Portfolio Management Issues in Mauritius

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This dissertation is dedicated to

Mom, Dad, Shyamala, Arouna

and

Ganapati Bappa

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ABBREVIATIONS

A. Mtius	Air Mauritius Ltd
ASL	Automated Systems Ltd
BAI	British American insurance
BE	Book Value of equity
BMH	Belle Mare Holding
CAPM	Capital Asset Pricing Model
CDS	Central Depository & Settlement Co Ltd
CIT	Consolidated Investments Ltd
CMPL	Compagnies des Magasins Populaires Ltee
EMH	Efficient Market Hypothesis
FINCORP	Fincorp Investment
GBH	Grand Baie Hotel
GCL	Gamma Civic Ltd
GIDC	General Investments Development Co
H. Freres	Harel Freres
H. Mallac	Harel Mallac
HWF	Happy World Foods
IBL	Ireland Blyth Ltd
IFC	International Finance Corporation
LIT	Liberty Investment Trust
LSE	London Stock Exchange
MBL	Mauritius Breweries Ltd
MCB	Mauritius Commercial Bank
MCFI	Mauritius Chemical & Fertiliser Industries Ltd
MDA	Mon Desert Alma Sugar Estate
MDIT	Mauritius Development Investment Trust
ME	Market Value of Equity
MEI	Mauritian Eagle Insurance

MOR/MOROIL	Mauritius Oil Refineries
MSM	Mauritius Stationery Manufacturers
MTMD	Mon Tresor & Mon Desert Sugar Estate
MUA	Mauritius Union Assurance
NIT	National Investment Trust
NMH	New Mauritius Hotels
NYSE	New York Stock Exchange
OTC	Over The Counter
PAD	Promotion & Development Co Ltd
P/BV	Price to Book Value
P/E	price Earnings
PIM	Plastics Industries Mauritius
SAVA	Savannah Sugar Estate
SBM	State Bank of Mauritius
SEC	Stock Exchange Commission
SRO	Self Regulatory Organisation
SWAN	Sawn Insurance
TSE	Tokyo Stock Exchange
UBP	United Basalt Products
UDL	United Docks Ltd.

TERRORIST ATTACKS AND GLOBAL PORTFOLIO MANAGEMENT

It has definitely been a trying time in the world's markets over the last 6 months. After the devastating strike at the heart of the world's biggest financial centre, there have been some debates in portfolio management, such as the need to invest in portfolios of securities that can counter losses due to terrorism of any forms and also how to protect investor confidence during such unforeseen situations.

Henceforth, Investors have been questioning the future direction of markets and the safety of their investments following the September 11th attacks.

There is a simple reason that investing in equities over the long term is usually more profitable than investing in fixed income. The excess return generated is an investor's "reward" or "compensation" for investing in something whose return is not certain or guaranteed. Investor resolve is being tested like never before.

However, for those who have taken a long-term view in designing their investment portfolios, the current state of the market should not be viewed as an unrecoverable setback. History shows that markets are resilient. Although many would argue that the severity and magnitude of the attacks on the United States are unprecedented. History may provide investors with some context with which to judge what the market response may be over the months and years to come.

A well-diversified and comprehensive investment portfolio will help buffer the effects of a single market or single security. Sovereign investors should decide on portfolios that are highly diversified across asset classes, markets, investment styles and money managers.

Although some market corrections and "shocks" may be more sustained or dramatic than others, history has shown that eventually markets return to normalcy and those that have withstood the temptation to shift all or part of their portfolio into less volatile investments have been rewarded for their perseverance.

ABSTRACT

This dissertation relates to the study of the financial market of Mauritius, which is categorised as “Emerging”.

Its performance as an exchange system has been assessed with a view to find whether it is operationally efficient. Consequently, two issues in portfolio management have been analysed.

In the first instance, the risk reduction effect of increasing portfolio size, based on the simple diversification strategy has been experienced. Secondly, the hypothesis that investment in low P/BV shares on average yields higher returns than investment in high P/BV shares has been tested.

CHAPTER ONE: INTRODUCTION

1.1 Aims and Objectives

This dissertation attempts to study, as well as apply a few selected portfolio management issues in the financial market of Mauritius. For this purpose, the efficiency of the market has been assessed since a prerequisite for the application of portfolio management is the existence of an efficient marketplace within the economy.

Pertaining to the above research, distinction needs to be made between informational and operational efficiency. Informational efficiency refers to the performance of a market in processing information and setting prices while operational efficiency refers to the performance of a market as an exchange system. These two are linked since an operationally efficient market allows for the prompt processing of information and setting of prices.

This dissertation also analyses such issues in portfolio management, which have been subjected to numerous studies.

1. The risk reduction effect of increasing portfolio size.
2. The levels of diversifiable risk that the listed securities possess.
3. Whether risks can be reduced in the local market by holding portfolios of securities, rather than a single security. If so, how many securities need an investor possess using simple diversification techniques so that a substantial amount of risk is eliminated?

If the optimal portfolio size is low, then individual investors may consider holding portfolios (conforming to the optimal size) rather than holding single securities. Portfolio managers, on their side may consider reducing their portfolio size (in terms of number of securities) if their portfolios are substantially larger than the optimal size.

Finally, on the assumption that it is better to invest in portfolios of securities, this study then analyses the applicability of the Price to Book Value (P/BV) Ratio. Researchers and analysts contend that P/BV ratio is useful for making investment decisions. Some have asserted that P/BV ratio is a better determinant of stock returns than Price to Earnings (P/E) ratios and Beta coefficients. Empirical studies have shown that portfolios consisting of low P/BV securities consistently yield higher returns than portfolios of higher P/BV securities.

As a result, the hypothesis that lower P/BV securities portfolios yield higher returns than higher P/BV securities portfolios has been tested. If the results turn out to be positive, then this may bring a new point of reference to portfolio selection and management in Mauritius.

CHAPTER TWO: THE CONCEPT OF MARKET EFFICIENCY

In discussing the concept of market efficiency, it is essential to distinguish between two kinds of efficiency: Informational (outside) efficiency and operational (inside) efficiency.
Outside efficiency refers to the performance of a market as an information processor and a price setter whereas inside efficiency refers to the performance of a market as an exchange system.

If one wants to know whether a market is informationally efficient, one must ask if that market is able to process information rapidly and set the price of securities at a level that reflects all that is known about firms.

If one wants to know whether a market is operationally efficient, one must ask if the market offers an inexpensive and reliable trading mechanism. In other words, one wishes to know what the magnitude of transaction costs (Commissions, bid-ask spread, market impact of trade etc.) is, how fast orders can be executed and how long it takes to settle a trade.

It should be noted that informational efficiency and operational efficiency are related. Poor operational efficiency may delay the adjustment of prices to new information and prevent them from reaching their equilibrium value.

This chapter provides some literature review on the concept of operational efficiency and sets out the various factors that are important in determining whether a market can be considered as being operationally efficient. Brief notes on informational efficiency of stock markets are also provided for the sake of completeness.

2.1 Informational Efficiency

In general, a market is said to be informationally efficient if, at any time, the current price of securities fully reflects all available and relevant information as suggested by Fama (1976). Under such circumstances security prices should be equal to their time value defined as the discounted future cash flows, which in turn implies that investors cannot use public information to earn abnormal returns.

Efficiency can however, only be defined relative to a specific type of information, which is usually classified into three categories:

1. Historical sequence of prices.
2. Public knowledge of companies' past performance as well as public forecasts regarding future performance and possible actions.
3. Private or privileged information, which is only available to insiders and those who have access to companies' policies and plans.

These three types of information are then used to define three forms of degrees of market efficiency.

1. **The weak form** of the Efficient Market Hypothesis (EMH) corresponds to the first type of information. It asserts that current prices fully and instantaneously reflect all the information implied by the historical sequence of prices.

2. **The semi strong** form of the EMH corresponds to first and second types of information. It asserts that current prices fully and instantaneously reflect all public information about companies, including the information implied in the historical sequence of prices.

3. **The strong form** of the EMH corresponds to the first, second and third types of information. It asserts that current prices fully and instantaneously reflect all information, public as well as private.

2.2 Operational Efficiency

While research and other literature regarding informational efficiency abound, it is relatively less easy to find the same on operational efficiency. Developed markets like New York Stock

Exchange (NYSE), London Stock Exchange (LSE) and to a great extent, Tokyo Stock Exchange (TSE) can reasonably be considered to be operationally efficient.

2.3 Characteristics of Selected Developed Markets

Some characteristics of these markets will be taken as being relevant factors in assessing the operational efficiency of a particular market.

2.3.1 New York Stock Exchange (NYSE) www.nyse.com

At NYSE assigned specialists called Brokers and Dealers are responsible for ensuring a liquid, low cost, fast and orderly market. The NYSE has 1336 members who are allowed to trade on the floor of the exchange. Each specialist group is assigned exclusively certain number of listed shares. As brokers, they undertake limit orders. A limit order is an order to buy or sell a share at a specified price. As dealers, they buy and sell securities on their own account and are allowed to seek profits in doing so.

2.3.2 London Stock Exchange (LSE) www.londonstockexchange.com

On the LSE, market makers (formerly called 'jobbers') voluntarily make an active market for some but not all listed shares. There are no assigned specialists like those trading on NYSE. Since market makers are competing for many of the active shares, nobody has an exclusive 'affirmative obligation' to ensure a liquid, low cost, fair and orderly market. There are no official limit orders. The public can give limit orders to their brokers but there is no guarantee these will be actually executed chronologically or even at the exact limit order price.

2.3.3 Tokyo Stock Exchange (TSE) www.tse.or.jp

The system of trading at TSE is both in the most active and the relatively less active securities. It is quite different from any system found in either US or UK. Members known as 'saitori', who act as auctioneers in that they are neither dealers nor specialists, run it. At the opening of the exchange, the 'saitori' follow methods called 'iyatose', which operate like a call market in that the 'saitori' seek to set a single price so that the amount of trading is maximised.

2.4 Emerging Markets

Securities markets in developing countries are characterised to be small relative to the economies where they operate, particularly when the representation of the industrial sector in stock markets is not proportional to its contribution to the economic activity.

Regarding relative riskiness, perhaps due to market imperfections in the real sector and in the industrial organisation of the developing countries, it has been suggested that large companies in developing markets may have smaller risk than those of developed countries. Such riskiness, however, only focuses on the low variability of prices and not on the market power of some companies, this permits stock market manipulation, thereby representing a higher risk to investors.

CHAPTER THREE: THE CONCEPTS OF RISK, RETURN AND PORTFOLIO DIVERSIFICATION

Any decision to invest, whether in a project or in securities is normally based on expectations about the future. The investor makes forecasts of future cash flows that are likely to arise from a particular investment strategy. Unfortunately, in an uncertain world, the returns on investment may not always turn out to be as expected. In fact, the actual cash flows will almost certainly be different from those expected. It is this uncertainty that gives rise to risk in investment activity.

Managers of investment institutions need to know the calculations of expected return and risk of individual securities, the risk reduction effect of combining securities in a portfolio, as well as the risk-return trade-off of investors for a proper management of funds. This chapter provides a literature review on the concepts of risk, return and portfolio diversification.

3.1 Measurement of Investor Return and Risk

It is generally accepted that where an investor takes on extra risk, he should be rewarded with extra returns. Investors in financial securities demand higher returns from risky investments than from risk-free Government securities. This behaviour is most typical of risk averse investors. Historically then, investors on average have earned substantial premiums for investing in risky securities rather than in Government securities. However, this additional return has been accompanied by a higher volatility in earnings as the average earnings calculations hide the fact that in some years there have been high positive returns while in others there have also been high negative returns earned by holders of equity investments.

3.1.1 Measuring Return of a single Security

It is usual to measure the periodic return from an investor's point of view by taking into consideration both dividends received and any change in value of the share over the period concerned, i.e, capital gain or loss. Thus, return in period t_1 can be written as:

$$R_1 = \left[D_1/P_0 + (P_1 - P_0)/P_0\right]$$

Where	R_1	=	return in period t_1
	D_1	=	dividends received in period t_1
	P_1	=	value of the share at end of period
	P_0	=	value of the share at start of period

Effectively, the formula for average rate of return based on historical data is: $\tilde{R} = \frac{1}{n}\sum_{t=1}^{n} R_t$, where n is the number of periods. The return could be an expected one, based on a subjective probability distribution drawn up by a financial analyst, or it could be measured historically to assess the performance of the security concerned.

Calculating estimated returns is very difficult because estimations of both the dividends expected to be paid during the forthcoming period and the end of period price of the share are required. Such an estimation process requires the use of probability distributions and expected values. Thus the analyst will need to forecast both the range of dividend payments and the range of share prices possible during the ensuing period and assign to each value a probability of its occurrence. This is subjective since these probabilities depend upon the decision-maker's opinion. The expected return E(R) is calculated by multiplying each outcome of possible return Ri by the probability Pi that it occurs and summing:

$$\textbf{Expected Return, E(R)} = \sum_{t=1}^{n} P_i R_i$$

3.1.2 Sources of Risk

- **Interest Rate Risk**: This is defined as the potential variability of return caused by changes in the market interest rates. If market interest rates rise, then investments' values and market prices will fall, and vice versa. The resulting variability of return is termed, 'Interest Rate Risk'.

This risk affects not only share prices, but also bonds, real estate, gold, futures contracts and other investments.

- **Purchasing Power Risk:** This refers to the variability of return an investor suffers because of inflation. The nominal rate of return on a security that is, the return that is not adjusted to eliminate the effects of inflation, has to be adjusted for inflation. It is only the real adjusted rate of return that goes on to increase the investors' real purchasing power.

- **Bull-Bear Market Risk:** This arises from the variability in market returns resulting from alternating bull and bear market forces. Over the last decades, bear markets have lasted from one month to over 3 years, with an average duration of about one year. Fortunately, bull markets that usually rise more than enough to compensate for the bear market losses follow bear markets. The movements of the overall stock market affect virtually all securities' prices. However, the degree of effect varies among securities, with some being more affected than others.

- **Management Risk:** Despite the fact that many top executives earn high salaries, occupy luxurious offices, cars and possess enormous power within their organisations, they are capable of making a mistake or a poor decision. These errors may cause harm to those persons who have invested in these firms.

