EFFECTS OF DIVERSIFICATION ON RISK AND RETURN: AN EMPIRICAL STUDY OF SECURITIES IN THAILAND DURING THE PERIOD OF 1996 TO 2001

by

YAOWALUK TECHARONGROJWONG

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Business Administration

Graduate School of Business
Assumption University
Bangkok Thailand

November 2002
EFFECTS OF DIVERSIFICATION ON RISK AND RETURN: AN EMPIRICAL STUDY OF SECURITIES IN THAILAND DURING THE PERIOD OF 1996 TO 2001

By

YAOWALUK TECHARONGROJWONG

A Thesis submitted in partial fulfillment of the requirements for the degree of

Master of Business Administration

Examination Committee:

1. Dr. Ismail Ali Siad (Advisor)
2. Dr. Michael Schemmann (Member)
3. Dr. Thongdee Kijboonchoo (Member)
4. Dr. Chittipa Ngamkroeckjoti (Member)
5. Dr. Thanawan Sangeuwan (MUA Representative)

Examined on: 28 November 2002
Approved for Graduation on:

Graduate School of Business
Assumption University
Bangkok Thailand
November
2002
ABSTRACT

Modern Portfolio Theory (MPT) indicates that, by diversifying their portfolios, investors can reduce risk without sacrificing expected return. Hence, the present study attempts to examine whether the rate of return on well-diversified low risk portfolios is indeed significantly lower than the return on well-diversified higher risk portfolios and to show how diversification can be utilized to offset the riskiness of individual securities. This is so that portfolios consisting of large numbers of higher risk securities are less risky than portfolios consisting of small numbers of low risk securities, and yet earn a substantially higher rate of return.

Fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS) and have a complete set of data during January 1996 through December 2001, have been selected to construct two types of portfolio. The first classification of portfolios, involves dividing the fifty-four securities into three equal groups based on their corporate bond rating by Thai Rating and Information Services (TRIS). Eighteen companies with class A bond rating are grouped in portfolio A. Eighteen companies with class B bond rating are grouped in portfolio B. Eighteen companies with class C bond rating or the companies under rehabilitation specified by Stock Exchange of Thailand are grouped in portfolio C. In addition, the second classification of the portfolio is constructed to show the effects of changing number of stocks in the portfolio, so eighteen stocks are selected from class A quality stocks to create one-stock portfolio to eighteen-stock portfolio.

The result of the present study indicates that there is a negative relationship between the quality rating of a portfolio and the risk of a portfolio, measured by beta, which means that when the quality rating of the portfolio increases, the risk of the portfolio measured by beta will decrease. The present study also indicates that there is no significant relationship between the quality rating of the portfolio and the average return of the portfolio. Although the average returns on class B portfolio are greater than the average returns on class A portfolio, the average returns on class C portfolio are not greater than the average returns on class B portfolio.
Moreover, the present study indicates that there is no significant relationship between the number of holdings in the portfolio and average return of each portfolio. Portfolios composed of different number of securities in the same quality class have the same level of systematic risk; even the level of unsystematic risk varies. The return of the portfolio relates only to that risk, which cannot be diversified, i.e., the systematic risk. Finally, the present study indicates that there is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return. Portfolios of a small number of securities are very undiversified, whereas the portfolios of as few as fourteen to eighteen securities have a strong relationship to market index.

This empirical findings would be helpful for the investors in improving the investment performance by expanding the list of qualified securities to include the higher return, the higher risk securities, while offsetting the increase in market risk by holding many securities in one portfolio. The appropriate numbers of holding are fourteen to eighteen securities in one portfolio, and the investors with small account should exploit these possibilities.
ACKNOWLEDGEMENT

I wish to express my most sincere appreciation and deepest gratitude to my advisor, Dr. Ismail Ali Siad, for his valuable guidance and helpful suggestions, which are very essential for this thesis formation.

I am also indebted to Dr. Somprot Sarakosas for his advice and encouragement to complete this thesis.

My sincere thankfulness is also extended to Dr. Thongdee Kijboonchao, Dr. Michael Schemmann, and Dr. Chittipa Ngamkroeckjoti, the members of my thesis committee, for their useful suggestions and comments to my thesis.

Special thanks go to a number of unmentioned teachers who previously taught me since I was young. They helped me succeed both in my study and life.

I also would like to thank all of my friends for any of their encouragement.

Most of all, I would like to express my profound gratitude and deep appreciation to my dad, my mom, my elder brother and my elder sister for their endless moral supports, inspirations, and invaluable encouragement. Without them, I would never have achieved this great success in my life.

