of f and ft, all the others remain similar to the results from the previous dependent model. Figure 6.2.2 gives a more visual presentation of the results.

Table 6.2.2: Results of independent model using Bootstrap Re-sampling data

	α	sp500	f	ft	mb	ml
al	0.02784	0.6199	0.6422	-1.564	-0.9551	0.7383
a2	0.003789	0.7532	-1.343	1.006	-0.3332	0.4018
cl	0.006319	0.9145	0.7068	-0.8798	-1.038	0.5865
c2	0.005426	0.9168	-2.796	2.725	-2.071	1.145
el	-5.79E-05	0.9962	0.02009	-0.02392	-0.03351	0.00303
e2	0.001741	1.014	-0.3878	0.3593	-0.6002	0.5199
f	0.003051	0.8187	-0.1557	-0.07205	-0.555	0.443
h	1.23E-04	0.6777	1.442	-1.786	-0.2592	0.2568
i	0.01074	0.8586	-5.676	5.246	-1.118	0.7018
jl	0.002778	0.9666	2.661	-2.64	-1.79	0.3269
j2	-0.004191	0.7694	-0.1115	-0.09767	-0.1692	0.4879
ll	0.001506	0.6274	1.617	-2.058	-0.01231	-0.3172
l2	0.007361	0.8037	-3.355	2.982	-0.7744	0.4146
ml	0.01391	0.7643	-2.193	1.721	-0.9571	0.5122
m2	0.006419	0.64	-2.077	1.563	-0.4617	0.5565
m3	0.00616	0.646	-2.115	1.635	-0.4794	0.5249
ol	0.006995	0.6219	-0.4585	-0.00188	-0.9124	0.2925
o2	0.02028	-0.1539	6.592	-7.646	-2.611	0.8473
p	0.008293	0.8871	-0.9589	0.7258	-1.282	0.6705
sl	0.003222	0.7192	0.9008	-1.201	-1.093	0.346
s2	0.001194	0.9913	-0.2381	0.2241	-0.06918	0.01831
tl	0.005001	0.7258	0.3209	-0.6633	-0.7194	0.3582
t2	0.01004	0.8334	-0.3382	-0.07681	-0.3266	-0.1367
u	-0.002184	1.014	-1.445	1.402	-0.0615	0.6781
wl	0.001391	0.8239	-2.899	2.813	-1.349	0.5583
w2	0.01369	1.056	0.6581	-0.6796	-2.566	1.025
Mean	0.006185997	0.780988	-0.42257	0.115853	-0.86913	0.459978
Variance	4.82665E-05	0.054999	5.260696	5.664236	0.538105	0.107708

Figure 6.2.2: Results of independent model using Bootstrap Re-sampling data



α is almost a flat line fully lying on the x axis. The sp500 line has a near 1 intercept, and as usual drops for Fund o2. Factors f and ft are almost perfectly matched against each other due to multicollinearity.

6.2.3 Bootstrap Bayesian Models Results Comparison

Table 6.2.3: Bayesian results of the five factor model based on bootstrap data

	beta[n,1] α	beta[n,2] sp500	beta[n,3] f	beta[n,4] ft	beta[n,5] mb	beta[n,6] ml
Mean (Dependent)	0.005977067	0.780454	-0.11041	-0.21144	-0.70166	0.338641
Variance (Dependent)	2.04651E-05	0.048384	0.019124	0.012419	0.321079	0.067781
Mean (Independent)	0.006185997	0.780988	-0.42257	0.115853	-0.86913	0.459978
Variance (Independent)	4.82665E-05	0.054999	5.260696	5.664236	0.538105	0.107708

Results are consistent to those found in previous models. Both independent and dependent models have a near zero α and a coefficient close to 1 for the market portfolio sp500, which proves that the 26 funds cannot beat the market portfolio. The coefficients of the remaining factors are similar to the previous models based on the original data. Means of f and ft show the same pattern to previous models. While considering variances of those factors from both models, a considerable difference can be found in the variances for f and ft from the independent model. These are 5.27 and 5.7 for variance of f and ft respectively and those figures are significant compared to their means of the same model. A similar effect is seen in the dependent Bayesian model based on original data. A further investigation will be carried out in the next section. Results of fund o2 are consistent to previous findings which further confirm the explanation in Chapter 5.

6.2.4 Comparison of Bootstrap and Non-bootstrap Re-sampling Results

Table 6.2.4 compares results from all models. In the table, original stands for that original data used in the models and bootstrap stands for the bootstrap re-sampled data used. The independent Bayesian model assumes that all the coefficients of the variables are independent. They are all considered as having their own distributions.

In other words, α, β and the other four variables have an independent distribution which only belongs to them. The dependent model, however, considers α of the funds and the five factors will influence each other. Changes of any single factor will lead a chain reaction between them and can even feedback towards itself. Basically, they share a common distribution together.

Table 6.2.4: Comparison of results of the five-factor model based on different methods and data sets

		α	sp500	f	ft	mb	ml
OLS	Mean	0.006269231	0.775923	-0.44762	0.128231	-0.92954	0.476231
	Variance	5.67E-05	0.05278	5.669191	5.939506	0.495567	0.107924
Original	Mean (Dependent)	0.0056045	0.783775	-0.3832235	0.0854312	-0.8075796	0.4430608
	Variance (Dependent)	0.000024	0.048586	3.222401	3.52605	0.333402	0.055163
	Mean (Independent)	0.006238	0.7813192	-0.4134431	0.1009192	-0.8303142	0.4326627
	Variance (Independent)	0.0000428	0.052006	0.066538	0.058027	0.486756	0.089315
Bootstrap	Mean (Dependent)	0.005977067	0.780454	-0.11041	-0.21144	-0.70166	0.338641
	Variance (Dependent)	2.04651E-05	0.048384	0.019124	0.012419	0.321079	0.067781
	Mean (Independent)	0.006185997	0.780988	-0.42257	0.115853	-0.86913	0.459978
	Variance (Independent)	4.82665E-05	0.054999	5.260696	5.664236	0.538105	0.107708

In Table 6.2.4, αs for all models have almost identical results. Variances of αs are different from model to model, but the difference between them are small. Apart from factors f and ft, the rest of them have similar means and variances.

Factors f and ft have a very high correlation. The means of f and ft are not the same, but they have a similar pattern from other models. The variances of f and ft from the original independent model and the bootstrap dependent model are similar and both of them are insignificant when compared to their means. Variances of f and ft in the rest of the models are considerably large compared with their means. As the descriptive statistics show such features, a further investigation on the data of all factors and funds becomes necessary. The difference between dependent and independent models based on the original and the bootstrap data sets have been calculated in order to explore the pattern. Please refer to Appendix G for details. The values of factors f or ft in certain models are quite different from their value in other models. Table 6.2.5 extracts factors f and ft from Appendix G. Table 6.2.5 illustrates results of f and ft from four models and differences among those models. In the table, the first column is the funds' abbreviated name and the first row tells the type of the data. 'Var' in the table stands for variance; 'original' and 'bootstrap' stand for original and bootstrap data; 'de' and 'inde' stand for dependent and independent models, respectively; 'de-inde' stands for the difference between dependent and independent models; 'original-bootstrap' stands for the difference between models using the original data and the bootstrap data.

Not all the coefficients of f and ft from various models are noticeably large, but it appears that some large figures come from both the original dependent and bootstrap independent models. That is consistent with the results from Table 6.2.4 which shows significant variance happens in the original dependent and bootstrap independent models. Funds i and o2 seem to have particularly big coefficients for factors f and ft. Overall, the phenomenon of extremely large means appearing in the original dependent and bootstrap independent models are confirmed. Such phenomenon also seem to be exaggerated in funds i and o2.

f and ft seems to radically fluctuate across the different models due to their values being unstable. The explanation is obvious because f and ft have a very high correlation. Both the parameters' factors suffer from multicollinearity, which occurs when predictor variables of the model have a higher correlation with other predictor variables than with the dependent variable. Multicollinearity does not affect the creditability of the model particularly if it is used for prediction. The overall R square will not be reduced by multicollinearity either, hence, both f and ft are included in the model.

Table 6.2.5: Comparison table of factor f and ft among all models

	original de		bootstrap de		original inde		bootstrap inde		original de-inde		bootstrap de-inde		original-bootstrap de		original-bootstrap inde	
	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]	beta[n,3]	beta[n,4]
a1	-1.353	0.718	-0.289	-0.437	-0.649	-0.224	0.642	-1.564	-0.704	0.942	-0.931	1.127	-1.065	1.155	-1.291	1.340
a2	-1.172	0.827	-0.156	-0.217	-0.589	0.253	-1.343	1.006	-0.584	0.575	1.187	-1.223	-1.016	1.044	0.755	-0.753
c1	0.287	-0.450	-0.017	-0.174	-0.185	0.012	0.707	-0.880	0.472	-0.462	-0.724	0.706	0.305	-0.276	-0.892	0.892
c2	-1.843	1.667	0.054	-0.192	-0.514	0.416	-2.796	2.725	-1.329	1.251	2.850	-2.917	-1.897	1.859	2.282	-2.309
e1	0.027	-0.039	0.009	-0.013	-0.109	0.105	0.020	-0.024	0.136	-0.144	-0.011	0.010	0.018	-0.025	-0.129	0.129
e2	-0.648	0.610	0.026	-0.079	-0.318	0.286	-0.388	0.359	-0.331	0.324	0.413	-0.438	-0.674	0.689	0.070	-0.074
f	-0.278	0.032	-0.083	-0.177	-0.379	0.138	-0.156	-0.072	0.101	-0.106	0.073	-0.105	-0.195	0.209	-0.223	0.210
h	1.123	-1.468	-0.158	-0.212	-0.100	-0.207	1.442	-1.786	1.223	-1.261	-1.600	1.574	1.281	-1.256	-1.542	1.579
i	-3.665	3.306	-0.169	-0.267	-0.711	0.182	-5.676	5.246	-2.954	3.124	5.507	-5.513	-3.496	3.573	4.965	-5.064
j1	2.454	-2.445	0.082	-0.152	0.287	-0.317	2.661	-2.640	2.167	-2.128	-2.579	2.488	2.372	-2.293	-2.374	2.323
j2	-0.129	-0.138	-0.137	-0.162	-0.355	0.133	-0.112	-0.098	0.226	-0.271	-0.025	-0.065	0.007	0.024	-0.243	0.230
l1	0.956	-1.371	-0.228	-0.204	-0.158	-0.278	1.617	-2.058	1.114	-1.093	-1.845	1.854	1.184	-1.167	-1.775	1.780
l2	-2.762	2.414	-0.159	-0.243	-0.779	0.362	-3.355	2.982	-1.983	2.052	3.196	-3.225	-2.603	2.657	2.576	-2.620
m1	-1.943	1.536	-0.190	-0.283	-0.786	0.290	-2.193	1.721	-1.157	1.246	2.003	-2.004	-1.753	1.819	1.407	-1.431
m2	-1.870	1.350	-0.258	-0.322	-0.783	0.237	-2.077	1.563	-1.087	1.113	1.819	-1.885	-1.612	1.672	1.294	-1.326
m3	-1.597	1.104	-0.227	-0.293	-0.664	0.164	-2.115	1.635	-0.933	0.940	1.888	-1.928	-1.370	1.397	1.451	-1.471
o1	-0.054	-0.391	-0.172	-0.274	-0.527	0.097	-0.459	-0.002	0.473	-0.488	0.286	-0.272	0.118	-0.118	-0.068	0.098
o2	5.735	-6.829	-0.516	-0.531	-0.517	-0.426	6.592	-7.646	6.252	-6.403	-7.108	7.115	6.251	-6.298	-7.109	7.220
p	-1.106	0.879	-0.034	-0.213	-0.446	0.186	-0.959	0.726	-0.660	0.694	0.925	-0.939	-1.072	1.092	0.513	-0.540
s1	0.848	-1.143	-0.092	-0.220	-0.099	-0.207	0.901	-1.201	0.947	-0.937	-0.992	0.981	0.939	-0.923	-1.000	0.995
s2	-0.144	0.122	0.003	-0.022	-0.252	0.238	-0.238	0.224	0.108	-0.116	0.241	-0.246	-0.147	0.144	-0.014	0.014
t1	0.157	-0.499	-0.131	-0.217	-0.349	0.013	0.321	-0.663	0.506	-0.512	-0.451	0.446	0.288	-0.282	-0.670	0.677
t2	-0.802	0.542	-0.121	-0.190	-0.487	0.079	-0.338	-0.077	-0.316	0.463	0.218	-0.113	-0.682	0.732	-0.148	0.156
u	-1.476	1.407	-0.063	-0.073	-0.481	0.429	-1.445	1.402	-0.995	0.978	1.383	-1.475	-1.414	1.480	0.964	-0.973
w1	-0.624	0.436	-0.006	-0.154	-0.525	0.406	-2.899	2.813	-0.099	0.030	2.893	-2.967	-0.618	0.590	2.374	-2.407
w2	-0.085	0.043	0.159	-0.177	-0.278	0.259	0.658	-0.680	0.193	-0.215	-0.499	0.502	-0.244	0.221	-0.936	0.938
mean	-0.383	0.085	-0.110	-0.211	-0.413	0.101	-0.423	0.116	0.030	-0.015	0.312	-0.327	-0.273	0.297	0.009	-0.015
var	3.222	3.526	0.019	0.012	0.067	0.058	5.261	5.664	2.741	2.890	5.435	5.497	3.350	3.408	4.652	4.786

6.3 Macroeconomic Impact on Fund Performance Survey

6.3.1 The Structure of Questionnaire

Based on Figure 1.2 in Chapter 1, a questionnaire has been designed to collect experts' view about impacts of macroeconomic factors and capital market on fund performance. The questionnaire has been designed in three sections. The first section is an introduction explaining the nature of the questionnaire. It provides interviewees with the concepts of the questionnaire, followed by a brief explanation of the questions and their length.

The second section of the questionnaire is the main body. It consists of three parts: the first part includes questions which give interviewees a list of eight leading indicators and then asks them to rank the indicators in importance from the highest to the lowest. Respondents are also asked to provide their own opinion about other leading indicators they think will have an impact on fund performance. At the beginning of the second part, an example is given to the interviewee. It provides the interviewee with a guide as how to complete the questionnaire. Then a list of questions are presented to respondents in order to collect their opinion about how much the impact those eight leading indicators will have on a fund's performance by using the FTSE 100 as a proxy. Respondents are given a scenario which includes either increase or decrease of the indicators and then are asked to provide their view about what is the minimum, likely and maximum impacts of those leading indicators on fund performance. The last part of the main body of the questionnaire asks interviewees the same questions about their own leading indicators.

The final section asks respondents to fill in their personal information and it is optional. The aim of this part is to gain demographic background information from the interviewee. It may provide further understanding to the responses of the questionnaire. The questionnaire ends with comments and suggestions which are also an essential part of the whole questionnaire. It should improve the response to the questionnaire. A full version of the questionnaire can be found in the Appendix H

6.3.2 Results of Questionnaire

Although questionnaires were distributed to a large number of individuals, the rate of valid responses was very low. Seven acceptable responses are included. Three out of seven finished the questionnaire completely. Only three people answered Question 1.0. Only one person answered Questions 1.0, 2.1, 2.2, 2.7 and 2.8. Therefore, four respondents only answered part of the questionnaire. Although their answers are not complete, the information will still be concluded in the analysis. One of the three completed questionnaires is defined as incoherent during the analysis, but the response is retained in the analysis since parts of answers are still within levels of acceptability. Another respondent had an incoherent answer. The original answer seems more reasonable but has been scribbled out and replaced by an erroneous one. A writing error has been assumed in this case. The original scribbled out answer will be used only as the Bayesian prior. In other situations, the erroneous answer has been used.

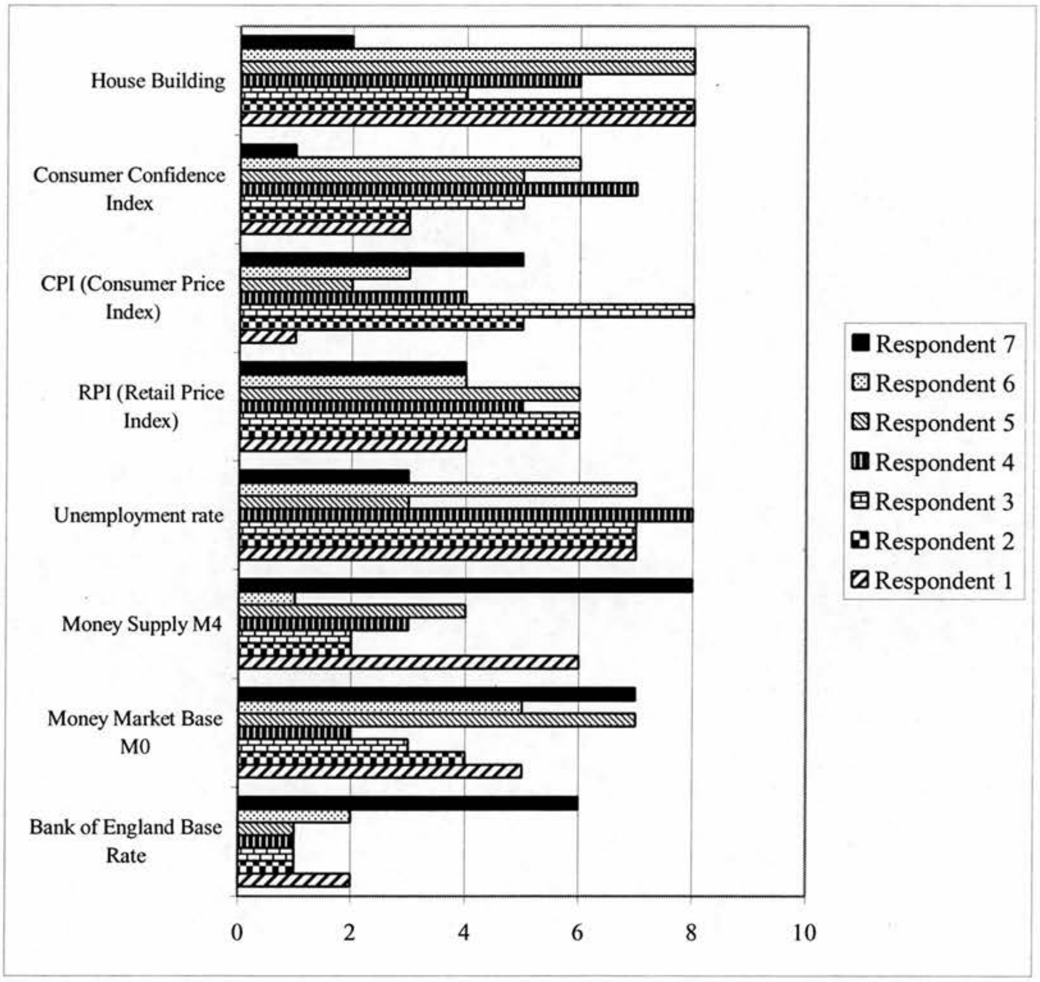
Question 1.0 asks the interviewee to rank 8 leading indicators in order of the most to the least important on the performance of the fund (1 means the most and 8 means the least important) from their perspective. These leading indicators are: Bank of England Base Rate, Money Market Base M0, Money Supply M4, Unemployment Rate, Retail Price Index (RPI), Consumer Price Index (CPI), Consumer Confidence Index and House Building. Table 6.3.1 shows all seven valid responses to this question.

Table 6.3.1: Responses of Q1.0

Respondent	1	2	3	4	5	6	7	Mean	Median
Bank of England Base Rate	2	1	1	1	1	2	6	2	1
Money Market Base M0	5	4	3	2	7	5	7	4.714286	5
Money Supply M4	6	2	2	3	4	1	8	3.714286	3
Unemployment rate	7	7	7	8	3	7	3	6	7
Retail Price Index (RPI)	4	6	6	5	6	4	4	5	5
Consumer Price Index (CPI)	1	5	8	4	2	3	5	4	4
Consumer Confidence Index	3	3	5	7	5	6	1	4.285714	5
House Building	8	8	4	6	8	8	2	6.285714	8

Since it is a ranked question mean and median can not be the absolute measure, but they can provide at the very least a guide. Figure 6.3.1 presents the results visually from Table 6.3.1. In Figure 6.3.1, the y axis lists all 8 indicators with all 7 respondents' ranking on each indicator. The x axis represents the ranking of which, for example, 1 represents the factor with the heaviest influence on funds' performance. An indicator, therefore, with a shorter bar has a larger impact on funds' performance. In the Figure, interviewees are represented by bars with different pattern.

Figure 6.3.1: Responses of Q1.0



Based on both the table and the figure, it is quite obvious that the Bank of England Base Rate is recognised as one of the most influence indicators. House building and Unemployment Rate are definitely the two with the least effect. Among the rest of the indicators, M4 and Consumer Price Index have high priority. Respondents have very differing opinions of the last three factors. For example, Respondent 4 think M0 should be put in second place, but this is strongly opposed by Respondents 5 and 7. Respondent 7 regarded Consumer Confidence Index as the most important factor on fund performance. The other respondent, however, disagreed with this. The average rank of M0, Retail Price Index and Consumer Confidence Index are very close. So from the most to the least impact, according to the 7 respondents, the order is at follow: Bank of England Base Rate, M4, CPI, Consumer Confidence Index, M0, RPI, Unemployment Rate and House Building.

Basically, it matches factors used in the previous Chapter. The Bank of England Base rate matches factors f and ft which represent interest rates in the States. M0 and M4 in the UK are the counterpart of mb and m1 factors in the States. CPI and Consumer Confidence Index are not included.

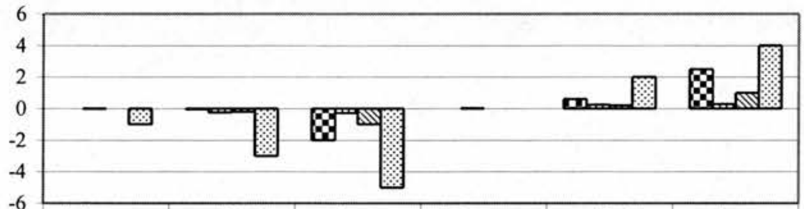
After ranking, respondents have also been asked if there are any other factors they think will have an impact on fund performance. Three people gave a response. Respondent 2 though good news in the media and good weather such as sun and warm temperatures are other factors which may have influence on fund performance. Respondent 5 regards Trade Deficit as an additional factor. Respondent 6 points out Exchange Rate needs to be considered.

People were asked about the impact of an increase or decrease of 0.25 percent of one of the leading indicators on fund performance. Questions about the Bank of England Base Rate (BoE) and Unemployment Rate (UE) have been answered by four respondents. The other questions were only responded by three people. Results of the Bank of England Base Rate and Unemployment Rate are illustrated in Figure 6.3.2 and 6.3.3, respectively. In the figure, minimum, most likely and maximum stands for the minimum, most likely and maximum impacts of indicators on FTSE 100.

Figure 6.3.2 provides the results for the BoE base rate of 0.25% change. In Figure 6.3.2, respondents give a negative correlation between the BoE and the FTSE 100.

When the Base Rate increases, the FTSE 100 goes down and visa versa. The impacts from the Bank of England Base Rate are quite significant. According to the questionnaire, when the rate is up, there will be a 2.07% average maximum decrease in the FTSE 100, and when the rate decreases, the FTSE 100 will have a 1.945% average maximum increase. The minimum impacts are smaller at 0.255% down with a rising Base Rate and 0.005% up with a falling Base Rate.

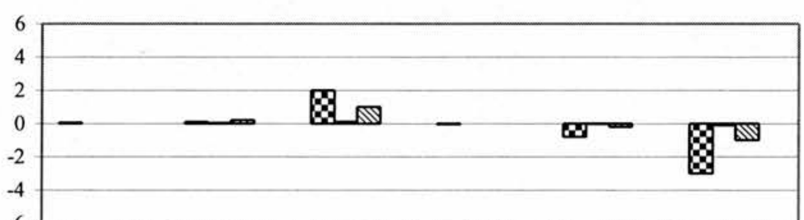
Figure 6.3.2: Results of the Bank of England Base Rate



	BoE up			BoE down		
	minimum	most likely	maximum	minimum	most likely	maximum
Respondent 2	0	-0.04	-2	0	0.6	2.5
Respondent 4	-0.02	-0.25	-0.28	0.02	0.25	0.28
Respondent 5	0	-0.2	-1	0	0.2	1
Respondent 6	-1	-3	-5	0	2	4

Figure 6.3.3 provides views of four respondents on the Unemployment Rate (UE). UE rise and fall in the figure indicates a 0.25% increase or decrease of Unemployment Rate.

Figure 6.3.3: Results of Unemployment Rate



	UE up			UE down		
	minimum	most likely	maximum	minimum	most likely	maximum
Respondent 2	0.05	0.08	2	-0.05	-0.8	-3
Respondent 4	0	0.02	0.1	0	-0.02	-0.1
Respondent 5	0	0.2	1	0	-0.2	-1
Respondent 6	0	0	0	0	0	0

Since Unemployment Rate is regarded as one of the two insignificant leading indictors to influence the FTSE 100, values given by respondents are small. In Figure 6.3.3, it is obvious that all the UE bars are shorter than those for Bank of England Base Rate. The Unemployment Rate, however, has a positive relation with the FTSE 100 giving a 0.775% average maximum impact with UE up and -1.025% average maximum with UE decreasing.

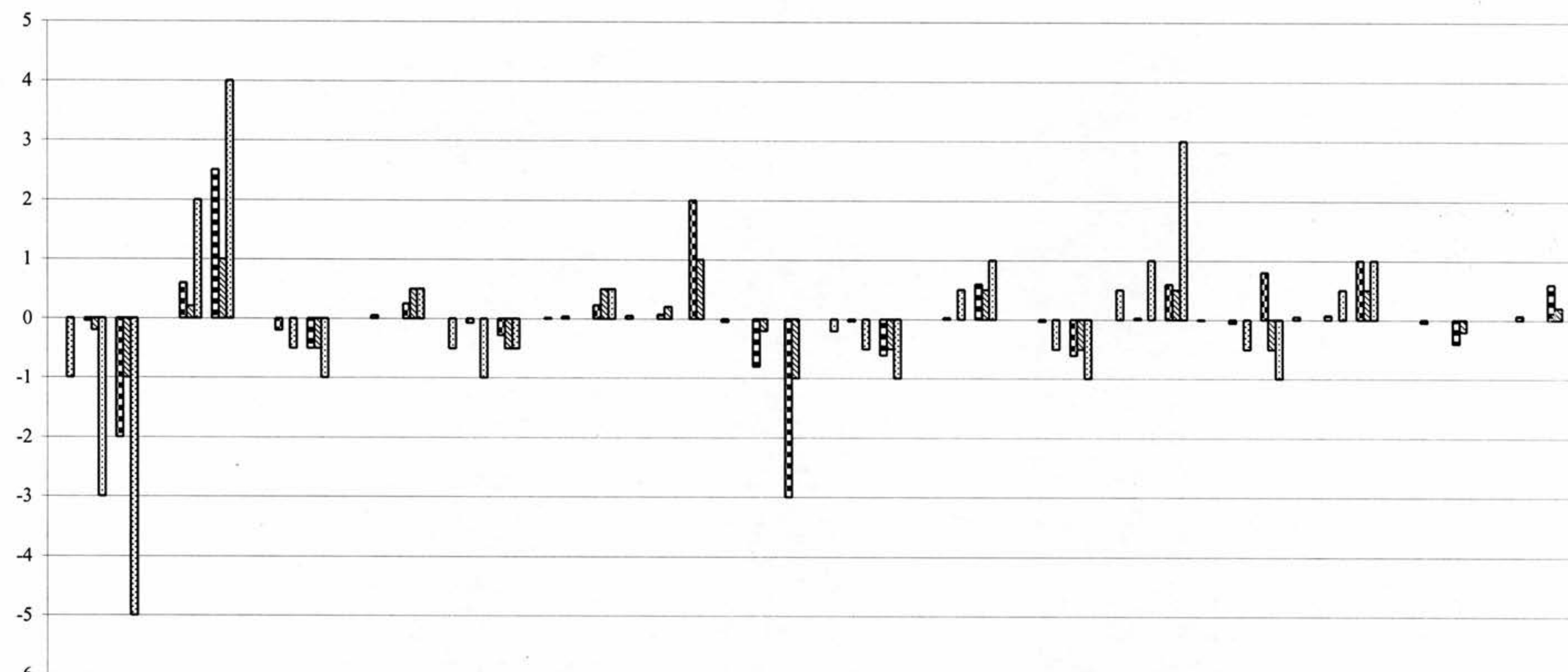
In the following part full results of experts' beliefs on leading indicators will be analysed. Three experts' responses will be discussed, since only three completed the relevant questions. Firstly, Table 6.3.2 explains abbreviations in Figure 6.3.2. Figure 6.3.2 presents answers of all questions in section 2 of the questionnaire from the three respondents.

Table 6.3.2: Notes for Figure 6.3.4

Abbreviation	Note
min	minimum (in percentage)
mos	most likely (in percentage)
max	maximum (in percentage)
up	the scenario a unexpected increase of a quarter percentage point in the leading indicator
down	the scenario a unexpected decrease of a quarter percentage point in the leading indicator
BoE	Bank of England Base Rate
M0	Money Market Base M0
M4	Money Supply M4
UE	Unemployment rate
RPI	RPI (Retail Price Index)
CPI	CPI (Consumer Price Index)
CCI	Consumer Confidence Index
HB	House Building

Following Figure 6.3.2 and 6.3.3, a similar diagram of the interviewee results on all leading indicators will be presented in Figure 6.3.4. Figures of minimum, most likely and maximum impact from them on the FTSE 100 will be displayed in Figure 6.3.4 as well

Figure 6.3.4: Results for second section of questionnaire



	BoE up			BoE down			M0 up			M0 down		
	min	most	max	min	most	max	min	most	max	min	most	max
Respondent 2	0	-0	-2	0	0.6	2.5	0	-0.2	-0.5	0	0.05	0.25
Respondent 5	0	-0.2	-1	0	0.2	1	0	0	-0.5	0	0	0.5
Respondent 6	-1	-3	-5	0	2	4	0	-0.5	-1	0	0	0.5

	M4 up			M4 down			UE up			UE down		
	min	most	max	min	most	max	min	most	max	min	most	max
Respondent 2	0	-0.1	-0.3	0	0.04	0.23	0.05	0.08	2	-0.1	-0.8	-3
Respondent 5	0	0	-0.5	0	0	0.5	0	0.2	1	0	-0.2	-1
Respondent 6	-0.5	-1	-0.5	0.01	0	0.5	0	0	0	0	0	0

	RPI up			RPI down			CPI up			CPI down		
	min	most	max	min	most	max	min	most	max	min	most	max
Respondent 2	0	-0	-0.6	0	0.03	0.6	0	-0	-0.6	0	0.03	0.6
Respondent 5	0	0	-0.5	0	0	0.5	0	0	-0.5	0	0	0.5
Respondent 6	-0.2	-0.5	-1	0	0.5	1	0	-0.5	-1	0.5	1	3

	CCI up			CCI down			HB up			HB down		
	min	most	max	min	most	max	min	most	max	min	most	max
Respondent 2	-0	-0.1	0.8	0.05	0.08	1	0	-0.1	-0.4	0	0.07	0.6
Respondent 5	0	0	-0.5	0	0	0.5	0	0	-0.2	0	0	0.2
Respondent 6	0	-0.5	-1	0	0.5	1	0	0	0	0	0	0

Figure 6.3.4 provides a straightforward view of all those who answered the questions in section 2. It is quite obvious that BoE is the most significant factor among others. Unemployment Rate is another noticeable indicator. When it goes down, a 3% change will occur to the FTSE 100. This is not consistent to the rankings from the beginning of the questionnaire. CPI also gets a high score and it fills the third place in the overall ranking. Table 6.3.3 presents the breakdown.

Table 6.3.3: Breakdown of Figure 6.3.4

		Respondent 2		Respondent 5		Respondent 6		Mean
		Rank	Change	Rank	Change	Rank	Change	
BoE up	min		0		0		-1	-0.33333
	most		-0.04		-0.2		-3	-0.94667
	max	1	-2	1	-1	2	-5	-2
BoE down	min		0		0		0	0
	most		0.6		0.2		2	0.933333
	max		2.5		1		4	2.5
M0 up	min		0		0		0	0
	most		-0.2		0		-0.5	-0.23333
	max	4	-0.5	7	-0.5	5	-1	-0.66667
M0 down	min		0		0		0	0
	most		0.05		0		0	0.016667
	max		0.25		0.5		0.5	0.416667
M4 up	min		0		0		-0.5	-0.16667
	most		-0.07		0		-1	-0.35667
	max	2	-0.28	4	-0.5	1	-0.5	-0.42667
M4 down	min		0		0		0.01	0.003333
	most		0.04		0		0	0.013333
	max		0.23		0.5		0.5	0.41
UE up	min		0.05		0		0	0.016667
	most		0.08		0.2		0	0.093333
	max	7	2	3	1	7	0	1
UE down	min		-0.05		0		0	-0.01667
	most		-0.8		-0.2		0	-0.33333
	max		-3		-1		0	-1.33333
RPI up	min		0		0		-0.2	-0.06667
	most		-0.03		0		-0.5	-0.17667
	max	6	-0.6	6	-0.5	4	-1	-0.7
RPI down	min		0		0		0	0
	most		0.03		0		0.5	0.176667
	max		0.6		0.5		1	0.7
CPI up	min		0		0		0	0
	most		-0.03		0		-0.5	-0.17667
	max	5	-0.6	2	-0.5	3	-1	-0.7
CPI down	min		0		0		0.5	0.166667
	most		0.03		0		1	0.343333
	max		0.6		0.5		3	1.366667
CCI up	min		-0.01		0		0	-0.00333
	most		-0.06		0		-0.5	-0.18667
	max	3	0.8	5	-0.5	6	-1	-0.23333
CCI down	min		0.05		0		0	0.016667
	most		0.08		0		0.5	0.193333
	max		1		0.5		1	0.833333
HB up	min		0		0		0	0
	most		-0.05		0		0	-0.01667
	max	8	-0.4	8	-0.2	8	0	-0.2
HB down	min		0		0		0	0
	most		0.07		0		0	0.023333
	max		0.6		0.2		0	0.266667

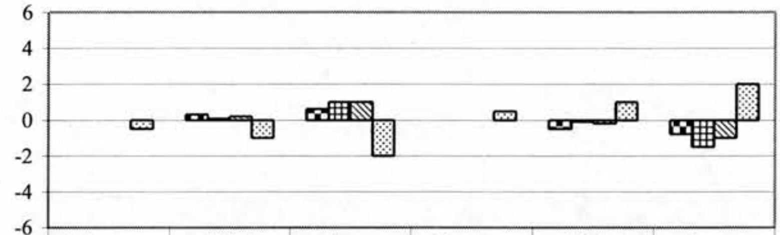
In Table 6.3.3, answers from responses on each leading indicators are given associated with their rank from Q1.0. The purpose of doing so is to check the consistence of the respondents' answers.

As noted before, Unemployment Rate has been considered as a far less significant factor, but has a significant impact on fund performance in Figure 6.3.4 when respondents were asked about impacts on the FTSE 100. This is inconsistent and may be caused by the relatively large value mentioned mainly by Respondents 2 and 5. It is understandable that Respondent 5 has indicated a 1% change of the FTSE can be caused by a 0.25% change in the Unemployment Rate, as Respondent 5 regarded it as the third most important indicator with respect to the FTSE 100. This, however, is inconsistent with Respondent 2s'answers, since Respondent 2 put Unemployment Rate second from the bottom. Respondent 2 also placed M4 into the third place; nevertheless Respondent 2 only gave -0.28% and 0.23% as a maximum impact of FTSE 100 from M4's change. These figures are smaller than those of other indicators which have a lower rank than M4. further still, although Respondent 2 gave an eighth rank to the House Building indicator, Respondent 2 estimates it will produce a larger impact on the FTSE 100 than any other factor except the Bank of England Base Rate.

The inconsistency of Respondent 2 caused some confusion with the initial analysis of the questionnaire results. Nonetheless, after discounting part of the feedback from Respondent 2, the rest results seem to correlate with Question 1.0 and results from previous models.

Figure 6.3.5 presents additional indicators provided by respondents. Respondent 2 suggests that good news and weather may lead to a rise in the market. Respondent 5 thinks Trade Deficit could be another indicator to the stock market. Moreover, Respondent 6 proposes Exchange Rate as an additional factor.

Figure 6.3.5: Results for additional indicators suggested by respondents



	minimum	most likely	maximum	minimum	most likely	maximum
		up			down	
Respondent 2 good news in media	0	0.3	0.6	0	-0.5	-0.8
Respondent 2 good weather (sun, warm temperatures)	0	0.08	1	0	-0.1	-1.5
Respondent 5 Trade Deficit	0	0.2	1	0	-0.2	-1
Respondent 6 exchange rate	-0.5	-1	-2	0.5	1	2

Respondent 2 suggest that good new in media and weather may benefit the stock market. This is acceptable reasoning, but to measure the impact of such factors will be near impossible due to their complicated and qualitative nature. Furthermore, it is outside the scope of this study.

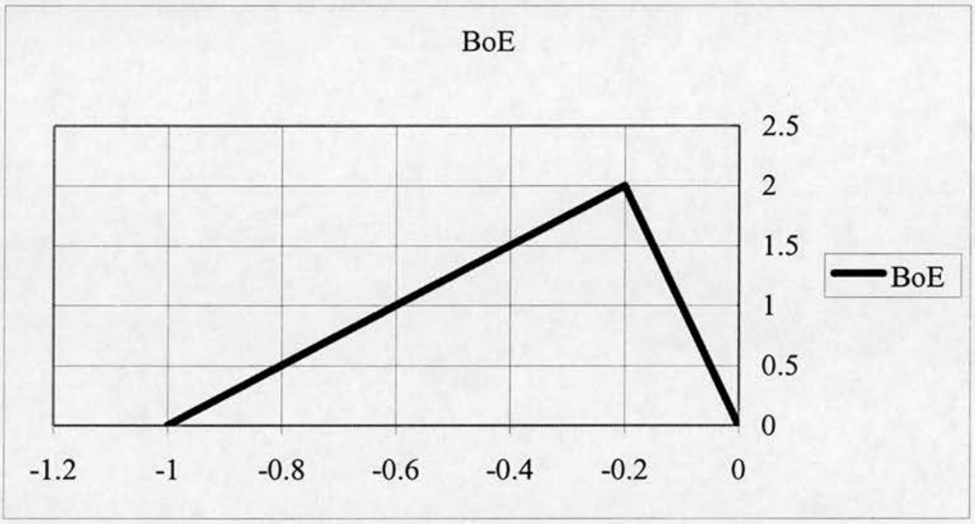
Respondents 5 and 6 provide more practical indicators which could be used in the study. Respondent 5 suggests that Trade Deficit may have a positive relationship with the FTSE 100, while Respondent 6 suggests Exchange Rate will have a rather negative relationship with the market index. According to those two respondents' estimate, both Trade Deficit and Exchange Rate could have a fairly significant influence on the FTSE 100.

6.3.3 Bayesian Models on Elicited Prior

The task now is to convert these results from a questionnaire format into prior distribution which can be used by the Bayesian model created in a previous part of the study. Since only two respondents have acceptable consistency of response, their answers will be used to create the empirical prior.

A means of direct transformation is to create a Triangular distribution based on all of the answers provided by Respondent 5 and 6. In the second section of the questionnaire, people are asked to provide their beliefs in impacts of certain changes of particular leading indicators such as the Bank of England Base Rate on FTSE100 stock index. They are asked to provide a figure of the minimum, most likely and maximum impact while up and down of the leading indicators. Parameters of Triangular distributions are established based on these experts' beliefs. Figure 6.4.1 shows an example of established Triangular distribution based on the belief of Respondent 5 on the impact of Bank of England Base Rate changes to the FTSE100.

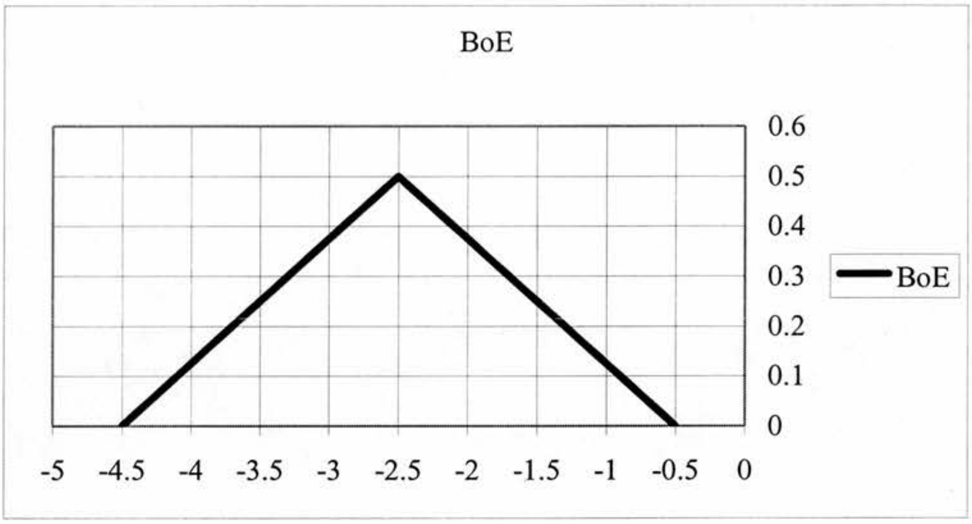
Figure 6.4.1: Triangular distribution of BoE rising (Respondent 5)



When BoE rise 0.25%, Respondent 5 suggests that the maximum change of the FTSE100 is down 1%, most likely situation is down 0.2% and the minimum change is 0%.

Each answer of Respondents 5 and 6 are converted into Triangular distributions followed rules which are demonstrated in the above figure. Since the answers of Respondent 5 for each leading indicators rising and falling situation are the same in absolute value, this means only one distribution need to be made for each indicator in both situation. The beliefs of Respondent 6 are another story. The pattern of rising and falling situations are different. Therefore the average value of rising and falling is taken as the measure to create the Triangular distribution. Figure 6.4.2 shows an example of Triangular distribution for Respondent 6 on his belief of a rising BoE rate's impact on the FTSE100.

Figure 6.4.2: Triangular distribution of BoE rising (Respondent 6)



The actual answers of Respondent 6 on this question are different. The -4.5% maximum, -2.5% most likely and -0.5% minimum change are the average values for both rising and falling situations. Please refer to Table 6.4.1 for conversion detail.

Table 6.4.1: Example of data conversion for Respondent 6

BoE up	BoE down	Average	Negative relation with BoE applied
-1	0	(I -1 I +0)/2=0.5	-0.5
-3	2	(I -3 I + I 2 I)/2=2.5	-2.5
-5	4	(I -5 I + I 4 I)/2=4.5	-4.5

The conversion of Respondent 6's answers to Triangular distribution will follow the rules above. Since there is no syntax for Triangular distribution in WinBUGS, Beta or Gamma distribution will be used as a compromise. Using the equation of mean and mode, Triangular distribution can be transformed into either Beta or Gamma distribution. Both distributions have been experimented with using the Bayesian independent model as used in a previous part of this study. The reason of using the independent rather than the dependent model is limited by the nature of questions asked. People are only asked to provide their beliefs on certain indicators separately rather than taking into account the interaction between these measures. One reason of doing so is to keep the model initially simple.

Both Beta and Gamma distribution were used in analysis. Unfortunately, both distributions were unsuccessful in analysis. The defined boundary of Beta distribution is between 0 and 1. Even after carefully converting all the data used in the model into a range of between 0 and 1, during the Gibbs sampling the simulation kept moving outside the boundary and the model stopped updating. Then Gamma distribution was applied to loose one of the boundaries since it only has lower boundary 0. The situation, however, is that simulation still attempted to go outside the lower boundary, hence it did not resolve the problem.

After the failure of Beta and Gamma distribution, the normal distribution becomes the next choice although it is not ideal. Equating the mean and variance of both distributions provides an ability to convert a Triangular to a Normal distribution. These converted normal distributions are regarded as a prior to the Bayesian model. In this stage, only two respondents' beliefs are concerned, and model can be generalised for more. Factors gained from interviews are related with the UK market, but they will be combined with US data in the Bayesian models. People may argue the differences between these two markets. It is an inevitable factor. The globalization and merging of the capital market, however, generate an integrated market from the different countries and the close connection between the UK and the US capital market is well known. Therefore UK data has sufficient power to provide certain insights into the US market. All experts' beliefs on UK leading indicators will be applied on their US counterparts, respectively.

The model for Respondent 5 contains nine factors: Standard & Poor's 500 (sp500), Federal Fund Rate (f), Monetary Base Rate (mb), M1 money supply (m1), Unemployment Rate (ue), Consumer Price Index (cpi), Consumer Confidence Index (cci) and House Building (hb) and Trade Deficit (td). The model for Respondent 6 only contains six of previous nine factors with absence of ue, hb and td since the respondent regarded ue and hb as having no effects on the stock index at all and td has not been mentioned as the additional factor, but the Exchange Rate (d) has been added to the model for Respondent 6 who mentioned Exchange Rate as the additional factor which may have influence over fund performance. The data for the

Exchange Rate is the US Trade weighted value of the US dollar against major currencies which has been introduced in Chapter 5 as one of the 12 macroeconomic factors. The results of both models are shown in Table 6.4.2 and 6.4.3, respectively.

Table 6.4.2: Results of the Bayesian independent model for Respondent 5

	α	sp500	f	mb	m1	ue	cpi	cci	hb	td
a1	-0.01705	0.6557	-0.1093	0.02944	0.1503	0.03511	0.005411	3.36E-05	0.001003	-1.77E-03
a2	-0.00846	0.7823	-0.01494	0.02406	0.003443	0.002751	0.002383	-8.41E-06	0.001639	-1.46E-03
c1	-0.00304	0.944	-0.01899	-0.05827	0.05519	0.009673	-0.00204	1.90E-05	9.27E-04	-5.09E-04
c2	-0.01006	0.9569	0.04297	-0.2392	0.1773	0.002977	0.003153	-1.05E-05	0.003198	-1.81E-03
e1	-8.08E-05	0.9979	7.06E-04	-0.00677	0.005488	0.001926	1.81E-04	-1.70E-06	-4.13E-05	-3.71E-05
e2	0.002077	1.016	-0.00659	-0.03055	0.02542	-0.00618	-0.00116	3.09E-06	0.001423	8.79E-04
f	-0.00678	0.8358	-0.00407	-0.06647	0.06712	0.01016	-9.39E-05	2.85E-06	3.64E-04	8.37E-04
h	-0.01429	0.6996	-0.01176	0.02084	0.02503	0.004538	0.001831	-3.17E-06	-9.38E-04	-4.07E-04
i	-0.00522	0.8612	-0.07365	-0.03448	0.04331	0.01211	-7.47E-04	1.62E-05	0.0102	-4.32E-04
j1	-0.00447	0.9717	0.01245	-0.05112	0.002723	-0.00156	0.002298	-1.23E-05	-0.00106	1.72E-03
j2	-0.01585	0.7954	-0.00574	0.06359	1.49E-04	-1.62E-04	0.003964	-8.23E-06	5.70E-04	9.32E-04
l1	-0.00178	0.6709	-0.05218	-0.00349	-0.02323	0.001166	-0.00302	3.77E-06	2.10E-04	-1.76E-04
l2	-0.00498	0.8063	-0.04932	-0.111	0.06249	0.01645	0.001439	4.69E-06	0.002084	-2.01E-03
m1	0.03124	0.7521	-0.141	-0.3162	0.02042	0.02632	-0.00598	1.97E-06	0.001039	-2.14E-03
m2	-0.01044	0.6857	-0.05568	0.03887	-0.02038	6.18E-04	-5.26E-04	1.44E-05	-0.00149	2.72E-04
m3	-0.02575	0.7453	-0.05144	-0.0724	0.1624	0.01881	0.005422	2.85E-05	0.001375	1.30E-03
o1	-0.00819	0.6441	-0.07483	-0.05366	0.006738	0.008273	6.07E-04	1.55E-05	4.98E-04	2.08E-03
o2	0.005251	-0.04959	-0.128	-0.487	0.1107	0.02957	-0.00749	1.95E-05	-2.48E-04	-1.20E-03
p	-0.01044	0.9295	0.01307	-0.09364	0.0744	0.01191	0.004069	-8.75E-06	0.003265	-8.98E-04
s1	-0.00486	0.7673	-0.0378	-0.07468	0.031	0.008294	8.43E-04	-1.60E-06	0.001561	-5.14E-04
s2	0.001352	0.9923	6.89E-04	-0.00522	0.002646	-6.28E-04	-1.82E-05	-2.47E-06	-9.34E-04	-1.97E-04
t1	-0.00463	0.7723	-0.02655	-0.02151	0.01365	-0.0105	-3.73E-04	7.99E-07	-1.76E-04	1.89E-04
t2	0.009008	0.8781	-0.07594	0.006894	-0.05758	0.01536	-0.00158	-3.18E-06	0.005662	1.40E-03
u	-0.00905	1.009	0.02082	0.01231	0.03905	-0.0028	0.002654	-7.29E-06	-1.35E-04	1.24E-03
w1	-0.02202	0.86	0.03966	0.07354	-0.01395	-0.00577	0.009469	-2.96E-05	4.18E-04	-1.54E-04
w2	-0.01233	1.044	0.03182	-0.1527	0.1267	0.01646	0.005613	4.41E-07	-0.00182	-4.28E-03
Mean	-0.0058	0.808608	-0.02983	-0.06188	0.041943	0.00788	0.001012	2.58E-06	0.0011	-2.75E-04
Variance	0.000119	0.045786	0.002436	0.015162	0.00363	0.000127	1.32E-05	1.88E-10	6.05E-06	1.45E-06

These results show that αs and βs are consistent to previous results, but coefficients of all other factors are quite small which implies they have less effect on fund performance. Fund o2 has abnormal performance as indicated by previous results.

Table 6.4.3 shows the results of the Bayesian independent model for Respondent 6. Only six factors are included in the model since respondent 6 thinks factors ue and hb do not have any influence on fund performance.

Table 6.4.3: Results of Bayesian independent model for Respondent 6

	α	sp500	f	mb	m1	cpi	cci	d
a1	-0.0294	0.6712	-0.1072	0.005789	0.1135	0.005258	2.26E-05	4.92E-05
a2	0.02124	0.7748	-0.04895	0.01467	0.009704	-8.78E-04	1.49E-05	-7.49E-05
c1	-0.02768	0.9438	-0.00232	-0.1014	0.04592	7.17E-04	-2.29E-06	7.07E-05
c2	-0.009204	0.9537	0.02485	-0.2341	0.1575	0.001202	-3.91E-06	8.19E-06
e1	-5.48E-04	0.9988	0.002219	-0.00733	0.005183	-1.59E-04	-3.23E-06	4.61E-06
e2	0.00732	1.015	-0.01527	-0.03852	0.02748	-0.001721	1.04E-05	-1.56E-05
f	-0.007746	0.8418	0.002811	-0.04564	0.05261	0.001401	-5.68E-06	-7.96E-07
h	-0.02604	0.698	0.001489	0.007048	0.01768	0.003297	-1.49E-05	3.21E-05
i	0.04243	0.8584	-0.1278	-0.08682	0.048	-0.009465	5.59E-05	-9.77E-05
j1	0.007987	0.9669	0.003835	-0.0232	0.006792	0.001861	-4.83E-06	-3.90E-05
j2	-0.01063	0.7896	-0.00973	0.06483	0.02012	0.003902	-2.99E-06	-1.88E-05
l1	-0.001504	0.6705	-0.0505	-0.01076	-0.02849	-0.002887	3.66E-06	-2.00E-06
l2	-0.001265	0.8182	-0.04368	-0.06807	0.0535	0.001904	1.17E-05	-2.72E-05
m1	0.05807	0.7354	-0.1336	-0.3042	0.04269	-0.0026	-2.59E-06	-9.24E-05
m2	-0.006748	0.6847	-0.05898	0.0529	-0.00496	-0.001106	2.33E-05	-1.69E-05
m3	-0.004139	0.7313	-0.05742	-0.03272	0.1904	0.004589	4.51E-05	-7.34E-05
o1	-0.005753	0.6428	-0.07742	-0.07337	0.02014	8.35E-04	1.71E-05	-8.27E-06
o2	-0.004813	-0.0165	-0.1206	-0.5283	0.1272	-0.009138	1.90E-05	3.76E-05
p	-0.01084	0.9094	0.01482	-0.09835	0.05566	0.00583	-1.91E-05	3.81E-07
s1	-0.00653	0.7741	-0.0323	-0.0765	0.03427	0.001071	-5.51E-06	5.40E-06
s2	0.002646	0.9937	0.002173	-0.00199	-0.00278	-2.74E-05	-3.57E-06	-2.46E-06
t1	0.007132	0.7693	-0.03609	-0.04706	0.03362	-0.001761	8.70E-06	-2.81E-05
t2	0.0101	0.8662	-0.05385	-0.08466	0.02147	-0.001617	1.03E-05	-2.19E-05
u	-0.001799	1.006	0.02012	0.009553	0.05945	0.004063	-1.73E-06	-3.37E-05
w1	0.001182	0.8527	0.01852	0.06071	0.01208	0.007335	-9.40E-06	-6.48E-05
w2	-0.04633	1.074	0.05087	-0.09534	0.0741	0.008857	-2.31E-05	9.46E-05
Mean	-0.001649	0.808608	-0.03208	-0.06703	0.045879	0.0007986	5.38E-06	-1.21E-05
Variance	0.0004332	0.043813	0.002515	0.015515	0.002607	1.811E-05	3.25E-10	2.16E-09

Table 6.4.3 represents similar results to Table 6.4.2 in those common factors. Firstly, a near zero α and close to 1 β shows that funds do not have superior performance over the market and share similar risk preferences to the market portfolio. Secondly, small coefficients of other factors imply they have limited influence on fund performance. Finally, the abnormal fund o2 performance is consistent with all previous models. The reason for this is that fund o2 is a leverage fund rather than an equity fund.

Table 6.4.4 shows the results comparison among models using the OLS estimate, the prior derived from the OLS estimate, prior derived from bootstrap sampling, and the prior derived from the interview/elicited prior. From the table, it is found that αs and βs are similar in different models, but coefficients of the other factors in the models using the elicited prior are very small compared with those of models using other priors. In those non interview based prior models, the absence of factors ue, cpi, cci, td and d are due to their insignificance. Actually, the results in the elicited prior model confirm this fact. Coefficients of factor cpi, cci, td and d from both respondents are very small and they are not significantly different from zero. Therefore, in this case, the experts' view is consistent with the results from models in previous Chapters.

Elicited prior models have a small coefficient of factor f in both respondents' models. The coefficients, however, are significantly different from zero within the 5% level which confirms factor f has explanatory power on fund performance and consistent with findings in the previous OLS and Bayesian models. Factors mb and m1 are the same case. Although values of their coefficients are quite small, they are both significantly different from zero.

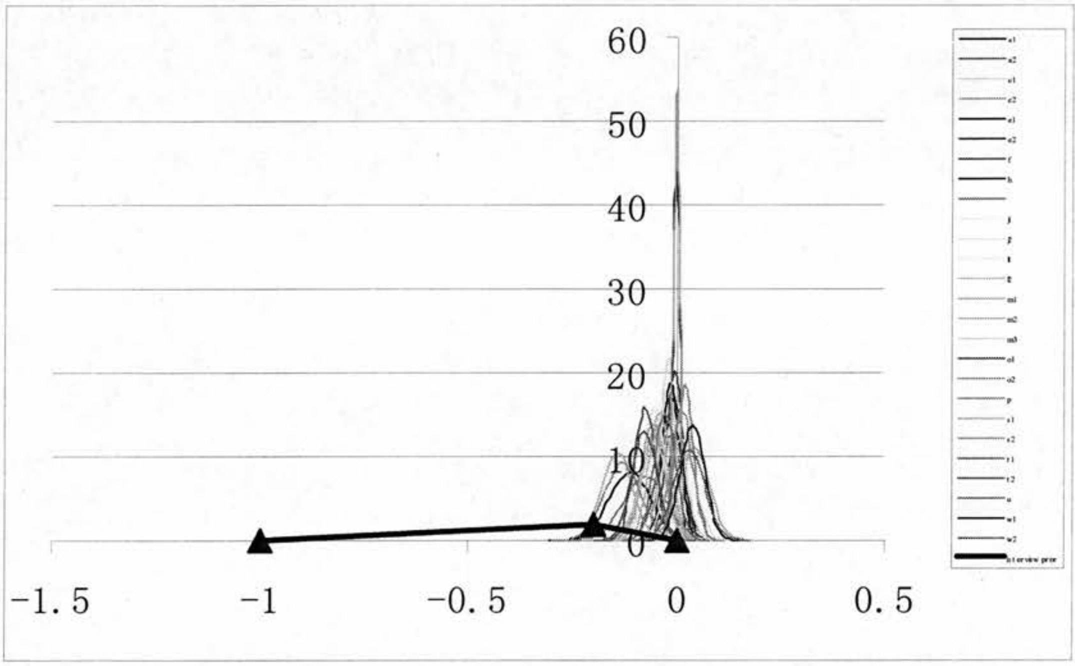
Factors ue and hb have no effects on fund performance according to Respondent 6, which means there are no results for these two factors in the model of Respondent 6. The results from Respondent 5 show that coefficients of factors ue and hb are significantly different from zero, however, they have a very limit influence on fund performance.

Table 6.4.4: Results comparison table

		α	sp500	f	ft	mb	ml	ue	cpi	cci	hb	td	d
OLS	Mean	0.006269231	0.775923	-0.44762	0.128231	-0.92954	0.476231						
	Variance	0.0000567	0.05278	5.669191	5.939506	0.495567	0.107924						
Original	Mean (Dependent)	0.0056045	0.783775	-0.3832235	0.0854312	-0.8075796	0.4430608						
	Variance (Dependent)	0.000024	0.048586	3.222401	3.52605	0.333402	0.055163						
	Mean (Independent)	0.006238	0.7813192	-0.4134431	0.1009192	-0.8303142	0.4326627						
	Variance (Independent)	0.0000428	0.052006	0.066538	0.058027	0.486756	0.089315						
Bootstrap	Mean (Dependent)	0.005977067	0.780454	-0.11041	-0.21144	-0.70166	0.338641						
	Variance (Dependent)	2.04651E-05	0.048384	0.019124	0.012419	0.321079	0.067781						
	Mean (Independent)	0.006185997	0.780988	-0.42257	0.115853	-0.86913	0.459978						
	Variance (Independent)	4.82665E-05	0.054999	5.260696	5.664236	0.538105	0.107708						
Elicited prior	Mean (Respondent 5)	-0.0058	0.808608	-0.02983		-0.06188	0.041943	0.00788	0.001012	2.58E-06	0.0011	-2.75E-04	
	Variance (Respondent 5)	0.000119	0.045786	0.002436		0.015162	0.00363	0.000127	1.32E-05	1.88E-10	6.05E-06	1.45E-06	
	Mean (Respondent 6)	-0.001649	0.808608	-0.03208		-0.06703	0.045879		0.0007986	5.38E-06			-1.21E-05
	Variance (Respondent 6)	0.0004332	0.043813	0.002515		0.015515	0.002607		1.811E-05	3.25E-10			2.16E-09

Figure 6.4.3 shows the comparison between the prior and posterior from Respondent 5. It shows how the respondent's prior compare with the posteriors of 26 funds. Only one comparison is shown here which is factor f. The other graphs can be found in Appendix I.

Figure 6.4.3: Prior and Posterior comparison for Factor f (Respondent 5)



From the figure, some important conclusions can be made. Firstly, the data is dominating the situation, as large amounts of data are used. In many cases there is a degree of overlap between prior and posterior. Secondly, it shows that the 'experts' have limitations, and have vague views about likely values and do not appreciate that values often cross the 0 boundary. In this case the respondent is pessimistic about the influence of the factor on funds. Finally, the figure suggests that the reason why Beta and Gamma distribution failed in many cases since most of the posteriors cross the lower boundary of 0 which will fail the Beta and Gamma distribution.

Figure 6.4.4 shows the prior and posterior comparison from Respondent 6. Only one comparison figure of factor f will be given out here. The rest of the graphs can be found in the Appendix J.