- **Default Risk:** This risk results from changes in the financial integrity of the investment. For instance, when a company that issues securities moves either away from bankruptcy or closer to it, these changes in the firm's financial integrity will be reflected in the market price of the securities. Another area where default risk is possible is in the use of debt to finance a firm's assets. The use of fixed cost financing affects the earnings per share available to the shareholders thereby magnifying both gains and losses through a process called leverage. Because of the risk of default, e.g the company being unable to pay its fixed interest obligations, variability of a company's returns should increase with the use of financial leverage.

- **Business Risk:** This involves the probability of a company suffering losses or profits less than expected for a given period because of adverse circumstances in that company's line of activity. This risk could occur because of external forces such as trade restrictions, worldwide recession or as Lloyds of London classifies a new type of risk called "Acts of Terrorism". Internally, business risk comes about because of such factors as efficiency considerations, poor planning, and illegal activities by employees.

- **Industry Risk:** This refers to the possibility of virtually all firms in a given industry being adversely affected by some common factor that does not affect, or affects to a much lesser degree, firms outside that industry. The stage of the industry's life cycle, international tariffs and quotas on the products produced by an industry, product-or industry-related taxes, industry-wide labour union problems are but a few of those factors. As a result, the prices of securities issued by competing firms tend to rise and fall together.

- **Political Risk:** International investors face political risk in the form of expropriation of non residents' assets, foreign exchange controls that do not allow foreign investors to withdraw their funds, disadvantageous tax and tariff treatment, etc. Domestic political risk arises from changes in environmental regulations, fees, licences and above all, taxes.

3.1.3 Measuring Total Risk of a Security

The variability of rates of return of a share may be defined as the extent of the deviation or dispersion of individual rates of return from the average rate of return. There are two measures of this dispersion:

1. Variance
2. Standard Deviation (which is the square root of variance).

The following formula can be used to calculate variances of historical rates of return of a share:

$$\text{Variance} = \sigma^2 = \frac{1}{n} \sum_{t=1}^{n} \left[R_t - \bar{R} \right]^2$$

Where n = Number of periods

R_t = Actual return in a given period t

R = Average rate of return over the total period

When using forecast data, the formula for variance is slightly modified and becomes:

$$\text{Variance} = \sigma^2 = \sum_{t=1}^{n} \left[R_t - E(R) \right]^2 P_i$$

Where Ri	=	possible return given a particular state of the economy
Pi	=	probability that return Ri occurs
E (R)	=	expected return for the period

It is to be noted that the standard deviation as a measure of risk, has the advantage of being expressed in the same units as the expected return. The discussion so far has been concerned with risk and return in the context of single investments. An investor, however, may choose any combination of the available investments in addition to each investment individually.

3.2 Portfolio Theory and Diversification

In the early 1950's, Harry Markowitz originated the basic portfolio model that underlies modern portfolio theory. Before Markowitz, investors dealt loosely with the concepts of risk and return. Although they were familiar with the concept of risk, it was not usually quantified. Investors have known intuitively for many years that it is smart to diversify. Markowitz, was the first to develop formally the concept of portfolio diversification. He showed why and how portfolio diversification works to reduce the risk of a portfolio to an investor. A portfolio is simply a combination of assets - in this case, securities.

3.2.1 Portfolio Return

The expected return on any portfolio is calculated as the weighted average of the individual securities' expected returns. The weights used are the proportion of total investable funds invested in each security. The expected return of a portfolio can be calculated as

$$E\,(Rp) = \sum_{i=1}^{n} W_i\, E(Ri)$$

Where $E\,(Rp)$	=	the expected return on the portfolio
W_i	=	the expected return on security
n	=	number of securities

3.2.2 Portfolio Risk

Portfolio risk is measured by the variance or standard deviation of the portfolio's return, just as in the case of each individual security. However, unlike portfolio return, portfolio risk is not a weighted average of the risk of the individual securities in the portfolio. Symbolically,

$$VAR\,(Rp) \neq \sum_{t=1}^{n} W\; tVAR\,(Rt)$$

It is because of this inequality that investors are able to reduce the risk of a portfolio. Portfolio risk depends not only on the weighted average of the risks of the individual securities in the portfolio, but also on the relationships or covariance among the returns on securities in the portfolio. Stated in terms of variance, the portfolio risk is

$$\sigma_p^2 = \sum_{i=1}^{n} W_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j=1}^{n} W_i W_j \sigma_{ij}$$

Where σ_p^2 = the variance of the return on the portfolio

σ_i^2 = the variance of the return for security i

σ_{ij} = the covariance between the returns for securities i and j

W_i & W_j = the percentage of investable funds placed in security i

The double summation sign indicates that n^2 numbers are to be added together (i.e all possible pairs of values for i and j).

3.2.3 Covariance and Correlation Coefficient

The covariance is a measure of the degree of association between the returns for a pair of securities. Covariance is defined as the extent to which the returns on two securities co-vary (move together) over time. The covariance can be:

- **Positive** - which indicates that the returns on the two securities tend to move in the same direction at the same time.

- **Negative** - which indicates that the returns on the two securities tend to move in opposite directions.

- **Zero** - indicating that the returns on the two securities are independent and have no tendency to move in the same or opposite directions together.

The formula for calculating covariance is:

$$Cov\,(R_i, R_j) = \sigma_{ij} = \sum_{k=1}^{m} P_k \left[R_{ik} - E(R_i)\right]\left[R_{ik} - E(R_j)\right]$$

Where	$Cov\,(R_i, R_j)$	=	The covariance between securities I and j
	R_i & R_j	=	The potential return I and j given a particular State of the economy
	$E(R_I)$ & $E(R_j)$	=	The expected returns on securities I and j
	P_k	=	The probability that a particular state of the World will occur
	m	=	number of likely outcomes for a security for the period

The correlation coefficient is a statistical measure of the strength of the relationship between the two distributions of expected returns. The covariance and the correlation coefficient are linked in the following manner:

$$Cov\,(R_i, R_j) = \sigma_{ij} = \rho_{ij}\,\sigma_i\,\sigma_j$$

The correlation coefficient, ρ, can take on values between +1 and -1. A value of +1 indicates positive correlation with the returns of two securities moving with the same proportion and in the same direction. A value of - 1 indicates perfect negative correlation with movement in one security being matched by an equal and opposite movement by other security. A value of zero would indicate that there is no relationship between the returns.

A closer look at the expression for portfolio risk reveals that it is the second part of the expression, that is, the one with the covariance term that is responsible for risk diversification. Combining securities with perfect positive correlation provides no reduction in portfolio risk. The risk of the resulting portfolio is simply a weighted average of the individual risks of the securities. As more securities with perfect positive correlation are added, the portfolio risk remains a weighted average. There is no risk reduction. On the other hand, combining securities with zero correlation reduces the risk of a portfolio. Significant risk reduction can be achieved as more securities with uncorrelated returns are added to the portfolio. But, still portfolio risk cannot be wholly eliminated. The complete elimination of risk can be obtained by combining securities with perfect negative correlation.

In the real world, these extreme correlations are rare. Rather, securities typically have some positive correlation with each other. Thus although risk can be reduced, it usually cannot be eliminated.

3.3 CAPM and Risk Decomposition

One of the building blocks of the Capital Asset Pricing Model (CAPM) - developed by Sharpe in 1964 - is the principle of risk decomposition. The total risk of a security can be broken down into two independent components, a Market- related component and a Firm-specific component. The former is a measure of the extent to which the price of a security fluctuates in response to the general market movement. The latter is a measure of the extent to which the price of a security fluctuates in response to information unique to the firm, which issued security.

It can be shown that the market risk of a security is proportional to the variance of the market as a whole. Thus Market risk of a security i = β_i^2 [variance of the market]

The factor β_i is called the Beta coefficient of security *i* or its systematic risk. It is a measure of the sensitivity of security ***i*** return to the returns of the market. A security with a β coefficient equal to one has as much market risk as the market as a whole. A security with a β coefficient less than one has less market risk that the market as a whole. A security with a β coefficient more than one has more market risk than the market as a whole. In other words, high beta shares have higher market risks than low beta shares.

The firm specific risk σ_{ei^2} is the difference between total risk of a security and its market risk. To summarise, therefore, the total risk of a security can be partitioned into its two components as follows:

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^{\ 2}$$ **= Systematic Risk + Unsystematic Risk**

The unsystematic risk portion of a security's variance can be diversified away by holding a portfolio of securities. In effect, the unique part of the risk of each security is cancelled out, leaving the portion that is attributable to the systematic variance arising from the market. What is important is each security's contribution to the total risk of the portfolio. If a portfolio is completely diversified, the only risk it has is a systematic risk. Therefore, the contribution of any one security to the riskiness of a portfolio is its systematic risk.

Each individual security's risk can be related to the risk of the portfolio through its covariance with the market portfolio, COV_{im}. The market portfolio is a portfolio consisting of all securities where the proportion invested in each security corresponds to its relative market value. The relative market value is simply equal to the aggregate market value of the security divided by the sum of the aggregate market values of all securities. The relationship between the risk of individual securities and the portfolio is more conveniently expressed by using the standardised measure of systematic risk, the Beta coefficient.

3.4 The Beta Coefficient

Estimating Beta from past data and using this historical Beta as an estimate of Beta could arrive at estimates of Beta. There is evidence that historical Betas provide useful information about future Betas. Estimates of the Beta coefficient of a security can be obtained from time series regression analysis. For this purpose, the Market model (Sharpe 1963) is used. The model can be stated as

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$$

Where R_{it} = the random return on security I during period t

R_{mt} = the random return on the overall market during period t

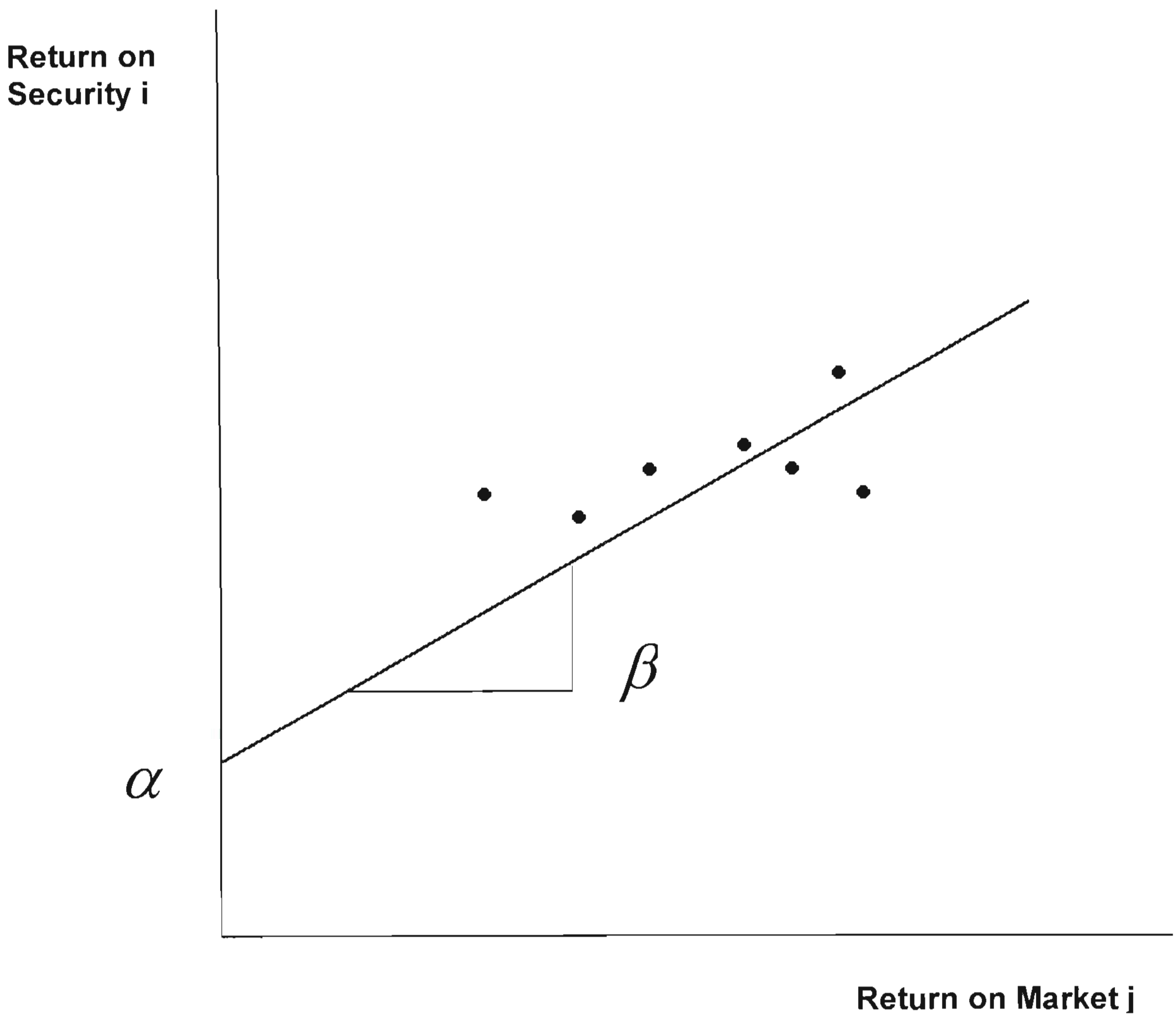
α_i = the unique part of security *I* return

β_i = the measure of the expected increase in return for security I Given a 1% increase in market return

e_{it} = the random residual error in period t (i.e, difference between the actual return in period t and the predicted return in period t)

This equation is expected to hold at each moment in time, although the values of α_i, β_i or σ_{ei}^2, the firm specific risk, might differ over time. The values of α_i, β_i or σ_{ei}^2 cannot directly be observed when looking at historical data. Rather, past returns on the security and the market are observable. If α_i, β_i or σ_{ei}^2 are assumed to be constant through time, then the same equation is expected to hold at each point in time. The presence of the random variable e_i means that the actual return will scatter around the straight line. Figure 3.1 illustrates this pattern. The vertical axis is the return on security the horizontal axis and is the return on the market. Each point on the diagram is the periodical return on security I over a particular time interval plotted against the return on the market for the same time interval. The actual returns lie on and around the true relationship (shown as a solid line). The greater $\sigma_{ei}{}^{2}$, the greater the scatter around the line. Usually, the location of the line is estimated using regression analysis. The slope of this straight line will be the best estimate of beta β_i, over the period to which the line was fit, and the intercept would be the best estimate of α_i.