Any errors in this paper are my sole responsibility.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>i</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
</tbody>
</table>

## CHAPTER

1. INTRODUCTION

1.1 Background and Statement of Problems                                   | 1    |
1.2 Research Objectives                                                    | 4    |
1.3 Significance of the Study                                              | 5    |
1.4 Scope of the Research                                                  | 5    |
1.5 Limitations of the Research                                            | 7    |
1.6 Definition of Terms                                                    | 8    |
1.7 Organization of the Research                                           | 17   |

2. THE STOCK AND BOND MARKET IN THAILAND

2.1 Thailand’s Economic Performance                                         | 18   |
2.1.1 Causes of Economic Crisis                                            | 19   |
2.1.2 Thailand’s Reaction after the Economic Crisis                        | 20   |
2.1.3 Recent Development in Thai Economy                                   | 21   |

2. The Stock Market in Thailand                                            | 25   |
2.1 Trading System and Trading Hours                                       | 27   |
2.2 Floor and Ceiling Price Limits                                         | 29   |
2.3 Brokerage Commissions and Taxations                                   | 29   |
2.4 Clearing and Settlement                                                | 29   |
2.5 Investor Information and Companies’ Accounting System                  | 29   |
2.6 Rules and Regulations for Internet Trading                             | 30   |
2.7 Historical Performance of SET and Market Capitalization                | 31   |
3. Thai Rating and Information Services (TRIS) 39
   3.1 Rating Criteria 40
   3.2 Rating Profile for Corporate 40
   3.3 Rating Profile for Financial Institutions 41
   3.4 Rating Process 42
   3.5 Monitoring Process 44
   3.6 Symbols and Definitions 45

3. REVIEW OF LITERATURE AND RELATED THEORIES
   3.1 Literature Review 46
   3.2 Related Theory 79
      3.2.1 Portfolio Theory 79
      3.2.2 Capital Market Line: CML 87
      3.2.3 Capital Asset Pricing Model (CAPM) 94
      3.2.4 Security Market Line: SML 98
      3.2.5 Some Applications of the CAPM in Investment Decision 101

4. RESEARCH FRAMEWORK
   4.1 Conceptual Framework 103
   4.2 Definition of Key Variables 106
   4.3 Research Hypothesis 108
   4.4 Expected Outcome 110

5. RESEARCH METHODOLOGY
   5.1 Data Source and Data Collection 112
   5.2 The Variable Estimation
      5.2.1 Beta Estimation 113
      5.2.2 Monthly Return Estimation 115
      5.2.3 The Estimation of the Coefficient of Determination 116
   5.3 Empirical Testing Procedure 117
   5.4 Operational Procedure 118
   5.5 Hypothesis Testing 121
6. DATA ANALYSIS AND PRESENTATION OF THE RESULTS

6.1 The General Results 125
6.2 The Empirical Results of Portfolio Theory 131

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions 144
7.2 Limitations and Recommendations 149

BIBLIOGRAPHY 151
APPENDIX A 156
APPENDIX B 165
APPENDIX C 182
### APPENDIX A

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Gross Domestic Products of Thailand’s Economy during 1979-2001</td>
<td>156</td>
</tr>
<tr>
<td>A2</td>
<td>Thailand’s International Trade during 1979-2001</td>
<td>157</td>
</tr>
<tr>
<td>A3</td>
<td>Thailand’s International Trade in Percentage Change during 1979-2001</td>
<td>158</td>
</tr>
<tr>
<td>A4</td>
<td>Thailand’s International Reserve and Balance of Payments during 1979-2001</td>
<td>159</td>
</tr>
<tr>
<td>A5</td>
<td>The Exchange Rate (Baht : US$) during 1979-2001</td>
<td>160</td>
</tr>
<tr>
<td>A6</td>
<td>Loan and NPLS Loan Outstanding in Thailand during 1979-2001</td>
<td>161</td>
</tr>
<tr>
<td>A7</td>
<td>Inflation Rate in Thailand during 1979-2001</td>
<td>162</td>
</tr>
<tr>
<td>A8</td>
<td>Annual Interest Rate in Thailand during 1979-2001</td>
<td>163</td>
</tr>
<tr>
<td>A9</td>
<td>Event Chart of the SET Index Monthly Movement 01/1992-12/2001</td>
<td>164</td>
</tr>
</tbody>
</table>
APPENDIX B