Figure 6.4.4: Prior and Posterior comparison for Factor f (Respondent 6)

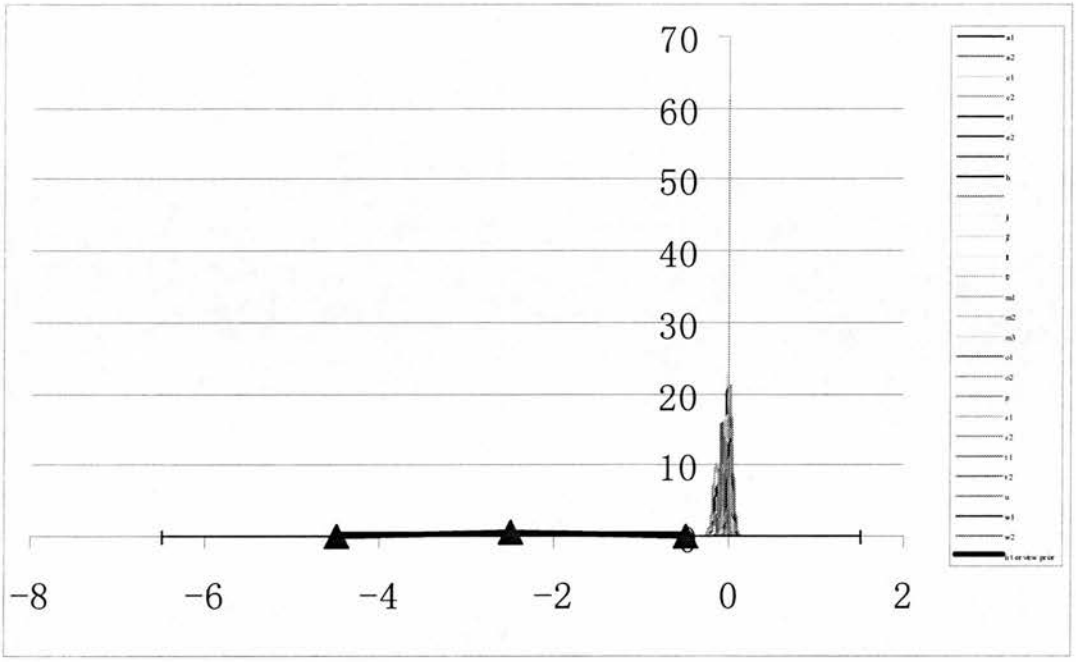
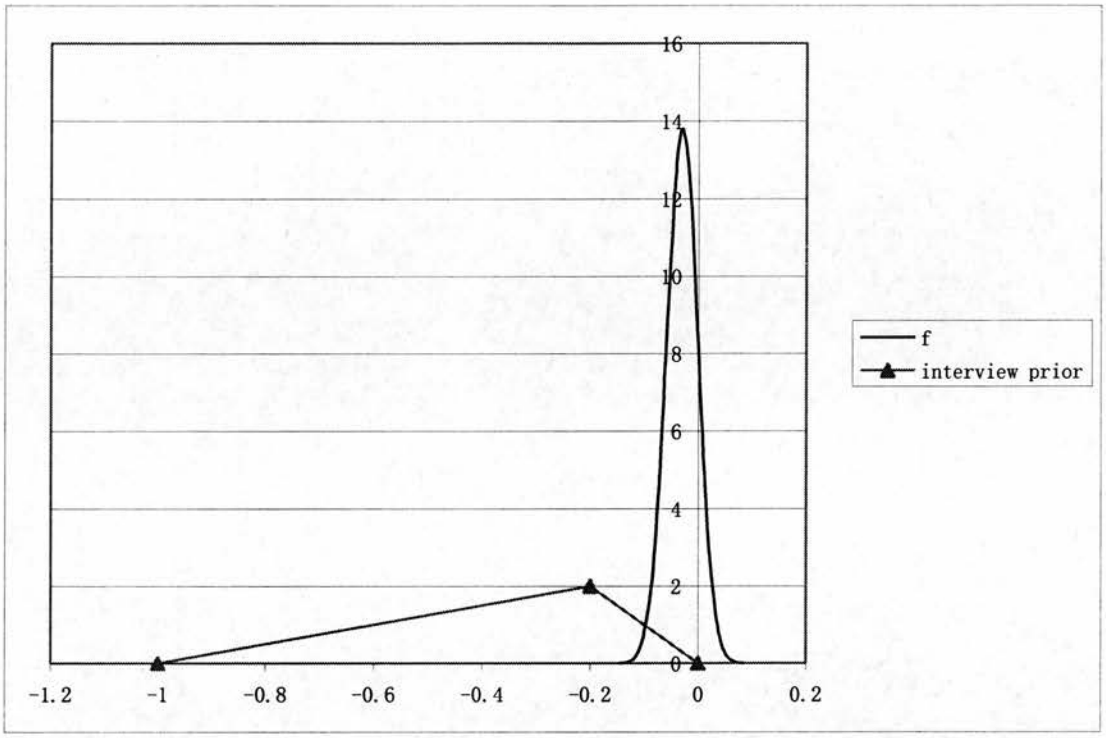
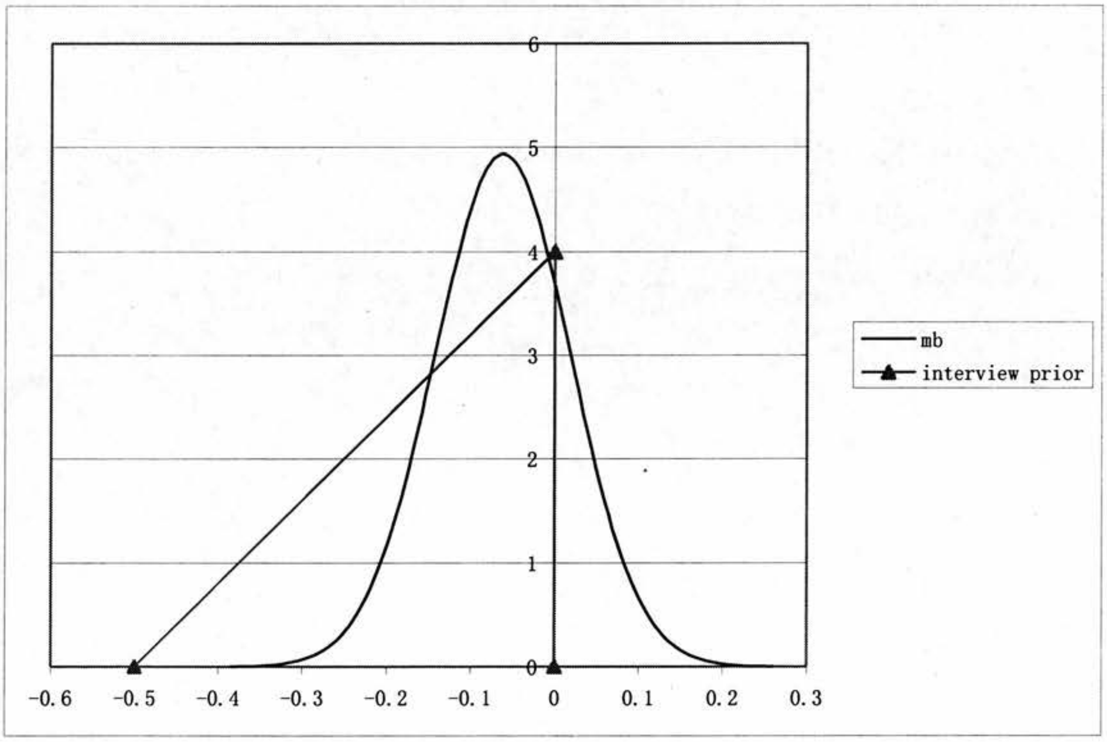


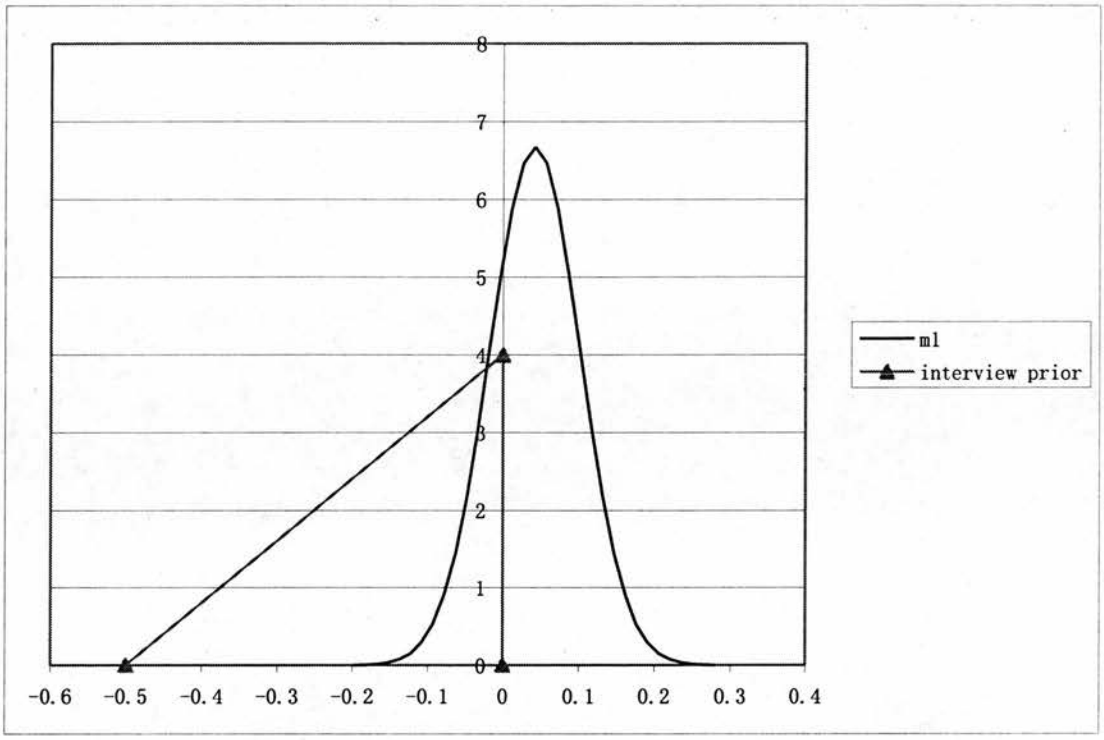
Figure 6.4.4 shows the prior and posteriors from Respondent 6. In this case, there is no overlap between the prior and posteriors at all, and expert is even more pessimistic. Data dominates the situation here as well, and the posteriors again cross the 0 boundary.

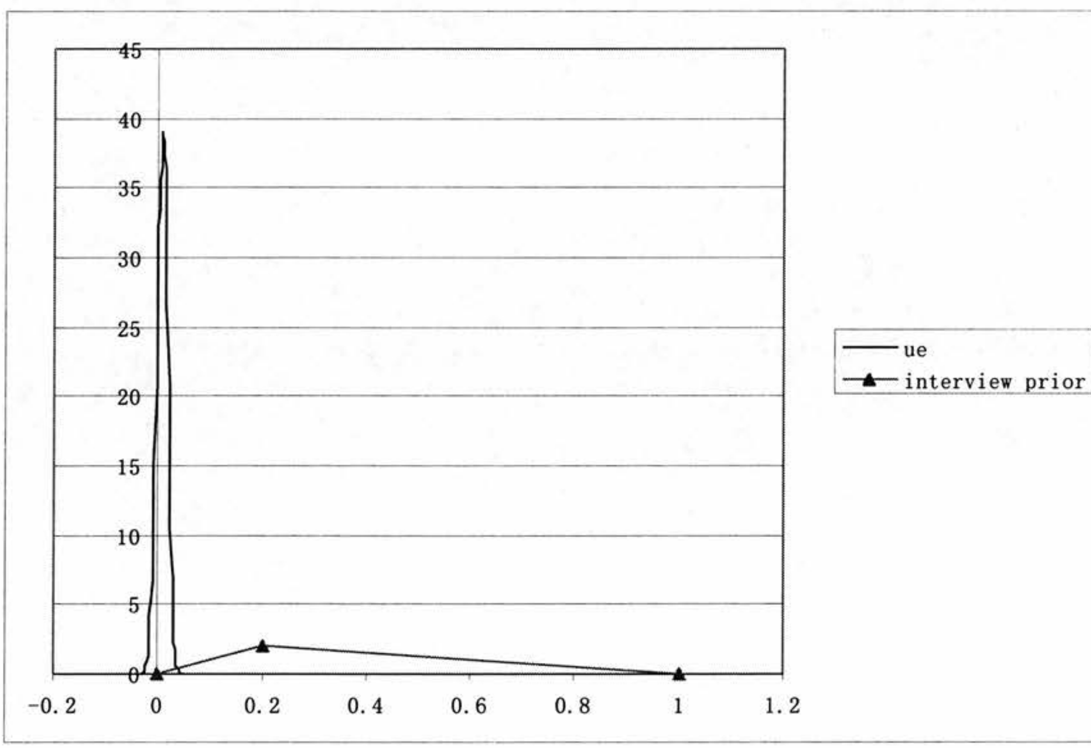
Figure 6.4.5 is a group of diagrams of comparison between the prior and the average posterior. It provides more details of comparisons between the priors and posteriors of funds of different factors from Respondent 5. The priors are the same as those in the previous figures and from the expert's view. The posterior are the average of 26 funds' posterior for each factor. They may not provide as much information as showing all the 26 funds' posterior together, but the average posterior distribution makes the diagram easier to read and it still represents sufficient information which can be used to interpret the results based on the elicited prior.

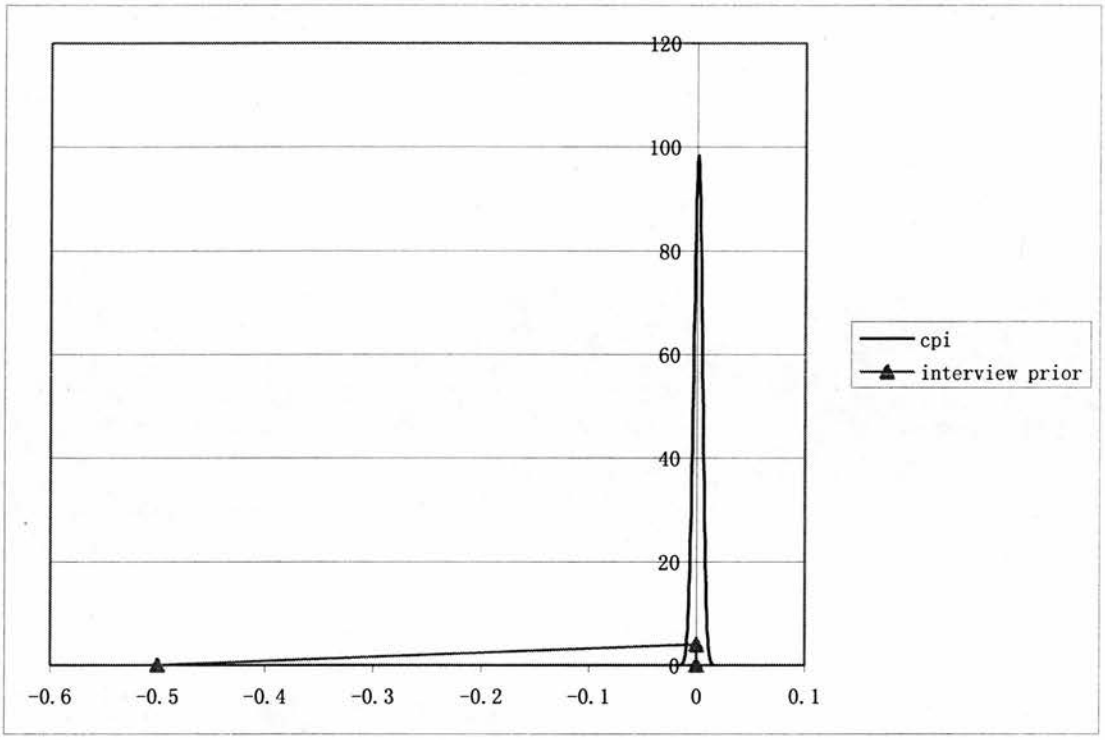
Figure 6.4.5: Group diagram between the Prior and average Posterior (Respondent 5)

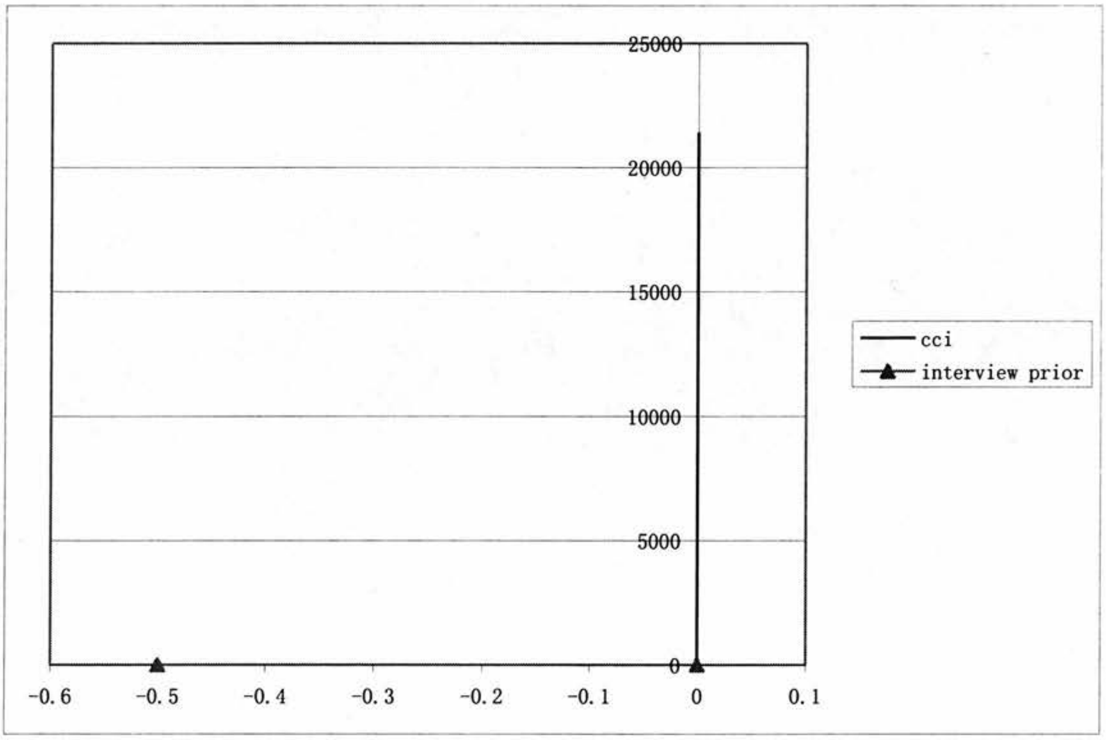





8
7
6
5
4
3
2
1
0
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
ml
interview prior


45
40
35
30
25
20
15
10
5
0
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
ue
interview prior


120
100
80
60
40
20
0
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
cpi
interview prior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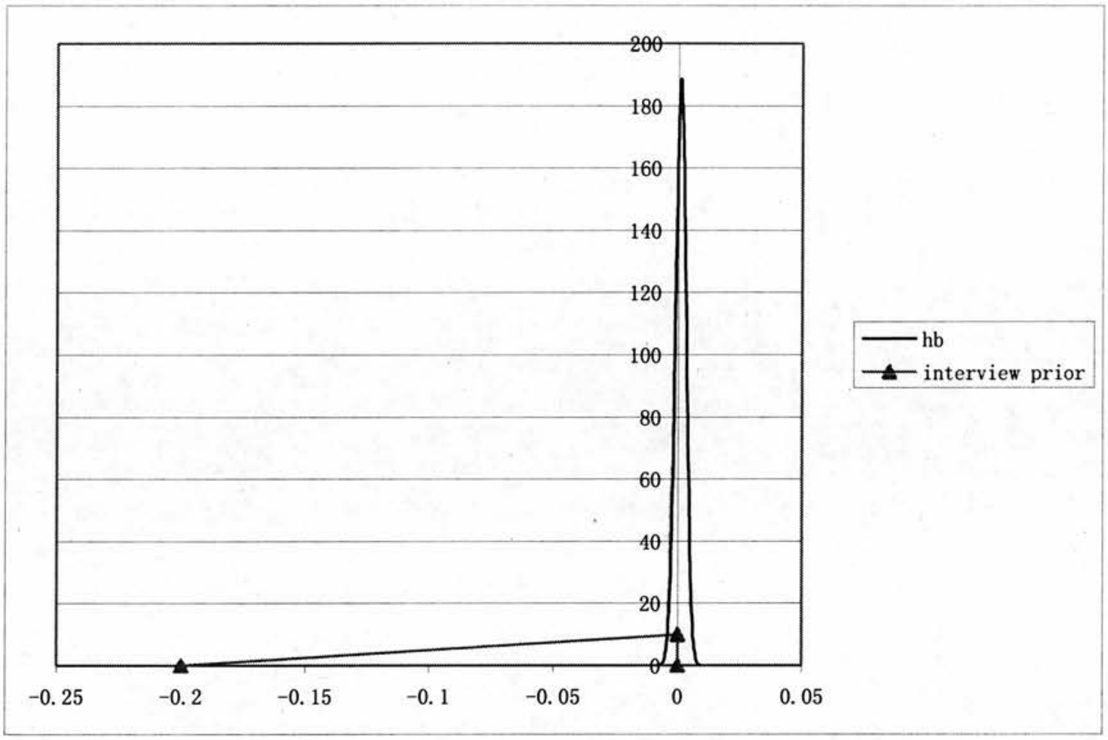
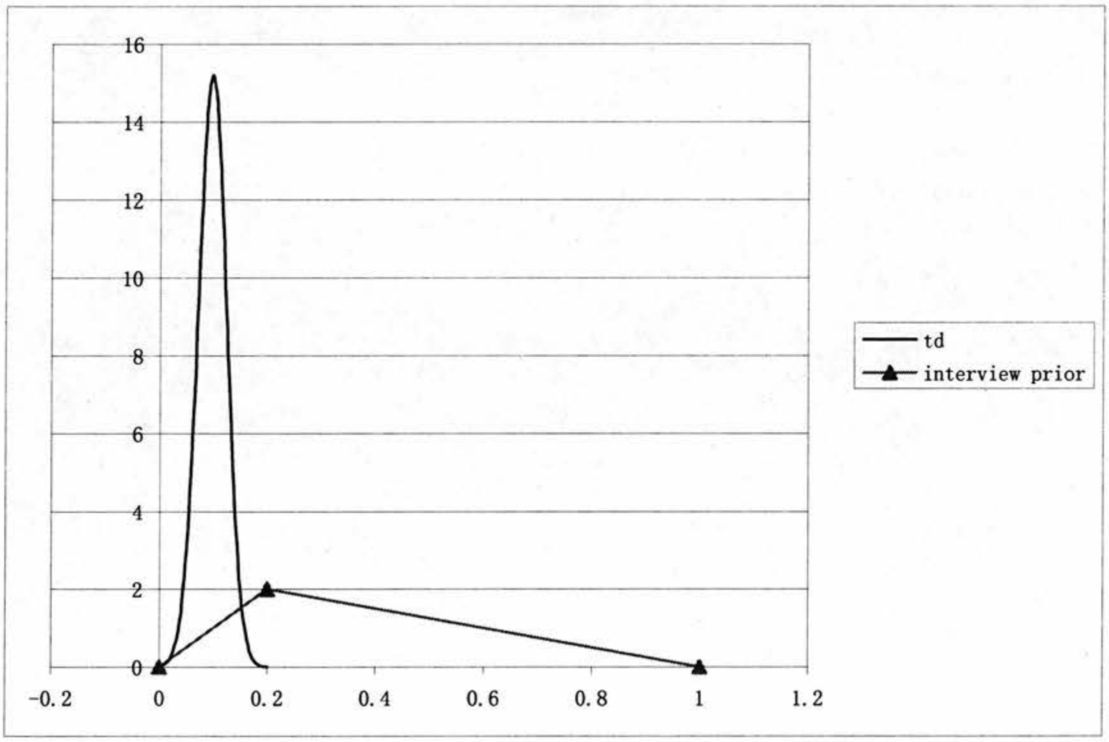
cci
interview prior

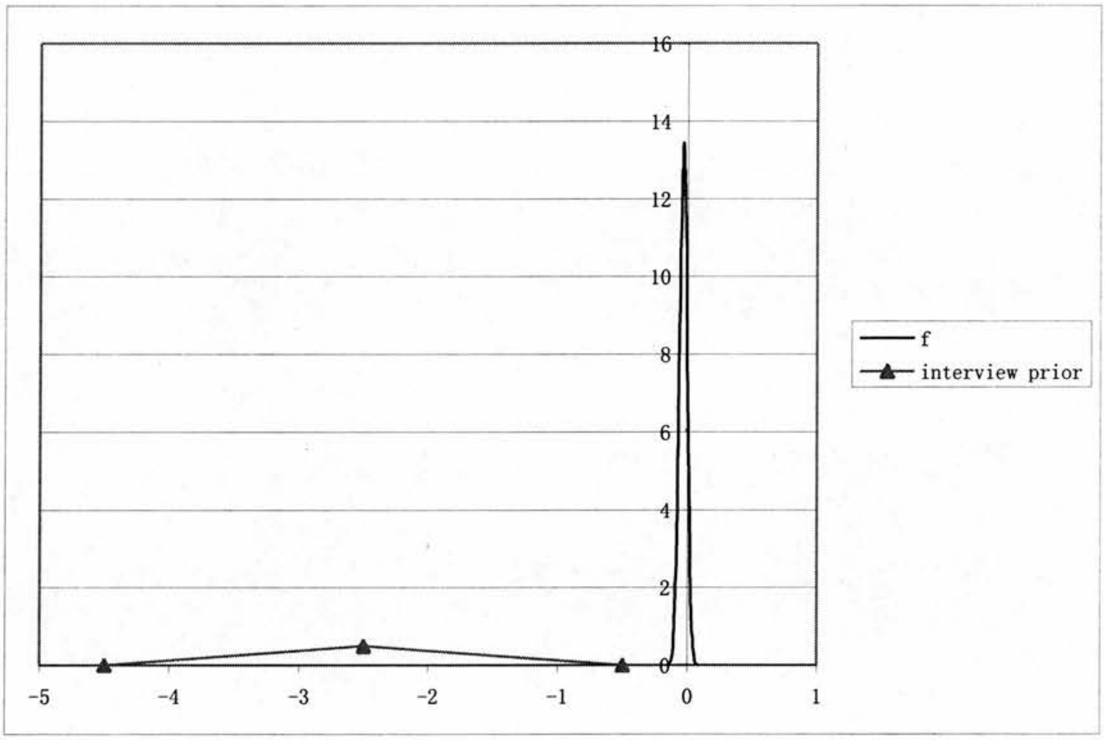


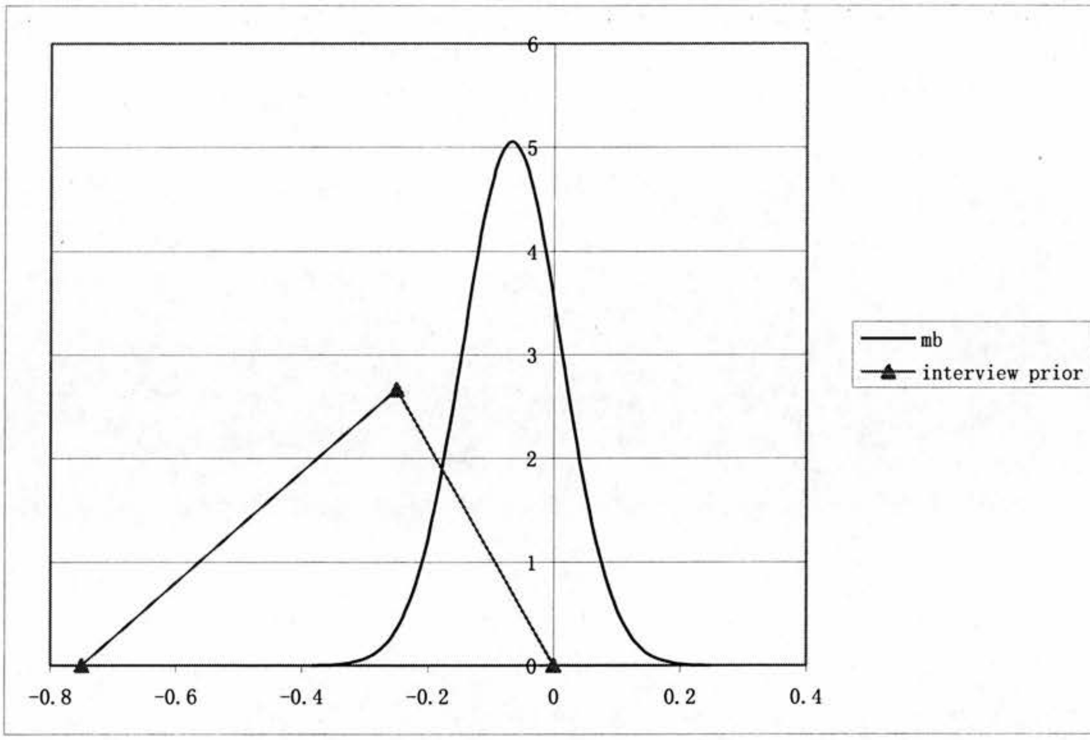


From Figure 6.4.5, most graphs have an overlap between the prior and posterior which implies Respondent 5 has a good understanding of these factors' influence on fund performance. Apart from factors ue and td, respondent 5 has a very pessimistic view of these factors. Even mb which is the closest estimate for Respondent 5 is still 0.2 away from the average posterior. In other words, Respondent 5 has quite a positive belief of factors ue and td. Still, the elicited prior is very limited and the expert's view is quite vague.

Figure 6.4.6 shows similar group of diagrams as Respondent 6.

Figure 6.4.6: Group diagram between the Prior and average Posterior (Respondent 6)




6
5
4
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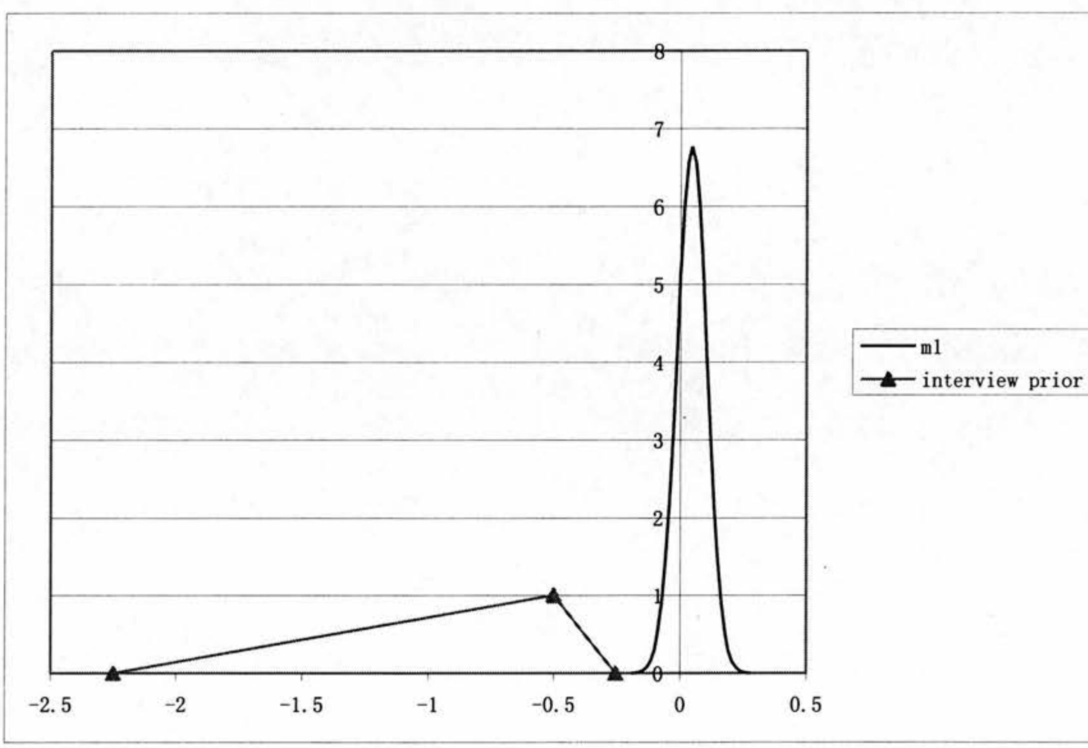
2
1
0
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
mb
interview prior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-2.5
-2
-1.5
-1
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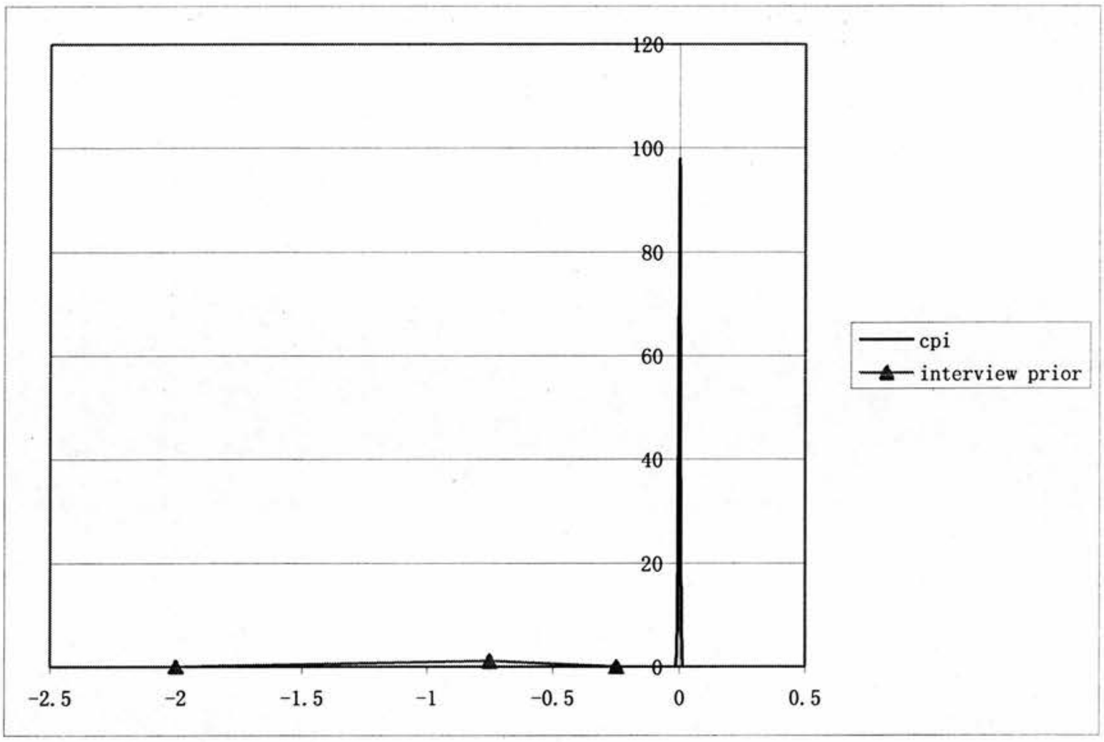
0.5
ml
interview prior



120
100
80
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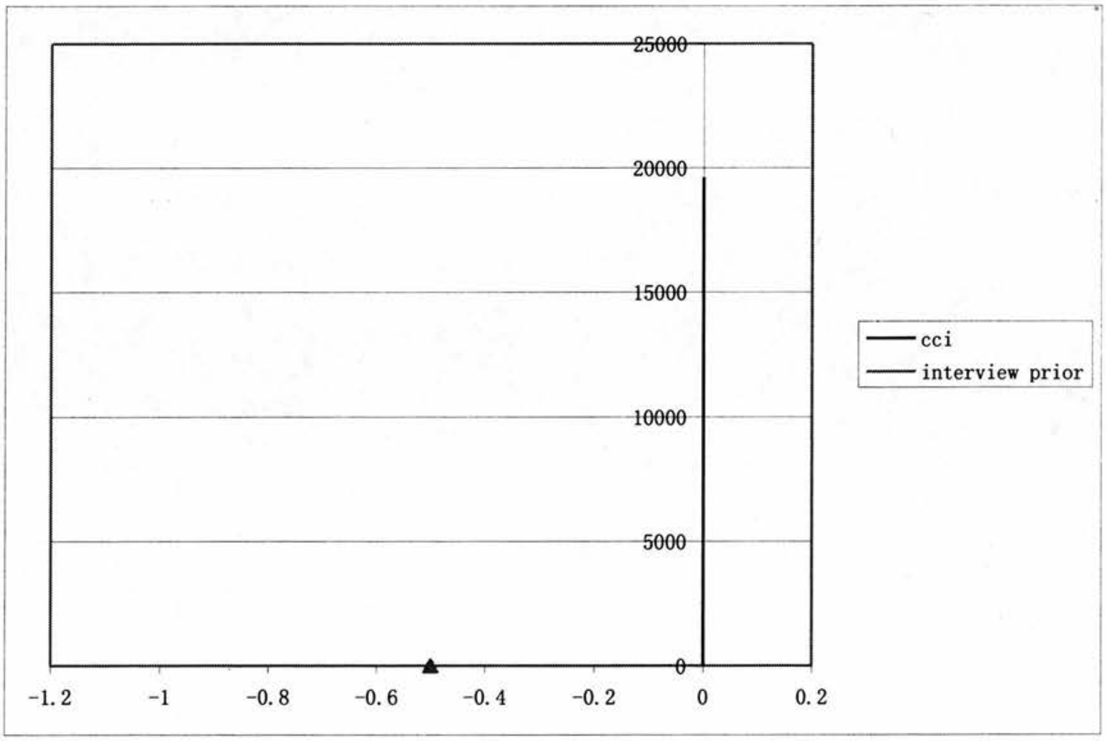
-2.5
-2
-1.5
-1
-0.5
0
0.5
cpi
interview prior



25000
20000
15000
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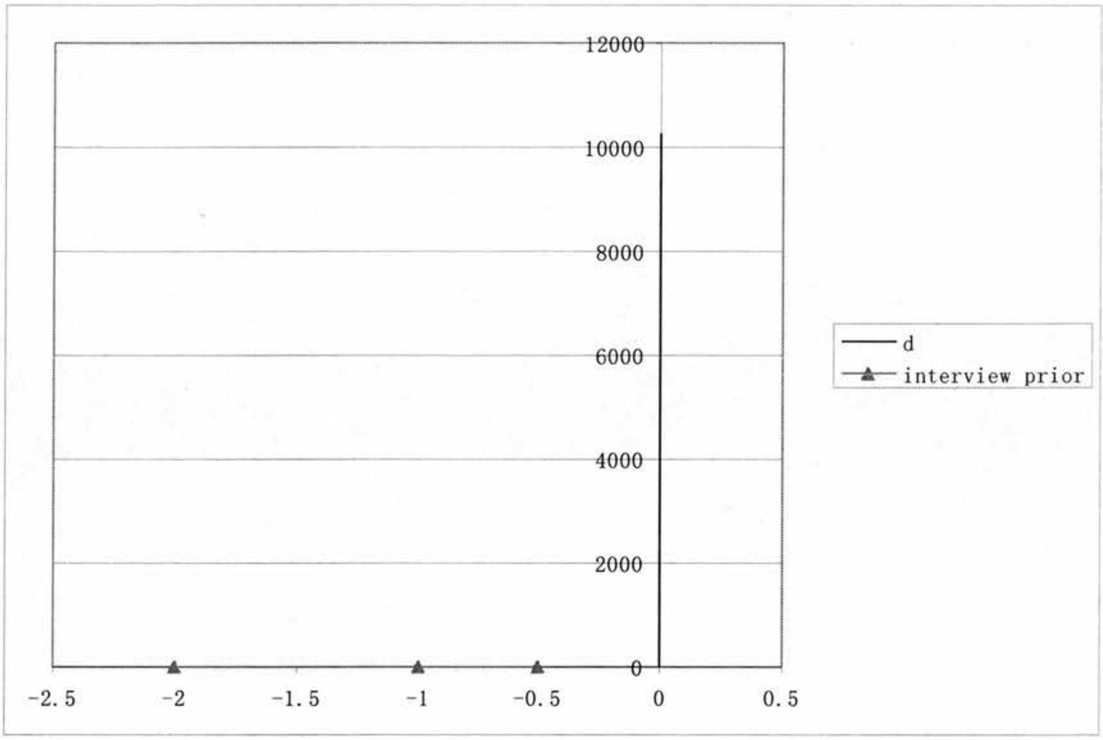
5000
0
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
cci
interview prior



In Figure 6.4.6, just couple of priors and posteriors overlap. The closest estimate of Respondent 6 is factor mb, but comparing to Respondent 5 it has less overlap. Respondent 6 has a very strong pessimistic feeling about all the factors. Overall, Respondent 5 has a better understanding than Respondent 6 of these factors' impacts on fund performance which is based on all of the 16 years data.

The overall pessimistic thoughts from both experts imply a phenomenon called availability heuristic. The availability heuristic is when people base their prediction of the frequency of an event or the proportion within a population based on how easily an example can be brought to mind. These experts may remember the worst cases, the most significant cases or the most recent cases. Since unpleasant experience is more memorable, it causes these experts to hold a very pessimistic view on those factors' influence on fund performance. This bias is inevitable since these elicited priors are from qualitative surveys.

6.4 Conclusion

Bootstrap re-sampled data has been used to generate empirical priors. Five factor dependent and independent Bayesian models have been fitted based on empirical data to examine the 26 funds' performance. Most of the results confirm the findings from previous OLS and Bayesian models based on the original data. There is a non-superior performance over the market portfolio which is confirmed by a near zero α and similar risk level to the market portfolio which is confirmed by a value close to one for β. The distortions of factors f and ft which happened in the previous OLS and Bayesian models appear again, not in the dependent, but in the independent Bayesian under the bootstrap re-sampled prior. The cause of the model misspecification is considered to be multicollinearity between factors f and ft which have a high joint correlation, but multicollinearity does not affect a model if it is used for prediction. The predictions in the regression will still be sound, and the overall adjusted R square of the models indicate a good fit.

The attempt to gain priors from questionnaires has not been altogether successful due to low response rate and poor quality of answers. Despite these aspects, useful information was gained and used as raw material to provide elicited priors for the Bayesian model. According to the questionnaire, most people think the Bank of England Base Rate is the most influential leading indicator to the FTSE 100, the stock market index, followed by M4, the broad money supply. Overall, the questionnaire generated useful information for the study. The overall conclusion is that the elicitation was relatively successful in producing prior distribution. It illustrates that this approach can be used. It also demonstrates that insights into views of the analyst can be gained.

The results from the questionnaire corroborate majority of findings for the study, especially in the aspect of selection from macroeconomic factors. The questionnaire is conducted in UK due to constrains of time and budget. The globalization and the merging of capital markets generate an integrated market from the different countries and ensures the close connection between the UK and the US market. Therefore, UK data can also provide lots of insights into the US market. Finally, it can be concluded that the Central Bank base rate and money supply are the most concerning factors among others for the investment market.

Elicited priors have been used in the Bayesian independent model. The failure of adapting Beta and Gamma distributions can be explained by the diagrams of comparison between priors and posteriors. The posteriors keep crossing the lower boundary of 0, and this leads to difficulties in using the Gibbs sampler. The results show the consistence. Factors such as cpi, cci, ue, td and d are either insignificant or have very limited influence on fund performance. Experts have some opinions on fund performance, but most of them are pessimistic and vague, and may suffer from bias caused by availability heuristic. Although the elicited prior only provided very limited information, the overlap between prior and posterior shows that experts still have considerable understanding of the factors' impact on fund performance and Respondent 5 has a better idea than Respondent 6. Overall, results based on elicited priors are consistent to results based on OLS estimated and Bootstrap re-sampled priors. In the 16 years from May 1990, these 26 equity funds do not have superior performance over the market and have a similar risk preference to the market portfolio.

Chapter 7 Conclusion

7.1 Introduction

The measurement of fund management performance is critical to making good decisions in investment. It can be aided by analysing the performance of the fund. This is far from simple because assessment requires that an analyst take account of a number of factors, a central factor is the benchmark against which a fund is to be judged. Traditionally the benchmark is included in a fund management performance model which is mainly based on the Capital Assets Pricing Model (CAPM). This thesis aims to provide a model of fund management performance that incorporates both market behaviour and economic index into measurement in an attempt to characterise the performance of funds. Given that some of the measures will be subjective, rather than using the standard Ordinary Least Squares(OLS) approach to estimation, Bayesian models are employed. Several alternative models are explored using data collected.

Moreover, fund management is not isolated from a wide range of influences. These are not solely economic factors or even market effects, but also include the content of management. The management of a fund is controlled by the various governors who influence policy for the fund, but there are also influences such as style of management, management expertise and asset allocation requirement. Human behaviour is another driven force behind these influences. All of these factors have been explored by an initial survey and followed by a further questionnaire in an attempt to quantify those subjective beliefs to incorporate into the Bayesian models. Behavioural finance are also used to try to explain anomaly of experts' beliefs.

7.2 Summary of Findings

7.2.1 Initial Survey Results

Based on information from literature and pilot surveys in Chapter 2, the relationship between trustee and manager is concluded to be more complex and profound than other have thought. Although trustees and fund managers do not intend to take a short term view, under pressure managers may sometimes behave as short-term investors. Some evidence shows that managers' past performance may not be the only guide concerning manager selection, but it is still widely used by trustees. However, it does not seem fair to fund managers. Moreover, trustees intend to have a long-term relationship with the fund manager, provided they behave appropriately. Hence they are willing to give fund managers sufficient space to act with the funds. Nonetheless, there will be intervention if they believe that the fund managers are not performing as demanded. Finally, respondents from the initial interview concluded that the fund may achieve persistent performance, but that such an effect is more likely to be found in the long term.

7.2.2 Pilot Study Results

In a pilot study, historical data from five funds over 15 years have been explored using both OLS and Bayesian methods on a single-factor CAPM model. Four different models have been implemented: OLS, Bayesian dependent, Bayesian independent and Bayesian constant β model. Findings show the Bayesian dependent and independent, and standard OLS models generate similar estimates for both α and β. The constant β model has αs similar to the average of αs from previous models. This is due to the use of the cross-section mean of β from five funds and so it can be explained by modern portfolio theory. When the risk level of fund is determined, return of fund can be predicted. All the evidence from the pilot study is consistent with the EMH theory and suggest that fund managers have no ability to outperform the market and that all five funds have a similar risk preference to the market portfolio. Hence, passive management would be a better way to manage a mutual fund.

7.2.3 Full Scale Study and Intermarket Effect Results

Based on 26 US equity funds with 16 years historical market data, using market portfolio sp500 and twelve macroeconomic factors, an OLS stepwise model is employed to eliminate insignificant factors in Chapter 5. As a result, a five factor model has been developed. The model contains sp500, the benchmark, and four macroeconomic factors which are f (Federal Rate), ft (Federal Target Rate), mb (Monetary Base Rate) and m1 (Money Supply 1). An unanticipated change in interest rate or money supply will influence price of share in the fund portfolio through discount rate or value cash flow. Based on these five-factor, dependent and independent Bayesian models have been fitted and compared to the OLS model. Unusual results appear for f and ft, on further consideration this is mainly due to multicolinearity.

The findings from both Bayesian models prove that all 26 funds cannot outperform the market portfolio and have very similar risk preference to the market portfolio. They confirm the results found in the pilot study in Chapter 4.

People argue that there might be an intermarket effect among securities markets. Hence, an investigation of such an effect has been carried out in order to find out whether significant interactions among bonds, equities and commodities market exists. First, an intermarket index has been created based on the weighted average of coefficients of every securities index to funds in regression. Then a stepwise OLS model was used to explore the most significant ones among twelve economic factors. Another five factor model with different significant factors from those of the previous model was developed. All the evidence shows that intermarket effect is unlikely to exist at least among these 26 funds. Although the five factor intermarket OLS does not provide better measurement of funds and shows quite weak intermarket effect, it does corroborate the previous results, that most funds can not beat the market and have a really similar risk level to the market portfolio, sp500.

After decomposition of the intermarket index, the evidence shows that the most of the effect is solely due to sp500, the equity market benchmark. Hence, the influence of intermarket effect is really only the influence of sp500 itself. Since it is most likely that there is no intermarket effect among these 26 funds, the intermarket model was not employed in subsequent modelling.

7.2.4 Bootstrap Re-sampling Results

Using the OLS results as priors for the Bayesian models perhaps biases the results obtained, so it was decided to explore alternative methods to derive priors. One method is to use bootstrap methodology. The bootstrap data has been generated by following the procedure below:

Firstly, bootstrap re-sampling has been carried out, in order to obtain empirical results. This is based on the original data set which contains monthly data of 26 funds over a 16 year time period, thus it has 192 data points for each fund. 40 points of data have been randomly extracted from 192 points of the original data set. Such a process has been repeated 100 times in order to construct an empirical data set which has 4000 data points for each fund. In the mean time, for each single data point obtained from funds, 12 macroeconomic factors and Standard and Poor's 500 (sp500) have undergone bootstrap re-sampling at the same time points. After 100 draws, an empirical distribution can be created between the funds and the factors. Finally, those distributions are used as priors for a five-factor Bayesian model.

Empirical priors have been employed using both dependent and independent Bayesian models. Results confirm the findings from previous OLS and Bayesian models based on original data such as lack of superior performance over market portfolio and similar risk level to the market portfolio. The inconsistency of factors f and ft that occurred in the previous OLS and Bayesian models appeared again, not in the dependent, but in the independent Bayesian model when using bootstrap re-sampling data. The cause of the model misspecification is again likely to be multicollinearity between factors f and ft which have a high correlation.

Overall, fund o2 does not fit the model very well. A further investigation has been carried out on this particular fund. After checking the asset allocation of fund o2, it comes out that fund o2 is defined as a leverage fund rather than an equity fund. The reason for low adjusted R square of fund o2 becomes obvious, since sp500 is only an appropriate benchmark for equity fund not leverage fund. Hence the current model does not fit fund o2 well.

7.2.5 Survey and Elicited Prior Results

The aim of this study is to produce a model of fund management measuring using Bayesian Methods. It is hoped that the model developed will provide greater insight into the performance of funds than traditional methods since it will contain not only the raw data but the ability to introduce the beliefs/opinions of the analyst into the study.

An alternative approach to obtain a prior distribution is through the use of surveys. A questionnaire on macroeconomic likelihood and impact on fund performance has been constructed. The questionnaire has been distributed through several channels including to staffs, undergraduate and postgraduate students in the Management School of the University of Edinburgh. Since the questionnaire is aimed at fund managers, others who do not have sufficient finance or investment background may encounter some difficulties in completing the questionnaire. Therefore although many responses from the university have been received, unfortunately most of them were invalid. Due to their commitments it is quite difficult to get hold of fund managers. Follow up e-mails were sent to get as many responses as possible before the deadline. The results were encouraging, a number of questionnaires were returned. These were analysed.

Based on Figure 1.2 in Chapter 1, the questionnaire was designed to collect experts' views on the impact of macroeconomic factors and capital market on fund performance. Seven respondents' answers are included in the analysis. Four only partially completed the questionnaire, three completed the questionnaire fully. One of the three was found to be incoherent in analysis. The questionnaire was slightly disappointing due to the low response rate and quality of answers. Despite this, it still provides useful information which can be used for the empirical Bayesian model. According to the questionnaire most people think the Bank of England Base Rate is the most influential leading indicators, followed by M4, the broad money supply.

The results from questionnaire mostly corroborate the findings of the study, especial concerning the aspect of selection from macroeconomic factors. Although the questionnaire was conducted in the UK, which is constrained by time and budge limitations, the globalization and merging of capital market means that one can consider this as one large market. Close connection exists between the UK and the US capital market. Therefore, UK data should provide certain insights into the US market.

Questionnaire results have been converted into prior distributions. Triangular distribution would have been the best choice, but WinBUGS lacks syntax for this distribution. Beta and Gamma distribution were candidates. Using either Beta or Gamma distribution with Gibbs sampling leads the simulation to fail because the posterior kept falling outside the defined boundary and so the model stopped updating. Figures of comparison prior and posterior in Chapter 6 illustrate the problem very clearly. It is seen that most posteriors span a negative value. Given the failure of both Beta and Gamma distribution, normal distribution was employed. Equating the mean and variance of both the distributions provides the ability to approximate to the Triangular distribution by the normal distribution. At this stage only two respondents' thoughts were considered. Approach could be generalised for more.

Factors gained from the interviews were about the UK market, but they have been used to provide priors for their US counterparts in the Bayesian independent models. Model for Respondent 5 contains nine factors and they are Standard & Poor's 500 (sp500), Federal Fund Rate (f), Monetary Base Rate (mb), M1 money supply (m1), Unemployment Rate (ue), Consumer Price Index (cpi), Consumer Confidence Index (cci) House Building (hb) and Trade Deficit (td). Model for Respondent 6 only contains six of the previous nine factors with the absence of ue, hb and td, since Respondent 6 regard ue and hb as having no effect on the stock index at all and td was not mentioned as the additional factor, but factor Exchange Rate (d) was added into the model for Respondent 6 who mentioned Exchange Rate as the additional factor which may have influence on fund performance. The data of Exchange Rate is US Trade weighted value of US dollar against the major currencies which has been introduced in Chapter 5 as one of 12 macroeconomic factors.

Results from Respondent 5 and 6 show firstly, a nearly zero α and close to 1 coefficient for market portfolio which implies that funds do not have superior performance over market and share similar risk preference to the market portfolio. Secondly, small coefficients of other factors imply they have limited influence on fund performance. Finally, abnormal fund o2 performance is consistent to all previous models. The reason is that fund o2 is a leverage fund rather than an equity fund.

Figures 6.4.3 and 6.4.4, when comparing priors and posteriors for both respondents indicate firstly that data are dominating the situation, since large amount of data are used. In many cases there is a degree of overlap between priors and posteriors. Secondly, shows that the 'experts' have limitations in that they have vague views about likely values and do not appreciate values often cross boundary of 0. In this case the respondents are pessimistic about the influences of the factors on funds. Finally, the Figures confirm the reason of Beta and Gamma failed in many cases since most posteriors cross the lower boundary of 0.

A group of diagrams show the comparison between priors and average posterior for the Respondent 5 and 6, respectively. From these Figures, most of them have overlaps between priors and posteriors which implies that both respondents have considerable understanding of these factors' influence on fund performance. Both respondents, however, show a very pessimistic view on these factors since most of their priors are in the negative side, though a number of factors have posteriors which are positive.

The overall pessimistic thoughts from both experts may demonstrate a phenomenon called availability heuristic. The availability heuristic is where people base their prediction on the frequency of an event or the proportion within a population based on how easily an example can be brought to mind. These experts may remember the worst cases, the most significant cases or the most recent cases. Since unpleasant experience is normally more memorable to people, it causes these experts to hold a very pessimistic view on those factors' influence on fund performance. This bias is inevitable since these elicited priors are from a qualitative survey.

Overall, the overlaps between priors and posteriors show that experts still have an understanding of the factors' impact on fund performance and Respondent 5 has better insights than Respondent 6. Elicited prior results are consistent to previous results based on OLS estimated and Bootstrap re-sampling prior. In 16 years from May 1990, these 26 equity funds do not have superior performance over the market and have similar risk preference to the market portfolio.

7.2.6 Models Comparison

Table 7.1 compares result from the different models. In the Table original means the original prior means OLS estimates used as priors; bootstrap prior means priors are based on bootstrap re-sampling of data and elicited prior means priors based on expert's beliefs. The independent Bayesian model assumes that all the coefficients of the variables are independent. The dependent model, however, allows interaction between coefficients of the variables.

The values for α are close to 0 in all cases. For the models using elicited priors the mean value of α is negative, whilst for the other models it is positive. The variances are all relatively small. For the sp500 coefficients are around 0.8 with elicited prior coefficient above the value and other means below. Variances are all similar at around 0.05. f (Federal Rates) and ft (Federal Target Rate) again show a degree of variability across the models with relatively large variances. This demonstrates the multicollinearity between these two variables. mb is always negative with elicited prior moel closer to zero than the rest. The variance in the case of elicited prior is smaller than the rest. m1 follows similar pattern, but the mean values are positive. For the other variables the extra variables are relatively small and several could be considered insignificant. This is unsurprising given the previous decision not to include them in other models.

Table 7.1: Models Comparison

		α	sp500	f	ft	mb	ml	ue	cpi	cci	hb	td	d
OLS	mean	0.006269231	0.775923	-0.44762	0.128231	-0.92954	0.476231						
	variance	0.0000567	0.05278	5.669191	5.939506	0.495567	0.107924						
Original prior	mean (dependent)	0.0056045	0.783775	-0.3832235	0.0854312	-0.8075796	0.4430608						
	variance (dependent)	0.000024	0.048586	3.222401	3.52605	0.333402	0.055163						
	mean (independent)	0.006238	0.7813192	-0.4134431	0.1009192	-0.8303142	0.4326627						
	variance (independent)	0.0000428	0.052006	0.066538	0.058027	0.486756	0.089315						
Bootstrap prior	mean (dependent)	0.005977067	0.780454	-0.11041	-0.21144	-0.70166	0.338641						
	variance (dependent)	2.04651E-05	0.048384	0.019124	0.012419	0.321079	0.067781						
	mean (independent)	0.006185997	0.780988	-0.42257	0.115853	-0.86913	0.459978						
	variance (independent)	4.82665E-05	0.054999	5.260696	5.664236	0.538105	0.107708						
Elicited prior	mean (Respondent 5)	-0.0058	0.808608	-0.02983		-0.06188	0.041943	0.00788	0.001012	2.58E-06	0.0011	-2.75E-04	
	variance (Respondent 5)	0.000119	0.045786	0.002436		0.015162	0.00363	0.000127	1.32E-05	1.88E-10	6.05E-06	1.45E-06	
	mean (Respondent 6)	-0.001649	0.808608	-0.03208		-0.06703	0.045879		0.0007986	5.38E-06			-1.21E-05
	variance (Respondent 6)	0.0004332	0.043813	0.002515		0.015515	0.002607		1.811E-05	3.25E-10			2.16E-09

Notes of the Table: Standard & Poor's 500 (sp500), Federal Fund Rate (f), Monetary Base Rate (mb), M1 money supply (m1), Unemployment Rate (ue), Consumer Price Index (cpi), Consumer Confidence Index (cci), House Building (hb), Trade Deficit (td), Exchange Rate (d).

In the Table, coefficients of the other factors in the models using elicited prior are very small compared to those of models using other priors. The absence of factors ue (Unemployment Rate), cpi (Consumer Price Index), cci (Consumer Confidence Index), td (Trade Deficit) and d (Exchange Rate) in previous models is because of their insignificance. Coefficients of factors cpi, cci, td and d from both respondents are very small and they are insignificantly different from zero.

Although factor f has smaller coefficients in elicited prior models than those in other models, they are significantly different from zero in 5% level which proves factor f is one explanatory variable on fund performance and consistent with previous findings. Factors mb (Monetary Base Rate) and m1 (Money Supply 1) are in the same case. Although their coefficients values are quite small, they are significantly different from zero in 5% level.

Factors ue (Unemployment Rate) and hb (House Building) have no effects on fund performance according to Respondent 6. The results from Respondent 5 show that coefficients of both factors ue and hb are significant different from zero, but they have a very limited influence on fund performance.

When comparing the prior distributions to the posterior distributions in the case of elicited priors it does appear that the experts are both pessimistic and vague. Partly this can be explained by the volume of data which dominates the estimates. It also it can be explained by the behaviour of the experts. Individuals tend to be guided by memorial events in case large and negative gains, this is referred to as the availability heuristics. It is noticeable, though, there is overlap between prior and posterior distributions.

Results overall are consistent across the whole set of models, OLS, Bootstrap and elicited priors. Over the period of 16 years considered the 26 equity funds area to have similar performance and similar risk preference to the market portfolio. None of the 26 funds out performance the market. Results in this thesis are consistent to studies by Jensen (1968), Malkiel (1995), Gruber (1996), Carhart (1997), Miranda

(1999), and Quigley and Sinquefield (2000) and prove that active managers fail to outperform the passive benchmark portfolio. Moreover, they not only have similar performance, but similar risk preference to the market portfolio. The conclusion is that passive management is more likely a better way to manage the funds.

7.3 Contribution

7.3.1 Contributions to Academics

The research explores several issues. The initial impetus of the research was to explore the use of Bayesian modelling within fund management. The aim was to combine market data with the subjective views of the experts. It was believed that this would provide new insights into performance. The contribution has been to allow the assessment of the expert's subjective view. It has been found in this study using data over 16 years that the experts interview tend to be pessimistic with vague beliefs about the size of impact of variables.

Another aspect that was hoped to explore was the range of influences to which fund management is subject. Initially it had been planned to consider a wide range of influences as described by Figure 1.2 in Chapter 1. These were explored at two levels through interviews with those involved with the industry. Also one might have taken into account some of the results of behavioural finance. Given timescales within a doctoral study it has not been possible to explore as widely as desired and primarily on macroeconomic factors have been considered in the modelling.

The influence of policy is seen as important. This has been raised in the past but does not seem to have received the attention it deserves. In this study it has been addressed qualitatively through literature search and interviews. These confirm the influence of policy on performance, but there has not been possible to explore quantitatively within this study.

It had been suggested by Murphy (1991) that there ought to be an intermarket effect, given the interaction between security markets. This study cannot confirm the intermarket effect and the main influence appears to be the equity market index rather than other indices.

The study shows that the Bayesian analysis in all the forms considered is consistent with OLS solutions. It also finds for the current set of 26 equity funds that the main determinants of performance are sp500 (Standard and Poor's 500), f (Federal Rate), ft (Federal Target Rate), ft, mb (Monetary Base Rate), m1 (Money Supply 1). Hence Bayesian approach might be used to explore fund performance. As said earlier it also provides insight into the behaviour of analysts.

7.3.2 Contributions to Industry

The approach yields another way to assess the performance of fund management. The comparison of prior distribution to posteriors provides a way to assess behaviour of fund managers. It is a way to explore the insight the fund manager has. It is a way to explain the intuition and flair of the fund manager and help them to correct their biases.

The approach can be extended to other asset classes. In the current study equity funds have been considered, but there is no reasons why other types of funds could not benefit. Also whilst macroeconomic factors were explored in this study other influences could be treated in a similar manner. Again the focus was on US fund management but there is no inhibitor to explore other regions.

7.3.3 Contributions to Investor

This research focuses on fund performance measuring and hence, provides valuable information for investors to find funds which can meet their investment requirement and risk tolerance. The benefits of using informative information can offer deeper and more reliable insights into funds. Moreover, the research model can also assist investors to get opinions from fund managers on leading indicators and may help them to understand the market from a fund mangers perspective. It also provides, through priors and posteriors comparison, another judgement to be made about the fund managers.

Chapter 8 Limitations and Future Works

8.1 Introduction

The aim of this work was to investigative the development of a better model of fund performance by using Bayesian technique. It focused on using the traditional CAPM model. The initial ideas are embedded within Figure 1.2. It shows the range of influences thought to be significant at the beginning of the project. The first part of the work employed the views of a range of individuals around UK fund management. Individuals were approached through interviews and questionnaires. The analysis from the initial questionnaire can be summarised as follows, that trustees or policy makers have a significant impact on fund performance which is reflected by several issues: firstly, league table or performance assessing is used to measure the performance of funds, but with an inappropriate benchmark the bias is obvious. Secondly, performance is a guide to hire or fire a fund manager, but it is not the only one. Trustees are willing to have a long-term relationship with fund managers, if they perform reasonably. Moreover, trustees always allow fund managers a trial period. Along side the initial discussion with people in the industry, a pilot study using 5 funds was carried out using Ordinary Least Squares and Bayesian models. The findings from the pilot study show that consistent results come from both OLS and Bayesian models. These five funds never outperform the market and have a similar risk level to the market portfolio.

A larger scale was then implemented. A sample of 26 funds from the US market during April 1990 and May 2006 was explored. Using the opinions of experts and a review of the literature 12 macroeconomic variables were selected for analysis. Using stepwise regression on these 12 variables and a market index the five most significant variables were identified. These 5 variables were then used in Bayesian models, both dependent and independent. The priors used were based on OLS results. More natural priors were also used for analysis. There were priors developed from a bootstrap approach and elicited from experts. The expert's prior were obtained through questionnaires.

The intermarket effect has been investigated as well. Indices from equity, bond and commodity market are used to create an intermarket benchmark which has shown only slight improvement on fund performance measuring. The quity market index, , plays the most important role among the three indices. Therefore, no significant intermarket effect exists among these 26 equity funds in the period from April 1990 to May 2006.

Although the results are fruitful, the limitations of the research are inevitable. In this Chapter limitations and future works will be discussed as well.

8.2 Limitations

A PhD study is limited by time and resources. Hence it was not possible to acquire a professional database and databases available to the University were used. This is not ideal since it is not designed for the current research. The reliability and availability of the data is far from ideal and a lot of adjustments were needed. The outcome was a study of 26 US equity funds collected over a 16 year period. It would be interesting to extend the number of funds and include other types of funds.

12 macroeconomic factors plus equity market index, sp500, 30 years Treasury bond yields and Commodity Research Bureau (CRB) index were considered in this research. Although it is a limited list of factors which may influence funds, it already covers the most important leading indicators used to predict economic changes. Whilst it is possible to argue for other variables there currently appears to be little support for alternatives, except those considered in Behavioural finance. There is little to inhibit the use of such but the limitations of the study period.

Based on Figure 1.2 in Chapter 1, only half of the factors listed in the figure have been analysed in the study. The upper half of the factors, which are about relations among trustees and managers are not used in the quantitative analysis. They are only discussed in the literature review and original survey. The policy issues are as important as the impact from external factors. Putting these internal factors into a model, however, may be difficult because of their complicated nature. They require more information from experts to clarify. Hence, the exploration of internal factors into the quantitative model has not been pursued.

This study is based on CAPM. It is a single factor and single period model. It assumes that the only risk that the investor is concerned with is uncertainty about the future price of the investment. It has been criticised by a number of papers including Roll (1977), Chen, Roll and Ross (1986), Fama and French (1992) and Jagannathan and Wang (1996). Models such as positive period weighting (PPW) measure from Grinblatt and Titman (1989), Fama and French 3 factors model from Fama and French (1992), and characteristic based model from Daniel, Grinblatt, Titman and Wermers (1997) could be explored in the future using Bayesian approach.

Although people argue about the creditability of CAPM, people are still trying to produce alternatives which are based on the CAPM theory. Examples of such paper are Merton (1973), Ross (1976), Basu (1983), Bhandari (1988), Fama and French (1992, 1993, 1996), Lettau and Ludvigson (2001), Pastor and Stambaugh, (2002), and Huij and Verbeek (2003, 2004). This thesis has followed these models constructing a five factors model based on the CAPM theory to assess fund performance.

Time series analysis is not implemented in this study. The time series analysis is another very important method to assess mutual fund performance. This study, however, aims to follow finance house view of fund performance and is concerned general trend of fund rather than particular volatility. Constrained by time and budget, analysis such as autoregressive (AR) models, the integrated (I) models, or the moving average (MA) models will not be discussed in this thesis. It may become part of future work.

The statistic model used in this thesis is Bayesian method. The Bayesian method requires further data. It combins market data and experts' beliefs together. It offers a chance to explore peoples' beliefs on fund performance which may provide insights that have not been explored before.

Behavioural finance seems to match the requirement of this thesis, since surveys of people's beliefs about fund performance and policy study are centred to this study. Time is one of the constraints for not using behavioural finance theory. It is acknowledged that currently there is no unified theory of behavioural finance. Identifying portfolio anomalies by psychological traits in analysts or portfolio managers is not an easy job which requires huge effects. Lacking sufficient information is another constraint. The explanations of psychological anomalies are based on a vast amount of information which can be produced by large scale survey.

In this study two surveys were run. The first aimed to explore issues around fund management especially the processes. The second aimed to gain specific information on factors and their impact. These in depth surveys could have been carried out. A larger range of fund managers, trustees, policy managers and others could have been interviewed or surveyed. This would have led to greater insight into fund management and would have enriched the understanding and analysis. It would have required more time and greater access to the community involved with fund management.

Finally, after the priors have been elicited from the questionnaires, they are applied as prior distributions into the model. The questionnaire asks experts about their view of factors' maximum, most likely and minimum influence on fund influence. Naturally these beliefs are converted into Triangular distributions. The WinBUGS programme, however, does not have such distribution which makes finding an alternative distribution necessary. Both Beta and Gamma distribution were consider, but proved unsuitable. Hence the normal distribution was used as prior Although the normal distribution is not the best choice, it is still acceptable within the context. If more time is given, the syntax of Triangulation distribution can be programmed and other distributions might be explored. It would have been helpful if there had been more respondents to the second survey and the opportunity to consider consensual priors. It would have been interesting if a consensus over factors and effects could have been drawn up.

All these restrictions did not decrease the creditability of the research, but only constrained the potential of better understanding of fund industry. If more resources had been available, all these limitations would have been lessened.

8.3 Future Works

Since the limitations of the study have been listed above, the agenda of future work becomes very clear. Firstly, a larger database should be created based on a more recent period. The category will not be limited to equity fund, but more general funds. The time frame could be expanded as well. More than one market could be under examination such as UK, EU and emerging markets.

Secondly, more factors that have an influence on funds could be assessed. Since more time and budget could be put into the survey and using the experience of the previous survey to improve the questionnaire, a bigger scale of survey on issues around fund performance could be carried out. It will provide more information to create a model including internal factors. A snow ball effect could occur with more fund managers joining the survey. They will help to promote the survey which may give a boost to response rate. Longer waiting time will be given; therefore fund managers can have more time to think about these questions and provide better feedback.

Thirdly, the syntax of Triangular distribution will be programmed and elicited prior will be examined without any conversion. Since the constraints of this research are lessened, it will release the full potential of this thesis. It is believed that this research will provide a full spectrum way to assess fund performance which is more accurate, more reliable and more convenient.

Finally, this thesis is based on standard finance theory. Notably, during the last decade, a new branch of financial economics has been developed referred to as behavioural finance. As noted by Olsen (1998), behavioural finance recognises that the standard finance model of rational behaviour and profit maximization can be true within specific boundaries, but advocates of behavioural finance assert that this model is incomplete since it does not consider individual behaviour. Using behavioural finance based on the thesis, concerns of various psychological traits of individuals and how these traits affect how they act as investors, analysts, and portfolio managers can be further explored. Policy study will be further developed to identify portfolio anomalies that can be explained by various behaviours among professional individuals or groups.