Fig 3.1: Scatter diagram Re Security's Returns Against Market Returns



The values of α_i and β_i produced by regression analysis are estimates of the true α_i and β_i that exist for a security. The estimates are subject to error. As such, the estimates of α_i and β_i may not be equal to the true α_i and β_i that existed during the period. Furthermore, the process is complicated by the fact that α_i and β_i are not perfectly stationary over time. Changes in the fundamental characteristics of a firm are expected. For example, β_i as a risk measure should be related to the capital structure of the firm and thus, should change as the capital structure changes.

Despite error in measuring the true β_i and the possibility of real shifts in β_i over time, the most straight forward way to forecast β_i for a future period is to use an estimate of β_i obtained via regression analysis from a past period.

3.5 Approaches to Diversification

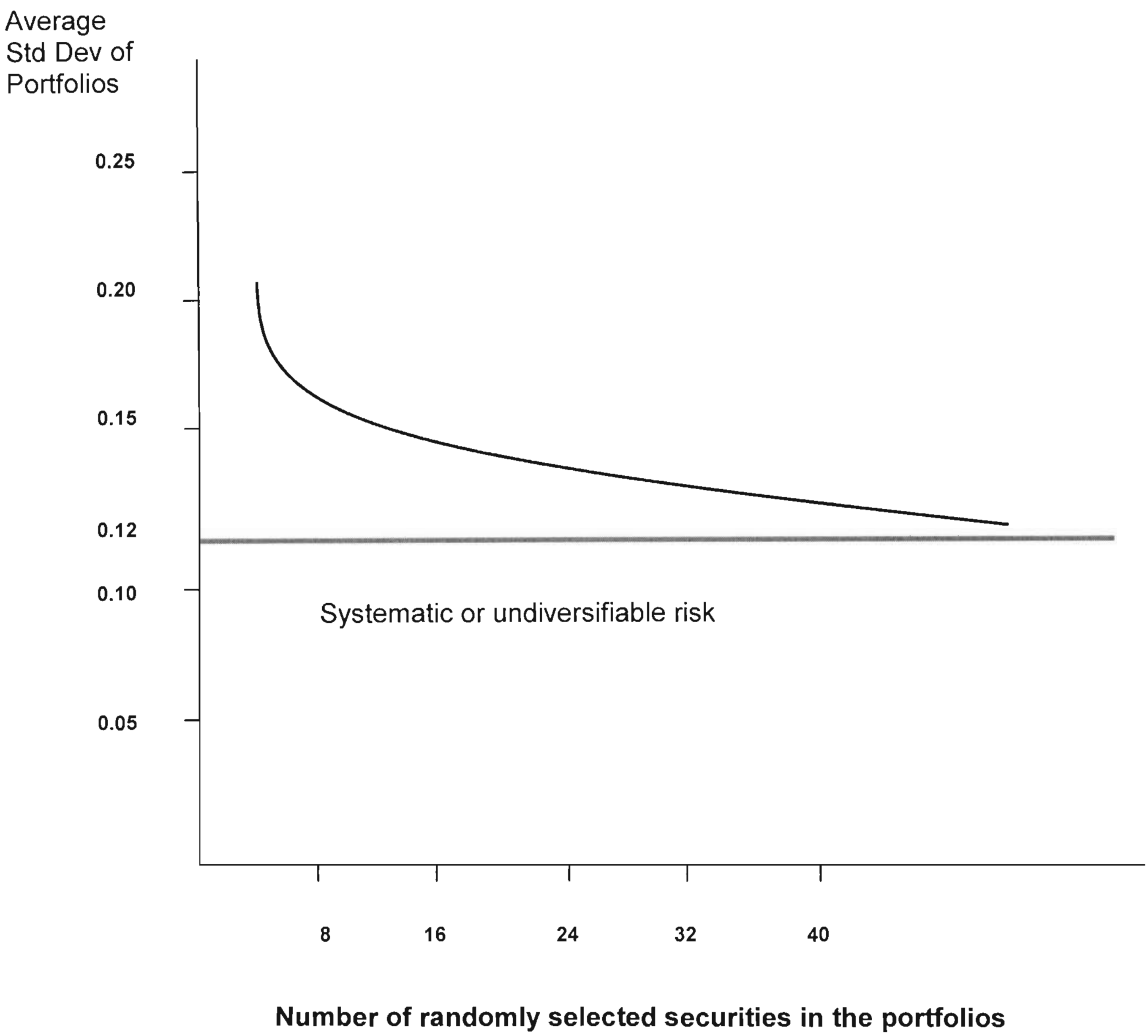
Two straightforward approaches to diversification are considered. In the first instance, simple diversification strategy, which a naïve investor might employ, is examined. In the second part, diversification across industries is analysed.

3.5.1 Simple Diversification

The explanation of this diversification technique is based on the work of J. Evans and S. H Archer (1968). They examined the rate at which the variation of returns for randomly selected portfolios is reduced as a function of the number of securities included in the portfolio.

Figure 3.2 gives the end result of their analyses. The work was based on the empirical data on 410 shares from the NYSE. Observations on the securities were taken at semi-annual intervals for the period of return for all 470 shares was 0.21. The level of undiversifiable risk in the market was estimates at 0.12 (i.e., σ_m = 12%).

Fig 3.2: Risk Reduction Effect of Simple Diversification Technique.



The following approach was used. Sixty different portfolios of each size assembled were randomly selected NYSE shares. In other words, 60 different one-security, 60 different 2-security, 60 different 3-security portfolios and so on up to 40-security portfolios were calculated by usage of computer software. These portfolios were constructed so that each randomly selected security was allocated an equal weight in its portfolio. Then the average standard deviation of returns was calculated for the 60 different portfolios of each size. Altogether 2400 portfolios were generated (40* 60).

The results of their analysis suggested that a single and predictable relationship did, in fact exist between the number of securities included in a portfolio and the level of portfolio dispersion. Prior to this study, King B.F (1996) found that market risk on the NYSE listed shares contributes about 50% in the variation of the shares. Figure 3.2 illustrates the average standard deviations for each portfolio size. It can be seen from the diagram that randomly combining 10-15 shares will, on average, halve a portfolio's total risk to the undiversifiable level of variation found in market averages. Spreading the portfolio's assets randomly still further cannot be expected to reduce risk much further.

Another study conducted by Whitmore (1970) examined the level of diversification possible by holding random securities for different countries. He found that the effectiveness of diversification varied from country to country depending on the average covariance relative to variance in each of the countries.

In the Indian context, Gupta L.C (1981) found that a portfolio of 40 shares could almost totally eliminate unsystematic risk. However, Sehgal (1995), who attempted a similar study as that of Evan and Archer in the Indian context, proposed that a portfolio of about eight securities would yield the benefits of diversification without too high a cost. The study used monthly-adjusted returns for 50 Bombay Stock Exchange (BSE) securities over the period April 1984 to March 1993. The BSE National Index was used as a proxy for the market. However, in contrast to the Evans and Archer study, he used a Single Index model for his analysis. Some of the other studies dealing with similar issues are Wagner and Lau (1971), Brenman (1975), Elto and Gruber (1977) and Statman (1987).

3.5.2 Diversification across Industries

Studies of rates of return from securities in many industries have shown that nearly all industries are highly correlated with one another. Professors Fisher and Lories (1970) measured the effectiveness of diversifying across industries and of increasing the number of different assets in the portfolio. Consequently, portfolios containing 8, 16, 32 and 128 NYSE-listed shares were formed by two separate techniques – simple random selection of assets as opposed to selection of assets from different industries. Numerous portfolios were constructed and statistics were tabulated about the portfolio's rates return and risk. The results are presented in Table 3.1.

Table 3.1: Statistics from various diversification techniques

No. of Shares in Portfolio	Diversification Technique used	Min. Rate of Return %	Max. Rate of Return %	Mean Rate of Return %	Std Dev of Returns
8	Random	-47	164	13	0.22
8	Across Industries	-47	158	13	0.22
16	Random	-37	121	13	0.21
16	Across Industries	-37	121	13	0.21
32	Random	-31	98	13	0.20
32	Across Industries	-29	93	13	0.20
128	Random	-29	76	13	0.19

Source: Franc, is J.C., (1991), "Investments: Analysis & Management", 5th Ed., p230, table 9-1

Two conclusions may be drawn from Table 3.1:

(i) Diversifying across industries is not better than simple diversification.

(ii) Increasing the number of different assets held in the portfolio to above eight does not significantly reduce the portfolio's risk.

3.5.3 Superfluous Diversification

The above discussions have shown that further spreading of a portfolio's assets beyond a particular number of shares (depending on the market, whether New York, London or Bombay) will not bring further significant risk reduction. On the contrary, this superfluous diversification usually results in portfolio management problems and should be avoided:

- **Impossibility of good portfolio management:** This arises when the portfolio contains dozens of different assets in which case the portfolio's management cannot consider the status of all of them simultaneously.

- **Purchase of low performers:** The search for numerous different assets may lead to the ill-informed purchase of investments that may not yield an adequate return for the risk they bear.

- **High search costs:** As the number of candidate securities for a portfolio increases, it will be more costly to do the necessary security analysis.

- **High transaction costs:** Frequent purchases of small quantities of shares will result in larger broker's commissions than will less frequent purchases of larger blocks of shares.

As a result, despite the fact that more money may be spent to manage a superfluously diversified portfolio, this will most likely not bring any concurrent improvement in the portfolio's performance. On the other hand, superfluous diversification may lower the net return to the portfolio's owners after the portfolio's management expenses are deducted.

CHAPTER FOUR: SECURITIES' RISK AND ITS DECOMPOSITION

Given the growing sophistication of investors nowadays, it is expected that local investors do not consider solely potential returns of a security before investing in that security. They also take into consideration, somehow, the riskiness of individual shares. The vast majority of individual investors, however do not usually have recourse to analysts for their investment decisions. Analysts would normally work out the risk of individual securities through scientific means. The small investors would only consider the general risk of individual securities, without going through all the mathematics.

This chapter aims at computing the individual risk of each security listed on the Official list of the Stock Exchange of Mauritius. It sets out in logical steps the various computations involved in estimating the risk of individual securities and segregates the total risk into their two components: Market related risk and Non-market related risk.

4.1 Computation of Returns

The population surveyed here consists of all the shares listed on the Official market of the SEM as at 2000. The share prices have been observed for all trading sessions during the period December 1995 to 2000. The number of trading sessions during this period is set as follows in table 4.0.

Table 4.0: Trading Sessions 1995 - 2000

Period	Trading Sessions
December 1995	6
Calendar Year 1996	97
Calendar Year 1997	147
Calendar Year 1998	149
Calendar Year 1999	148
Calendar Year 2000	160
Total	707

It is observed that not all securities were traded during all sessions. Trading in some securities were suspended temporarily for some time during the survey period while other securities obtained their listings after December 1995. Prices had to be adjusted for bonus issues, rights issues and stock splits. Without adjustments, the returns will be distorted during periods of bonus or rights issues or stock splits.

The adjustment for stock splits is very simple. If, for example, for security X, a stock split occurred at a particular time which resulted in the nominal value of the share being reduced from Rs100 to Rs10, then all prices prior to that period must be divided by a factor of 10 (i.e., 100/10). Similarly, for bonus issues, all prices prior to the issue must be divided by a factor of 2 (for a bonus issue of 1:1) or by a factor of 1.5 (for a bonus issue of 1:2), and so on.

Adjustments for rights issues are slightly more complicated. The share prices must be adjusted for the bonus component of the rights only. The bonus component is calculated using the following formula:

$$BR = [(M+N).P1 - (M.P1 + N.P2)] - 1$$

Where	BR	=	the bonus component of the rights issue
	M	=	the number of shares before the rights issue
	N	=	the number of shares issues as rights
	P1	=	market price per share before the rights
	P2	=	issue price at rights

In the event that more than one bonus, rights or stock splits or a combination of these take place over a particular period, then the adjustments factor is simply the product of the individual factors as one moves up the time scale, from the most recent period to the earlier period. A list of the bonus and rights issues that occurred over the period. December 1995 to December 2000 is given in **Appendices 1- 2**. The share prices have accordingly been adjusted following the same principles as set out earlier.

The average monthly-adjusted prices have then been worked out. It is these monthly averages, which have been used to compute monthly-adjusted returns for each security. It is recalled that the total adjusted return is the sum of the capital gain/loss and dividend yield. However, in arriving at the monthly returns for this exercise, the dividend yields have been ignored so that only the capital element has been considered. It is believed that this will not affect the end result as dividend yield usually forms only a small portion of total returns. The dividend yield for 2000 confirms this argument (see **Appendix 3**). In the absence of dividend yield, the equation for returns becomes $R_i = (P_1 - P_0)/P_0$

4.2 Risk of Individual Securities

Based on the monthly-adjusted returns, the variance and standard deviation of the securities work out to be as shown in Table 4.1.

Table 4.1: Securities' Variance and Standard Deviation

Security	Variance	Std Dev (%)	Security	Variance	Std Dev (%)	Security	Variance	Std Dev (%)
Banks & Insurance			Investments			Commerce		
BAI	0.00360	6.00	BMH	0.00542	7.36	CORTS	0.01971	14.04
MCB	0.00313	5.59	CIT	0.2123	14.57	CMPL	0.00667	8.17
MEI	0.00163	4.04	FINCOR	0.01968	4.77	H.FOOD	0.00233	4.83
SBM	0.00408	6.39	LIT	0.01006	6.56	IBL	0.02878	16.96
SWAN	0.00634	7.96	MDIT	0.00629	10.03	RGERS	0.02853	16.89
Industry			NIT	0.00568	7.93	SHELL	0.00743	8.62
GC	0.00337	5.81	PAD	0.0568	7.54	Leisure		
MBL	0.00351	5.92	POLICY	0.01232	11.10	ASL	0.00423	6.50
MCFI	0.00663	8.14	UDL	0.00441	6.64	GBH	0.00176	4.22
MOROIL	0.00748	8.65	Sugar			NMH	0.00116	3.41
MSM	0.00445	6.67	H.F	0.00885	9.41	S.R	0.00386	6.21
PIM	0.00741	8.61	MDA	0.00841	9.17	Transport		
UBP	0.00870	9.33	MUNT	0.01086	10.42	MK	0.06687	25.86
			MTMD	0.00712	8.44	SEM	0.00401	6.33

It is to be noted that the market risk as given by the variability in the market index (SEM) turns out to be 6.33% for the period. One striking observation is that many securities have lower risks than that of the market, implying that they have lower price variability than that of the market. Most of these companies fall within the Banks, Insurance and Hotels industries. Investors in Mauritius are very much risk averse, preferring to invest their savings in Banks and Insurance companies rather than in the more risky, but higher yielding, securities market. Consequently, Banks and Insurance companies have good profitability records even in times of economic declines. Such stability in earnings implies low overall risk. As regards to the Hotel Industry, this has benefited from a prospering tourism sector over the years. The number of tourist arrivals and spending has kept on increasing. Moreover, the performance of this sector depends heavily on the international economic conjecture. Given that the world economy has been prospering over the recent years, the Hotel industry in Mauritius has also flourished.