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Trading Hours of the Stock Exchange of Thailand</td>
<td>165</td>
</tr>
<tr>
<td>B2 Rules and Regulations of Off-Hour Trading</td>
<td>166</td>
</tr>
<tr>
<td>B3 Price Regulation</td>
<td>167</td>
</tr>
<tr>
<td>B4 Taxation on Dividends and Interest</td>
<td>168</td>
</tr>
<tr>
<td>B5 Information Disclosure Requirements of the Stock Exchange of Thailand</td>
<td>169</td>
</tr>
<tr>
<td>B6 Some General Listing Criteria for Common Stocks</td>
<td>170</td>
</tr>
<tr>
<td>B7 Brokerage Member Firms</td>
<td>171</td>
</tr>
<tr>
<td>B8 Ratings Symbols and Rating Definitions</td>
<td>175</td>
</tr>
<tr>
<td>B9 Listed Companies Used in Sample Period</td>
<td>177</td>
</tr>
</tbody>
</table>
APPENDIX C

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 Average Return, Beta, and Standard Deviation for Class A Securities during January 1996 to December 2001</td>
<td>182</td>
</tr>
<tr>
<td>C2 Average Return, Beta, and Standard Deviation for Class B Securities during January 1996 to December 2001</td>
<td>183</td>
</tr>
<tr>
<td>C3 Average Return, Beta, and Standard Deviation for Class C Securities during January 1996 to December 2001</td>
<td>184</td>
</tr>
<tr>
<td>C4 Key Financial Ratios of SPL and Z-MICO</td>
<td>185</td>
</tr>
</tbody>
</table>
# List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Tracking the Fall</td>
<td>32</td>
</tr>
<tr>
<td>2.2 The Stock Exchange of Thailand Historical Data</td>
<td>38</td>
</tr>
<tr>
<td>3.1 Risk and Return of Banking Securities, SET and Risk-Less Security</td>
<td>63</td>
</tr>
<tr>
<td>3.2 Summary of Literature Reviews</td>
<td>71</td>
</tr>
<tr>
<td>5.1 Operationalization of Variables</td>
<td>119</td>
</tr>
<tr>
<td>6.1.1 Variables Entered / Removed for the First Hypothesis</td>
<td>132</td>
</tr>
<tr>
<td>6.1.2 Model Summary for the First Hypothesis</td>
<td>132</td>
</tr>
<tr>
<td>6.1.3 One-Way Anova for the First Hypothesis</td>
<td>133</td>
</tr>
<tr>
<td>6.1.4 Coefficients for the First Hypothesis</td>
<td>134</td>
</tr>
<tr>
<td>6.1.5 Residuals Statistics for the First Hypothesis</td>
<td>135</td>
</tr>
<tr>
<td>6.2.1 Variables Entered / Removed for the Second Hypothesis</td>
<td>136</td>
</tr>
<tr>
<td>6.2.2 Model Summary for the Second Hypothesis</td>
<td>137</td>
</tr>
<tr>
<td>6.2.3 One-Way Anova for the Second Hypothesis</td>
<td>138</td>
</tr>
<tr>
<td>6.2.4 Coefficients for the Second Hypothesis</td>
<td>138</td>
</tr>
<tr>
<td>6.2.5 Casewise Diagnostics for the Second Hypothesis</td>
<td>140</td>
</tr>
<tr>
<td>6.3.1 Descriptive Statistics for the Third Hypothesis</td>
<td>141</td>
</tr>
<tr>
<td>6.3.2 Correlations for the Third Hypothesis</td>
<td>141</td>
</tr>
<tr>
<td>6.4.1 Descriptive Statistics for the Fourth Hypothesis</td>
<td>142</td>
</tr>
<tr>
<td>6.4.2 Correlations for the Fourth Hypothesis</td>
<td>143</td>
</tr>
<tr>
<td>7.1 Summarized Results of Four Hypotheses</td>
<td>148</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>3.1 Risk and Naïve Diversification Using Real S&amp;P 500 Returns</td>
<td>81</td>
</tr>
<tr>
<td>3.2 Illustrations of Various Correlation Coefficients</td>
<td>83</td>
</tr>
<tr>
<td>3.3 Feasible and Efficient Sets</td>
<td>86</td>
</tr>
<tr>
<td>3.4 Investment Equilibrium: Combining the Risk-Free Assets with the Market Portfolio</td>
<td>89</td>
</tr>
<tr>
<td>3.5 Derivation of the Security Market Line</td>
<td>96</td>
</tr>
<tr>
<td>3.6 The Security Market Line</td>
<td>100</td>
</tr>
<tr>
<td>3.7 The Expected Return and Risk for a Universe of Stocks</td>
<td>102</td>
</tr>
<tr>
<td>4.1 Conceptual Framework</td>
<td>103</td>
</tr>
<tr>
<td>6.1 R-Square VS Number of Issues in Portfolio for Class A Portfolio</td>
<td>128</td>
</tr>
<tr>
<td>6.2 Average Return VS Number of Issues for Class A Portfolio</td>
<td>129</td>
</tr>
<tr>
<td>6.3 Average Return on Portfolio VS Number of Issues for Two Classes of Portfolio</td>
<td>129</td>
</tr>
<tr>
<td>6.4 R-Square VS Number of Issues for Two Classes of Portfolio</td>
<td>130</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

This chapter presents a statement of the problems, explaining the background and significance of the present study. The objectives and scope of the study are discussed then the definitions of terms are defined. Finally, the organization of the study is stated.

