Risk Management and Extreme Scenario Development using Multiple Regime Switching Approaches

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Abstract

Over the last twenty-five years, there have been an increasingly large number of extreme events in the financial markets. This includes market crashes and natural disasters that have led to extremely large losses and claims. Extreme event risk affects all aspects of risk assessment modeling and management. Traditional risk measurement methods focus on probability of laws governing average of sums, and do not focus on the tails of distribution. The investigation concerns the characterization and development of extreme markets scenarios for use in risk measurement and capital adequacy determination frameworks. The first part of the investigation concerns the development of event timelines that can be used for characterizing whether a period of time should be considered normal or extreme market conditions or regimes. The time lines have allowed the identification of the different times when the markets were calm and when the markets were turbulent. They assist in building scenarios, and also to identify the scenarios for decomposition of data to model the different regions, either the tail or the center of the distribution using the mentioned regime switching models. The information from the event time line can be used to define scenarios in a stress testing context.

In this investigation, extreme value analysis, which is an extension of the standard VaR techniques, useful in measuring extreme events has been used, which fits density functions by placing more weights in the tails than the normal Gaussian distribution and model the upper and lower tail of an underlying distribution. Extreme value distribution functions including "*fat tailed*" will be fitted to the tails of critical market factors to model the extreme market events that are not given appropriate probability of occurrence under normal conditions. The Hill estimator, which is recognized as the consistent estimator for empirical analysis is used for calculating the tail index parameter for EVT modeling, However, it has to be noted that the Hill estimator is efficient when the underlying distribution is fat-tailed as compared to the gaussian, where the tail index estimates tend to go to infinity. The

performance of Extreme value theory estimation technique with multiple regimes on real and simulated financial time series for efficient results, compared to the standard VaR techniques has been studied.

In this investigation, multiple regime switching approach has been used to identify regimes and measure risk accordingly. It is assumed that the center of the returns distribution is normally distributed with 90 percent of the data in the in the center region and each tail contains 5 percent of the data. Three regime switching models have been used in this analysis which includes, the Unconditional LT-C-RT (Left tail – Center – Right Tail) transfers, the 3 State Regime Markov Transition Model and the Geometric Time in Trail Model. The regime switching models are modeled using the following procedures:

1) The Unconditional LT-C-RT (Left Tail – Center – Right Tail) model is an IID model (Independent and Identically Distributed) model and has a simple Bernoulli approach where the market is in a normal state with probability P or an abnormal state with probability $1-p$. The transition between states is independent of the last state.

2) A Markov chain approach where the next state of the market is a function of the current state. That there are the following transitions possible:

2.1) Normal to normal
2.2) Normal to abnormal
2.3) Abnormal to abnormal
2.4) Abnormal to normal

3). The Geometric Time in Tail model is a hybrid Bernoulli approach where the markets stays in a given state based on a duration model and when the duration in a given states has expired, the sampling of the next state using a independent Bernoulli approach similar to approach one. This implies that the after the market has stayed in a given regime for the sample duration time, it can stay in the current regime with probability p or leave the regime with probability $1-p$. The sample duration can be based on the exponential distribution for continuous time and the geometric distribution for discrete time such as daily movements.

Tail index estimation results using EVT indicate the presence of fat tails in equity data and the results of Value-at-Risk (VaR) and Expected Shortfall (ES) are considerably similar for the three regime switching models. The comparison of results from the multiple regime switching models to the one region distribution results, which serve as the base case prove the efficiency of using this approach for a better risk measure.

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Chapter – 1

Introduction

The investigation concerns the characterization and development of extreme market scenarios for use in risk measurement and capital adequacy determination frameworks. The first part of the investigation concerns the development of event timelines that can be used for characterizing whether periods of time should be considered normal or extreme market conditions or regimes. Although it was not implemented in this investigation; the next step would be to use decomposed log-returns time series from different financial markets data into the various regions and model them into center and tail regions. The transitions between the different regions may then be modeled as independent or dependent. The resulting regime model can then be used in stress test or other risk assessment scenario analysis procedures. The first approach used to modeling the returns process is to decompose the log-return distribution of a financial time series into two states: a left loss tail region (or abnormal market conditions) and a center normal region (or abnormal market conditions). This model is an unconditional model and can be extended into a three regions where the given third region is the right tail. The next approach used for modeling regimes is a Markov Chain conditional process where the next state is dependent on the current state of returns. The third model used is an extension of the Markov Chain process where the returns are considered to be geometrically distributed and estimates the duration of returns in a given region. This model assumes that the transition from the current region can be to one of the other two regions and not back to the current region.

1.1 Definition of an Event and Event Types

An event is an occurrence or realization of some entity or the result of some action. Events usually involve a subject or an action on which it evolves such as counter party defaults, failure of a system, stock market crash, political incidents and natural disasters to mention a few. Compound events are one or more events which roll-on and are interrelated. They are usually referred to as *incidents.* Trigger Events are those which initiate the change in the market views, the price of assets or the outlook of the firm after a news event. A reinforcing event is one that reinforced the current market consensus perception on a stock. Event risk is the risk of loss which is beyond the control of an institution. Event risk is the risk from exposure to these events.. Event risk can be of several types including legal risk, credit risk, disaster risk and regulatory risk arising from different types of events like unusual events, extreme events, exceptional events, and extraordinary events.

1.1.1 Normal and Extreme Events

Normal events are the events which cause minor price/rate changes but do not disturb the stability in the market. They are referred as *"business as usual"* events which occurs in the day to day operations of the institution. Extreme events on the other hand are those events whose occurrence results in large price reactions or rate movements. Systematic events are events, which affects the system as a whole, spreading to banks, financial institutions and economic systems.

1.2 Overview of Market Risk

Risk and uncertainty are associated with most objectives of financial planning. Risk cannot be eliminated. It can only be transferred from one party to another who has conflicting view of the same underlying exposure. Risk arises when there are waves of change and is subjective in nature. Risks have increased because of shifts in the economy from commercial banking to capital markets, increased complexity of transactions and competition, product innovations, increased market volatility and the disappearance of barriers. All these factors limit the scope of financial institutions. Risk can be classified into different groups and planned accordingly. The major types of risk classifications are market risk, credit risk, operations risk, banking risk, liquidity risk, solvency risk (or default risk), and foreign exchange risk. In this study, we would restrict ourselves with market risk and its different forms.

Market risk is the deviations from the mark-to- market value of the portfolio during the period required to liquidate the transactions. Market risk is the risk, which arise from performing everyday market transactions. It is caused from changes in markets performance and this risk is limited to liquidation period. If there is no effective risk control, the value of portfolios deviate and hedging finally occurs. Interest rates, stock exchange indexes, exchange rates are few market parameters, which can be measured by market volatility. Market risk can be controlled by allowing the value of the portfolio to vary in a given normal deviation band. Market risk can be divided into several dimensions. Liquidity is a component of market risk where it is difficult to find counterparty for a transaction. Discounting and other measures become unavoidable. Volatility risk is also a component of market risk where risk is generated from instability of market parameters. This form of risk influences all derived measures of market risk. There are two types of market risk normal market risk and extreme market risk.

1.2.1 Normal and Extreme Market Risk

Normal market risk is concerned with the central region of the profit and loss distribution, which is inherent to the normal functioning of the economy and clear relationships are defined between market movements and their likelihood. Any adverse movements from normal standard deviation bands will result in a shift of regime from normal market risk to extreme risk. Potential downward variation of the market values beyond a given tolerance level can be termed as unexpected loss. Unexpected losses are caused by extreme market risk, which is the risk of an event that is considered rare or extreme. It is concerned with the tail region of a profit and loss distribution. Extreme market risk is a result of profound structural economic or political changes and occurs when there are large price movements or jumps. Correlation breakdowns and spillover effects are caused due to extreme market risk.

1.3 Causes of Catastrophic Risk

Catastrophic risks arise from natural hazards or systemic business events that affect a large proportion of the community or group. As noted by Embrechts (2001), extreme events, which inherit catastrophic risks, can now be handled by alternative investment vehicles called Alternative Risk Transfer (ART) products that claim to offer additional protection to the holder of the risk and attract investors who are less risk averse with promises of high yield on securities. The usual strategy to manage these catastrophic risks is by reinsurance, where they reinsure the primary insurers. Catastrophic risks can be caused by unexpected business events, natural disasters or failure of systems. These different types of risks leads to losses of various magnitudes and loss distributions help us to identify these losses.

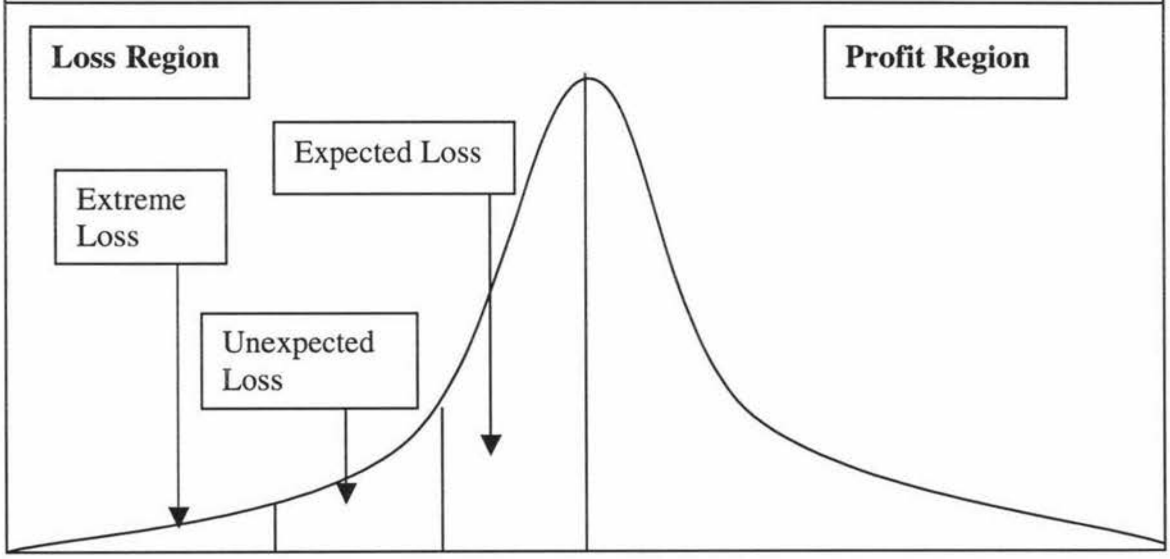
1.4 Loss Distributions

A *loss distribution* is the probability distribution of the losses associated with a given set of events. The most common loss distribution is that the returns follow the Gaussian distribution. However, the *bell curve* (Gaussian distribution) is not an appropriate distribution for extreme risks, which are highly skewed as compared to the symmetric Gaussian distribution. Different class of distributions which are non-symmetrical and skewed should be used instead, called the Fréchet, Weibull and Gumbel distributions. Typically a loss distribution would be decomposed into

1. ***Expected losses,*** which arise from "*business as usual*" events and are anticipated by institutions over a given period of time. As indicated in Figure L.1, expected losses lie in the center of the distribution and can be measure by measures of central tendency namely the mean and the variance.
2. ***Unexpected losses,*** which is the difference between the actual loss and the expected loss. These losses are unusual but predictable losses
3. ***Extreme losses,*** which are located beyond the unexpected losses and caused by extreme scenarios. They are locate way beyond in the tail region and are

catastrophic in nature. Extreme losses are located in the right tail of the loss distribution and the left tail of the profit and loss distribution as shown in Figure L.1.

Figure L.1- Profit and loss Distribution



1.5 Limitations of Traditional Risk Measurement Approaches.

More often than not, catastrophic events will happen that were considered extremely unlikely but possible events. These are rare but possible events and they will happen given enough time. These extreme events cannot usually be handled using standard risk measurement techniques. Traditional parametric statistical techniques are based on the entire distribution with focus on the center of the distribution. This underlies the use of extreme risk measurement techniques in risk management which places more weights on the tail regions of the distribution to measure extreme losses.

A mathematical aspect of modeling extreme losses can be explained by the '*law of large numbers*' which states as follows

> *"The observed averages from an experiment that is repeated a large number of times will be close to its population average"*

This statement implies that mean values are not useful in modeling extreme values as extreme losses are rare but possible, and it is not usually repeated. Generally, the simplest way to calculate losses is by looking at the mean and the variance of a risk. Standard *VaR* techniques such as the variance/covariance *VaR* assume that assets' log-returns are jointly normally (or Gaussian) distributed, where the log-returns r_t are defined as:

$$r(t) = \ln(P(t)/P(t-1)) = \ln(P(t)) - \ln(P(t-1))$$

and $P(t)$ is the asset price at time t. The normal distribution is a suitable choice since it has very tractable analytical properties and can be completely described by only its mean and variance. Also, if $r(t)$ is normally distributed, $P(t)$ is log-normally distributed, which is the most commonly assumed distributional model for asset prices. However the two statistical measures don't provide much information about extreme risk as extreme losses are situated in the tails of the distribution. Extreme risk measurement models are intimately concerned with tail quantiles and tail probabilities which are of particular interest because assessing them accurately can manage extreme financial risks.

Traditional models implicitly produce a good fit to the center of the distribution where most of the data is present, which potentially miss out the tail regions where few observations fall. Key ideas from the area of probability and statistics to model these extremes emerges from Extreme Value Theory (EVT) where one can estimate by fitting a model to the empirical survival function using the extreme event data from the tail, which is tailored to the object of interest rather than the center of distribution. EVT accommodates non normal distributions such as skewed or fat tailed distributions and notably allows the determination of the probability of extreme values.

Traditional VaR models evaluate the maximum trading losses using historical data for a given portfolio over a period of time. Danielson, Hartmaan and De Vries (January 1998) noted that the most difficult part in VaR estimation is the deviation of the portfolio return frequency distribution Two approaches namely the variance-covariance and historical simulation. The Variance-covariance approach assumes that the returns follow the multivariate normal distribution but in practical sense, financial market returns are skewed and fat tailed which fails the guassianity assumption. VaR models has been recognized by the Basle Market Risk Amendment, which specializes the use of 99 percent confidence levels, but these models are particularly weak when predicting large losses for regulatory and risk control purposes.

Traditional VaR models use exponential weighting of past returns by placing more weights to the present than those several months or year ago. This feature is due to the conditional heteroskedasticity in financial markets where one volatile day is followed by volatile days. Danielson, Hartman and De Vries (January 1998) have noted that, although daily returns exhibit conditional heteroskedasticy effects, they are not clearly noticeable in fortnightly returns such as regulated 10-day holding period and that extreme events with losses beyond 99 percent confidence level are scattered more independently over time, whereas conditional heteroskedasticity originates from small or medium range volatility periods. Historical simulation approach is more appropriate compared to the variance-covariance approach as it can incorporate non-linear positions, but this approach is very sensitive to a particular data window and inclusions of a year with extreme events makes a huge difference with high variance in VaR predictions. These VaR models satisfy minimum capital standards but they should also correctly present smooth tail estimates of the portfolio returns distribution that extends beyond the historical sample to predict extreme events.

1.6 Introduction to Extreme Value theory

Although, we apply extreme value theory (EVT) in finance and insurance, much of its original impetus for the development of this theory came from modeling extreme hydrological events in early 1950s. Early EVT applications occurred in 1990s, and were extensions of Value-at-Risk (VaR) models, where VaR is a statistical estimate of a portfolio loss such that there is a given probability that the loss will be greater than the given size. EVT provides a family of natural models for assessment of catastrophic or extreme events. Extreme value distributions represent the possible limit distributions of centered and scaled maxima (and minima) of IID random variables. EVT attempts to fit density functions by placing more weights for the tails than the normal distribution

Traditional methods focuses on the probability laws governing average sums, whereas EVT focuses on the properties of the largest observation in the sample and the laws governing these external values (See Section 1.5 of Beirlant, Teugels and Vyncker (1996)) EVT is a tool, which attempts to provide the best possible estimate of the tail area of the distribution. However in the absence of historical data, it suggests the kind of distribution that can be considered to estimate the tails, thus managing extreme risks conservatively. Extreme value theory is used to model the likelihood of extreme events based on historical prices. They could be extreme price or rate movements based on market corrections during ordinary periods, stock market crashes, bond market collapses or foreign exchange crisis. It can define a worst-case scenario that can be tolerated not considering the occurrence of the event. It allows for the procedures to check for the probability of exceeding the critical regulatory capital level for a given time interval.

1.7 Relevant Literature

The first investigations into the area of extreme value theory were by statisticians. Then the hydrologists came along in the early 1970s, actuaries in the 1980s, financial time series analysts in the mid-1990s, and finally the quantitative risk managers in the later 1990s. Reasonably accessible references to the theory and practice of EVT include Beirlant, Teugels, and Vyncker (1996) where the focus is on nonparametric tail index estimation. Castillo (1994) focuses on the EVT properties of extreme order statistics and high quantiles and De Haan (1994) where the focus is more statistical. Embrechts, Kluppelberg, and Mikosch (1997) were advanced with a viewpoint of actuarial mathematicians, but it is a leading text for quantitative risk managers. Reiss and Thomas

(2000) is a more practical text with numerous applications in insurance, finance, hydrology and other engineering fields.

The investigations of the extreme returns of equity markets by Jansen and De Vries (1991), Longin (1996) and Loretan and Phillips (1994) were some of the earliest financial investigations using EVT. Early investigations of EVT in risk measurement include Longin (1996) and Bassi, Embrechts, and Kafetzaki (1998). They considered determining capital requirements based on high quantiles on the profit/loss distributions, which is related to VaR forecasting. E.J. Gumbel beginning in the late 1930s and early 1940s extensively developed the application of extreme value theory. These efforts are summarized in Gumbel (1958).

Danielson, Philip Hartmann and Casper De Vries (January 1998) points out the limitations of the traditional VaR techniques. They discuss the traditional VaR models, and the Basle Multiplication factor for minimum risk capital. This study also discuss the limitations of the traditional VaR techniques wherein traditional techniques like the variance-covariance approach relies on the assumption that financial market returns are normally distributed, but in reality financial returns are fat-tailed, meaning that losses are much more frequent than predicted by variance-covariance analysis. They investigate the extreme value theory approach by considering the daily spot returns on spot oil prices from 1986 to 1997. The study compares the performance of different VaR models with a 1000-day horizon and suggests that at tail estimation technique is remarkably good estimate at high confidence levels compared with the variance-covariance and historical simulation technique. Embrechts (2000) studies the use of the bell curve (normal distribution) in modeling extreme events and this study suggests that the bell curve is right when applied to the right sort of problem, but however it is not the case in credit and operational risks where the loss distributions are highly skewed. Embrechts (2001) cites the risk of extreme events like the 1953 floods in the Netherlands, which took the lives of 1800 people. This study also investigates the Danish fire insurance losses using extreme value theory to measure extreme losses from fire. The example clearly shows the advantages of EVT in fitting tails of distributions based essentially on data far out in the tail, however he also contradicts the view of using these complicated models as it would raise the problem of cost because higher VaR values leads to higher values of regulatory capital. McNeil (2000) focuses on modeling extreme risk using extreme value theory. This paper provides a framework for estimating tails of distribution and EVT based VaR and expected shortfall. It also provides insight on stochastic volatility models and extending from a one-day horizon to a multiple day horizon. Eric Jondeau and Micheal Rockinger (1999) investigate the tail behaviour of stock returns by comparing emerging and mature markets. This study highlights the use of non-parametric estimator technique by using the hill estimator as compare to the parametric estimation technique.

Extreme value theory has been extensively used to study the tail behavior of the univariate financial time series. However the application of regime switching models in studying extreme returns has been more limited comparatively. Maheu and Curdy (2000) investigates the returns using regime-switching models. They identified two regimes namely the bull and the bear markets, and used a markov regime-switching model to automatically switch between regimes. They found that the model switched regimes from bull to bear market in advance of stock market crashes. James (1989) proposed a tactable approach to model changes in regimes, where he viewed the parameters of an autoregression as a discrete-state markov process and he studied the discrete shift in US real GNP from positive to negative growth in the business cycle. He found that shifts were better characterized by a recurrent pattern of the business cycles than by positive coefficients at low lags in an autoregressive model. Ross (1993) in his text "Introduction to Probability Models" provides a framework of the markov chain stochastic process and the one-step probabilities in a matrix.

Chapter - 2

Financial Crisis, Liquidity and Systematic Risk

In this chapter, financial crisis will be defined, which is the main motive for this investigation and distinguish its various types of financial crisis. Further, some of the major financial crises, which have occurred in the last twenty years, will be listed and also the effect of financial crisis on market liquidity will be discussed. Finally, systematic risk, its consequences, and its effects on global turbulence will be defined.

2.1 Defining Financial Crisis

Financial crisis is an example of extreme events, where there is a massive collapse of asset prices and economic activity. According to Raymond Goldsmith, a financial crisis can be defined as (See page 3 of Kindleberger (1996)):

> *"...a sharp, brief, ultracyclical deterioration of all or most of a group of financial indicators, short-term interest rates, asset(stock, real estate and land) prices, commercial insolvencies and failures of financial institutions."*

Traditional techniques are based on the estimation of entire loss distribution usually focusing on the centre of the distribution. Financial Crisis is difficult to define as they cannot be precisely identified by analyzing fluctuations in financial time series. The frequency and severity of global financial crises have increased over the last twenty years. They have replaced the small regional and national crisis and the magnitude of these global crises has been extreme. Financial crises are produced by the sudden alternation of expectations that are based partly in reality and partly in imagination.

Financial crisis can be broadly classified into five different categories

1. **Currency crisis**

A currency crisis occurs when there is speculative attack on the exchange value of currency, which might lead to devaluation of a currency or sharp depreciation in its exchange rate.

2. **Banking Crisis**

A banking crisis is a situation where there is a bank failure or bank run (a situation where there is a sudden increase in deposit withdrawals), causing suspension of internal convertibility of their liabilities, huge non-performing loans, or government intervention by extending assistance.

3. **Systematic Financial Crisis**

Systematic Crisis refers to a situation where there are severe disruptions in financial markets which adversely affect the functioning of the real economy. Banking and currency crisis can be so extensive, and can turn into a systematic crisis

4. **Foreign Debt Crisis**

Foreign debt crisis is a situation when a country cannot service its foreign debt obligation. Examples include the Russian debt crisis in 1998 or the Mexican sovereign debt default in August 1982.

5. **Twin Crisis**

Twin Crisis occurs when both financial crisis and balance of payments crisis occurs at the same time. It can refer to a situation where the exchange rate peg collapses because of a banking crisis where stabilizing the banking system and maintaining the peg becomes incompatible objectives.

Financial crises are also distinguished by monetarists as a ***'real'*** financial crisis which involves the shrinkage of the monetary base and this puts the banking system is put at risk or the ***'pseudo'*** financial crisis which involves decrease in asset prices of equities, real assets, commodities, depreciation of exchange rate, or financial distress of a large financial firm or an institution.

Table FC.1 Recent Financial Market Crises	
Financial Crises	**Event Details**
Breakdown of Bretton Woods	Inflationary pressures caused the breakdown and abandonment of the Bretton-Woods Act in February 1973
The Energy Crisis of 1973- Oil price shocks of the early 1970's	The oil price shocks starting in 1973 were accompanied by high inflation and volatile fluctuations in interest rates
Black Monday- Stock Markets Crash beginning on October 19th 1987	The 1987 crash led to a flight to quality and caused 19 markets out of the 23 major markets to decline more than 20 percent
The LDC Debt Default of 1982	The LDC crisis was triggered when the large positions in many third world countries went bad after the default by Mexico on their debt payments in August of 1982
1989 Collapse of Japanese Stock Market	The Japanese stock market bubble burst at the end of 1989 sent the NIKKEI 225 index on a three year fall from around 39000 to 17000 basis points.
The 1990 Iraqi Invasion of Kuwait	The Iraqi invasion of Kuwait threatened the world oil supplies weeks after the invasion. The fear wave erased close to USD 1.1 trillion value off major stock exchanges in Tokyo, New York and London
1990 High Yield Crisis	The Lehman High Yield index fell 22.86 percent between June 3rd 1990 and the end of the year
Black Wednesday- The September 12th, 1992 – Breakdown of the European Monetary System	In September 1192, the British pound sterling, Italian lira and the Spanish peseta "fell" beyond their bands stipulated by the European Exchange Rate Mechanism (ERM)
US Bond Market Sell-off	In 1994, there was a bond market sell-off that occurred after a series of hikes in US interest rates. Major derivative losses were attributed indirectly to these interest rate

	increases which included institutions like Mettallgellschaft, Kidder Peabody, and Orange County, which went bankrupt after losing close to USD 1.6 billion
The Tequila Effect: The Mexican Peso Crisis of 1994-1995	The Mexican peso crisis resulted in a rise in interest rates to 48.7 percent and a near collapse of the banking sector the following year. In December, the peso was devalued and their index of the Mexican Bolsa fell 20 percent in response.
The Asian Flu : 1997-98 Southeast Asian Crisis	The Asian turmoil erased almost three fourths of the dollar capitalization of the equities in Indonesia, Korea, Malaysia, Philippines, and Thailand. Many losses became non –performing and the end of the crisis spread through Southeast Asia
The Russian Cold: The Russian debt crisis of August 1998	Russia suspended bond and currency trading on August 14, 1998. On august 17th 1998, Russia gave up on its defense of the ruble and defaulted on a global loan exposure estimated to be USD 200 billion
1998 Liquidity crisis of Long Term Capital Management (LTCM)	On September 23rd 1998, The US Federal Reserve put together a USD 3.6 billion bailout package for hedge fund LCTM. This was after the partners had announced that more than 52 percent of the total assets were wiped out by the recent global crisis
The Brazilian Sneeze : The Brazilian Currency Crisis	In January of 1999, the Brazilian currency was devalued after the governor of the Brazilian Central Bank resigned.
The Nasdaq Rash: The March 2000 correction in the 'new economy' shares	There were major corrections in the values of the new economy shares beginning at the end of march 2000, when the technology bubble burst.
The September 11th, 2001 Terrorist attacks on major US cities	Market turmoil arose in the aftermath of the September 11th 2001 coordinated terrorist attacks on the New York Trade Center and The Pentagon in Washington DC.

2.2 The Aftermath of National Banking Crisis

The GDP cost of financial insolvencies with their country and period of crisis are summarized in the following table:

Table GD.1 – The GDP cost of Financial Insolvencies				
Country	**Period of Crisis**	**Result of Crisis**	**Estimated Loss**	
			% of GDP	**USD billions**
Argentina	1980-1982	70 institutions closed	55	46
Australia	1989-1992	2 large banks recapitalised	2	6
Chile	1981-1983	8 institutions closed	41	8
China	1990s	4 large state banks declared insolvent	47	498
Finland	1991-1993	Savings and Banking sector	8	7
France	1994-1995	Credit Lyonnais	0.7	10
Israel	1997-1983	Entire Banking sector	30	8
Japan	1990s	Bad loans and Property loans	14	550
Malaysia	1997-	Banking sector	35	25
Mexico	1995-	20 Banks recapitalised	17	72
Norway	1987-93	State takes over 3 banks	8	8
South Korea	1998	Restructuring of banks	28	90
Spain	1977-1985	20 banks nationalized	17	28
Sweden	1991-1994	5 banks rescued	4	15
Thailand	1987-	Banking sector	32	36
United States	1984-1991	1400 S&L's and	2.7	150
Venezuela	1994	Insolvent banks	20	14
Source: Dalle Molle (2003), Working Notes				

2.3 **Financial Crisis and Liquidity**

Liquidity risk is a major risk, and refers to a situation where markets become illiquid. This causes losses or costs when attempting to unwind positions. When markets become illiquid, it becomes difficult for market participants to hedge or lay-off their positions. Liquidity risk can refer to the inability of a business entity to meet their payments. The situation might arise from the presence of extreme illiquidity in the supply or demand for an asset, or the safety cushions provided by a portfolio of liquid assets during times when the values of the short term assets are not sufficient to match the values of the short-term liabilities.

Financial Crisis often arises when the financial sector becomes illiquid. Practical aspects of liquidity include bid/ask spread, price concessions, and the size and tiering of the issues. Issues include the differences on whether a security is "***off- the- run***" or ***"on- the-run***". Liquidity crisis occurs when there is a sharp decline in asset prices of equities or commodities, exchange rates or interest rates. Liquidity crisis leads to changes in normal market volatilities or correlations. Examples of liquidity risk include the August 1998 Russian crisis which exposed the excessive leverage and inadequate problems of liquidity which led to the near collapse of hedge fund Long Term Capital Management (LCTM) and The 1994 interest rate crisis, when the US Federal Reserve had series of hikes in interest rates is another example which caused problems in the bond market and made it difficult to deal in Eurobonds or mortgage-backed securities.

2.4 Systematic Risk

2.4.1 Defining Systematic Risk

Systemic Risk is the risk of a chain reaction of bankruptcies that in turn disrupt the process of circulation of capital. Systematic risk arises when the default or financial duress of one institution has a cascading effect on the financial stability of other firms. Systematic risk focuses on the interlocking relationships of the major players in a market and the potential chain reaction or *"domino effect"* that arises as an after shock caused by the failure of a large institution.

The term systematic in systematic risk refers to the following:

"An event having effects on the functioning of banking, financial or economic system, rather than just one or a few institutions"

2.4.2 Consequences of Systematic Risk

The consequences of materialization of systematic risk and the market exposures to systematic risks are the following:

1. The multilateral nature of the market increases the potential scale of *"domino effects"*
2. Clearing-house guarantees concentrate risks and necessitate effective risk management programs by the clearing houses.
3. Spillovers effects like loss in confidence in one market spreads directly to other markets, even without the default of a member or user.

The complex financial system defends against systematic risk by allowing markets to independently monitor day-to-day exposures and the markets officially recognized status allows effective actions to be taken that can limit domino effects.

2.5 Systematic Risk, Event Triggers and Global Turbulence

Social or political events generally trigger systematic risk. When a social event is triggered, the systematic risk is large and results in spillover into the global market place. The extent of spillover and its effects depends on market linkages or critical market driving factors. This is seen in the case of Russian crisis, which was triggered when the government defaulted on its debt obligations; and the LCTM crisis when systematic problems arose from the common strategy of the funds in which basis risk turned into a general problem of systematic risk. Hedge funds, being highly leveraged, have little equity capital. This feature caused many hedge funds to be liquidated leaving the pool of speculative capital to absorb these losses.

The liberalization of financial markets has led to large volumes of highly liquid capital being traded in an ever expanding complexity of financial instruments. The pace of these capital flows has produced an ever growing number of financial crises as mentioned in Table FC.1. Market turbulence changes the perception of risk and the preferences towards increased risk aversion leading to subsequent flight to quality. *"Flight to Quality"* may result in margin calls, rebalancing of portfolios, reassessment of counterparty risk and heightened state of risk aversion. Structural changes take place due to mature market turbulence in the form of unbundling and repacking the components of financial risk, advanced trading and portfolio management techniques, and the evolution of investment banks into financial conglomerates, and the growing influence of institutional investors.

Chapter – 3

Overview of Distributions, Quantiles and Order Statistics

In this chapter, mathematical prerequisites and notions that are used in the development of extreme value distributions will be discussed. First various types of distributions that are common to extreme value theory will be defined. Later quantile functions, rank statistics, excess distributions, maxima and minima and other order statistics which are used in defining the tail regions of distribution functions will be defined.

3.1 Extreme Values and ά-Stable Distributions

Distributions used in extreme value theory are closely related to ά-stable distributions. The case where ά = 2 corresponds to the normal limit for which the central limit theorem can be applied, which requires a sufficient condition for finite second moments. The second case where ά < 2, corresponds to infinite variance IID summands. These stable distributions can be used for worst case analysis in financial risk management. The stable laws can be used to model tail regions, but the results are heavily affected by data from the center region of the distribution. In the case of extreme value theory, it uses data only from the tail region and extremal point behaviour and not the entire distribution.

3.2 Defining Heavy- Tailed Distributions

Tail regions of a probability distribution are the extreme values which are located far from the mean value. If they exhibit large masses in the tail regions, it is said to have "*fat-tails*" or "*heavy tails*" or "*broad tails*". Fat tailed distributions are "*fatter*" than normal and have unbound second moments. Thin tails are thinner than normal tails and they are bounded in the sense that the probability of zero density above some extreme threshold level. Tail fatness is measured by the tail-index parameter and fat-tailed can be assessed using the excess kurtosis measure. Fréchet distribution is the limiting distribution for *fat tailed*; Gumbel for *thin tailed* and Weibull distribution is the limiting distribution for *short-tailed* distributions.

A distribution is said have *heavy -tails* if variable X in the distribution function $F_x(x)$, has its moment generating function such that $M_x(S)=\infty$ for $s \geq 0$. A distribution function $F_x(x)$ is said to be *light tailed*, if it has an exponentially bounded tail, where an exponentially bounded tail is defined for constants $a, b, c \geq 0$, such that

$$\overline{F}_x(x) \leq a\exp(-bx) \quad \textbf{(3.1)}$$

for all $x \geq 0$ and $\overline{F_x}(x)=1-F_x(x)$,which is a tail function. Examples of heavy tail distributions include the lognormal, Pareto and the Weibull distributions. The tail fatness can be measured using the tail index parameter and the fat-tailed can be assessed using the excess kurtosis measure.

3.3 Power Law Distributions

The power law distribution is the corner stone for univariate EVT. It is used in statistical procedures in the estimation of the tail event probability, extreme quantiles and upper order statistics. Paris born Italian socio economist *Vilfredo Pareto* (1848-1923) was the first to study power law distributions. Pareto investigated the statistical characteristics of the wealth of individuals in a stable economy.

The survival function of distribution function $F_x(X \leq x)$ of the random variable X is given as $\overline{F}_x(X \geq x)$ where

$$\overline{F}_x(X \geq x) = \Pr ob(X \geq x)$$
$$= 1 - F_x(X \leq x) \quad \textbf{(3.2)}$$

In the domain of attraction of a fréchet distribution, the tails of the survival function is a power law distribution times a slow varying function.

$$\Pr ob(X > x) = k(x)\chi^{-\alpha} \quad \textbf{(3.3)}$$

where k and α are constants that must be estimated and α is the tail index. The distribution of stable random variables for $0<\alpha<2$ is a power law distribution. The Gaussian is the only variable with all finite moments, such that $\alpha=2$. The power law distribution hold good only for extreme tail region. The term pareto- type tail implies that the tail region of a distribution tends to zero at a polynomial rate. The variance and other moments are not bounded in a power-law distribution.

3.4 Generating Heavy-tails from Ratios of Independent Random Variables

The following ratio can be used to generate fat-tailed distributions

$$Y = \frac{X_1}{X_2} \quad \textbf{(3.4)}$$

where X_1 and X_2 are independent random variables. The right tail described by Y is much thicker than the tails of either of the original independent random variables X_1 and X_2.

3.5 Fat Tails and Returns Distributions

In real world, log-returns of financial time series are typically leptokurtic with heavy and highly non-normal tails, where the log-returns are given as $\{r_1, r_2 r_{3...} r_n\}$ for the collection of prices $\{s_1, s_2 s_{3...} s_n\}$. Log returns for an underlying price series are given as

$$r_t = \ln(s_t / s_{t-1}) = \ln(s_t) - \ln(s_{t-1}) \tag{3.5}$$

for $t = 1,2,\cdots n$. The tails of financial returns distributions typically exhibit fat-tails where there is large number of large price changes. This implies that when the returns are standardized through scaling, they exhibit more mass in the tails than the normal Gaussian distribution. When there is more mass in the tails, with very large numbers and very small numbers in the distribution, the tail probabilities are greater than the probabilities of the standard gaussian distribution i.e. the tail probabilities $\Pr ob(S_t \le -Z_q)$ and $\Pr ob(S_t \le Z_q)$ of the observed log return series are greater than the tails of the same quantile Z_q for the standard gaussian distribution.

In risk management context, heavy tails indicates that the gains or losses can be more severe than those anticipated using a Gaussian distribution. Heavy tails implies that the tail region can be approximately defined using a power law distribution. Thus, it is important to focus more on the tail regions rather than the center of the distribution for measuring extreme losses. The normal distribution is a suitable distribution, since it has tractable properties and it can be completely described by the mean and variance, but it has been continually criticized in empirical studies because the distribution asset returns have *fatter* tails than the normal distribution. Fatter tails imply that the tail region approaches zero at a polynomial rate whereas normal tails approach zero at an exponential rate. The inability of standard risk measurement techniques based on the normal distributions to account for the empirically-observed stylized fact of fat tails have lead researchers to investigate alternatives to the normal distribution theory.

3.6 Quantile Functions

Quantiles are variate values that divide the total range of the frequency of observations for a random variable X such that a given fraction is less than or equal to the value and one minus that fraction is greater than it. A *fractile* is a fraction of the ordered data which is less than or equal to a given value of the quantile and when multiplied by 100, it gives us the percentile value of the ordered data. The *quantile of order q* of the random variable X denoted by X_q is defined by the following pair of inequalities.

$$\Pr ob(X \leq \varsigma_q) \geq q$$

and

$$\Pr ob(X \geq \varsigma_q) \geq 1 - q \qquad \textbf{(3.6)}$$

for some number ς_q and $0 \leq q \leq 1$

The q-th quantile X_q represents the cut-off point such that the area to the tight represents a probability:

$$\Pr ob(X \geq x_q) = \int_{X_q}^{\infty} dF_x(x)$$

$$= 1 - F_x(X_q) \qquad \textbf{(3.7)}$$

and the probability for the area to the left is given by $F_x^{-1}(X_q)$.

The q-th quantile function $x_q = F_x^{-1}(q)$ can be defined as a generalized inverse:

$$F_x^{\leftarrow}(q) = \inf\{x \in \Re : F_x(x) \geq q\} \qquad \textbf{(3.8)}$$

for $0 \leq q \leq 1$.

$F_x^{-1}(X_q)$ can be used to indicate $F_x^{\leftarrow}(q)$, if the distribution function is strictly increasing, because distribution functions are not necessarily strictly increasing.

In practice, a risk manager would be willing to know the frequency of occurrence of an extreme event, like the drop in stock returns beyond a certain threshold. Traditional approach uses historical data and count the frequency of stock market drops for a certain period, but the difficulty is that there might be very few days that exceeds beyond a certain level. Hence it this better off to model the entire tail and even in situations where one would be interested to find out the variations which have never occurred before. When we have large number of realizations, for instance 5 to 50 years of data which have to be modeled, as a consequence we have to model them at very high quantiles.

3.7 Excess Distribution Functions.

The risk manager would be interested to know the magnitude of the loss which would typically exceed $100.\alpha\%$ of the time, where $1 \leq \alpha \leq 1$. This is because; it is the small probability of extreme losses which cause maximum damages. In situations, where α is large, i.e. close to 1, then there is insufficient data in the tail regions to estimate the losses. Therefore, one must find a suitable model or approximation for estimating the loss u_α, which needs extrapolating beyond the available data range with some additional assumptions on the underlying loss distribution. The probability of occurrence of these extreme losses is given by

$$\Pr ob(X > u) = \overline{F}_x(u) \tag{3.9}$$

where $\overline{F_x}(u) = 1 - F_x(u)$. This type of loss is referred to as excess loss. Threshold is set at a given confidence level α which is called the α-th quantile. This threshold level u can be set at a specified confidence level α and then the excess losses over the corresponding distribution can be determined. The exceedence above the threshold level contains information about extreme events. If there is a given threshold

(u), then the values exceeding over the threshold, denoted k can be regarded as Poisson random variable.

3.8 Maxima

The MAXIMA operator is used to define an extreme distribution. There is a distinction between a tail distribution and an extreme value distribution. Defining $x_{\max}$ = $\max(x_1, x_2, x_n)$ and the asymptotic distribution of $x_{\max}$ as $n \to \infty$ is called the extreme distribution Defining a sequence of block maxima from a number of groups of random variables given as under (See Reiss and Thomas (2000))

$\{X_{i,j}, j = 1,2,\ldots,m; i = 1,2,\ldots,n\}$, which may be observable as follows

$$M_{i,m} = \max(X_{i,1}, X_{i,2}, k, X_{i,m})$$

$$= \bigvee_{i=1}^{m} X_{i,m} \quad \textbf{(3.10)}$$

The running maxima are defined as the sequence of maxima of the random variables $\{X_i, i = 1,2,\ldots,n\}$, which may not be observable is defined as

$$M_n = \max(X_{i,}, X_{i,}, \ldots, X_n)$$

for $i = 1,2,k,n$. The distribution function of the maxima m_n is given by

$$\Pr ob(m_n) = \Pr ob(X_1 \leq x, X_2 \leq x, k, X_n \leq x)$$

$$= \overline{F}_x^n(x) \quad \textbf{(3.11)}$$

3.9 Minima

Defining a sequence of block minima from a number of groups of random variables given as $\{X_{i,j}, j = 1,2,\ldots,m; i = 1,2,\ldots,n\}$, which may be observable as follows (See Reiss and Thomas (2000))

$$M_{i,m} = \min(X_{i,1}, X_{i,2}, \ldots, X_{i,m})$$

$$= \bigvee_{i=1}^{m} X_{i,m} \tag{3.12}$$

The running maxima are defined as the sequence of maxima of the random variables $\{X_i, i = 1,2,\ldots,n\}$, which may not be observable is defined as

$$M_n = \min(X_{i,}, X_{i,}, \ldots, X_n)$$

for $i = 1,2,k,n$. The distribution function of the minima m_n is given by

$$\Pr ob(m_n) = \Pr ob(X_1 \le x, X_2 \le x, \ldots, X_n \le x)$$

$$= 1 - \overline{F}_x^n(x) \tag{3.13}$$

3.10 Order Statistics

Order statistics are the order values of the observed sample having a common distribution function and defined as rearrangement in ascending order. It is given as

$$x_{(1)} \le x_2 \le x_{(3)} \le x_{(n-1)} \le x_{(n)} \tag{3.14}$$

Where

$X_{(n)} = \max\{x_{1,}x_{2,} \ldots, x_{n-1}x_n\}$

$X_{(n)} = \min\{x_{1,}x_{2,} \ldots, x_{n-1}x_n\}$ and

n is the sample size

3.11 Upper Order Statistics and the Magnitude of Exceedence

In situations, where the risk manager knows the level of the loss they can withstand, but he would be interested in the frequency of exceedence of that level. The exceedence over a given threshold gives information about extreme events. The method of exceedence consists of fitting all the exceedence of the chosen threshold to a particular family of distributions. Common practice is to pick the K largest values and allow the smallest value of K to be identified as the threshold.

For a given distribution range $\{x_i; i = 1,2,\ldots,n\}$, let Y_j denote the exceedence for $j = 1,2,\ldots,m$, where $Y_j = X_i$ for those i such that $x_i \geq u$ where u is the predetermined upper threshold and k is the number of exceedence over the threshold in the sample. The values $v_j = y_j - u = x_i - u$ are the excess over the threshold such that $v_i \geq 0$. The exceedence distribution function of u, denoted $F_y(y) = F_x^u(y) = F_x^u(x)$ is the following conditional distribution function:

$$F_x^y(y) = \Pr ob(X \leq x | X \geq u)$$

$$= \frac{F_x(y) - F_x(u)}{1 - F_x(u)} \qquad \textbf{(3.15)}$$

Chapter – 4

Univariate Extreme Value Theory and Tail Index Estimation

In this chapter, extreme value theory and the distribution of extremes are introduced. After introducing extreme distributions, generalized Pareto distributions (GPD) and extreme value distributions used in modeling extremes and the relationship between these two classes of distributions will be discussed. Further both the parametric and the non-parametric approaches to tail index estimation with focus on the Hill estimator, which is the most consistent among the class of non-parametric tail index estimators, will be presented. Next, the basic one region EVT-based Value-at-risk extension and the expected shortfall risk measured are discussed. Finally, relevant literature and limitations of EVT modeling are discussed.

4.1 Introduction to Extreme Value theory

According to Former Academic Richard Bookstaber (see page 104 of Bookstaber (spring 1997) :

"A general rule of thumb is that every financial market will experience one or more daily price moves of four standard deviations or more each year and in any year there is usually atleast one market that has a daily move that is greater than ten standard deviations"

Over the last twenty-five years there have been an increasingly large number of extreme events in the financial sector, which have led to large catastrophic losses. Excessive market force and the subsequent market-wide large loss have forced regulators to consider inherent systematic issues to these events.

Extreme value theory is used to model the likelihood of extreme events based on historical prices. They could be extreme price or rate movements based on market corrections during ordinary periods, stock market crashes, bond market collapses or foreign exchange crisis. Although we apply EVT in finance and insurance, much of its original impetus for the development of this theory came from modeling extreme hydrological events in early 1950s. Early EVT applications occurred in 1990s, and were extensions of Value-at-risk (VAR) models where VAR is a statistical estimate of a portfolio loss such that there is a given probability that the loss will be greater than the given size. The earliest EVT investigations of extreme equity market returns included Jansen and De Vries (1991), Longin (1996) and Loretan and Phillips (1994). EVT provides a family of natural models for assessment of catastrophic or extreme events.

EVT attempts to fit density functions by placing more weights for the tails than the normal distribution. EVT is used to model the upper and lower tails of the parent distribution. The bell curve (Gaussian distribution) performs well for normal tails, which usually underestimate at the higher confidence levels for the potential losses when there are heavy tails. EVT fits better with calculations involving the tails of the data than the standard tools that are used for the central part of the curve. EVT address both the limitations with the generalized Pareto family of distributions and the expected shortfall risk measure. This is because standard VaR methodologies do not offer information on how much the actual portfolio losses might exceed VaR. There are two approaches in modeling extreme returns. The first approach uses the law of maxima and minima of returns over given time horizons and the alternative approach is by considering an entire tail set of observations and estimating its associated distribution

According to Embrechts (2001):

"Extreme Value theory does not offer any magical solutions. It does however gives better results than other approaches, many of which lack a theoretical justification. It has

developed into a useful tool for the integrated risk manager. It gives the manager a pair of spectacles through which to view extreme events more objectively. It has been and is being tested in numerous applications and has been extended in many different countries. In future EVT should be as much a part of risk manager's everyday work as are the extreme events it seeks to analyze."

The Basle committee considers this approach of measuring extreme events more precisely than other more widely known standard alternatives. The committee suggests that a 99% VAR estimate should be multiplied by a factor of ten to determine the minimum regulatory capital against market risk. "*Extreme value theory has been increasing used to study the tail behaviour of univariate time series. However, the application of multivariate extreme value theory to study the joint probability or dependence of extreme realizations in financial markets has been more limited*" (See Chan-Lau, Mathieson, and Yao (May 2002))

4.2 Generalized Extreme Value Distributions

Extreme value distributions represent the possible limit distributions of centered and scaled maxima (and minima) of IID random variables. The three extreme value distributions are

1. The Gumbel (*normal-tailed*) distribution
2. The Fréchet (*fat-tailed*) distribution
3. The Weibull (*thin-tailed*) distribution

The general extreme value distribution is the generalization of the three extreme value distributions. The distribution and density functions of the generalized extreme value distribution functions can be collectively summarized as follows:

$$F_{GEV}(x) = \begin{cases} \exp\left(-(1+\gamma x)^{-1/\gamma}\right) & if \quad \gamma \neq 0 \\ \exp(-\exp(-x)) & if \quad \gamma = 0 \end{cases} \tag{4.1}$$

and $$f_{GEV}(x) = \begin{cases} \exp\left(-(1+\gamma x)^{-1/\gamma}\right)(1+\gamma x)^{-(1+1/\gamma)} & if \quad \gamma \neq 0 \\ \exp(-x-\exp(-x)) & if \quad \gamma = 0 \end{cases} \tag{4.2}$$

respectively for $1+\gamma x \geq 0$. The shape parameter $\alpha = 1/\gamma$ determines the shape of the tail region of the distribution.

4.2.1 The Gumbel Distribution

This Type I extreme value distribution or the Gumbel distribution is the limiting case where these distributions have tails which decline exponentially and all the moments exist. This Gumbel distribution is also called the Fisher-Tippett type I distribution and is given as follows

$$F_{EVo}(t) = \exp(-\lambda \exp(-t)) \tag{4.3}$$

for $-\infty \leq t \leq \infty$. Distributions of this type are also called as *light-tailed distributions*. Some other distributions with similar asymptotic forms include the exponential, gamma, normal, lognormal and the logistic distribution. (See Bury (1999), Embrechts, Kluppelberg and Mikosch (1997) and Resis and Thomas (2000))

4.2.2 The Fréchet Distribution

If the upper tail of the distribution is unbounded, but not all of its moments are finite, the underlying asymptotic distribution is a type II extreme value distribution or the Fréchet Distribution. This type of distribution is defined as

$$F_{EV2}(t) = \begin{cases} \exp\left(-\lambda t^{-\alpha}\right) & for \quad t > 0 \\ 0 & for \quad t < 0 \end{cases} \qquad \textbf{(4.4)}$$

where $\alpha > 0$ denotes a positive constant. Some other types of asymptotic distributional forms include the Pareto, Burr, Student-t, Cauchy, Log –gamma, and other various mixture models. This type of tail decay are referred to as *heavy-tailed* distributions and implies that the underlying distributions are *fat-tailed*, used for modeling extreme events. (See Bury (1999), Embrechts, Kluppelberg and Mikosch (1997) and Resis and Thomas (2000))

4.2.3 The Weibull Distribution

If the upper tail of the distribution is bounded and all of its moments are finite, the underlying asymptotic distribution is a type III extreme value distribution or the Weibull Distribution. This type of distribution is defined as

$$F_{EV3}(t) = \begin{cases} \exp\left(-\lambda(-t)^{\alpha}\right) & for \quad t > 0 \\ 1 & for \quad t < 0 \end{cases} \qquad \textbf{(4.4)}$$

where $\alpha > 1$ denotes a positive constant. Some other types of asymptotic distributional forms include the reflected power distribution, uniform, and the beta distribution. Distributions with this type of tail decay are called *short-tailed* *distributions.* (See Bury (1999), Embrechts, Kluppelberg and Mikosch (1997) and Resis and Thomas (2000))

4.3 Generalized Pareto Distributions

The generalized Pareto distribution (GPD) functions are used as natural approximations for excess distribution functions for very high thresholds. The GPD model can also be used to approximate the tail losses of a parent log return distribution and extreme measures of conditional excess market risk. The excess distribution measures the probability that the excess realizations, given the condition that they are above the threshold; is below a certain value relative to the threshold. The number of exceedence of a high threshold follows a Poisson process. The value of the high threshold can be found by the plotting of mean excess function.

The means excess function averages those realizations, which are above the threshold, and considers the distance between the mean and the threshold. There are three mean excess functions given a certain distribution of the tail given as follows.

The generalized Pareto distribution and density function of the GPD is given as

$$F_{GPD}(x)=\begin{cases} 1-\left(1+\gamma\dfrac{x}{\sigma}\right)^{-1/\gamma} & if\ \gamma\neq 0 \\ 1-\exp\left(-\dfrac{x}{\sigma}\right) & if\ \gamma=0 \end{cases} \tag{4.5}$$

and the density function of the GPD is given by

$$f_{GPD}(x)=\begin{cases} \sigma^{-1/\gamma}(\sigma+\gamma x)^{-(1+1/\gamma)} & if\ \gamma\neq 0 \\ \dfrac{1}{\sigma}\exp\left(-\dfrac{x}{\sigma}\right) & if\ \gamma=0 \end{cases} \tag{4.6}$$

where $1+\gamma x/\sigma>0$, and $\sigma>0$.

4.3.1 The Exponential Distribution

The Exponential Distribution corresponds to the Gumbel distribution and is given as follows:

$$F_{GPO}(x)=1+\ln(F_{EVO}(x))$$
$$=1-\exp(-x) \qquad \textbf{(4.7)}$$

for $x\geq 0$. (See Embrechts, Kluppelberg and Mikosch (1997) and Resis and Thomas (2000))

4.3.2 The Pareto Distribution

The Pareto distribution or the ordinary Pareto distribution corresponds to fréchet distribution. This can be given as follows:

$$F_{GP1,\alpha}(x)=1+\ln(F_{EV1,\alpha}(x))$$
$$=1-x^{-\alpha} \qquad \textbf{(4.8)}$$

for $x\geq 1$ and $\alpha>0$. The Pareto distribution is the most relevant of the GPD family of distributions as it is heavy tailed and corresponds to the Fréchet distribution, which is an appropriate distribution to measure extreme events. (See Reiss and Thomas (2000))

4.3.3 The Beta Distribution

The beta distribution corresponds to the Weibull distribution, which is given as:

$$F_{GP2,\alpha}(x)=1+\ln(F_{EV2,\alpha}(x))$$
$$=1-(-x)^{-\alpha} \qquad \textbf{(4.9)}$$

for $-1 \leq x \geq 0$ and $\alpha < 0$.(See Reiss and Thomas (2000))

The following analytical relationship exists between the generalized Pareto distribution (GPD) functions and the generalized extreme value (GEV) distribution functions for γ parameterization. (See Embrechts, Kluppelberg and Mikosch (1997) and Resis and Thomas (2000))

$$F_{GPD}(x) = 1 + \ln(F_{GEV}(x)) \tag{4.10}$$

4.4 Extreme Value Modeling

There are two principal model approaches to the estimation of the external properties of the extreme values of a probability distribution or a stochastic process.

4.4.1 Block Maxima Models

Block Maxima models are the oldest models, which are used for the largest observations collected from large samples of identically, distributed observations. (See Embrechts, Kluppelberg, and Mikosch (1997)) The descriptive statistics and the maximum likelihood estimates can be calculated from the sequence of maxima. The drawback of this model is that the use of sub samples reduces the precision of the estimators. The block maxima models can be used to determine the seasonality of a collection of hourly or daily profits and losses derived from transacting in an individual instrument or a portfolio of instruments.

4.4.2 Peaks –over – Threshold Models

This approach is a more recent approach to modeling the distribution of the extreme values, which focuses on modeling the characteristics of the largest values of a sequence that exceed a given high threshold. The peaks-over-threshold models are generally considered to be the most useful for practical applications owing to their more efficient use of the data on extreme values (see McNeil (2000)). The key result for the peak-over threshold models is that the general asymptotic form of the distribution of the excess value is a generalized Pareto distribution. This approach is usually applied by fitting the GPD to the observed excesses over a threshold. The advantage of this approach over the block maxima models is that the exceedence is associated with a specific event, which makes it possible for the parameters of the GPD to depend on other variables.

This class of models can be further distinguished into two styles of analysis. There are the semi parametric models that are derived from the Hill Tail index estimator for the Pareto tail estimation. The tail index of a density function is an indicator of the probability of observing values which represents a large deviation from the average or central values. The alternative style of analysis is the parametric models that are based on heavy-tailed GPD's. These models include methods based on absolute extremes of epochs and events based on exceedence over a given period.

4.5 Overview of Tail Estimation Procedures

Usually the tail region is assumed to follow a power law function and the distributions are in the maximum domain of attraction of a Fréchet distribution. We have discussed earlier that the asymptotic behaviour of extreme values depends on the tail index estimator and the scale parameter. The maximum likelihood estimator of the scale parameter σ of a sample of n independent observations $\{x_i, i = 1,2, K, n\}$ from a fréchet distribution is given as below

$$\hat{\sigma} = \left(\sum_{i=1}^{n} x_i^{-\hat{\alpha}} \right)^{-1/\hat{\alpha}} \qquad \textbf{(4.11)}$$

where $\hat{\alpha}$ is the estimate of the Tail Index. (See Bury (1999))

The tail index estimate allows us to extrapolate information on the empirical distribution outside its domain of observed samples as it is unlikely to have a large number of realizations above a given high threshold. The 'fatness' of the tails and the shape of the tail region are directly related to the tail index parameter. Depending on the values taken by the index, we can identify the distribution which is either, the Fréchet, Gumbel or the Weibull distribution. The shape parameter denoted $\alpha = 1/\gamma$ represents the maximum order of finite moments. The shape parameter is not an intrinsic parameter of extreme value distributions and it does not depend on the number of observations used in the tail estimation. The shape parameter corresponds to the number of degrees of freedom for a student-t distribution and characteristic exponent of a stable Paretian distribution.

If $\alpha = \infty$, the tails decline exponentially and in many cases the distribution is normal. If $\alpha < \infty$, the tails are fat and they decline as a power law. Some characteristics of the tail index in this case include:

1. α is the number of finite moments
2. For the Student –t distributions, α is the number of degrees of freedom
3. For the Stable distributions α is the characteristic exponent.

4.5.1 General Steps to the Estimation of Tail Index

The general steps to the estimation of the tail index that are any of the maximum domain of attractions for the generalized extreme value distributions are as follows:

1. Choose an appropriate estimator for the shape parameter γ of the general extreme value distribution.
2. Choose appropriate estimators for the normalization constants
3. Test that the proposed estimators form steps one and two result in reasonable approximations to the tail in the end of the tail where the high quantiles are located.
4. Determine the statistical properties of the estimators.

An important issue that has to be addressed in the estimation of the tail index parameter is:

How many extreme values to include in the optimal estimator of the tail index?

4.6 Approaches in Tail Index Estimation

There are two general approaches in tail index estimation. They are the semi-parametric approach and the non-parametric models. These are discussed below.

4.6.1 Tail Index Estimation using Maximum Likelihood Methods

The parameters of the generalized Pareto distribution can be estimated using the maximum likelihood method. By maximizing the log likelihood function of the GPD, we can obtain the parameters σ_u and γ, which are normalizing coefficients. Maximum likelihood estimators exist in large samples. Provided that $\gamma<1$, they are asymptotically normal and efficient when $\gamma<$ ½. Maximum likelihood estimator is simply for both exposition and implementation however it is fully efficient asymptotically, when the Cramer regularity conditions hold. The problems with endpoints cause problems for maximum likelihood estimators.

The drawbacks associated with this method in estimation of the tail index include:

1. Maximum Likelihood method assumes that the extreme values exactly follow the limiting distribution exactly the convergence-to-types theorem is an "*approximation*" in finite samples.
2. The normalizing coefficients must be estimated along with the tail index when maximum likelihood is used.
3. A sampling interval must be specified.

4.6.2 Non parametric Methods for Tail Index Estimation

There are large numbers of non parametric tail index estimators that have been developed. The non-parametric models we would discuss in this chapter are the De Hann and Resnick (1980), Deckers – Einmahl-De-Haan (, Hill (1975) and Pickands (1975). The Hill estimator is an estimator for the Pareto index, γ of the heavy tailed distributions, which are in the maximum domain of attraction of the heavy tailed Fréchet distribution. The Hill estimator is consistent among these estimators and this investigation uses the hill estimator for tail index estimator. The various non-parametric tail index estimators as discussed as follows:

4.6.2.1 De-Haan and Resnick Tail Index Estimator

The De-Haan and Resnick Tail Index Estimator is based on the order sample of the observed sample $\{x_1, x_2, x_3, k, x_n\}$ and is given as

$$\gamma_{k,n}^{HR} = \frac{\ln(x_1) - \ln(x_k)}{\ln(k)} \quad \textbf{(4.12)}$$

where n is the sample size and

k is the upper order statistics used. (See De Haan and Resnick (1980))

4.6.2.2 Deckers – Einmahl-De-Haan Tail Index Estimator

Deckers – Einmahl-de-Haan Tail Index is a moment estimator and is based on the order sample. It is given as

$$\gamma_{K,n}^{DEH} = \gamma_{k,n}^{H(1)} + 1 - \frac{1}{2}\left(1 - \frac{\left(\gamma_{k,n}^{h(1)}\right)^2}{\left(\gamma_{k,n}^{h(2)}\right)}\right)^{-1} \quad \textbf{(4.13)}$$

where $\gamma_{k,n}^{h(1)}$ and $\gamma_{k,n}^{h(2)}$ are first and second moments of the Hill Estimator. (See Pictet, Dacoronga and Müller (1998))

4.6.2.3 Pickands Tail Index Estimator

The *Pickands Tail Index Estimator* is also based on the order sample of the observed sample $\{x_1, x_2, x_3, k, x_n\}$ and is given as

$$\gamma_{K,n}^{P} = \frac{1}{\ln(2)} \ln\left(\frac{x_k - x_{2k}}{x_{2k} - x_{4k}} \right) \qquad \textbf{(4.14)}$$

where n is the sample size and
k is the number of upper order statistics used. (See Pickands III (1975))

4.6.2.4 The Hill Tail Index Estimator

Hill proposed a method of moments appropriate for positive values of the shape parameter. Since this estimator is for the Pareto index $\alpha = 1/\gamma$, the underlying original distribution F_x must be heavy tailed. The Hill estimator can be interpreted as the average vertical excess of the log-transformed data above a given threshold. This is the most consistent estimator and is used in the study of extreme risk in financial risk management.

The *Hill Estimator* is appropriate for the fréchet distribution. It is based on the order sample of the population and is given as

$$\alpha_{k,n}^{H} = \left(\frac{1}{k} \sum_{i=1}^{k} \ln(x_i) - \ln(x_k) \right)^{-1} \qquad \textbf{(4.15)}$$

where n is the sample size and k is the number of the observed sample of log returns. It has been shown that if the log returns are generated by a Fréchet distribution, then the Hill index will yield a more efficient tail index than the Pickands one (See Eric Jondeau and Micheal Rockinger(1999))

4.6.3 Bias-Variance Trade-off for the Hill estimator.

In practice, there are only a limited number of samples in the tail region which leads to small sample bias. The main issues in the estimation of the Hill tail index estimator is the choice of the number of upper order statistics to be used in the estimation. The bias of the Hill estimator is a function of the number of upper orders statistics used or given as the tail sample size $k(n)$ in total sample size of n. Increasing tail sample size ($k(n)$) will move the tail closer to the center and large number of observations in the tail will reduce the variance in the estimation but increase the bias. (See Embrechts, Kluppelberg and Mikosch (1997)) An important decision to be made is the choosing the threshold and the number of observations to be included in the estimation. The bias is also a function of the tail sample size and is related inversely to the variance of the estimation. The heteroskedasticity also arises from the bias-variance trade-off.

A recent study by Huisman, Keodijk, Kool, and Palm in January 2001 addresses the problem of small-sample bias in the Hill estimator. It is known as Huisman, Keodijk, Kool, and Palm (HKKP) estimator. The HKKP estimator is a robust small sample corrector estimator that is based on a set of Hill tail index estimates and can reduce the bias in sample sizes as small as 100. The HKKP estimates are based on a set of Hill estimates which have a different number of observations in the tail region. The resulting index is the weighted averages of the set of Hill estimates where the weights are drawn through a least squares estimation procedure. The HKKP estimator are based on approximately linear relationship between the tail sample size and the magnitude of the bias, and thus this estimator produces relatively unbiased tail index estimates in relatively small samples.

4.7 EVT-based Value-at- Risk Extension and Expected Shortfall measure

The EVT VaR estimates high quantiles, where the quantile is an unknown parameter for an underlying distribution. The confidence level of the VaR estimate can be given. This yields an asymptotic interval within which VaR lies, for a given confidence level. This interval reflects fundamental symmetry in the problem of estimating a high quantile for heavy tailed data.

EVT methods are appropriate risk measures for defining high quantiles levels such as *extreme VaR* and the "*beyond VaR*" risk measure. The GPD is the appropriate model for approximating the conditional distribution of exceedence above a high loss threshold using samples only from the extreme region. The GPD appropriation requires the threshold level to be sufficiently high enough such that the probability of exceeding it is very close to zero, so that the law of small numbers is applicable. The EVT – VaR estimate is derived from inversing the tail estimate formula and the results in the sections to follow are from Embrechts, Kluppelberg, and Mikosch (1997) and Reiss and Thomas (2000).

The appropriate extreme VaR based forecast at a high loss quantile with log returns $r = r(t)$ parent distribution is

$$VaR_q \approx r_u + \frac{\sigma}{\gamma}\left(\left(\frac{n}{k_u}-1\right)^{-\gamma}-1\right) \qquad \textbf{(4.16)}$$

where $VaR_q > r_u$

r_u is the threshold quantile

k_u is the number of observations exceeding the quantile

σ is the scaling parameter and

γ is the tail index parameter, which indicates the fatness of the tail.

The q-th loss quantile (x_q) estimated relative to r_u is such that 100.q percent of the observations are less than x_q. The choice of the threshold quantile allows for the VaR estimate to fall beyond the observed range. The beyond VaR measure is defined as a mean-excess function at a high tail threshold, which is the expected shortfall for a loss distribution. This is given as, follows:

$$\mu_{r_u} = E[r - r_u | r \geq r_u] = E[r | r - r_u] - r_u$$

where $r - r_u$ is an excess over r_u and when defined over VaR_q is given as

$$VaR_q = \frac{\sigma}{1-\gamma} + \gamma\left(\frac{VaR_q - r_u}{1-\gamma}\right) \qquad \textbf{(4.17)}$$

The following expression is the expected loss conditioned that the loss is greater than a VaR_q forecast defined relative to r_u

$$E[r | r > VaR_q] = VaR_q + \mu_{VaR_q} \qquad \textbf{(4.18)}$$

When the log returns are normally distributed, it is given as VaR_q. This is because, the inverse of VaR_q approaches zero, as we move towards the tails of the normal distribution. This is given as follows:

$$E[r | r > VaR_q] = VaR^{-1}{}_q + VaR_q \qquad \textbf{(4.19)}$$

The VaR technique is adequate when the log returns are normally distributed, however, in practical sense, empirical studies point out that the financial time series exhibit a range of $1.5 < \gamma < 5$. This implies that the log returns for fat-tailed Pareto distributions can be written as

$$1.2VaR_q < E\left[r \middle| r > VaR_q\right] < 3VaR_q \qquad \textbf{(4.20)}$$

These lower and upper bounds justify the use of the EVT approach and the upper bound is a justification of the suggested BIS risk capital multiplier of three for "*beyond VaR*" measure

4.8 EVT VaR and Risk Management

EVT will stay as an important technique in every risk manager's toolkit and in the future this technique will be used on a frequent basis, due to the growing complexities in global markets. The methods based on normal distributions are unlikely to measure tail risk and historical simulations provide imprecise estimates of tail risk. Traditional downside risk measures have been replaced with EVT, which is the most acceptable scientific approach to an inherently difficult problem – predicting the size of a rare event.

EVT addresses the extreme-downside risk of a portfolio, which most of the risk managers would be interested in as opposed to overall global risk. EVT allows senior management and regulators to set minimal requirements for the level of risk to be held against unexpected losses or even as a minimal allowable limit on potential losses. EVT addresses questions asked on extreme VaR forecasts which can be answered by estimation of high quantiles, which is usually beyond the observed range. VaR is a coherent risk measure only when the underlying parent distribution is from the family of elliptical distributions which include the multivariate gaussian distributions. Expected shortfall has been proposed as an alternative method, to measure the magnitude of exceedence beyond a VaR forecast relative to some high quantile and the corresponding coverage level.

Regulators concerned with capital requirements for security firms would be interested in the possibility of bankruptcy, which could result from an extremely large change in the value of the firm's portfolio. It helps regulators to determine the amount of risk capital to be kept aside by an institution to cover the largest loss in such a way that the company stays solvent even after post-extreme event shocks. Another financial application of EVT concerns the setting of margins in derivative markets which are very sensitive to large price changes. A high margin by brokers will protect against insolvent customers and reinforce market integrity, however it will increase the cost that investors must support, and this makes the market less attractive. This trade-off can be addressed by EVT approach to set acceptable margins by taking into account the appropriate amount of extremes in distribution of price changes and providing a simple analytical formula to compute the *"optimal"* margin level. EVT is one of the procedures for stress testing which has been accepted as an alternative to scenario analysis and sensitivity analysis where the difficulty lies in identifying the key risk factors, their magnitudes and generating scenarios. This approach has been used in the context of scenario analysis and the modeling of loss distributions.

Empirical studies have proved that credit spreads are typically highly skewed and exhibit heavy tails (See Campbell (2002)). This shows the danger of using gaussian distributions to incorporate the tail region. Normality assumption is not adequate in extreme value theory approach can be used to quantify the boundaries between these different loss classes. These are given as expected loss, unexpected loss and extreme losses. Phoa (Spring 1999) investigates the use of extreme value theory to model the maximum daily one-day shifts in swaps spreads, specifically in the Australian dollar swap spread. The driving force behind this investigation was the widening of credit spreads that occurred in the third quarter of 1998, which surprised most market participants and caused losses that greatly exceeded the reported values of VaR forecasts.

In the area of operational risk management, the normality assumption is not adequate as the operational risk loss distributions are typically heavily skewed and therefore exhibit heavy right tails. Cruz (November 1999) and Cruz, Coleman and Salkin (2000) use the

GPD in the modeling of catastrophic operational losses using operational risk-linked bonds. The EVT approach has also gained recognization in areas of Pension fund management, where fund managers have to decide on the allocation of funds to risky assets such as equities, foreign exchange and derivatives. The allocation is a function of liquidity and solvency of the funds, since they have to be paid out every period. Thus management will be concerned about the negative returns which can harm the solvency of the fund.

Another financial application of EVT concerns the upper limits of open positions to foreign currency dealers by the treasurers of the FOREX dealing room in a financial institution. The tail index assists in detecting the changes in regime sections that affect the foreign exchange rate distribution. The trading limit can be determined as a function of the single negative return which is large enough to endeavor the solvency of the financial institution.

The area of insurance, especially in the area of reinsurance and actuarial sciences is the most important application of EVT, where the contracts are written on single or few events which involves upper or catastrophic losses. EVT can be used to investigate the role of the extremal claims in an insurance company's portfolio through the use of reinsurance treaties. EVT can be used to estimate premiums and choices of layers of reinsurance in an excess-of-loss treaty. This commits the reinsurer to an obligation to cover the excesses above the k-th largest claim for a specific premium. The priority for a layer can be reformulated as a high quantile of the claims distribution and tail estimation methods can be used to estimate the risk involved within a certain layer.

4.9 Limitations and difficulties in application of Extreme Value Theory

Some of the difficulties in applying extreme value theory to financial time series are summarized below.

1. Generalized extreme value distributions which include the Fréchet, Gumbel and the Weibull distributions are different for Maxima and Minima. They have to be

modeled in the proper corresponding situation, which would otherwise produce spurious results.

2. EVT deals with the problem of estimation low frequency events using short historical records. The study of rare extreme events is based on the occurrence of the events which are rare by definition, result in small samples. There is a conflict with the requirement that a sufficiently large number of observations are included in the estimators in order that the results are statistically significant.

3. The difficulty is with the period underlying EVT assumptions

4. Using data outside the tail of interest may bias the estimation of the tail region. This highlights the difficulties in determining the optimal tail threshold, leading to bias-variance trade-off.

5. The choice of cumulative distribution function in the context of EVT procedures is often made incorrectly by fitting families of distributions to the entire sample and then using the relationship for the distribution of the maxima (minima) in terms of power of the distribution of the original IID random variables.

6. The assumption that the random variables are independent and identically distributed is not valid in practice because the even in cases where the IID assumption is not valid, the asymptotic independence assumption has some theoretical justifications.
7. The EVT results can be used only to infer the characteristics of the tail regions and not to infer the characteristics of the parent distribution.

8. The difficulty of extending univariate EVT to multivariate framework when there are more than a few risk factors.

9. Serial dependencies violate the usual independently distributed assumption.

10. Random variables with bounded right endpoints are wrongly approximated for extremes using the Fréchet distribution. Also random variables with unbounded right endpoints are wrongly approximated for extremes using Weibull distributions.

Although there are numerous limitations to the use do EVT procedures, the following comments of EVT researcher Richard Smith and Jonathan Tawn summarize the advantages and limitations and also points towards the inherent value of the extreme value theory in applications (See page xvi of Embrechts (2000A))

"There is always going to be an element of doubt as one is extrapolation into areas one doesn't know about, but what EVT is doing is making the best use of whatever data you have about extreme phenomena."

(Richard L. Smith)

and

"The key message is that EVT cannot do magic – but it can do a whole lot better than empirical curve fitting and guesswork. My answer to the skeptics is that if people aren't given well-founded methods like EVT, they'll use dubious ones instead."

(Jonathan A. Tawn)

An extension of the univariate approach to EVT modeling is the bivariate extreme case, in which each of regime switches can be modeled using data in the extreme section of the appropriate quarter of the two dimension returns space. Each of regime switching decompositions can also be assessed for the bivariate normal market condition case using the appropriate quarter of the two dimension returns space, but in the center part of the distribution.

Chapter – 5

Multiple Regime Switching Models

In this chapter, the concept of regime switching between regions will be introduced, and further the different multiple regime switching models and the probability matrix for these models will be discussed. The basic focus of assumption for regime switching models is that the user decides where the tail starts or the regions. In this investigation, the center of the returns distribution will be assumed to be normally distributed containing 90 percent of the returns data and each tail contains 5 percent of the data implying that the center region is modeled using the mean and variance.

5.1 Introduction

Many of the major exogenous economic events influencing financial time series, such as the Oil shocks, Stock market crashes are viewed as episodes of identifiable duration in which the dynamic behaviour of some key economic time series change significantly from that seen outside these episodes. In recent years, several time series models have been proposed which formalize the idea of the existence of different regimes generated by a stochastic process. Stock returns features such as time-varying risk premiums, market crashes, bubbles, and irrational behavior lead to nonlinear dependence in stock returns. Determining the exact/explicit form of nonlinearities in conditional returns is unknown, but "regime-switching behavior" provides an attractive/plausible possibility. (See Maheu & McCurdy (2000))

The use of regime switching regressions was introduced in econometrics by Quandt (1958) in which the regimes follow an unobserved Markov process (See Hamilton

(1990)). This was extended by Lee and Porter (1984) who considered a dichotomous indicator that provides sample separation. An extension of the idea of Quandt (1973), and Cosslett and Lee (1983) is the Markov switching regime model considered by Hamilton (1989, 1990, and 1992). Regime switching models differ in the way the regime evolves over time. Two classes of models can be identified where the first class of models assumes that the regime can be characterized by an observed variable. Consequently, the regimes that have occurred in the past and present are known with certainty. The second class of models assumes that the regime cannot be observed but is determined by an underlying unobservable stochastic process. (See Franses (2000)). This implies that one cannot be certain that a particular regime has occurred at a particular point of time, but can only assign probabilities to the occurrence of the different regimes.

In the Markov switching regression model, the probabilities of switching from one region to the other in the next period are assumed to be constant. A simple Bernoulli can model the regime switching, where the market is in the normal state with a probability *(P)* or in the abnormal state with a probability *(1-p)*. The transition state is independent of the last state. A Markov chain approach for modeling regime switching is where the next state of the market is a function of the current state.

The hybrid Bernoulli approach is combination of duration theory which studies the time duration of the returns generating process in a given region, and the simple Bernoulli approach. In this hybrid approach, the market stays in a given regime based on the duration model. Once the time period of the regime has expired, the sampling of the next state is modeled using an independent Bernoulli approach. The market can either continue to stay in the same regime or leave the regime with a probability of *1-p*. The sample duration can be based on the exponential distribution for continuous time and the geometric distribution for discrete time such as daily movements.

5.2 The IID Unconditional LT-C-RT regime-switching model

The unconditional regime-switching model is a simple Bernoulli model in which the transitions are not conditioned or independent of the previous state. In this model, the probability of staying back in the regime is not possible, because once it leaves the regimes, it will move to any of the other regimes identified in the two state and three state models. The observations are fitted from the simulated tails and the center based on the unconditional probabilities determined from the log returns of the underlying series.

This approach to modeling the returns process decomposes the log-return distribution of a financial time series into two states: a left loss tail region (or abnormal market conditions) and a center normal region (or abnormal market conditions). The design is such that the transitions between states are independent. Both the two- and three-state unconditional Markov chains are presented in Tables R.1 and R.2. Only the three-state unconditional Markov chains will be used in the analysis. The two state unconditional Markov chain is described below

Table R.1 - Two State Unconditional Probabilities for the Left Tail and Center Regions of a Returns Distribution*		
Left Tail	**Center Region**	**Sum of Probabilities**
P_L	P_C	$P_L + P_C = 1$
* This model could also be used to model the center and right tail regions		

The two-state unconditional Markov chain can be extended to a three state unconditional Markov chain and described as shown in the following table

Table R.2 – Three-State Unconditional Probabilities for Left Tail, Center and Right Tail Regions of a Returns Distribution			
Left Tail	**Center Region**	**Right Tail**	**Sum of Probabilities**
P_L	P_C	P_R	$P_L + P_C + P_R = 1$

where

P_L is the probability of the left tail region

P_C is the probability of the center region

P_R is the probability of the right tail region

The probability of leaving the right tail of the returns distribution and probability of moving into the left tail regime or the center region is given as follows

$$\Pr ob(LT|leavingRT) = \Pr ob(LT|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \quad \textbf{(5.1)}$$

$$\Pr ob(C|leavingRT) = \Pr ob(C|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \quad \textbf{(5.2)}$$

where C = Center Region

LT = Left Tail Region

RT = Right Tail Region

5.3 The Markov Regime Switching Model

The Markov Chain is a stochastic process $\{X_n : n = -\infty, \ldots -1,0,1\ldots\infty\}$ which denotes that the state realized at time n, where the state space is $\{i_0, i_1 \ldots, i_\infty\}$is such that whenever the process enters state i_1, $i \geq 0$. If $X_n = i$, then the process is said to be in state i, at time n. In the next state, which is a function of the current state, the process will enter state j with probability $\Pr ob(X_{n+1} = j|X_n = i)$ for $i, j \geq 0$ where the latter is called the transition probability and given as

$$P_{ij} = \Pr ob(X_{n+1} = j|X_n = i_n, \ldots, X_2 = i_2, X_0 = i_0) \quad \textbf{(5.3)}$$

$$= \Pr ob(X_{n+1} = j|X_n = i_n) \quad \textbf{(5.4)}$$

Thus Markov chain conditional probability for modeling regime switching is where the next state X_{n+1} of the market is a function of the current state, given all the past states $\{X_n = i_n, \ldots, X_2 = i_2, X_0 = i_0\}$ depend only on the current state X_n. The measure P_{ij} is the probability that the process will make the transition to state j, given that it is currently in state i. The properties of the measure P_{ij} include

1. $P_{ij} \geq 0$ for $i, j \geq 0$ and
2. $\sum_{j=1}^{\infty} P_{ij} = 1$ for $i = 1,2,3,\ldots\infty$

All the one step transition probabilities $P_{ij} \geq 0$ for $i, j \geq 0$ can be formulated in a matrix as follows (See Section 4.1 of Ross (1993)).

$$P = \begin{Vmatrix} p_{00} & p_{01} & p_{02} & \cdots \\ p_{10} & p_{11} & p_{12} & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ p_{i0} & p_{i1} & p_{i2} & \cdots \end{Vmatrix} \qquad \textbf{(5.5)}$$

Applying the transition probability matrix given above, we can formulate the transition probability matrix of two and three state Markov chain process for returns as described in the following tables R.3 and R.4 respectively

Table R.3 – Two State Conditional Markov Chain Transitional Probabilities for the Left Tail and Center Regions of a Returns Distribution

Starting $(\downarrow)$/ Resulting $(\rightarrow)$	**Left Tail**	**Center**	**Sum of Probabilities**
Left Tail	P_{LL}	P_{LC}	$P_{LL} + P_{LC} = 1$
Center	P_{CL}	P_{CC}	$P_{CL} + P_{CC} = 1$

Table R.4 – Three-State Conditional Probabilities for Left Tail, Center and Right Tail Regions of a Returns Distribution				
Starting $(\downarrow)$/ Resulting $(\rightarrow)$	**Left Tail**	**Center**	**Right Tail**	**Sum of Probabilities**
Left Tail	P_{LL}	P_{LC}	P_{LR}	$P_{LL} + P_{LC} + P_{LR} = 1$
Center	P_{CL}	P_{CC}	P_{CR}	$P_{CL} + P_{CC} + P_{CR} = 1$
Right Tail	P_{RL}	P_{RC}	P_{RR}	$P_{RL} + P_{RC} + P_{RR}=1$

In the Table R.3 and R.4,

P_{CC} = Prob (Next Return in Center / Current Return in Center)

P_{CL} = Prob (Next Return in Left Tail / Current Return in Center)

P_{CR} = Prob (Next Return in Right Tail / Current Return in Center)

P_{LL} = Prob (Next Return in Left Tail / Current Return in Left Tail)

P_{LC} = Prob (Next Return in Center / Current Return in Left Tail)

P_{LR} = Prob (Next Return in Right Tail / Current Return in Left Tail)

P_{RR} = Prob (Next Return in Right Tail / Current Return in Right Tail)

P_{RC} = Prob (Next Return in Center / Current Return in Right Tail)

P_{RR} = Prob (Next Return in Right Tail / Current Return in Right Tail)

The probability of leaving the right tail of the returns distribution and probability of moving into the left tail regime or the center region are represented below

$$\Pr ob(LT|leavingRT) = \Pr ob(LT|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \qquad \textbf{(5.6)}$$

$$\Pr ob(C|leavingRT) = \Pr ob(C|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \qquad \textbf{(5.7)}$$

Where C = Center Region;

LT = Left Tail Region; and

RT = Right Tail Region

5.4 Geometric Time in Tail Regime Switching Model

The Geometric Time in Tail Model is an extension of the Markov Chain stochastic process which estimates the number of days left before there is a transition to the next state. It is a conditional model where the probability that the process will make the transition to state j depends on the current state i. In this model, it is assumed that there is a transition upon expiration of time in that region, and the transition is to one of the other regions and not back to the current region of the returns distribution. A geometric distribution can be sampled as $G(\Pr ob(R))$ where (R) is a given region of a returns distribution such that $E[K] = (1 - p / p)$.

$\Pr ob(R)$ represents the probability that the returns where generated from the given section (R) and $[K]$ represents the total number of days until the returns which have been generated from a given section of the returns distribution for 'M' days, transfers to another section of the returns distribution where the transfer day is included in value, i.e. $[K] = (M) + 1$. (M) represents the number of days that the returns generating process is generating from a given section of the returns distribution.

The one additional day in the equation $[K] = (M) + 1$ represents the day that the returns generating mechanism leaves its current section of the returns distribution and transfers to the other section of the returns distribution. Once the returns generating mechanism has transferred to another section, a geometric distribution can be sampled that represents the time the returns are generated from this region and the day it transfers to another.

The generating of the returns distribution using geometrically distributed transitions times between regions, transition probability matrix between the regions is given in Tables R.5 and R.6.

Start in a given region based on the following unconditional probabilities of being in a given region: Prob(C), Prob (LT), and Prob(RT)

If in Center

The total numbers in the center (C) plus the transfer day is a function of G(Prob(C)). When leaving the center, the returns may be next generated form either the Left Tail or the Right Tail, but not back to the Center Region of the returns distribution. The transition probabilities for moving from the Center to another region are defined below:

$$\Pr ob(RT|leavingC) = \Pr ob(RT|C)/(\Pr ob(RT|C) + \Pr ob(LT|C)) \quad \textbf{(5.8)}$$

$$\Pr ob(LT|leavingC) = \Pr ob(LT|C)/(\Pr ob(RT|C) + \Pr ob(LT|C)) \quad \textbf{(5.9)}$$

If in Left Tail

The total numbers in left tail (LT) plus the transfer day is a function of G(Prob(LT)). When leaving the left tail (LT) the returns may be next generated form either the Center Region or the Right Tail, but not back to the Left Tail of the returns distribution. The transition probabilities for moving from the Left Tail to another region are defined below:

$$\Pr ob(C|leavingLT) = \Pr ob(C|LT)/(\Pr ob(RT|LT) + \Pr ob(C|LT)) \quad \textbf{(5.10)}$$

$$\Pr ob(RT|leavingLT) = \Pr ob(RT|LT)/(\Pr ob(RT|LT) + \Pr ob(C|LT)) \quad \textbf{(5.11)}$$

If in Right Tail

The total numbers in left tail (RT) plus the transfer day is a function of G(Prob(RT)). When leaving the left tail (RT) the returns may be next generated form either the Center Region or the Left Tail, but not back to the Right Tail of the returns distribution. The transition probabilities for moving from the Right Tail to another region are defined below:

$$\Pr ob(LT|leavingRT) = \Pr ob(LT|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \quad \textbf{(5.12)}$$

$$\Pr ob(C|leavingRT) = \Pr ob(C|RT)/(\Pr ob(LT|RT) + \Pr ob(C|RT)) \quad \textbf{(5.13)}$$

Table R.5 - Two State Unconditional Probabilities for Returns with Geometrically Distributed Times Between Regions Transitions			
	Left Tail	Center	Sum of Probabilities
Probability	p_L	p_C	$p_L + p_C = 1$
Time in Tail	$G(p_L)$	$G(p_C)$	
Transition with probability one	$LT \rightarrow C$	$C \rightarrow LT$	

Table R.6 - Three State Unconditional and Conditional Probabilities for Returns with Geometrically Distributed Times Between Regions Transitions				
	Left Tail	**Center**	**Right Tail**	**Sum of Probabilities**
Probability	p_L	p_C	p_R	$p_L + p_C + p_R = 1$
Time in Tail	$G(p_L)$	$G(p_C)$	$G(p_R)$	
Transition Probabilities	$\Pr ob(LT \rightarrow C)$ $\Pr ob(LT \rightarrow RT)$	$\Pr ob(C \rightarrow LT)$ $\Pr ob(C \rightarrow RT)$	$\Pr ob(RT \rightarrow C)$ $\Pr ob(RT \rightarrow LT)$	$\Pr ob(LT \rightarrow C) +$ $\Pr ob(LT \rightarrow RT) = 1$ $\Pr ob(C \rightarrow LT) +$ $\Pr ob(C \rightarrow RT) = 1$ $\Pr ob(RT \rightarrow C) +$ $\Pr ob(RT \rightarrow LT) = 1$

where $G(p)$ is a geometric distribution with parameter p with $E[K] = (1-p)/p$ and $VAR[K] = (1-p)/p^2$

The duration in a section of the returns distribution is geometrically distributed in the sense that the time until one leaves the tail once in the tail has a geometric distribution.

Chapter – 6

Stress Testing and Scenario Analysis

In this chapter, stress testing and the different types of scenarios built for testing will be introduced. Various stress testing procedures that include scenario analysis, sensitivity analysis, simulation analysis, EVT based testing and crash modeling will also be discussed in this chapter. Finally, advantages and disadvantages of stress testing are listed.

6.1 Overview of Stress Testing

VaR is a commonly accepted risk measure for measuring the loss magnitudes with rare tail events in financial markets. On management interest, it is necessary at time, to quantify losses of improbable but possible events than those analyzed by the standard VaR techniques. There has been atleast one major market movement by more than ten standard deviations every year. Some of the unexpected financial crises include:

1. The Energy Crisis in 1973
2. Global Stock Market crash in 1987
3. Japanese Stock Market Bubble in 1990
4. US High Yield Crisis in 1990
5. European Currency Crisis in 1992
6. US Interest Rate Crisis in 1994
7. Mexican Peso Crisis in late 1994
8. Latin American Crisis in 1995
9. Asian Crisis in 1997
10. Russian Crisis in 1998
11. Brazilian Crisis in 1999

12. NASDAQ Bubble Burst in 2000
13. Argentinean Debt Crisis
14. September 11th Terrorist Attacks in 2000.

General VaR techniques used by institutions measure exposures at a move of two to three standard deviations, however these financial crises have shown us that market move more than their standard volatility bands during abnormal periods. Due to deficiencies in VaR techniques in many respects, it is not possible to be solely used as a risk measure. A survey conducted by the Committee on the Global Financial System of Central Banks of the Group of Ten countries in April 2001 stated that, 'risk managers gave several reasons why VaR may mis-measure risk for some markets or products, leading them to rely on stress tests. These include a lack of historical price data, a tendency of markets to gap, liquidity, or difficulties in estimating the highly non linear exposures from options lending'. The techniques to quantify such special scenarios are often called 'Stress Test'. This technique is common among risk managers but there is no best-set procedure to accomplish a stress test.

Satyajit Das (2001) defines stress testing as 'a set of techniques that are used to examine the potential effect on the firm's financial position of exceptional but not impossible changes in market price/rates or combination of such changes'. It is used to test the capacity of the institution to withstand plausible but exceptional market conditions. Stress testing measures extreme movements and is helpful in testing portfolio risks at times of financial crisis, market breakdowns or any possible extreme scenarios. The demand for stress test is driven by the fact that institutions do not want to suffer a loss in positions where they face bankruptcy. Stress testing represents the dynamic quantification of exposure based on an assumed evolution of prices or price paths.

Stress testing is widely used for setting limits and for risk capital allocation. Given the fact that stress testing is customized complicated process, as well as expensive and used to measure extreme events, it is usually run on high frequency data (daily or weekly). A stress test is good for examining the consequences of changes in volatility. Given a crosscountry portfolio, historical techniques may indicate little exchange rate risk, if the exchange rate is stable for a considerable time. When the exchange rate changes abruptly, the market would face major losses, which were not accounted, and yet this vulnerability can be measured by a simple stress test. Stress tests are also used to highlight dependence and correlation assumptions, which changes drastically during market breakdowns or financial crisis when markets move against us and the only way to sort this exposure is by carrying out a scenario analysis. The main motive for stress tests is to provide the senior management with the expected effects of worst-case scenarios. This makes them prepared to withstand the worst situations. Stress testing has gained importance over standard VaR techniques and it helps us to answer the question:

"What can go wrong when there is an extreme market breakdown?"

Stress testing is one of the seven conditions required by the *Basle Committee* that must be satisfied in order to use their internal model procedures. Stress testing begins with a set of hypothetical scenarios. These can be stylized scenarios, actual historical extremes events or one-off hypothetical events.

1. ***Stylized Scenarios*** are scenarios where there are simulated movements in one or more risk factors. Some risk factors that can be used in stress tests include interest rates, mortgage spreads, corporate bond spreads, stock price shifts, exchange rate fluctuations, commodity price shifts, market linkages, cash flow liquidity implications, trading liquidity, and implied volatilities. Simulated changes can either be discrete, percentage changes, or changes in standard deviations.

2. ***Historical Scenarios*** are alternative ways to user-defined scenarios. They entail actual extreme movements, and identify days in the past that were actually stressful. This approach is to scale the current market risk factors by the relative changes experienced during abnormal periods in the past. We have had extreme movement's atleast once every year where standard deviation moves beyond 10 units. We could model a scenario similar to the global stock market crash of 1987 by considering the stock price fall by about 23%or 22 standard deviations, the

Asian markets declining by about 30% and market volatilities shifting upward from 20 to 50 percent.

3. ***Hypothesized One-off scenarios*** are designed to represent the implication of certain one-off events. They are not always obvious, and are the only way to be aware market linkages and what is going on in the world at large. Some of the events include an earthquake in Tokyo, Taipei or San Francisco, major terrorist attack in New York, the onset of a major war, or a major bankruptcy. It is not complete to consider only the initiating event but it has to be further complemented with potential consequences. Each combination of initiating event and the roll-on event is a different scenario. These are difficult to think through clearly and also they procreate at a rapid rate.

Having developed the scenarios, it is of out most importance to create the correct set of scenario, which will significantly affect the perceived risk exposures. It should incorporate a complete set of significant large changes in risk factors. The main issue is to identify the key underlying risk factors affecting the portfolio and the sensitivities whose hypothetical changes affect portfolio returns.

Considering a one to one FX position, it is affected by the underlying exchange rate and similarly a stock portfolio changes with movement in the stock index. The scenarios are created and it is then used for periodic stress analysis of a position by keeping the set of extreme scenarios fixed. The effect can be inferred by subtracting the initial portfolio from the post- scenario portfolio values. On evaluating the effects of scenarios on positions, it is important to consider the state of the markets in which they operate. It is improbable to consider normal market trading during extreme market movements, because they may be overwhelming orders to be executed within minutes and part of the order can expire due to time limits or price limits.

Another important factor is lack of liquidity, when it is needed the most during financial crisis as market strategies are based on dynamic hedging. Volatility and correlation assumptions have to be accounted for as the markets may break down and move against traders leading to mismatches in hedges, leaving bigger exposures than expected.

6.2 Stress Testing Procedures

Broadly speaking there are two types of stress testing approaches. The first approach focuses on developed scenarios and the impact of particular scenarios on positions. Certain scenarios are generated and tested through an analytical process called as '*Scenario Analysis'*. The other approach is the mechanical approach where there are different possibilities of events to determine the maximum loss that would be possible. This approach is different from scenario analysis as it emphasizes on working out different possibilities than fixed scenarios. This approach has more likelihood outcomes as it can be customized and it allows us to decide how serious a particular outcome should be considered. The major types of stress testing include the following

6.2.1. Sensitivity Analysis:

This is the simplest type of stress testing and is used as a mechanism to reveal major underlying risk factors in the portfolio. The main idea of this approach is to vary key factors and work out the effect on the value of the portfolio. The extreme shock is basically an extreme outlier in the distribution of the key factor. It aids the risk manager to isolate the key risk areas of the portfolio. Sensitivity analysis can be standalone where it is stress tested for one single factor by keeping other factors constant. The process is repeated to almost all the other risk factors where all the risk factors are pushed up and down individually. This standalone approach is useful in determining the loss given there is extreme movement in on market risk fact at a given point of time.

6.2.2 The Maximum Loss Approach:

This approach assesses the risk when all the market risk factors are varied and by selecting the combination of extreme movements, which has the worst effect on the portfolio. All the variables are pushed in the direction, which creates the worst loss. Collectively, the worst movements for each factor will give us the worst-case scenario for a portfolio and the maximum loss can be determined by subtracting the current value of the portfolio from the worst-case portfolio, which serves as the benchmark. This approach is not limited to any assumptions and it is possible to plug in any correlation to check the impact on the maximum loss of the portfolio. The fact that any correlation can be inputted into the analysis ignores correlations. If two variables are positively correlated, then it makes no sense to move them in opposite direction to determine the worst-case scenario. Maximum Loss Approach is similar to the factor push analysis except for the fact that factor push analysis measures intermediate whereas this approach measures extreme values of risk variables.

6.2.3 Scenario Analysis:

Scenario Analysis is used to asses risk exposures where one or more price/rate changes affect the portfolio simultaneously. It analyses the changes in the value of the portfolio when there is simultaneous effect or combination of extreme changes in a number of market risk factors. Scenario analysis helps in identifying the vulnerability of the portfolios as well as other weaknesses in our risk management set-up. When a stress test exercise is done, the risk manager realizes the ramifications of bad scenarios as well as the weaknesses that they have overlooked. Scenario Analysis is infact, a combination of sensitivity analysis, which changes some key risk factors expect for the fact that sensitivity analysis is a micro approach as compared to scenario analysis, which is macro in nature. Scenario analysis aids the management for strategic decision process as compared to sensitivity analysis, which is more a tactical decision process. However, in practice, it might be tempting to stress multiple key factors in the set of exogenous shocks included in the scenario. Therefore it is important to keep cautious when selecting which factors to shock. There are generally two types of scenario-based stress tests:

6.3.1.1 Fixed Scenario Analysis:

A fixed scenario analysis is the building of hypothetical combination of events where there are extreme market risk factor changes. The scenario identified should be clearly defined with factors affecting the portfolio behaviour and plausible to inflict large stress on the portfolio. Key factors, which can be shocked, include market volatility, (which focuses on market moves), extreme price/rate changes, gaps in price rate changes and volatility/ correlations regime shifts. Trading liquidity factors focus on market liquidity and cash flow liquidity implications focuses on maximum, or average borrowings required for investments. Other key factors include risk horizon, market linkages, counterparty risks, option premiums, and political phenomenon that could be generated included the unexpected collapse of the government, crisis of the exchange rate system or even an unexpected death of head of a state. The specified risk factors should be tested for reasonableness and consistency, and also the magnitude of such changes to be experienced should be identified.

6.2.3.2 Historical Scenarios:

Historical scenarios analyses involves the use of historical extreme events that have been experienced in the past and use the same key factors and magnitudes to stress test the current portfolio, conditioned that the historical event is repeated. These scenarios are typically taken from the past, and tested for effects on the potential future. The risk manager identifies scenarios, which may lie outside the VaR window, and these scenarios will yield a set of joint movements in financial variables which takes care of correlations in them. Examples of historical scenarios include the October 1987 Equity Market Crash, The European Monetary System crisis in September 1992, The US bond market collapse in April 1994 (due to interest rate crisis), Mexican Devaluation in December 1994, Asian crisis in July 1997, Russian Credit crisis in August 1998 and the NASDAQ market correction in April 2000. Natural disasters like the Japanese earthquake in 1995 or a political event like the September 11th 2001 terrorist attacks on the World Trade Center in New York and the Pentagon in Washington can also cause extreme price movements.

Strong directional movements in markets can have drastic effects on portfolio values which can also be included in scenario analysis. The drawback from historical scenarios is the limited number of extreme events. Complex financial instruments have been developed for hedging risk exposures and part of the extreme events may not be possible due to changes in regulations or the use complex financial instruments which were absent earlier. Trading behaviour may be conditioned and restricted to avoid the problems encountered in the past and the possibility of the event to reoccur is unclear. Likewise events such as sovereign defaults are extremely rare and if the Russian default on its domestic debt and Ecuador on its Brady bonds is considered, then we have to go way back to 1930's to encounter previous sovereign defaults on external debt. However, historical scenarios used in scenario analysis are transparent and free of subjective judgment.

6.2.4 Simulation Analysis:

Static stress testing techniques like sensitivity analysis and scenario analysis have certain limitations, which makes way for simulation approaches of stress testing. Static approaches do not account the path dependency of the portfolio and it does not allow the risk manager to make adjustments to the positions as markets evolve. Typically, when there are extreme movements in the markets, traders will seek to adjust the positions by either scaling back or hedging their exposures. This suggests that once the positions can be adjusted then the magnitude can be eliminated or minimized, thus stating that the real risk factor is the ability to adjust to the extreme conditions. The most common approach to stress testing using simulation approach is the Monte Carlo method. This generates sequences of pseudo random representations for each of the market risk factors. The random representations can be based either on a parametric criteria or historical data and are used to model the behaviour of the portfolio over time. The general method of Monte Carlo simulation is to generate random representations of new market data, which is then matched with the current market portfolio and revalued based on the new market portfolio. This process is repeated to give different paths of future values of the portfolio based on which the VaR and other risk estimates are generated. The Monte Carlo simulation approach has the ability to generate extreme outcomes and the path dependent simulations enable us for a wider and a richer view as the portfolio's behaviour can be sampled and observed, but if the parameters are mis-specified, then it may lead to underestimation of the large changes in the underlying variables.

6.3.5 Extreme Value Analysis:

Extreme Value theory is precisely concerned with the analysis of tail behaviour and it has its roots from the works of Fisher and Tippett first published in 1928, with a long history of applications in the field of hydrology and insurance. Extreme value theory allows stress tests to incorporate information from tail regions of a returns distribution that has been extrapolated beyond the range of the observed data. It is a relatively new technique used in stress testing and the focus on the tail of distributions allows this methodology to capture the losses in extreme but possible conditions. EVT in stress testing helps to identify the likelihood of extreme price changes in financial risk factors. The EVT distribution is described by three parameters; namely the mean, standard deviation and the tail index. The tail index is specific to EVT and determines the fatness and behaviour of the observations in the tail region. Since EVT allows for determining the confidence levels for each probability or quantile estimate, the risk manager can use this theory to estimate that the confidence levels and the quantiles lies in the given range helping him with valuable information on the accuracy of the estimates.

6.2.6 Crash Modeling Analysis:

Crash modeling is relatively a mathematical technique used in stress testing, which is derived from the jump diffusion theory and option pricing theory. It is a methodology developed to price, and hedge a portfolio for an extreme movement in market conditions. Normal hedging usually does not work during crashes and crash modeling approach can be used to derive hedges against the possibility of a crash as it establishes a hedge based on the worst event. Crash Metrics is an extension of crash modeling which is a form of maximum loss that is designed to estimate the worst case scenario losses. The worst-case scenario is associated with the most adverse daily outcome.

6.3 Advantages of Stress Testing:

1. Stress tests are the most ideal complements to VaR measurements. VaR approach estimates the maximum we might lose with a certain maximum possibility but stress testing gives an idea of what we stand to lose if a worst case event occurs.

2. Stress testing methodology also applies to credit and operational risk management and it ensures that the firm survives in times of market turmoil. Since the primary objective of stress testing is to identify the scenarios which cause significant losses, it will help institutions to assess their positions and to set risk limits for minimizing the amount lost under extreme market conditions.

3. It helps to identify the vulnerable aspects of the firm's portfolio to a variety of extreme market conditions. It identifies the key areas where the portfolio is exposed to excess risk.

4. Stress tests help to establish the capital requirements that have to be maintained against trading risks of a portfolio.

5. Scenario analysis in stress testing helps to identify the key areas where extreme movements occur and to adjust positions accordingly to reduce the risk profile to within acceptable limits.

6. The main motive for stress tests is to provide the senior management with the expected effects of worst-case scenarios, so that they can be prepared to withstand them.

6.4 Limitations of Stress Testing

1. The main limitation of stress testing is its objectivity. There are no universal standards for stress testing procedures. The risk manager makes the choice of scenarios and the factors to be stressed, and the range of events to be considered Thus it is totally dependent on the chosen scenarios and hence on the judgment and experience of the people who undertake the stress tests.

2. Stress testing is a complex, slow and an expensive process. There are possible chances of the scenario happening sometime in the future than in the risk horizon period. Thus it becomes a continuous process to run the scenarios for different time horizons, which involves huge costs. It is not clear on the type of the scenario to be used for a particular time horizon.

3. Identifying the risk factors is a complex decision. When portfolios are complex, it becomes extremely difficult to identify the risk factors that have to be considered for stress testing and even if they are identified, the magnitude of these risks have to be assessed which in all settles down to the perceptions of the person and the institution carrying out these stress tests.

4. The potential number of combinations of the basic stress tests shocks can become overwhelming if more than a few risk factors are used. Stress testing uses scenario analysis to generate worst-case losses during extreme market conditions but the probability of occurrence of these extreme events is not specified.

5. Stress testing using scenario analysis does not account for correlations adequately.

Chapter – 7

Event Time Lines and Scenario Development

This part of the investigation is concerned with the development of an event timeline that can be used for charaterizing whether a period should be considered normal or extreme market condition conditions or regime. In this chapter, various events which have occurred over a period of time and its description are listed in a chronological order. Later, various event categories and the description of these event categories which have been used in identifying the type of events are presented. Finally, the application of these developed time lines in developing our scenarios and using them to identify and model the center and tail regions of the distribution are discussed.

An event is an occurrence or realization of some entity or the result of some action. Events evolve over a particular subject or action and every event can be classified into different categories depending on the nature of the event. They are normal events, extreme events, trigger events, reinforcing events and systematic events.

Event timelines are a tabular chronological summary of events which are of interest over a given time interval. They specify the event, its cause and effects, the time of the event, and other relevant information. Event timelines do not have any specified format and solely depends on the person framing it. Event timelines provide a "*helicopter*" view of a set of events over a given interval. These timelines are used for scenario analysis to measure the effects of a certain kind of event. They serve as a baseline for measuring extreme market movements before the event and post event scenario.

The breakdown of the timeline into regimes is based on certain macro and micro events that have occurred over time. Macro events are considered to be events that affects a given national market or region of the global market place, such as 1995 Mexican Crisis and the 1997 Southeast Asian Crisis. Micro events are considered events that mainly affected firms or were propagated by a financial disaster at a tone of few firms. Examples of micro events are the collapse of Barings Bank, or the Long-Term Capital Management's near bankruptcy.

The list of the turbulent market regimes which have been identified on the event time lines are listed below with the period of the regions identified.

Table FC.2 Turbulent Market Regime Categories from the Event Time Lines	
Identified Regimes	**Approximate Time Period.**
Energy Crisis	1973-74
LDC Debt Crisis	1982-1985
US Savings and Loan Industry Crises	1980 -1986
African Crisis	1987-1989
US High Yield Crisis	July 1990 – December 1990
Global Stock Market Crash	1987- 1989
Iraq Invasion of Kuwait	August 1990- December 1991
ERM Crisis	1992-1994
US Interest Rate Crisis	February 1994- December 1994
Mexican Peso Crisis	Late 1994 – 1995
Southeast Asian Crisis	July 1997 – March 1998
Russian Debt Crisis	July 1998- late 1998
LTCM Crisis	September 1998- November 1998
Brazilian Currency Crisis	January 1999 – April 1999
NASDAQ Bubble	May 1999- 2000
NASDAQ Market Correction	Feb 2000 - 2001
September 11th Terrorist Attacks	September 2001- December 2001

Events in the timelines are identified based on the type of risk associated with the event. The list of event categories used in the timelines to describe the type of event and the definitions of the event types are listed in the table below.