Appendix A: Types of Mutual Funds

The types of mutual funds vary according to the fund's investment objective. A fund's investment objective will usually seek capital gains (gains from the sale of portfolio securities), income (interest and dividends earned on the portfolio securities) or a combination of both. While not a comprehensive list of all mutual funds, the basic types of funds are described below. Source adapted from Investment Company Institute(1997)

Money Market: A money market fund seeks safety of principal by investing in high quality, short-term securities. This type of fund is designed with the aim that an investor's principal should not decrease in value. There is no guarantee, how ever, that this will always be the case. A money market fund seeks to provide a regular distribution of income which is determined by short-term interest rates.

Growth: A growth fund invests primarily in the common stock of well established companies. This type of fund may invest for long-term capital gains and is not intended for an investor who seeks income.

Aggressive Growth: Like a growth fund, an aggressive growth fund will invest primarily in common stock for long-term capital gains. An aggressive growth fund may invest in the common stock of small companies, out-of-favour companies or companies in new industries. It, therefore, has a higher degree of risk than a basic growth fund.

Income: An income fund invests in either corporate, government, or municipal debt securities. A debt security is an obligation which pays interest on a regular basis. Hence, this type of fund is designed for investors who desire periodic income payments. There are, however, substantial differences and varying degrees of risk among income funds depending on the credit quality of the debt issuer, the maturity of the debt instrument, and prevailing interest rates.

High Income: This category of income fund seeks to achieve a high degree of income by investing a material portion of its portfolio in below investment grade debt securities or junk bonds. These funds have a high degree of risk and should be purchased by investors who can incur the risk of loss of principal.

Balanced: A balanced fund, as the name implies, invests for both growth and income. The fund will invest in both equity and debt securities. A balanced fund seeks to provide long-term growth through its equity component as well as income to be generated by the portfolio's debt securities.

Appendix B: Pilot Study Questionnaire

How do trustees select fund managers, what are the influences that may lead them to a decision?

Besides the selection of fund manager and requirement on fund manager in terms of style and asset allocation are there other effects, which trustees have on the management of funds?

Is it possible to characterise these aspects?

How much influence does policy have on fund performance? How strong is the influence of trustees on performance? Does the pressure come from the policy managers?

Is it possible to describe the linkage between policy and performance?

Does the length of time a manager is responsible for a fund affect the performance? Do trustees and policy managers wish to develop long-term relationship with fund managers? Does this happen in practice?

What might characterise the desirable facts of a fund manager?

Does the personality or behavioural characteristics of fund manager have a demonstratable effect on fund performance?

Is it possible to measure these aspects in relationship to fund management?

How does the fund manager balance policy aims and performance of the funds? What are the mechanisms/processes for balancing risk and return? What modelling support do fund managers use?

How does the macro-economic factors effect fund performance?

How are regulatory requirements implemented?

Do you believe fund performance persistent? How strong is the relationship between past and future performance?

Appendix C: Transcripts of Pilot Study Questionnaire

Fund Manager A

How do trustees select fund managers, what are the influences that may lead them to a decision?

Yes, of course. It will be a huge impact on it. Normally trustees will bear their ideas which are the investment aim in their mind and try to find some fund managers who can accomplish these goals or who can fit their styles on investment.

Besides the selection of fund manager and requirement on fund manager in terms of style and asset allocation are there other effects, which trustees have on the management of funds?

Normally the actual fund managers will meet those trustees at least twice a year. And quarterly report is required as well. The contents of the report will be what's happening in recent stage of those portfolio? How are their performances?

Is it possible to characterise these aspects?

How much influence does policy have on fund performance? How strong is the influence of trustees on performance? Does the pressure come from the policy managers?

Not very strong they do set aims of the investment and they do care about the performance. Apart form these quarterly report, they will leave enough room for fund managers themselves to play.

Is it possible to describe the linkage between policy and performance?

Does the length of time a manager is responsible for a fund affect the performance? Do trustees and policy managers wish to develop long-term relationship with fund managers? Does this happen in practice?

Yes it dose. Trustees, they will pay attention about historical performance say maybe five years of fund managers. But they also care about fund managers investment style stability, risk attitude. Past performance could be important factor which may influent they way those trustee to pick fund managers, though, sometimes it may not be the only factor which give influence on decision making .
The relationship between trustees and fund managers mostly depends on performance. Trustees may leave fund managers a certain period like a trial. However if the fund managers suffer cataclysmic lost. The relationship could be end in a very beginning. Half year or one year, it is all up to the performance how well fund manager have done.

What might characterise the desirable facts of a fund manager?

Does the personality or behavioural characteristics of fund manager have a demonstratable effect on fund performance?

It's hard to say. Individual personality could have profound influence on their investment style.

Is it possible to measure these aspects in relationship to fund management?

How does the fund manager balance policy aims and performance of the funds? What are the mechanisms/processes for balancing risk and return? What modelling support do fund managers use?

Modelling things could be an easy way to measure fund performance. But it makes no sense in practice. Trustees do set benchmark for assessing. However, as fund manager themselves, they don't really want to be assessed in this way. Selection bias is big problem. The benchmark assessing method is absolutely unfair to fund managers as their point of view. But is there any better and easier way for trustees to do such performance assessment?
Normally stock broker will give some recommendations. But fund managers have their on a process to pick stock. Company background information is really important. It is also depends on what type is the investment, long-term or shot-term. If it's long-term investment, the growth potential will be a most significant factor. Cash flow will be important as well for both kinds of investment.

How does the macro-economic factors effect fund performance?

Definitely, GDP, interest rate, inflation rate, those things are like a chain reaction. They will have influence on funds and funds could react with the changing of those macro-economic factors.

How are regulatory requirements implemented?

The level of legal requirement is increasing. Regulation authority many check routinely once or twice a year, which depends on how well your company have done in the past. Fund managers, they also will be checked of self-checked such as what kinds of equities you are holding now. What are the transactions doing with those equities?

Do you believe fund performance persistent? How strong is the relationship between past and future performance?

No. not very strong performance persistent exist fund managers. They may keep their style consistently, however, market is difficult to predict. The same style may not work in all periods. Keep you mind open and adapt different strategies maybe persistent way to do fund management.

Fund Manager J

How do trustees select fund managers, what are the influences that may lead them to a decision?

Normally, trustee will arrange and hold a 'beauty parade', where potential fund managers provide presentations of their skills and services. Trustee choose investment consultancy. One or more managers may be chosen by trustee. After trustee set invest policy which includes investment aims, it will become guideline to fund manager. Fund managers will be asked to hand a usual report every 3 months which concludes market environment, fund asset allocation and achievement of fund for last 3 months, and future plan or aims for the fund. Trustee can also make a simple phone call and ask manager the recent performance of fund.

Besides the selection of fund manager and requirement on fund manager in terms of style and asset allocation are there other effects, which trustees have on the management of funds?

Policy is main tool trustee using to control behaviour of manager. Investment policy set a space in which something mangers are allowed to do and something they can't do. Mangers are also asked to behaviour judicious. It can be interpreted as if with large amount of money yourself, what kinds of investment option you will take.

Is it possible to characterise these aspects?

Risk tolerance

How much influence does policy have on fund performance? How strong is the influence of trustees on performance? Does the pressure come from the policy managers?

The influence of policy have on fund performance is a lot and it is also very important.

Is it possible to describe the linkage between policy and performance?

Relative performance attribution is a measure to assess relationship between fund performance and benchmark. Relative performance attribution is added up by asset mix contribution and selection contribution. These two contributions are calculated by following equations

n

Asset mix contribution of portfolio =Σ (portfolio portion of asset i-benchmark portion

i=1

of asset i)*(% return of asset i in benchmark-% return of benchmark)

n

Asset mix contribution of portfolio =Σ portfolio portion of asset i*(% return of asset i

i=1

in portfolio-% return of asset i in benchmark)

Does the length of time a manager is responsible for a fund affect the performance? Do trustees and policy managers wish to develop long-term relationship with fund managers? Does this happen in practice?

Normally, trustees are willing to maintain a long-term relationship with fund managers. Expensive to fire and hire could be concluded as one of reasons of long-term relationship. Because of relative high transaction cost involved, trustees always want to keep relationship with a manager with not too bad performance. Brown, Dick, and Paul (1992) discussed that 'terminating a long-standing personal relationship with fund managers was described to us as a fairly traumatic experience and a task not to be undertaken lightly.' and 'Very unpleasant was how one pension fund official described it'. But with bad performance managers, trustees not only intend to but also must do something to deal with this situation.

What might characterise the desirable facts of a fund manager?

Investment style can be dedicated to measure these aspects. A group of securities is said to belong to a similar 'style' when there is a high degree of co-movement in their prices. Commonly described styles include "value", "growth", "large market capitalisation" and "small market capitalisation".

Does the personality or behavioural characteristics of fund manager have a demonstratable effect on fund performance?

Book of Fenton-O'Creevy et al. (2004) discussed that investment bank traders are predominantly young, male, and well-educated with a tendency towards introversion and conservatism.

Is it possible to measure these aspects in relationship to fund management?

How does the fund manager balance policy aims and performance of the funds? What are the mechanisms/processes for balancing risk and return? What modelling support do fund managers use?

Every fund managers are given a target to pursue. The tracking error is a measure applied to assess the performance of fund manager. Tracking error can be defined as the total return on the portfolio (gross of fees) minus the total return on the benchmark index. Bps (1 basis point=0.01 percent)

How does the macro-economic factors effect fund performance?

Every where

How are regulatory requirements implemented?

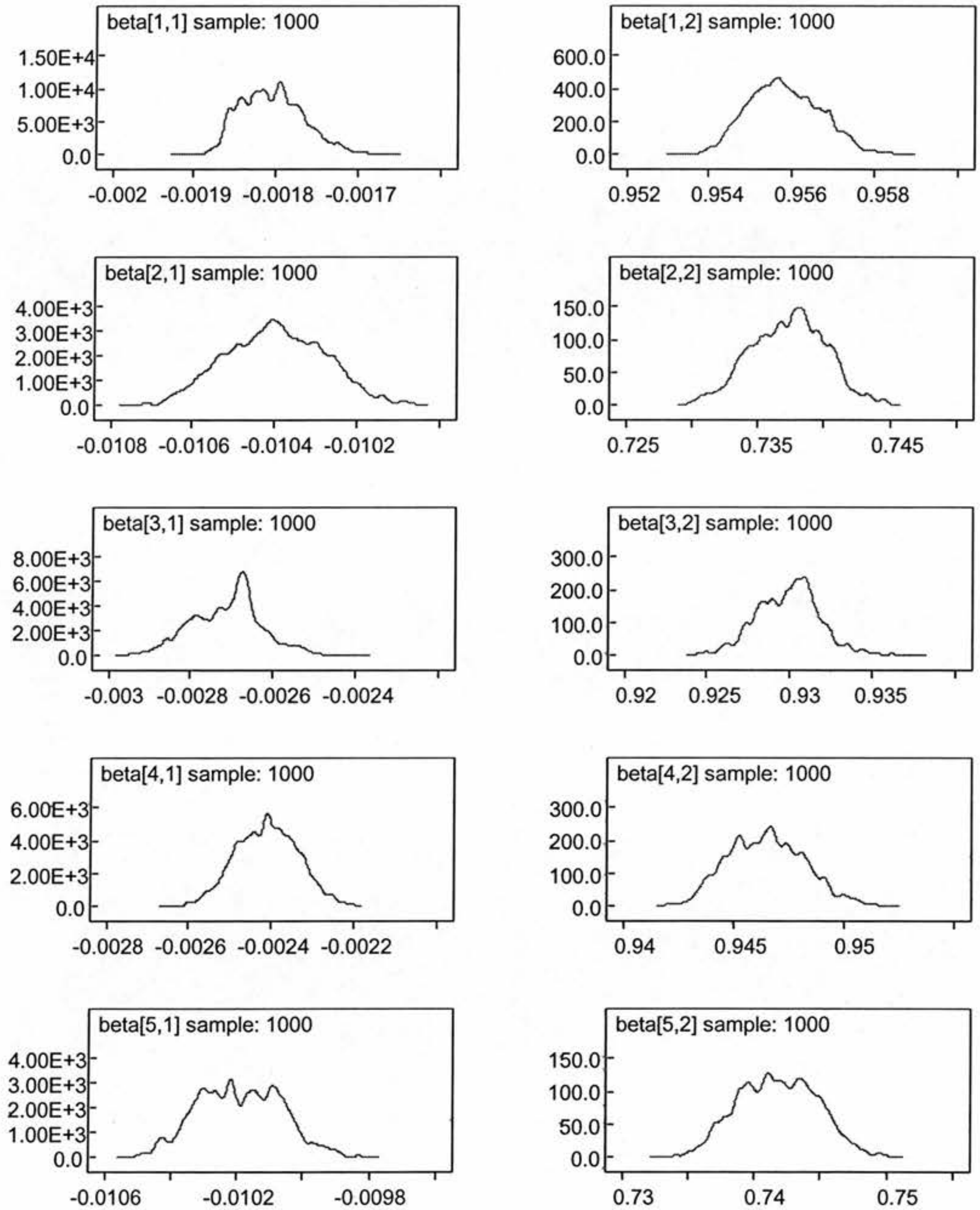
Every where

Do you believe fund performance persistent? How strong is the relationship between past and future performance?

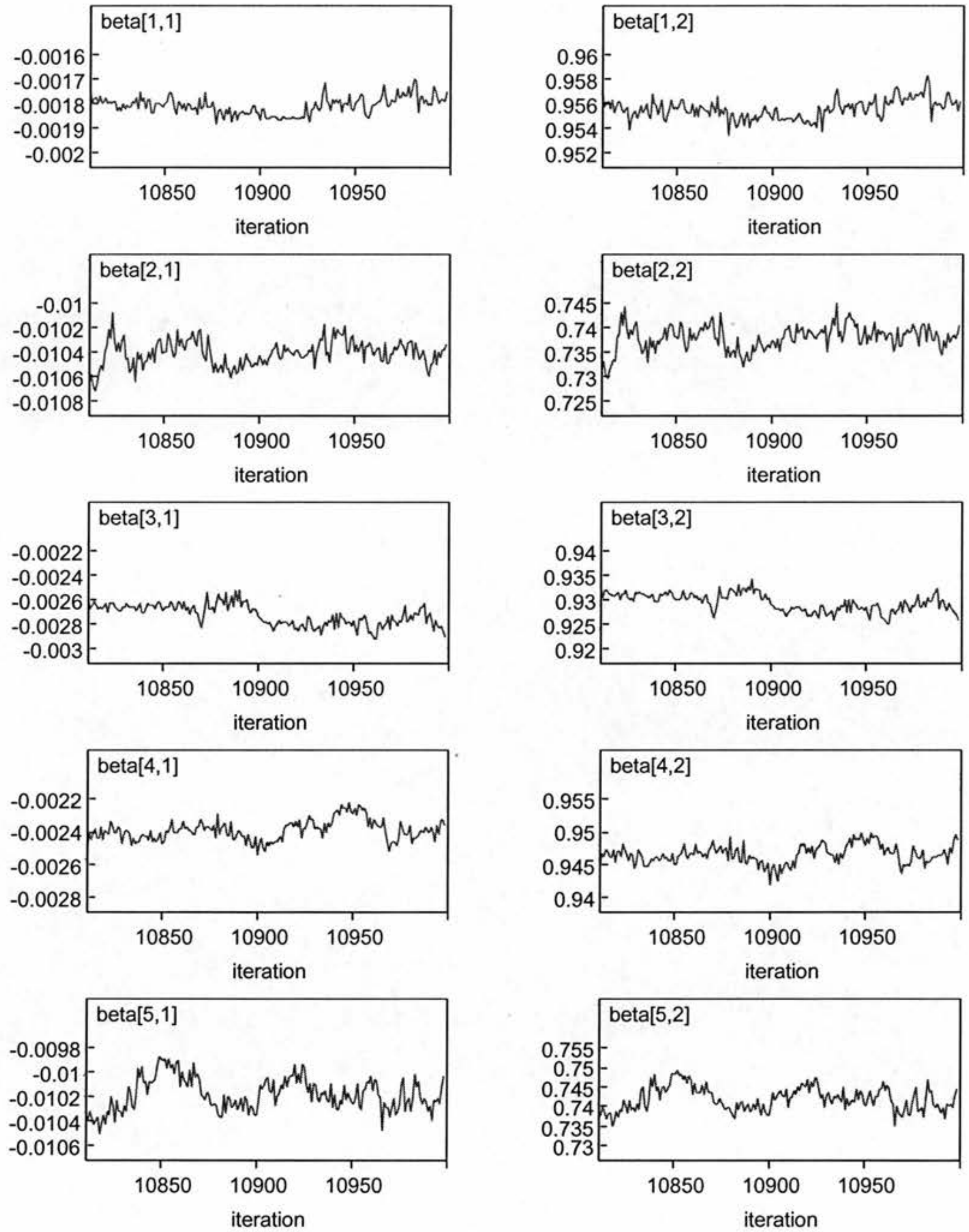
Fund may persistent in long-term base such as 3~5 years, but not in short-term base.

Appendix D (a): Fund Density and Trace of Dependent Model

Fund Density:



Fund Trace: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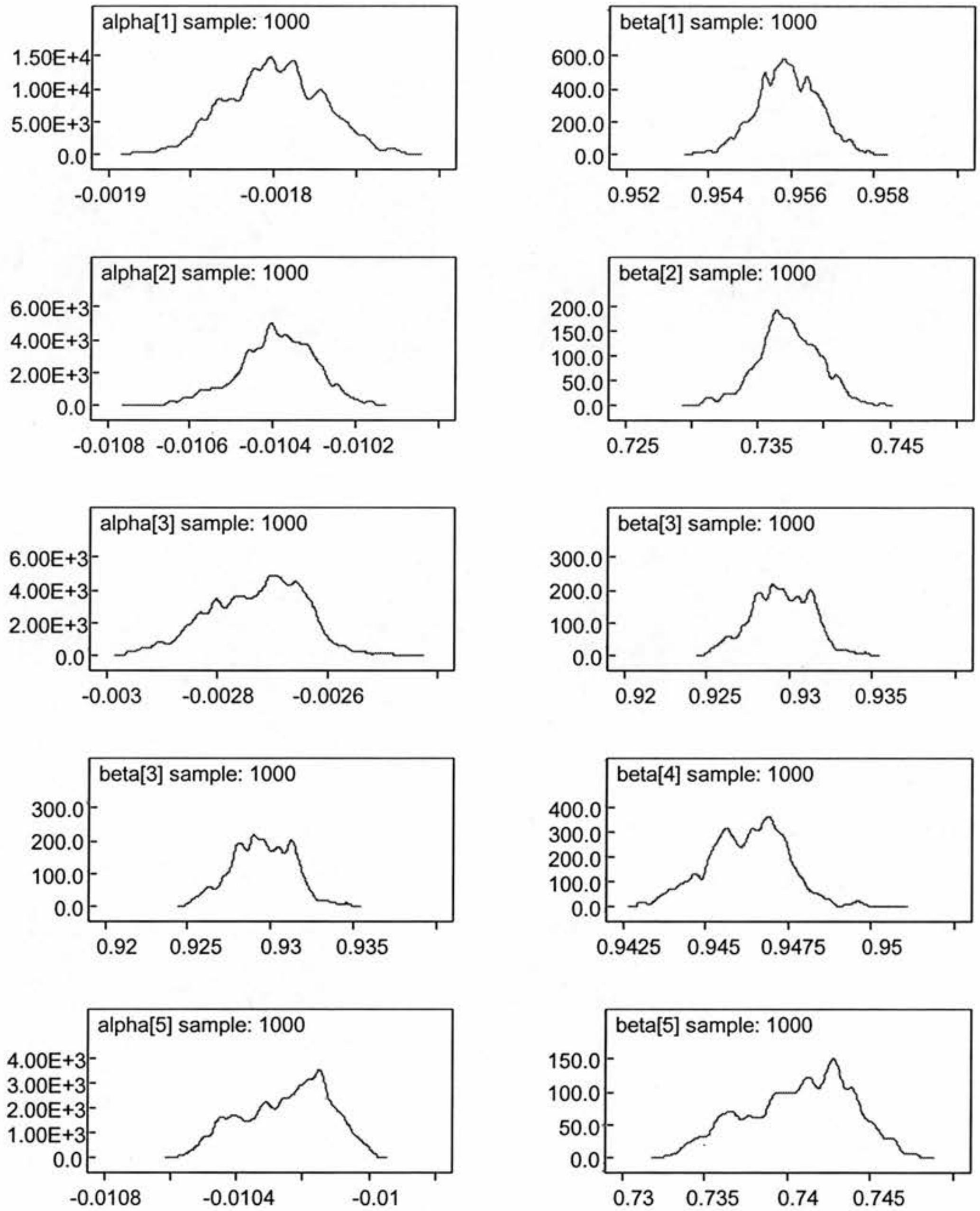
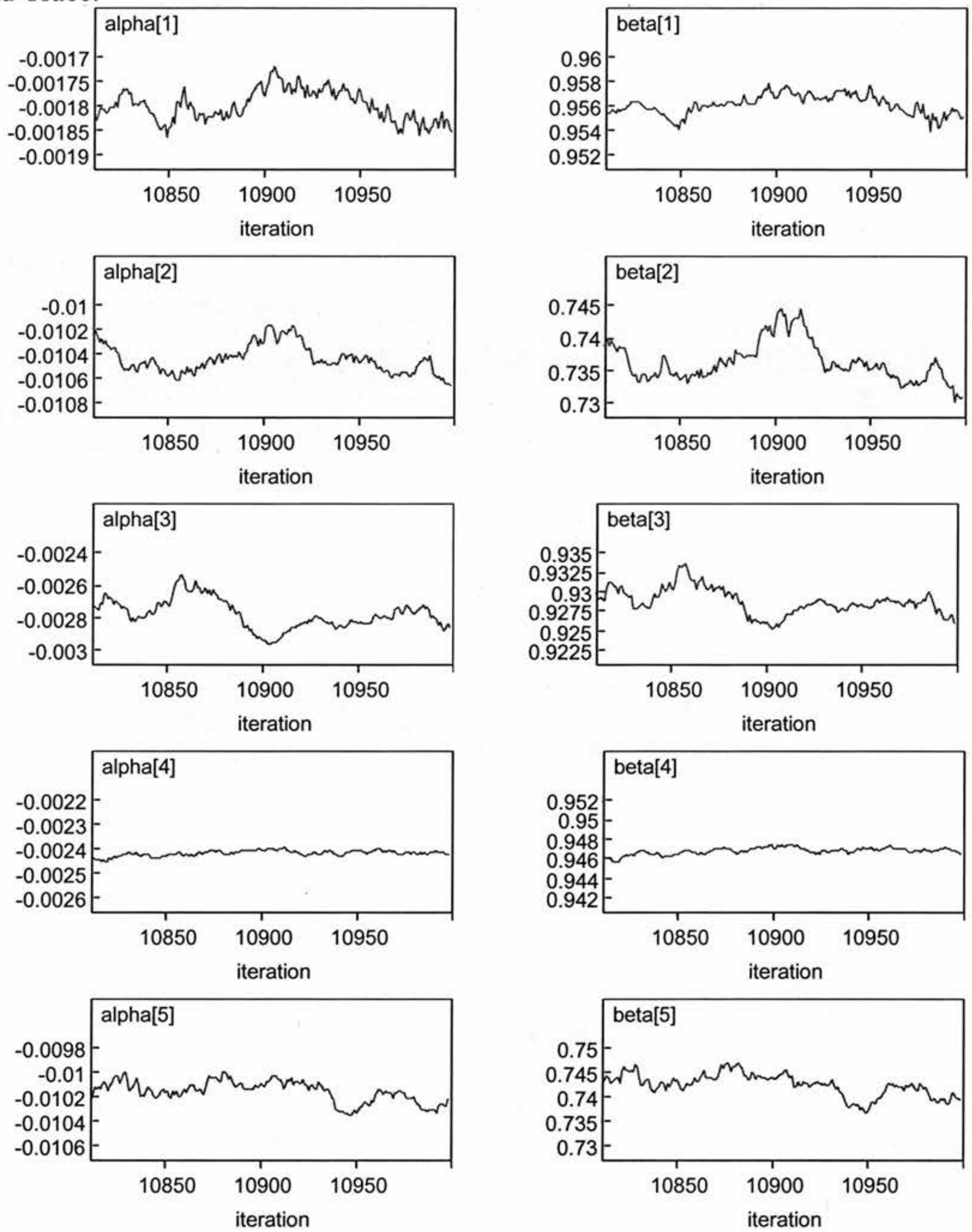
-0.0017
-0.0018
-0.0019
-0.002
10850 10900 10950
iteration
beta[1,2]
0.96
0.958
0.956
0.954
0.952
10850 10900 10950
iteration
beta[2,1]
-0.01
-0.0102
-0.0104
-0.0106
-0.0108
10850 10900 10950
iteration
beta[2,2]
0.745
0.74
0.735
0.73
0.725
10850 10900 10950
iteration
beta[3,1]
-0.0022
-0.0024
-0.0026
-0.0028
-0.003
10850 10900 10950
iteration
beta[3,2]
0.94
0.935
0.93
0.925
0.92
10850 10900 10950
iteration
beta[4,1]
-0.0022
-0.0024
-0.0026
-0.0028
10850 10900 10950
iteration
beta[4,2]
0.955
0.95
0.945
0.94
10850 10900 10950
iteration
beta[5,1]
-0.0098
-0.01
-0.0102
-0.0104
-0.0106
10850 10900 10950
iteration
beta[5,2]
0.755
0.75
0.745
0.74
0.735
0.73
10850 10900 10950
iteration

Appendix D (b): Fund Density and Trace of Independent Model

Fund Density:

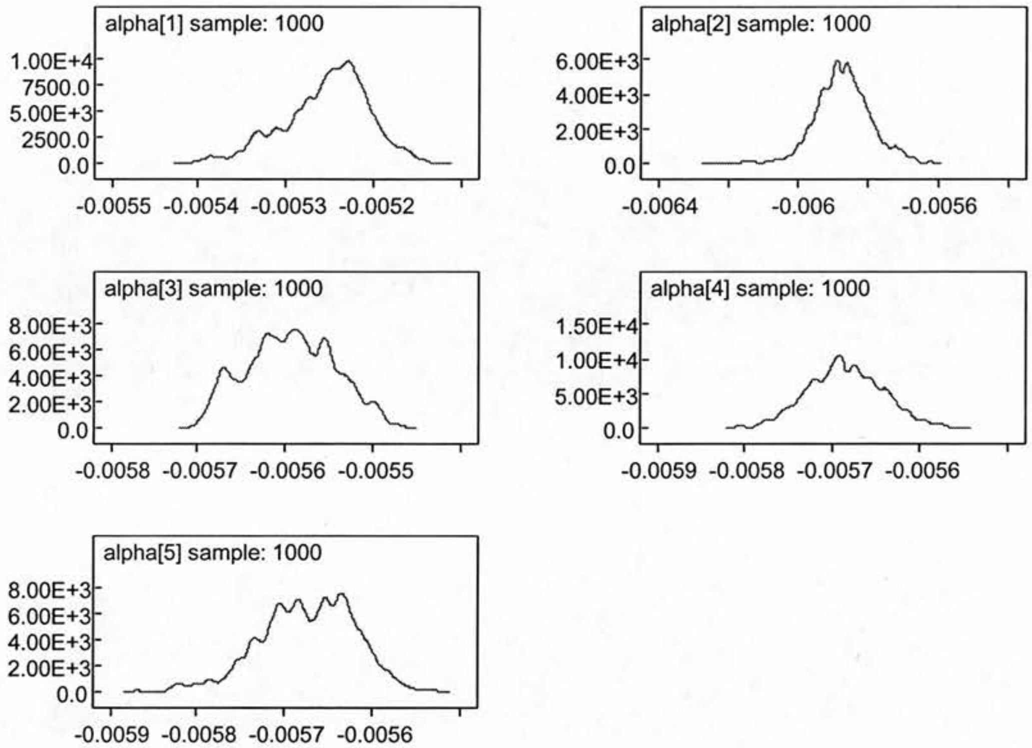


Fund Trace:

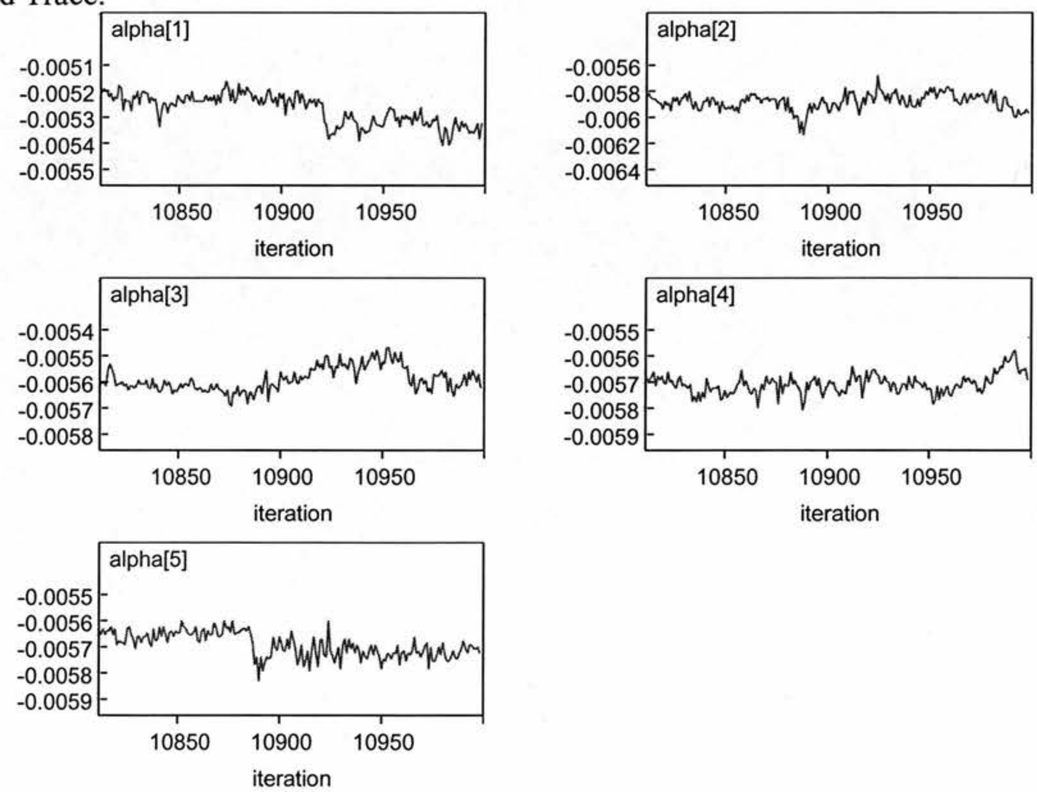

alpha[1]
-0.0017
-0.00175
-0.0018
-0.00185
-0.0019
10850 10900 10950
iteration
beta[1]
0.96
0.958
0.956
0.954
0.952
10850 10900 10950
iteration
alpha[2]
-0.01
-0.0102
-0.0104
-0.0106
-0.0108
10850 10900 10950
iteration
beta[2]
0.745
0.74
0.735
0.73
10850 10900 10950
iteration
alpha[3]
-0.0024
-0.0026
-0.0028
-0.003
10850 10900 10950
iteration
beta[3]
0.935
0.9325
0.93
0.9275
0.925
0.9225
10850 10900 10950
iteration
alpha[4]
-0.0022
-0.0023
-0.0024
-0.0025
-0.0026
10850 10900 10950
iteration
beta[4]
0.952
0.95
0.948
0.946
0.944
0.942
10850 10900 10950
iteration
alpha[5]
-0.0098
-0.01
-0.0102
-0.0104
-0.0106
10850 10900 10950
iteration
beta[5]
0.75
0.745
0.74
0.735
0.73
10850 10900 10950
iteration

Appendix D (c): Fund Density and Trace of Constant β Model

Fund Density:



Fund Trace:



Appendix E: Overall Portfolio Composition and Macroeconomic Factors Tables

Overall Portfolio Composition:

Abbreviated Fund Name	Fund Name	Cash:	Stocks:	Bonds:	Other:
a1	**Alpine International Real Estate**	0.01	99.06	0.51	0.42
a2	**AXA Enterprise Equity Income A**	1.78	97.09	N/A	1.14
c1	**Calvert Social Investment Equity A**	3.89	95.3	N/A	0.81
c2	**CGM Advisor Targeted Equity A**	1.38	98.62	N/A	0
e1	**Evergreen Equity Index Instl**	9.3	88.95	N/A	1.75
e2	**Excelsior Blended Equity**	1.06	98.5	N/A	0.44
f	**Federated Equity-Income A**	6.71	84.54	N/A	8.75
h	**Huntington Income-Equity Tr**	0.17	99.83	N/A	0
i	**Federated International Equity A**	0.01	99.98	N/A	0
j1	**JHancock Large Cap Equity A**	2.68	95.3	0.01	2
j2	**JPMorgan Equity Income Select**	0.45	97.24	0.85	1.47
l1	**Legg Mason Partners Social Awareness B**	5.69	73.69	20.62	0
l2	**Lord Abbett Global Equity A**	0	99.95	0.04	0
m1	**MFS Global Equity B**	2.09	97.07	N/A	0.85
m2	**BlackRock Equity Dividend B**	8.18	91.63	N/A	0.19
m3	**BlackRock Equity Dividend I**	8.18	91.63	N/A	0.19
o1	**Old Mutual Analytic Defensive Equity Z**	11	88.96	N/A	0
o2	**Orbis Leveraged Equity Fund**	Orbis Leveraged fund is funds of hedge funds which is to borrow money to invest in the Orbis Optimal fund.			
p	**Phoenix Insight Equity N**	0.95	99.05	N/A	0
s1	**SM&R Equity Income T**	1.3	98.7	N/A	0
s2	**Fidelity Spartan U.S. Equity Index Inv**	0.99	97.78	N/A	1.23
t1	**T. Rowe Price Equity Income**	4.98	94.04	0.14	0.86
t2	**T. Rowe Price Instl Foreign Equity**	1.76	97.59	N/A	0.65
u	**U.S. Global Investors All American Eq**	12.2	79.14	0.83	7.88
w1	**Westwood Equity AAA**	0	100	N/A	0
w2	**Principal Inv West Coast Equity A**	2.17	97.02	0.54	0.26

Class a: Mutual fund shares of a class that carries a front-end load. Front load sales charge paid when an individual buys an investment, such as a mutual fund, limited partnership, annuity, or insurance policy. The load is clubbed with the first payment made by an investor, so the total initial payment is higher than the later payments.

The purpose of a load is to cover administrative expenses and transaction costs and sometimes to discourage asset turnover.

Class b: Mutual fund shares of a class that carries a back-end load. The back-end load is paid when the fund is sold .

Class c Mutual fund shares of a class that carries an ongoing fee. The ongoing fee is often a 12b-1 fee, paid annually. 12b-1 the fees, charged every year.

Class I would be sold only to institutional investors and might have different fees and expenses. J Shares are available to retirement plan participants who are departing a retirement plan.

Class N shares are available to the general public without a sales load.

Class y Mutual fund shares of a class available to institutional investors. Institutional shares carry no load or 12b-1 fees. It is also called Y shares.

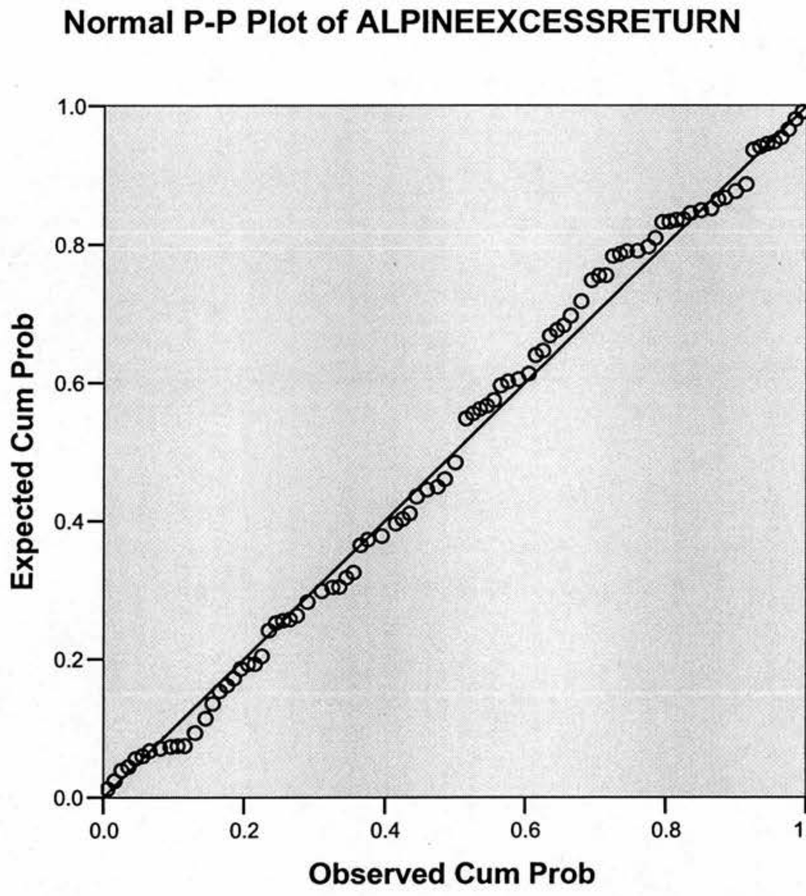
Class z Mutual fund shares of a class available to employees of the fund.

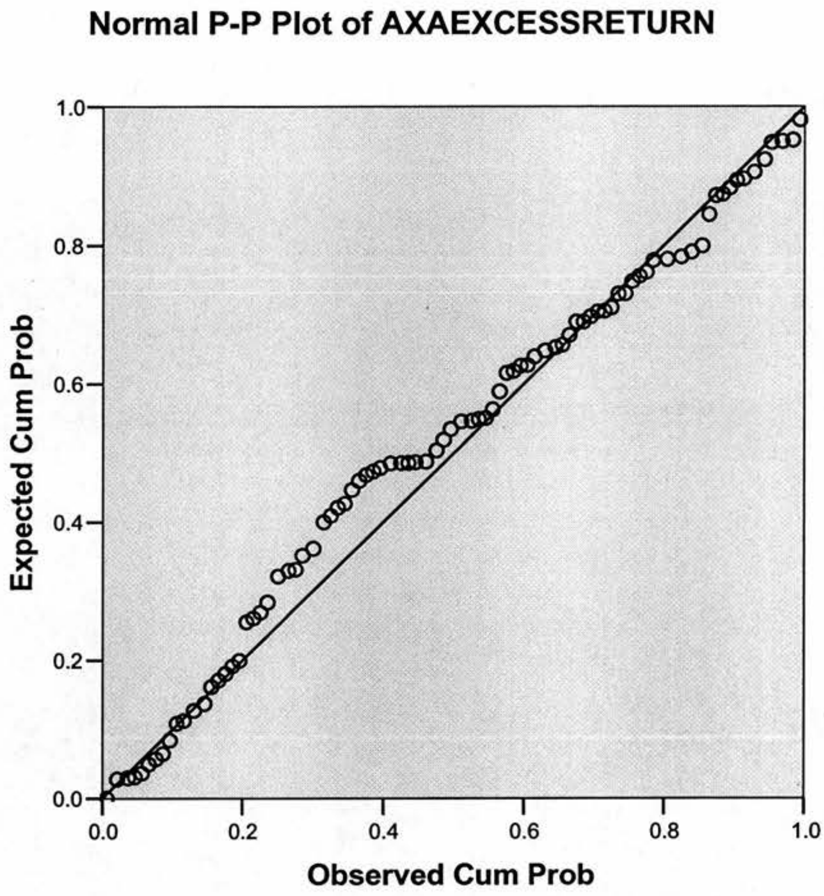
Macroeconomic Factors Table:

US COMMERCIAL BANK ASSETS - COMMERCIAL & INDUSTRIAL LOANS		hereafter cci
US COMMERCIAL BANK ASSETS - LOANS & LEASES IN BANK CREDIT		hereafter cll
US CPI ALL URBAN	The index has been designed as a macro-economic measure of consumer price inflation. It includes expenditures by all urban consumers.	hereafter cpi
US TRADE-WEIGHTED VALUE OF US DOLLAR AGAINST MAJOR CURRENCIES	Seven of the twenty-six currencies in the broad index—the euro, Canadian dollar, Japanese yen, British pound, Swiss franc, Australian dollar, and Swedish krona—trade widely in currency markets outside their respective home areas, and these currencies (along with the U.S. dollar) are referred to by the Board's staff as ''major'' currencies. Track the trade-weighted exchange value of the dollar against the corresponding subsets of currencies. As the major currencies generally trade in liquid financial markets, the major currencies index can be used to gauge financial market pressures on the dollar.	hereafter d
US FEDERAL FUND RATE	The **federal funds rate** is the interest rate at which depository institutions lend balances (federal funds) at the Federal Reserve to other depository institutions overnight. It is *not* (as the name might initially suggest) the rate at which the Fed lends to financial institutions. That is the discount rate.	hereafter f
US FEDERALFUND RATE TARGET	The **federal funds rate target** is a target set by the governors of the Federal Reserve	hereafter ft
US MONETARY BASE	The total of all physical currency, plus accounts at the central bank which can be exchanged for physical currency.	hereafter mb
US MONEY SUPPLY M1	M0 + the amount in demand accounts ("checking" or "current" accounts).	hereafter m1
US MONEY SUPPLY M2	M1 + most savings accounts, money market accounts, and certificate of deposit accounts (CDs) of under $100,000	hereafter m2

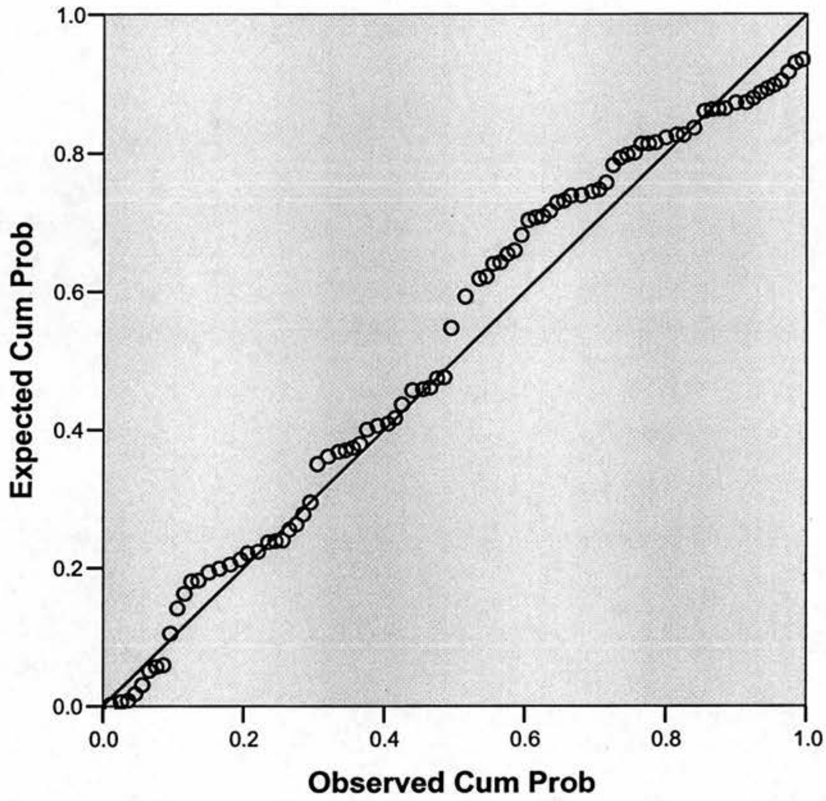
US PERSONAL CONSUMPTION EXPENDITURES	Comprehensive measure of how much consumers spend each month, counting expenditures on durable goods, consumer products, and services.	hereafter pp
US UNEMPLOYMENT RATE	The unemployment rate is the percentage of the labour force that is unemployed and actively seeking a job. Figures are seasonally adjusted percentages of the civilian labour force age 16 years and older obtained from the U.S. Bureau of Labour Statistics	hereafter ur
US CONSUMER CONFIDENCE INDEX	The US **Consumer Confidence Index** (CCI) is defined as the degree of optimism on the state of the economy that consumers are expressing through their activities of savings and spending.	hereafter coci
MARKET PORTFOLIO S&P 500	The **S&P 500** is an index containing the stocks of 500 Large-Cap corporations, most of which are American. The index is the most notable of the many indices owned and maintained by Standard & Poor's, a division of McGraw-Hill.	hereafter sp500

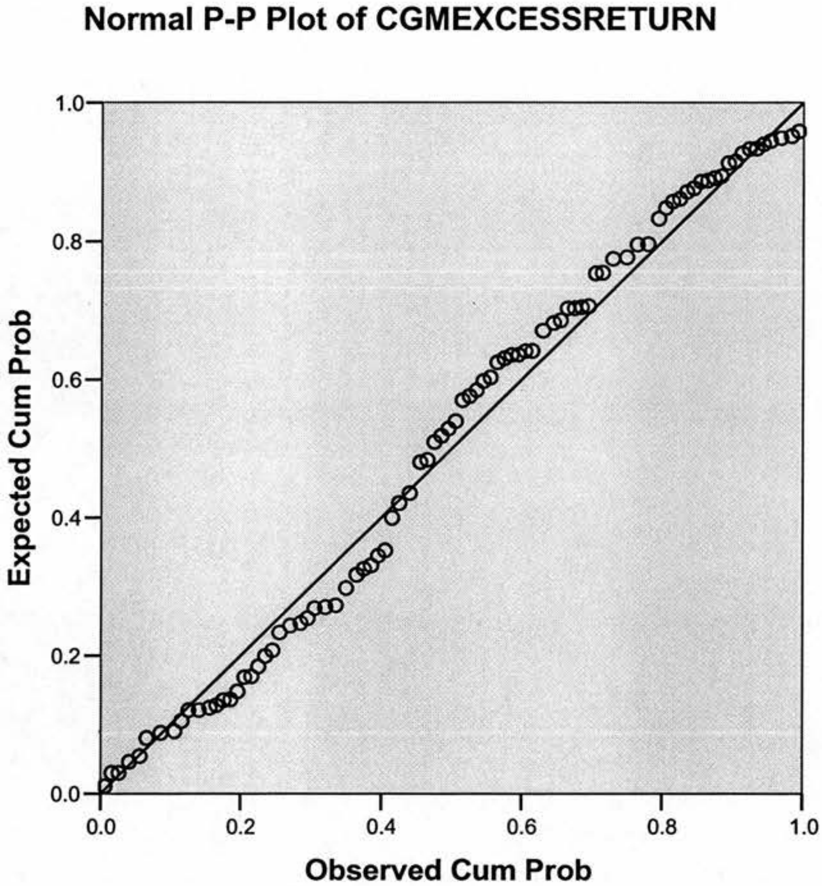
Appendix F (a) P-P Plot for Factor sp500

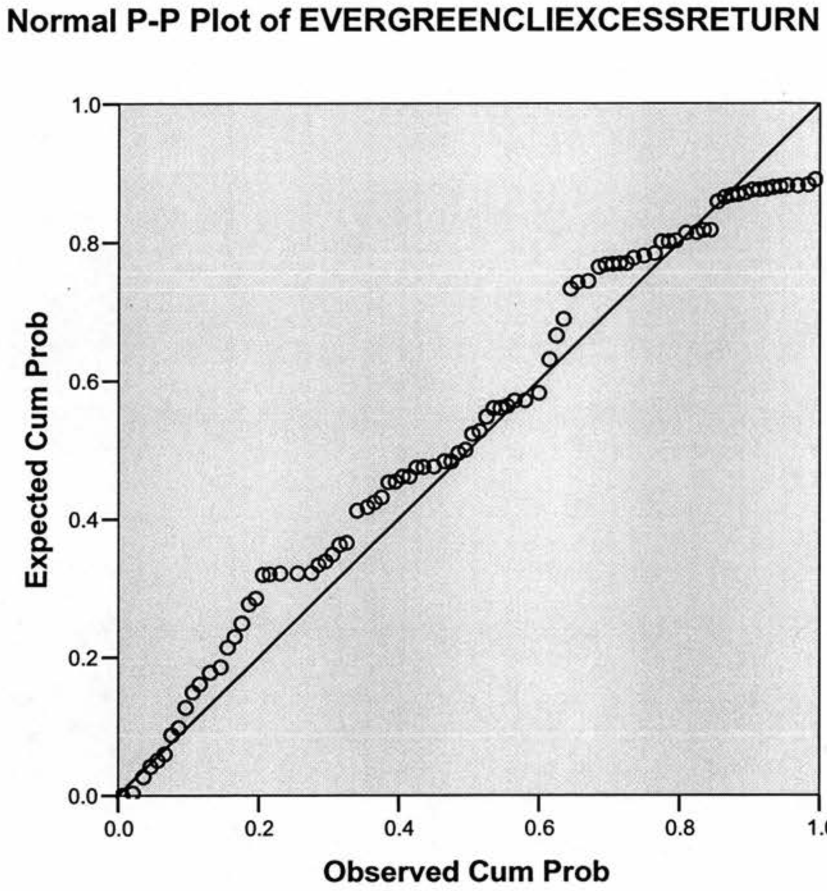



Normal P-P Plot of AXAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

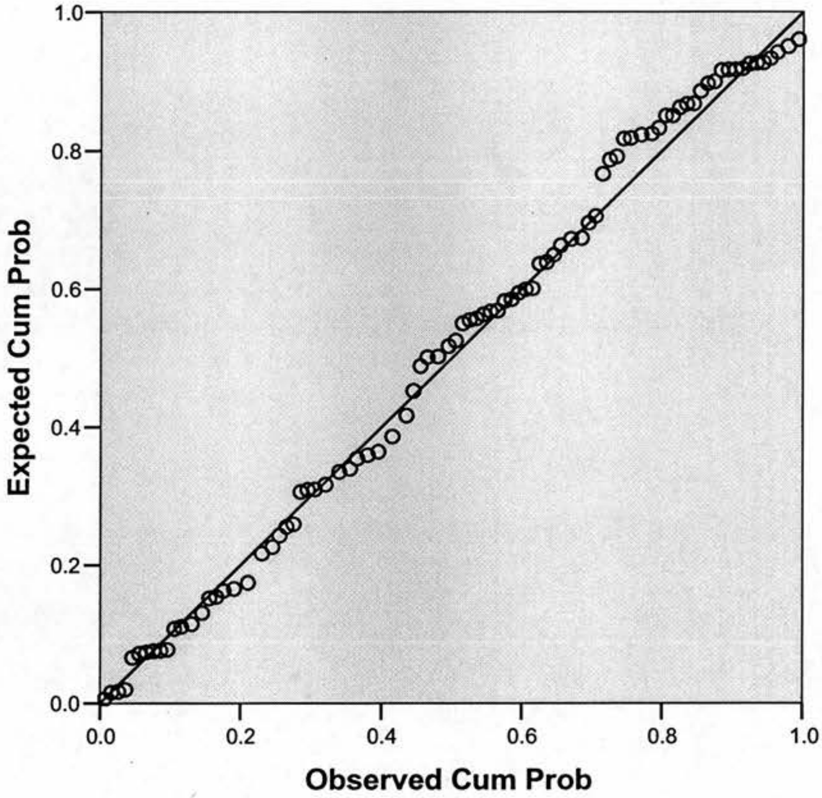
Normal P-P Plot of CALVERTEXCESSRETURN



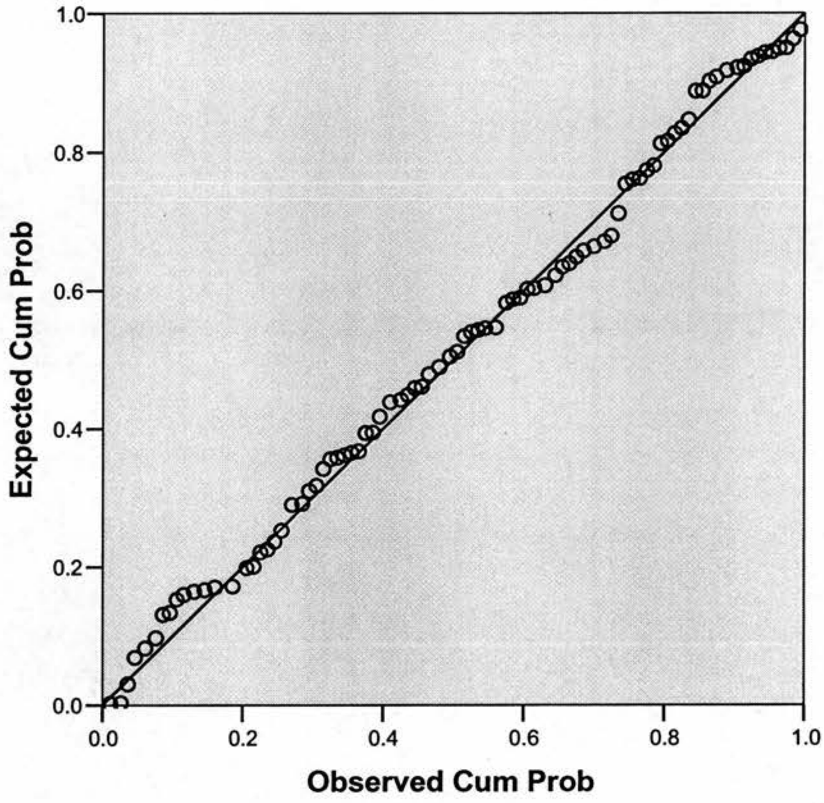

Normal P-P Plot of CGMEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of EVERGREENCLIEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

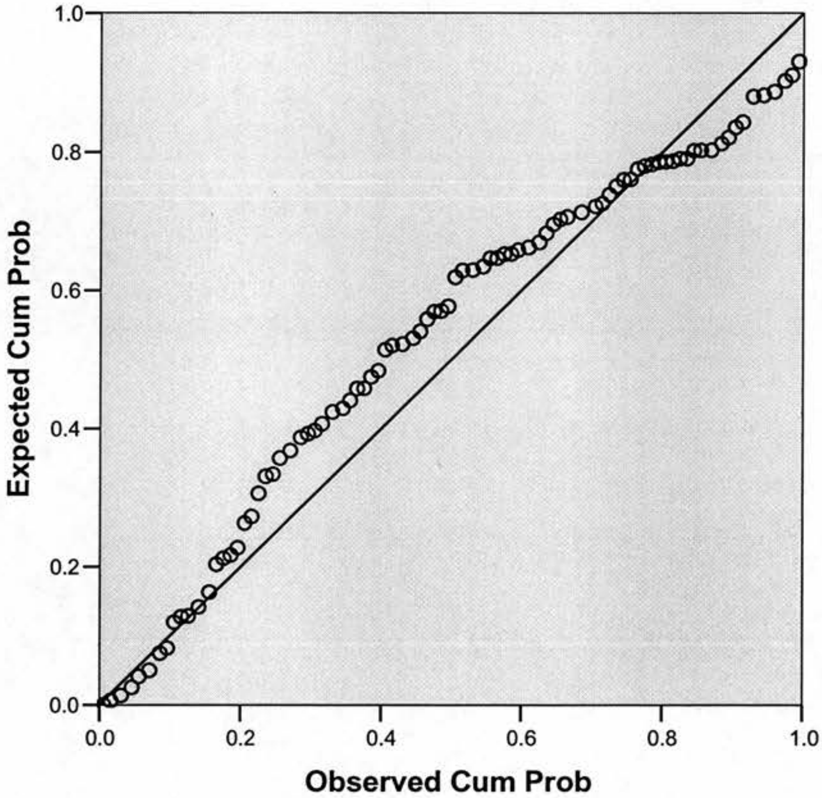
Normal P-P Plot of EXCELSIOREXCESSRETURN



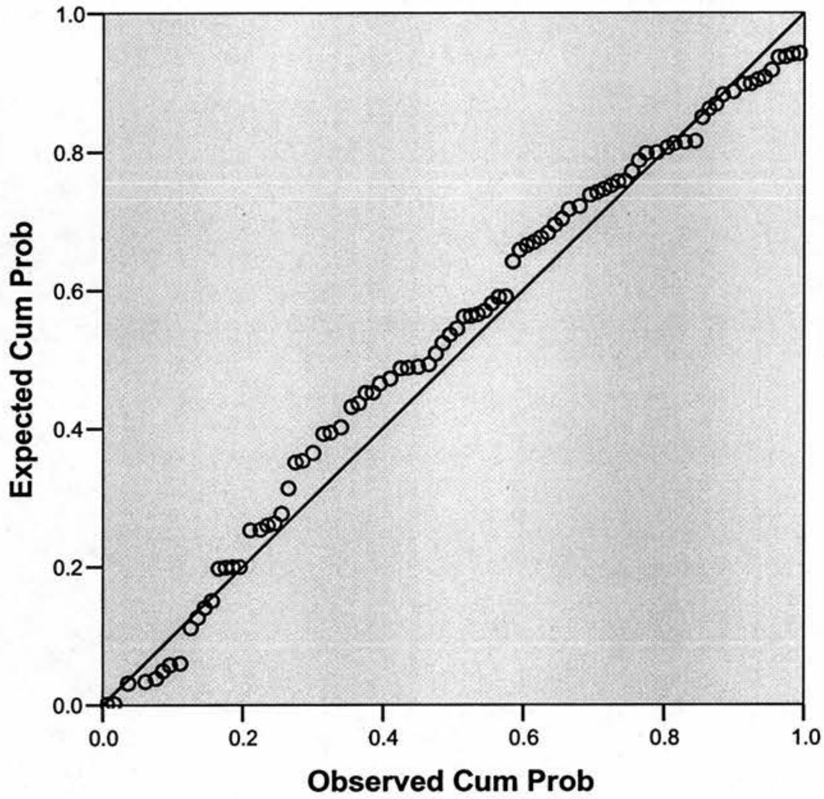
Normal P-P Plot of FEDERATEDEXCESSRETURN



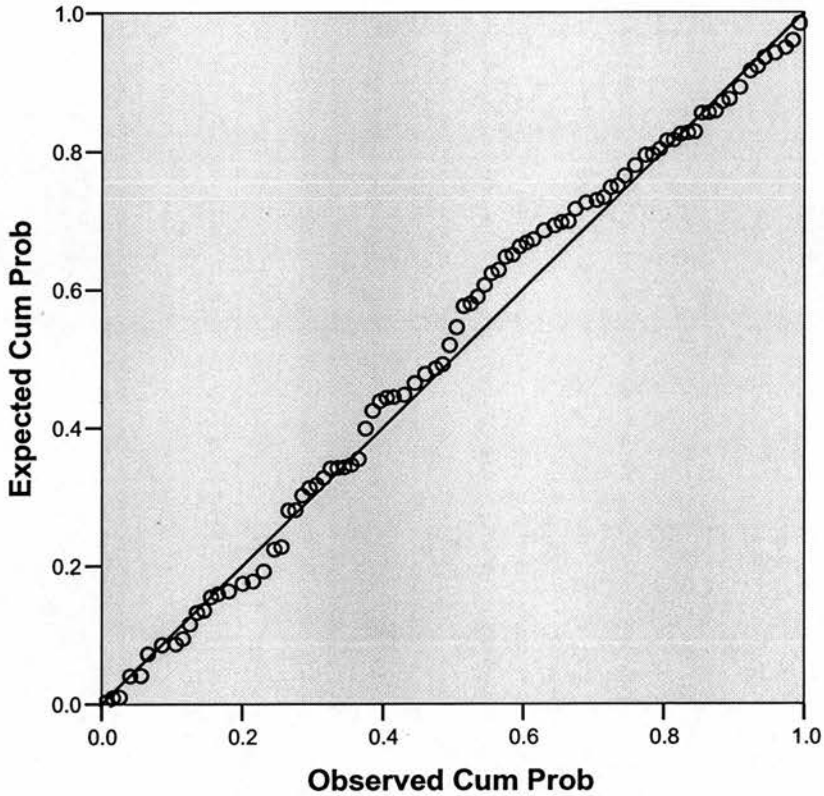
Normal P-P Plot of HUNTINGTONEXCESSRETURN