1.1 Background and Statement of the Problems

Thailand was one of the world’s emerging capital markets. During the period of 1971 to 1995, Thailand’s economy recorded an average growth rate in excess of 7 percent with a moderate inflation rate and a stable exchange rate due to a high saving rate and a tradition of very conservative monetary and fiscal policies. However, there was a bubble economy in Thailand during 1994-1996 resulting from large inflows of foreign capital in 1994 and 1995, a collapse in exports in 1996, large current account deficits and weakness in the financial sectors. Therefore, the Thai economy remained sluggish during 1997-1998 due to poor export performance, widening current account deficit, a surge in capital outflows and confusing macroeconomic policy mix. As a result, the Stock Exchange of Thailand (SET) experienced greater volatility and lost market value.

The Stock Exchange of Thailand (SET) is an important mechanism to raise fund from the public. It provides a pool of saving and investment for private sector and helps business entity not only to rely on financial institutions but also on the public for funding. This helps the business sector reduce its cost and brings about competitive advantages. Trading on the stock market sounds attractive, but also involves a great deal of risk. Investment managers and institutional investors are well aware of the fact that risk is of utmost concern, yet in their dealings with each other, frank discussions of risk may be the exception rather than the rule. Some investors enter into this business but they do not really understand it. This might lead to the poor investment decisions. In fact, stock is just a certificate of ownership that might bring prosperity but at the same time it might also bring insolvency if it is used
inappropriately. To cope with risk, there are some theories related to the investment
decision such as “Portfolio Selection” by Markowitz ¹, which focuses on risk and
return trade-offs and the “Capital Asset Pricing Model” (CAPM) which is a model
that deals with how an asset should be priced in the capital market.

The basic Markowitz portfolio model derived the expected rate of return for a
portfolio of assets and a measure of expected risk, which is the standard deviation of
expected rate of return. Markowitz showed that the expected rate of return of a
portfolio is the weighted average of the expected return for the individual investments
in the portfolio. The standard deviation of a portfolio is a function not only of the
standard deviations for the individual investments, but also of the covariance between
the rates of return for all the pairs of assets in the portfolio. In large portfolios, these
covariances are the important factors. Different weights or amounts of a portfolio held
in various assets yield a curve of potential combinations. Correlation coefficients are
the critical factors that the investors must consider when selecting investments
because they can maintain their rate of return while diversifying the risk level of their
portfolio by combining assets or portfolios that have low positive or negative
correlation. Assuming numerous assets and a multitude of combination curves, the
efficient frontier is the enveloped curve that encompasses all of the best combinations.
It defines the set of portfolios that has the highest expected return for each given level
of risk, or the minimum risk for each given level of return. From this set of dominant
portfolios, the investors can select the one that lies at the point of tangency between
the efficient frontier and their highest utility curve.

This was the prevailing theory until the capital asset pricing model (CAPM)
was developed. The CAPM supersedes some of the findings of classic portfolio
theories, which are the Pure Theory of Portfolio Investment² and the Theory of
Money³ with the introduction of the risk-free asset as represented by (RF) into the
analysis. The assumption is that an individual can choose an investment combining

the return on the risk-free asset with the market rate of return, and this will provide superior returns to the efficient frontier at all points except point M, where they are equal. The investor may invest in any combination of point RF and point M to achieve the risk-return positions described by the securities market line. This line describes the general trade-off between risk and return for portfolio managers in the economy. Any attempt to get higher portfolio returns must be matched by higher portfolio risks. Although the portfolio manager is investing in stocks and bonds, the general pattern set out for the risk-free asset and market combination is perceived to establish the limits for investment performance of any nature. Any increase in portfolio returns ($R_p$) must be associated with an increase in the portfolio standard deviation ($\sigma_p$).