4.3 The Beta Coefficient

After having obtained the total risk of the individual securities, it is now relevant to decompose these risks into their two components. The object of this exercise is to assess how much risk general movement in the market can explain.

For this purpose, regression is run between the returns of the market and those of the individual securities in order to estimate the Beta coefficients. The Beta coefficient is a measure of the sensitivity of a security's returns relative to the returns of the market. The regression line is:

$$Ri = \alpha_i + \beta_i Rm + e_i$$

The slope of the regression line gives the Beta coefficient. The results of the regression are given in **Appendix 4**.

The general observation is that most of the securities have Beta values less than one. Another striking observation is that quite a few of the securities have either negative Betas or Beta values close to zero. A few of the securities have Beta values higher than one. A list of these securities with the above characteristics is given in Table 4.2 .

These Beta values, especially those which are negative or zero, need further investigation. IBL, was engaged in commerce when the market was nearing the crest of its bullish trend. Profit before tax peaked at Rs 162 million for the year ended December 1996 but then, following the sharp market decline in 1997, profit before tax also declined sharply to reach Rs 50.3 million in 1998. However, in 1999 and 2000, when the market was recovering from the slump, IBL still suffered declines in profitability. It is not surprising then to find that IBL does not have an overall negative Beta for the whole period.

Table 4.2: Securities with Beta Values at Extreme Ends

Security	Beta Coefficient	Coefficient of Determination, R^2
Negative Betas		
IBL	-0.59**	0.04
ASL	-0.13**	0.05
Zero Betas		
BAI	0**	0
CMPL	0.05**	0
GBH	0**	0.08
GAMMA CIVIC LTD	0.01**	0.05
High Betas		
CIT	0.89	0.20
PAD	1.63	0.51
COURTS	1.15	0.28
AIR MAURITIUS	1.33**	0.07

** (Not significant at 10% level)

As regards to ASL, which is a tote betting company, the negative Beta over the period may be explained by the fact that its profits have kept on increasing even during the period of sharp decline of the market. The behaviour and attitude of the horse-betting population may explain this trend. Even in times of economic depression, people have been increasingly betting on horses, probably in the hope of earning high rewards for the risk they were bearing. Over the period surveyed therefore, the overall Beta values turned out to be negative.

A security with zero Beta means that its returns are not correlated with those of the market. In theory, one would expect an insurance company such as BAI, and a company engaged in the construction business such as Gamma Civic Ltd, to have positive correlations. The better and sounder the economy, the higher the level of saving and hence the greater the amounts of such funds captured by insurance companies. Similarly, during sound economic conditions, the level of construction goes up. Moreover, CMPL, which is a company engaged in the retail commercial business, should also normally co-vary positively with the economic trend.

Consequently, the goodness of fit, as measured by the coefficient of determination, R^2, has been worked out for each of these Beta estimates. These are shown in Table 4.2. The coefficient of determination measures how well the data points conform to the characteristics line and gives some indication of how much faith should be placed in the risk statistics where securities frequently have Betas that are random coefficients. These random coefficients are essentially wild Beta coefficients, which move up and down over a wide range in a spurious fashion as the characteristics line is empirically estimated again and again using data from different sample periods. Studies along these lines were carried out by Marshall Blume (1971) and J.C Francis (1979).

As a result of above comments, the movement of those negative and zero Beta values over the period has been investigated. A few of the high Beta securities have also been considered. The objective of this exercise was to examine how stable are these Betas over time.

It would have been more appropriate to break down the survey period into these two parts namely the pre-boom period (1996 and 1997) and the post-boom period (1999 to 2000). However, given that many of the securities obtained their listings after 1994, this has not been possible. Instead, the stability of the Betas has been analysed on a yearly basis. The adjusted monthly returns are used for this purpose. Table 4.3 gives the results of this exercise.

Table 4.3: Movement of Beta Coefficient over Time

BETA COEFFICIENT					
Security	**1993**	**1994**	**1995**	**1996**	**1997**
IBL**	-	-	-1.87	-0.80	0.02
ASL**	-	-	-0.06	0	0.06
BAI**	-	-0.28	.21	0.72	-0.06
CMPL**	-0.36	-0.01	-0.56	0.15	1.58
GBH**	-	-	-	0.70	0.63
G.CIVIC**	-	-	-0.09	0.16	.30
CIT	1.27	-0.21	0.07	1.45	1.09
PAD	-	-	-	2.17	1.52
COURTS	1.13	0.55	0.56	0.62	2.71
AIR MK**	-	-	0.30	8.05	-2.54

** Securities whose beta values are not significant at 10% level

It is observed from Table 4.3 that, apart from ASL and GBH, all other securities have Beta values, which vary enormously over time. The stability of ASL and GBH's Beta values is questionable since the period under review was very small (their securities having obtained their listing late during the survey period). The instability of these Beta values, therefore, cast doubts about the reliability of the Betas of all listed securities. Another test was needed to be carried out on the Betas in order to assess their reliability of prediction of expected return. This is described in the ensuing section.

4.4 Explanatory Power of the Regression Equation

Having obtained the Beta coefficients of all selected listed securities, the next logical step is to assess the explanatory power of the regression equation:

$$R_i = \alpha_i + \beta_i \, R_m + e_i$$

This can be done through the statistical measure called coefficient of determination, R^2. The higher the coefficient of determination, the greater the explanatory power of the regression. The coefficient of determination for each security is given in **Appendix 4**. It is observed that all securities have fairly low coefficient of determination and some of them have even extremely lower values. Low coefficient of determination implies that Beta can only explain to a small extent the variation in security return given a change in market return. In front of such observations, it becomes imperative to test whether or not the Beta coefficients are significantly different from zero. The following tests had to be performed.

- Test the null hypothesis $H_O : \beta = 0$
- Against a two-sided alternative $H_1 : \beta \neq 0$

The decision rule is:

Reject H_O if $(b-0)/S_b > t_{n-2,\alpha/2}$

Or $(b-0)/S_b >- t_{n-2,\alpha/2}$

Where $S_b = S/\sqrt{\sum (xi - x)^2}$

And S =standard error of the estimate

The t-statistics for each security is provided in **Appendix 4**. It can be seen that at 10% significance level, many of the securities t-values do not exceed 1,671 (the value from the student's distribution table corresponding to 60 degrees of freedom at 10% level of significance for a two-tailed alternative) nor do they fall short of -1.671. Note that 60 degrees of freedom have been used despite the fact that many of the securities have not traded for all the 60 months. In other words, for those securities whose t-values fall within the critical area, the null hypothesis, $Ho : \beta = 0$, cannot be rejected, implying that their Beta coefficients are not significantly different from zero. These securities are: BAI, SBM, Gamma Civic, MCFI, Moroil, PIM,GIDC, NIT, MDA, Mount, CMPL, IBL, Rogers, ASL, GBH and Air Mauritius.

The t-values for the other securities do not fall within the critical area. So the null hypothesis has to be rejected. Their Beta coefficients are, therefore significantly different from zero.

4.5 Systematic and Unsystematic Risks

Based on the findings of the previous section, the total risk of those securities whose Beta coefficients are significantly different from zero can be computed. The market related or systematic risk is given by the term:

$$\beta_{i}\sigma_{m}^{2}$$

where σ_{m^2} is the variance of the market returns.

The securities' specific or unsystematic risk is the difference between the total risk and the market-related risk. Note that:

Total Risk = Systematic Risk + Unsystematic Risk

Accordingly, the risk components of each individual security work out to be as shown in Table 4.4. It is observed that the portion of total risk that can be explained by market movement varies for each individual security, depending on the securities' total risk and its firm-specific risk component. We also note, from Table 4.4 that five companies, in particular have relatively high market element of risk. These are MCB, MBL, PAD, Courts and HW Foods. The probable reason for this behaviour is that these companies have either high Betas or low total risk.

Table 4.4: securities' Beta Values and Risks

Securities	Beta Value (B)	Systematic Risk	Unsystematic Risk	Total Risk	Market Element (%)
MCB	0.51	0.00106	0.00130	0.00313	33.87
MEI	0.33	0.00033	0.00362	0.00163	20.25
MUA	0.48	0.00069	0.00621	0.00431	16.01
SWAN	0.57	0.00013	0.00245	0.00634	2.05
MBL	0.58	0.00106	0.00393	0.00351	30.20
MSM	0.38	0.00059	0.00780	0.00445	13.26
UBP	0.47	0.00090	0.00422	0.00870	10.34
BMH	0.64	0.00120	0.01803	0.00542	22.14
CIT	0.89	0.00320	0.00188	0.02123	15.07
FINCORP	0.38	0.00040	0.00402	0.00228	17.54
LIT	0.30	0.00028	0.00817	0.00430	6.51
MDIT	0.69	0.00189	0.00294	0.01006	18.79
PAD	1.63	0.00274	0.01156	0.00568	48.24
POLICY	0.44	0.00076	0.00369	0.01232	6.17
UDL	0.43	0.00072	0.00814	0.00441	16.33
HAREL FRERES	0.42	0.00071	0.00631	0.00885	8.02
MTMD	0.45	0.00081	0.01437	0.00712	11.38
COURTS	1.15	0.00534	0.00163	0.01971	27.09
HW FOODS	0.81	0.00070	0.00584	0.0023	30.04
HAREL MALLAC	0.52	0.00107	0.00651	0.00691	15.48
SHELL	0.48	0.00092	0.00088	0.00743	12.38
NMH	0.52	0.00028	0.00358	0.00116	24.14
SUN RESORTS	0.26	0.00028	0.00456	0.00386	7.25

CHAPTER FIVE: RISK DIVERSIFICATION AND OPTIMAL PORTFOLIO SIZE

Authors on Portfolio Theory consider that investors can reduce their risk by investing in a portfolio of securities rather than holding a single security. As the size of the portfolio grows the possibility of further reducing risk increases. This assertion has in fact been proved through various studies carried out in developed markets. Evidence from these studies also shows that risk does not decrease uniformly as more and more securities are added to the portfolio and that beyond a point there is not much risk reduction. These findings confirm the fact that total risk can be separated into two components: Systematic and Unsystematic risks.

The objective of this chapter is to examine the relationship between the degree of portfolio diversification and the associated risk of portfolio returns in Mauritius.

5.1 Assumptions

A number of assumptions needed to be made before the exercise could be started. These were:

- Investors' utility functions are based on two parameters: Expected Return and Risk
- Risk is proxied by the statistical notion of Variance/Standard Deviation of return.
- Investors prefer lower risk for given return and higher return for a given risk.
- Equal amounts are invested in each of the securities constituting the portfolio.

5.2 Hypotheses

Given that the various studies conducted on developed markets points to the fact that the rate of risk reduction decreases as the size of the portfolio grows, the most likely relationship between portfolio risk and size would be **$Y = a + b(1/X)$,** where **Y** is the portfolio variance and X is the number of scrips.

5.3 Methodology

The following methodology was adopted for this exercise:

1. All the forty securities on the Official market were taken. For these scrip, the monthly-adjusted returns were computed (see section 6.1) for the period 1998 to 2000, i.e. 3 years or 36 months.

2. There was trading for 457 days in this period. But some of the securities were traded for a few number of days, the reasons being that many of these securities obtained listing only during that period and that trading in a few securities was temporarily suspended during that period (see Table 5.1).

Table 5.1: Securities traded for less than the Total Trading Sessions during 1995 to 1997

No .of Trading Sessions	Security
244	HWF
289	GBH
320	AIR MAURITIUS
440	IBL
448	PIM
452	SUN RESORTS

1. The variance-covariance matrix was calculated for all the securities and for all possible pairing of the securities.

2. The following approach was used to calculate the average portfolio variance for different portfolio sizes. For each portfolio size of ***n*** securities:

   - ***n*** securities constituting the portfolio were randomly chosen through computer.
   - The variance of the portfolio was calculated by assigning equal weights to all securities in the portfolio.

- The above two steps were repeated 40 times. If the number of ways of choosing n securities out of 40 scripts was less than 40 (e.g in the case of 40-security portfolio, only one possibility exists) or equal to 40 (e.g in the case of 1-security portfolio where only 40 possibilities exist), then all possible combinations were taken.
- The average of the 40 values (or the total number of combinations, as the case may be) was used as the average portfolio variance for ***n*** securities.