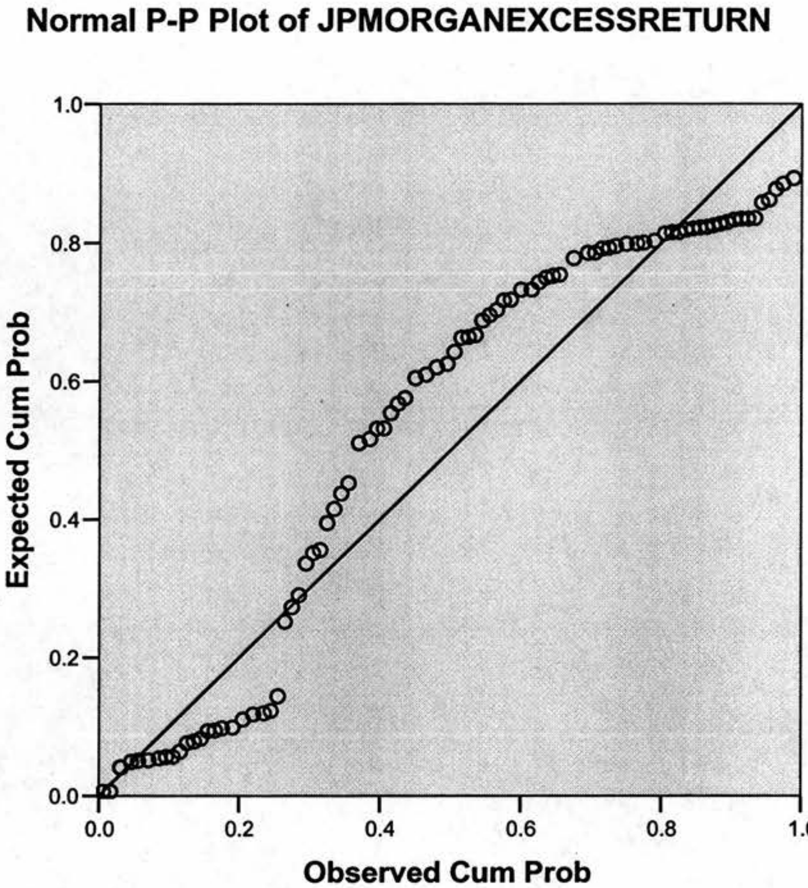


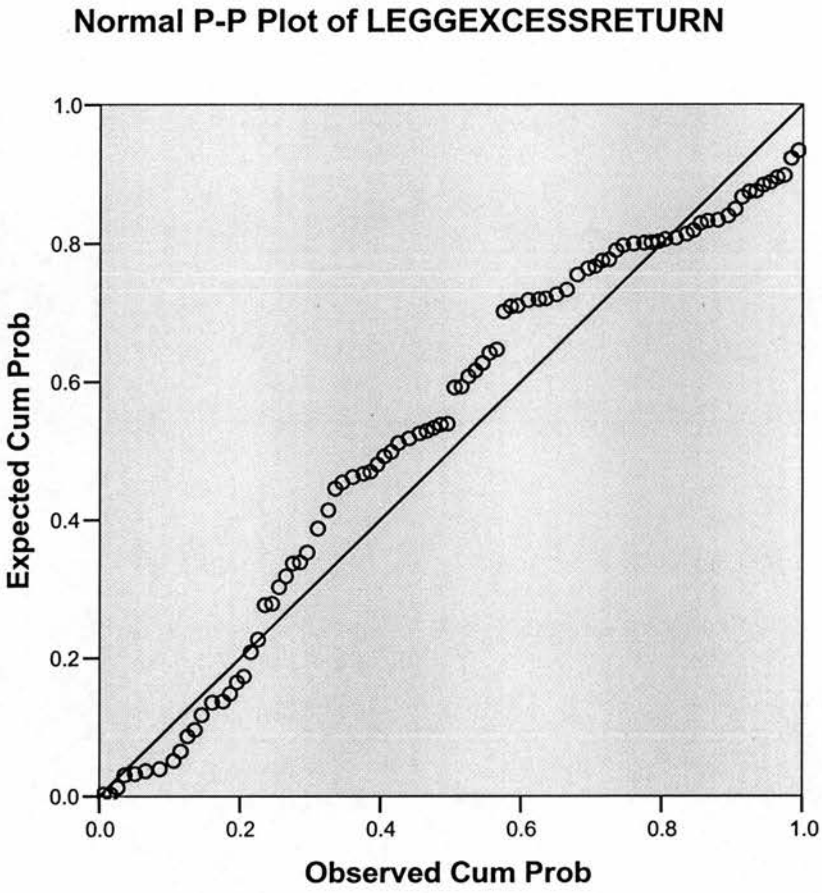
Normal P-P Plot of INTLCLAEXCESSRETURN



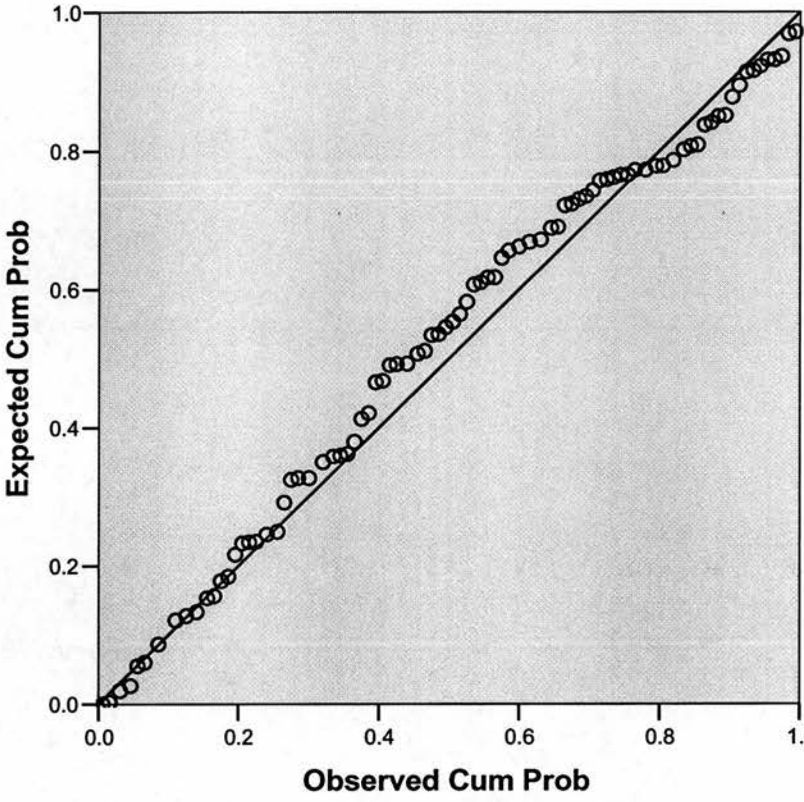
Normal P-P Plot of JCOCKCLAEXCESSRETURN

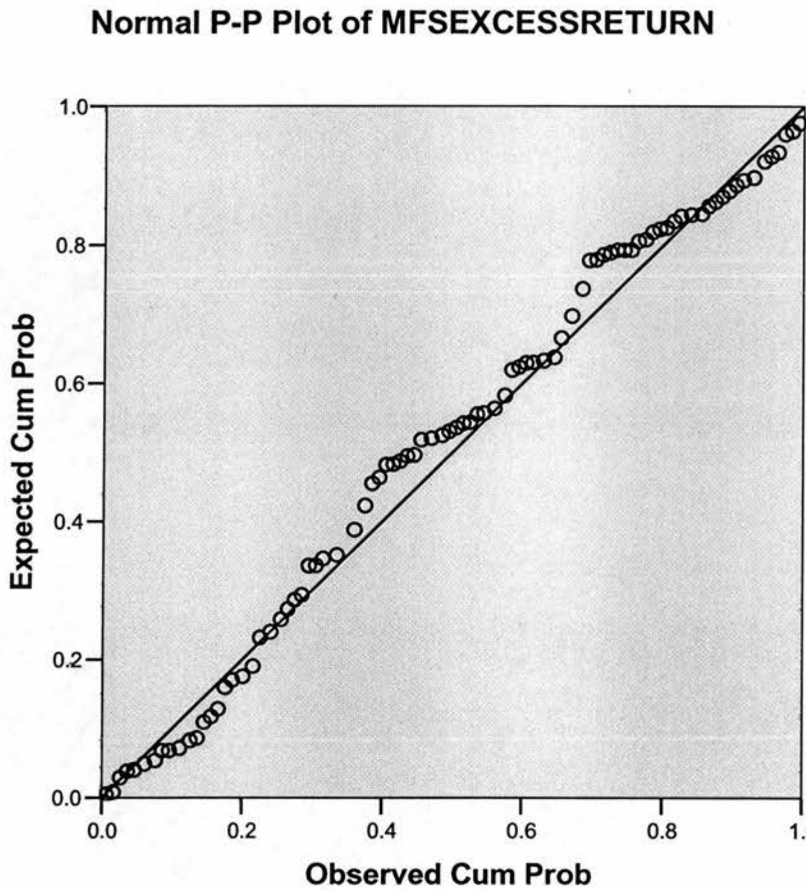


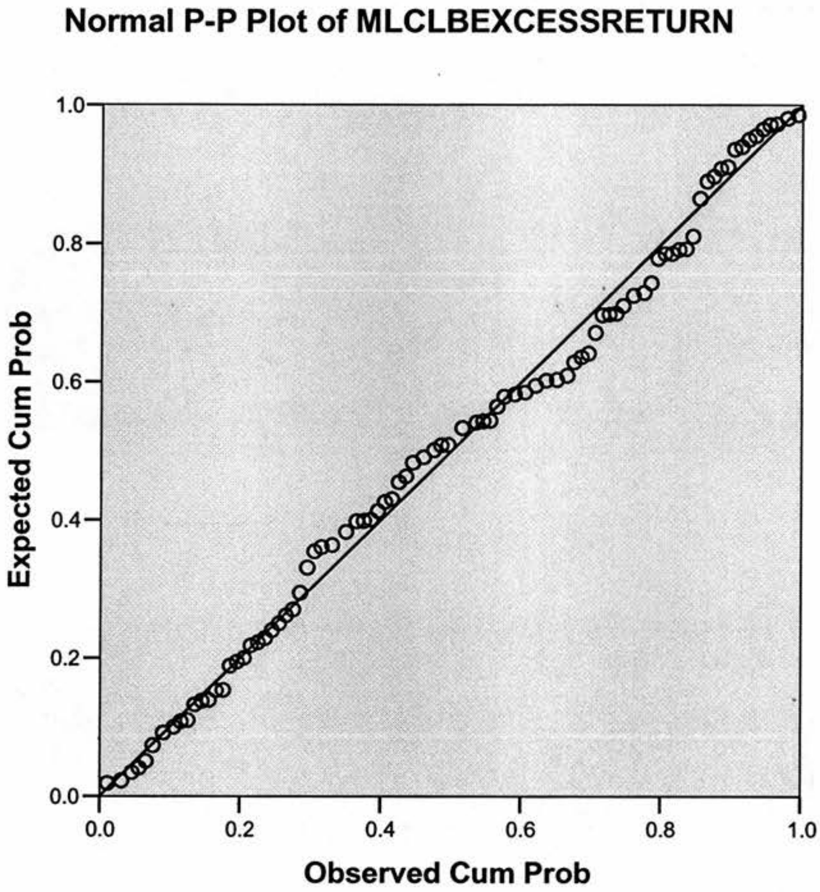

Normal P-P Plot of JPMORGANEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of LEGGEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

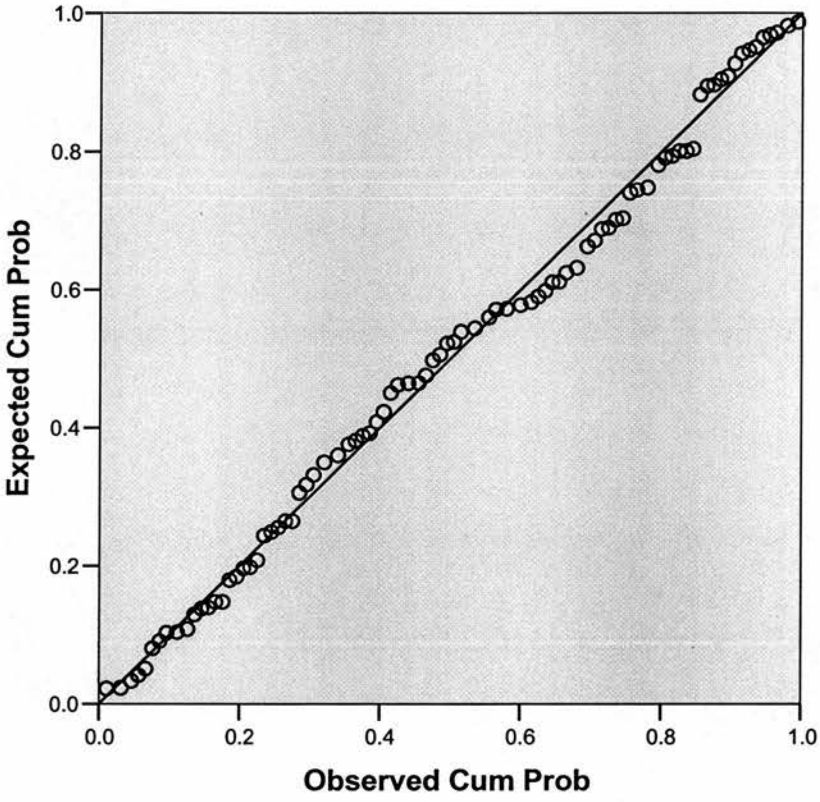
Normal P-P Plot of LORDABBETTEXCESSRETURN



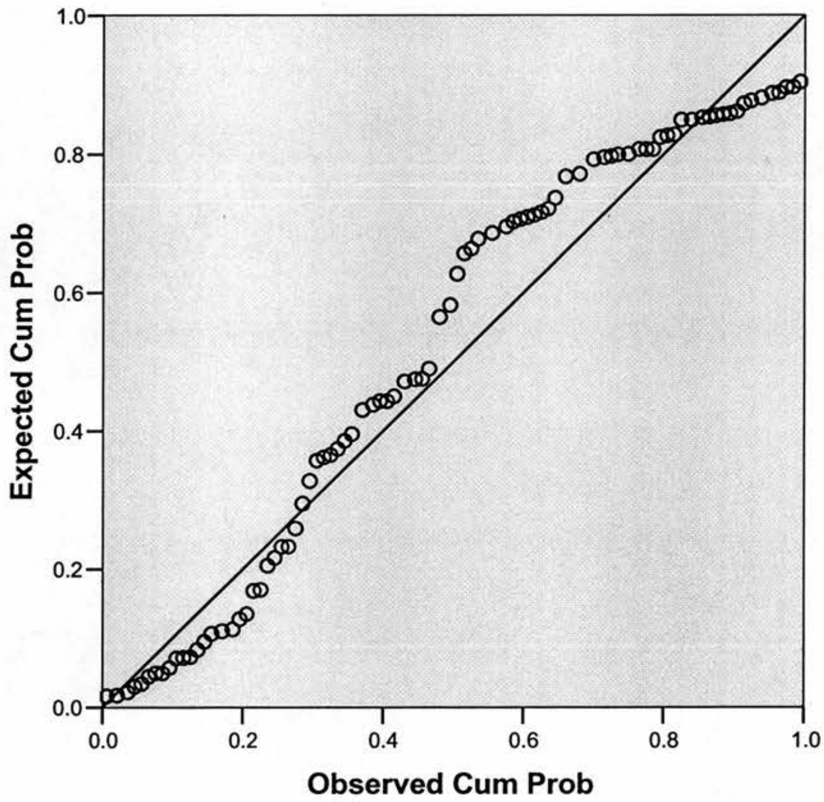

Normal P-P Plot of MFSEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

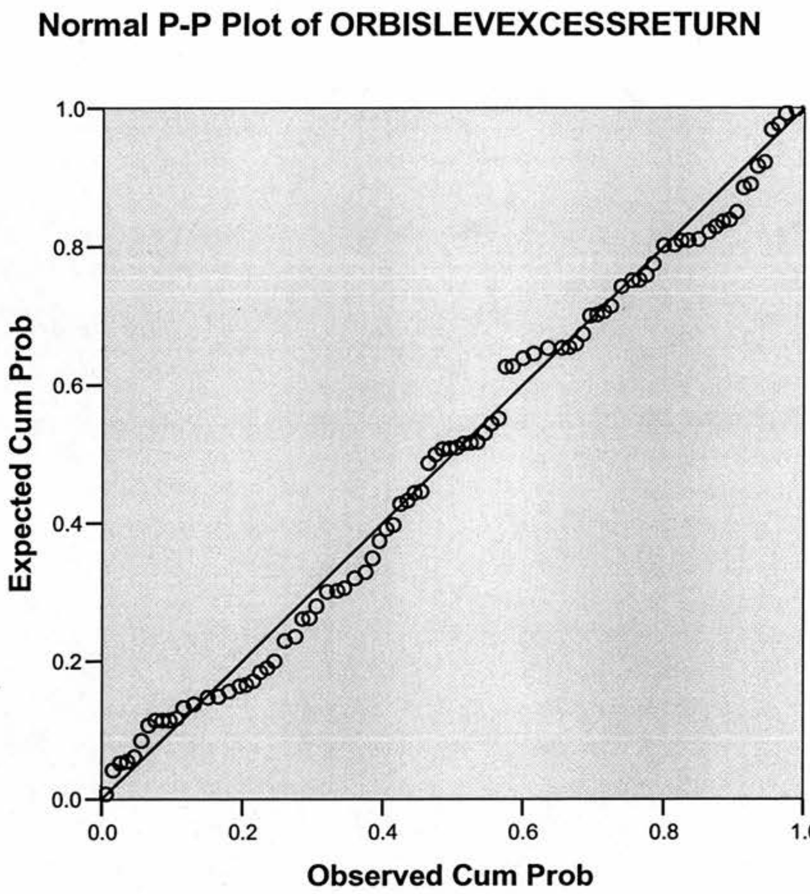

Normal P-P Plot of MLCLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of MLCLIEXCESSRETURN

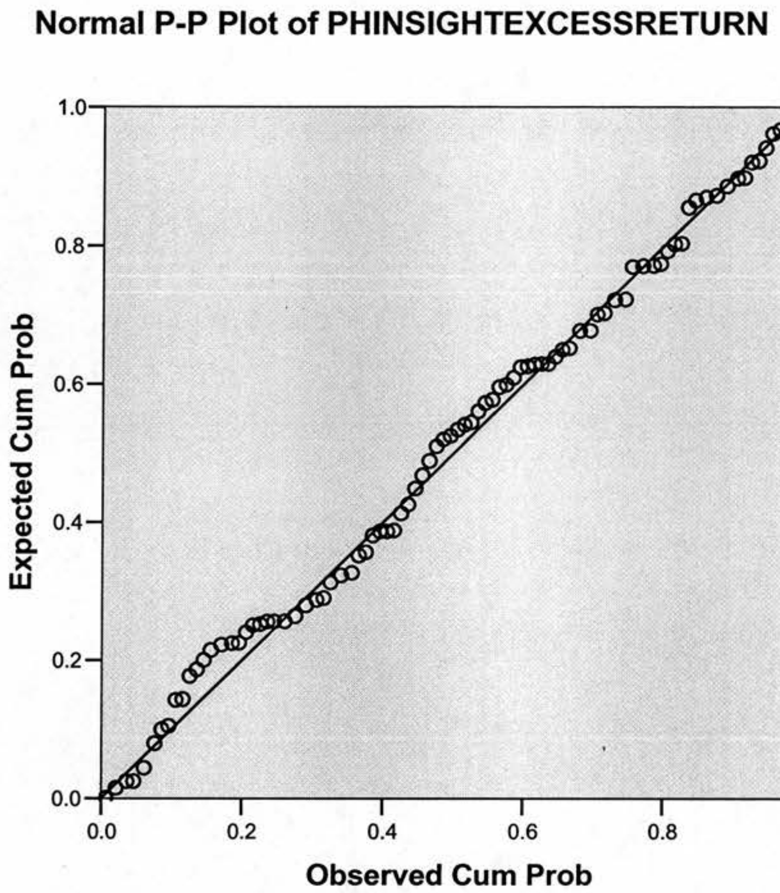


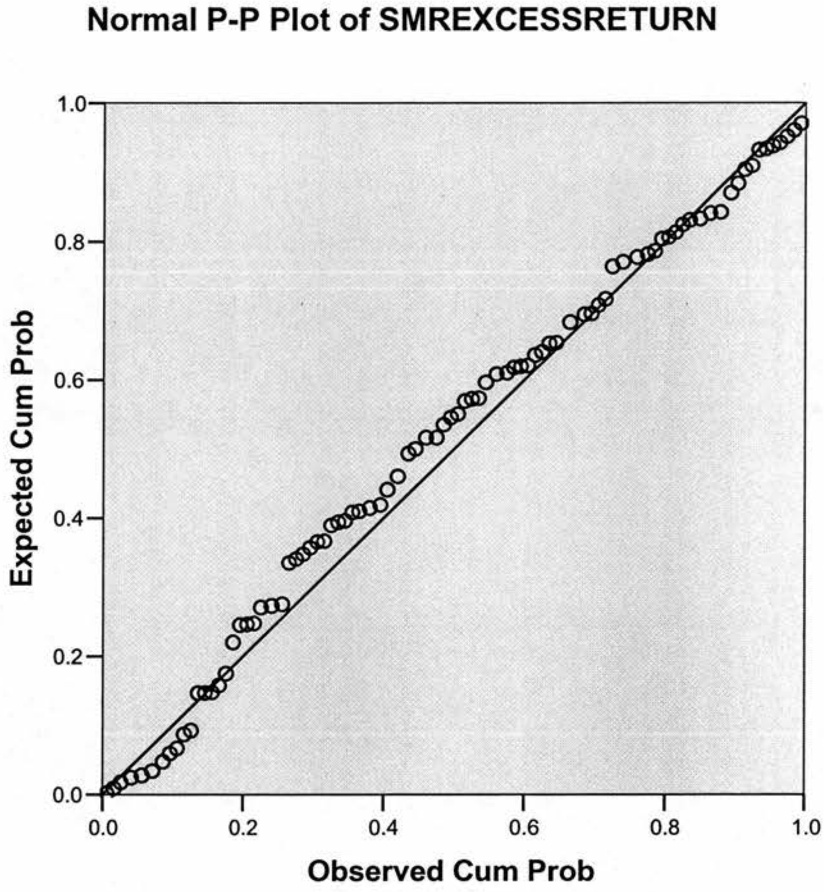
Normal P-P Plot of OLDMUTCLZEXCESSRETURN

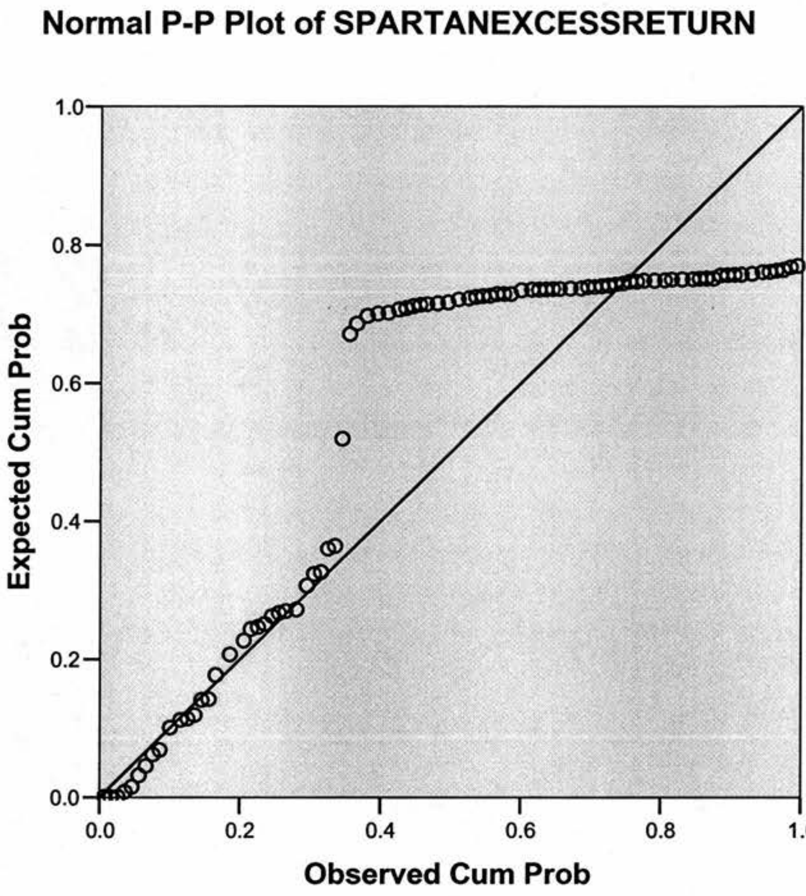


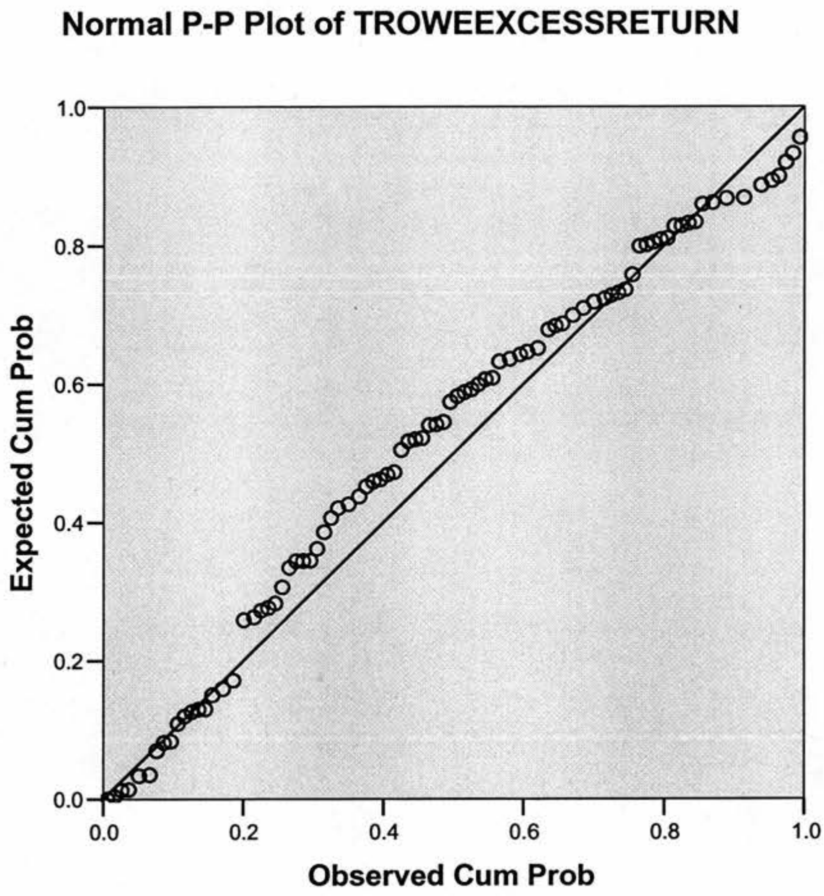


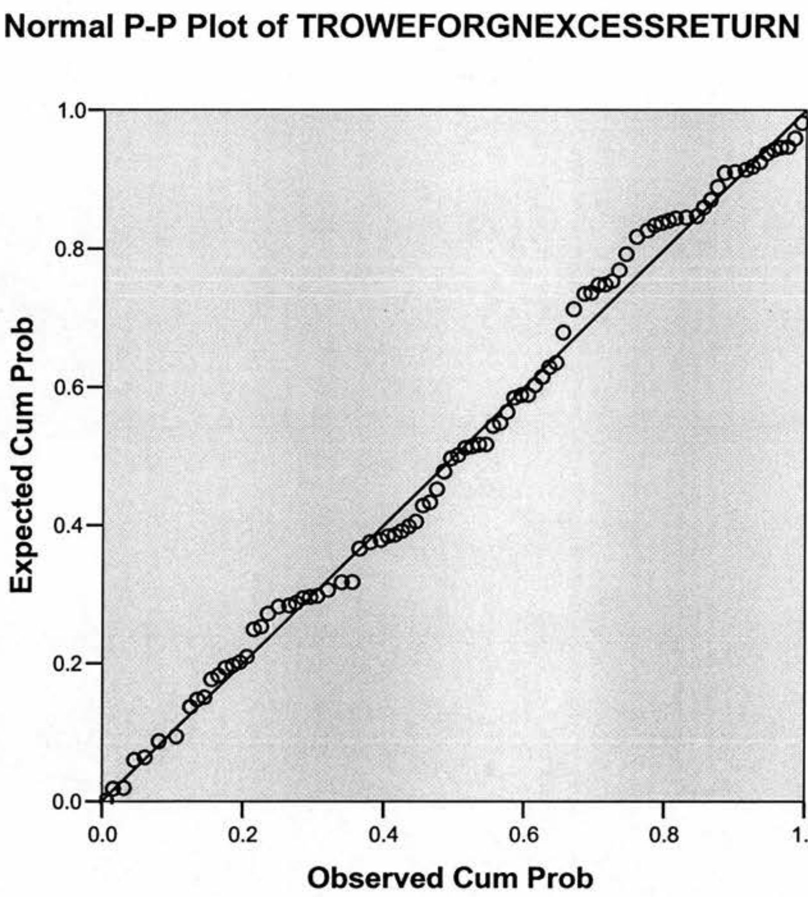
Normal P-P Plot of ORBISLEVEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of PHINSIGHTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

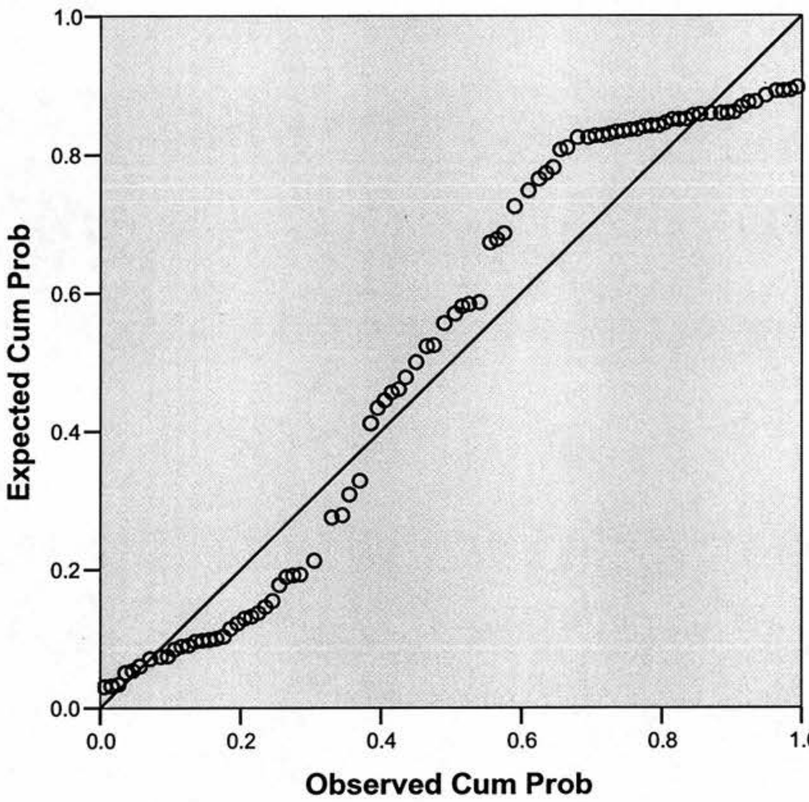

Normal P-P Plot of SMREXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

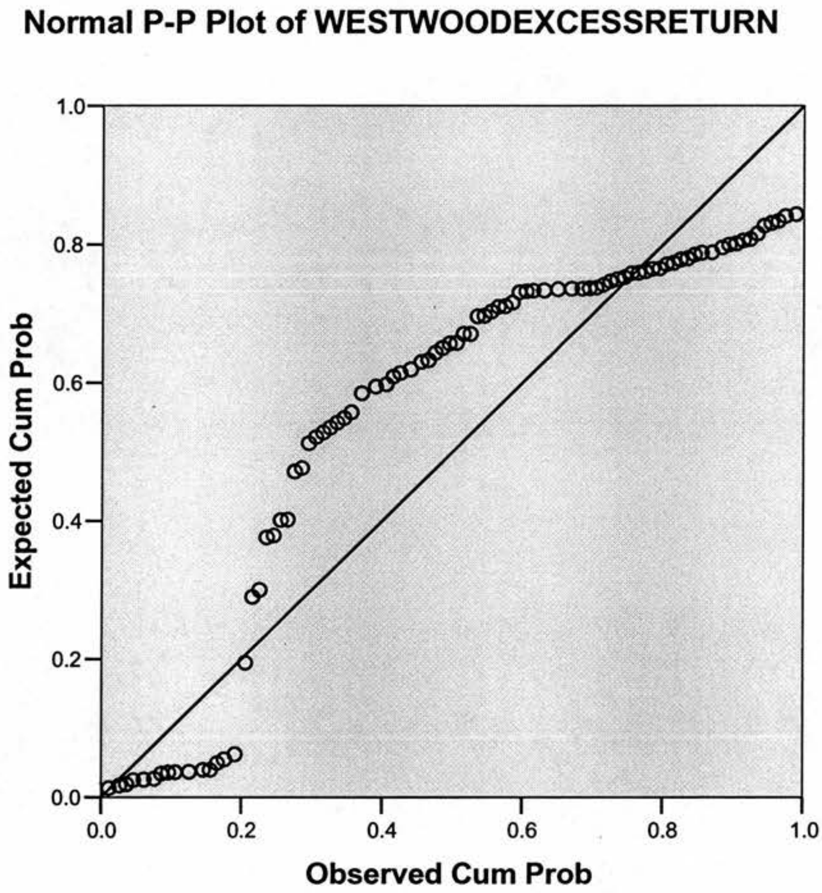

Normal P-P Plot of SPARTANEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

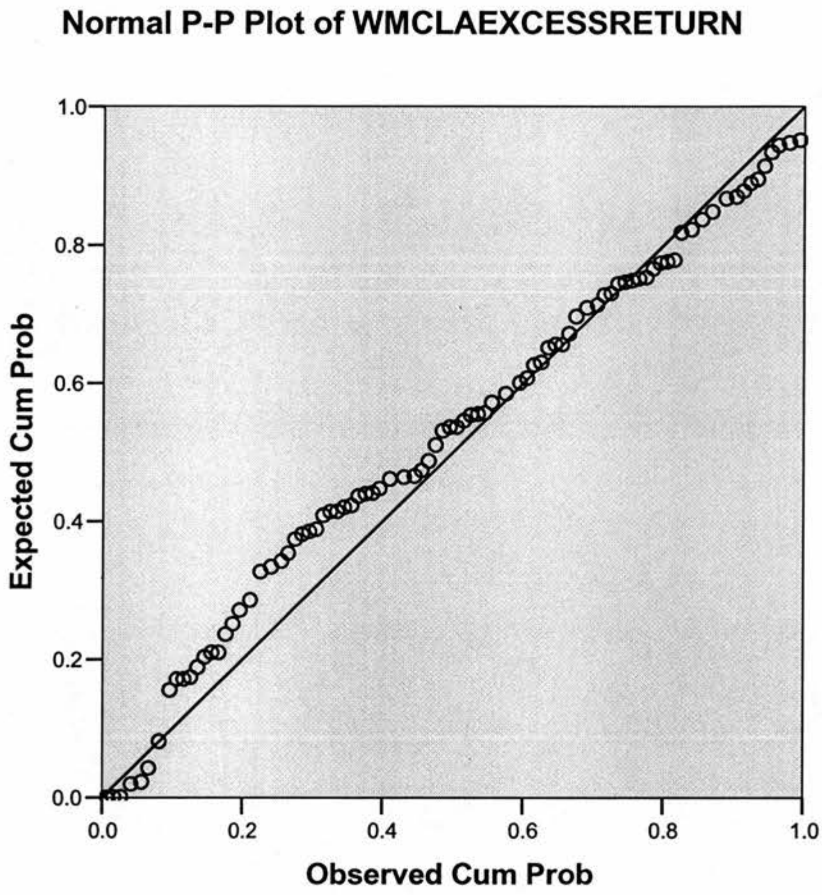

Normal P-P Plot of TROWEEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob


Normal P-P Plot of TROWEFORGNEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

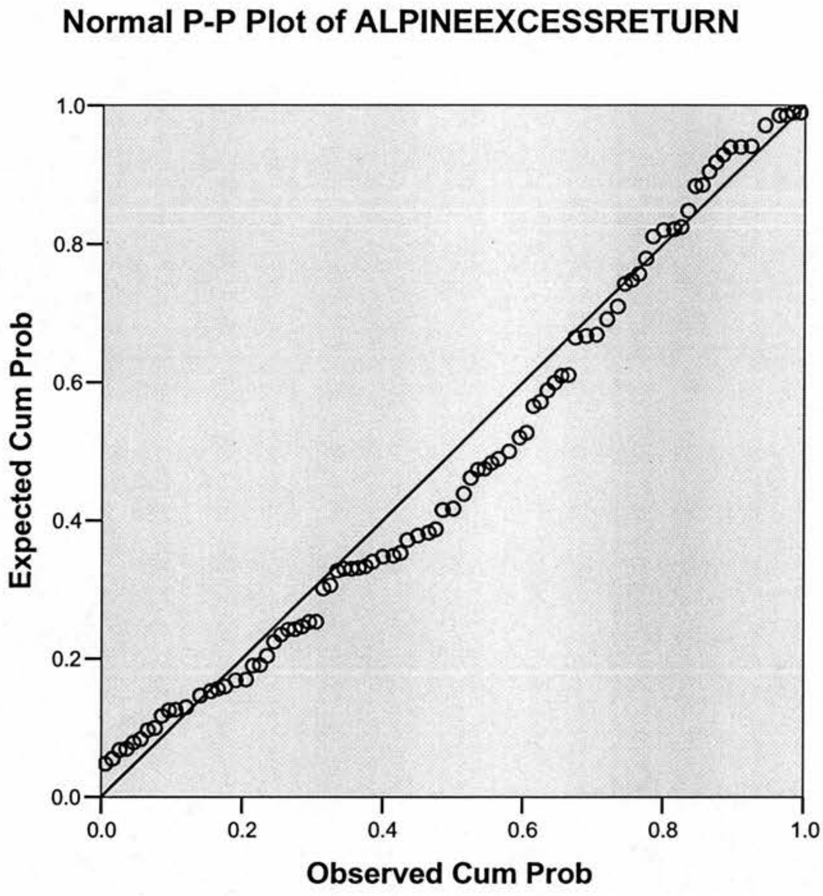
Normal P-P Plot of USGLBEXCESSRETURN

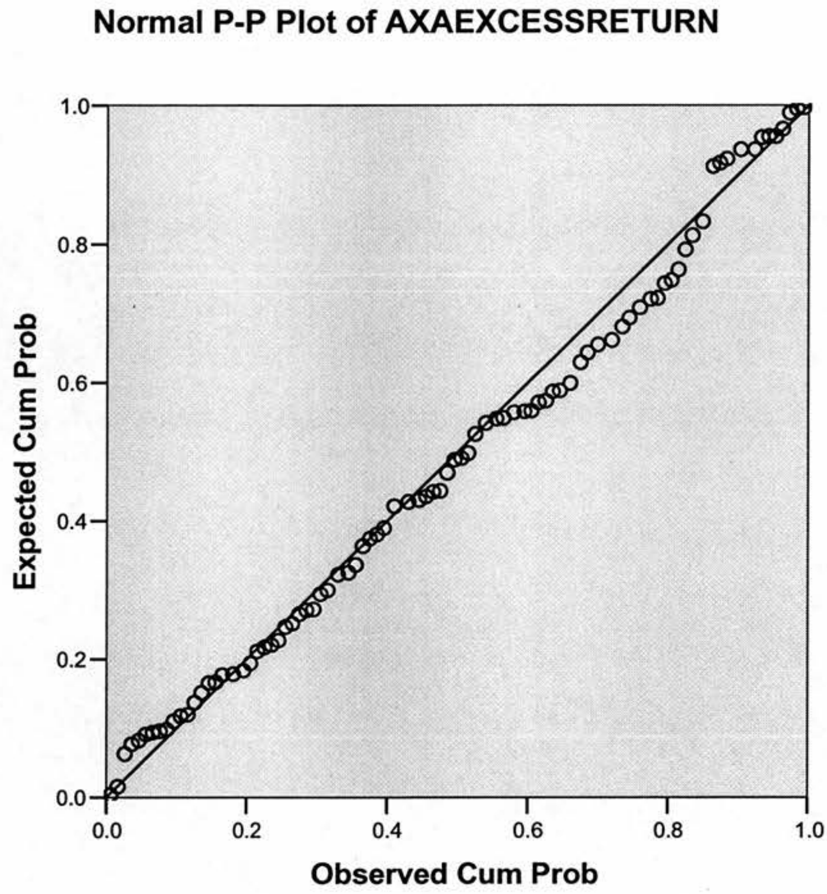


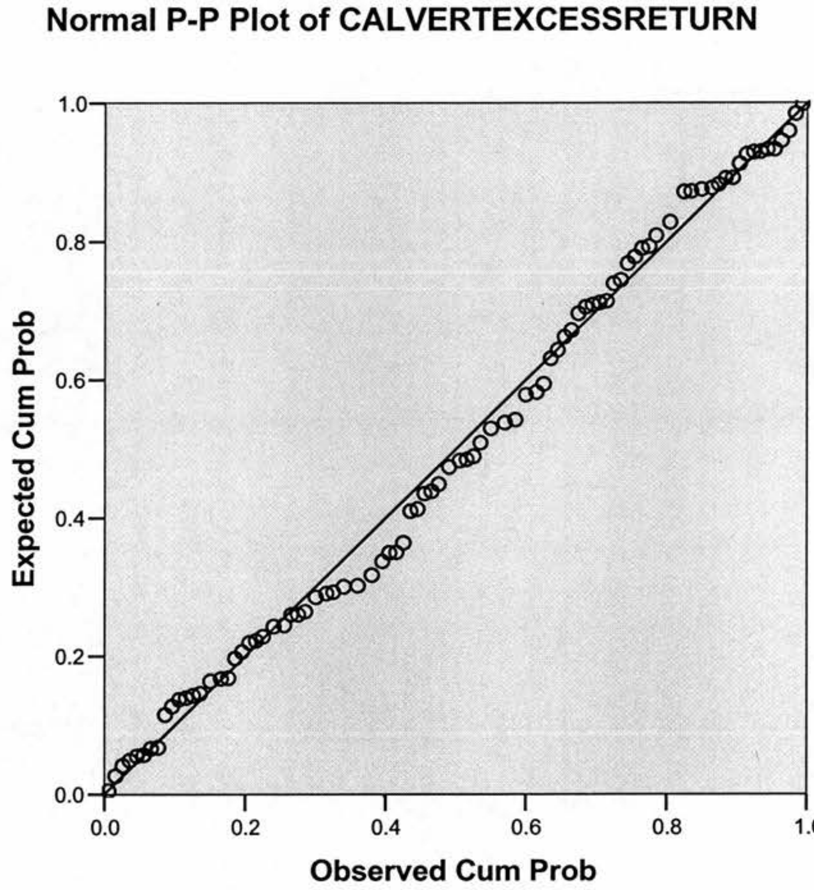

Normal P-P Plot of WESTWOODEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of WMCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

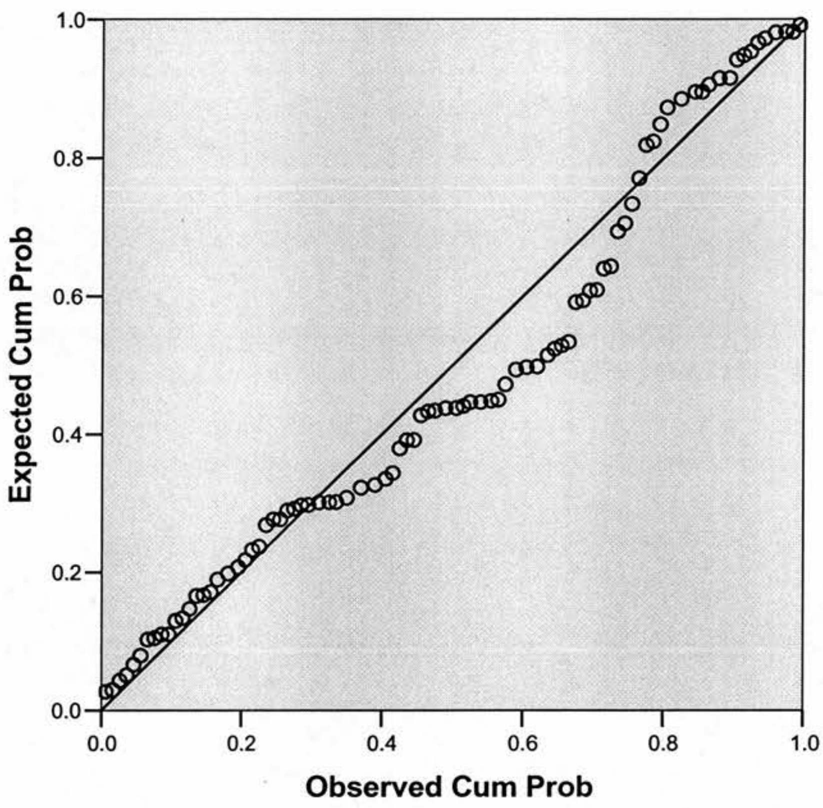
Appendix F (b) P-P Plot for Factor f

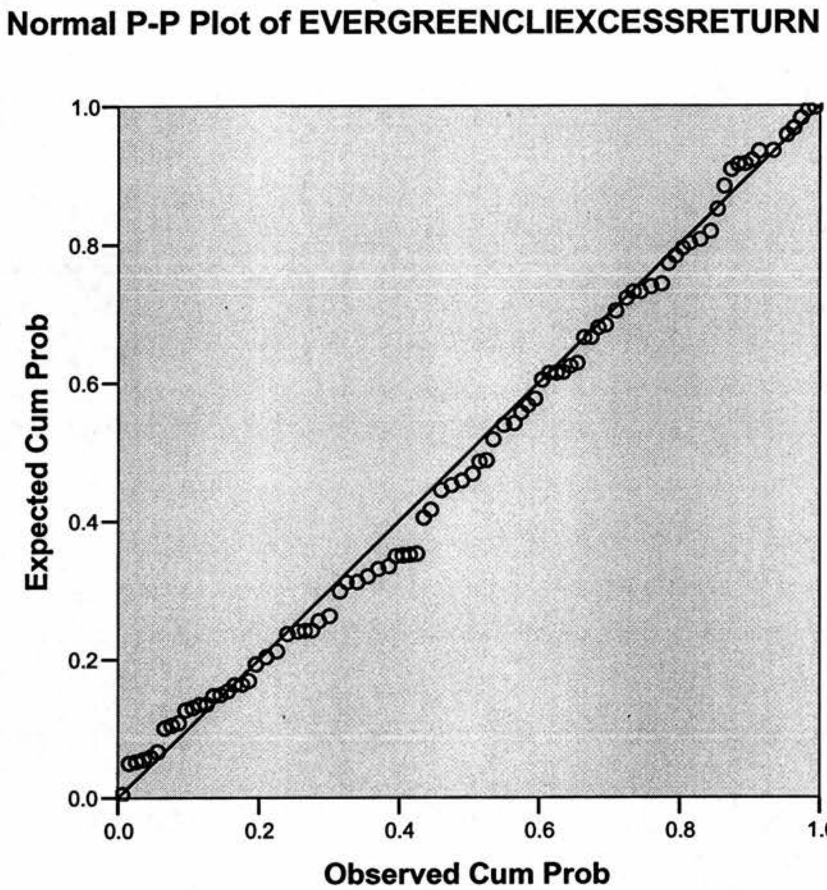


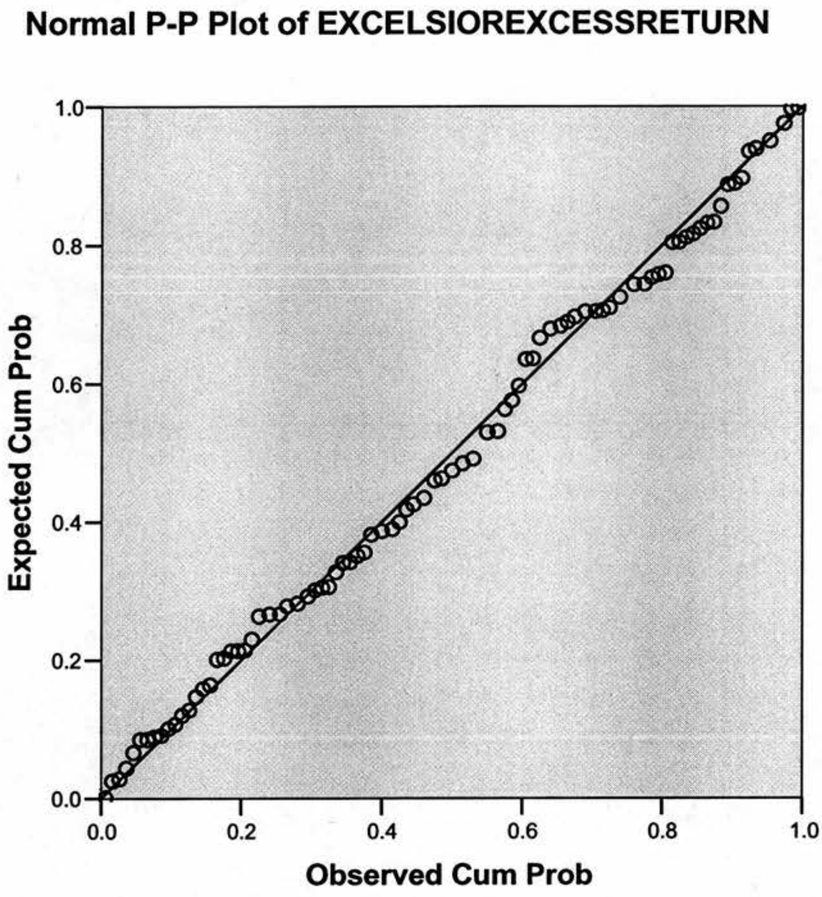

Normal P-P Plot of AXAEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

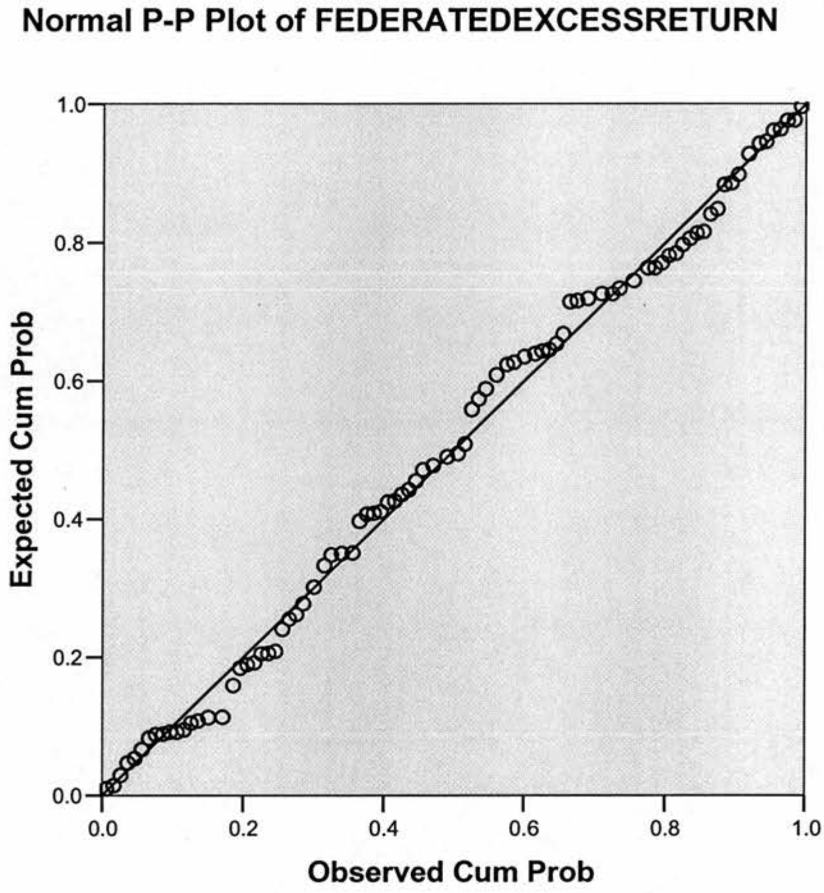

Normal P-P Plot of CALVERTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of CGMEXCESSRETURN

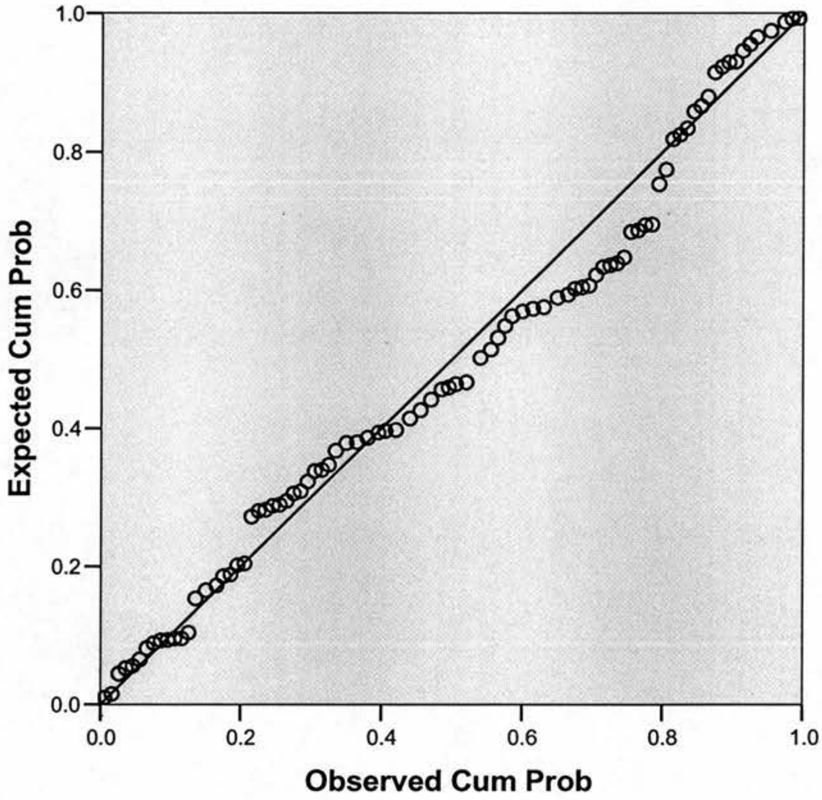


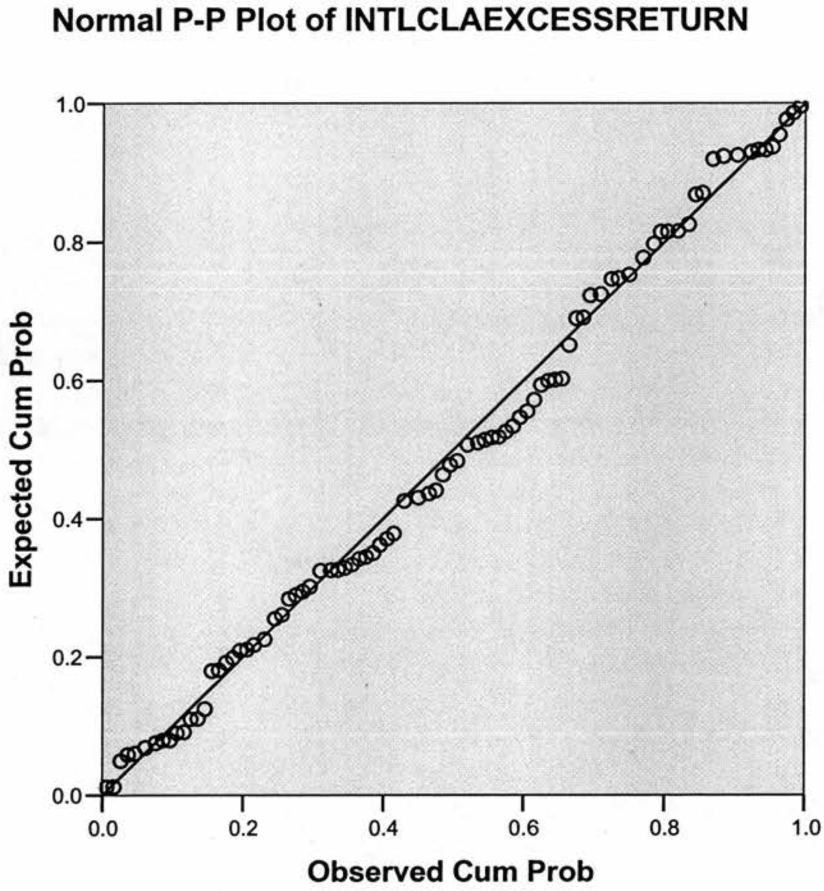

Normal P-P Plot of EVERGREENCLIEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob


Normal P-P Plot of EXCELSIOREXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of FEDERATEDEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

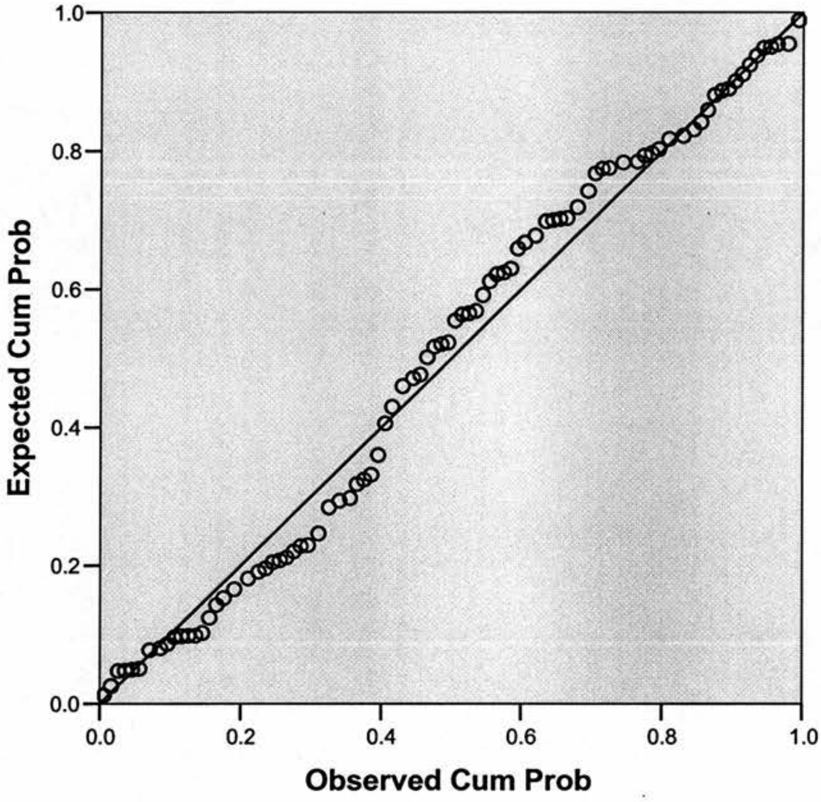
Normal P-P Plot of HUNTINGTONEXCESSRETURN

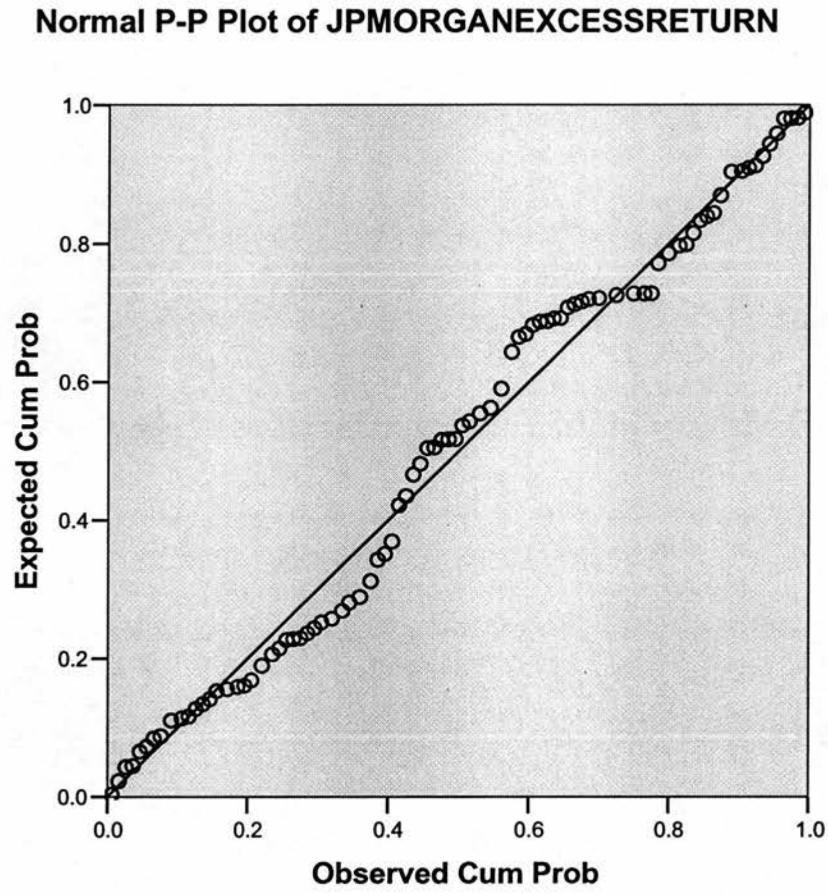


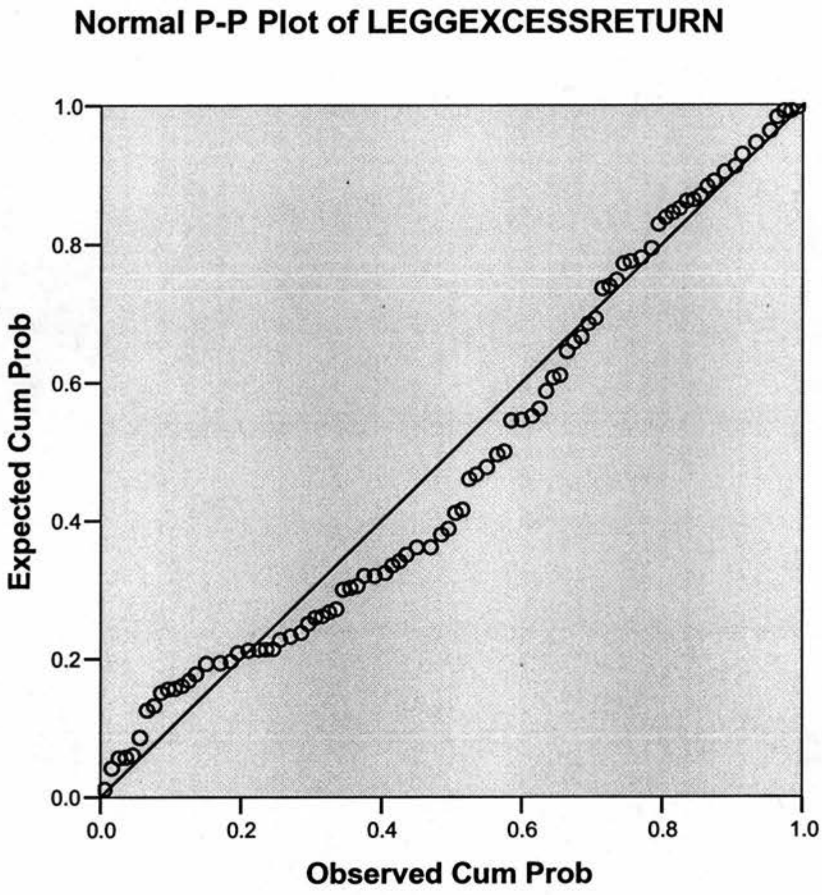


Normal P-P Plot of INTLCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

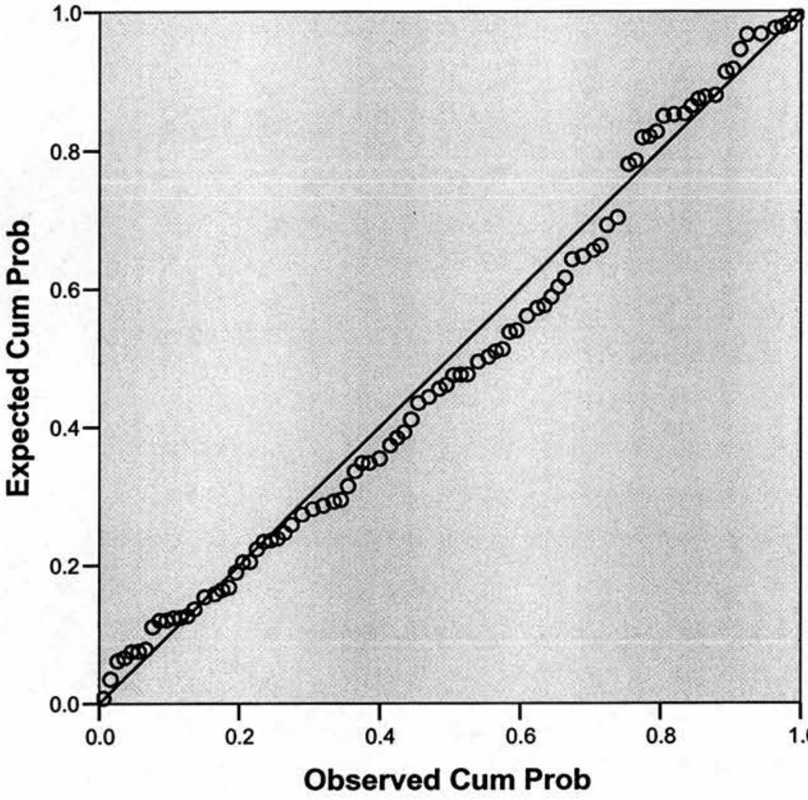
Normal P-P Plot of JCOCKCLAEXCESSRETURN

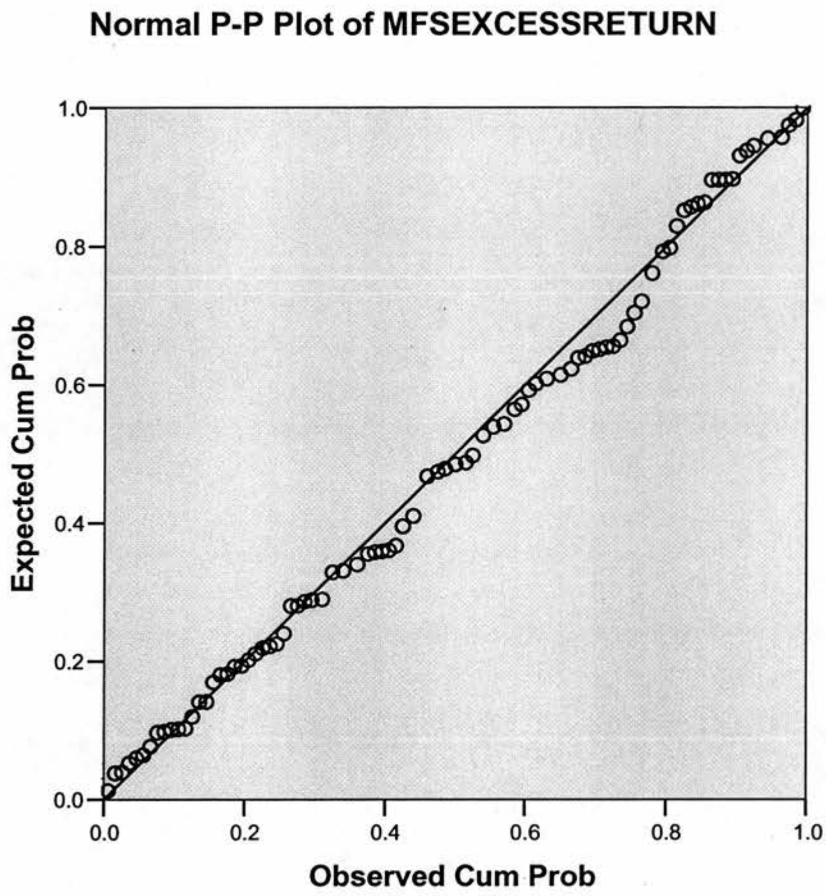


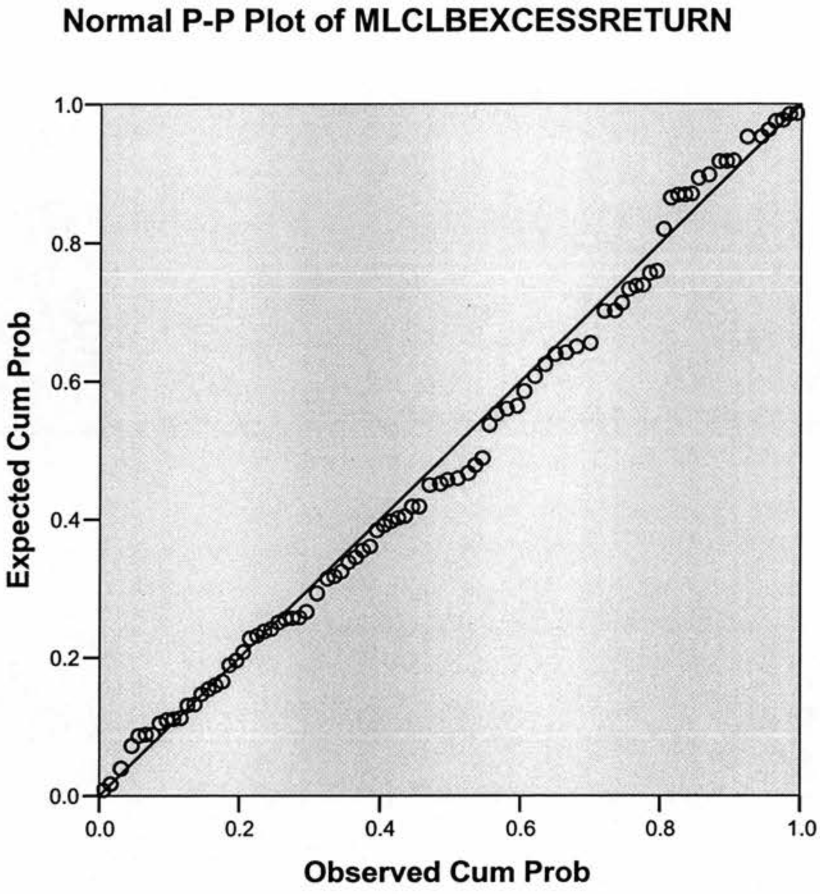

Normal P-P Plot of JPMORGANEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of LEGGEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