The Capital asset pricing model also calls for an evaluation of individual assets (rather than portfolios). The securities market line shows the same type of risk-return trade-off for individual securities as the capital market line did for portfolios. Investors in individual assets are only assumed to be rewarded for systematic, market-related risk, known as the beta ($\beta$) risk. All other risks are assumed to be susceptible to diversification. While a number of assumptions associated with the capital asset pricing model are subject to close review and challenge, there are some questions about the appropriate measures for RF and RM as well as the stability of beta and the appropriate slope of the SML line. Nevertheless, the capital asset pricing model represents a generally useful device for portraying the relationship of risk and return in the capital markets over the long term. Arbitrage pricing theory, the alternative way to price the asset, which allows for several sources of systematic risk as opposed to one measure under the capital asset pricing model, further assumes investors will appropriately hedge or arbitrage between securities and portfolios to establish expected returns. While arbitrage-pricing theory offers some conceptual and empirical advantages over the capital asset pricing model as it allows for a multiple number of sources of risk, it is less widely used because the theory does not clearly identify what these multiple risks might be.
1.2 Research Objectives

As stated above, recent advances in economic theory emphasizes that investors who hold portfolios of riskier stocks should expect higher returns than more conservative investors. In addition, the theory indicates that, by diversifying their portfolios, investors can reduce risk without sacrificing expected return. Therefore, the main purposes of this empirical study are:

1. To examine whether the rate of return on well-diversified low risk portfolios is indeed significantly lower than the return on well-diversified higher risk portfolios.

2. To show how diversification can be utilized to offset the riskiness of individual securities, so that portfolios consisting of large numbers of higher risk securities are less risky than portfolios consisting of small numbers of low risk securities, and yet earn a substantially higher rate of return.

To achieve the main purposes of this study, the researcher attempts (ed) to answer the following questions:

1. Is there a negative relationship between the quality rating of portfolio and the risk of portfolio, measured by beta?

2. Is there a negative relationship between the quality rating of each portfolio and the average return of each portfolio?

3. Is there a significant relationship between the number of issues in the portfolio and the average return of each portfolio?

4. Is there a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return?
1.3 Significance of the Study

After answering these four main questions effectively, the findings of this research could provide valuable information and insight for academic researchers and practitioners such as stock investors in emerging markets. The benefits resulting from this research will include:

1. Providing a superior investment strategy that can identify and reduce those risks that bear no compensation through the means of diversification in which the unsystematic risk can be reduced simply and effectively.

2. Testing the idea to the performance – oriented fund manager who concentrates his holding on a small number of issues and gambles on his ability to select securities whose individual rates of return will more than compensate for the loss of return due to lack of diversification.

3. Minimizing the risk in the individual stock by selecting the stocks on grounds of safety / quality / and prudence. In addition restricting the very risk that the theory suggests bear systematic compensation in favor of risks that do not bear compensation.

4. Improving the investment performance by expanding the list of qualified securities to include higher return, higher risk stocks, while offsetting the increase in market risk through more effective diversification.

1.4 Scope of the Research

To demonstrate the effect of diversification on risk and return, fifty-four securities whose prices were quoted continuously on the SET during January 1996 through December 2001 are selected for analysis. During the period of January 1996 through December 2001, there were three hundred and eighty two securities traded on the Stock Exchange of Thailand, so the total population is three hundred and eighty two securities. Among three hundred and eighty two securities, there are only fifty-four securities, which have an assigned bond rating by Thai Rating and Information
Services (TRIS) and have a complete set of data during January 1996 through December 2001, therefore the sampled size is fifty-four securities. Then this study will use these fifty-four securities to construct two types of portfolio. The first classification of portfolios involves dividing the fifty-four securities into three equal groups based on their corporate bond rating by the Thai Rating and Information Services (TRIS). Eighteen companies with class A bond rating will be grouped in portfolio A. Eighteen companies with class B bond rating will be grouped in portfolio B. Eighteen companies with class C bond rating or the companies under rehabilitation specified by Stock Exchange of Thailand will be grouped in portfolio C. In addition, the second classification of the portfolio will be constructed to show the effect of the changing number of stocks in the portfolio, so eighteen stocks will be selected from class A quality stocks to create one-stock portfolio to eighteen-stock portfolio.

The period of study is during January 1996 through December 2001, which includes all types of the trading volume whether high or low. There was a high volatility in this period, as the result of the changing macro economic factors, which will be discussed in chapter two. In this period, there was high level of the systematic risk. The systematic risk is the important variable for this study because the level of systematic risk can be measured by beta and beta will be used in testing the second hypothesis. Hence, this period will be the appropriate period for conducting this empirical study. Moreover, the period of the study will be examined as a single period without subdividing into two periods because the monthly data for each three-year period (thirty six months' data) will not be significant.

The testing procedures begin with the calculation of the returns on the securities and returns on the market. Next, the average monthly returns are computed. Subsequently, the estimation of the betas and the coefficient of determination between the portfolio returns and the market returns are obtained. Based on the fact that the stock return and capital gain are closely related and limitation on availability of dividend data. In this study, the return on the stock will be proxied by its capital gain. Monthly returns of the SET index are used as a return on the market.
1.5 Limitations of the Research

Prior to the empirical study of portfolio effect of diversification on risk and return, there are some constraints that the investors who study this evidence need to keep in mind.