5.4 Findings

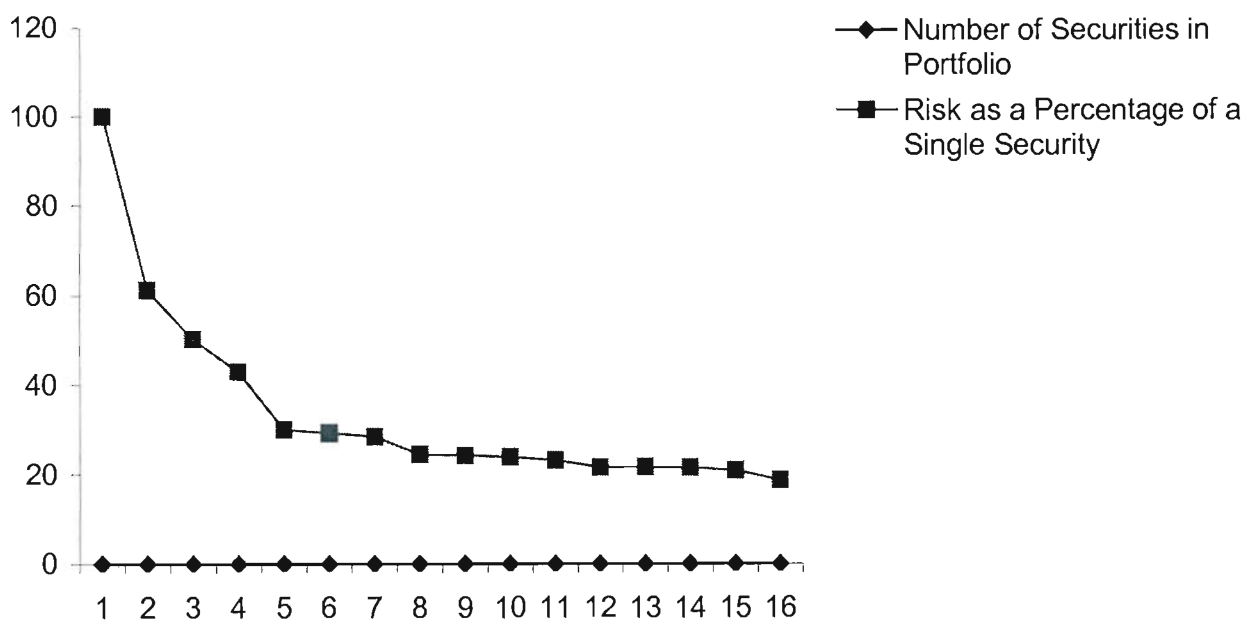
The average portfolio variances for different portfolio sizes are given in Table 5.2.

Table 5.2: Variance of Different Portfolio Sizes and their Proportion to a Single Security

No. of Securities	Variance of Returns	Percentage
1	0.008274	100.00
2	0.005066	61.23
3	0.004159	50.27
4	0.003553	42.94
5	0.002480	29.97
6	0.002419	29.24
7	0.002356	28.47
8	0.002025	24.47
9	0.002005	24.23
10	0.001981	23.94
11	0.001913	23.12
12	0.001787	21.60
13	0.001792	21.66
14	0.00177	21.48
15	0.001723	20.82
40	0.001550	18.73

The above data can be better pictured through a line chart, as shown in Figure 5.1

Fig 5.1: Risk Diversification Effect with Increasing Portfolio Size



The following observations are made from Figure 5.1:

(i) Average risk decreases fast as the number of securities held in the portfolio increases.

(ii) Each time one more security is added, risk is reduced by a smaller amount.

(iii) No matter how many securities are held, risk cannot be reduced on average to below 18.7% of the risk of holding only one security.

(iv) Holding about 6-7 securities can substantially reduce risk. Beyond this portfolio size, the benefits of holding additional securities in the portfolio are minimal.

The hypothesised equation **Y = a+ b(1/x)** is now tested in order to assess the strength of above observations. Regression is run on the data in Table 5.1. The results are as follows.

Regression Statistics

Multiple R	0.9931
R Square	0.9863
Adjusted R Square	0.9853
Standard Error	0.0002
Observations	16

	Coefficients	Standard Error	t-statistics
Intercept	0.00130*	0.000072	18.166
X Variable	0.00721*	0.000227	31.699

* (Significant at 5% level)

It is observed that the equation is significant and the estimated parameters are also significant at 5% level. The intercept term signifies the variance of a portfolio consisting of infinitely large number of securities. The intercept term calculated (0.00130) is comparable to the variance of the 40-security portfolio (0.00155, see Table 7.1)

5.5 Limitations of the study

In this exercise, equal weights for the shares in the portfolios have been used. This is, however, not strictly a limitation. It is simplifying assumption in order to avoid the complications of size effect. Other wise, there are a few limitations to this study, namely:

- A buy and hold strategy has been considered, i.e a static model where the portfolio remains the same throughout the period.
- Some of the securities obtained their listing late during the survey period, so that readings for these securities could not be observed for all sessions during the survey period.
- Not all the portfolio sizes have been considered. This is because working out the variances through Microsoft Office XP Excel programme is extremely time consuming. Nevertheless, it is believed that the observations in respect of those portfolio sizes which have been worked out (up to 15-security portfolios) provide ample evidence of risk diversification.

5.6 Conclusion

This study confirms the hypothesis that the rate of reduction of risk decreases as the number of securities in the portfolio increases. Moreover, by holding about 6-7 randomly selected securities an investor will be able to diversify a substantial amount of his risk.

This study also demonstrates that it is not enough to concentrate on risk reduction alone and in so doing run the risk of holding a very large portfolio, just for the sake of complete elimination of risk, at a high cost. The benefits of risk reduction must be weighted against the costs associated with the marginal reduction of risk. At a particular stage, the marginal costs of acquiring the additional security would be higher than the associated benefits. Such costs normally include transactions costs, search costs etc.

Coupled with these cost implications, there are other problems associated with holding portfolios consisting of a large number of securities. In the first instance, there is the impossibility of good portfolio management in that the status of all these securities cannot be considered simultaneously. Moreover, there is a risk that the search for numerous different assets may lead to the ill-informed purchase of investments that may not yield an adequate return for the risk they bear.

This study also has implications for the role of financial intermediaries. If holding 6 to 7 securities can reduce sufficient risks, then the need for financial intermediaries is questionable as the individual investor can also achieve the required results.

Computation of the actual cost based on market data may be beneficial for computing marginal costs of increasing the portfolio size. This would enable the practitioner to identify the optimal portfolio, at which the marginal benefits equal marginal costs.

The study has, up to now, given much attention to risk reduction without much consideration to expected return. In practice, the investor will make a trade off between risk and return and it is only diversification can reduce unsystematic risk.

CHAPTER SIX: TECHNIQUES IN PORTFOLIO SELECTION

If it assumed that investors are risk averse, which is not a completely unrealistic assumption, then it is expected that they will prefer investing in portfolios of securities rather than in single securities. It has been shown earlier that by randomly selecting about 6-7 securities, most of the risk can be diversified away. However, if there were some more structured technique for selecting securities, then the investor would probably be able to achieve his expected returns. How would the investors proceed to select their portfolios which would give them the returns which they are expecting?. This is essentially the subject of this chapter.

This chapter provides brief descriptions on how investors should normally choose their portfolios-through the expected utility model. The chapter then goes on to discuss an alternative portfolio selection technique, which is becoming increasingly popular-Price/Book Value ratio approach.

6.1 Choosing between Risky Alternatives

Risk adverse investors will prefer high-expected returns and low standard deviations. Put in another way, investors will prefer an investment giving the highest expected return for a given level of risk or one that has the lowest risk for a given level of expected return. So far, as particular investments have either similar expected returns or standard deviations, it is relatively easy for the investor to choose between them. But what is the position where investments have increasing levels of return accompanied by increasing levels of risk? How do investors choose between alternative risky investments?

The choice between risky alternatives, having different risk levels and different returns, is purely subjective and depends upon each individual's attitude to risk and the extra return that might be required for taking on extra exposure to risk.

A model, known as the Expected Utility Model, has been constructed which reflects the risk attitude of shareholders, how they perceive risk and how they react to its presence. Expected Utility is a function of expected return and standard deviation, and is positively related to the former and negatively related to the latter. While formulating this model, it has been assumed that individual investors act rationally and consistently. More specifically, four basic axioms regarding the behaviour of investors have been formulated:

1. Investors are able to choose between alternatives by ranking them in some order or merit, i.e they are capable of actually coming to a decision.

2. Any such ranking of alternatives is "transitive", i.e, if alternative A is preferred to B and alternative B is preferred to C, then A must be preferred to C.

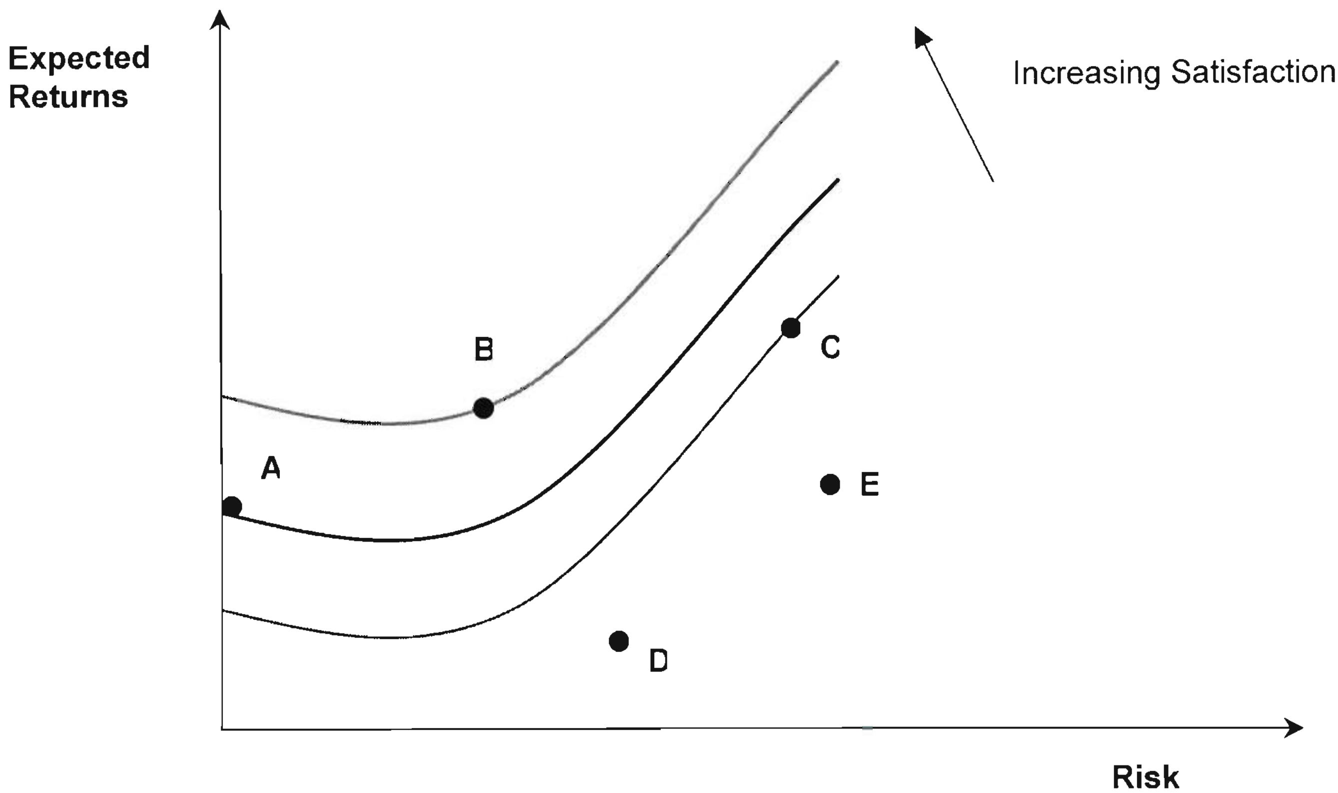
3. Investors do not differentiate between alternatives that have the same degree of risk.

4. Investors are able to specify for any investment whose returns are uncertain, an exactly equivalent alternative that would be just as preferable but which involves a certain return, i.e they are able to specify a certainty equivalent.

Utility functions for individuals can be represented by indifference curves as shown in Figure 6.1 with each curve showing combination of expected return and risk yielding equal satisfaction.

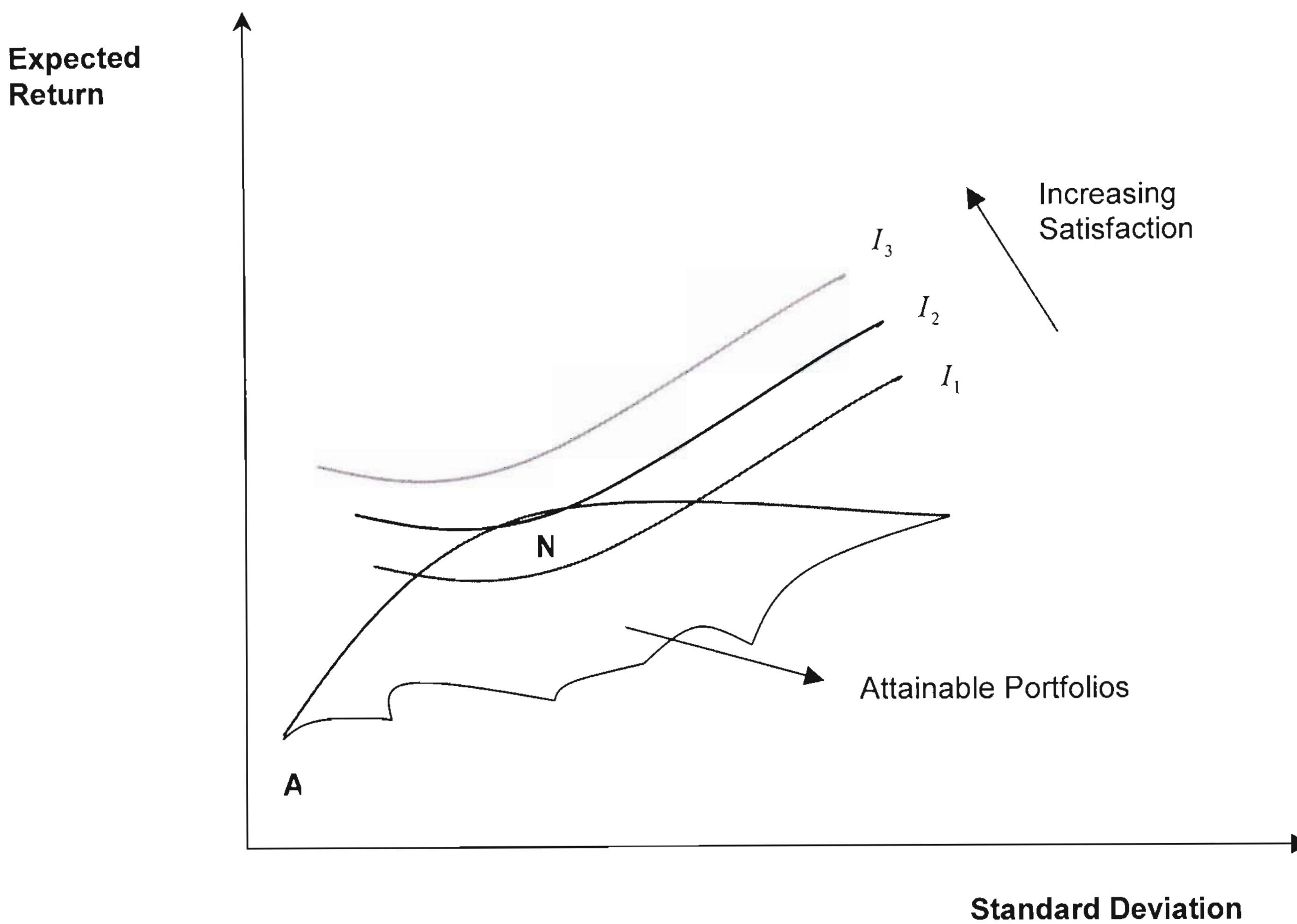
An investor will choose between alternative risky investments that will give him the greatest possible amount of utility. Thus, from Figure 6.1, the investor would choose security B since it gives him maximum utility. The other alternatives lie on even lower curves and would be relatively unattractive to the investor.