Table EC.1 - Events Categories and their Descriptions	
Event Category	**Description**
SR – Systemic Risk	Systemic risk is the risk of damage being done to the health of the financial system as whole and not just specific participants. Systemic risk conveys a breakdown and it can

Event Category	**Description**
	be featured by initiation, where firms start to go bankrupt, and *domino effects* or *contagion.*
SE1 – Specific Systemic Events	Specific systemic events are financial crisis events which are large in magnitude and restricted to a particular region or an industry. They are unique events and the spillover is limited to the region of occurrence. Some of the specific Systemic events include Asian Crisis, Breakdown of the European Monetary system, The 1987 Stock markets crash to mention a few.
SE2 – General Systemic Events	General systemic events are generalized events which are not characterized by the region of occurrence.
Financial Markets Recovery	When markets regain and become stronger after a slump period
Global Markets Spillover	When an adverse event in one country has affected the financial markets in another country like the Asian crisis affected the global financial markets
SVR - Sovereign Risk	Sovereign risk is the risk which arises from legal, political settlement and other risks which are associated with the cross-border transactions into a specific country.
SVE - Sovereign Event	Sovereign events are events which have evolved from government agencies defaulting on payments or changes in political, legal, and economic policies of a country.
Budgetary Reforms	Budgetary reforms components like corporation tax, levied on equity and dividends, budget expenditures, other revenues, are altered to increase investor confidence, spending cuts and to build favorable conditions.
Political Crisis	Political crisis relates to political changes in the country affecting the financial markets and regular functioning of the economy, like changes in government policies, new government, new ministers, resignations and other issues beyond macro issues
Policy Reforms	Policy reforms are announcements of changes in policies relating to trading, new measures implemented, liberalizing regulations, or any modifications in current policies
Policy Responses	Responses by financial institution for changes in policies, like changes in risk assessment measures by regulators
FR - Financial Markets Risk	Financial markets risk is market risk which is inherent to the functioning economy with clear relationships between the magnitude of market movements and their likelihood. Extreme market risk is the result of profound structural economic or political changes.
FE - Financial Market Event	Financial events are events which are caused by price changes or changes in market reactions
Financial Markets Crash	When financial stock markets crash due to some unexpected events or announcements

Event Category	**Description**
Banking Crisis	When there are significant non-performing loans, defaults by banks, moratorium on loans, shutting down or liquidation of major banks and government intervention to rescue them.
Debt Defaults	Default on payments by a sovereign nation or an organization
Debt Restructuring	Debt repayment schedule including the terms and/or payments periods are restructured and/or renegotiated.
Derivatives Trading	When there are changes in derivative trading volumes, developments in trading, or information about derivatives contracts made by organizations are furnished.
Debt Issue	When either debut issues to tap markets or new issues are made to raise capital.
Financial Restructuring	When issues relating to mergers, acquisitions, spin-offs, capital compositions are changed or modified, new financial systems are undertaken, complete restructuring of the finance wing is undertaken.
Financial Reform	When reforms plans are announced relating to capital requirements, assessment methods, managing crises or any other financial changes for better supervision and coordination.
Credit Spread Problems	These events relates to changes in credit spreads triggering panics in financial markets
Bankruptcy	Bankruptcy is a closure event when the organization has excessive debts and its purpose is to ease the debt burden by arranging the liquidation of assets and distributing the sale proceeds amongst the organization creditors accordingly.
CR – Currency Risk	Reform or announcement significantly affecting the FOREX markets, but does not induce adverse shock waves throughout the market.
CE - Currency Event	A currency event occurs when there is a shift from fixed to floating, central bank intervention to rescue the currency, devaluation of the currency, imposing currency controls, or announcements which make the FOREX markets unfavorable are termed as currency events.
Currency Crisis	Currency is attacked by speculators leading to an extreme decline in the FOREX rate and causes the currency's bands to be widened or abandoned. The extreme decline in one currency can lead to contagion or spillover effects that cause other currencies to realize significant declines in value.
ER - Economic Risk	Economic risk is the risk which arises from sudden changes in socio-economic indicators which affects the financial system.
EE - Economic Event	Economic event are events due to changes in economic indicators that causes concern but does not adversely affect the functioning of the economy which include:

Event Category	Description
	1) Small declines in GDP, 2) Unemployment rates increases and 3) Market growth and progress is stagnated amid global crisis.
Economic Crisis	Similar to a financial crisis but occurs when economic indicators like inflation, unemployment, and real wages are adversely affected.
Financial Credit Line	Financial aid package to nation facing financial or economic crisis from other nations or international financial institutions such as the IMF or the World Bank.
CMR – Commodity Risk	Commodity risk is the risk inherited to changes in commodity prices, due to supply and demand of the commodity in the international markets. Commodity price volatility affects state budgets and company cash flows, making future less predictable. Commodity price changes causes losses by exposing hedged positions. Commodities include agricultural products, metals, petroleum, and financial instruments to name a few.
CME - Commodity Events	Commodity Events are events which occur due to sudden price changes in traded commodities causing concerns in international markets.
Gold Price Crisis	Relates to increase or decrease in gold price due to announcements made by central banks or other major market dealers
Oil price Crisis	Relates to sudden increase or decrease in oil prices in international markets due to reduction/increment in oil supplies. Oil prices crisis causes huge losses by exposing hedged positions.
DR – Debt/Default Risk	Default risk is the risk that a company or an individual will be unable to pay the contractual interest or principal on its debt obligations
DE – Debt/Default Event	Default events are events which a country or a company is not able to service its debt obligations and defaults on its debt causing huge losses to counterparties
IR - Interest Rate Risk	Interest rate risk is the risk which arises from interest rate changes by the Central Bank to control the functioning of the economy.
IE - Interest Rate Event	Periodic interest rate announcements which do not trigger any significant changes but causes concern and adjusts the financial sector from going to a crisis situation
Interest Rate Crisis	Relates to crisis triggered by sudden unanticipated change in interest rates by banks, leading to changes in spreads and capital flows and huge losses on unfavorable positions.
LR - Liquidity Risk	Liquidity risk is the major risk during financial crisis. It refers to the losses arising from the markets becoming

Event Category	Description
	illiquid and disappears several financial transactions and causes difficulty for a market participant to close a position.
LE - Liquidity Event	Liquidity events are loss events due to the inability of a business entity to meet their payments because of the presence of extreme illiquidity or when liquid assets in portfolios are not sufficient to meet the short-term liabilities.
Liquidity Crisis	Markets become illiquid leading to organizational bankruptcy's triggering a crisis such as the LCTM hedge fund disaster.
Financial Distress	Stock markets, currency markets and other markets weaken and become illiquid, which leads to a gradual lose of investor confidence.
OR - Operational Risk	Operational risk is the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events.
OE - Operational Events	Relates to events triggered by inefficient supervision at the firm level, changes in trading systems or other factors relating to regular functioning of a system, like non-performing bank loans due to inefficient supervision.
Fraudulent Losses	Events relating to losses incurred due to rogue trading, malpractices and fines imposed for false announcements or recordings.
Operational Risk Event	Announcements relating to change in a nation's financial operations or internal operational changes at a firm level for better performance not effectively an event to trigger a crisis.
Technological Developments	Relates to announcements about new technological upgrades like setting up electronic trading, electronic clearing houses etc.
Trading Developments	Relates to changes in trading systems, setting up new consortiums, clearing houses, new trading instruments, going into offshore markets, launching new products, combining markets, imposing sanctions on trading, regulating transactions on the exchanges and all other changes to financial markets trading.
MR – Model Risk	Model risk is a firm-wide risk. It is the risk exposure that arises from incorrect specification of mathematical models in the pricing/valuing or hedging of financial instruments.
ME - Model Risk Event	Model risk events are loss events which arise from either of the following 1. Use of improper mathematical assumptions about pricing. 2. An incorrect or inappropriate choice of model's structure and dynamics relative to the market risk 3. The use of incorrect inputs to a model 4. Incorrectly calibrating a model or using a model in a wrong context.

Event Category	Description
LER – Legal Risk	Legal risks can be understood to the risk of confiscation of property, the controlling law of agreements, damages from law suits and foreign law suits that is the proper legal forum to interpret agreements and currency controls.
LEE- Legal Event	Legal Events occur when losses are incurred in the form of law suit damages or any other risk events which arise from breach of agreements.
AR – Accounting Risk	Accounting risk is the risk exposure which arises from accounting malpractices, translating accounting information into one common currency, false disclosure of accounts or presenting information contrary to standard practices.
AE – Accounting Event	Accounting risk events occur when there is potential for loss or for stimulation of pathological management actions resulting from inappropriate presentation given by accounting or financial reporting.
Accounting Fraud	Accounting fraud is the loss which is incurred due to false disclosure of accounting information or false portrayal, transactions in hidden assets or any form of accounting malpractices which include capitalizing ordinary expenses, unaccepted transfer pricing, and hidden debts to state a few.
Accounting Translation Loss	It is a currency exchange rate risk which affects the valuation of balance sheet assets and liabilities between financial reporting dates or reporting them in one common currency. It is the losses which arise from valuating a company assets in a foreign currency
Accounting Provision loss	These are losses that are incurred by providing provisions for various expenses. These include depreciation, bad debts, doubtful debts, replacements to mention a few. These are losses only in the books as provision is not an actual expense for itself; it is merely allocating funds for safety purposes.

The turbulent regimes identified in Table FC.2 are illustrated graphically in the time line graphs which are attached in appendix. These time line graphs plot the events on a time scale and the x-axis which denotes the time scale in the graphs are not uniform and have been adjusted to illustrate maximum information.

7.1 Approaches for Scenario Development

The approach of developing the timelines consisted of searching printed materials and through internet for articles those discussed extreme events. The collection of events was then segmented into macro and micro event categories and they were finally ordered by country and then arranged chronologically in time. The events were then arranged by major macro or regional crisis and normal "*uneventful*" market regimes.

The objective of time lines is to decompose the regimes of normal and abnormal conditions. This information can be used in scenario simulation based modeling for capital adequacy determination frameworks.

Although it was not implemented in this investigation, the next step would be to decompose log-returns time series from different financial markets data into the various regions. Once decomposed, we would model the data from the different regions using either the center or tail region modeling procedures. The model data can be used in stress test or other risk assessment scenario analysis procedures. Two possible approaches for scenarios that can be developed by decomposing the event time lines are as follows:

1) The first approach is where the returns are aggregated, independent of the market regime. One decides where the tail starts and then models the tail and center regions of the returns distribution separately. The tail region represents abnormal markets conditions and the center represents normal markets conditions. Once the tail and center regions are modeled, one can simulate samples from of the returns using a compound Bernoulli approach where with probability p the sample comes from the center and with probability $(1-p)$ the sample comes from the tail.

2) The second approach is where the time line of returns is decomposed into normal and abnormal market conditions based on historical events, where the historical events come from the event timeline. Then the normal (abnormal) market regimes are aggregated and model using a center and tail approach as in the first approach

Chapter - 8

Empirical and Simulated Data Analyses

In this section the empirical and simulated analysis are discussed. The first section discusses the formation of the data bases and the two simulated time series. Intermediate data analysis section discusses the descriptive statistics, tail parameter estimation results, and the transitional probabilities for all the portfolios. The final section of this chapter analyses the risk measurements from the different regime switching models.

8.1 Preliminary Data Analysis

The data collection for the simulated regime switching models is discussed in this section. The time horizon for the stock price data analyzed in this study is from 1 March 1983 to 29 August 2003, resulting in a sample consisting of 5390 observations. This time horizon is referred to as 'the sample period' in this investigation. The price level time series for the equity shares that were used in the analysis were adjusted closing price data. The price level time series were collected from ten different countries where ten equities were selected from each country based on the largest market capitalization as of 29th August 2003. The initial dataset included the 15 largest stocks by market capitalization and ten stocks were chosen based on the largest available data range with priority given to the largest stocks. Also two simulated time series were included in the analysis as reference cases:

1) A ***Geometric Brownian motion,*** which is the standard model used in financial model for price series, since it is a multiplicative growth model that is lognormally distributed, implying that log-differences are normally distributed. The lognormal and normal distributions are considered the normal-tailed distributions in the context of the thin-tailed, normal-tailed and fat-tailed decomposition of distributions associated with the generalized extreme distributions. This model will be the

reference case where there is minimal probabilistic weight in the both tail regions. The results of the tail index estimation for this model should be examined with care, since the Hill tail index estimator is only suitable for fat-tailed distributions, and not the normal tails associated with the log-returns of the geometric Brownian motion.

2) A ***centered two-sided symmetric Fréchet random walk***, which is defined as the multiplicative product formed by the composition of Fréchet random variable and minus one times the same Fréchet random variable with respect to its parameters. The composition of these two random variables is through the use of a Bernoulli random variable where the likelihood of each these Fréchet-based random variables are equal. The sample mean of each of these Fréchet random variables are subtracted out in order to center the distribution statistically close to zero. The Fréchet distributions are considered the fat-tailed distributions in the context of the thin-tailed, normal-tailed and fat-tailed decomposition of distributions associated with the generalized extreme distributions. This model will be the reference case where there is extensive probabilistic weight in the both tail regions. The results of the tail index estimation for this model should be considered the best case scenario since the Hill tail index estimator is designed specifically for fat-tailed distributions.

The scale and tail index parameters of the Fréchet random variables that underlie the simulated symmetric two-sided Fréchet random walk were set to $\sigma = 0.0075$ and $\alpha = 1/\lambda = 3$, respectively. These parameters correspond to the following population estimates for the mean, variance and standard deviation; 0.010156, 4.755E-05, and 0.006896, respectively. The generated symmetric two-sided Fréchet random walk is an exponential product of samples from the Fréchet distribution, each multiplied by Bernoulli random variables that are either equal to plus or minus one with equal probability. The underlying normal parameters of the discrete-time continuous-space geometric Brownian motion or lognormal random walk were set as follows: the mean was set to zero and the variance was set to the population estimate of the variance which was 4.755E-05. This parameter setting guarantees that the mean and variance properties of the geometric Brownian motion and the Fréchet random walk were similar with the

Fréchet random walk having fatter tails, as the geometric Brownian motion is generated as the exponentiated product of samples from the normal distribution.

In the discussion of the simulation models, the initial value of the positions is set to set to 100. The analysis is designed such that ten different portfolios were formed and analyzed from each country. The portfolios were formed by adding stock into the current portfolio as a function of market capitalization starting from the top market capitalization and thereon. The initial amount in each position for a given portfolio is 1,000,000 expressed in domestic currencies, divided by the number of positions, i.e. initial equal wealth in all positions in a given portfolio. The position weights in each portfolio are presented in Table A.1. The stock price time series are defined in terms of their local currency. All time series were obtained from 'DataStream' service. Table C.1 contains a set of two-letter codes used to indicate the two simulated time series and each of the ten countries and appendix.1 lists the names of the ten stocks for each of the ten countries included in the datasets. It also contains the codes for the stocks that were defined for use in this study and also the corresponding DataStream codes of the stocks. .

Table CC.1 - Two-Letter Codes used in the Analysis

Code	Description
GBM	Simulated Discrete-time Continuous-time Approximation of the Geometric Brownian Motion
FRW	Simulated Symmetric Two-sided Fréchet Random Walk
AU	Australia
CA	Canada
DE	Germany
HK	Hong Kong
JP	Japan
SG	Singapore
SE	Sweden
CH	Switzerland
UK	United Kingdom
US	United States of America

Figures GBM.1, FRW.1, AU.1, CA.1, DE.1, HK.1, JP.1, SG.1, SE.1, CH.1, UK.1 and US.1 are the time series plots of position price series for the two simulated base cases and for all ten positions from each of the ten countries, which include Australia, Canada, Germany, Hong Kong, Japan, Singapore, Switzerland, Sweden, United Kingdom and United States respectively. Note that the axis scales of the graphs are not the same across all the countries since they have been adjusted to illustrate maximum information. The simulated graphs look similar with the Fréchet random walk exhibiting a wider range of values (due to its fatter tails). Most of the countries exhibit the NASDAQ bubble, with Asian countries such as Hong Kong and Singapore exhibiting a decline over the period of the South East Asian crisis.

Figures GBM.2, FRW.2, AU.2, CA.2, DE.2, HK.2, JP.2, SG.2, SE.2, CH.2, UK.2 and US.2 are the time series plots of the price levels for the two simulated cases and the ten country portfolios (with ten positions), which give information on the total portfolio value over the entire sample period. Note that the axis scales of the graphs are not the same across all the countries since they have been adjusted to illustrate maximum information. The simulated graphs look similar with both exhibiting similar upward trends, which is to be expected from growth models. The price-level time series plots for all the countries exhibit the NASDAQ bubble and a rapid decline over the period of the South East Asian crisis. The Asian countries such as Hong Kong and Singapore exhibit a more drastic decline over the period of the South East Asian crisis than the other countries from Europe and North America.

Figures GBM.3, FRW.3, AU.3, CA.3, DE.3, HK.3, JP.3, SG.3, SE.3, CH.3, UK.3 and US.3 are the time series plots of the log-return series for the two simulated cases and the ten country portfolios (with ten positions). The time series plot of the simulated log-return series for the geometric Brownian motion did not exhibit too many significantly extreme returns, i.e. returns greater than three standard deviations, whereas the simulated log-return series for the Fréchet random walk did not exhibit frequent significantly extreme returns. The log-return time series plots for all the countries exhibit numerous large log-returns, especially around the NASDAQ bubble, the South East Asian crisis, and the 1987 global markets crash, which did not show up in the other time series plots due to much larger price level magnitudes exhibited in the markets in the late 1990s.

Figures GBM.4, FRW.4, AU.4, CA.4, DE.4, HK.4, JP.4, SG.4, SE.4, CH.4, UK.4 and US.4 are histograms of the log-return series for the two simulated cases and the ten country portfolios (with ten positions). The log-returns histograms of the simulated geometric Brownian motion look normal, whereas the log-return series for the simulated Fréchet random walk exhibited fat tails, especially the left tail. The log-returns histograms for all the countries were significantly peaked, which is an indication of significant probalistic weight in the tails.

8.2 Intermediate Data Analysis

The estimation of the log-returns for the one-region risk measurements was based on the actual sample of 5390 observations for each of the portfolios, from one position up to, and including 10 positions. These risk measurement estimates for each of the three regime-switching models are averages over 25 simulated sample paths of 1,000 observations, where the model parameter were estimate from the actual sample of 5390 observations for each of the portfolios.

An assumption is required concerning where the tail starts; in this investigation the center of the returns distribution will be assumed to be normally distributed contain 90 percent of the returns data and each tail contains 5 percent of the data. This implies that the center region will be modeled using the sample mean and sample variance, and the upper- and lower-tail regions will be modeled using approximation of Pareto distributions. The transitions generating the regime switches may be modeled using the following procedures, which are illustrated for the unconditional regime switching model: A simple trinomial approach where the probability of sampling from the left tail-region is p_L, the probability of sampling from the center region is p_C, and the probability of sampling from the right-tail region is p_R. This implies generating a pseudo-random $U(0,1)$ variate. The next log-return is from the left-tail region if the variate is between 0 and p_L; the next log-return is from the center region if the variate is between p_L and $p_L + p_c$; and the next log-return is from the right-tail region if the variate is between $p_L + p_c$ and 1.

The parameter estimation results for the simulated regime switching models are discussed in this section. Each table presents information on each country separately, and the first two tables (GBM.* and FRW.*) present information on the simulated Geometric Brownian Motion and the simulated symmetric two-sided Fréchet random walk respectively, and serve as the base cases in this study.

Table A.1 includes a description of the general structure of the ten different portfolios constructed in this investigation, and these are portfolios with one position, all the way up to ten total positions. The addition of the positions is from largest market capitalization to the tenth largest market capitalization. The table also contains the weight of each position in each portfolio defined as an increasing function of the number of positions, and the corresponding monetary amounts allocated to each position as a function of the number of positions. An initial wealth of 1,000,000 (in the local currency of each country) is allocated to each of the ten portfolios. Table A.2 lists the sample tail location parameters used in the tail index estimation procedures, which are defined as a functions of the percentage of observations in the each of the upper and lower tails. Three different sets of upper and lower tails were investigated: 1%, 2.5% and 5% upper and lower tails.

The table also presents information on the total number of observations used in the study since some observation were excluded from the extreme ends of each tail sections as a function of the percent size of the tail, the total number of observations in each tail and the number of extreme tail observations excluded from the total tail observations. The table also provides information on the number of the starting and ending observations for the left and right tails. The information is provided for all the three tail sizes for which the tail index parameters were estimated. In this investigation, 5 percent upper and lower tails were used in the simulation analysis. Table A.3 presents the information on the unconditional probabilities (used in the regime switching simulations) for the three dedicated regions, namely the center region, the left tail and the right tail, using 5 % upper and lower tails identified based on the observation sample size used in the analysis.

Tables GBM.1 and FRW.1 contain the descriptive statistics for the ten simulated time series for the individual positions of the geometric Brownian motion, and the simulated symmetric two-sided Fréchet random walk, respectively. They also contain the results for the log-returns, changes, and values of the simulated portfolios. These two simulated models are considered as the reference cases in this study. The results for the geometric Brownian motion are as expected, with little weight in the tails as indicated by the near-zero kurtosis estimates. The results for the Fréchet random walk exhibit a larger range than the geometric Brownian motion and significant weight in the tails as indicated by the non-zero kurtosis estimates ranging between 10 and 300. Tables AU.1, CA.1, DE.1, HK.1, JP.1, SG.1, SE.1, CH.1, UK.1 and US.1 are the descriptive statistics ten simulated time series for the individual positions of Australia, Canada, Germany, Hong Kong, Japan, Singapore, Switzerland, Sweden, United States and United Kingdom, respectively. For all countries, all the positions and portfolios exhibit significant kurtosis, which is a sign that the region-switching models that explicitly focus on the modeling of the tails may be useful. The descriptive statistics are estimated over the entire sample period for all twelve sets of ten positions.

Tables GBM.2, FRW.2, AU.2, CA.2, DE.2, HK.2, JP.2, SG.2, SE.2, CH.2, UK.2 and US.2 contains the sample estimates for the transitional probabilities associated with the three-state Markovian transition matrices for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The above mentioned sets of probability transition matrices present the information on the one-step conditional probabilities of going from one region to another. Since the pseudo random samples were generated independently, the conditional transitional probabilities of simulated time series should be equal to the unconditional transitional probabilities of 5% for both tails, and 90% for the center region. Qualitatively, the 20 simulated portfolios exhibited these values. The results for the country portfolios indicate that the when the current sample is in the left/right tail there is usually a greater likelihood to stay in the left/right tail respectively. When in the center there is a greater likelihood of transferring to the left tail than to the right tail. There does not seem to be a diversification effect on the transitional probabilities.

Tables GBM.3, FRW.3, AU.3, CA.3, DE.3, HK.3, JP.3, SG.3, SE.3, CH.3, UK.3 and US.3 contain the sample estimates of the transitional probabilities for the three-state two-transitions Markovian transition matrices for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The time duration that the log-returns generating mechanisms stays in a given region is geometrically distributed. This implies that the duration of the log-returns generated from a given region, once in that region has a geometric distribution. When the duration for generating the log-returns from a given region has elapsed, the transition is restricted to the two other regions. Table entries marked as *'NP'* indicates that the transition is not possible for that model. These transition probabilities are required for defining the transition in the geometric time-a-region regime switching model after the generated returns series has realized its geometrically distributed time in the current region.

Since the pseudo random samples were generated independently, the conditional transitional probabilities of simulated time series given the current sample is in a tail should be equal to the 5.263% to the other tail and 94.737% to the center region, and given the current sample is in the center region should be equal to the 50% to each of the two tails. Qualitatively, the 20 simulated portfolios exhibited these values. When in the center, there is usually a greater likelihood of transferring to the left tail than to the right tail. There does not seem to be a diversification effect on the transitional probabilities.

Tables GBM.4, FRW.4, AU.4, CA.4, DE.4, HK.4, JP.4, SG.4, SE.4, CH.4, UK.4 and US.4 contain the estimated parameters for right and left tails of the three different tail sizes, and the estimated parameters of the normally distributed center regions where the observations from both tails were excluded. The estimated parameters for right and left tails consisted of the sample mean, the sample standard deviation, the sample right tail starting points, and the sample left tail starting points for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. Using the estimates of the mean and standard deviation as a starting point, normally distributed left and right tail starting points were determined, and were referred to as the normal left tail and normal right tail, respectively. The sample right and the sample left tail starting points were used along with an assumed mean of zero to back out the standard deviation of a normally distributed center region where all observations less than the 5-th percentile and greater than the 95-th percentile were excluded. The parameters were used in the generation of the simulated normally-distributed center regions used in the regime switching models. With respect to the different tail index estimators, there seems to be a diversification effect on the transitional probabilities, since the standard deviation decreases as the number of positions increases. Also the standard deviation increases as the tail starting point is chosen further to the maximum or minimum. Moreover, the starting points of the sample left and right tails are greater than the tail starting points that would occur if the distribution was normal, indicating the presence of wider and possibly fatter tails with the model results. The backed-out standard deviations for the normal distribution using the sample tail starting points were larger than if the data was assumed to be normally distributed.

Tables GBM.5, FRW.5, AU.5, CA.5, DE.5, HK.5, JP.5, SG.5, SE.5, CH.5, UK.5 and US.5 contain the estimated parameters for the three-different sized left-tail (or downside) regions, which are modeled to (approximately) exhibit a Fréchet distribution. Tables GBM.6, FRW.6, AU.6, CA.6, DE.6, HK.6, JP.6, SG.6, SE.6, CH.6, UK.6 and US.6 contain the estimated parameters for the three-different sized right-tail (or upside) regions, which are also modeled to (approximately) exhibit a Fréchet distribution. Both sets of tables contain the results for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The sizes of the two set of the three tail regions are 5, 2.5 and 1 percent of the total distribution, respectively. The information presented in these tables includes the maximum likelihood estimator of sigma, which is the scale parameter for the Fréchet distribution and the sample estimates of alpha, which is the location parameter of the Fréchet distribution. Also the sample mean and standard deviation of the Fréchet distribution used to model the tail regions. It should be noted that larger the alpha estimates of the tail index, the fatter the tails. This is evident when comparing the geometric Brownian motion results with the results of the Fréchet random walk. Note that the tail index estimator for the normal distribution should be equal to infinity, which indicates the inability of the Hill estimator to properly model tails that are not fat. Although the Hill estimator was able to assign thinner tails to the geometric Brownian motion results and fatter tails to the Fréchet random walk results. Most of the tail index estimation results for the equities data indicated the presence of fat tails. In general, it is clear that as the tail size is decreased from 5 to 2.5 and finally to 1 percent of the total distribution, the tail becomes thinner, as indicated by increasing tail index estimates as a function of a decreasing tail size. For the simulated data, as the number of positions in the portfolio is increased, the tail index estimates increase in magnitude, indicating thinner tails, where as (in general), the number of positions in the for real data portfolios is increased, the tail index estimates decrease in magnitude, indicating fatter tails. This indicates that the normal distribution assumption may not be valid, implying that the functions of the standard deviation may not be a reasonable risk measure.

8.3 Analysis of the Simulated Regime-Switching Models

In the final analysis, six risks measurement estimates using the historical method are calculated, including the Value-at–Risk (VaR) and expected shortfall (ES) forecasts at the 95%, 97.5% and 99% confidence levels for all three regime-switching models. These results are compared to the original one-region results of this six risk measurement forecasts. The historical *VaR* and historical *ES* methods will be used to assess the capabilities of the risk forecasts generated by the regime-switching models. Risk measurements will be estimated at the 1, 2.5 and 5 quantiles. There are four types of presentations used to illustrate the trends in the information contained in the tables. The first type is where the VaR and ES forecasts at the 95%, 97.5% and 99% confidence levels for a given set of ten portfolios are grouped by model. The second type is where the results of the VaR and ES forecasts for the original one-region model and the three regime-switching models for a given set of ten portfolios are grouped by confidence levels. The third and fourth types are defined as ratios of the risk measurement forecast are grouped by model types and confidence levels, respectively.

A few graphical representations of the simulated log-returns from the three regime switching models will be presented before the simulated risk measurement forecasts are discussed. All of the graphical representations consisted of 1,000 simulated log-returns. Figure FRW.5.1 illustrates the simulated log returns time series plot for the unconditional regime switching model of simulated two-sided symmetric Fréchet random walk. Figure FRW.5.2 illustrates the simulated log returns time series plot for the three-state Markovian regime switching model for simulated two-sided symmetric Fréchet random walk. Figure FRW.5.3 illustrates the simulated log returns time series plot for three-region geometrically distributed time-in-tails regime switching model of the simulated two sided symmetric Fréchet random walk. The log-returns time series plot for the unconditional regime switching model and the three-state Markovian regime switching model looked very similar. This may be attributed to the procedures used in generating the models and the similarity of their log-returns generating mechanisms. The geometrically distributed time-in-tails regime switching model looks different since once in a region, the observations are generating within that region for a random-sampled duration. This is not the case for the other two models where once in a region, there is always a chance that the next generated sample will be from a different region.

Only these three examples of the simulated time series for the regime switching models are presented due to the set up of the analysis, which used the same collections of pseudo-random variates in generating the regime switching models for each of the twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The result of this is that the time series for each of the regime switching models will graphically look the same except for the magnitude of the generated variates. The magnitudes were different, since the parameters of each of the three regions were estimated from real data. This use of the same collections of pseudo-random noise series was required in order for the analysis to be comparable across all twelve sets of ten portfolios.

Figures GBM.6, FRW.6, AU.6, CA.6, DE.6, HK.6, JP.6, SG.6, SE.6, CH.6, UK.6 and US.6 are the histograms for the simulated log-returns of the unconditional regime switching model for the ten position portfolios for each of the ten countries, respectively.

Figures GBM.7, FRW.7, AU.7, CA.7, DE.7, HK.7, JP.7, SG.7, SE.7, CH.7, UK.7 and US.7 are the histograms for the simulated log-returns of the Markovian regime switching model the ten position portfolios for each of the ten countries, respectively. Histograms for the simulated log-returns of geometric time-in-tail model are presented in Figures GBM.8, FRW.8, AU.8, CA.8, DE.8, HK.8, JP.8, SG.8, SE.8, CH.8, UK.8 and US.8 for the ten position portfolios for each of the ten countries, respectively. All the histograms of the simulated log-returns exhibited similar features, peaked in the middle and fat-tails. However for a given data set, the histograms of the simulated log-returns for the unconditional regime switching model and the three-state Markovian regime switching model looked very similar. This may also be attributed to the procedures used in generating the models and the similarity of their log-returns generating mechanisms. Again the geometrically distributed time-in-tails regime switching model looks different since once in a region the observations are generating within that region for a random-sampled duration.

Tables GBM.7, FRW.7, AU.7, CA.7, DE.7, HK.7, JP.7, SG.7, SE.7, CH.7, UK.7 and US.7 contains the VaR and expected shortfall forecasts for the one-region log-returns distributional model, estimated using the historical method, at the 95%, 97.5% and 99% confidence levels for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. As mentioned earlier, the estimation of the values for the one-region risk measurements are based on the actual sample of 5390 observations for each of the portfolios. It has to be noted that the one-region results may be considered the reference case where the entire observed samples of 5390 observations were used in estimating the results presented in the tables. Tables GBM.7 and FRW.7 show that the log-returns of the geometric Brownian motion has larger negative VaR forecasts at 95% and 97.5 percent, whereas the VaR forecast at 99% and all expected shortfall forecasts the log-returns of the Fréchet random walk exhibit larger losses. This is expected since the log-returns of the geometric Brownian motion exhibits a wider center region and thinner tails when compared to those of the Fréchet random walk. The results also exhibit the risk reduction benefits of naïve diversification where the risk measurements for the ten position portfolios are reduced to approximately one-third of those for the single position portfolios. This reduction is for all three VaR forecasts and all three expected shortfall estimates for each of the simulated portfolios. These results are the reference results since they exhibit the characteristic properties for normal and fat tailed log-returns. The results for the country portfolios exhibit reasonable risk reduction. Further comments on the country portfolios are included after the results for the different regime switching models are introduced.

Tables GBM.8, FRW.8, AU.8, CA.8, DE.8, HK.8, JP.8, SG.8, SE.8, CH.8, UK.8 and US.8 contain the VaR and expected shortfall forecasts for the three regime-switching models, estimated using the historical method at the 95%, 97.5% and 99% confidence levels, for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. These tables provide a complete summary of the risk measurements for all the three regime switching models used; the unconditional LT-C-RT transfers, the three state Markov chain transfers, and the geometric time-in-tails transfers regime switching models. These risk measurement estimates for each of the three regime-switching models are averages over 25 simulated sample paths of 1,000 observations, where the model parameter were estimate from the actual sample of 5,390 observations for each of the portfolios. The simulated regime switching models exhibit considerable risk reduction.

In order to make some general statements about the results, various averages and ratios were taken of the risk measurement models over the ten portfolios. The average risk measurements over the 10 portfolios for each of the ten countries and the ten portfolios are presented in Table A.22 in order to analyze the result of each of the ten countries The results are summarized by the one region distribution function, unconditional left-tail-center-right tail transfers, 3 state Markov chain transfers and the geometric time in tails transfers models. Analyses indicate that the main features of these results are that the one-region results are quite different than the results for the three regime switching models, whose exhibit considerable similarity. Australia and Canada, which are considered old economies, exhibit the lowest risk levels for the one-region reference case. Countries including Hong Kong, Japan, Singapore and Sweden exhibited large values, possibly due to the major finaneial markets crisis that affected the countries over the sample period; although, the crisis occurred during different time periods. The modeled regime-switching results for countries like Australia were quite different that the one-region results. This may be attributable to the influence of market turbulence on the samples. The risk rankings for the countries are presented in Table A.22 for the regime switching models and the average risk measurements for 10 position portfolios are summarized in Table A.23 where the lower rankings represent lower risk. The Swedish and Hong Kong portfolios, on an average exhibited maximum risk. The Canadian portfolios exhibited the lowest average risk levels for both the one-region and regime-switching models.

Table A.24 contains the risk reduction ratios which were calculated in order to illustrate the effects of diversification on the tail index estimation. These results are summarized using risk ranking. Table A.22 also contains the country risk rankings with respect to the risk reduction and diversification effects. The Swedish portfolios, which were the riskiest on an average, also exhibited the greatest degree of risk reduction through diversification. The Hong Kong portfolios which exhibited highest risk on an average, also exhibited the least risk reduction of all portfolios.

Table A.25 contains the average ES/VaR ratio at different confidence levels, average over all the ten portfolios of a given country. Table A.22 also contains the country risk rankings with respect to the average ES/VaR ratio at different confidence levels. The Hong Kong portfolios exhibited the largest ratios, indicating that these portfolios had significant weight in the tail events, and that the explicit modeling of the tails was necessary. The Canadian portfolio exhibited the lowest ratios for the one-region model and the Japanese exhibited the lowest ratios for the three regime switching models. Hong Kong and Singapore exhibited the largest risk rankings for the ratios. The Hong Kong result is not surprising, but the Singapore result is since it exhibited the third greatest diversification ranking. The Singapore results may be due to the influence of the 1997 Southeast Asian crisis

The results in the Tables *.9 through *.14 are just rearrangement of the information in Table *.7 through *.8, except the tables are grouped by confidence levels and risk measurement models where the tables contain the results of the one-region and the three regime switching models. Tables GBM.9, FRW.9, AU.9, CA.9, DE.9, HK.9, JP.9, SG.9, SE.9, CH.9, UK.9 and US.9 contain for the 95% confidence level, the one-region distribution result and the average and standard deviation estimates for VaR forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. Tables GBM.10, FRW.10, AU.10, CA.10, DE.10, HK.10, JP.10, SG.10, SE.10, CH.10, UK.10 and US.10 contain for the 97.5% confidence level, the one-region distribution result and the average and standard deviation estimates for VaR forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. Tables GBM.11, FRW.11, AU.11, CA.11, DE.11, HK.11, JP.11, SG.11, SE.11, CH.11, UK.11 and US.11 contain for the 99% confidence level, the one-region distribution result and the average and standard deviation estimates for VaR forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The three sets of tables just discussed are rearrangements by confidence level of the VaR forecast information in Tables GBM.8, FRW.8, AU.8, CA.8, DE.8, HK.8, JP.8, SG.8, SE.8, CH.8, UK.8 and US.8.

Tables GBM.12, FRW.12, AU.12, CA.12, DE.12, HK.12, JP.12, SG.12, SE.12, CH.12, UK.12 and US.12 contain for the 95% confidence level, the one-region distribution result and the average and standard deviation estimates for ES forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. Tables GBM.13, FRW.13, AU.13, CA.13, DE.13, HK.13, JP.13, SG.13, SE.13, CH.13, UK.13 and US.13 contain for the 97.5% confidence level, the one-region distribution result and the average and standard deviation estimates for ES forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. Tables GBM.14, FRW.14, AU.14, CA.14, DE.14, HK.14, JP.14, SG.14, SE.14, CH.14, UK.14 and US.14 contain for the 99% confidence level, the one-region distribution result and the average and standard deviation estimates for ES forecasts for all three regime-switching models for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries. The three sets of tables just discussed are rearrangements by confidence level of the ES forecast information in Tables GBM.8, FRW.8, AU.8, CA.8, DE.8, HK.8, JP.8, SG.8, SE.8, CH.8, UK.8 and US.8.

The various possible ratios of the average risk measurements for VaR forecasts at the 95% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.15, FRW.15, AU.15, CA.15, DE.15, HK.15, JP.15, SG.15, SE.15, CH.15, UK.15 and US.15. The various possible ratios of the average risk measurements for VaR forecasts at the 97.5% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.16, FRW.16, AU.16, CA.16, DE.16, HK.16, JP.16, SG.16, SE.16 CH.16, UK.16 and US.16. The various possible ratios of the average risk measurements for VaR forecasts at the 99% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.17, FRW.17, AU.17, CA.17, DE.17, HK.17, JP.17, SG.17, SE.17, CH.17, UK.17 and US.17.

The various possible ratios of the average risk measurements for the ES forecasts at the 95% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.18, FRW.18, AU.18, CA.18, DE.18, HK.18, JP.18, SG.18, SE.18, CH.18, UK.18 and US.18. The various possible ratios of the average risk measurements for the ES forecasts at the 97.5% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.19, FRW.19, AU.19, CA.19, DE.19, HK.19, JP.19, SG.19, SE.19, CH.19, UK.19, and US.19. The various possible ratios of the average risk measurements for the ES forecasts at the 99% confidence levels from the regime switching models and the one region distribution function are presented for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries in Tables GBM.20, FRW.20, AU.20, CA.20, DE.20, HK.20, JP.20, SG.20, SE.20, CH.20, UK.20 and US.20.

Tables GBM.21, FRW.21, AU.21, CA.21, DE.21, HK.21, JP.21, SG.21, SE.21, CH.21, UK.21 and US.21 present a different summary of the information in the ratios of risk measurement models where the information on the ratios is grouped by model type, as opposed to confidence level. The set of ratios for all twelve sets of ten portfolios including the two simulated series and the empirical time series for the ten countries are compared within different models and with each model compared with one region distribution, across the six risk measurement estimates (VaR and ES).

These results in these sets of tables were fairly consistent across risk measurement forecasts, regime switching models and confidence levels.

Conclusions, Recommendations and Extensions

The time lines were designed to determine which time periods may be used for abnormal and normal market scenarios. Recall these time lines are based on macro and micro market events. The event time lines have allowed for various market regions to be identified (see Table FC.2 - Financial Crises and Period of Crises from Chapter 7). The time lines have allowed the identification of the different times when the markets were calm and when the markets were turbulent.

Most of the tail index estimation results for the equities data indicated the presence of fat tails. The results of the simulation of the three regime-switching models indicate that these models where the tail and center regions are modeled separately were able to incorporate the stylized fact of fat tails for the log-returns of equity shares. This indicates that these regime switching model should be studied further as candidate log-returns generating mechanisms in stress tests or other scenario simulation analyses. The results for the three regime-switching models were surprisingly similar with respect to VaR and expected shortfall forecasts. With respect to graphical illustrations, the unconditional and three-state Markov chain regime-switching models were very similar to the naked eye, with the geometric time in the tails exhibiting a distinct time series.

The way the sampling procedures were implemented guarantees that composition of the samples of the pseudo-random log-returns from all three regions (for all three models) are independently generated. The pseudo-random log-returns from each region were generated independently. Also the composition of the samples from the three regions was generated independently. In the unconditional regime switching model there is the absence of dependence between samples. Both the Markovian and geometric regime switching model exhibit one-step dependence in the sense that the independent transitions are dependent on what is the current region that the log-returns generating mechanism. Some preliminary studies (not included in the report) on the autocorrelation of the generated pseudo-random log-returns up to 20 lags, indicates the absence of autocorrelation between the observed simulated samples form the regime switching models.

The scenario modeling procedures developed in this investigation may be used to determine objective forecasts of risk capital requirements and risk limits levels. Position limits or risk limits are based on the amount of capital that can be supported at a given VaR levels. This leads to a limits on the losses based on the probability of losses. Extreme position limits may be calculated using the methods developed in this investigation.

An extension on these three regime models is to a five-regime switching model based on a bivariate distribution with normal center region and four different joint extreme tail sections. This could be used to model the co-movements of a portfolio relative to market index or an exchange rate. The co-movements could be normal co-movement from when the market is calm of various extreme co-movements when the markets are exhibiting turbulence. This model would include four tail regions and one center where the tail regions can be identified as the extreme value in four quadrants of a two dimensional XY plane. They can be given as (-X,-Y), (-X, Y), (X, Y) and (X,-Y), where X corresponds to the market index or an exchange rate and Y is the co-movement of the portfolio relative to the market index.

Another natural extension of the regime switching analysis would be to collect and separately model the log-returns data from the different times when the markets were calm and when the markets were turbulent. Once the data has been model the empirical fits to the data from different market regimes can be used in a stress testing framework to determine the effects of the market characteristics of given historical regime on a current portfolio. The value of this extension is that crises may occur over different time periods but in traditional risk measurement procedures such issues are not considered and all samples are mixed together and modeled as if the log-returns were generated from only one distribution or generating mechanism. Potentially, decomposing the regions from different markets into different calm and turbulent regimes, which are modeled separately, may overcome the limitations of the traditional approaches and improve the capabilities of stress tests.

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Appendix.1 – Codes for Positions included in Analysis with Datastream Codes

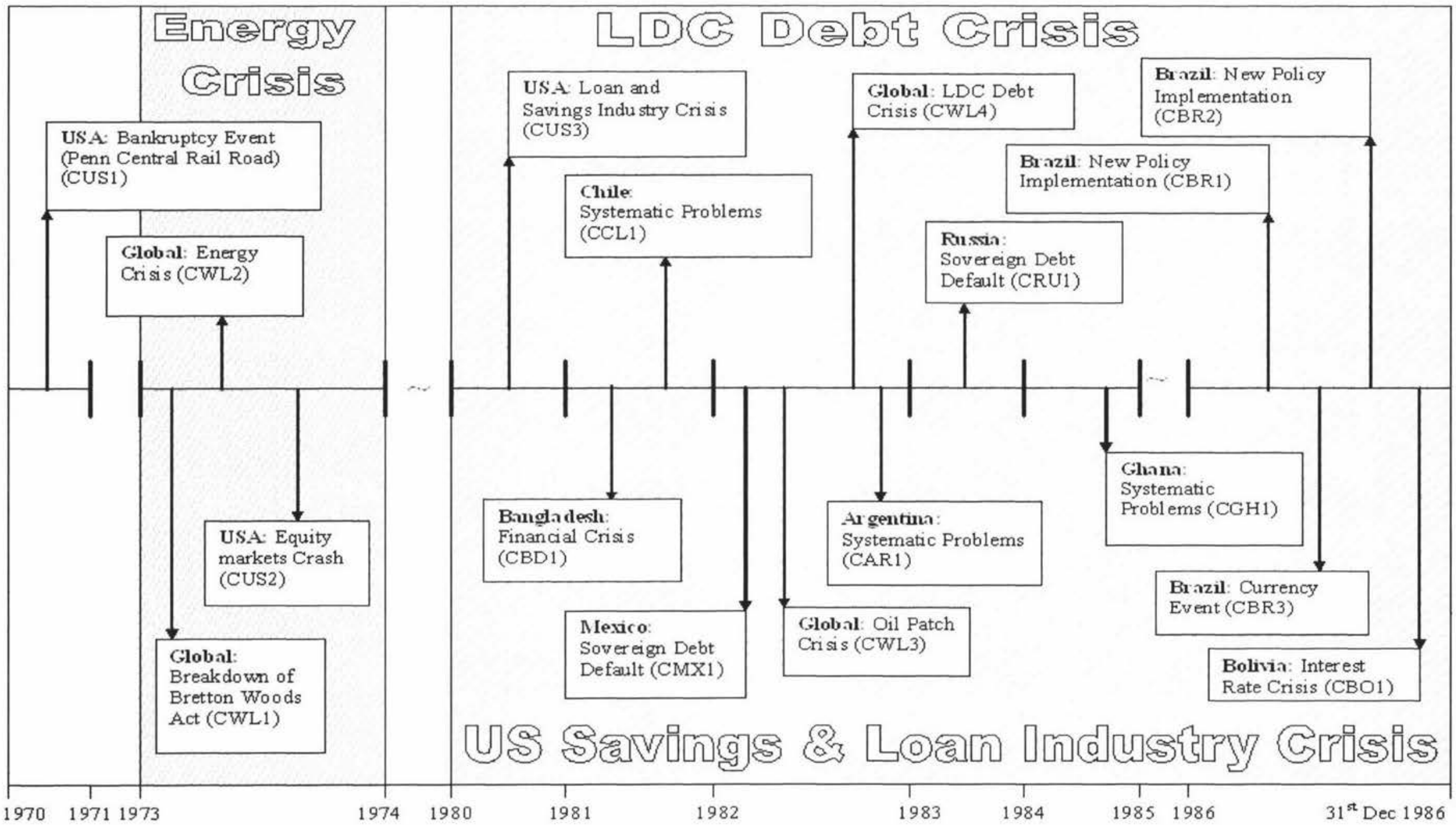
Table CC.2 – Codes for Positions included in Analysis with Datastream Code		
CODE	**COMPANY NAME**	**DATASTREAM CODE**
AUSTRALIA		
NABK	National Australian Bank	A:NABK(P)
BHPY	BHP Bhilliton	A:BHPY(P)
NECO	News Corporation	A:NECO(P)
WEBA	Westpac Banking	A:WEBA(P)
ANBG	Australia and NZ Banking Group	A:ANBG(P)
CRAM	Rio Tinto	A:CRAM(P)
COLE	Coles Myer	A:COLE(P)
FOST	Fosters Group	A:FOST(P)
WOOD	Woodside Petroleum	A:WOOD(P)
WELD	Westfield Holdings	A:WELD(P)
CANADA		
RBCN	Royal Bank Canada	C:RY(P)
BNSC	Bank of Nova Scotia	C:BNS(P)
BCE	BCE	C:BCE(P)
THOM	Thomson	C:TOC(P)
HCHP	Canadian Pac.	C:HCH(P)
ENCN	Encana	C:ECA(P)
IMPO	Imperial Oil	C:IMO(P)
LOBL	Loblaw	C:L(P)
NORT	Nortel Networks	C:NT(P)
ALCN	Alcan	C:AL(P)
GERMANY		
SIE	Siemens Corporation	D:SIE(P)
DBK	Deutsche Bank	D:DBK(P)
ALV	Allianz Group	D:ALV(P)
EOA	E ON	D:EOA(P)
BAS	BASF	D:BAS(P)
HOE	Hoechst	D:HOE(P)
BMW	BMW	D:BMW(P)
BAY	Bayer Group	D:BAY(P)
RWE	RWE	D:RWE(P)
VOW	Volkswagen	D:VOW(P)
HONG KONG		
HSBC	HSBC Holding	K:HSBC(P)
HUTI	Hutchison Whamp	K:HUTI(P)
HSBA	Hang Seng Bank	K:HSBA(P)
CHGK	Cheung Kong Holding	K:CHGK(P)
SHKP	Sun Hung Kai Properties	K:SHKP(P)
CLIG	CLP Holdings LTD	K:CLIG(P)

CODE	COMPANY NAME (Table Continued)	DATASTREAM CODE
HKEL	Hong Kong Electric	K:HKEL(P)
HKCG	Hong Kong & China Gas	K:HKCG(P)
HELD	Henderson Land Developers	K:HELD(P)
HKWH	Wharf Holdings	K:HKWH(P)
JAPAN		
TYMO	Toyota Motors	J:TYMO(P)
NSNM	Nissan Motors	J:NR@N(P)
CNON	Canon Corporation	J:CN@N(P)
HONM	Honda Motors	J:HO@N(P)
TAKC	Takeda Chemical Industries	J:TA@N(P)
SONC	Sony Corporation	J:SO@N(P)
MATE	Matsusita Electrical Industries	J:MI@N(P)
FUTC	Fujitsu Corporation	J:FT@N(P)
HITC	Hitachi Corporation	J:HC@N(P)
SRPC	Sharp Corporation	J:SH@N(P)
SINGAPORE		
UOBS	United Overseas Bank	T:UOBS(P)
DBSS	DBS Group	T:DBSS(P)
OCBC	Overseas Chinese Banking	T:OCBC(P)
GELA	Great Eastern Holding	T:GELA(P)
KEPP	Keppel Corporation	T:KEPP(P)
CITY	City Developments	T:CITY(P)
FRAS	Fraser & Neave	T:FRAS(P)
NOLS	Neptune Orient Lines	T:NOLS(P)
ASIA	Asia Pacific Brews.	T:ASIA(P)
NATS	Natsteel corporation	T:NATS(P)
SWITZERLAND		
NOVN	Novartis	S:NOVN(P)
NESN	Nestle	S:NESN(P)
UBSN	UBS	S:UBSN(P)
ROGH	Roche Holding	S:ROG(P)
CSGN	Credit Suisse	S:CSGN(P)
RUKN	Swiss Re	S:RUKN(P)
ZURN	Zurich Financial Systems	S:ZURN(P)
ADEN	Adecco	S:ADEN(P)
HOLN	Holcim	S:HOLN(P)
ABB	ABB Ltd	S:ABB(P)
SWEDEN		
ERSN	Ericsson	W:SL@G(P)
HMBF	Hennes & Mauritz	W:HMBF(P)
SVK	SHB	W:SVK(P)
VOBF	Volvo	W:VOBF(P)
ELUX	Electrolux	W:SE@G(P)

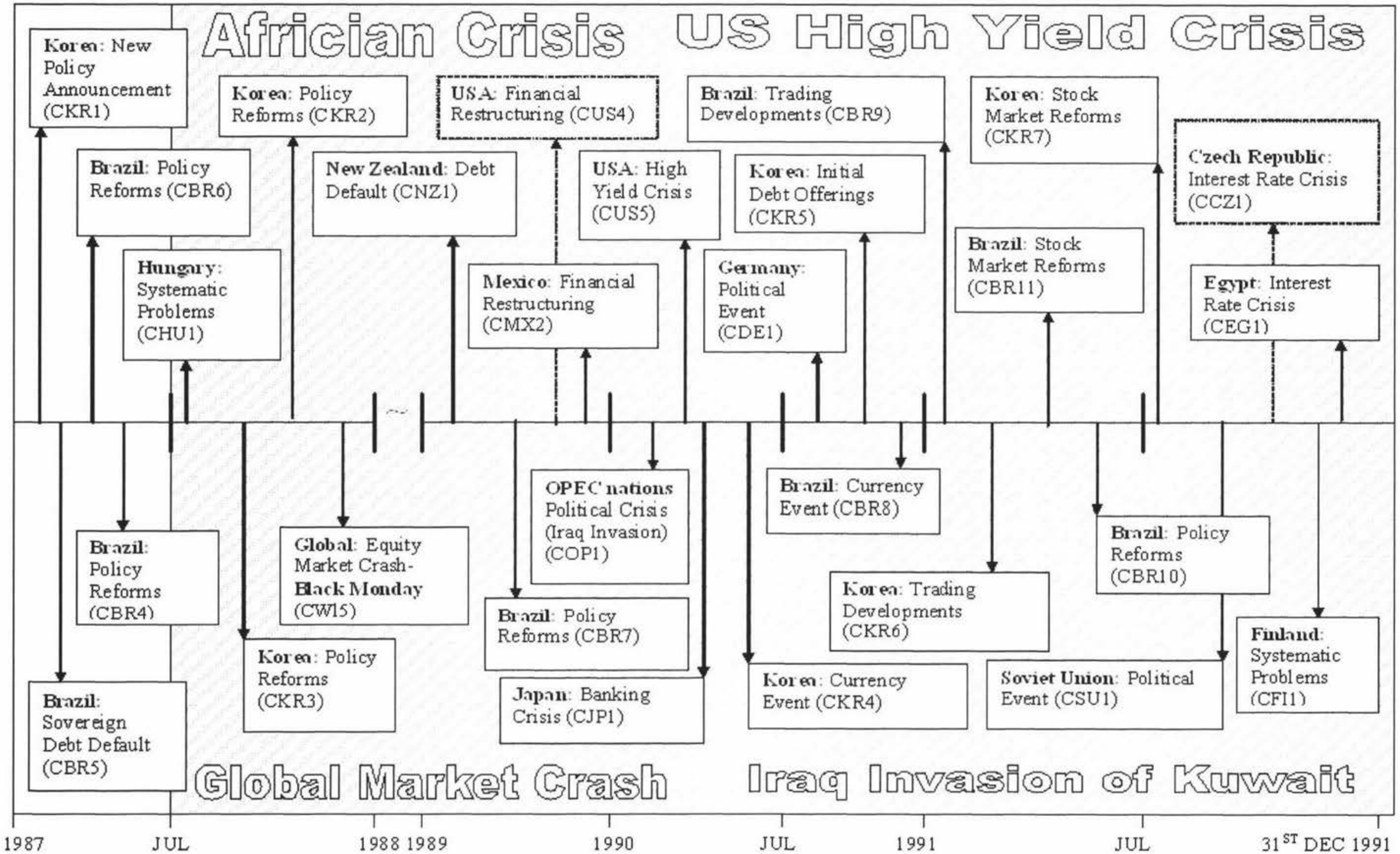
CODE	COMPANY NAME (Table Continued)	DATASTREAM CODE
SCA	SCA	W:SW@G(P)
SKDA	Skandia	W:SX@G(P)
SKFB	SKF	W:SKFB(P)
INDV	Industrivarden	W:IU(P)
ATCC	Atlas Copco	W:SR@G(P)
UNITED KINGDOM		
BPC	British Petroleum	BP.(P)
GSK	Glaxo smithkline	GSK(P)
SHEL	Shell Transport & Trading.	SHEL(P)
BARC	Barclays	BARC(P)
TSCO	Tesco	TSCO(P)
ULVR	Unilever (UK)	ULVR(P)
BATS	British American Tobacco	BATS(P)
RIO	Rio Tinto	RIO(P)
AVIV	Aviva	AV.(P)
STAN	Standard Chartered	STAN(P)
UNITED STATES		
GEC	General Electric Corporation	U:GE(P)
XON	Exxon Mobil	U:XOM(P)
PFE	Pfizer	U:PFE(P)
INTC	Intel Corporation	U:INTC(P)
AIG	American International Group	U:AIG(P)
MRK	Merck & Merck	U:MRK(P)
JHJ	Johnson & Johnson	U:JNJ(P)
HOD	Home Depot	U:HD(P)
COC	Coco Cola	U:KO(P)
BOA	Bank of America	U:BAC(P)

Appendix.2 – Macro Events Timeline Graphs for the Period Ranging from 1970 - 2002

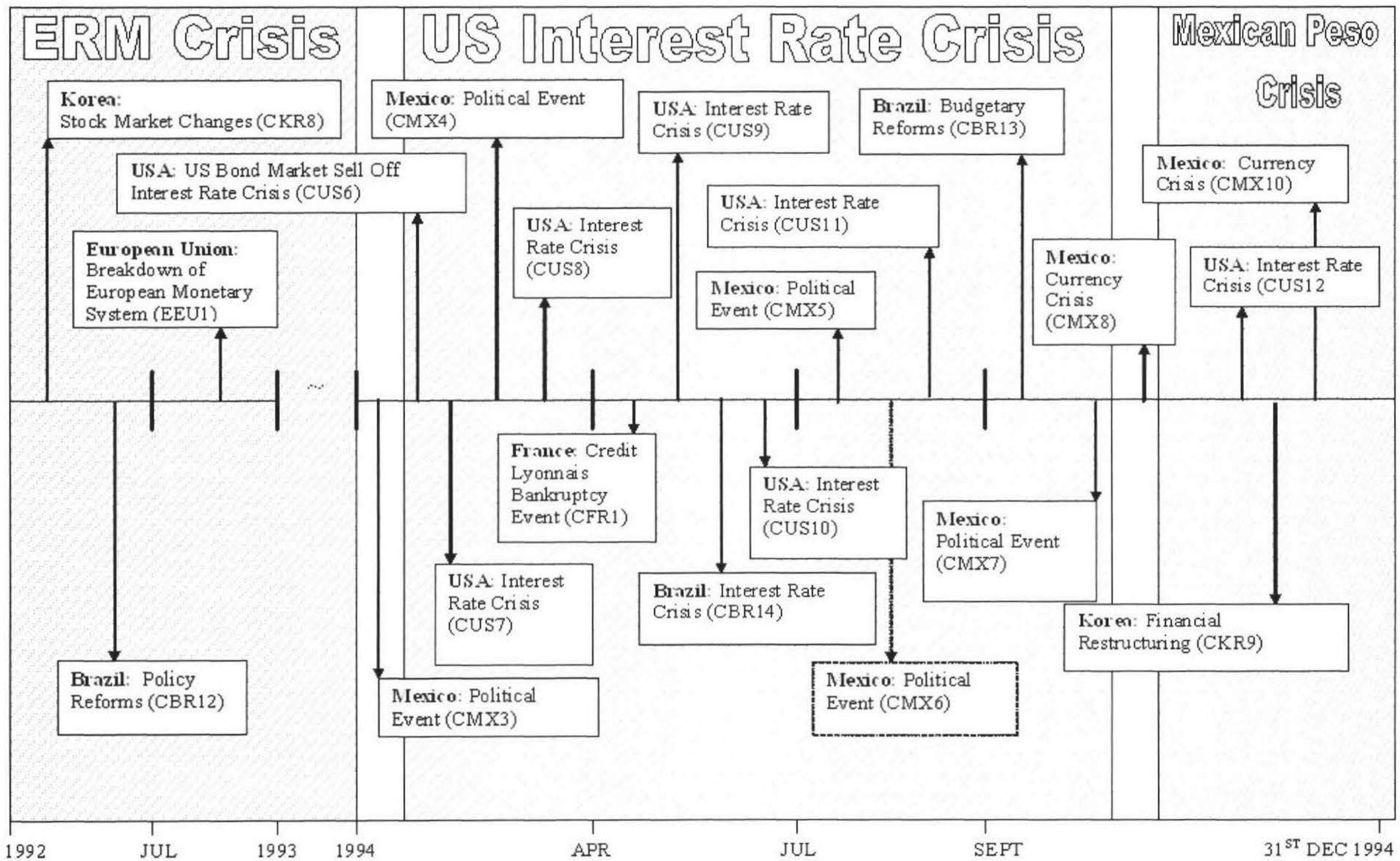
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM 1980 TO 1987



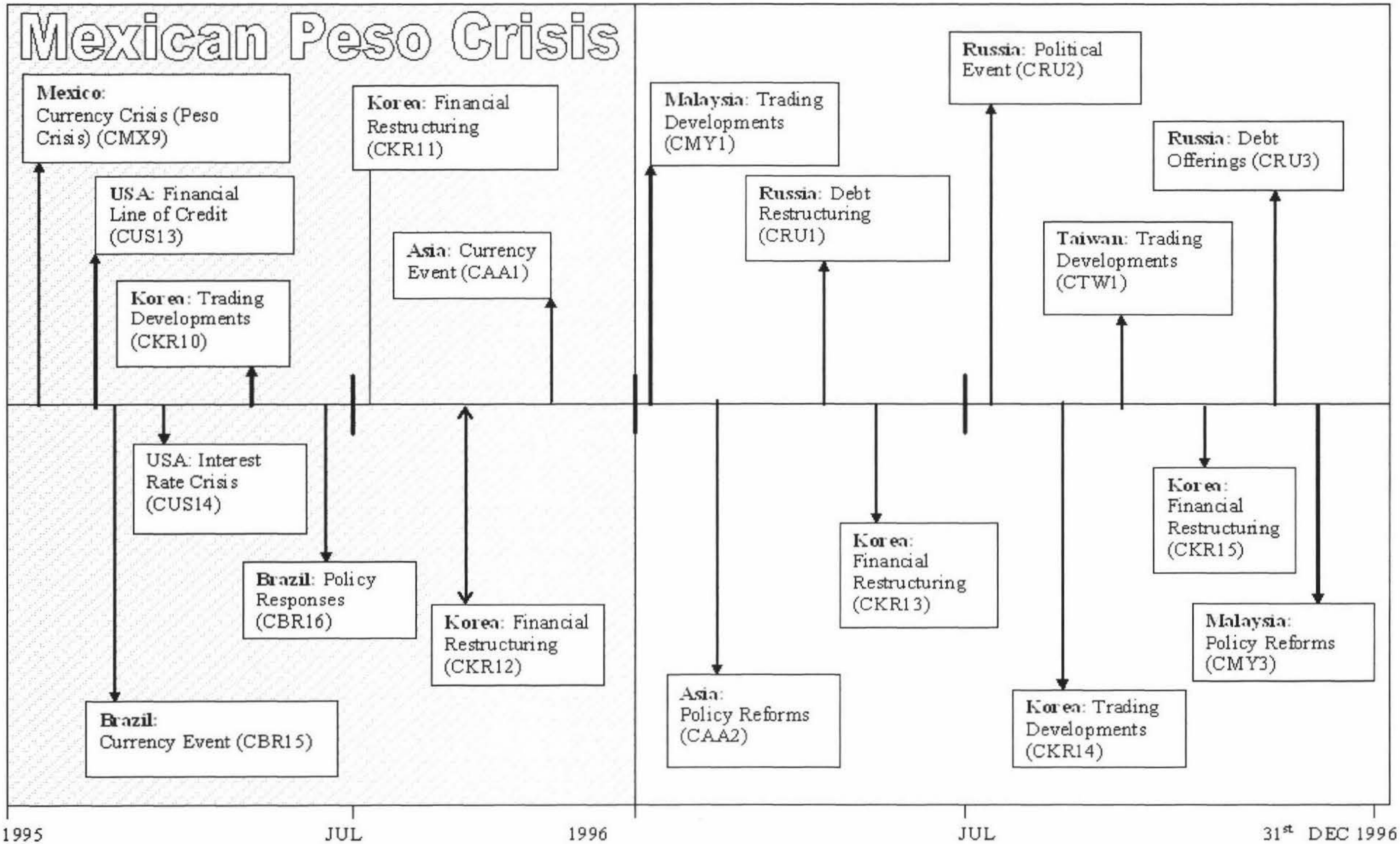
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM 1987-1991



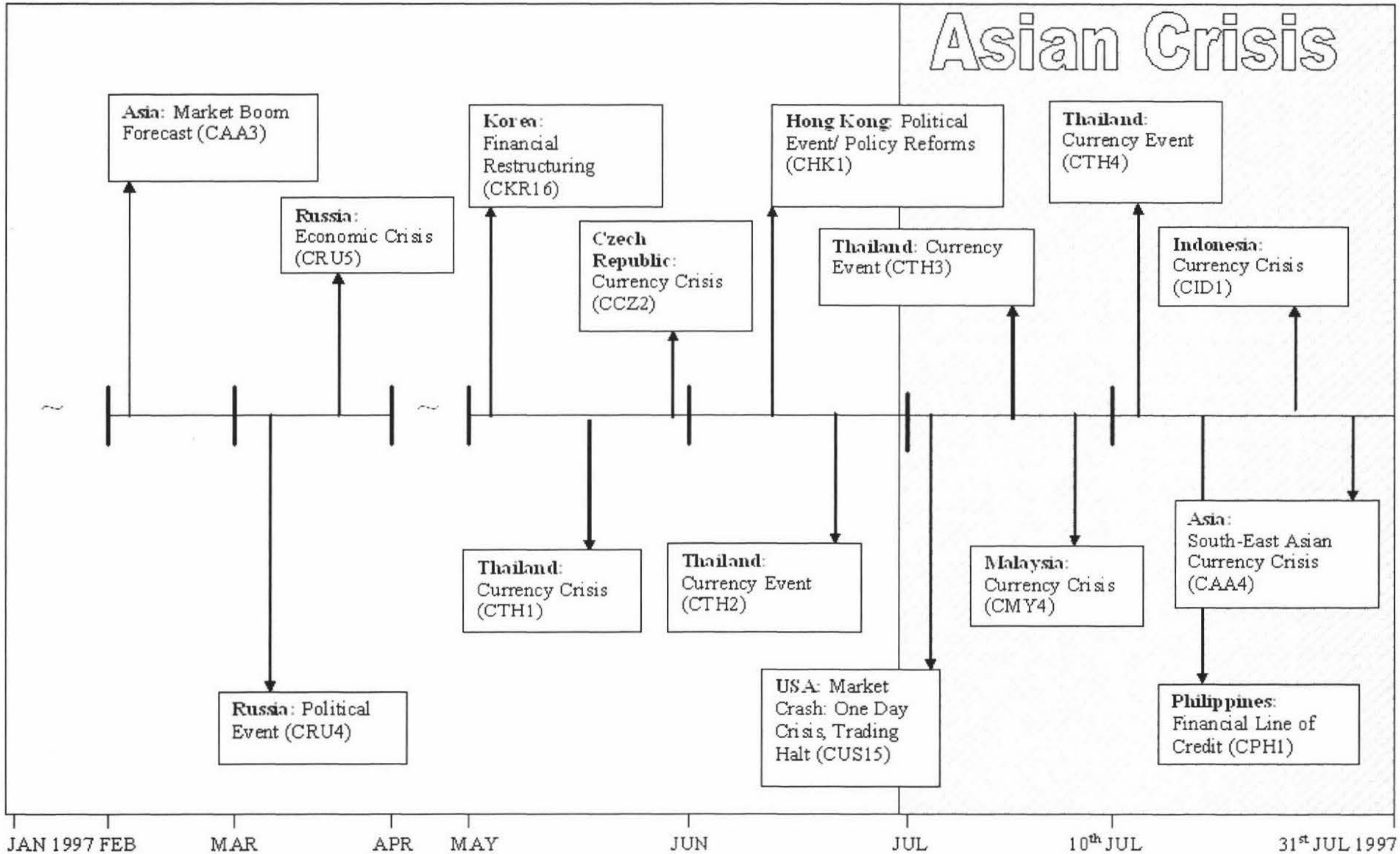
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM 1992 TO 1994



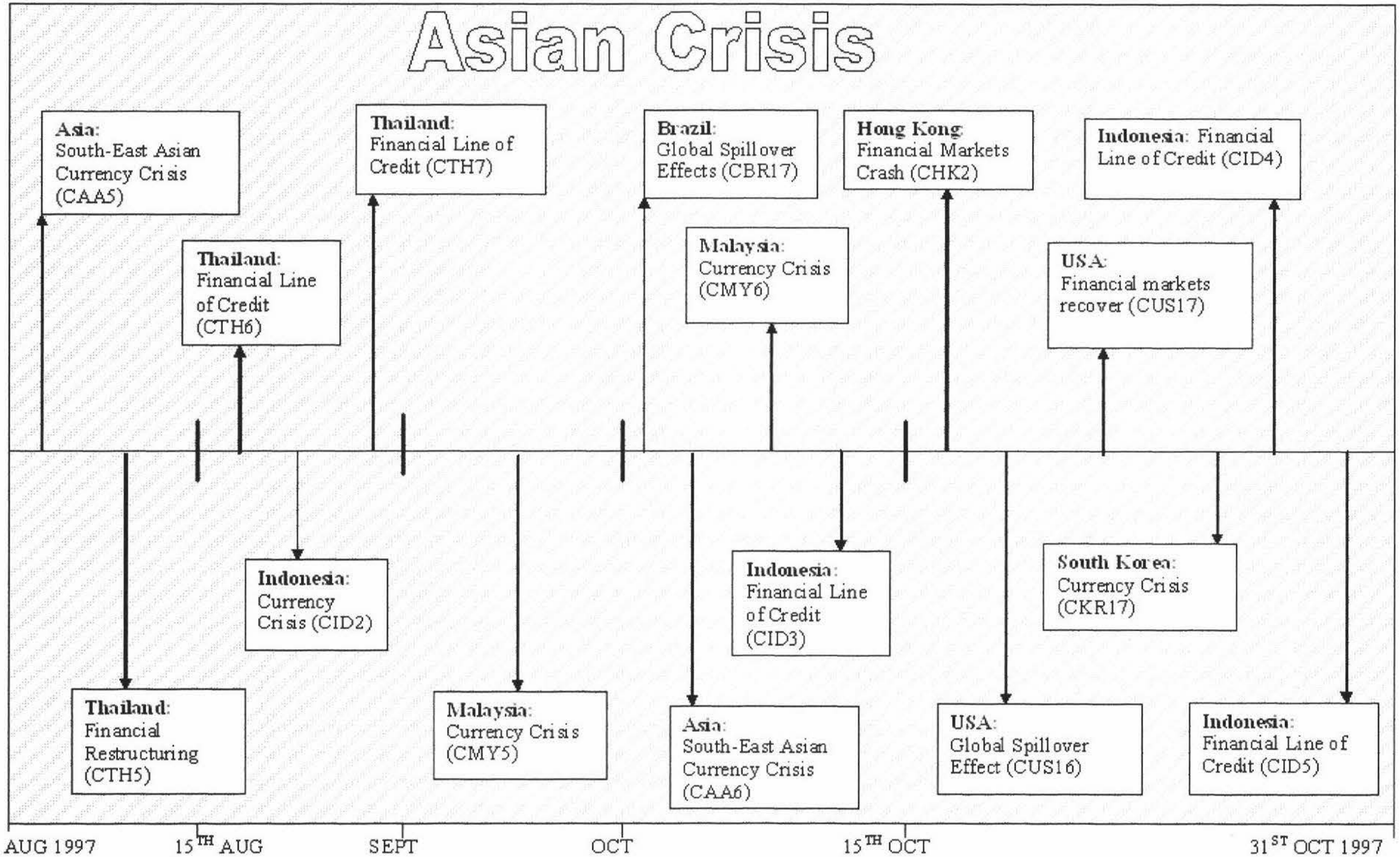
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM 1995 TO 1996



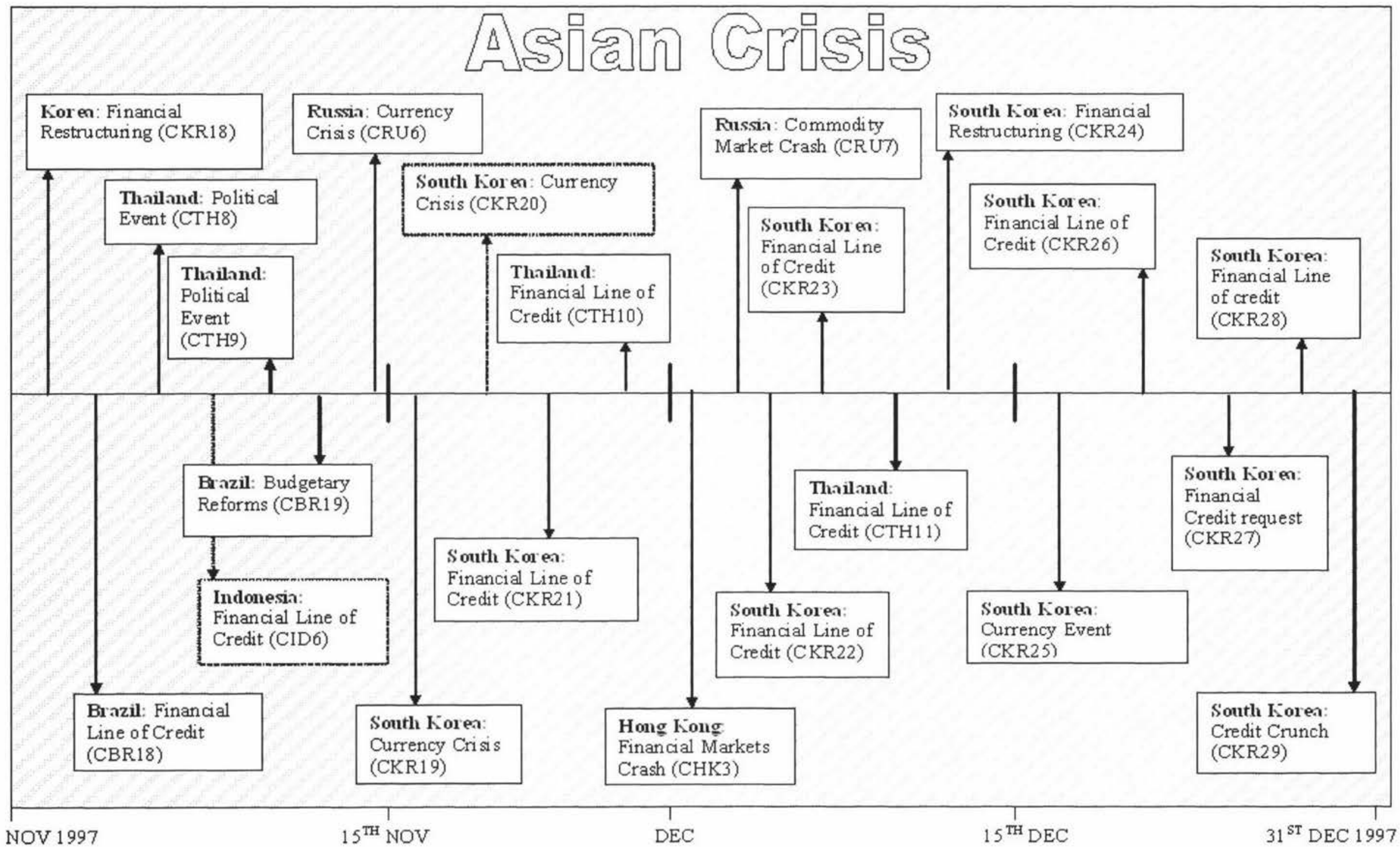
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM JANUARY 1997 – JULY 1997



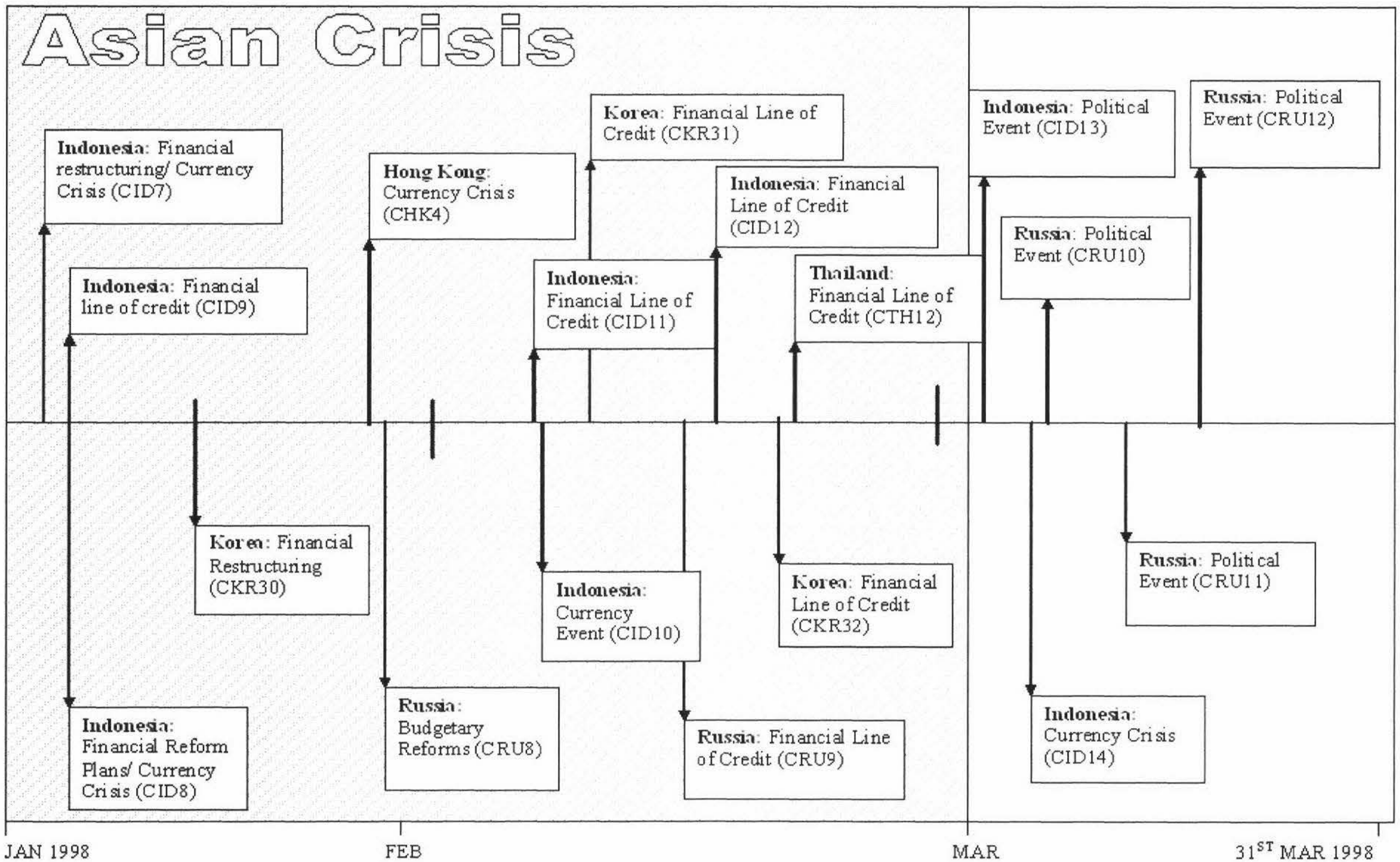
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM AUGUST 1997 – OCTOBER 1997



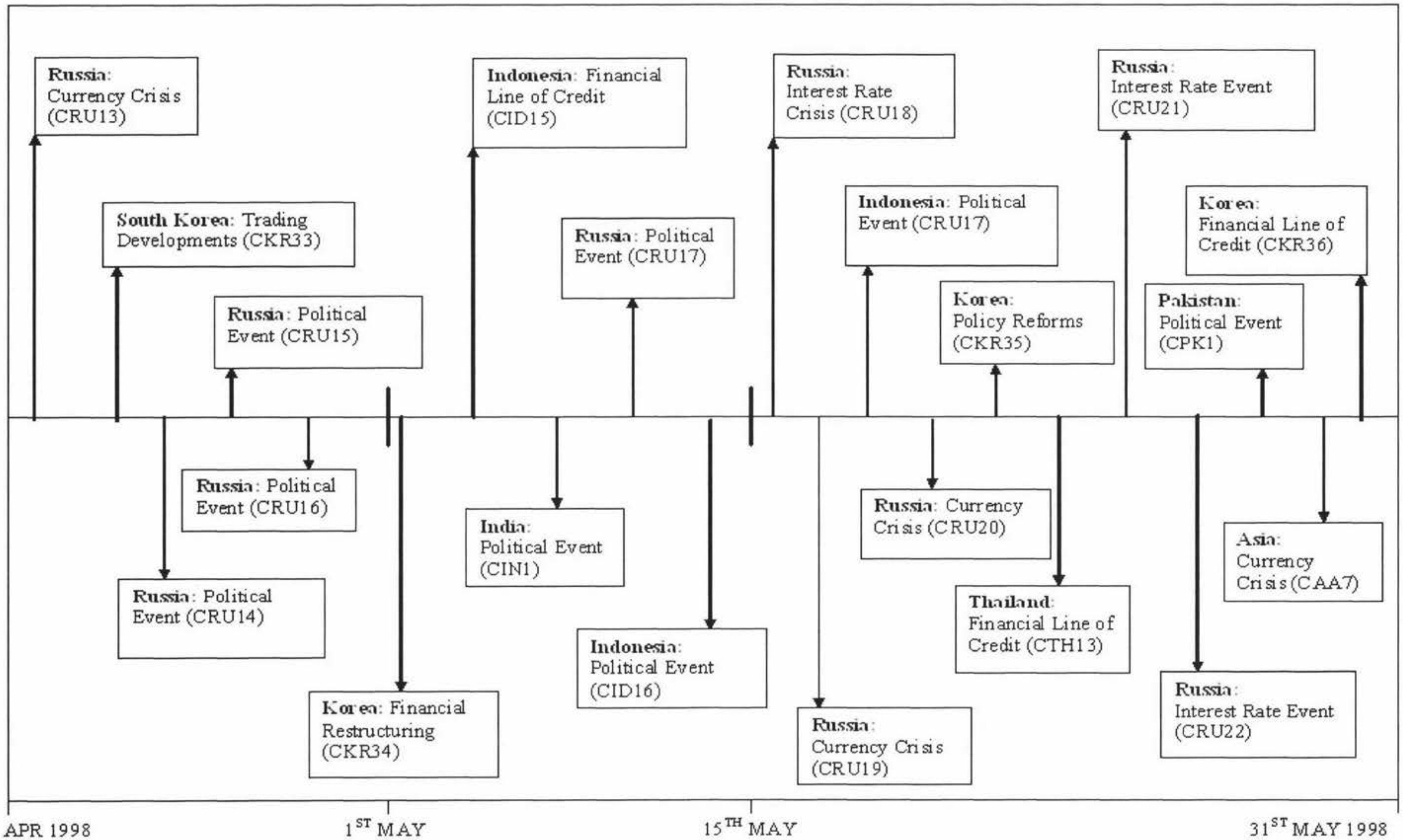
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM NOVEMBER 1997 – DECEMBER 1997



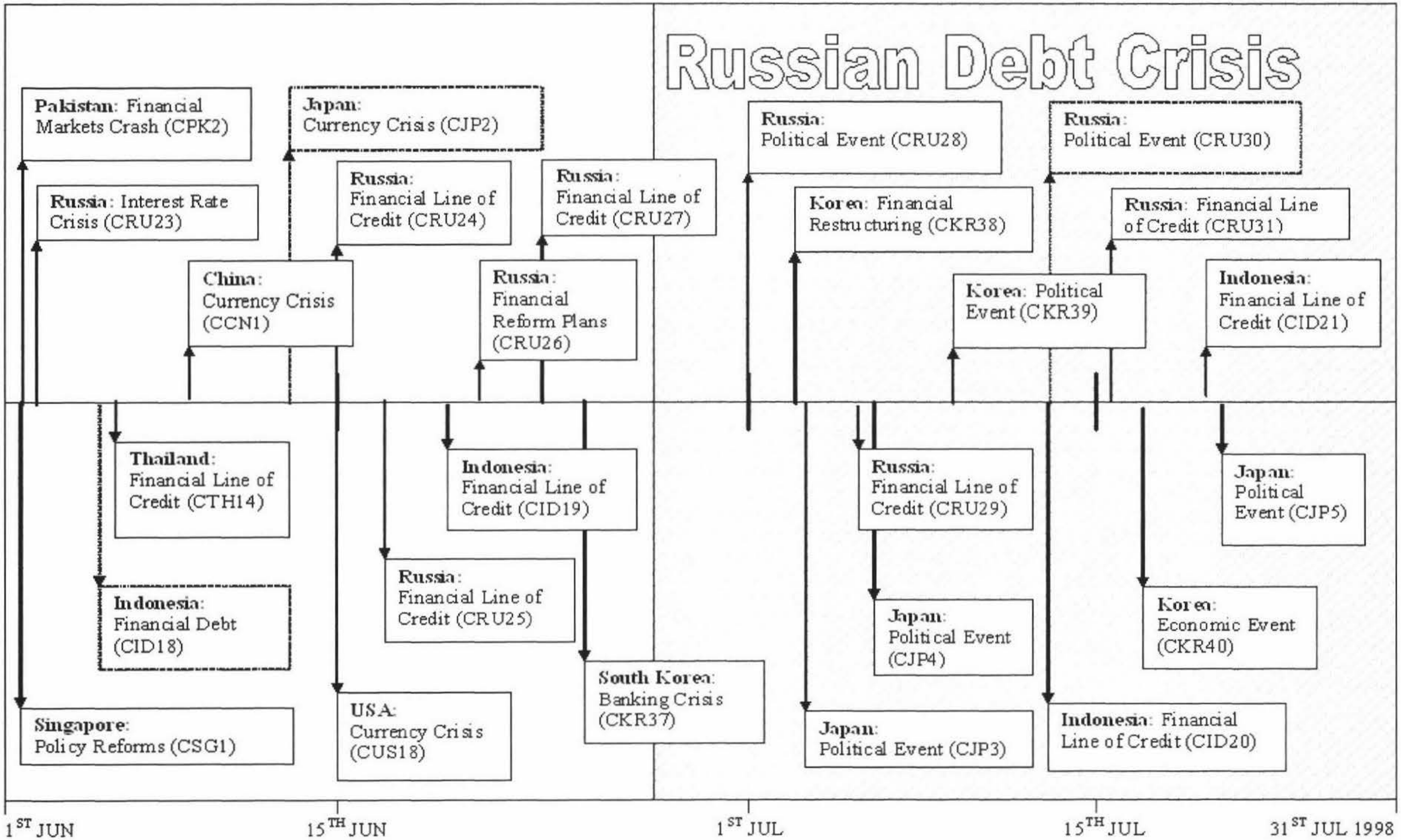
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM JANUARY 1998 TO MARCH 1998



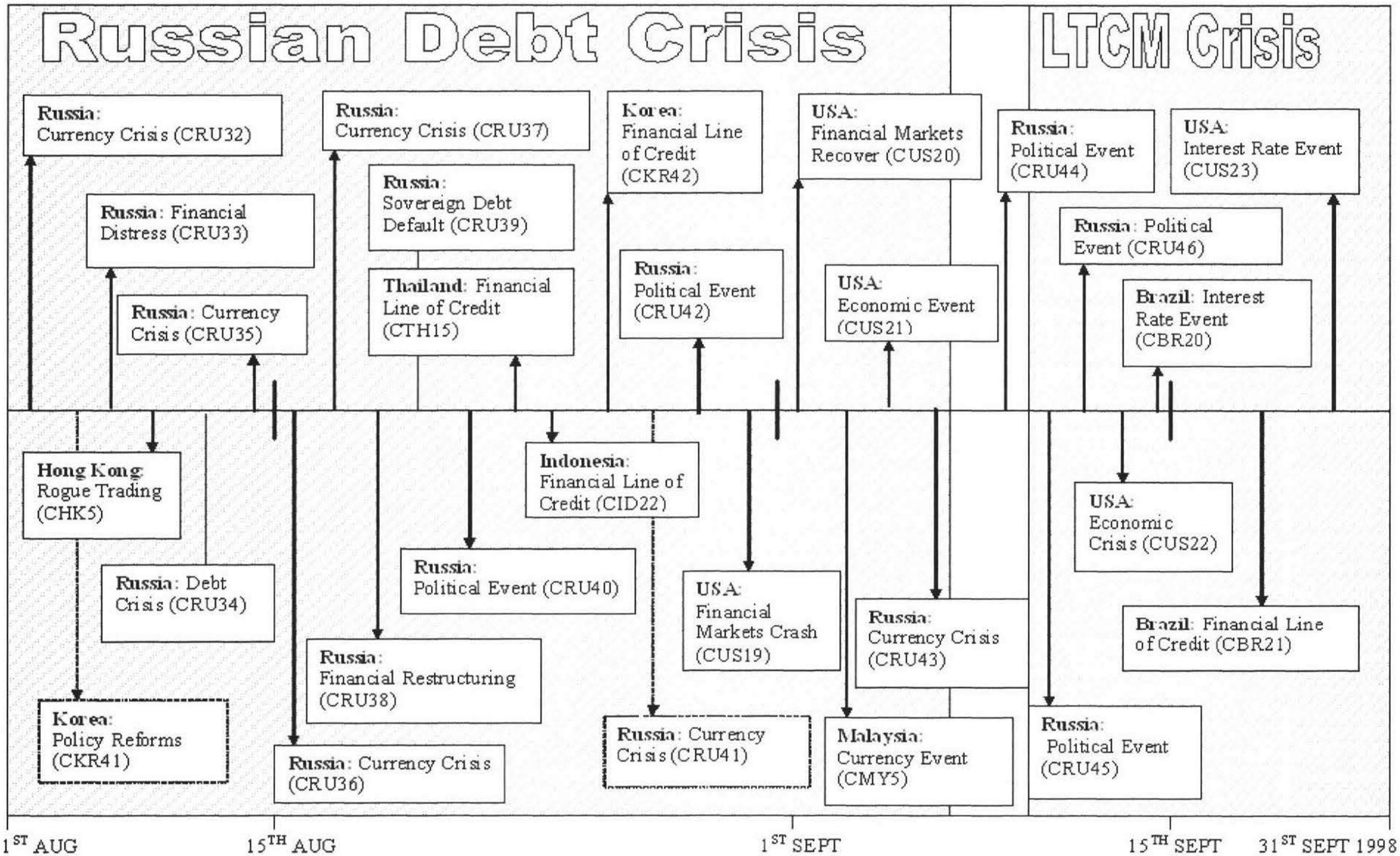
MACRO EVENT TIMELINES FOR THE PERIOD STARTING FROM APRIL 1998 TO MAY 1998



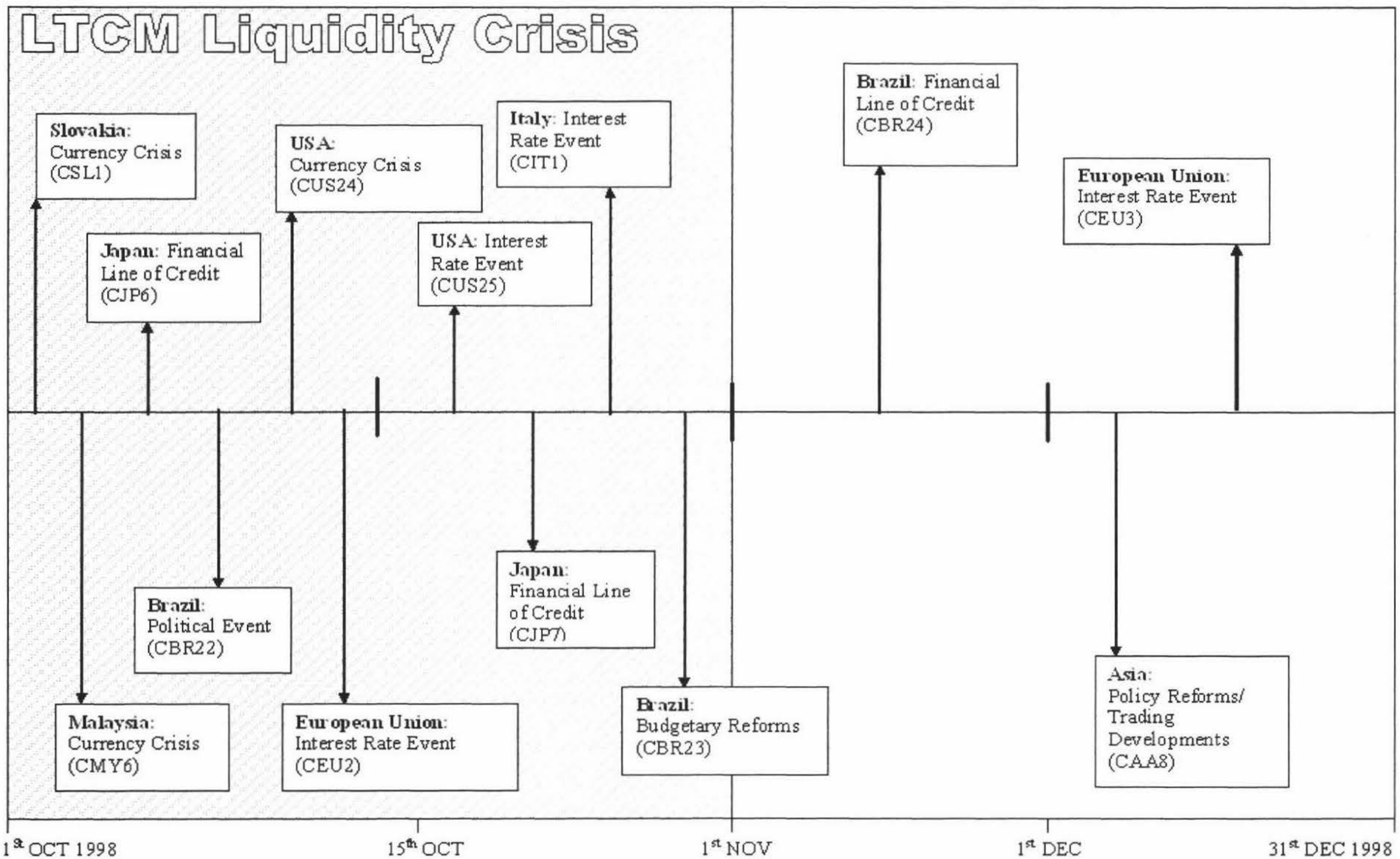
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM JUNE 1998 TO JULY 1998



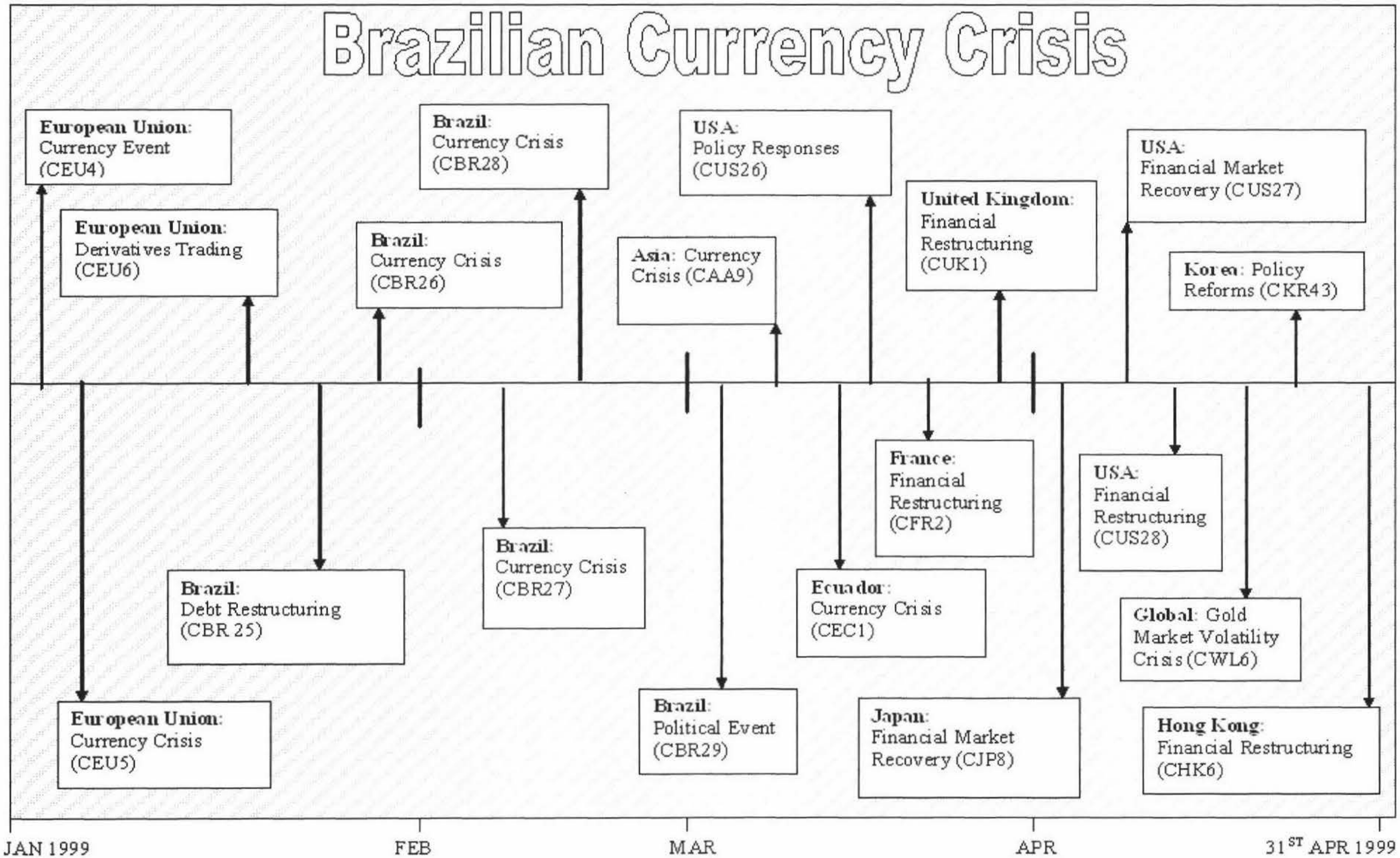
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM AUGUST 1998 TO SEPTEMBER 1998



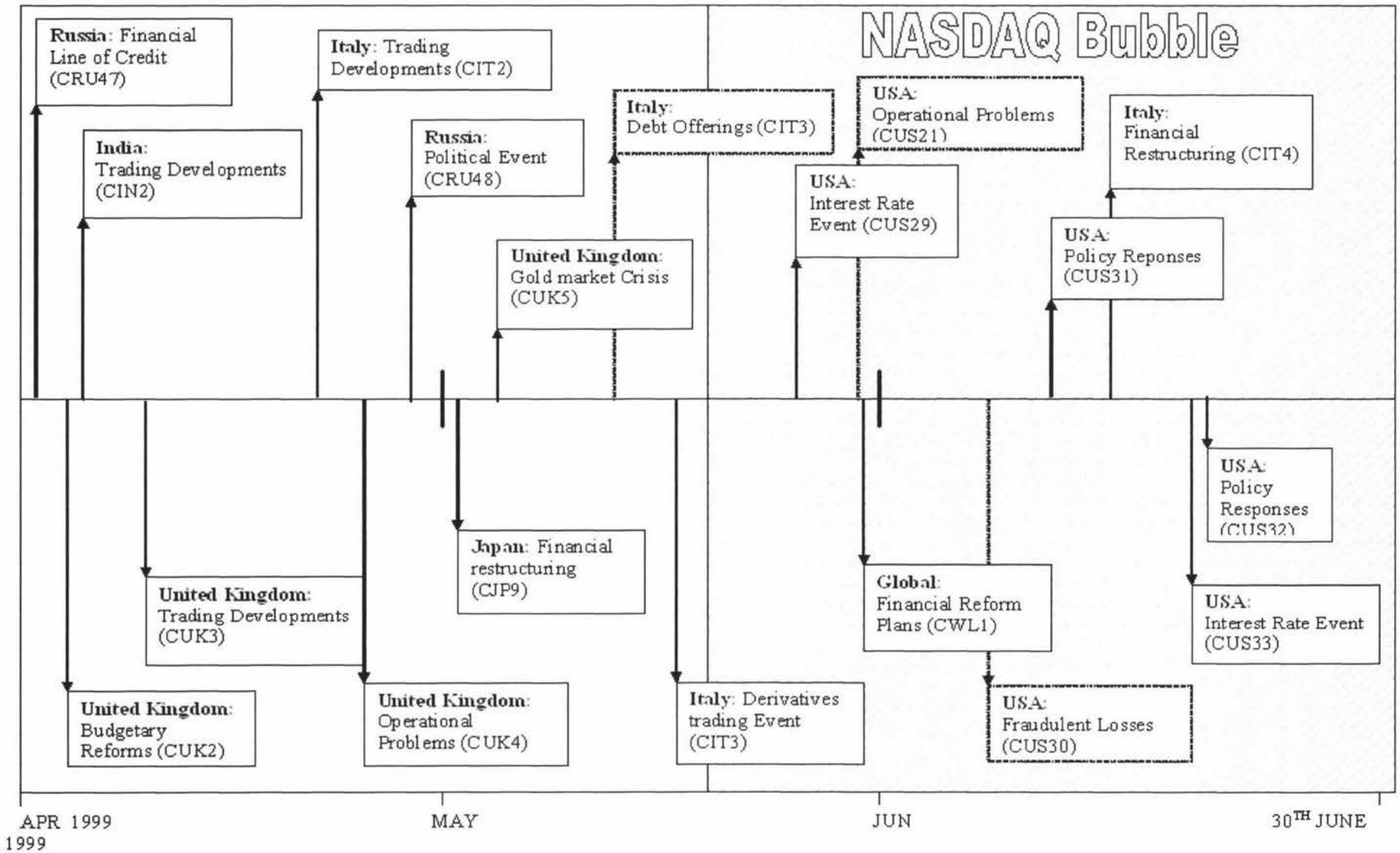
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM OCTOBER1998 TO DECEMBER 1998



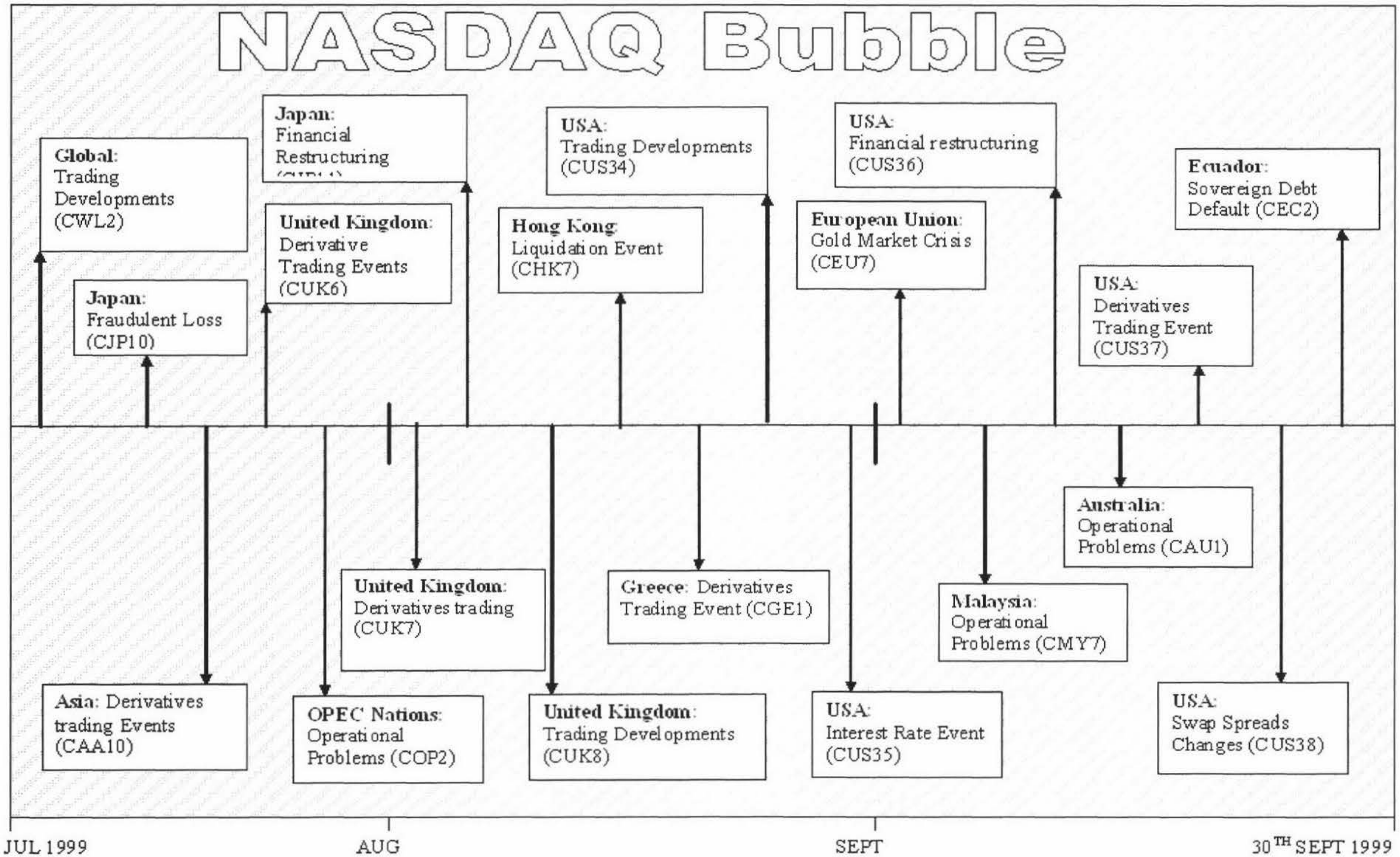
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM JANUARY 1999 TO APRIL 1999