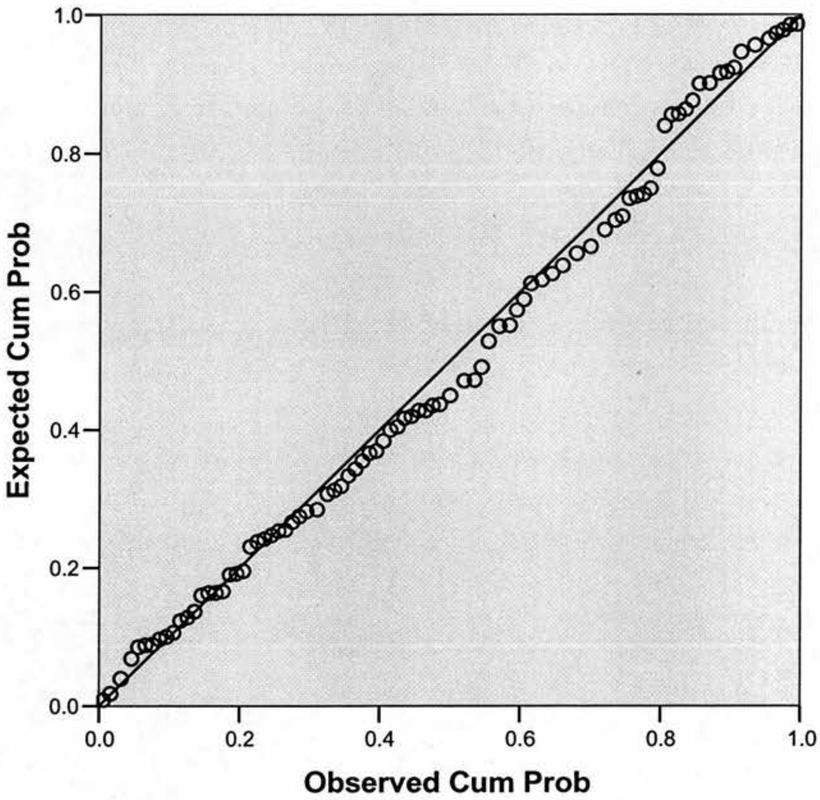
Normal P-P Plot of LORDABBETTEXCESSRETURN

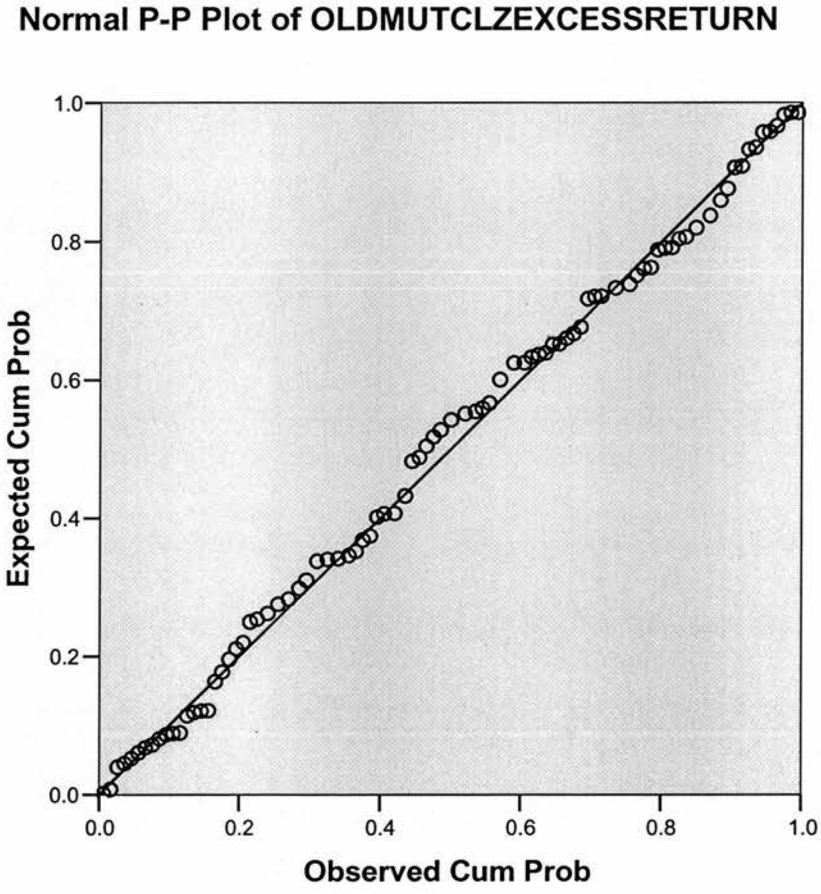


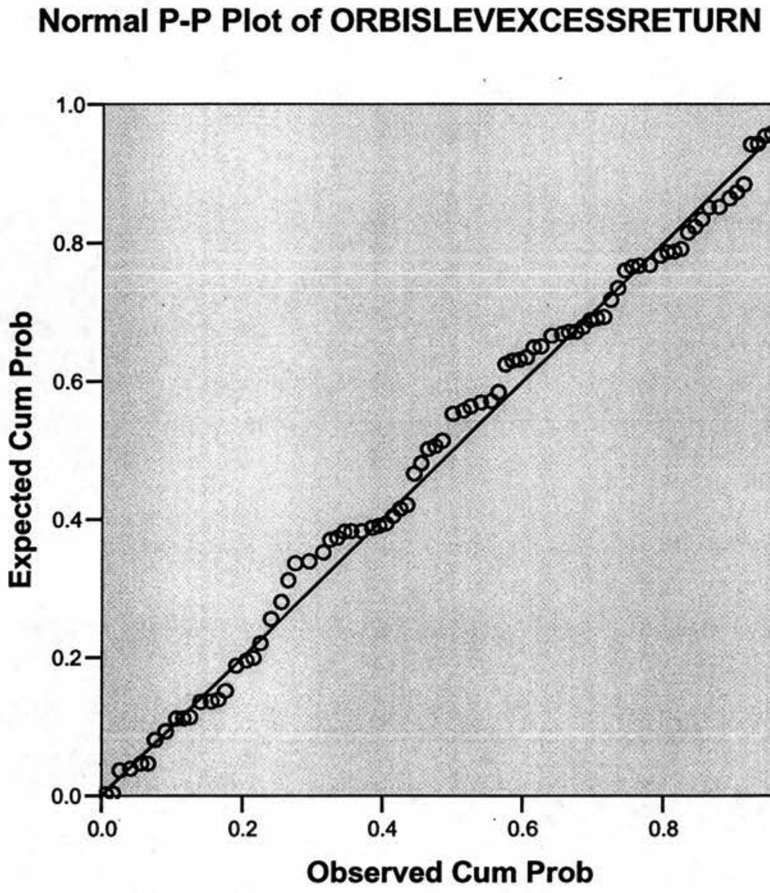

Normal P-P Plot of MFSEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

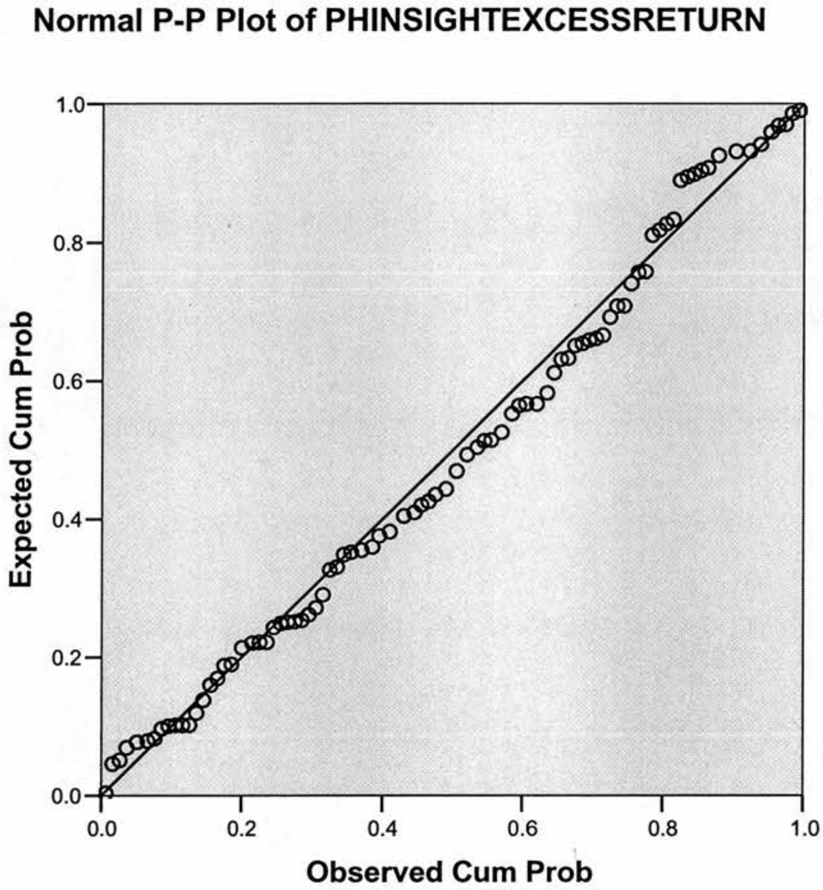

Normal P-P Plot of MLCLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

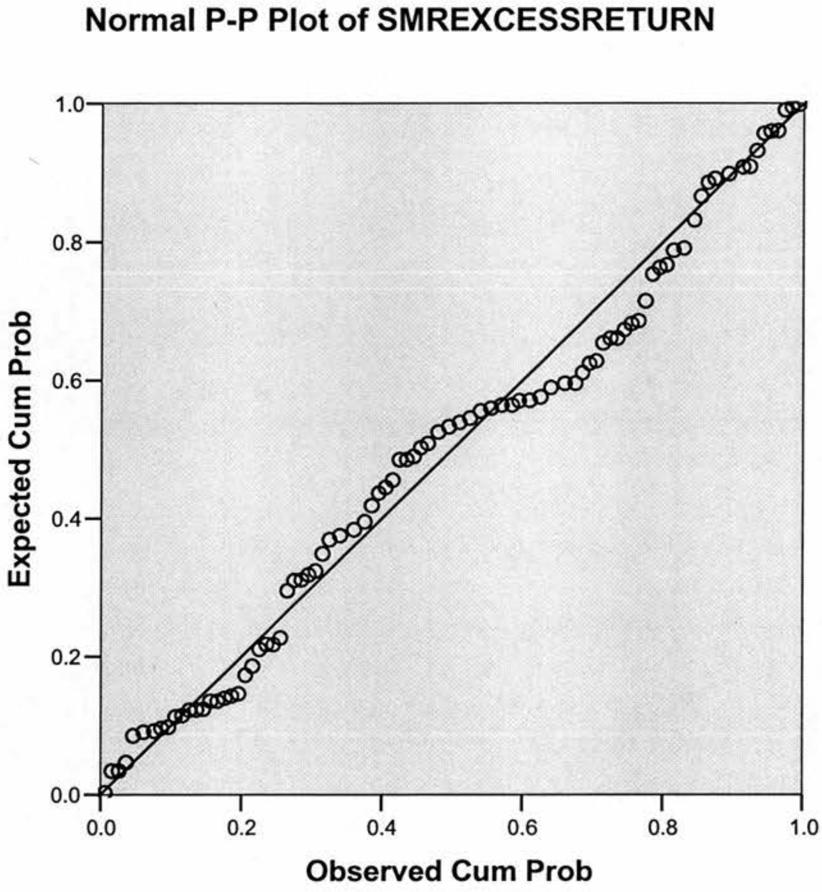
Normal P-P Plot of MLCLIEXCESSRETURN

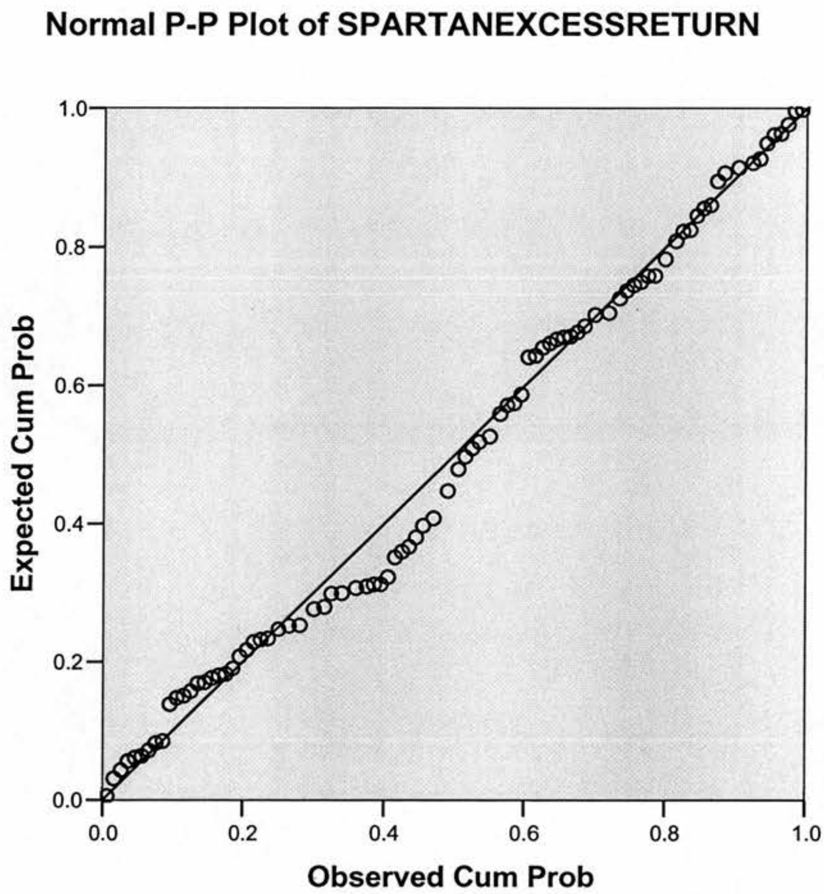


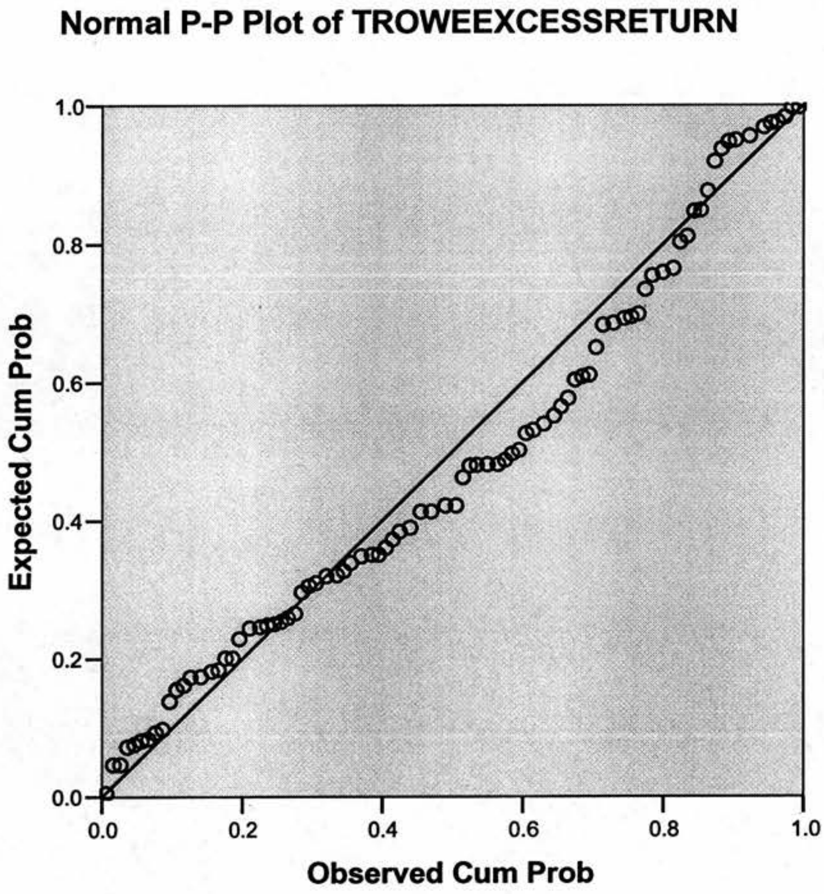

Normal P-P Plot of OLDMUTCLZEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob


Normal P-P Plot of ORBISLEVEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

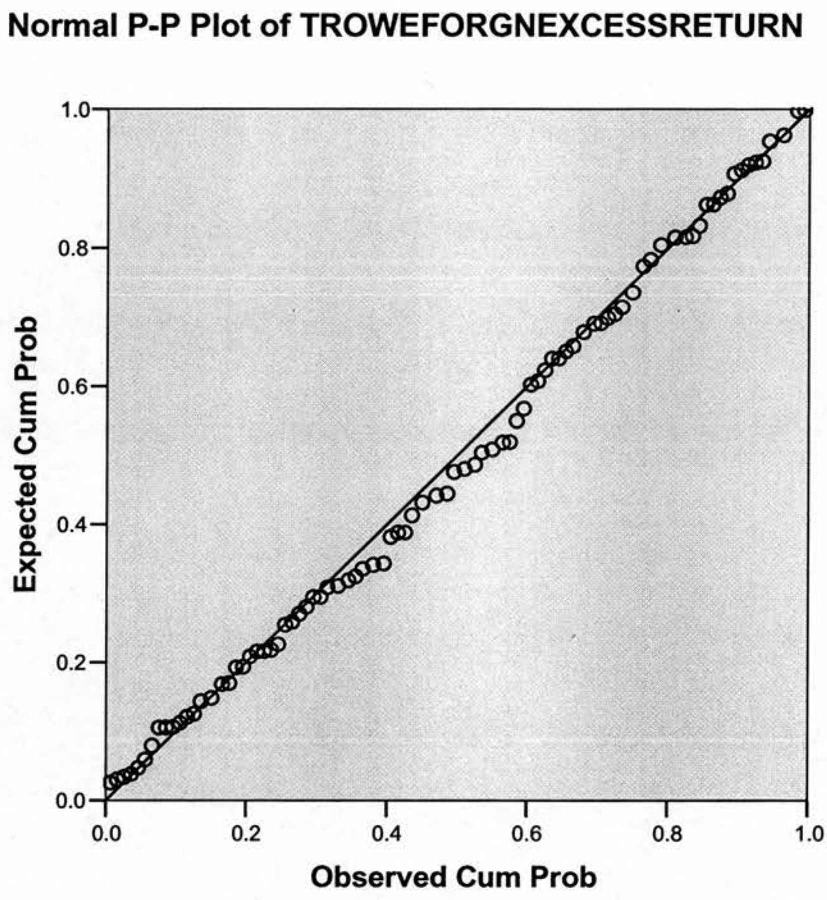

Normal P-P Plot of PHINSIGHTEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

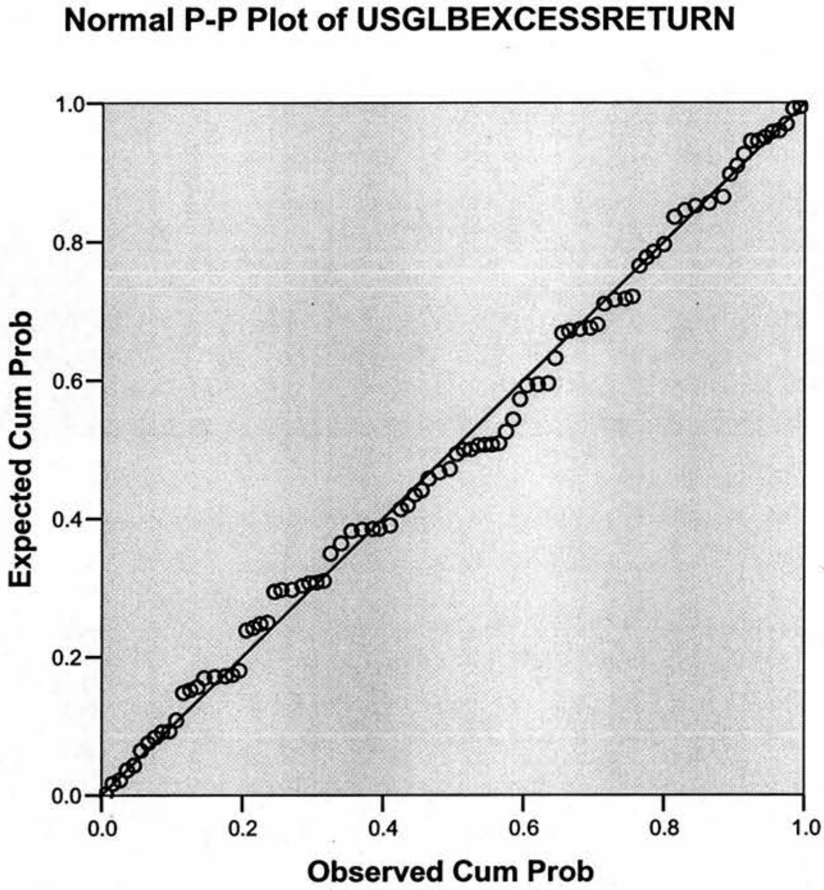

Normal P-P Plot of SMREXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

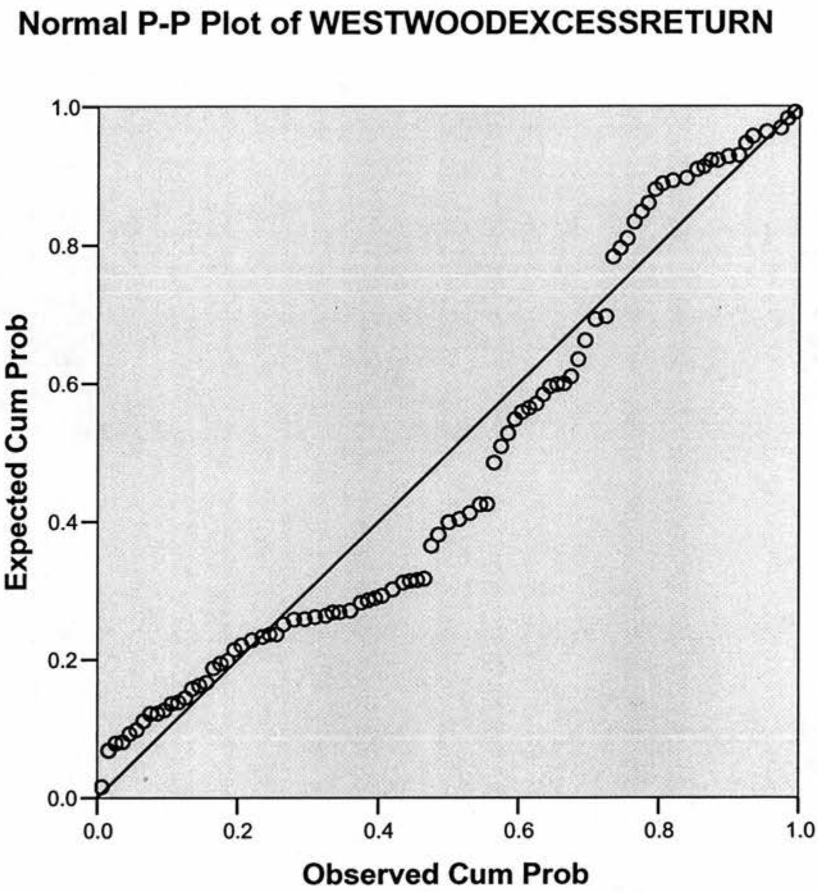

Normal P-P Plot of SPARTANEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



Normal P-P Plot of TROWEEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

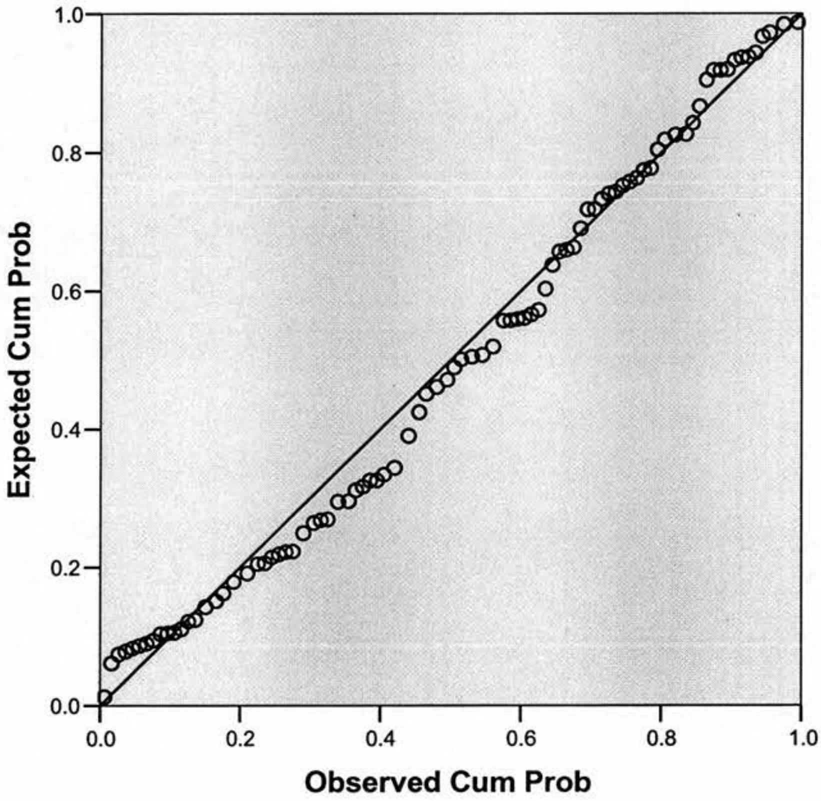



Normal P-P Plot of USGLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

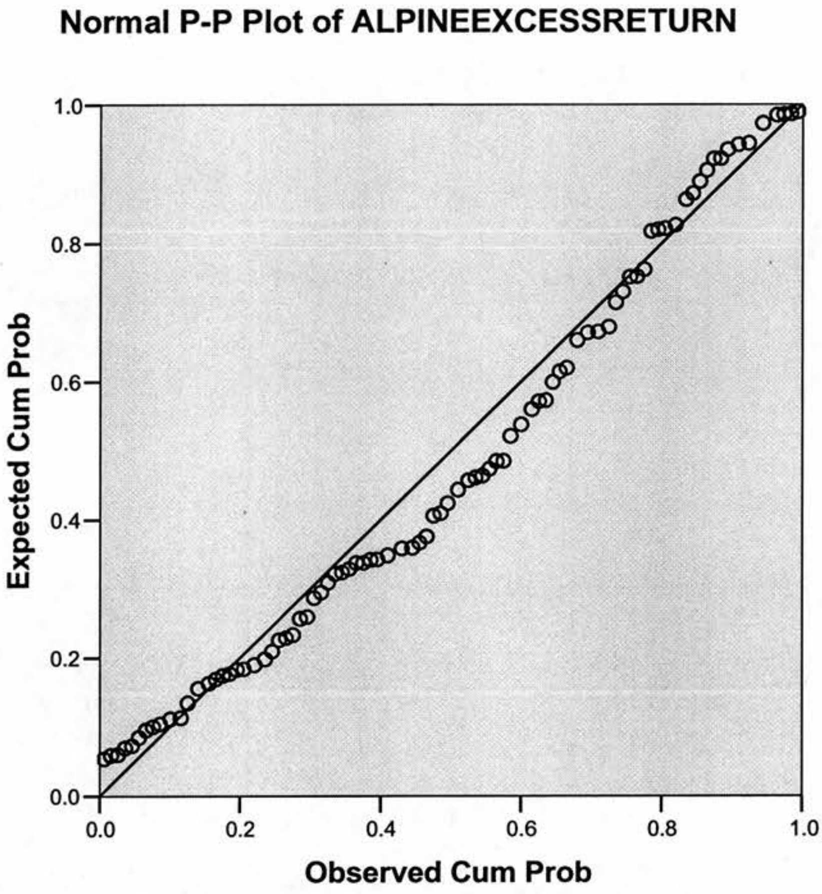


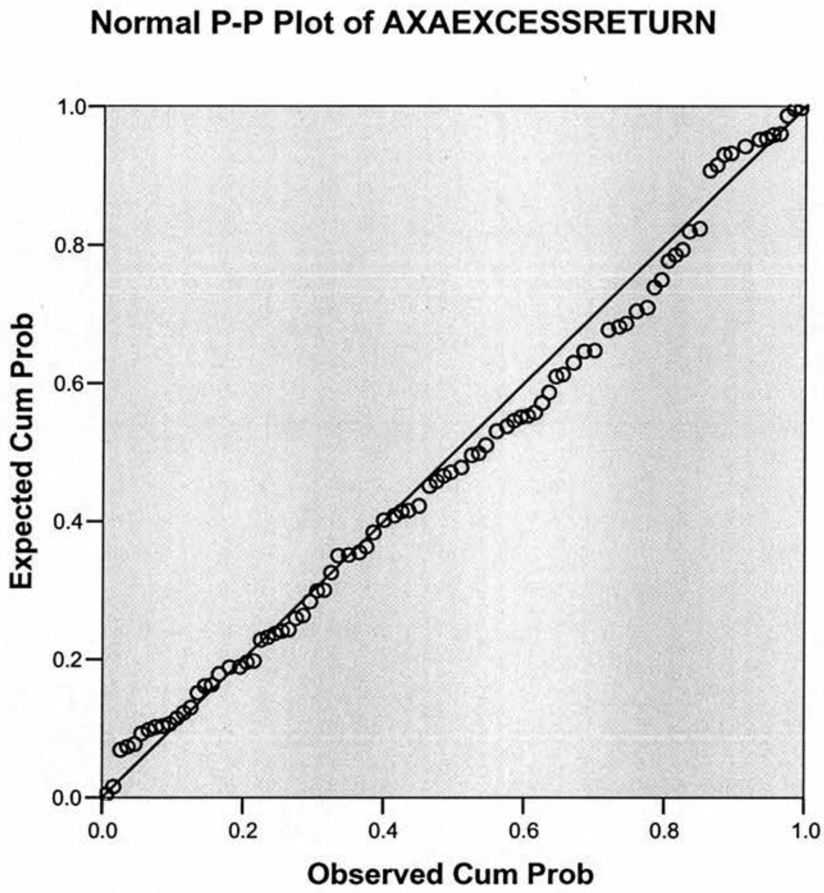
Normal P-P Plot of WESTWOODEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

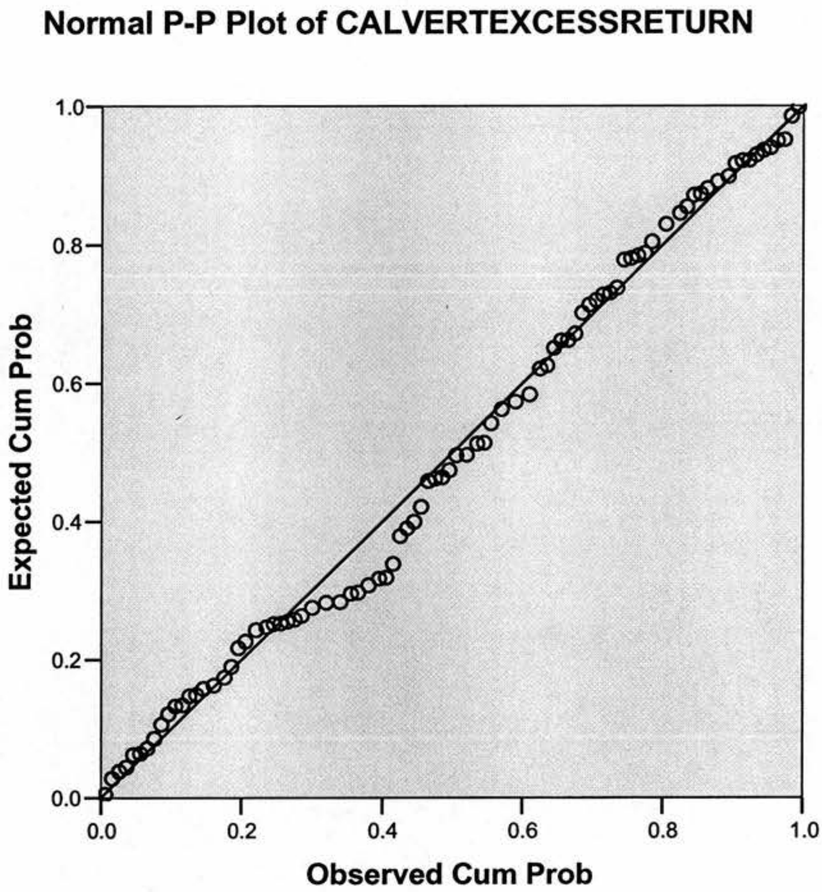
Normal P-P Plot of WMCLAEXCESSRETURN



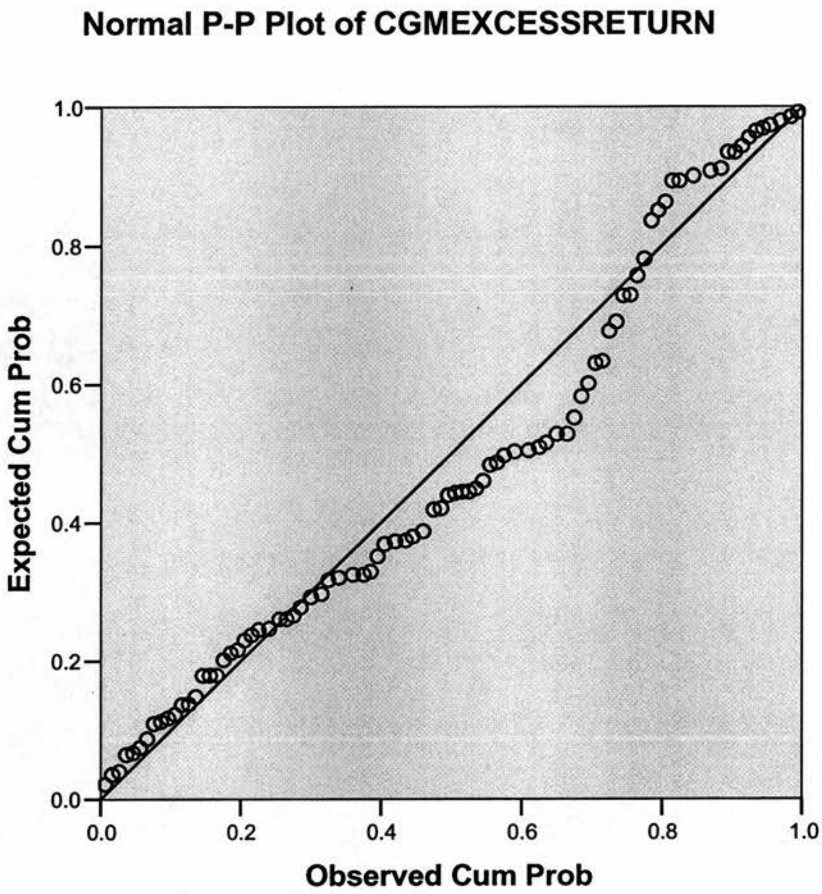
Appendix F (c) P-P Plot for Factor ft



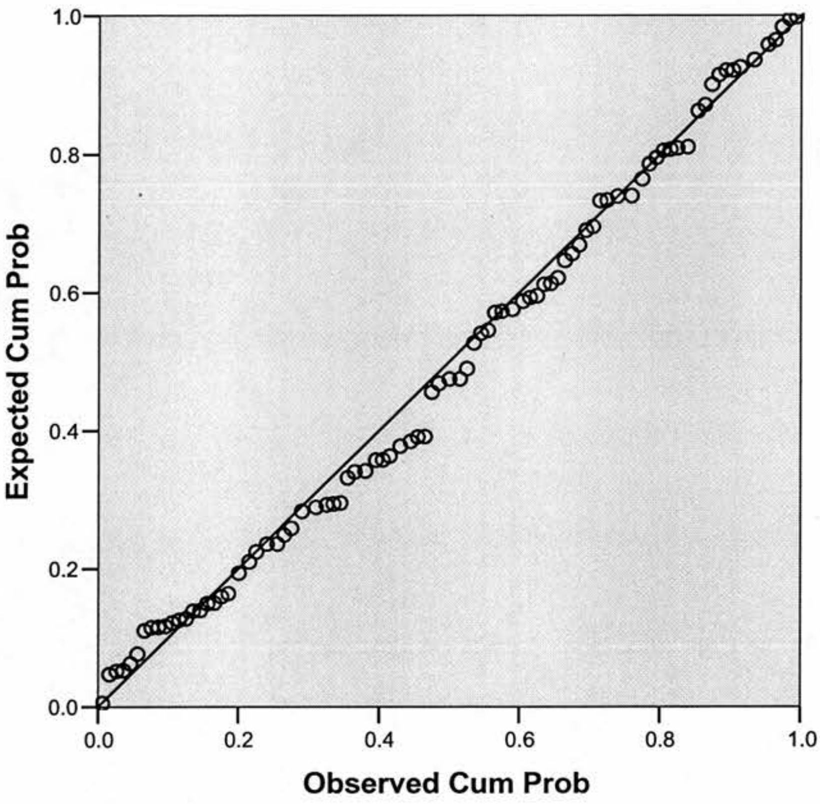

Normal P-P Plot of AXAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



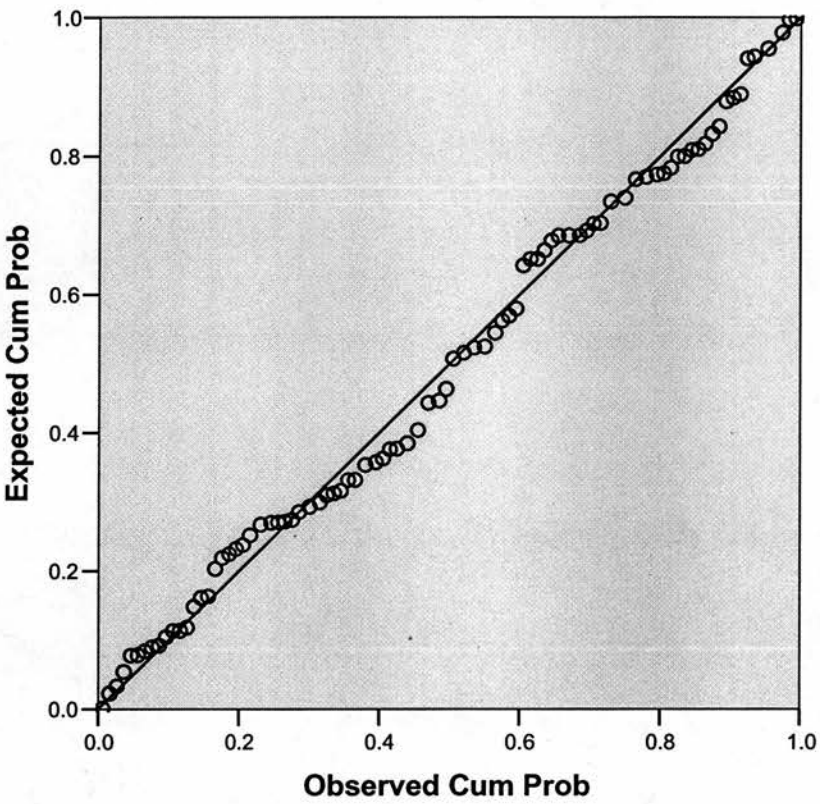
Normal P-P Plot of CALVERTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

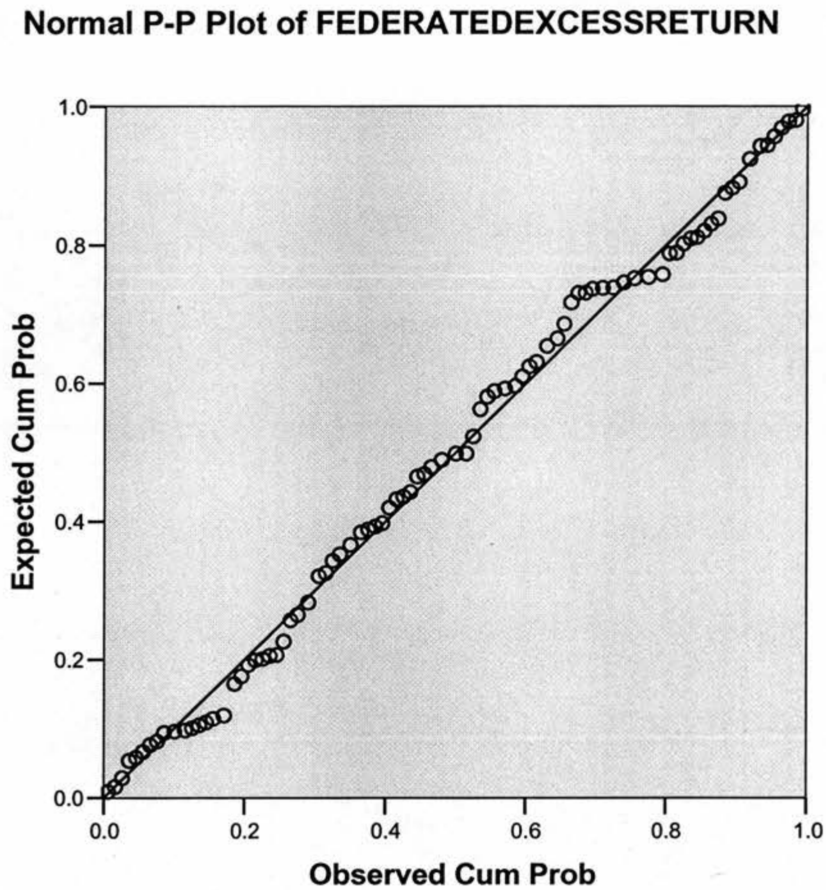

Normal P-P Plot of CGMEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of EVERGREENCLIEXCESSRETURN

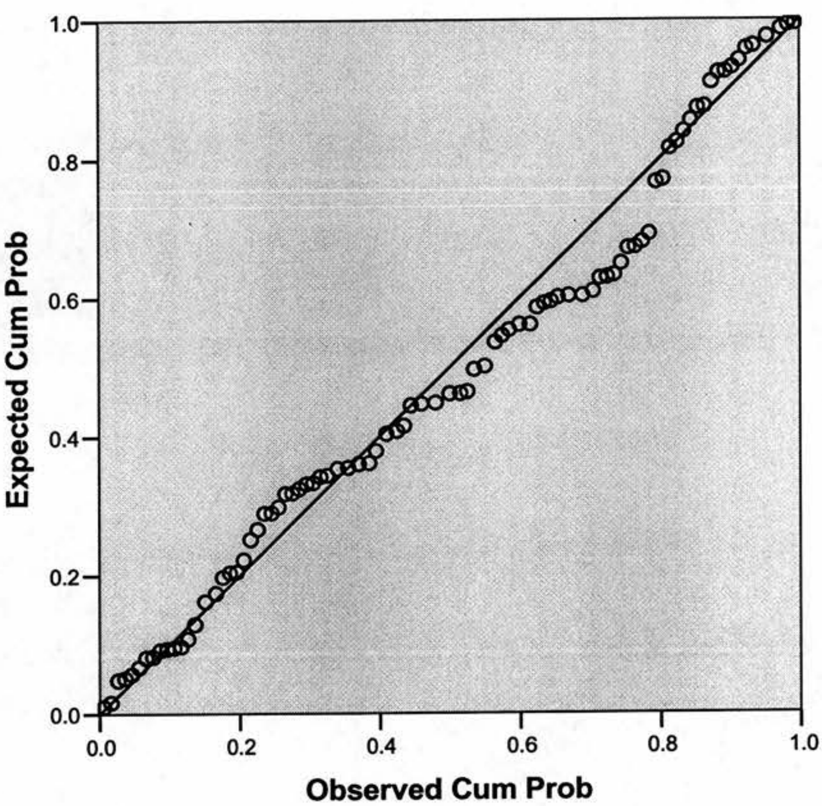


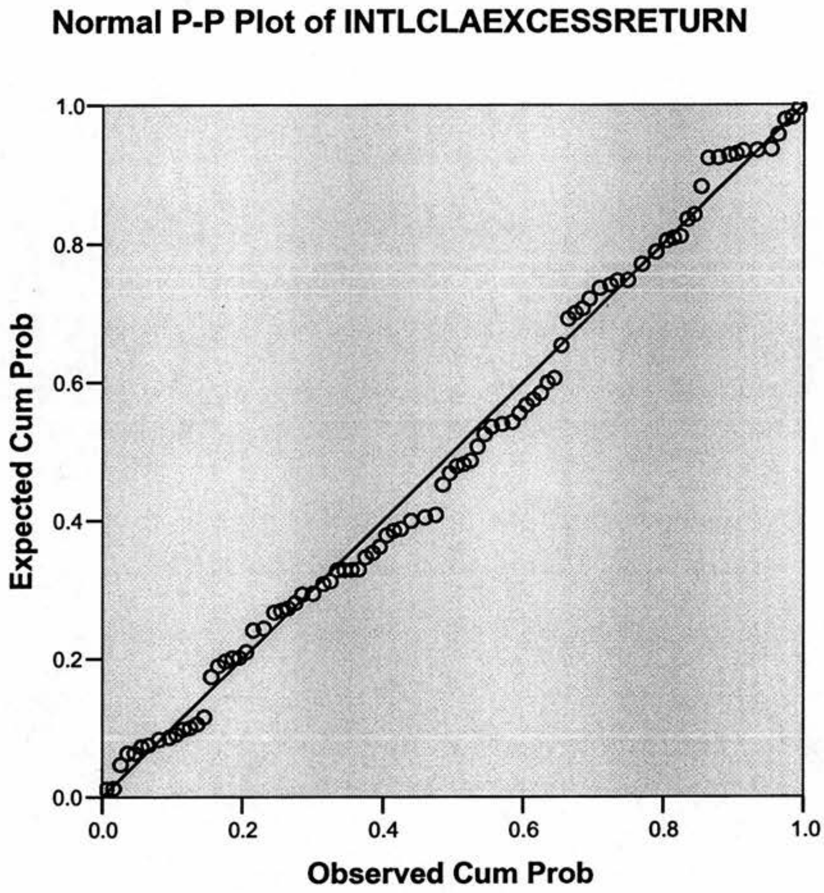
Normal P-P Plot of EXCELSIOREXCESSRETURN

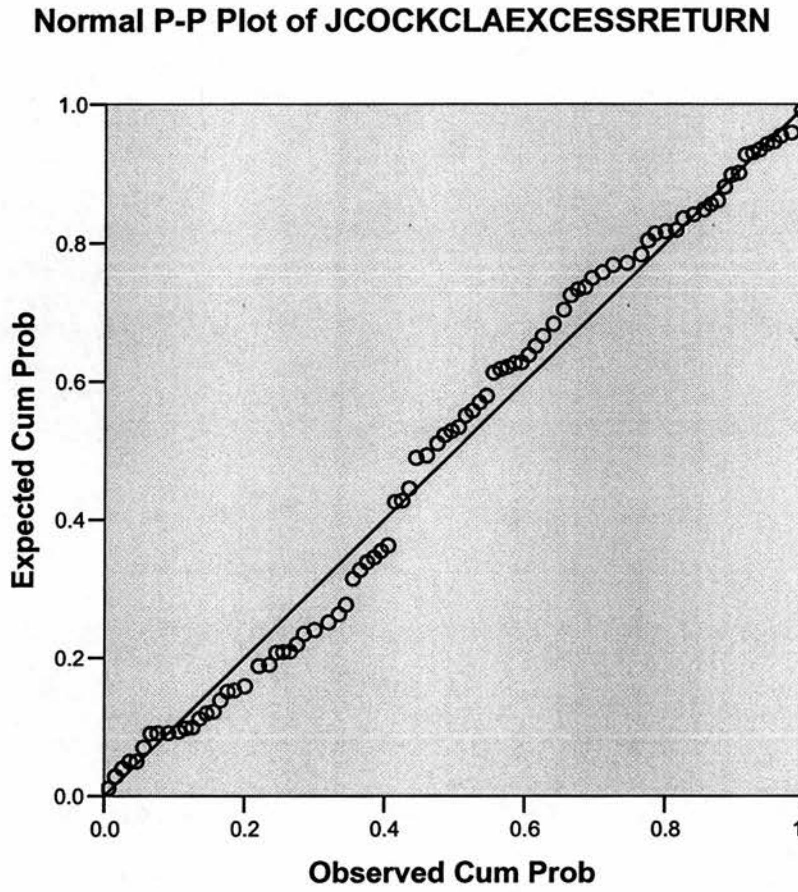



Normal P-P Plot of FEDERATEDEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

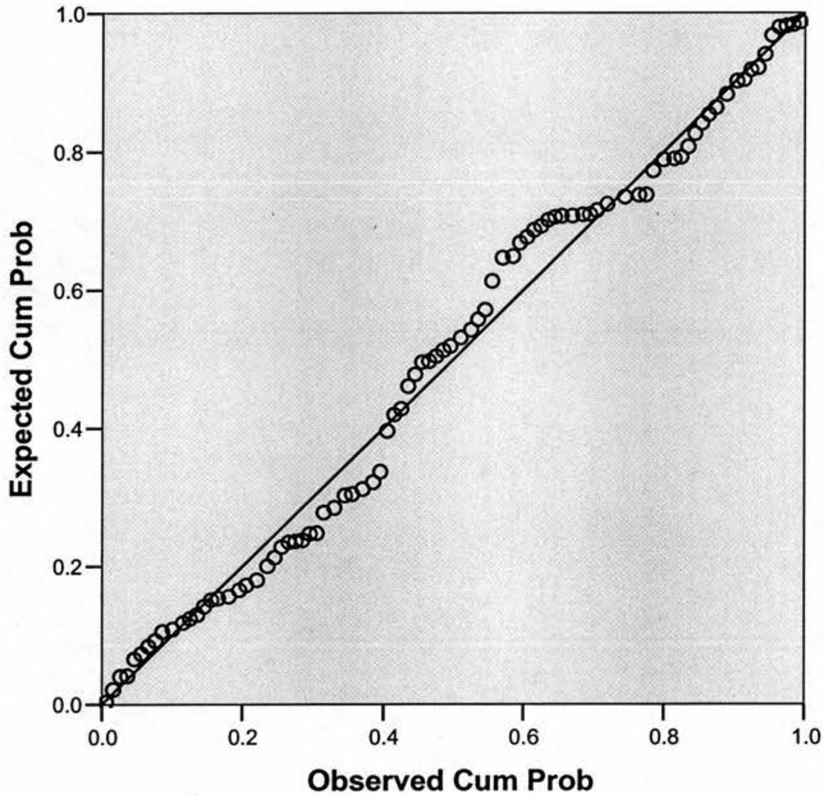
Normal P-P Plot of HUNTINGTONEXCESSRETURN

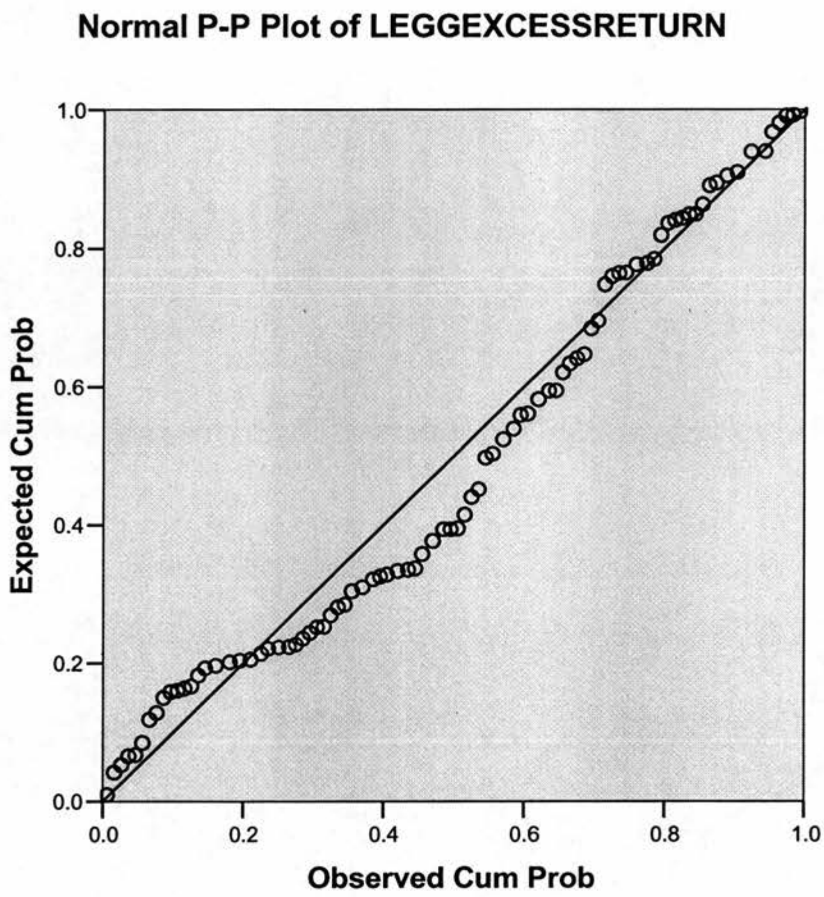


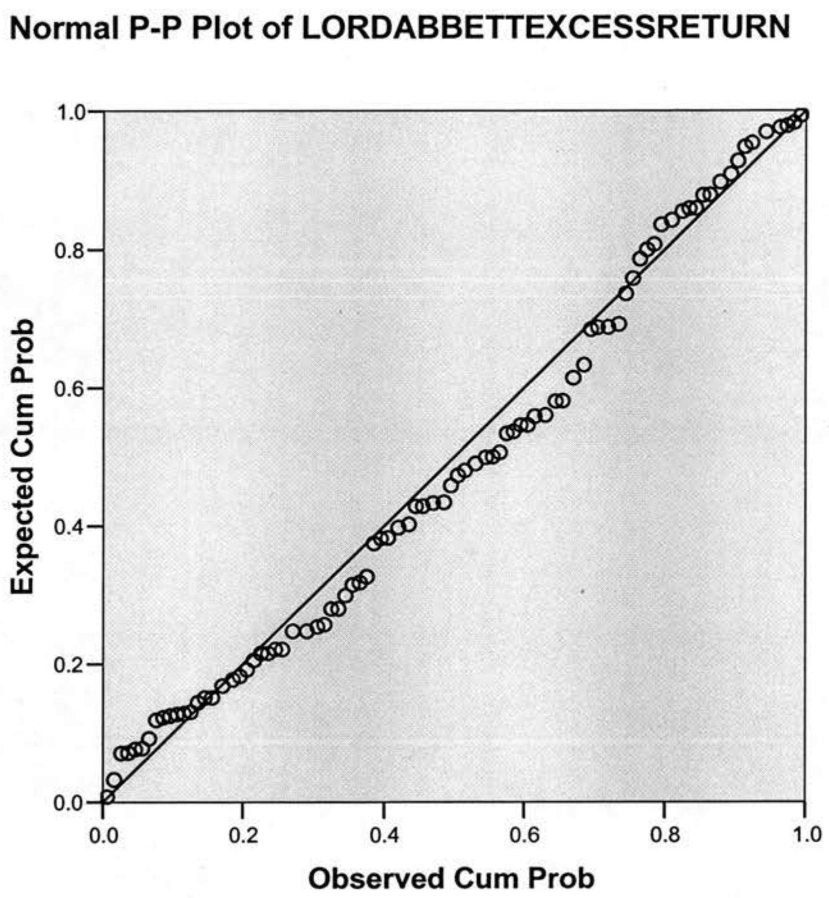

Normal P-P Plot of INTLCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of JCOCKCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of JPMORGANEXCESSRETURN

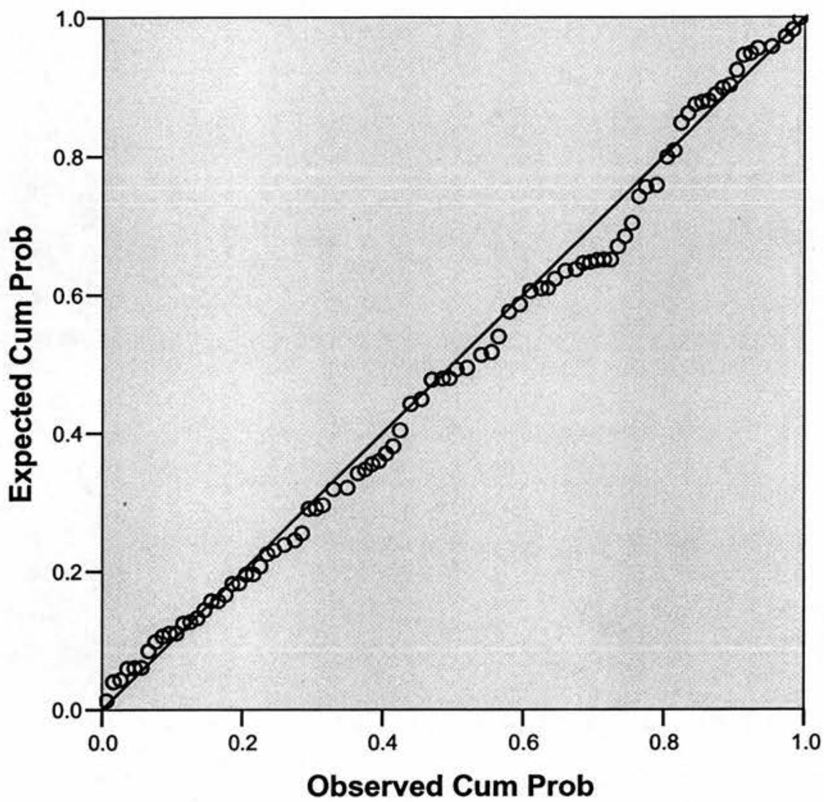


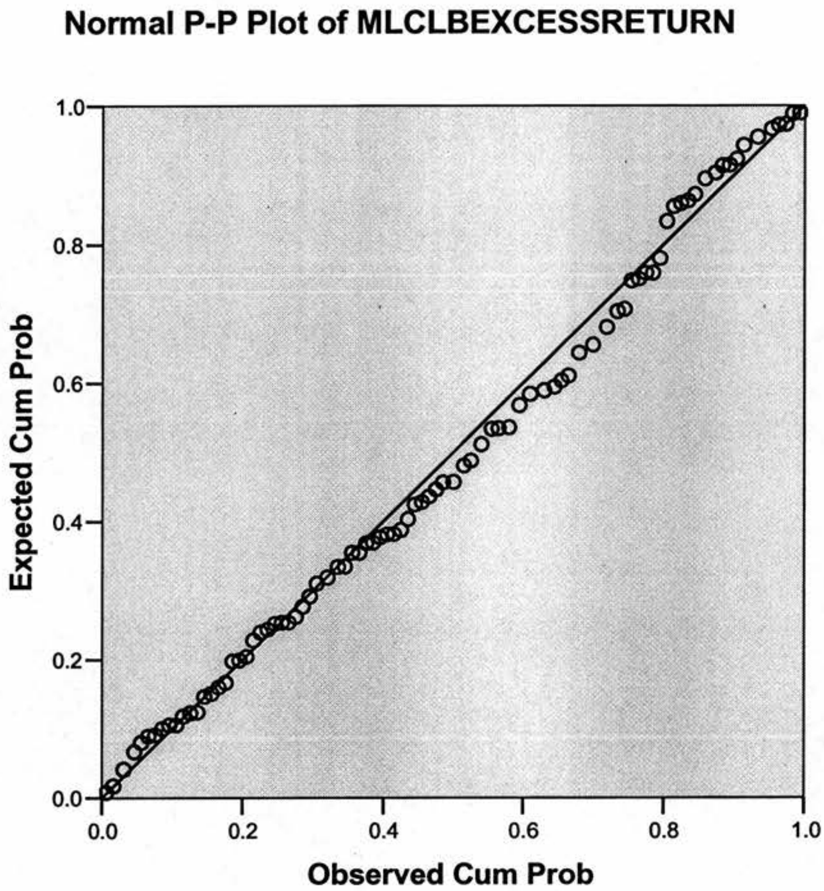

Normal P-P Plot of LEGGEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



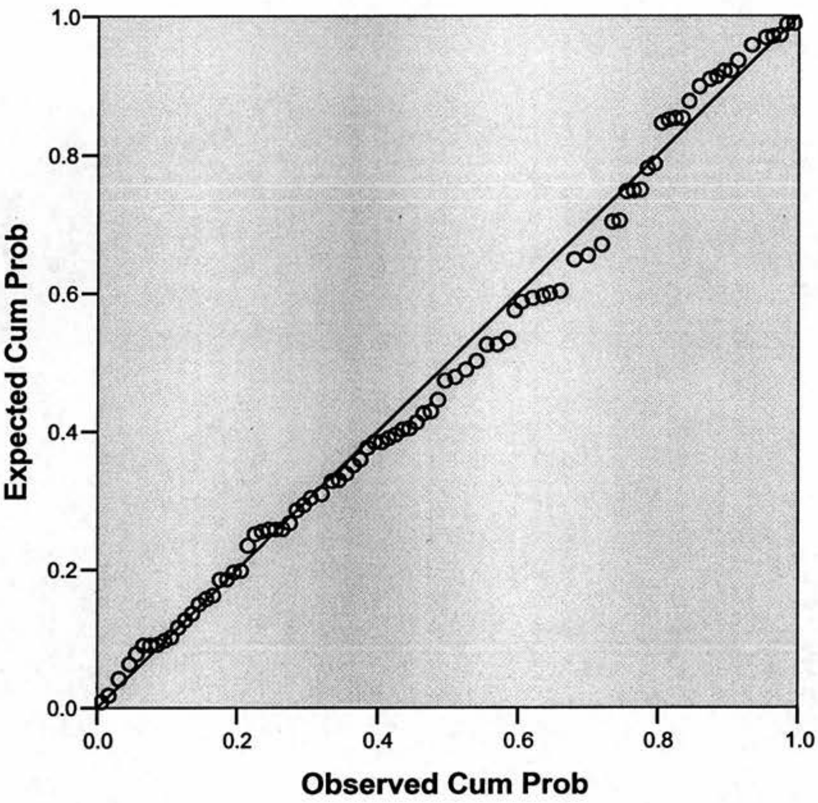
Normal P-P Plot of LORDABBETTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of MFSEXCESSRETURN