Figure 6.1: Indifference Curves



The expected utility model can be applied not only to individual securities but also to portfolios of securities. In this case, the investor would choose a portfolio from the efficient set (indicated by the curves AB) as shown in Figure 6.2 which is tangent to his indifference curve. Thus, the investor will choose portfolio N.

Fig 6.2: The Efficient Set and Indifference Curves



However, the Expected Utility Model has limited use since two major problems are associated with the model, namely:-

1. Its has little practical usefulness since to derive an accurate representation of an individual's utility function is both difficult and time-consuming. Moreover, an individual's attitude to risk can be expected to change over time as his personal attitudes and circumstances change, thus necessitating a periodic re-estimation of the function.

2. Since a company has several shareholders, management would need to be aware of each individual's utility function. The utility functions of these individual's are likely to be different and there is no way in which they can sensibly be aggregated to assist decision-making.

Given that the expected utility model has limited practical use, investors must then seek other ways of selecting their portfolios. Analysts have contended that the measure of a security's market value relative to its book value can be a useful ratio for investment purposes. The ensuing section analyses this issue.

6.2 Price/Book Value Approach

Internationally, the most widely used method for valuing common shares is the Dividend Discount Model (DDM), even though this has some limitations. However, it is generally found to be convenient to identify a single indicator particularly, some accounting variable which can be used to reflect the changes in the underlying fundamentals pertaining to a security. The Price to Earnings (P/E) ratio is one such formula. But, some studies have highlighted the limitations of the P/E ratio and have referred to another measure, the Price to Book Value (P/BV) ratio.

The probable rationale underlying this notion is that a firm is composed of the value of its existing assets and the present value of its future growth prospects. The Book Value per share can be considered as an indicator of the value of the assets in place. In mature and capital-intensive industries, asset values provide an indicator to the amount of investment that a new entrant has to make in order to gain entry. To that extent, therefore, P/BV ratio is an indicator of the inherent value of the firm.

The asset-pricing model as formulated by Sharpe (1964), Lintner (1965) and Black (1972) has long influenced analysts in their perception of risk and return. The main prediction of the model is that the market portfolio of invested wealth is mean variance efficient in the sense of Markowitz (1959). This implies that:

- Expected returns on securities are a positive linear function of their market βs (the slope in the regression of a security's return on the market's return), and

- The market βs suffice to describe the cross-section of expected returns.

There are many contradictions to the Sharpe - Litner - Black (SLB) model. The most prominent one is the size effect as advanced by Banz in 1981. He finds that market equity, ME (which is the security's price times shares outstanding), adds to the explanation of the cross-section of average returns provided by market βs. Average returns on small (low ME) securities are too high given their β estimates, whilst average returns on large shares are too low.

Another research conducted by Bhandari (1988) show that there is a positive relation between leverage and average return. Bhandari found that leverage helps explain the cross-section of average security returns in tests that include size (ME) as well as β.

In yet other studies by Stattman (1980) and Rosenberg, Reid and Lanstein (1985), it was found that average returns on US shares are positively related to the ratio of a firm's book value of equity, BE, to its market equity, ME. Chan, Hamao and Lakonishok (1991) found that book-to-market equity (B/ME) also has a strong role in explaining the cross-section of average returns on Japanese securities.

Traditionally the P/E ratio has been more popular than the P/BV ratio, and is widely used in making investment decision. Evans (1993) found that the usual stock market rule of 20 - which says that the P/E ratio plus the inflation rate should equal 20, no longer holds true. He suggested that this rule might have lost validity and many are trading at much higher P/Es, but there still exist some fundamental relationship between the yield on stock and bonds. A study in the Indian context pertaining to the relevance of P/E ratio as an investment criteria done by Vaidyanathan and Goswami (1997) indicates that no firm conclusions can be drawn regarding the relevance of P/E as a criteria for investment in the stock market, since the returns are not significantly different between low P/E and high P/E securities. An earlier study by Gupta and Gandhi (1995) indicates similar results.

Of all these factors discussed above which are likely to influence average returns of securities, it is reasonable to expect that some of them are redundant for describing average returns. Ball (1978), in his research work, argues that E/P is a catchall proxy for unnamed factors in expected returns. E/P is likely to be higher (prices are lower relative to earnings) for securities with higher risks and expected returns, whatever the sources of risk. Keim (1988) argues, along the same line, that Ball's proxy argument for E/P might also apply to size (ME), leverage and book to market equity (B/ME). All these values can be regarded as different ways to scale security prices, to extract the information in prices about risk and expected returns.

Black, Jensen and Scholes (1972) found that, as predicted by the SLB model, there is a positive simple relation between average security returns on the NYSE and β during the pre-1969 period. Fama and French (1992), as Reinganum (1981) and Lakonishok and Shapiro (1986), found that the relationship between β and average returns disappears during the more recent 1963-1990 period, even when β is used alone to explain average returns. In other words, the tests carried out by Fama and French (1992) do not support the predictions of the SLB model that average security returns are positively related to market βs.

Fama and French (1992) find that unlike the simple relation between β and average return, the univariate relations between average return and size, leverage, E/P and book-to-market equity are strong. In multivariate tests, the negative relation between size and average return is robust to the inclusion of other variables. The positive relation between book-to-market equity and average return also persists in competition with other variables. Moreover, although the size effect has attracted more attention, book-to-market equity has a stronger role in average returns.

The results of Fama and French research are:

- β does not seem to help explain the cross-section of average security returns, and

- The combination of size and book-to-market equity seems to absorb the roles of leverage and E/P in average security returns, at least during the 1963-1990 sample period.

In other words, Fama and French advocate that if assets are priced rationally, then security risks be multi-dimensional, one dimension being proxied by size (ME) and another by the book-to-market equity (B/ME). Moreover, they contended that B/ME was the single best explanatory variable for expected security returns.

The P/BV ratio is important if the company's book value per share has some relationship to the share's economic worth. For example, if the company is liquidated and its assets sold, the book value will provide the floor on the security's price. But this is not so in reality because the liquidation values of assets are generally much lower than their book values. The higher a company's price to book ratio, the more likely it is overvalued whereas the lower the ratio, the chances are that it is undervalued. Companies with market book ratios of less that 1 are serious candidates for under-valuation and represent possibly good buys.

Many analysts have suggested that P/BV ratios can be used as an investment decision rule. Consequently, studies have been conducted along this line. Wilcox (1984) showed that the P/BV-ROE model appears to be a better valuation model. Some argued that shares with low P/E ratios outperform shares with high P/BV ratios. Rosenberg, Reid and Lanstein (1985) examined this strategy and found that shares with low P/BV ratios experienced significantly higher risk - adjusted rates of return than the average securities.

Harris and Marston (1994) showed that the P/BV ratio is positively impacted by future growth prospects and risk factors similar to the P/E ratio. The risk factor used is Beta. Similarly, using accounting information, Fairfield (1994) showed that P/E ratio is a function of expected level of profitability on book value, which is related to ROE. This again implies that the P/BV ratio is impacted by growth expectations.

Shefrin and Statman (1995), on their side, contended that the Fortune survey showed that the respondents believed that good companies are large companies with high P/BV ratios and also that the shares of these companies will be good shares. These survey results are not consistent with empirical results obtained by Rosenberg, Reid and Lanstein, which show that shares with high P/BV ratios are not good shares in terms of risk-adjusted rates of return.

Penman (1996) in his study explains that the P/E ratio indicates future growth in earnings that is positively related to expected future return on equity and negatively related to current return on equity. The P/BV ratio indicates expected future returns on equity. So the two are reconciled by a comparison of current and expected future return on equity. Empirical evidence indicates that the return on equity is strongly correlated and predicts future profitability on which the P/BV is based. Current return is not a good indicator of P/E since a given level of P/E can be associated with alternative combinations of current and expected future return on equity.

A recent study by Agarwal et al (1996) carried out on the Singapore market investigated the usefulness of the P/BV ratio as a valuation model. They concluded that the identified fundamental variables that are supposed to determine the value of the firm also explain a significant portion of the variability in the price to book value ratio. Therefore, the latter can be used as a proxy for the former.

P/BV ratio has proved itself to be valuable in developed markets. It's use is consequently becoming more and more widespread throughout the world.

CHAPTER SEVEN: SECURITIES RETURNS AND PRICE TO BOOK VALUE RATIO

The Mauritian stock market has known significant increases in the number of securities listed on the market over its relatively small lifetime. Likewise, the daily turnover and market capitalisation have also increased tremendously. Other than individual investors and institutions, many new investment firms and mutual funds have also started participating in the market. Alongside all these developments, investors and many financial analysts are looking at various parameters for assessing the performance of companies in the stock market.

It has been suggested that price to book value ratio is a valuable measure on which investment decisions could be based. Consequently, an attempt is made in this chapter to examine whether (P/BV) price to book value ratio is a good investment criterion for Mauritius.

7.1 Hypothesis

Empirical studies have shown that low P/BV ratio securities, on average, will yield higher returns than high P/BV ratio securities. Consequently, the proposition to be tested is that investment in low P/BV securities will give, on average, higher returns than investment in higher P/BV securities.

The null hypothesis can be stated in the form of:

$H_0: \mu_i = \mu j$ for each pair of portfolios ***i*** and ***j*** at the 95% confidence level.

7.2 Methodology

All the securities, which were regularly traded during the four-year period 1996 to 2000, have been considered.

7.2.2 Portfolio Construction

The securities selected have varying accounting year ends such as April, June, September and December. In order to have the smallest time lag between the time when the market price is observed and the time when the book value per share is available from the published accounts, the average price for the month of June of each year has been retained. If December prices had been chosen, then for those companies whose accounting for the year-end in December their annual published accounts would not be available for the year ending December 2000. The P/BV ratio for 2000 would then have been based on the latest available account that is 1999, thus giving a time lag of 12 months. With June prices, the lag is decreased to 6 months.

Average prices for June of each year 1996 to 2000 were observed and the P/BV ratio for each security calculated. The book value is taken as the shareholders' net worth divided by the number of shares. The securities are then sorted in ascending order of the P/BV ratio. Given that there are 29 selected securities and that only 28 securities can be used to constitute four portfolios of seven securities, the security with the highest P/BV ratio has been excluded from the portfolios in each of the four years. So, each year four portfolios of seven securities are formed on the basis of P/BV ratio (ranging from low P/BV to high P/BV). Each year, the portfolios are reshuffled or reformed in June, based on the prevailing P/BV ratio. The P/BV ratios and annual returns of the selected securities for each of the four years are given in **Appendices 5(a) to 5(d).**

7.2.3 Portfolio Returns

Returns are calculated for each security based on June prices for each year. Thus, the return for the year 1999/2000 is:

$$\left(P_{June2000} - P_{June1999}\right)^{*100\ /\ p_{June\ 99}}$$

The return on the portfolio is defined as the simple average of the returns of the securities composing the portfolio since these are equally weighted.

The returns on the portfolios over the four years are given at **Appendix 6**. It is observed, at first sight, that there does not seem to be a relationship between P/BV ratio and portfolio return. However, in order to confirm this observation, the results have to be statistically tested for significance.

7.2.4 Testing for significance

Based on the annual returns of these portfolios, a t-test for each pair of portfolios was conducted in order to assess whether the annual return of the portfolios are significantly different. The t-test was run for each pair of portfolios, i.e (1,2), (1,3), (1,4), (2, 3), (2,4) and (3,4)

The following hypothesis has been tested:

- $H_0 : \mu_i - \mu_j = 0$ against the two-sided alternative
- $H_1 : \mu_i - \mu_j \neq 0$

7.2.5 Findings

The results of the return and standard deviation of the different portfolios are given in Table 7.1.

Table 7.1: Mean and Standard Deviation of Different P/BV Category Portfolios

Portfolio	Mean	Std. Deviation	Std. Error
1	11.43	44.00	22.00
2	-2.72	16.35	8.18
3	14.54	21.17	10.58
4	4.90	17.25	8.63

The significance of the mean returns of the different portfolios in a pair-wise fashion has been tested. The results are given in Table 7.2

Table 7.2: T-Statistics for the Different P/BV Category Portfolios Pairs

Portfolio	Mean Diff.	t-value
1,2	14.15	0.603
1,3	-3.11	-0.127
1,4	6.53	0.276
2,3	-17.26	-1.290
2,4	-7.62	-0.641
3,4	9.64	0.706

It is observed that at 5% significance level, the t-values do not exceed 2.447 (that from the student's t-distribution corresponding to the 5% level of significance for a two-tailed alternative) nor do they fall short of -2.447. The null hypothesis therefore cannot be rejected. This implies that portfolios formed on the basis of price to book value ratio are not significantly different. In other words, there is no strong evidence suggesting that, on average, portfolios of lower P/BV securities will yield higher returns than those of higher P/BV ratio securities.

7.3 Possible rationale

It has been pointed out in the literature review that leverage constitutes an important determinant of returns of a security. Some explanation to the results of the above study may, therefore be obtained from a study of the relationship between the average annual returns of the individual securities and their P/BV ratios and leverage (which has been taken as the total current and long term liabilities divided by shareholders' interest). These relationships are provided in **Appendix 6**. The following observations are made:

- In the light of surveys conducted in developed markets, it is expected that securities' returns will have a negative correlation with their P/BV ratios, so that the lower the P/BV ratio the higher the returns. However, this does not appear to be the case here in Mauritius. Most of the securities studied have a positive correlation with their P/BV ratio. This is probably because Mauritian investors view companies with increasing P/BV ratios as being indication of increasing levels of future profitability.