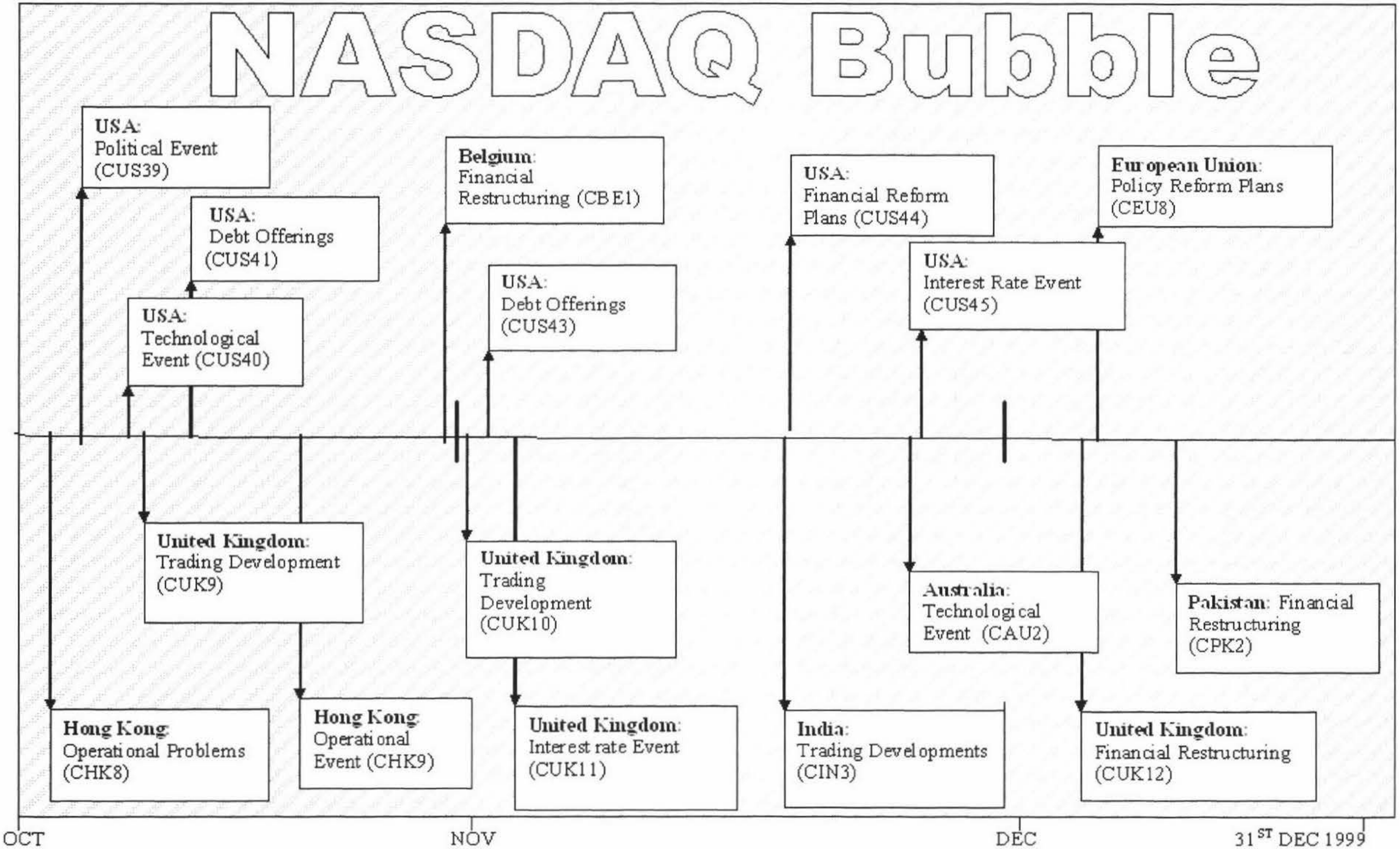
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM APRIL 1999 TO JUNE 1999



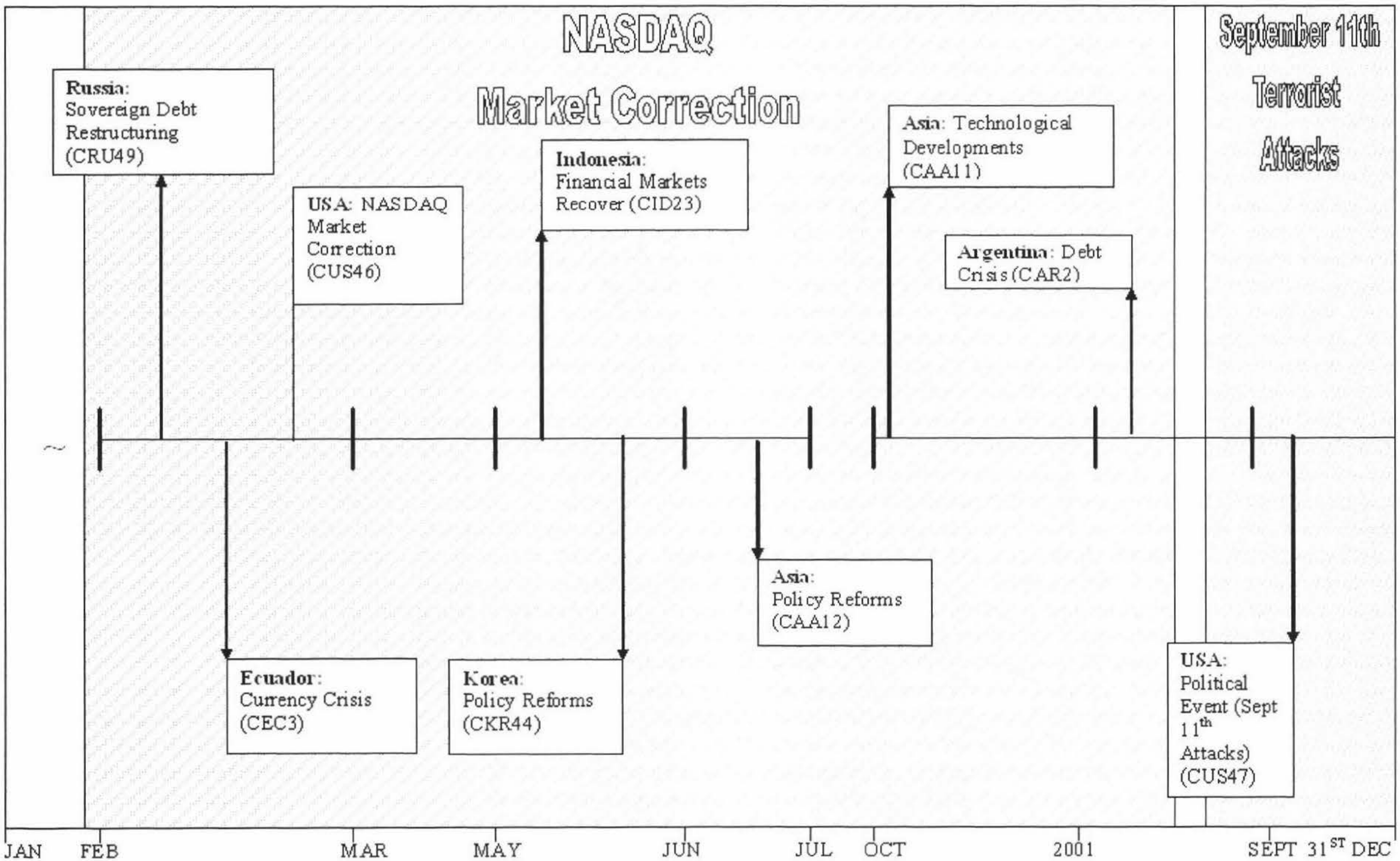
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM JULY 1999 TO SEPTEMBER 1999



MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM OCTOBER 1999 TO DECEMBER 1999

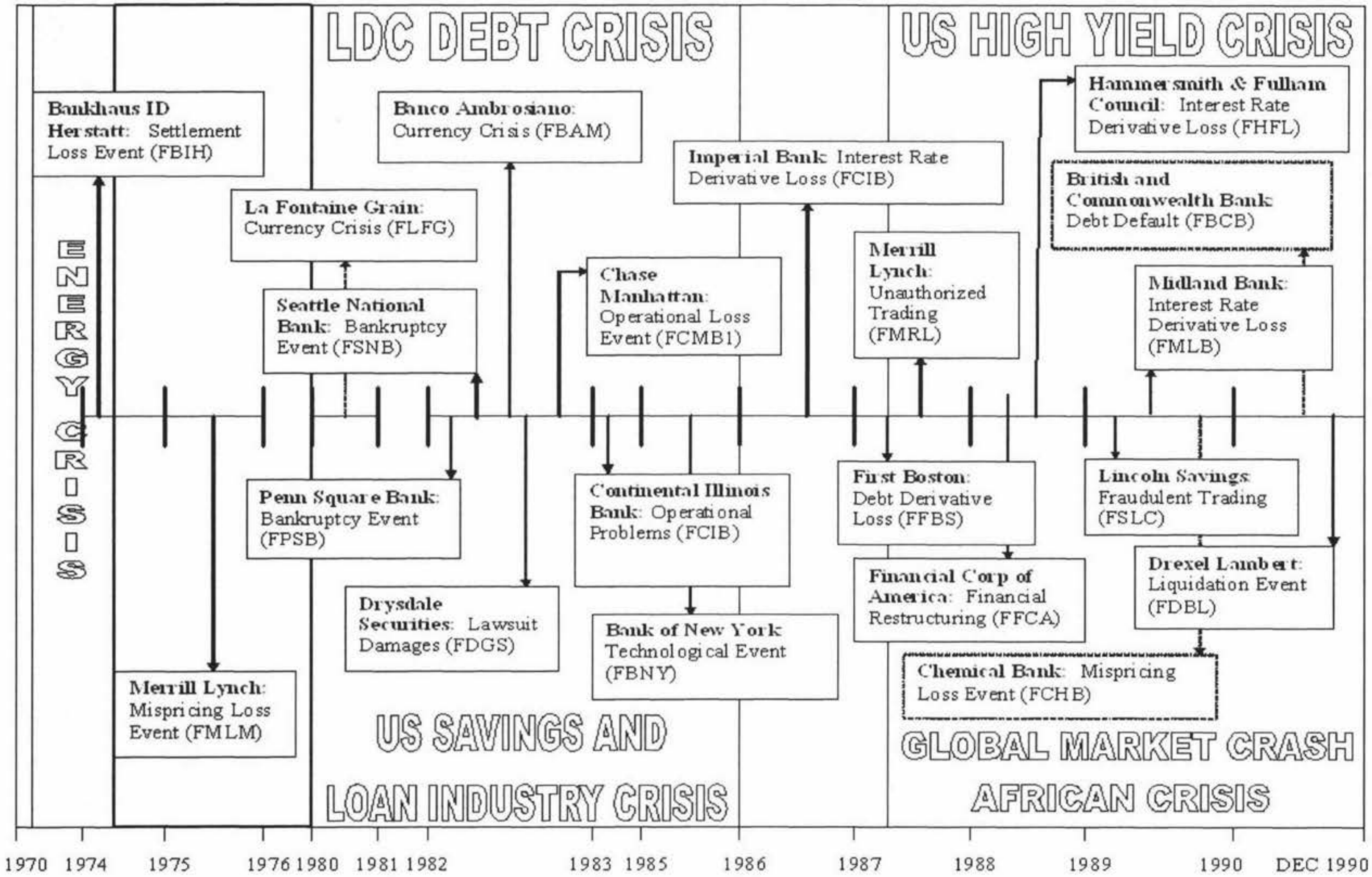


MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM AUGUST JANUARY 2000 TO DECEMBER 2001

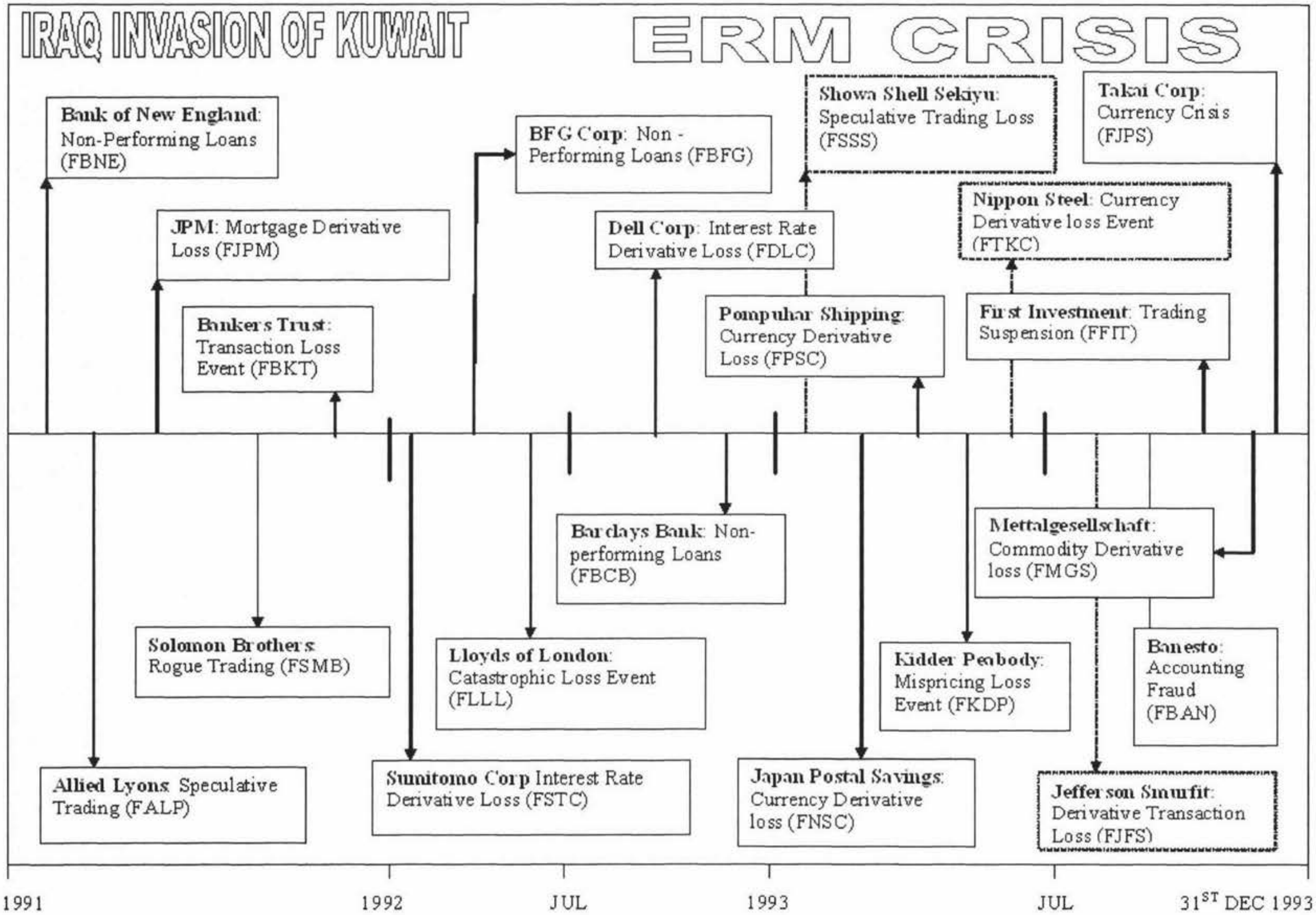


Appendix.3 – Micro Events Timeline Graphs for the period ranging from 1970-2002

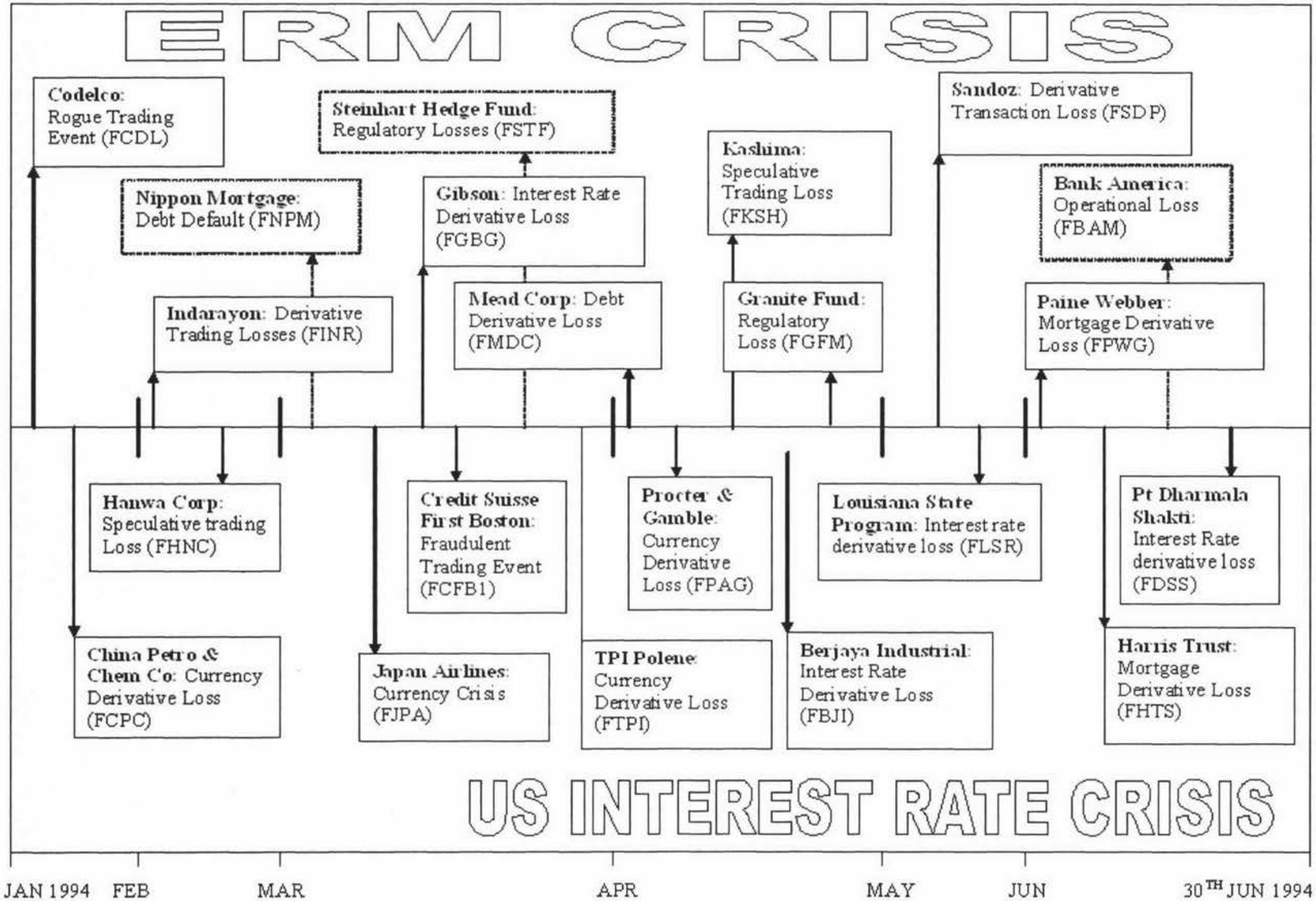
MICRO EVENT TIME LINE FOR THE PERIOD STARTING FROM 1970-1990



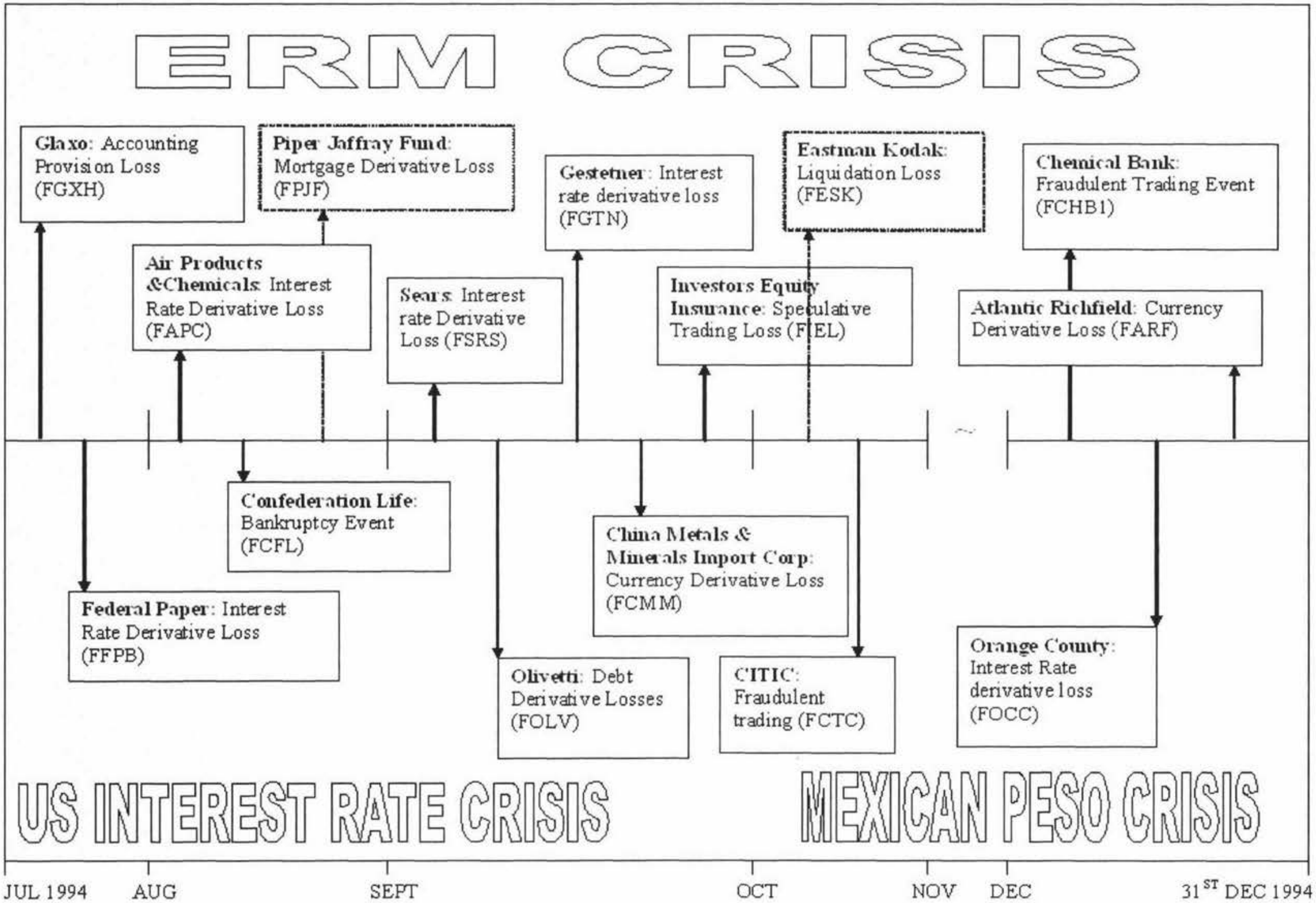
MICRO TIME LINES FOR THE PERIOD STARTING FROM 1991 TO 1993



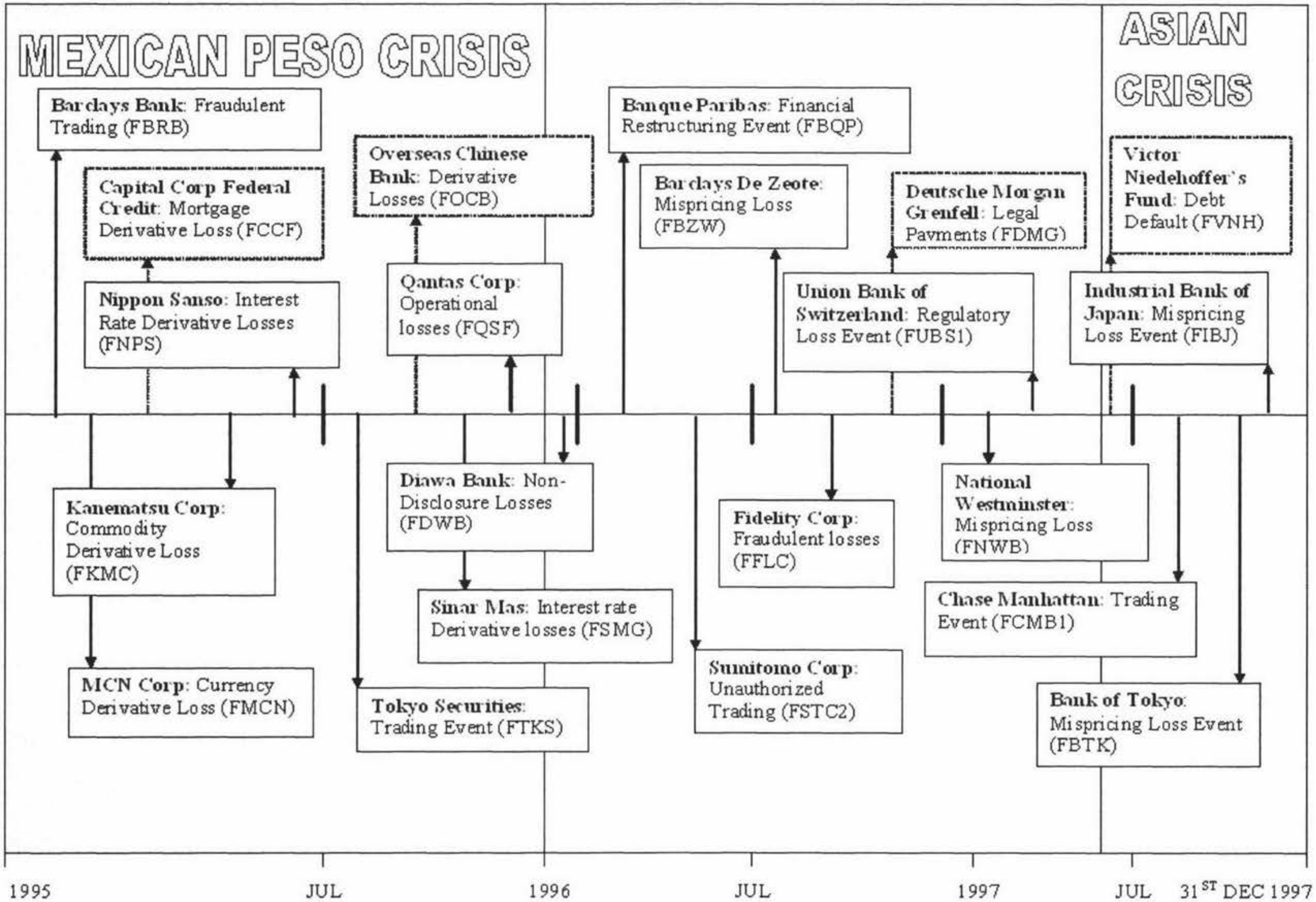
MICRO TIME LINES FOR THE PERIOD STARTING FROM JANUARY 1994 TO JUNE 1994



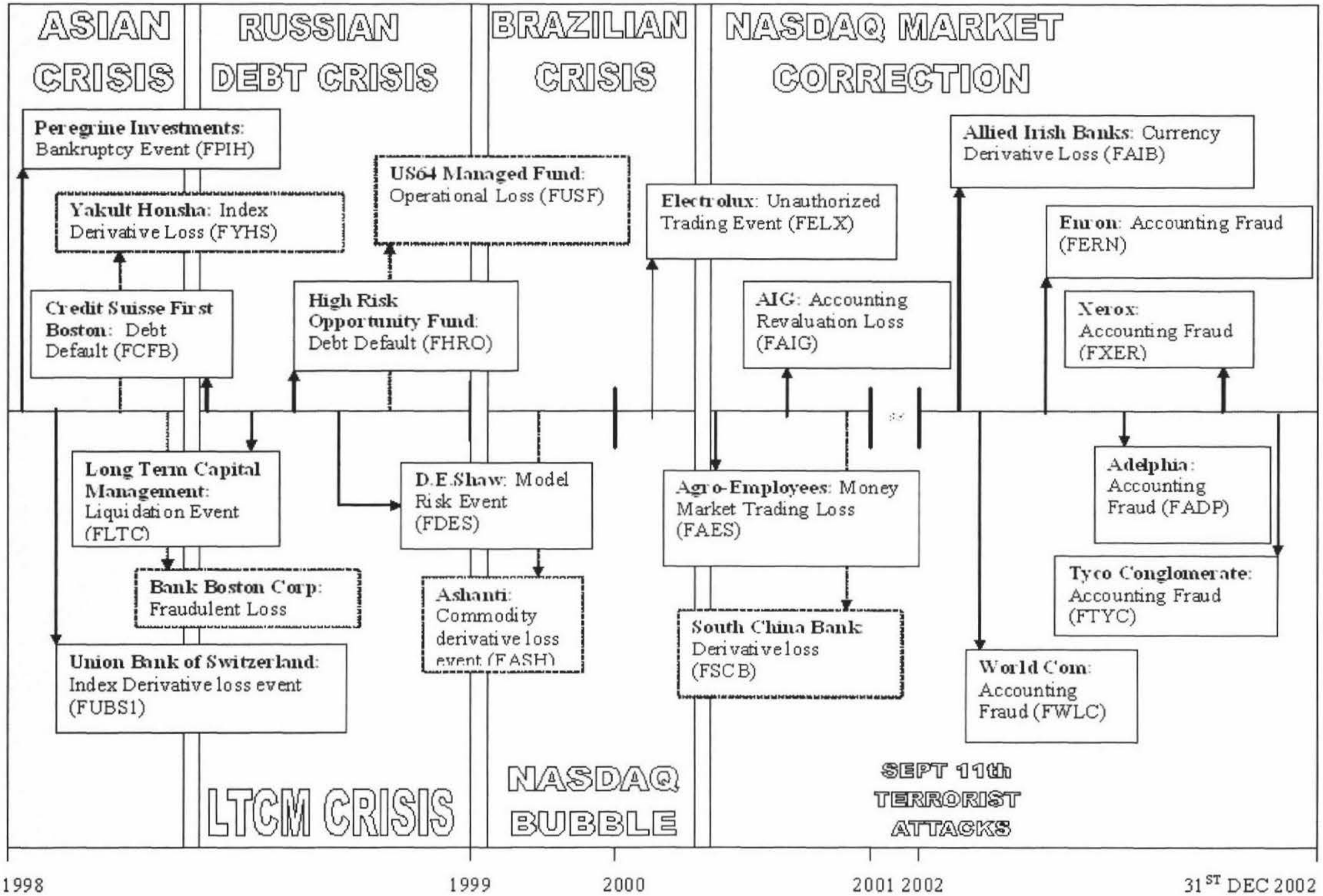
MACRO EVENT TIME LINES FOR THE PERIOD STARTING FROM JULY 1994 TO DECEMBER 1994



MICRO TIME LINES FOR THE PERIOD STARTING FROM 1995 TO 1997



MICRO EVENT TIMELINES FOR THE PERIOD STARTING FROM 1999 TO 2002



Appendix.4 – Macro Event Timelines

Table MA.1 MACRO EVENT TIMELINES			
Date	**Code**	**Event Type**	**Description**
ARGENTINA			
1980-82	CAR1	Systemic Problems	Interest rate spreads were high; Credit and payments systems were disrupted; Growth was reduced in the crises. Substantial redistribution of wealth in favor of debtors (G1998)
2001 December	CAR2	Debt Default	On December 24th 2001, Argentina halted interest and principal payments to the extent of USD 132 billion in debt. It had failed to manage fiscal deficits and to secure a disbursement of IMF financial support. Argentina further declared it would not be able to service the sovereign debts.
ASIA			
1995	CAA1	Currency Event	Trading volumes were on the rise but more focused on the Singapore dollar, Thai Baht, Indonesian Rupiah and the Malaysian Ringitt (AR2000)
1996 April	CAA2	Policy reform	International Swaps and Derivatives Association (ISDA) announces series of initiatives for the region (AR2000)
1997 February	CAA3	Industry Participants Announcement	Industry participants predict big boom in currency derivatives, offshore interest rate options, Asian equity derivatives and Australian warrants (AR2000)
1997 July	CAA4	Asian Crisis	On 24th July, Baht, rupiah, ringitt and peso slump due to confidence. Malaysian Prime Minister Mahathir Mohammad launched an attack on *"rogue traders"*. Hong Kong revealed its one billion dollar spending on intervention (T2000)
1997 August	CAA5	The Asian Crisis	Currency markets were slow, destroying the exchange rate regimes of Thailand, Philippines, Malaysia and Indonesia (AR2000)
1997 October	CAA6	The Asian Crisis	Tensions between banks and regulators about the crisis erupted at World Bank/IMF conference. Just 7 out of 127 institutional offshore funds showed positive returns (AR2000)
1998 May	CAA7	Currency crisis	On 29th May, US dollar rose to seven-year high against yen on fears of nuclear arms race in Asia and increased Japanese unemployment (T2000)
1998 December	CAA8	Technological Events/policy reforms	Dealers prepared for Y2K millennium bug. The Monetary Authority of Singapore (MAS) continues to liberalise banking regulations (AR2000)
1999 February	CAA9	Currency crisis	Offshore trading started off and the emerging markets crisis continued with the devaluation of the Brazilian real (AR2000)

Date	Code	Event Type	Description
1999 July	CAA10	Derivatives trading	Equity derivatives volumes began to recover. Dealers reviewed their derivatives documentation (AR2000)
2000 October	CAA11	Technological Event	Internet service provider's platforms spreads in Asia and electronic trading started off (AR2000)
2000 October	CAA12	Policy reforms	Bankers suggested that if region's derivatives industry is to evolve, then regulatory reforms must continue. (AR2000)
AUSTRALIA			
1999 September	CAU1	Operational Problems	Chief Executive of the Sydney Futures Exchange (SFE) Les Hosking resigned. (R1999)
1999 November	CAU2	Technological Events	SFE (Sydney Futures Exchange) also became completely electronic (R1999)
BANGLADESH			
1980+1998	CBD1	Financial crisis	Credit spreads were wide and reduced intermediation (G1998)
BELGIUM			
1999 October	CBE1	Financial restructuring	KBC Bancassurance completed acquisition of DE Shaw Financial Products for $ 107 million (R1999)
BRAZIL			
1986	CBR1	Policy implementation	Introduction of insider trading laws (BHL85)
1986 February	CBR2	Policy implementation	Cruzado plan was implemented (price and wage controls) (BHL85)
1986 September	CBR3	Currency event	Fixed nominal exchange rate was abandoned (BHL85)
1987 January	CBR4	Policy reforms	Major provisions of Cruzado plan was abandoned (BHL85)
1987 February	CBR5	Debt default	Brazil unilaterally suspended its interest payments on debt (T2000)
1987 March	CBR6	Policy reforms	CMV resolution 1289 Annex II limited foreign direct investment through special conditions (BHL85)
1989	CBR7	Policy reforms	Deposit rates were fully liberalised (BHL85)
1990 March	CBR8	Currency event	Collor plan named after the Brazilian president Collor De Mello was made with high expectations to solve Brazil's economic problem and set the country in an international arena. The plan introduced new currency in march 1990(BHL85)
1991	CBR9	Trading developments	Exclusive broker system was eliminated and the NYSE (New York Stock Exchange) system was created (BHL85)

Date	Code	Event Type	Description
1991 May	CBR10	Policy reforms	Foreign investment policy changed, bank debt restructuring agreement was made and economic ministers agreed to direct foreign investment (BHL85)
1991 May	CBR11	Stock market reforms	Official equity market liberalisation began
1992 June	CBR12	Policy reforms	On 30th June, foreign investors were authorised to operate in the derivatives market (BHL85)
1994 October	CBR13	Budgetary reforms	New 15% tax on all consumer loans and instalment payments by banks and businesses (BHL85)
1994-1998	CBR14	Interest rates crisis	High interest rates and due to heightened caution about liquidity; bank limited the access of small business to credit (G1998)
1995 March	CBR15	Currency event	On 6th March, New exchange rate system based on bands was introduced (BHL85)
1995 May	CBR16	Policy responses	Trade policy turns inward as import quotas introduced and tariffs increased (BHL85)
1997 October	CBR17	Spillover effect	Stock market suffers from spillover effects caused by Hong Kong market crash (BHL85)
1997 November	CBR18	Financial Credit Line	Brazil's legislature approves austerity package (BHL85)
1997 November	CBR19	Budgetary reforms	On 10th, Brazil promises tax increments and spending cuts to ease investor concerns over deficit (T2000)
1998 September	CBR20	Interest rate event	On 11th, Brazil hikes interest rates to nearly 50% in desperate bid to check capital flows. (T2000)
1998 September	CBR21	Financial Credit Line	On 15th, Brazil held discussions with IMF (T2000)
1998 October	CBR22	Political event	Fernando Henrique Cardoso was re-elected Brazilian President on 4th October 1998 (T2000)
1998 October	CBR23	Budgetary reforms	On 28th, government unveils plan to save by tax increments, budget cuts and other measures (T2000)
1998 November	CBR24	Financial Credit Line	On 13th, IMF and other wealthy nations announced a loan package to avoid financial meltdown (T2000)
1999 January	CBR25	Debt restructuring	On 6th, The Governor of Brazil's Minas Gerais State, declared 90-day moratorium on debt payments to central government (T2000)
1999 January	CBR26	Currency crisis	In January 1999, the Brazilian real was devalued and the governor of the Brazilian Central Bank resigned. The crisis had its beginnings in the Mexican peso crisis of December 1994, which caused the net flow of capital into Brazil insufficient to cover the current account deficit. (Riskmg7)

Date	Code	Event Type	Description
1999 January	CBR27	Currency crisis	On 15th, Central Bank of Brazil scraped support for the real and allows it to float (T2000)
1999 January	CBR28	Currency crisis	On 29th, Real sank below the psychological two per-dollar exchange rate barrier for the first time. (T2000)
1999 February	CBR29	Political event	Brazil government surprised markets by naming Arnimio Fraga, aide to billionaire speculator George Soros, as new Central Bank president. (T2000)
CHILE			
1981-87	CCL1	Systemic problem	Growth was reduced from eight percent to one percent in the five years after it. Payments systems were disrupted. (G1998)
CHINA			
1998 June	CCN1	Currency crisis	On 10th, Central bank governor warned of weak Yuan on foreign trade and raising fears of devaluation (T2000)
CZECH REPUBLIC			
1991-present	CCZ1	Interest rate Crisis	High spreads between domestic deposit and loan rates and between rates on domestic and foreign funds. High levels of non-performing loans reduced banks ability to extend credit (G1998)
1997 May	CCZ2	Currency Crisis	On 10th June, Central Bank abandoned its currency trading band and floated the crown; currency weakened by 10% (T2000)
ECUADOR			
1999 February	CEC1	Currency crisis	On 12th, Ecuador abandoned its currency band system and floated the sucre (T2000)
1999 September	CEC2	Sovereign debt default	On 28th September, Ecuador became the first country to default on Brady bonds, stating it cannot service the debt (T2000)
2000 February	CEC3	Currency crisis	On 29th, Congress approved bill to scrap sucre and adopt dollar as national currency. (T2000)
EGYPT			
1991-95	CEG1	Interest rate crisis	Interest rate spreads were high (G1998)
EUROPEAN UNION			
1992-September	CEU1	Breakdown of the European Monetary System	In September 1992, the British pound, the Italian lira and the Spanish Pesto" *fell*" outside their bands stipulated by the ERM. UK devalued the pound effectively leading tot the collapse of ERM. The European Monetary System lasted till July 1993 and it was argued that the French franc and the Irish punt came under attack as a result of the earlier attacks (Riskmg7)
1998 October	CEU2	Interest rate event	Spain, Denmark, Portugal, Ireland and Greece cut interest rates (T2000)

Date	Code	Event Type	Description
1998 December	CEU3	Interest rates event	On 3rd December, all euro zone countries cut interest rates simultaneously (T2000)
1999 January	CEU4	Currency event	Euro became official currency and immediately started to weaken against dollar (R1999)
1999 January	CEU5	Currency crisis	Euro at its highest (at $1.19 on its first trading day) and by December it dropped below parity and European Central Bank intervention brought it back (R1999)
1999 January	CEU6	Derivatives trading	Arrival of Euro eliminated currency risk in the Euro zone and contributed to fall in FOREX derivatives by 17% in the first half of 1999 (R1999)
1999 September	CEU7	Gold Market crisis	European central banks announced its limiting gold sales, thereby increasing gold prices. Gold producers were left scrambling to unwind hedges. Ashanti Goldfields Hedge book turned into a $570 million liability. (R1999)
1999 December	CEU8	Financial reform plans	EU leaders meet in Helsinki and clash over plans for a 20% withholding tax. (R1999)
FINLAND			
1991-94	CFI1	Systemic problems	Growth averaged 4.0% in three years prior to 1990, 0% in 1990 and –4.0% in following three years. Unemployment peaked up to18.4% in 1994 (G1998)
FRANCE			
1994	CFR1	Credit Lyonnais Bankruptcy Event	Credit Lyonnais, one of the largest banks in the world declared bankruptcy in 1994. Unfettered expansion and poor management caused the failure and the bank was bailed out by the French government to the sum of FFR 23 billion and an additional subsidy of FFR 44.9 billion from the government in 1995
1999 February	CFR2	Financial restructuring	Société Des Bourses Français (SBF) launched its new clearinghouse for SBFs exchanges but it looked more inclined towards promoting Paris over its rivals Frankfurt. (R1999)
GERMANY			
1989 November	CDE1	Political event	Berlin wall falls and the collapse of communism (T2000)
GHANA			
1983-89	CGH1	Systemic problems	Low level of intermediation, inadequate resource mobilization. Large non-performing loans resulted in reduced flexibility for bank lending. (G1998)

Date	Code	Event Type	Description
GLOBAL			
1973	CWL1	Breakdown of Bretton Woods Act	Inflationary pressures caused the breakdown and abandonment of Bretton-Woods Act in February 1973.Floating exchange rate system followed the demise of Bretton Woods Agreement, leading to more volatile movements in exchange rates. (Riskmg7)
1973	CWL2	Energy Crisis	Oil price shocks in 1973 were accompanied by high inflation and volatile fluctuations in interest rates. The 1973 oil price shock created huge international payment imbalances. (Riskmg7)
1982	CWL3	Oil Patch Crisis	The 1982 patch crisis threatened major US banks such as continental Illinois. It was linked with the Penn state bank, which had huge exposures in Oil and gas. (Riskmg7)
1982+	CWL4	LDC (Less Developed Countries) Debt Crisis	The large borrowings of Third- World countries went bad after the Mexican bankruptcy in August 1982. Foreign banks lent unwisely to Mexico and other Latin American countries, and even the ruling political party allowed excessive capital flight out of the country. The capital flight made it impossible for the government to service, let alone repay, its foreign debt and triggered the LDC crisis. (Riskmg7)
1987 October	CWL5	Stock Market Crash	*"Black Monday"*-On October 19th, global market crash began with DJIA, dropping 508 basis points, which was 22.7 percent and largest drop in the history of Dow Jones. The S&P dropped 28 percent, the largest in NYSE's 205-year history. Global equity markets in more than 12 countries had dropped between 25-35 percent between August 1987 and November 1987 due to the panic triggered in the US markets. (Riskmg7)
1999	CWL6	Gold Market volatility	Unparallel periods of excess volatility hit the gold market as gold prices increased rapidly over 20% in a single day Many banks announced reduction in planned gold sales and their gold lending program. It caused large losses for gold hedgers who had engaged in large forward sales (Riskmg7).
1999 June	CWL7	Financial reform plans	Basle Committee on banking released its consultation on new capital adequacy framework to replace the 1988 capital accord. Proposals included grading of risks, use of external credit ratings and capital changes for operational risk (R1999)

Date	Code	Event Type	Description
1999 July	CWL8	Trading developments	Brokertec, a consortium of Citibank, Deutsche Bank, Lehman Brothers, Morgan Stanley Dean Writer, Goldman Sachs, and Merrill Lynch proposed the idea of a global exchange to leading exchanges. (R1999)
GREECE			
1999 August	CGR1	Derivatives trading	Athens derivatives exchange started trading its first product, a futures on the Athens stock exchange/FTSE index of 20 Greek Blue-chip companies (R1999)
HONG KONG			
1997 June	CHK1	Political event/Policy reforms	Hong Kong was returned to China and the legality of derivatives was an issue. International Derivatives and Swaps Association (IDSA) issued new standards and the Hong Kong warrant market collapsed (AR2000)
1997 October-	CHK2	Financial market crash	On 20th, markets suffered heavy losses, losing quarter of its value in 4 days (T2000)
1997 December	CHK3	The Asian Crisis (Market crash)	The Hong Kong Stock Exchange (HKSE) crashed, sending the equity-derivatives downward. (AR2000)
1998 February	CHK4	Currency crisis	Peregrine Investment collapsed and Hong Kong was rumoured to be selling US dollar calls and Hong Kong puts to shore up its currency (AR2000)
1998 August	CHK5	Rogue trading	On 14th August, government intervened into stock market to accuse investors speculating against currency and interest rates against the stock market (T2000)
1999 March	CHK6	Financial restructuring	Hong Kong announced plans to merge stock market and futures exchange. (AR2000)
1999 August	CHK7	Liquidation event	First significant dividend worth HK$ 1 billion was paid out from the liquidation of Peregrine Fixed Income, which collapsed in February 1998 (R1999)
1999 October	CHK8	Operational problems	Hong Kong Futures Exchange (HKFE) plan to go electronic was hindered by systems problems (AR2000)
1999 October	CHK9	Operational event	Hong Kong Futures Exchange (HKFE) announced that its former chief Ivers Riley will return to help the merger of future's exchange with the stock exchange of Hong Kong, replacing Randy Gilmore who opposed the merger (R1999)
INDIA			
1998 May	CIN1	Political event	On 11th May, India conducted three nuclear tests (T2000)
1999 April	CIN2	Trading	India launched its first rupee interest rate swaps

		developments	market (AR2000)
Date	**Code**	**Event Type**	**Description**
1999 November	CIN3	Trading developments	India's parliament okays trading in stock market derivatives, but only on futures and not on options. (R1999)
INDONESIA			
1997 July	CID1	Currency crisis	On 11th July, Jakarta widened its trading band of rupiah from 8 to 12%. (T2000)
1997 August	CID2	Currency crisis	On 14th August, Indonesia abolished its exchange rate band and the rupiah severely declined (T2000)
1997 October	CID3	Financial Credit Line	Indonesian government agreed to request help from IMF on 8th October. (AFC1999)
1997 October	CID4	Financial Credit Line	On 30th, IMF unveiled its USD 43.2 billion financial package for Indonesia. (T2000)
1997 October	CID5	Financial Credit Line	On 31st, IMF announced a USD 23 billion multilateral financial package involving World Bank and Asian Development Bank (AFC1999)
1997 November	CID6	Financial Credit Line	On 5th November, IMF approved a USD 10billion stand-by credit and disbursed USD 3billion, which involved financial restructuring package. (AFC1999)
1998 January	CID7	Financial Structuring/ Currency crisis	On 6th January, rupiah lost half its value against US dollar after unveiling its optimistic budget and also rumours that it might declare a debt moratorium (T2000)
1998 January	CID8	Financial reform plan/ Currency crisis	On 15th January, IMF and Indonesia signed an agreement for strengthening economic reforms; Rupiah fell after IMF packages showed no signs of easing debt burden. (T2000)
1998 January	CID9	Financial Credit Line	On 22nd January, the second package for Indonesia was agreed upon. Part of previous IMF conditions that were not fulfilled was reiterated in the second package. (T2000)
1998 February,	CID10	Currency event	On 11th February, Finance minister Mar'ie Muhammad announced preparation for currency broad system and the rupiah rose (T2000)
1998 February	CID11	Financial Credit Line	On 14th, IMF threatened to halt bailout funding over currency board system plan (T2000)
1998 March	CID12	Financial Credit Line	On 6th March, Indonesia delayed its economic reform plan and bailout payment (T2000)
1998 March	CID13	Political event	On 10th March, Suharto was re-elected as president (T2000)
1998 March	CID14	Currency crisis	Indonesia scraped currency board system plan on 20th March. (T2000)
1998 May	CID15	Financial Credit Line	On May 4th, IMF disbursed USD 1billion to Indonesia after issuing a supplementary memorandum of Economic and Financial Policies on additional measures (T2000)

Date	Code	Event Type	Description
1998 May	CID16	Political event	On May 14th, Mobs rampaged through Jakarta and students demand Suharto's resignation. Asian markets suffered sharp losses. (T2000)
1998 May	CID17	Political event	On 21st May, Indonesian President Suharto resigned and was succeeded by vice president Jusuf Habibie (T2000)
1998 June	CID18	Financial debt	On June 5th, International lenders and Indonesian companies reach deal to reschedule corporate debt (T2000)
1998 June	CID19	Financial Credit Line	On 24th June, additional IMF reforms was agreed to by Indonesia in light of changing political climate and worsening economic situation (T2000)
1998 July	CID20	Financial Credit Line	On 15th July, Korea's new letter of intent announced further easing of macroeconomic policies (T2000)
1998 July	CID21	Financial Credit Line	On 29th July, The Indonesian government requested the cancellation of the existing arrangement with the IMF, and its replacement with a new extended arrangement (T2000)
1998 August	CID22	Financial Credit Line	On 25th, IMF disbursed USD one billion to Indonesia (T2000)
2000 May	CID23	Financial Market recovery	Derivatives markets recovered (T2000)
ITALY			
1998 October	CIT1	Interest rate event	On 26th October, Italy cut its interest rates (T2000)
1999 April	CIT2	Trading Development	Euro MTS, owned by a consortium of 24 investment companies launched its electronic trading (R1999)
1999 May	CIT3	Debt offering	Olivetti launched Europe's largest bond issue to bid for Telecom Italia. It also included Technost, a holding company. (R1999)
1999 May	CIT4	Derivatives trading	Lehman Brothers sells Olivetti a euro 2 million autocap (exotic interest rate option) to hedge its interest rate exposure. (R1999)
1999 June	CIT5	Financial restructuring	Banca Commerciale Italiana accepted friendly takeover from Banca Intesa, which created Italy's largest bank.
1999 November	CIT6	Financial restructuring	Board of Italian insurance firm INA agreed to euro 12 billion taker by the number one insurer Generali (R1999)
HUNGARY			
1987-1998	CHU1	Systemic problems	Stability and growth was impeded. Inadequate reforms to banks lending policy hampered its enterprise restructuring (G1998)

Date	Code	Event Type	Description
JAPAN			
1990	CJP1	Japan Banking crisis	Japan crisis rose in the aftermath of 1990 collapse of real estate and equity markets. From 1955-1990, the Japan real estate market had risen more than 75 times and the myth was that the prices would never fall down. In mid 1990's the prices fell more than 50% and the *'Japanese Miracle'* was over. Financial institutions were holding more than USD 500 billion in non-performing loans. By December 1989, the NIKKEI 225 stock index had reached JPY 38915.87. In January 1990, the markets were abetted by revelations of scandals in which major banks had made significant losses. The financial deflations affected the equity markets and in turn the Japan banking system. (Riskmg7)
1998 June	CJP2	Currency crisis	On 12th June, Japanese yen fell to the dollar due to the fall in GDP by an annualised 5.3% (T2000)
1998 July	CJP	Political event	On July 12th, LDP (liberal Democratic Party) was trounced in upper house elections (T2000)
1998 July	CJP4	Political event	On 13th July, Japanese Prime Minister Ryutaro Hashimoto announced his resignation. (T2000)
1998 July	CJP5	Political event	On July 30th, LDP's Keizo Obuchi was named as Prime minister. (T2000)
1998 October	CJP6	Financial Credit Line	On 3rd October, the government announced USD30 billion under Miyazawa plan to help Asian neighbours (T2000)
1998 October	CJP7	Financial Credit Line	On 16th October, the parliament approved USD500 billion to support country's crumbling financial system. (T2000)
1999 March	CJP8	Financial market recovery	Japanese stock market began recovery after an 18-month slide. Nikkei 225 rose steadily until October, breaking through 18000 level, after which its going was harder (R1999)
1999 May	CJP9	Financial restructuring (Securitization)	Goldman Sachs brought to market USD 200 million, catastrophic risk securitization for Oriental Land Company, the owner and operator of Tokyo Disneyland. (R1999)
1999 July	CJP10	Fraudulent loss event	Japan's financial supervisory withdrew the banking license of CDFBs derivative unit following an investigation into Tobashi deals which were designed to hide losses as well as breaches of firewalls designed to separate trading from fund management (R1999)
1999 August	CJP11	Financial restructuring	Fuji Bank, Dai-Ichi Kangyo Bank and Industrial Bank of Japan announced to set up a holding company, which creates the largest bank in terms of assets. (R1999)

Date	Code	Event Type	Description
KOREA			
1987 April	CKR1	Policy announcement	Koreas announced its trade liberalisation policy. (BHL85)
1987 July	CKR2	Policy reforms	On 1st July, Certain tax privileges, which were announced to attract FDI was reduced, and after-investment controls were relaxed to put foreign investment companies on par with domestic firms. (BHL85)
1987 December	CKR3	Policy reforms	On 28th December, overseas investments of Korean residents upto USD 1 million was automatically approved (BHL85)
1989	CKR4	Currency event	Foreign exchange controls were phased out (BHL85)
1990 November	CKR5	Debt issue	First ADR (American Depositary Receipts) was announced (BHL85)
1991 January 3	CKR6	Trading developments	On 3rd January, markets were opened to foreign investors and new notification system makes authorisation of foreign investment subject to approval (BHL85)
1991 September	CKR7	Stock market changes	Government announced that markets will open to investors in January 1992 after Korea is admitted into United Nations (BHL85)
1992 January	CKR8	Stock market changes	Korea opened its stock markets partially to foreign investors (BHL85)
1994 December	CKR9	Financial restructuring	Foreign ownership limits in domestically listed firms was raised from 10% to 12% (BHL85)
1995 May	CKR10	Trading development	International institutions were permitted to issue won-denominated bonds in the domestic market (BHL85)
1995 July	CKR11	Financial restructuring	Government raised foreign ownership limit from 12% to 15% and single ownership limit from 3% to 5% (BHL85)
1995 September	CKR12	Financial restructuring	Government announced that foreign firms will be able to list on Korean stock exchanges as of 1996 (BHL85)
1996 May	CKR13	Financial restructuring	Government further raised foreign ownership limits of domestically listed firms from 15% to 18% (BHL85)
1996 July	CKR14	Trading developments	Government introduced its own stock index contract on the Korean stock exchange (AR2000)
1996 September	CKR15	Financial restructuring	Government further relaxes ownership from 18% to 20% (BHL85)
1997 May	CKR16	Financial restructuring	Government raised foreign ownership from 20% - 23% (BHL85)
1997 October	CKR17	Currency crisis	On October 30th, Won hit its lowest permitted level of 984.70 within daily trading band (T2000)

Date	Code	Event Type	Description
1997 November	CKR18	Financial restructuring	Government raised foreign share holding limit from 23% to 26%, state-run firms limit was raised to 21% from 18% (BHL85)
1997 November	CKR19	Currency crisis	On 17th November, Central bank announced it will no longer defend the Korean won; currency fell to its daily lower limit (T2000)
1997 November	CKR20	Currency crisis	On November 19th, Korean won trading band was widened by 10%. (T2000)
1997 November	CKR21	Financial Credit Line	On 21st November, Korea requested IMF assistance (AFC1999)
1997 December	CKR22	Financial Credit Line	On 3rd December, IMF announced its USD 58.2billion rescue package to Korea. (T2000)
1997 December	CKR23	Financial Credit Line	On 4th December, IMF approved a USD 21billion stand-by credit for Korea and disbursed USD 5.6 billion (AFC1999)
1997 December	CKR24	Financial restructuring	Government announced 50% foreign ownership ceiling (BHL85)
1997 December	CKR25	Currency event	On 16th December, Korean government allowed its won to float freely.(AR2000)
1997 December	CKR26	Financial Credit Line	On 18th December, IMF disbursed USD 3.5billion to Korea (AR2000)
1997 December	CKR27	Financial Credit Line	On 24th December, Korea sent letter of intent to IMF, pointing the need for acceleration of the programme as the situation detoriated (BHL85)
1997 December	CKR28	Financial Credit Line	On 30th December, IMF further disbursement of USD 2billion to Korea (BHL85)
1997 December	CKR29	The Asian Crisis- credit crunch	Investors shut down credit lines to chaebols, brought massive credit crunch (AR2000)
1998 January	CKR30	Financial re-structuring	On 28th January, international creditor banks and South Korea exchanged short-term debt for new long-term loan swaps. (T2000)
1998 February	CKR31	Financial Credit Line	On 7th February, Korea agreed to third IMF programme and the letter of intent included additional measures to target fiscal deficit to 1% of GDP (BHL85)
1998 February	CKR32	Financial Credit Line	On 17th February, IMF disbursed USD 2 billion to Korea (BHL85)
1998 April	CKR33	Trading development	Futures exchange, stated to be opened in October was put off until first quarter of 1999. (AR2000)
1998 May	CKR34	Financial restructuring	Foreign ownership was raised to 55% and state run firms limit raised to 30% (BHL85)
1998 May	CKR35	Policy reforms	On 25th May, investment policy was amended, stating that foreigners were free to purchase domestic collective investment securities without restriction and they were also allowed to take over corporations. The ceiling on stock holding

			limit was abolished. (BHL85)
Date	**Code**	**Event Type**	**Description**
1998 May	CKR36	Financial Credit Line	On May 29th, IMF Disbursed USD 2 billion to Korea
1998 June	CKR37	Banking crisis	On 29th May, South Korea closed five ailing banks in meeting IMF mandate (T2000)
1998 July	CKR38	Financial re-structuring	On 12th July, government imposed involuntary re-structuring on chaebols (T2000)
1998 July	CKR39	Political event	On 14th July, thousands of South Korean workers protested against wage cuts and layoffs. (T2000)
1998 July	CKR40	Economic event	On 23rd July, Korea recorded 7.0 % unemployment and census showed that 1.5 million was unemployed. (T2000)
1998 August	CKR41	Policy reform	Korea announced several forms to its foreign exchange and equity regulations, and bankers refocused on credit risk issues (AR2000)
1998 August	CKR42	Financial Credit Line	On 25th August, IMF further disbursed USD one billion to Korea
1999 March	CKR43	Policy reform	Korea liberalised its foreign exchange rules. (AR2000)
2000 June	CKR44	Policy reform	Risk management consultants worked with Korea as banks took on credit risk reforms and derivatives markets launched. (AR2000)
MALAYSIA			
1996 April	CMY1	Trading Development	Malaysian Monetary Exchange opened by the end of March; Non-deliverable forwards (NDF) made their debut (AR2000)
1996 November	CMY2	Policy reform	Malaysian government liberalised on derivatives regulations (AR2000)
1997 September - 20	CMY3	Currency crisis	On 20th September, Prime Minister Mahathir informed IMF/World Bank that currency trading was immoral (T2000)
1997 October 8	CMY4	Currency crisis	On 8th October, Malaysian ringgit slumped following prime minister remarks (T2000)
1998 September 1	CMY5	Currency Event	On 1st, September, Malaysia imposed new foreign exchange and capital controls to contain speculation. It announced fixed exchange rate to dollar indefinitely (T2000)
1999 September	CMY6	Operational event	IMF conceded Malaysia's capital controls to limit foreign speculators who bought better than expected results (R1999)
1998 October	CMY7	Currency crisis	Malaysia imposed currency controls in early October (AR2000)
MEXICO			
1982 August	CMX1	Sovereign debt default	Mexico defaulted on its foreign debt obligations (T2000)
1989 June	CMX2	Financial restructuring	Restructuring its troubled bank loans into tradable Brady bonds (T2000)
1994	CMX3	Political event	On 1st January, Zapatista rebels launched peasant

January			uprising in state of Chiapas (T2000)
Date	**Code**	**Event Type**	**Description**
1994 March	CMX4	Political event	On 23rd March, Mexico's presidential heir, Luis Donaldo Colosio was assassinated (T2000)
1994 August	CMX5	Political event	On 21st August, Ernesto Zedillo was elected new Mexican president (T2000)
1994 September	CMX6	Political event	On 29th September, Secretary General was Shot dead (T2000)
1994 December	CMX7	Political event	Zapatista rebel armed conflict (T2000)
1994 December	CMX8	Currency crisis	Mexico was hit with political problems and natural disasters by the end of 1994. On December 1994 the currency band of the Mexican peso was suddenly devalued 13 percent, which also in turn abandoned a seven-year policy of fixing the peso to the US dollar. Mexican interest rates spiked upward following the devaluation and Mexican equity markets dropped as investors pulled out of Mexico. (Riskmg7).
1994 December-	CMX9	Currency crisis	ON 20th December, Mexican peso trading band was broadened and the currency fell by 13% against US dollar (T2000)
1994 December-	CMX10	Currency crises	On 22nd December, Crawling peg system was scraped and the Mexican peso was floated. Markets plunged further 18% and there was turmoil in emerging markets (T2000)
NEW ZEALAND			
1989	CNZ1	Debt Default	The Development Corporation of New Zealand defaulted on its debt obligations. They left a derivative position of NZD 3 billion notional and covered 100 transactions with 70 counterparties (Riskmg7)
OPEC NATIONS			
1990	COP	Iraq invasion of Kuwait	The invasion of Kuwait threatened world oil supplies. The consequences of fear erased USD 1.1 trillion in value from major stock exchanges.(Riskmg7)
1999 July	COP1	Operational problems	The International Petroleum Exchange members voted on demutualisation, but failed to get 75% approval (R1999)
PHILIPPINES			
1997 July	CPH1	Financial Credit Line	On 14th July, IMF announced its financial support package to Philippines (T2000)
1997 July	CPH2	Financial Credit Line	On 14th July, Philippines extended and augmented its existing support programme of 1997 and arranged a stand-by facility in 1998 (AFC1999)
PAKISTAN			
1998 May	CPK1	Political event	On 28th May, Pakistan conducted nuclear tests (T2000)

Date	Code	Event Type	Description
1998 June	CPK2	Financial markets crash	On 1st June, stock market plunged as sanctions were imposed after nuclear tests (T2000)
1999 December	CPK3	Financial restructuring	First eurobond was restructured successfully. (T2000)
RUSSIA			
1996 April	CRU1	Sovereign debt restructuring	Russia began negotiations with Paris and London Clubs for repayment of sovereign debt (R2002)
1996 July- 3	CRU2	Political event	On 3rd July, Boris Yelstin was re-elected into office for second term and he assured investors of free-market path (T2000)
1996 November	CRU3	Debt offering	Government tapped international capital markets with eurobond issue (T2000)
1997 March/April	CRU4	Political event	Boris Yelstin reshuffled his cabinet putting reformers in key positions (T2000)
1997-March	CRU5	Economic crisis	Trade surplus moved towards balance; Inflation was around 11%; Real wages declined, only 40% of workforce were being paid fully and public sector deficit was high (R2002)
1997 November	CRU6	Currency crisis	On 11th November, Asian crisis caused a speculative attack on the Russian ruble. Central Bank of Russia defended the rubble losing USD 6 billion (R2002)
1997December	CRU7	Commodity markets crash	Oil and nonferrous metal prices began to drop (R2002)
1998 February	CRU8	Budgetary reforms	New tax code was submitted to Duma (Lower House in Parliament)(R2002)
1998 February	CRU9	Financial Credit Line	Russian government requested IMF funds (R2002)
1998 march	CRU10	Political event	On 23rd March, Yelstin fired Prime Minister Viktor Chernomyrdin (T2000)
1998March	CRU11	Political event	On 24th March, Yelstin fired entire government and appointed Kiriyenko as Prime Minister (R2002)
1998 April	CRU12	Political event	ON 10th April, Russia's state Duma (lower House of parliament) rejected Kiriyenko as Prime Minister (T2000)
1998 April	CRU13	Currency crisis	Another speculative attack on the rubble (R2002)
1998 April	CRU14	Political event	On 17th, Kiriyenko was rejected again and markets reacted negatively.(T2000)
1998 April	CRU15	Political event	On 24th April, Duma finally confirmed Kiriyenko as Prime Minister (R2002)
1998 April	CRU16	Political event	On 29th April, New Russian cabinet was formed with full of reformers and markets recovered slightly (T2000)
1998 May	CRU17	Political event	On 12th May, Coal miners at Artic north protested over unpaid wages (T2000)

Date	Code	Event Type	Description
1998 May	CRU18	Interest rate crisis	On 19th May, CBR (Central Bank of Russia) increased lending rate from 20 percent to 50 percent (R2002)
1998 May	CRU19	Currency crisis	On 19th May, CBR defended the Russian ruble with USD 1 billion (R2002)
1998 Mid May	CRU20	Currency crisis	Oil prices continued to decrease and oil and gas oligarchs advocated devaluation of the ruble to improve exports (R2002)
1998 May	CRU21	Interest rate crisis	On 27th May, Central Bank tripled key interest rate to 150 percent. (T2000)
1998 May	CRU22	Interest rate crisis	On 27th May, CBR increased lending rate again to 150%. (R2002)
1998 June	CRU23	Interest rates event	ON 4th June, Central bank cut key interest rates to 60% from 150% (T2000)
1998 June	CRU24	Financial Credit Line	IMF delayed loan to Russia, citing problems with implementing reforms (T2000)
1998 June	CRU25	Financial Credit Line	On 19th June, Russia sought additional credit from IMF and other lenders (T2000)
1998 June	CRU26	Financial reform plans	ON 24th June, Yelstin and Kiriyenko presented anti-crisis plan consisting of mainly tax laws. (T2000) (T2000)
1998 June	CRU27	Financial Credit Line	On 25th, IMF approved the release of funds to Russia. (T2000)
1998 July	CRU28	Political event	On 1st July, Siberian miners started new pickets of railways, demanded wage arrears and the resignation of Yelstin. (T2000)
1998 July	CRU29	Financial Credit Line	On 13th, IMF approved a bailout package for Russia (T2000)
1998 July	CRU30	Political event	On 15th July, Duma rejected anti-crisis plan and put down large revenue raising measures (T2000)
1998 July	CRU31	Financial credit Line	On 20th, IMF approved an emergency aid package to Russia (R2002)
1998 August	CRU32	Currency crisis	On 13th August, international financiers advised Russia to devalue and adopt currency board. Stocks declined and treasury bills soared well above 100%. (T2000)
1998 August	CRU33	Financial distress	On 13th, Russian stock, bond and currency markets weakened as a result of investor fears on devaluation (R2002)
1998 August	CRU34	Currency crisis	On 15th August, Yelstin ruled out devaluation and the US dollars became scarce. (T2000)
1998 August	CRU35	Russia Debt crisis	On August 17, 1998, Russia gave up on its defence of the ruble and defaulted on global loan exposure. The Russian crisis caused the Dow Jones 30 Index to fall 4 percent and the FTSE 100 to fall by 3.2 Percent. The Russian default erased the world capitalisation to the extent of USD 4

			trillion (Riskmg7)
Date	**Code**	**Event Type**	**Description**
1998 August	CRU36	Currency crisis	On 17th August, Russia widened its trading band. Exchange rates collapsed and there was frantic search for US dollars. (T2000)
1998 August	CRU37	Currency crisis	On 17th August, Russian government devalued the rubble (R2002)
1998 August	CRU38	Financial restructuring	O 17th August, government ordered 90-day moratorium of repayments to some foreign bank debt and also stated that part of ruble denominated debt will be restructured. (T2000)
1998 August	CRU39	Sovereign debt default	On 17th August, Russia defaults on its domestic debt and declared moratorium on payment to foreign creditors (R2002)
1998 August	CRU40	Political event	On 23rd August, Yelstin dissolved the government, and called back Chernomyrdin as acting Prime Minister. (T2000)
1998 August	CRU41	Currency crisis	On 28th August, ruble trading was suspended on Moscow Interbank Currency Exchange (MICEX) (T2000)
1998 August	CRU42	Political Event	On 31st August, Duma voted against Chernomyrdin as Prime Minister and Yelstin re-nominated him. (T2000)
1998 September-	CRU43	Currency crisis	On 2nd September, Central bank abandoned support for ruble (T2000)
1998 September	CRU44	Political event	On 7th September, Duma rejected Chernomyrdin as Prime Minister for second time. (T2000)
1998 September	CRU45	Political event	On 10th September, Yelstin nominated foreign minister Yevgeny Primakov as Prime Minister (T2000)
1998 September	CRU46	Political event	On 11th September, Parliament approved Primakov as Prime Minister. He promised to go conservative in economic reforms (T2000)
1999 April	CRU47	Financial Credit Line	On 28th April, IMF agreed to lend to Russia, but insisted that Duma must pass some reforms before money is released (T2000)
1999 May	CRU48	Political event	On 12th May, Yelstin sacked Primakov and appoints Sergei Stepashin as acting Prime Minister. (T2000)
2000 February	CRU49	Sovereign debt restructuring	On February 13th, Russia and London Club of Creditors agreed to reschedule soviet debt of nearly USD 32 billion (T2000)
SINGAPORE			
1998 June	CSG1	Policy reforms/ Trading developments	Singapore launched its own '*big bang*' reforms and the Singapore International Monetary Exchange announced to launch them based on a variety of overseas equity indexes (AR2000)
SLOVAKIA			
1998	CSL1	Currency crisis	On 1st October, Abandoned its currency band and

October-1			floated its crown (T2000)
Date	**Code**	**Event Type**	**Description**
SOVIET UNION			
1991 December	CSU1	Political event	Soviet union dissolved into newly independent nations (T2000)
TAIWAN			
1996 July	CTW1	Trading developments	Launched a stock market index futures market (AR2000)
Date	**Code**	**Event Type**	**Description**
THAILAND			
1997 May	CTH1	Currency Crisis	On 14th May, Thai baht came under attack by speculators (T2000)
1997 June	CTH2	Currency event	On 30th June, Prime Minister Chavalit Yongchaiyudh assured the country that the Baht will not be devalued (T2000)
1997 July	CTH3	Currency event	On July 2nd, Thailand announced managed float of baht and requested IMF for technical assistance. (T2000)
1997 July	CTH4	Currency event	On 2nd July, Thailand announced a managed float of the baht and IMF negotiations began for technical assistance (AFC1999)
1997 August	CTH5	Financial restructuring	On 5th August, Thailand announced complete restructuring of finance sector as part of IMF suggested policies (T2000)
1997 August	CTH6	Financial Credit Line	On 11th August, IMF approved a rescue package to Thailand (T2000)
1997 August	CTH7	Financial Credit Line	On 20th August, IMF approved a USD 3.9billion credit for Thailand (AFC1999)
1997 November	CTH8	Political event	On 4th November, Prime minister Chavalit Yongchaiyudh resigned and the Thai baht appreciated on his departure (T2000)
1997 November	CTH9	Political event	On 9th November, Chuan Leekpai was elected as new Prime Minister (T2000)
1997 November	CTH10	Financial Credit Line	On 25th November, Thai baht depreciated more than expected and the IMF second package was approved (AFC1999)
1997 December	CTH11	Financial Credit Line	On 8th December, IMF disbursed USD 810 million to Thailand
1998 February	CTH12	Financial Credit Line	On 24th February, The Thai plan was further modified, with the fiscal policy target adjusted from 1% deficit to 2% of GDP deficit
1998 May	CTH13	Financial Credit Line	On May 26th, Thailand approved the fourth IMF programme. The main priority was to prevent further slowdown of the economy and foster an early recovery
1998 June	CTH14	Financial Credit Line	On 10th June, IMF disbursed USD 135million to Thailand
1998 August	CTH15	Financial Credit Line	On August 25th, The Thai program was modified to incorporate a more comprehensive approach to

			bank and corporate restructuring
Date	**Code**	**Event Type**	**Description**
USA			
1970 June	CUS1	Bankruptcy Event	In June, the surprise announcement of Penn Central Rail Road bankruptcy caused turmoil in the commercial paper market. The US Federal reserve decision to supply liquidity in the market was criticized as unwise due to the potential of moral hazard and there was no serious systemic disturbance in the markets. Others supported the decision that the disturbance would be severe if US Fed had not intervened in it. (Riskmg7)
1973-74	CUS2	Stock market crash	In November 1973, the 7th Stock market crash in US history occurred when the Dow Jones crashed from 1050.71 to 556.0 basis points by the end of June 1974The US markets crashed in 1973-74. The crash lasted for 695 days and the total loss was estimated to be 45.4 percent. It was accompanied by war in the middle east region, restricting oil exports and accelerating inflation.(Riskmg7)
1980 +	CUS3	US Savings and Loan Industry	The Savings and Loan industry lost USD 150 billion in 1980s. The trouble was that their demand for loans was in loan term mortgages and their supply of funds was short term in the form of commercial deposits. The crisis started by the broadening of US potential investors base for mortgage loans and the increase in nominal interest rates as a consequence of inflation.(Riskmg7)
1989 March	CUS4	Financial Restructuring	US treasury secretary proposes plan to restructure LDC (Less Developed Countries) debt (T2000)
1990	CUS5	High Yield Crisis	The Lehman Index fell 22.86 percent between June 1990 and the end of the year. Drexel Burnham Lambert went bankrupt after defaulting on loans worth USD 100 million. The bankruptcy caused collapse of junk bond market. (Riskmg7)
1994	CUS6	US Bond Market sell off	After keeping interest rates low for over three years, the chairman of the US Federal Reserve, Alan Greenspan, began the series of a six consecutive interest rate hikes. Large number of financial institutions suffered significant losses from derivatives that were directly attributed to interest rate hikes. (Riskmg7)
1994 February	CUS7	Interest Rate Crisis	On 4th February, the US Federal Reserve started their series of interest rate hikes by raising it from 3.00% to 3.25%
1994 March	CUS8	Interest Rate Crisis	On 22nd March, the US Federal Reserve made their second interest rate hike from 3.25% to 3.50%

Date	Code	Event Type	Description
1994 April	CUS9	Interest Rate Crisis	On 17th April, US Federal Reserve rates interest rates by 25 basis points from 3.50% to 3.75%
1994 May	CUS10	Interest Rate Crisis	On 17th May, US federal Reserve raised interest rates again by 50 basis points to 4.25%.
1994 August	CUS11	Interest Rate Crisis	On 16th August, interest rates were hiked from 4.25% to 4.75% and the discounted rate was maintained at 4.00%.
1994 November	CUS12	Interest Rate Crisis	On 16th November, US Federal Reserve raised its interest rates from 4.75% to 5.50%
1995 January	CUS13	Financial Credit Line	On 31st January, President Clinton announced international rescue package to Mexico, part of which was drawn from US exchange stabilization fund. (T2000)
1995 February	CUS14	Interest Rate Crisis	On 1st February, US Federal Reserve raised its interest rates from 5.50% to 6.00% and the discount rate was maintained at 5.25%
1997 July	CUS15	Market Crash-One Day Crisis event	In October 1997, after Hong Kong was handed over to Peoples Republic of China (PRC), several events rolled out and there was a general pressure in US markets as investors began to dump their shares due to frenzied selling. The Dow dropped 350 points and trading was halted at 2.36pm for 30 minutes. When the markets reopened, it dropped 200 points further, tripping the circuit breakers at 3.30pm halting the trading for one more hour, imply that trading was over for the day. This was the first day in NYSE history that trading had closed before the end of regular trading hours. (Riskmg7)
1997 October	CUS16	Global market spillover	On 27th October, Asian market worries spilled into global markets, Dow Jones dropped by 554 points; which was the largest single day point loss (T2000)
1997 October	CUS17	Financial markets recovery	On 28th October, Dow Jones rebounded by gaining 337 points which was the largest single day gain ever (T2000)
1998 June	CUS18	Currency crisis	On 17th June, USA joined Japan in buying yen, which appreciated the yen against the US dollar and took markets by surprise (T2000)
1998 August	CUS19	Financial market crash	On 31st August, Wall street suffered its second largest loss, dropping by 6.37% and sparking another series of shocks in Asia (T2000)
1998 September	CUS20	Financial market recovery	On 1st September, Wall street staged its comeback in history, leading to a rally in Asian markets (T2000)
1998 September	CUS21	Economic event	On 4th September, US Federal Reserve Chairman, Alan Greenspan announced that USA cannot remain "Oasis of Prosperity" amid global

			economic stress (T2000)
Date	**Code**	**Event Type**	**Description**
1998 September-	CUS22	Economic event	On 14th September, President Clinton stated that balance of risk in world economy had shifted away from inflation, and the priority was to spur growth (T2000)
1998 September	CUS23	Interest rates event	On 29th September, US Federal Reserve cut interest rates by 25 basis points and the world markets were disappointed that the cut was not as big as expected. (T2000)
1998 October	CUS24	Currency crisis	On October 5th, US dollar fell to the yen as hedge funds unwound their positions (T2000)
1998 October- 15	CUS25	Interest rate event	On 15th October, US Federal Reserve announced a surprise interest rate cut of 25 basis points; Canada followed with dropping their interest rates and world markets started to recover (T2000)
1999 February	CUS26	Policy responses	Basle Committee issued Brockmeijer report in response to LTCM collapse. Report recommend that banks dealing with hedge funds, insist more credit information, but concluded that regulation of hedge funds is impossible due to its offshore nature (R1999)
1999 March	CUS27	Financial market recovery	The DJIA passed the 10000 mark for the first time, and showed evidence of growing gap between the leading stocks and the rest of the market. Technology stocks outperformed the energy, financial and healthcare sectors (R1999)
1999 May	CUS28	Financial restructuring	After 130 years as partnership, Goldman Sachs goes public at the second attempt (R1999)
1999 June	CUS29	Interest rate event	On 20th June, US Federal Reserve Bank raised interest rate by 25 basis points, indicating that global crisis was ending (T2000)
1999 June	CUS30	Fraudulent loss	Bankers Trust name disappeared following its acquisition by Deutsche bank and it was fined USD60 million for falsely recording credit owed to customers. (R1999)
1999 June	CUS31	Policy response	BIS warned bank regulators that they still lack methods to assess the risk taken by hedge funds (R1999)
1999 June	CUS32	Policy response	Another report was published on LTCM from Counter Party Risk Management Policy Group, which made 20 recommendations. (R1999)
1999 June	CUS33	Interest rate event	Us Federal Reserve raises its key short term rate by 0.25%, to 5% (R1999)
1999 August	CUS34	Trading development	LIFFE (London Financial Futures and Options Exchange) and CME announced an alliance, bringing LIFFE's trading system to the CME and in turn provided access to GLOBEX for LIFFE users. (R1999)

Date	Code	Event Type	Description
1999 August	CUS35	Interest rate event	US Federal Reserve increased interest rates by another 0.25%, to 5.25%. (R1999)
1999 September	CUS36	Financial restructuring	GLOBEX alliance expanded to include Brazil's Bolsa de Mercadorias & Futuros (BM&F) (R1999)
1999 September	CUS37	Derivatives Trading	CME introduced weather derivatives trading on GLOBEX. The same month, hurricane floods hit the east coast of the US, forcing the largest US home evacuation (R1999)
1999 September	CUS38	Swap spread changes	10-year swap spreads for AAA corporate risk reached 108 basis points over US treasuries. Central Bank started to ensure liquidity over the Y2K transition and spreads narrowed back (R1999)
1999 October	CUS39	Political event	US Congress approved the repeal of the 1933 Glass-Steagall Act, which had separated the banking and securities industries since the Great Depression.(R1999)
1999 October	CUS40	Technological event	Electronic communications networks had captured an estimated 25% of NASDAQ Trading. NASDAQ suffered a computer glitch that forced the removal of three ECN's (Electronic Component News) from the quote system. Reuters ECN's were also suspended until the problem was rectified (R1999)
1999 October	CUS41	Debt offering	Ford Motor Credit launched USD 5 billion, 10-year bonds priced 126 basis points over the equivalent US treasuries bond. This issue proved extremely popular among investors. (R1999)
1999 October	CUS42	Technological Event	CBOT (Chicago Board of Trade) and EUREX signed an agreement to create an alliance and a new global electronic trading platform. (R1999)
1999 November	CUS43	Debt offering	John Meriwether, founder of LCTM launched his new hedge fund after raising USD 500 million (R1999)
1999 November	CUS44	Financial reform plans	The US General Accounting Office (GAO) recommended better coordination between financial regulators to prevent a similar crisis like LCTM (R1999)
1999 November	CUS45	Interest rate event	The US Federal Reserve Bank raised its interest rates to 5.5% for the final time in 1999. (R1999)
2000 March	CUS46	NASDAQ market correction	The dot-com and telecom bubble busted with the "*march 2000 market correction*", when major corrections were made in the value of "*new economy*" shares. On April 15th 2000, the NASDAQ declined more than 13 percent as investors reacted to a highly overvalued technology driven bull markets of the early

Date	Code	Event Type	Description
			1990s. (Riskmg7)
2001 September	CUS47	Political Event	Market Turmoil arose in the aftermath of the September 11th terrorist attacks on the New York World Trade Center and the Pentagon in Washington DC.
UNITED KINGDOM			
1999 February	CUK1	Financial restructuring	Prebon Yamane, an over-the-counter broker agreed reverse takeover with Marshall. The newly merged firm had an estimated 20% share of London foreign exchange market, with world's largest annual revenues of £ 320 million (R1999)
1999 April	CUK2	Budgetary reform	UK abolished its corporation tax, which was a 25% levy on equity and dividends. (R1999)
1999 April	CUK3	Trading developments	The London International Financial Futures and Options Exchange ends open-outcry for UK gilt futures (R1999)
1999 April	CUK4	Operational problem	Matthew Barrett was appointed as chief executive of Barclays, following the shocking resignation of Michael O'Neil just after two months in the post (R1999)
1999 May	CUK5	Gold market crisis	The Bank of England announced that it would sell more than half of its gold reserves. This information weakened gold prices and reached its lowest level for 20 years (R1999)
1999 July	CUK6	Derivatives Trading	Largest ever swap premium was paid by a life insurance firm with Morgan Stanley Dean Writer to hedge its guaranteed annuity option liabilities (R1999)
1999 August	CUK7	Derivatives Trading	Markets view about UK joining the European union led to widening of spreads between euro and sterling swaps, leading the firms to mispricing trades (R1999)
1999 August	CUK8	Trading development	The London clearinghouse launched its Pan-European repo clearing facility. It also launched Swapclear which offered central clearing for interest rate swaps (R1999)
1999 October	CUK9	Trading development	Eurobor futures trading on LIFFE moved to new connect electronic trading system (R1999)
1999 November	CUK10	Trading developments	LIFFE officially closed its open out-cry financial futures trading floor. (R1999)
1999 November	CUK11	Interest rate event	ECB for the first time raises its three lending interest rates (R1999)
1999 December	CUK12	Technological events/Financial restructuring	Deutsche Borse announced plans to create an electronic communications network. It also had planed to sell its 25% of its total equity in a restructuring operation designed to salvage the creation of Pan-European electronic exchange (R1999)

Appendix.5 – Micro Event Timelines

Table MI.1 MICRO EVENT TIME LINES				
Date	**Institution**	**Code**	**Event Type**	**Description**
AUSTRALIA				
1995	Quantas Superannuation Fund	FQSF	Operational Inefficiency	Lost in excess of AUD 5 million from derivative instruments. Failure to adequately monitor the open positions.(JDM1)
CHILE				
1994 January	Codelco	FCDL	Rogue trading Loss event	Lost approximately USD 207 million from unauthorised trading by Juan Pablo Davila on the London Metals Exchange. (JDM1)
CHINA				
1994 January	China International Petroleum & Chemical Company	FCPC	Currency derivative loss	Lost an estimated USD 44 million in foreign exchange derivative instruments. (JDM1)
1994 September	China National Metals And Mineral Import Co.	FCMM	Currency derivative loss	Lost an estimated USD 55 million from series of foreign exchange related derivatives. Lehman brothers also sued them for contractual fees. (JDM1)
1994 October	CITIC	FCTC	Fraudulent Trading	Loss due to fraudulent and unauthorized trading to the extent of USD 42 million. (JDM1)
2000 October	South China Bank	FSCB	Derivative loss	Initially made profits of USD 6 billion and had long positions in shanghai and Hong Kong indexes and short in US and Japan funds. Lost an estimated USD 10 million with foreign counterparties. (JDM1)
FRANCE				
1996 April	Banque Paribas	FBQP	Financial restructuring event	The bank faced an increased cost of borrowing from lowering their credit rating, which was in the wake of FFR 2.9 billion from 1995. (JDM1)
GERMANY				
1974 June	Bankhaus Id Herstatt	FBIH	Settlement Loss event	USD 628 million in losses for its USA counterparties. Bank closed by German regulatory authorities. (JDM1)
1992	BFG Bank	FBFG	Non-performing loans	Losses mainly attributed to an increased provision for doubtful debts and its owner Credit Lyonnais boosted capital after declaring DM 1.1 billion loss for 1992. (JDM1)

Date	Institution	Code	Event Type	Description
1993 December	Metalgesellschaft	FMGS	Commodity derivatives losses	The US subsidiary of the German conglomerate announced loss of close to DM 2.3 billion from trading in oil futures/forwards contracts. They arose from major liquidity problems inherent to a hedging strategy using futures and occurred when the hedging positions were unwound by the firm. (JDM1)
1996 September	Deutsche Morgan Grenfell	FDMG	Fine Payments	The investment bank stated that it would set aside 450 million pounds for losses by their fund manager Peter Young for authorised trading fines. (JDM1)
2000 January	Electrolux	FELX	Unauthorised trading event	It reported that it had lost USD 11.25 million through unauthorised currency trading, by and unnamed employee working in its internal bank in Germany. (JDM1)
GHANA				
1999	Ashanti	FASH	Commodity derivative loss Event	Lost close to USD 570 million from transactions in exotic gold derivatives. (JDM1)
HONG KONG				
1993 August	First Investment	FFIT	Trading suspension	The USD one billion, leveraged US government bond fund suspended trading. (JDM1)
1998 January	Peregrine Investments Holdings	FPGH	Bankruptcy	The leading investment banks were hit by Asian crisis and the losses realised form loans to Asian borrowers who couldn't repay their foreign currency loans. (JDM1)
INDIA				
1993	Pompuhar Shipping Corporation	FPSC	Currency derivative loss	Anticipating fall of the rupee, they purchased USD 8 million forwards, finally lost Rs. 17 million. (JDM1)
1998 September	US-64 Managed Fund	FUMF	Operational losses	Had a shortfall of USD one billion, lost consumer confidence and investors pulled out from the fund to the tune of USD 20 million. (JDM1)
INDONESIA				
1994	Indarayon	FINR	Derivative trading losses	The group lost USD 3.3 million in derivatives trades
1994	Pt Dharmala Sakti Sejahtara	FDSS	Interest rate derivative losses	The company lost USD 64- 65 million from dealings in leveraged swaps and LIBOR barrier swaps. (JDM1)

Date	Institution	Code	Event Type	Description
1995	Sinar Mas Group	FSMG	Interest rate derivative loss	The group lost approximately USD 69 million from dealings in interest rate and currency derivatives. (JDM1)
IRELAND				
2002	Allied Irish Banks	FAIB	currency derivative loss event	John Rusnak, a trader at the Baltimore based Allfirst Bank, subsidiary of Allied banks lost USD 691 million through foreign exchange derivatives trading. (JDM1)
ITALY				
1982	Banco Ambrosiano Of Milano	FBAM	Operational crisis	The president Roberto Calvi was found hanging under the blackfires bridge in London and the bank had debts to the extent of USD 1.3 billion. (JDM1)
1994 September	Olivetti	FOLV	Debt derivative losses	The Italian computer and office equipment concern reported USD 220 million in losses from bond derivatives. Market risk exposure caused the problems. (JDM1)
JAPAN				
1992 Autumn	Sumitomo Corporation	FSTC	Interest rate derivative loss	Sumitomo Finance International, which is a London- based division of the Sumitomo bank lost between USD 2.6 million on its interest rate options book after an employee had apparently concealed his true trading position from senior management. (JDM1)
1993	Japanese Postal Savings Bureau	FJPS	Currency crisis	The postal bureau lost several billion US dollars from currency exchange trading. (JDM1)
1993 February	Showa Shell Sekiyu	FSSS	Speculative trading loss	The oil refiner reported unrealised losses between 125 billion and 166 billion JPY, involving speculation in Yen/USD foreign dollar contracts/ historical rate rollovers. (JDM1)
1993	Nippon Steel Chemicals	FNSC	Currency derivative losses	They lost an estimated 13.9 billion yen due to dealings in forward agreements and currency futures that were entered in 1990 and committed the company. There were no offsetting gains to hedge the losses. (JDM1)

Date	Institution	Code	Event Type	Description
1993	Tokai Corporation	FTKC	Currency derivative loss	The gas company lost close to 3.87 JPY from dealings in Australia and US currency options and forwards. (JDM1)
1994 April	Kashima	FKSH	Speculative trading losses	Kashima oil, affiliated to Mitsubishi corporation announced unrealised losses of 153 billion yen on foreign exchange speculation in Japanese yen/ USD forward contracts. (JDM1)
1994	Hanwa Corporation	FHNC	Speculative trading loss	The company was highly involved in speculative investments and they lost 177 billion yen and part of it was attributed to derivatives. (JDM1)
1994	Nippon Mortgage	FNPM	Deft default	The company collapsed with liabilities of more than 518 billion yen. This was the third largest corporate failure since World War II and is attributed to Japanese real estate bubble. (JDM1)
1994	Japan Airlines	FJPA	Currency crisis	The airlines company had unrealised losses to the extent of 176 billion yen and all began when the yen was 165/1USD and continued to strengthen to 79/1USD. (JDM1)
1995	Kanematsu Corporation	FKMC	Commodity derivatives losses	They lost USD 83 million from dealings in oil futures. (JDM1)
1995	Nippon Sanso	FNPS	Interest rate derivative losses	The company lost approximately 11.9 billion yen from dealings in Japanese yen yield curve swaps. They were betting that the two reference interest rates would narrow, but they unfortunately widened from under 100 basis points. (JDM1)
1995	Tokyo Securities	FTKS	Trading Event	The Japanese firm affiliated with Nikko securities posted extraordinary losses of approximately JPY 32 billion from dealings with OTC options on US treasury instruments, UK gilts, and other various foreign currencies. (JDM1)

Date	Institution	Code	Event Type	Description
1995 September	Daiwa Bank	FDWB	Non-disclosure losses	Toshihide Iguchi who traded on the New York city branch had allegedly accumulated and concealed USD 1.1 billion in losses from transactions in US treasury bond futures. (JDM1)
1996 June	Sumitomo Corporation, Copper Futures And The Sumitomo Affair	FSTC1	Unauthorised trading	Yasuo Hamanaka, the head copper trader for the Japanese trading company lost close to USD 2.6 billion. The loss was attributed to unauthorised trading and fraud in copper futures and options on the London metal exchange. (JDM1)
1997	Bank Of Tokyo	FBTK	Mispricing loss	Losses amounting to USD 83 million due to misprising of swaptions on US interest rates. (JDM1)
1997	Industrial Bank Of Japan	FIBJ	Mispricing loss event	The London branch of the bank lost 10 billion yen due to mis-pricing of interest rate swaps. (JDM1)
1998 March	Yakult Honsha	FYHS	Index Derivatives loss	The Japanese firm lost close to USD 523 million from transactions in stock index derivatives. (JDM1)
MALAYSIA				
1994	Berjaya Industrial	FBJI	Interest rate derivative loss	Lost approximately USD 14 million from Austrian dollar and deutsche mark leveraged interest rate swaps. (JDM1)
NETHERLANDS				
1991	ABN AMRO	FABN	Fraudulent trading	A trader hid losses from transactions in options trading to the extent of USD 70 million. (JDM1)
2000 July	AIG	FAIG	Accounting revaluation losses	AIG, and the Dutch insurance company lost approximately USD 90 million due to derivatives revaluation. (JDM1)
SWITZERLAND				
1997 July	Union Bank Of Switzerland	FUBS	Regulatory loss Event	The bank made losses that exceeded USD 70 million when the UK New labour government abolished the obscure tax break that had allowed pension funds to claim back taxes paid of share dividends. Losses arose out of transactions made by USB's global equities group. (JDM1)

Date	Institution	Code	Event Type	Description
1998 January	Union Bank Of Switzerland	FUBS1	Index Derivative Losses	The largest Swiss Bank acknowledged it had lost between 500 million to SFR one billion from equity derivatives transactions. The losses arose from complicated transactions using long dated index options. (JDM1)
1998	Credit Suisse, First Boston	FCFB	Debt default	Defaults in Russian operations, provisions made for USD 1.6 billion, of which USD 637 million was due to forwards. (JDM1)
TAIWAN				
1995	Overseas Chinese Bank	FOCB	Derivative losses	The bank lost USD 20 million from series of quanto swaps over previous two years (JDM1)
THAILAND				
1994	TPI Polene	FTPI	Currency derivatives loss	The petrochemical company lost USD 31.3 million from mis-hedging of an underlying deutsche mark exposure with currency swap (JDM1)
UNITED KINGDOM				
1988	Hammersmith & Fulham London Borough Council	FHFL	Interest rate derivative loss	The council lost approximately 500 million pounds from sterling interest rate swaps. (JDM1)
1989	Midland Bank	FMLB	Interest rate derivative loss	The company reported BPD 116 million on a wrong bet on the future direction of the interest rate movements. Instead of pulling out, they moved against the position (JDM1)
1990	British And Commonwealth Merchant Bank	FBCB	Debt default	The bank defaulted on its obligations and collapsed. It had 1.5 – 2.0 billion pounds outstanding in notional and its derivatives when defaulted. (JDM1)
1991 March	Allied Lyons Plc	FALP	Speculative Trading	Lost between 147 and 150 million pounds in foreign exchange options. The magnitude of these options grew beyond their foreign currency cash flows implying that they had gone into speculating (JDM1)
1992 June 25	Lloyds Of London	FLLL	Catastrophic loss event	Lloyds faced a loss of USD 3.82 million from policies written in 1989 and the losses reported in 1988 were due to major natural disasters. (JDM1)

Date	Institution	Code	Event Type	Description
1992 December	Barclays Bank	FBCB	Non-performing loans	The bank set aside 2.5 to 2.6 Billion pounds for bad and doubtful debts and declared its first yearly losses in history (JDM1)
1994 July	Glaxo Holdings	FGXH	Accounting provisions loss	The pharmaceutical company set aside provisions of GBP 115 million and 16 million pounds for losses on derivatives and asset backed bonds (JDM1)
1994 September	Gestetner	FGTN	Interest rate derivative loss	It lost 6.1 million GBP on two leveraged swaps (JDM1)
1995 February	Barings Bank Plc	FBRB	Fraudulent trading event	USD 1.3 –1.4billion from proprietary trading of long ranger-cum-trader Nick Lesson, working in Singapore office. ECU clearing almost grid locked (JDM1)
1996 July	Barclays De Zeote Wedd	FBZW	Mis-pricing loss	Lost 90 million British pounds from misprising foreign exchange options (JDM1)
1997 March	National Westminster Bank	FNWB	Mis-pricing loss	The bank announced that they need a loss write off of BPS 77 million against pre-tax profits, which occurred from mis-pricing out of the money over-the-counter interest rate options (JDM1)
USA				
1975	Merrill Lynch And Mortgage Derivatives	FMLM	Mis-pricing loss	It lost USD 70 million from pricing errors that resulted in undervalued IOs and overvalued Pos (JDM1)
1980	La Fontaine Grain Co-Operative	FLFG	Currency crisis	Lack of hedging resulted in loss of USD 424 million (JDM1)
1982 May	Drysdale Government Securities Inc	FDGS	Lawsuit Damages	Heuwetter couldn't meet interest payments and the damage from lawsuits was estimated at USD 20 billion. (JDM1)
1982	Chase Manhattan Bank	FCMB	Operational loss	Major player in repos market and due to fall of Drysdale securities, Chase lost USD 250 million. (JDM1)
1985 November	Bank Of New York	FBNY	Technological event	Failure of the CHIPS clearing system, no crisis involved, but left deficit of USD 23 billion in reserve account, bailed out by US Federal Reserve (JDM1)
1986	Canadian Imperial Bank	FCIB	Interest rate derivative losses	Lost USD 10 million due to interest rate swaps (JDM1)

Date	Institution	Code	Event Type	Description
1987	First Boston	FFBS	Debt derivatives loss	Lost USD 50 million in OTC bond options (JDM1)
1987	Merrill Lynch	FMRL	Unauthorised Trading	It lost an estimated USD 377 million through unauthorized dealings in mortgage derivatives (JDM1)
1988	Financial Corporation Of America	FFCA	Financial restructuring	Derivative strategies that amounted to large unhedged bets. Government sold part of the FCA, and then the government kept the bad loans and paid USD 1.7 billion to depositors. (JDM1)
1989	Lincoln Savings Of California	FLSC	Fraudulent trading	Political environment turns decisively antitrust, links of Lincoln in insider trading scandal. Eventually cost of closing down was in excess of USD one billion. (JDM1)
1989	Chemical Bank	FCHB	Mispricing	Due to misprising, its known to have lost approximately USD 33 million in interest rate cap book (JDM1)
1990 February	Drexel Burnham Lambert	FDBL	Liquidation event	It suffered loss in confidence leading to liquidation; It had USD 30 billion in derivative portfolios but finally gained USD 10 million after unwinding their positions (JDM1)
1991	JP Morgan	FJPM	Mortgage derivatives loss	It lost approximately USD 50 million in 1991 and close to USD 200 million in 1992 in mortgage derivatives. (JDM1)
1991	Solomon Brothers	FSMB	Rogue trading	Tried to "Corner" the US treasury market and was fined USD 290 million for violating rules and lost consumer confidence. (JDM1)
1991	Bankers Trust	FBKT	Transaction loss event	Set aside USD 39 million for non-performing assets from interest rate swaps (JDM1)
1991 January	Bank Of New England	FBNE	Non-performing Loans	Bad loans, lending too much to property firms despite asset price bubble burst. Losses estimated at USD 450 million. (JDM1)
1992 November	Dell Computers	FDLC	Interest rate derivatives loss	Lost USD 35 million from leveraged interest rate swaps (JDM1)
1993	Kidder Peabody	FKDP	Mis-pricing loss	Lost approximately USD 83 million by mis-pricing and false reporting. It was finally sold to Paine Webber at a loss of USD 1.5 billion (JDM1)

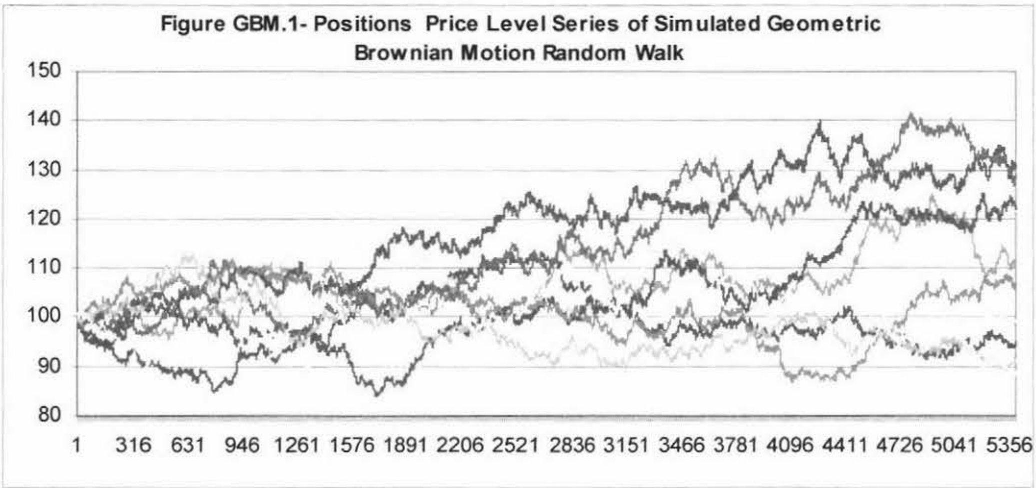
Date	Institution	Code	Event Type	Description
1993	Jefferson Smurfit	FJFS	Derivative transaction losses	They allegedly lost USD 2.4 million due to derivative business transacted with Bankers trust securities corporation (JDM1)
1994	Confederation Life	FCFL	Bankruptcy event	Financial demise due to derivative loss. (JDM1)
1994 March	Gibson Greetings	FGBG	Interest rate derivatives loss	Lost between USD 16.3 to USD 23 million in interest rate derivative transactions, arranged by Bankers Trust (JDM1)
1994 March	Credit Suisse, First Boston Investment Company	FCFB1	Fraudulent trading event	Unauthorized use of derivatives trades, loss approximately USD 40 million (JDM1)
1994 March	Steinhart Hedge Fund	FSTF	Regulatory losses	Estimated loss of USD one billion was attributed to six consecutive interest rate increases (JDM1)
1994 April	Mead Corporation	FMDC	Debt derivative transaction loss	Lost USD 12.1 million in debt hedging operations. (JDM1)
1994 April	Procter And Gamble	FPAG	Currency derivative loss	Lost an estimated USD 195 million from ill-judged bets on future interest rates using currency swaps. (JDM1)
1994 April	Granite Fund Management	FGFM	Regulatory losses	Unanticipated change in policy measures leading to default in calls and the USD 600 million fund was reduced to USD 30 million after liquidation (JDM1)
1994 May	Sandoz Pharmaceutical	FSDP	Derivative transaction loss	Lost between USD 60 – 80 million in derivative transactions arranged by bankers trust. (JDM1)
1994 May	Louisiana State Retirees Program	FLSR	Interest rate derivative loss	Lost USD 25 million from positions in interest only strips and principal only strips (JDM1)
1994 June	Bank America	FBAM	Operational loss	Bank America Pacific Horizon fund derivative loss was in excess of USD 167.8 million, Bank America injected USD 68 million to keep share price above one USD. (JDM1)
1994 June	Paine Webber US Government Income Fund	FPWG	Mortgage derivative loss	It lost approximately USD 268 million in mortgage based structured notes to enhance returns. (JDM1)
1994 June	Harris Trust And Savings Bank	FHTS	Mortgage derivatives loss	Division of Bank of Montreal, lost USD 51.3 million from their mortgage derivatives (JDM1)
1994 July	Federal Paper Board Company	FFPB	Interest rate derivative loss	Lost USD 47 million in interest rate derivatives transacted with Bankers trust. (JDM1)

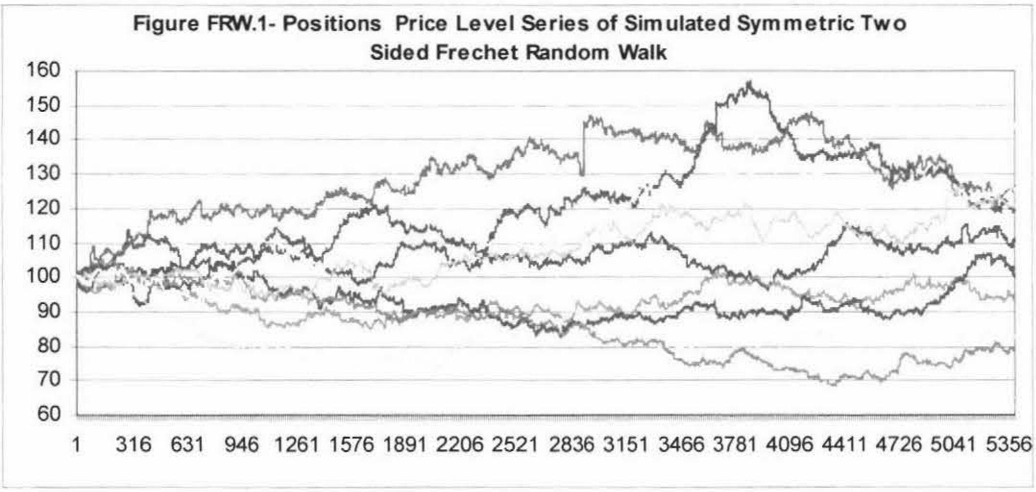
Date	Institution	Code	Event Type	Description
1994 August	Air Products And Chemicals	FAPC	Interest rate derivative losses	Lost USD 60 million, involving interest rate derivatives by Bankers Trust. (JDM1)
1994 August	Piper Jaffray Funds Inc	FPJF	Mortgage derivative loss	They lost an estimated USD 700 – 800 million due to misuse of mortgage-based securities, losing 27% of their portfolio. (JDM1)
1994 September	Investors Equity Life Insurance Company	FIEL	Speculative trading loss	It lost USD 90 million by the use of 30-year bond futures to create leveraged position, which evolved into speculation (JDM1)
1994 September	Sears	FSRS	Interest rate derivative loss	Lost USD 237 million by use of swaps (JDM1)
1994 October	Eastman Kodak	FESK	Liquidation loss	Unwounded numerous contracts in connection to a debt tender of USD 4.8 billion. Their costs amounted to USD 220 million (JDM1)
1994 December	Atlantic Richfield	FARF	Currency derivative loss	Lost USD 22 million due to multi-million dollar derivatives (JDM1)
1994 December	Chemical Bank	FCHB1	Fraudulent trading event	Unauthorized use of currency derivatives, Chemical Bank lost USD 70 million (JDM1)
1994 December	Orange County Council	FOCC	Interest rate derivative loss	Losses due to hike in interest rates where Citron was betting on falling rates, with an estimated loss of USD 1.5 to USD 2.0 billion. (JDM1)
1995 February	Capital Corporate Federal Credit Union	FCCF	Mortgage Derivative Losses	It lost USD 126 million in February of 1995 through the use of mortgage derivatives (JDM1)
1995 February	MCN Corporation	FMCN	Currency Derivative Losses	It lost USD 10 million through the use of forwards (JDM1)
1996Augu st	Fidelity Corporation	FFLC	Fraudulent loss	Fund manager went missing leaving USD 2.2 million in client's money unaccounted (JDM1)
1997 November	Chase Manhattan Bank	FCMB1	Trading event	Trading in emerging market debts, known to have USD 200 million in complex derivatives (JDM1)
1997	Victor Niedehoffer's Hedge Fund	FVNH	Debt default	Stock market plummeted by 8% and the Asian crisis dried liquidity, he was unable to meet his margin calls, causing his hedge fund to collapse (JDM1)
1998	Bank Boston Corporation	FBBC	Fraudulent Trading loss	Discovered USD 73 million in irregular loans to fraudulent or nonexistent collateral to friends of an employee. (JDM1)