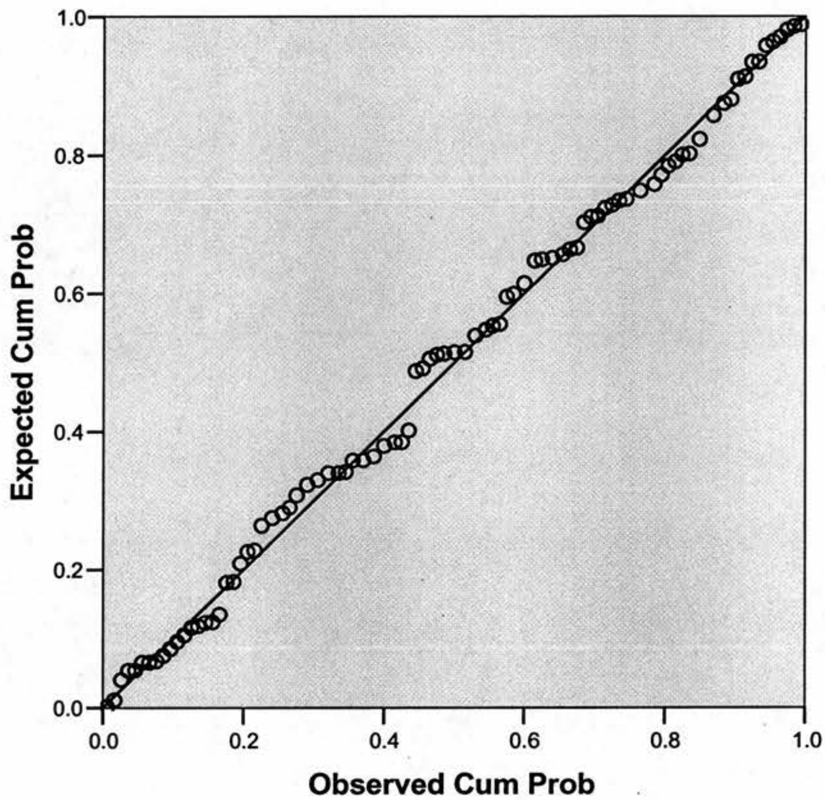



Normal P-P Plot of MLCLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

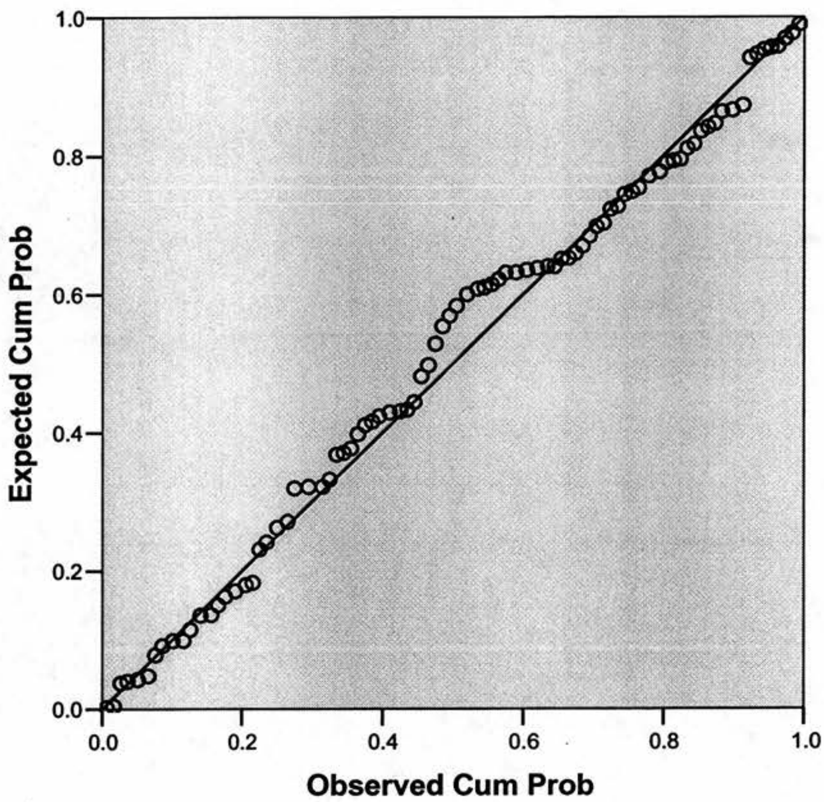
Normal P-P Plot of MLCLIEXCESSRETURN



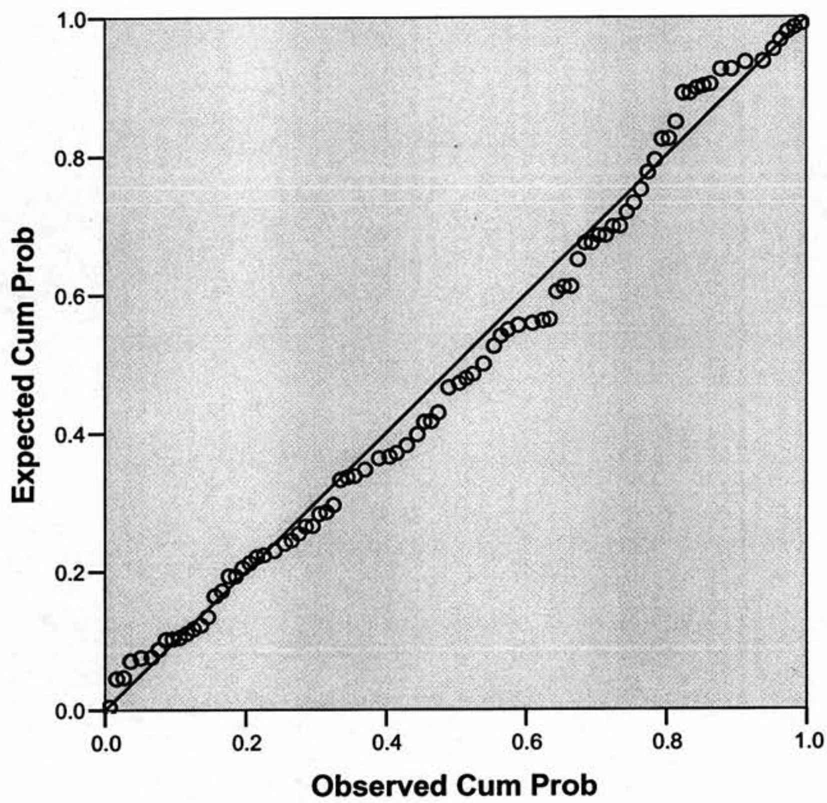
Normal P-P Plot of OLDMUTCLZEXCESSRETURN



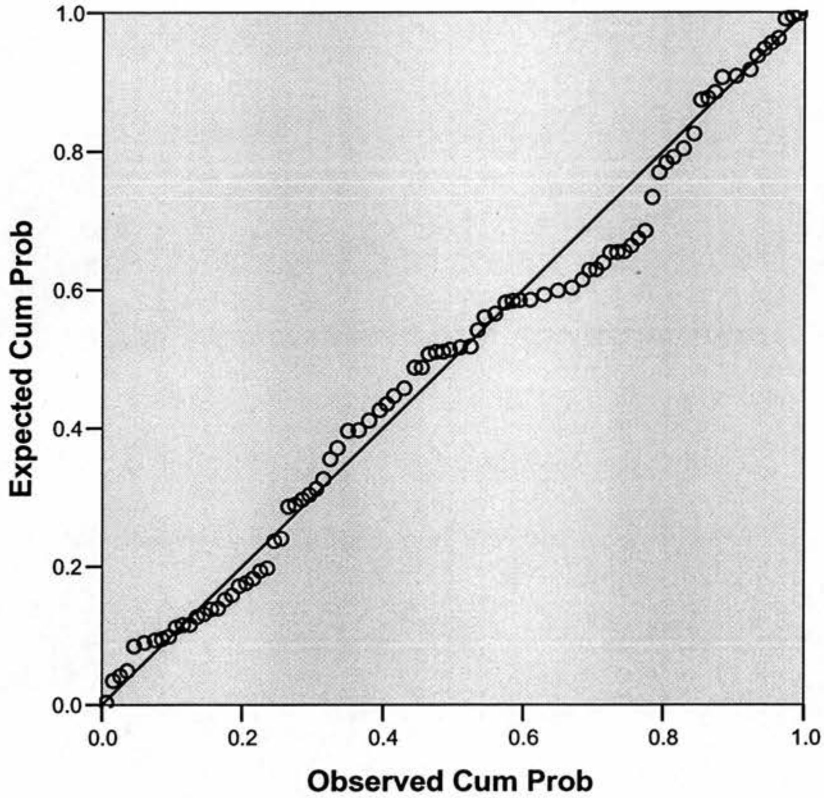
Normal P-P Plot of ORBISLEVEXCESSRETURN



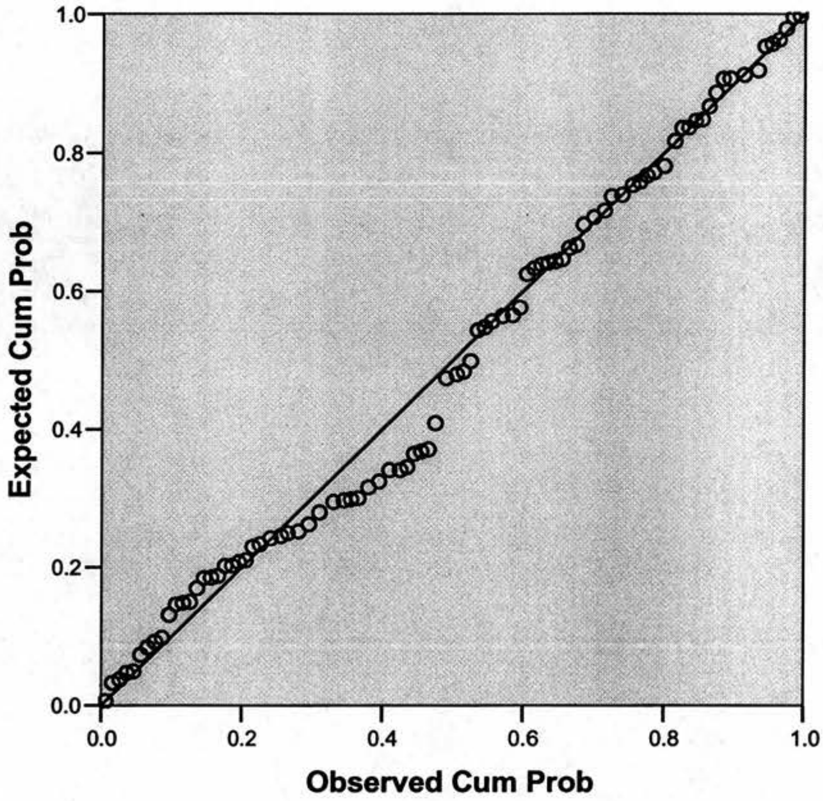
Normal P-P Plot of PHINSIGHTEXCESSRETURN



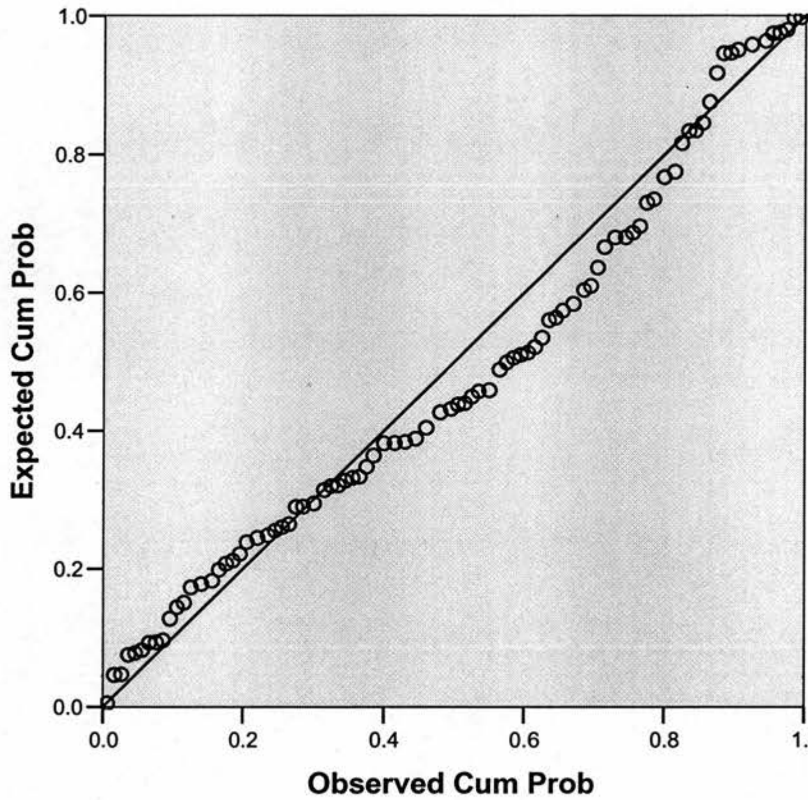
Normal P-P Plot of SMREXCESSRETURN

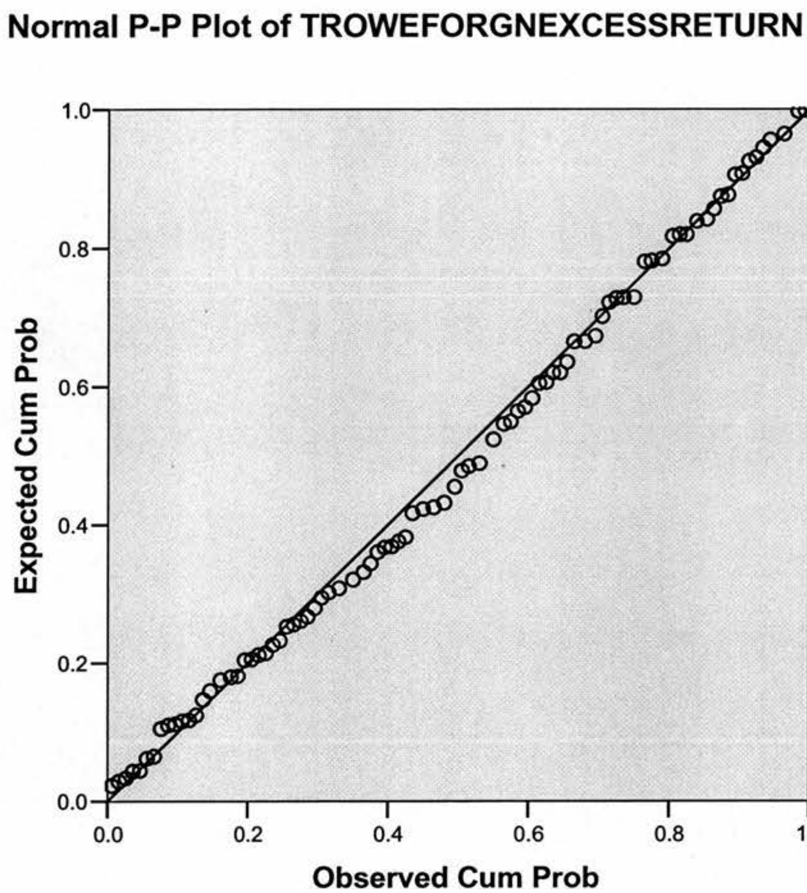


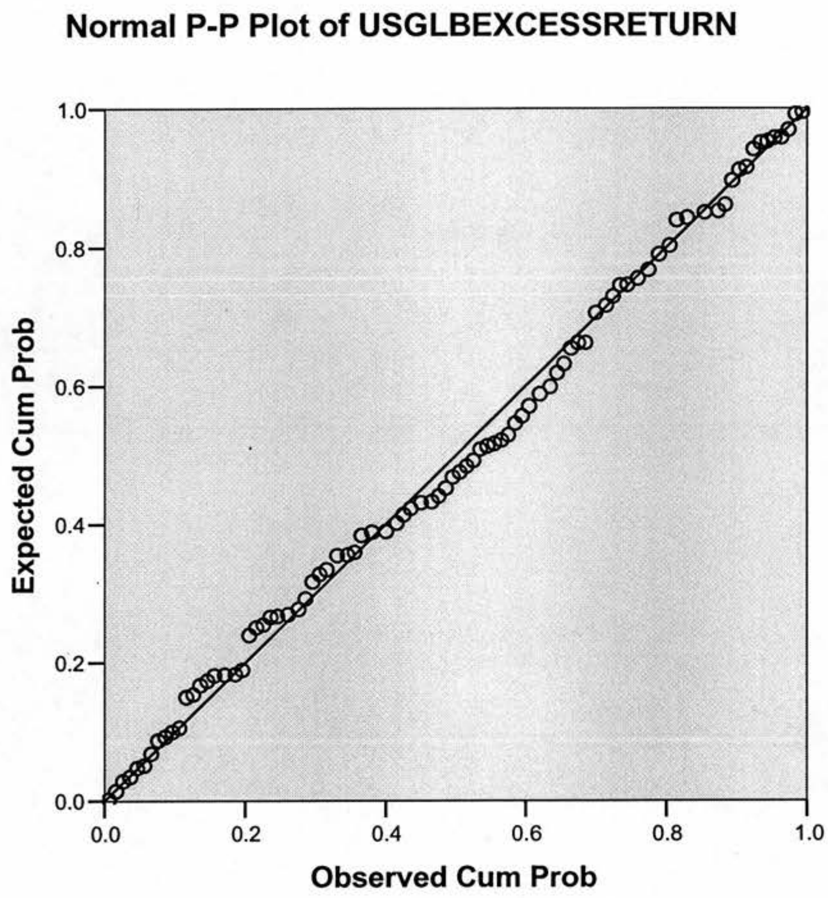
Normal P-P Plot of SPARTANEXCESSRETURN



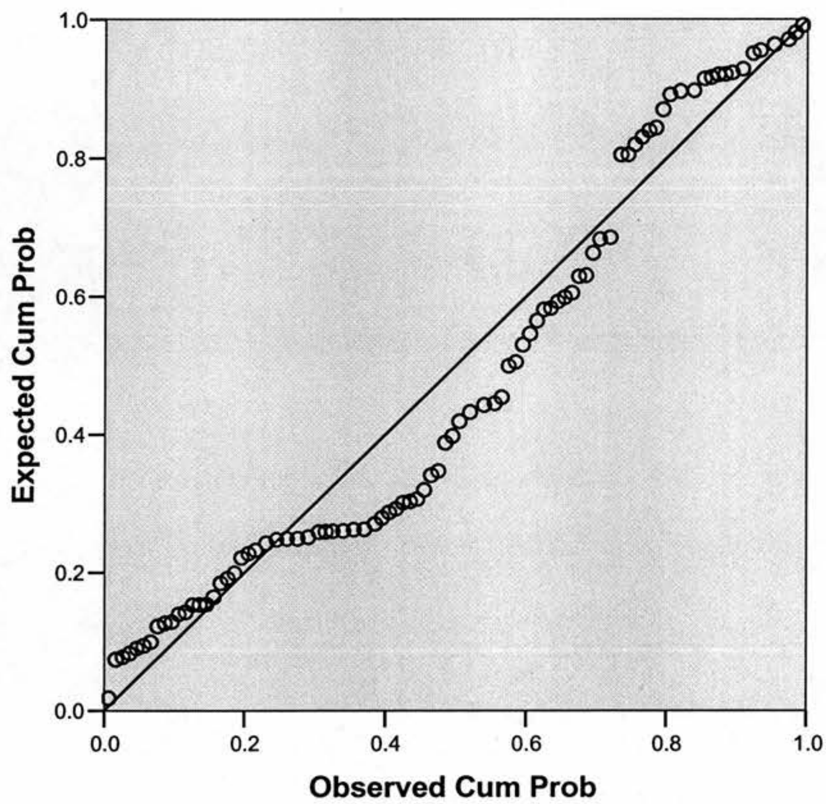
Normal P-P Plot of TROWEEXCESSRETURN



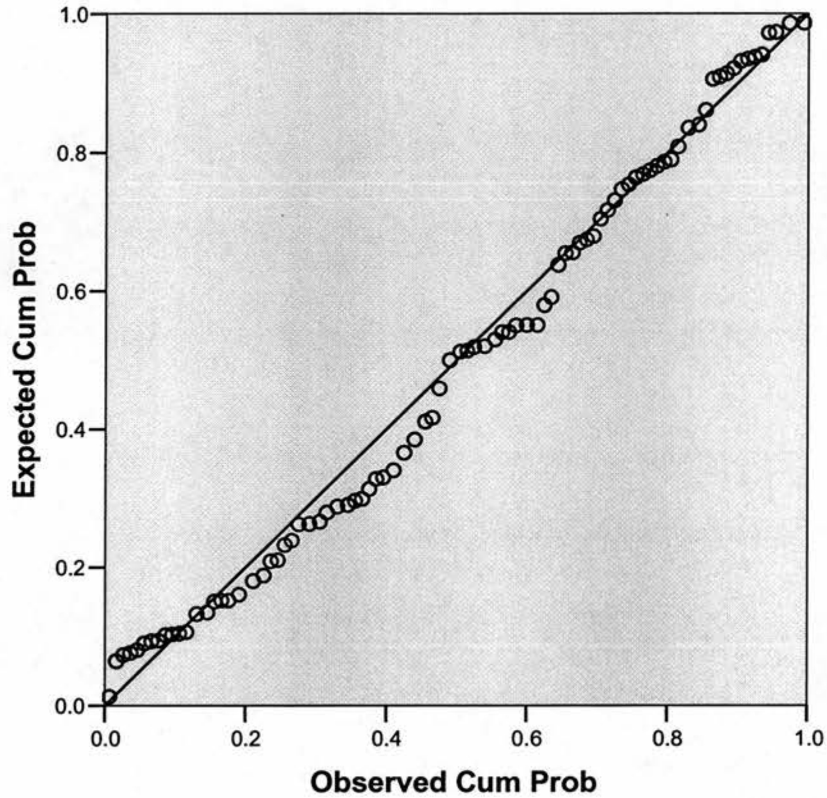

Normal P-P Plot of TROWEFORGNEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of USGLBEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

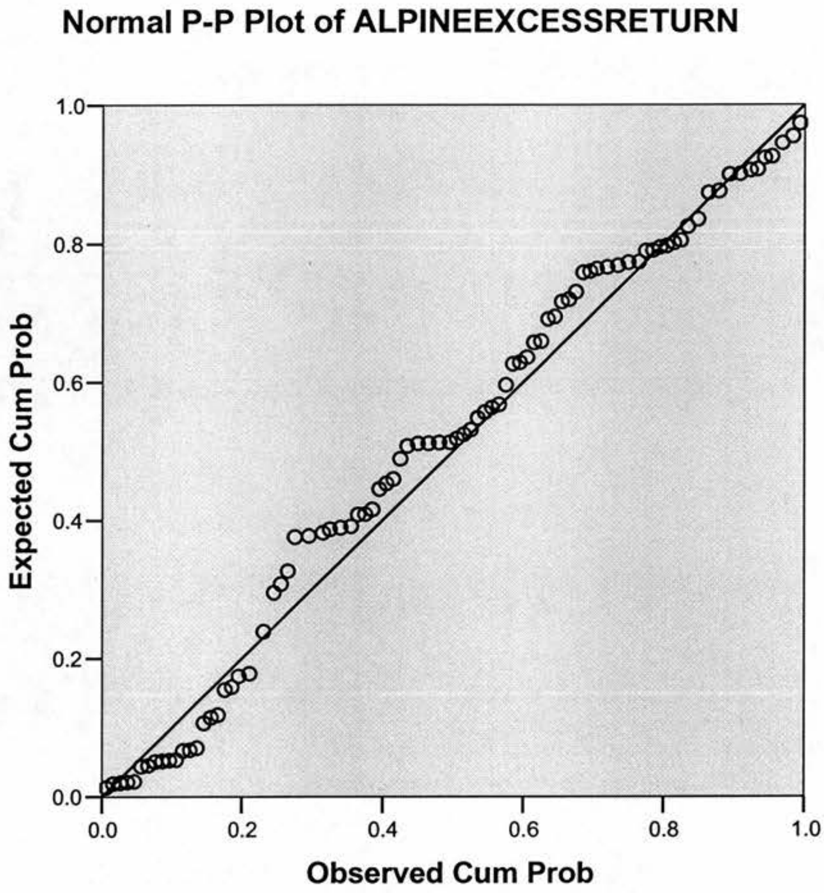
Normal P-P Plot of WESTWOODEXCESSRETURN

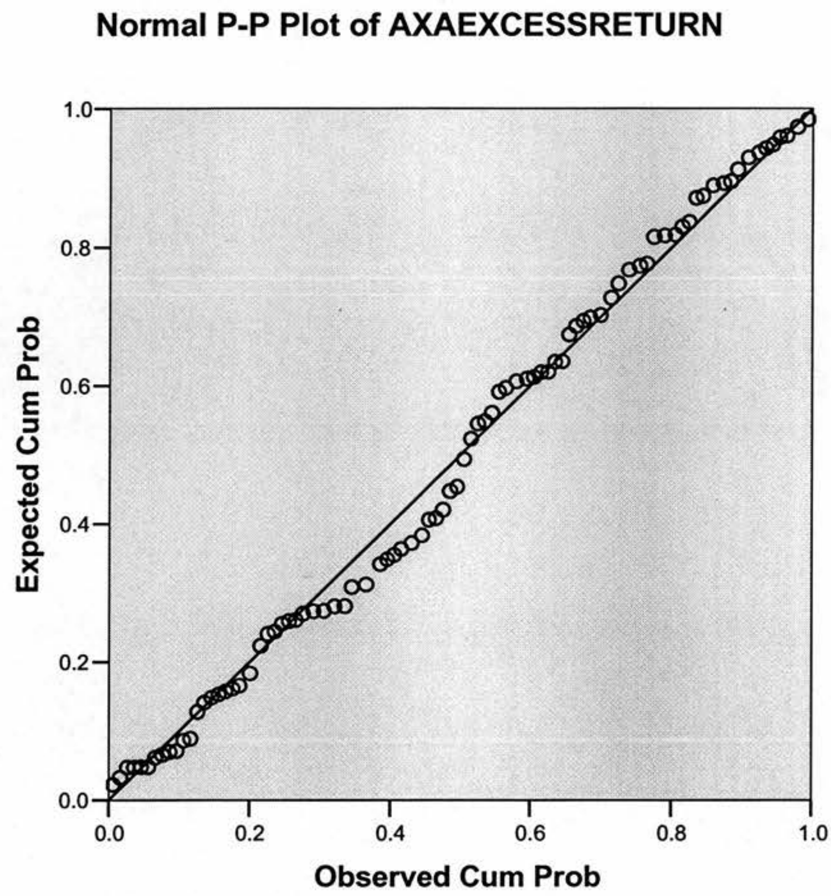


Normal P-P Plot of WMCLAEXCESSRETURN



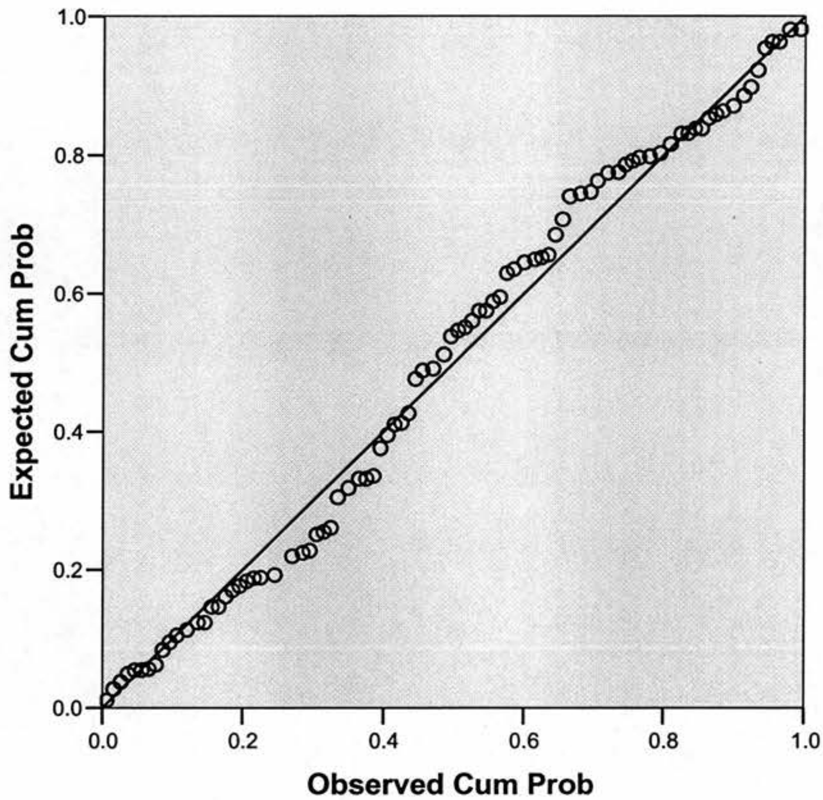
Appendix F (d) P-P Plot for Factor m1

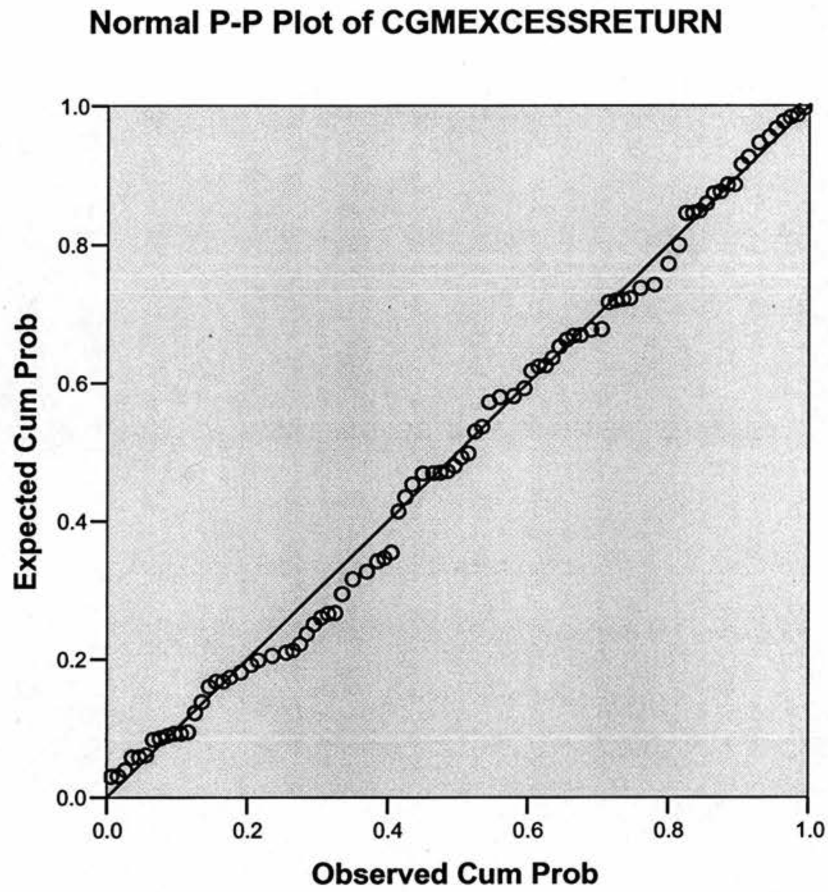




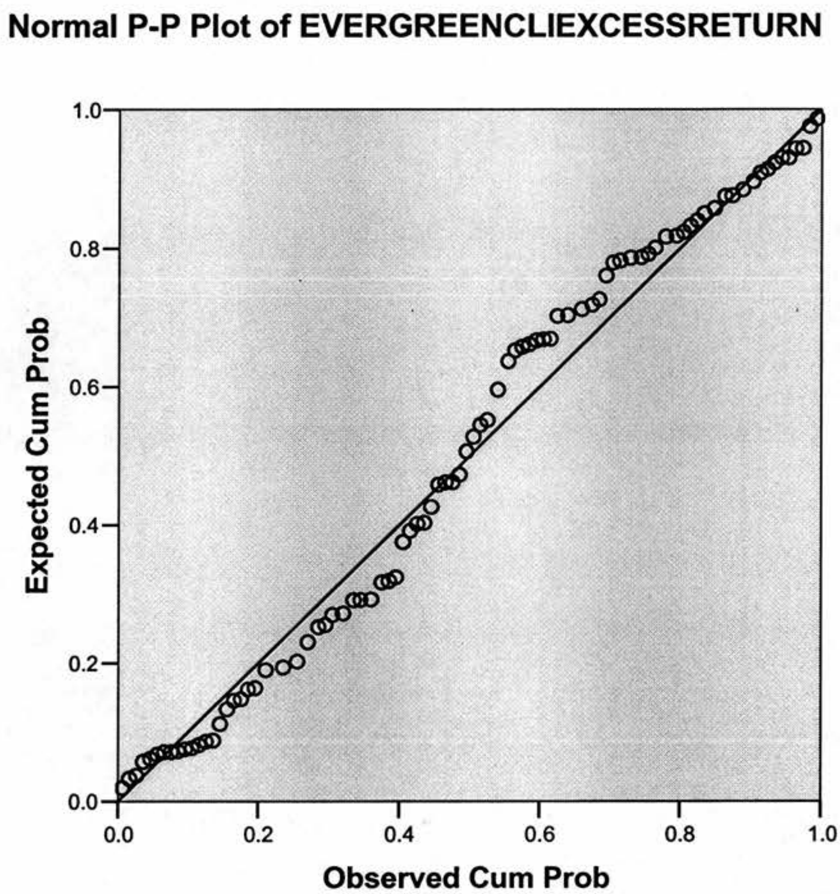
Normal P-P Plot of AXAEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

Normal P-P Plot of CALVERTEXCESSRETURN

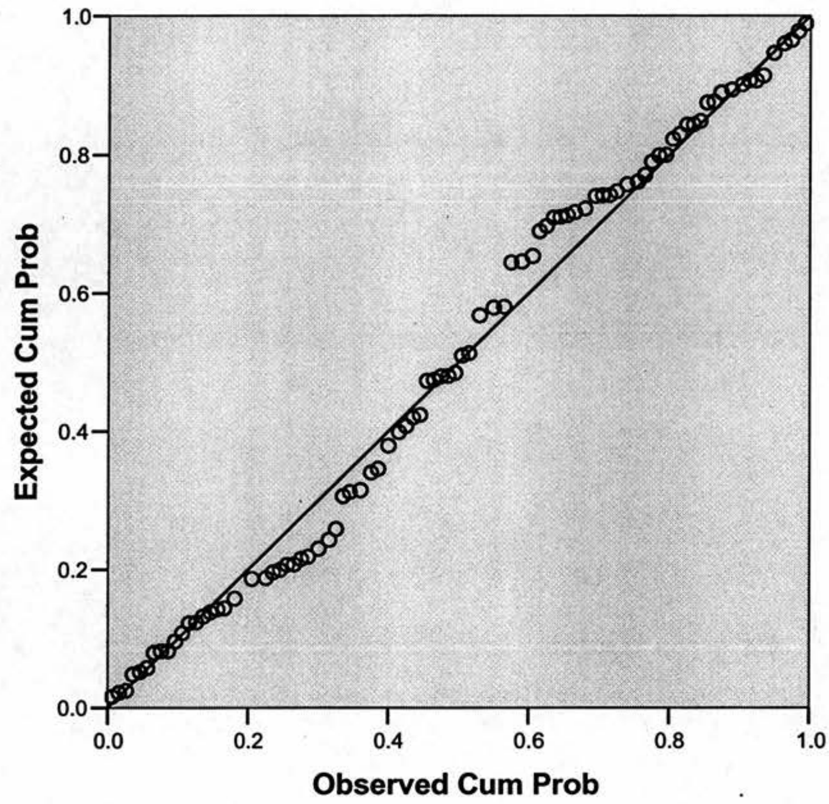




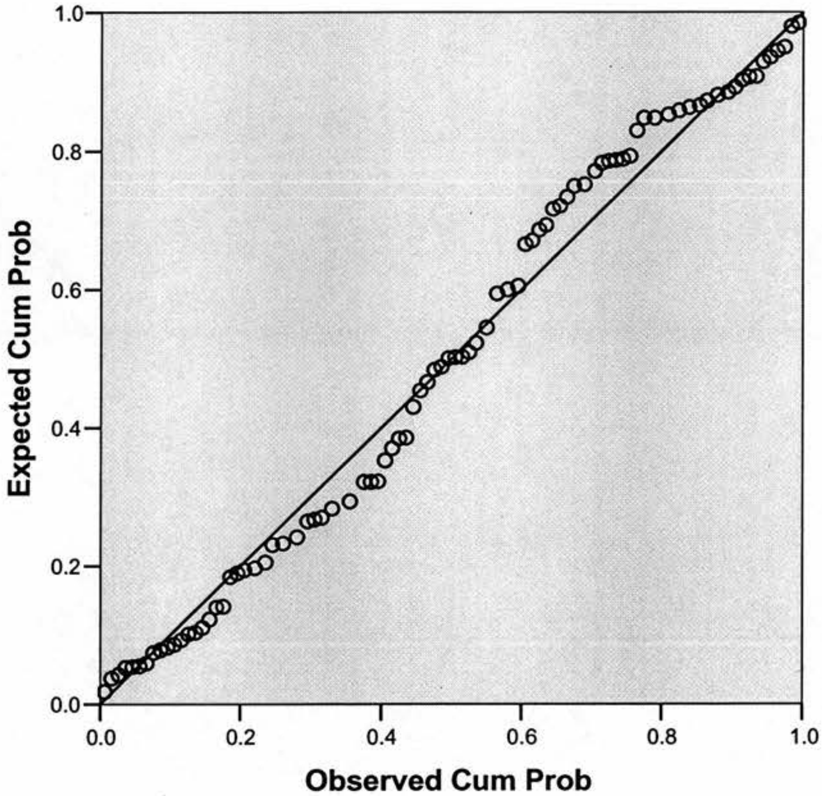
Normal P-P Plot of CGMEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

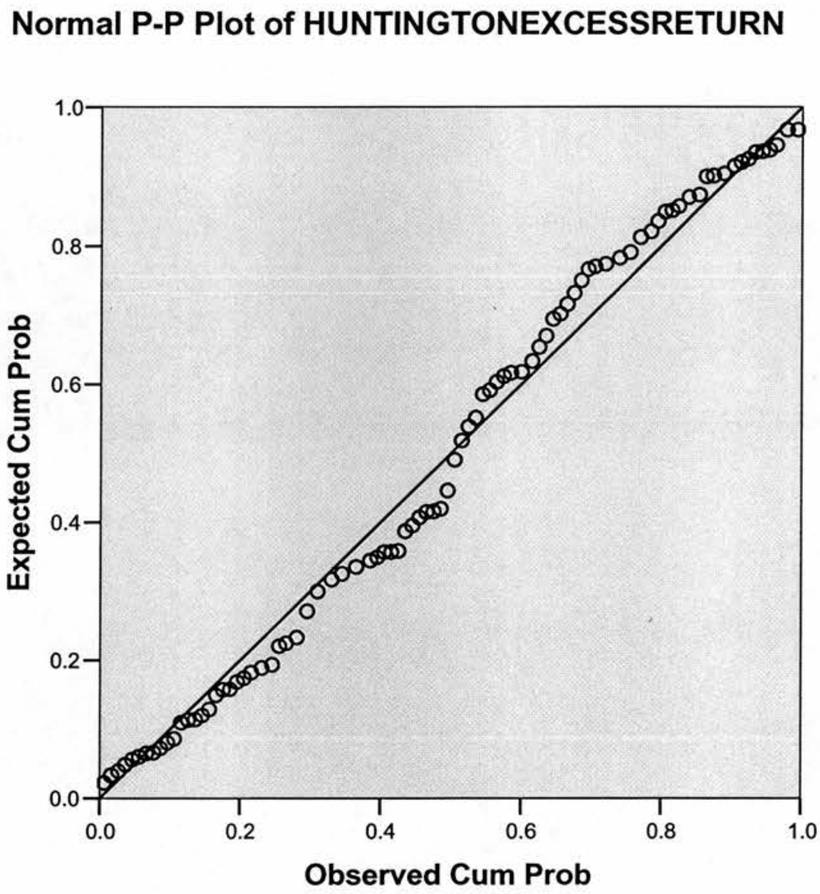

Normal P-P Plot of EVERGREENCLIEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

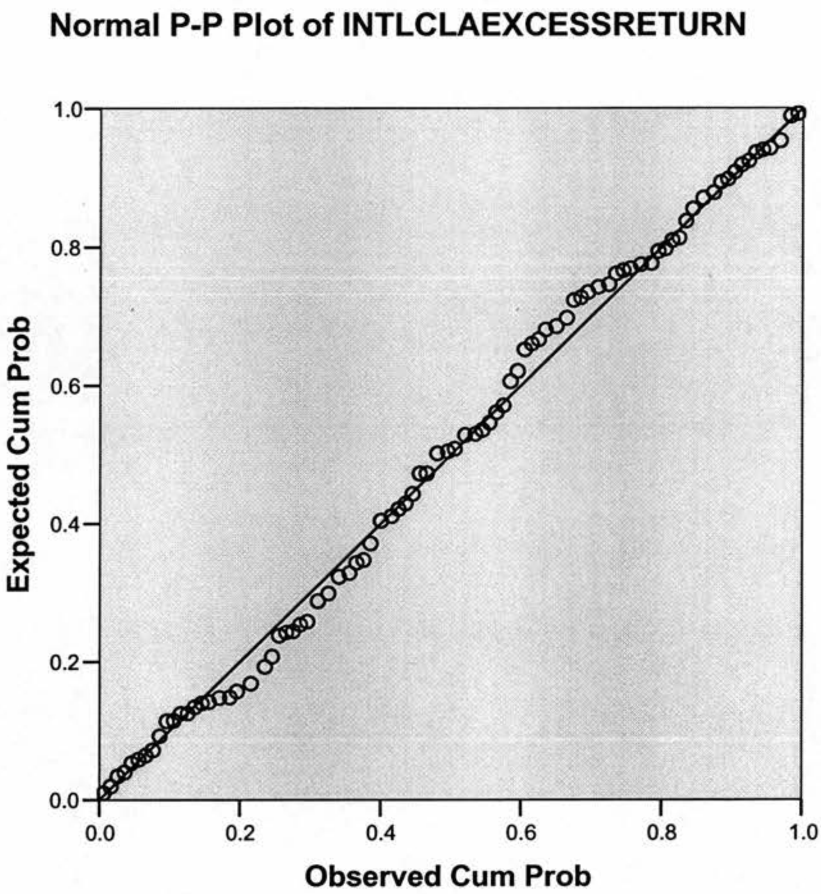
Normal P-P Plot of EXCELSIOREXCESSRETURN



Normal P-P Plot of FEDERATEDEXCESSRETURN

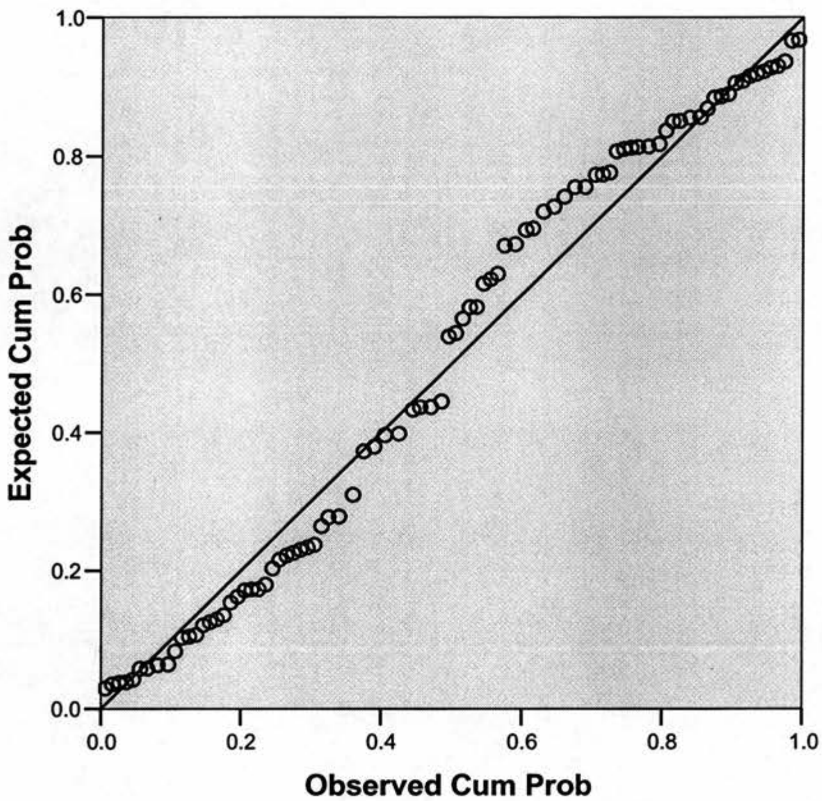



Normal P-P Plot of HUNTINGTONEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

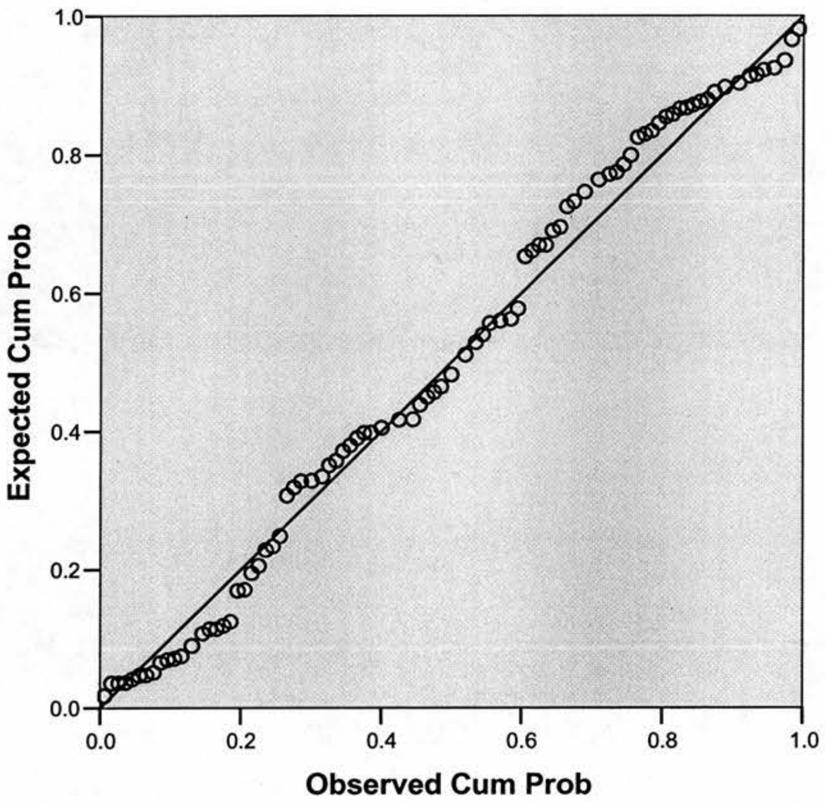


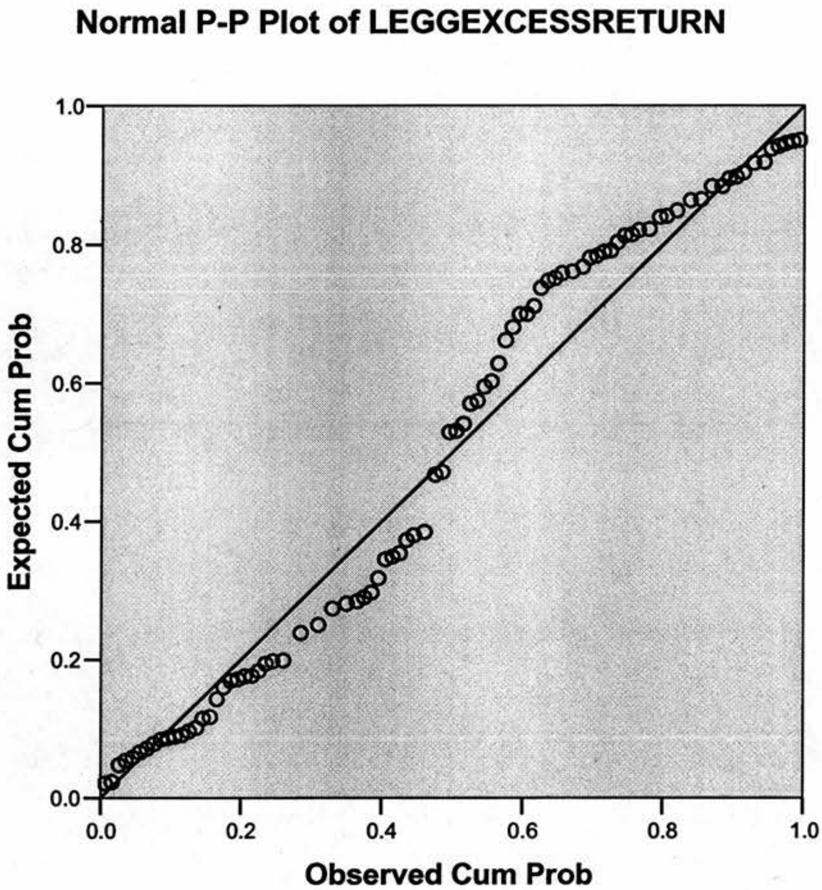
Normal P-P Plot of INTLCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

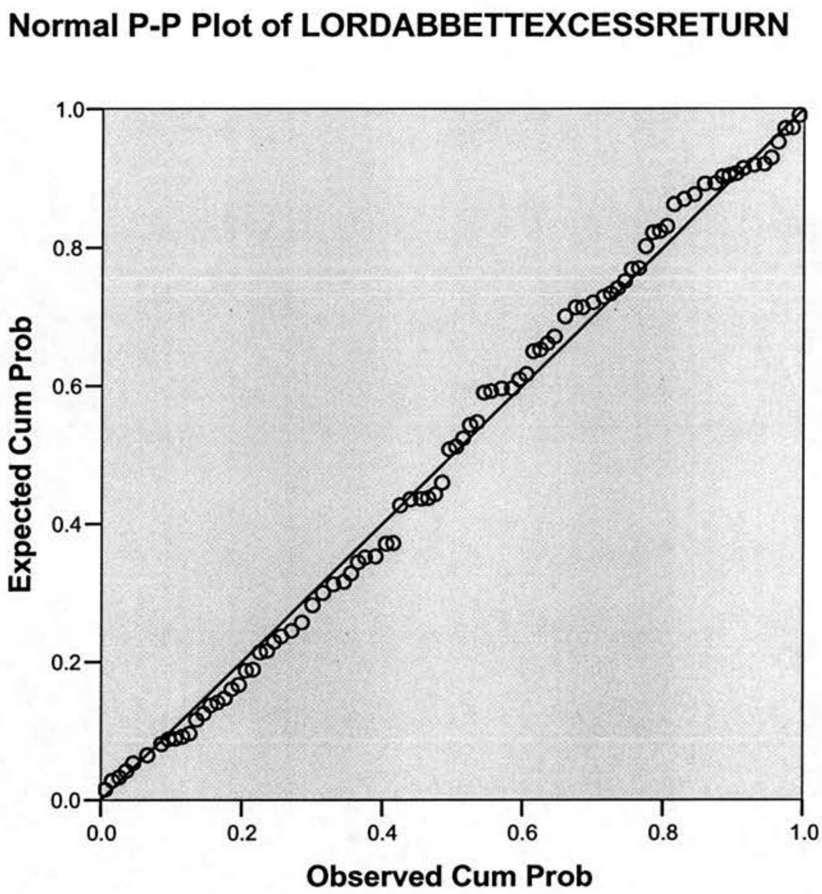
Normal P-P Plot of JCOCKCLAEXCESSRETURN



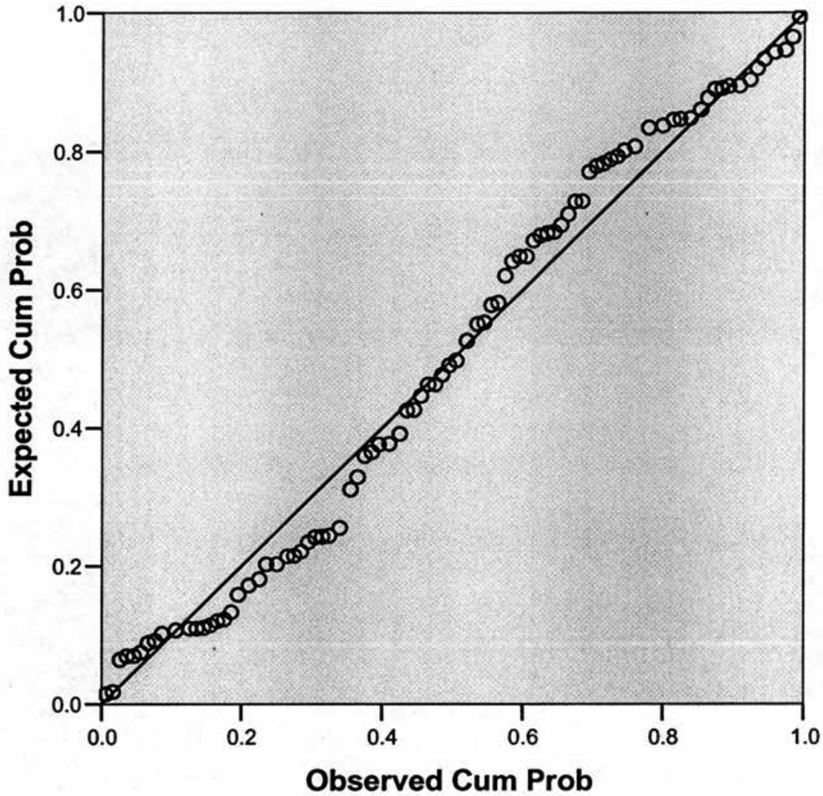
Normal P-P Plot of JPMORGANEXCESSRETURN

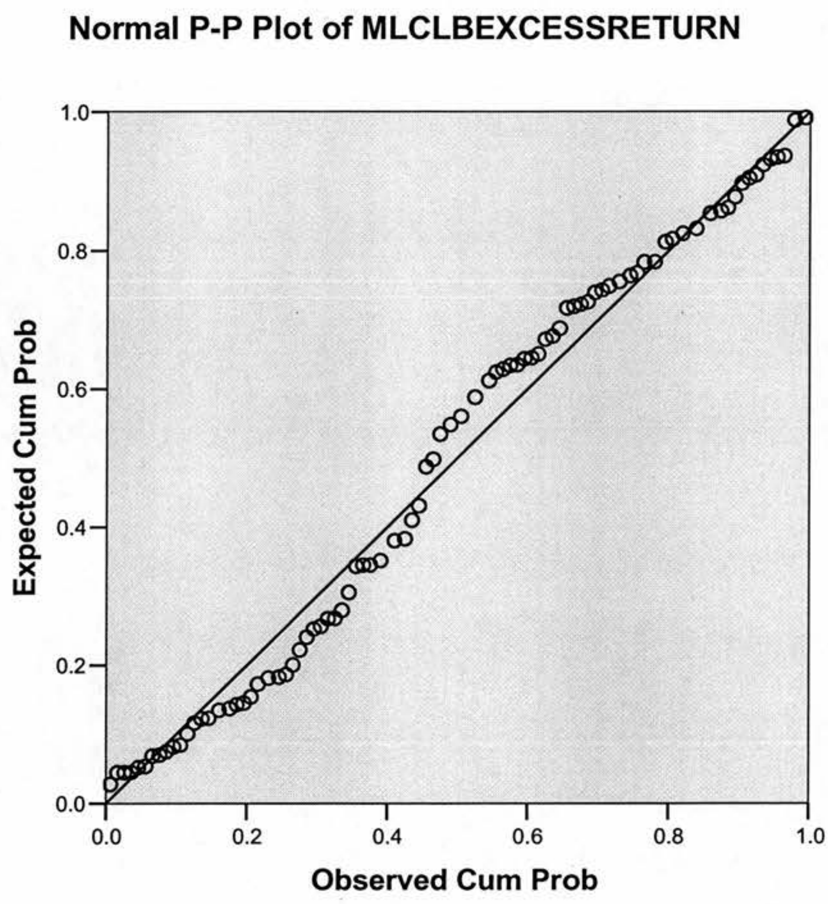


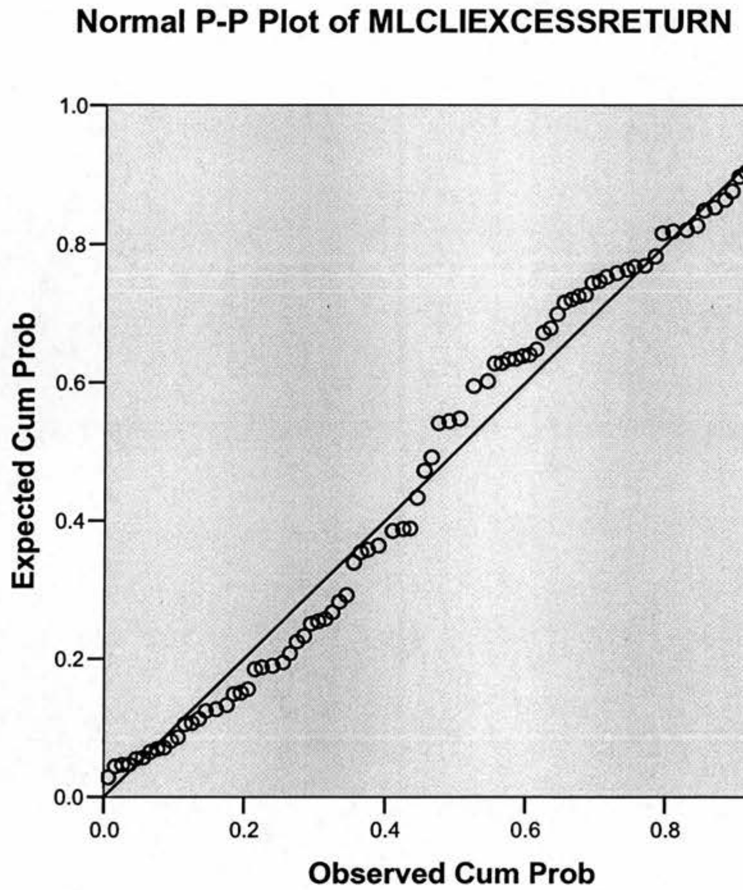

Normal P-P Plot of LEGGEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of LORDABBETTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

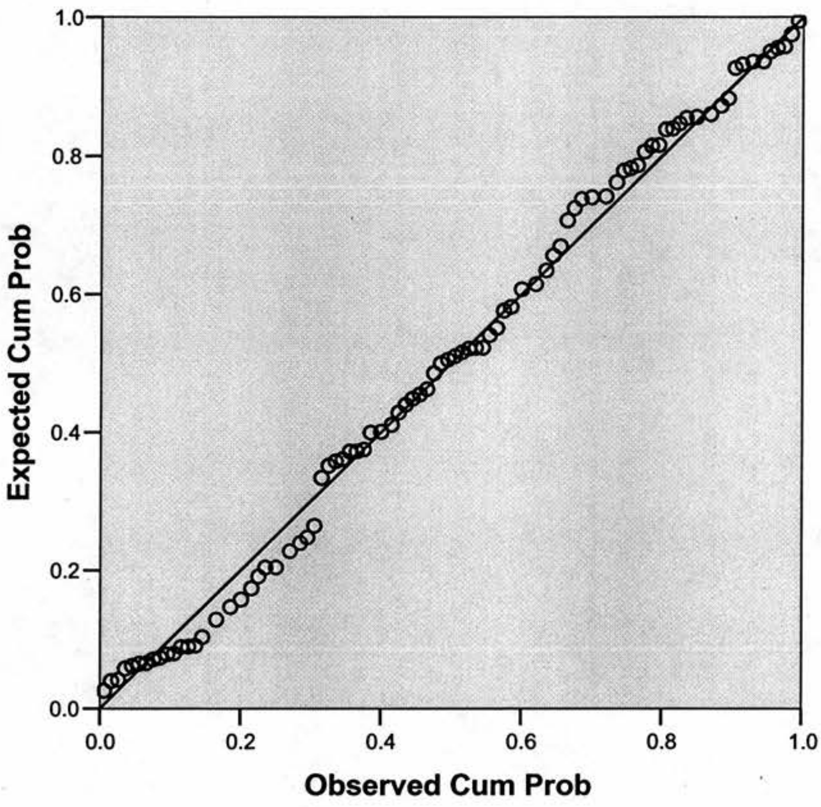
Normal P-P Plot of MFSEXCESSRETURN

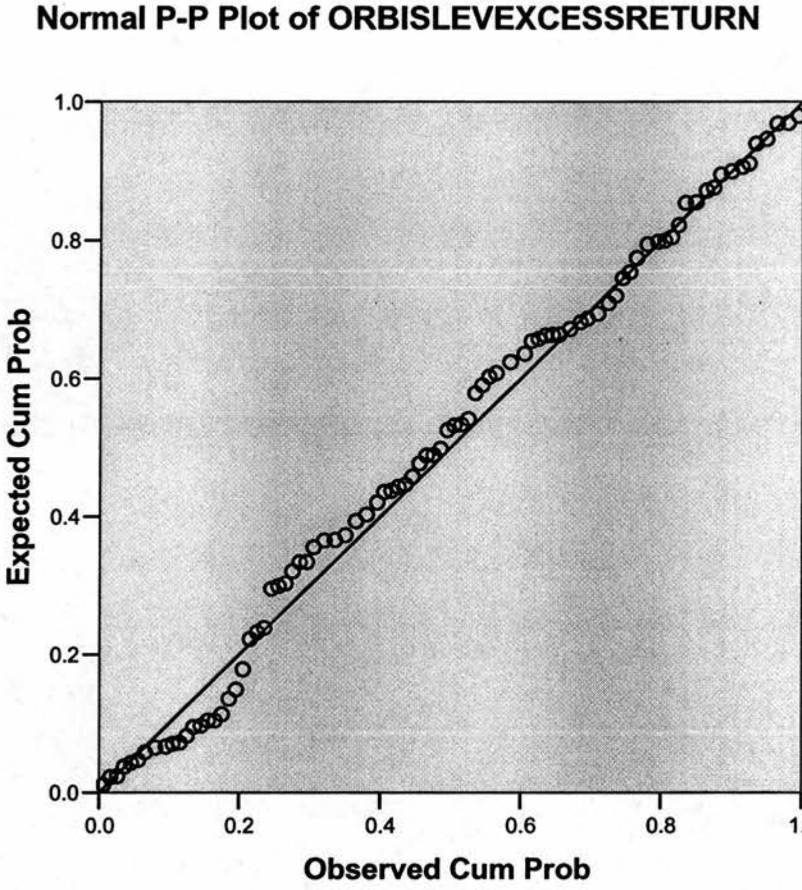


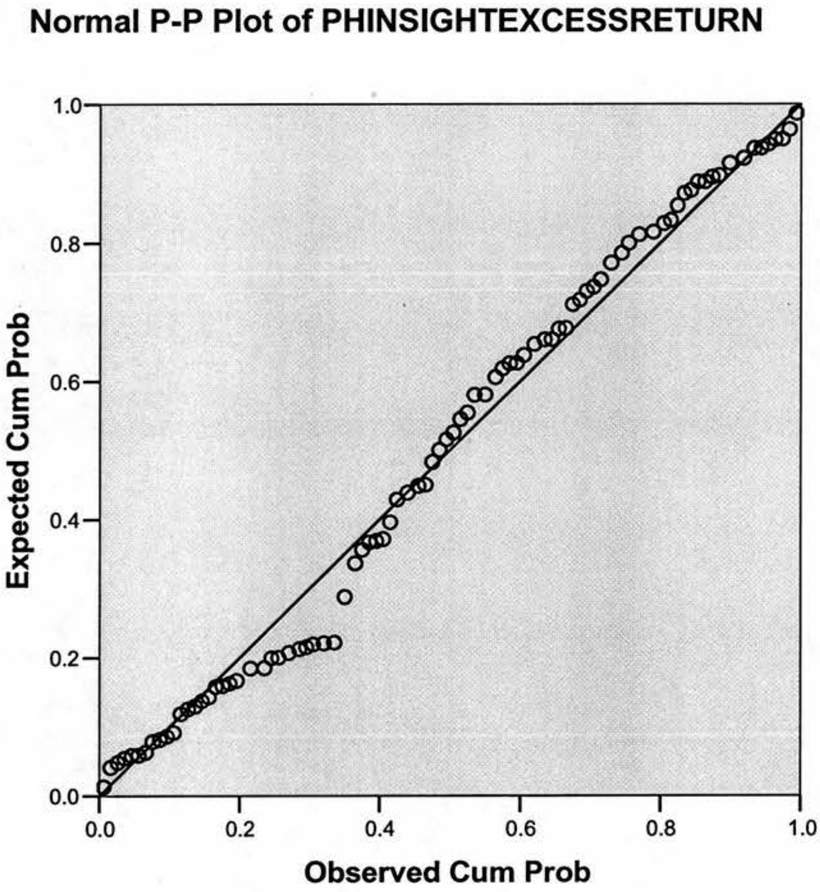

Normal P-P Plot of MLCLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of MLCLIEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

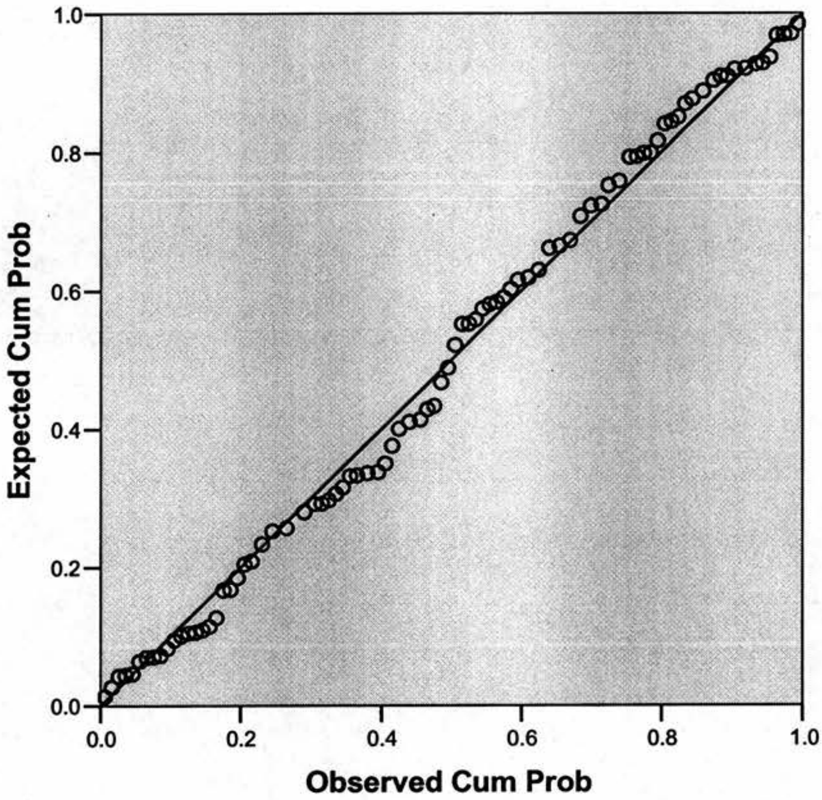
Normal P-P Plot of OLDMUTCLZEXCESSRETURN