- Using the same line of reasoning, but with leverage this time instead of P/BV ratio, it is observed that many companies' returns, contrary to logical expectations, have negative or zero correlation with leverage. This implies that local investors view these companies as high risk and that increasing their leverage will affect adversely their returns.

The P/BV ratio of a particular security may be falling, but leverage on the other hand may act in such a way as to nullify or reverse the effect of changing P/BV ratios. This is what has been happening with many of the listed securities.

It is to be noted that in developed markets such as the United States, a company whose market value falls significantly below its book value becomes a potential candidate for take-over. Due to this, to some extent, the market value tends to be more closely related to the book value. In Mauritius, however, such practices are not common.

7.4 Limitations

The underlying assumption was that the investor is reconstructing this portfolio in an equally weighted manner for each of the years during the period under review. Value weighted portfolios could have been considered but they have the problem associated with size difference.

Returns, which have not been adjusted for risk, have been considered in the analysis. If a reliable set of betas could be obtained, then the analysis could be performed using risk adjusted returns and checked whether the results are the same.

7.5 Conclusion

This study has tested for the hypothesis that investment in low P/BV securities will yield, on average, higher returns than higher P/BV securities. 28 scrips, which are regularly traded over the last four years, have been considered. Four portfolios of seven securities have been constructed based on ascending order of P/BV ratios. The annual returns for each of these portfolios were obtained and a statistical test was performed to compare the annual average return for each pair of portfolios. The test reveals that the annual returns of portfolios formed on the basis of P/BV ratio are not significantly different from each other. This is also true for all combinations. P/BV ratio is therefore not a measure that can be applied to Mauritius. In other words, investors would not be better off by selecting portfolios based on the securities' P/BV ratios than if they had selected securities randomly, based on a naïve investment strategy.

CHAPTER EIGHT: CONCLUSION

This dissertation studied the Mauritian stock market, which is categorised as an emerging one. In the first instance, the operational efficiency of the local market was assessed. It was found that though the market cannot be said to be fully efficient, there are grounds to believe that it is efficient. The main problem area is the relative illiquidity of the market, which is further aggravated by factors such as extreme market concentration, unwillingness of domestic companies to participate in the securities' market, lack of breadth and depth in the less popular shares and high risk averseness of local individual investors. Nevertheless, the market is developing and evolving in the right direction towards greater operational efficiency.

The local market was then examined for the effect of portfolio size on risk. It was found that, in conformity with developed markets, risk on the local market decreases as portfolio size increases. Moreover, the rate of decrease of risk declines as one more security is added to the portfolio. It has been observed that the level of risk reduction as a result of diversification is rather high in Mauritius compared to developed markets. Holding about 6-7 securities selected randomly reduces substantially the amount of risk of an investor.

Finally, one portfolio selection technique, P/BV ratio was tested on the local market. It was found that this ratio did not constitute a valuable investment criterion for the Mauritian context.

This dissertation has focussed on one specific portfolio selection technique. There are many other techniques, which have been identified by researchers and analysts. Since these measures are beyond the scope of this dissertation, they have not been tested here. But, it is relevant to note that any or all of them may constitute reliable investment formula in Mauritius. Moreover, one model, which is becoming increasingly popular, is the Single Index Model, developed by Sharpe in 1964. This model is a simplification of the Markowitz full Variance-Covariance model. Based on this model, simple procedures that are easy to implement have been developed for determining optimal portfolios. In short, these procedures state that the desirability of adding any security to an optimal portfolio is directly related to its ' excess return to beta' ratio. Excess return is the difference between the expected return on the security and the riskless rate R_t of interest (such as the interest rate on treasury bills). The excess return to Beta ratio measured the additional return on a security (beyond that offered by a riskless asset) per unit of non-diversifiable risk. It might, therefore, be highly relevant to assess the relevance of this technique in Mauritius.

APPENDICES

Appendix 1

Bonus Issues of Listed Companies 1995-2000						
Year	Month	Issuer	Number of shares before operation	Ratio	Number of Shares	Number of shares after operation
1995	April	ROGERS	16,803,020	1:2	8,041,510	25,204,530
	July	GAMMA CIVIC	4,100,000	1:1	4,100,000	8,200,000
1996	Nov	MUA	2,530,000	1:2	1,265,000	3,795,000
	May	MOR	12,480,096	1:2	6,240,048	18,720,144
1997	Oct	MBL	5,043,000	1:1	5,043,000	10,086,000
	Aug	BAI	50,000,000	1:1	50,000,000	100,000,000
1998	Jan	UBP	8,836,681	1:1	8,836,681	17,673,362
	Jan	FINCORP	8,010,324	2:1	80,103,240	120,154,860
	June	MUA	5,100,000	1:5	1,020,000	6,120,000
1999	Jan	MDIT	58,803,822	1:2	117,607,644	176,411,466
2000	April	AIR MTIUS	51,152,500	1:1	51,152,500	102,305,000
		MOROIL	18,720,144	1:3	6,240,048	24,960,192

Appendix 2

Rights Issues 1995-2000						
Year	Month	Issuer	Number of Rights Issued	Ratio	Subscription Price (Rs)	Amount Raised (Rs)
1995	Feb	MSM	221,000	1:15	70.00	15,470,000
	Feb	UDL	960,000	1:10	36.00	34,560,000
	Mar	SUN RESORTS	12,078,219	1:6	36.00	434,815,884
	Mar	NIT	8,000,000	1:5	12.00	104,000,000
	July	GAMMA CIVIC	2,050,000	1:4	20.00	41,000,000
1996	Nov	MUA	1,265,000	1:3	20.00	25,300,000
1999	Nov	COURTS	39,000,000	1:2	14.65	571,350,000
2000	May	SUN RESORTS LTD	9,783,585	3:26	51.00	498,962,847
	Aug	POLICY	30,400,001	2:3	2.00	60,800,002

Appendix 3

Summary Financial Data for Listed Securities 2000							
Company	Nominal Value (Rs)	Price at 29.12.00	Market Capitalisation at 29.12.00	E.P.S (Rs) at 29.12.00	P.E.R at 29.12.00	Dividend Yield (%) at 29.12.00	Financial Year End
BANKS & INSURANCE							
B. A. I	1.00	3.60	360,000,000	0.60	6.00	11.11	Dec-99
Delphis Bank	1.00	3.50	1,050,000,000	0.34	10.29	4.29	Dec-99
MCB	10.00	81.00	4,718,878,236	14.14	4.91	5.06	Jun-00
Mauritius Union Assurance	10.00	31.10	190,332,000	8.27	9.17	8.04	Dec-99
SBM	1.00	16.40	6,273,000,000	3.53	7.59	4.27	Jun-00
INDUSTRY							
Gamma Civic	10.00	20.00	205,000,000	4.22	4.74	5.00	Jun-00
Mauritius Breweries Ltd	10.00	52.00	524,472,000	7.43	7.00	5.77	Jun-00
Mauritius Chemical Industry Ltd	10.00	6.45	141,941,396	1.42	4.54	10.85	Jun-00
Mauritius Oil Refineries Ltd	5.00	8.25	205,921,396	1.43	5.79	9.09	Jun-00
Stationery Manufacturers	10.00	44.40	157,069,440	8.99	4.94	7.32	Jun-00

Appendix 3 Contd..

Summary Financial Data for Listed Securities 2000							
Company	Nominal Value (Rs)	Price at 29.12.00	Market Capitalisation at 29.12.00	E.P.S (Rs) at 29.12.00	P.E.R at 29.12.00	Dividend Yield (%) at 29.12.00	Financial Year End
INVESTMENTS							
Fincorp Investments	1.00	3.20	384,45,552	0.42	7.62	8.75	Jun-00
General Investments & Development	1.00	5.10	152,316,644	0.81	1.55	6.72	Jun-00
Liberty Investments	10.00	13.40	73,500,000	0.91	14.73	4.48	Sep-00
SUGAR							
Mon Desert Alma Ltd	25.00	50.00	89,958,900	22.11	2.26	9.00	Dec-99
Mount Sugar Estates Co.	10.00	9.25	103,426,100	0.18	51.39	9.00	Dec-99
Mon Tresor	7.50	23.50	1,574,791,494	2.93	8.02	9.34	Dec-99
COMMERCE							
Courts (Mtuis)	1.00	3.90	456,300,00	1.08	3.61	4.36	Mar-00
Happy World Foods Ltd	10.00	20.00	734,605,320	2.82	7.09	6.00	Jun-00
Harel Mallac	10.00	22.30	251,084,352	3.96	5.63	9.87	Dec-99
Ireland Blyth	10.00	19.00	1,357,328,32	2.82	6.74	4.74	Dec-99

Appendix 3 Contd..

Summary Financial Data for Listed Securities 2000							
Company	Nominal Value (Rs)	Price at 29.12.00	Market Capitalisation at 29.12.00	E.P.S (Rs) at 29.12.00	P.E.R at 29.12.00	Dividend Yield (%) at 29.12.00	Financial Year End
LEISURE AND HOTELS							
Automatic Systems Ltd	10.00	25.00	88,375,000	2.86	8.74	10.00	Dec-99
Grand Baie Hotels Ltd	10.00	54.50	1,100,900,000	5.39	10.11	8.26	Sep-00
New Mauritius Hotels Ltd	10.00	34.70	3,470,000,000	3.24	10.71	7.20	Sep-00
Sun Resorts	10.00	48.90	4,624,700,727	5.20	9.40	7.73	Dec-99
TRANSPORT							
Air Mauritius	10.00	16.00	1,688,032,500	6.24	4.14	12.06	Mar-00

Appendix 4

Securities Beta Values, Coefficients of Determination and t-statistics				
Securities	**Beta Value b**	**Coefficient of Determination R**	**Std. Error of Estimate s (%)**	**t-statistics t**
BAI	0	0.00	0.0602	0.016
MCB	0.51	0.34	0.0463	5.442
MEI	0.33	0.20	0.0368	3.405
MUA	0.48	0.16	0.0615	2.948
SBM	0.38	0.05	0.0644	1.211
SWAN	0.57	0.20	0.0723	3.845
GAMMA CIVIC	0.01	0.00	0.0639	0.066
MBL	0.58	0.30	0.0506	4.688
MCFI	0.12	0.01	0.082	0.739
MOR	0.26	0.04	0.0863	1.505
MSM	0.38	0.13	0.0633	2.949
PIM	0.33	0.05	0.0855	1.58
UBP	0.47	0.10	0.0898	2.589
BMH	0.64	0.22	0.0665	3.487
CIT	0.89	0.15	0.1366	3.207

Appendix 4 Contd..

Securities Beta Values, Coefficients of Determination and t-statistics				
Securities	Beta Value b	Coefficient of Determination R	Std. Error of Estimate s (%)	t-statistics t
MDIT	0.69	0.19	0.0919	3.666
NIT	0.3	0.04	0.079	1.532
PAD	1.63	0.48	0.0567	4.422
POLICY	0.44	0.06	0.1094	1.955
UDL	0.43	0.16	0.0617	3.38
HAREL FRERES	0.42	0.08	0.0917	2.258
MDA(O)	0.25	0.03	0.0919	1.324
MOUNT	0.27	0.11	0.1045	1.28
MTMD	0.45	0.06	0.0809	2.715
SAVANNA H	0.36	0.27	0.089	1.96
COURTS	1.15	0.00	0.1219	4.643
CMPL	0.05	0.30	0.083	0.297
HW FOODS	0.81	0.15	0.0424	2.937
HAREL MALLAC	0.52	0.03	0.0777	3.257
IBL	-0.59	0.02	0.171	-1.156

Appendix 4 Contd..

Securities Beta Values, Coefficients of Determination and t-statistics				
Securities	Beta Value b	Coefficient of Determination R	Std. Error of Estimate s (%)	t-statistics t
ROGERS	0.36	0.12	0.1702	1.029
SHELL	0.48	0.01	0.082	2.875
ASL	-0.13	0.00	0.0664	-0.641
GBH	0	0.24	0.0438	-0.025
NMH	0.52	0.07	0.0311	2.275
SUN RESORTS	0.26	0.06	0.0608	2.109
AIR MAURITIU S	1.33	0.06	0.2578	1.489

Appendix 5 (a)

P/BV Ratio and Annual Returns of Listed Securities for 1998							
Security	F/Y End	Avg Price at June 98 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 97	Avg. Adj Price June 98	Avg Annual Return (%)
MDA	Dec	102.08	472.18	0.22	40.38	102.08	152.80
H FRERES	Dec	33.33	86.34	0.39	25.04	33.33	33.11
SAVANAH	Dec	114.15	236.41	0.48	56.06	114.15	103.62
GIDC	June	12.50	22.78	0.55	4.20	12.50	197.62
MOUNT	Dec	23.97	34.85	0.69	21.58	23.97	11.08
MOR	June	9.33	10.99	0.85	5.00	5.78	15.60
CMPL	June	39.00	43.25	0.90	41.18	39.00	-5.29
LIT	Sep	15.97	17.03	0.94	10.43	14.45	38.54
NIT	June	15.02	15.18	0.99	10.47	10.76	2.77
MCFI	June	17.02	15.47	1.10	20.09	17.02	-15.28
ROGERS	Sep	138.46	121.03	1.14	64.74	75.27	16.27
MDIT	June	15.22	10.66	1.43	8.86	11.52	30.02
H. MALLAC	Dec	42.51	29.70	1.43	32.25	34.08	5.67
MCB	June	62.38	42.56	1.47	54.28	62.38	14.92

Appendix 5 (a) Contd..