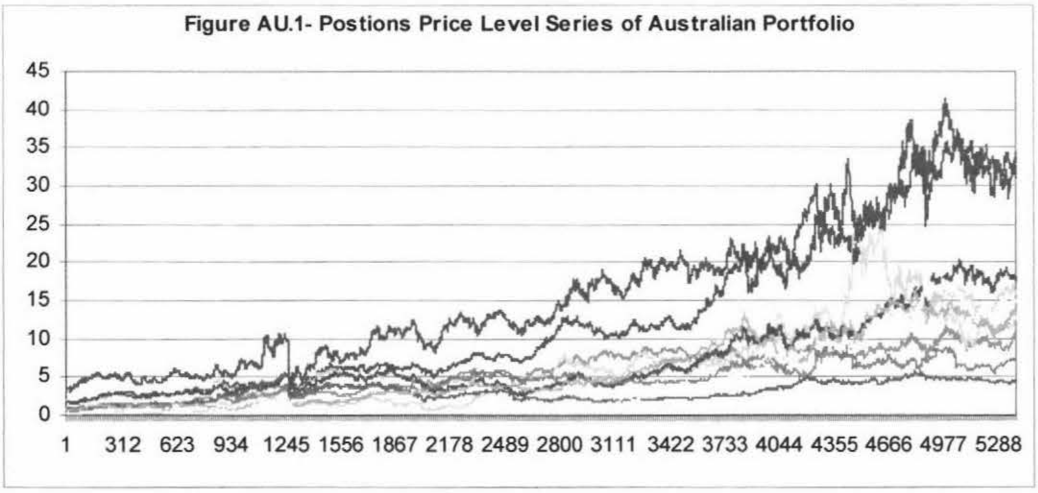
Date	Institution	Code	Event Type	Description
1998	Long Term Capital Management	FLTC	Liquidity / Model risk loss event	Multiple losses cumulative to approximately USD 4.4 billion and the US federal Reserve created a bailout package of USD 3.65 billion from a consortium of financial institutions. (JDM1)
1998 September	High-Risk Opportunity Fund	FHRO	Debt default	Liquidated a month after Russia suspended bond and currency trading in august 1998. European banks also suspense payments to the fund to the extent of USD 400 million (JDM1)
1998 October	D.E. Shaw	FDES	Model risk event	One of the imitators of LTCM ended the joint venture with Bank of America and later when NationsBank took over Bank of America, they announced loss of USD 370 million from positions that D.E. Shaw had opened. D.E. Shaw blamed the failure on computer models (JDM1)
2000- March	Agro Employees Savings Program	FAES	Money-market trading losses	Lost USD 22 million due to money market derivatives. (JDM1)
2002 January	WorldCom	FWLC	Accounting Fraud	Mr Ebbers, chief executive borrowed hundreds of millions from the firm to underwrite the inflated prices he paid for the company shares. The company admitted that it had inflated its profits by USD 3.8 billion (BBC2003)
2002 October	Enron	FENR	Accounting Fraud	Enron admitted it inflated its profits sending shares even lower after US financial regulator launched an investigation into the firm and its results (BBC2003)
2002 June	Adelphia	FADP	Accounting Fraud	The telecom company filed bankruptcy on June 25 and admitted that it had restated its profits and that it didn't have as many cable operators as it had claimed. (BBC2003)
2002 April	Xerox Corporation	FXER	Accounting Fraud	Xerox misstated four years worth of profits, resulting in an overstatement of close to USD 3 billion (BBC2003)

Date	Institution	Code	Event Type	Description
2002 June	Tyco Conglomerate	FTYC	Accounting fraud	The firm was charges with avoiding USD 1 million in New York state sales taxes on purchases of artwork worth USD 14 million (BBC2003)

Appendix.6 - Position Price Level Series Graphs for Portfolios







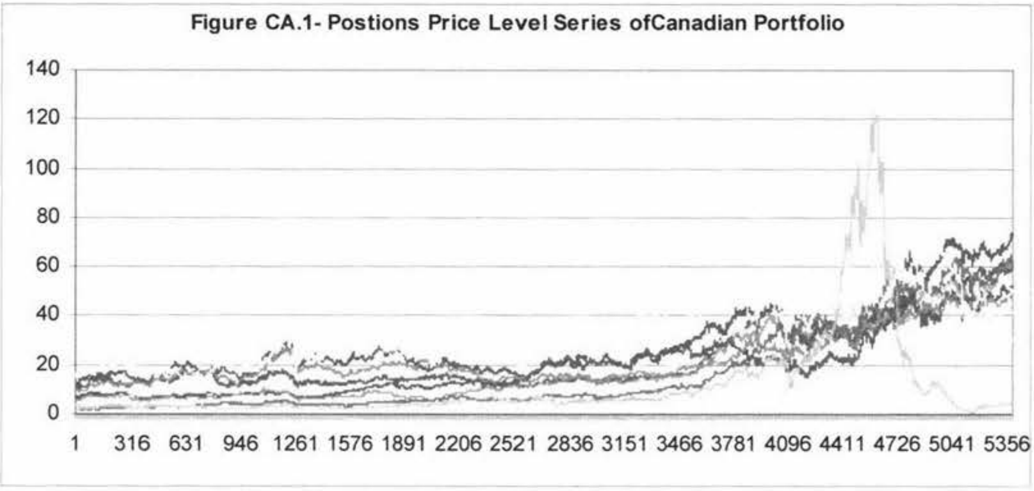


Figure CA.1- Postions Price Level Series ofCanadian Portfolio
140
120
100
80
60
40
20
0
1 316 631 946 1261 1576 1891 2206 2521 2836 3151 3466 3781 4096 4411 4726 5041 5356

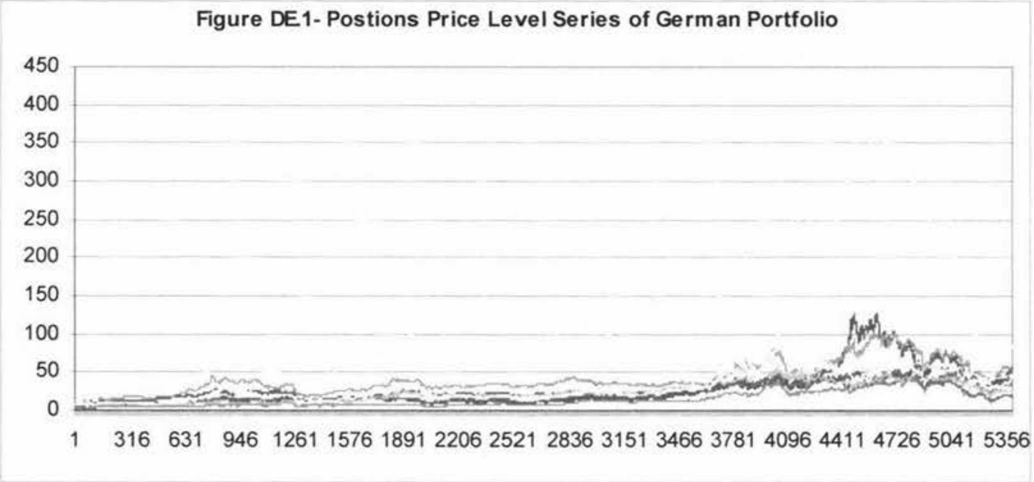


Figure DE.1- Postions Price Level Series of German Portfolio
450
400
350
300
250
200
150
100
50
0
1 316 631 946 1261 1576 1891 2206 2521 2836 3151 3466 3781 4096 4411 4726 5041 5356

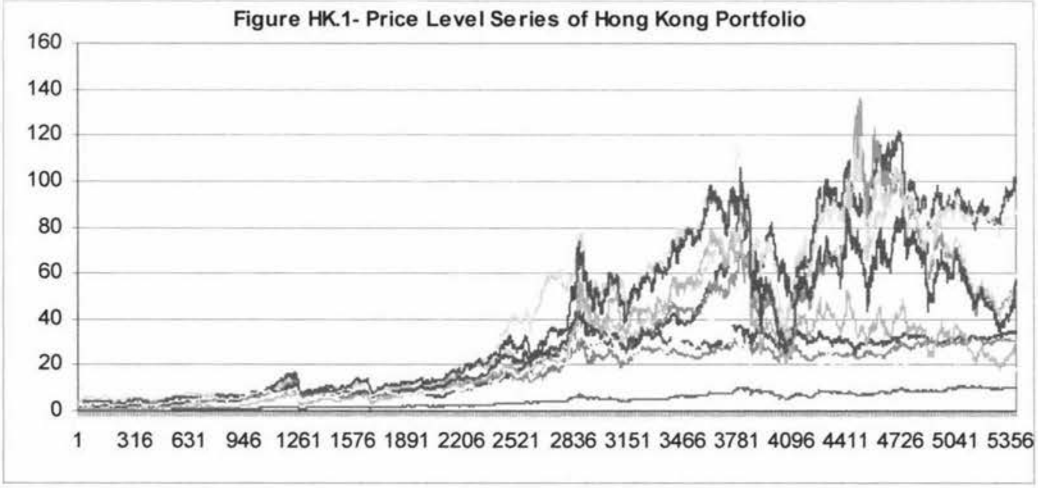


Figure HK.1- Price Level Series of Hong Kong Portfolio
160
140
120
100
80
60
40
20
0
1 316 631 946 1261 1576 1891 2206 2521 2836 3151 3466 3781 4096 4411 4726 5041 5356

Figure JP.1- Postions Price Level Series of Japanese Portfolio

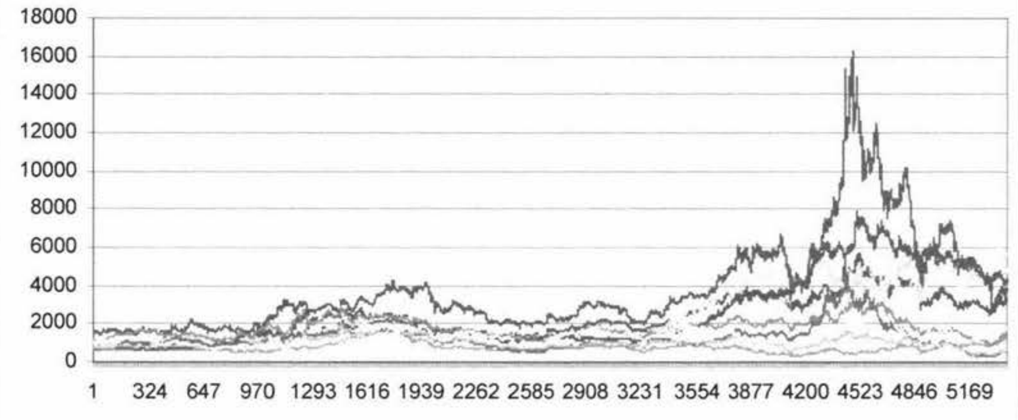


Figure SG.1- Position Price Level Series of Singaporean Portfolio

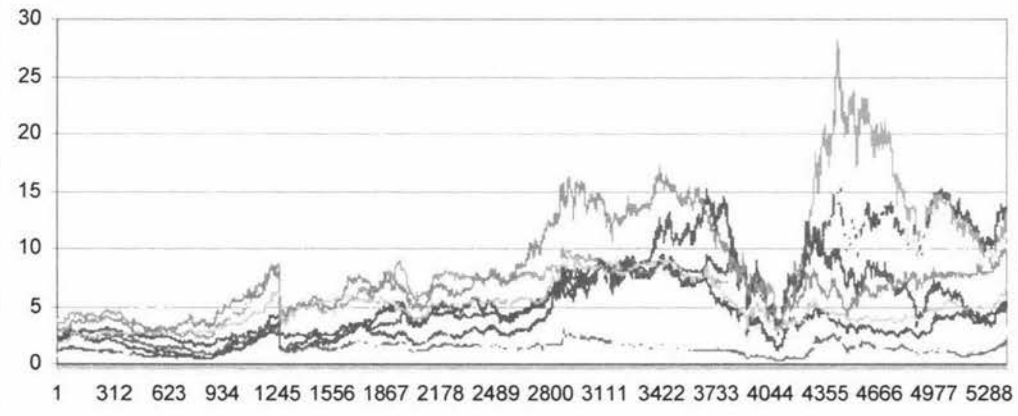


Figure SE.1- Postions Price Level Series of Swedish Portfolio

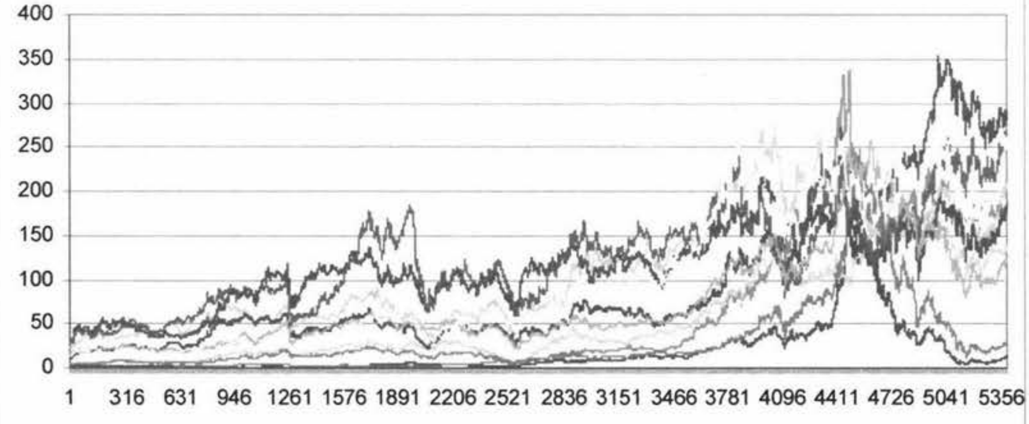


Figure CH.1- Postions Price Level Series of Swiss Portfolio

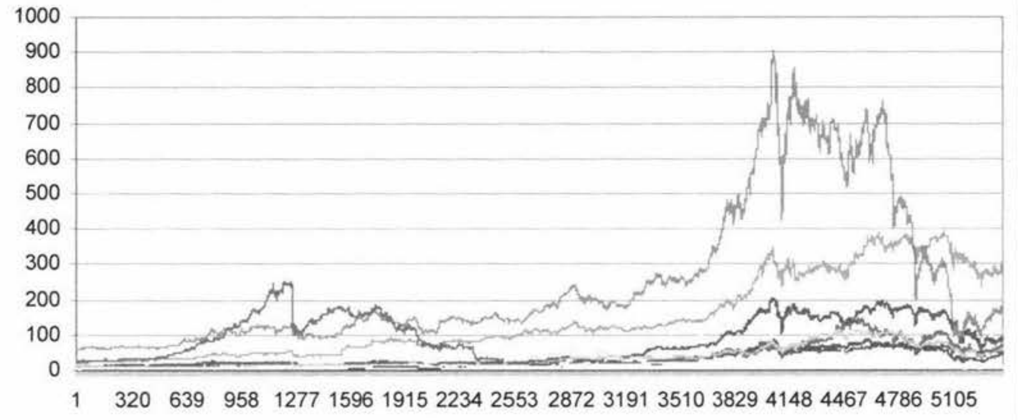
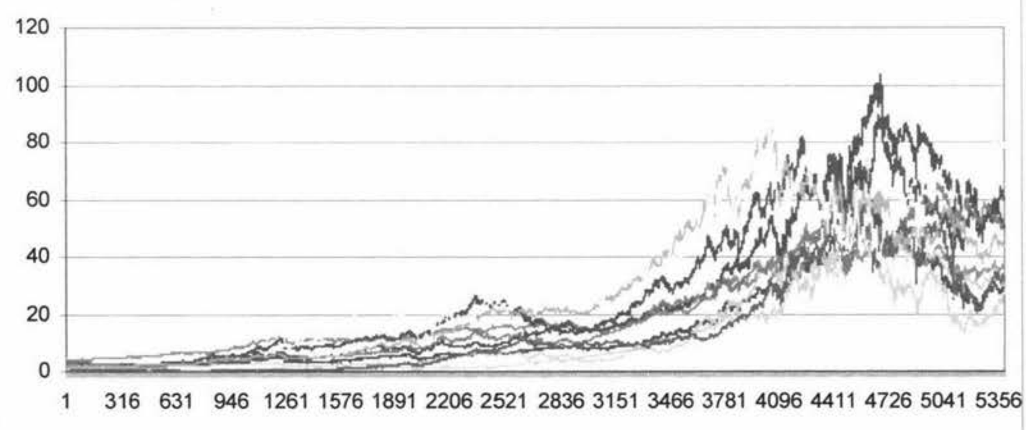
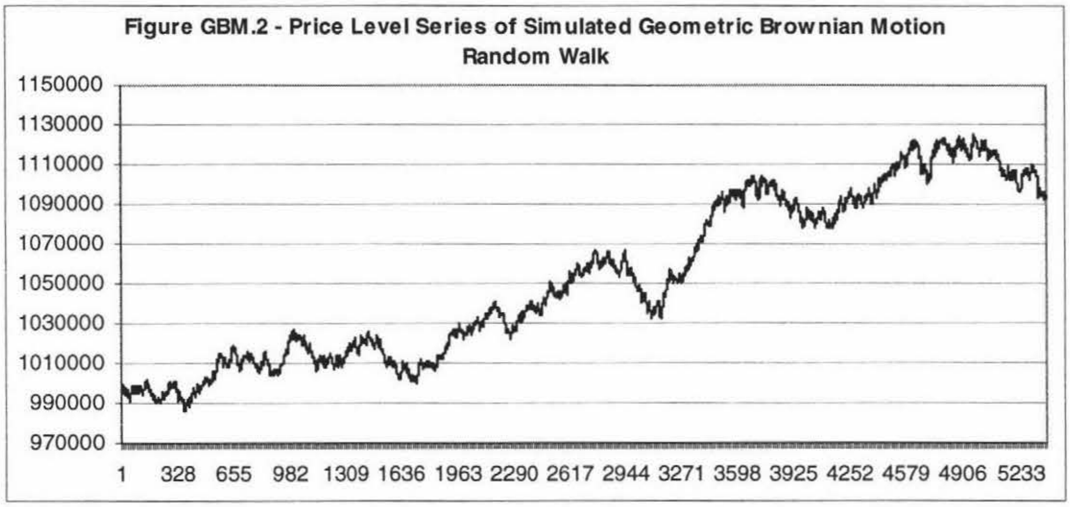


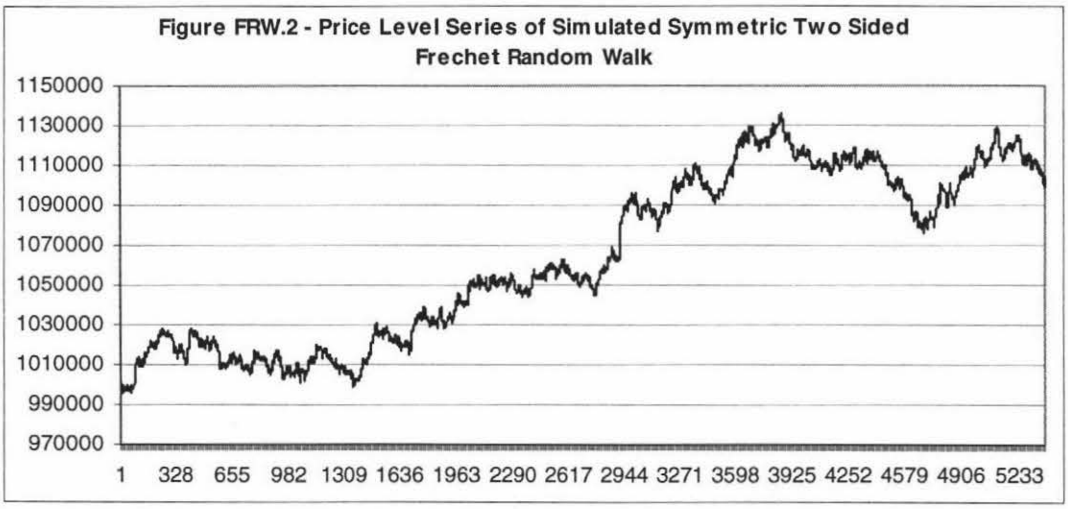
Figure UK.1- Price Level Series of United Kingdom Portfolio

Figure US.1- Position Price Level Series of United States Portfolio



Appendix.7 - Price Level Series Graphs for Ten Position Portfolios





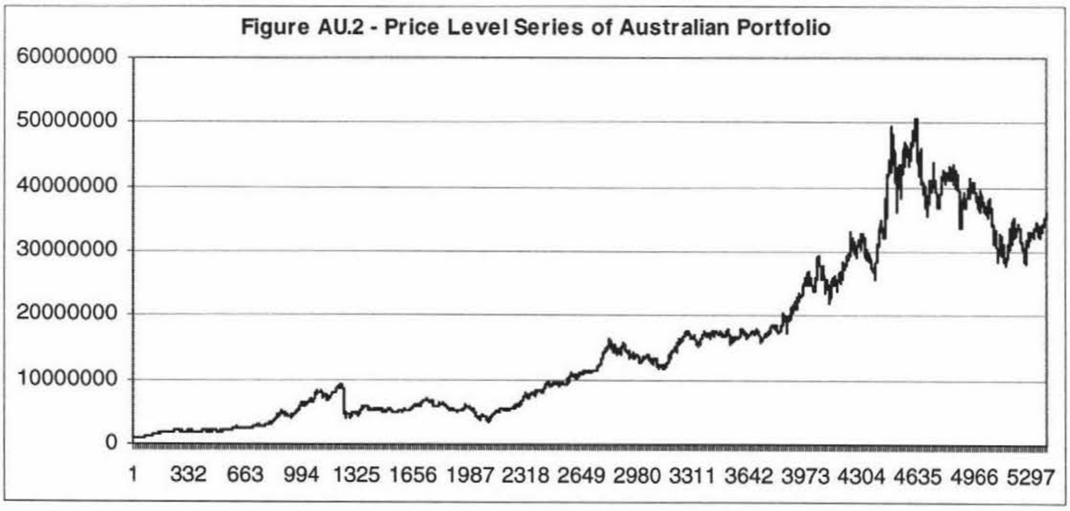


Figure CA.2 - Price Level Series of Canadian Portfolio

Figure DE.2 - Price Level Series of German Portfolio

Figure HK.2 - Price Level Series of Hong Kong Portfolio

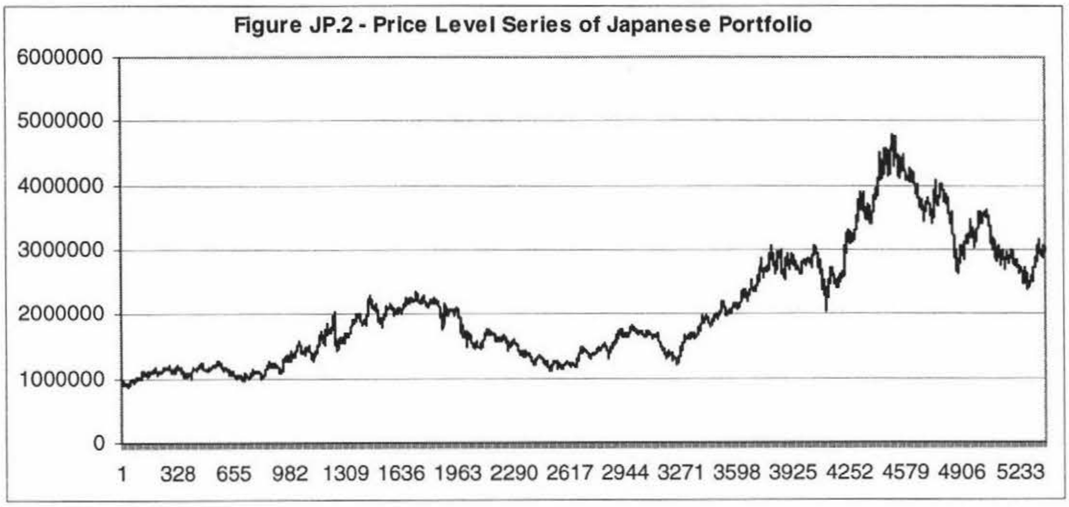


Figure JP.2 - Price Level Series of Japanese Portfolio
6000000
5000000
4000000
3000000
2000000
1000000
0
1 328 655 982 1309 1636 1963 2290 2617 2944 3271 3598 3925 4252 4579 4906 5233

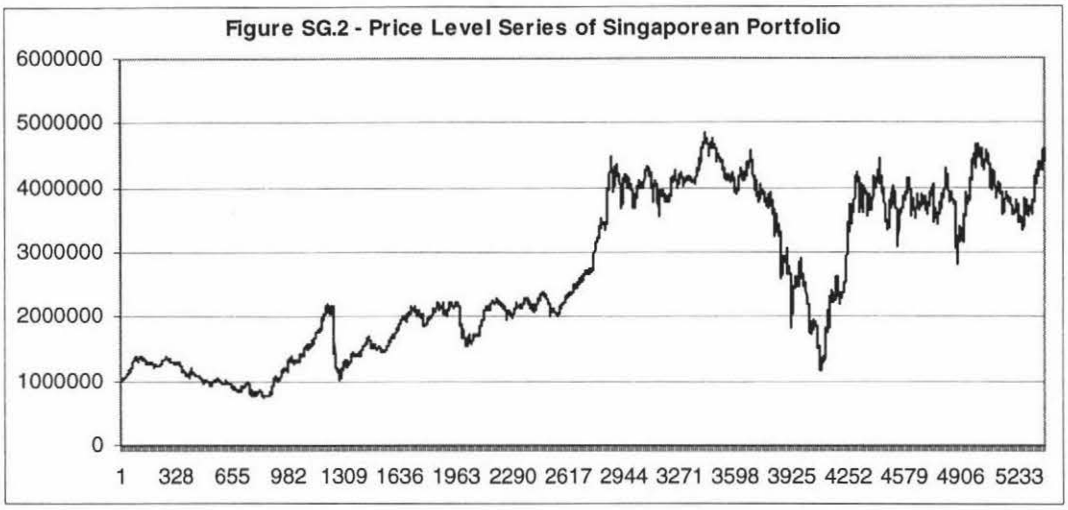


Figure SG.2 - Price Level Series of Singaporean Portfolio
6000000
5000000
4000000
3000000
2000000
1000000
0
1 328 655 982 1309 1636 1963 2290 2617 2944 3271 3598 3925 4252 4579 4906 5233

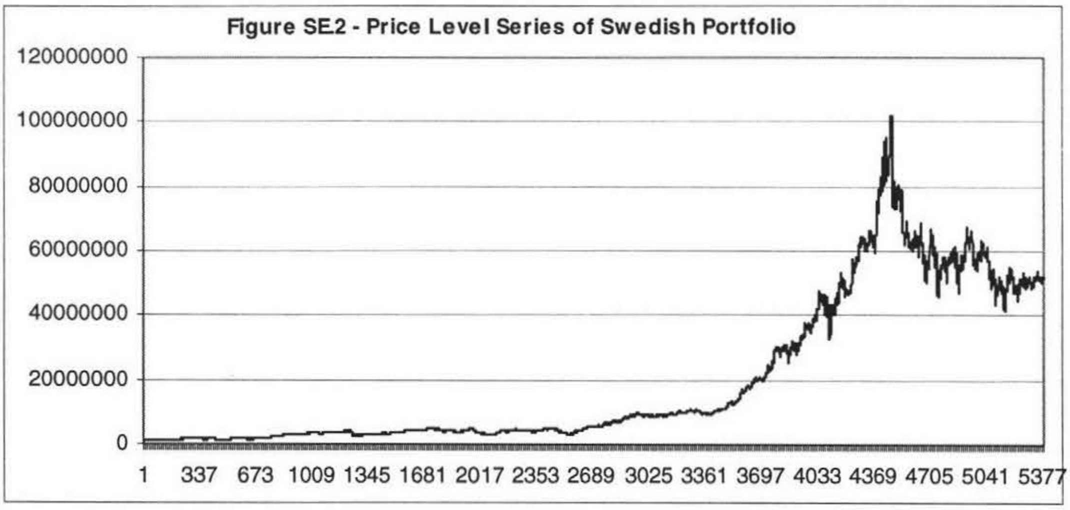
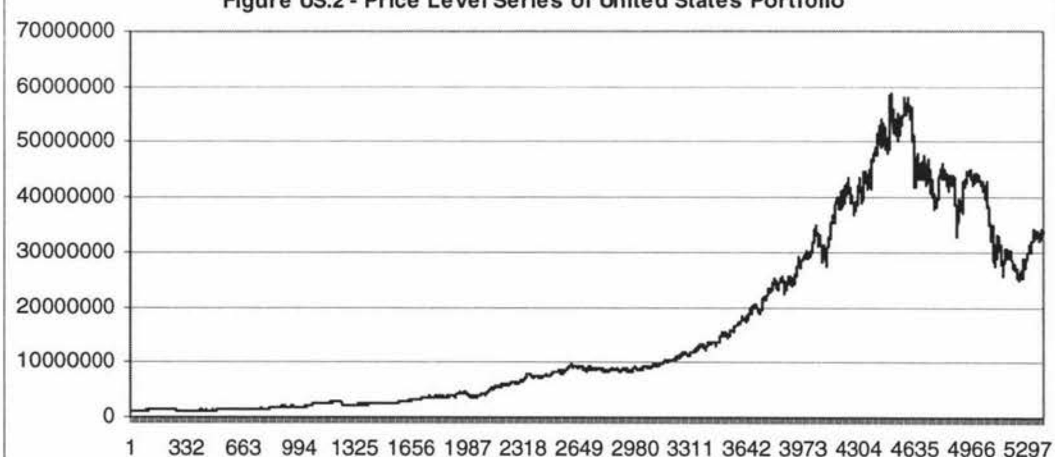


Figure SE.2 - Price Level Series of Swedish Portfolio
120000000
100000000
80000000
60000000
40000000
20000000
0
1 337 673 1009 1345 1681 2017 2353 2689 3025 3361 3697 4033 4369 4705 5041 5377

Figure CH.2 - Price Level Series of Swiss Portfolio

Figure UK.2 - Price Level Series of United Kingdom Portfolio

Figure US.2 - Price Level Series of United States Portfolio



Appendix.8 - Log-Return Series Graphs for Ten Position Portfolios

Figure GBM.3 - Log-Returns Series of Simulated Geometric Brownian Motion Random Walk

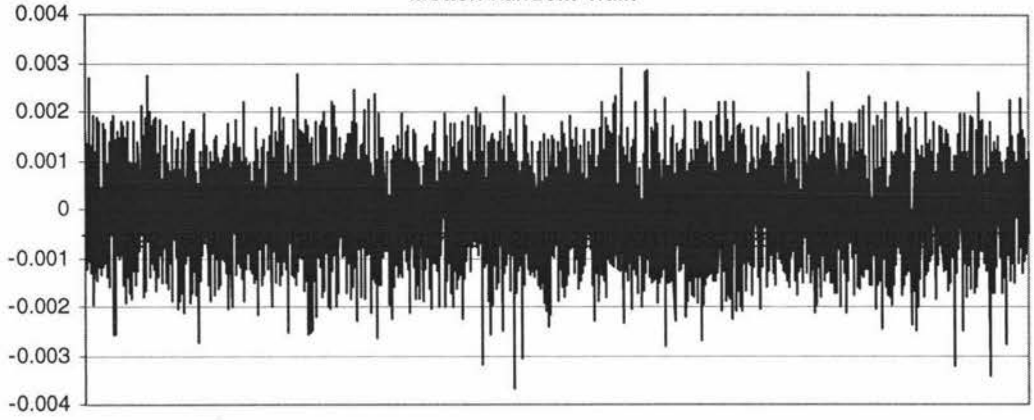


Figure FRW.3 - Log-Returns Series of Simulated Symmetric Two Sided Frechet Random Walk

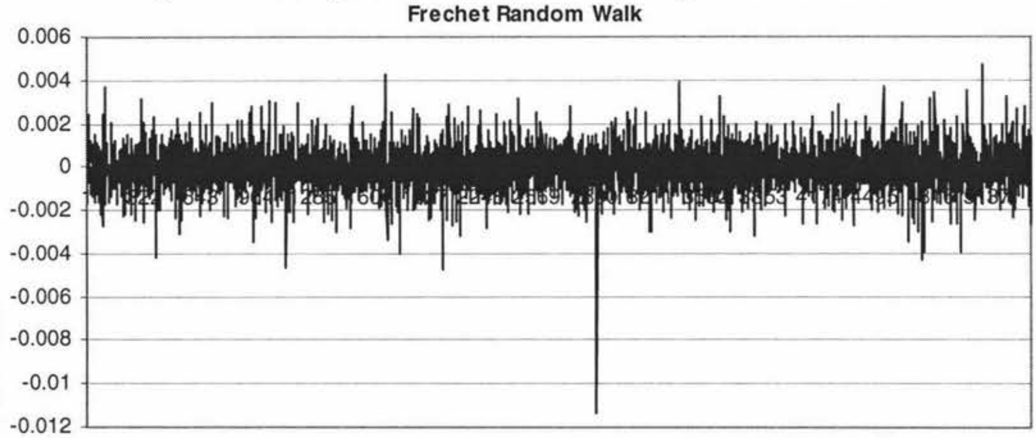


Figure AU.3 - Log-Returns Series of Australian Portfolio

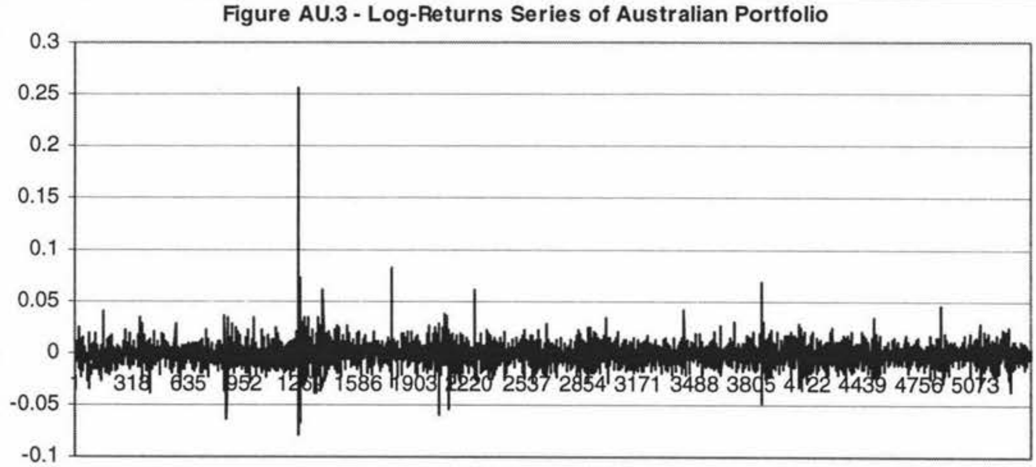


Figure CA.3 - Log-Returns Series of Canadian Portfolio

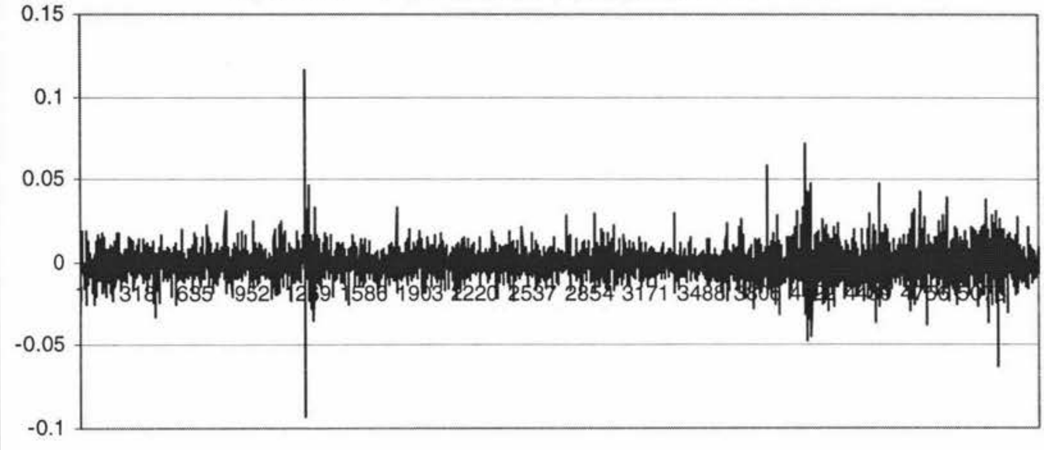


Figure DE.3 - Log-Returns Series of German Portfolio

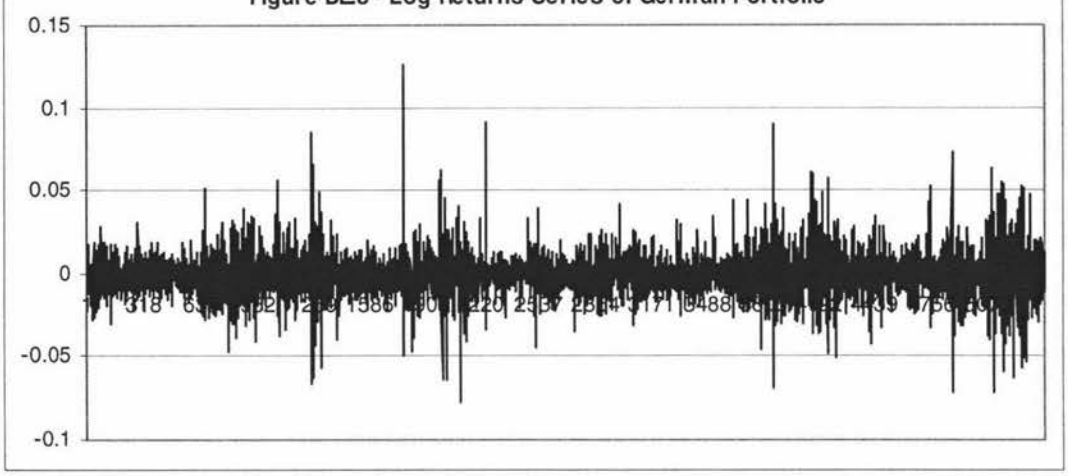


Figure HK.3 - Log-Returns Series of Hong Kong Portfolio

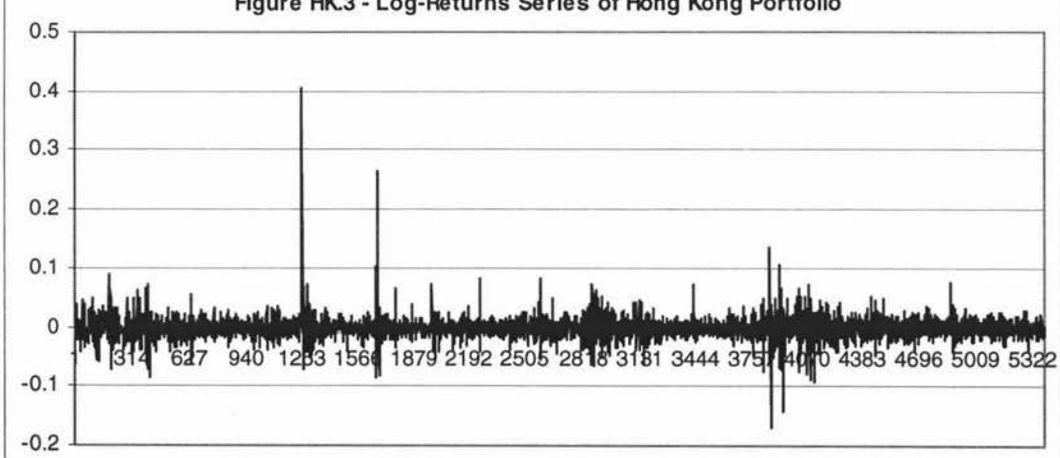


Figure JP.3 - Log-Returns Series of Japanese Portfolio

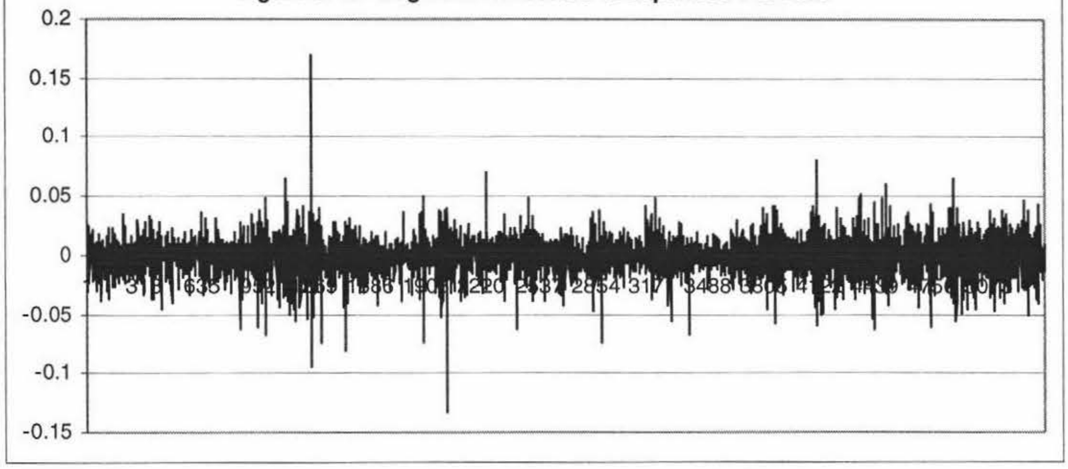


Figure SG.3 - Log-Returns Series of Singaporean Portfolio

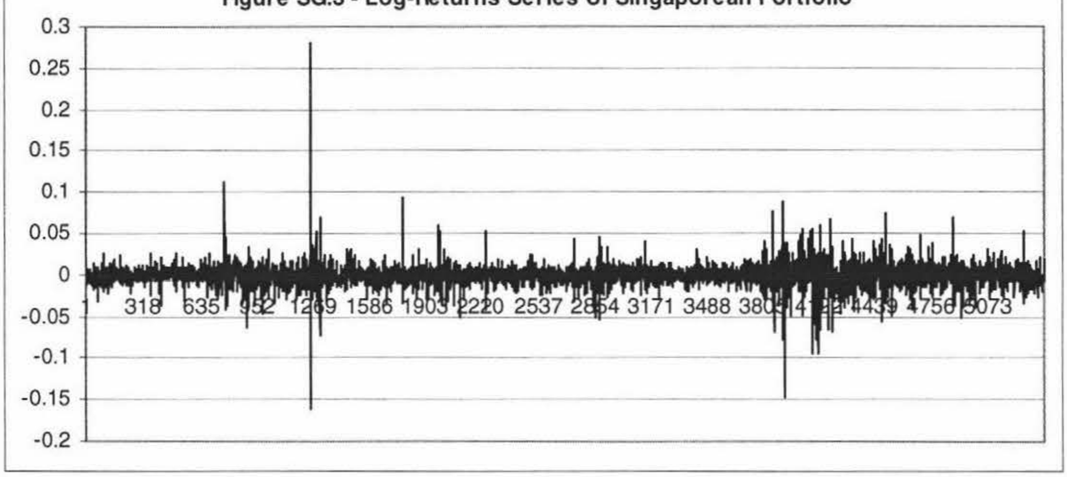


Figure SE.3 - Log-Returns Series of Swedish Portfolio

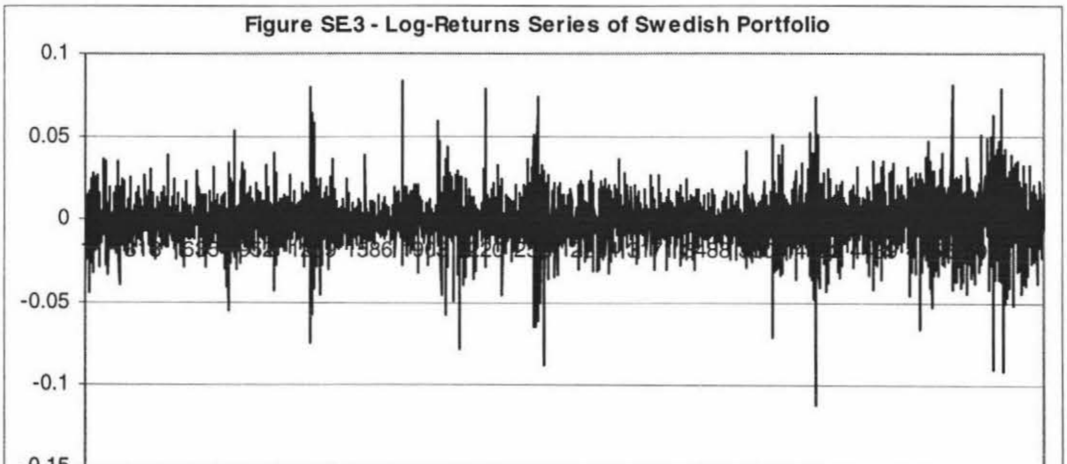


Figure CH.3 - Log-Returns Series of Swiss Portfolio

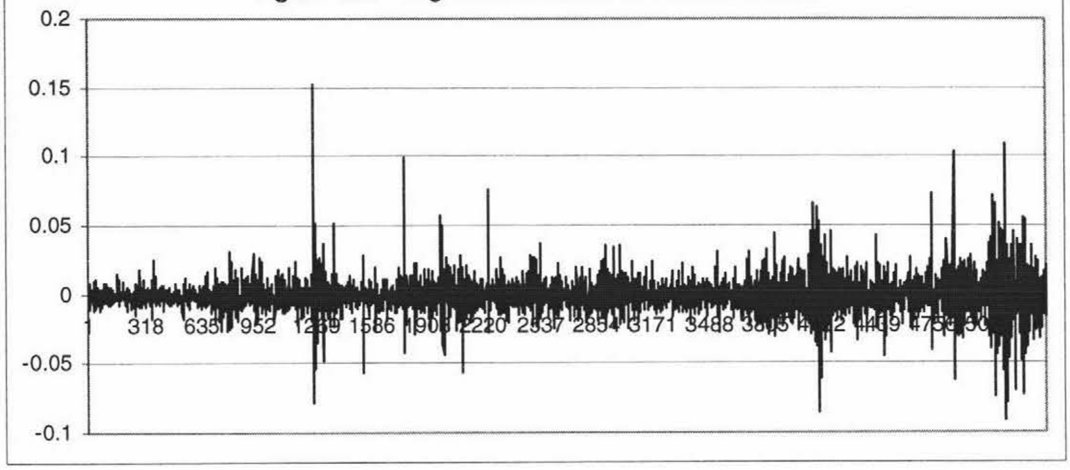


Figure UK.3 - Log-Returns Series of United Kingdom Portfolio

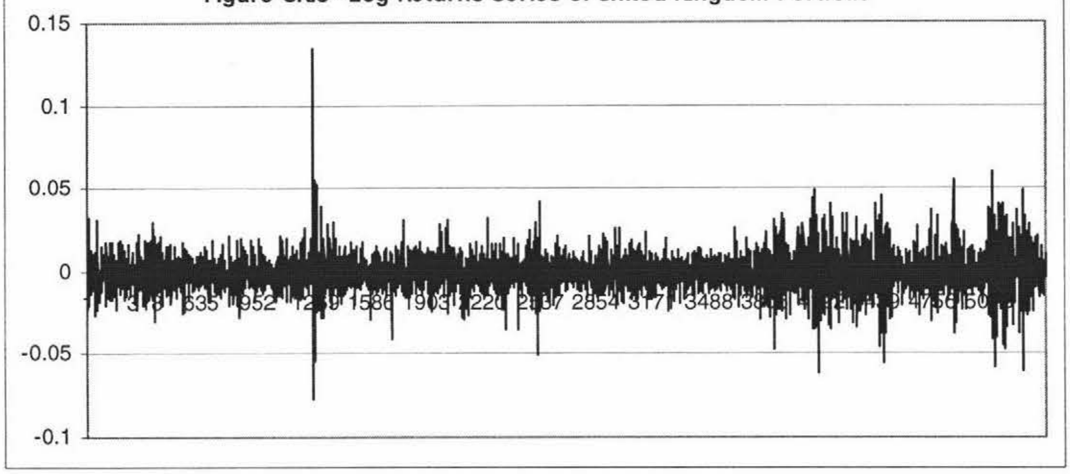
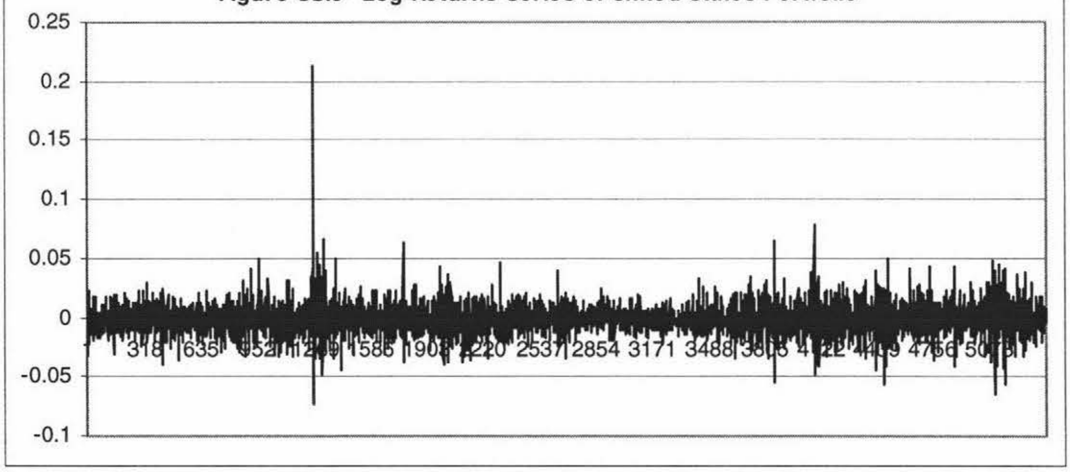
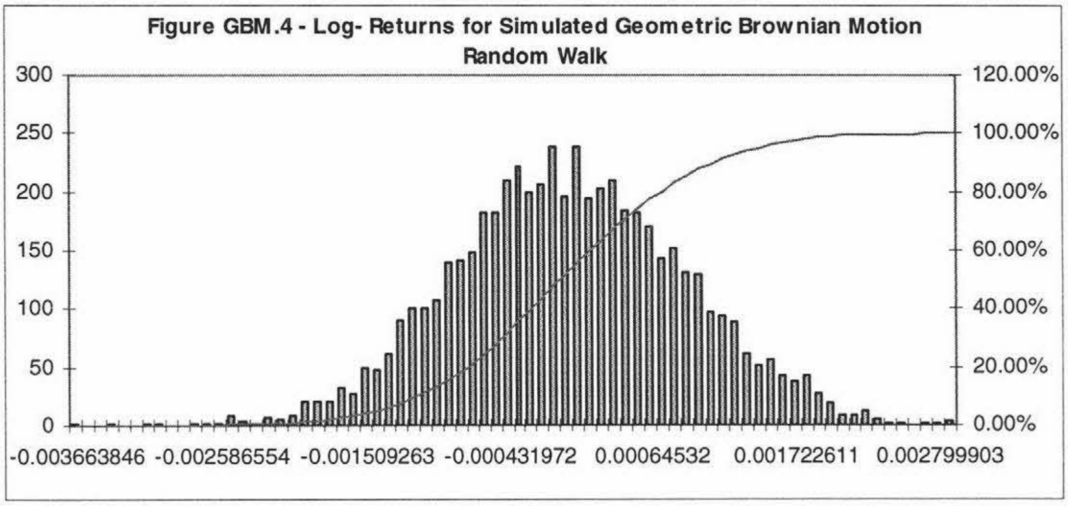
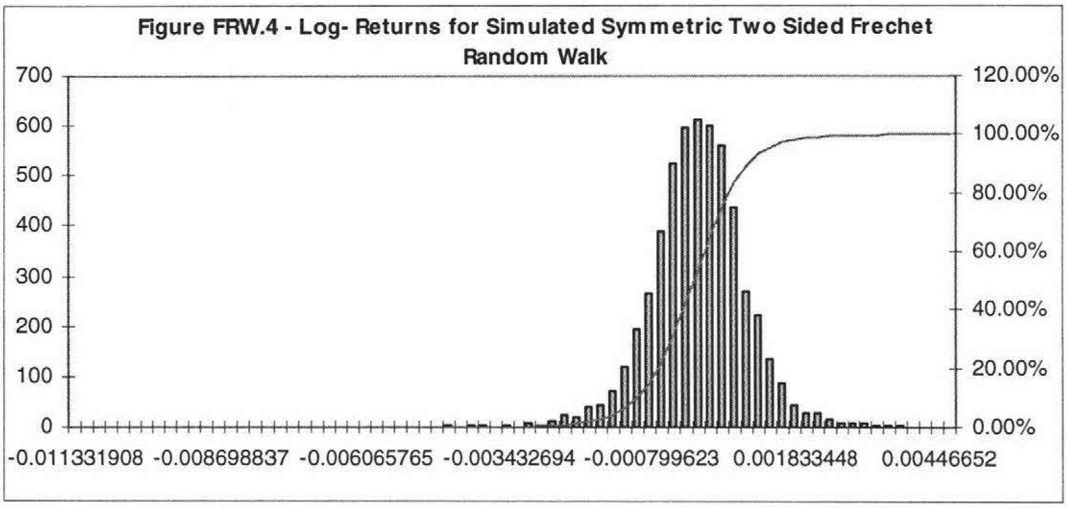


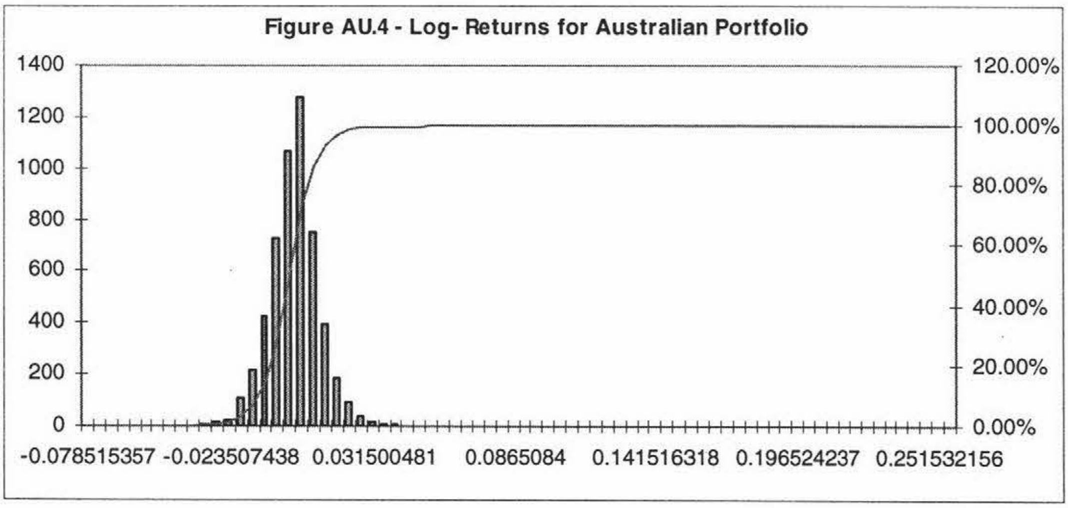
Figure US.3 - Log-Returns Series of United States Portfolio



Appendix.9 - Histograms for Log-Returns Series of Portfolios







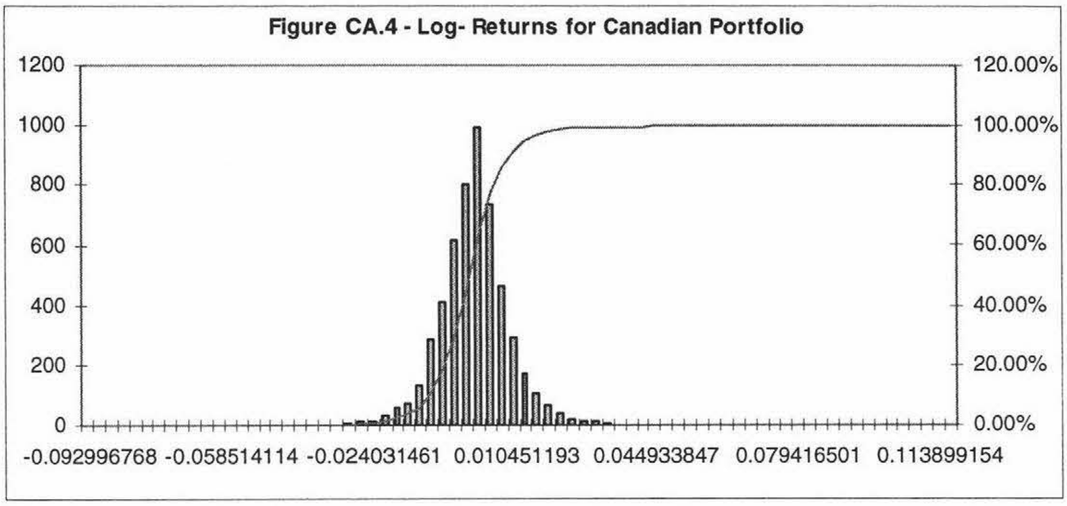


Figure CA.4 - Log- Returns for Canadian Portfolio
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.092996768 -0.058514114 -0.024031461 0.010451193 0.044933847 0.079416501 0.113899154

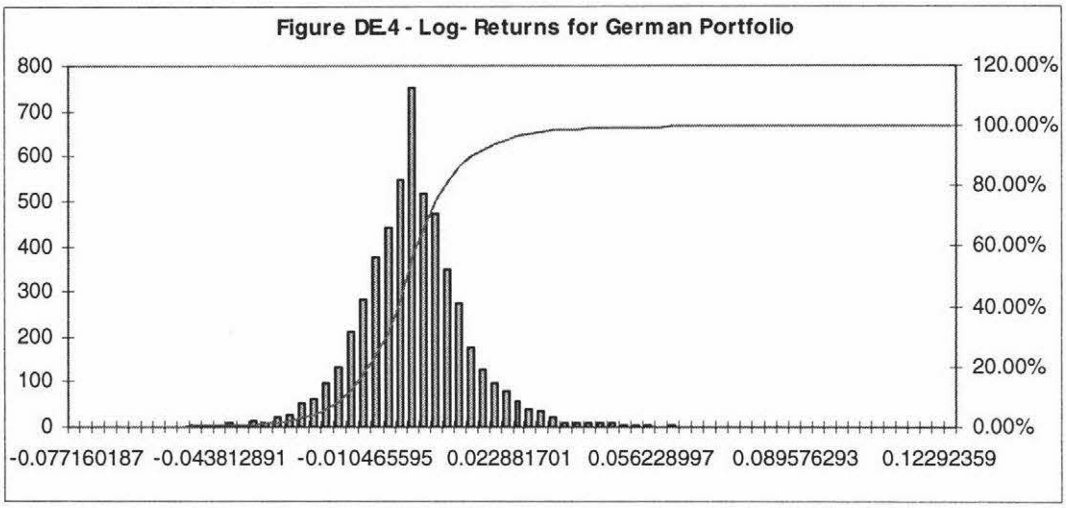


Figure DE.4 - Log- Returns for German Portfolio
800
700
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.077160187 -0.043812891 -0.010465595 0.022881701 0.056228997 0.089576293 0.12292359

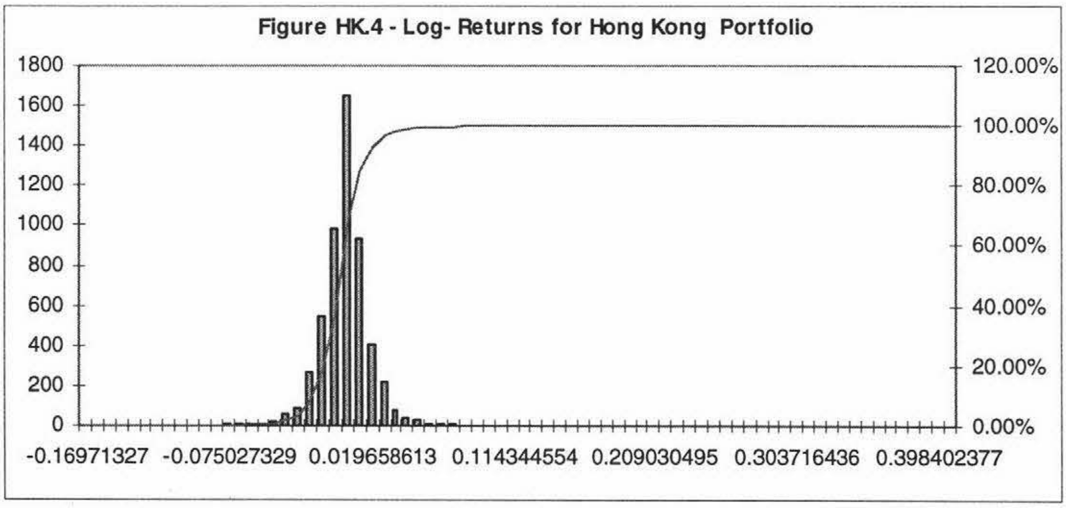


Figure HK.4 - Log- Returns for Hong Kong Portfolio
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.16971327 -0.075027329 0.019658613 0.114344554 0.209030495 0.303716436 0.398402377

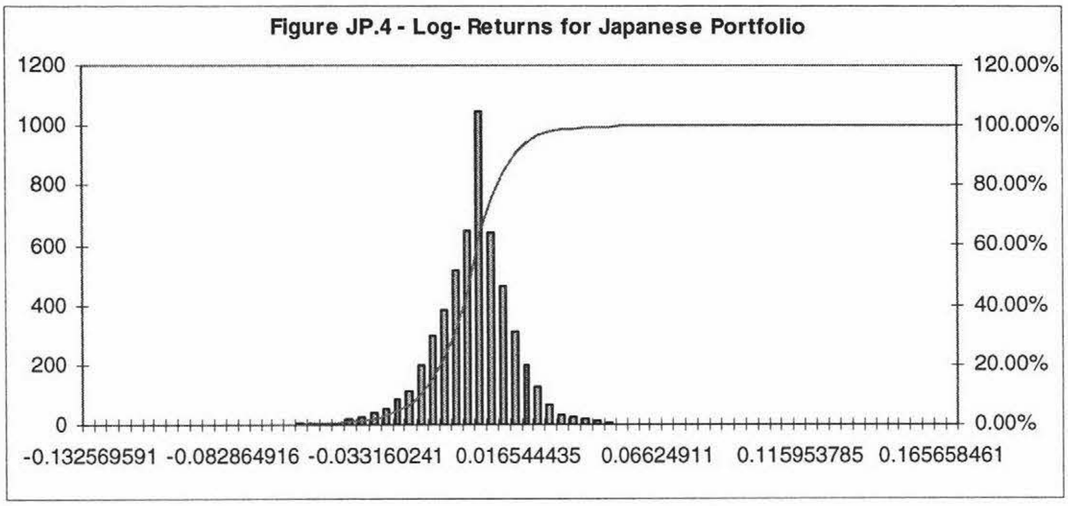


Figure JP.4 - Log- Returns for Japanese Portfolio
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.132569591 -0.082864916 -0.033160241 0.016544435 0.06624911 0.115953785 0.165658461

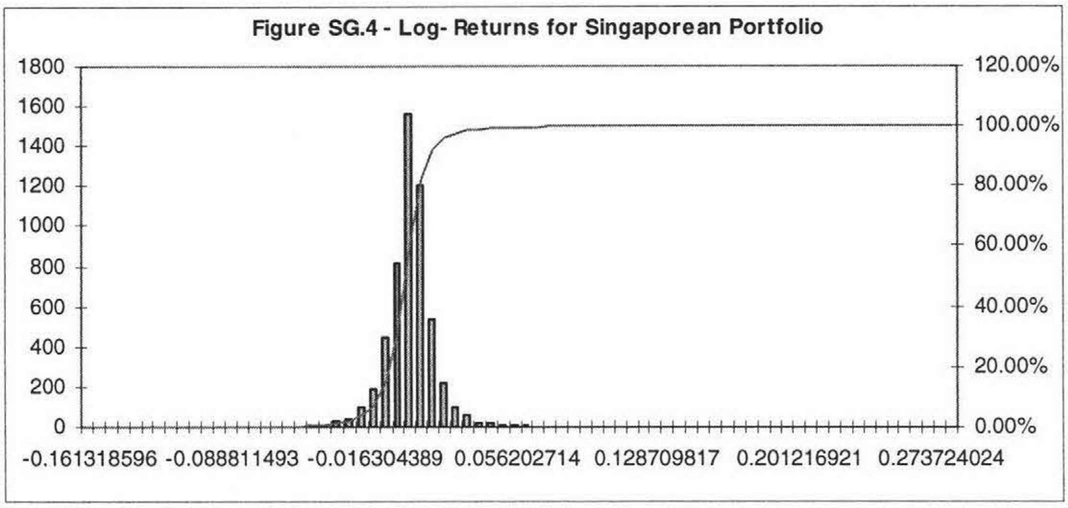


Figure SG.4 - Log- Returns for Singaporean Portfolio
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.161318596 -0.088811493 -0.016304389 0.056202714 0.128709817 0.201216921 0.273724024

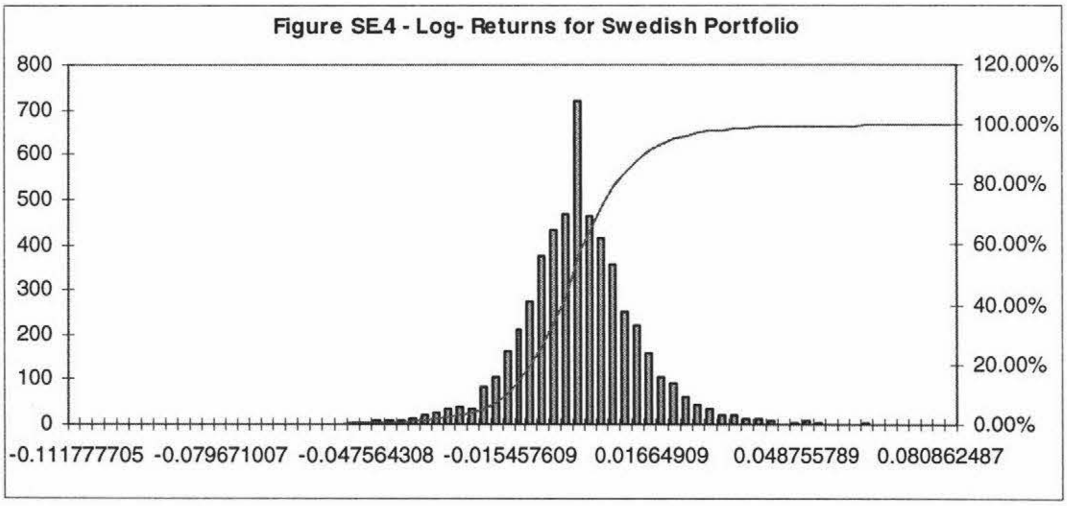


Figure SE.4 - Log- Returns for Swedish Portfolio
800
700
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.111777705 -0.079671007 -0.047564308 -0.015457609 0.01664909 0.048755789 0.080862487

Figure CH.4 - Log- Returns for Swiss Portfolio

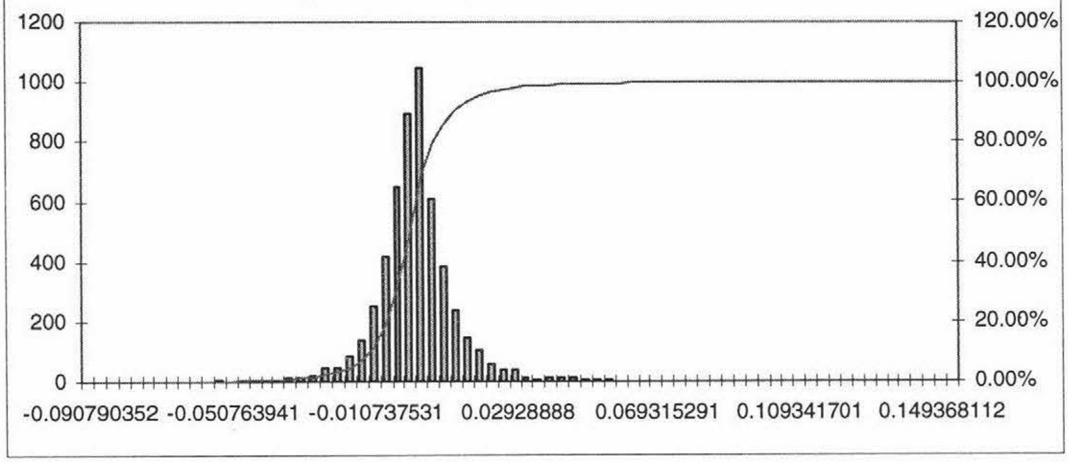


Figure UK.4 - Log- Returns for United Kingdom Portfolio

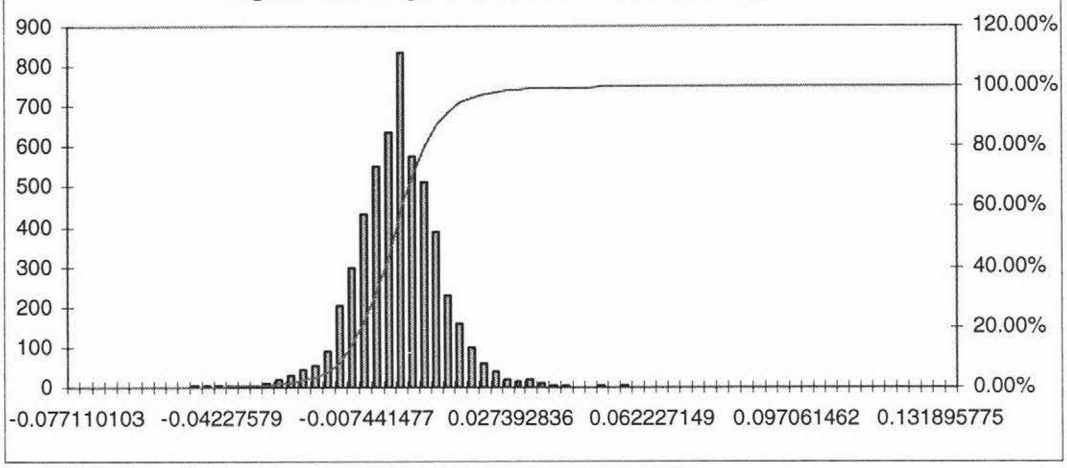
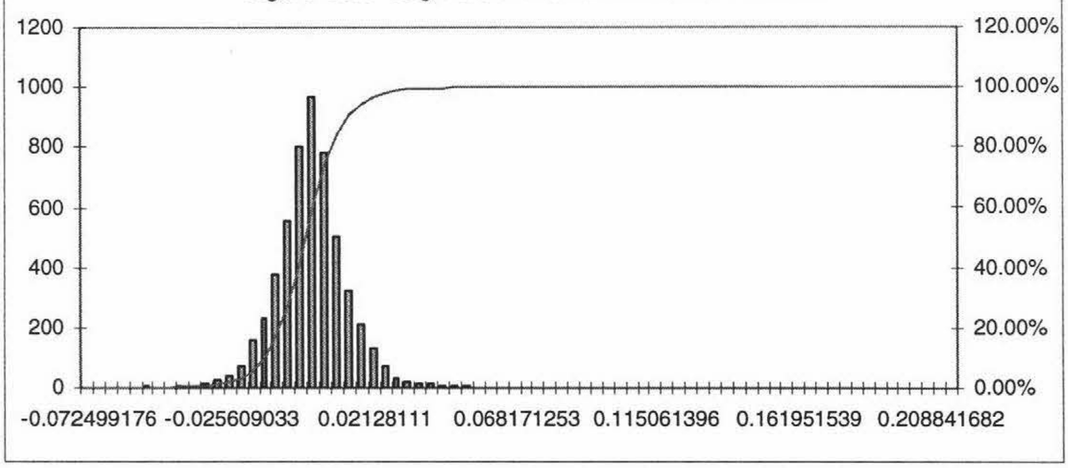
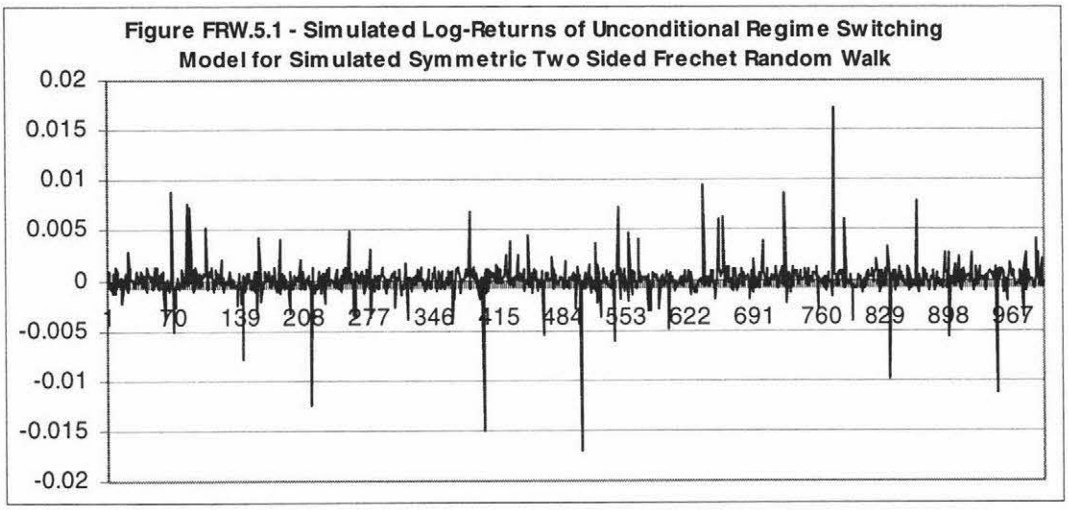
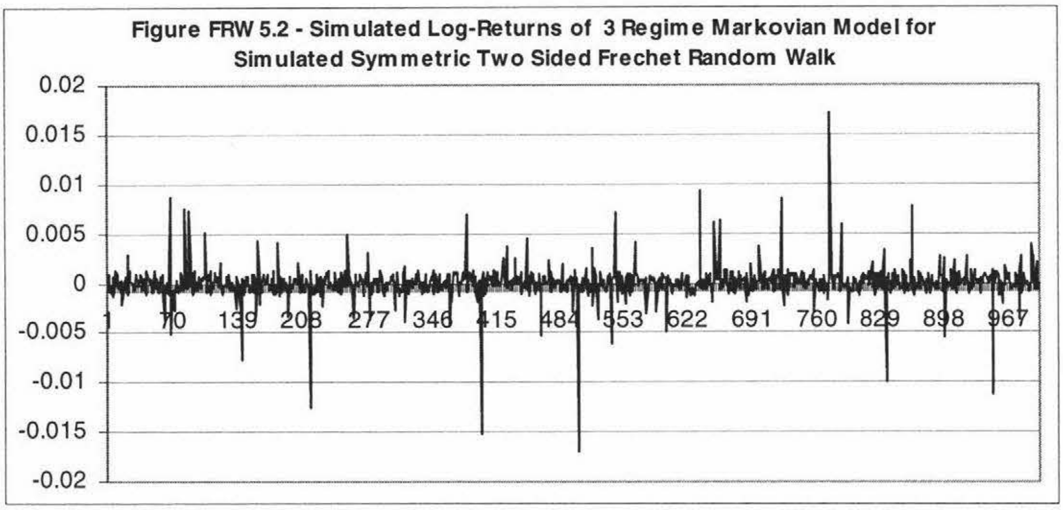


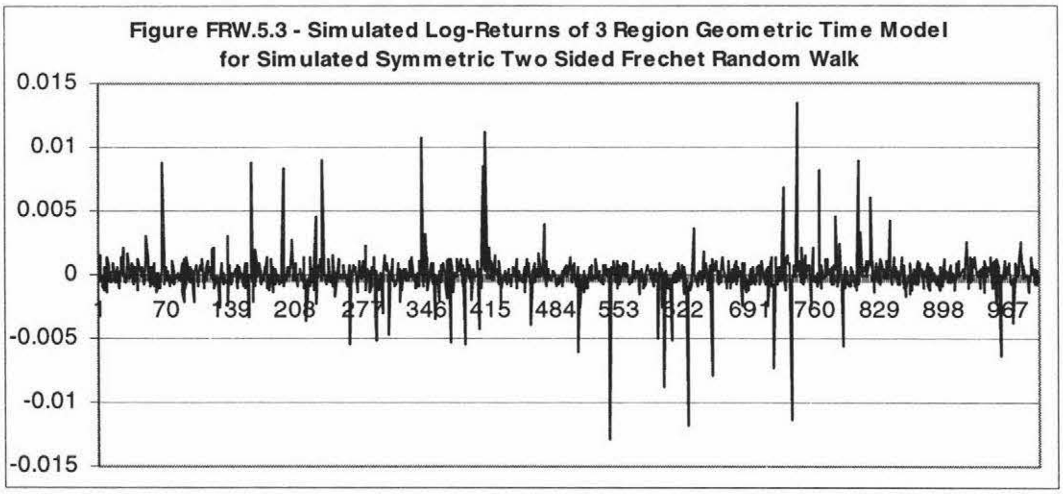
Figure US.4 - Log- Returns for United States Portfolio



Appendix.10 - Time Series Graphs of Regime Switching Models for Simulated Two Sided Symmetric Fréchet Random Walk







Appendix.11 - Histograms for Unconditional Regime Switching Model Portfolio Returns

Figure GBM.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Simulated Geometric Brownian Motion Walk

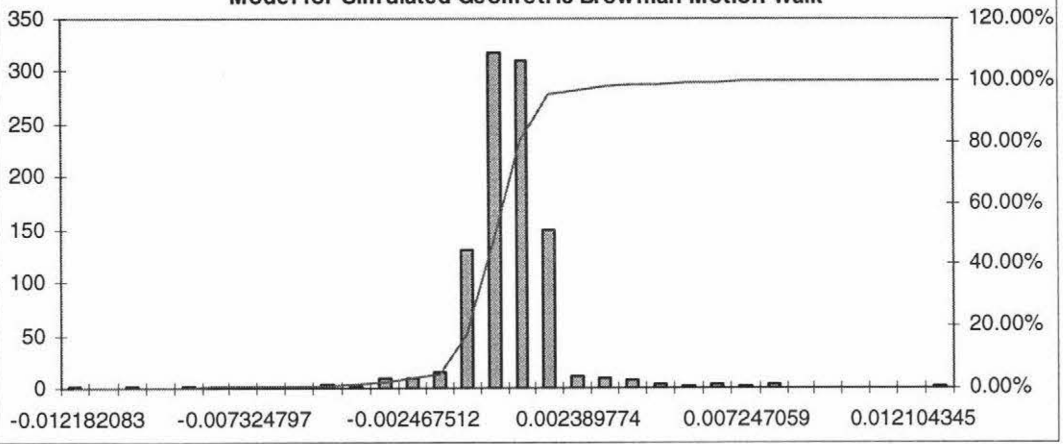


Figure FRW.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Simulated Symmetric Two Sided Frechet Random Walk

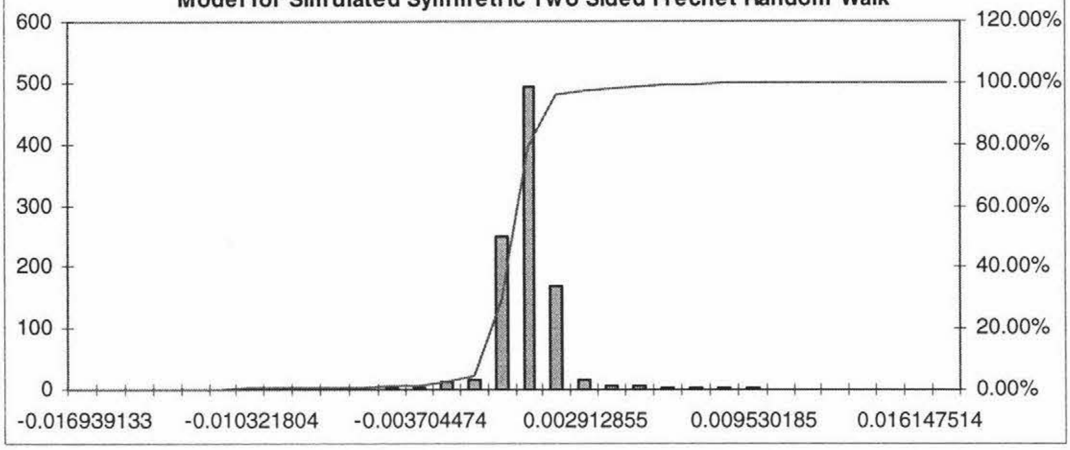
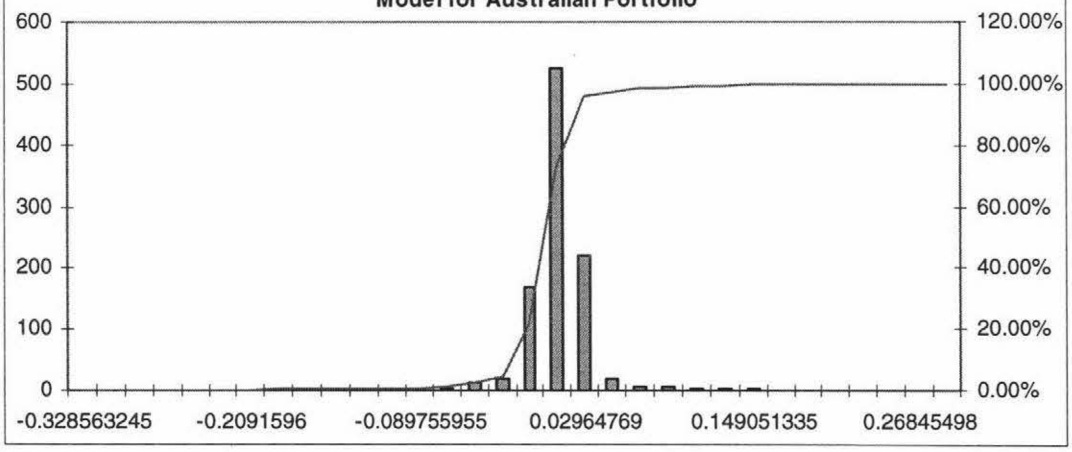


Figure AU.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Australian Portfolio



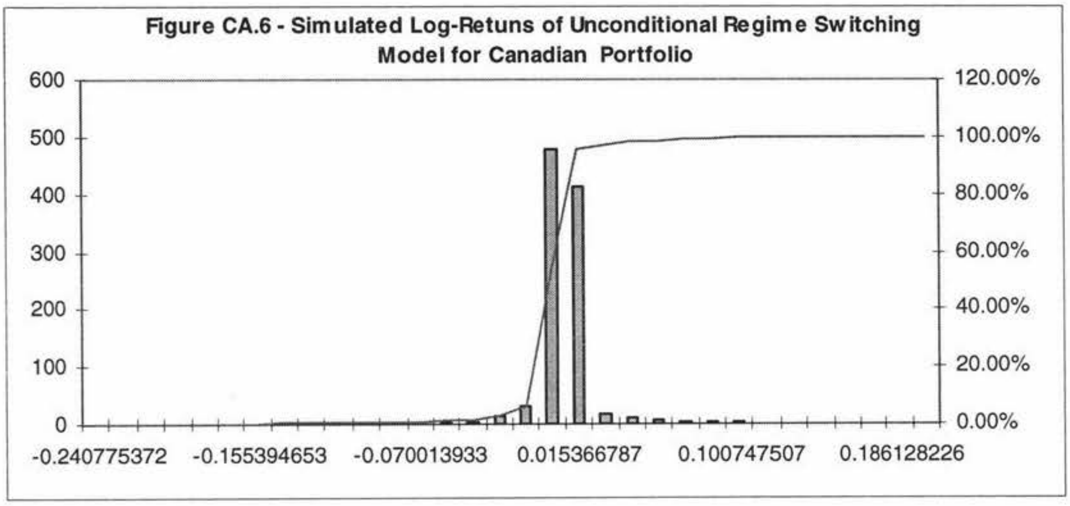


Figure CA.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Canadian Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.240775372
-0.155394653
-0.070013933
0.015366787
0.100747507
0.186128226

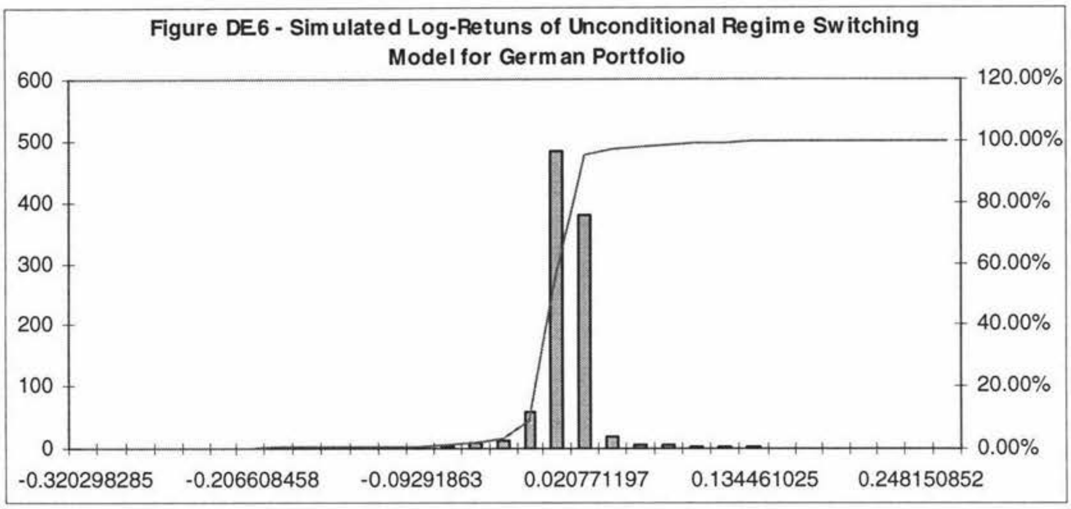


Figure DE.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for German Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.320298285
-0.206608458
-0.09291863
0.020771197
0.134461025
0.248150852

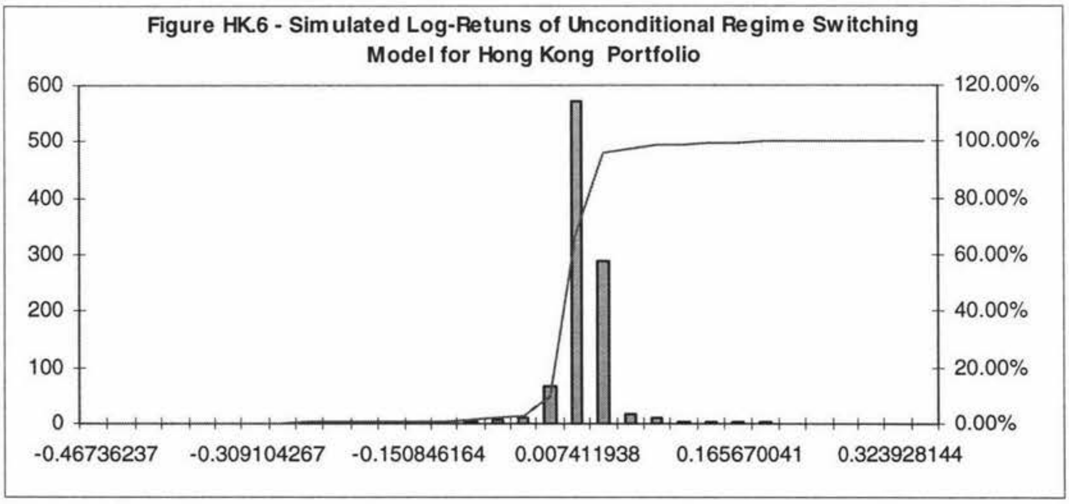


Figure HK.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Hong Kong Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.46736237
-0.309104267
-0.150846164
0.007411938
0.165670041
0.323928144

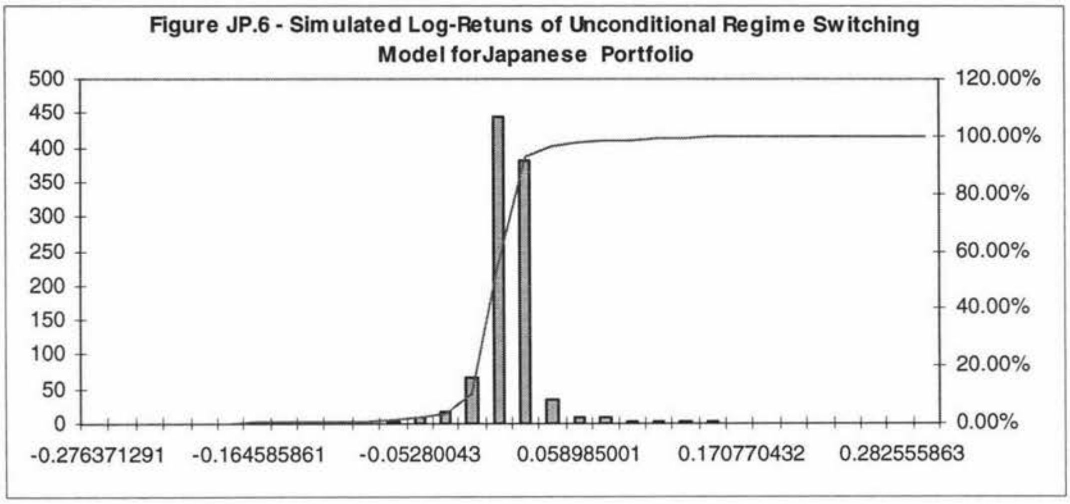


Figure JP.6 - Simulated Log-Retuns of Unconditional Regime Switching Model forJapanese Portfolio
500
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.276371291
-0.164585861
-0.05280043
0.058985001
0.170770432
0.282555863

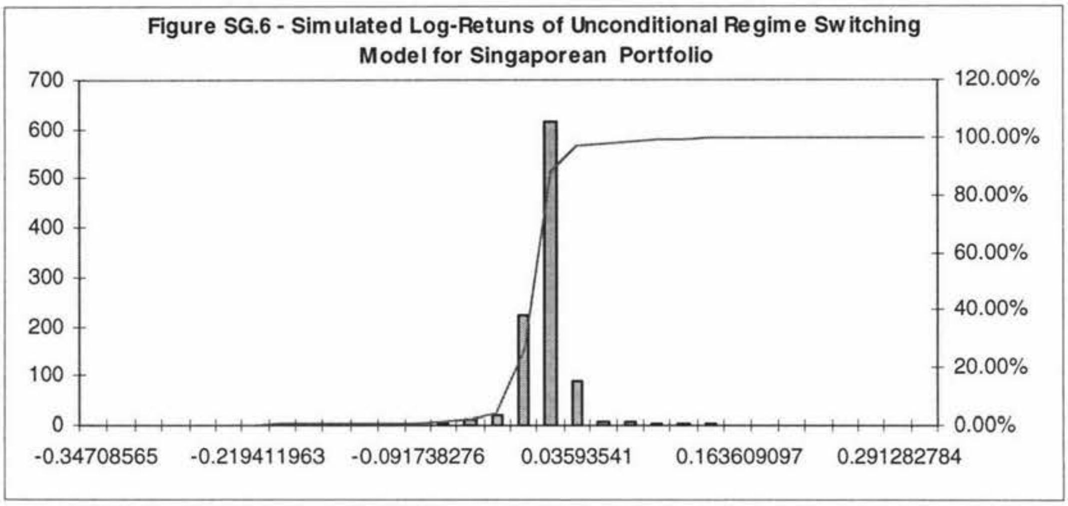


Figure SG.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Singaporean Portfolio
700
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.34708565
-0.219411963
-0.091738276
0.03593541
0.163609097
0.291282784

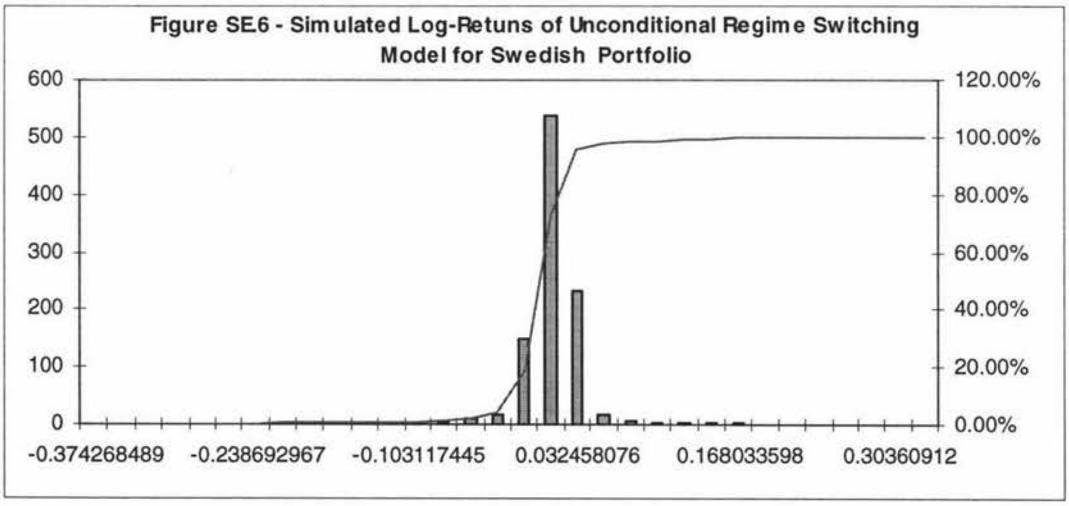


Figure SE.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Swedish Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.374268489
-0.238692967
-0.103117445
0.032458076
0.168033598
0.30360912

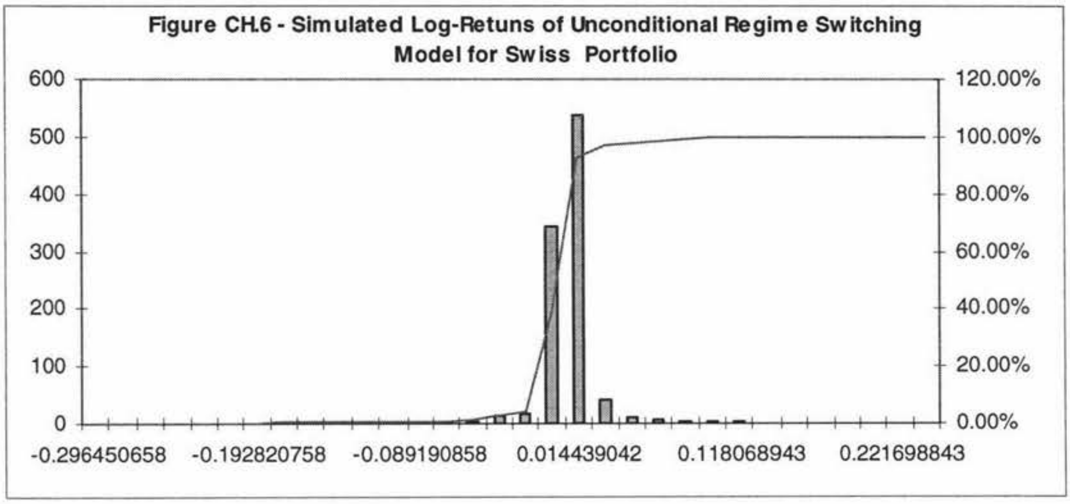


Figure CH.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for Swiss Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.296450658
-0.192820758
-0.089190858
0.014439042
0.118068943
0.221698843

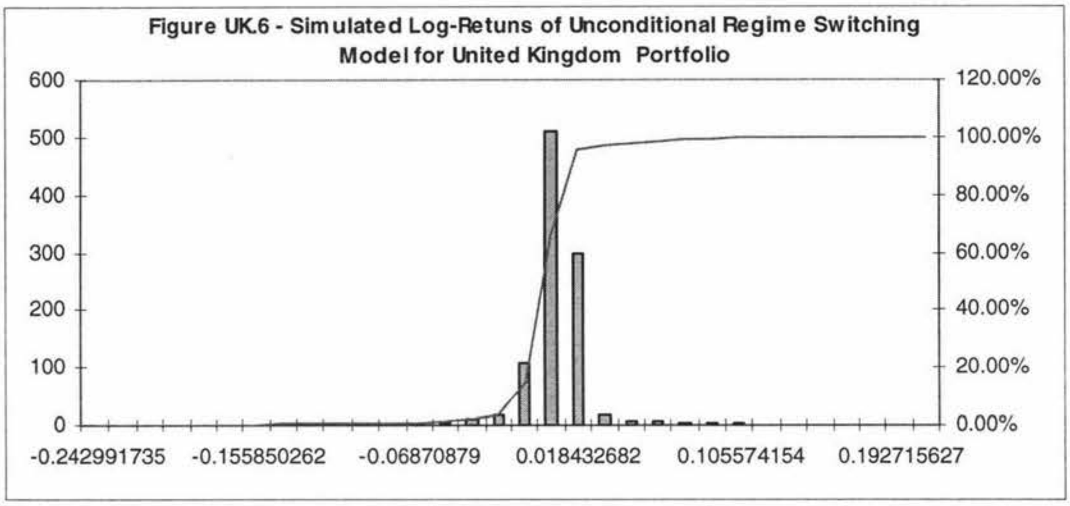


Figure UK.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for United Kingdom Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.242991735
-0.155850262
-0.06870879
0.018432682
0.105574154
0.192715627

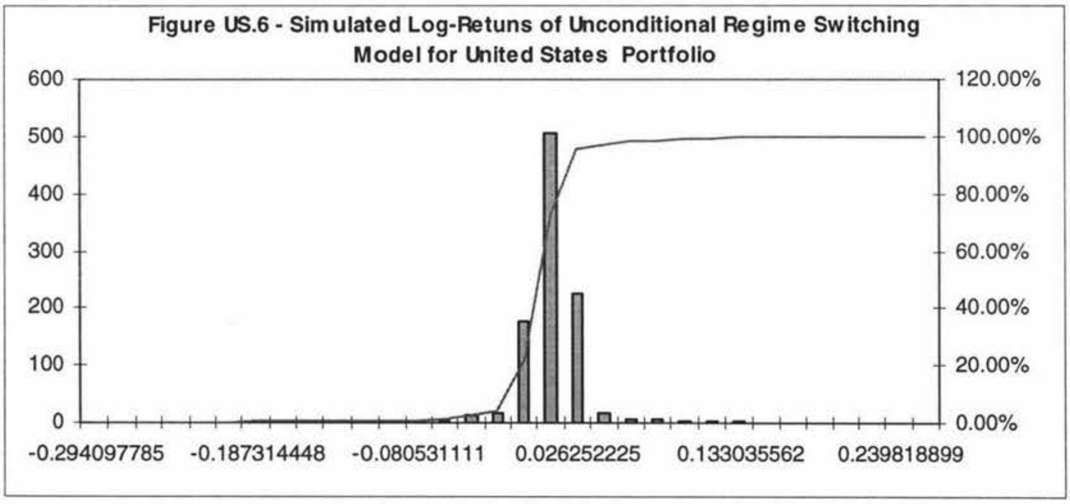


Figure US.6 - Simulated Log-Retuns of Unconditional Regime Switching Model for United States Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.294097785
-0.187314448
-0.080531111
0.026252225
0.133035562
0.239818899

Appendix.12 - Histograms for Log-Returns Series of 3 Regime Markovian Model for Portfolios

Figure GBM.7 - Simulated Log-Returns of 3 Regime Markovian Model for Simulated Geometric Brownian Motion Random Walk

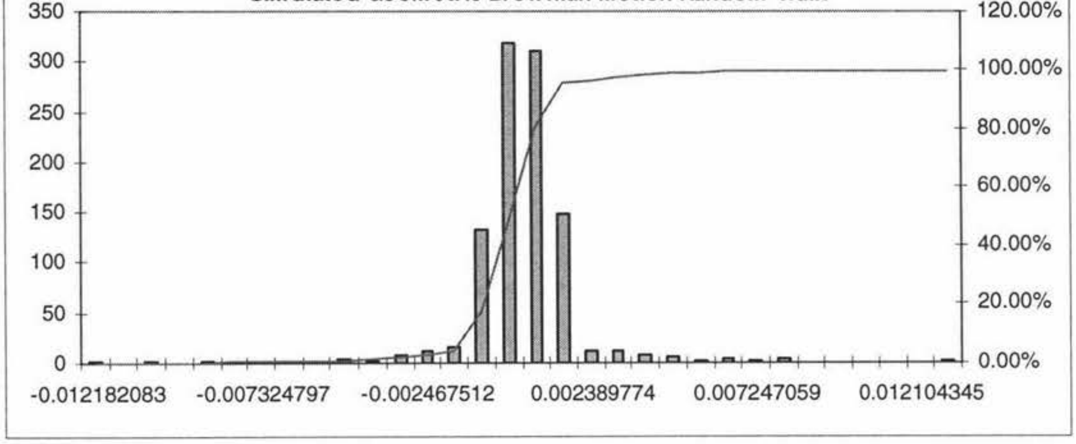


Figure FRW.7 - Simulated Log-Returns of 3 Regime Markovian Model for Simulated Symmetric Two Sided Frechet Random Walk

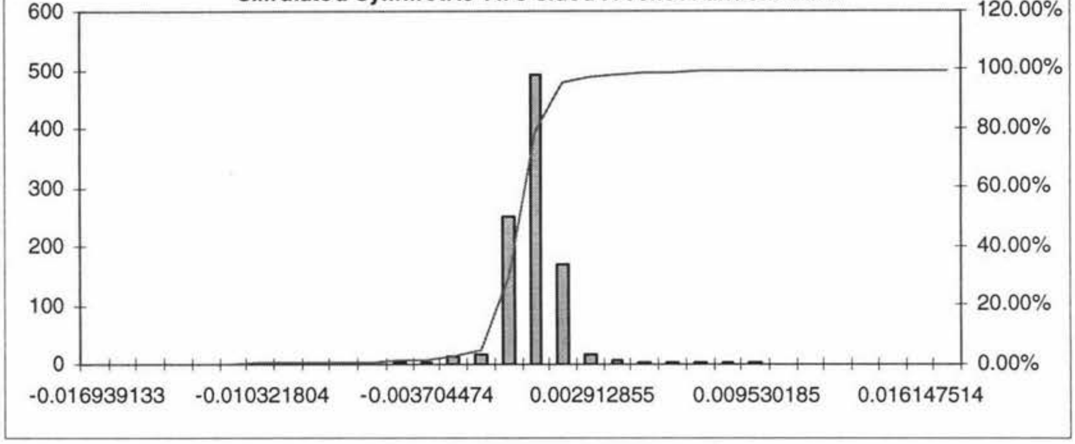
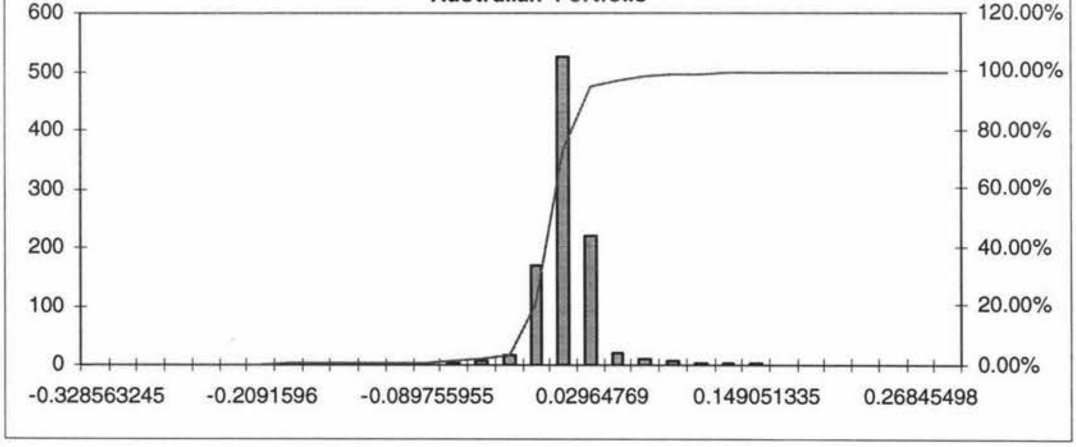