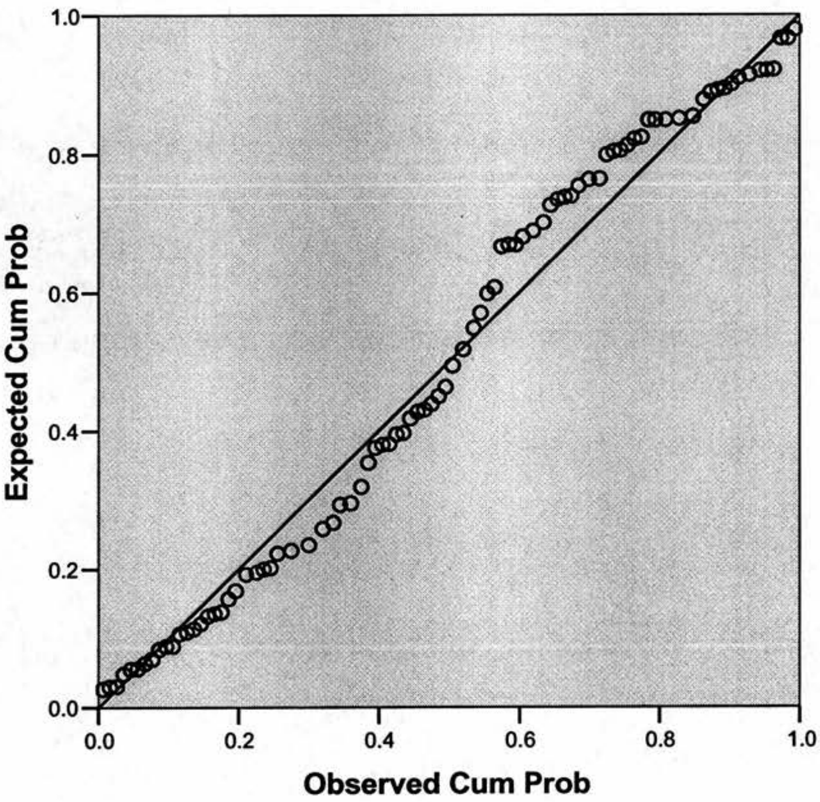

Normal P-P Plot of ORBISLEVEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

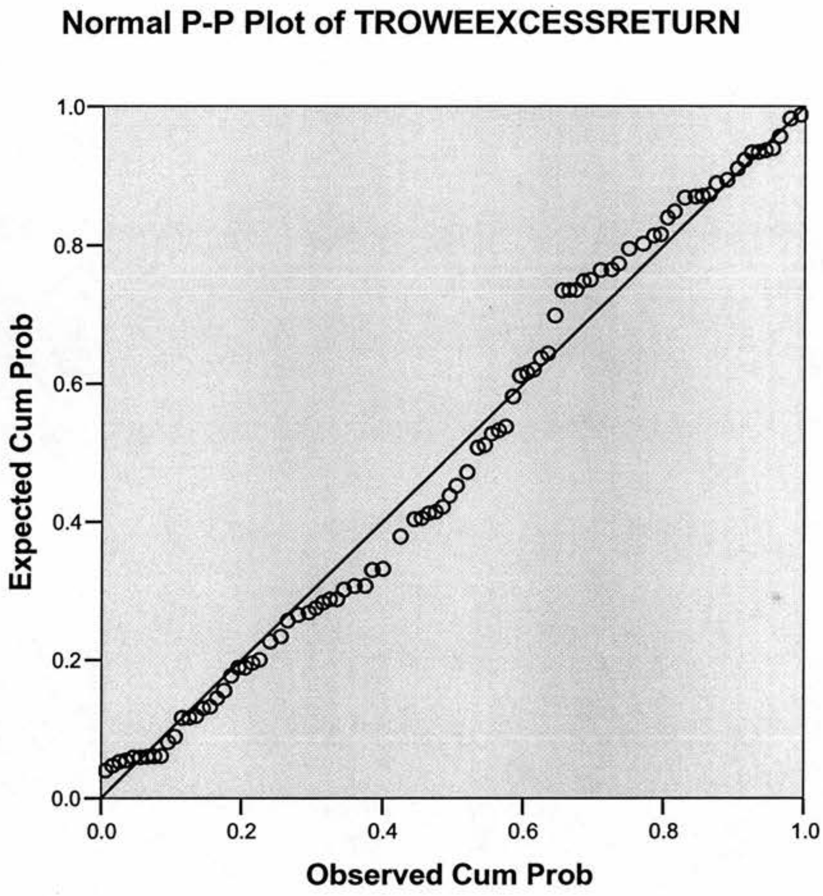

Normal P-P Plot of PHINSIGHTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of SMREXCESSRETURN

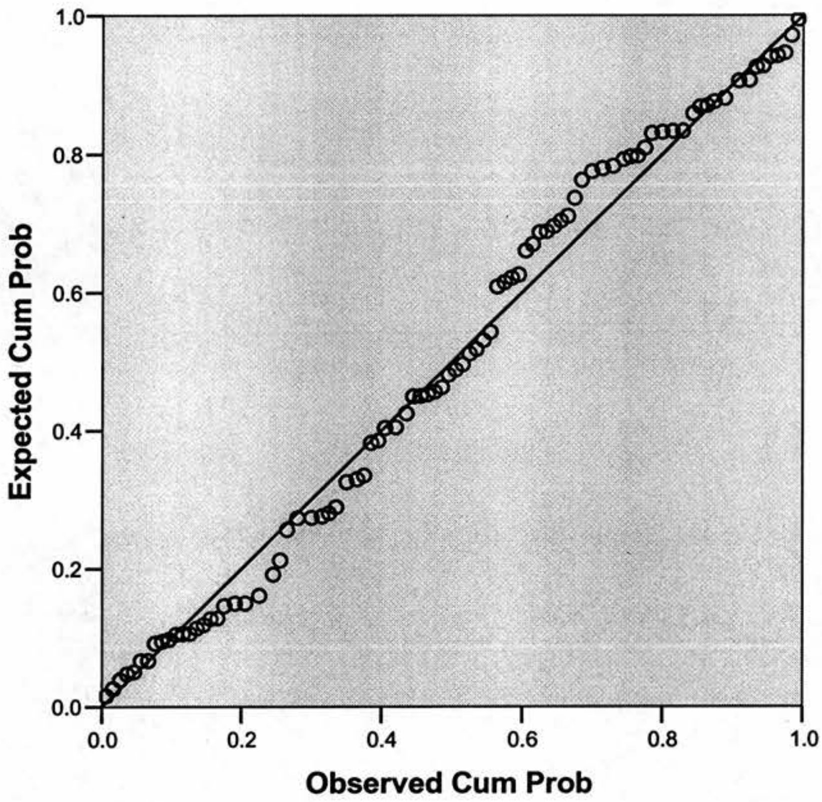


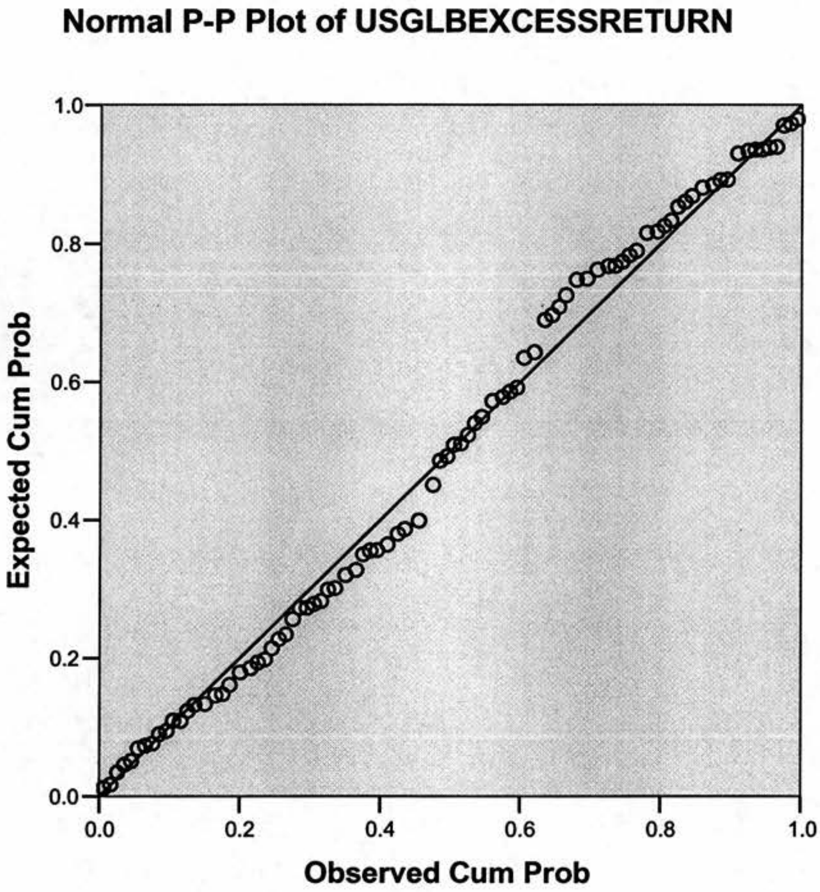
Normal P-P Plot of SPARTANEXCESSRETURN

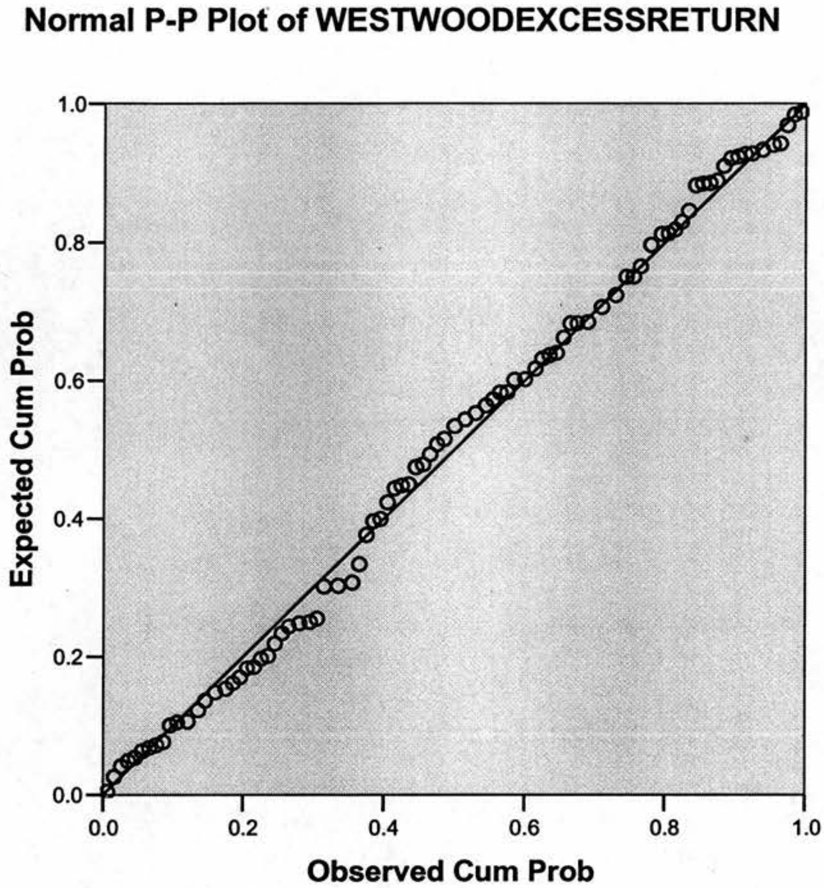


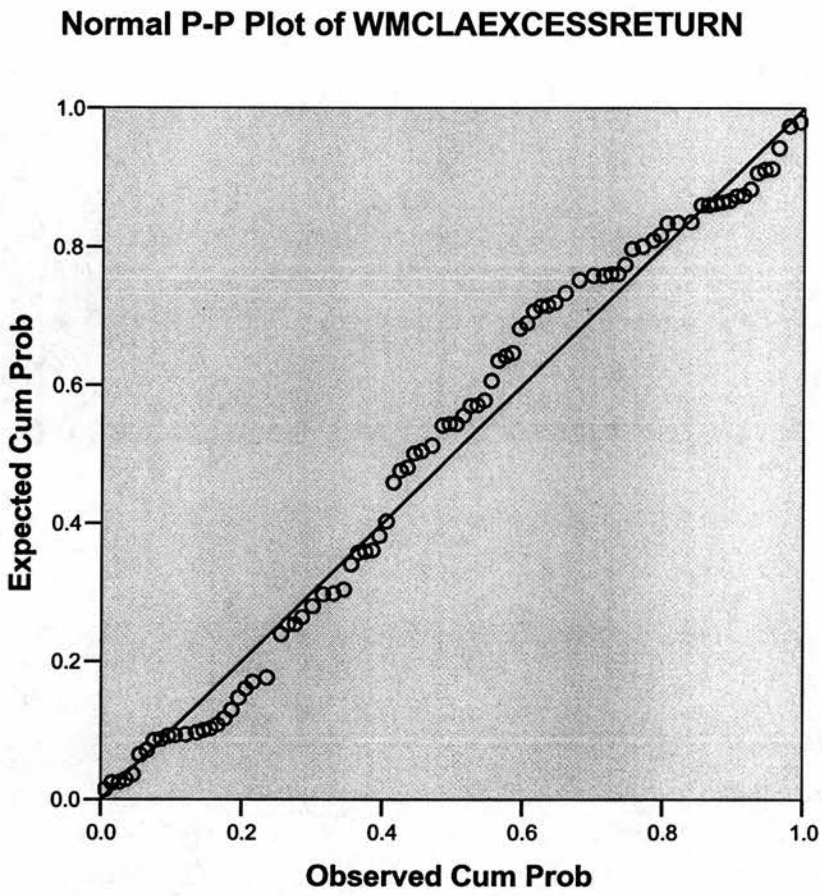

Normal P-P Plot of TROWEEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of TROWEFORGNEXCESSRETURN



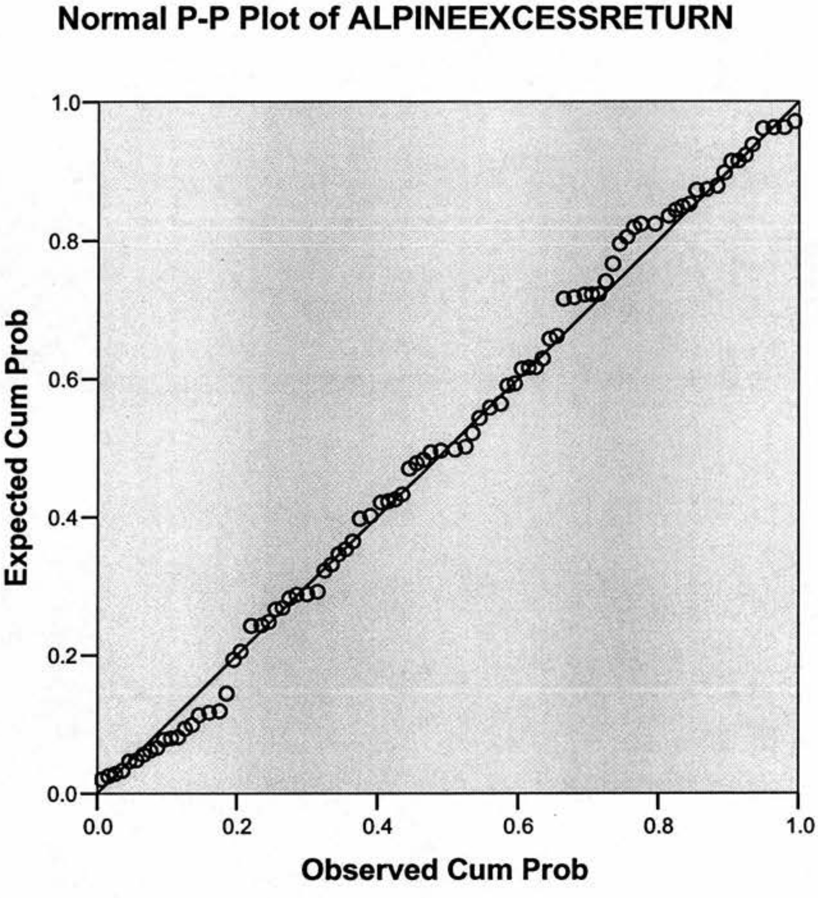

Normal P-P Plot of USGLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

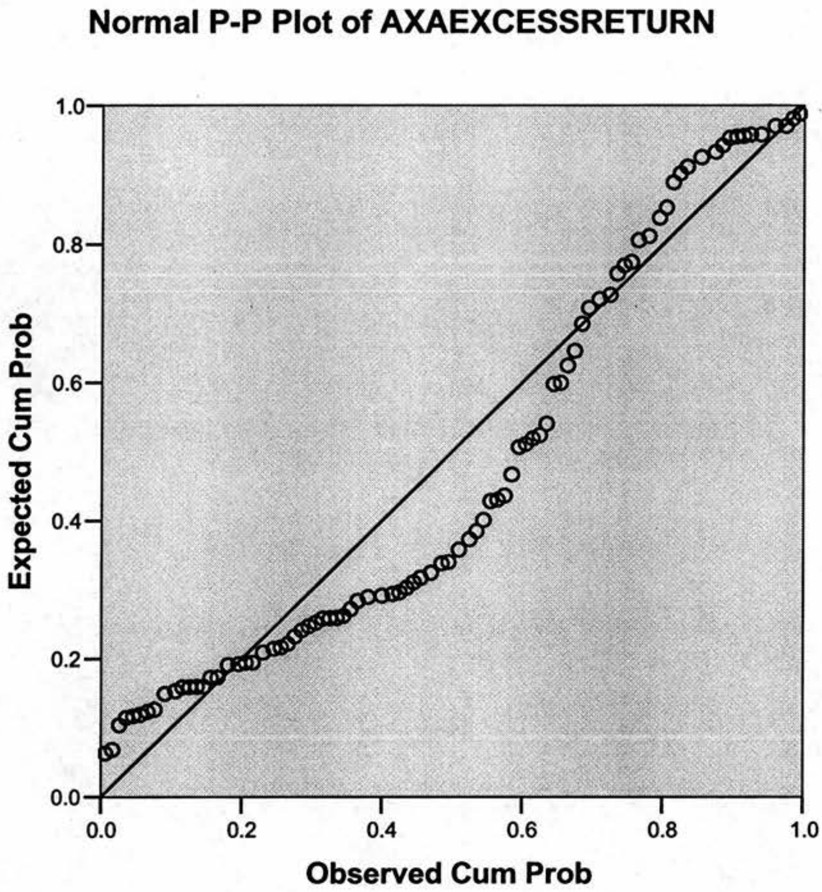




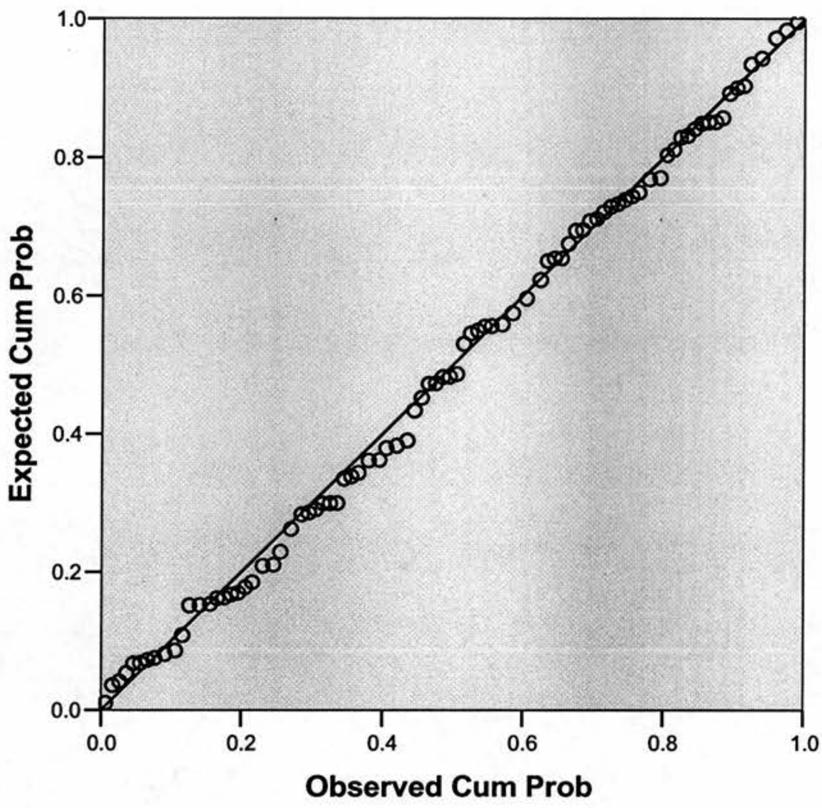
Normal P-P Plot of WMCLAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Appendix F (e) P-P Plot for Factor mb

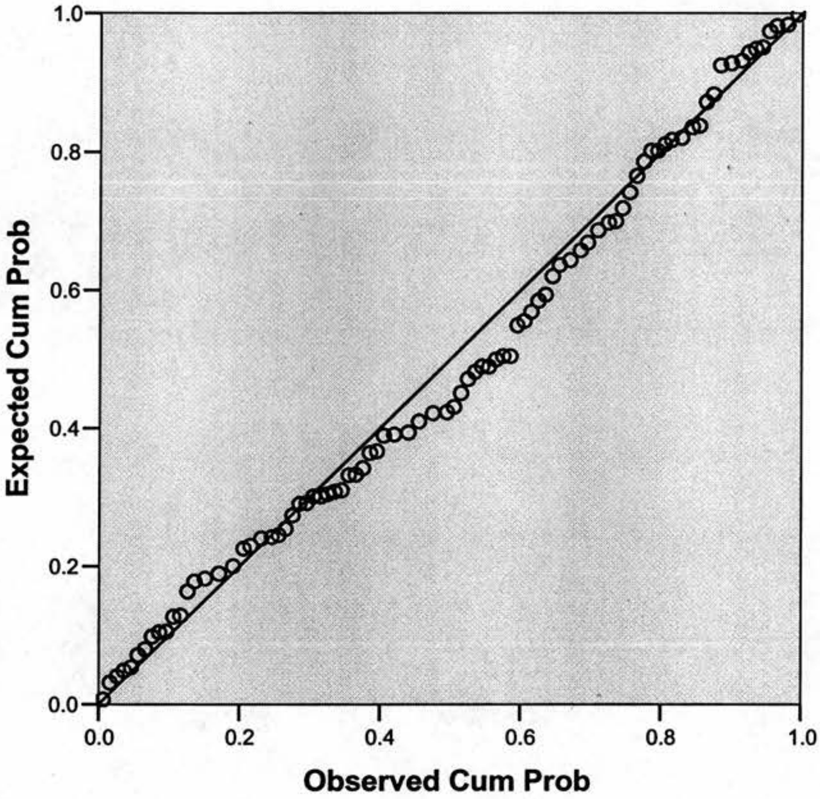



Normal P-P Plot of AXAEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

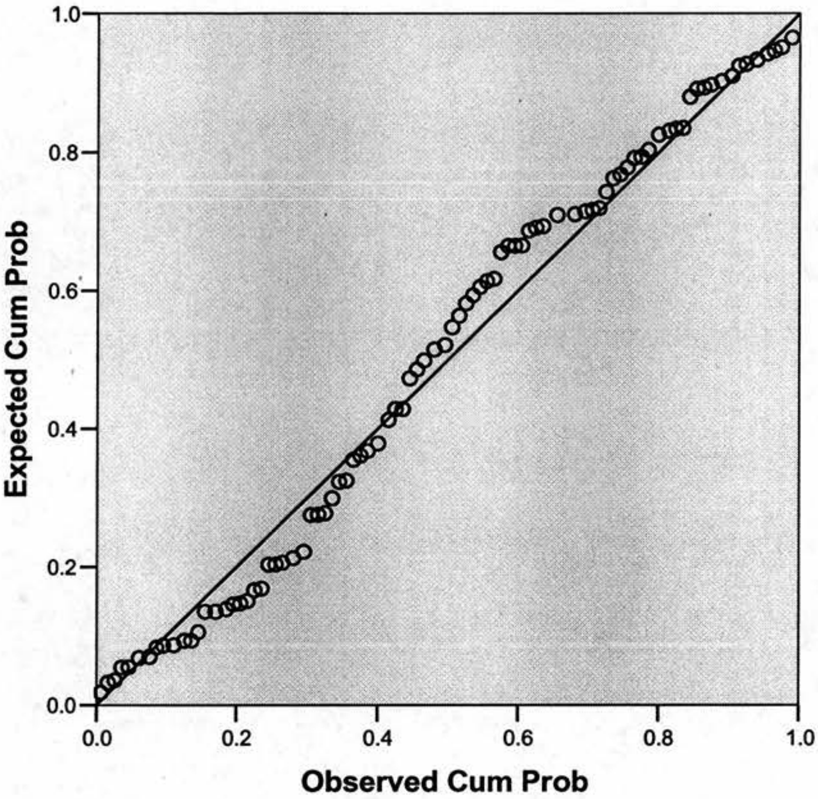
Normal P-P Plot of CALVERTEXCESSRETURN



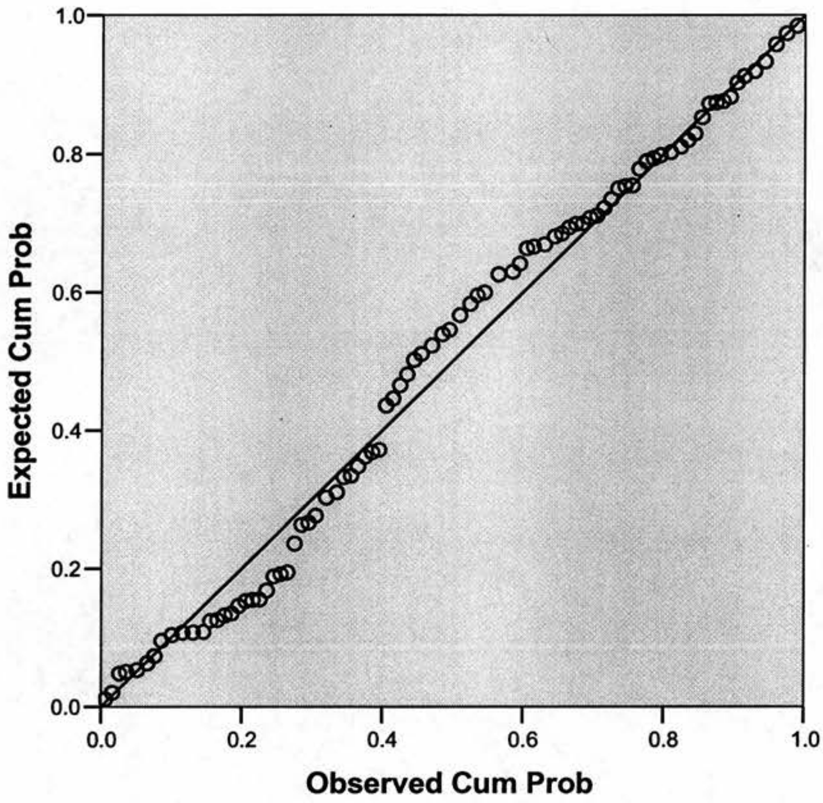
Normal P-P Plot of CGMEXCESSRETURN

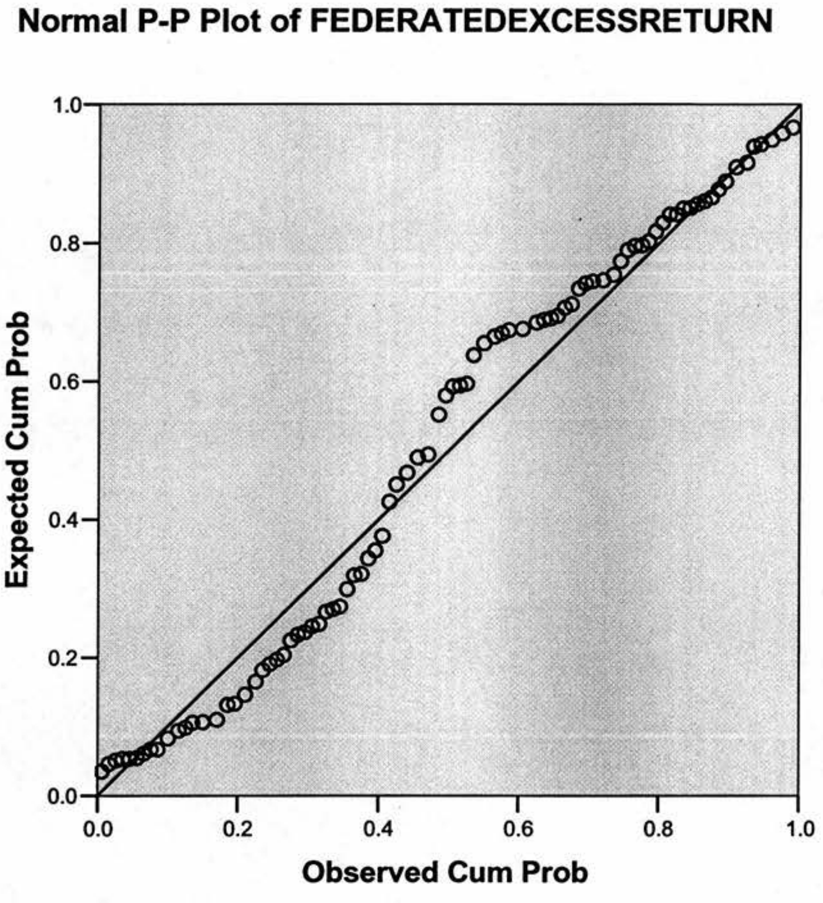


Normal P-P Plot of EVERGREENCLIEXCESSRETURN

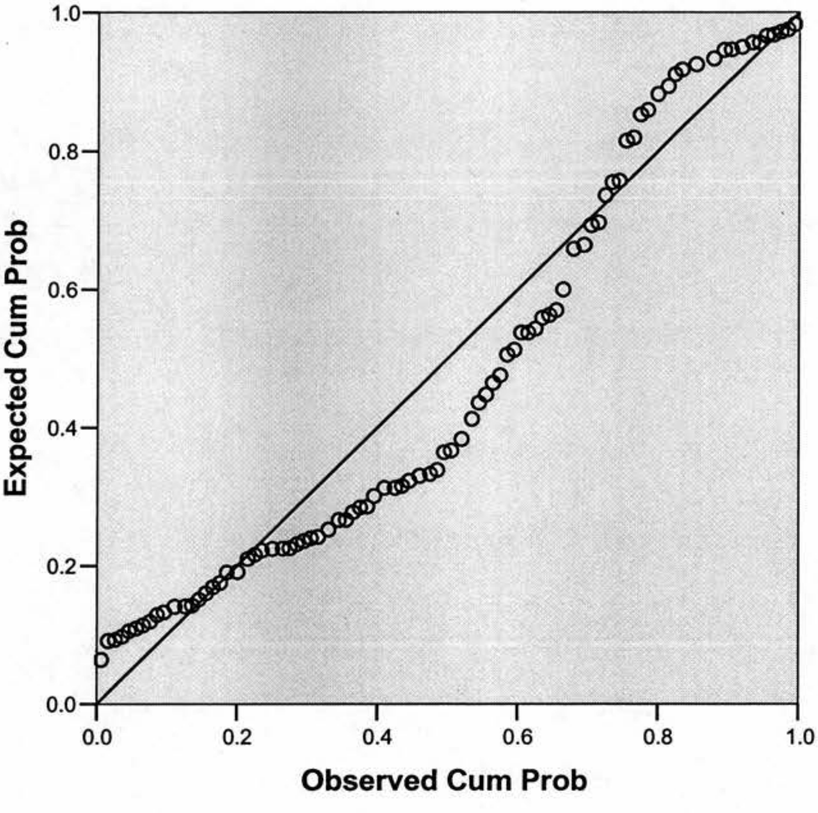


Normal P-P Plot of EXCELSIOREXCESSRETURN

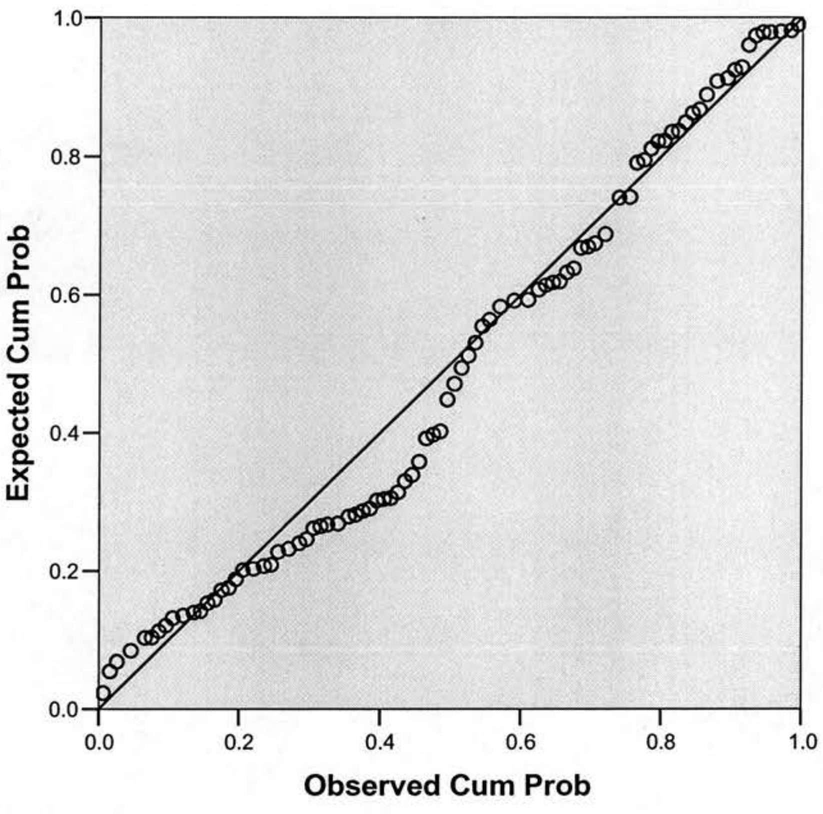


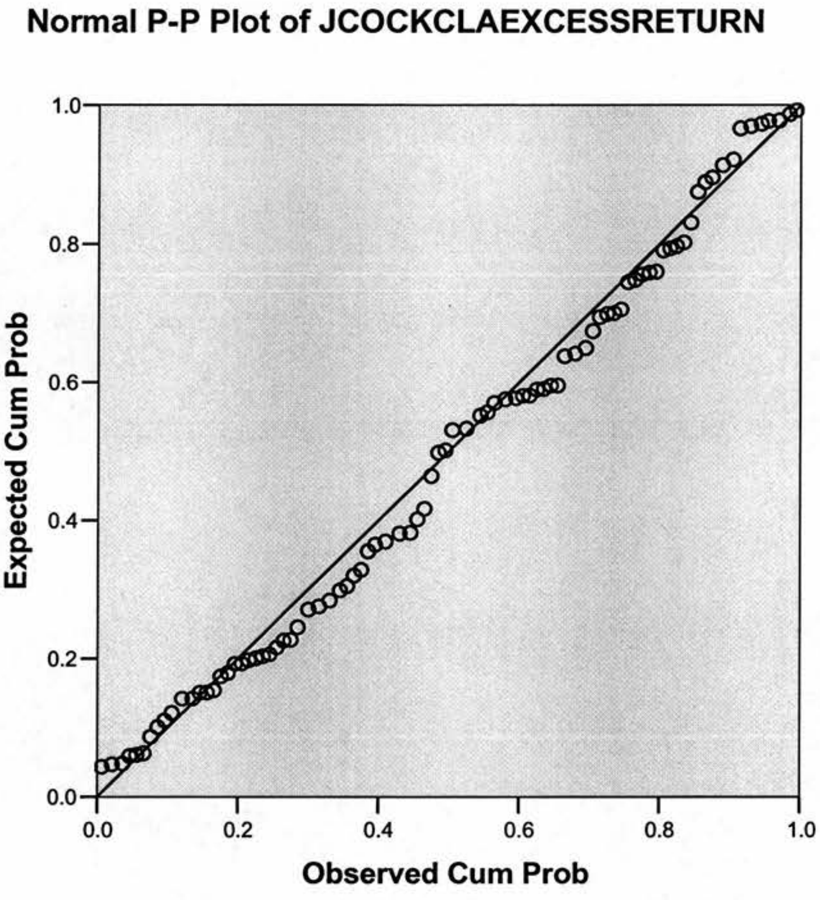

Normal P-P Plot of FEDERATEDEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of HUNTINGTONEXCESSRETURN

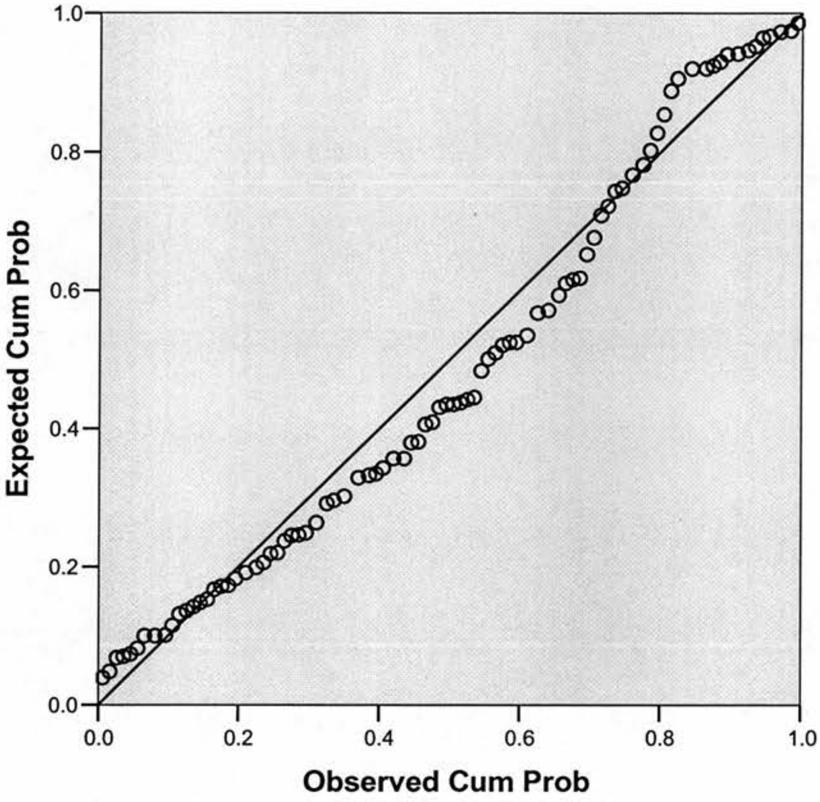


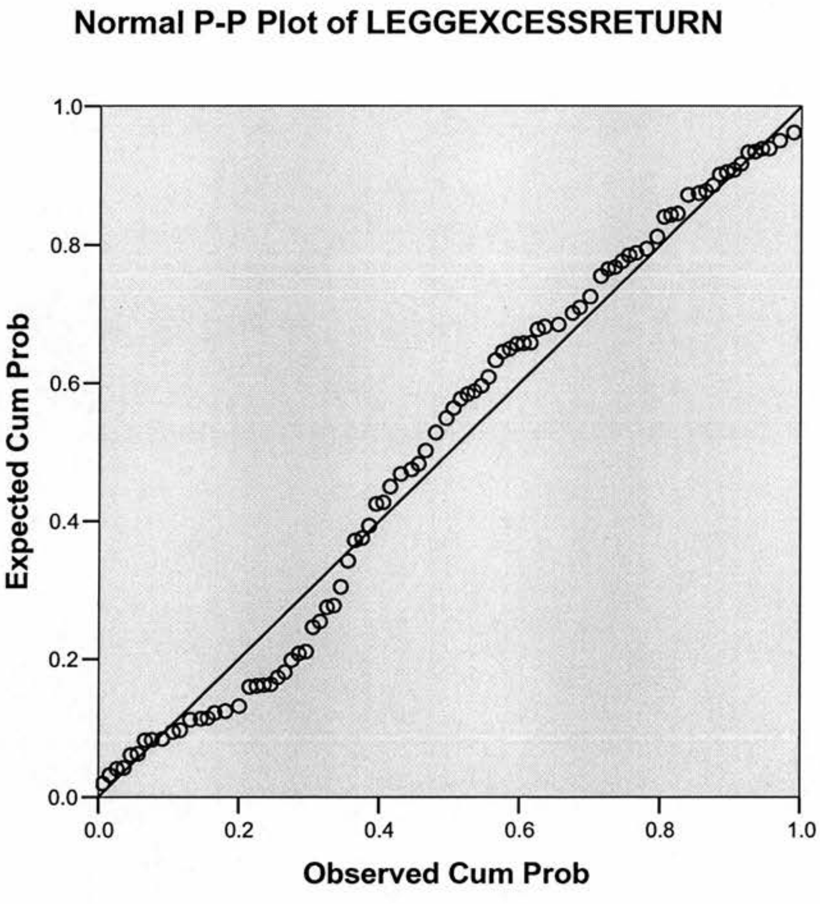
Normal P-P Plot of INTLCLAEXCESSRETURN

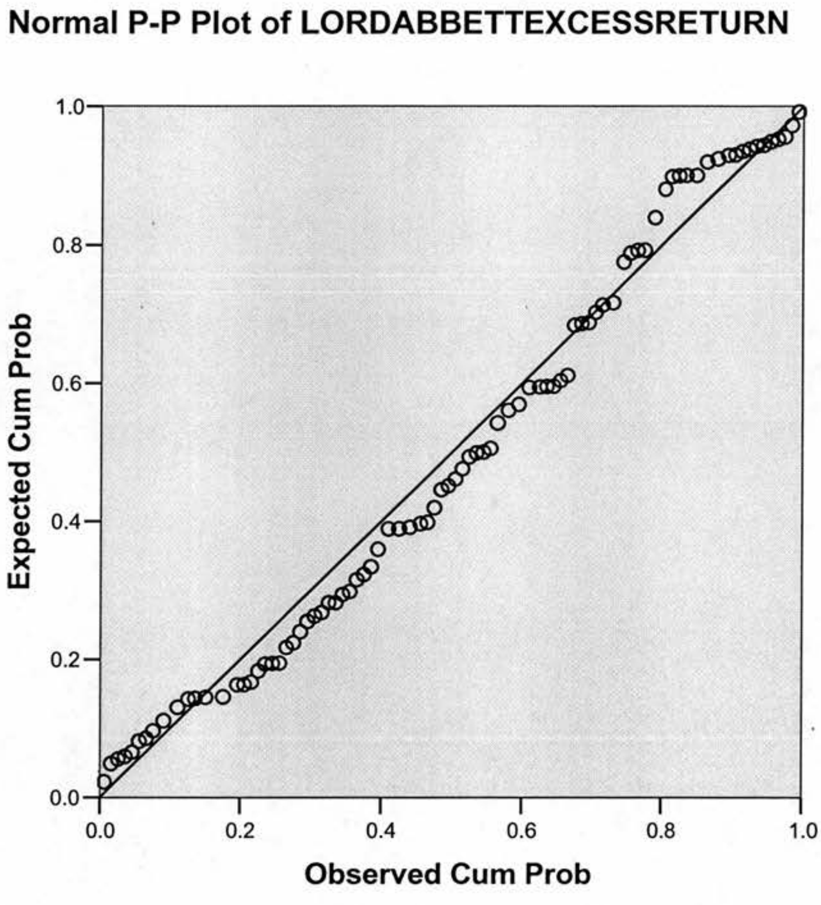


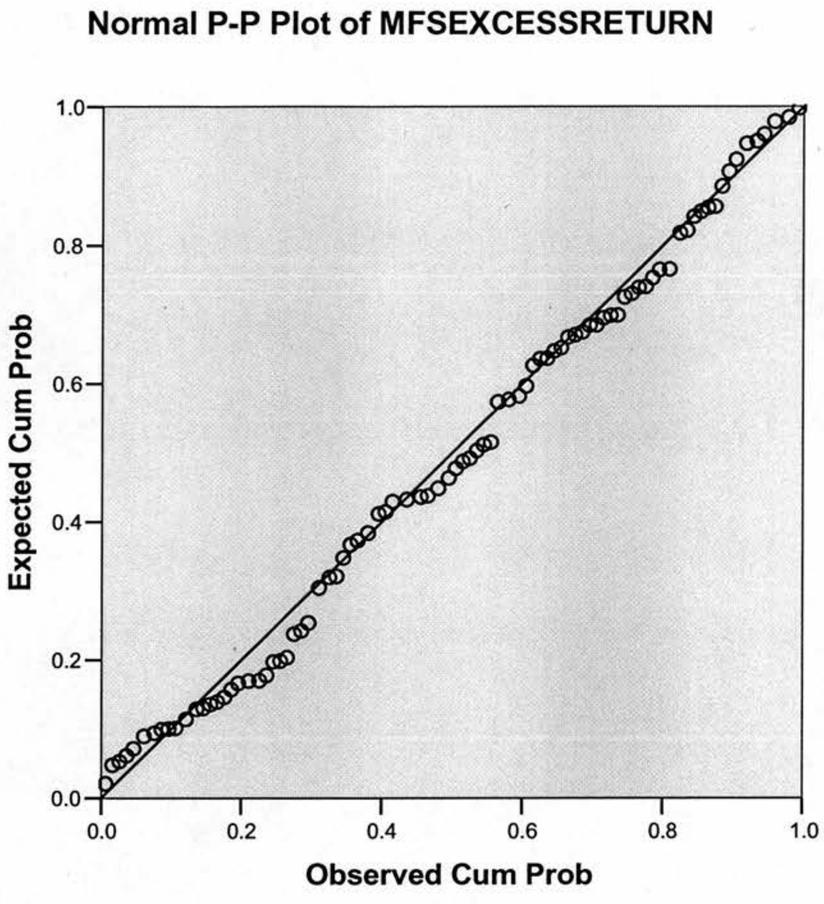

Normal P-P Plot of JCOCKCLAEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

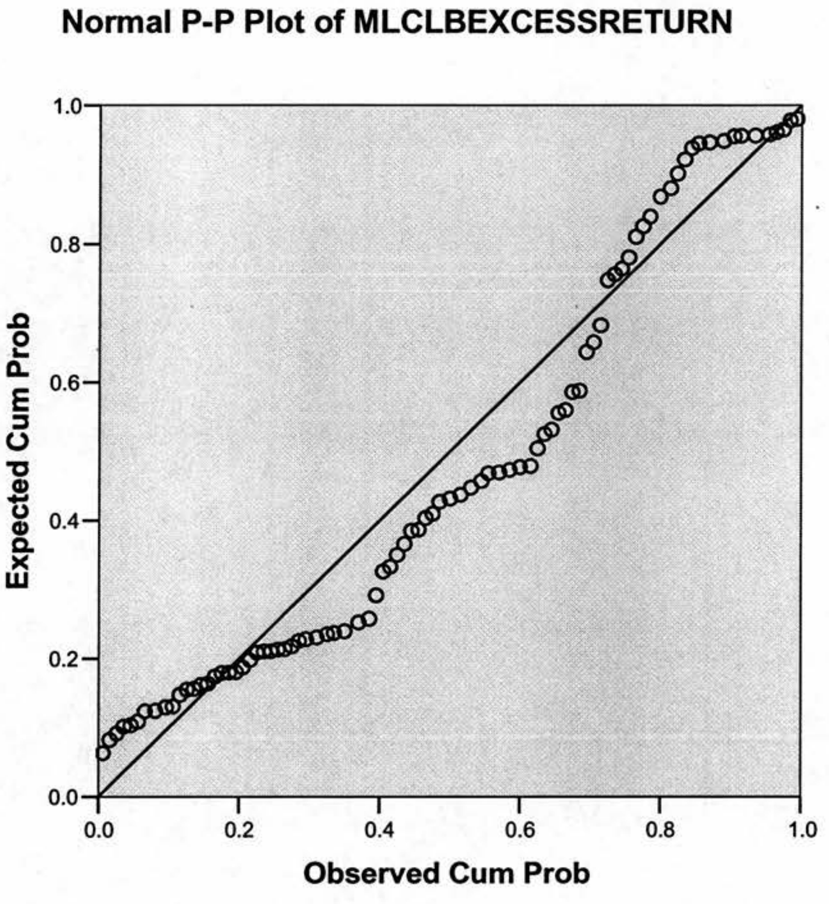
Normal P-P Plot of JPMORGANEXCESSRETURN

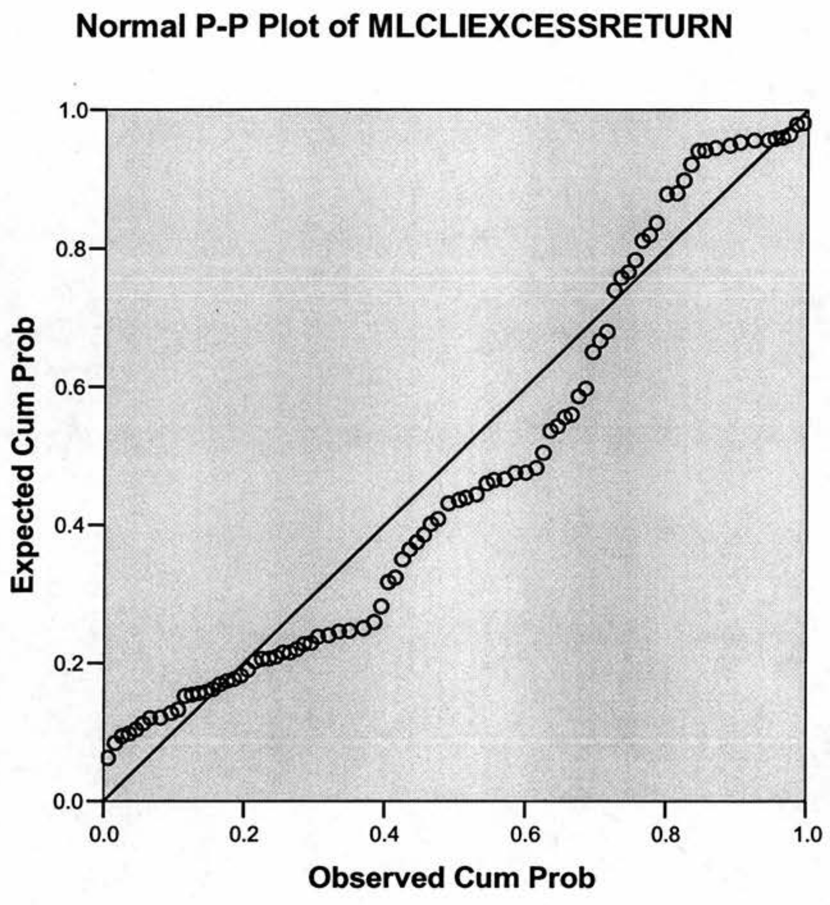



Normal P-P Plot of LEGGEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

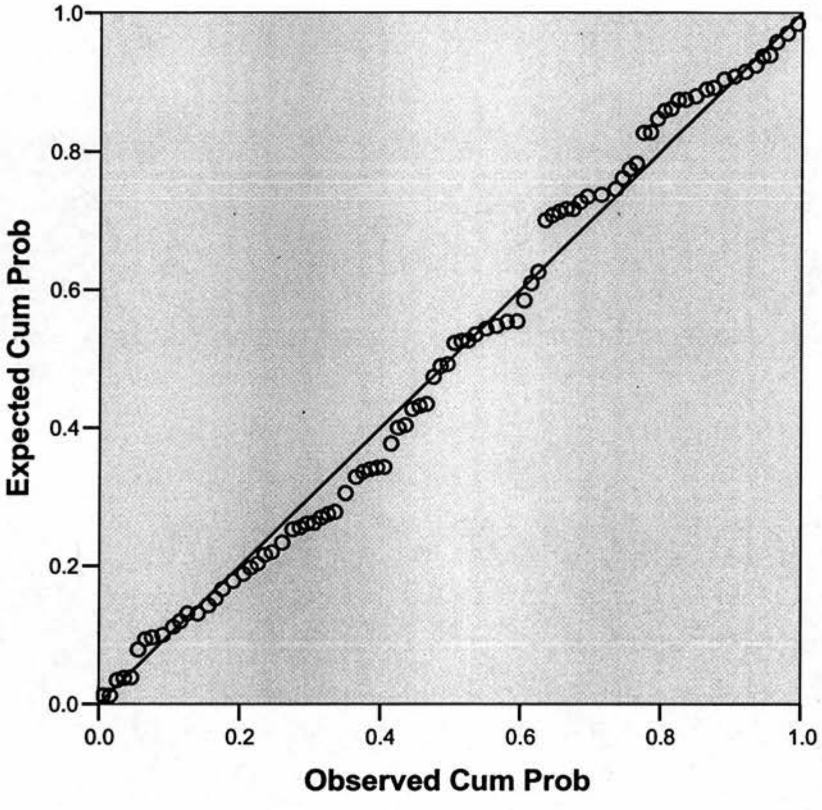

Normal P-P Plot of LORDABBETTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

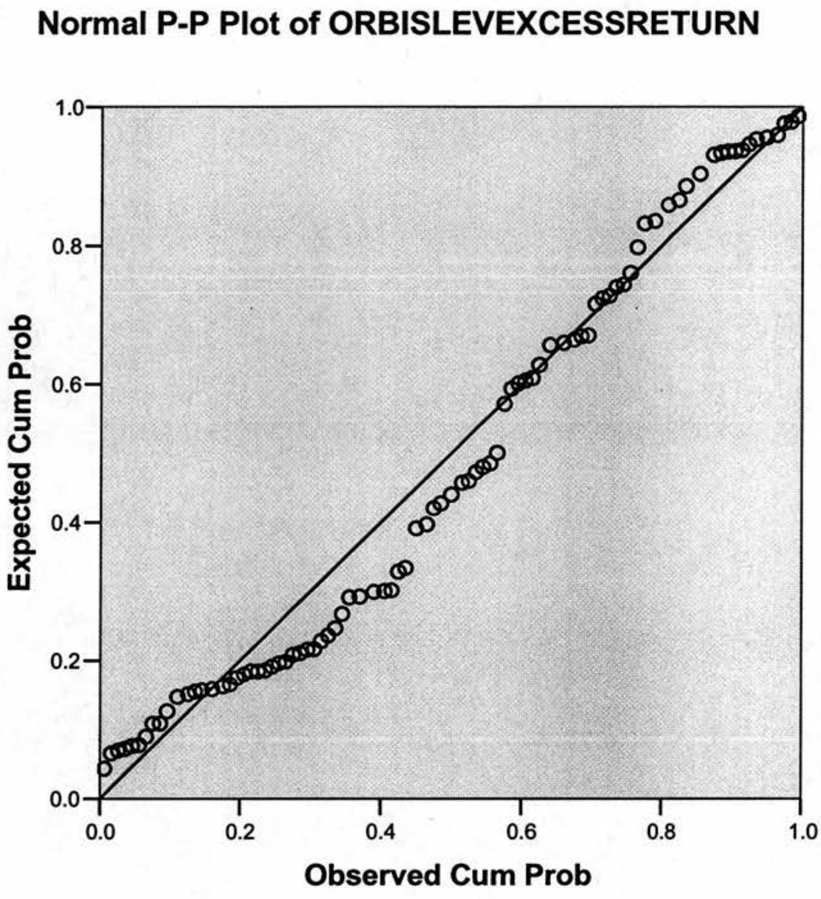

Normal P-P Plot of MFSEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

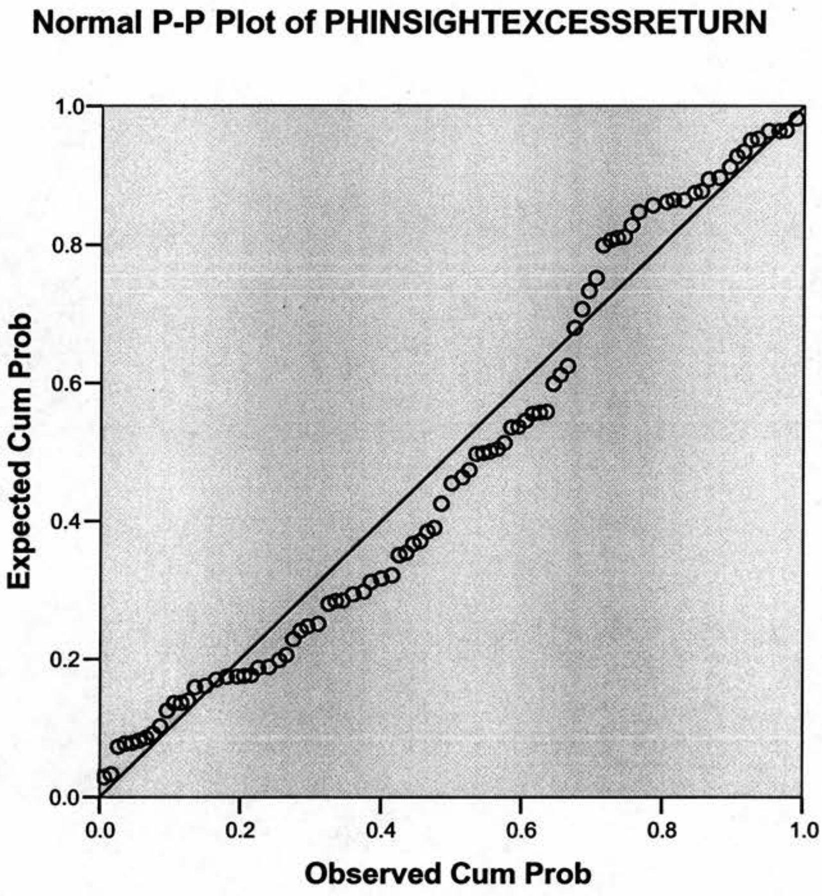

Normal P-P Plot of MLCLBEXCESSRETURN
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

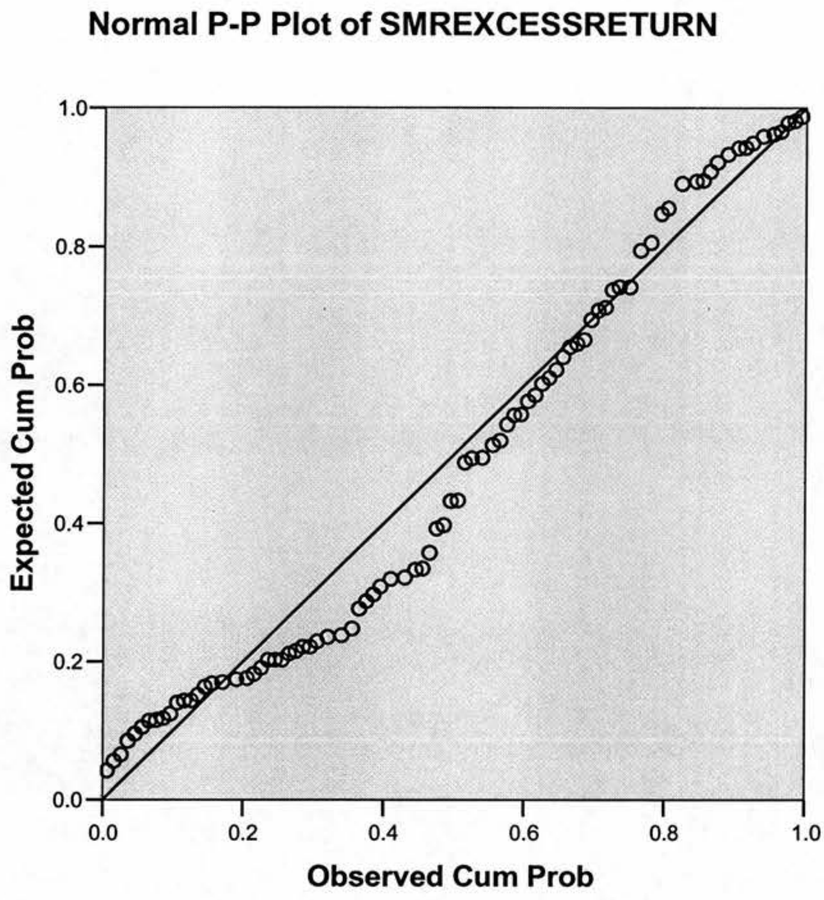

Normal P-P Plot of MLCLIEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of OLDMUTCLZEXCESSRETURN

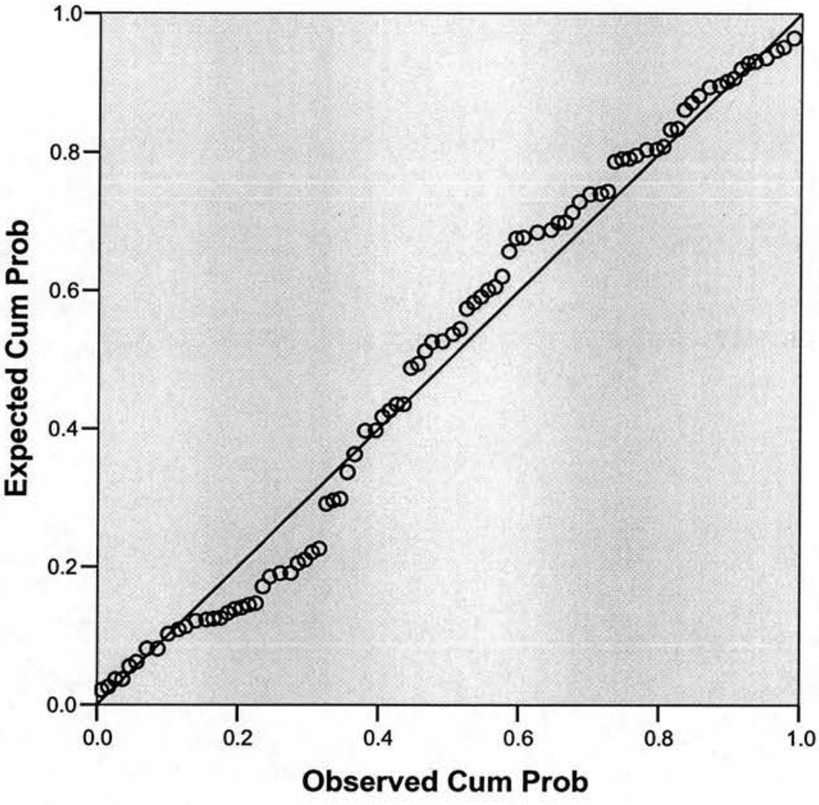


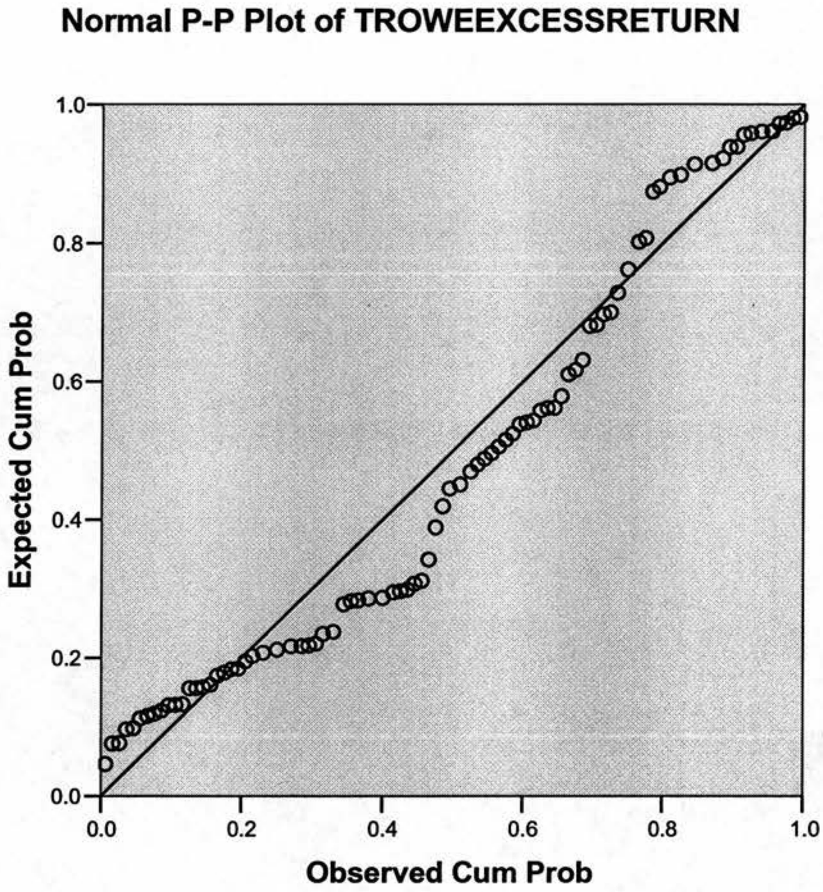

Normal P-P Plot of ORBISLEVEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Normal P-P Plot of PHINSIGHTEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