P/BV Ratio and Annual Returns of Listed Securities for 1998							
Security	F/Y End	Avg Price at June 98 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 97	Avg. Adj Price June 98	Avg Annual Return (%)
UBP	June	47.42	30.76	1.54	39.27	47.42	20.75
SWAN	Dec	39.55	24.46	1.62	37.88	39.55	4.41
MTMD	March	37.03	21.70	1.71	26.14	37.03	41.66
COURTS	March	12.11	6.73	1.80	6.95	14.76	112.37
UDL	June	48.03	26.29	1.83	28.45	36.54	28.44
POLICY	Dec	6.76	3.45	1.96	2.65	4.65	75.47
SHELL	Dec	23.93	11.52	2.08	19.34	23.93	23.73
MBL	June	117.23	53.62	2.19	41.21	54.65	32.61
MEI	Dec	50.17	22.74	2.21	49.75	50.17	0.84
SUN RESORTS	Dec	33.02	14.92	2.21	25.66	33.02	28.68
MSM	June	82.00	35.78	2.29	76.35	93.22	22.10
PIM	June	28.47	10.95	2.60	28.33	28.47	0.49
BAI	Dec	5.58	1.47	3.80	2.04	2.20	7.84
MUA	Dec	62.96	15.90	3.96	34.67	37.28	7.53

Appendix 5 (b)

P/BV Ratio and Annual Returns of Listed Securities for 1999							
Security	F/Y End	Avg Price at June 99 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 98	Avg. Adj Price June 99	Avg Annual Return (%)
MDA	Dec	106.38	463.71	0.23	102.08	106.38	4.21
H FRERES	Dec	44.48	89.94	0.49	33.33	44.48	33.45
SAVANAH	Dec	137.54	242.99	0.57	114.15	137.54	20.49
GIDC	June	17.68	17.24	1.03	12.50	17.68	41.44
MOUNT	Dec	24.52	34.71	0.71	23.97	24.52	2.29
MOR	June	9.33	10.99	0.85	5.00	9.33	86.60
CMPL	June	39.00	43.25	0.90	41.18	39.00	-5.29
LIT	Sep	14.38	17.03	0.84	14.45	14.38	-0.48
NIT	June	15.90	16.44	0.97	10.76	15.90	47.77
MCFI	June	16.16	15.78	1.02	17.02	16.16	-5.05
ROGERS	Sep	138.46	121.03	1.14	64.74	138.46	113.87
MDIT	June	11.03	11.31	0.98	11.52	11.03	-4.25
H. MALLAC	Dec	31.90	32.24	0.99	34.08	31.90	-6.40
MCB	June	75.14	49.45	1.52	62.38	75.14	20.46

Appendix 5 (b) Contd..

P/BV Ratio and Annual Returns of Listed Securities for 1999							
Security	F/Y End	Avg Price at June 99 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 98	Avg. Adj Price June 99	Avg Annual Return (%)
UBP	June	32.01	33.00	0.97	47.42	32.01	-32.50
SWAN	Dec	31.51	26.66	1.18	39.55	31.51	-20.33
MTMD	March	35.38	24.11	1.47	37.03	35.38	-4.46
COURTS	March	5.48	6.48	0.85	14.76	5.48	-62.87
UDL	June	43.56	54.64	0.80	36.54	43.56	19.21
POLICY	Dec	4.75	4.32	1.10	4.65	4.75	2.15
SHELL	Dec	27.72	11.72	2.37	23.93	27.72	15.84
MBL	June	119.54	79.74	1.50	54.65	119.54	118.74
MEI	Dec	48.85	25.65	1.90	50.17	48.85	-2.63
SUN RESORTS	Dec	32.88	15.50	2.12	38.02	32.88	-13.52
MSM	June	66.08	41.11	1.61	93.22	66.08	-29.11
PIM	June	17.47	10.20	1.71	28.47	17.47	-38.64
BAI	Dec	7.25	1.88	3.86	2.20	3.62	64.55
MUA	Dec	47.45	23.27	2.04	37.28	29.29	-21.43

Appendix 5 (c)

P/BV Ratio and Annual Returns of Listed Securities for 2000

Security	F/Y End	Avg Price at June 00 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 99	Avg. Adj Price June 00	Avg Annual Return (%)
MDA	Dec	81.08	493.56	0.16	106.38	81.08	-23.78
H FRERES	Dec	40.53	140.07	0.29	44.48	40.53	-8.88
SAVANAH	Dec	122.17	266.56	0.46	137.54	122.17	-11.17
GIDC	June	6.45	14.54	0.44	17.68	6.45	-63.52
MOUNT	Dec	19.32	33.35	0.58	24.52	19.32	-21.21
MOR	June	7.73	9.49	0.81	5.25	7.73	47.24
CMPL	June	8.73	40.99	0.21	22.23	8.73	-60.73
LIT	Sep	11.74	16.38	0.72	14.38	11.74	-18.36
NIT	June	12.10	15.66	0.77	15.90	12.10	-23.90
MCFI	June	9.98	16.32	0.61	13.16	9.98	-24.16
ROGERS	Sep	94.38	118.06	0.80	112.27	94.38	-15.93
MDIT	June	7.89	9.59	0.82	11.03	7.89	-28.47
H. MALLAC	Dec	32.17	32.82	0.98	31.09	32.17	3.47
MCB	June	75.08	55.47	1.35	75.14	75.08	-0.08

Appendix 5 (c) Contd

P/BV Ratio and Annual Returns of Listed Securities for 2000							
Security	F/Y End	Avg Price at June 00 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 99	Avg. Adj Price June 00	Avg Annual Return (%)
UBP	June	25.76	35.41	0.73	32.01	25.76	-19.53
SWAN	Dec	31.73	29.80	1.06	31.51	31.73	0.70
MTMD	March	32.28	24.36	1.33	35.38	32.28	-8.76
COURTS	March	3.53	7.10	0.50	5.48	3.53	-35.58
UDL	June	40.43	55.09	0.73	43.56	40.43	-7.19
POLICY	Dec	3.68	3.78	0.97	4.75	3.68	-22.53
SHELL	Dec	27.72	11.72	2.37	23.93	27.72	15.84
MBL	June	15.92	11.49	1.39	27.72	15.92	-42.57
MEI	Dec	49.28	28.81	1.71	48.45	49.28	1.71
SUN RESORTS	Dec	35.46	23.30	1.52	32.88	35.46	7.85
MSM	June	50.63	43.69	1.16	78.11	50.63	-35.18
PIM	June	7.79	8.63	0.90	17.47	7.79	-55.41
BAI	Dec	7.02	2.03	3.46	3.62	3.51	-3.04
MUA	Dec	28.14	22.35	1.26	29.29	28.14	-3.93

Appendix 5 (d)

P/BV Ratio and Annual Returns of Listed Securities for 2001							
Security	F/Y End	Avg Price at June 01 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 00	Avg. Adj Price June 01	Avg Annual Return (%)
MDA	Dec	89.54	497.01	0.18	81.08	89.54	10.43
H FRERES	Dec	56.15	148.24	0.38	40.53	56.15	38.54
SAVANAH	Dec	146.38	274.67	0.53	122.17	146.38	19.82
GIDC	June	5.68	14.54	0.39	6.45	5.68	-11.94
MOUNT	Dec	21.43	63.60	0.34	19.32	21.43	10.92
MOR	June	11.52	10.77	1.07	7.73	11.52	49.03
CMPL	June	8.74	40.94	0.21	8.73	8.74	0.11
LIT	Sep	11.46	16.06	0.71	11.74	11.46	-2.39
NIT	June	11.30	16.71	0.68	12.10	11.30	-6.61
MCFI	June	10.54	17.20	0.61	9.98	10.54	5.61
ROGERS	Sep	98.23	122.55	0.80	94.38	98.23	4.08
MDIT	June	7.40	11.22	0.66	7.89	7.40	-6.21
H. MALLAC	Dec	34.02	36.86	0.92	32.17	34.02	5.75
MCB	June	89.62	62.88	1.43	75.08	89.62	19.37

Appendix 5 (d) Contd..

P/BV Ratio and Annual Returns of Listed Securities for 2001							
Security	F/Y End	Avg Price at June 01 (Rs)	NAV Per Share	P/BV Ratio	Avg Adj Price June 00	Avg. Adj Price June 01	Avg Annual Return (%)
UBP	June	32.75	37.16	0.88	25.76	32.75	27.14
SWAN	Dec	49.13	33.96	1.45	31.73	49.13	54.84
MTMD	March	40.44	24.36	1.66	32.28	40.44	25.28
COURTS	March	5.04	7.10	0.71	3.53	5.04	42.78
UDL	June	37.08	54.94	0.67	40.43	37.08	-8.29
POLICY	Dec	4.10	4.04	1.01	3.68	4.10	11.41
SHELL	Dec	20.32	11.85	1.71	15.92	20.32	27.64
MBL	June	75.31	116.49	0.65	57.95	75.31	29.96
MEI	Dec	54.31	32.54	1.67	49.28	54.31	10.21
SUN RESORTS	Dec	50.08	25.74	1.95	35.46	50.08	41.23
MSM	June	51.35	45.89	1.12	50.63	51.35	1.42
PIM	June	3.43	6.13	0.56	7.79	3.43	-55.97
BAI	Dec	4.18	3.14	1.33	3.51	4.18	19.09
MUA	Dec	29.24	27.10	1.08	28.14	29.24	3.91

Appendix 6

Average Returns of Different P/BV Category Portfolios								
1997/98		1998/99		1999/00		2000/2001		Overall Mean Return
Securities	Return	Securities	Return	Securities	Return	Securities	Return	
Portfolio 1: Lowest P/BV								
MDA	152.8	MDA	4.21	MDA	-23.78	MDA	10.43	
H FRERES	33.11	H FRERES	33.45	CMPL	-60.9	CMPL	-2.98	
SAVANNAH	103.62	CMPL	-42.74	H FRERES	-8.88	MOUNT	10.92	
MOR	15.6	MOUNT	2.29	COURTS	-35.58	SAVANNAH	19.82	
Average	76.28	Average	-0.697	Average	-32.28	Average	9.54	13.21
Portfolio 2: Lower Intermediate P/BV								
LIT	38.54	MCFI	-22.68	MCFI	-24.16	MCFI	5.61	
NIT	3.02	LIT	-0.48	LIT	-18.36	MBL	29.96	
MCFI	-15.28	COURTS	-62.87	UBP	-19.53	MDIT	-6.21	
ROGERS	16.27	NIT	47.77	UDL	-7.19	UDL	-8.29	
MDIT	30.02	UBP	-32.5	NIT	-23.9	NIT	-6.61	
H.MALLAC	5.67	MDIT	-4.25	UBP	-15.93	COURTS	42.78	
Average	13.04	Average	-12.50	Average	-18.18	Average	9.54	-2.03

Appendix 6 Contd..

Average Returns of Different P/BV Category Portfolios								
1997/98		1998/99		1999/00		2000/2001		Overall Mean Return
Securities	Return	Securities	Return	Securities	Return	Securities	Return	
Portfolio 3: Higher Intermediate P/BV								
MCB	14.92	H. MALLAC	-6.4	MOR	47.24	LIT	-2.39	
UBP	20.75	GIDC	41.44	MDIT	-28.47	ROGERS	4.08	
SWAN	4.41	POLICY	2.15	PIM	-55.41	UBP	27.14	
MTMD	41.46	SWAN	-20.33	POLICY	-22.53	H.MALLAC	5.75	
UDL	28.44	MTMD	-4.46	SWAN	0.7	MOR	49.03	
Average	21.99	Average	2.48	Average	-11.69	Average	16.72	7.37
Portfolio 4: Highest Intermediate P/BV								
SHELL	23.73	MCB	20.46	MSM	-35.68	MSM	1.42	
MBL	32.61	MSM	-15.57	MUA	-3.93	BAI	19.09	
MEI	1.68	PIM	-38.64	MTMD	-8.76	MCB	19.37	
SUN RESORTS	28.68	MEI	-3.43	MCB	-0.08	SWAN	54.84	
MSM	22.1	MUA	-21.43	SHELL	-42.57	MTMD	25.28	
Average	21.76	Average	-11.72	Average	-18.20	Average	24.00	3.96

Appendix 7

Correlation Between Returns and P/BV and Leverage												
Year	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E
	BAI			MCB			MEI			POLICY		
1998	7.84	1.79	1.00	14.92	1.93	10.71	1.68	1.95	0.68	75.47	1.38	0.04
1999	64.55	1.78	0.69	20.46	1.47	10.38	-3.43	1.67	0.74	2.15	1.09	0.04
2000	-3.04	1.20	0.78	-0.80	1.33	10.50	1.71	1.57	0.87	-22.53	0.92	0.04
2001	19.09	1.21	0.89	19.37	1.45	10.11	10.21	1.63	0.67	11.41	0.99	0.04
Correlation Coefficient		0.54	0.06		0.32	-0.30		-0.16	-0.6		0.96	N/A

Correlation Between Returns and P/BV and Leverage												
Year	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E
	MUA			SWAN			MBL			MDA		
1998	15.06	1.65	0.50	4.41	1.39	0.77	32.61	1.29	0.23	152.80	0.27	0.11
1999	-21.43	1.26	0.37	-20.33	0.85	0.79	9.37	0.66	0.20	4.21	0.19	0.18
2000	-3.93	1.01	0.41	0.70	1.05	0.78	-3.05	0.58	0.16	-23.78	20.00	0.22
2001	3.91	1.31	0.46	54.84	1.44	0.71	29.96	0.64	0.15	10.43	0.12	0.24
Correlation Coefficient		0.61	0.73		0.81	-0.77		0.65	0.34		0.72	-0.90

Appendix 7 Contd..

Correlation Between Returns and P/BV and Leverage

Year	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E
	MCFI			MOR			MSM			SAVA		
1998	-15.28	1.05	0.33	15.60	0.51	0.22	22.10	2.36	0.82	103.62	0.34	0.10
1999	-22.68	0.64	0.28	-9.71	0.46	0.40	-15.57	1.47	0.72	20.49	0.36	0.15
2000	-24.16	0.63	0.38	47.24	1.01	0.48	-35.68	1.07	0.63	-11.17	0.53	0.16
2001	5.61	0.52	0.36	49.03	1.05	0.45	1.42	0.98	0.77	19.82	0.51	0.20
Correlation Coefficient		-0.29	0.29		0.95	0.48		0.71	0.99		-0.75	0.77

Correlation Between Returns and P/BV and Leverage

Year	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E	Return (%)	P/BV	D/E
	UBP			CIT			GIDC			H.MALLAC		
1998	20.75	1.59	0.72	16.96	1.06	0.00	197.62	0.65	0.00	5.67	1.59	0.33
1999	-32.50	0.86	0.59	-33.38	0.86	0.00	41.44	0.55	0.00	-6.40	0.91	0.60
2000	-19.53	0.86	0.54	-17.11	0.77	0.04	-63.52	0.56	0.00	0.85	0.84	0.66
2001	27.14	1.02	0.56	6.08	0.63	0.04	-11.94	0.38	0.00	5.75	0.70	0.59
Correlation Coefficient		0.67	0.41		0.22	N/A		0.62	N/A		0.29	-0.94

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