Figure AU.7 - Simulated Log-Returns of 3 Regime Markovian Model for Australian Portfolio



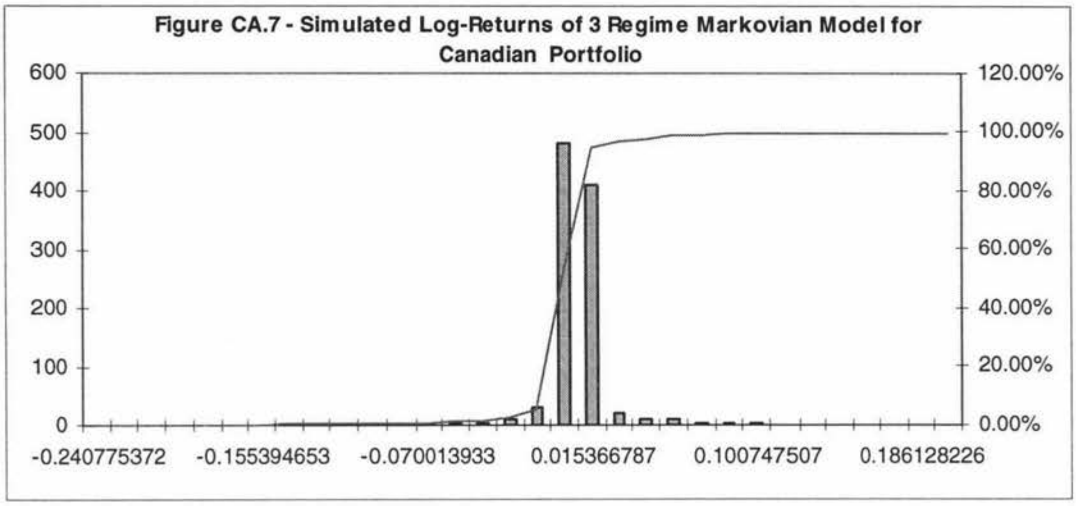


Figure CA.7 - Simulated Log-Returns of 3 Regime Markovian Model for Canadian Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.240775372
-0.155394653
-0.070013933
0.015366787
0.100747507
0.186128226

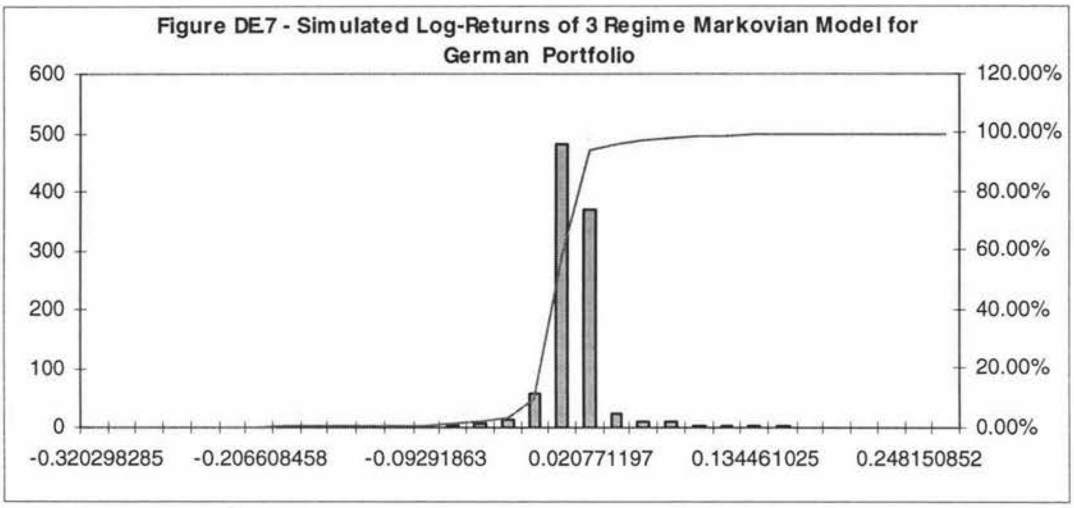


Figure DE.7 - Simulated Log-Returns of 3 Regime Markovian Model for German Portfolio
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.320298285
-0.206608458
-0.09291863
0.020771197
0.134461025
0.248150852

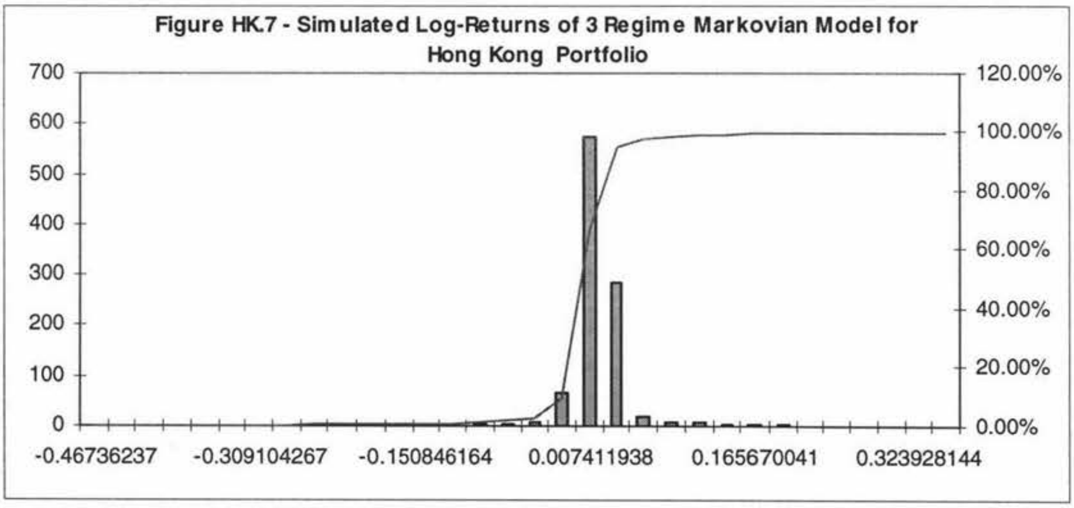


Figure HK.7 - Simulated Log-Returns of 3 Regime Markovian Model for Hong Kong Portfolio
700
600
500
400
300
200
100
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.46736237
-0.309104267
-0.150846164
0.007411938
0.165670041
0.323928144

Figure JP.7 - Simulated Log-Returns of 3 Regime Markovian Model for Japanese Portfolio

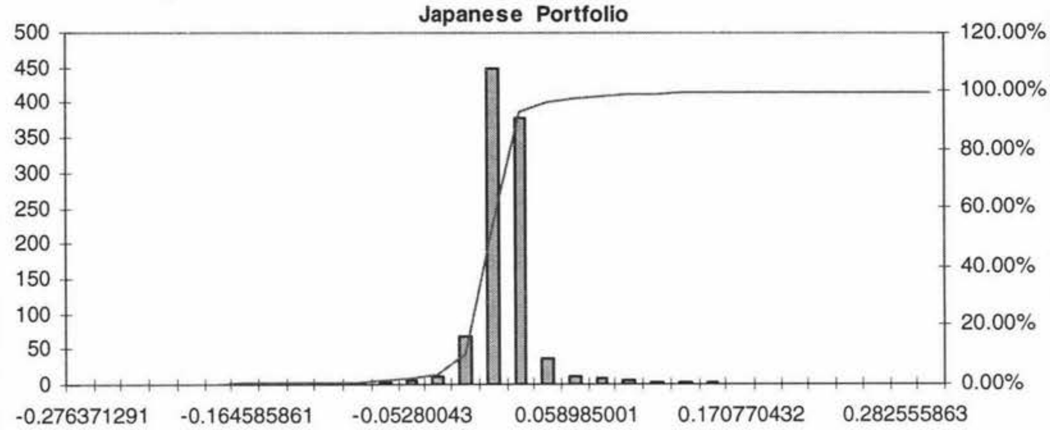


Figure SG.7 - Simulated Log-Returns of 3 Regime Markovian Model for Singaporean Portfolio

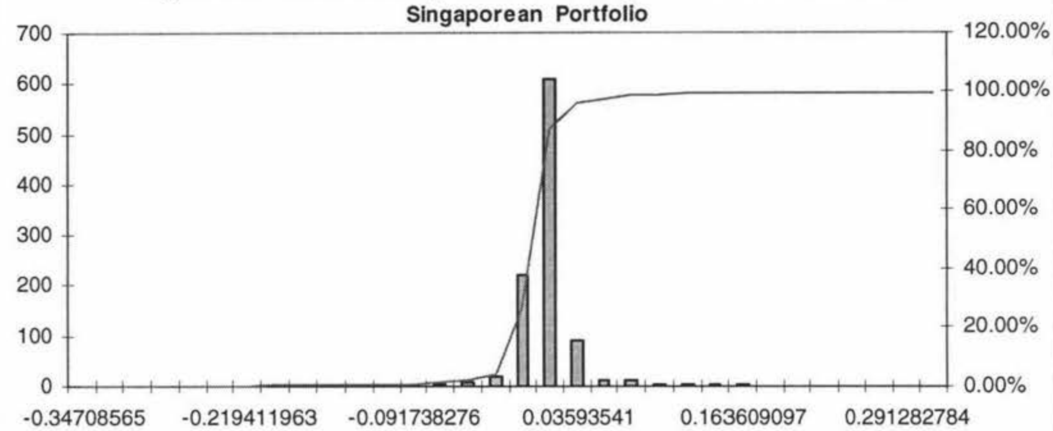


Figure SE.7 - Simulated Log-Returns of 3 Regime Markovian Model for Swedish Portfolio

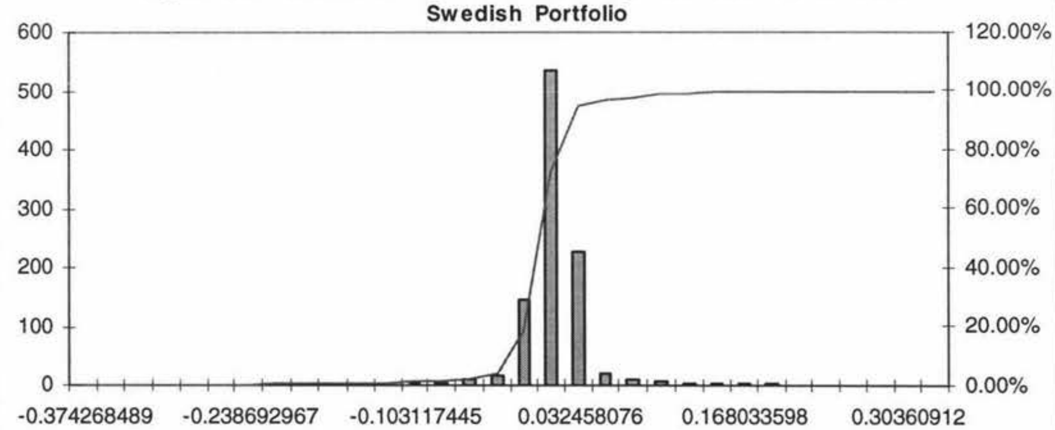


Figure CH.7 - Simulated Log-Returns of 3 Regime Markovian Model for Swiss Portfolio

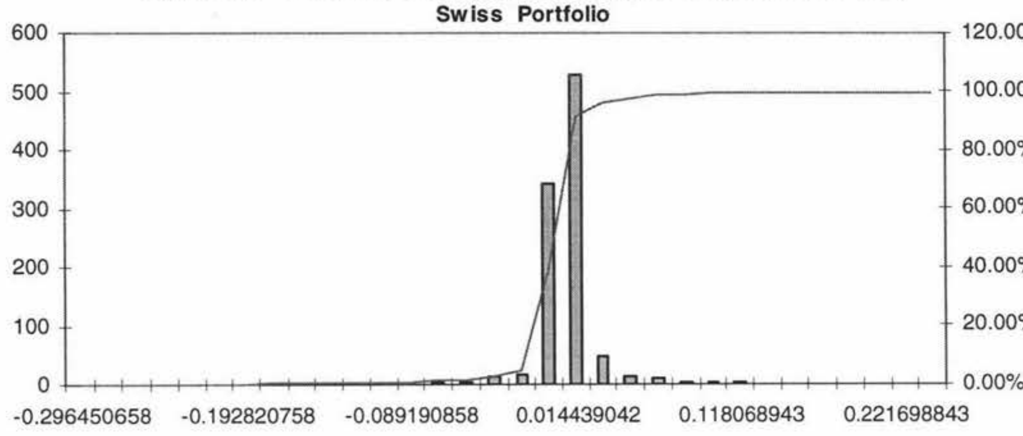


Figure UK.7 - Simulated Log-Returns of 3 Regime Markovian Model for United Kingdom Portfolio

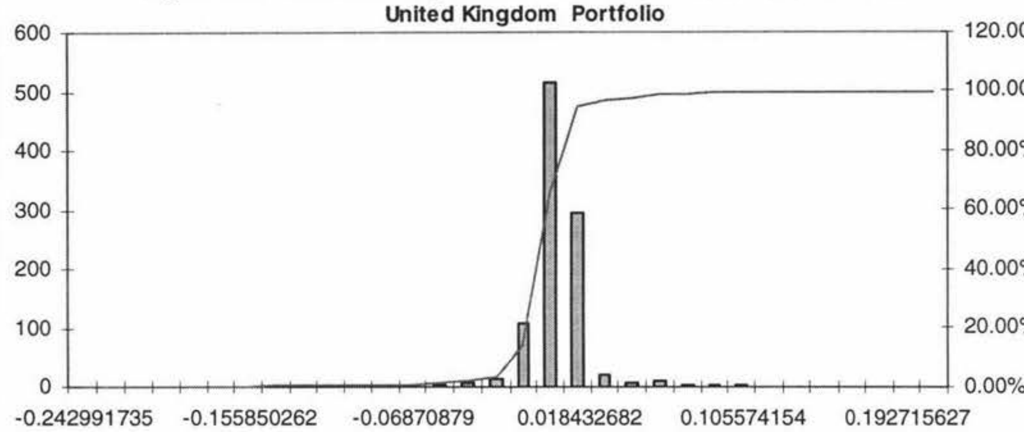
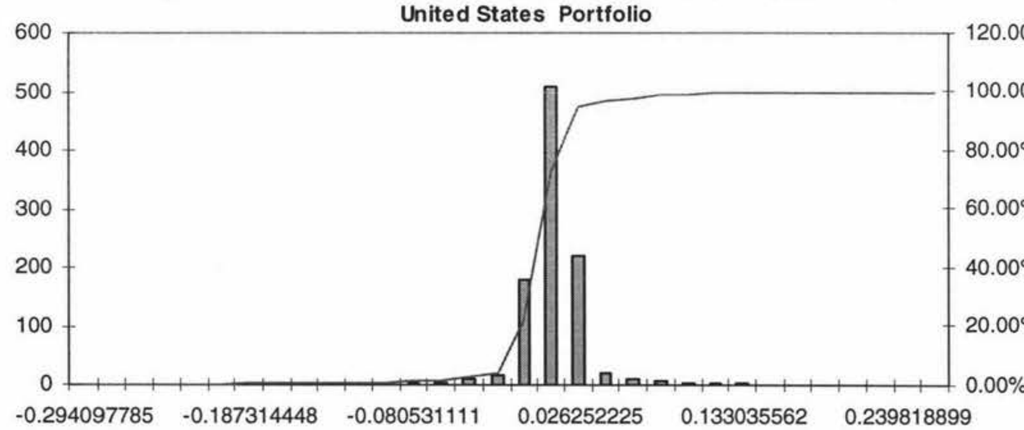


Figure US.7 - Simulated Log-Returns of 3 Regime Markovian Model for United States Portfolio



Appendix.13 - Histograms for Log Returns of Three Region Geometric Time Model for Portfolios

Figure GBM.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Simulated Geometric Brownian Motion Random Walk

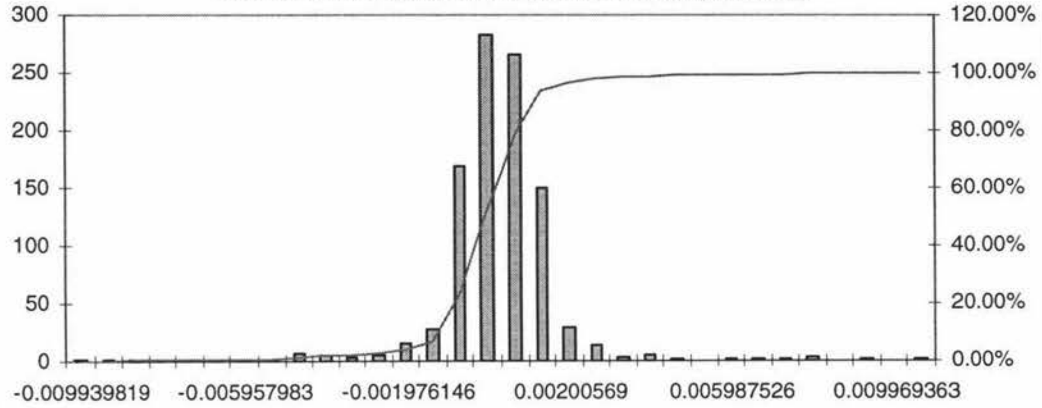


Figure FRW.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Simulated Symmetric Two Sided Frechet Random Walk

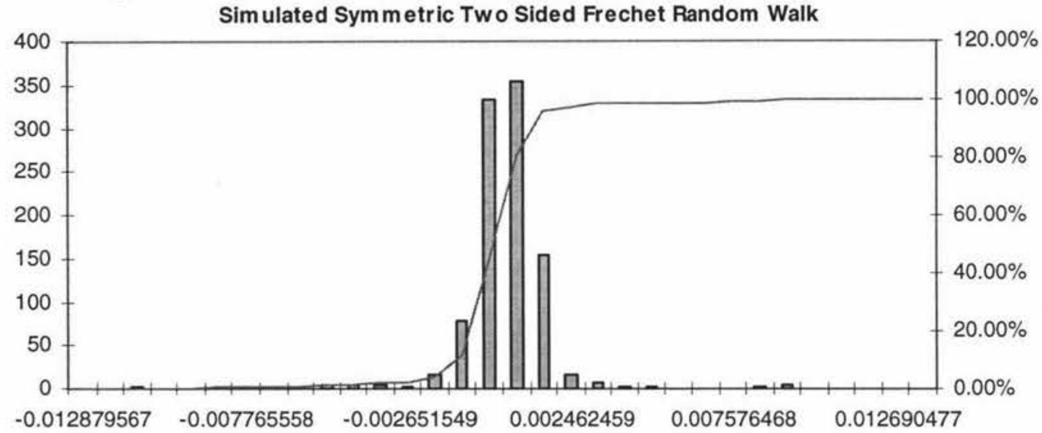
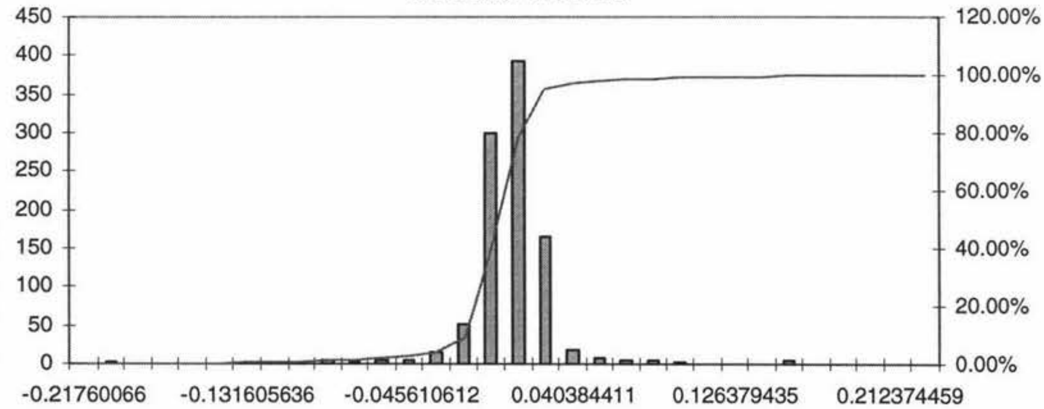


Figure AU.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Australian Portfolio



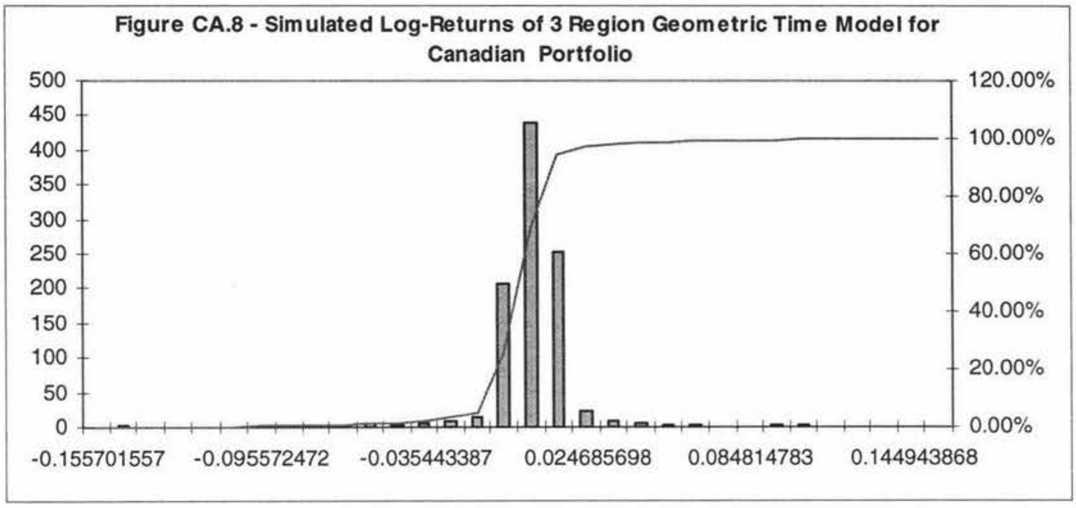


Figure CA.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Canadian Portfolio
500
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.155701557
-0.095572472
-0.035443387
0.024685698
0.084814783
0.144943868

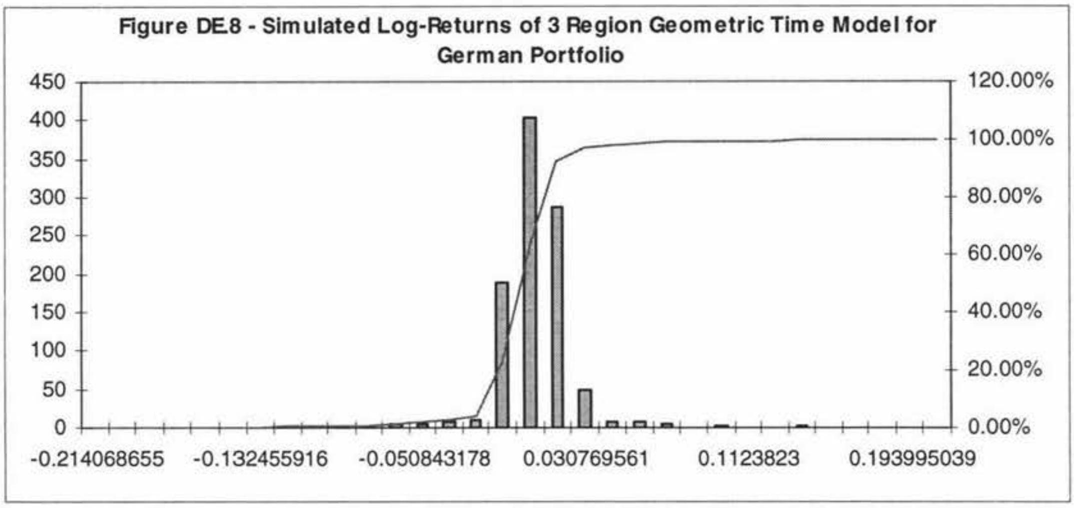


Figure DE.8 - Simulated Log-Returns of 3 Region Geometric Time Model for German Portfolio
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.214068655
-0.132455916
-0.050843178
0.030769561
0.1123823
0.193995039

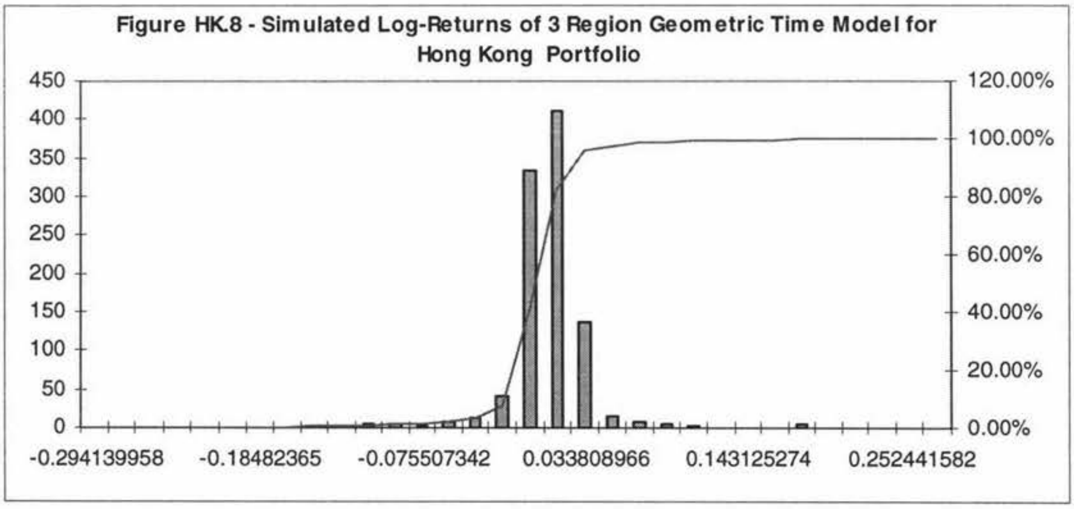


Figure HK.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Hong Kong Portfolio
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.294139958
-0.18482365
-0.075507342
0.033808966
0.143125274
0.252441582

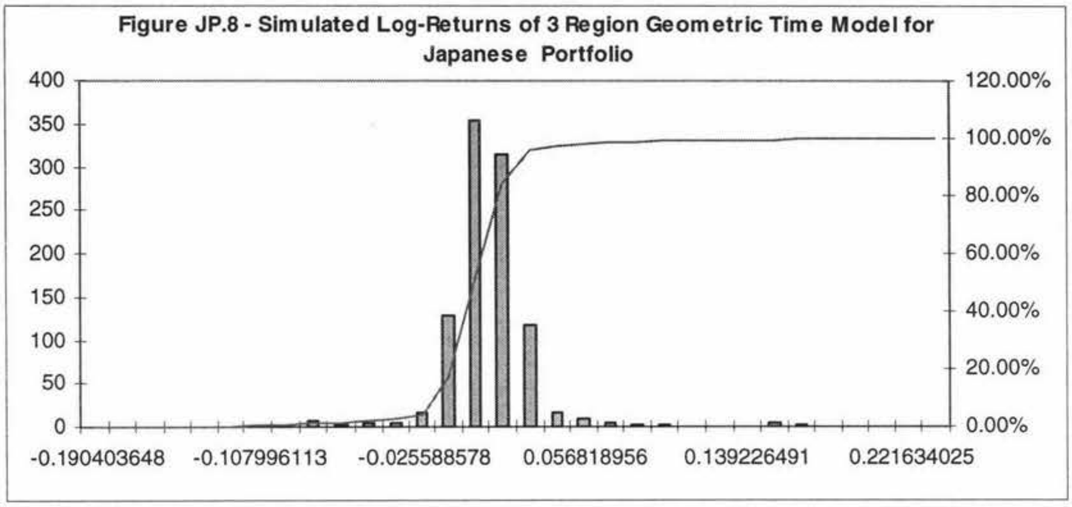


Figure JP.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Japanese Portfolio
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.190403648
-0.107996113
-0.025588578
0.056818956
0.139226491
0.221634025

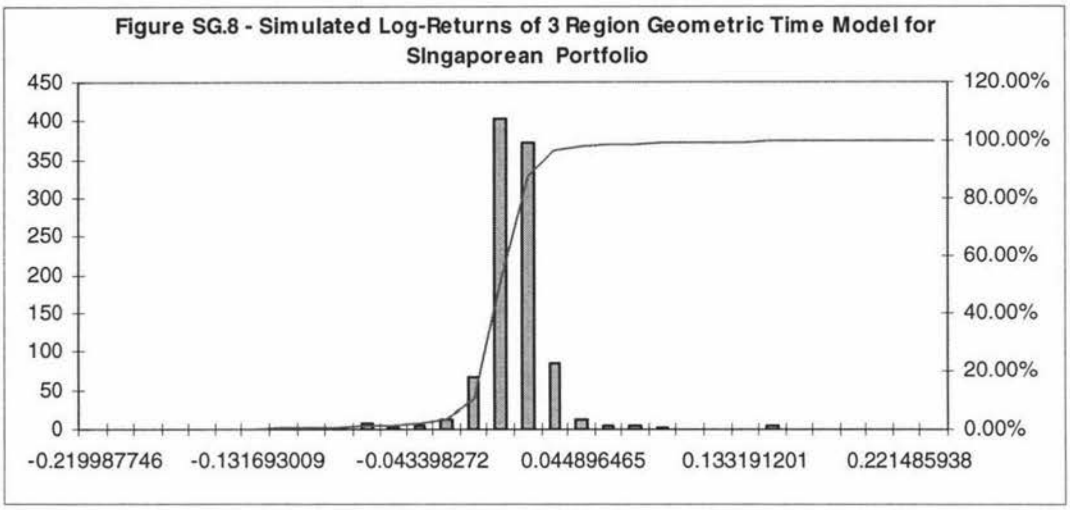


Figure SG.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Singaporean Portfolio
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.219987746
-0.131693009
-0.043398272
0.044896465
0.133191201
0.221485938

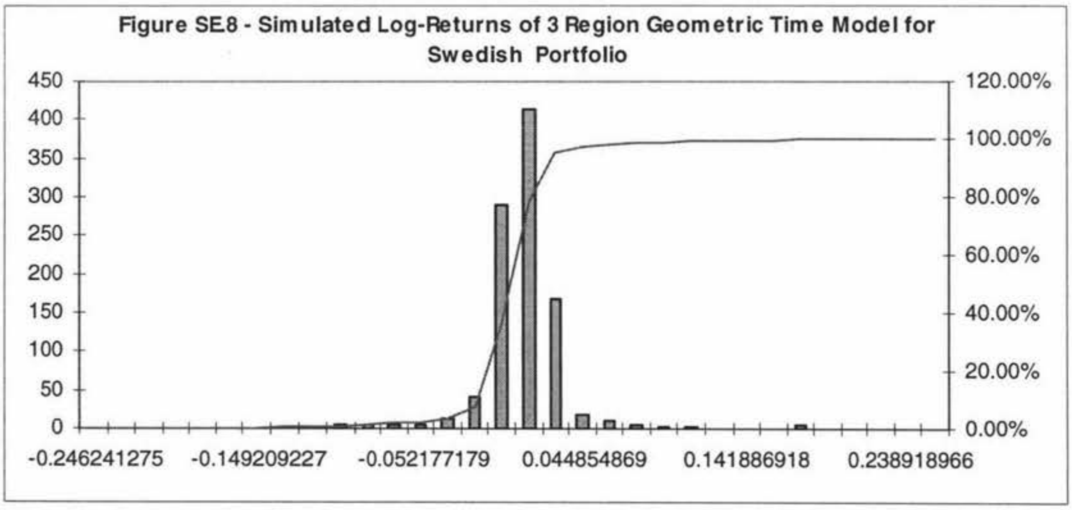


Figure SE.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Swedish Portfolio
450
400
350
300
250
200
150
100
50
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-0.246241275
-0.149209227
-0.052177179
0.044854869
0.141886918
0.238918966

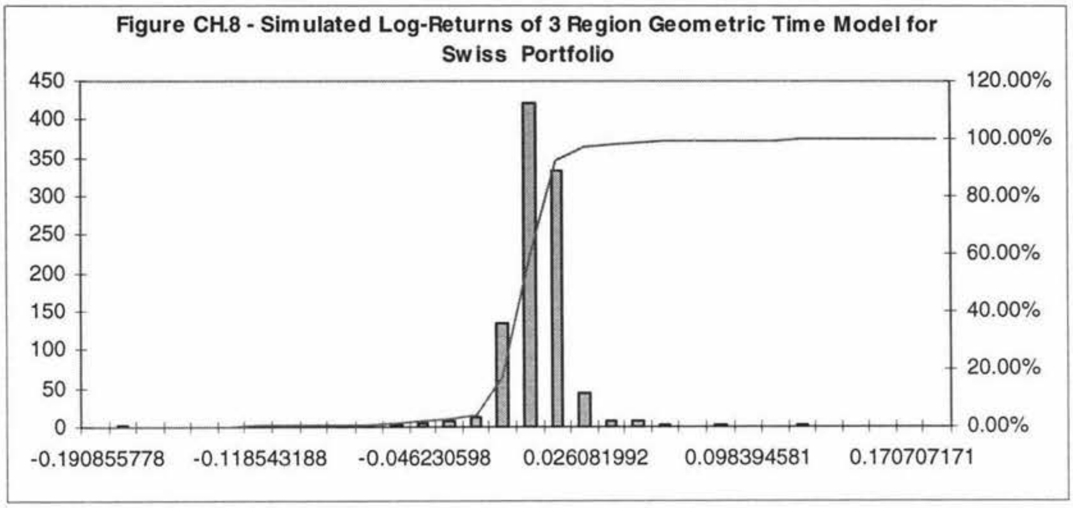


Figure CH.8 - Simulated Log-Returns of 3 Region Geometric Time Model for Swiss Portfolio

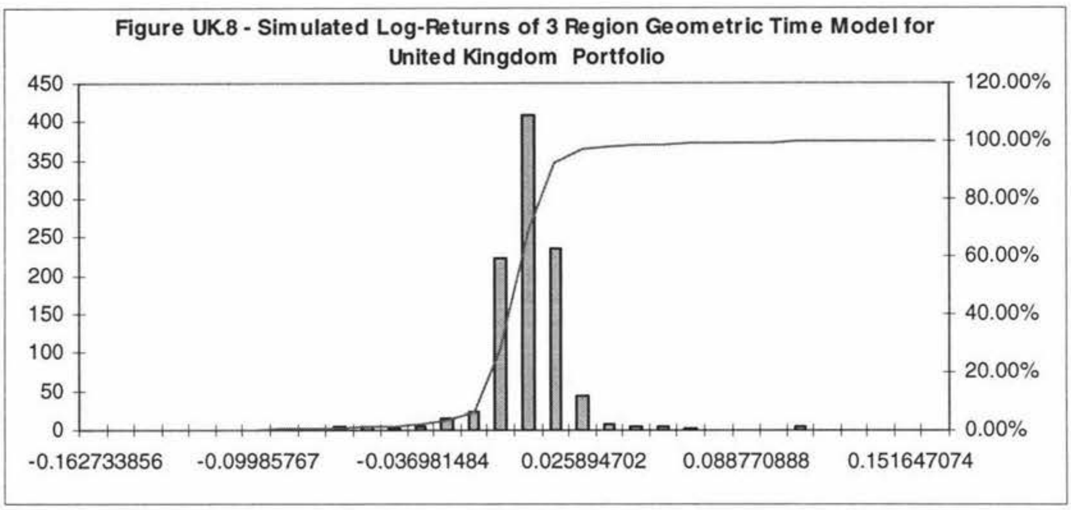


Figure UK.8 - Simulated Log-Returns of 3 Region Geometric Time Model for United Kingdom Portfolio

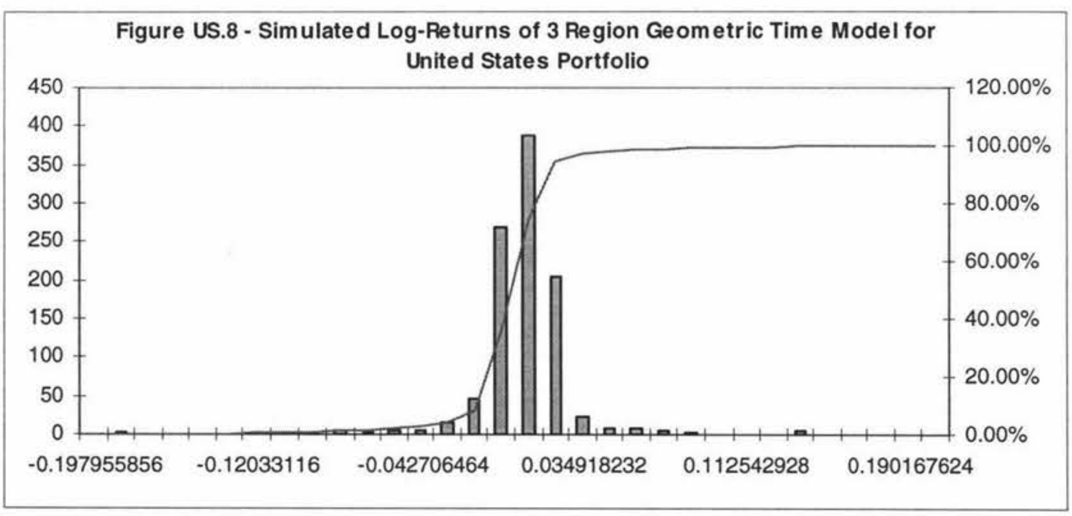


Figure US.8 - Simulated Log-Returns of 3 Region Geometric Time Model for United States Portfolio

Appendix.14 - SAMPLE TAIL LOCATION PARAMETERS AND PORTFOLIO WEIGHTS

Table A.1 Portfolio Weights										
Portfolio Number	**POR_01**	**POR_02**	**POR_03**	**POR_4**	**POR_5**	**POR_6**	**POR_7**	**POR_8**	**POR_9**	**POR_10**
Total Initial Wealth	1000000	1000000	1000000	1000000	1000000	1000000	1000000	1000000	1000000	1000000
Total positions	1	2	3	4	5	6	7	8	9	10
Position weight	1	0.5	0.333333	0.25	0.2	0.166667	0.142857	0.125	0.111111	0.1
Amount in Position										
Position 1	1000000	500000	333333.3	250000	200000	166666.7	142857.1	125000	111111.1	100000
Position 2	0	500000	333333.3	250000	200000	166666.7	142857.1	125000	111111.1	100000
Position 3	0	0	333333.3	250000	200000	166666.7	142857.1	125000	111111.1	100000
Position 4	0	0	0	250000	200000	166666.7	142857.1	125000	111111.1	100000
Position 5	0	0	0	0	200000	166666.7	142857.1	125000	111111.1	100000
Position 6	0	0	0	0	0	166666.7	142857.1	125000	111111.1	100000
Position 7	0	0	0	0	0	0	142857.1	125000	111111.1	100000
Position 8	0	0	0	0	0	0	0	125000	111111.1	100000
Position 9	0	0	0	0	0	0	0	0	111111.1	100000
Position 10	0	0	0	0	0	0	0	0	0	100000

Table A.2 Sample Tail Location Parameters			
Total # Observations	**5389**		
	5% Tail	**2.5 % Tail**	**1% Tail**
# Total Tail	270	135	55
# Used in Estimation	245	125	50
# Excluded	25	10	5
Left Tail Start	32	17	12
Left Tail End	276	141	61
# Left Tail Observations	245	125	50
Right Tail Start	5370	5385	5390
Right Tail End	5126	5261	5341
# Right Tail Observations	245	125	50

Table A.3 - Sample Unconditional Probabilities	
Prob(Left Tail)	0.049916
Prob(Center Region)	0.900167
Prob(Right Tail)	0.049916

Appendix.15 – Descriptive Statistics of Portfolio Positions

Table GBM.1 Sample Statistics of Simulated Geometric Brownian Motion Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	9.6515722	982862.57
Median	0.0000	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001	0.0000	0.0000	0.0000	22.767704	971341.43
Maximum	0.0088	0.0110	0.0262	0.0099	0.0097	0.0093	0.0101	0.0093	0.0110	0.0110	0.0088	8760.7605	1136127.3
Minimum	-0.0110	-0.0096	-0.0090	-0.0094	-0.0091	-0.0105	-0.0098	-0.0095	-0.0101	-0.0147	-0.0110	-10997.652	848025.72
Std Dev Over Entire Series	0.0027	0.0028	0.0028	0.0027	0.0028	0.0027	0.0027	0.0027	0.0028	0.0027	0.0027	2704.5317	64649.394
75th-25th range	0.0036	0.0038	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0038	0.0038	0.0036	3648.1028	78951.131
Kurtosis Over Entire Series	-0.0102	-0.0494	1.3827	0.0360	-0.0401	-0.0672	-0.0466	-0.1008	-0.0367	0.1558	-0.0102	-0.0101662	-0.340548
Skewness Over Entire Series	-0.0321	-0.0152	0.1852	0.0390	0.0394	0.0013	-0.0034	0.0395	0.0075	-0.0263	-0.0321	-0.0320833	0.5061281
Max-Min	0.0198	0.0206	0.0352	0.0193	0.0188	0.0198	0.0198	0.0187	0.0211	0.0257	0.0198	19758.413	288101.59

Table FRW.1 Sample Statistics of Simulated Two Sided Symmetric Fréchet Random Walk Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-19.915648	1051798.1
Median	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	-78.39697	1051470.9
Maximum	0.0309	0.0257	0.0348	0.0291	0.0192	0.0332	0.0257	0.0435	0.0435	0.0228	0.0309	30852.306	1160863.1
Minimum	-0.0272	-0.0319	-0.0278	-0.0257	-0.0386	-0.0291	-0.0249	-0.1101	-0.0394	-0.0435	-0.0272	-27188.804	917595.94
Std Dev Over Entire Series	0.0026	0.0029	0.0027	0.0026	0.0028	0.0028	0.0026	0.0032	0.0028	0.0028	0.0026	2647.561	50063.429
75th-25th range	0.0030	0.0030	0.0030	0.0029	0.0030	0.0029	0.0029	0.0029	0.0030	0.0029	0.0030	2993.1648	77881.374
Kurtosis Over Entire Series	14.0858	17.9300	15.3544	12.3354	16.6869	22.6186	12.6042	290.4292	27.8700	25.5302	14.0858	14.085795	-0.7103804
Skewness Over Entire Series	-0.2087	-0.6541	-0.0541	0.0620	-1.0357	0.4382	0.2184	-7.4035	0.4577	-1.3782	-0.2087	-0.2086752	-0.1927712
Max-Min	0.0580	0.0577	0.0625	0.0549	0.0578	0.0623	0.0507	0.1536	0.0829	0.0663	0.0580	58041.11	243267.14

Table AU.1 Sample Statistics of Australian Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	NABK	BHPY	NECO	WEBA	ANBG	CRAM	COLE	FOST	WOOD	WELD	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0005	-0.0005	-0.0010	-0.0004	-0.0004	-0.0004	-0.0004	-0.0003	-0.0005	-0.0008	-0.0005	-536.69309	7571370
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	5278422.3
Maximum	0.2091	0.2006	0.4309	0.2719	0.1407	0.3764	0.2496	0.2890	0.3930	0.5108	0.2091	209096.64	21403712
Minimum	-0.0921	-0.1066	-0.3291	-0.0793	-0.0920	-0.1481	-0.1283	-0.1823	-0.2963	-0.2092	-0.0921	-92068.529	923433.87
Std Dev Over Entire Series	0.0141	0.0153	0.0254	0.0149	0.0152	0.0181	0.0148	0.0179	0.0213	0.0208	0.0141	14071.777	5908804.8
75th-25th range	0.0142	0.0167	0.0228	0.0153	0.0163	0.0187	0.0142	0.0172	0.0183	0.0124	0.0142	14171.944	9736223.9
Kurtosis Over Entire Series	15.7332	7.8148	27.5620	22.3992	3.7811	40.0322	26.0231	21.6429	40.4165	102.1197	15.7332	15.733156	-0.6915391
Skewness Over Entire Series	1.1797	0.2273	0.2881	1.2623	0.2240	1.6376	1.6072	0.9001	0.8869	4.0564	1.1797	1.1796803	0.8226348
Max-Min	0.3012	0.3072	0.7600	0.3512	0.2326	0.5245	0.3780	0.4713	0.6894	0.7200	0.3012	301165.16	20480278

Table CA.1 Sample Statistics of Canadian Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	RBCN	BNSC	BCE	THOM	HCHP	ENCN	IMPO	LOBL	NORT	ALCN	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0004	-0.0004	-0.0004	-0.0004	-0.0003	-0.0003	-0.0003	-0.0007	-0.0002	-0.0002	-0.0004	-393.20427	2976617
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	1877095
Maximum	0.0925	0.1057	0.1004	0.1671	0.1975	0.1438	0.1176	0.1734	0.3979	0.2144	0.0925	92509.058	8581006
Minimum	-0.0826	-0.1013	-0.1805	-0.2135	-0.1422	-0.1795	-0.1257	-0.1307	-0.2258	-0.1068	-0.0826	-82642.875	877095
Std Dev Over Entire Series	0.0127	0.0152	0.0133	0.0173	0.0161	0.0174	0.0139	0.0152	0.0287	0.0179	0.0127	12688.207	2248348
75th-25th range	0.0130	0.0171	0.0113	0.0169	0.0162	0.0176	0.0135	0.0163	0.0220	0.0195	0.0130	12968.537	3462291
Kurtosis Over Entire Series	3.7442	2.7458	12.9282	11.3417	8.1115	6.6763	6.3479	8.6243	17.8352	7.0270	3.7442	3.7441726	-0.38453
Skewness Over Entire Series	-0.0289	-0.0163	-0.4750	-0.1604	0.0417	-0.1689	0.1100	0.2040	0.9277	0.2949	-0.0289	-0.0288843	1.032459
Max-Min	0.1752	0.2071	0.2809	0.3806	0.3397	0.3232	0.2433	0.3041	0.6237	0.3212	0.1752	175151.93	7703911

Table DE.1 Sample Statistics of German Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	SIE	DBK	ALV	EOA	BAS	HOE	BMW	BAY	RWE	VOW	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.00051	-0.00043	-0.00057	-0.0008	-0.00058	-0.00058	-0.00052	-0.00089	-0.00056	-0.00052	-0.00051	-508.379	7907907
Median	0	0	0	0	0	0	0	0	0	0	0	0	4026178
Maximum	0.1923	0.266578	0.191268	0.248762	0.171169	0.139607	0.203599	0.338681	0.284334	0.204584	0.1923	192300.3	31413613
Minimum	-0.11743	-0.16466	-0.09361	-0.24116	-0.10468	-0.09351	-0.10586	-0.19106	-0.18054	-0.10903	-0.11743	-117428	1000000
Std Dev Over Entire Series	0.016814	0.01478	0.018688	0.028974	0.01724	0.016364	0.016361	0.025308	0.016925	0.019102	0.016814	16814.27	7931725
75th-25th range	0.017886	0.015908	0.020943	0.033626	0.018708	0.017811	0.018655	0.02554	0.018182	0.019781	0.017886	17886.14	11510471
Kurtosis Over Entire Series	6.70036	25.06619	4.262662	5.410971	4.325911	3.534132	8.702252	16.89932	20.0569	5.42064	6.70036	6.70036	0.156984
Skewness Over Entire Series	0.215042	0.826685	0.266473	0.330511	0.117666	0.139107	0.568648	1.095337	0.650439	0.218171	0.215042	0.215042	1.180111
Max-Min	0.309728	0.431242	0.284878	0.489924	0.275847	0.233112	0.309456	0.529737	0.464872	0.313618	0.309728	309728.2	30413613

Table HK.1 Sample Statistics of Hong Kong Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	HSBC	HUTI	HSBA	CHCK	SHKP	CLIG	HKEL	HKCG	HELD	HKWH	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0006	-0.0007	-0.0006	-0.0007	-0.0006	-0.0005	-0.0005	-0.0008	-0.0007	-0.0004	-0.0006	-619.56712	10398365
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	6618439.3
Maximum	0.3209	0.4116	0.3305	0.3454	0.5220	0.3893	0.2678	0.3815	0.7077	0.3863	0.3209	320915.66	33740628
Minimum	-0.1930	-0.2163	-0.1572	-0.2155	-0.2406	-0.1839	-0.1574	-0.1823	-0.1706	-0.2945	-0.1930	-193015.71	926409.33
Std Dev Over Entire Series	0.0173	0.0234	0.0195	0.0233	0.0256	0.0175	0.0169	0.0197	0.0272	0.0248	0.0173	17264.028	9822866.8
75th-25th range	0.0159	0.0220	0.0166	0.0229	0.0233	0.0154	0.0147	0.0182	0.0239	0.0223	0.0159	15900.05	17825743
Kurtosis Over Entire Series	32.1110	30.6766	22.7537	19.8507	46.3550	53.8880	19.5134	36.4552	97.6753	21.6577	32.1110	32.111022	-1.0287579
Skewness Over Entire Series	1.3649	1.5779	1.1654	0.9175	2.1731	2.0579	0.7604	1.4103	3.7615	0.8178	1.3649	1.3648721	0.7161156
Max-Min	0.5139	0.6279	0.4877	0.5609	0.7626	0.5732	0.4252	0.5638	0.8783	0.6808	0.5139	513931.37	32814218

Table JP.1 Sample Statistics of Japanese Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	TYMO	NSNM	CNON	HONM	TAKC	SONC	MATE	FUTC	HITC	SRPC	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0003	-0.0001	-0.0003	-0.0003	-0.0003	-0.0002	0.0000	0.0000	0.0000	-0.0001	-0.0003	-270.88275	2974135.9
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	2607091.3
Maximum	0.2113	0.1876	0.1875	0.2106	0.1643	0.1687	0.1767	0.1542	0.1541	0.1987	0.2113	211311.34	7593989
Minimum	-0.1625	-0.1437	-0.1488	-0.1495	-0.1318	-0.1547	-0.1530	-0.1657	-0.1112	-0.1398	-0.1625	-162517.36	865460.72
Std Dev Over Entire Series	0.0188	0.0222	0.0221	0.0219	0.0187	0.0207	0.0194	0.0226	0.0206	0.0210	0.0188	18837.765	1451075.1
75th-25th range	0.0178	0.0200	0.0228	0.0232	0.0184	0.0205	0.0208	0.0226	0.0210	0.0214	0.0178	17757.539	2259479.1
Kurtosis Over Entire Series	7.8500	5.5645	4.1410	5.7959	4.4785	4.3812	4.2764	3.7095	3.1235	4.2036	7.8500	7.8499723	-0.3763291
Skewness Over Entire Series	-0.3027	-0.1338	-0.1890	-0.0282	-0.3444	-0.2171	-0.2711	-0.3924	-0.2983	-0.2369	-0.3027	-0.3027467	0.6707942
Max-Min	0.3738	0.3313	0.3362	0.3601	0.2961	0.3234	0.3296	0.3198	0.2654	0.3384	0.3738	373828.7	6728528.3

Table SG.1 Sample Statistics of Singaporean Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	UOBS	DBSS	OCBC	GELA	KEPP	CITY	FRAS	NOLS	ASIA	NATS	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0003	-0.0002	-0.0002	-0.0005	-0.0002	-0.0003	-0.0002	0.0000	-0.0002	-0.0003	-0.0003	-343.00516	3142901.5
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	2283500
Maximum	0.2670	0.3982	0.1736	0.2620	0.3459	0.6559	0.3443	0.3514	0.3887	0.2981	0.2670	266961.44	7700000
Minimum	-0.1857	-0.2274	-0.1640	-0.2262	-0.2482	-0.4643	-0.2150	-0.3044	-0.2347	-0.2721	-0.1857	-185749.48	773000
Std Dev Over Entire Series	0.0185	0.0195	0.0169	0.0177	0.0237	0.0291	0.0212	0.0271	0.0165	0.0253	0.0185	18451.211	1881080.5
75th-25th range	0.0166	0.0171	0.0142	0.0000	0.0215	0.0258	0.0180	0.0224	0.0000	0.0191	0.0166	16627.545	2937000
Kurtosis Over Entire Series	18.1371	42.3750	11.1414	36.6316	17.8829	66.9649	21.0740	18.7202	83.0483	18.0105	18.1371	18.13708	-0.8936622
Skewness Over Entire Series	0.4192	1.4900	-0.2495	-0.8405	0.4680	0.9334	0.6683	0.0855	2.3370	0.4221	0.4192	0.4192255	0.6099082
Max-Min	0.4527	0.6256	0.3376	0.4882	0.5941	1.1202	0.5593	0.6558	0.6234	0.5702	0.4527	452710.91	6927000

Table SE.1 Sample Statistics of Swedish Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	ERSN	HMBF	SVK	VOBK	ELUX	SCA	SKDA	SKFB	INDV	ATCC	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0004	-0.0011	-0.0006	-0.0004	-0.0005	-0.0004	-0.0003	-0.0004	-0.0004	-0.0005	-0.0004	-408.01416	12357492
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	4042253.5
Maximum	0.2738	0.3531	0.2149	0.1328	0.1324	0.1081	0.2464	0.1256	0.2204	0.1686	0.2738	273767.25	116345070
Minimum	-0.2231	-0.1559	-0.2491	-0.1457	-0.1760	-0.1751	-0.2231	-0.1193	-0.1824	-0.1612	-0.2231	-223143.55	457746.48
Std Dev Over Entire Series	0.0288	0.0223	0.0211	0.0192	0.0203	0.0189	0.0280	0.0205	0.0198	0.0206	0.0288	28784.979	20108515
75th-25th range	0.0258	0.0192	0.0194	0.0202	0.0197	0.0185	0.0250	0.0203	0.0188	0.0204	0.0258	25828.233	14352113
Kurtosis Over Entire Series	8.1361	17.8544	13.3905	3.8498	4.7698	4.2505	7.2524	3.4419	8.3559	4.5929	8.1361	8.1361003	8.2468718
Skewness Over Entire Series	0.2584	0.5368	-0.6099	-0.1682	-0.1992	-0.2159	-0.2542	0.0277	0.2981	-0.3313	0.2584	0.2583526	2.803645
Max-Min	0.4969	0.5090	0.4641	0.2785	0.3084	0.2831	0.4695	0.2449	0.4028	0.3297	0.4969	496910.8	115887324

Table CH.1 Sample Statistics of Swiss Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	NOVN	NESN	UBSN	ROGH	CSGN	RUKN	ZURN	ADEN	HOLN	ABB	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0007	-0.0005	-0.0003	-0.0005	-0.0002	-0.0004	-0.0002	-0.0002	-0.0003	-0.0002	-0.0007	-661.1886	17487066
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	9726027.4
Maximum	0.1503	0.1124	0.1542	0.1339	0.1500	0.1902	0.2257	0.3364	0.3185	0.9630	0.1503	150282.2	50787671
Minimum	-0.1824	-0.3403	-0.1542	-0.1362	-0.1626	-0.1685	-0.1920	-0.1629	-0.2133	-0.3773	-0.1824	-182384.95	1000000
Std Dev Over Entire Series	0.0136	0.0129	0.0162	0.0142	0.0186	0.0168	0.0199	0.0258	0.0217	0.0272	0.0136	13575.991	16261752
75th-25th range	0.0122	0.0109	0.0146	0.0119	0.0139	0.0134	0.0147	0.0215	0.0176	0.0175	0.0122	12216.814	33405822
Kurtosis Over Entire Series	12.6359	94.9149	8.3681	10.3233	9.8238	15.7544	18.5370	12.1773	16.4905	305.5171	12.6359	12.635869	-1.2849043
Skewness Over Entire Series	-0.1817	-3.0150	0.1817	0.5060	0.2330	0.3232	0.8554	0.6298	0.3754	8.0499	-0.1817	-0.1817173	0.636699
Max-Min	0.3327	0.4527	0.3084	0.2701	0.3126	0.3586	0.4177	0.4993	0.5317	1.3403	0.3327	332667.15	49787671

Table UK.1 Sample Statistics of United Kingdom Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	BPC	GSK	SHEL	BARC	TSCO	ULVR	BATS	RIO	AVIV	STAN	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0004	-0.0005	-0.0004	-0.0005	-0.0005	-0.0005	-0.0005	-0.0004	-0.0003	-0.0004	-0.0004	-401.35916	5309743.9
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	3555138.9
Maximum	0.1507	0.1838	0.1275	0.1416	0.1336	0.1482	0.1438	0.2011	0.1121	0.1665	0.1507	150727.19	13602270
Minimum	-0.0944	-0.1881	-0.0912	-0.1438	-0.1040	-0.1446	-0.3226	-0.1178	-0.1202	-0.2309	-0.0944	-94380.607	1000000
Std Dev Over Entire Series	0.0161	0.0181	0.0150	0.0192	0.0172	0.0150	0.0200	0.0183	0.0195	0.0213	0.0161	16100.295	3600562.1
75th-25th range	0.0176	0.0196	0.0153	0.0200	0.0190	0.0140	0.0197	0.0184	0.0195	0.0199	0.0176	17591.462	5882576.5
Kurtosis Over Entire Series	3.9792	7.4698	4.5181	3.8727	3.0810	11.0176	21.9811	6.9978	4.4668	7.6236	3.9792	3.9791586	-0.8598656
Skewness Over Entire Series	0.2087	-0.0180	0.0922	0.0225	-0.0059	0.3968	-1.2742	0.2206	-0.0906	-0.1579	0.2087	0.2087057	0.7639016
Max-Min	0.2451	0.3719	0.2187	0.2854	0.2376	0.2927	0.4664	0.3189	0.2323	0.3974	0.2451	245107.8	12602270

Table US.1 Sample Statistics of the United States Original Portfolio and Positions

Positions	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6	Position 7	Position 8	Position 9	Position 10			
Name	GEC	XON	PFE	INTC	AIG	MRK	JHJ	HOD	COC	BOA	portfolio Returns	portfolio changes	portfolio values
Average Over Entire Series	-0.0005	-0.0004	-0.0006	-0.0008	-0.0006	-0.0006	-0.0005	-0.0009	-0.0006	-0.0005	-0.0005	-508.3794	7907906.8
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	4026178
Maximum	0.1923	0.2666	0.1913	0.2488	0.1712	0.1396	0.2036	0.3387	0.2843	0.2046	0.1923	192300.26	31413613
Minimum	-0.1174	-0.1647	-0.0936	-0.2412	-0.1047	-0.0935	-0.1059	-0.1911	-0.1805	-0.1090	-0.1174	-117427.9	1000000
Std Dev Over Entire Series	0.0168	0.0148	0.0187	0.0290	0.0172	0.0164	0.0164	0.0253	0.0169	0.0191	0.0168	16814.265	7931725.1
75th-25th range	0.0179	0.0159	0.0209	0.0336	0.0187	0.0178	0.0187	0.0255	0.0182	0.0198	0.0179	17886.136	11510471
Kurtosis Over Entire Series	6.7004	25.0662	4.2627	5.4110	4.3259	3.5341	8.7023	16.8993	20.0569	5.4206	6.7004	6.7003603	0.1569836
Skewness Over Entire Series	0.2150	0.8267	0.2665	0.3305	0.1177	0.1391	0.5686	1.0953	0.6504	0.2182	0.2150	0.2150424	1.1801114
Max-Min	0.3097	0.4312	0.2849	0.4899	0.2758	0.2331	0.3095	0.5297	0.4649	0.3136	0.3097	309728.24	30413613

Appendix.16 – Sample Estimates for Three State Markov Probabilities and Three State Two Transitions Markov Probabilities

TableGBM.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
	From Left Tail									
To Left Tail	0.0296	0.0667	0.0593	0.0741	0.0630	0.0630	0.0481	0.0370	0.0519	0.0444
To Center	0.9296	0.8963	0.8963	0.8852	0.9148	0.9000	0.9000	0.9111	0.9148	0.9000
To Right Tail	0.0407	0.0370	0.0444	0.0407	0.0222	0.0370	0.0519	0.0519	0.0333	0.0556
	From Center Region									
To Left Tail	0.0518	0.0499	0.0497	0.0497	0.0499	0.0493	0.0497	0.0505	0.0503	0.0518
To Center	0.8981	0.9002	0.9006	0.9002	0.8993	0.9002	0.9006	0.9002	0.8979	0.8985
To Right Tail	0.0501	0.0499	0.0497	0.0501	0.0507	0.0505	0.0497	0.0493	0.0518	0.0497
	From Right Tail									
To Left Tail	0.0407	0.0370	0.0444	0.0296	0.0370	0.0481	0.0556	0.0519	0.0407	0.0222
To Center	0.9000	0.8963	0.8926	0.9111	0.8963	0.8963	0.8889	0.8852	0.9222	0.9259
To Right Tail	0.0593	0.0667	0.0630	0.0593	0.0667	0.0556	0.0556	0.0630	0.0370	0.0519

Table GBM.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center	0.9580	0.9603	0.9528	0.9560	0.9763	0.9605	0.9455	0.9462	0.9648	0.9419
To Right Tail	0.0420	0.0397	0.0472	0.0440	0.0237	0.0395	0.0545	0.0538	0.0352	0.0581
	From Center Region									
To Left Tail	0.5081	0.5000	0.5000	0.4979	0.4959	0.4938	0.5000	0.5062	0.4929	0.5102
To Center	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4919	0.5000	0.5000	0.5021	0.5041	0.5062	0.5000	0.4938	0.5071	0.4898
	From Right Tail									
To Left Tail	0.0433	0.0397	0.0474	0.0315	0.0397	0.0510	0.0588	0.0553	0.0423	0.0234
To Center	0.9567	0.9603	0.9526	0.9685	0.9603	0.9490	0.9412	0.9447	0.9577	0.9766
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

*** NP = Not Possible**

Table FRW.2 - Sample Estimates for 3 States Markov Probability Matrix										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
	From Left Tail									
To Left Tail	0.0222	0.0630	0.0556	0.0593	0.0481	0.0481	0.0481	0.0704	0.0481	0.0704
To Center Region	0.9222	0.8852	0.8963	0.9000	0.9333	0.9111	0.9148	0.8889	0.9148	0.9148
To Right Tail	0.0556	0.0519	0.0481	0.0407	0.0185	0.0407	0.0370	0.0407	0.0370	0.0148
	From Center Region									
To Left Tail	0.0516	0.0491	0.0489	0.0478	0.0485	0.0483	0.0485	0.0489	0.0503	0.0489
To Center Region	0.8983	0.9000	0.9002	0.9006	0.8985	0.9008	0.9010	0.9004	0.8989	0.9000
To Right Tail	0.0501	0.0509	0.0509	0.0516	0.0530	0.0509	0.0505	0.0507	0.0507	0.0512
	From Right Tail									
To Left Tail	0.0481	0.0519	0.0632	0.0781	0.0781	0.0818	0.0781	0.0481	0.0444	0.0481
To Center Region	0.9074	0.9148	0.8996	0.8885	0.8922	0.8736	0.8662	0.9037	0.9037	0.8852
To Right Tail	0.0444	0.0333	0.0372	0.0335	0.0297	0.0446	0.0558	0.0481	0.0519	0.0667

Table FRW.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.9432	0.9447	0.9490	0.9567	0.9805	0.9572	0.9611	0.9562	0.9611	0.9841
To Right Tail	0.0568	0.0553	0.0510	0.0433	0.0195	0.0428	0.0389	0.0438	0.0389	0.0159
	From Center Region									
To Left Tail	0.5071	0.4907	0.4897	0.4813	0.4776	0.4865	0.4896	0.4907	0.4980	0.4887
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4929	0.5093	0.5103	0.5187	0.5224	0.5135	0.5104	0.5093	0.5020	0.5113
	From Right Tail									
To Left Tail	0.0504	0.0536	0.0656	0.0808	0.0805	0.0856	0.0827	0.0506	0.0469	0.0516
To Center Region	0.9496	0.9464	0.9344	0.9192	0.9195	0.9144	0.9173	0.9494	0.9531	0.9484
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table AU.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
	From Left Tail									
To Left Tail	0.1074	0.0741	0.1296	0.1259	0.1148	0.1148	0.1259	0.1296	0.1296	0.1333
To Center Region	0.8074	0.8296	0.7481	0.7593	0.7778	0.7741	0.7519	0.7481	0.7630	0.7481
To Right Tail	0.0852	0.0963	0.1222	0.1148	0.1074	0.1111	0.1222	0.1222	0.1074	0.1185
	From Center Region									
To Left Tail	0.0456	0.0476	0.0435	0.0439	0.0448	0.0448	0.0441	0.0435	0.0439	0.0439
To Center Region	0.9115	0.9088	0.9146	0.9136	0.9123	0.9130	0.9144	0.9150	0.9138	0.9144
To Right Tail	0.0429	0.0435	0.0419	0.0425	0.0429	0.0423	0.0415	0.0415	0.0423	0.0417
	From Right Tail									
To Left Tail	0.0741	0.0704	0.0889	0.0852	0.0815	0.0815	0.0815	0.0889	0.0815	0.0778
To Center Region	0.7815	0.8074	0.7852	0.7926	0.7963	0.7889	0.7852	0.7778	0.7852	0.7889
To Right Tail	0.1444	0.1222	0.1259	0.1222	0.1222	0.1296	0.1333	0.1333	0.1333	0.1333

Table AU.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.9046	0.8960	0.8596	0.8686	0.8787	0.8745	0.8602	0.8596	0.8766	0.8632
To Right Tail	0.0954	0.1040	0.1404	0.1314	0.1213	0.1255	0.1398	0.1404	0.1234	0.1368
	From Center Region									
To Left Tail	0.5152	0.5226	0.5097	0.5084	0.5106	0.5142	0.5157	0.5121	0.5096	0.5133
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4848	0.4774	0.4903	0.4916	0.4894	0.4858	0.4843	0.4879	0.4904	0.4867
	From Right Tail									
To Left Tail	0.0866	0.0802	0.1017	0.0970	0.0928	0.0936	0.0940	0.1026	0.0940	0.0897
To Center Region	0.9134	0.9198	0.8983	0.9030	0.9072	0.9064	0.9060	0.8974	0.9060	0.9103
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table CA.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
	From Left Tail									
To Left Tail	0.1370	0.1444	0.1630	0.1222	0.1148	0.1148	0.1333	0.1000	0.1407	0.1370
To Center Region	0.7741	0.7370	0.7593	0.7815	0.7926	0.8000	0.7889	0.8037	0.7370	0.7444
To Right Tail	0.0889	0.1185	0.0778	0.0963	0.0926	0.0852	0.0778	0.0963	0.1222	0.1185
	From Center Region									
To Left Tail	0.0437	0.0429	0.0423	0.0435	0.0443	0.0443	0.0435	0.0458	0.0437	0.0443
To Center Region	0.9146	0.9163	0.9160	0.9148	0.9144	0.9142	0.9148	0.9111	0.9150	0.9140
To Right Tail	0.0417	0.0408	0.0417	0.0417	0.0413	0.0415	0.0417	0.0431	0.0413	0.0417
	From Right Tail									
To Left Tail	0.0741	0.0815	0.0741	0.0926	0.0889	0.0852	0.0815	0.0741	0.0741	0.0630
To Center Region	0.7630	0.7704	0.7519	0.7519	0.7444	0.7444	0.7444	0.7963	0.7889	0.8037
To Right Tail	0.1630	0.1481	0.1741	0.1556	0.1667	0.1704	0.1741	0.1296	0.1370	0.1333

Table CA.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8970	0.8615	0.9071	0.8903	0.8954	0.9038	0.9103	0.8930	0.8578	0.8627
To Right Tail	0.1030	0.1385	0.0929	0.1097	0.1046	0.0962	0.0897	0.1070	0.1422	0.1373
	From Center Region									
To Left Tail	0.5121	0.5123	0.5037	0.5109	0.5181	0.5168	0.5109	0.5151	0.5146	0.5156
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4879	0.4877	0.4963	0.4891	0.4819	0.4832	0.4891	0.4849	0.4854	0.4844
	From Right Tail									
To Left Tail	0.0885	0.0957	0.0897	0.1096	0.1067	0.1027	0.0987	0.0851	0.0858	0.0726
To Center Region	0.9115	0.9043	0.9103	0.8904	0.8933	0.8973	0.9013	0.9149	0.9142	0.9274
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table DE.2 - Sample Estimates for 3 State Markov Probability Transition Matrix

Portfolio Number	GER 01	GER 02	GER 03	GER 04	GER 05	GER 06	GER 07	GER 08	GER 09	GER 10
	From Left Tail									
To Left Tail	0.1519	0.1370	0.1630	0.1370	0.1444	0.1444	0.1556	0.1407	0.1630	0.1741
To Center Region	0.6963	0.7074	0.7000	0.7148	0.7111	0.7037	0.7000	0.7222	0.6926	0.6889
To Right Tail	0.1519	0.1556	0.1370	0.1481	0.1444	0.1519	0.1444	0.1370	0.1444	0.1370
	From Center Region									
To Left Tail	0.0427	0.0439	0.0413	0.0423	0.0423	0.0423	0.0431	0.0435	0.0421	0.0419
To Center Region	0.9177	0.9173	0.9171	0.9171	0.9165	0.9165	0.9152	0.9144	0.9160	0.9160
To Right Tail	0.0396	0.0388	0.0417	0.0406	0.0413	0.0413	0.0417	0.0421	0.0419	0.0421
	From Right Tail									
To Left Tail	0.0815	0.0741	0.0963	0.1037	0.0963	0.0963	0.0704	0.0778	0.0815	0.0741
To Center Region	0.7815	0.7778	0.7889	0.7741	0.7889	0.7963	0.8222	0.8148	0.8148	0.8185
To Right Tail	0.1370	0.1481	0.1148	0.1222	0.1148	0.1074	0.1074	0.1074	0.1037	0.1074

Table DE.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix

Portfolio Number	GER_01	GER_02	GER_03	GER_04	GER_05	GER_06	GER_07	GER_08	GER_09	GER_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8210	0.8197	0.8363	0.8283	0.8312	0.8225	0.8289	0.8405	0.8274	0.8341
To Right Tail	0.1790	0.1803	0.1637	0.1717	0.1688	0.1775	0.1711	0.1595	0.1726	0.1659
	From Center Region									
To Left Tail	0.5188	0.5312	0.4975	0.5100	0.5062	0.5062	0.5085	0.5084	0.5012	0.4988
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4812	0.4688	0.5025	0.4900	0.4938	0.4938	0.4915	0.4916	0.4988	0.5012
	From Right Tail									
To Left Tail	0.0944	0.0870	0.1088	0.1181	0.1088	0.1079	0.0788	0.0871	0.0909	0.0830
To Center Region	0.9056	0.9130	0.8912	0.8819	0.8912	0.8921	0.9212	0.9129	0.9091	0.9170
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table HK.2 - Sample Estimates for 3 State Markov Probability Transition Matrix

Portfolio Number	HKG 01	HKG 02	HKG 03	HKG 04	HKG 05	HKG 06	HKG 07	HKG 08	HKG 09	HKG 10
	From Left Tail									
To Left Tail	0.1185	0.1148	0.1370	0.1222	0.1259	0.1259	0.1296	0.1444	0.1519	0.1333
To Center Region	0.7444	0.7593	0.7259	0.7593	0.7444	0.7444	0.7444	0.7333	0.7296	0.7556
To Right Tail	0.1370	0.1259	0.1370	0.1185	0.1296	0.1296	0.1259	0.1222	0.1185	0.1111
	From Center Region									
To Left Tail	0.0443	0.0441	0.0433	0.0448	0.0441	0.0439	0.0433	0.0439	0.0429	0.0443
To Center Region	0.9123	0.9138	0.9140	0.9130	0.9138	0.9148	0.9154	0.9138	0.9144	0.9121
To Right Tail	0.0433	0.0421	0.0427	0.0423	0.0421	0.0413	0.0413	0.0423	0.0427	0.0435
	From Right Tail									
To Left Tail	0.0852	0.0926	0.0852	0.0741	0.0815	0.0852	0.0926	0.0667	0.0778	0.0704
To Center Region	0.8296	0.7889	0.8185	0.8037	0.8037	0.7852	0.7741	0.8148	0.8074	0.8222
To Right Tail	0.0852	0.1185	0.0963	0.1222	0.1148	0.1296	0.1333	0.1185	0.1148	0.1074

Table HK.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix

Portfolio Number	HKG_01	HKG_02	HKG_03	HKG_04	HKG_05	HKG_06	HKG_07	HKG_08	HKG_09	HKG_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8445	0.8577	0.8412	0.8650	0.8517	0.8517	0.8553	0.8571	0.8603	0.8718
To Right Tail	0.1555	0.1423	0.1588	0.1350	0.1483	0.1483	0.1447	0.1429	0.1397	0.1282
	From Center Region									
To Left Tail	0.5059	0.5120	0.5036	0.5142	0.5120	0.5157	0.5122	0.5096	0.5012	0.5047
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4941	0.4880	0.4964	0.4858	0.4880	0.4843	0.4878	0.4904	0.4988	0.4953
	From Right Tail									
To Left Tail	0.0931	0.1050	0.0943	0.0844	0.0921	0.0979	0.1068	0.0756	0.0879	0.0788
To Center Region	0.9069	0.8950	0.9057	0.9156	0.9079	0.9021	0.8932	0.9244	0.9121	0.9212
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table JP.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	JAP 01	JAP 02	JAP 03	JAP 04	JAP 05	JAP 06	JAP 07	JAP 08	JAP 09	JAP 10
	From Left Tail									
To Left Tail	0.1037	0.1148	0.1222	0.1333	0.1185	0.1296	0.1185	0.1111	0.1222	0.1185
To Center Region	0.7852	0.7593	0.7667	0.7481	0.7407	0.7481	0.7741	0.7852	0.7778	0.7815
To Right Tail	0.1111	0.1259	0.1111	0.1185	0.1407	0.1222	0.1074	0.1037	0.1000	0.1000
	From Center Region									
To Left Tail	0.0446	0.0437	0.0443	0.0431	0.0433	0.0431	0.0441	0.0446	0.0448	0.0450
To Center Region	0.9115	0.9140	0.9119	0.9142	0.9146	0.9142	0.9127	0.9115	0.9115	0.9109
To Right Tail	0.0439	0.0423	0.0437	0.0427	0.0421	0.0427	0.0431	0.0439	0.0437	0.0441
	From Right Tail									
To Left Tail	0.0963	0.1000	0.0815	0.0926	0.1037	0.0963	0.0889	0.0889	0.0741	0.0741
To Center Region	0.8037	0.7852	0.8148	0.7926	0.7926	0.7926	0.7926	0.8037	0.8111	0.8185
To Right Tail	0.1000	0.1148	0.1037	0.1148	0.1037	0.1111	0.1185	0.1074	0.1148	0.1074

Table JP.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8760	0.8577	0.8734	0.8632	0.8403	0.8596	0.8782	0.8833	0.8861	0.8866
To Right Tail	0.1240	0.1423	0.1266	0.1368	0.1597	0.1404	0.1218	0.1167	0.1139	0.1134
	From Center Region									
To Left Tail	0.5035	0.5084	0.5035	0.5024	0.5072	0.5024	0.5059	0.5035	0.5058	0.5046
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4965	0.4916	0.4965	0.4976	0.4928	0.4976	0.4941	0.4965	0.4942	0.4954
	From Right Tail									
To Left Tail	0.1070	0.1130	0.0909	0.1046	0.1157	0.1083	0.1008	0.0996	0.0837	0.0830
To Center Region	0.8930	0.8870	0.9091	0.8954	0.8843	0.8917	0.8992	0.9004	0.9163	0.9170
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table SG.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	SIN 01	SIN 02	SIN 03	SIN 04	SIN 05	SIN 06	SIN 07	SIN 08	SIN 09	SIN 10
	From Left Tail									
To Left Tail	0.1370	0.1815	0.1963	0.2111	0.2111	0.1889	0.1963	0.2111	0.2037	0.2111
To Center Region	0.7593	0.7185	0.7037	0.6852	0.6852	0.7074	0.7111	0.6963	0.7037	0.6926
To Right Tail	0.1037	0.1000	0.1000	0.1037	0.1037	0.1037	0.0926	0.0926	0.0926	0.0963
	From Center Region									
To Left Tail	0.0417	0.0410	0.0396	0.0375	0.0377	0.0400	0.0400	0.0390	0.0400	0.0400
To Center Region	0.9160	0.9187	0.9216	0.9226	0.9226	0.9189	0.9173	0.9183	0.9179	0.9177
To Right Tail	0.0423	0.0402	0.0388	0.0398	0.0396	0.0410	0.0427	0.0427	0.0421	0.0423
	From Right Tail									
To Left Tail	0.1148	0.0815	0.0926	0.1148	0.1111	0.0926	0.0852	0.0889	0.0778	0.0704
To Center Region	0.7481	0.7407	0.7037	0.7037	0.7037	0.7481	0.7741	0.7704	0.7704	0.7852
To Right Tail	0.1370	0.1778	0.2037	0.1815	0.1852	0.1593	0.1407	0.1407	0.1519	0.1444

Table SG.3- Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	SIN_01	SIN_02	SIN_03	SIN_04	SIN_05	SIN_06	SIN_07	SIN_08	SIN_09	SIN_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8798	0.8778	0.8756	0.8685	0.8685	0.8721	0.8848	0.8826	0.8837	0.8779
To Right Tail	0.1202	0.1222	0.1244	0.1315	0.1315	0.1279	0.1152	0.1174	0.1163	0.1221
	From Center Region									
To Left Tail	0.4963	0.5051	0.5053	0.4853	0.4880	0.4936	0.4838	0.4773	0.4874	0.4862
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.5037	0.4949	0.4947	0.5147	0.5120	0.5064	0.5162	0.5227	0.5126	0.5138
	From Right Tail									
To Left Tail	0.1330	0.0991	0.1163	0.1403	0.1364	0.1101	0.0991	0.1034	0.0917	0.0823
To Center Region	0.8670	0.9009	0.8837	0.8597	0.8636	0.8899	0.9009	0.8966	0.9083	0.9177
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table SE.2 - Sample Estimates for 3 State Markov Probability Transition Matrix

Portfolio Number	SWE 01	SWE 02	SWE 03	SWE 04	SWE 05	SWE 06	SWE 07	SWE 08	SWE 09	SWE 10
	From Left Tail									
To Left Tail	0.1630	0.1370	0.1444	0.1667	0.1815	0.1667	0.1704	0.1778	0.1815	0.1852
To Center Region	0.7037	0.7593	0.7519	0.7185	0.7222	0.7296	0.7296	0.7111	0.7111	0.7037
To Right Tail	0.1333	0.1037	0.1037	0.1148	0.0963	0.1037	0.1000	0.1111	0.1074	0.1111
	From Center Region									
To Left Tail	0.0402	0.0431	0.0433	0.0425	0.0421	0.0427	0.0423	0.0419	0.0419	0.0415
To Center Region	0.9175	0.9142	0.9140	0.9152	0.9146	0.9146	0.9146	0.9160	0.9158	0.9167
To Right Tail	0.0423	0.0427	0.0427	0.0423	0.0433	0.0427	0.0431	0.0421	0.0423	0.0419
	From Right Tail									
To Left Tail	0.1148	0.0889	0.0778	0.0704	0.0630	0.0667	0.0704	0.0704	0.0667	0.0704
To Center Region	0.7778	0.7815	0.7926	0.8037	0.8111	0.8037	0.8037	0.7963	0.8000	0.7926
To Right Tail	0.1074	0.1296	0.1296	0.1259	0.1259	0.1296	0.1259	0.1333	0.1333	0.1370

Table SE.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix

Portfolio Number	SWE_01	SWE_02	SWE_03	SWE_04	SWE_05	SWE_06	SWE_07	SWE_08	SWE_09	SWE_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8407	0.8798	0.8788	0.8622	0.8824	0.8756	0.8795	0.8649	0.8688	0.8636
To Right Tail	0.1593	0.1202	0.1212	0.1378	0.1176	0.1244	0.1205	0.1351	0.1312	0.1364
	From Center Region									
To Left Tail	0.4875	0.5024	0.5036	0.5012	0.4928	0.5000	0.4952	0.4988	0.4975	0.4975
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.5125	0.4976	0.4964	0.4988	0.5072	0.5000	0.5048	0.5012	0.5025	0.5025
	From Right Tail									
To Left Tail	0.1286	0.1021	0.0894	0.0805	0.0720	0.0766	0.0805	0.0812	0.0769	0.0815
To Center Region	0.8714	0.8979	0.9106	0.9195	0.9280	0.9234	0.9195	0.9188	0.9231	0.9185
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table CH.2 - Sample Estimates for 3 State Markov Probability Transition Matrix

Portfolio Number	SWZ 01	SWZ 02	SWZ 03	SWZ 04	SWZ 05	SWZ 06	SWZ 07	SWZ 08	SWZ 09	SWZ 10
	From Left Tail									
To Left Tail	0.1296	0.1333	0.1481	0.1593	0.1519	0.1561	0.1667	0.1667	0.1778	0.1630
To Center Region	0.7667	0.7519	0.7074	0.7296	0.7074	0.7138	0.6926	0.6815	0.6778	0.6815
To Right Tail	0.1037	0.1148	0.1444	0.1111	0.1407	0.1301	0.1407	0.1519	0.1444	0.1556
	From Center Region									
To Left Tail	0.0443	0.0448	0.0441	0.0437	0.0435	0.0431	0.0421	0.0419	0.0410	0.0425
To Center Region	0.9130	0.9146	0.9169	0.9156	0.9177	0.9169	0.9177	0.9193	0.9191	0.9187
To Right Tail	0.0427	0.0406	0.0390	0.0406	0.0388	0.0400	0.0402	0.0388	0.0398	0.0388
	From Right Tail									
To Left Tail	0.0741	0.0630	0.0593	0.0556	0.0667	0.0704	0.0778	0.0815	0.0852	0.0741
To Center Region	0.7963	0.7815	0.7852	0.7852	0.7704	0.7778	0.7852	0.7667	0.7741	0.7778
To Right Tail	0.1296	0.1556	0.1556	0.1593	0.1630	0.1519	0.1370	0.1519	0.1407	0.1481

Table CH.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix

Portfolio Number	SWZ_01	SWZ_02	SWZ_03	SWZ_04	SWZ_05	SWZ_06	SWZ_07	SWZ_08	SWZ_09	SWZ_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8809	0.8675	0.8304	0.8678	0.8341	0.8458	0.8311	0.8178	0.8243	0.8142
To Right Tail	0.1191	0.1325	0.1696	0.1322	0.1659	0.1542	0.1689	0.1822	0.1757	0.1858
	From Center Region									
To Left Tail	0.5095	0.5242	0.5310	0.5183	0.5288	0.5186	0.5113	0.5192	0.5077	0.5228
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4905	0.4758	0.4690	0.4817	0.4712	0.4814	0.4887	0.4808	0.4923	0.4772
	From Right Tail									
To Left Tail	0.0851	0.0746	0.0702	0.0661	0.0796	0.0830	0.0901	0.0961	0.0991	0.0870
To Center Region	0.9149	0.9254	0.9298	0.9339	0.9204	0.9170	0.9099	0.9039	0.9009	0.9130
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table UK.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
	From Left Tail									
To Left Tail	0.1074	0.1037	0.1185	0.1259	0.0815	0.1148	0.1111	0.1148	0.1148	0.1370
To Center Region	0.8148	0.7963	0.7926	0.7852	0.8185	0.7815	0.7926	0.7852	0.7963	0.7630
To Right Tail	0.0778	0.1000	0.0889	0.0889	0.1000	0.1037	0.0963	0.1000	0.0889	0.1000
	From Center Region									
To Left Tail	0.0446	0.0460	0.0454	0.0435	0.0448	0.0433	0.0433	0.0427	0.0425	0.0419
To Center Region	0.9086	0.9094	0.9103	0.9127	0.9107	0.9127	0.9119	0.9130	0.9127	0.9146
To Right Tail	0.0468	0.0446	0.0443	0.0437	0.0446	0.0439	0.0448	0.0443	0.0448	0.0435
	From Right Tail									
To Left Tail	0.0926	0.0704	0.0667	0.0926	0.1148	0.1074	0.1111	0.1185	0.1222	0.1111
To Center Region	0.8259	0.8296	0.8185	0.7815	0.7852	0.7852	0.7889	0.7778	0.7704	0.7704
To Right Tail	0.0815	0.1000	0.1148	0.1259	0.1000	0.1074	0.1000	0.1037	0.1074	0.1185

Table UK.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.9129	0.8884	0.8992	0.8983	0.8911	0.8828	0.8917	0.8870	0.8996	0.8841
To Right Tail	0.0871	0.1116	0.1008	0.1017	0.1089	0.1172	0.1083	0.1130	0.1004	0.1159
	From Center Region									
To Left Tail	0.4876	0.5080	0.5057	0.4988	0.5012	0.4965	0.4918	0.4905	0.4870	0.4903
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.5124	0.4920	0.4943	0.5012	0.4988	0.5035	0.5082	0.5095	0.5130	0.5097
	From Right Tail									
To Left Tail	0.1008	0.0782	0.0753	0.1059	0.1276	0.1203	0.1235	0.1322	0.1369	0.1261
To Center Region	0.8992	0.9218	0.9247	0.8941	0.8724	0.8797	0.8765	0.8678	0.8631	0.8739
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Table US.2 - Sample Estimates for 3 State Markov Probability Transition Matrix										
Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
	From Left Tail									
To Left Tail	0.1333	0.1148	0.1111	0.1000	0.1148	0.1259	0.1185	0.1222	0.1111	0.1185
To Center Region	0.7444	0.7741	0.7704	0.7704	0.7667	0.7630	0.7704	0.7593	0.7704	0.7519
To Right Tail	0.1222	0.1111	0.1185	0.1296	0.1185	0.1111	0.1111	0.1185	0.1185	0.1296
	From Center Region									
To Left Tail	0.0452	0.0452	0.0452	0.0443	0.0446	0.0441	0.0452	0.0462	0.0466	0.0460
To Center Region	0.9111	0.9094	0.9109	0.9117	0.9111	0.9111	0.9097	0.9099	0.9088	0.9109
To Right Tail	0.0437	0.0454	0.0439	0.0439	0.0443	0.0448	0.0452	0.0439	0.0446	0.0431
	From Right Tail									
To Left Tail	0.0558	0.0741	0.0778	0.1037	0.0852	0.0815	0.0704	0.0481	0.0519	0.0556
To Center Region	0.8550	0.8556	0.8333	0.8148	0.8296	0.8333	0.8519	0.8593	0.8667	0.8481
To Right Tail	0.0892	0.0704	0.0889	0.0815	0.0852	0.0852	0.0778	0.0926	0.0815	0.0963

Table US.3 - Sample Estimates for 3 States 2 Transitions Markov Probability Matrix										
Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
	From Left Tail									
To Left Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Center Region	0.8590	0.8745	0.8667	0.8560	0.8661	0.8729	0.8739	0.8650	0.8667	0.8529
To Right Tail	0.1410	0.1255	0.1333	0.1440	0.1339	0.1271	0.1261	0.1350	0.1333	0.1471
	From Center Region									
To Left Tail	0.5081	0.4989	0.5069	0.5023	0.5012	0.4965	0.5000	0.5126	0.5113	0.5162
To Center Region	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
To Right Tail	0.4919	0.5011	0.4931	0.4977	0.4988	0.5035	0.5000	0.4874	0.4887	0.4838
	From Right Tail									
To Left Tail	0.0612	0.0797	0.0854	0.1129	0.0931	0.0891	0.0763	0.0531	0.0565	0.0615
To Center Region	0.9388	0.9203	0.9146	0.8871	0.9069	0.9109	0.9237	0.9469	0.9435	0.9385
To Right Tail	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

Appendix.17 – Sample Parameters for Left and Right Tail Distributions

Table GBM.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
5% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0021	0.0015	0.0012	0.0011	0.0010	0.0009	0.0008	0.0008	0.0007	0.0007
Sample Right Tail	0.0044	0.0032	0.0026	0.0023	0.0020	0.0019	0.0017	0.0016	0.0015	0.0014
Sample Left Tail	-0.0045	-0.0032	-0.0026	-0.0023	-0.0020	-0.0018	-0.0017	-0.0016	-0.0015	-0.0014
Normal Right Tail	0.0035	0.0025	0.0021	0.0018	0.0016	0.0015	0.0014	0.0013	0.0012	0.0012
Normal Left Tail	-0.0035	-0.0025	-0.0020	-0.0018	-0.0016	-0.0014	-0.0013	-0.0012	-0.0012	-0.0011
2.5% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0024	0.0017	0.0014	0.0000	0.0011	0.0010	0.0009	0.0008	0.0008	0.0008
Sample Right Tail	-0.0053	-0.0038	-0.0031	-0.0027	-0.0024	-0.0021	-0.0020	-0.0019	-0.0018	-0.0017
Sample Left Tail	0.0053	0.0039	0.0032	0.0027	0.0024	0.0022	0.0020	0.0018	0.0018	0.0017
Normal Right Tail	0.0039	0.0028	0.0023	0.0020	0.0018	0.0016	0.0015	0.0014	0.0013	0.0013
Normal Left Tail	-0.0039	-0.0028	-0.0023	-0.0019	-0.0017	-0.0016	-0.0015	-0.0014	-0.0013	-0.0012
1% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0025	0.0018	0.0015	0.0000	0.0011	0.0010	0.0010	0.0009	0.0009	0.0008
Sample Right Tail	-0.0063	-0.0045	-0.0038	-0.0032	-0.0028	-0.0025	-0.0024	-0.0022	-0.0021	-0.0019
Sample Left Tail	0.0062	0.0045	0.0036	0.0032	0.0029	0.0025	0.0023	0.0022	0.0021	0.0020
Normal Right Tail	0.0041	0.0030	0.0024	0.0021	0.0019	0.0017	0.0016	0.0015	0.0014	0.0014
Normal Left Tail	-0.0042	-0.0030	-0.0024	-0.0021	-0.0019	-0.0017	-0.0016	-0.0015	-0.0014	-0.0013
Simulated Normal Center without tails @ 95%										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Backed-out Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Backed-out Standard Deviation	0.0027	0.0019	0.0016	0.0014	0.0012	0.0011	0.0010	0.0010	0.0009	0.0009
Sample Right Tail	0.0044	0.0032	0.0026	0.0023	0.0020	0.0019	0.0017	0.0016	0.0015	0.0014
Sample Left Tail	-0.0045	-0.0032	-0.0026	-0.0023	-0.0020	-0.0018	-0.0017	-0.0016	-0.0015	-0.0014

Table FRW.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
5% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0016	0.0012	0.0010	0.0009	0.0008	0.0008	0.0007	0.0007	0.0007	0.0006
Sample Right Tail	0.0032	0.0027	0.0023	0.0021	0.0019	0.0018	0.0016	0.0016	0.0015	0.0014
Sample Left Tail	-0.0032	-0.0026	-0.0024	-0.0020	-0.0018	-0.0017	-0.0016	-0.0015	-0.0014	-0.0013
Normal Right Tail	0.0027	0.0020	0.0017	0.0015	0.0014	0.0013	0.0012	0.0011	0.0011	0.0010
Normal Left Tail	-0.0026	-0.0020	-0.0017	-0.0015	-0.0014	-0.0013	-0.0012	-0.0011	-0.0011	-0.0010
2.5% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0018	0.0014	0.0012	0.0000	0.0010	0.0009	0.0008	0.0008	0.0007	0.0007
Sample Right Tail	-0.0047	-0.0039	-0.0031	-0.0026	-0.0025	-0.0022	-0.0021	-0.0019	-0.0018	-0.0017
Sample Left Tail	0.0050	0.0037	0.0032	0.0027	0.0026	0.0024	0.0022	0.0021	0.0019	0.0018
Normal Right Tail	0.0030	0.0023	0.0020	0.0017	0.0016	0.0015	0.0014	0.0013	0.0012	0.0012
Normal Left Tail	-0.0030	-0.0023	-0.0019	-0.0017	-0.0016	-0.0014	-0.0014	-0.0013	-0.0012	-0.0011
1% Tail Estimate										
Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	0.0021	0.0016	0.0013	0.0000	0.0011	0.0010	0.0009	0.0009	0.0008	0.0008
Sample Right Tail	-0.0072	-0.0053	-0.0040	-0.0035	-0.0032	-0.0030	-0.0026	-0.0025	-0.0024	-0.0023
Sample Left Tail	0.0073	0.0056	0.0046	0.0041	0.0036	0.0031	0.0029	0.0027	0.0024	0.0023
Normal Right Tail	0.0034	0.0026	0.0022	0.0019	0.0018	0.0016	0.0015	0.0014	0.0014	0.0013
Normal Left Tail	-0.0034	-0.0026	-0.0022	-0.0019	-0.0017	-0.0016	-0.0015	-0.0014	-0.0013	-0.0013
Simulated Normal Center without tails @ 95%										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Backed-out Mean	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Backed-out Standard Deviation	0.0020	0.0016	0.0014	0.0013	0.0011	0.0011	0.0010	0.0009	0.0009	0.0008
Sample Right Tail	0.0032	0.0027	0.0023	0.0021	0.0019	0.0018	0.0016	0.0016	0.0015	0.0014
Sample Left Tail	-0.0032	-0.0026	-0.0024	-0.0020	-0.0018	-0.0017	-0.0016	-0.0015	-0.0014	-0.0013

Table AU.4 Sample Parameters For Left and Right Tail Distributions

Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
5% Tail Estimate										
Mean	0.0007	0.0006	0.0007	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0007
Standard Deviation	0.0092	0.0084	0.0127	0.0123	0.0119	0.0116	0.0112	0.0109	0.0106	0.0097
Sample Right Tail	0.0220	0.0193	0.0310	0.0301	0.0293	0.0283	0.0273	0.0268	0.0259	0.0234
Sample Left Tail	-0.0211	-0.0180	-0.0278	-0.0269	-0.0263	-0.0256	-0.0251	-0.0246	-0.0236	-0.0216
Normal Right Tail	0.0158	0.0145	0.0216	0.0209	0.0203	0.0198	0.0191	0.0186	0.0180	0.0166
Normal Left Tail	-0.0144	-0.0133	-0.0202	-0.0196	-0.0190	-0.0185	-0.0178	-0.0174	-0.0167	-0.0153
2.5% Tail Estimate										
Mean	0.0007	0.0006	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Standard Deviation	0.0105	0.0095	0.0146	0.0002	0.0137	0.0133	0.0128	0.0125	0.0121	0.0111
Sample Right Tail	-0.0265	-0.0227	-0.0369	-0.0360	-0.0349	-0.0336	-0.0326	-0.0320	-0.0307	-0.0281
Sample Left Tail	0.0276	0.0240	0.0407	0.0392	0.0374	0.0365	0.0350	0.0342	0.0330	0.0297
Normal Right Tail	0.0180	0.0162	0.0247	0.0239	0.0232	0.0226	0.0218	0.0213	0.0205	0.0190
Normal Left Tail	-0.0166	-0.0151	-0.0232	-0.0224	-0.0218	-0.0212	-0.0204	-0.0200	-0.0192	-0.0175
1% Tail Estimate										
Mean	0.0007	0.0006	0.0008	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Standard Deviation	0.0116	0.0104	0.0164	0.0002	0.0153	0.0149	0.0144	0.0140	0.0135	0.0123
Sample Right Tail	-0.0380	-0.0286	-0.0505	-0.0489	-0.0477	-0.0463	-0.0438	-0.0427	-0.0411	-0.0369
Sample Left Tail	0.0346	0.0300	0.0545	0.0518	0.0497	0.0482	0.0465	0.0453	0.0432	0.0380
Normal Right Tail	0.0198	0.0177	0.0277	0.0267	0.0259	0.0252	0.0243	0.0237	0.0228	0.0210
Normal Left Tail	-0.0185	-0.0165	-0.0261	-0.0252	-0.0245	-0.0238	-0.0229	-0.0224	-0.0215	-0.0195
Simulated Normal Center without tails @ 95%										
Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
Backed-out Mean	0.0005	0.0006	0.0016	0.0016	0.0015	0.0014	0.0011	0.0011	0.0011	0.0009
Backed-out Standard Deviation	0.0131	0.0113	0.0179	0.0173	0.0169	0.0164	0.0159	0.0156	0.0150	0.0137
Sample Right Tail	0.0220	0.0193	0.0310	0.0301	0.0293	0.0283	0.0273	0.0268	0.0259	0.0234
Sample Left Tail	-0.0211	-0.0180	-0.0278	-0.0269	-0.0263	-0.0256	-0.0251	-0.0246	-0.0236	-0.0216

Table CA.4 Sample Parameters For Left and Right Tail Distributions

Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
5% Tail Estimate										
Mean	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
Standard Deviation	0.0086	0.0087	0.0073	0.0070	0.0068	0.0064	0.0060	0.0056	0.0061	0.0061
Sample Right Tail	0.0214	0.0207	0.0177	0.0173	0.0161	0.0153	0.0144	0.0136	0.0147	0.0146
Sample Left Tail	-0.0191	-0.0198	-0.0165	-0.0156	-0.0150	-0.0144	-0.0136	-0.0123	-0.0139	-0.0140
Normal Right Tail	0.0145	0.0146	0.0123	0.0120	0.0116	0.0110	0.0103	0.0097	0.0106	0.0106
Normal Left Tail	-0.0139	-0.0139	-0.0116	-0.0112	-0.0108	-0.0101	-0.0094	-0.0087	-0.0095	-0.0096
2.5% Tail Estimate										
Mean	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
Standard Deviation	0.0099	0.0099	0.0083	0.0001	0.0078	0.0074	0.0069	0.0064	0.0071	0.0071
Sample Right Tail	-0.0249	-0.0252	-0.0210	-0.0205	-0.0200	-0.0192	-0.0178	-0.0168	-0.0192	-0.0188
Sample Left Tail	0.0269	0.0264	0.0228	0.0219	0.0213	0.0200	0.0189	0.0171	0.0197	0.0193
Normal Right Tail	0.0167	0.0167	0.0141	0.0137	0.0132	0.0125	0.0118	0.0111	0.0121	0.0121
Normal Left Tail	-0.0159	-0.0159	-0.0133	-0.0129	-0.0124	-0.0117	-0.0109	-0.0100	-0.0111	-0.0111
1% Tail Estimate										
Mean	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
Standard Deviation	0.0110	0.0110	0.0093	0.0001	0.0087	0.0083	0.0077	0.0071	0.0080	0.0079
Sample Right Tail	-0.0319	-0.0322	-0.0265	-0.0270	-0.0262	-0.0251	-0.0234	-0.0223	-0.0263	-0.0261
Sample Left Tail	0.0339	0.0337	0.0300	0.0303	0.0291	0.0273	0.0246	0.0220	0.0266	0.0262
Normal Right Tail	0.0185	0.0185	0.0157	0.0153	0.0147	0.0140	0.0131	0.0123	0.0136	0.0135
Normal Left Tail	-0.0177	-0.0177	-0.0148	-0.0144	-0.0139	-0.0132	-0.0123	-0.0112	-0.0126	-0.0126
Simulated Normal Center without tails @ 95%										
Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
Backed-out Mean	0.0011	0.0005	0.0006	0.0009	0.0005	0.0004	0.0004	0.0007	0.0004	0.0003
Backed-out Standard Deviation	0.0123	0.0123	0.0104	0.0100	0.0095	0.0090	0.0085	0.0079	0.0087	0.0087
Sample Right Tail	0.0214	0.0207	0.0177	0.0173	0.0161	0.0153	0.0144	0.0136	0.0147	0.0146
Sample Left Tail	-0.0191	-0.0198	-0.0165	-0.0156	-0.0150	-0.0144	-0.0136	-0.0123	-0.0139	-0.0140

Table DE.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	GER_01	GER_02	GER_03	GER_04	GER_05	GER_06	GER_07	GER_08	GER_09	GER_10
5% Tail Estimate										
Mean	0.0004	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005
Standard Deviation	0.0114	0.0106	0.0105	0.0098	0.0095	0.0092	0.0091	0.0090	0.0089	0.0090
Sample Right Tail	0.0290	0.0258	0.0251	0.0232	0.0220	0.0211	0.0211	0.0209	0.0204	0.0204
Sample Left Tail	-0.0285	-0.0265	-0.0252	-0.0229	-0.0221	-0.0214	-0.0214	-0.0213	-0.0210	-0.0214
Normal Right Tail	0.0192	0.0179	0.0178	0.0166	0.0161	0.0156	0.0155	0.0154	0.0151	0.0153
Normal Left Tail	-0.0184	-0.0170	-0.0168	-0.0156	-0.0151	-0.0146	-0.0144	-0.0143	-0.0141	-0.0142
2.5% Tail Estimate										
Mean	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005
Standard Deviation	0.0136	0.0124	0.0122	0.0001	0.0109	0.0105	0.0104	0.0104	0.0102	0.0103
Sample Right Tail	-0.0391	-0.0352	-0.0345	-0.0323	-0.0309	-0.0297	-0.0289	-0.0285	-0.0279	-0.0284
Sample Left Tail	0.0392	0.0345	0.0329	0.0295	0.0279	0.0267	0.0263	0.0263	0.0255	0.0258
Normal Right Tail	0.0227	0.0209	0.0205	0.0191	0.0184	0.0178	0.0176	0.0175	0.0172	0.0174
Normal Left Tail	-0.0219	-0.0201	-0.0197	-0.0182	-0.0175	-0.0169	-0.0167	-0.0166	-0.0163	-0.0165
1% Tail Estimate										
Mean	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Standard Deviation	0.0155	0.0141	0.0139	0.0002	0.0122	0.0118	0.0117	0.0116	0.0114	0.0115
Sample Right Tail	-0.0532	-0.0477	-0.0492	-0.0436	-0.0410	-0.0380	-0.0396	-0.0398	-0.0378	-0.0392
Sample Left Tail	0.0517	0.0450	0.0455	0.0413	0.0382	0.0360	0.0352	0.0344	0.0342	0.0338
Normal Right Tail	0.0259	0.0235	0.0232	0.0214	0.0205	0.0198	0.0196	0.0195	0.0191	0.0193
Normal Left Tail	-0.0252	-0.0228	-0.0225	-0.0206	-0.0197	-0.0190	-0.0187	-0.0186	-0.0183	-0.0185
Simulated Normal Center without tails @ 95%										
Portfolio Number	GER_01	GER_02	GER_03	GER_04	GER_05	GER_06	GER_07	GER_08	GER_09	GER_10
Backed-out Mean	0.0003	-0.0003	-0.0001	0.0001	-0.0001	-0.0001	-0.0001	-0.0002	-0.0003	-0.0005
Backed-out Standard Deviation	0.0175	0.0159	0.0153	0.0140	0.0134	0.0129	0.0129	0.0128	0.0126	0.0127
Sample Right Tail	0.0290	0.0258	0.0251	0.0232	0.0220	0.0211	0.0211	0.0209	0.0204	0.0204
Sample Left Tail	-0.0285	-0.0265	-0.0252	-0.0229	-0.0221	-0.0214	-0.0214	-0.0213	-0.0210	-0.0214

Table HK.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	HKG_01	HKG_02	HKG_03	HKG_04	HKG_05	HKG_06	HKG_07	HKG_08	HKG_09	HKG_10
5% Tail Estimate										
Mean	0.0007	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Standard Deviation	0.0106	0.0124	0.0115	0.0119	0.0121	0.0116	0.0112	0.0104	0.0107	0.0107
Sample Right Tail	0.0268	0.0305	0.0277	0.0288	0.0290	0.0277	0.0271	0.0250	0.0258	0.0259
Sample Left Tail	-0.0238	-0.0285	-0.0266	-0.0275	-0.0281	-0.0266	-0.0257	-0.0234	-0.0243	-0.0245
Normal Right Tail	0.0181	0.0212	0.0197	0.0205	0.0208	0.0200	0.0193	0.0180	0.0185	0.0185
Normal Left Tail	-0.0167	-0.0196	-0.0180	-0.0188	-0.0191	-0.0182	-0.0176	-0.0162	-0.0167	-0.0167
2.5% Tail Estimate										
Mean	0.0007	0.0009	0.0008	0.0008	0.0009	0.0008	0.0008	0.0009	0.0009	0.0009
Standard Deviation	0.0122	0.0143	0.0132	0.0002	0.0139	0.0134	0.0129	0.0119	0.0123	0.0123
Sample Right Tail	-0.0324	-0.0373	-0.0355	-0.0365	-0.0369	-0.0360	-0.0345	-0.0316	-0.0321	-0.0324
Sample Left Tail	0.0342	0.0390	0.0358	0.0380	0.0376	0.0355	0.0345	0.0328	0.0339	0.0339
Normal Right Tail	0.0208	0.0244	0.0226	0.0234	0.0238	0.0228	0.0221	0.0205	0.0211	0.0212
Normal Left Tail	-0.0194	-0.0227	-0.0209	-0.0218	-0.0221	-0.0211	-0.0204	-0.0188	-0.0194	-0.0194
1% Tail Estimate										
Mean	0.0007	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	0.0008
Standard Deviation	0.0138	0.0160	0.0148	0.0002	0.0157	0.0150	0.0145	0.0134	0.0138	0.0139
Sample Right Tail	-0.0437	-0.0509	-0.0494	-0.0512	-0.0526	-0.0509	-0.0499	-0.0465	-0.0480	-0.0491
Sample Left Tail	0.0456	0.0516	0.0489	0.0507	0.0514	0.0491	0.0459	0.0409	0.0427	0.0430
Normal Right Tail	0.0234	0.0272	0.0252	0.0262	0.0266	0.0255	0.0247	0.0229	0.0236	0.0237
Normal Left Tail	-0.0219	-0.0255	-0.0236	-0.0246	-0.0249	-0.0239	-0.0231	-0.0212	-0.0219	-0.0220
Simulated Normal Center without tails @ 95%										
Portfolio Number	HKG_01	HKG_02	HKG_03	HKG_04	HKG_05	HKG_06	HKG_07	HKG_08	HKG_09	HKG_10
Backed-out Mean	0.0015	0.0010	0.0005	0.0007	0.0004	0.0005	0.0007	0.0008	0.0007	0.0007
Backed-out Standard Deviation	0.0154	0.0179	0.0165	0.0171	0.0174	0.0165	0.0161	0.0147	0.0152	0.0153
Sample Right Tail	0.0268	0.0305	0.0277	0.0288	0.0290	0.0277	0.0271	0.0250	0.0258	0.0259
Sample Left Tail	-0.0238	-0.0285	-0.0266	-0.0275	-0.0281	-0.0266	-0.0257	-0.0234	-0.0243	-0.0245