1. The use of the stock quality ratings as a measure of the risk of the corporations is not unfamiliar. Unfortunately, when collecting a sample of corporate stock rating, it is found that the majority of the companies do not have an assigned stock rating. Therefore, this study uses bond ratings by Thai Rating and Information Services (TRIS) as indicators of the quality of stock. The use of bond quality rating can replace the stock quality rating because when the rating company assigns the credit rating to each stock or bond, it will evaluate the performance of each company by analyzing the financial ratios and many involving factors. Therefore, both bond quality rating and stock quality rating can be used as the indicator of each company’s quality.

2. To demonstrate the effect of diversification on risk and return, fifty-four securities whose prices were quoted continuously on the SET during January 1996 through December 2001 are selected for analysis. During the period of January 1996 through December 2001, there were three hundred and eighty two securities traded on the Stock Exchange of Thailand. Therefore, the total population is three hundred and eighty two securities. Among three hundred and eighty two securities, there are only fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS) and have a complete set of data during January 1996 through December 2001, so the sample size is fifty-four securities.

3. The monthly returns of each Thai stock and the SET index can be calculated by computing the percentage change in the stock price. The closing price (P_t) of a given stock or a given index at date t and the previous closing stock price or index at date t-1 need to be found. In this research, the stock’s dividend at date t is ignored due to the fact that the average yearly stock’s dividend yield
is quite low, at 2.36% for years 1997 – 2001. In addition, due to the lack of available monthly dividend information. Also most Thai stocks declared ex dividend date at the beginning or middle of the month, which is not the same as the price at the end of the month that is used in this study. Therefore, this study assumes that the dividend will be reinvested 100% and the relevant rate of return is the price change only.

4. Modern Portfolio Theory assumes that the portfolio would include all of the assets and liabilities, not only stocks or even marketable securities, but also such items as cars, houses and less marketable investments such as coins, stamps, art pieces, antiques, and furniture. To gather the full spectrum of one’s investment is difficult, so this study will construct the portfolio from the common stocks listed in the Stock Exchange of Thailand as the proxy of one’s asset portfolio.

1.6 Definition of Terms

For better understanding of the terms employed in this research, these terms will be defined as follows:

**Beta** or the slope of a security characteristic line measures the sensitivity or responsiveness of the security’s excess return to that of the market portfolio. In other words, beta ($\beta_m$) measures the expected change in its excess return per 1% change in the excess return on the market portfolio. In addition, it is a standardized measure of systematic risk because it relates the covariance of any asset i with the market portfolio. As a result market portfolio has a beta of 1 (Sharpe; 1981).

**Bonds** are the debt securities issued by the government, a public organization, a state enterprise, or company or corporation for sale to investors to raise funds directly (TRIS website).

---

6 Thai Rating and Information Services Website Address: [www.tris.co.th](http://www.tris.co.th).
**Bondholders** are ranked as creditor of the issuer and are entitled to interest during the bond's life and principal repayment at maturity (TRIS website).

**Brokerage Firm** is a securities firm that buys and sells securities in the secondary market on behalf of its clients for a commission. The term "broker" also refers to an employee of the firm who conducts such activities (SET website).

**Business Risk** is the risk associated with the business itself. For instance if an investor contributes to a venture for drilling for gold under the sea, that would be more risky than running a restaurant. As some businesses are by their very nature more risky than others, investing in them is essentially riskier (Cassell; 1999).

**Capital Gains** are the profits made on selling a stock at a price higher than its purchasing price. Individual investors are exempted from paying income tax on capital gains from trading in the SET (SET website).

**Capital Asset Pricing Model (CAPM)** is the pricing theory that specifies the relationship between risk and required rates of return on assets when they are held in well-diversified portfolios (Brigham, Gapenski, Ehrhardt; 1999).

**Capital Market Line (CML)** is the line from the intercept point that represents the risk-free rate tangent to the original efficient frontier; it becomes the new efficient frontier. It states the equilibrium relationship that exists between the returns that should be expected on efficient portfolios of securities and the total risks of such portfolio (Radcliffe; 1997).

**Close Price** is the last price at which a security is traded on a trading day (SET website).

---

10 Stock Exchange of Thailand Website Address: www.set.or.th
Coefficient of Determination is the statistical method to indicate how much of one variable is associated with another variable. This correlation can be measured by R-square. More specifically, the correlation of the portfolio to the market indicates how much of the variability in the return on the portfolio is associated with the variability in the market. The higher R-square, the more perfectly diversified the portfolio. The R-square equals to one would indicate the perfect correlation between two variables (Wagner and Lau; 1971)\textsuperscript{11}.