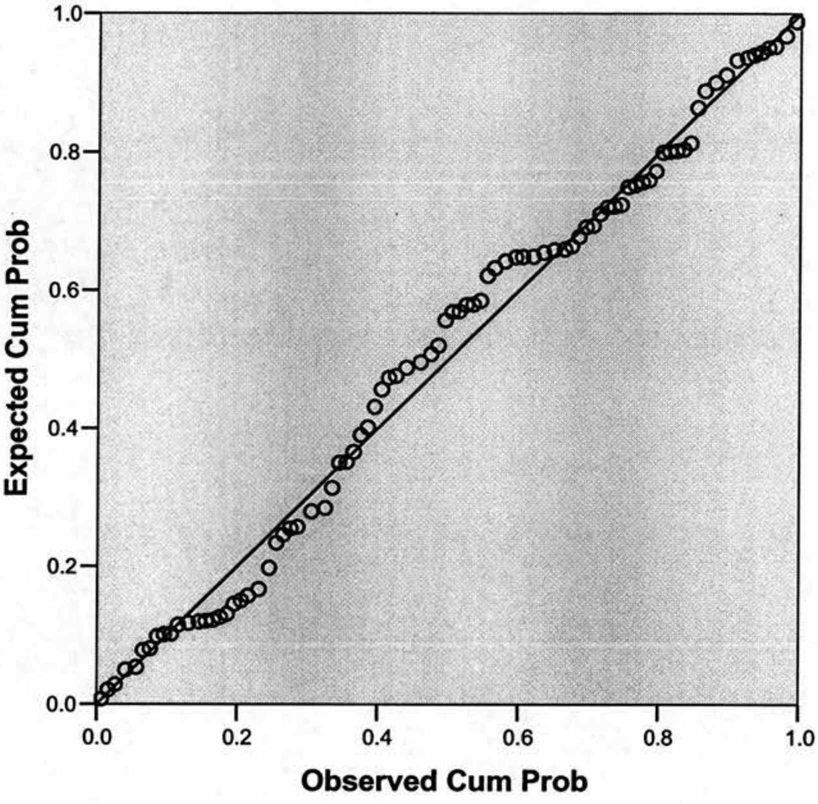

Normal P-P Plot of SMREXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

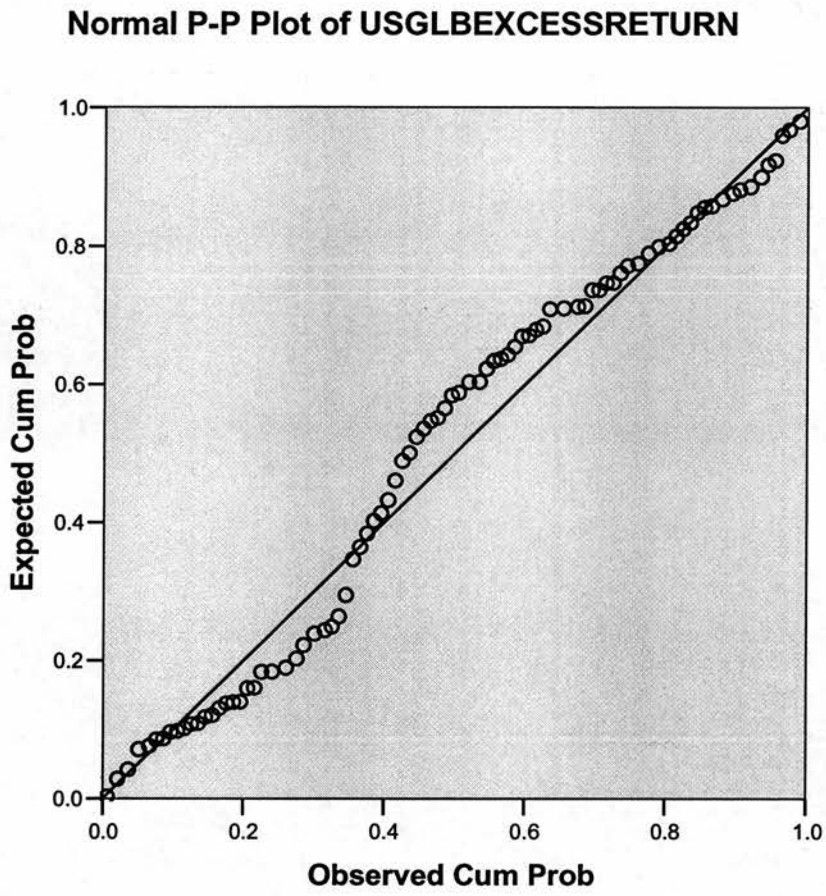
Normal P-P Plot of SPARTANEXCESSRETURN




Normal P-P Plot of TROWEEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

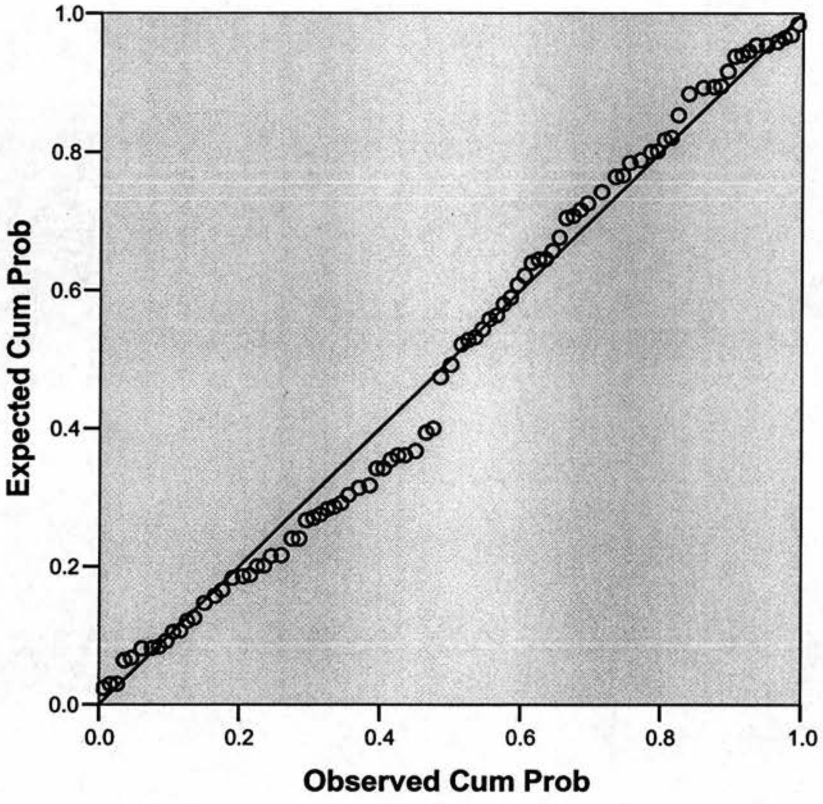
Normal P-P Plot of TROWEFORGNEXCESSRETURN



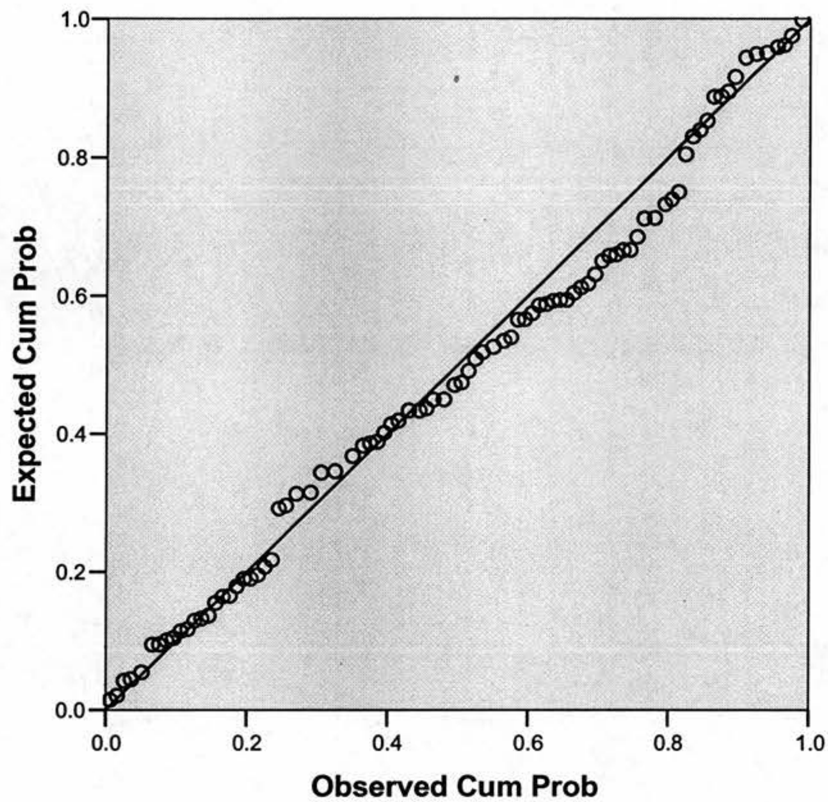


Normal P-P Plot of USGLBEXCESSRETURN
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Normal P-P Plot of WESTWOODEXCESSRETURN



Normal P-P Plot of WMCLAEXCESSRETURN



Appendix G: Estimates and Differences Table

	original		bootstrap						
	de	inde	de	inde	difference original de-inde	difference bootstrap de-inde	difference original de-boot de	difference original inde-boot inde	difference between difference
beta [1,1]	0.01714	0.02716	0.02311	0.02777	-0.01002	-0.00466	-0.00597	0.00061	0.00536
beta [1,2]	0.6223	0.6262	0.6409	0.6189	-0.0039	0.022	-0.0186	-0.0073	0.0259
beta [1,3]	-1.353	-0.6489	-0.6224	0.7171	-0.7041	-1.3395	-0.7306	1.366	-0.6354
beta [1,4]	0.7179	-0.2236	-0.162	-1.641	0.9415	1.479	0.8799	-1.4174	0.5375
beta [1,5]	-1.2	-1.057	-1.021	-0.953	-0.143	-0.068	-0.179	0.104	0.075
beta [1,6]	0.817	0.7097	0.5252	0.7583	0.1073	-0.2331	0.2918	0.0486	-0.3404
beta [2,1]	0.004166	0.003567	0.004808	0.003374	0.000599	0.001434	-0.00064	-0.00019	0.000835
beta [2,2]	0.754	0.7501	0.7408	0.7561	0.0039	-0.0153	0.0132	0.006	-0.0192
beta [2,3]	-1.172	-0.5885	-0.2728	-1.286	-0.5835	1.0132	-0.8992	-0.6975	1.5967
beta [2,4]	0.8271	0.2526	-0.08836	0.9581	0.5745	-1.04646	0.91546	0.7055	-1.62096
beta [2,5]	-0.382	-0.3485	-0.4034	-0.3404	-0.0335	-0.063	0.0214	0.0081	-0.0295
beta [2,6]	0.3993	0.3816	0.2705	0.4029	0.0177	-0.1324	0.1288	0.0213	-0.1501
beta [3,1]	0.006353	0.006391	0.007335	0.00629	-3.8E-05	0.001045	-0.00098	-0.0001	0.001083
beta [3,2]	0.9118	0.9154	0.9103	0.9136	-0.0036	-0.0033	0.0015	-0.0018	0.0003
beta [3,3]	0.2874	-0.1849	-0.2102	0.8558	0.4723	-1.066	0.4976	1.0407	-1.5383
beta [3,4]	-0.4496	0.01234	0.01724	-1.027	-0.46194	1.04424	-0.46684	-1.03934	1.50618
beta [3,5]	-1.088	-0.969	-0.9776	-1.067	-0.119	0.0894	-0.1104	-0.098	0.2084
beta [3,6]	0.5556	0.5571	0.4429	0.5875	-0.0015	-0.1446	0.1127	0.0304	-0.1431
beta [4,1]	0.008235	0.006388	0.007573	0.00472	0.001847	0.002853	0.000662	-0.00167	0.001006
beta [4,2]	0.9206	0.9091	0.8979	0.9127	0.0115	-0.0148	0.0227	0.0036	-0.0263
beta [4,3]	-1.843	-0.514	-0.2581	-2.791	-1.329	2.5329	-1.5849	-2.277	3.8619
beta [4,4]	1.667	0.4157	0.07997	2.732	1.2513	-2.65203	1.58703	2.3163	-3.90333
beta [4,5]	-1.585	-2.164	-1.554	-2.101	0.579	0.547	-0.031	0.063	-0.032
beta [4,6]	0.8246	1.193	0.6217	1.178	-0.3684	-0.5563	0.2029	-0.015	-0.1879

beta [5,1]	6.95E-05	-2.7E-05	-0.00035	0.000115	9.67E-05	-0.00047	0.000422	0.000143	-0.00056
beta [5,2]	0.9944	0.9965	0.9985	0.9962	-0.0021	0.0023	-0.0041	-0.0003	0.0044
beta [5,3]	0.02687	-0.1088	0.01376	0.04112	0.13567	-0.02736	0.01311	0.14992	-0.16303
beta [5,4]	-0.03871	0.1049	-0.00928	-0.04947	-0.14361	0.040191	-0.02943	-0.15437	0.183801
beta [5,5]	-0.06767	-0.05616	-0.08589	-0.0366	-0.01151	-0.04929	0.01822	0.01956	-0.03778
beta [5,6]	0.03383	0.01799	0.1339	-0.00672	0.01584	0.140615	-0.10007	-0.02471	0.124775
beta [6,1]	0.001965	0.00198	0.002552	0.001749	-1.5E-05	0.000803	-0.00059	-0.00023	0.000818
beta [6,2]	1.008	1.016	1.002	1.013	-0.008	-0.011	0.006	-0.003	-0.003
beta [6,3]	-0.6484	-0.3175	-0.06752	-0.4958	-0.3309	0.42828	-0.58088	-0.1783	0.75918
beta [6,4]	0.6102	0.2858	0.01313	0.4671	0.3244	-0.45397	0.59707	0.1813	-0.77837
beta [6,5]	-0.5947	-0.6077	-0.5068	-0.6172	0.013	0.1104	-0.0879	-0.0095	0.0974
beta [6,6]	0.4572	0.5299	0.2814	0.5318	-0.0727	-0.2504	0.1758	0.0019	-0.1777
beta [7,1]	0.003899	0.003532	0.003973	0.003402	0.000367	0.000571	-7.4E-05	-0.00013	0.000204
beta [7,2]	0.8143	0.8159	0.8096	0.816	-0.0016	-0.0064	0.0047	1E-04	-0.0048
beta [7,3]	-0.2778	-0.3786	-0.2097	-0.2058	0.1008	-0.0039	-0.0681	0.1728	-0.1047
beta [7,4]	0.0323	0.1382	-0.04096	-0.02852	-0.1059	-0.01244	0.07326	-0.16672	0.09346
beta [7,5]	-0.6173	-0.5931	-0.5469	-0.6067	-0.0242	0.0598	-0.0704	-0.0136	0.084
beta [7,6]	0.4289	0.4793	0.3063	0.472	-0.0504	-0.1657	0.1226	-0.0073	-0.1153
beta [8,1]	0.001968	0.000334	0.001997	-0.00067	0.001634	0.002667	-2.9E-05	-0.001	0.001033
beta [8,2]	0.6783	0.6881	0.6829	0.6795	-0.0098	0.0034	-0.0046	-0.0086	0.0132
beta [8,3]	1.123	-0.09996	-0.2572	1.59	1.22296	-1.8472	1.3802	1.68996	-3.07016
beta [8,4]	-1.468	-0.2074	-0.07942	-1.906	-1.2606	1.82658	-1.38858	-1.6986	3.08718
beta [8,5]	-0.478	-0.4284	-0.4096	-0.3375	-0.0496	-0.0721	-0.0684	0.0909	-0.0225
beta [8,6]	0.2572	0.4041	0.2628	0.2978	-0.1469	-0.035	-0.0056	-0.1063	0.1119
beta [9,1]	0.007613	0.01255	0.01236	0.01116	-0.00494	0.0012	-0.00475	-0.00139	0.006137
beta [9,2]	0.8502	0.8494	0.8454	0.8627	0.0008	-0.0173	0.0048	0.0133	-0.0181
beta [9,3]	-3.665	-0.7107	-0.4294	-5.516	-2.9543	5.0866	-3.2356	-4.8053	8.0409
beta [9,4]	3.306	0.182	-0.0838	5.073	3.124	-5.1568	3.3898	4.891	-8.2808
beta [9,5]	-0.7441	-0.8847	-0.9608	-1.071	0.1406	0.1102	0.2167	-0.1863	-0.0304
beta [9,6]	0.6462	0.3519	0.485	0.6724	0.2943	-0.1874	0.1612	0.3205	-0.4817
beta [10,1]	0.002242	0.003446	0.002976	0.002867	-0.0012	0.000109	-0.00073	-0.00058	0.001313

beta [10,2]	0.9574	0.9577	0.9686	0.9699	-0.0003	-0.0013	-0.0112	0.0122	-0.001
beta [10,3]	2.454	0.2866	-0.1847	2.586	2.1674	-2.7707	2.6387	2.2994	-4.9381
beta [10,4]	-2.445	-0.3174	0.1255	-2.574	-2.1276	2.6995	-2.5705	-2.2566	4.8271
beta [10,5]	-1.672	-1.937	-1.632	-1.749	0.265	0.117	-0.04	0.188	-0.148
beta [10,6]	0.395	0.5128	0.6351	0.3219	-0.1178	0.3132	-0.2401	-0.1909	0.431
beta [11,1]	-0.00078	-0.00361	-0.00072	-0.00361	0.002823	0.00289	-5.9E-05	-8E-06	6.71E-05
beta [11,2]	0.7703	0.7688	0.7666	0.7686	0.0015	-0.002	0.0037	-0.0002	-0.0035
beta [11,3]	-0.1291	-0.3546	-0.1811	0.2551	0.2255	-0.4362	0.052	0.6097	-0.6617
beta [11,4]	-0.1382	0.1326	-0.09724	-0.4911	-0.2708	0.39386	-0.04096	-0.6237	0.66466
beta [11,5]	-0.1873	-0.1316	-0.06433	-0.02309	-0.0557	-0.04124	-0.12297	0.10851	0.01446
beta [11,6]	0.3043	0.4544	0.156	0.3519	-0.1501	-0.1959	0.1483	-0.1025	-0.0458
beta [12,1]	-0.00013	0.000711	-0.00072	0.000542	-0.00084	-0.00126	0.000585	-0.00017	-0.00042
beta [12,2]	0.6255	0.6151	0.6203	0.6289	0.0104	-0.0086	0.0052	0.0138	-0.019
beta [12,3]	0.9563	-0.1581	-0.2662	1.578	1.1144	-1.8442	1.2225	1.7361	-2.9586
beta [12,4]	-1.371	-0.2778	-0.1479	-2.003	-1.0932	1.8551	-1.2231	-1.7252	2.9483
beta [12,5]	0.04102	0.06641	0.04735	0.04181	-0.02539	0.00554	-0.00633	-0.0246	0.03093
beta [12,6]	-0.1156	-0.2505	0.1232	-0.3074	0.1349	0.4306	-0.2388	-0.0569	0.2957
beta [13,1]	0.006491	0.008073	0.007344	0.007538	-0.00158	-0.00019	-0.00085	-0.00054	0.001388
beta [13,2]	0.8131	0.7871	0.8042	0.8077	0.026	-0.0035	0.0089	0.0206	-0.0295
beta [13,3]	-2.762	-0.7788	-0.3202	-3.432	-1.9832	3.1118	-2.4418	-2.6532	5.095
beta [13,4]	2.414	0.3624	-0.07822	3.061	2.0516	-3.13922	2.49222	2.6986	-5.19082
beta [13,5]	-0.7199	-0.6833	-0.6356	-0.8042	-0.0366	0.1686	-0.0843	-0.1209	0.2052
beta [13,6]	0.5016	0.31	0.3558	0.4371	0.1916	-0.0813	0.1458	0.1271	-0.2729
beta [14,1]	0.01094	0.0133	0.01305	0.01262	-0.00236	0.00043	-0.00211	-0.00068	0.00279
beta [14,2]	0.773	0.7771	0.7809	0.7668	-0.0041	0.0141	-0.0079	-0.0103	0.0182
beta [14,3]	-1.943	-0.7862	-0.4004	-2.195	-1.1568	1.7946	-1.5426	-1.4088	2.9514
beta [14,4]	1.536	0.2896	-0.1	1.747	1.2464	-1.847	1.636	1.4574	-3.0934
beta [14,5]	-0.9458	-0.7434	-0.7481	-0.8672	-0.2024	0.1191	-0.1977	-0.1238	0.3215
beta [14,6]	0.5654	0.4045	0.4057	0.4652	0.1609	-0.0595	0.1597	0.0607	-0.2204
beta [15,1]	0.006992	0.006705	0.008278	0.006242	0.000287	0.002036	-0.00129	-0.00046	0.001749
beta [15,2]	0.6407	0.6329	0.6258	0.6352	0.0078	-0.0094	0.0149	0.0023	-0.0172

beta [15,3]	-1.87	-0.7832	-0.4348	-1.993	-1.0868	1.5582	-1.4352	-1.2098	2.645
beta [15,4]	1.35	0.2372	-0.1397	1.477	1.1128	-1.6167	1.4897	1.2398	-2.7295
beta [15,5]	-0.521	-0.3667	-0.5512	-0.4613	-0.1543	-0.0899	0.0302	-0.0946	0.0644
beta [15,6]	0.5398	0.4034	0.3424	0.5552	0.1364	-0.2128	0.1974	0.1518	-0.3492
beta [16,1]	0.007548	0.007034	0.008451	0.006243	0.000514	0.002208	-0.0009	-0.00079	0.001694
beta [16,2]	0.6585	0.6571	0.6514	0.6569	0.0014	-0.0055	0.0071	-0.0002	-0.0069
beta [16,3]	-1.597	-0.6644	-0.3953	-2.056	-0.9326	1.6607	-1.2017	-1.3916	2.5933
beta [16,4]	1.104	0.1637	-0.1188	1.587	0.9403	-1.7058	1.2228	1.4233	-2.6461
beta [16,5]	-0.5622	-0.4516	-0.5793	-0.4645	-0.1106	-0.1148	0.0171	-0.0129	-0.0042
beta [16,6]	0.503	0.4889	0.3443	0.5639	0.0141	-0.2196	0.1587	0.075	-0.2337
beta [17,1]	0.00632	0.006137	0.005872	0.006017	0.000183	-0.00015	0.000448	-0.00012	-0.00033
beta [17,2]	0.6322	0.6314	0.6372	0.627	0.0008	0.0102	-0.005	-0.0044	0.0094
beta [17,3]	-0.0542	-0.5267	-0.3666	-0.5792	0.4725	0.2126	0.3124	-0.0525	-0.2599
beta [17,4]	-0.3913	0.09655	-0.06065	0.1481	-0.48785	-0.20875	-0.33065	0.05155	0.2791
beta [17,5]	-0.8742	-0.9065	-0.8823	-0.8666	0.0323	-0.0157	0.0081	0.0399	-0.048
beta [17,6]	0.4034	0.3427	0.4223	0.3069	0.0607	0.1154	-0.0189	-0.0358	0.0547
beta [18,1]	0.01837	0.01627	0.0103	0.02067	0.0021	-0.01037	0.00807	0.0044	-0.01247
beta [18,2]	-0.08075	-0.1211	-0.07432	-0.1506	0.04035	0.07628	-0.00643	-0.0295	0.03593
beta [18,3]	5.735	-0.5165	-0.7141	6.689	6.2515	-7.4031	6.4491	7.2055	-13.6546
beta [18,4]	-6.829	-0.4264	-0.1589	-7.747	-6.4026	7.5881	-6.6701	-7.3206	13.9907
beta [18,5]	-1.893	-2.031	-1.2	-2.622	0.138	1.422	-0.693	-0.591	1.284
beta [18,6]	0.4787	0.6056	0.5232	0.8757	-0.1269	-0.3525	-0.0445	0.2701	-0.2256
beta [19,1]	0.007924	0.009438	0.009198	0.008763	-0.00151	0.000435	-0.00127	-0.00068	0.001949
beta [19,2]	0.8842	0.8854	0.8829	0.8904	-0.0012	-0.0075	0.0013	0.005	-0.0063
beta [19,3]	-1.106	-0.4463	-0.2839	-0.9294	-0.6597	0.6455	-0.8221	-0.4831	1.3052
beta [19,4]	0.8794	0.1855	0.01496	0.6892	0.6939	-0.67424	0.86444	0.5037	-1.36814
beta [19,5]	-1.26	-1.332	-1.196	-1.295	0.072	0.099	-0.064	0.037	0.027
beta [19,6]	0.6648	0.6416	0.5231	0.6902	0.0232	-0.1671	0.1417	0.0486	-0.1903
beta [20,1]	0.002969	0.004019	0.002989	0.003131	-0.00105	-0.00014	-2E-05	-0.00089	0.000908
beta [20,2]	0.7226	0.7228	0.7306	0.7211	-0.0002	0.0095	-0.008	-0.0017	0.0097
beta [20,3]	0.8475	-0.09906	-0.2925	0.885	0.94656	-1.1775	1.14	0.98406	-2.12406

beta [20,4]	-1.143	-0.2065	0.002204	-1.181	-0.9365	1.183204	-1.1452	-0.9745	2.119704
beta [20,5]	-1.042	-1.14	-1.076	-1.099	0.098	0.023	0.034	0.041	-0.075
beta [20,6]	0.3442	0.3965	0.4696	0.3505	-0.0523	0.1191	-0.1254	-0.046	0.1714
beta [21,1]	0.001183	0.001148	0.000872	0.0012	3.5E-05	-0.00033	0.000311	0.000052	-0.00036
beta [21,2]	0.9853	0.9905	0.9863	0.9918	-0.0052	-0.0055	-0.001	0.0013	-0.0003
beta [21,3]	-0.1436	-0.2519	0.001928	-0.1658	0.1083	0.167728	-0.14553	0.0861	0.059428
beta [21,4]	0.1222	0.2382	-0.00785	0.1539	-0.116	-0.16175	0.130046	-0.0843	-0.04575
beta [21,5]	-0.1077	-0.06887	-0.1329	-0.08038	-0.03883	-0.05252	0.0252	-0.01151	-0.01369
beta [21,6]	0.04165	0.01464	0.1486	0.02302	0.02701	0.12558	-0.10695	0.00838	0.09857
beta [22,1]	0.00487	0.004517	0.005002	0.004911	0.000353	9.1E-05	-0.00013	0.000394	-0.00026
beta [22,2]	0.7258	0.7269	0.7231	0.7277	-0.0011	-0.0046	0.0027	0.0008	-0.0035
beta [22,3]	0.1571	-0.349	-0.2889	0.322	0.5061	-0.6109	0.446	0.671	-1.117
beta [22,4]	-0.4986	0.01326	-0.04953	-0.6644	-0.51186	0.61487	-0.44907	-0.67766	1.12673
beta [22,5]	-0.6926	-0.6494	-0.7267	-0.6805	-0.0432	-0.0462	0.0341	-0.0311	-0.003
beta [22,6]	0.3627	0.3719	0.3675	0.3565	-0.0092	0.011	-0.0048	-0.0154	0.0202
beta [23,1]	0.005481	0.00998	0.006111	0.009743	-0.0045	-0.00363	-0.00063	-0.00024	0.000867
beta [23,2]	0.8405	0.8343	0.8391	0.837	0.0062	0.0021	0.0014	0.0027	-0.0041
beta [23,3]	-0.8024	-0.4866	-0.2382	-0.4705	-0.3158	0.2323	-0.5642	0.0161	0.5481
beta [23,4]	0.5415	0.07895	-0.05786	0.07911	0.46255	-0.13697	0.59936	0.00016	-0.59952
beta [23,5]	-0.5969	-0.3552	-0.5321	-0.3804	-0.2417	-0.1517	-0.0648	-0.0252	0.09
beta [23,6]	0.3028	-0.1019	0.3106	-0.06707	0.4047	0.37767	-0.0078	0.03483	-0.02703
beta [24,1]	-0.0007	-0.00215	0.001506	-0.00228	0.001444	0.003784	-0.00221	-0.00013	0.00234
beta [24,2]	1.014	1.011	1.006	1.015	0.003	-0.009	0.008	0.004	-0.012
beta [24,3]	-1.476	-0.4807	-0.04837	-1.372	-0.9953	1.32363	-1.42763	-0.8913	2.31893
beta [24,4]	1.407	0.429	-0.07833	1.331	0.978	-1.40933	1.48533	0.902	-2.38733
beta [24,5]	-0.02512	0.04055	0.1891	-0.04221	-0.06567	0.23131	-0.21422	-0.08276	0.29698
beta [24,6]	0.508	0.5314	0.07387	0.6523	-0.0234	-0.57843	0.43413	0.1209	-0.55503
beta [25,1]	0.003297	0.002015	0.002029	0.001505	0.001282	0.000524	0.001268	-0.00051	-0.00076
beta [25,2]	0.8279	0.8176	0.8186	0.8277	0.0103	-0.0091	0.0093	0.0101	-0.0194
beta [25,3]	-0.6239	-0.5246	-0.1941	-3.116	-0.0993	2.9219	-0.4298	-2.5914	3.0212
beta [25,4]	0.4356	0.406	0.0635	3.029	0.0296	-2.9655	0.3721	2.623	-2.9951

beta [25,5]	-0.9886	-1.323	-1.212	-1.307	0.3344	0.095	0.2234	0.016	-0.2394
beta [25,6]	0.3936	0.5064	0.4974	0.5415	-0.1128	-0.0441	-0.1038	0.0351	0.0687
beta [26,1]	0.0113	0.01327	0.0133	0.01341	-0.00197	-0.00011	-0.002	0.00014	0.00186
beta [26,2]	1.034	1.053	1.043	1.052	-0.019	-0.009	-0.009	-0.001	0.01
beta [26,3]	-0.08458	-0.2776	-0.2464	-0.00455	0.19302	-0.24185	0.16182	0.273053	-0.43487
beta [26,4]	0.04342	0.2585	0.1651	-0.01207	-0.21508	0.17717	-0.12168	-0.27057	0.39225
beta [26,5]	-2.193	-2.467	-2.133	-2.598	0.274	0.465	-0.06	-0.131	0.191
beta [26,6]	0.9064	0.9923	0.8047	1.038	-0.0859	-0.2333	0.1017	0.0457	-0.1474

Appendix H: Questionnaire

Management School & Economics

FUND RISK MANAGEMENT RESEARCH PROJECT

MACRO-ECONOMIC LIKELIHOOD AND IMPACT ON FUND PERFORMANCE SURVEY

INTRODUCTION

The aim of the project is to assess the impact of macro-economic factors on fund performance. This means identifying the most important factors and their likely impact.

As part of this project we are trying to ascertain the views on the effect of such changes by experts in fund management. Therefore your participation is greatly appreciated. The objective is to capture your beliefs about the consequence of changes in macro-economic factors.

The short questionnaire should take about 5 minutes to complete. If you have any questions about it or require clarification do not hesitate to contact myself.

All information collected will be treated in strictest confidence and will not be revealed to others.

A summary of the results will be produced and circulated to those who return the questionnaire.

Please Contact:

❶ Yun Fan (Julian)

❷ Prof. Jake Ansell
Tel.: 0131-650 3806
E-mail: J.Ansell@ed.ac.uk

RELATIVE LIKELIHOOD OF THE IMPACT THE MACRO-ECONOMIC FACTORS ON FUND PERFORMANCE

1.0 The following leading indicators are thought to impact on the value of funds. Please rank their potential impact. (From 1 being highest to 8 being lowest). For definition of factors please see notes on page 4.

- ❑ Bank of England Base Rate
- ❑ Money Market Base M0
- ❑ Money Supply M4
- ❑ Unemployment rate
- ❑ RPI (Retail Price Index)
- ❑ CPI (Consumer Price Index)
- ❑ Consumer Confidence Index
- ❑ House Building

Are there any other factors you think will have an impact on funds?

❑ Yes ❑ No

If yes, can you please state them ....

2.0 **What do you believe would be the effect of an unexpected change in a factor on the value of funds?**

Suppose under recent circumstance the interest rate rose/dropped unexpected by 0.25 % in the current period it may have an impact on the price of shares. This might generally be described by a movement in the FTSE 100. Obviously the precise figure will not be possible to predict. Moreover, we hope you can give us your view on the minimum effect, most likely effect and maximum effect you would expect in the current period.

For example if you believe the minimum would be no change, the most likely would be a 0.020% change in the overall value and maximum would be 1% change one would respond with

minimum ......0.00.............% most likely ......0.020........ % maximum ......1.00.......%

2.1 If there was a unexpected increase of a quarter percentage point in the Bank of England base rate, what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.2 If there was a unexpected decrease of a quarter percentage point in the Bank of England base rate, what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.3 If there was a unexpected increase of a quarter percentage point in the Money Supply 0 (M0), what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.4 If there was a unexpected decrease of a quarter percentage point in the Money Supply 0 (M0), what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.5 If there was a unexpected increase of a quarter percentage point in the Money Supply 4 (M4), what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.6 If there was a unexpected decrease of a quarter percentage point in the Money Supply 4 (M4), what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.7 If there was a unexpected increase of a quarter percentage point in the Unemployment rate , what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.8 If there was a unexpected decrease of a quarter percentage point in the Unemployment rate, what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.9 If there was a unexpected increase of a quarter percentage point in the RPI (Retail price index), what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.10 If there was a unexpected decrease of a quarter percentage point in the RPI (Retail price index), what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.11 If there was a unexpected increase of a quarter percentage point in the CPI (Consumer Price Index), what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.12 If there was a unexpected decrease of a quarter percentage point in the CPI (Consumer Price Index), what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.13 If there was a unexpected increase of a quarter percentage point in the Consumer Confidence Index, what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.14 If there was a unexpected decrease of a quarter percentage point in the Consumer Confidence Index, what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.15 If there was a unexpected increase of a quarter percentage point in the House Building, what would you estimate to be the percentage change in the FTSE 100?

minimum ....% most likely ....% maximum ....%

2.16 If there was a unexpected decrease of a quarter percentage point in the House Building, what would you estimate to be the percentage change in the FTSE 100?

Minimum ....% most likely ....% maximum ....%

2.17 If you answered yes to question 1.0 could you please specific for a quarter percentage point unexpected change in leading indicator what would you estimate to be the most likely, maximum and mimimum percentage of change in FTSE 100?

Factor 1 Name: ....

Factor increase minimum ....% most likely ....% maximum ....%

Factor decrease minimum ....% most likely ....% maximum ....%

Factor 2 Name:..

Factor increase minimum ....% most likely ....% maximum ....%

Factor decrease minimum ....% most likely ....% maximum ....%

2.18 Please add further factors if you feel they have an effect on FTSE 100

....

....

....

....

....

....

3.0 It would be helpful if you could fill in the following information or attach your business card.

Title: ....

First Name(s): .... Surname: ....

Job Title: ....

Company: ....

Address: ....

Telephone: ....

Fax: ....

Thank you for your cooperation and assistance with the study.

Notes:

Bank Base Rate: The rate currently referred to as the Bank of England's UK repurchase agreements Rate as varied from time to time or, in the event of this rate not being available, the average of the variable base lending rates of the four largest clearing banks in the London market from time to time.

M0(Money market base): Where M0 (Narrow Money) denotes the total of notes and coin in circulation in the economy plus commercial banks' deposits at the Bank of England.

M4 (Money supply 4): **M4** is a definition of the money supply denoting *Broad Money*, a wide definition of the volume of sterling in the economy, encompassing notes and coin as well as money held in bank accounts.

M4 = M0 + UK residents' bank deposits + deposits made by the private sector

Retail price index: The RPI is defined as an average measure of change in the prices of goods and services bought for the purpose of consumption by the vast majority of households in the UK.

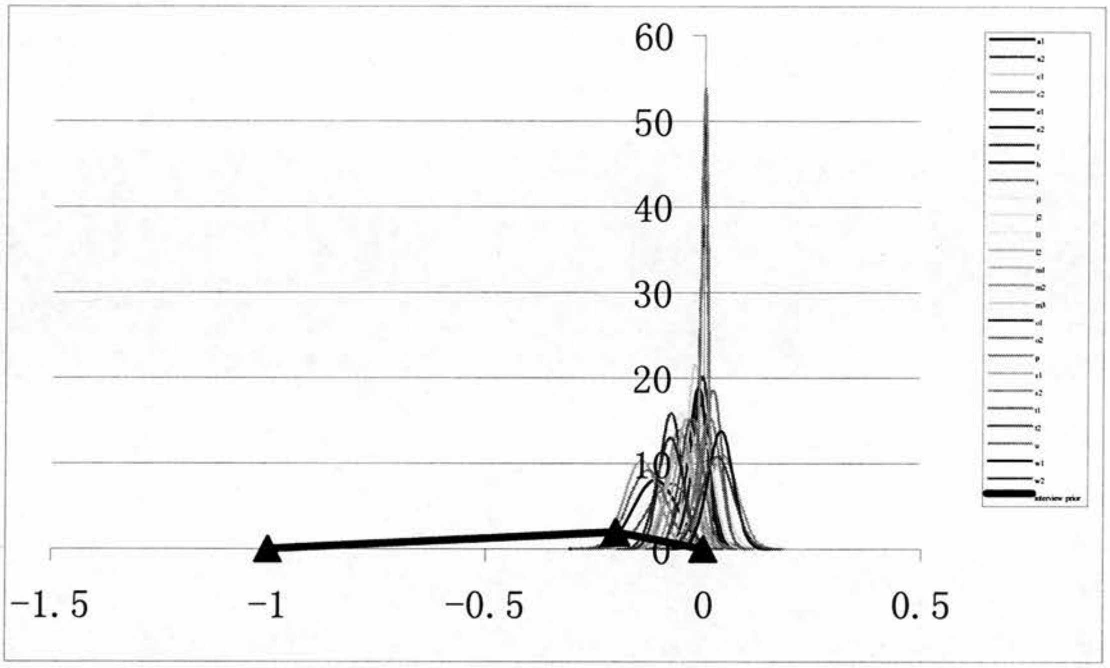
Consumer Price Index: The Consumer Prices (CPI) and the Harmonised Index of Consumer Prices (HICP) are the same index. The index has been designed as a macro-economic measure of consumer price inflation. It forms the basis for the Government's inflation target which the Bank of England's Monetary Policy Committee is required to achieve.

Consumer Confidence Index: The Consumer Confidence Index measures the population's view of the current position and future prospects of the UK. The index takes into account the general economic situation, employment conditions and personal expectations of the months ahead.

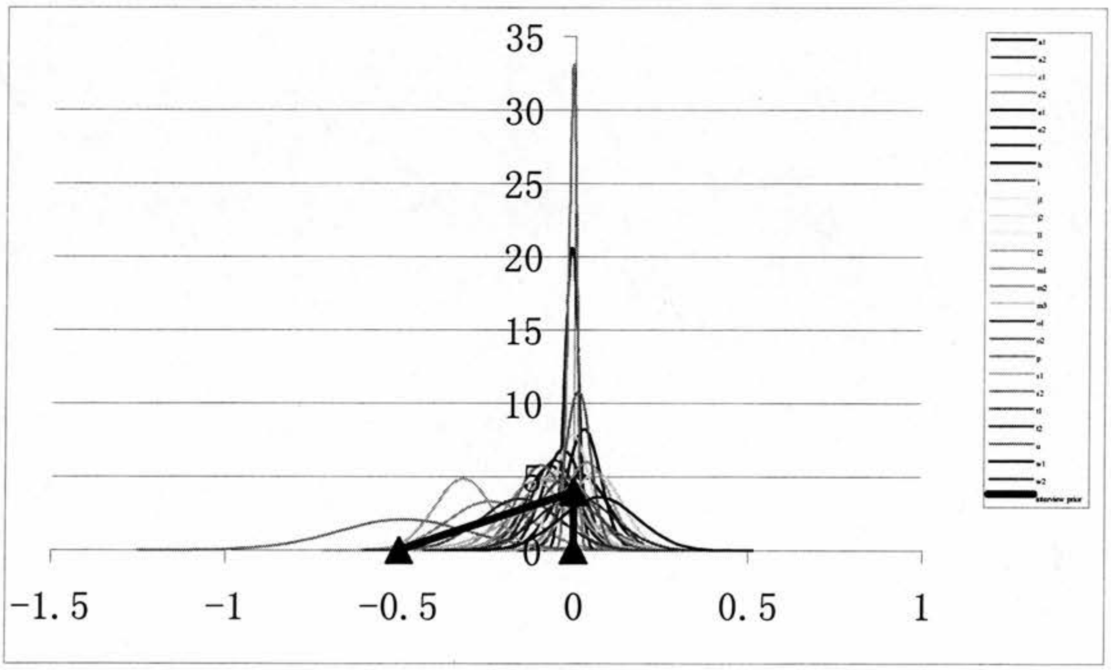
House Building: This statistical presents the figures on new house building starts and completions in the UK.

Appendix I: Prior and Posterior Comparison Respondent 5

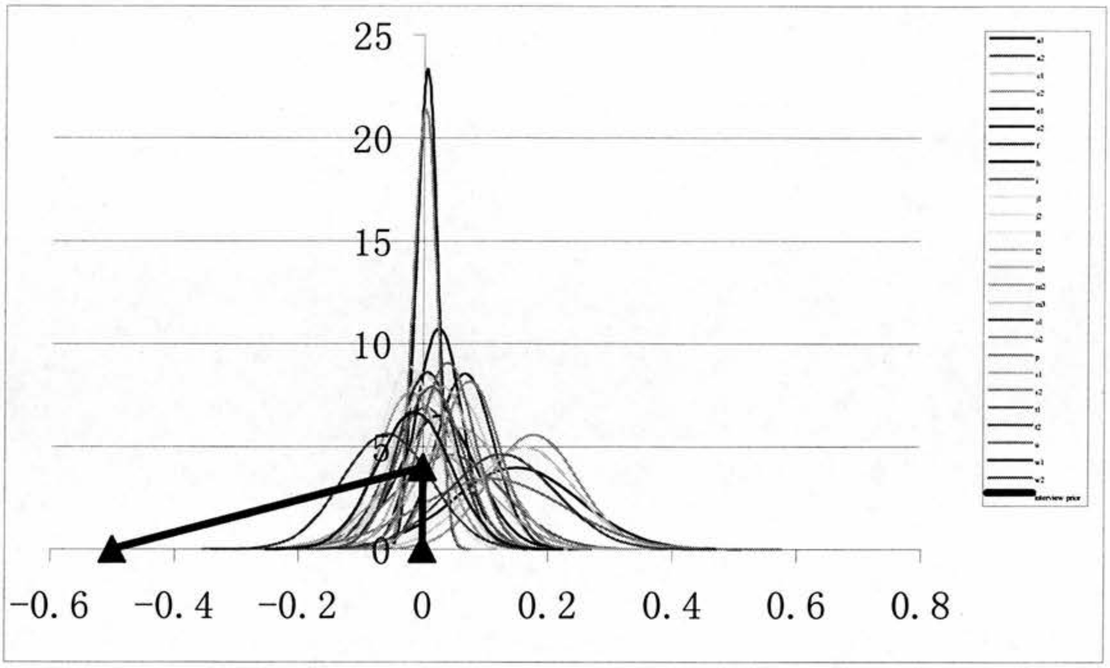
Federal Fund Rate (f):



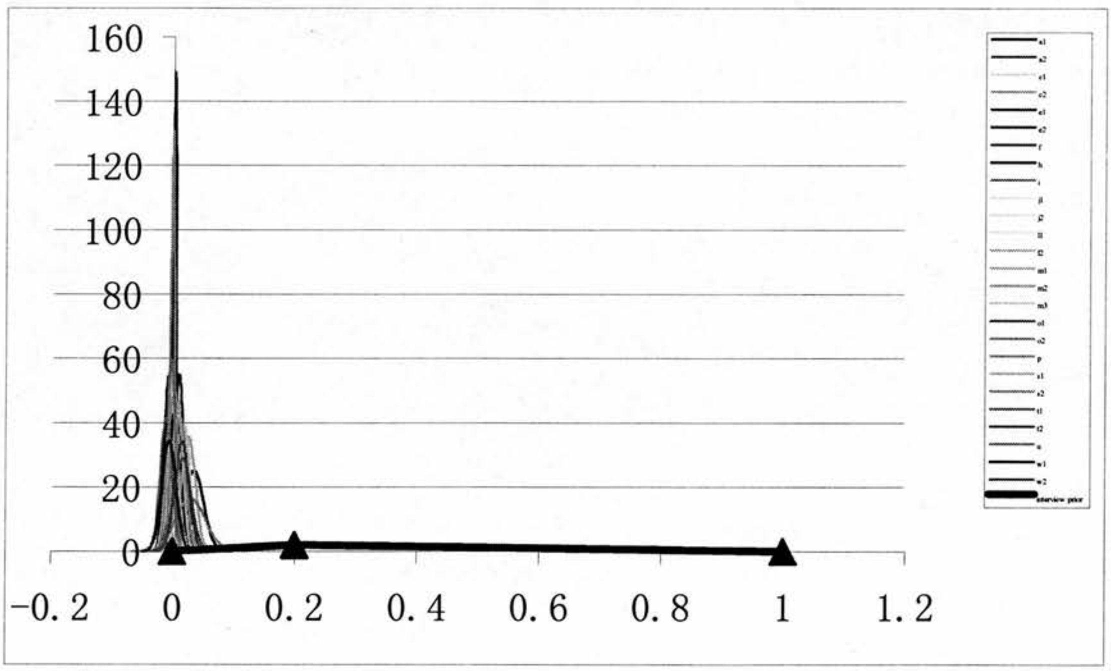
Monetary Base (mb):



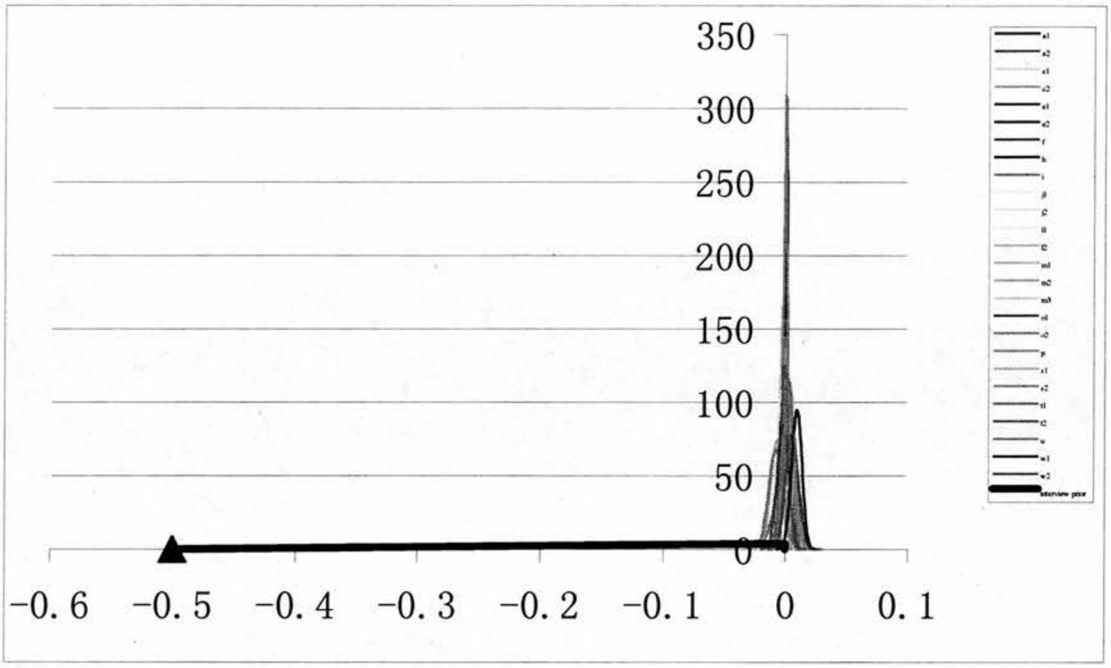
Money Supply M1 (m1):



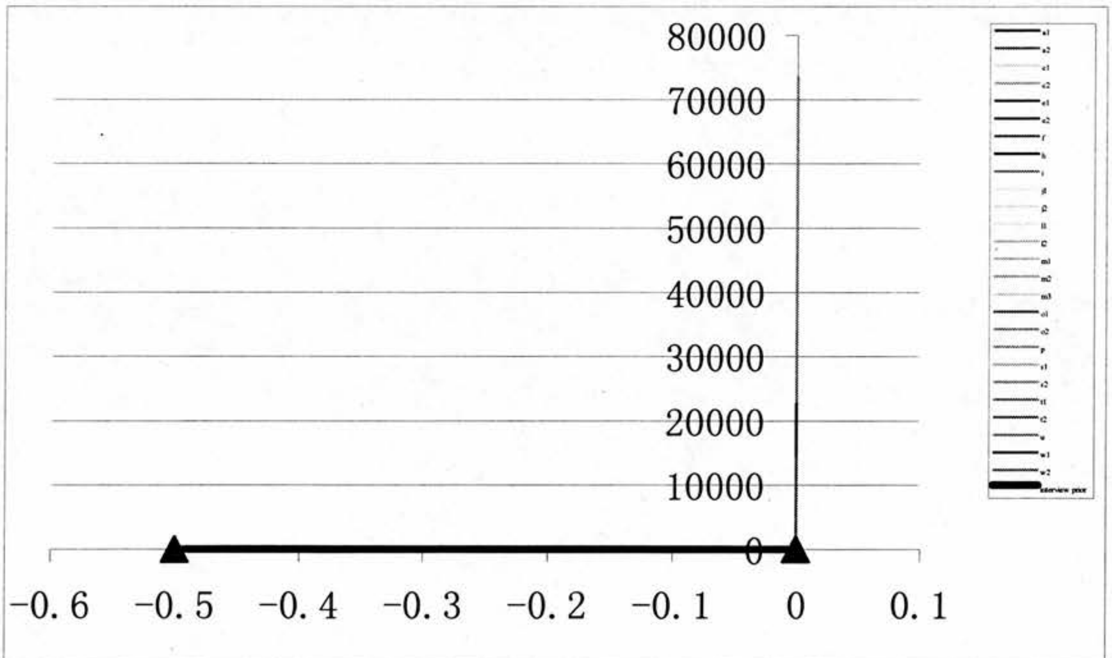
Unemployment Rate (ue):



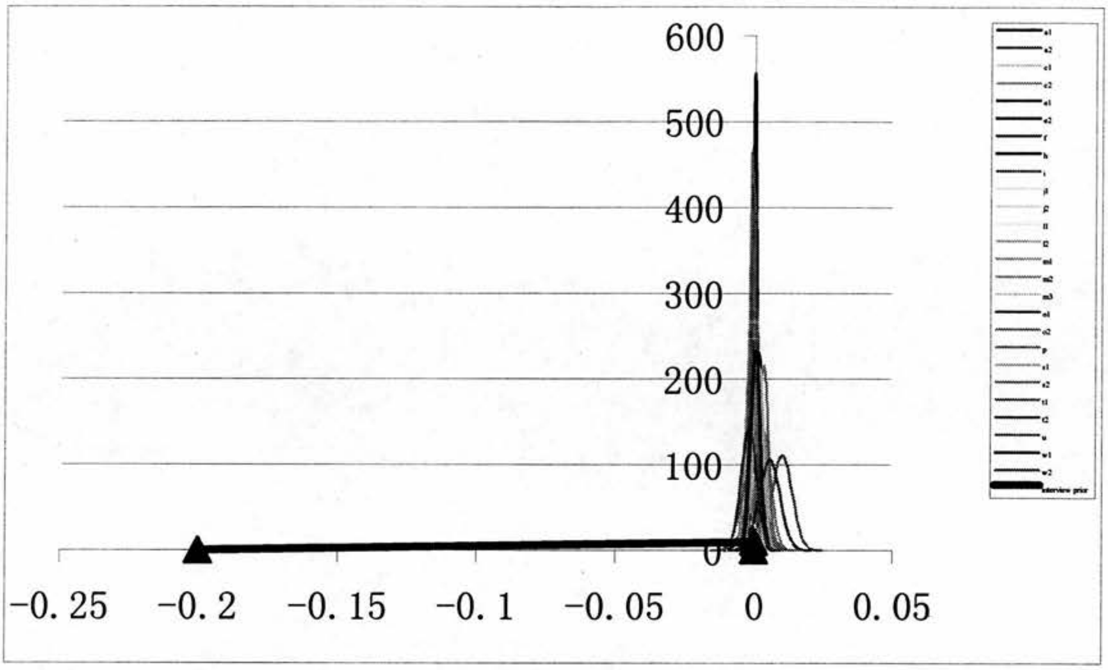
Consumer Price Index (cpi):



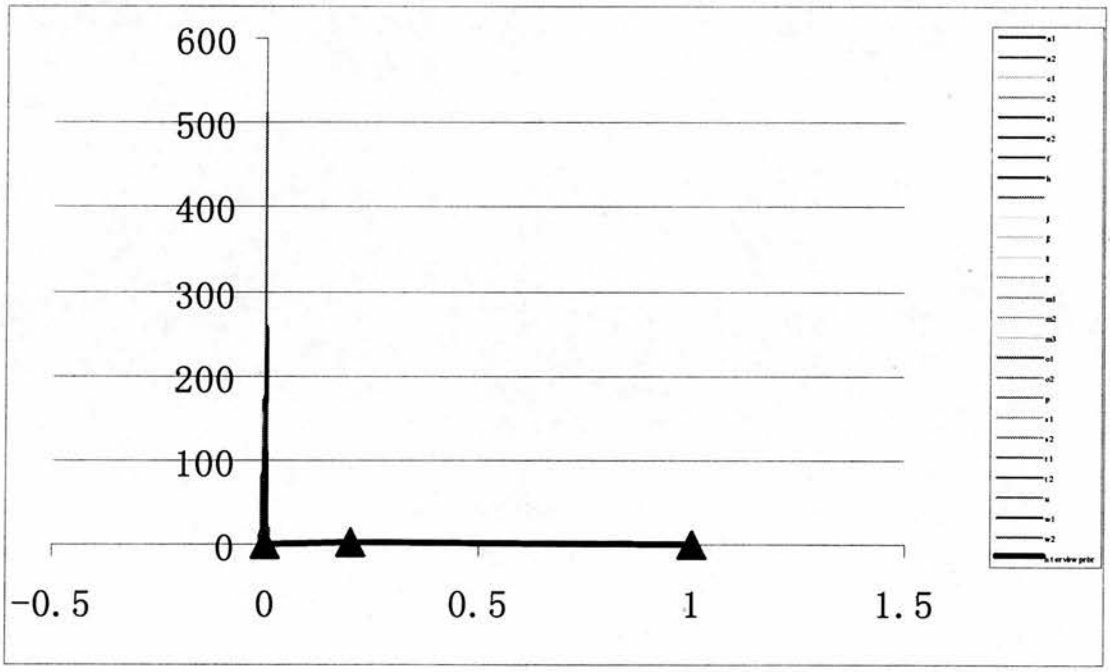
Consumer Confidence Index (cci):



House Building (hb):

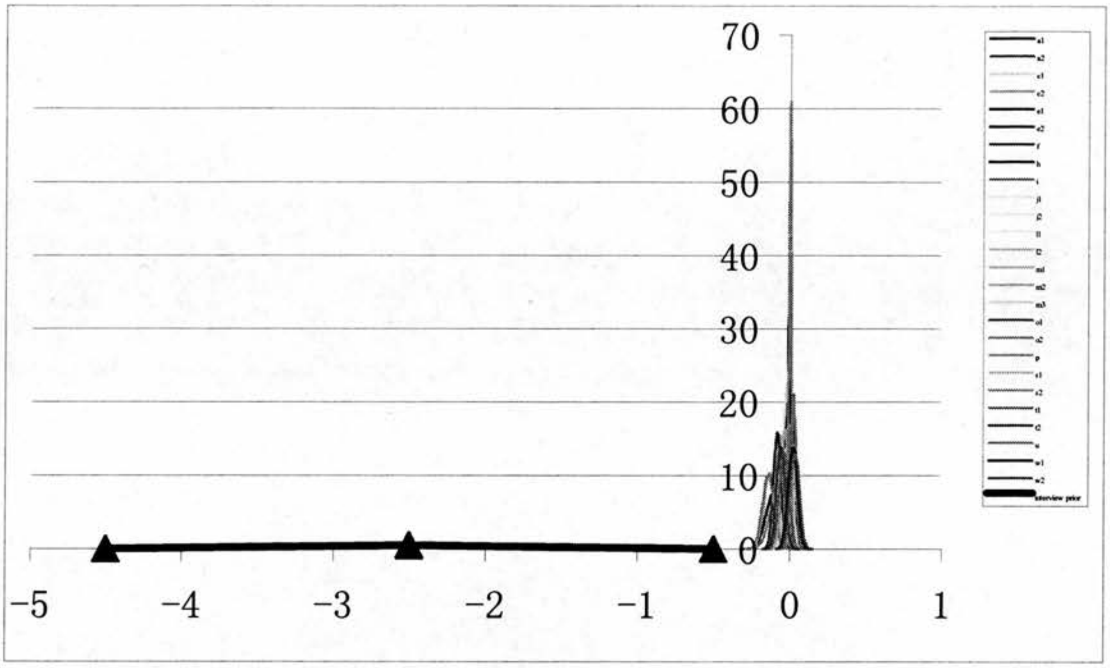


Trade Deficit (td):

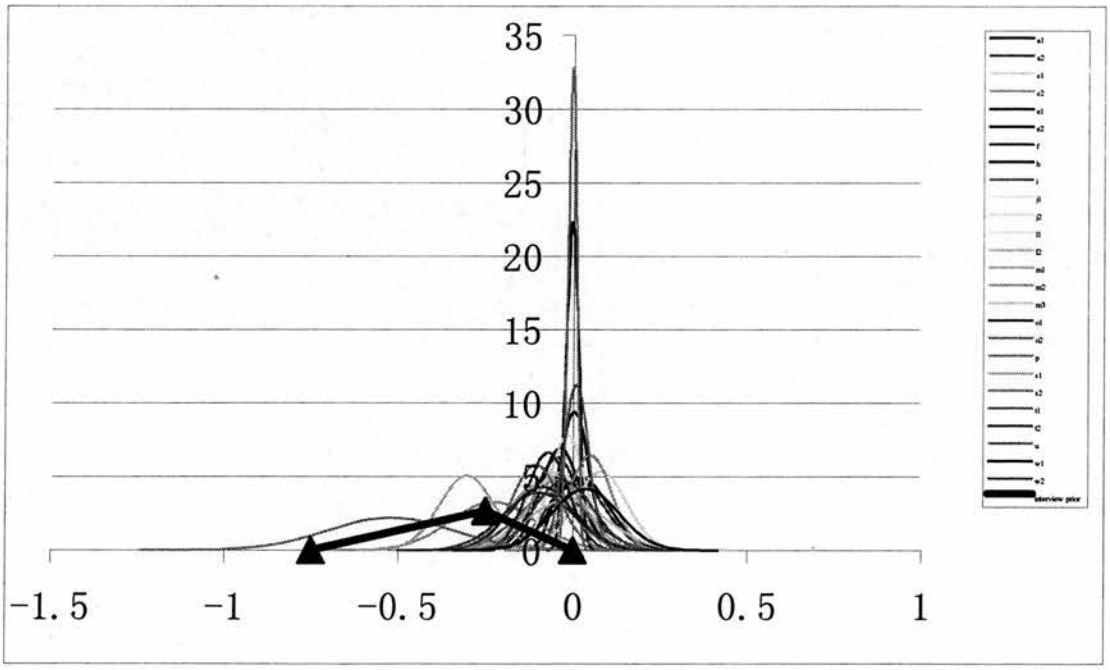


Appendix J: Prior and Posterior Comparison Respondent 6

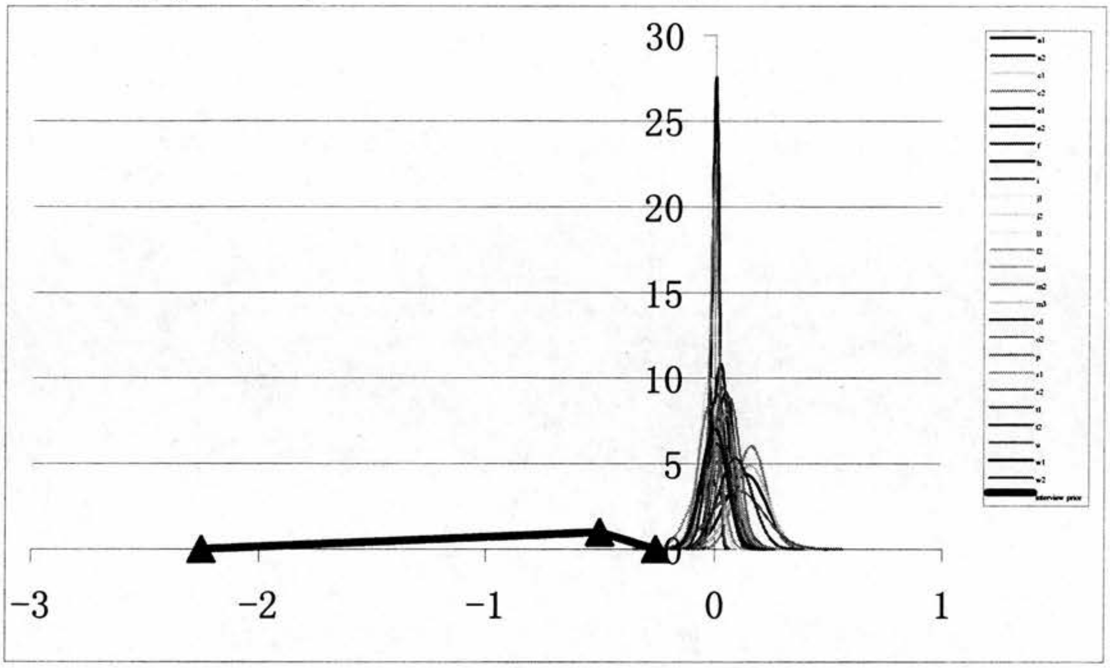
Federal Fund Rate (f):



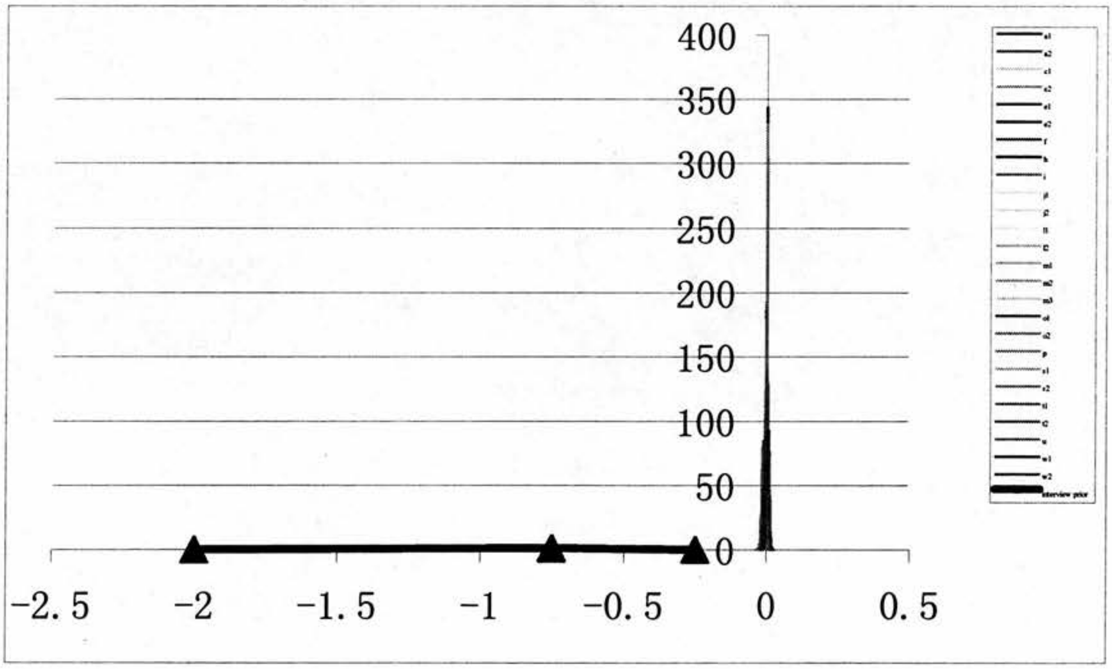
Monetary Base (mb):



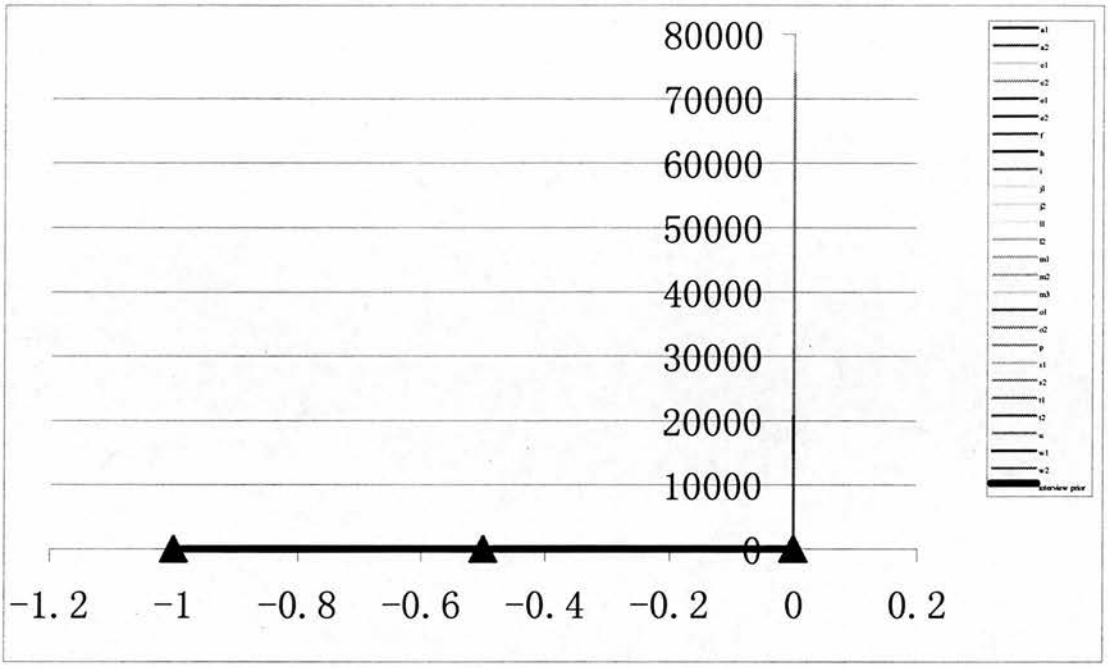
Money Supply M1 (m1):



Consumer Price Index (cpi):



Consumer Confidence Index (cci):



Exchange Rate (d):