Table JP.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
5% Tail Estimate										
Mean	-0.0001	-0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
Standard Deviation	0.0120	0.0109	0.0108	0.0108	0.0097	0.0096	0.0096	0.0098	0.0098	0.0098
Sample Right Tail	0.0303	0.0275	0.0270	0.0265	0.0232	0.0229	0.0228	0.0235	0.0235	0.0237
Sample Left Tail	-0.0268	-0.0249	-0.0245	-0.0242	-0.0214	-0.0211	-0.0210	-0.0211	-0.0211	-0.0210
Normal Right Tail	0.0197	0.0178	0.0178	0.0178	0.0161	0.0159	0.0159	0.0161	0.0161	0.0161
Normal Left Tail	-0.0198	-0.0180	-0.0178	-0.0177	-0.0159	-0.0157	-0.0158	-0.0160	-0.0160	-0.0160
2.5% Tail Estimate										
Mean	0.0000	0.0000	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001
Standard Deviation	0.0139	0.0126	0.0125	0.0002	0.0111	0.0110	0.0110	0.0111	0.0111	0.0111
Sample Right Tail	-0.0361	-0.0327	-0.0315	-0.0317	-0.0279	-0.0273	-0.0278	-0.0276	-0.0273	-0.0271
Sample Left Tail	0.0414	0.0367	0.0363	0.0353	0.0310	0.0302	0.0301	0.0303	0.0305	0.0304
Normal Right Tail	0.0229	0.0207	0.0206	0.0206	0.0185	0.0183	0.0182	0.0184	0.0184	0.0184
Normal Left Tail	-0.0229	-0.0207	-0.0205	-0.0203	-0.0181	-0.0179	-0.0179	-0.0181	-0.0182	-0.0182
1% Tail Estimate										
Mean	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Standard Deviation	0.0158	0.0143	0.0141	0.0002	0.0124	0.0123	0.0123	0.0123	0.0124	0.0124
Sample Right Tail	-0.0469	-0.0421	-0.0405	-0.0401	-0.0354	-0.0357	-0.0353	-0.0354	-0.0354	-0.0345
Sample Left Tail	0.0583	0.0524	0.0490	0.0470	0.0402	0.0409	0.0421	0.0403	0.0401	0.0397
Normal Right Tail	0.0262	0.0236	0.0234	0.0231	0.0206	0.0204	0.0204	0.0205	0.0205	0.0205
Normal Left Tail	-0.0258	-0.0234	-0.0230	-0.0227	-0.0202	-0.0200	-0.0200	-0.0201	-0.0202	-0.0202
Simulated Normal Center without tails @ 95%										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
Backed-out Mean	0.0018	0.0013	0.0013	0.0012	0.0009	0.0009	0.0009	0.0012	0.0012	0.0014
Backed-out Standard Deviation	0.0174	0.0159	0.0157	0.0154	0.0136	0.0134	0.0133	0.0136	0.0136	0.0136
Sample Right Tail	0.0303	0.0275	0.0270	0.0265	0.0232	0.0229	0.0228	0.0235	0.0235	0.0237
Sample Left Tail	-0.0268	-0.0249	-0.0245	-0.0242	-0.0214	-0.0211	-0.0210	-0.0211	-0.0211	-0.0210

Table SG.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	SIN_01	SIN_02	SIN_03	SIN_04	SIN_05	SIN_06	SIN_07	SIN_08	SIN_09	SIN_10
5% Tail Estimate										
Mean	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Standard Deviation	0.0111	0.0097	0.0089	0.0074	0.0076	0.0086	0.0084	0.0084	0.0078	0.0078
Sample Right Tail	0.0282	0.0257	0.0239	0.0201	0.0203	0.0217	0.0214	0.0213	0.0196	0.0201
Sample Left Tail	-0.0267	-0.0230	-0.0213	-0.0180	-0.0180	-0.0203	-0.0199	-0.0199	-0.0190	-0.0185
Normal Right Tail	0.0184	0.0162	0.0148	0.0124	0.0128	0.0144	0.0142	0.0142	0.0131	0.0131
Normal Left Tail	-0.0180	-0.0158	-0.0145	-0.0118	-0.0123	-0.0139	-0.0136	-0.0136	-0.0126	-0.0126
2.5% Tail Estimate										
Mean	0.0003	0.0003	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Standard Deviation	0.0130	0.0115	0.0105	0.0001	0.0091	0.0101	0.0099	0.0099	0.0092	0.0092
Sample Right Tail	-0.0348	-0.0310	-0.0281	-0.0247	-0.0250	-0.0274	-0.0266	-0.0266	-0.0252	-0.0255
Sample Left Tail	0.0377	0.0338	0.0314	0.0282	0.0279	0.0298	0.0289	0.0287	0.0266	0.0264
Normal Right Tail	0.0216	0.0191	0.0175	0.0148	0.0152	0.0169	0.0166	0.0165	0.0154	0.0154
Normal Left Tail	-0.0210	-0.0185	-0.0171	-0.0142	-0.0146	-0.0163	-0.0160	-0.0160	-0.0148	-0.0148
1% Tail Estimate										
Mean	0.0003	0.0003	0.0003	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003
Standard Deviation	0.0147	0.0130	0.0120	0.0001	0.0104	0.0115	0.0112	0.0112	0.0104	0.0104
Sample Right Tail	-0.0450	-0.0420	-0.0392	-0.0361	-0.0353	-0.0373	-0.0364	-0.0358	-0.0363	-0.0351
Sample Left Tail	0.0509	0.0465	0.0451	0.0381	0.0385	0.0409	0.0393	0.0393	0.0373	0.0364
Normal Right Tail	0.0245	0.0218	0.0201	0.0172	0.0175	0.0192	0.0188	0.0187	0.0175	0.0175
Normal Left Tail	-0.0238	-0.0211	-0.0195	-0.0165	-0.0168	-0.0185	-0.0181	-0.0181	-0.0168	-0.0169
Simulated Normal Center without tails @ 95%										
Portfolio Number	SIN_01	SIN_02	SIN_03	SIN_04	SIN_05	SIN_06	SIN_07	SIN_08	SIN_09	SIN_10
Backed-out Mean	0.0007	0.0014	0.0013	0.0011	0.0012	0.0007	0.0008	0.0007	0.0003	0.0008
Backed-out Standard Deviation	0.0167	0.0148	0.0137	0.0116	0.0116	0.0128	0.0126	0.0125	0.0117	0.0117
Sample Right Tail	0.0282	0.0257	0.0239	0.0201	0.0203	0.0217	0.0214	0.0213	0.0196	0.0201
Sample Left Tail	-0.0267	-0.0230	-0.0213	-0.0180	-0.0180	-0.0203	-0.0199	-0.0199	-0.0190	-0.0185

Table SE.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	SWE_01	SWE_02	SWE_03	SWE_04	SWE_05	SWE_06	SWE_07	SWE_08	SWE_09	SWE_10
5% Tail Estimate										
Mean	0.0005	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007	0.0007	0.0007
Standard Deviation	0.0176	0.0122	0.0111	0.0108	0.0105	0.0104	0.0103	0.0102	0.0101	0.0099
Sample Right Tail	0.0430	0.0317	0.0287	0.0276	0.0269	0.0262	0.0263	0.0258	0.0254	0.0252
Sample Left Tail	-0.0439	-0.0275	-0.0249	-0.0243	-0.0239	-0.0237	-0.0240	-0.0237	-0.0232	-0.0234
Normal Right Tail	0.0295	0.0210	0.0191	0.0186	0.0181	0.0179	0.0177	0.0176	0.0173	0.0171
Normal Left Tail	-0.0284	-0.0193	-0.0175	-0.0170	-0.0165	-0.0163	-0.0162	-0.0161	-0.0158	-0.0156
2.5% Tail Estimate										
Mean	0.0005	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
Standard Deviation	0.0206	0.0143	0.0130	0.0002	0.0123	0.0121	0.0120	0.0120	0.0118	0.0116
Sample Right Tail	-0.0591	-0.0359	-0.0330	-0.0325	-0.0321	-0.0315	-0.0317	-0.0318	-0.0317	-0.0310
Sample Left Tail	0.0572	0.0424	0.0386	0.0373	0.0361	0.0357	0.0355	0.0352	0.0345	0.0341
Normal Right Tail	0.0344	0.0244	0.0222	0.0215	0.0210	0.0208	0.0206	0.0204	0.0201	0.0199
Normal Left Tail	-0.0335	-0.0225	-0.0205	-0.0198	-0.0193	-0.0191	-0.0190	-0.0189	-0.0186	-0.0184
1% Tail Estimate										
Mean	0.0005	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0008
Standard Deviation	0.0236	0.0161	0.0147	0.0002	0.0139	0.0138	0.0137	0.0136	0.0134	0.0132
Sample Right Tail	-0.0781	-0.0501	-0.0457	-0.0440	-0.0435	-0.0431	-0.0442	-0.0446	-0.0438	-0.0422
Sample Left Tail	0.0829	0.0548	0.0514	0.0499	0.0487	0.0480	0.0471	0.0469	0.0465	0.0461
Normal Right Tail	0.0392	0.0274	0.0251	0.0243	0.0237	0.0235	0.0233	0.0231	0.0228	0.0225
Normal Left Tail	-0.0383	-0.0254	-0.0232	-0.0225	-0.0220	-0.0218	-0.0216	-0.0215	-0.0212	-0.0209
Simulated Normal Center without tails @ 95%										
Portfolio Number	SWE_01	SWE_02	SWE_03	SWE_04	SWE_05	SWE_06	SWE_07	SWE_08	SWE_09	SWE_10
Backed-out Mean	-0.0005	0.0021	0.0019	0.0017	0.0015	0.0013	0.0011	0.0011	0.0011	0.0009
Backed-out Standard Deviation	0.0264	0.0180	0.0163	0.0158	0.0154	0.0152	0.0153	0.0151	0.0148	0.0148
Sample Right Tail	0.0430	0.0317	0.0287	0.0276	0.0269	0.0262	0.0263	0.0258	0.0254	0.0252
Sample Left Tail	-0.0439	-0.0275	-0.0249	-0.0243	-0.0239	-0.0237	-0.0240	-0.0237	-0.0232	-0.0234

Table CH.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	SWZ_01	SWZ_02	SWZ_03	SWZ_04	SWZ_05	SWZ_06	SWZ_07	SWZ_08	SWZ_09	SWZ_10
5% Tail Estimate										
Mean	0.0006	0.0006	0.0006	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Standard Deviation	0.0085	0.0075	0.0073	0.0070	0.0069	0.0068	0.0068	0.0070	0.0068	0.0068
Sample Right Tail	0.0216	0.0189	0.0181	0.0169	0.0167	0.0163	0.0166	0.0172	0.0167	0.0165
Sample Left Tail	-0.0199	-0.0178	-0.0174	-0.0165	-0.0166	-0.0166	-0.0167	-0.0172	-0.0167	-0.0169
Normal Right Tail	0.0146	0.0129	0.0126	0.0121	0.0119	0.0117	0.0117	0.0121	0.0118	0.0118
Normal Left Tail	-0.0133	-0.0116	-0.0114	-0.0108	-0.0107	-0.0105	-0.0105	-0.0108	-0.0105	-0.0106
2.5% Tail Estimate										
Mean	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Standard Deviation	0.0099	0.0087	0.0085	0.0001	0.0080	0.0079	0.0079	0.0081	0.0079	0.0080
Sample Right Tail	-0.0266	-0.0240	-0.0238	-0.0229	-0.0230	-0.0225	-0.0226	-0.0232	-0.0231	-0.0221
Sample Left Tail	0.0283	0.0239	0.0233	0.0217	0.0214	0.0207	0.0208	0.0213	0.0214	0.0214
Normal Right Tail	0.0169	0.0149	0.0145	0.0139	0.0138	0.0135	0.0136	0.0140	0.0136	0.0137
Normal Left Tail	-0.0156	-0.0137	-0.0134	-0.0127	-0.0126	-0.0124	-0.0124	-0.0128	-0.0125	-0.0125
1% Tail Estimate										
Mean	0.0007	0.0006	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Standard Deviation	0.0112	0.0098	0.0096	0.0001	0.0090	0.0089	0.0089	0.0092	0.0090	0.0090
Sample Right Tail	-0.0365	-0.0328	-0.0312	-0.0305	-0.0308	-0.0302	-0.0313	-0.0322	-0.0315	-0.0321
Sample Left Tail	0.0381	0.0325	0.0303	0.0284	0.0289	0.0296	0.0290	0.0302	0.0294	0.0294
Normal Right Tail	0.0190	0.0167	0.0163	0.0156	0.0154	0.0152	0.0152	0.0157	0.0154	0.0154
Normal Left Tail	-0.0177	-0.0156	-0.0152	-0.0145	-0.0143	-0.0141	-0.0142	-0.0146	-0.0143	-0.0144
Simulated Normal Center without tails @ 95%										
Portfolio Number	SWZ_01	SWZ_02	SWZ_03	SWZ_04	SWZ_05	SWZ_06	SWZ_07	SWZ_08	SWZ_09	SWZ_10
Backed-out Mean	0.0008	0.0005	0.0003	0.0002	0.0001	-0.0002	-0.0001	0.0000	0.0000	-0.0002
Backed-out Standard Deviation	0.0126	0.0112	0.0108	0.0102	0.0101	0.0100	0.0101	0.0104	0.0102	0.0101
Sample Right Tail	0.0216	0.0189	0.0181	0.0169	0.0167	0.0163	0.0166	0.0172	0.0167	0.0165
Sample Left Tail	-0.0199	-0.0178	-0.0174	-0.0165	-0.0166	-0.0166	-0.0167	-0.0172	-0.0167	-0.0169

Table UK.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
5% Tail Estimate										
Mean	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0005	0.0006
Standard Deviation	0.0111	0.0102	0.0092	0.0088	0.0083	0.0078	0.0076	0.0075	0.0074	0.0074
Sample Right Tail	0.0265	0.0234	0.0210	0.0199	0.0184	0.0175	0.0169	0.0166	0.0166	0.0165
Sample Left Tail	-0.0245	-0.0220	-0.0196	-0.0188	-0.0178	-0.0169	-0.0165	-0.0165	-0.0165	-0.0166
Normal Right Tail	0.0188	0.0172	0.0157	0.0150	0.0142	0.0133	0.0131	0.0129	0.0127	0.0127
Normal Left Tail	-0.0179	-0.0162	-0.0147	-0.0140	-0.0131	-0.0122	-0.0120	-0.0118	-0.0116	-0.0115
2.5% Tail Estimate										
Mean	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Standard Deviation	0.0127	0.0115	0.0104	0.0001	0.0093	0.0088	0.0086	0.0085	0.0084	0.0083
Sample Right Tail	-0.0316	-0.0283	-0.0255	-0.0241	-0.0229	-0.0217	-0.0213	-0.0214	-0.0213	-0.0215
Sample Left Tail	0.0335	0.0290	0.0271	0.0250	0.0233	0.0222	0.0218	0.0212	0.0211	0.0211
Normal Right Tail	0.0213	0.0195	0.0176	0.0168	0.0159	0.0149	0.0147	0.0144	0.0143	0.0142
Normal Left Tail	-0.0204	-0.0184	-0.0166	-0.0158	-0.0148	-0.0139	-0.0136	-0.0134	-0.0132	-0.0132
1% Tail Estimate										
Mean	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Standard Deviation	0.0140	0.0126	0.0115	0.0001	0.0102	0.0097	0.0095	0.0093	0.0092	0.0092
Sample Right Tail	-0.0419	-0.0366	-0.0346	-0.0330	-0.0303	-0.0304	-0.0289	-0.0287	-0.0291	-0.0297
Sample Left Tail	0.0420	0.0363	0.0330	0.0317	0.0297	0.0282	0.0276	0.0268	0.0278	0.0283
Normal Right Tail	0.0235	0.0213	0.0194	0.0185	0.0173	0.0164	0.0161	0.0159	0.0157	0.0157
Normal Left Tail	-0.0226	-0.0203	-0.0184	-0.0175	-0.0163	-0.0154	-0.0151	-0.0148	-0.0147	-0.0147
Simulated Normal Center without tails @ 95%										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Backed-out Mean	0.0010	0.0007	0.0007	0.0005	0.0003	0.0003	0.0002	0.0001	0.0000	-0.0001
Backed-out Standard Deviation	0.0155	0.0138	0.0123	0.0118	0.0110	0.0104	0.0102	0.0101	0.0100	0.0101
Sample Right Tail	0.0265	0.0234	0.0210	0.0199	0.0184	0.0175	0.0169	0.0166	0.0166	0.0165
Sample Left Tail	-0.0245	-0.0220	-0.0196	-0.0188	-0.0178	-0.0169	-0.0165	-0.0165	-0.0165	-0.0166

Table US.4 Sample Parameters For Left and Right Tail Distributions										
Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
5% Tail Estimate										
Mean	0.0005	0.0005	0.0005	0.0008	0.0007	0.0007	0.0007	0.0008	0.0008	0.0007
Standard Deviation	0.0114	0.0090	0.0089	0.0113	0.0104	0.0098	0.0095	0.0098	0.0095	0.0093
Sample Right Tail	0.0269	0.0216	0.0210	0.0264	0.0241	0.0229	0.0220	0.0229	0.0220	0.0215
Sample Left Tail	-0.0251	-0.0196	-0.0193	-0.0255	-0.0236	-0.0221	-0.0213	-0.0215	-0.0207	-0.0204
Normal Right Tail	0.0192	0.0153	0.0152	0.0194	0.0179	0.0167	0.0163	0.0169	0.0163	0.0160
Normal Left Tail	-0.0182	-0.0143	-0.0141	-0.0178	-0.0164	-0.0153	-0.0149	-0.0154	-0.0148	-0.0145
2.5% Tail Estimate										
Mean	0.0005	0.0005	0.0005	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Standard Deviation	0.0130	0.0102	0.0101	0.0002	0.0119	0.0111	0.0108	0.0112	0.0107	0.0105
Sample Right Tail	-0.0322	-0.0259	-0.0249	-0.0344	-0.0309	-0.0280	-0.0270	-0.0278	-0.0265	-0.0267
Sample Left Tail	0.0346	0.0266	0.0268	0.0345	0.0318	0.0294	0.0286	0.0287	0.0276	0.0271
Normal Right Tail	0.0218	0.0173	0.0172	0.0220	0.0203	0.0190	0.0184	0.0191	0.0184	0.0180
Normal Left Tail	-0.0208	-0.0163	-0.0161	-0.0205	-0.0189	-0.0176	-0.0171	-0.0176	-0.0169	-0.0166
1% Tail Estimate										
Mean	0.0005	0.0005	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Standard Deviation	0.0143	0.0113	0.0112	0.0002	0.0133	0.0124	0.0120	0.0123	0.0119	0.0116
Sample Right Tail	-0.0428	-0.0331	-0.0328	-0.0456	-0.0415	-0.0378	-0.0373	-0.0370	-0.0359	-0.0347
Sample Left Tail	0.0422	0.0351	0.0337	0.0444	0.0423	0.0382	0.0364	0.0371	0.0364	0.0355
Normal Right Tail	0.0241	0.0191	0.0189	0.0244	0.0226	0.0210	0.0204	0.0210	0.0202	0.0198
Normal Left Tail	-0.0230	-0.0181	-0.0178	-0.0229	-0.0212	-0.0196	-0.0190	-0.0195	-0.0188	-0.0184
Simulated Normal Center without tails @ 95%										
Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
Backed-out Mean	0.0009	0.0010	0.0008	0.0004	0.0003	0.0004	0.0004	0.0007	0.0006	0.0006
Backed-out Standard Deviation	0.0158	0.0125	0.0123	0.0158	0.0145	0.0137	0.0132	0.0135	0.0130	0.0127
Sample Right Tail	0.0269	0.0216	0.0210	0.0264	0.0241	0.0229	0.0220	0.0229	0.0220	0.0215
Sample Left Tail	-0.0251	-0.0196	-0.0193	-0.0255	-0.0236	-0.0221	-0.0213	-0.0215	-0.0207	-0.0204

Appendix.18 – Left tail and Right Tail Fréchet Random Variable Statistics

Table GBM.5 - Left Tail/Downside Fréchet Random Variables Statistics										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
5 % Tail										
MLE sigma	0.0051	0.0037	0.0031	0.0026	0.0023	0.0021	0.0020	0.0018	0.0017	0.0017
Estimated Alpha	6.4011	6.2390	5.5214	6.0722	6.3680	5.5394	5.9334	5.7571	5.9276	6.6508
Fréchet Mean	0.0058	0.0041	0.0035	0.0030	0.0026	0.0024	0.0022	0.0021	0.0020	0.0018
Fréchet Std Dev	0.0013	0.0010	0.0010	0.0007	0.0006	0.0007	0.0006	0.0005	0.0005	0.0004
2.5% Tail										
MLE sigma	0.0060	0.0043	0.0036	0.0031	0.0027	0.0024	0.0023	0.0021	0.0020	0.0019
Estimated Alpha	8.2720	7.7973	6.5520	7.4058	7.7701	6.5767	7.5057	7.0540	7.2548	7.5676
Fréchet Mean	0.0065	0.0047	0.0040	0.0034	0.0030	0.0027	0.0025	0.0024	0.0022	0.0021
Fréchet Std Dev	0.0011	0.0009	0.0009	0.0007	0.0005	0.0006	0.0005	0.0005	0.0004	0.0004
1% Tail										
MLE sigma	0.0069	0.0049	0.0043	0.0035	0.0031	0.0029	0.0027	0.0025	0.0024	0.0022
Estimated Alpha	10.7734	9.3417	7.4872	8.3628	8.4076	8.9203	9.8798	9.0672	9.9904	8.5708
Fréchet Mean	0.0073	0.0053	0.0047	0.0038	0.0034	0.0032	0.0028	0.0027	0.0025	0.0024
Fréchet Std Dev	0.0009	0.0008	0.0009	0.0007	0.0006	0.0005	0.0004	0.0004	0.0004	0.0004

Table GBM.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
5 % Tail										
MLE sigma	0.0051	0.0037	0.0030	0.0026	0.0023	0.0021	0.0019	0.0018	0.0017	0.0016
Estimated Alpha	5.6401	6.0118	5.6694	6.0402	5.9176	5.8911	5.3860	5.2190	5.4865	5.3541
Fréchet Mean	0.0058	0.0042	0.0034	0.0029	0.0027	0.0024	0.0022	0.0021	0.0020	0.0019
Fréchet Std Dev	0.0016	0.0010	0.0009	0.0007	0.0007	0.0006	0.0006	0.0006	0.0005	0.0005
2.5% Tail										
MLE sigma	0.0059	0.0043	0.0035	0.0030	0.0027	0.0024	0.0022	0.0021	0.0020	0.0019
Estimated Alpha	6.6878	7.4547	7.0552	7.3706	6.9004	6.2602	6.1899	5.8802	6.2440	6.0018
Fréchet Mean	0.0066	0.0047	0.0039	0.0033	0.0030	0.0027	0.0025	0.0024	0.0022	0.0021
Fréchet Std Dev	0.0014	0.0009	0.0008	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005
1% Tail										
MLE sigma	0.0068	0.0049	0.0040	0.0034	0.0031	0.0028	0.0026	0.0025	0.0023	0.0022
Estimated Alpha	7.5145	8.5340	7.7489	8.1303	8.0340	6.7460	7.0465	6.9236	6.7046	6.6777
Fréchet Mean	0.0075	0.0053	0.0043	0.0037	0.0034	0.0031	0.0028	0.0027	0.0025	0.0025
Fréchet Std Dev	0.0014	0.0009	0.0008	0.0006	0.0006	0.0007	0.0006	0.0006	0.0006	0.0005

Table FRW.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
5 % Tail										
MLE sigma	0.0045	0.0036	0.0030	0.0026	0.0023	0.0021	0.0020	0.0019	0.0018	0.0017
Estimated Alpha	2.3608	2.9403	3.2266	3.3242	3.5541	3.5224	3.6600	3.5777	3.6778	3.6843
Fréchet Mean	0.0069	0.0049	0.0039	0.0033	0.0030	0.0027	0.0025	0.0023	0.0022	0.0021
Fréchet Std Dev	0.0086	0.0035	0.0023	0.0019	0.0015	0.0014	0.0012	0.0012	0.0011	0.0010
2.5% Tail										
MLE sigma	0.0064	0.0049	0.0038	0.0033	0.0030	0.0027	0.0025	0.0024	0.0022	0.0021
Estimated Alpha	2.7846	3.5490	3.5438	3.7456	4.4716	4.1472	4.1975	4.1950	4.2881	4.4207
Fréchet Mean	0.0090	0.0062	0.0048	0.0041	0.0036	0.0033	0.0030	0.0028	0.0027	0.0025
Fréchet Std Dev	0.0071	0.0031	0.0025	0.0019	0.0013	0.0013	0.0012	0.0011	0.0010	0.0009
1% Tail										
MLE sigma	0.0098	0.0067	0.0052	0.0044	0.0039	0.0036	0.0033	0.0031	0.0029	0.0027
Estimated Alpha	3.3913	4.1015	4.1568	4.8645	5.9322	5.4327	4.9693	5.1870	5.0009	5.5873
Fréchet Mean	0.0126	0.0081	0.0063	0.0052	0.0044	0.0041	0.0038	0.0035	0.0034	0.0031
Fréchet Std Dev	0.0069	0.0033	0.0025	0.0017	0.0011	0.0012	0.0012	0.0011	0.0011	0.0008

Table FRW.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
5 % Tail										
MLE sigma	0.0045	0.0035	0.0030	0.0026	0.0024	0.0022	0.0020	0.0019	0.0018	0.0017
Estimated Alpha	2.2599	2.5084	2.8653	3.0706	3.0313	3.2130	3.3574	3.3661	3.4907	3.4665
Fréchet Mean	0.0072	0.0052	0.0042	0.0035	0.0032	0.0029	0.0026	0.0025	0.0023	0.0022
Fréchet Std Dev	0.0107	0.0053	0.0031	0.0023	0.0021	0.0017	0.0015	0.0014	0.0012	0.0012
2.5% Tail										
MLE sigma	0.0065	0.0048	0.0040	0.0034	0.0032	0.0029	0.0026	0.0024	0.0023	0.0022
Estimated Alpha	2.6207	2.8161	3.3702	3.5638	3.6545	3.8266	3.9104	3.6208	3.6801	3.7717
Fréchet Mean	0.0094	0.0067	0.0052	0.0043	0.0040	0.0036	0.0032	0.0031	0.0028	0.0027
Fréchet Std Dev	0.0086	0.0051	0.0029	0.0022	0.0019	0.0016	0.0014	0.0015	0.0014	0.0013
1% Tail										
MLE sigma	0.0092	0.0068	0.0054	0.0047	0.0041	0.0037	0.0033	0.0031	0.0028	0.0027
Estimated Alpha	2.9013	3.2811	4.1866	4.7142	4.1822	4.3550	4.5857	3.5487	3.4830	3.4836
Fréchet Mean	0.0127	0.0088	0.0066	0.0055	0.0050	0.0044	0.0039	0.0039	0.0036	0.0034
Fréchet Std Dev	0.0092	0.0051	0.0026	0.0019	0.0020	0.0017	0.0014	0.0020	0.0019	0.0018

Table AU.5 - Left Tail/Down Side Fréchet Random Variables Statistics										
Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
5 % Tail										
MLE sigma	0.0266	0.0223	0.0355	0.0344	0.0335	0.0325	0.0314	0.0309	0.0295	0.0271
Estimated Alpha	2.8404	3.4141	2.7763	2.7985	2.8309	2.8435	2.8578	2.8705	2.8433	2.8114
Fréchet Mean	0.0369	0.0287	0.0499	0.0482	0.0465	0.0452	0.0435	0.0427	0.0410	0.0378
Fréchet Std Dev	0.0280	0.0155	0.0397	0.0377	0.0355	0.0341	0.0326	0.0316	0.0310	0.0292
2.5% Tail										
MLE sigma	0.0345	0.0278	0.0476	0.0461	0.0446	0.0431	0.0416	0.0406	0.0388	0.0351
Estimated Alpha	2.8050	3.2576	2.9591	2.9833	3.0090	2.9752	2.9911	2.9566	2.8926	2.7570
Fréchet Mean	0.0482	0.0365	0.0649	0.0626	0.0603	0.0586	0.0564	0.0554	0.0534	0.0494
Fréchet Std Dev	0.0375	0.0213	0.0453	0.0429	0.0407	0.0404	0.0385	0.0387	0.0390	0.0399
1% Tail										
MLE sigma	0.0503	0.0366	0.0668	0.0642	0.0618	0.0596	0.0573	0.0560	0.0538	0.0490
Estimated Alpha	2.8313	2.7730	2.9429	2.9396	2.9447	2.8958	2.8610	2.7932	2.7088	2.5713
Fréchet Mean	0.0700	0.0514	0.0912	0.0877	0.0844	0.0820	0.0793	0.0784	0.0766	0.0718
Fréchet Std Dev	0.0534	0.0410	0.0643	0.0620	0.0594	0.0597	0.0592	0.0616	0.0644	0.0687

Table AU.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	AUS_01	AUS_02	AUS_03	AUS_04	AUS_05	AUS_06	AUS_07	AUS_08	AUS_09	AUS_10
5 % Tail										
MLE sigma	0.0265	0.0232	0.0388	0.0374	0.0362	0.0352	0.0338	0.0329	0.0316	0.0289
Estimated Alpha	3.8001	4.0303	3.0764	3.1028	3.1415	3.1771	3.2130	3.2102	3.2843	3.4367
Fréchet Mean	0.0329	0.0283	0.0520	0.0499	0.0481	0.0465	0.0445	0.0434	0.0413	0.0371
Fréchet Std Dev	0.0151	0.0119	0.0337	0.0318	0.0300	0.0284	0.0267	0.0260	0.0238	0.0199
2.5% Tail										
MLE sigma	0.0322	0.0281	0.0499	0.0480	0.0463	0.0448	0.0430	0.0417	0.0396	0.0357
Estimated Alpha	4.1157	4.2993	3.2775	3.3276	3.3565	3.3934	3.4371	3.3827	3.3904	3.5080
Fréchet Mean	0.0392	0.0338	0.0651	0.0624	0.0599	0.0578	0.0552	0.0539	0.0511	0.0455
Fréchet Std Dev	0.0160	0.0130	0.0377	0.0352	0.0333	0.0316	0.0295	0.0296	0.0280	0.0236
1% Tail										
MLE sigma	0.0407	0.0341	0.0654	0.0626	0.0602	0.0581	0.0556	0.0539	0.0510	0.0456
Estimated Alpha	4.6804	4.1968	3.4371	3.4654	3.4863	3.5119	3.6268	3.4608	3.4433	3.5146
Fréchet Mean	0.0480	0.0412	0.0840	0.0802	0.0769	0.0740	0.0701	0.0690	0.0655	0.0581
Fréchet Std Dev	0.0164	0.0164	0.0449	0.0423	0.0402	0.0382	0.0345	0.0365	0.0349	0.0300

Table CA.5 - Left Tail/Downside Fréchet Random Variables Statistics										
Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
5 % Tail										
MLE sigma	0.0240	0.0243	0.0205	0.0200	0.0194	0.0186	0.0174	0.0158	0.0184	0.0183
Estimated Alpha	3.3871	3.7134	3.4749	2.9972	2.9269	2.9062	2.9264	2.8281	2.6281	2.6235
Fréchet Mean	0.0310	0.0304	0.0262	0.0271	0.0265	0.0255	0.0238	0.0220	0.0266	0.0265
Fréchet Std Dev	0.0170	0.0144	0.0138	0.0184	0.0189	0.0185	0.0170	0.0169	0.0241	0.0241
2.5% Tail										
MLE sigma	0.0307	0.0303	0.0257	0.0260	0.0251	0.0240	0.0224	0.0210	0.0248	0.0244
Estimated Alpha	3.7223	4.1629	3.6758	3.0169	2.9006	2.8313	2.7963	2.8222	2.7002	2.6149
Fréchet Mean	0.0385	0.0367	0.0323	0.0351	0.0345	0.0334	0.0314	0.0292	0.0353	0.0354
Fréchet Std Dev	0.0182	0.0147	0.0156	0.0236	0.0250	0.0255	0.0246	0.0225	0.0299	0.0324
1% Tail										
MLE sigma	0.0402	0.0396	0.0344	0.0355	0.0348	0.0336	0.0314	0.0288	0.0362	0.0359
Estimated Alpha	3.7249	4.8459	3.8358	2.8809	2.7614	2.7018	2.6285	2.5110	2.7073	2.6292
Fréchet Mean	0.0502	0.0464	0.0427	0.0489	0.0490	0.0478	0.0455	0.0428	0.0515	0.0519
Fréchet Std Dev	0.0237	0.0152	0.0193	0.0360	0.0394	0.0405	0.0411	0.0437	0.0434	0.0469

Table CA.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	CAN_01	CAN_02	CAN_03	CAN_04	CAN_05	CAN_06	CAN_07	CAN_08	CAN_09	CAN_10
5 % Tail										
MLE sigma	0.0259	0.0252	0.0217	0.0212	0.0202	0.0192	0.0179	0.0165	0.0185	0.0185
Estimated Alpha	3.8703	3.7739	3.5145	3.3062	3.2460	3.2669	3.3535	3.6605	3.0806	3.1330
Fréchet Mean	0.0320	0.0314	0.0276	0.0276	0.0264	0.0251	0.0232	0.0207	0.0248	0.0245
Fréchet Std Dev	0.0143	0.0145	0.0143	0.0157	0.0156	0.0146	0.0129	0.0100	0.0160	0.0154
2.5% Tail										
MLE sigma	0.0316	0.0312	0.0271	0.0268	0.0258	0.0244	0.0228	0.0203	0.0238	0.0236
Estimated Alpha	4.1983	4.2832	3.8771	3.6548	3.5793	3.6053	3.7033	3.8839	3.3642	3.4069
Fréchet Mean	0.0383	0.0376	0.0335	0.0337	0.0327	0.0309	0.0285	0.0251	0.0308	0.0304
Fréchet Std Dev	0.0152	0.0145	0.0149	0.0164	0.0164	0.0153	0.0136	0.0111	0.0171	0.0165
1% Tail										
MLE sigma	0.0391	0.0388	0.0346	0.0348	0.0332	0.0316	0.0289	0.0255	0.0315	0.0311
Estimated Alpha	4.3110	4.6379	4.4778	3.9073	3.6344	3.7391	3.6234	3.8336	3.6639	3.7317
Fréchet Mean	0.0470	0.0459	0.0412	0.0429	0.0419	0.0394	0.0364	0.0316	0.0396	0.0389
Fréchet Std Dev	0.0180	0.0159	0.0150	0.0188	0.0205	0.0185	0.0179	0.0143	0.0191	0.0183

Table DE.5 - Left Tail/Down Side Fréchet Random Variables Statistics										
Portfolio Number	GER_01	GER_02	GER_03	GER_04	GER_05	GER_06	GER_07	GER_08	GER_09	GER_10
5 % Tail										
MLE sigma	0.0374	0.0338	0.0331	0.0305	0.0290	0.0279	0.0277	0.0275	0.0270	0.0273
Estimated Alpha	3.2804	3.2918	2.8750	2.9649	2.9592	3.0021	2.9423	2.9625	3.0129	2.9975
Fréchet Mean	0.0488	0.0441	0.0457	0.0415	0.0394	0.0377	0.0378	0.0374	0.0365	0.0370
Fréchet Std Dev	0.0282	0.0253	0.0337	0.0288	0.0275	0.0256	0.0267	0.0260	0.0246	0.0252
2.5% Tail										
MLE sigma	0.0495	0.0438	0.0454	0.0408	0.0385	0.0367	0.0363	0.0360	0.0353	0.0358
Estimated Alpha	4.0750	3.8364	3.5103	3.4540	3.3840	3.3949	3.2459	3.2880	3.3314	3.3369
Fréchet Mean	0.0604	0.0543	0.0579	0.0523	0.0497	0.0474	0.0476	0.0470	0.0459	0.0465
Fréchet Std Dev	0.0250	0.0245	0.0299	0.0278	0.0273	0.0259	0.0280	0.0270	0.0258	0.0261
1% Tail										
MLE sigma	0.0650	0.0592	0.0620	0.0562	0.0537	0.0512	0.0517	0.0516	0.0503	0.0509
Estimated Alpha	4.8828	4.8333	4.1928	3.9675	3.9696	3.8903	3.8628	4.0558	4.0180	4.0088
Fréchet Mean	0.0761	0.0694	0.0751	0.0691	0.0659	0.0633	0.0640	0.0630	0.0615	0.0624
Fréchet Std Dev	0.0246	0.0228	0.0298	0.0297	0.0283	0.0280	0.0286	0.0262	0.0260	0.0264

Table DE.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	GER_01	GER_02	GER_03	GER_04	GER_05	GER_06	GER_07	GER_08	GER_09	GER_10
5 % Tail										
MLE sigma	0.0370	0.0325	0.0315	0.0287	0.0271	0.0259	0.0257	0.0254	0.0249	0.0252
Estimated Alpha	3.4749	3.5282	2.9447	3.0899	3.0847	3.2175	3.1521	3.1632	3.1240	3.1880
Fréchet Mean	0.0473	0.0413	0.0431	0.0384	0.0362	0.0340	0.0341	0.0337	0.0331	0.0332
Fréchet Std Dev	0.0249	0.0212	0.0303	0.0247	0.0233	0.0203	0.0211	0.0208	0.0209	0.0202
2.5% Tail										
MLE sigma	0.0473	0.0414	0.0409	0.0364	0.0342	0.0323	0.0324	0.0319	0.0313	0.0315
Estimated Alpha	4.1865	4.4036	3.3296	3.3446	3.3340	3.4096	3.4211	3.3768	3.3641	3.4116
Fréchet Mean	0.0573	0.0495	0.0531	0.0472	0.0444	0.0416	0.0416	0.0412	0.0405	0.0406
Fréchet Std Dev	0.0228	0.0184	0.0300	0.0264	0.0250	0.0225	0.0224	0.0227	0.0225	0.0220
1% Tail										
MLE sigma	0.0599	0.0524	0.0547	0.0496	0.0460	0.0431	0.0429	0.0420	0.0413	0.0414
Estimated Alpha	4.7988	5.8793	4.0547	4.2591	4.1749	4.2042	4.2216	4.0401	4.0445	4.0830
Fréchet Mean	0.0703	0.0593	0.0668	0.0597	0.0557	0.0521	0.0518	0.0513	0.0505	0.0505
Fréchet Std Dev	0.0233	0.0152	0.0278	0.0232	0.0223	0.0206	0.0204	0.0215	0.0211	0.0208

Table HK.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	HKG_01	HKG_02	HKG_03	HKG_04	HKG_05	HKG_06	HKG_07	HKG_08	HKG_09	HKG_10
5 % Tail										
MLE sigma	0.0308	0.0367	0.0343	0.0355	0.0362	0.0348	0.0335	0.0310	0.0319	0.0321
Estimated Alpha	2.7030	2.6809	2.6118	2.6545	2.6010	2.5884	2.5568	2.4806	2.4618	2.4548
Fréchet Mean	0.0439	0.0526	0.0498	0.0511	0.0527	0.0508	0.0493	0.0465	0.0479	0.0484
Fréchet Std Dev	0.0371	0.0453	0.0458	0.0451	0.0490	0.0478	0.0479	0.0492	0.0519	0.0528
2.5% Tail										
MLE sigma	0.0418	0.0491	0.0458	0.0472	0.0488	0.0470	0.0456	0.0424	0.0435	0.0441
Estimated Alpha	2.8486	2.7254	2.6422	2.6725	2.6486	2.6457	2.6463	2.5615	2.5350	2.5522
Fréchet Mean	0.0580	0.0696	0.0660	0.0676	0.0702	0.0676	0.0657	0.0623	0.0642	0.0648
Fréchet Std Dev	0.0437	0.0577	0.0589	0.0587	0.0623	0.0602	0.0584	0.0602	0.0639	0.0633
1% Tail										
MLE sigma	0.0592	0.0710	0.0691	0.0694	0.0721	0.0695	0.0671	0.0645	0.0668	0.0669
Estimated Alpha	2.5953	2.6047	2.7255	2.6915	2.7189	2.6726	2.6708	2.6844	2.7031	2.6798
Fréchet Mean	0.0862	0.1032	0.0979	0.0991	0.1024	0.0995	0.0962	0.0921	0.0951	0.0958
Fréchet Std Dev	0.0805	0.0955	0.0812	0.0846	0.0854	0.0864	0.0836	0.0792	0.0804	0.0826

Table HK.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	HKG_01	HKG_02	HKG_03	HKG_04	HKG_05	HKG_06	HKG_07	HKG_08	HKG_09	HKG_10
5 % Tail										
MLE sigma	0.0328	0.0375	0.0344	0.0358	0.0360	0.0343	0.0333	0.0309	0.0318	0.0319
Estimated Alpha	3.3476	3.3544	3.1778	3.1992	3.1730	3.1591	3.1858	3.1313	3.1163	3.1308
Fréchet Mean	0.0425	0.0486	0.0454	0.0472	0.0476	0.0455	0.0440	0.0411	0.0424	0.0424
Fréchet Std Dev	0.0238	0.0270	0.0277	0.0285	0.0292	0.0281	0.0267	0.0258	0.0268	0.0266
2.5% Tail										
MLE sigma	0.0416	0.0463	0.0436	0.0458	0.0458	0.0436	0.0420	0.0391	0.0403	0.0404
Estimated Alpha	3.7471	3.5170	3.5140	3.5488	3.4278	3.3931	3.3838	3.2759	3.2741	3.2921
Fréchet Mean	0.0519	0.0590	0.0555	0.0581	0.0589	0.0562	0.0543	0.0511	0.0527	0.0527
Fréchet Std Dev	0.0243	0.0304	0.0287	0.0295	0.0316	0.0307	0.0298	0.0296	0.0305	0.0303
1% Tail										
MLE sigma	0.0537	0.0613	0.0584	0.0590	0.0605	0.0578	0.0554	0.0503	0.0518	0.0518
Estimated Alpha	4.2077	4.1625	4.2703	3.7901	3.7989	3.7972	3.7174	3.2842	3.3351	3.3178
Fréchet Mean	0.0650	0.0743	0.0704	0.0734	0.0752	0.0719	0.0693	0.0656	0.0673	0.0674
Fréchet Std Dev	0.0257	0.0298	0.0273	0.0337	0.0344	0.0329	0.0328	0.0378	0.0378	0.0382

Table JP.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
5 % Tail										
MLE sigma	0.0342	0.0313	0.0306	0.0301	0.0267	0.0264	0.0262	0.0262	0.0263	0.0263
Estimated Alpha	3.3259	3.4056	3.6595	3.4794	3.4972	3.5264	3.5013	3.4391	3.4506	3.4484
Fréchet Mean	0.0444	0.0403	0.0385	0.0385	0.0341	0.0336	0.0335	0.0337	0.0338	0.0337
Fréchet Std Dev	0.0251	0.0219	0.0186	0.0202	0.0177	0.0172	0.0174	0.0180	0.0179	0.0179
2.5% Tail										
MLE sigma	0.0445	0.0402	0.0387	0.0382	0.0339	0.0338	0.0337	0.0338	0.0337	0.0336
Estimated Alpha	3.7967	3.8410	3.9881	3.7206	3.7741	3.8804	3.8858	3.8448	3.7872	3.7665
Fréchet Mean	0.0553	0.0499	0.0475	0.0479	0.0422	0.0418	0.0416	0.0419	0.0420	0.0419
Fréchet Std Dev	0.0253	0.0225	0.0203	0.0226	0.0195	0.0185	0.0184	0.0189	0.0193	0.0194
1% Tail										
MLE sigma	0.0590	0.0531	0.0494	0.0496	0.0439	0.0431	0.0430	0.0434	0.0437	0.0439
Estimated Alpha	3.8360	3.9614	3.7158	3.4477	3.4957	3.5621	3.5993	3.6181	3.6342	3.6837
Fréchet Mean	0.0732	0.0653	0.0618	0.0636	0.0560	0.0546	0.0544	0.0548	0.0550	0.0550
Fréchet Std Dev	0.0330	0.0281	0.0293	0.0339	0.0292	0.0276	0.0270	0.0270	0.0270	0.0264

Table JP.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
5 % Tail										
MLE sigma	0.0387	0.0347	0.0340	0.0333	0.0292	0.0287	0.0286	0.0289	0.0290	0.0292
Estimated Alpha	3.1112	3.0714	3.3037	3.3080	3.3562	3.3365	3.3270	3.3451	3.3581	3.3967
Fréchet Mean	0.0516	0.0466	0.0443	0.0434	0.0378	0.0372	0.0372	0.0374	0.0376	0.0376
Fréchet Std Dev	0.0327	0.0302	0.0253	0.0247	0.0211	0.0209	0.0210	0.0209	0.0209	0.0205
2.5% Tail										
MLE sigma	0.0517	0.0458	0.0446	0.0426	0.0371	0.0366	0.0366	0.0364	0.0366	0.0368
Estimated Alpha	3.8672	3.7566	4.1357	3.6894	3.6850	3.7225	3.7581	3.6428	3.6896	3.7522
Fréchet Mean	0.0639	0.0571	0.0542	0.0534	0.0466	0.0457	0.0456	0.0458	0.0459	0.0459
Fréchet Std Dev	0.0285	0.0266	0.0219	0.0256	0.0223	0.0216	0.0212	0.0224	0.0220	0.0214
1% Tail										
MLE sigma	0.0664	0.0610	0.0570	0.0543	0.0471	0.0472	0.0473	0.0473	0.0472	0.0470
Estimated Alpha	4.2492	4.8189	4.8612	3.8625	3.7680	4.0236	4.1648	4.0777	4.0890	4.1060
Fréchet Mean	0.0802	0.0715	0.0667	0.0672	0.0587	0.0578	0.0574	0.0577	0.0575	0.0572
Fréchet Std Dev	0.0313	0.0236	0.0217	0.0300	0.0272	0.0243	0.0230	0.0238	0.0237	0.0234

Table SG.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	SIN_01	SIN_02	SIN_03	SIN_04	SIN_05	SIN_06	SIN_07	SIN_08	SIN_09	SIN_10
5 % Tail										
MLE sigma	0.0337	0.0301	0.0278	0.0241	0.0242	0.0268	0.0262	0.0261	0.0247	0.0245
Estimated Alpha	2.8929	2.6595	2.6128	2.4343	2.4592	2.5304	2.5107	2.4920	2.5374	2.4765
Fréchet Mean	0.0465	0.0432	0.0403	0.0365	0.0365	0.0396	0.0389	0.0390	0.0365	0.0367
Fréchet Std Dev	0.0339	0.0379	0.0370	0.0409	0.0396	0.0396	0.0397	0.0407	0.0362	0.0391
2.5% Tail										
MLE sigma	0.0436	0.0399	0.0370	0.0331	0.0331	0.0355	0.0347	0.0346	0.0328	0.0331
Estimated Alpha	2.7314	2.5892	2.5460	2.4847	2.4820	2.4225	2.3932	2.3757	2.4758	2.4681
Fréchet Mean	0.0618	0.0582	0.0545	0.0495	0.0496	0.0540	0.0531	0.0533	0.0492	0.0496
Fréchet Std Dev	0.0510	0.0547	0.0536	0.0521	0.0524	0.0616	0.0631	0.0650	0.0524	0.0533
1% Tail										
MLE sigma	0.0605	0.0575	0.0534	0.0498	0.0499	0.0544	0.0535	0.0539	0.0505	0.0505
Estimated Alpha	2.4187	2.3679	2.3548	2.4529	2.4811	2.3617	2.3586	2.3700	2.5994	2.5472
Fréchet Mean	0.0920	0.0887	0.0826	0.0750	0.0747	0.0840	0.0828	0.0831	0.0735	0.0744
Fréchet Std Dev	0.1054	0.1093	0.1039	0.0821	0.0790	0.1045	0.1035	0.1021	0.0684	0.0730

Table SG.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	SIN_01	SIN_02	SIN_03	SIN_04	SIN_05	SIN_06	SIN_07	SIN_08	SIN_09	SIN_10
5 % Tail										
MLE sigma	0.0358	0.0323	0.0301	0.0262	0.0261	0.0279	0.0273	0.0272	0.0253	0.0254
Estimated Alpha	3.0328	3.0462	2.8310	2.6979	2.7667	2.6617	2.6779	2.6858	2.6791	2.7051
Fréchet Mean	0.0482	0.0434	0.0419	0.0374	0.0368	0.0401	0.0391	0.0389	0.0361	0.0361
Fréchet Std Dev	0.0321	0.0286	0.0319	0.0318	0.0295	0.0352	0.0337	0.0334	0.0312	0.0305
2.5% Tail										
MLE sigma	0.0465	0.0417	0.0392	0.0350	0.0346	0.0369	0.0360	0.0359	0.0333	0.0332
Estimated Alpha	3.2571	3.2775	3.0243	2.9800	3.0147	2.8294	2.8264	2.8349	2.8278	2.8371
Fréchet Mean	0.0609	0.0545	0.0529	0.0476	0.0467	0.0513	0.0500	0.0499	0.0463	0.0461
Fréchet Std Dev	0.0356	0.0316	0.0354	0.0327	0.0314	0.0392	0.0383	0.0380	0.0354	0.0350
1% Tail										
MLE sigma	0.0603	0.0548	0.0529	0.0480	0.0469	0.0512	0.0501	0.0498	0.0459	0.0458
Estimated Alpha	3.1536	3.2671	3.1341	3.3320	3.2612	3.0045	3.0226	3.0012	2.9855	3.0203
Fréchet Mean	0.0800	0.0717	0.0703	0.0623	0.0613	0.0692	0.0676	0.0674	0.0623	0.0618
Fréchet Std Dev	0.0495	0.0417	0.0440	0.0351	0.0358	0.0469	0.0453	0.0457	0.0427	0.0414

Table SE.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	SWE_01	SWE_02	SWE_03	SWE_04	SWE_05	SWE_06	SWE_07	SWE_08	SWE_09	SWE_10
5 % Tail										
MLE sigma	0.0569	0.0355	0.0327	0.0319	0.0312	0.0310	0.0309	0.0308	0.0306	0.0302
Estimated Alpha	2.9475	2.7934	2.7787	2.7558	2.7774	2.7933	2.7958	2.7952	2.7839	2.8164
Fréchet Mean	0.0776	0.0498	0.0459	0.0450	0.0439	0.0435	0.0432	0.0431	0.0429	0.0421
Fréchet Std Dev	0.0545	0.0391	0.0364	0.0364	0.0349	0.0341	0.0339	0.0338	0.0339	0.0325
2.5% Tail										
MLE sigma	0.0752	0.0464	0.0434	0.0426	0.0418	0.0413	0.0411	0.0411	0.0406	0.0399
Estimated Alpha	3.1602	2.7972	2.8725	2.8802	2.9247	2.9297	2.9577	2.9722	2.9404	2.9580
Fréchet Mean	0.0996	0.0650	0.0600	0.0588	0.0572	0.0565	0.0561	0.0558	0.0555	0.0544
Fréchet Std Dev	0.0614	0.0509	0.0444	0.0433	0.0408	0.0402	0.0391	0.0386	0.0392	0.0380
1% Tail										
MLE sigma	0.1024	0.0665	0.0614	0.0603	0.0592	0.0588	0.0588	0.0584	0.0582	0.0574
Estimated Alpha	3.1243	2.7861	2.7840	2.7840	2.8552	2.8935	3.0278	3.0359	3.0482	3.1020
Fréchet Mean	0.1363	0.0933	0.0861	0.0846	0.0820	0.0810	0.0793	0.0787	0.0783	0.0767
Fréchet Std Dev	0.0858	0.0736	0.0681	0.0669	0.0614	0.0590	0.0529	0.0522	0.0516	0.0489

Table SE.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	SWE_01	SWE_02	SWE_03	SWE_04	SWE_05	SWE_06	SWE_07	SWE_08	SWE_09	SWE_10
5 % Tail										
MLE sigma	0.0546	0.0400	0.0364	0.0350	0.0341	0.0336	0.0334	0.0331	0.0326	0.0320
Estimated Alpha	2.9445	3.1968	3.0935	3.0731	3.1048	3.1238	3.1795	3.2134	3.2150	3.2463
Fréchet Mean	0.0746	0.0527	0.0486	0.0469	0.0455	0.0447	0.0442	0.0435	0.0429	0.0419
Fréchet Std Dev	0.0525	0.0319	0.0311	0.0304	0.0290	0.0281	0.0269	0.0261	0.0256	0.0247
2.5% Tail										
MLE sigma	0.0723	0.0508	0.0466	0.0450	0.0438	0.0432	0.0431	0.0427	0.0423	0.0415
Estimated Alpha	3.4492	3.3509	3.2979	3.3221	3.4048	3.4395	3.5424	3.6110	3.6759	3.7052
Fréchet Mean	0.0927	0.0659	0.0607	0.0584	0.0565	0.0555	0.0548	0.0540	0.0531	0.0519
Fréchet Std Dev	0.0493	0.0367	0.0348	0.0331	0.0307	0.0296	0.0279	0.0267	0.0256	0.0247
1% Tail										
MLE sigma	0.0953	0.0649	0.0602	0.0585	0.0568	0.0559	0.0551	0.0543	0.0539	0.0526
Estimated Alpha	3.9575	3.3518	3.4230	3.5546	3.6345	3.6571	3.6922	3.7232	3.8470	3.8466
Fréchet Mean	0.1172	0.0840	0.0774	0.0743	0.0716	0.0703	0.0691	0.0679	0.0667	0.0652
Fréchet Std Dev	0.0505	0.0468	0.0417	0.0376	0.0351	0.0341	0.0330	0.0321	0.0300	0.0293

Table CH.5 - Left Tail/ Downside Fréchet Random Variables Statistics										
Portfolio Number	SWZ_01	SWZ_02	SWZ_03	SWZ_04	SWZ_05	SWZ_06	SWZ_07	SWZ_08	SWZ_09	SWZ_10
5 % Tail										
MLE sigma	0.0256	0.0231	0.0227	0.0219	0.0219	0.0217	0.0220	0.0226	0.0221	0.0222
Estimated Alpha	3.0241	3.0600	3.1331	3.0706	3.0220	2.8494	2.8200	2.6997	2.6560	2.5958
Fréchet Mean	0.0346	0.0310	0.0302	0.0293	0.0296	0.0301	0.0306	0.0322	0.0318	0.0323
Fréchet Std Dev	0.0231	0.0203	0.0189	0.0191	0.0198	0.0226	0.0236	0.0273	0.0280	0.0301
2.5% Tail										
MLE sigma	0.0336	0.0302	0.0296	0.0289	0.0289	0.0288	0.0291	0.0300	0.0297	0.0299
Estimated Alpha	3.2906	3.3917	3.4575	3.4631	3.3520	3.0926	3.0003	2.7747	2.7768	2.7188
Fréchet Mean	0.0438	0.0390	0.0379	0.0370	0.0374	0.0386	0.0394	0.0422	0.0417	0.0425
Fréchet Std Dev	0.0252	0.0213	0.0201	0.0196	0.0208	0.0247	0.0267	0.0336	0.0332	0.0355
1% Tail										
MLE sigma	0.0462	0.0413	0.0395	0.0389	0.0392	0.0408	0.0416	0.0436	0.0431	0.0443
Estimated Alpha	3.5430	3.5803	3.4321	3.4462	3.3778	3.2471	3.2301	2.7677	2.7508	2.8057
Fréchet Mean	0.0587	0.0523	0.0507	0.0499	0.0506	0.0534	0.0547	0.0613	0.0608	0.0619
Fréchet Std Dev	0.0299	0.0262	0.0272	0.0266	0.0278	0.0314	0.0325	0.0491	0.0494	0.0481

Table CH.6 - Right Tail/Upside Fréchet Random Variables Statistics										
Portfolio Number	SWZ_01	SWZ_02	SWZ_03	SWZ_04	SWZ_05	SWZ_06	SWZ_07	SWZ_08	SWZ_09	SWZ_10
5 % Tail										
MLE sigma	0.0269	0.0230	0.0222	0.0208	0.0205	0.0204	0.0204	0.0212	0.0207	0.0207
Estimated Alpha	3.2034	3.1751	3.1769	3.2091	3.1292	2.9625	2.9427	3.0171	2.9903	2.9374
Fréchet Mean	0.0354	0.0304	0.0294	0.0274	0.0273	0.0278	0.0279	0.0286	0.0281	0.0282
Fréchet Std Dev	0.0213	0.0186	0.0179	0.0164	0.0171	0.0194	0.0197	0.0192	0.0192	0.0200
2.5% Tail										
MLE sigma	0.0343	0.0293	0.0280	0.0262	0.0259	0.0259	0.0259	0.0267	0.0264	0.0266
Estimated Alpha	3.5588	3.3748	3.2649	3.3088	3.2100	2.9963	2.9667	3.2047	3.2640	3.2466
Fréchet Mean	0.0436	0.0378	0.0367	0.0341	0.0341	0.0351	0.0352	0.0352	0.0346	0.0349
Fréchet Std Dev	0.0221	0.0209	0.0214	0.0194	0.0204	0.0239	0.0244	0.0212	0.0202	0.0205
1% Tail										
MLE sigma	0.0446	0.0381	0.0359	0.0339	0.0339	0.0351	0.0353	0.0363	0.0356	0.0357
Estimated Alpha	3.8098	3.3553	3.0794	3.2938	3.2562	3.2793	3.3117	4.0395	4.1052	3.9932
Fréchet Mean	0.0554	0.0493	0.0481	0.0442	0.0444	0.0458	0.0459	0.0444	0.0433	0.0438
Fréchet Std Dev	0.0253	0.0274	0.0311	0.0253	0.0260	0.0265	0.0261	0.0186	0.0177	0.0186

Table UK.5 - Left Tail/ Downside Fréchet Random Variables Statistics

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
5 % Tail										
MLE sigma	0.0307	0.0275	0.0246	0.0239	0.0222	0.0213	0.0208	0.0206	0.0207	0.0208
Estimated Alpha	3.3230	3.5167	3.2330	3.1823	3.1628	3.1629	3.1705	3.1560	3.0807	3.0879
Fréchet Mean	0.0400	0.0350	0.0323	0.0316	0.0294	0.0283	0.0275	0.0273	0.0277	0.0278
Fréchet Std Dev	0.0226	0.0181	0.0192	0.0192	0.0181	0.0174	0.0169	0.0169	0.0179	0.0179
2.5% Tail										
MLE sigma	0.0395	0.0347	0.0321	0.0306	0.0287	0.0277	0.0267	0.0265	0.0269	0.0270
Estimated Alpha	3.6632	3.7578	3.6327	3.3585	3.4344	3.4555	3.3446	3.3441	3.3049	3.3142
Fréchet Mean	0.0496	0.0433	0.0405	0.0396	0.0368	0.0355	0.0346	0.0344	0.0350	0.0351
Fréchet Std Dev	0.0240	0.0202	0.0198	0.0220	0.0197	0.0188	0.0194	0.0192	0.0200	0.0199
1% Tail										
MLE sigma	0.0526	0.0457	0.0428	0.0419	0.0396	0.0381	0.0368	0.0363	0.0371	0.0373
Estimated Alpha	3.8677	3.6762	3.7130	3.6133	3.6667	3.7141	3.5284	3.4290	3.4997	3.5537
Fréchet Mean	0.0651	0.0574	0.0536	0.0529	0.0498	0.0477	0.0468	0.0466	0.0474	0.0474
Fréchet Std Dev	0.0290	0.0276	0.0254	0.0261	0.0240	0.0226	0.0240	0.0250	0.0246	0.0240

Table UK.6 - Right Tail/Upside Fréchet Random Variables Statistics

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
5 % Tail										
MLE sigma	0.0318	0.0281	0.0255	0.0240	0.0222	0.0212	0.0207	0.0203	0.0202	0.0202
Estimated Alpha	4.0435	4.0746	3.9129	3.7285	3.7222	3.5689	3.4950	3.4322	3.3775	3.3503
Fréchet Mean	0.0388	0.0343	0.0315	0.0301	0.0278	0.0268	0.0264	0.0261	0.0261	0.0262
Fréchet Std Dev	0.0162	0.0142	0.0138	0.0142	0.0131	0.0135	0.0137	0.0140	0.0144	0.0146
2.5% Tail										
MLE sigma	0.0389	0.0337	0.0311	0.0297	0.0274	0.0263	0.0258	0.0254	0.0253	0.0254
Estimated Alpha	4.7419	4.1998	4.1930	4.0690	4.0158	3.8169	3.7785	3.7061	3.6141	3.6792
Fréchet Mean	0.0458	0.0408	0.0376	0.0362	0.0335	0.0326	0.0322	0.0318	0.0319	0.0319
Fréchet Std Dev	0.0154	0.0162	0.0149	0.0150	0.0141	0.0148	0.0149	0.0151	0.0158	0.0154
1% Tail										
MLE sigma	0.0479	0.0415	0.0383	0.0371	0.0341	0.0330	0.0323	0.0317	0.0323	0.0327
Estimated Alpha	5.4651	4.2000	4.2548	4.3190	4.1332	3.9160	3.7397	3.6842	3.8581	4.0501
Fréchet Mean	0.0549	0.0502	0.0462	0.0446	0.0415	0.0407	0.0403	0.0398	0.0399	0.0399
Fréchet Std Dev	0.0154	0.0199	0.0180	0.0170	0.0168	0.0178	0.0189	0.0191	0.0179	0.0166

Table US.5 - Left Tail/Down Side Fréchet Random Variables Statistics

Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
5 % Tail										
MLE sigma	0.0315	0.0248	0.0243	0.0325	0.0298	0.0276	0.0266	0.0273	0.0262	0.0257
Estimated Alpha	3.2122	3.0211	3.2123	3.0782	3.1043	3.1811	3.1512	3.1354	0.3240	3.0892
Fréchet Mean	0.0414	0.0334	0.0319	0.0435	0.0397	0.0365	0.0352	0.0363	0.0350	0.0344
Fréchet Std Dev	0.0248	0.0224	0.0191	0.0281	0.0253	0.0223	0.0218	0.0227	0.0225	0.0221
2.5% Tail										
MLE sigma	0.0404	0.0323	0.0307	0.0423	0.0389	0.0356	0.0342	0.0349	0.0335	0.0331
Estimated Alpha	3.3732	3.1737	3.2313	3.2700	3.3385	3.3441	3.2947	3.1653	3.0985	3.1568
Fréchet Mean	0.0523	0.0427	0.0404	0.0552	0.0504	0.0462	0.0446	0.0462	0.0448	0.0439
Fréchet Std Dev	0.0288	0.0261	0.0239	0.0321	0.0283	0.0258	0.0256	0.0284	0.0286	0.0271
1% Tail										
MLE sigma	0.0546	0.0444	0.0423	0.0575	0.0525	0.0488	0.0473	0.0481	0.0468	0.0458
Estimated Alpha	3.3688	3.0461	3.1944	3.1346	3.2568	3.4147	3.4178	3.0902	3.0496	3.0172
Fréchet Mean	0.0706	0.0597	0.0558	0.0764	0.0687	0.0628	0.0609	0.0643	0.0629	0.0618
Fréchet Std Dev	0.0390	0.0394	0.0338	0.0478	0.0402	0.0340	0.0328	0.0413	0.0414	0.0415

Table US.6 - Right Tail/Upside Fréchet Random Variables Statistics

Portfolio Number	USA_01	USA_02	USA_03	USA_04	USA_05	USA_06	USA_07	USA_08	USA_09	USA_10
5 % Tail										
MLE sigma	0.0329	0.0258	0.0256	0.0324	0.0300	0.0278	0.0269	0.0276	0.0266	0.0261
Estimated Alpha	3.5494	3.5486	3.8567	3.6661	3.6574	3.7198	3.7519	3.5919	3.5662	3.5523
Fréchet Mean	0.0418	0.0328	0.0316	0.0407	0.0377	0.0348	0.0335	0.0349	0.0338	0.0332
Fréchet Std Dev	0.0212	0.0166	0.0142	0.0197	0.0183	0.0164	0.0156	0.0174	0.0170	0.0168
2.5% Tail										
MLE sigma	0.0406	0.0315	0.0314	0.0407	0.0377	0.0348	0.0337	0.0342	0.0330	0.0324
Estimated Alpha	3.7942	3.5583	4.1794	4.1891	4.2795	4.3311	4.4331	3.9858	3.9149	3.8901
Fréchet Mean	0.0505	0.0399	0.0380	0.0493	0.0454	0.0418	0.0403	0.0420	0.0407	0.0400
Fréchet Std Dev	0.0232	0.0202	0.0152	0.0196	0.0176	0.0159	0.0148	0.0179	0.0178	0.0177
1% Tail										
MLE sigma	0.0516	0.0403	0.0383	0.0508	0.0470	0.0430	0.0413	0.0437	0.0421	0.0415
Estimated Alpha	4.1298	3.5589	4.0299	4.6173	4.9273	4.8667	4.8372	4.7379	4.5028	4.6020
Fréchet Mean	0.0627	0.0511	0.0469	0.0601	0.0549	0.0503	0.0484	0.0514	0.0501	0.0492
Fréchet Std Dev	0.0254	0.0259	0.0197	0.0209	0.0176	0.0164	0.0159	0.0173	0.0180	0.0172

Appendix.19 – Risk Measurements of One Region Distribution Function for all Portfolios

Table GBM.7 - Risk Measurements of One Region Distribution Function for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
VaR Estimates of One Region Distribution										
VaR@95%	-4392.3	-3196.1	-2561.0	-2264.4	-2030.1	-1845.9	-1677.2	-1565.7	-1489.6	-1411.9
VaR@97.5%	-5360.8	-3869.7	-3126.1	-2649.1	-2415.5	-2137.5	-1959.1	-1815.9	-1758.3	-1694.2
VaR@99%	-6241.1	-4484.3	-3689.3	-3140.0	-2868.3	-2496.5	-2323.8	-2187.3	-2063.4	-1997.5
ES@95%	-5596.9	-4017.0	-3274.2	-2798.1	-2541.3	-2279.9	-2080.9	-1957.8	-1868.2	-1795.2
ES@97.5%	-6363.8	-4552.5	-3739.7	-3159.6	-2884.6	-2568.7	-2378.0	-2237.5	-2126.7	-2051.5
ES@99%	-7299.5	-5140.7	-4259.4	-3586.7	-3285.4	-2983.2	-2760.7	-2607.8	-2438.9	-2375.6

Table FRW.7 - Risk Measurements of One Region Distribution Function for Simulated Two Sided Symmetric Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
VaR Estimates of One Region Distribution										
VaR@95%	-3246	-2674	-2340	-2019	-1860	-1710	-1606	-1527	-1442	-1366
VaR@97.5%	-4976	-3664	-3135	-2655	-2419	-2298	-2094	-2019	-1855	-1780
VaR@99%	-7314	-5585	-4585	-3779	-3541	-3183	-2822	-2632	-2416	-2312
ES@95%	-6080	-4531	-3706	-3131	-2852	-2595	-2349	-2242	-2096	-1988
ES@97.5%	-8210	-5954	-4729	-3957	-3613	-3215	-2877	-2759	-2561	-2426
ES@99%	-11421	-8190	-6236	-5147	-4564	-4022	-3581	-3485	-3234	-3036

Table AU.7 - Risk Measurements of One Region Distribution Function for Australian Portfolio

Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
VaR Estimates of One Region Distribution										
VaR@95%	-22113.7	-19514.1	-21610.3	-19809.1	-19360.5	-18980.8	-18045.6	-17344.2	-17263.5	-16279.1
VaR@97.5%	-27579.7	-24133.5	-26919.8	-24704.9	-24104.4	-23055.6	-21847.2	-21031.8	-20753.9	-19841.2
VaR@99%	-34761.5	-30327.2	-34471.7	-31220.3	-29525.2	-28964.7	-27345.8	-26221.7	-25882.9	-24757.5
ES@95%	-30609.7	-26310.3	-30586.0	-27707.8	-26800.3	-26235.4	-24677.8	-23928.2	-23501.9	-22390.1
ES@97.5%	-36713.1	-31281.1	-37343.1	-33703.7	-32211.4	-31572.9	-29527.3	-28817.6	-28141.4	-26777.2
ES@99%	-45839.8	-37868.5	-48183.8	-42643.3	-40311.8	-39508.5	-37172.2	-36976.9	-35944.1	-34141.5

Table CA.7 - Risk Measurements of One Region Distribution Function for Canadian Portfolio

Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
VaR Estimates of One Region Distribution										
VaR@95%	-21409.3	-20742.3	-17601.5	-16816.3	-15635.5	-14908.0	-13466.5	-12879.1	-13760.0	-13749.4
VaR@97.5%	-26929.4	-26601.9	-22421.6	-21121.7	-20116.2	-19372.6	-17546.6	-16598.0	-17936.7	-17869.0
VaR@99%	-34059.0	-33981.3	-30165.7	-29153.4	-26994.0	-25296.2	-22437.1	-21203.1	-22428.1	-22361.4
ES@95%	-29925.4	-29302.7	-25044.1	-23987.9	-22934.6	-21434.9	-19379.3	-18307.0	-19793.6	-19758.0
ES@97.5%	-35870.8	-35414.4	-30401.9	-29444.1	-28276.9	-26093.4	-23381.6	-22044.6	-24034.7	-24013.8
ES@99%	-44225.1	-43674.5	-37498.7	-37082.7	-35533.5	-32415.5	-28965.6	-27167.8	-29999.9	-30217.6

Table DE.7 - Risk Measurements of One Region Distribution Function for German Portfolio										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
VaR Estimates of One Region Distribution										
VaR@95%	-28987.5	-25366.9	-24597.6	-21995.3	-20815.6	-20413.4	-20684.1	-20713.8	-19641.3	-20057.1
VaR@97.5%	-39422.4	-34098.5	-31039.1	-28605.2	-27208.0	-26078.8	-25696.6	-25588.4	-25136.5	-25702.8
VaR@99%	-52039.7	-45033.0	-46015.2	-39598.7	-36613.5	-34338.7	-35482.3	-34036.6	-32986.2	-34184.9
ES@95%	-43965.4	-37764.1	-36971.5	-33240.5	-31334.6	-29941.4	-29937.2	-29884.2	-29113.2	-29402.3
ES@97.5%	-54055.3	-46528.9	-46713.2	-41536.7	-38959.5	-36744.6	-36860.5	-36847.3	-36063.1	-36276.3
ES@99%	-67205.6	-57808.6	-60165.4	-53908.4	-50909.1	-47716.0	-48052.2	-48235.4	-47340.9	-47251.0

Table HK.7 - Risk Measurements of One Region Distribution Function for Hong Kong Portfolio										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
VaR Estimates of One Region Distribution										
VaR@95%	-26955.8	-27885.3	-26057.6	-27074.5	-27695.2	-25834.1	-24574.1	-23454.1	-24176.8	-24421.3
VaR@97.5%	-34552.1	-35602.0	-33889.2	-35299.3	-36044.7	-33342.9	-31590.8	-30778.2	-31993.9	-32330.2
VaR@99%	-46032.7	-47200.4	-46912.9	-47759.4	-49317.1	-44128.5	-41603.6	-39090.0	-41563.0	-41768.9
ES@95%	-39196.7	-40764.5	-38750.2	-40500.2	-41485.3	-38495.0	-36629.1	-35589.4	-36644.6	-37172.4
ES@97.5%	-48474.5	-50211.9	-48233.5	-50562.1	-52028.2	-48252.9	-45773.9	-44633.6	-46007.5	-46729.6
ES@99%	-61799.2	-64562.2	-63125.0	-65461.0	-67450.2	-63246.5	-60098.4	-58831.4	-60488.2	-61411.7

Table JP.7 - Risk Measurements of One Region Distribution Function for Japanese Portfolio										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
VaR Estimates of One Region Distribution										
VaR@95%	-30368.2	-28336.2	-26853.0	-26510.5	-24095.0	-23470.1	-27238.3	-24005.6	-24078.5	-24325.9
VaR@97.5%	-41501.8	-37335.4	-36137.8	-35564.2	-31958.0	-31010.9	-35671.1	-31202.8	-31761.0	-31895.7
VaR@99%	-58371.8	-50527.2	-48637.2	-45874.7	-41166.7	-42463.4	-49164.7	-41455.4	-41727.9	-41572.5
ES@95%	-47330.6	-42079.0	-40123.8	-39409.1	-35731.8	-35187.9	-40728.0	-35084.8	-35418.1	-35656.7
ES@97.5%	-59822.2	-52087.9	-49419.2	-48442.9	-43888.0	-43554.2	-50324.8	-43136.3	-43497.8	-43649.9
ES@99%	-75235.2	-65600.6	-61572.3	-61140.5	-54835.2	-54725.0	-63303.8	-54591.7	-54722.3	-54715.4

Table SG.7 - Risk Measurements of One Region Distribution Function for Singaporean Portfolio										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
VaR Estimates of One Region Distribution										
VaR@95%	-28170.9	-25829.2	-23381.6	-20292.4	-20175.7	-21395.5	-20650.0	-21011.0	-19759.9	-19811.7
VaR@97.5%	-37753.6	-33606.7	-31018.9	-28169.1	-28163.1	-28800.6	-27735.4	-28111.8	-26569.1	-26554.6
VaR@99%	-51634.0	-46188.3	-44830.9	-37677.2	-36004.0	-38447.0	-38627.7	-37737.3	-35199.8	-36507.1
ES@95%	-43850.1	-39632.7	-37272.0	-32646.6	-32366.9	-34332.9	-33293.2	-33552.6	-31209.8	-31470.0
ES@97.5%	-55302.3	-49995.1	-47748.1	-41852.9	-41186.4	-44037.7	-43009.6	-42998.4	-39955.4	-40256.1
ES@99%	-72161.3	-65597.2	-64129.9	-55984.7	-55701.3	-60362.8	-58700.8	-58074.8	-54269.0	-54414.2

Table SE.7 - Risk Measurements of One Region Distribution Function for Swedish Portfolio

Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
VaR Estimates of One Region Distribution										
VaR@95%	-43098.3	-32397.6	-28168.0	-25475.2	-23784.0	-22662.8	-23400.9	-22800.1	-22505.3	-21657.6
VaR@97.5%	-57158.4	-42007.9	-35737.2	-32858.3	-31880.6	-30001.3	-31284.4	-29849.9	-29584.7	-30007.6
VaR@99%	-83013.3	-56958.1	-48789.4	-43359.6	-41486.3	-38716.3	-41509.9	-40697.6	-39457.0	-38705.9
ES@95%	-67281.2	-47792.6	-40900.0	-36958.8	-35417.6	-33686.3	-35202.6	-34194.5	-33394.8	-33181.4
ES@97.5%	-85427.6	-58882.0	-50313.6	-45262.1	-43617.8	-41483.0	-43673.3	-42479.3	-41507.0	-41246.9
ES@99%	-110083.5	-74473.0	-63704.8	-57262.1	-54912.7	-52827.5	-55705.2	-54147.2	-52846.5	-52388.0

Table CH.7 - Risk Measurements of One Region Distribution Function for Swiss Portfolio

Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
VaR Estimates of One Region Distribution										
VaR@95%	-21590.6	-17809.2	-17711.5	-16863.9	-17199.5	-17377.3	-17607.2	-17805.9	-17389.9	-17163.4
VaR@97.5%	-28505.5	-22648.8	-22549.3	-21341.0	-22578.7	-22512.4	-23392.1	-23950.6	-23409.6	-23968.8
VaR@99%	-38126.4	-30176.8	-29618.9	-27996.2	-29985.4	-30799.1	-32332.7	-33624.1	-33248.9	-33697.5
ES@95%	-32463.9	-26285.6	-25987.2	-24745.1	-26215.6	-26613.5	-27516.1	-28149.8	-27386.7	-28010.2
ES@97.5%	-40427.5	-32635.1	-32304.7	-30746.1	-32930.8	-33816.0	-35167.5	-35934.7	-35018.2	-36054.5
ES@99%	-52224.1	-42662.0	-42723.1	-40446.7	-43799.6	-45478.3	-47726.8	-48158.6	-46947.6	-48764.8

Table UK.7 - Risk Measurements of One Region Distribution Function for United Kingdom Portfolio

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
VaR Estimates of One Region Distribution										
VaR@95%	-26510.3	-22496.6	-20471.0	-19383.7	-18130.3	-17105.3	-16789.6	-16600.6	-16417.8	-16485.1
VaR@97.5%	-33603.2	-27736.6	-26827.1	-24694.2	-23338.0	-22173.2	-21918.0	-21588.5	-21293.0	-21919.7
VaR@99%	-42062.3	-33990.5	-33963.8	-32175.4	-29964.3	-29213.6	-28669.6	-27763.0	-28426.2	-28610.6
ES@95%	-36484.8	-30582.5	-29041.8	-27763.5	-25850.0	-24838.5	-24466.6	-24058.7	-24355.0	-24515.5
ES@97.5%	-43533.1	-36144.7	-35119.5	-33815.7	-31461.1	-30406.9	-29966.3	-29517.4	-30009.9	-30371.4
ES@99%	-52928.7	-44389.7	-43082.2	-42306.2	-39244.8	-38604.4	-37780.0	-37412.3	-38540.1	-38651.4

Table US.7 - Risk Measurements of One Region Distribution Function for United States Portfolio

Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
VaR Estimates of One Region Distribution										
VaR@95%	-26907.5	-20909.1	-20411.9	-22196.7	-21357.6	-20197.4	-20033.8	-20007.7	-19396.7	-19312.4
VaR@97.5%	-34618.8	-26262.7	-25976.4	-28143.7	-26296.5	-25398.5	-25024.4	-24940.3	-23935.9	-23784.4
VaR@99%	-42619.3	-32623.1	-32416.6	-34758.5	-34440.3	-33030.4	-32062.5	-32319.2	-31671	-30991.1
ES@95%	-38602.6	-29283.9	-28657.6	-30942.4	-29752.1	-28539.7	-27796.3	-27969.7	-27251.9	-26810.9
ES@97.5%	-46767.1	-35266.9	-34425.8	-37217.6	-36082.2	-34485.2	-33348.9	-33834.7	-32966.6	-32481.9
ES@99%	-59434	-44863.6	-42747.8	-46133.8	-45151.3	-42752.9	-41253.7	-42101.8	-41480.5	-40708.2

Appendix.20 – Average Risk Measurements of Multi-Region Distribution Functions for all Portfolios

Table GBM.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-4537.1	-3258.6	-2675.0	-2298.7	-2045.9	-1831.8	-1726.2	-1604.1	-1514.8	-1466.2
VaR@97.5%	-7818.8	-5604.0	-4648.3	-3977.1	-3532.2	-3173.0	-2973.7	-2778.0	-2624.1	-2516.6
VaR@99%	-13163.0	-9417.4	-7937.8	-6717.3	-5940.8	-5389.4	-5016.3	-4713.9	-4443.4	-4203.4
ES@95%	-10128.5	-7248.7	-6122.9	-5166.3	-4565.5	-4153.7	-3864.1	-3631.5	-3419.1	-3230.2
ES@97.5%	-14272.3	-10203.6	-8703.4	-7293.6	-6428.8	-5885.0	-5452.1	-5141.9	-4834.5	-4529.7
ES@99%	-20316.7	-14507.9	-12558.8	-10405.3	-9133.5	-8449.9	-7781.6	-7374.2	-6914.3	-6398.6
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-4563.1	-3264.2	-2676.9	-2298.4	-2044.5	-1835.3	-1723.4	-1603.5	-1507.9	-1466.7
VaR@97.5%	-7946.4	-5618.0	-4647.8	-3976.0	-3521.1	-3177.9	-2977.9	-2797.0	-2615.7	-2541.4
VaR@99%	-13374.2	-9373.7	-7914.8	-6668.1	-5912.6	-5441.3	-5007.8	-4739.3	-4410.1	-4223.7
ES@95%	-10211.8	-7243.6	-6129.2	-5147.9	-4554.5	-4173.8	-3865.3	-3641.1	-3396.8	-3238.7
ES@97.5%	-14421.7	-10216.0	-8732.7	-7281.6	-6428.8	-5922.6	-5452.5	-5156.4	-4806.9	-4557.0
ES@99%	-20524.3	-14571.6	-12659.6	-10425.0	-9172.6	-8508.8	-7778.7	-7386.5	-6893.0	-6446.1
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-4319.8	-3086.9	-2527.6	-2177.3	-1940.0	-1730.9	-1637.0	-1523.8	-1427.7	-1401.9
VaR@97.5%	-7207.0	-5116.4	-4210.5	-3631.7	-3270.2	-2886.4	-2701.4	-2538.9	-2392.5	-2359.7
VaR@99%	-12230.0	-8661.8	-7162.9	-6168.8	-5488.0	-4894.8	-4624.7	-4351.5	-4073.9	-3961.2
ES@95%	-9663.9	-6889.0	-5771.6	-4879.2	-4378.0	-3934.3	-3668.9	-3463.1	-3239.6	-3094.0
ES@97.5%	-13828.4	-9861.6	-8341.9	-6985.2	-6274.7	-5672.3	-5263.8	-4986.9	-4665.9	-4398.1
ES@99%	-20412.2	-14545.6	-12495.2	-10266.6	-9228.2	-8461.9	-7749.2	-7394.1	-6933.5	-6377.3

Table FRW.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Simulated Two Sided Symmetric Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-3298.0	-2706.4	-2406.7	-2073.8	-1880.5	-1757.0	-1646.8	-1518.9	-1444.1	-1355.3
VaR@97.5%	-6426.3	-5106.8	-4390.3	-3791.2	-3421.6	-3191.7	-2968.1	-2754.8	-2622.8	-2457.1
VaR@99%	-12721.4	-9538.8	-7995.3	-6918.0	-6164.5	-5788.2	-5317.3	-4975.2	-4719.5	-4423.1
ES@95%	-10323.1	-7452.3	-6249.8	-5409.5	-4787.6	-4522.1	-4136.5	-3878.8	-3666.4	-3441.0
ES@97.5%	-16013.6	-11160.7	-9232.7	-8000.5	-7024.3	-6664.4	-6051.1	-5701.6	-5375.8	-5047.4
ES@99%	-26293.3	-17302.1	-14097.9	-12235.0	-10595.7	-10144.7	-9105.9	-8641.3	-8104.3	-7620.1
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-3327.4	-2713.5	-2416.0	-2090.1	-1896.2	-1777.4	-1657.8	-1515.3	-1438.0	-1352.1
VaR@97.5%	-6611.0	-5113.5	-4390.1	-3802.7	-3428.5	-3219.0	-2979.2	-2760.3	-2627.7	-2462.1
VaR@99%	-13218.8	-9649.9	-7950.0	-6984.1	-6207.1	-5839.3	-5363.1	-4989.3	-4695.1	-4435.6
ES@95%	-10534.0	-7498.7	-6224.6	-5457.7	-4803.8	-4549.0	-4155.3	-3880.8	-3654.9	-3442.5
ES@97.5%	-16389.2	-11255.3	-9197.0	-8110.4	-7064.4	-6717.9	-6092.5	-5721.3	-5363.3	-5064.3
ES@99%	-26868.9	-17468.8	-14025.0	-12473.5	-10675.2	-10235.1	-9179.3	-8685.9	-8101.7	-7658.4
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-3125.2	-2539.2	-2280.1	-1951.5	-1775.4	-1665.8	-1562.1	-1430.9	-1361.4	-1276.8
VaR@97.5%	-5768.5	-4521.0	-3948.3	-3367.5	-3092.7	-2863.9	-2689.1	-2469.0	-2376.1	-2246.4
VaR@99%	-11493.4	-8632.9	-7405.1	-6366.7	-5726.1	-5269.9	-4881.7	-4458.5	-4233.5	-4023.6
ES@95%	-10163.4	-7105.6	-6059.2	-5164.5	-4569.3	-4336.0	-3970.5	-3683.2	-3492.9	-3311.4
ES@97.5%	-16145.1	-10888.9	-9154.0	-7818.1	-6836.8	-6518.8	-5919.3	-5526.3	-5223.6	-4960.9
ES@99%	-27853.8	-17624.8	-14609.3	-12508.2	-10683.1	-10389.4	-9308.5	-8750.1	-8238.2	-7799.4

Table AU.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Australia										
Portfolio Number	**AU_01**	**AU_02**	**AU_03**	**AU_04**	**AU_05**	**AU_06**	**AU_07**	**AU_08**	**AU_09**	**AU_10**
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-21513	-18365	-28360	-27429	-26846	-26079	-25580	-25093	-24040	-21972
VaR@97.5%	-39543	-33183	-52627	-50879	-49581	-48208	-46967	-46073	-44114	-40325
VaR@99%	-73387	-59719	-98738	-95183	-92322	-89864	-87199	-85433	-81832	-74751
ES@95%	-58025	-46552	-78378	-75366	-73001	-71084	-69038	-67560	-64767	-59115
ES@97.5%	-86753	-68293	-117935	-113186	-109338	-106535	-103262	-100965	-96825	-88331
ES@99%	-135204	-103254	-185508	-177414	-170745	-166518	-161135	-157294	-150977	-137591
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-21894	-18419	-29083	-28117	-27479	-26708	-26263	-25745	-24602	-22511
VaR@97.5%	-40565	-33545	-54257	-52245	-50982	-49573	-48450	-47474	-45339	-41493
VaR@99%	-74809	-60374	-102150	-98599	-95552	-93015	-90429	-88320	-84817	-77779
ES@95%	-59565	-46908	-81151	-77057	-75326	-73365	-71341	-69873	-67024	-61334
ES@97.5%	-89559	-69005	-122739	-115782	-113305	-110409	-107084	-104930	-100707	-92092
ES@99%	-140051	-104415	-193483	-17987	-176478	-172127	-166487	-163771	-157134	-143284
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-20540	-17760	-27164	-26060	-25587	-24887	-24490	-24086	-22930	-20965
VaR@97.5%	-37101	-31499	-49884	-46997	-46018	-44941	-44785	-43760	-41104	-38160
VaR@99%	-70431	-57304	-90857	-86257	-84314	-82973	-81100	-79743	-74328	-69552
ES@95%	-58468	-46553	-79412	-73746	-71652	-70374	-68599	-68558	-63599	-58366
ES@97.5%	-89561	-69620	-122604	-113148	-109565	-107752	-104612	-105052	-97024	-89056
ES@99%	-146156	-109604	-203585	-184622	-178019	-175358	-169408	-172277	-157437	-143806

Table CA.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_0 7**	**CA_08**	**CA_09**	**CA_10**
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-19440	-20151	-16811	-15876	-15328	-14736	-13836	-12503	-14246	-14247
VaR@97.5%	-35487	-36171	-30446	-29371	-28424	-27294	-25589	-23295	-26851	-26783
VaR@99%	-64530	-64387	-54859	-54333	-52793	-50662	-47436	-43675	-51056	-50866
ES@95%	-50388	-49995	-42739	-42657	-41523	-39855	-37313	-34545	-40604	-40479
ES@97.5%	-74366	-72855	-62736	-63599	-62057	-59545	-55708	-51932	-61542	-61320
ES@99%	-113351	-108990	-94882	-98396	-96374	-92451	-86422	-81437	-97658	-97285
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-19823	-20683	-17392	-16243	-15750	-15103	-14203	-12661	-14579	-14507
VaR@97.5%	-36483	-37243	-31713	-30148	-29343	-28092	-26304	-23739	-27827	-27416
VaR@99%	-66276	-66683	-56376	-56074	-54581	-52279	-49189	-44389	-52613	-52438
ES@95%	-52070	-51643	-43823	-43289	-42918	-41094	-38668	-35234	-42234	-42588
ES@97.5%	-77218	-75559	-64238	-64552	-64351	-61625	-58009	-53243	-64322	-65191
ES@99%	-117912	-113030	-96398	-98901	-99531	-95391	-90038	-83726	-102375	-104571
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-18542	-19263	-15992	-15240	-14734	-14125	-13210	-11947	-13620	-13737
VaR@97.5%	-32882	-34268	-27835	-27530	-27186	-25701	-23398	-21629	-25503	-25073
VaR@99%	-60838	-59972	-50676	-51552	-50951	-48369	-43423	-41094	-47488	-47419
ES@95%	-49352	-48773	-40830	-43435	-42448	-39862	-35461	-34391	-40384	-40537
ES@97.5%	-74272	-72277	-60816	-66513	-64964	-60750	-53518	-52799	-62526	-62788
ES@99%	-117731	-111467	-94659	-108868	-105715	-97877	-84893	-86736	-103108	-103948

Table DE.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-29065	-27020	-25792	-23382	-22613	-21808	-21825	-21741	-21433	-21836
VaR@97.5%	-54029	-49725	-48450	-43877	-42012	-40547	-40515	-40353	-39700	-40294
VaR@99%	-99398	-91338	-91623	-81773	-77738	-75219	-75286	-75189	-73687	-74620
ES@95%	-77408	-71485	-72617	-63989	-60845	-58973	-59177	-59249	-57939	-58700
ES@97.5%	-114931	-106120	-109692	-95737	-90685	-88038	-88456	-88726	-86556	-87593
ES@99%	-176098	-163075	-173110	-148403	-139989	-136290	-137344	-138249	-134334	-135810
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-30210	-27717	-26946	-24003	-23237	-22400	-22533	-22329	-22239	-22695
VaR@97.5%	-56118	-51315	-51231	-45154	-43504	-41986	-42538	-41712	-41393	-42770
VaR@99%	-102911	-93971	-95223	-84673	-80463	-77872	-77000	-78257	-76219	-77603
ES@95%	-79585	-74147	-74976	-65408	-62290	-60341	-61416	-61558	-59508	-60681
ES@97.5%	-118090	-110539	-113047	-98059	-92985	-90230	-91839	-92672	-88815	-90337
ES@99%	-179400	-169927	-176550	-150801	-142370	-138608	-142518	-144639	-136715	-138669
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-27761	-26164	-24639	-22463	-21711	-20920	-20955	-20645	-20352	-20881
VaR@97.5%	-51198	-48411	-44663	-41380	-39434	-37876	-37817	-37290	-37093	-37080
VaR@99%	-93727	-87431	-84244	-76854	-73101	-70322	-69083	-67995	-68527	-68014
ES@95%	-75685	-71241	-72547	-64322	-60835	-58814	-57380	-56591	-55932	-56222
ES@97.5%	-114293	-107404	-112810	-98692	-92930	-90019	-87399	-86175	-85260	-85554
ES@99%	-180022	-169610	-187315	-159775	-149930	-145992	-139913	-138470	-136267	-136665

Table HK.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-24232	-29088	-27171	-28110	-28704	-27194	-26238	-23943	-24844	-25017
VaR@97.5%	-45347	-54252	-50772	-52449	-53650	-51163	-49404	-45479	-46931	-47323
VaR@99%	-85756	-102405	-96300	-99155	-101914	-97557	-94526	-87829	-90352	-91339
ES@95%	-68201	-81460	-76868	-78968	-81463	-77911	-75729	-70627	-72705	-73634
ES@97.5%	-103078	-123001	-116421	-119357	-123505	-118333	-115277	-108082	-111099	-112696
ES@99%	-163082	-194430	-184978	-188995	-196593	-188622	-184498	-174270	-178932	-181968
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-24796	-29869	-27931	-28793	-29570	-28005	-27031	-24460	-25712	-25596
VaR@97.5%	-46450	-55928	-52343	-53964	-55404	-52577	-50921	-47278	-48885	-48865
VaR@99%	-88699	-105698	-99951	-102540	-105859	-101190	-97511	-90663	-94231	-94366
ES@95%	-69979	-83398	-80068	-81693	-84329	-79701	-78562	-73300	-75937	-77903
ES@97.5%	-106140	-126065	-121964	-124137	-128308	-121050	-120198	-112604	-116545	-120391
ES@99%	-167387	-197527	-194389	-196695	-203543	-191181	-192994	-181513	-187958	-196461
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-22995	-27868	-25815	-26856	-27394	-26061	-25158	-22947	-23571	-23721
VaR@97.5%	-41579	-51364	-46351	-49154	-49850	-47503	-46205	-42199	-43249	-43310
VaR@99%	-76965	-96870	-86456	-91618	-93871	-89886	-89471	-80199	-82414	-82789
ES@95%	-65105	-84589	-73593	-78642	-80781	-77826	-79414	-70266	-71582	-72591
ES@97.5%	-100124	-131860	-113506	-121549	-125371	-121030	-125083	-110117	-112138	-113871
ES@99%	-164074	-221302	-187156	-200448	-208765	-201848	-213562	-186355	-188682	-192372

Table JP.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Japan

Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-27332	-25339	-24920	-24623	-21844	-21501	-21390	-21476	-21488	-21371
VaR@97.5%	-50251	-46213	-45269	-44554	-39528	-39107	-38882	-39011	-39047	-38901
VaR@99%	-91903	-83881	-81597	-80016	-71041	-70801	-70352	-70691	-70640	-70437
ES@95%	-71766	-65437	-63476	-62228	-55273	-55215	-54861	-55219	-55096	-54918
ES@97.5%	-106255	-96467	-93178	-91155	-81005	-81278	-80730	-81344	-81071	-80844
ES@99%	-162555	-146756	-140790	-137365	-122174	-123412	-122525	-123748	-123050	-122740
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-27906	-25953	-25511	-25272	-22428	-22111	-21961	-21950	-21998	-21835
VaR@97.5%	-51049	-47408	-46559	-45831	-40498	-40180	-40140	-40039	-40108	-40030
VaR@99%	-94032	-86108	-84259	-82545	-72813	-72550	-72771	-72743	-72852	-72650
ES@95%	-73118	-66158	-65349	-64174	-55849	-56705	-56157	-56639	-56767	-56470
ES@97.5%	-108790	-97408	-96364	-94399	-81719	-83820	-82735	-83768	-83910	-83462
ES@99%	-166399	-146526	-145290	-142191	-121905	-127579	-124369	-127021	-127281	-126555
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-26086	-24343	-23640	-23539	-20976	-20564	-20423	-20463	-20519	-20386
VaR@97.5%	-46891	-43612	-41778	-41668	-37136	-36646	-36124	-36131	-36095	-35798
VaR@99%	-86916	-79185	-74882	-74847	-65544	-66460	-64672	-64674	-65895	-65977
ES@95%	-73033	-65918	-61321	-62219	-54560	-55295	-54181	-53982	-54846	-54613
ES@97.5%	-111630	-99722	-91890	-93688	-81748	-83630	-81610	-81275	-82681	-82412
ES@99%	-180587	-159289	-143645	-148140	-128579	-133316	-129805	-128739	-132079	-131694

Table SG.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Singapore

Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-27221	-23490	-21766	-18358	-18373	-20770	-20290	-20328	-19446	-18926
VaR@97.5%	-50079	-44082	-40812	-35048	-35147	-39204	-38302	-38301	-36419	-35895
VaR@99%	-92811	-83519	-77400	-67869	-68046	-74917	-73229	-73181	-69204	-69138
ES@95%	-73247	-66407	-61642	-54543	-54592	-59832	-58515	-58517	-55252	-55499
ES@97.5%	-109398	-100460	-93322	-83575	-83619	-90976	-89004	-88987	-83765	-84796
ES@99%	-170116	-159076	-148027	-134885	-134785	-145187	-142131	-142125	-133248	-136373
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-28085	-24748	-22916	-19480	-19502	-21885	-21364	-21477	-20452	-19872
VaR@97.5%	-52212	-47145	-43461	-38280	-38179	-41896	-40951	-40939	-38717	-38285
VaR@99%	-95882	-87716	-80829	-71974	-72396	-78703	-76858	-76658	-73041	-71791
ES@95%	-75367	-69398	-64053	-56633	-57003	-62162	-60674	-60901	-57327	-57226
ES@97.5%	-112724	-104682	-96613	-86155	-86795	-94150	-91912	-92173	-86619	-86925
ES@99%	-173874	-163614	-150948	-135841	-137157	-147775	-144495	-144901	-135694	-137569
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-26012	-22377	-20828	-17556	-17431	-19705	-19190	-19163	-18369	-17782
VaR@97.5%	-46700	-40685	-38292	-32377	-32458	-35916	-34624	-34703	-32584	-31912
VaR@99%	-90136	-75878	-73769	-64586	-66043	-70434	-67360	-67009	-62007	-62519
ES@95%	-75239	-65929	-64334	-56547	-56813	-61710	-58581	-58510	-53428	-53776
ES@97.5%	-116342	-102155	-100838	-89783	-90353	-97389	-92012	-92067	-83021	-84549
ES@99%	-190873	-169475	-170114	-153952	-154650	-166228	-156689	-156396	-138112	-142781

Table SE.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Sweden										
AVERAGE										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-44824	-28047	-25432	-24777	-24369	-24144	-24469	-24172	-23692	-23848
VaR@97.5%	-83194	-52234	-47677	-46572	-45678	-45249	-45544	-45135	-44510	-44410
VaR@99%	-154595	-97840	-89677	-87991	-86068	-85051	-85468	-84754	-83909	-83227
ES@95%	-121525	-77356	-70859	-69695	-68122	-67160	-67706	-67027	-66329	-65815
ES@97.5%	-181655	-116226	-106688	-105220	-102688	-101073	-101857	-100842	-99993	-98913
ES@99%	-282070	-182108	-167486	-165894	-161570	-158533	-159996	-158260	-157226	-155048
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-46645	-28877	-26122	-25620	-25176	-25099	-25256	-24944	-24627	-24831
VaR@97.5%	-88868	-54046	-49546	-49368	-48221	-47948	-48323	-47992	-47386	-47636
VaR@99%	-161336	-101340	-93554	-90876	-89345	-87724	-88259	-87774	-87246	-86593
ES@95%	-125774	-80512	-73896	-71838	-70026	-69089	-69708	-68997	-68419	-68113
ES@97.5%	-187383	-121599	-111802	-108126	-105267	-103539	-104507	-103418	-102726	-101941
ES@99%	-286353	-190848	-175631	-168482	-163768	-160612	-162120	-160322	-159529	-157722
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-42767	-26652	-24087	-23475	-22985	-22785	-23037	-22877	-22303	-22534
VaR@97.5%	-76854	-48132	-43704	-42505	-41252	-41032	-40893	-41117	-40559	-40338
VaR@99%	-143460	-89529	-81784	-79706	-78804	-77628	-77722	-76222	-76907	-74834
ES@95%	-118532	-77628	-69221	-67413	-66521	-65130	-65419	-64798	-64648	-63528
ES@97.5%	-181539	-120136	-106689	-104060	-103060	-100432	-101001	-99615	-99985	-97625
ES@99%	-294363	-199230	-174451	-170683	-169820	-163757	-165526	-162541	-163846	-159223

Table CH.8 - Averages Risk Measurements of Multi-Region Distribution Functions for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-20297	-18213	-17795	-16858	-16925	-16969	-17019	-17568	-17096	-17235
VaR@97.5%	-37588	-33718	-32980	-31582	-31621	-31614	-31914	-32968	-32199	-32448
VaR@99%	-69634	-62277	-60756	-58769	-58686	-58964	-59920	-62318	-61100	-61819
ES@95%	-54696	-48796	-47461	-45980	-45887	-46385	-47222	-49407	-48503	-49285
ES@97.5%	-81617	-72668	-70549	-68736	-68493	-69481	-71003	-74618	-73414	-74801
ES@99%	-126430	-112147	-108447	-106437	-105842	-108185	-111132	-117756	-116212	-119033
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-20758	-18608	-18164	-17257	-17363	-17570	-17745	-18395	-17920	-17959
VaR@97.5%	-38663	-34527	-34092	-33017	-33021	-33204	-33860	-35043	-34274	-33931
VaR@99%	-71772	-64251	-62774	-60426	-60286	-60315	-62395	-64946	-64034	-63889
ES@95%	-57273	-51005	-49446	-47577	-47438	-48178	-48859	-51248	-50468	-50770
ES@97.5%	-86253	-76617	-73943	-71248	-70909	-72164	-73335	-77254	-76143	-76876
ES@99%	-135013	-119194	-113912	-110271	-109391	-112310	-113603	-120604	-119015	-121299
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-19293	-17751	-17269	-16327	-16264	-16171	-16171	-16775	-16388	-16571
VaR@97.5%	-34680	-32322	-32175	-29953	-30570	-29233	-30017	-30787	-29915	-31211
VaR@99%	-63485	-59651	-59148	-56946	-56506	-54025	-56508	-58301	-56481	-57937
ES@95%	-53237	-49382	-47750	-45940	-45818	-44636	-46225	-48190	-47256	-48852
ES@97.5%	-81105	-75016	-72319	-70046	-69724	-67934	-71009	-74025	-72880	-75394
ES@99%	-130476	-120599	-114152	-111657	-110794	-109020	-114654	-120399	-119577	-123678

Table UK.8 - Averages Risk Measurements of Multi-Region Distribution Functions for United Kingdom

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-24963	-22408	-19983	-19180	-18156	-17217	-16872	-16782	-16810	-16972
VaR@97.5%	-45560	-40672	-36506	-35216	-33077	-31629	-30871	-30627	-30724	-31023
VaR@99%	-83009	-73323	-66694	-64564	-60479	-58293	-56608	-56086	-56413	-57099
ES@95%	-64914	-57066	-52235	-50545	-47478	-45818	-44418	-44030	-44344	-44972
ES@97.5%	-95928	-83781	-77324	-74962	-70336	-68185	-65902	-65284	-65858	-66898
ES@99%	-146572	-126650	-118492	-115086	-108036	-105346	-101369	-100374	-101525	-103437
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-25413	-22698	-20414	-19670	-18565	-17686	-17376	-17264	-17295	-17406
VaR@97.5%	-46346	-41399	-37398	-36196	-33870	-32485	-31612	-31511	-31606	-31985
VaR@99%	-85195	-74126	-68016	-66614	-61574	-59747	-57478	-57270	-57830	-58922
ES@95%	-66291	-58053	-53448	-51580	-48337	-46375	-44846	-44492	-44961	-46084
ES@97.5%	-98445	-85562	-79433	-76577	-71774	-68902	-66413	-65784	-66693	-68726
ES@99%	-150193	-129637	-121675	-116772	-109596	-105280	-101134	-100018	-101583	-105580
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-23572	-21376	-18951	-18213	-17544	-16419	-16182	-16179	-16182	-16318
VaR@97.5%	-40989	-37352	-33201	-32263	-31568	-29245	-28617	-28466	-28936	-28851
VaR@99%	-75137	-68082	-62158	-60065	-59068	-56086	-54047	-54453	-54860	-55458
ES@95%	-60431	-56249	-50853	-49719	-48312	-47051	-44959	-44452	-45056	-45943
ES@97.5%	-90273	-84544	-77039	-75580	-73472	-72592	-68771	-67834	-68876	-70559
ES@99%	-140963	-134423	-123369	-121322	-118480	-119114	-111947	-109566	-111021	-115320

Table US.8 - Averages Risk Measurements of Multi-Region Distribution Functions for United States

Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Risk Measurements using the Historical Method for Unconditional LT-C-RT transfers										
VaR@95%	-25564	-19932	-19692	-26044	-24086	-22507	-21704	-21930	-21155	-20753
VaR@97.5%	-46686	-36656	-35940	-47922	-44185	-41082	-39586	-40266	-38785	-38074
VaR@99%	-84948	-67660	-65542	-88331	-81384	-75167	-72497	-73894	-71273	-70029
ES@95%	-66694	-53230	-51293	-69359	-63991	-58970	-56946	-57896	-55961	-55000
ES@97.5%	-98694	-79293	-75847	-103209	-95202	-87387	-84445	-85919	-83134	-81750
ES@99%	-151204	-122710	-116027	-159346	-147074	-134216	-129897	-132070	-128108	-126073
Risk Measurements using the Historical Method for 3 State Markov Chain Transfers										
VaR@95%	-26036	-20369	-20082	-26567	-24638	-23173	-22135	-22386	-21507	-21115
VaR@97.5%	-47651	-37656	-36816	-48680	-45169	-42208	-40544	-40941	-39478	-38785
VaR@99%	-87456	-69328	-67229	-89828	-83880	-77603	-74048	-75415	-71897	-71263
ES@95%	-69633	-54664	-52618	-70217	-65514	-60606	-58207	-59334	-56887	-56198
ES@97.5%	-104047	-81730	-78194	-104814	-97785	-90055	-86565	-88504	-84817	-83879
ES@99%	-160859	-126424	-119588	-161360	-150561	-137757	-132828	-136362	-131061	-129464
Risk Measurements using the Historical Method for Geometric Time in Tails Transfers										
VaR@95%	-24588	-18847	-18716	-24998	-22896	-21291	-20525	-21178	-20394	-20024
VaR@97.5%	-44585	-33278	-33272	-44963	-40957	-37407	-35987	-37148	-35727	-35156
VaR@99%	-81026	-61668	-59887	-83414	-74092	-68678	-66382	-68384	-65687	-65591
ES@95%	-66089	-51383	-49814	-70235	-61985	-56973	-54919	-55958	-53975	-53804
ES@97.5%	-99521	-78278	-75114	-107648	-94122	-86399	-83322	-84266	-81379	-81410
ES@99%	-157422	-125619	-118863	-175286	-150729	-137904	-132841	-132732	-128718	-129213

Appendix.21 – VaR Estimates @ 95% for all Portfolios

Table GBM.9 - Estimates for VaR@95% for Simulated Geometric Brownian Motion										
Portfolio Number	**GBM_01**	**GBM_02**	**GBM_03**	**GBM_04**	**GBM_05**	**GBM_06**	**GBM_07**	**GBM_08**	**GBM_09**	**GBM_10**
One Region	-4392.3	-3196.1	-2561.0	-2264.4	-2030.1	-1845.9	-1677.2	-1565.7	-1489.6	-1411.9
Average										
Unconditional	-4537.1	-3258.6	-2675.0	-2298.7	-2045.9	-1831.8	-1726.2	-1604.1	-1514.8	-1466.2
Markov Regime Switching	-4563.1	-3264.2	-2676.9	-2298.4	-2044.5	-1835.3	-1723.4	-1603.5	-1507.9	-1466.7
Geometric Time in Tails	-4319.8	-3086.9	-2527.6	-2177.3	-1940.0	-1730.9	-1637.0	-1523.8	-1427.7	-1401.9
Standard Deviation										
Unconditional	336.5	241.0	200.5	172.1	152.8	137.2	127.7	119.9	113.5	108.3
Markov Regime Switching	369.9	263.6	208.9	189.7	165.1	142.5	127.5	122.8	119.1	114.6
Geometric Time in Tails	353.4	230.2	173.5	162.1	143.1	120.8	110.1	114.2	108.3	114.6

Table FRW.9 - Estimates for VaR@95% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	**FRW_01**	**FRW_02**	**FRW_03**	**FRW_04**	**FRW_05**	**FRW_06**	**FRW_07**	**FRW_08**	**FRW_09**	**FRW_10**
One Region	-3246.0	-2673.5	-2340.2	-2018.5	-1859.7	-1710.4	-1605.9	-1527.1	-1442.1	-1365.7
Average										
Unconditional	-3298.0	-2706.4	-2406.7	-2073.8	-1880.5	-1757.0	-1646.8	-1518.9	-1444.1	-1355.3
Markov Regime Switching	-3327.4	-2713.5	-2416.0	-2090.1	-1896.2	-1777.4	-1657.8	-1515.3	-1438.0	-1352.1
Geometric Time in Tails	-3125.2	-2539.2	-2280.1	-1951.5	-1775.4	-1665.8	-1562.1	-1430.9	-1361.4	-1276.8
Standard Deviation										
Unconditional	293.9	232.8	194.5	168.5	152.3	141.2	130.9	122.1	116.8	109.1
Markov Regime Switching	319.6	250.5	223.8	195.7	172.5	160.4	143.8	129.4	119.0	115.6
Geometric Time in Tails	267.8	195.5	167.7	138.2	121.6	118.9	112.2	104.7	99.5	90.6

Table AU.9 - Estimates for VaR@95% for Australia										
Portfolio Number	**AU_01**	**AU_02**	**AU_03**	**AU_04**	**AU_05**	**AU_06**	**AU_07**	**AU_08**	**AU_09**	**AU_10**
One Region	-22113.7	-19514.1	-21610.3	-19809.1	-19360.5	-18980.8	-18045.6	-17344.2	-17263.5	-16279.1
Average										
Unconditional	-21513.1	-18365.1	-28359.8	-27428.8	-26845.7	-26079.0	-25580.0	-25092.5	-24040.1	-21972.0
Markov Regime Switching	-21894.4	-18418.8	-29082.6	-28117.0	-27479.0	-26707.7	-26263.1	-25744.6	-24601.7	-22511.2
Geometric Time in Tails	-20539.6	-17759.9	-27163.6	-26060.0	-25587.4	-24886.8	-24490.0	-24085.7	-22930.0	-20965.4
Standard Deviation										
Unconditional	1753.5	1468.6	2355.5	2280.4	2215.9	2154.9	2084.2	2046.1	1958.2	1790.1
Markov Regime Switching	2172.8	1623.7	3242.6	3166.6	3060.2	2996.7	3005.9	2854.0	2782.8	2525.3
Geometric Time in Tails	1477.6	1395.4	1881.0	1845.6	1907.9	1863.9	1650.8	1640.2	1687.8	1469.5

Table CA.9 - Estimates for VaR@95% for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_07**	**CA_08**	**CA_09**	**CA_10**
One Region	-21409.3	-20742.3	-17601.5	-16816.3	-15635.5	-14908.0	-13466.5	-12879.1	-13760.0	-13749.4
Average										
Unconditional	-19439.9	-20150.8	-16811.0	-15875.6	-15328.1	-14736.4	-13836.4	-12502.7	-14245.6	-14246.9
Markov Regime Switching	-19822.7	-20682.6	-17391.8	-16243.1	-15750.4	-15103.4	-14203.3	-12660.6	-14579.1	-14506.9
Geometric Time in Tails	-18542.0	-19263.3	-15991.7	-15240.0	-14733.6	-14124.9	-13209.5	-11947.4	-13619.7	-13737.4
Standard Deviation										
Unconditional	1585.8	1595.8	1350.8	1320.6	1275.9	1223.1	1145.5	1048.2	1211.7	1204.8
Markov Regime Switching	2149.1	2197.6	1980.6	1765.4	1809.0	1730.8	1585.7	1317.9	1659.2	1723.2
Geometric Time in Tails	1364.7	1265.0	1254.5	1103.4	1093.3	1026.7	1031.0	903.1	977.6	1177.5

Table DE.9 - Estimates for VaR@95% for Germany										
Portfolio Number	**DE_01**	**DE_02**	**DE_03**	**DE_04**	**DE_05**	**DE_06**	**DE_07**	**DE_08**	**DE_09**	**DE_10**
One Region	-28987.5	-25366.9	-24597.6	-21995.3	-20815.6	-20413.4	-20684.1	-20713.8	-19641.3	-20057.1
Average										
Unconditional	-29064.9	-27019.9	-25791.5	-23382.1	-22612.9	-21808.1	-21825.4	-21741.2	-21432.5	-21836.3
Markov Regime Switching	-30210.3	-27716.8	-26945.5	-24003.2	-23236.9	-22400.1	-22533.3	-22329.1	-22239.4	-22694.9
Geometric Time in Tails	-27761.4	-26164.3	-24639.0	-22462.7	-21711.2	-20919.7	-20954.7	-20645.3	-20352.4	-20881.2
Standard Deviation										
Unconditional	2439.9	2214.0	2177.4	1988.5	1887.1	1819.5	1812.3	1801.0	1771.0	1789.2
Markov Regime Switching	3499.6	3129.7	3230.3	2785.4	2627.9	2537.3	2535.1	2537.9	2644.9	2581.5
Geometric Time in Tails	1869.7	1935.9	1814.3	1675.6	1577.5	1534.4	1919.9	1373.2	1294.6	1899.3

Table HK.9 - Estimates for VaR@95% for Hong Kong										
Portfolio Number	**HK_01**	**HK_02**	**HK_03**	**HK_04**	**HK_05**	**HK_06**	**HK_07**	**HK_08**	**HK_09**	**HK_10**
One Region	-26955.8	-27885.3	-26057.6	-27074.5	-27695.2	-25834.1	-24574.1	-23454.1	-24176.8	-24421.3
Average										
Unconditional	-24231.7	-29087.5	-27170.8	-28109.6	-28704.2	-27193.5	-26238.0	-23943.4	-24843.8	-25017.4
Markov Regime Switching	-24796.4	-29869.4	-27931.2	-28793.3	-29569.6	-28005.4	-27031.2	-24459.9	-25712.0	-25596.0
Geometric Time in Tails	-22994.9	-27868.4	-25814.8	-26855.7	-27394.2	-26061.2	-25157.5	-22947.2	-23571.3	-23721.2
Standard Deviation										
Unconditional	2042.7	2428.9	2268.3	2344.4	2394.4	2297.8	2218.2	2053.7	2108.5	2126.2
Markov Regime Switching	2863.6	3436.0	3172.6	3277.3	3501.9	3302.0	3160.2	2818.1	2986.2	2970.0
Geometric Time in Tails	1552.5	1961.6	1705.8	1951.8	1858.3	1746.0	1782.0	1976.7	1630.4	1747.5

Table JP.9 - Estimates for VaR@95% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-30368.2	-28336.2	-26853.0	-26510.5	-24095.0	-23470.1	-27238.3	-24005.6	-24078.5	-24325.9
Average										
Unconditional	-27332.3	-25339.0	-24919.6	-24622.6	-21843.5	-21501.3	-21390.4	-21476.3	-21488.1	-21371.3
Markov Regime Switching	-27906.3	-25952.6	-25511.1	-25272.2	-22427.9	-22111.1	-21960.8	-21950.2	-21998.1	-21835.3
Geometric Time in Tails	-26086.3	-24342.9	-23639.7	-23539.3	-20976.1	-20563.8	-20423.4	-20463.1	-20518.9	-20385.5
Standard Deviation										
Unconditional	2259.6	2063.6	2019.6	1981.3	1755.6	1740.8	1730.2	1735.6	1739.6	1737.6
Markov Regime Switching	3034.0	2831.2	2846.1	2712.7	2411.7	2454.1	2454.8	2311.1	2426.6	2359.7
Geometric Time in Tails	1827.4	1787.8	1695.0	1595.8	1512.0	1391.6	1428.5	1459.8	1491.7	1488.8

Table SG.9 - Estimates for VaR@95% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-28170.9	-25829.2	-23381.6	-20292.4	-20175.7	-21395.5	-20650.0	-21011.0	-19759.9	-19811.7
Average										
Unconditional	-27220.8	-23489.7	-21765.8	-18357.5	-18372.6	-20770.0	-20290.2	-20328.2	-19445.6	-18925.5
Markov Regime Switching	-28084.5	-24747.6	-22915.8	-19479.8	-19501.6	-21885.1	-21364.1	-21476.8	-20452.0	-19871.7
Geometric Time in Tails	-26011.5	-22377.0	-20828.2	-17556.3	-17430.9	-19705.2	-19189.9	-19162.6	-18368.5	-17781.5
Standard Deviation										
Unconditional	2226.4	1989.3	1838.8	1594.1	1603.3	1767.9	1727.9	1724.1	1628.8	1621.9
Markov Regime Switching	3120.2	2994.3	2739.4	2431.5	2451.7	2709.3	2592.1	2671.1	2452.5	2446.5
Geometric Time in Tails	1723.0	1629.0	1474.8	1484.2	1252.5	1411.8	1400.3	1386.5	1330.7	1320.1

Table SE.9 - Estimates for VaR@95% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-43098.3	-32397.6	-28168.0	-25475.2	-23784.0	-22662.8	-23400.9	-22800.1	-22505.3	-21657.6
Average										
Unconditional	-44824.2	-28046.5	-25431.8	-24776.6	-24369.4	-24143.9	-24469.0	-24171.8	-23692.0	-23847.9
Markov Regime Switching	-46645.2	-28876.8	-26122.3	-25620.2	-25175.9	-25098.8	-25256.0	-24944.2	-24626.5	-24830.5
Geometric Time in Tails	-42767.0	-26652.2	-24087.1	-23474.9	-22985.2	-22784.5	-23036.5	-22876.5	-22303.3	-22533.8
Standard Deviation										
Unconditional	3719.1	2355.7	2162.0	2111.5	2065.7	2047.3	2043.8	2032.1	2014.7	1993.7
Markov Regime Switching	5133.8	3290.5	2964.9	2948.9	2979.9	2866.1	2850.2	2829.3	2871.6	2857.9
Geometric Time in Tails	3102.4	1928.8	1797.9	1664.0	1732.3	1670.9	1688.4	1623.2	1639.8	1582.9

Table CH.9 - Estimates for VaR@95% for Switzerland										
Portfolio Number	**CH_01**	**CH_02**	**CH_03**	**CH_04**	**CH_05**	**CH_06**	**CH_07**	**CH_08**	**CH_09**	**CH_10**
One Region	-21590.6	-17809.2	-17711.5	-16863.9	-17199.5	-17377.3	-17607.2	-17805.9	-17389.9	-17163.4
Average										
Unconditional	-20297.0	-18213.1	-17794.7	-16857.7	-16924.8	-16968.8	-17018.8	-17567.7	-17095.6	-17235.2
Markov Regime Switching	-20758.3	-18607.7	-18163.7	-17256.7	-17362.9	-17570.0	-17745.2	-18394.5	-17919.7	-17958.5
Geometric Time in Tails	-19292.6	-17751.0	-17268.5	-16326.8	-16263.7	-16171.1	-16171.1	-16775.3	-16387.8	-16571.0
Standard Deviation										
Unconditional	1688.1	1514.4	1483.9	1430.7	1428.6	1417.1	1437.3	1480.5	1449.3	1454.7
Markov Regime Switching	2405.7	2117.7	2122.1	1929.0	1902.8	1990.6	2135.1	2191.9	2169.8	2155.1
Geometric Time in Tails	1467.9	1611.0	1447.0	1556.6	1141.6	1101.9	1089.2	1123.1	1207.0	1208.6

Table UK.9 - Estimates for VaR@95% for United Kingdom										
Portfolio Number	**UK_01**	**UK_02**	**UK_03**	**UK_04**	**UK_05**	**UK_06**	**UK_07**	**UK_08**	**UK_09**	**UK_10**
One Region	-26510.3	-22496.6	-20471.0	-19383.7	-18130.3	-17105.3	-16789.6	-16600.6	-16417.8	-16485.1
Average										
Unconditional	-24963.3	-22408.1	-19982.7	-19179.6	-18155.6	-17217.3	-16872.0	-16781.7	-16810.1	-16972.0
Markov Regime Switching	-25413.4	-22698.3	-20413.7	-19670.3	-18565.0	-17686.4	-17376.0	-17264.2	-17295.0	-17406.2
Geometric Time in Tails	-23572.0	-21376.2	-18950.9	-18212.5	-17543.6	-16419.4	-16181.7	-16179.0	-16182.2	-16317.9
Standard Deviation										
Unconditional	2028.8	1808.3	1623.8	1572.2	1462.7	1406.8	1369.2	1354.1	1358.4	1368.6
Markov Regime Switching	2643.2	2222.1	2163.5	2147.7	1868.9	1939.1	1773.9	1810.9	1878.3	1882.3
Geometric Time in Tails	1665.6	1542.3	1311.8	1246.6	1226.5	1132.3	1110.9	1163.8	1111.1	1100.7

Table US.9 - Estimates for VaR@95% for United States										
Portfolio Number	**US_01**	**US_02**	**US_03**	**US_04**	**US_05**	**US_06**	**US_07**	**US_08**	**US_09**	**US_10**
One Region	-26907.5	-20909.1	-20411.9	-22196.7	-21357.6	-20197.4	-20033.8	-20007.7	-19396.7	-19312.4
Average										
Unconditional	-25563.7	-19932.2	-19691.5	-26044.2	-24086.3	-22507.4	-21703.5	-21929.6	-21154.6	-20753.4
Markov Regime Switching	-26036.1	-20369.2	-20082.2	-26567.3	-24638.4	-23172.9	-22135.3	-22385.6	-21506.9	-21115.0
Geometric Time in Tails	-24588.3	-18846.6	-18716.4	-24998.4	-22895.6	-21290.6	-20525.0	-21177.8	-20393.8	-20024.1
Standard Deviation										
Unconditional	2076.3	1637.3	1600.1	2135.5	1961.1	1820.3	1751.2	1797.6	1726.0	1694.6
Markov Regime Switching	2822.3	2190.5	2051.5	2927.0	2711.0	2633.2	2331.0	2338.4	2107.1	2228.6
Geometric Time in Tails	1841.4	1356.7	1299.3	1822.4	1537.7	1500.2	1436.3	2246.4	2154.6	1973.4

Appendix.22 – VaR Estimates @97.5% for all Portfolios

Table GBM.10 - Estimates for VaR @ 97.5% for Simulated Geometric Brownian Motion										
Portfolio Number	**GBM_01**	**GBM_02**	**GBM_03**	**GBM_04**	**GBM_05**	**GBM_06**	**GBM_07**	**GBM_08**	**GBM_09**	**GBM_10**
One Region	-5360.8	-3869.7	-3126.1	-2649.1	-2415.5	-2137.5	-1959.1	-1815.9	-1758.3	-1694.2
Average										
Unconditional	-7818.8	-5604.0	-4648.3	-3977.1	-3532.2	-3173.0	-2973.7	-2778.0	-2624.1	-2516.6
Markov Regime Switching	-7946.4	-5618.0	-4647.8	-3976.0	-3521.1	-3177.9	-2977.9	-2797.0	-2615.7	-2541.4
Geometric Time in Tails	-7207.0	-5116.4	-4210.5	-3631.7	-3270.2	-2886.4	-2701.4	-2538.9	-2392.5	-2359.7
Standard Deviation										
Unconditional	870.2	621.5	527.9	445.5	393.4	357.5	331.5	312.7	294.9	277.0
Markov Regime Switching	885.7	593.0	521.7	436.7	373.7	358.1	336.4	333.8	306.4	274.6
Geometric Time in Tails	1166.9	788.5	680.2	619.3	553.3	460.0	419.8	412.6	389.1	420.7

Table FRW.10 - Estimates for VaR@97.5% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	**FRW_01**	**FRW_02**	**FRW_03**	**FRW_04**	**FRW_05**	**FRW_06**	**FRW_07**	**FRW_08**	**FRW_09**	**FRW_10**
One Region	-4975.8	-3664.0	-3135.1	-2654.6	-2419.0	-2298.2	-2093.8	-2018.9	-1855.2	-1779.5
Average										
Unconditional	-6426.3	-5106.8	-4390.3	-3791.2	-3421.6	-3191.7	-2968.1	-2754.8	-2622.8	-2457.1
Markov Regime Switching	-6611.0	-5113.5	-4390.1	-3802.7	-3428.5	-3219.0	-2979.2	-2760.3	-2627.7	-2462.1
Geometric Time in Tails	-5768.5	-4521.0	-3948.3	-3367.5	-3092.7	-2863.9	-2689.1	-2469.0	-2376.1	-2246.4
Standard Deviation										
Unconditional	898.1	667.8	548.3	475.0	422.7	395.9	362.2	340.1	323.2	302.4
Markov Regime Switching	1030.7	668.8	575.0	519.2	452.0	451.9	381.6	338.3	337.8	300.8
Geometric Time in Tails	1168.6	851.0	629.5	514.5	470.2	433.6	421.8	419.2	438.6	367.1

Table AU.10 - Estimates for VaR@97.5% for Australia										
Portfolio Number	**AU_01**	**AU_02**	**AU_03**	**AU_04**	**AU_05**	**AU_06**	**AU_07**	**AU_08**	**AU_09**	**AU_10**
One Region	-27579.7	-24133.5	-26919.8	-24704.9	-24104.4	-23055.6	-21847.2	-21031.8	-20753.9	-19841.2
Average										
Unconditional	-39542.8	-33182.9	-52626.6	-50878.8	-49580.6	-48208.1	-46966.8	-46073.0	-44113.5	-40324.6
Markov Regime Switching	-40564.5	-33544.9	-54257.2	-52245.1	-50982.1	-49573.0	-48450.2	-47473.7	-45338.7	-41493.3
Geometric Time in Tails	-37100.9	-31499.2	-49883.5	-46997.0	-46018.1	-44940.7	-44784.6	-43759.9	-41103.7	-38159.8
Standard Deviation										
Unconditional	5041.6	4071.4	6814.4	6571.4	6359.1	6192.9	5983.4	5864.0	5613.2	5129.2
Markov Regime Switching	5405.3	4618.6	7765.9	7357.2	6783.2	6606.5	6610.1	6676.5	6273.9	5629.6
Geometric Time in Tails	7526.1	5617.4	7444.6	6569.6	7476.3	7270.4	7413.9	6413.1	6524.6	5970.2

Table CA.10 - Estimates for VaR@97.5% for Canada

Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
One Region	-26929.4	-26601.9	-22421.6	-21121.7	-20116.2	-19372.6	-17546.6	-16598.0	-17936.7	-17869.0
Average										
Unconditional	-35486.6	-36170.6	-30446.3	-29371.4	-28424.4	-27294.4	-25588.8	-23295.2	-26851.0	-26783.0
Markov Regime Switching	-36483.4	-37243.4	-31713.2	-30147.8	-29342.7	-28091.7	-26303.9	-23738.7	-27827.4	-27416.0
Geometric Time in Tails	-32882.3	-34267.9	-27835.1	-27530.3	-27186.3	-25700.7	-23398.4	-21629.2	-25503.0	-25072.8
Standard Deviation										
Unconditional	4426.0	4375.0	3746.4	3753.1	3650.9	3501.0	3275.0	3024.3	3555.5	3536.6
Markov Regime Switching	5098.4	5103.5	4802.2	4285.2	4024.5	3877.8	3626.7	3286.0	4190.2	3920.1
Geometric Time in Tails	5272.8	4947.1	4055.2	4290.8	5092.8	5070.1	3392.0	3749.9	4397.0	4459.2

Table DE.10 - Estimates for VaR@97.5% for Germany

Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
One Region	-39422.4	-34098.5	-31039.1	-28605.2	-27208.0	-26078.8	-25696.6	-25588.4	-25136.5	-25702.8
Average										
Unconditional	-54028.8	-49724.9	-48449.8	-43876.6	-42012.3	-40547.2	-40514.6	-40352.5	-39700.4	-40293.6
Markov Regime Switching	-56118.3	-51315.4	-51230.6	-45154.3	-43504.2	-41985.6	-42538.2	-41712.4	-41392.7	-42769.6
Geometric Time in Tails	-51198.4	-48410.9	-44662.8	-41379.7	-39434.0	-37876.4	-37816.7	-37289.5	-37092.6	-37079.8
Standard Deviation										
Unconditional	6902.8	6297.3	6375.1	5703.9	5390.4	5216.0	5212.3	5202.1	5094.9	5147.2
Markov Regime Switching	8210.7	7045.9	8450.9	7009.1	6693.2	6481.6	6717.8	5961.2	6548.7	6765.3
Geometric Time in Tails	7446.5	6963.5	5917.5	5412.5	4823.5	4846.8	5632.6	4471.7	4536.3	5278.3

Table HK.10 - Estimates for VaR@97.5% for Hong Kong

Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
One Region	-34552.1	-35602.0	-33889.2	-35299.3	-36044.7	-33342.9	-31590.8	-30778.2	-31993.9	-32330.2
Average										
Unconditional	-45346.7	-54252.4	-50772.3	-52448.8	-53649.9	-51162.8	-49403.7	-45478.5	-46931.1	-47323.2
Markov Regime Switching	-46450.2	-55928.4	-52343.2	-53964.0	-55403.9	-52576.9	-50921.1	-47277.9	-48885.1	-48864.6
Geometric Time in Tails	-41579.2	-51363.6	-46350.8	-49154.4	-49849.7	-47503.2	-46204.9	-42199.2	-43248.5	-43310.4
Standard Deviation										
Unconditional	5945.3	7086.9	6667.2	6862.3	7054.8	6780.4	6567.4	6126.8	6282.5	6353.5
Markov Regime Switching	6457.5	7866.7	7601.8	7406.8	7811.0	7603.2	7604.8	7189.8	7777.0	7131.7
Geometric Time in Tails	5245.5	7607.4	5613.4	8009.8	6514.0	5853.0	5701.9	7323.3	6170.3	6596.8

Table JP.10 - Estimates for VaR@97.5% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-41501.8	-37335.4	-36137.8	-35564.2	-31958.0	-31010.9	-35671.1	-31202.8	-31761.0	-31895.7
Average										
Unconditional	-50250.9	-46212.9	-45268.9	-44554.4	-39527.7	-39106.8	-38881.8	-39010.8	-39047.2	-38901.1
Markov Regime Switching	-51048.9	-47407.5	-46558.5	-45831.4	-40497.9	-40180.4	-40139.5	-40038.5	-40108.3	-40030.3
Geometric Time in Tails	-46890.9	-43611.8	-41777.9	-41668.2	-37135.5	-36646.0	-36124.2	-36131.3	-36094.5	-35798.2
Standard Deviation										
Unconditional	6331.6	5751.5	5584.6	5462.9	4850.1	4847.0	4814.5	4832.7	4832.4	4823.8
Markov Regime Switching	7464.8	6961.2	6139.8	6199.3	5942.8	5888.3	5322.3	5284.0	5192.5	5359.1
Geometric Time in Tails	5947.6	5583.3	5793.1	5340.9	4426.0	4626.7	5032.4	4958.2	5068.1	5157.7

Table SG.10 - Estimates for VaR@97.5% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-37753.6	-33606.7	-31018.9	-28169.1	-28163.1	-28800.6	-27735.4	-28111.8	-26569.1	-26554.6
Average										
Unconditional	-50078.6	-44082.3	-40812.3	-35048.3	-35146.8	-39204.0	-38301.6	-38301.4	-36418.5	-35894.8
Markov Regime Switching	-52211.8	-47145.2	-43461.3	-38280.3	-38179.4	-41895.8	-40951.1	-40938.9	-38717.2	-38284.9
Geometric Time in Tails	-46699.5	-40685.3	-38292.3	-32377.1	-32457.9	-35916.2	-34623.6	-34702.5	-32584.2	-31911.8
Standard Deviation										
Unconditional	6382.1	5800.4	5370.6	4747.7	4767.0	5215.9	5097.8	5088.3	4797.6	4820.7
Markov Regime Switching	7313.2	7733.3	7181.2	6230.9	6303.9	7164.9	6950.9	6985.2	6506.3	6848.1
Geometric Time in Tails	5221.8	5892.5	5042.1	4249.7	4007.5	5143.0	5284.4	5241.9	5043.0	4923.5

Table SE.10 - Estimates for VaR@97.5% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-57158.4	-42007.9	-35737.2	-32858.3	-31880.6	-30001.3	-31284.4	-29849.9	-29584.7	-30007.6
Average										
Unconditional	-83193.7	-52234.3	-47677.2	-46572.1	-45677.6	-45248.7	-45543.9	-45135.1	-44509.5	-44410.4
Markov Regime Switching	-88867.5	-54046.1	-49545.6	-49368.4	-48221.3	-47948.1	-48322.8	-47992.1	-47386.2	-47636.1
Geometric Time in Tails	-76853.8	-48131.6	-43703.6	-42504.6	-41251.6	-41032.0	-40892.7	-41116.9	-40558.7	-40338.1
Standard Deviation										
Unconditional	10702.3	6772.6	6232.8	6121.9	5979.6	5912.2	5912.7	5877.0	5839.9	5762.4
Markov Regime Switching	13421.1	7834.9	7208.8	8147.2	7700.4	7676.5	7867.9	7864.3	7870.9	7709.6
Geometric Time in Tails	9937.3	6859.9	6480.3	6595.3	6621.0	6109.1	6206.7	6649.8	6573.6	6567.7

Table CH.10 - Estimates for VaR@97.5% for Switzerland

Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
One Region	-28505.5	-22648.8	-22549.3	-21341.0	-22578.7	-22512.4	-23392.1	-23950.6	-23409.6	-23968.8
Average										
Unconditional	-37588.0	-33717.9	-32980.3	-31581.6	-31620.9	-31614.3	-31913.7	-32967.9	-32198.8	-32448.0
Markov Regime Switching	-38663.4	-34526.5	-34091.6	-33017.4	-33020.7	-33203.5	-33859.5	-35042.9	-34274.1	-33931.0
Geometric Time in Tails	-34679.6	-32321.5	-32174.5	-29953.1	-30570.3	-29233.4	-30017.3	-30787.4	-29915.3	-31211.1
Standard Deviation										
Unconditional	4812.8	4306.7	4208.1	4095.3	4083.9	4090.5	4170.7	4333.1	4256.0	4300.9
Markov Regime Switching	5313.5	4543.4	4732.5	5060.4	4931.9	5273.3	5465.7	5683.5	5694.3	5551.7
Geometric Time in Tails	5547.8	5860.8	5172.6	5869.4	5035.0	3934.9	3892.2	4516.9	3673.5	4677.2

Table UK.10 - Estimates for VaR@97.5% for United Kingdom

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
One Region	-33603.2	-27736.6	-26827.1	-24694.2	-23338.0	-22173.2	-21918.0	-21588.5	-21293.0	-21919.7
Average										
Unconditional	-45560.0	-40672.4	-36506.0	-35215.7	-33077.3	-31629.1	-30870.9	-30627.2	-30723.8	-31022.5
Markov Regime Switching	-46345.8	-41398.8	-37398.0	-36195.8	-33870.1	-32484.6	-31611.8	-31510.9	-31606.0	-31985.4
Geometric Time in Tails	-40988.9	-37351.8	-33201.4	-32262.5	-31567.7	-29244.5	-28617.4	-28465.7	-28935.6	-28850.9
Standard Deviation										
Unconditional	5691.5	5016.0	4574.3	4443.1	4139.0	4009.2	3885.4	3843.1	3868.0	3913.6
Markov Regime Switching	6307.2	5494.2	5111.1	5043.2	4307.9	4871.9	4710.8	4500.4	4546.8	4422.5
Geometric Time in Tails	5761.5	5418.4	5012.3	4692.8	4825.5	3623.1	3760.6	3331.9	3873.1	3336.4

Table US.10 - Estimates for VaR@97.5% for United States

Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
One Region	-34618.8	-26262.7	-25976.4	-28143.7	-26296.5	-25398.5	-25024.4	-24940.3	-23935.9	-23784.4
Average										
Unconditional	-46685.8	-36655.9	-35940.1	-47922.3	-44185.4	-41082.1	-39586.4	-40266.1	-38785.0	-38074.4
Markov Regime Switching	-47650.7	-37656.3	-36816.2	-48679.5	-45169.4	-42207.6	-40543.7	-40941.1	-39477.8	-38784.8
Geometric Time in Tails	-44584.6	-33277.5	-33271.7	-44963.0	-40956.7	-37407.0	-35987.3	-37148.4	-35726.5	-35156.0
Standard Deviation										
Unconditional	5837.5	4654.1	4493.1	6082.9	5592.3	5151.2	4964.5	5084.0	4896.6	4812.8
Markov Regime Switching	6109.8	5176.5	4886.4	7214.9	6082.9	5697.5	5605.3	5206.1	5261.1	5046.3
Geometric Time in Tails	6342.5	4857.4	4552.4	5743.3	5722.0	5546.8	5157.0	7489.1	7130.2	5925.6

Appendix.23 – VaR Estimates @99% for all Portfolios

Table GBM.11 - Estimates for VaR@99% for Simulated Geometric Brownian Motion										
Portfolio Number	**GBM_01**	**GBM_02**	**GBM_03**	**GBM_04**	**GBM_05**	**GBM_06**	**GBM_07**	**GBM_08**	**GBM_09**	**GBM_10**
One Region	-6241.1	-4484.3	-3689.3	-3140.0	-2868.3	-2496.5	-2323.8	-2187.3	-2063.4	-1997.5
Average										
Unconditional	-13163.0	-9417.4	-7937.8	-6717.3	-5940.8	-5389.4	-5016.3	-4713.9	-4443.4	-4203.4
Markov Regime Switching	-13374.2	-9373.7	-7914.8	-6668.1	-5912.6	-5441.3	-5007.8	-4739.3	-4410.1	-4223.7
Geometric Time in Tails	-12230.0	-8661.8	-7162.9	-6168.8	-5488.0	-4894.8	-4624.7	-4351.5	-4073.9	-3961.2
Standard Deviation										
Unconditional	1366.7	974.5	851.6	701.7	614.4	571.3	523.9	498.4	467.0	428.2
Markov Regime Switching	1701.1	915.8	776.8	656.8	577.4	586.0	538.2	491.6	436.8	372.4
Geometric Time in Tails	1931.0	1331.4	1116.9	989.7	879.4	692.8	712.3	686.8	641.1	654.4

Table FRW.11 - Estimates for VaR@99% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	**FRW_01**	**FRW_02**	**FRW_03**	**FRW_04**	**FRW_05**	**FRW_06**	**FRW_07**	**FRW_08**	**FRW_09**	**FRW_10**
One Region	-7313.8	-5584.8	-4584.8	-3779.1	-3540.7	-3183.0	-2821.7	-2632.4	-2415.7	-2311.8
Average										
Unconditional	-12721.4	-9538.8	-7995.3	-6918.0	-6164.5	-5788.2	-5317.3	-4975.2	-4719.5	-4423.1
Markov Regime Switching	-13218.8	-9649.9	-7950.0	-6984.1	-6207.1	-5839.3	-5363.1	-4989.3	-4695.1	-4435.6
Geometric Time in Tails	-11493.4	-8632.9	-7405.1	-6366.7	-5726.1	-5269.9	-4881.7	-4458.5	-4233.5	-4023.6
Standard Deviation										
Unconditional	1792.4	1208.5	975.6	847.0	734.4	701.2	628.7	597.5	561.3	527.2
Markov Regime Switching	2432.5	1243.0	927.6	820.9	746.5	696.6	624.5	584.7	524.7	515.9
Geometric Time in Tails	2441.4	1647.9	1335.7	1211.5	1072.5	918.0	823.8	750.4	679.2	760.9

Table AU.11 - Estimates for VaR@99% for Australia										
Portfolio Number	**AU_01**	**AU_02**	**AU_03**	**AU_04**	**AU_05**	**AU_06**	**AU_07**	**AU_08**	**AU_09**	**AU_10**
One Region	-34761.5	-30327.2	-34471.7	-31220.3	-29525.2	-28964.7	-27345.8	-26221.7	-25882.9	-24757.5
Average										
Unconditional	-73387.0	-59718.7	-98737.8	-95182.7	-92321.5	-89863.9	-87199.0	-85433.2	-81832.0	-74750.9
Markov Regime Switching	-74808.5	-60374.1	-102149.	-98599.3	-95552.0	-93014.8	-90428.8	-88319.9	-84816.6	-77778.8
Geometric Time in Tails	-70431.3	-57303.6	-90857.4	-86256.5	-84314.4	-82973.2	-81099.7	-79743.1	-74328.3	-69551.6
Standard Deviation										
Unconditional	9313.5	7130.2	12770.1	12233.8	11773.2	11481.5	11085.9	10830.4	10387.7	9472.3
Markov Regime Switching	9344.5	7086.8	14558.9	13490.5	12592.5	12282.2	12271.3	12329.7	11562.6	10591.1
Geometric Time in Tails	17149.3	9667.7	16391.4	16028.6	15220.3	16089.7	15149.5	14818.2	13603.4	12846.4

Table CA.11 - Estimates for VaR@99% for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_07**	**CA_08**	**CA_09**	**CA_10**
One Region	-34059.0	-33981.3	-30165.7	-29153.4	-26994.0	-25296.2	-22437.1	-21203.1	-22428.1	-22361.4
Average										
Unconditional	-64530.3	-64386.9	-54858.8	-54333.4	-52793.1	-50662.3	-47435.7	-43675.2	-51056.4	-50866.4
Markov Regime Switching	-66276.3	-66682.9	-56376.0	-56073.5	-54581.1	-52279.4	-49188.7	-44389.3	-52612.8	-52437.7
Geometric Time in Tails	-60838.2	-59971.9	-50675.9	-51551.5	-50951.1	-48368.6	-43423.3	-41093.9	-47487.7	-47418.9
Standard Deviation										
Unconditional	7847.3	7516.7	6558.6	6818.4	6675.4	6401.1	5981.7	5625.6	6735.8	6703.4
Markov Regime Switching	8032.5	8569.7	6776.2	7652.4	7139.5	6892.6	6775.8	5491.0	6890.8	6878.8
Geometric Time in Tails	11425.0	10133.9	9338.3	9555.0	10030.0	11891.6	8737.1	8174.1	9023.8	9480.6

Table DE.11 - Estimates for VaR@99% for Germany										
Portfolio Number	**DE_01**	**DE_02**	**DE_03**	**DE_04**	**DE_05**	**DE_06**	**DE_07**	**DE_08**	**DE_09**	**DE_10**
One Region	-52039.7	-45033.0	-46015.2	-39598.7	-36613.5	-34338.7	-35482.3	-34036.6	-32986.2	-34184.9
Average										
Unconditional	-99397.5	-91337.7	-91622.7	-81772.6	-77737.5	-75218.9	-75286.2	-75189.2	-73687.3	-74619.6
Markov Regime Switching	-102910	-93971.0	-95222.5	-84672.6	-80462.7	-77872.1	-76999.5	-78257.3	-76219.3	-77603.0
Geometric Time in Tails	-93726.9	-87430.8	-84243.6	-76854.4	-73100.7	-70322.1	-69083.3	-67995.3	-68526.5	-68013.6
Standard Deviation										
Unconditional	12274.0	11307.1	11964.1	10342.2	9730.5	9466.1	9520.7	9567.9	9305.5	9396.3
Markov Regime Switching	13815.9	11503.5	12454.8	11777.2	10869.0	10578.9	10957.2	10710.4	9779.1	9761.7
Geometric Time in Tails	15520.5	14374.2	15654.4	12706.8	10881.4	10823.9	11443.6	10773.3	10587.5	11255.6

Table HK.11 - Estimates for VaR@99% for Hong Kong										
Portfolio Number	**HK_01**	**HK_02**	**HK_03**	**HK_04**	**HK_05**	**HK_06**	**HK_07**	**HK_08**	**HK_09**	**HK_10**
One Region	-46032.7	-47200.4	-46912.9	-47759.4	-49317.1	-44128.5	-41603.6	-39090.0	-41563.0	-41768.9
Average										
Unconditional	-85756.0	-102405	-96300.4	-99154.7	-101914	-97557.4	-94525.6	-87828.8	-90351.8	-91338.8
Markov Regime Switching	-88699.2	-105698	-99950.9	-102540	-105858	-101189	-97511.0	-90663.0	-94230.5	-94366.4
Geometric Time in Tails	-76964.6	-96869.5	-86455.7	-91617.7	-93870.5	-89885.7	-89471.2	-80198.6	-82414.0	-82788.8
Standard Deviation										
Unconditional	11230.6	13379.1	12700.1	12994.7	13483.3	12962.5	12647.8	11927.5	12227.7	12418.4
Markov Regime Switching	12552.0	14192.9	14722.1	12944.7	14975.1	14334.2	15166.5	12340.5	14170.3	12792.4
Geometric Time in Tails	12610.2	17288.2	14020.3	17954.0	16910.8	16538.0	16099.3	14666.3	15114.0	15338.2

Table JP.11 - Estimates for VaR@99% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-58371.8	-50527.2	-48637.2	-45874.7	-41166.7	-42463.4	-49164.7	-41455.4	-41727.9	-41572.5
Average										
Unconditional	-91903.4	-83880.8	-81597.0	-80015.7	-71040.7	-70801.4	-70352.4	-70690.8	-70640.4	-70436.8
Markov Regime Switching	-94032.4	-86107.6	-84259.1	-82544.9	-72812.8	-72550.3	-72770.7	-72743.2	-72851.5	-72650.2
Geometric Time in Tails	-86915.6	-79184.6	-74882.1	-74846.5	-65543.9	-66460.1	-64671.8	-64673.5	-65895.2	-65977.2
Standard Deviation										
Unconditional	11277.0	10161.3	9746.0	9497.0	8446.1	8539.1	8476.3	8552.5	8510.6	8494.7
Markov Regime Switching	12324.5	11121.7	10839.2	10935.8	10002.0	10245.2	9134.9	9347.4	8450.5	8420.1
Geometric Time in Tails	14880.3	12580.5	12563.8	12258.5	10412.6	10478.3	11454.8	11267.8	12230.1	11854.8

Table SG.11 - Estimates for VaR@99% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-51634.0	-46188.3	-44830.9	-37677.2	-36004.0	-38447.0	-38627.7	-37737.3	-35199.8	-36507.1
Average										
Unconditional	-92810.7	-83519.1	-77399.8	-67869.0	-68045.8	-74916.5	-73228.7	-73181.4	-69204.3	-69138.0
Markov Regime Switching	-95882.4	-87716.4	-80828.9	-71974.1	-72396.1	-78702.9	-76857.7	-76658.4	-73041.1	-71790.9
Geometric Time in Tails	-90136.4	-75878.4	-73768.7	-64585.6	-66042.9	-70433.8	-67359.6	-67008.9	-62007.2	-62519.1
Standard Deviation										
Unconditional	11734.9	10963.2	10187.1	9244.3	9254.1	9983.1	9768.7	9759.4	9151.1	9345.2
Markov Regime Switching	12450.8	11216.0	11270.9	10179.0	10257.5	10416.1	10003.1	11700.6	10230.1	10027.8
Geometric Time in Tails	14137.2	14321.7	13788.2	12293.0	11922.5	12906.0	15139.6	14423.7	11763.4	11547.2

Table SE.11 - Estimates for VaR@99% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-83013.3	-56958.1	-48789.4	-43359.6	-41486.3	-38716.3	-41509.9	-40697.6	-39457.0	-38705.9
Average										
Unconditional	-154595	-97839.7	-89677.1	-87991.4	-86068.0	-85051.3	-85468.1	-84753.6	-83908.9	-83227.4
Markov Regime Switching	-161335	-101340	-93553.8	-90875.6	-89344.9	-87724.0	-88258.6	-87774.2	-87245.6	-86592.9
Geometric Time in Tails	-143460	-89528.6	-81783.9	-79705.7	-78803.6	-77627.8	-77721.6	-76221.5	-76907.0	-74834.2
Standard Deviation										
Unconditional	19551.8	12581.2	11593.0	11469.6	11170.0	10978.3	11037.9	10939.1	10885.5	10711.5
Markov Regime Switching	20911.0	14548.0	13194.4	12488.6	11745.2	11918.2	11943.8	11868.9	11459.3	11296.1
Geometric Time in Tails	21263.3	16811.5	14804.6	14118.1	14291.0	13680.3	13730.5	13913.1	13634.0	13569.3

Table CH.11 - Estimates for VaR@99% for Switzerland

Portfolio Number	**CH_01**	**CH_02**	**CH_03**	**CH_04**	**CH_05**	**CH_06**	**CH_07**	**CH_08**	**CH_09**	**CH_10**
One Region	-38126.4	-30176.8	-29618.9	-27996.2	-29985.4	-30799.1	-32332.7	-33624.1	-33248.9	-33697.5
Average										
Unconditional	-69633.8	-62277.3	-60756.4	-58769.3	-58686.1	-58963.9	-59920.0	-62317.9	-61099.5	-61818.5
Markov Regime Switching	-71772.0	-64250.7	-62773.8	-60425.7	-60286.0	-60315.3	-62395.0	-64946.3	-64033.8	-63888.8
Geometric Time in Tails	-63484.9	-59651.2	-59148.1	-56945.7	-56506.1	-54024.9	-56507.8	-58301.1	-56481.1	-57936.6
Standard Deviation										
Unconditional	8761.0	7782.3	7540.6	7415.2	7371.6	7502.2	7708.8	8134.7	8026.3	8193.2
Markov Regime Switching	8941.1	7901.0	7588.4	8423.7	7829.0	8634.8	8109.2	8562.7	8410.6	8584.1
Geometric Time in Tails	11248.4	10944.4	9620.7	10218.6	9365.4	9016.6	7574.9	10225.0	8950.8	10546.9

Table UK.11 - Estimates for VaR@99% for United Kingdom

Portfolio Number	**UK_01**	**UK_02**	**UK_03**	**UK_04**	**UK_05**	**UK_06**	**UK_07**	**UK_08**	**UK_09**	**UK_10**
One Region	-42062.3	-33990.5	-33963.8	-32175.4	-29964.3	-29213.6	-28669.6	-27763.0	-28426.2	-28610.6
Average										
Unconditional	-83008.5	-73323.2	-66694.0	-64564.1	-60478.9	-58292.6	-56608.2	-56085.9	-56413.3	-57099.4
Markov Regime Switching	-85195.4	-74125.8	-68016.3	-66613.8	-61573.9	-59746.6	-57477.5	-57269.7	-57830.1	-58922.2
Geometric Time in Tails	-75137.1	-68082.4	-62158.2	-60064.9	-59068.4	-56086.0	-54046.6	-54453.3	-54859.9	-55457.5
Standard Deviation										
Unconditional	10140.3	8764.2	8194.2	7972.1	7456.8	7282.7	7007.1	6931.6	7009.0	7133.3
Markov Regime Switching	11329.4	8575.1	7880.1	8963.7	7383.1	8514.3	8331.5	7994.5	8242.3	7527.6
Geometric Time in Tails	14668.6	11242.0	10721.0	11046.8	9356.7	9273.5	9654.2	8749.9	9036.7	9520.8

Table US.11 - Estimates for VaR@99% for United States

Portfolio Number	**US_01**	**US_02**	**US_03**	**US_04**	**US_05**	**US_06**	**US_07**	**US_08**	**US_09**	**US_10**
One Region	-42619.3	-32623.1	-32416.6	-34758.5	-34440.3	-33030.4	-32062.5	-32319.2	-31671.0	-30991.1
Average										
Unconditional	-84947.5	-67660.0	-65542.3	-88331.1	-81384.2	-75167.4	-72497.0	-73893.8	-71272.9	-70028.6
Markov Regime Switching	-87456.2	-69328.2	-67228.8	-89828.2	-83880.1	-77602.7	-74047.7	-75414.8	-71897.2	-71263.3
Geometric Time in Tails	-81026.1	-61667.7	-59887.3	-83413.8	-74091.7	-68678.3	-66381.9	-68384.4	-65687.4	-65590.7
Standard Deviation										
Unconditional	10756.9	8479.6	8024.2	11026.9	10161.7	9271.8	8965.7	9144.6	8856.5	8715.9
Markov Regime Switching	11069.2	8245.5	8946.4	12478.6	10977.5	10340.8	9182.1	9209.3	8869.4	8455.5
Geometric Time in Tails	15033.4	10605.4	10299.1	13205.2	13143.2	11828.7	11236.9	13989.2	13555.7	12496.2

Appendix.24 – ES Estimates @ 95% for all Portfolios

Table GBM.12 - Estimates for ES@95% for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
One Region	-5596.9	-4017.0	-3274.2	-2798.1	-2541.3	-2279.9	-2080.9	-1957.8	-1868.2	-1795.2
Average										
Unconditional	-10128.5	-7248.7	-6122.9	-5166.3	-4565.5	-4153.7	-3864.1	-3631.5	-3419.1	-3230.2
Markov Regime Switching	-10211.8	-7243.6	-6129.2	-5147.9	-4554.5	-4173.8	-3865.3	-3641.1	-3396.8	-3238.7
Geometric Time in Tails	-9663.9	-6889.0	-5771.6	-4879.2	-4378.0	-3934.3	-3668.9	-3463.1	-3239.6	-3094.0
Standard Deviation										
Unconditional	1058.1	753.5	676.0	544.7	473.5	449.3	407.8	391.0	364.1	327.3
Markov Regime Switching	1167.8	726.7	671.2	503.9	461.4	454.9	412.1	399.1	370.2	337.5
Geometric Time in Tails	1463.8	1015.4	923.6	781.8	646.7	598.6	557.8	548.6	490.4	480.1

Table FRW.12 - Estimates for ES@95% for Simulated Two Sided Symmetric Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
One Region	-6079.7	-4531.2	-3706.2	-3131.2	-2852.3	-2594.6	-2348.7	-2242.1	-2095.9	-1987.6
Average										
Unconditional	-10323.1	-7452.3	-6249.8	-5409.5	-4787.6	-4522.1	-4136.5	-3878.8	-3666.4	-3441.0
Markov Regime Switching	-10534.0	-7498.7	-6224.6	-5457.7	-4803.8	-4549.0	-4155.3	-3880.8	-3654.9	-3442.5
Geometric Time in Tails	-10163.4	-7105.6	-6059.2	-5164.5	-4569.3	-4336.0	-3970.5	-3683.2	-3492.9	-3311.4
Standard Deviation										
Unconditional	2085.0	1130.6	885.3	771.7	641.0	631.5	548.1	530.9	489.7	462.6
Markov Regime Switching	2262.7	1142.1	904.7	784.9	655.2	639.1	552.3	533.3	497.8	464.8
Geometric Time in Tails	3157.8	1628.8	1290.3	1172.5	866.5	956.1	836.7	749.8	678.4	633.7

Table AU.12 - Estimates for ES@95% for Australia

Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
One Region	-30609.7	-26310.3	-30586.0	-27707.8	-26800.3	-26235.4	-24677.8	-23928.2	-23501.9	-22390.1
Average										
Unconditional	-58024.9	-46551.5	-78378.1	-75366.4	-73000.7	-71083.5	-69038.1	-67559.9	-64767.2	-59115.1
Markov Regime Switching	-59565.0	-46907.8	-81150.6	-77056.5	-75326.1	-73365.2	-71341.4	-69872.6	-67023.7	-61334.2
Geometric Time in Tails	-58467.9	-46553.2	-79411.8	-73746.3	-71651.7	-70373.9	-68599.4	-68557.9	-63599.2	-58365.6
Standard Deviation										
Unconditional	9065.5	6302.1	12804.4	12098.3	11511.2	11258.0	10855.9	10537.8	10147.5	9214.7
Markov Regime Switching	9530.5	6166.2	14834.7	11911.0	11675.6	11440.0	11528.6	12224.7	11855.1	10752.8
Geometric Time in Tails	15053.0	9488.1	19087.5	18525.6	17217.7	17111.0	16307.3	15419.0	15473.0	13433.4

Table CA.12 - Estimates for ES@95% for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_07**	**CA_08**	**CA_09**	**CA_10**
One Region	-29925.4	-29302.7	-25044.1	-23987.9	-22934.6	-21434.9	-19379.3	-18307.0	-19793.6	-19758.0
Average										
Unconditional	-50387.5	-49994.6	-42738.7	-42657.4	-41522.9	-39854.5	-37312.5	-34545.2	-40604.2	-40478.5
Markov Regime Switching	-52069.5	-51642.5	-43823.4	-43288.8	-42918.2	-41094.4	-38667.8	-35233.6	-42233.5	-42588.3
Geometric Time in Tails	-49352.1	-48772.7	-40830.1	-43435.1	-42447.9	-39861.9	-35461.3	-34391.4	-40383.7	-40537.2
Standard Deviation										
Unconditional	7078.4	6451.4	5793.4	6424.6	6367.3	6105.3	5693.8	5553.7	6914.2	6889.0
Markov Regime Switching	8154.5	7577.6	6097.1	6127.0	6488.2	6264.2	6604.1	5744.1	7969.2	8674.6
Geometric Time in Tails	10765.7	9148.8	8756.4	8095.3	8627.8	9547.2	7905.8	8721.3	10271.0	10638.2

Table DE.12 - Estimates for ES@95% for Germany										
Portfolio Number	**DE_01**	**DE_02**	**DE_03**	**DE_04**	**DE_05**	**DE_06**	**DE_07**	**DE_08**	**DE_09**	**DE_10**
One Region	-43965.4	-37764.1	-36971.5	-33240.5	-31334.6	-29941.4	-29937.2	-29884.2	-29113.2	-29402.3
Average										
Unconditional	-77407.9	-71484.7	-72617.3	-63988.7	-60844.7	-58973.0	-59176.7	-59249.3	-57939.1	-58700.4
Markov Regime Switching	-79585.3	-74146.8	-74975.9	-65408.1	-62290.3	-60340.6	-61416.0	-61558.4	-59508.1	-60681.2
Geometric Time in Tails	-75685.0	-71241.0	-72547.0	-64321.8	-60835.0	-58813.5	-57379.7	-56590.6	-55932.2	-56221.8
Standard Deviation										
Unconditional	11125.1	10426.3	12032.5	9708.8	9059.7	8901.2	9063.3	9231.9	8857.0	8935.0
Markov Regime Switching	11683.9	12052.0	12014.3	9384.3	8721.5	8524.9	11176.6	10692.2	9116.9	9070.7
Geometric Time in Tails	13420.4	12279.0	14571.9	11712.6	10525.5	10374.0	11551.2	10290.7	10274.3	10627.8

Table HK.12 - Estimates for ES@95% for Hong Kong										
Portfolio Number	**HK_01**	**HK_02**	**HK_03**	**HK_04**	**HK_05**	**HK_06**	**HK_07**	**HK_08**	**HK_09**	**HK_10**
One Region	-39196.7	-40764.5	-38750.2	-40500.2	-41485.3	-38495.0	-36629.1	-35589.4	-36644.6	-37172.4
Average										
Unconditional	-68200.7	-81460.0	-76868.3	-78968.4	-81463.3	-77910.8	-75728.9	-70626.9	-72704.8	-73633.9
Markov Regime Switching	-69979.3	-83397.5	-80068.1	-81692.5	-84329.4	-79701.3	-78562.2	-73299.8	-75936.6	-77903.2
Geometric Time in Tails	-65104.6	-84589.1	-73592.8	-78641.6	-80780.5	-77826.2	-79413.7	-70265.5	-71582.1	-72591.1
Standard Deviation										
Unconditional	11455.7	13629.0	13196.6	13326.6	14116.4	13579.7	13476.2	13038.0	13358.5	13707.5
Markov Regime Switching	12029.4	13834.2	15199.4	13992.8	14833.3	13221.9	15572.3	15152.7	15821.4	17427.5
Geometric Time in Tails	13085.9	19994.0	15371.7	19762.7	21111.4	20609.0	19937.9	20419.4	20248.6	21424.8

Table JP.12 - Estimates for ES@95% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-47330.6	-42079.0	-40123.8	-39409.1	-35731.8	-35187.9	-40728.0	-35084.8	-35418.1	-35656.7
Average										
Unconditional	-71766.4	-65437.1	-63476.4	-62227.8	-55272.6	-55215.0	-54860.9	-55219.4	-55096.1	-54918.2
Markov Regime Switching	-73118.0	-66157.9	-65349.4	-64173.9	-55849.1	-56704.8	-56157.1	-56639.0	-56767.0	-56470.2
Geometric Time in Tails	-73032.6	-65918.1	-61320.7	-62218.9	-54559.8	-55295.3	-54181.1	-53981.6	-54846.4	-54612.9
Standard Deviation										
Unconditional	10251.6	9111.0	8566.0	8297.2	7398.6	7620.7	7556.6	7690.4	7591.4	7575.9
Markov Regime Switching	10591.1	8708.5	9355.8	9639.7	7294.2	8888.2	7793.5	7983.7	8018.1	8120.9
Geometric Time in Tails	14533.7	11925.8	12289.1	11408.7	8704.4	9915.9	10896.1	11316.1	11940.7	11952.1

Table SG.12 - Estimates for ES@95% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-43850.1	-39632.7	-37272.0	-32646.6	-32366.9	-34332.9	-33293.2	-33552.6	-31209.8	-31470.0
Average										
Unconditional	-73246.5	-66406.9	-61641.7	-54543.3	-54592.2	-59831.7	-58514.8	-58517.0	-55251.9	-55499.0
Markov Regime Switching	-75367.2	-69397.6	-64052.8	-56632.8	-57003.0	-62161.7	-60673.5	-60900.8	-57326.6	-57226.0
Geometric Time in Tails	-75238.6	-65928.9	-64333.6	-56546.5	-56812.6	-61710.3	-58580.8	-58509.7	-53428.4	-53775.5
Standard Deviation										
Unconditional	11316.8	11196.8	10486.0	10109.3	10047.4	10486.0	10289.1	10300.8	9537.8	10112.7
Markov Regime Switching	10343.0	10796.5	9397.9	8841.6	8906.8	9439.7	9243.6	9639.5	8920.2	9563.3
Geometric Time in Tails	15132.5	17163.9	15204.4	15746.5	14553.6	15087.4	16850.7	16494.8	14401.6	15492.3

Table SE.12 - Estimates for ES@95% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-67281.2	-47792.6	-40900.0	-36958.8	-35417.6	-33686.3	-35202.6	-34194.5	-33394.8	-33181.4
Average										
Unconditional	-121525	-77356.1	-70858.7	-69695.0	-68122.0	-67160.3	-67706.2	-67027.0	-66329.3	-65814.9
Markov Regime Switching	-125773	-80512.1	-73895.7	-71837.7	-70026.0	-69088.6	-69707.5	-68996.5	-68419.1	-68113.0
Geometric Time in Tails	-118531	-77628.1	-69221.3	-67412.6	-66520.9	-65130.1	-65419.3	-64797.7	-64648.3	-63527.7
Standard Deviation										
Unconditional	18618.2	12386.5	11443.2	11494.4	11124.9	10798.8	10978.1	10813.5	10792.4	10559.4
Markov Regime Switching	17153.2	14181.2	13155.3	12136.5	11003.6	11372.2	11256.0	11076.8	10728.4	10616.3
Geometric Time in Tails	19786.1	18816.2	17131.9	17208.5	16388.6	15886.4	16409.2	16183.4	16020.1	15776.9

Table CH.12 - Estimates for ES@95% for Switzerland										
Portfolio Number	**CH_01**	**CH_02**	**CH_03**	**CH_04**	**CH_05**	**CH_06**	**CH_07**	**CH_08**	**CH_09**	**CH_10**
One Region	-32463.9	-26285.6	-25987.2	-24745.1	-26215.6	-26613.5	-27516.1	-28149.8	-27386.7	-28010.2
Average										
Unconditional	-54696.4	-48795.9	-47460.6	-45979.8	-45886.9	-46385.4	-47221.7	-49406.6	-48502.6	-49285.0
Markov Regime Switching	-57273.3	-51004.9	-49445.8	-47576.9	-47437.5	-48178.0	-48859.0	-51248.2	-50467.9	-50770.3
Geometric Time in Tails	-53237.0	-49382.0	-47749.6	-45939.6	-45818.2	-44636.0	-46224.9	-48189.9	-47256.0	-48851.7
Standard Deviation										
Unconditional	8286.0	7259.9	6928.3	6942.9	6862.5	7198.5	7511.5	8187.4	8157.6	8514.4
Markov Regime Switching	10452.4	8980.5	8398.0	8369.6	8215.9	8865.8	7555.1	8102.0	8066.3	8850.5
Geometric Time in Tails	12224.6	10984.8	8714.1	10266.1	8586.0	8305.0	8628.0	9459.3	9498.4	10046.6

Table UK.12 - Estimates for ES@95% for United Kingdom										
Portfolio Number	**UK_01**	**UK_02**	**UK_03**	**UK_04**	**UK_05**	**UK_06**	**UK_07**	**UK_08**	**UK_09**	**UK_10**
One Region	-36484.8	-30582.5	-29041.8	-27763.5	-25850.0	-24838.5	-24466.6	-24058.7	-24355.0	-24515.5
Average										
Unconditional	-64913.9	-57066.3	-52235.1	-50545.0	-47477.6	-45818.1	-44417.8	-44030.2	-44344.2	-44971.9
Markov Regime Switching	-66291.4	-58052.7	-53447.6	-51579.6	-48337.4	-46375.1	-44845.7	-44492.4	-44961.1	-46083.5
Geometric Time in Tails	-60431.3	-56249.0	-50853.0	-49719.3	-48311.9	-47051.4	-44959.2	-44452.1	-45055.8	-45942.6
Standard Deviation										
Unconditional	9223.7	7717.7	7524.8	7342.0	6918.0	6860.2	6512.8	6444.3	6572.5	6762.9
Markov Regime Switching	10174.3	8060.1	7940.4	7356.7	6301.5	6534.6	6140.2	6002.8	6184.5	6286.9
Geometric Time in Tails	12405.5	11463.1	11370.1	9556.1	8540.6	9103.3	8351.8	7959.8	8753.2	9195.6

Table US.12 - Estimates for ES@95% for United States										
Portfolio Number	**US_01**	**US_02**	**US_03**	**US_04**	**US_05**	**US_06**	**US_07**	**US_08**	**US_09**	**US_10**
One Region	-38602.6	-29283.9	-28657.6	-30942.4	-29752.1	-28539.7	-27796.3	-27969.7	-27251.9	-26810.9
Average										
Unconditional	-66693.6	-53230.4	-51293.4	-69359.2	-63991.1	-58970.3	-56945.9	-57896.1	-55960.6	-55000.4
Markov Regime Switching	-69632.6	-54664.0	-52617.7	-70217.4	-65513.5	-60605.7	-58207.1	-59333.5	-56886.6	-56198.0
Geometric Time in Tails	-66088.7	-51382.5	-49814.2	-70235.3	-61985.4	-56972.9	-54918.5	-55958.1	-53975.4	-53804.1
Standard Deviation										
Unconditional	9634.2	8033.8	7329.2	10347.4	9578.3	8587.6	8355.0	8459.3	8276.2	8163.9
Markov Regime Switching	12267.9	8677.3	7910.4	10878.4	10131.3	9424.5	9120.2	9433.9	9010.1	8698.8
Geometric Time in Tails	13606.1	11773.1	10531.1	13677.8	13798.7	12549.1	12052.4	13453.7	13029.8	12771.1

Appendix.25 - ES Estimates @ 97.5% for all Portfolios

Table GBM.13 - Estimates for ES@97.5% for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
One Region	-6363.8	-4552.5	-3739.7	-3159.6	-2884.6	-2568.7	-2378.0	-2237.5	-2126.7	-2051.5
Average										
Unconditional	-14272.3	-10203.6	-8703.4	-7293.6	-6428.8	-5885.0	-5452.1	-5141.9	-4834.5	-4529.7
Markov Regime Switching	-14421.7	-10216.0	-8732.7	-7281.6	-6428.8	-5922.6	-5452.5	-5156.4	-4806.9	-4557.0
Geometric Time in Tails	-13828.4	-9861.6	-8341.9	-6985.2	-6274.7	-5672.3	-5263.8	-4986.9	-4665.9	-4398.1
Standard Deviation										
Unconditional	1779.8	1266.0	1159.1	918.3	793.2	765.3	689.2	664.6	616.1	544.1
Markov Regime Switching	1917.5	1220.2	1145.4	844.8	770.5	768.7	694.6	668.0	615.8	554.3
Geometric Time in Tails	2483.0	1725.1	1632.2	1326.3	1099.5	1045.9	976.3	954.0	841.9	802.6

Table FRW.13 - Estimates for ES@97.5% for Simulated Symmetric Two Sided Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
One Region	-8209.7	-5954.5	-4728.8	-3956.5	-3613.4	-3215.1	-2877.1	-2759.3	-2560.8	-2426.5
Average										
Unconditional	-16013.6	-11160.7	-9232.7	-8000.5	-7024.3	-6664.4	-6051.1	-5701.6	-5375.8	-5047.4
Markov Regime Switching	-16389.2	-11255.3	-9197.0	-8110.4	-7064.4	-6717.9	-6092.5	-5721.3	-5363.3	-5064.3
Geometric Time in Tails	-16145.1	-10888.9	-9154.0	-7818.1	-6836.8	-6518.8	-5919.3	-5526.3	-5223.6	-4960.9
Standard Deviation										
Unconditional	3993.8	2079.7	1613.9	1408.4	1153.1	1148.4	985.3	961.0	880.6	833.7
Markov Regime Switching	4237.9	2089.5	1640.9	1427.1	1175.9	1162.8	995.7	961.1	885.0	833.9
Geometric Time in Tails	6095.0	3058.3	2407.7	2230.4	1623.6	1788.4	1547.8	1385.2	1243.3	1189.2

Table AU.13 - Estimates for ES@97.5% for Australia

Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
One Region	-36713.1	-31281.1	-37343.1	-33703.7	-32211.4	-31572.9	-29527.3	-28817.6	-28141.4	-26777.2
Average										
Unconditional	-86752.7	-68293.4	-117935	-113186	-109338	-106535	-103262	-100965	-96825.1	-88331.1
Markov Regime Switching	-89559.0	-69004.9	-122739	-115782	-113305	-110409	-107084	-104930	-100707	-92091.7
Geometric Time in Tails	-89561.1	-69619.6	-122603	-113148	-109565	-107752	-104612	-105052	-97023.9	-89055.7
Standard Deviation										
Unconditional	16842.4	11387.3	23944.3	22557.4	21408.0	20950.6	20196.2	19575.6	18867.8	17116.8
Markov Regime Switching	17497.1	11105.7	26525.8	21535.0	21429.7	20971.0	20598.4	21678.1	20969.1	19046.1
Geometric Time in Tails	27472.1	17288.6	37123.3	35315.8	32589.7	32331.7	31131.3	29820.8	29323.7	25660.7

Table CA.13 - Estimates for ES@97.5% for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_07**	**CA_08**	**CA_09**	**CA_10**
One Region	-35870.8	-35414.4	-30401.9	-29444.1	-28276.9	-26093.4	-23381.6	-22044.6	-24034.7	-24013.8
Average										
Unconditional	-74366.3	-72854.6	-62736.3	-63599.0	-62057.4	-59545.1	-55708.2	-51931.9	-61542.1	-61319.5
Markov Regime Switching	-77217.9	-75559.1	-64237.8	-64552.4	-64351.1	-61625.0	-58008.6	-53242.8	-64322.1	-65191.3
Geometric Time in Tails	-74271.6	-72276.8	-60816.4	-66513.2	-64963.5	-60750.0	-53518.2	-52799.4	-62525.5	-62788.4
Standard Deviation										
Unconditional	12878.3	11527.0	10466.1	11839.5	11771.6	11287.0	10520.9	10351.0	12990.6	12946.2
Markov Regime Switching	14111.7	12711.7	10045.8	11060.5	11766.4	11318.6	11647.8	10584.9	14290.5	15667.9
Geometric Time in Tails	19784.6	17053.6	16103.5	15406.0	16008.0	17291.7	14718.0	16320.2	19792.6	20231.2

Table DE.13 - Estimates for ES@97.5% for Germany										
Portfolio Number	**DE_01**	**DE_02**	**DE_03**	**DE_04**	**DE_05**	**DE_06**	**DE_07**	**DE_08**	**DE_09**	**DE_10**
One Region	-54055.3	-46528.9	-46713.2	-41536.7	-38959.5	-36744.6	-36860.5	-36847.3	-36063.1	-36276.3
Average										
Unconditional	-114931	-106120	-109692	-95737.2	-90685.2	-88038.0	-88455.7	-88726.0	-86555.6	-87592.5
Markov Regime Switching	-118089	-110538	-113047	-98058.9	-92985.3	-90230.4	-91838.5	-92671.6	-88815.2	-90336.7
Geometric Time in Tails	-114293	-107403	-112810	-98692.0	-92929.8	-90019.2	-87399.0	-86175.4	-85260.3	-85554.1
Standard Deviation										
Unconditional	20274.4	19099.8	22516.2	17875.4	16642.6	16395.8	16748.0	17116.8	16366.2	16506.2
Markov Regime Switching	19940.3	20979.5	20931.1	16497.1	15271.4	14989.5	19169.4	18840.4	15455.2	15358.8
Geometric Time in Tails	24939.9	22577.0	28105.1	22120.3	20039.5	19636.8	21603.7	19634.1	19843.1	20023.8

Table HK .13 - Estimates for ES@97.5% for Hong Kong										
Portfolio Number	**HK_01**	**HK_02**	**HK_03**	**HK_04**	**HK_05**	**HK_06**	**HK_07**	**HK_08**	**HK_09**	**HK_10**
One Region	-48474.5	-50211.9	-48233.5	-50562.1	-52028.2	-48252.9	-45773.9	-44633.6	-46007.5	-46729.6
Average										
Unconditional	-103078	-123001	-116421	-119357	-123505	-118333	-115277	-108082	-111099	-112696
Markov Regime Switching	-106140	-126065	-121964	-124137	-128308	-121050	-120198	-112604	-116545	-120391
Geometric Time in Tails	-100124	-131860	-113506	-121549	-125371	-121030	-125083	-110117	-112138	-113871
Standard Deviation										
Unconditional	21496.8	25568.5	24850.7	25034.1	26618.9	25609.8	25488.5	24760.9	25367.3	26070.4
Markov Regime Switching	22176.7	25318.4	27317.6	26111.1	27007.4	24247.0	28195.1	27623.4	28430.5	31971.0
Geometric Time in Tails	24984.5	38826.2	29495.3	37908.1	40739.0	39810.6	38890.7	39335.0	39496.4	41500.2

Table JP.13 - Estimates for ES@97.5% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-59822.2	-52087.9	-49419.2	-48442.9	-43888.0	-43554.2	-50324.8	-43136.3	-43497.8	-43649.9
Average										
Unconditional	-106254	-96466.9	-93178.4	-91154.9	-81004.9	-81278.3	-80729.6	-81344.4	-81071.2	-80844.3
Markov Regime Switching	-108789	-97407.7	-96363.5	-94398.6	-81718.7	-83820.3	-82734.8	-83767.7	-83909.5	-83461.5
Geometric Time in Tails	-111630	-99721.7	-91889.6	-93688.2	-81748.0	-83630.2	-81609.7	-81274.6	-82681.4	-82412.3
Standard Deviation										
Unconditional	18697.8	16544.2	15446.7	14928.7	13325.2	13816.3	13695.0	13977.4	13760.5	13731.4
Markov Regime Switching	18959.7	15328.7	16499.0	16442.2	12595.0	15242.7	13662.6	14250.9	14371.9	14464.8
Geometric Time in Tails	27751.3	22703.0	22923.1	21745.9	16074.4	18915.9	20487.6	21113.7	22182.3	22165.0

Table SG.13 - Estimates for ES@97.5% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-55302.3	-49995.1	-47748.1	-41852.9	-41186.4	-44037.7	-43009.6	-42998.4	-39955.4	-40256.1
Average										
Unconditional	-109397	-100459	-93322.1	-83574.8	-83619.2	-90975.7	-89003.5	-88987.1	-83765.3	-84795.5
Markov Regime Switching	-112724	-104681	-96612.5	-86155.4	-86794.6	-94149.6	-91912.4	-92173.2	-86618.7	-86925.0
Geometric Time in Tails	-116342	-102155	-100838	-89782.7	-90353.0	-97389.3	-92012.4	-92067.4	-83021.4	-84549.3
Standard Deviation										
Unconditional	20978.6	21016.2	19711.6	19200.2	19061.4	19784.5	19422.4	19451.6	17970.9	19175.3
Markov Regime Switching	18481.5	18787.2	16080.5	15547.8	15547.7	16350.7	15997.3	16495.9	15330.7	16590.2
Geometric Time in Tails	29582.9	32786.8	29449.9	30826.4	28846.2	29546.2	32672.7	32024.4	27721.8	29997.5

Table SE.13 - Estimates for ES@97.5% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-85427.6	-58882.0	-50313.6	-45262.1	-43617.8	-41483.0	-43673.3	-42479.3	-41507.0	-41246.9
Average										
Unconditional	-181654	-116225	-106688	-105220	-102688	-101072	-101856	-100842	-99992.7	-98913.4
Markov Regime Switching	-187382	-121598	-111801	-108125	-105267	-103539	-104506	-103418	-102725	-101941
Geometric Time in Tails	-181539	-120135	-106689	-104059	-103060	-100432	-101001	-99615.0	-99985.3	-97624.8
Standard Deviation										
Unconditional	34407.3	23071.8	21327.1	21492.7	20774.5	20110.9	20494.3	20160.4	20134.2	19674.7
Markov Regime Switching	29000.6	25163.6	23329.4	21105.0	19167.0	19673.5	19503.9	19156.0	18608.2	18359.4
Geometric Time in Tails	38827.0	36105.9	32695.0	33138.7	31178.9	30456.1	31429.3	30907.3	30520.3	30096.4

Table CH.13 - Estimates for ES@97.5% for Switzerland										
Portfolio Number	**CH_01**	**CH_02**	**CH_03**	**CH_04**	**CH_05**	**CH_06**	**CH_07**	**CH_08**	**CH_09**	**CH_10**
One Region	-40427.5	-32635.1	-32304.7	-30746.1	-32930.8	-33816.0	-35167.5	-35934.7	-35018.2	-36054.5
Average										
Unconditional	-81617.3	-72668.2	-70549.1	-68735.7	-68492.8	-69480.6	-71002.5	-74617.9	-73414.0	-74801.4
Markov Regime Switching	-86253.4	-76616.7	-73942.7	-71247.5	-70909.4	-72164.4	-73334.7	-77254.2	-76143.1	-76875.7
Geometric Time in Tails	-81105.3	-75015.8	-72319.3	-70045.5	-69724.1	-67934.2	-71008.6	-74024.6	-72880.1	-75393.6
Standard Deviation										
Unconditional	15285.2	13343.0	12678.3	12773.9	12606.0	13328.6	13959.4	15323.4	15297.6	16034.3
Markov Regime Switching	18426.9	15973.0	14574.1	14491.5	14261.1	15250.5	12934.8	14066.4	13965.5	15475.5
Geometric Time in Tails	23095.5	20175.5	15689.0	18896.1	15692.1	15541.5	16466.8	17934.2	18172.0	19232.1

Table UK.13 - Estimates for ES@97.5% for United Kingdom										
Portfolio Number	**UK_01**	**UK_02**	**UK_03**	**UK_04**	**UK_05**	**UK_06**	**UK_07**	**UK_08**	**UK_09**	**UK_10**
One Region	-43533.1	-36144.7	-35119.5	-33815.7	-31461.1	-30406.9	-29966.3	-29517.4	-30009.9	-30371.4
Average										
Unconditional	-95927.9	-83780.9	-77324.0	-74961.9	-70336.3	-68184.7	-65902.4	-65284.2	-65858.1	-66897.5
Markov Regime Switching	-98444.6	-85561.7	-79432.6	-76576.5	-71774.0	-68902.2	-66412.5	-65784.3	-66693.0	-68725.9
Geometric Time in Tails	-90273.4	-84544.0	-77039.1	-75580.2	-73472.3	-72591.7	-68771.0	-67834.0	-68876.3	-70558.7
Standard Deviation										
Unconditional	16826.2	13927.1	13766.9	13444.1	12694.5	12641.5	11957.5	11832.5	12096.6	12483.7
Markov Regime Switching	18169.1	14409.5	14378.8	12957.1	11720.8	11683.9	10958.2	10704.7	10952.6	11136.6
Geometric Time in Tails	23112.7	21341.0	21180.5	17917.6	16464.9	17492.1	15977.7	15375.2	16821.9	17976.4

Table US.13 - Estimates for ES@97.5% for United States										
Portfolio Number	**US_01**	**US_02**	**US_03**	**US_04**	**US_05**	**US_06**	**US_07**	**US_08**	**US_09**	**US_10**
One Region	-46767.1	-35266.9	-34425.8	-37217.6	-36082.2	-34485.2	-33348.9	-33834.7	-32966.6	-32481.9
Average										
Unconditional	-98693.8	-79292.7	-75846.9	-103208	-95202.4	-87387.2	-84444.9	-85918.8	-83133.9	-81750.1
Markov Regime Switching	-104046	-81729.9	-78193.5	-104814	-97784.8	-90055.2	-86565.4	-88503.8	-84817.3	-83879.2
Geometric Time in Tails	-99520.5	-78278.3	-75114.0	-107648	-94122.0	-86398.8	-83321.6	-84265.8	-81379.2	-81410.2
Standard Deviation										
Unconditional	17604.5	14826.2	13387.3	19048.1	17653.5	15750.8	15350.8	15510.1	15217.7	15020.9
Markov Regime Switching	21814.4	15746.8	14241.9	19679.6	18262.1	16513.8	16546.0	17181.2	16367.3	15817.2
Geometric Time in Tails	24751.5	22396.7	19946.2	26240.9	26348.5	23618.5	22882.0	24470.9	23833.6	23297.1

Appendix.26 – ES Estimates @ 99% for all Portfolios

Table GBM.14 - Estimates for ES@99% for Simulated Geometric Brownian Motion										
Portfolio Number	**GBM_01**	**GBM_02**	**GBM_03**	**GBM_04**	**GBM_05**	**GBM_06**	**GBM_07**	**GBM_08**	**GBM_09**	**GBM_10**
One Region	-7300	-5141	-4259	-3587	-3285	-2983	-2761	-2608	-2439	-2376
Average										
Unconditional	-20317	-14508	-12559	-10405	-9133	-8450	-7782	-7374	-6914	-6399
Markov Regime Switching	-20524	-14572	-12660	-10425	-9173	-8509	-7779	-7386	-6893	-6446
Geometric Time in Tails	-20412	-14546	-12495	-10267	-9228	-8462	-7749	-7394	-6933	-6377
Standard Deviation										
Unconditional	3760	2671	2496	1944	1669	1637	1463	1419	1309	1136
Markov Regime Switching	3848	2633	2469	1835	1646	1632	1465	1415	1304	1127
Geometric Time in Tails	5060	3504	3399	2643	2087	2185	1995	1955	1726	1546

Table FRW.14 - Estimates for ES@99% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	**FRW_01**	**FRW_02**	**FRW_03**	**FRW_04**	**FRW_05**	**FRW_06**	**FRW_07**	**FRW_08**	**FRW_09**	**FRW_10**
One Region	-11421	-8190	-6236	-5147	-4564	-4022	-3581	-3485	-3234	-3036
Average										
Unconditional	-26293	-17302	-14098	-12235	-10596	-10145	-9106	-8641	-8104	-7620
Markov Regime Switching	-26869	-17469	-14025	-12474	-10675	-10235	-9179	-8686	-8102	-7658
Geometric Time in Tails	-27854	-17625	-14609	-12508	-10683	-10389	-9309	-8750	-8238	-7799
Standard Deviation										
Unconditional	9562	4793	3688	3222	2602	2618	2222	2182	1987	1885
Markov Regime Switching	9740	4781	3751	3251	2647	2655	2256	2199	1986	1900
Geometric Time in Tails	14494	6917	5406	5006	3425	4039	3439	3076	2756	2566

Table AU.14 - Estimates for ES@99% for Australia										
Portfolio Number	**AU_01**	**AU_02**	**AU_03**	**AU_04**	**AU_05**	**AU_06**	**AU_07**	**AU_08**	**AU_09**	**AU_10**
One Region	-45839.8	-37868.5	-48183.8	-42643.3	-40311.8	-39508.5	-37172.2	-36976.9	-35944.1	-34141.5
Average										
Unconditional	-135204	-103255	-185508	-177415	-170745	-166519	-161135	-157295	-150977	-137592
Markov Regime Switching	-140051	-104416	-193483	-179873	-176478	-172128	-166488	-163772	-157134	-143285
Geometric Time in Tails	-146157	-109604	-203586	-184622	-178019	-175358	-169409	-172277	-157438	-143806
Standard Deviation										
Unconditional	39183.8	25807.5	56048.5	52656.1	49853.7	48818.3	47047.3	45538.3	43929.9	39816.6
Markov Regime Switching	40238.7	25523.1	58612.8	48227.1	49252.1	48231.8	46094.3	47498.8	45868.2	41761.7
Geometric Time in Tails	60896.6	38286.2	85695.2	80209.5	73798.6	72821.9	70393.2	68137.7	66265.2	58396.1

Table CA.14 - Estimates for ES@99% for Canada										
Portfolio Number	**CA_01**	**CA_02**	**CA_03**	**CA_04**	**CA_05**	**CA_06**	**CA_07**	**CA_08**	**CA_09**	**CA_10**
One Region	-44225.1	-43674.5	-37498.7	-37082.7	-35533.5	-32415.5	-28965.6	-27167.8	-29999.9	-30217.6
Average										
Unconditional	-113351	-108990	-94882.5	-98396.2	-96374.8	-92451.2	-86421.6	-81437.3	-97657.6	-97284.9
Markov Regime Switching	-117911	-113030	-96397.5	-98900.5	-99531.4	-95391.1	-90038.4	-83726.1	-102375	-104570
Geometric Time in Tails	-117730	-111467	-94659.3	-108867	-105715	-97876.6	-84892.9	-86736.2	-103108	-103947
Standard Deviation										
Unconditional	29377.6	25845.3	23715.0	27335.6	27260.2	26137.8	24351.9	24154.1	30541.9	30443.9
Markov Regime Switching	30234.3	26520.2	21281.2	24900.9	26825.4	25711.1	25361.3	24734.1	31804.4	35185.9
Geometric Time in Tails	44294.6	36827.7	36125.3	35329.3	36079.2	36909.2	33012.9	37309.0	45682.0	46164.9

Table DE.14 - Estimates for ES@99% for Germany										
Portfolio Number	**DE_01**	**DE_02**	**DE_03**	**DE_04**	**DE_05**	**DE_06**	**DE_07**	**DE_08**	**DE_09**	**DE_10**
One Region	-67206	-57809	-60165	-53908	-50909	-47716	-48052	-48235	-47341	-47251
Average										
Unconditional	-176098	-163075	-173110	-148403	-139989	-136290	-137344	-138249	-134334	-135810
Markov Regime Switching	-179400	-169927	-176550	-150801	-142370	-138608	-142518	-144639	-136715	-138669
Geometric Time in Tails	-180022	-169610	-187315	-159775	-149930	-145992	-139913	-138470	-136267	-136665
Standard Deviation										
Unconditional	46318	43850	52737	41234	38308	37837	38767	39745	37881	38197
Markov Regime Switching	42555	45261	46897	36632	33999	33559	40796	41161	33858	33510
Geometric Time in Tails	54081	48627	63468	48266	44422	43723	47285	44343	44207	44166

Table HK.14 - Estimates for ES@99% for Hong Kong										
Portfolio Number	**HK_01**	**HK_02**	**HK_03**	**HK_04**	**HK_05**	**HK_06**	**HK_07**	**HK_08**	**HK_09**	**HK_10**
One Region	-61799	-64562	-63125	-65461	-67450	-63246	-60098	-58831	-60488	-61412
Average										
Unconditional	-163082	-194430	-184978	-188995	-196593	-188622	-184498	-174270	-178932	-181968
Markov Regime Switching	-167387	-197527	-194389	-196695	-203543	-191181	-192994	-181513	-187958	-196460
Geometric Time in Tails	-164074	-221302	-187156	-200448	-208765	-201848	-213562	-186355	-188682	-192372
Standard Deviation										
Unconditional	50483	60030	58550	58847	62796	60422	60300	58804	60239	61999
Markov Regime Switching	51052	58225	60989	60804	61488	55146	63280	62329	63378	72840
Geometric Time in Tails	56980	90236	67592	87200	94523	92115	91588	91384	92662	96996

Table JP.14 - Estimates for ES@99% for Japan										
Portfolio Number	**JP_01**	**JP_02**	**JP_03**	**JP_04**	**JP_05**	**JP_06**	**JP_07**	**JP_08**	**JP_09**	**JP_10**
One Region	-75235	-65601	-61572	-61141	-54835	-54725	-63304	-54592	-54722	-54715
Average										
Unconditional	-162555	-146756	-140790	-137365	-122174	-123412	-122525	-123748	-123050	-122740
Markov Regime Switching	-166399	-146526	-145290	-142191	-121905	-127579	-124369	-127021	-127281	-126555
Geometric Time in Tails	-180587	-159289	-143645	-148140	-128578	-133316	-129805	-128738	-132079	-131693
Standard Deviation										
Unconditional	42753	37670	34940	33697	30106	31412	31126	31854	31280	31212
Markov Regime Switching	42920	33944	36359	34831	27226	32456	30131	31764	32313	32342
Geometric Time in Tails	62227	50914	50111	48176	33910	42436	45065	46134	48915	48840

Table SG.14 - Estimates for ES@99% for Singapore										
Portfolio Number	**SG_01**	**SG_02**	**SG_03**	**SG_04**	**SG_05**	**SG_06**	**SG_07**	**SG_08**	**SG_09**	**SG_10**
One Region	-72161	-65597	-64130	-55985	-55701	-60363	-58701	-58075	-54269	-54414
Average										
Unconditional	-170116	-159076	-148027	-134885	-134785	-145187	-142131	-142125	-133248	-136372
Markov Regime Switching	-173874	-163614	-150948	-135841	-137157	-147775	-144495	-144901	-135694	-137569
Geometric Time in Tails	-190873	-169475	-170114	-153952	-154650	-166228	-156689	-156396	-138112	-142781
Standard Deviation										
Unconditional	48705	49366	46366	45601	45224	46699	45864	45949	42363	45472
Markov Regime Switching	42435	42309	35910	35067	34863	36928	36174	36837	34120	37123
Geometric Time in Tails	69796	74750	67917	72476	69197	68969	74596	73201	63962	69722

Table SE.14 - Estimates for ES@99% for Sweden										
Portfolio Number	**SE_01**	**SE_02**	**SE_03**	**SE_04**	**SE_05**	**SE_06**	**SE_07**	**SE_08**	**SE_09**	**SE_10**
One Region	-110083	-74473	-63705	-57262	-54913	-52827	-55705	-54147	-52847	-52388
Average										
Unconditional	-282070	-182108	-167486	-165894	-161570	-158533	-159995	-158260	-157226	-155048
Markov Regime Switching	-286353	-190848	-175631	-168482	-163768	-160612	-162120	-160322	-159529	-157722
Geometric Time in Tails	-294363	-199230	-174451	-170683	-169820	-163756	-165526	-162541	-163845	-159223
Standard Deviation										
Unconditional	79648	53807	49765	50305	48564	46893	47896	47057	47024	45897
Markov Regime Switching	64116	55587	51448	46001	42561	42757	42615	41970	41227	40418
Geometric Time in Tails	90714	82179	74357	75910	71518	69828	71637	70408	69738	68440

Table CH.14 - Estimates for ES@99% for Switzerland										
Portfolio Number	**CH_01**	**CH_02**	**CH_03**	**CH_04**	**CH_05**	**CH_06**	**CH_07**	**CH_08**	**CH_09**	**CH_10**
One Region	-52224	-42662	-42723	-40447	-43800	-45478	-47727	-48159	-46948	-48765
Average										
Unconditional	-126430	-112147	-108447	-106437	-105842	-108184	-111132	-117756	-116212	-119032
Markov Regime Switching	-135013	-119194	-113912	-110271	-109391	-112310	-113603	-120604	-119015	-121299
Geometric Time in Tails	-130476	-120599	-114152	-111657	-110794	-109020	-114654	-120399	-119577	-123678
Standard Deviation										
Unconditional	35324	30728	29078	29446	29016	30909	32484	35895	35901	37779
Markov Regime Switching	40435	35312	31711	30918	30356	32547	28455	31305	31179	34488
Geometric Time in Tails	51859	44783	33837	41794	33971	34565	37323	40487	41199	43515

Table UK.14 - Estimates for ES@99% for United Kingdom										
Portfolio Number	**UK_01**	**UK_02**	**UK_03**	**UK_04**	**UK_05**	**UK_06**	**UK_07**	**UK_08**	**UK_09**	**UK_10**
One Region	-52929	-44390	-43082	-42306	-39245	-38604	-37780	-37412	-38540	-38651
Average										
Unconditional	-146572	-126650	-118492	-115086	-108036	-105346	-101369	-100374	-101525	-103437
Markov Regime Switching	-150193	-129637	-121675	-116772	-109596	-105280	-101134	-100018	-101583	-105580
Geometric Time in Tails	-140963	-134423	-123369	-121322	-118480	-119114	-111947	-109566	-111021	-115320
Standard Deviation										
Unconditional	38480	31524	31570	30854	29192	29186	27511	27225	27895	28867
Markov Regime Switching	40375	32744	32799	28389	27650	26195	24547	24260	24807	25283
Geometric Time in Tails	51337	47758	48013	40253	38831	40005	37136	36048	38568	42273

Table US.14 - Estimates for ES@99% for United States										
Portfolio Number	**US_01**	**US_02**	**US_03**	**US_04**	**US_05**	**US_06**	**US_07**	**US_08**	**US_09**	**US_10**
One Region	-59434.0	-44863.6	-42747.8	-46133.8	-45151.3	-42752.9	-41253.7	-42101.8	-41480.5	-40708.2
Average										
Unconditional	-151203	-122709	-116026	-159345	-147074	-134215	-129896	-132070	-128107	-126073
Markov Regime Switching	-160859	-126423	-119587	-161359	-150560	-137757	-132828	-136361	-131061	-129464
Geometric Time in Tails	-157421	-125618	-118863	-175286	-150729	-137904	-132841	-132731	-128718	-129213
Standard Deviation										
Unconditional	40267.8	34277.8	30652.3	43934.0	40763.4	36204.4	35342.5	35639.2	35061.3	34629.1
Markov Regime Switching	47762.8	35810.4	31900.4	44645.7	41219.1	36121.3	37438.9	38811.5	36858.7	36021.1
Geometric Time in Tails	52160.9	50584.2	44600.3	60079.2	59568.6	52581.0	51610.1	52676.9	51781.2	50505.4

Appendix.27 – Ratio for Average Risk Measurements of VaR @ 95% for all Portfolios

Table GBM.15 - Ratio for Average Risk Measurements of VaR@95% for Simulated Geometric Brownian Motion										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	1.0330	1.0195	1.0445	1.0151	1.0078	0.9924	1.0293	1.0245	1.0169	1.0385
Ratio of 3 State Markov Chain/One Region	1.0389	1.0213	1.0453	1.0150	1.0071	0.9943	1.0276	1.0241	1.0123	1.0388
Ratio of Geometric Time in Tail/One Region	0.9835	0.9658	0.9870	0.9615	0.9556	0.9377	0.9761	0.9732	0.9584	0.9929
Ratio of 3 State Markov Chain/Unconditional	1.0057	1.0017	1.0007	0.9999	0.9993	1.0019	0.9984	0.9996	0.9955	1.0003
Ratio of Unconditional/Geometric Time in Tail	1.0503	1.0556	1.0583	1.0558	1.0546	1.0583	1.0545	1.0527	1.0610	1.0459
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0563	1.0574	1.0591	1.0557	1.0539	1.0603	1.0528	1.0523	1.0562	1.0462

Table FRW.15 - Ratio for Average Risk Measurements of VaR@95% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	1.0160	1.0123	1.0284	1.0274	1.0112	1.0273	1.0255	0.9946	1.0013	0.9924
Ratio of 3 State Markov Chain/One Region	1.0251	1.0150	1.0324	1.0354	1.0196	1.0391	1.0323	0.9923	0.9971	0.9900
Ratio of Geometric Time in Tail/One Region	0.9628	0.9498	0.9743	0.9668	0.9547	0.9739	0.9728	0.9370	0.9440	0.9349
Ratio of 3 State Markov Chain/Unconditional	1.0089	1.0026	1.0038	1.0079	1.0083	1.0116	1.0067	0.9976	0.9958	0.9976
Ratio of Unconditional/Geometric Time in Tail	1.0553	1.0659	1.0555	1.0626	1.0592	1.0548	1.0542	1.0615	1.0607	1.0615
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0647	1.0687	1.0596	1.0710	1.0680	1.0670	1.0612	1.0590	1.0563	1.0589

Table AU.15 - Ratio for Average Risk Measurements of VaR@95% for Australia										
Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	0.9728	0.9411	1.3123	1.3847	1.3866	1.3740	1.4175	1.4467	1.3925	1.3497
Ratio of 3 State Markov Chain/One Region	0.9901	0.9439	1.3458	1.4194	1.4193	1.4071	1.4554	1.4843	1.4251	1.3828
Ratio of Geometric Time in Tail/One Region	0.9288	0.9101	1.2570	1.3156	1.3216	1.3112	1.3571	1.3887	1.3282	1.2879
Ratio of 3 State Markov Chain/Unconditional	1.0177	1.0029	1.0255	1.0251	1.0236	1.0241	1.0267	1.0260	1.0234	1.0245
Ratio of Unconditional/Geometric Time in Tail	1.0474	1.0341	1.0440	1.0525	1.0492	1.0479	1.0445	1.0418	1.0484	1.0480
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0660	1.0371	1.0706	1.0789	1.0739	1.0732	1.0724	1.0689	1.0729	1.0737

Table CA.15 - Ratio for Average Risk Measurements of VaR@95% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	0.9080	0.9715	0.9551	0.9441	0.9803	0.9885	1.0275	0.9708	1.0353	1.0362
Ratio of 3 State Markov Chain/One Region	0.9259	0.9971	0.9881	0.9659	1.0073	1.0131	1.0547	0.9830	1.0595	1.0551
Ratio of Geometric Time in Tail/One Region	0.8661	0.9287	0.9085	0.9063	0.9423	0.9475	0.9809	0.9277	0.9898	0.9991
Ratio of 3 State Markov Chain/Unconditional	1.0197	1.0264	1.0345	1.0231	1.0276	1.0249	1.0265	1.0126	1.0234	1.0183
Ratio of Unconditional/Geometric Time in Tail	1.0484	1.0461	1.0512	1.0417	1.0403	1.0433	1.0475	1.0465	1.0460	1.0371
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0691	1.0737	1.0876	1.0658	1.0690	1.0693	1.0752	1.0597	1.0704	1.0560

Table DE.15 - Ratio for Average Risk Measurements of VaR@95% for Germany										
Portfolio Number	GE_01	GE_02	GE_03	GE_04	GE_05	GE_06	GE_07	GE_08	GE_09	GE_10
Ratio of Unconditional/One Region	1.0027	1.0652	1.0485	1.0630	1.0863	1.0683	1.0552	1.0496	1.0912	1.0887
Ratio of 3 State Markov Chain/One Region	1.0422	1.0926	1.0954	1.0913	1.1163	1.0973	1.0894	1.0780	1.1323	1.1315
Ratio of Geometric Time in Tail/One Region	0.9577	1.0314	1.0017	1.0212	1.0430	1.0248	1.0131	0.9967	1.0362	1.0411
Ratio of 3 State Markov Chain/Unconditional	1.0394	1.0258	1.0447	1.0266	1.0276	1.0271	1.0324	1.0270	1.0376	1.0393
Ratio of Unconditional/Geometric Time in Tail	1.0470	1.0327	1.0468	1.0409	1.0415	1.0425	1.0415	1.0531	1.0531	1.0457
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0882	1.0593	1.0936	1.0686	1.0703	1.0708	1.0753	1.0816	1.0927	1.0869

Table HK.15 - Ratio for Average Risk Measurements of VaR@95% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	0.8989	1.0431	1.0427	1.0382	1.0364	1.0526	1.0677	1.0209	1.0276	1.0244
Ratio of 3 State Markov Chain/One Region	0.9199	1.0712	1.0719	1.0635	1.0677	1.0840	1.1000	1.0429	1.0635	1.0481
Ratio of Geometric Time in Tail/One Region	0.8531	0.9994	0.9907	0.9919	0.9891	1.0088	1.0237	0.9784	0.9750	0.9713
Ratio of 3 State Markov Chain/Unconditional	1.0233	1.0269	1.0280	1.0243	1.0301	1.0299	1.0302	1.0216	1.0349	1.0231
Ratio of Unconditional/Geometric Time in Tail	1.0538	1.0437	1.0525	1.0467	1.0478	1.0434	1.0430	1.0434	1.0540	1.0546
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0783	1.0718	1.0820	1.0722	1.0794	1.0746	1.0745	1.0659	1.0908	1.0790

Table JP.15 - Ratio for Average Risk Measurements of VaR@95% for Japan										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region	0.9000	0.8942	0.9280	0.9288	0.9066	0.9161	0.7853	0.8946	0.8924	0.8785
Ratio of 3 State Markov Chain/One Region	0.9189	0.9159	0.9500	0.9533	0.9308	0.9421	0.8062	0.9144	0.9136	0.8976
Ratio of Geometric Time in Tail/One Region	0.8590	0.8591	0.8803	0.8879	0.8706	0.8762	0.7498	0.8524	0.8522	0.8380
Ratio of 3 State Markov Chain/Unconditional	1.0210	1.0242	1.0237	1.0264	1.0268	1.0284	1.0267	1.0221	1.0237	1.0217
Ratio of Unconditional/Geometric Time in Tail	1.0478	1.0409	1.0541	1.0460	1.0414	1.0456	1.0474	1.0495	1.0472	1.0484
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0698	1.0661	1.0792	1.0736	1.0692	1.0752	1.0753	1.0727	1.0721	1.0711

Table SG.15 - Ratio for Average Risk Measurements of VaR@95% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	0.9663	0.9094	0.9309	0.9047	0.9106	0.9708	0.9826	0.9675	0.9841	0.9553
Ratio of 3 State Markov Chain/One Region	0.9969	0.9581	0.9801	0.9600	0.9666	1.0229	1.0346	1.0222	1.0350	1.0030
Ratio of Geometric Time in Tail/One Region	0.9233	0.8663	0.8908	0.8652	0.8640	0.9210	0.9293	0.9120	0.9296	0.8975
Ratio of 3 State Markov Chain/Unconditional	1.0317	1.0535	1.0528	1.0611	1.0615	1.0537	1.0529	1.0565	1.0518	1.0500
Ratio of Unconditional/Geometric Time in Tail	1.0465	1.0497	1.0450	1.0456	1.0540	1.0540	1.0573	1.0608	1.0586	1.0643
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0797	1.1059	1.1002	1.1096	1.1188	1.1106	1.1133	1.1208	1.1134	1.1175

Table SE.15 - Ratio for Average Risk Measurements of VaR@95% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	1.0400	0.8657	0.9029	0.9726	1.0246	1.0654	1.0456	1.0602	1.0527	1.1011
Ratio of 3 State Markov Chain/One Region	1.0823	0.8913	0.9274	1.0057	1.0585	1.1075	1.0793	1.0940	1.0943	1.1465
Ratio of Geometric Time in Tail/One Region	0.9923	0.8227	0.8551	0.9215	0.9664	1.0054	0.9844	1.0034	0.9910	1.0405
Ratio of 3 State Markov Chain/Unconditional	1.0406	1.0296	1.0271	1.0340	1.0331	1.0395	1.0322	1.0320	1.0394	1.0412
Ratio of Unconditional/Geometric Time in Tail	1.0481	1.0523	1.0558	1.0554	1.0602	1.0597	1.0622	1.0566	1.0623	1.0583
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0907	1.0835	1.0845	1.0914	1.0953	1.1016	1.0963	1.0904	1.1042	1.1019

Table CH.15 - Ratio for Average Risk Measurements of VaR@95% for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	0.9401	1.0227	1.0047	0.9996	0.9840	0.9765	0.9666	0.9866	0.9831	1.0042
Ratio of 3 State Markov Chain/One Region	0.9615	1.0448	1.0255	1.0233	1.0095	1.0111	1.0078	1.0331	1.0305	1.0463
Ratio of Geometric Time in Tail/One Region	0.8936	0.9967	0.9750	0.9681	0.9456	0.9306	0.9184	0.9421	0.9424	0.9655
Ratio of 3 State Markov Chain/Unconditional	1.0227	1.0217	1.0207	1.0237	1.0259	1.0354	1.0427	1.0471	1.0482	1.0420
Ratio of Unconditional/Geometric Time in Tail	1.0521	1.0260	1.0305	1.0325	1.0406	1.0493	1.0524	1.0472	1.0432	1.0401
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0760	1.0483	1.0518	1.0570	1.0676	1.0865	1.0973	1.0965	1.0935	1.0837

Table UK.15 - Ratio for Average Risk Measurements of VaR@95% for United Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	0.9416	0.9961	0.9761	0.9895	1.0014	1.0065	1.0049	1.0109	1.0239	1.0295
Ratio of 3 State Markov Chain/One Region	0.9586	1.0090	0.9972	1.0148	1.0240	1.0340	1.0349	1.0400	1.0534	1.0559
Ratio of Geometric Time in Tail/One Region	0.8892	0.9502	0.9257	0.9396	0.9676	0.9599	0.9638	0.9746	0.9856	0.9899
Ratio of 3 State Markov Chain/Unconditional	1.0180	1.0130	1.0216	1.0256	1.0226	1.0272	1.0299	1.0288	1.0288	1.0256
Ratio of Unconditional/Geometric Time in Tail	1.0590	1.0483	1.0544	1.0531	1.0349	1.0486	1.0427	1.0373	1.0388	1.0401
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0781	1.0618	1.0772	1.0800	1.0582	1.0772	1.0738	1.0671	1.0688	1.0667

Table US.15 - Ratio for Average Risk Measurements of VaR@95% for United Kingdom										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	0.9501	0.9533	0.9647	1.1733	1.1278	1.1144	1.0833	1.0961	1.0906	1.0746
Ratio of 3 State Markov Chain/One Region	0.9676	0.9742	0.9838	1.1969	1.1536	1.1473	1.1049	1.1188	1.1088	1.0933
Ratio of Geometric Time in Tail/One Region	0.9138	0.9014	0.9169	1.1262	1.0720	1.0541	1.0245	1.0585	1.0514	1.0369
Ratio of 3 State Markov Chain/Unconditional	1.0185	1.0219	1.0198	1.0201	1.0229	1.0296	1.0199	1.0208	1.0167	1.0174
Ratio of Unconditional/Geometric Time in Tail	1.0397	1.0576	1.0521	1.0418	1.0520	1.0572	1.0574	1.0355	1.0373	1.0364
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0589	1.0808	1.0730	1.0628	1.0761	1.0884	1.0785	1.0570	1.0546	1.0545

Appendix.28 – Ratio for Average Risk Measurements of VaR @ 97.5% for all Portfolios

Table GBM.16 - Ratio of Average Risk Measurements for VaR@97.5% for Simulated Geometric Brownian Motion										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	1.4585	1.4482	1.4869	1.5013	1.4623	1.4845	1.5179	1.5298	1.4925	1.4854
Ratio of 3 State Markov Chain/One Region	1.4823	1.4518	1.4867	1.5009	1.4577	1.4868	1.5200	1.5403	1.4877	1.5001
Ratio of Geometric Time in Tail/One Region	1.3444	1.3222	1.3469	1.3709	1.3538	1.3504	1.3789	1.3982	1.3607	1.3928
Ratio of 3 State Markov Chain/Unconditional	1.0163	1.0025	0.9999	0.9997	0.9969	1.0015	1.0014	1.0069	0.9968	1.0098
Ratio of Unconditional/Geometric Time in Tail	1.0849	1.0953	1.1040	1.0951	1.0801	1.0993	1.1008	1.0941	1.0968	1.0665
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1026	1.0980	1.1038	1.0948	1.0767	1.1010	1.1024	1.1016	1.0933	1.0770

Table FRW.16 - Ratio of Average Risk Measurements for VaR@97.5% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	1.2915	1.3938	1.4004	1.4282	1.4145	1.3888	1.4175	1.3645	1.4137	1.3808
Ratio of 3 State Markov Chain/One Region	1.3286	1.3956	1.4003	1.4325	1.4173	1.4007	1.4229	1.3672	1.4164	1.3835
Ratio of Geometric Time in Tail/One Region	1.1593	1.2339	1.2594	1.2686	1.2785	1.2461	1.2843	1.2230	1.2807	1.2624
Ratio of 3 State Markov Chain/Unconditional	1.0287	1.0013	0.9999	1.0030	1.0020	1.0086	1.0037	1.0020	1.0019	1.0020
Ratio of Unconditional/Geometric Time in Tail	1.1140	1.1296	1.1119	1.1258	1.1063	1.1145	1.1038	1.1157	1.1038	1.0938
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1461	1.1311	1.1119	1.1292	1.1086	1.1240	1.1079	1.1180	1.1059	1.0960

Table AU.16 - Ratio of Average Risk Measurements for VaR@97.5% for Australia										
Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	1.4338	1.3750	1.9549	2.0595	2.0569	2.0909	2.1498	2.1906	2.1256	2.0324
Ratio of 3 State Markov Chain/One Region	1.4708	1.3900	2.0155	2.1148	2.1151	2.1501	2.2177	2.2572	2.1846	2.0913
Ratio of Geometric Time in Tail/One Region	1.3452	1.3052	1.8530	1.9023	1.9091	1.9492	2.0499	2.0807	1.9805	1.9233
Ratio of 3 State Markov Chain/Unconditional	1.0258	1.0109	1.0310	1.0269	1.0283	1.0283	1.0316	1.0304	1.0278	1.0290
Ratio of Unconditional/Geometric Time in Tail	1.0658	1.0535	1.0550	1.0826	1.0774	1.0727	1.0487	1.0529	1.0732	1.0567
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0934	1.0649	1.0877	1.1117	1.1079	1.1031	1.0818	1.0849	1.1030	1.0874