Common Stocks are the equity securities issued by a company to raise funds. Common stock holders are owners of the company and are entitled to vote in a shareholders' meeting to elect the company directors to participate in policies making and major business decision. Stockholders receive a share of company profits in the form of dividends and hold a right to buy new stocks the company issues for business expansion. In the case of liquidation, they are entitled to a share of the company's assets after debts and other liabilities are paid off (SET website).

Completely Diversified Portfolio is the portfolio in which all unsystematic risk has been eliminated by diversification (Reilly and Norton; 1995)\textsuperscript{12}.

Correlation Coefficient is the standardization of the covariance by the individual standard deviations and the value can vary in the range of -1 to +1 only (Reilly and Norton; 1995).

Covariance is a measure of the degree to which two variables, such as rates of return for investment assets, “move together” over time relative to their individual means return (Reilly and Norton; 1995).

Credit Rating Agency is a company engaged in the assessment and rating of the quality and risks of debt securities, companies, or organizations, in order to aid investment decision. Ratings are based on the ability of the debt issuer to service the


debts and repay principal at specified dates. Ratings are usually expressed in alphabets or alphabets together with numbers. In Thailand, a credit rating agency must have a license granted by the SEC (TRIS website).

**Credit Risk** is the risk, which mostly related with the ratings the company would get for its debt instruments. If one company would get a poor debt rating, then the value of its existing debt instruments (bonds, for example) will diminish in value. Also, poor credit rating for a company would mean that it would find it more difficult to raise debt (Cassell; 1999).

**Default Risk** is a spin off from financial risk. If a company has a weak financial structure and its earnings do not overpower its debt, then the risk of default is greater. If the company defaults on its debt payments then the public that invested in the company debt stands the risk of losing interest and principal (Cassell; 1999).

**Dividend** is a share of company (or a mutual fund) profit distributed to holders of the company's common and preferred stocks (or the mutual fund unit) holders. A dividend on preferred stocks is normally at a fixed rate while a dividend on common stocks depends on the company's annual performance. Dividends are determined by the company's board of directors and may be paid in cash or in kind (stock dividend) (SET website).

**Efficient Frontier** is the envelop curve which represents the set of portfolios that has the maximum rate of return for every given level of risk, or the minimum risk for every level of return (Reilly and Norton; 1995).

**Event Risk** is the risk that a company may face that is beyond its control such as negative things that happen that can affect the performance of a company from hostile takeovers to criminal situations (Cassell; 1999).

**Exchange Rate Risk** is the risk that relates to the conversion of foreign currency. When an investor acquires stocks in some other countries, the value of those securities will fluctuate in relation to the domestic currency rate to the other foreign currency. When those foreign securities remit earnings and those are converted during times of
a strong local currency, the return to the investor is lower in terms of the currency received (Cassell; 1999).

**Financial Risk** is the risk that can be explained by the debt and equity ratio to show how the company finances its fund. The larger the ratio of debt to equity, the greater the financial risk to shareholders. A company with less debt will have more earnings and cash flow for distribution to shareholders (Cassell; 1999).

**Interest Rate Risk** is the risk that is more apparent in fixed income securities like bonds, which have a fixed interest rate. An investor buys a bond for a fixed interest rate (say 10%). If the market interest rate rises (say 12%), new bonds will command higher interest rates. Thus the investor with the old bond in hand will still be receiving the old interest of 10% while bonds purchased thereafter will pay 12% (Cassell; 1999).

**Investor’s Utility Curve** is the curve that specifies the trade-offs the investor is willing to make between expected return and risk and it is used to determine the particular portfolio on the efficient frontier that best suits an individual investor (Reilly and Norton; 1995).

**Liquidity Risk** is the risk that not only embraces the speed at which an investment can be converted to cash but also if that conversion can take place without a loss (Cassell; 1999).

**Listed Company** is a company the equity securities of which are listed for trading on the stock exchange. A SET listed company must have qualifications as required by the SET and must abide by the Listing Agreement (SET website).

**Listed Security** is a security that is listed for trading on the stock exchange (SET website).

**Market Portfolio** is the optimal efficient portfolio, which includes all risky assets. This is referred as a completely diversified portfolio, which means all the risks that
are unique to individual assets in the portfolio are diversified (Reilly and Norton; 1995).

**Market Price** is the latest prices at which a security is traded in a market (SET website).

**Market Risk Premium** is the amount of return above the risk-free rate that investors expect from the market in general as compensation for systematic risk (Reilly and Norton; 1995).

**Modern Portfolio Theory** is the theory or idea about the portfolio investment, which includes the benefits of diversification, how to construct the efficient portfolio, how to measure the risk and what should be the required rate of return at a given level of risk.