Table CA.16 - Ratio of Average Risk Measurements for VaR@97.5% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	1.3178	1.3597	1.3579	1.3906	1.4130	1.4089	1.4583	1.4035	1.4970	1.4988
Ratio of 3 State Markov Chain/One Region	1.3548	1.4000	1.4144	1.4273	1.4587	1.4501	1.4991	1.4302	1.5514	1.5343
Ratio of Geometric Time in Tail/One Region	1.2211	1.2882	1.2414	1.3034	1.3515	1.3267	1.3335	1.3031	1.4218	1.4031
Ratio of 3 State Markov Chain/Unconditional	1.0281	1.0297	1.0416	1.0264	1.0323	1.0292	1.0279	1.0190	1.0364	1.0236
Ratio of Unconditional/Geometric Time in Tail	1.0792	1.0555	1.0938	1.0669	1.0455	1.0620	1.0936	1.0770	1.0529	1.0682
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1095	1.0868	1.1393	1.0951	1.0793	1.0930	1.1242	1.0975	1.0911	1.0935

Table DE.16 - Ratio of Average Risk Measurements for VaR@97.5% for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region	1.3705	1.4583	1.5609	1.5339	1.5441	1.5548	1.5767	1.5770	1.5794	1.5677
Ratio of 3 State Markov Chain/One Region	1.4235	1.5049	1.6505	1.5785	1.5990	1.6099	1.6554	1.6301	1.6467	1.6640
Ratio of Geometric Time in Tail/One Region	1.2987	1.4197	1.4389	1.4466	1.4494	1.4524	1.4717	1.4573	1.4757	1.4426
Ratio of 3 State Markov Chain/Unconditional	1.0387	1.0320	1.0574	1.0291	1.0355	1.0355	1.0499	1.0337	1.0426	1.0614
Ratio of Unconditional/Geometric Time in Tail	1.0553	1.0271	1.0848	1.0603	1.0654	1.0705	1.0713	1.0821	1.0703	1.0867
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0961	1.0600	1.1471	1.0912	1.1032	1.1085	1.1249	1.1186	1.1159	1.1534

Table HK.16 - Ratio of Average Risk Measurements for VaR@97.5% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	1.3124	1.5239	1.4982	1.4858	1.4884	1.5344	1.5639	1.4776	1.4669	1.4637
Ratio of 3 State Markov Chain/One Region	1.3444	1.5709	1.5445	1.5288	1.5371	1.5769	1.6119	1.5361	1.5279	1.5114
Ratio of Geometric Time in Tail/One Region	1.2034	1.4427	1.3677	1.3925	1.3830	1.4247	1.4626	1.3711	1.3518	1.3396
Ratio of 3 State Markov Chain/Unconditional	1.0243	1.0309	1.0309	1.0289	1.0327	1.0276	1.0307	1.0396	1.0416	1.0326
Ratio of Unconditional/Geometric Time in Tail	1.0906	1.0562	1.0954	1.0670	1.0762	1.0770	1.0692	1.0777	1.0851	1.0927
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1172	1.0889	1.1293	1.0978	1.1114	1.1068	1.1021	1.1204	1.1303	1.1282

Table JP.16 - Ratio of Average Risk Measurements for VaR@97.5% for Japan										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region	1.2108	1.2378	1.2527	1.2528	1.2369	1.2611	1.0900	1.2502	1.2294	1.2196
Ratio of 3 State Markov Chain/One Region	1.2300	1.2698	1.2884	1.2887	1.2672	1.2957	1.1253	1.2832	1.2628	1.2550
Ratio of Geometric Time in Tail/One Region	1.1299	1.1681	1.1561	1.1716	1.1620	1.1817	1.0127	1.1580	1.1364	1.1224
Ratio of 3 State Markov Chain/Unconditional	1.0159	1.0258	1.0285	1.0287	1.0245	1.0275	1.0323	1.0263	1.0272	1.0290
Ratio of Unconditional/Geometric Time in Tail	1.0717	1.0596	1.0836	1.0693	1.0644	1.0671	1.0763	1.0797	1.0818	1.0867
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0887	1.0870	1.1144	1.0999	1.0905	1.0964	1.1112	1.1081	1.1112	1.1182

Table SG.16 - Ratio of Average Risk Measurements for VaR@97.5% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	1.3265	1.3117	1.3157	1.2442	1.2480	1.3612	1.3810	1.3625	1.3707	1.3517
Ratio of 3 State Markov Chain/One Region	1.3830	1.4029	1.4011	1.3589	1.3557	1.4547	1.4765	1.4563	1.4572	1.4417
Ratio of Geometric Time in Tail/One Region	1.2370	1.2106	1.2345	1.1494	1.1525	1.2471	1.2484	1.2344	1.2264	1.2017
Ratio of 3 State Markov Chain/Unconditional	1.0426	1.0695	1.0649	1.0922	1.0863	1.0687	1.0692	1.0689	1.0631	1.0666
Ratio of Unconditional/Geometric Time in Tail	1.0724	1.0835	1.0658	1.0825	1.0828	1.0915	1.1062	1.1037	1.1177	1.1248
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1180	1.1588	1.1350	1.1823	1.1763	1.1665	1.1828	1.1797	1.1882	1.1997

Table SE.16 - Ratio of Average Risk Measurements for VaR@97.5% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	1.4555	1.2434	1.3341	1.4174	1.4328	1.5082	1.4558	1.5121	1.5045	1.4800
Ratio of 3 State Markov Chain/One Region	1.5548	1.2866	1.3864	1.5025	1.5126	1.5982	1.5446	1.6078	1.6017	1.5875
Ratio of Geometric Time in Tail/One Region	1.3446	1.1458	1.2229	1.2936	1.2939	1.3677	1.3071	1.3775	1.3709	1.3443
Ratio of 3 State Markov Chain/Unconditional	1.0682	1.0347	1.0392	1.0600	1.0557	1.0597	1.0610	1.0633	1.0646	1.0726
Ratio of Unconditional/Geometric Time in Tail	1.0825	1.0852	1.0909	1.0957	1.1073	1.1028	1.1137	1.0977	1.0974	1.1010
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1563	1.1229	1.1337	1.1615	1.1690	1.1686	1.1817	1.1672	1.1683	1.1809

Table CH.16 - Ratio of Average Risk Measurements for VaR@97.5% for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	1.3186	1.4887	1.4626	1.4799	1.4005	1.4043	1.3643	1.3765	1.3755	1.3538
Ratio of 3 State Markov Chain/One Region	1.3564	1.5244	1.5119	1.5471	1.4625	1.4749	1.4475	1.4631	1.4641	1.4156
Ratio of Geometric Time in Tail/One Region	1.2166	1.4271	1.4269	1.4035	1.3539	1.2985	1.2832	1.2855	1.2779	1.3022
Ratio of 3 State Markov Chain/Unconditional	1.0286	1.0240	1.0337	1.0455	1.0443	1.0503	1.0610	1.0629	1.0645	1.0457
Ratio of Unconditional/Geometric Time in Tail	1.0839	1.0432	1.0250	1.0544	1.0344	1.0814	1.0632	1.0708	1.0763	1.0396
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1149	1.0682	1.0596	1.1023	1.0802	1.1358	1.1280	1.1382	1.1457	1.0871

Table UK.16 - Ratio of Average Risk Measurements for VaR@97.5% for United Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	1.3558	1.4664	1.3608	1.4261	1.4173	1.4265	1.4085	1.4187	1.4429	1.4153
Ratio of 3 State Markov Chain/One Region	1.3792	1.4926	1.3940	1.4658	1.4513	1.4650	1.4423	1.4596	1.4843	1.4592
Ratio of Geometric Time in Tail/One Region	1.2198	1.3467	1.2376	1.3065	1.3526	1.3189	1.3057	1.3186	1.3589	1.3162
Ratio of 3 State Markov Chain/Unconditional	1.0172	1.0179	1.0244	1.0278	1.0240	1.0270	1.0240	1.0289	1.0287	1.0310
Ratio of Unconditional/Geometric Time in Tail	1.1115	1.0889	1.0995	1.0915	1.0478	1.0815	1.0787	1.0759	1.0618	1.0753
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1307	1.1084	1.1264	1.1219	1.0729	1.1108	1.1046	1.1070	1.0923	1.1086

Table US.16 - Ratio of Average Risk Measurements for VaR@97.5% for United States										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	1.3486	1.3957	1.3836	1.7028	1.6803	1.6175	1.5819	1.6145	1.6204	1.6008
Ratio of 3 State Markov Chain/One Region	1.3764	1.4338	1.4173	1.7297	1.7177	1.6618	1.6202	1.6416	1.6493	1.6307
Ratio of Geometric Time in Tail/One Region	1.2879	1.2671	1.2808	1.5976	1.5575	1.4728	1.4381	1.4895	1.4926	1.4781
Ratio of 3 State Markov Chain/Unconditional	1.0207	1.0273	1.0244	1.0158	1.0223	1.0274	1.0242	1.0168	1.0179	1.0187
Ratio of Unconditional/Geometric Time in Tail	1.0471	1.1015	1.0802	1.0658	1.0788	1.0982	1.1000	1.0839	1.0856	1.0830
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0688	1.1316	1.1065	1.0827	1.1029	1.1283	1.1266	1.1021	1.1050	1.1032

Appendix.29 – Ratio for Average Risk Measurements of VaR @ 99% for all Portfolios

Table GBM.17 - Ratio of Average Risk Measurements for VaR@99% for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	2.1091	2.1001	2.1516	2.1392	2.0712	2.1588	2.1586	2.1551	2.1534	2.1044
Ratio of 3 State Markov Chain/One Region	2.1429	2.0904	2.1453	2.1236	2.0614	2.1795	2.1550	2.1667	2.1373	2.1146
Ratio of Geometric Time in Tail/One Region	1.9596	1.9316	1.9415	1.9646	1.9133	1.9607	1.9901	1.9894	1.9743	1.9831
Ratio of 3 State Markov Chain/Unconditional	1.0160	0.9954	0.9971	0.9927	0.9953	1.0096	0.9983	1.0054	0.9925	1.0048
Ratio of Unconditional/Geometric Time in Tail	1.0763	1.0872	1.1082	1.0889	1.0825	1.1010	1.0847	1.0833	1.0907	1.0611
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0936	1.0822	1.1050	1.0809	1.0774	1.1116	1.0828	1.0891	1.0825	1.0663

Table FRW.17 - Ratio of Average Risk Measurements for VaR@99% for Simulated Symmetric Two Sided Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	1.7394	1.7080	1.7439	1.8306	1.7410	1.8185	1.8844	1.8900	1.9536	1.9133
Ratio of 3 State Markov Chain/One Region	1.8074	1.7279	1.7340	1.8481	1.7531	1.8345	1.9006	1.8953	1.9436	1.9187
Ratio of Geometric Time in Tail/One Region	1.5715	1.5458	1.6151	1.6847	1.6172	1.6556	1.7301	1.6937	1.7525	1.7405
Ratio of 3 State Markov Chain/Unconditional	1.0391	1.0116	0.9943	1.0096	1.0069	1.0088	1.0086	1.0028	0.9948	1.0028
Ratio of Unconditional/Geometric Time in Tail	1.1068	1.1049	1.0797	1.0866	1.0766	1.0983	1.0892	1.1159	1.1148	1.0993
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1501	1.1178	1.0736	1.0970	1.0840	1.1080	1.0986	1.1190	1.1090	1.1024

Table AU.17 - Ratio of Average Risk Measurements for VaR@99% for Australia

Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	2.1112	1.9691	2.8643	3.0487	3.1269	3.1025	3.1887	3.2581	3.1616	3.0193
Ratio of 3 State Markov Chain/One Region	2.1520	1.9908	2.9633	3.1582	3.2363	3.2113	3.3069	3.3682	3.2769	3.1416
Ratio of Geometric Time in Tail/One Region	2.0261	1.8895	2.6357	2.7628	2.8557	2.8646	2.9657	3.0411	2.8717	2.8093
Ratio of 3 State Markov Chain/Unconditional	1.0194	1.0110	1.0346	1.0359	1.0350	1.0351	1.0370	1.0338	1.0365	1.0405
Ratio of Unconditional/Geometric Time in Tail	1.0420	1.0421	1.0867	1.1035	1.0950	1.0830	1.0752	1.0714	1.1010	1.0748
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0621	1.0536	1.1243	1.1431	1.1333	1.1210	1.1150	1.1076	1.1411	1.1183

Table CA.17 - Ratio of Average Risk Measurements for VaR@99% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	1.8947	1.8948	1.8186	1.8637	1.9557	2.0028	2.1142	2.0599	2.2764	2.2747
Ratio of 3 State Markov Chain/One Region	1.9459	1.9623	1.8689	1.9234	2.0220	2.0667	2.1923	2.0935	2.3458	2.3450
Ratio of Geometric Time in Tail/One Region	1.7863	1.7649	1.6799	1.7683	1.8875	1.9121	1.9353	1.9381	2.1173	2.1206
Ratio of 3 State Markov Chain/Unconditional	1.0271	1.0357	1.0277	1.0320	1.0339	1.0319	1.0370	1.0163	1.0305	1.0309
Ratio of Unconditional/Geometric Time in Tail	1.0607	1.0736	1.0825	1.0540	1.0362	1.0474	1.0924	1.0628	1.0751	1.0727
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0894	1.1119	1.1125	1.0877	1.0712	1.0809	1.1328	1.0802	1.1079	1.1058

Table DE.17 - Ratio of Average Risk Measurements for VaR@99% for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region	1.9100	2.0282	1.9911	2.0650	2.1232	2.1905	2.1218	2.2091	2.2339	2.1828
Ratio of 3 State Markov Chain/One Region	1.9775	2.0867	2.0694	2.1383	2.1976	2.2678	2.1701	2.2992	2.3106	2.2701
Ratio of Geometric Time in Tail/One Region	1.8011	1.9415	1.8308	1.9408	1.9966	2.0479	1.9470	1.9977	2.0774	1.9896
Ratio of 3 State Markov Chain/Unconditional	1.0353	1.0288	1.0393	1.0355	1.0351	1.0353	1.0228	1.0408	1.0344	1.0400
Ratio of Unconditional/Geometric Time in Tail	1.0605	1.0447	1.0876	1.0640	1.0634	1.0696	1.0898	1.1058	1.0753	1.0971
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0980	1.0748	1.1303	1.1017	1.1007	1.1074	1.1146	1.1509	1.1123	1.1410

Table HK.17 - Ratio of Average Risk Measurements for VaR@99% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	1.8629	2.1696	2.0527	2.0761	2.0665	2.2108	2.2721	2.2468	2.1739	2.1868
Ratio of 3 State Markov Chain/One Region	1.9269	2.2393	2.1306	2.1470	2.1465	2.2931	2.3438	2.3193	2.2672	2.2592
Ratio of Geometric Time in Tail/One Region	1.6720	2.0523	1.8429	1.9183	1.9034	2.0369	2.1506	2.0516	1.9829	1.9821
Ratio of 3 State Markov Chain/Unconditional	1.0343	1.0322	1.0379	1.0341	1.0387	1.0372	1.0316	1.0323	1.0429	1.0331
Ratio of Unconditional/Geometric Time in Tail	1.1142	1.0571	1.1139	1.0823	1.0857	1.0853	1.0565	1.0951	1.0963	1.1033
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1525	1.0911	1.1561	1.1192	1.1277	1.1258	1.0899	1.1305	1.1434	1.1398

Table JP.17 - Ratio of Average Risk Measurements for VaR@99% for Japan										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region	1.5744	1.6601	1.6777	1.7442	1.7257	1.6674	1.4310	1.7052	1.6929	1.6943
Ratio of 3 State Markov Chain/One Region	1.6109	1.7042	1.7324	1.7994	1.7687	1.7085	1.4801	1.7547	1.7459	1.7476
Ratio of Geometric Time in Tail/One Region	1.4890	1.5672	1.5396	1.6315	1.5922	1.5651	1.3154	1.5601	1.5792	1.5870
Ratio of 3 State Markov Chain/Unconditional	1.0232	1.0265	1.0326	1.0316	1.0249	1.0247	1.0344	1.0290	1.0313	1.0314
Ratio of Unconditional/Geometric Time in Tail	1.0574	1.0593	1.0897	1.0691	1.0839	1.0653	1.0878	1.0930	1.0720	1.0676
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0819	1.0874	1.1252	1.1029	1.1109	1.0916	1.1252	1.1248	1.1056	1.1011

Table SG.17 - Ratio of Average Risk Measurements for VaR@99% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	1.7975	1.8082	1.7265	1.8013	1.8900	1.9486	1.8958	1.9392	1.9660	1.8938
Ratio of 3 State Markov Chain/One Region	1.8570	1.8991	1.8030	1.9103	2.0108	2.0470	1.9897	2.0314	2.0750	1.9665
Ratio of Geometric Time in Tail/One Region	1.7457	1.6428	1.6455	1.7142	1.8343	1.8320	1.7438	1.7757	1.7616	1.7125
Ratio of 3 State Markov Chain/Unconditional	1.0331	1.0503	1.0443	1.0605	1.0639	1.0505	1.0496	1.0475	1.0554	1.0384
Ratio of Unconditional/Geometric Time in Tail	1.0297	1.1007	1.0492	1.0508	1.0303	1.0636	1.0871	1.0921	1.1161	1.1059
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0637	1.1560	1.0957	1.1144	1.0962	1.1174	1.1410	1.1440	1.1779	1.1483

Table SE.17 - Ratio of Average Risk Measurements for VaR@99% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	1.8623	1.7177	1.8380	2.0293	2.0746	2.1968	2.0590	2.0825	2.1266	2.1503
Ratio of 3 State Markov Chain/One Region	1.9435	1.7792	1.9175	2.0959	2.1536	2.2658	2.1262	2.1567	2.2112	2.2372
Ratio of Geometric Time in Tail/One Region	1.7282	1.5718	1.6763	1.8382	1.8995	2.0050	1.8724	1.8729	1.9491	1.9334
Ratio of 3 State Markov Chain/Unconditional	1.0436	1.0358	1.0432	1.0328	1.0381	1.0314	1.0326	1.0356	1.0398	1.0404
Ratio of Unconditional/Geometric Time in Tail	1.0776	1.0928	1.0965	1.1040	1.0922	1.0956	1.0997	1.1119	1.0910	1.1122
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1246	1.1319	1.1439	1.1401	1.1338	1.1301	1.1356	1.1516	1.1344	1.1571

Table CH.17 - Ratio of Average Risk Measurements for VaR@99% for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	1.8264	2.0638	2.0513	2.0992	1.9572	1.9145	1.8532	1.8534	1.8376	1.8345
Ratio of 3 State Markov Chain/One Region	1.8825	2.1291	2.1194	2.1584	2.0105	1.9584	1.9298	1.9315	1.9259	1.8960
Ratio of Geometric Time in Tail/One Region	1.6651	1.9767	1.9970	2.0341	1.8845	1.7541	1.7477	1.7339	1.6987	1.7193
Ratio of 3 State Markov Chain/Unconditional	1.0307	1.0317	1.0332	1.0282	1.0273	1.0229	1.0413	1.0422	1.0480	1.0335
Ratio of Unconditional/Geometric Time in Tail	1.0969	1.0440	1.0272	1.0320	1.0386	1.0914	1.0604	1.0689	1.0818	1.0670
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1305	1.0771	1.0613	1.0611	1.0669	1.1164	1.1042	1.1140	1.1337	1.1027

Table UK.17 - Ratio of Average Risk Measurements for VaR@99% for Untied Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	1.9735	2.1572	1.9637	2.0066	2.0184	1.9954	1.9745	2.0202	1.9846	1.9957
Ratio of 3 State Markov Chain/One Region	2.0255	2.1808	2.0026	2.0703	2.0549	2.0452	2.0048	2.0628	2.0344	2.0595
Ratio of Geometric Time in Tail/One Region	1.7863	2.0030	1.8301	1.8668	1.9713	1.9199	1.8852	1.9614	1.9299	1.9384
Ratio of 3 State Markov Chain/Unconditional	1.0263	1.0109	1.0198	1.0317	1.0181	1.0249	1.0154	1.0211	1.0251	1.0319
Ratio of Unconditional/Geometric Time in Tail	1.1048	1.0770	1.0730	1.0749	1.0239	1.0393	1.0474	1.0300	1.0283	1.0296
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.1339	1.0888	1.0942	1.1090	1.0424	1.0653	1.0635	1.0517	1.0541	1.0625

Table US.17 - Ratio of Average Risk Measurements for VaR@99% for United States										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	1.9932	2.0740	2.0219	2.5413	2.3631	2.2757	2.2611	2.2864	2.2504	2.2596
Ratio of 3 State Markov Chain/One Region	2.0520	2.1251	2.0739	2.5844	2.4355	2.3494	2.3095	2.3334	2.2701	2.2995
Ratio of Geometric Time in Tail/One Region	1.9012	1.8903	1.8474	2.3998	2.1513	2.0792	2.0704	2.1159	2.0741	2.1164
Ratio of 3 State Markov Chain/Unconditional	1.0295	1.0247	1.0257	1.0169	1.0307	1.0324	1.0214	1.0206	1.0088	1.0176
Ratio of Unconditional/Geometric Time in Tail	1.0484	1.0972	1.0944	1.0590	1.0984	1.0945	1.0921	1.0806	1.0850	1.0677
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0794	1.1242	1.1226	1.0769	1.1321	1.1299	1.1155	1.1028	1.0945	1.0865

Appendix.30 – Ratio for Average Risk Measurements of ES @ 95% for all Portfolios

Table GBM.18 - Ratio of Average Risk Measurements for ES@95% for Simulated Geometric Brownian Motion										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	1.8097	1.8045	1.8700	1.8463	1.7965	1.8219	1.8570	1.8549	1.8302	1.7994
Ratio of 3 State Markov Chain/One Region	1.8246	1.8033	1.8720	1.8398	1.7922	1.8306	1.8576	1.8598	1.8182	1.8041
Ratio of Geometric Time in Tail/One Region	1.7267	1.7150	1.7627	1.7437	1.7228	1.7256	1.7632	1.7689	1.7341	1.7235
Ratio of 3 State Markov Chain/Unconditional	1.0082	0.9993	1.0010	0.9965	0.9976	1.0048	1.0003	1.0027	0.9935	1.0027
Ratio of Unconditional/Geometric Time in Tail	1.0481	1.0522	1.0609	1.0588	1.0428	1.0558	1.0532	1.0486	1.0554	1.0440
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0567	1.0515	1.0620	1.0551	1.0403	1.0609	1.0535	1.0514	1.0485	1.0468

Table FRW.18 - Ratio of Average Risk Measurements for ES@95% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	1.6980	1.6447	1.6863	1.7276	1.6785	1.7429	1.7612	1.7300	1.7493	1.7312
Ratio of 3 State Markov Chain/One Region	1.7326	1.6549	1.6795	1.7430	1.6842	1.7533	1.7692	1.7309	1.7438	1.7320
Ratio of Geometric Time in Tail/One Region	1.6717	1.5681	1.6349	1.6494	1.6020	1.6712	1.6905	1.6427	1.6665	1.6660
Ratio of 3 State Markov Chain/Unconditional	1.0204	1.0062	0.9960	1.0089	1.0034	1.0060	1.0046	1.0005	0.9969	1.0004
Ratio of Unconditional/Geometric Time in Tail	1.0157	1.0488	1.0315	1.0474	1.0478	1.0429	1.0418	1.0531	1.0497	1.0391
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0365	1.0553	1.0273	1.0568	1.0513	1.0491	1.0466	1.0537	1.0464	1.0396

Table AU.18 - Ratio of Average Risk Measurements for ES@95% for Australia										
Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	1.8956	1.7693	2.5625	2.7200	2.7239	2.7094	2.7976	2.8234	2.7558	2.6402
Ratio of 3 State Markov Chain/One Region	1.9460	1.7829	2.6532	2.7810	2.8106	2.7964	2.8909	2.9201	2.8518	2.7393
Ratio of Geometric Time in Tail/One Region	1.9101	1.7694	2.5963	2.6616	2.6735	2.6824	2.7798	2.8652	2.7061	2.6068
Ratio of 3 State Markov Chain/Unconditional	1.0265	1.0077	1.0354	1.0224	1.0319	1.0321	1.0334	1.0342	1.0348	1.0375
Ratio of Unconditional/Geometric Time in Tail	0.9924	1.0000	0.9870	1.0220	1.0188	1.0101	1.0064	0.9854	1.0184	1.0128
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0188	1.0076	1.0219	1.0449	1.0513	1.0425	1.0400	1.0192	1.0538	1.0509

Table CA.18 - Ratio of Average Risk Measurements for ES@95% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	1.6838	1.7061	1.7065	1.7783	1.8105	1.8593	1.9254	1.8870	2.0514	2.0487
Ratio of 3 State Markov Chain/One Region	1.7400	1.7624	1.7498	1.8046	1.8713	1.9172	1.9953	1.9246	2.1337	2.1555
Ratio of Geometric Time in Tail/One Region	1.6492	1.6644	1.6303	1.8107	1.8508	1.8597	1.8299	1.8786	2.0402	2.0517
Ratio of 3 State Markov Chain/Unconditional	1.0334	1.0330	1.0254	1.0148	1.0336	1.0311	1.0363	1.0199	1.0401	1.0521
Ratio of Unconditional/Geometric Time in Tail	1.0210	1.0251	1.0467	0.9821	0.9782	0.9998	1.0522	1.0045	1.0055	0.9986
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0551	1.0588	1.0733	0.9966	1.0111	1.0309	1.0904	1.0245	1.0458	1.0506

Table DE.18 - Ratio of Average Risk Measurements for ES@95% for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region	1.7607	1.8929	1.9641	1.9250	1.9418	1.9696	1.9767	1.9826	1.9901	1.9965
Ratio of 3 State Markov Chain/One Region	1.8102	1.9634	2.0279	1.9677	1.9879	2.0153	2.0515	2.0599	2.0440	2.0638
Ratio of Geometric Time in Tail/One Region	1.7215	1.8865	1.9622	1.9350	1.9415	1.9643	1.9167	1.8937	1.9212	1.9122
Ratio of 3 State Markov Chain/Unconditional	1.0281	1.0372	1.0325	1.0222	1.0238	1.0232	1.0378	1.0390	1.0271	1.0337
Ratio of Unconditional/Geometric Time in Tail	1.0228	1.0034	1.0010	0.9948	1.0002	1.0027	1.0313	1.0470	1.0359	1.0441
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0515	1.0408	1.0335	1.0169	1.0239	1.0260	1.0703	1.0878	1.0639	1.0793

Table HK.18 - Ratio of Average Risk Measurements for ES@95% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	1.7400	1.9983	1.9837	1.9498	1.9637	2.0239	2.0675	1.9845	1.9841	1.9809
Ratio of 3 State Markov Chain/One Region	1.7853	2.0458	2.0663	2.0171	2.0328	2.0704	2.1448	2.0596	2.0722	2.0957
Ratio of Geometric Time in Tail/One Region	1.6610	2.0751	1.8992	1.9418	1.9472	2.0217	2.1680	1.9743	1.9534	1.9528
Ratio of 3 State Markov Chain/Unconditional	1.0261	1.0238	1.0416	1.0345	1.0352	1.0230	1.0374	1.0378	1.0445	1.0580
Ratio of Unconditional/Geometric Time in Tail	1.0476	0.9630	1.0445	1.0042	1.0085	1.0011	0.9536	1.0051	1.0157	1.0144
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0749	0.9859	1.0880	1.0388	1.0439	1.0241	0.9893	1.0432	1.0608	1.0732

Table JP.18 - Ratio of Average Risk Measurements for ES@95% for Japan										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region	1.5163	1.5551	1.5820	1.5790	1.5469	1.5691	1.3470	1.5739	1.5556	1.5402
Ratio of 3 State Markov Chain/One Region	1.5448	1.5722	1.6287	1.6284	1.5630	1.6115	1.3788	1.6143	1.6028	1.5837
Ratio of Geometric Time in Tail/One Region	1.5430	1.5665	1.5283	1.5788	1.5269	1.5714	1.3303	1.5386	1.5485	1.5316
Ratio of 3 State Markov Chain/Unconditional	1.0188	1.0110	1.0295	1.0313	1.0104	1.0270	1.0236	1.0257	1.0303	1.0283
Ratio of Unconditional/Geometric Time in Tail	0.9827	0.9927	1.0352	1.0001	1.0131	0.9985	1.0125	1.0229	1.0046	1.0056
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0012	1.0036	1.0657	1.0314	1.0236	1.0255	1.0365	1.0492	1.0350	1.0340

Table SG.18 - Ratio of Average Risk Measurements for ES@95% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	1.6704	1.6756	1.6538	1.6707	1.6867	1.7427	1.7576	1.7440	1.7703	1.7635
Ratio of 3 State Markov Chain/One Region	1.7187	1.7510	1.7185	1.7347	1.7611	1.8106	1.8224	1.8151	1.8368	1.8184
Ratio of Geometric Time in Tail/One Region	1.7158	1.6635	1.7261	1.7321	1.7553	1.7974	1.7595	1.7438	1.7119	1.7088
Ratio of 3 State Markov Chain/Unconditional	1.0290	1.0450	1.0391	1.0383	1.0442	1.0389	1.0369	1.0407	1.0375	1.0311
Ratio of Unconditional/Geometric Time in Tail	0.9735	1.0072	0.9582	0.9646	0.9609	0.9696	0.9989	1.0001	1.0341	1.0320
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0017	1.0526	0.9956	1.0015	1.0034	1.0073	1.0357	1.0409	1.0730	1.0642

Table SE.18 - Ratio of Average Risk Measurements for ES@95% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	1.8062	1.6186	1.7325	1.8858	1.9234	1.9937	1.9233	1.9602	1.9862	1.9835
Ratio of 3 State Markov Chain/One Region	1.8694	1.6846	1.8067	1.9437	1.9772	2.0509	1.9802	2.0178	2.0488	2.0527
Ratio of Geometric Time in Tail/One Region	1.7617	1.6243	1.6925	1.8240	1.8782	1.9334	1.8584	1.8950	1.9359	1.9146
Ratio of 3 State Markov Chain/Unconditional	1.0350	1.0408	1.0429	1.0307	1.0279	1.0287	1.0296	1.0294	1.0315	1.0349
Ratio of Unconditional/Geometric Time in Tail	1.0253	0.9965	1.0237	1.0339	1.0241	1.0312	1.0350	1.0344	1.0260	1.0360
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0611	1.0372	1.0675	1.0656	1.0527	1.0608	1.0655	1.0648	1.0583	1.0722

Table CH.18 - Ratio of Average Risk Measurements for ES@95% for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	1.6848	1.8564	1.8263	1.8581	1.7504	1.7429	1.7162	1.7551	1.7710	1.7595
Ratio of 3 State Markov Chain/One Region	1.7642	1.9404	1.9027	1.9227	1.8095	1.8103	1.7757	1.8206	1.8428	1.8126
Ratio of Geometric Time in Tail/One Region	1.6399	1.8787	1.8374	1.8565	1.7477	1.6772	1.6799	1.7119	1.7255	1.7441
Ratio of 3 State Markov Chain/Unconditional	1.0471	1.0453	1.0418	1.0347	1.0338	1.0386	1.0347	1.0373	1.0405	1.0301
Ratio of Unconditional/Geometric Time in Tail	1.0274	0.9881	0.9939	1.0009	1.0015	1.0392	1.0216	1.0252	1.0264	1.0089
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0758	1.0329	1.0355	1.0356	1.0353	1.0794	1.0570	1.0635	1.0680	1.0393

Table UK.18 - Ratio of Average Risk Measurements for ES@95% for United Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	1.7792	1.8660	1.7986	1.8206	1.8367	1.8446	1.8154	1.8301	1.8207	1.8344
Ratio of 3 State Markov Chain/One Region	1.8170	1.8982	1.8404	1.8578	1.8699	1.8671	1.8329	1.8493	1.8461	1.8798
Ratio of Geometric Time in Tail/One Region	1.6563	1.8393	1.7510	1.7908	1.8689	1.8943	1.8376	1.8477	1.8500	1.8740
Ratio of 3 State Markov Chain/Unconditional	1.0212	1.0173	1.0232	1.0205	1.0181	1.0122	1.0096	1.0105	1.0139	1.0247
Ratio of Unconditional/Geometric Time in Tail	1.0742	1.0145	1.0272	1.0166	0.9827	0.9738	0.9880	0.9905	0.9842	0.9789
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0970	1.0321	1.0510	1.0374	1.0005	0.9856	0.9975	1.0009	0.9979	1.0031

Table US.18 - Ratio of Average Risk Measurements for ES@95% for United States										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	1.7277	1.8177	1.7899	2.2416	2.1508	2.0663	2.0487	2.0700	2.0535	2.0514
Ratio of 3 State Markov Chain/One Region	1.8038	1.8667	1.8361	2.2693	2.2020	2.1236	2.0941	2.1213	2.0874	2.0961
Ratio of Geometric Time in Tail/One Region	1.7120	1.7546	1.7383	2.2699	2.0834	1.9963	1.9757	2.0007	1.9806	2.0068
Ratio of 3 State Markov Chain/Unconditional	1.0441	1.0269	1.0258	1.0124	1.0238	1.0277	1.0221	1.0248	1.0165	1.0218
Ratio of Unconditional/Geometric Time in Tail	1.0092	1.0360	1.0297	0.9875	1.0324	1.0351	1.0369	1.0346	1.0368	1.0222
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0536	1.0639	1.0563	0.9997	1.0569	1.0638	1.0599	1.0603	1.0539	1.0445

Appendix.31 – Ratio for Average Risk Measurements of ES @ 97.5% for all Portfolios

Table GBM.19 - Ratio of Average Risk Measurements for ES@97.5% for Simulated Geometric Brownian Motion										
Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	2.2427	2.2413	2.3273	2.3084	2.2287	2.2911	2.2927	2.2981	2.2733	2.2080
Ratio of 3 State Markov Chain/One Region	2.2662	2.2440	2.3351	2.3046	2.2287	2.3057	2.2929	2.3046	2.2603	2.2213
Ratio of Geometric Time in Tail/One Region	2.1730	2.1662	2.2306	2.2108	2.1753	2.2082	2.2135	2.2288	2.1940	2.1438
Ratio of 3 State Markov Chain/Unconditional	1.0105	1.0012	1.0034	0.9984	1.0000	1.0064	1.0001	1.0028	0.9943	1.0060
Ratio of Unconditional/Geometric Time in Tail	1.0321	1.0347	1.0433	1.0442	1.0246	1.0375	1.0358	1.0311	1.0362	1.0299
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0429	1.0359	1.0468	1.0424	1.0246	1.0441	1.0359	1.0340	1.0302	1.0361

Table FRW.19 - Ratio of Average Risk Measurements for ES@97.5% for Simulated Symmetric Two Sided Fréchet Random Walk										
Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	1.9506	1.8743	1.9524	2.0221	1.9440	2.0728	2.1032	2.0663	2.0993	2.0801
Ratio of 3 State Markov Chain/One Region	1.9963	1.8902	1.9449	2.0499	1.9551	2.0895	2.1176	2.0734	2.0944	2.0871
Ratio of Geometric Time in Tail/One Region	1.9666	1.8287	1.9358	1.9760	1.8921	2.0276	2.0574	2.0028	2.0399	2.0445
Ratio of 3 State Markov Chain/Unconditional	1.0235	1.0085	0.9961	1.0137	1.0057	1.0080	1.0068	1.0034	0.9977	1.0033
Ratio of Unconditional/Geometric Time in Tail	0.9919	1.0250	1.0086	1.0233	1.0274	1.0223	1.0223	1.0317	1.0291	1.0174
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0151	1.0337	1.0047	1.0374	1.0333	1.0305	1.0293	1.0353	1.0267	1.0208

Table AU.19 - Ratio of Average Risk Measurements for ES@97.5% for Australia										
Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	2.3630	2.1832	3.1582	3.3583	3.3944	3.3743	3.4972	3.5036	3.4407	3.2987
Ratio of 3 State Markov Chain/One Region	2.4394	2.2060	3.2868	3.4353	3.5176	3.4970	3.6266	3.6412	3.5786	3.4392
Ratio of Geometric Time in Tail/One Region	2.4395	2.2256	3.2832	3.3572	3.4015	3.4128	3.5429	3.6454	3.4477	3.3258
Ratio of 3 State Markov Chain/Unconditional	1.0323	1.0104	1.0407	1.0229	1.0363	1.0364	1.0370	1.0393	1.0401	1.0426
Ratio of Unconditional/Geometric Time in Tail	0.9686	0.9810	0.9619	1.0003	0.9979	0.9887	0.9871	0.9611	0.9980	0.9919
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0000	0.9912	1.0011	1.0233	1.0341	1.0247	1.0236	0.9988	1.0380	1.0341

Table CA.19 - Ratio of Average Risk Measurements for ES@97.5% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	2.0732	2.0572	2.0636	2.1600	2.1946	2.2820	2.3826	2.3558	2.5605	2.5535
Ratio of 3 State Markov Chain/One Region	2.1527	2.1336	2.1130	2.1924	2.2757	2.3617	2.4810	2.4152	2.6762	2.7147
Ratio of Geometric Time in Tail/One Region	2.0705	2.0409	2.0004	2.2590	2.2974	2.3282	2.2889	2.3951	2.6015	2.6147
Ratio of 3 State Markov Chain/Unconditional	1.0383	1.0371	1.0239	1.0150	1.0370	1.0349	1.0413	1.0252	1.0452	1.0631
Ratio of Unconditional/Geometric Time in Tail	1.0013	1.0080	1.0316	0.9562	0.9553	0.9802	1.0409	0.9836	0.9843	0.9766
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0397	1.0454	1.0563	0.9705	0.9906	1.0144	1.0839	1.0084	1.0287	1.0383

Table DE.19 - Ratio of Average Risk Measurements for ES@97.5% for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region	2.1262	2.2807	2.3482	2.3049	2.3277	2.3959	2.3997	2.4079	2.4001	2.4146
Ratio of 3 State Markov Chain/One Region	2.1846	2.3757	2.4200	2.3608	2.3867	2.4556	2.4915	2.5150	2.4628	2.4902
Ratio of Geometric Time in Tail/One Region	2.1144	2.3083	2.4150	2.3760	2.3853	2.4499	2.3711	2.3387	2.3642	2.3584
Ratio of 3 State Markov Chain/Unconditional	1.0275	1.0416	1.0306	1.0243	1.0254	1.0249	1.0382	1.0445	1.0261	1.0313
Ratio of Unconditional/Geometric Time in Tail	1.0056	0.9880	0.9724	0.9701	0.9758	0.9780	1.0121	1.0296	1.0152	1.0238
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0332	1.0292	1.0021	0.9936	1.0006	1.0023	1.0508	1.0754	1.0417	1.0559

Table HK.19 - Ratio of Average Risk Measurements for ES@97.5% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	2.1264	2.4496	2.4137	2.3606	2.3738	2.4523	2.5184	2.4215	2.4148	2.4117
Ratio of 3 State Markov Chain/One Region	2.1896	2.5107	2.5286	2.4551	2.4661	2.5087	2.6259	2.5228	2.5332	2.5763
Ratio of Geometric Time in Tail/One Region	2.0655	2.6261	2.3533	2.4039	2.4097	2.5082	2.7326	2.4671	2.4374	2.4368
Ratio of 3 State Markov Chain/Unconditional	1.0297	1.0249	1.0476	1.0401	1.0389	1.0230	1.0427	1.0418	1.0490	1.0683
Ratio of Unconditional/Geometric Time in Tail	1.0295	0.9328	1.0257	0.9820	0.9851	0.9777	0.9216	0.9815	0.9907	0.9897
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0601	0.9560	1.0745	1.0213	1.0234	1.0002	0.9609	1.0226	1.0393	1.0573

Table JP.19 - Ratio of Average Risk Measurements for ES@97.5% for Japan										
Portfolio Number	JAP_01	JAP_02	JAP_03	JAP_04	JAP_05	JAP_06	JAP_07	JAP_08	JAP_09	JAP_10
Ratio of Unconditional/One Region	1.7762	1.8520	1.8855	1.8817	1.8457	1.8661	1.6042	1.8858	1.8638	1.8521
Ratio of 3 State Markov Chain/One Region	1.8186	1.8701	1.9499	1.9487	1.8620	1.9245	1.6440	1.9419	1.9291	1.9121
Ratio of Geometric Time in Tail/One Region	1.8660	1.9145	1.8594	1.9340	1.8626	1.9201	1.6217	1.8841	1.9008	1.8880
Ratio of 3 State Markov Chain/Unconditional	1.0239	1.0098	1.0342	1.0356	1.0088	1.0313	1.0248	1.0298	1.0350	1.0324
Ratio of Unconditional/Geometric Time in Tail	0.9518	0.9674	1.0140	0.9730	0.9909	0.9719	0.9892	1.0009	0.9805	0.9810
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9746	0.9768	1.0487	1.0076	0.9996	1.0023	1.0138	1.0307	1.0149	1.0127

Table SG.19 - Ratio of Average Risk Measurements for ES@97.5% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	1.9782	2.0094	1.9545	1.9969	2.0303	2.0659	2.0694	2.0695	2.0965	2.1064
Ratio of 3 State Markov Chain/One Region	2.0383	2.0938	2.0234	2.0585	2.1074	2.1379	2.1370	2.1436	2.1679	2.1593
Ratio of Geometric Time in Tail/One Region	2.1037	2.0433	2.1119	2.1452	2.1938	2.2115	2.1393	2.1412	2.0779	2.1003
Ratio of 3 State Markov Chain/Unconditional	1.0304	1.0420	1.0353	1.0309	1.0380	1.0349	1.0327	1.0358	1.0341	1.0251
Ratio of Unconditional/Geometric Time in Tail	0.9403	0.9834	0.9255	0.9309	0.9255	0.9341	0.9673	0.9665	1.0090	1.0029
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9689	1.0247	0.9581	0.9596	0.9606	0.9667	0.9989	1.0011	1.0433	1.0281

Table SE.19 - Ratio of Average Risk Measurements for ES@97.5% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	2.1264	1.9739	2.1205	2.3247	2.3543	2.4365	2.3322	2.3739	2.4091	2.3981
Ratio of 3 State Markov Chain/One Region	2.1935	2.0651	2.2221	2.3889	2.4134	2.4959	2.3929	2.4345	2.4749	2.4715
Ratio of Geometric Time in Tail/One Region	2.1251	2.0403	2.1205	2.2990	2.3628	2.4210	2.3127	2.3450	2.4089	2.3668
Ratio of 3 State Markov Chain/Unconditional	1.0315	1.0462	1.0479	1.0276	1.0251	1.0244	1.0260	1.0255	1.0273	1.0306
Ratio of Unconditional/Geometric Time in Tail	1.0006	0.9675	1.0000	1.0112	0.9964	1.0064	1.0085	1.0123	1.0001	1.0132
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0322	1.0122	1.0479	1.0391	1.0214	1.0309	1.0347	1.0382	1.0274	1.0442

Table CH.19 - Ratio of Average Risk Measurements for ES@97.5% for Switzerland

Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	2.0189	2.2267	2.1839	2.2356	2.0799	2.0547	2.0190	2.0765	2.0965	2.0747
Ratio of 3 State Markov Chain/One Region	2.1335	2.3477	2.2889	2.3173	2.1533	2.1340	2.0853	2.1498	2.1744	2.1322
Ratio of Geometric Time in Tail/One Region	2.0062	2.2986	2.2387	2.2782	2.1173	2.0089	2.0192	2.0600	2.0812	2.0911
Ratio of 3 State Markov Chain/Unconditional	1.0568	1.0543	1.0481	1.0365	1.0353	1.0386	1.0328	1.0353	1.0372	1.0277
Ratio of Unconditional/Geometric Time in Tail	1.0063	0.9687	0.9755	0.9813	0.9823	1.0228	0.9999	1.0080	1.0073	0.9921
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0635	1.0213	1.0224	1.0172	1.0170	1.0623	1.0328	1.0436	1.0448	1.0197

Table UK.19 - Ratio of Average Risk Measurements for ES@97.5% for United Kingdom

Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	2.2036	2.3179	2.2017	2.2168	2.2357	2.2424	2.1992	2.2117	2.1945	2.2026
Ratio of 3 State Markov Chain/One Region	2.2614	2.3672	2.2618	2.2645	2.2814	2.2660	2.2162	2.2287	2.2224	2.2629
Ratio of Geometric Time in Tail/One Region	2.0737	2.3390	2.1936	2.2351	2.3353	2.3873	2.2949	2.2981	2.2951	2.3232
Ratio of 3 State Markov Chain/Unconditional	1.0262	1.0213	1.0273	1.0215	1.0204	1.0105	1.0077	1.0077	1.0127	1.0273
Ratio of Unconditional/Geometric Time in Tail	1.0626	0.9910	1.0037	0.9918	0.9573	0.9393	0.9583	0.9624	0.9562	0.9481
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0905	1.0120	1.0311	1.0132	0.9769	0.9492	0.9657	0.9698	0.9683	0.9740

Table US.19 - Ratio of Average Risk Measurements for ES@97.5% for United States

Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	2.1103	2.2484	2.2032	2.7731	2.6385	2.5340	2.5322	2.5394	2.5218	2.5168
Ratio of 3 State Markov Chain/One Region	2.2248	2.3175	2.2714	2.8163	2.7101	2.6114	2.5957	2.6158	2.5728	2.5823
Ratio of Geometric Time in Tail/One Region	2.1280	2.2196	2.1819	2.8924	2.6085	2.5054	2.4985	2.4905	2.4685	2.5063
Ratio of 3 State Markov Chain/Unconditional	1.0542	1.0307	1.0309	1.0156	1.0271	1.0305	1.0251	1.0301	1.0202	1.0260
Ratio of Unconditional/Geometric Time in Tail	0.9917	1.0130	1.0098	0.9588	1.0115	1.0114	1.0135	1.0196	1.0216	1.0042
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0455	1.0441	1.0410	0.9737	1.0389	1.0423	1.0389	1.0503	1.0422	1.0303

Appendix.32 – Ratio for Average Risk Measurements of ES @ 99% for all Portfolios

Table GBM.20 - Ratio of Average Risk Measurements for ES@99% for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region	2.7833	2.8221	2.9485	2.9011	2.7801	2.8325	2.8187	2.8277	2.8349	2.6934
Ratio of 3 State Markov Chain/One Region	2.8117	2.8345	2.9721	2.9066	2.7920	2.8522	2.8177	2.8324	2.8262	2.7134
Ratio of Geometric Time in Tail/One Region	2.7964	2.8295	2.9335	2.8624	2.8089	2.8365	2.8070	2.8354	2.8428	2.6845
Ratio of 3 State Markov Chain/Unconditional	1.0102	1.0044	1.0080	1.0019	1.0043	1.0070	0.9996	1.0017	0.9969	1.0074
Ratio of Unconditional/Geometric Time in Tail	0.9953	0.9974	1.0051	1.0135	0.9897	0.9986	1.0042	0.9973	0.9972	1.0033
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0055	1.0018	1.0132	1.0154	0.9940	1.0055	1.0038	0.9990	0.9942	1.0108

Table FRW.20 - Ratio of Average Risk Measurements for ES@99% for Simulated Symmetric Two Sided Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region	2.3023	2.1125	2.2608	2.3770	2.3217	2.5223	2.5431	2.4794	2.5062	2.5103
Ratio of 3 State Markov Chain/One Region	2.3527	2.1329	2.2491	2.4234	2.3391	2.5448	2.5635	2.4922	2.5054	2.5229
Ratio of Geometric Time in Tail/One Region	2.4389	2.1519	2.3428	2.4301	2.3408	2.5832	2.5996	2.5106	2.5476	2.5693
Ratio of 3 State Markov Chain/Unconditional	1.0219	1.0096	0.9948	1.0195	1.0075	1.0089	1.0081	1.0052	0.9997	1.0050
Ratio of Unconditional/Geometric Time in Tail	0.9440	0.9817	0.9650	0.9782	0.9918	0.9764	0.9782	0.9876	0.9837	0.9770
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9646	0.9911	0.9600	0.9972	0.9993	0.9852	0.9861	0.9927	0.9834	0.9819

Table AU.20 - Ratio of Average Risk Measurements for ES@99% for Australia

Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region	2.9495	2.7267	3.8500	4.1604	4.2356	4.2148	4.3348	4.2539	4.2003	4.0300
Ratio of 3 State Markov Chain/One Region	3.0552	2.7573	4.0155	4.2181	4.3778	4.3567	4.4788	4.4290	4.3716	4.1968
Ratio of Geometric Time in Tail/One Region	3.1884	2.8943	4.2252	4.3294	4.4161	4.4385	4.5574	4.6591	4.3801	4.2121
Ratio of 3 State Markov Chain/Unconditional	1.0358	1.0112	1.0430	1.0139	1.0336	1.0337	1.0332	1.0412	1.0408	1.0414
Ratio of Unconditional/Geometric Time in Tail	0.9251	0.9421	0.9112	0.9610	0.9591	0.9496	0.9512	0.9130	0.9590	0.9568
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9582	0.9527	0.9504	0.9743	0.9913	0.9816	0.9828	0.9506	0.9981	0.9964

Table CA.20 - Ratio of Average Risk Measurements for ES@99% for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region	2.5631	2.4955	2.5303	2.6534	2.7122	2.8521	2.9836	2.9976	3.2553	3.2195
Ratio of 3 State Markov Chain/One Region	2.6662	2.5880	2.5707	2.6670	2.8011	2.9428	3.1085	3.0818	3.4125	3.4606
Ratio of Geometric Time in Tail/One Region	2.6621	2.5522	2.5243	2.9358	2.9751	3.0194	2.9308	3.1926	3.4370	3.4400
Ratio of 3 State Markov Chain/Unconditional	1.0402	1.0371	1.0160	1.0051	1.0328	1.0318	1.0419	1.0281	1.0483	1.0749
Ratio of Unconditional/Geometric Time in Tail	0.9628	0.9778	1.0024	0.9038	0.9116	0.9446	1.0180	0.9389	0.9471	0.9359
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0015	1.0140	1.0184	0.9084	0.9415	0.9746	1.0606	0.9653	0.9929	1.0060

Table DE.20 - Ratio of Average Risk Measurements for ES@99% for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region	2.6203	2.8209	2.8772	2.7529	2.7498	2.8563	2.8582	2.8661	2.8376	2.8742
Ratio of 3 State Markov Chain/One Region	2.6694	2.9395	2.9344	2.7974	2.7966	2.9049	2.9659	2.9986	2.8879	2.9347
Ratio of Geometric Time in Tail/One Region	2.6787	2.9340	3.1133	2.9638	2.9451	3.0596	2.9117	2.8707	2.8784	2.8923
Ratio of 3 State Markov Chain/Unconditional	1.0187	1.0420	1.0199	1.0162	1.0170	1.0170	1.0377	1.0462	1.0177	1.0210
Ratio of Unconditional/Geometric Time in Tail	0.9782	0.9615	0.9242	0.9288	0.9337	0.9335	0.9816	0.9984	0.9858	0.9937
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9965	1.0019	0.9425	0.9438	0.9496	0.9494	1.0186	1.0446	1.0033	1.0147

Table HK.20 - Ratio of Average Risk Measurements for ES@99% for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region	2.6389	3.0115	2.9303	2.8871	2.9146	2.9823	3.0699	2.9622	2.9581	2.9631
Ratio of 3 State Markov Chain/One Region	2.7086	3.0595	3.0794	3.0048	3.0177	3.0228	3.2113	3.0853	3.1074	3.1991
Ratio of Geometric Time in Tail/One Region	2.6550	3.4277	2.9648	3.0621	3.0951	3.1915	3.5535	3.1676	3.1193	3.1325
Ratio of 3 State Markov Chain/Unconditional	1.0264	1.0159	1.0509	1.0407	1.0354	1.0136	1.0461	1.0416	1.0504	1.0796
Ratio of Unconditional/Geometric Time in Tail	0.9940	0.8786	0.9884	0.9429	0.9417	0.9345	0.8639	0.9351	0.9483	0.9459
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0202	0.8926	1.0386	0.9813	0.9750	0.9471	0.9037	0.9740	0.9962	1.0213

Table JP.20 - Ratio of Average Risk Measurements for ES@99% for Japan										
Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region	2.1606	2.2371	2.2866	2.2467	2.2280	2.2551	1.9355	2.2668	2.2486	2.2432
Ratio of 3 State Markov Chain/One Region	2.2117	2.2336	2.3597	2.3256	2.2231	2.3313	1.9646	2.3267	2.3259	2.3130
Ratio of Geometric Time in Tail/One Region	2.4003	2.4282	2.3329	2.4229	2.3448	2.4361	2.0505	2.3582	2.4136	2.4069
Ratio of 3 State Markov Chain/Unconditional	1.0236	0.9984	1.0320	1.0351	0.9978	1.0338	1.0151	1.0264	1.0344	1.0311
Ratio of Unconditional/Geometric Time in Tail	0.9001	0.9213	0.9801	0.9273	0.9502	0.9257	0.9439	0.9612	0.9316	0.9320
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9214	0.9199	1.0115	0.9598	0.9481	0.9570	0.9581	0.9867	0.9637	0.9610

Table SG.20 - Ratio of Average Risk Measurements for ES@99% for Singapore										
Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region	2.3574	2.4250	2.3082	2.4093	2.4198	2.4052	2.4213	2.4473	2.4553	2.5062
Ratio of 3 State Markov Chain/One Region	2.4095	2.4942	2.3538	2.4264	2.4624	2.4481	2.4615	2.4951	2.5004	2.5282
Ratio of Geometric Time in Tail/One Region	2.6451	2.5836	2.6526	2.7499	2.7764	2.7538	2.6693	2.6930	2.5449	2.6240
Ratio of 3 State Markov Chain/Unconditional	1.0221	1.0285	1.0197	1.0071	1.0176	1.0178	1.0166	1.0195	1.0184	1.0088
Ratio of Unconditional/Geometric Time in Tail	0.8913	0.9386	0.8702	0.8761	0.8716	0.8734	0.9071	0.9088	0.9648	0.9551
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9109	0.9654	0.8873	0.8824	0.8869	0.8890	0.9222	0.9265	0.9825	0.9635

Table SE.20 - Ratio of Average Risk Measurements for ES@99% for Sweden										
Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region	2.5623	2.4453	2.6291	2.8971	2.9423	3.0010	2.8722	2.9228	2.9751	2.9596
Ratio of 3 State Markov Chain/One Region	2.6012	2.5626	2.7570	2.9423	2.9823	3.0403	2.9103	2.9609	3.0187	3.0107
Ratio of Geometric Time in Tail/One Region	2.6740	2.6752	2.7384	2.9807	3.0925	3.0998	2.9715	3.0018	3.1004	3.0393
Ratio of 3 State Markov Chain/Unconditional	1.0152	1.0480	1.0486	1.0156	1.0136	1.0131	1.0133	1.0130	1.0146	1.0173
Ratio of Unconditional/Geometric Time in Tail	0.9582	0.9141	0.9601	0.9719	0.9514	0.9681	0.9666	0.9737	0.9596	0.9738
Ratio of 3 State Markov Chain/Geometric Time in Tail	0.9728	0.9579	1.0068	0.9871	0.9644	0.9808	0.9794	0.9863	0.9737	0.9906

Table CH.20 - Ratio of Average Risk Measurements for ES@99% for Switzerland										
Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region	2.4209	2.6287	2.5384	2.6315	2.4165	2.3788	2.3285	2.4452	2.4754	2.4410
Ratio of 3 State Markov Chain/One Region	2.5853	2.7939	2.6663	2.7263	2.4975	2.4695	2.3803	2.5043	2.5351	2.4874
Ratio of Geometric Time in Tail/One Region	2.4984	2.8268	2.6719	2.7606	2.5296	2.3972	2.4023	2.5000	2.5470	2.5362
Ratio of 3 State Markov Chain/Unconditional	1.0679	1.0628	1.0504	1.0360	1.0335	1.0381	1.0222	1.0242	1.0241	1.0190
Ratio of Unconditional/Geometric Time in Tail	0.9690	0.9299	0.9500	0.9532	0.9553	0.9923	0.9693	0.9781	0.9719	0.9624
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0348	0.9883	0.9979	0.9876	0.9873	1.0302	0.9908	1.0017	0.9953	0.9808

Table UK.20 - Ratio of Average Risk Measurements for ES@99% for United Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region	2.7692	2.8531	2.7504	2.7203	2.7529	2.7289	2.6831	2.6829	2.6343	2.6762
Ratio of 3 State Markov Chain/One Region	2.8376	2.9204	2.8243	2.7602	2.7926	2.7271	2.6769	2.6734	2.6358	2.7316
Ratio of Geometric Time in Tail/One Region	2.6633	3.0282	2.8636	2.8677	3.0190	3.0855	2.9631	2.9286	2.8807	2.9836
Ratio of 3 State Markov Chain/Unconditional	1.0247	1.0236	1.0269	1.0147	1.0144	0.9994	0.9977	0.9964	1.0006	1.0207
Ratio of Unconditional/Geometric Time in Tail	1.0398	0.9422	0.9605	0.9486	0.9119	0.8844	0.9055	0.9161	0.9145	0.8970
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0655	0.9644	0.9863	0.9625	0.9250	0.8839	0.9034	0.9129	0.9150	0.9155

Table US.20 - Ratio of Average Risk Measurements for ES@99% for United States										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region	2.5441	2.7352	2.7142	3.4540	3.2574	3.1393	3.1487	3.1369	3.0884	3.0970
Ratio of 3 State Markov Chain/One Region	2.7065	2.8180	2.7975	3.4976	3.3346	3.2222	3.2198	3.2389	3.1596	3.1803
Ratio of Geometric Time in Tail/One Region	2.6487	2.8000	2.7806	3.7995	3.3383	3.2256	3.2201	3.1526	3.1031	3.1741
Ratio of 3 State Markov Chain/Unconditional	1.0639	1.0303	1.0307	1.0126	1.0237	1.0264	1.0226	1.0325	1.0231	1.0269
Ratio of Unconditional/Geometric Time in Tail	0.9605	0.9768	0.9761	0.9091	0.9758	0.9733	0.9778	0.9950	0.9953	0.9757
Ratio of 3 State Markov Chain/Geometric Time in Tail	1.0218	1.0064	1.0061	0.9206	0.9989	0.9989	0.9999	1.0273	1.0182	1.0019

Appendix.33 – Ratio of Average Risk Measurements from Different Models for all Portfolios

Table GBM.21 - Ratio of Average Risk Measurements from Different Models for Simulated Geometric Brownian Motion

Portfolio Number	GBM_01	GBM_02	GBM_03	GBM_04	GBM_05	GBM_06	GBM_07	GBM_08	GBM_09	GBM_10
Ratio of Unconditional/One Region										
VaR@95%	1.0330	1.0195	1.0445	1.0151	1.0078	0.9924	1.0293	1.0245	1.0169	1.0385
VaR@97.5%	1.4585	1.4482	1.4869	1.5013	1.4623	1.4845	1.5179	1.5298	1.4925	1.4854
VaR@99%	2.1091	2.1001	2.1516	2.1392	2.0712	2.1588	2.1586	2.1551	2.1534	2.1044
ES@95%	1.8097	1.8045	1.8700	1.8463	1.7965	1.8219	1.8570	1.8549	1.8302	1.7994
ES@97.5%	2.2427	2.2413	2.3273	2.3084	2.2287	2.2911	2.2927	2.2981	2.2733	2.2080
ES@99%	2.7833	2.8221	2.9485	2.9011	2.7801	2.8325	2.8187	2.8277	2.8349	2.6934
Ratio of 3 State Markov Chain/One Region										
VaR@95%	1.0389	1.0213	1.0453	1.0150	1.0071	0.9943	1.0276	1.0241	1.0123	1.0388
VaR@97.5%	1.4823	1.4518	1.4867	1.5009	1.4577	1.4868	1.5200	1.5403	1.4877	1.5001
VaR@99%	2.1429	2.0904	2.1453	2.1236	2.0614	2.1795	2.1550	2.1667	2.1373	2.1146
ES@95%	1.8246	1.8033	1.8720	1.8398	1.7922	1.8306	1.8576	1.8598	1.8182	1.8041
ES@97.5%	2.2662	2.2440	2.3351	2.3046	2.2287	2.3057	2.2929	2.3046	2.2603	2.2213
ES@99%	2.8117	2.8345	2.9721	2.9066	2.7920	2.8522	2.8177	2.8324	2.8262	2.7134
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9835	0.9658	0.9870	0.9615	0.9556	0.9377	0.9761	0.9732	0.9584	0.9929
VaR@97.5%	1.3444	1.3222	1.3469	1.3709	1.3538	1.3504	1.3789	1.3982	1.3607	1.3928
VaR@99%	1.9596	1.9316	1.9415	1.9646	1.9133	1.9607	1.9901	1.9894	1.9743	1.9831
ES@95%	1.7267	1.7150	1.7627	1.7437	1.7228	1.7256	1.7632	1.7689	1.7341	1.7235
ES@97.5%	2.1730	2.1662	2.2306	2.2108	2.1753	2.2082	2.2135	2.2288	2.1940	2.1438
ES@99%	2.7964	2.8295	2.9335	2.8624	2.8089	2.8365	2.8070	2.8354	2.8428	2.6845

Table FRW.21 - Ratio of Average Risk Measurements from Different Models for Simulated Symmetric Two Sided Fréchet Random Walk

Portfolio Number	FRW_01	FRW_02	FRW_03	FRW_04	FRW_05	FRW_06	FRW_07	FRW_08	FRW_09	FRW_10
Ratio of Unconditional/One Region										
VaR@95%	1.0160	1.0123	1.0284	1.0274	1.0112	1.0273	1.0255	0.9946	1.0013	0.9924
VaR@97.5%	1.2915	1.3938	1.4004	1.4282	1.4145	1.3888	1.4175	1.3645	1.4137	1.3808
VaR@99%	1.7394	1.7080	1.7439	1.8306	1.7410	1.8185	1.8844	1.8900	1.9536	1.9133
ES@95%	1.6980	1.6447	1.6863	1.7276	1.6785	1.7429	1.7612	1.7300	1.7493	1.7312
ES@97.5%	1.9506	1.8743	1.9524	2.0221	1.9440	2.0728	2.1032	2.0663	2.0993	2.0801
ES@99%	2.3023	2.1125	2.2608	2.3770	2.3217	2.5223	2.5431	2.4794	2.5062	2.5103
Ratio of 3 State Markov Chain/One Region										
VaR@95%	1.0251	1.0150	1.0324	1.0354	1.0196	1.0391	1.0323	0.9923	0.9971	0.9900
VaR@97.5%	1.3286	1.3956	1.4003	1.4325	1.4173	1.4007	1.4229	1.3672	1.4164	1.3835
VaR@99%	1.8074	1.7279	1.7340	1.8481	1.7531	1.8345	1.9006	1.8953	1.9436	1.9187
ES@95%	1.7326	1.6549	1.6795	1.7430	1.6842	1.7533	1.7692	1.7309	1.7438	1.7320
ES@97.5%	1.9963	1.8902	1.9449	2.0499	1.9551	2.0895	2.1176	2.0734	2.0944	2.0871
ES@99%	2.3527	2.1329	2.2491	2.4234	2.3391	2.5448	2.5635	2.4922	2.5054	2.5229
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9628	0.9498	0.9743	0.9668	0.9547	0.9739	0.9728	0.9370	0.9440	0.9349
VaR@97.5%	1.1593	1.2339	1.2594	1.2686	1.2785	1.2461	1.2843	1.2230	1.2807	1.2624
VaR@99%	1.5715	1.5458	1.6151	1.6847	1.6172	1.6556	1.7301	1.6937	1.7525	1.7405
ES@95%	1.6717	1.5681	1.6349	1.6494	1.6020	1.6712	1.6905	1.6427	1.6665	1.6660
ES@97.5%	1.9666	1.8287	1.9358	1.9760	1.8921	2.0276	2.0574	2.0028	2.0399	2.0445
ES@99%	2.4389	2.1519	2.3428	2.4301	2.3408	2.5832	2.5996	2.5106	2.5476	2.5693

Table AU.21 - Ratio of Average Risk Measurements from Different Models for Australia										
Portfolio Number	AU_01	AU_02	AU_03	AU_04	AU_05	AU_06	AU_07	AU_08	AU_09	AU_10
Ratio of Unconditional/One Region										
VaR@95%	0.9728	0.9411	1.3123	1.3847	1.3866	1.3740	1.4175	1.4467	1.3925	1.3497
VaR@97.5%	1.4338	1.3750	1.9549	2.0595	2.0569	2.0909	2.1498	2.1906	2.1256	2.0324
VaR@99%	2.1112	1.9691	2.8643	3.0487	3.1269	3.1025	3.1887	3.2581	3.1616	3.0193
ES@95%	1.8956	1.7693	2.5625	2.7200	2.7239	2.7094	2.7976	2.8234	2.7558	2.6402
ES@97.5%	2.3630	2.1832	3.1582	3.3583	3.3944	3.3743	3.4972	3.5036	3.4407	3.2987
ES@99%	2.9495	2.7267	3.8500	4.1604	4.2356	4.2148	4.3348	4.2539	4.2003	4.0300
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9901	0.9439	1.3458	1.4194	1.4193	1.4071	1.4554	1.4843	1.4251	1.3828
VaR@97.5%	1.4708	1.3900	2.0155	2.1148	2.1151	2.1501	2.2177	2.2572	2.1846	2.0913
VaR@99%	2.1520	1.9908	2.9633	3.1582	3.2363	3.2113	3.3069	3.3682	3.2769	3.1416
ES@95%	1.9460	1.7829	2.6532	2.7810	2.8106	2.7964	2.8909	2.9201	2.8518	2.7393
ES@97.5%	2.4394	2.2060	3.2868	3.4353	3.5176	3.4970	3.6266	3.6412	3.5786	3.4392
ES@99%	3.0552	2.7573	4.0155	4.2181	4.3778	4.3567	4.4788	4.4290	4.3716	4.1968
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9288	0.9101	1.2570	1.3156	1.3216	1.3112	1.3571	1.3887	1.3282	1.2879
VaR@97.5%	1.3452	1.3052	1.8530	1.9023	1.9091	1.9492	2.0499	2.0807	1.9805	1.9233
VaR@99%	2.0261	1.8895	2.6357	2.7628	2.8557	2.8646	2.9657	3.0411	2.8717	2.8093
ES@95%	1.9101	1.7694	2.5963	2.6616	2.6735	2.6824	2.7798	2.8652	2.7061	2.6068
ES@97.5%	2.4395	2.2256	3.2832	3.3572	3.4015	3.4128	3.5429	3.6454	3.4477	3.3258
ES@99%	3.1884	2.8943	4.2252	4.3294	4.4161	4.4385	4.5574	4.6591	4.3801	4.2121

Table CA.21 - Ratio of Average Risk Measurements from Different Models for Canada										
Portfolio Number	CA_01	CA_02	CA_03	CA_04	CA_05	CA_06	CA_07	CA_08	CA_09	CA_10
Ratio of Unconditional/One Region										
VaR@95%	0.9080	0.9715	0.9551	0.9441	0.9803	0.9885	1.0275	0.9708	1.0353	1.0362
VaR@97.5%	1.3178	1.3597	1.3579	1.3906	1.4130	1.4089	1.4583	1.4035	1.4970	1.4988
VaR@99%	1.8947	1.8948	1.8186	1.8637	1.9557	2.0028	2.1142	2.0599	2.2764	2.2747
ES@95%	1.6838	1.7061	1.7065	1.7783	1.8105	1.8593	1.9254	1.8870	2.0514	2.0487
ES@97.5%	2.0732	2.0572	2.0636	2.1600	2.1946	2.2820	2.3826	2.3558	2.5605	2.5535
ES@99%	2.5631	2.4955	2.5303	2.6534	2.7122	2.8521	2.9836	2.9976	3.2553	3.2195
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9259	0.9971	0.9881	0.9659	1.0073	1.0131	1.0547	0.9830	1.0595	1.0551
VaR@97.5%	1.3548	1.4000	1.4144	1.4273	1.4587	1.4501	1.4991	1.4302	1.5514	1.5343
VaR@99%	1.9459	1.9623	1.8689	1.9234	2.0220	2.0667	2.1923	2.0935	2.3458	2.3450
ES@95%	1.7400	1.7624	1.7498	1.8046	1.8713	1.9172	1.9953	1.9246	2.1337	2.1555
ES@97.5%	2.1527	2.1336	2.1130	2.1924	2.2757	2.3617	2.4810	2.4152	2.6762	2.7147
ES@99%	2.6662	2.5880	2.5707	2.6670	2.8011	2.9428	3.1085	3.0818	3.4125	3.4606
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.8661	0.9287	0.9085	0.9063	0.9423	0.9475	0.9809	0.9277	0.9898	0.9991
VaR@97.5%	1.2211	1.2882	1.2414	1.3034	1.3515	1.3267	1.3335	1.3031	1.4218	1.4031
VaR@99%	1.7863	1.7649	1.6799	1.7683	1.8875	1.9121	1.9353	1.9381	2.1173	2.1206
ES@95%	1.6492	1.6644	1.6303	1.8107	1.8508	1.8597	1.8299	1.8786	2.0402	2.0517
ES@97.5%	2.0705	2.0409	2.0004	2.2590	2.2974	2.3282	2.2889	2.3951	2.6015	2.6147
ES@99%	2.6621	2.5522	2.5243	2.9358	2.9751	3.0194	2.9308	3.1926	3.4370	3.4400

Table DE.21 - Ratio of Average Risk Measurements from Different Models for Germany										
Portfolio Number	DE_01	DE_02	DE_03	DE_04	DE_05	DE_06	DE_07	DE_08	DE_09	DE_10
Ratio of Unconditional/One Region										
VaR@95%	1.0027	1.0652	1.0485	1.0630	1.0863	1.0683	1.0552	1.0496	1.0912	1.0887
VaR@97.5%	1.3705	1.4583	1.5609	1.5339	1.5441	1.5548	1.5767	1.5770	1.5794	1.5677
VaR@99%	1.9100	2.0282	1.9911	2.0650	2.1232	2.1905	2.1218	2.2091	2.2339	2.1828
ES@95%	1.7607	1.8929	1.9641	1.9250	1.9418	1.9696	1.9767	1.9826	1.9901	1.9965
ES@97.5%	2.1262	2.2807	2.3482	2.3049	2.3277	2.3959	2.3997	2.4079	2.4001	2.4146
ES@99%	2.6203	2.8209	2.8772	2.7529	2.7498	2.8563	2.8582	2.8661	2.8376	2.8742
Ratio of 3 State Markov Chain/One Region										
VaR@95%	1.0422	1.0926	1.0954	1.0913	1.1163	1.0973	1.0894	1.0780	1.1323	1.1315
VaR@97.5%	1.4235	1.5049	1.6505	1.5785	1.5990	1.6099	1.6554	1.6301	1.6467	1.6640
VaR@99%	1.9775	2.0867	2.0694	2.1383	2.1976	2.2678	2.1701	2.2992	2.3106	2.2701
ES@95%	1.8102	1.9634	2.0279	1.9677	1.9879	2.0153	2.0515	2.0599	2.0440	2.0638
ES@97.5%	2.1846	2.3757	2.4200	2.3608	2.3867	2.4556	2.4915	2.5150	2.4628	2.4902
ES@99%	2.6694	2.9395	2.9344	2.7974	2.7966	2.9049	2.9659	2.9986	2.8879	2.9347
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9577	1.0314	1.0017	1.0212	1.0430	1.0248	1.0131	0.9967	1.0362	1.0411
VaR@97.5%	1.2987	1.4197	1.4389	1.4466	1.4494	1.4524	1.4717	1.4573	1.4757	1.4426
VaR@99%	1.8011	1.9415	1.8308	1.9408	1.9966	2.0479	1.9470	1.9977	2.0774	1.9896
ES@95%	1.7215	1.8865	1.9622	1.9350	1.9415	1.9643	1.9167	1.8937	1.9212	1.9122
ES@97.5%	2.1144	2.3083	2.4150	2.3760	2.3853	2.4499	2.3711	2.3387	2.3642	2.3584
ES@99%	2.6787	2.9340	3.1133	2.9638	2.9451	3.0596	2.9117	2.8707	2.8784	2.8923

Table HK.21 - Ratio of Average Risk Measurements from Different Models for Hong Kong										
Portfolio Number	HK_01	HK_02	HK_03	HK_04	HK_05	HK_06	HK_07	HK_08	HK_09	HK_10
Ratio of Unconditional/One Region										
VaR@95%	0.8989	1.0431	1.0427	1.0382	1.0364	1.0526	1.0677	1.0209	1.0276	1.0244
VaR@97.5%	1.3124	1.5239	1.4982	1.4858	1.4884	1.5344	1.5639	1.4776	1.4669	1.4637
VaR@99%	1.8629	2.1696	2.0527	2.0761	2.0665	2.2108	2.2721	2.2468	2.1739	2.1868
ES@95%	1.7400	1.9983	1.9837	1.9498	1.9637	2.0239	2.0675	1.9845	1.9841	1.9809
ES@97.5%	2.1264	2.4496	2.4137	2.3606	2.3738	2.4523	2.5184	2.4215	2.4148	2.4117
ES@99%	2.6389	3.0115	2.9303	2.8871	2.9146	2.9823	3.0699	2.9622	2.9581	2.9631
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9199	1.0712	1.0719	1.0635	1.0677	1.0840	1.1000	1.0429	1.0635	1.0481
VaR@97.5%	1.3444	1.5709	1.5445	1.5288	1.5371	1.5769	1.6119	1.5361	1.5279	1.5114
VaR@99%	1.9269	2.2393	2.1306	2.1470	2.1465	2.2931	2.3438	2.3193	2.2672	2.2592
ES@95%	1.7853	2.0458	2.0663	2.0171	2.0328	2.0704	2.1448	2.0596	2.0722	2.0957
ES@97.5%	2.1896	2.5107	2.5286	2.4551	2.4661	2.5087	2.6259	2.5228	2.5332	2.5763
ES@99%	2.7086	3.0595	3.0794	3.0048	3.0177	3.0228	3.2113	3.0853	3.1074	3.1991
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.8531	0.9994	0.9907	0.9919	0.9891	1.0088	1.0237	0.9784	0.9750	0.9713
VaR@97.5%	1.2034	1.4427	1.3677	1.3925	1.3830	1.4247	1.4626	1.3711	1.3518	1.3396
VaR@99%	1.6720	2.0523	1.8429	1.9183	1.9034	2.0369	2.1506	2.0516	1.9829	1.9821
ES@95%	1.6610	2.0751	1.8992	1.9418	1.9472	2.0217	2.1680	1.9743	1.9534	1.9528
ES@97.5%	2.0655	2.6261	2.3533	2.4039	2.4097	2.5082	2.7326	2.4671	2.4374	2.4368
ES@99%	2.6550	3.4277	2.9648	3.0621	3.0951	3.1915	3.5535	3.1676	3.1193	3.1325

Table JP.21 - Ratio of Average Risk Measurements from Different Models for Japan

Portfolio Number	JP_01	JP_02	JP_03	JP_04	JP_05	JP_06	JP_07	JP_08	JP_09	JP_10
Ratio of Unconditional/One Region										
VaR@95%	0.9000	0.8942	0.9280	0.9288	0.9066	0.9161	0.7853	0.8946	0.8924	0.8785
VaR@97.5%	1.2108	1.2378	1.2527	1.2528	1.2369	1.2611	1.0900	1.2502	1.2294	1.2196
VaR@99%	1.5744	1.6601	1.6777	1.7442	1.7257	1.6674	1.4310	1.7052	1.6929	1.6943
ES@95%	1.5163	1.5551	1.5820	1.5790	1.5469	1.5691	1.3470	1.5739	1.5556	1.5402
ES@97.5%	1.7762	1.8520	1.8855	1.8817	1.8457	1.8661	1.6042	1.8858	1.8638	1.8521
ES@99%	2.1606	2.2371	2.2866	2.2467	2.2280	2.2551	1.9355	2.2668	2.2486	2.2432
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9189	0.9159	0.9500	0.9533	0.9308	0.9421	0.8062	0.9144	0.9136	0.8976
VaR@97.5%	1.2300	1.2698	1.2884	1.2887	1.2672	1.2957	1.1253	1.2832	1.2628	1.2550
VaR@99%	1.6109	1.7042	1.7324	1.7994	1.7687	1.7085	1.4801	1.7547	1.7459	1.7476
ES@95%	1.5448	1.5722	1.6287	1.6284	1.5630	1.6115	1.3788	1.6143	1.6028	1.5837
ES@97.5%	1.8186	1.8701	1.9499	1.9487	1.8620	1.9245	1.6440	1.9419	1.9291	1.9121
ES@99%	2.2117	2.2336	2.3597	2.3256	2.2231	2.3313	1.9646	2.3267	2.3259	2.3130
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.8590	0.8591	0.8803	0.8879	0.8706	0.8762	0.7498	0.8524	0.8522	0.8380
VaR@97.5%	1.1299	1.1681	1.1561	1.1716	1.1620	1.1817	1.0127	1.1580	1.1364	1.1224
VaR@99%	1.4890	1.5672	1.5396	1.6315	1.5922	1.5651	1.3154	1.5601	1.5792	1.5870
ES@95%	1.5430	1.5665	1.5283	1.5788	1.5269	1.5714	1.3303	1.5386	1.5485	1.5316
ES@97.5%	1.8660	1.9145	1.8594	1.9340	1.8626	1.9201	1.6217	1.8841	1.9008	1.8880
ES@99%	2.4003	2.4282	2.3329	2.4229	2.3448	2.4361	2.0505	2.3582	2.4136	2.4069

Table SG.21 - Ratio of Average Risk Measurements from Different Models for Singapore

Portfolio Number	SG_01	SG_02	SG_03	SG_04	SG_05	SG_06	SG_07	SG_08	SG_09	SG_10
Ratio of Unconditional/One Region										
VaR@95%	0.9663	0.9094	0.9309	0.9047	0.9106	0.9708	0.9826	0.9675	0.9841	0.9553
VaR@97.5%	1.3265	1.3117	1.3157	1.2442	1.2480	1.3612	1.3810	1.3625	1.3707	1.3517
VaR@99%	1.7975	1.8082	1.7265	1.8013	1.8900	1.9486	1.8958	1.9392	1.9660	1.8938
ES@95%	1.6704	1.6756	1.6538	1.6707	1.6867	1.7427	1.7576	1.7440	1.7703	1.7635
ES@97.5%	1.9782	2.0094	1.9545	1.9969	2.0303	2.0659	2.0694	2.0695	2.0965	2.1064
ES@99%	2.3574	2.4250	2.3082	2.4093	2.4198	2.4052	2.4213	2.4473	2.4553	2.5062
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9969	0.9581	0.9801	0.9600	0.9666	1.0229	1.0346	1.0222	1.0350	1.0030
VaR@97.5%	1.3830	1.4029	1.4011	1.3589	1.3557	1.4547	1.4765	1.4563	1.4572	1.4417
VaR@99%	1.8570	1.8991	1.8030	1.9103	2.0108	2.0470	1.9897	2.0314	2.0750	1.9665
ES@95%	1.7187	1.7510	1.7185	1.7347	1.7611	1.8106	1.8224	1.8151	1.8368	1.8184
ES@97.5%	2.0383	2.0938	2.0234	2.0585	2.1074	2.1379	2.1370	2.1436	2.1679	2.1593
ES@99%	2.4095	2.4942	2.3538	2.4264	2.4624	2.4481	2.4615	2.4951	2.5004	2.5282
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9233	0.8663	0.8908	0.8652	0.8640	0.9210	0.9293	0.9120	0.9296	0.8975
VaR@97.5%	1.2370	1.2106	1.2345	1.1494	1.1525	1.2471	1.2484	1.2344	1.2264	1.2017
VaR@99%	1.7457	1.6428	1.6455	1.7142	1.8343	1.8320	1.7438	1.7757	1.7616	1.7125
ES@95%	1.7158	1.6635	1.7261	1.7321	1.7553	1.7974	1.7595	1.7438	1.7119	1.7088
ES@97.5%	2.1037	2.0433	2.1119	2.1452	2.1938	2.2115	2.1393	2.1412	2.0779	2.1003
ES@99%	2.6451	2.5836	2.6526	2.7499	2.7764	2.7538	2.6693	2.6930	2.5449	2.6240

Table SE.21 - Ratio of Average Risk Measurements from Different Models for Sweden

Portfolio Number	SE_01	SE_02	SE_03	SE_04	SE_05	SE_06	SE_07	SE_08	SE_09	SE_10
Ratio of Unconditional/One Region										
VaR@95%	1.0400	0.8657	0.9029	0.9726	1.0246	1.0654	1.0456	1.0602	1.0527	1.1011
VaR@97.5%	1.4555	1.2434	1.3341	1.4174	1.4328	1.5082	1.4558	1.5121	1.5045	1.4800
VaR@99%	1.8623	1.7177	1.8380	2.0293	2.0746	2.1968	2.0590	2.0825	2.1266	2.1503
ES@95%	1.8062	1.6186	1.7325	1.8858	1.9234	1.9937	1.9233	1.9602	1.9862	1.9835
ES@97.5%	2.1264	1.9739	2.1205	2.3247	2.3543	2.4365	2.3322	2.3739	2.4091	2.3981
ES@99%	2.5623	2.4453	2.6291	2.8971	2.9423	3.0010	2.8722	2.9228	2.9751	2.9596
Ratio of 3 State Markov Chain/One Region										
VaR@95%	1.0823	0.8913	0.9274	1.0057	1.0585	1.1075	1.0793	1.0940	1.0943	1.1465
VaR@97.5%	1.5548	1.2866	1.3864	1.5025	1.5126	1.5982	1.5446	1.6078	1.6017	1.5875
VaR@99%	1.9435	1.7792	1.9175	2.0959	2.1536	2.2658	2.1262	2.1567	2.2112	2.2372
ES@95%	1.8694	1.6846	1.8067	1.9437	1.9772	2.0509	1.9802	2.0178	2.0488	2.0527
ES@97.5%	2.1935	2.0651	2.2221	2.3889	2.4134	2.4959	2.3929	2.4345	2.4749	2.4715
ES@99%	2.6012	2.5626	2.7570	2.9423	2.9823	3.0403	2.9103	2.9609	3.0187	3.0107
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9923	0.8227	0.8551	0.9215	0.9664	1.0054	0.9844	1.0034	0.9910	1.0405
VaR@97.5%	1.3446	1.1458	1.2229	1.2936	1.2939	1.3677	1.3071	1.3775	1.3709	1.3443
VaR@99%	1.7282	1.5718	1.6763	1.8382	1.8995	2.0050	1.8724	1.8729	1.9491	1.9334
ES@95%	1.7617	1.6243	1.6925	1.8240	1.8782	1.9334	1.8584	1.8950	1.9359	1.9146
ES@97.5%	2.1251	2.0403	2.1205	2.2990	2.3628	2.4210	2.3127	2.3450	2.4089	2.3668
ES@99%	2.6740	2.6752	2.7384	2.9807	3.0925	3.0998	2.9715	3.0018	3.1004	3.0393

Table CH.21 - Ratio of Average Risk Measurements from Different Models for Switzerland

Portfolio Number	CH_01	CH_02	CH_03	CH_04	CH_05	CH_06	CH_07	CH_08	CH_09	CH_10
Ratio of Unconditional/One Region										
VaR@95%	0.9401	1.0227	1.0047	0.9996	0.9840	0.9765	0.9666	0.9866	0.9831	1.0042
VaR@97.5%	1.3186	1.4887	1.4626	1.4799	1.4005	1.4043	1.3643	1.3765	1.3755	1.3538
VaR@99%	1.8264	2.0638	2.0513	2.0992	1.9572	1.9145	1.8532	1.8534	1.8376	1.8345
ES@95%	1.6848	1.8564	1.8263	1.8581	1.7504	1.7429	1.7162	1.7551	1.7710	1.7595
ES@97.5%	2.0189	2.2267	2.1839	2.2356	2.0799	2.0547	2.0190	2.0765	2.0965	2.0747
ES@99%	2.4209	2.6287	2.5384	2.6315	2.4165	2.3788	2.3285	2.4452	2.4754	2.4410
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9615	1.0448	1.0255	1.0233	1.0095	1.0111	1.0078	1.0331	1.0305	1.0463
VaR@97.5%	1.3564	1.5244	1.5119	1.5471	1.4625	1.4749	1.4475	1.4631	1.4641	1.4156
VaR@99%	1.8825	2.1291	2.1194	2.1584	2.0105	1.9584	1.9298	1.9315	1.9259	1.8960
ES@95%	1.7642	1.9404	1.9027	1.9227	1.8095	1.8103	1.7757	1.8206	1.8428	1.8126
ES@97.5%	2.1335	2.3477	2.2889	2.3173	2.1533	2.1340	2.0853	2.1498	2.1744	2.1322
ES@99%	2.5853	2.7939	2.6663	2.7263	2.4975	2.4695	2.3803	2.5043	2.5351	2.4874
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.8936	0.9967	0.9750	0.9681	0.9456	0.9306	0.9184	0.9421	0.9424	0.9655
VaR@97.5%	1.2166	1.4271	1.4269	1.4035	1.3539	1.2985	1.2832	1.2855	1.2779	1.3022
VaR@99%	1.6651	1.9767	1.9970	2.0341	1.8845	1.7541	1.7477	1.7339	1.6987	1.7193
ES@95%	1.6399	1.8787	1.8374	1.8565	1.7477	1.6772	1.6799	1.7119	1.7255	1.7441
ES@97.5%	2.0062	2.2986	2.2387	2.2782	2.1173	2.0089	2.0192	2.0600	2.0812	2.0911
ES@99%	2.4984	2.8268	2.6719	2.7606	2.5296	2.3972	2.4023	2.5000	2.5470	2.5362

Table UK.21 - Ratio of Average Risk Measurements from Different Models for United Kingdom										
Portfolio Number	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_08	UK_09	UK_10
Ratio of Unconditional/One Region										
VaR@95%	0.9416	0.9961	0.9761	0.9895	1.0014	1.0065	1.0049	1.0109	1.0239	1.0295
VaR@97.5%	1.3558	1.4664	1.3608	1.4261	1.4173	1.4265	1.4085	1.4187	1.4429	1.4153
VaR@99%	1.9735	2.1572	1.9637	2.0066	2.0184	1.9954	1.9745	2.0202	1.9846	1.9957
ES@95%	1.7792	1.8660	1.7986	1.8206	1.8367	1.8446	1.8154	1.8301	1.8207	1.8344
ES@97.5%	2.2036	2.3179	2.2017	2.2168	2.2357	2.2424	2.1992	2.2117	2.1945	2.2026
ES@99%	2.7692	2.8531	2.7504	2.7203	2.7529	2.7289	2.6831	2.6829	2.6343	2.6762
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9586	1.0090	0.9972	1.0148	1.0240	1.0340	1.0349	1.0400	1.0534	1.0559
VaR@97.5%	1.3792	1.4926	1.3940	1.4658	1.4513	1.4650	1.4423	1.4596	1.4843	1.4592
VaR@99%	2.0255	2.1808	2.0026	2.0703	2.0549	2.0452	2.0048	2.0628	2.0344	2.0595
ES@95%	1.8170	1.8982	1.8404	1.8578	1.8699	1.8671	1.8329	1.8493	1.8461	1.8798
ES@97.5%	2.2614	2.3672	2.2618	2.2645	2.2814	2.2660	2.2162	2.2287	2.2224	2.2629
ES@99%	2.8376	2.9204	2.8243	2.7602	2.7926	2.7271	2.6769	2.6734	2.6358	2.7316
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.8892	0.9502	0.9257	0.9396	0.9676	0.9599	0.9638	0.9746	0.9856	0.9899
VaR@97.5%	1.2198	1.3467	1.2376	1.3065	1.3526	1.3189	1.3057	1.3186	1.3589	1.3162
VaR@99%	1.7863	2.0030	1.8301	1.8668	1.9713	1.9199	1.8852	1.9614	1.9299	1.9384
ES@95%	1.6563	1.8393	1.7510	1.7908	1.8689	1.8943	1.8376	1.8477	1.8500	1.8740
ES@97.5%	2.0737	2.3390	2.1936	2.2351	2.3353	2.3873	2.2949	2.2981	2.2951	2.3232
ES@99%	2.6633	3.0282	2.8636	2.8677	3.0190	3.0855	2.9631	2.9286	2.8807	2.9836

Table US.21 - Ratio of Average Risk Measurements from Different Models for United States										
Portfolio Number	US_01	US_02	US_03	US_04	US_05	US_06	US_07	US_08	US_09	US_10
Ratio of Unconditional/One Region										
VaR@95%	0.9501	0.9533	0.9647	1.1733	1.1278	1.1144	1.0833	1.0961	1.0906	1.0746
VaR@97.5%	1.3486	1.3957	1.3836	1.7028	1.6803	1.6175	1.5819	1.6145	1.6204	1.6008
VaR@99%	1.9932	2.0740	2.0219	2.5413	2.3631	2.2757	2.2611	2.2864	2.2504	2.2596
ES@95%	1.7277	1.8177	1.7899	2.2416	2.1508	2.0663	2.0487	2.0700	2.0535	2.0514
ES@97.5%	2.1103	2.2484	2.2032	2.7731	2.6385	2.5340	2.5322	2.5394	2.5218	2.5168
ES@99%	2.5441	2.7352	2.7142	3.4540	3.2574	3.1393	3.1487	3.1369	3.0884	3.0970
Ratio of 3 State Markov Chain/One Region										
VaR@95%	0.9676	0.9742	0.9838	1.1969	1.1536	1.1473	1.1049	1.1188	1.1088	1.0933
VaR@97.5%	1.3764	1.4338	1.4173	1.7297	1.7177	1.6618	1.6202	1.6416	1.6493	1.6307
VaR@99%	2.0520	2.1251	2.0739	2.5844	2.4355	2.3494	2.3095	2.3334	2.2701	2.2995
ES@95%	1.8038	1.8667	1.8361	2.2693	2.2020	2.1236	2.0941	2.1213	2.0874	2.0961
ES@97.5%	2.2248	2.3175	2.2714	2.8163	2.7101	2.6114	2.5957	2.6158	2.5728	2.5823
ES@99%	2.7065	2.8180	2.7975	3.4976	3.3346	3.2222	3.2198	3.2389	3.1596	3.1803
Ratio of Geometric Time in Tail/One Region										
VaR@95%	0.9138	0.9014	0.9169	1.1262	1.0720	1.0541	1.0245	1.0585	1.0514	1.0369
VaR@97.5%	1.2879	1.2671	1.2808	1.5976	1.5575	1.4728	1.4381	1.4895	1.4926	1.4781
VaR@99%	1.9012	1.8903	1.8474	2.3998	2.1513	2.0792	2.0704	2.1159	2.0741	2.1164
ES@95%	1.7120	1.7546	1.7383	2.2699	2.0834	1.9963	1.9757	2.0007	1.9806	2.0068
ES@97.5%	2.1280	2.2196	2.1819	2.8924	2.6085	2.5054	2.4985	2.4905	2.4685	2.5063
ES@99%	2.6487	2.8000	2.7806	3.7995	3.3383	3.2256	3.2201	3.1526	3.1031	3.1741

Appendix.34 – Country Risk Ranking for the Regime Switching Models

Table A.22 - Country Risk Ranking for the Regime Switching Models										
Country	**AU**	**CA**	**DE**	**HK**	**JP**	**SG**	**SE**	**CH**	**US**	**UK**
Country Risk Ranking – Average Risk Measurements*										
One-Region VaR Ranking	2	1	6	8	9	7	10	3	5	4
One-Region ES Ranking	2	1	6	9	8	7	10	4	5	3
Unconditional VaR Ranking	8	1	7	10	6	4	9	2	5	3
Unconditional ES Ranking	8	1	7	10	4	6	9	2	5	3
Markovian VaR Ranking	8	1	7	9	6	5	10	2	4	3
Markovian ES Ranking	8	1	7	10	5	6	9	3	5	2
Geometric VaR Ranking	8	1	7	10	6	4	9	2	5	3
Geometric ES Ranking	8	1	7	10	5	6	9	2	4	3
Country Risk Rankings - Risk Reduction and Diversification Effects**										
One-Region	7	2	3	10	8	6	1	9	5	4
Unconditional	9	6	4	10	5	3	1	8	7	2
Markovian	9	7	4	10	5	3	1	8	6	2
Geometric	9	6	4	10	5	3	1	8	7	2
Country Risk Ranking - Average ES/VaR Ratio for Different Confidence Levels***										
One-Region	2	1	7	8	5	10	6	9	3	4
Unconditional	6	4	5	10	1	9	8	7	3	2
Markovian	7	5	4	10	1	9	6	8	3	2
Geometric	7	4	5	9	1	10	8	6	2	3

* The lower the rankings the less risk
** The lower the ranking the greater the risk reduction
*** The lower the ranking the less relative risk weights in the tails

Appendix.35 – Summary of Average Risk Measurements for all Regime Switching Models across all Portfolios

Table A.23 Average Risk Measurements over the 10 portfolios

Country	GBM	FRW	AU	CA	DE	HK	JP	SG	SE	CH	US	UK
Average Risk Measurements over the 10 portfolios for One Region Distribution Function												
VaR@95%	-2243.42	-1978.92	-19032.1	-16096.8	-22327.3	-25812.9	-25928.1	-22047.8	-26595	-17851.8	-21073.1	-19039
VaR@97.5%	-2678.62	-2689.42	-23397.2	-20651.4	-28857.6	-33542.3	-34403.9	-29648.3	-35037	-23485.7	-26438.2	-24509.2
VaR@99%	-3149.16	-3816.79	-29347.9	-26807.9	-39032.9	-44537.6	-46096.1	-40285.3	-47269.3	-31960.6	-33693.2	-31483.9
ES@95%	-2820.94	-3156.96	-26274.8	-22986.8	-33155.4	-38522.8	-38675	-34962.7	-39801	-27337.4	-29560.7	-27195.7
ES@97.5%	-3206.26	-4030.15	-31608.9	-27897.6	-41058.5	-48090.8	-47782.3	-44634.2	-49389.3	-34503.5	-35687.7	-33034.6
ES@99%	-3673.8	-5291.5	-39859.1	-34678.1	-52859.3	-62647.4	-60044.2	-59939.6	-62835	-45893.2	-44662.8	-41294
Average Risk Measurements over the 10 portfolios for Unconditional LT-C-RT Transfers												
VaR@95%	-2295.84	-2008.75	-24527.6	-15717.3	-23651.5	-26454	-23128.5	-20896.6	-26777.3	-17597.3	-22336.6	-18934.2
VaR@97.5%	-3964.59	-3713.07	-45149.8	-28971.2	-43950.1	-49676.9	-42076.3	-39328.8	-50020.2	-32863.2	-40918.4	-34590.5
VaR@99%	-6694.26	-6856.12	-83842.7	-53459.9	-81586.9	-94713.3	-76136	-74931.3	-93858.1	-61424.3	-75072.5	-63256.8
ES@95%	-5153.05	-5386.7	-66288.5	-42009.6	-64038.2	-75756.6	-59349	-59804.5	-74159.5	-48362.1	-58934.1	-49582
ES@97.5%	-7274.5	-8027.21	-99142.5	-62566	-95653.4	-115085	-87332.8	-90790.1	-111515	-72537.9	-87487.9	-73445.8
ES@99%	-10384.1	-12414	-154564	-96724.8	-148270	-183637	-132511	-144595	-174819	-113162	-134672	-112689
Average Risk Measurements over the 10 portfolios for 3 State Markov Chain Transfers												
Country	**GBM**	**FRW**	**AU**	**CA**	**DE**	**HK**	**JP**	**SG**	**SE**	**CH**	**US**	**UK**
VaR@97.5%	-3981.93	-3739.41	-46392.3	-29830.8	-45772.1	-51261.5	-43184.1	-42006.6	-52933.4	-34363	-41792.7	-35440.7
VaR@99%	-6706.55	-6933.22	-86584.3	-55089.8	-84419.1	-98070.8	-78332.3	-78584.9	-97404.6	-63508.7	-76794.7	-64677.1
ES@95%	-5160.28	-5420.12	-68294.3	-43356	-65991.1	-78487	-60738.6	-62074.2	-76637	-50226.2	-60387.6	-50446.6
ES@97.5%	-7297.62	-8097.56	-102561	-64830.8	-98661.2	-119740	-89637.2	-93874.7	-115031	-75474.2	-90039	-74830.7
ES@99%	-10436.6	-12537.2	-159711	-100187	-152020	-190965	-135512	-147187	-178539	-117461	-138626	-114147
Average Risk Measurements over the 10 portfolios for Geometric Time in Tails Transfers												
VaR@95%	-2177.27	-1896.85	-23446.9	-15040.9	-22649.2	-25238.6	-22093.9	-19841.2	-25350.1	-16897.9	-21345.7	-18093.5
VaR@97.5%	-3631.47	-3334.25	-42424.7	-27100.6	-41224.1	-46076.4	-39187.9	-36025	-45638.4	-31086.4	-37847.9	-31948.6
VaR@99%	-6161.74	-6249.15	-77685.9	-50178.1	-75929.7	-87053.6	-70905.1	-69974.1	-85659.4	-57898.7	-69480.9	-59941.4
ES@95%	-4898.15	-5185.58	-65932.7	-41547.3	-62956.8	-75438.7	-58996.8	-60486.5	-72283.7	-47728.5	-57513.5	-49302.5
ES@97.5%	-7027.89	-7899.19	-100800	-63122.3	-96053.7	-117465	-89028.6	-94851.1	-111414	-72945.1	-87145.9	-74954.1
ES@99%	-10386.4	-12776.5	-164028	-101500	-154396	-196456	-141587	-159927	-182344	-117500	-138933	-120553

Appendix.36 – Risk Reduction and Diversification Effects for all Portfolios

Table A.24 - Risk Reduction and Diversification Effects												
Country	**GBM**	**FRW**	**AU**	**CA**	**DE**	**HK**	**JP**	**SG**	**SE**	**CH**	**US**	**UK**
Portfolio Risk Reduction - Portfolio 10 Relative to Portfolio 1 for One Region Distribution Function												
VaR@95%	0.321459	0.420741	0.736155	0.642218	0.691921	0.905974	0.801031	0.70327	0.502516	0.794945	0.717733	0.621835
VaR@97.5%	0.316033	0.357641	0.719415	0.663551	0.651984	0.935695	0.768539	0.703364	0.524991	0.84085	0.687035	0.652311
VaR@99%	0.320048	0.316088	0.712211	0.656549	0.6569	0.907375	0.712202	0.707037	0.466261	0.883835	0.72716	0.680195
ES@95%	0.320746	0.326923	0.731469	0.660241	0.668759	0.948356	0.753354	0.717673	0.493175	0.86281	0.694537	0.671937
ES@97.5%	0.322377	0.295564	0.729363	0.669452	0.671096	0.964003	0.72966	0.727927	0.482829	0.891831	0.694546	0.697662
ES@99%	0.32545	0.265798	0.744801	0.683268	0.703081	0.99373	0.727258	0.754063	0.475893	0.933759	0.684931	0.730254
Portfolio Risk Reduction - Portfolio 10 Relative to Portfolio 1 for Unconditional LT-C-RT transfers												
VaR@95%	0.323165	0.410955	1.021328	0.732872	0.751292	1.032425	0.781905	0.695259	0.532031	0.84915	0.811831	0.679879
VaR@97.5%	0.321867	0.382352	1.019772	0.754735	0.745781	1.043587	0.774138	0.716769	0.53382	0.863254	0.815545	0.680916
VaR@99%	0.319338	0.347692	1.018585	0.788256	0.750719	1.065101	0.766422	0.744935	0.538357	0.887766	0.824375	0.687874
ES@95%	0.318917	0.333331	1.01879	0.803344	0.758326	1.079665	0.765235	0.757702	0.541575	0.901065	0.824673	0.692793
ES@97.5%	0.317379	0.315195	1.018194	0.82456	0.76213	1.093304	0.760854	0.775112	0.544514	0.91649	0.828321	0.697373
ES@99%	0.31494	0.289811	1.017657	0.85826	0.771219	1.115806	0.755067	0.801643	0.549677	0.941493	0.833796	0.705709
Portfolio Risk Reduction - Portfolio 10 Relative to Portfolio 1 for 3 State Markov Chain Transfers												
VaR@95%	0.321434	0.406352	1.028172	0.731836	0.751229	1.032245	0.782452	0.707567	0.532327	0.865125	0.810988	0.684922
VaR@97.5%	0.319818	0.372418	1.022898	0.751465	0.762133	1.051978	0.784156	0.733262	0.536035	0.877599	0.813941	0.690146
VaR@99%	0.315814	0.335551	1.039706	0.791198	0.75408	1.063893	0.772608	0.748739	0.536724	0.890163	0.814846	0.691612
ES@95%	0.317157	0.326798	1.029701	0.817914	0.762468	1.113232	0.772316	0.759295	0.541553	0.886456	0.807065	0.695166
ES@97.5%	0.315984	0.309002	1.02828	0.84425	0.764984	1.134273	0.76718	0.771131	0.544026	0.891277	0.80617	0.698118
ES@99%	0.314071	0.285028	1.023091	0.886854	0.77296	1.173688	0.760551	0.791203	0.550797	0.898423	0.804829	0.70296
Portfolio Risk Reduction - Portfolio 10 Relative to Portfolio 1 for Geometric Time in Tails Transfers												
VaR@95%	0.324541	0.408565	1.020728	0.740879	0.752167	1.031586	0.781463	0.6836	0.526897	0.858929	0.814376	0.692258
VaR@97.5%	0.327422	0.389429	1.028541	0.762503	0.724238	1.041638	0.763437	0.683344	0.524868	0.899983	0.788525	0.703872
VaR@99%	0.323894	0.350078	0.987509	0.779426	0.725658	1.075675	0.759095	0.693606	0.521638	0.912604	0.809501	0.738084
ES@95%	0.320156	0.325816	0.99825	0.821388	0.742839	1.114991	0.747788	0.714733	0.535956	0.917626	0.81412	0.760244
ES@97.5%	0.318049	0.307267	0.994356	0.845389	0.748549	1.137298	0.73826	0.726729	0.537761	0.929577	0.818024	0.781611
ES@99%	0.312426	0.280011	0.983918	0.882927	0.759158	1.172469	0.729253	0.748044	0.540906	0.947897	0.82081	0.818086

Appendix.37 – Average ES/VaR Ratios for Different Models across all Portfolios

Table A.25 - Average ES/VaR Ratio for Different Confidence Levels												
Country	GBM	FRW	AU	CA	DE	HK	JP	SG	SE	CH	US	UK
Average VaR/ES Ratio for Different Confidence Levels and the One Region Distribution Function												
95%	1.257429	1.595292	1.380549	1.428033	1.484975	1.492385	1.491623	1.585769	1.49656	1.531347	1.428418	1.402772
97.5%	1.196984	1.498522	1.350968	1.350885	1.422797	1.433733	1.388864	1.505456	1.409631	1.46913	1.347847	1.349856
99%	1.166596	1.386374	1.358159	1.293575	1.354223	1.406616	1.302586	1.487877	1.329298	1.43593	1.311589	1.325572
Average VaR/ES Ratio for Different Confidence Levels and the Unconditional LT-C-RT transfers												
95%	2.24452	2.68162	2.702609	2.67282	2.707576	2.863711	2.566059	2.861925	2.769489	2.748261	2.618643	2.63845
97.5%	1.834867	2.161881	2.195859	2.159596	2.176409	2.316665	2.075583	2.308486	2.229406	2.207273	2.123294	2.13811
99%	1.551188	1.810648	1.843505	1.809297	1.817328	1.93887	1.740458	1.929703	1.862589	1.842297	1.781448	1.793898
Average VaR/ES Ratio for Different Confidence Levels and the 3 State Markov Chain Transfers												
95%	2.245164	2.68539	2.722841	2.693858	2.701126	2.888053	2.563616	2.82439	2.764715	2.76367	2.603181	2.648478
97.5%	1.832685	2.165468	2.210744	2.173283	2.155486	2.335869	2.075699	2.234762	2.173118	2.196376	2.111433	2.154418
99%	1.55618	1.808277	1.84457	1.818619	1.800774	1.947213	1.729958	1.872966	1.832959	1.849527	1.76487	1.805155
Average VaR/ES Ratio for Different Confidence Levels and the Geometric Time in Tails Transfers												
95%	2.249672	2.73378	2.812005	2.762282	2.779647	2.989017	2.670274	3.048534	2.851418	2.824526	2.69439	2.724871
97.5%	1.935275	2.369102	2.375962	2.329184	2.330039	2.549353	2.271841	2.632923	2.441241	2.346531	2.30253	2.34608
99%	1.685623	2.044515	2.11142	2.022797	2.033406	2.256729	1.996855	2.285516	2.128709	2.029414	1.99958	2.011173