**Open Price** is the first price that a particular security was traded for a particular trading day. The ASSET system determines the opening price of each stock at the price, which generates the largest volume in the matching process from the bid and offers orders received during the pre-opening period. When the orders are matched, the price at which the transaction is executed is the open or opening price of the stock for the day (SET website).

**Optimal Portfolio** is the efficient portfolio that has the highest utility for a given investor and it lies at the point of tangency between the efficient frontier and the curve with the highest possible utility (Reilly and Norton; 1995).

**Political Risk** is the risk that concerns about the stability of the government, which directly relates to the stability of the stock market. The less stable the political structure, the more uncertainty there is for catastrophic political events (Cassell; 1999).

**Portfolio** is a list of holdings of two or more securities owned by an investor. The purpose of a portfolio is to reduce the owner's investment risks through diversified holding of several securities asset classes (Reilly and Norton; 1995).
Purchasing Power Risk is uncertainty that the consumer price index (CPI) would rise dramatically and the returns that the investor gets would now be diminished. A rise in the CPI leads to a rise in interest rates as well. When the CPI rises, banks will demand higher interest rates. Therefore, a borrower who now needs a mortgage to buy a house will have to pay higher interest rates to lender. The borrower now has less money to invest, as more of his disposable income is needed to pay for higher interest rates on borrowed funds (Cassell; 1999).

Quality Rating of Portfolio is the riskiness of each security grouped in a portfolio (Wagner and Lau; 1971).

Quality Rating of Security is the riskiness of a security that depends on a credit rating for that company which has been assigned by the rating committee and accepted by the issuer or the rated company to be announced publicly and published in TRIS's "Credit News". TRIS uses letter-rating symbols for announcing credit rating results for long-term debt. Ratings range from AAA, the highest rating, to D, the lowest rating (TRIS website).

Rate of Return or the percentage return is the standardization of return by considering the return per unit of investment. It is the way to express the investment return without the scale and timing problems (Brigham, Gapenski, Ehrhardt; 1999).

Rate of Return for the Portfolio is the weight average of the rates of return for the individual investments in the portfolio and the weights are the proportion of the total values for each of the individual investment (Brigham, Gapenski, Ehrhardt; 1999).

Reinvestment Rate Risk is a spillover from fluctuation in interest rates (interest rate risk) and again is more apparent in fixed-income securities. If an investor is holding a bond that pays 12% per annum and the market interest rate falls to 10% per annum, the investor will still get the 12% on the old bond. However, if the investor wants to reinvest the interest proceeds in the new bonds he can do so only at a rate of 10% per annum. Thus the reinvestment was made at a lower return (Cassell; 1999).
Risk means the uncertainty of future outcomes or the probability of adverse effect or the likelihood that the investment will be worth less than originally invested (Reilly and Norton; 1995).

Risk-Free Asset is an asset with zero variance, which has the zero correlation with all other risky assets and would provide the risk-free rate of return (RFR) (Reilly and Norton; 1995).

Risky Asset is an asset with uncertain future returns (Reilly and Norton; 1995).

SET Index is a composite index calculated based on stock prices on the Main Board of SET. It is a market capitalization weighted index which compares the current market value of all listed common stocks with the value on a base date of April 30, 1975, when the SET Index was first calculated and set at 100 points. Its calculation is adjusted in line with new listings, de-listings, and capitalization changes (SET website).

Standard Deviation is a statistical measure of the dispersion around the arithmetic mean. If there is not much variation from the mean then the dispersion will be small and the investment has less risk. Wider variations about the mean would infer that a larger risk is associated with a particular stock (Radcliffe; 1997). In addition, standard deviation is normally used to measure total risk, both the unsystematic risk and the systematic risk (Markowitz; 1952)\(^\text{13}\).

Systematic Risk is the risk that is associated with market factors that is beyond the control of the investor. This risk tends to move with the gyrations of the market. If the market rises the investment will rise in value. Conversely, if the market declines the value of the investment will also decline. Thus, there is a 'systematic' relationship between the market and the investment. As long as investors invest in the stock market, they cannot avoid systematic risk. This un-diversified risk includes interest

---

rate risk, reinvestment rate risk, purchasing power risk, exchange rate risk and political risk (Cassell; 1999).

**Thai Rating and Information Services** or TRIS is the bond rating company that provides credit rating service and disseminates the rating results and other related information in the Thai bond market for the benefit of investors both local and international. Thai bond will be traded in the Stock Exchange of Thailand on the special board, which is the board for the trading of the government and state enterprise securities, such as bonds, debentures and convertible bonds (TRIS website).

**Unsystematic Risk** is the risk associated with an individual company and its operations and methods of doing business. The unsystematic risk of an investment is within the control of the investor. The risk can be reduced or diversified away by having diversified investments in a portfolio. The subcategories of unsystematic risk are business risk, financial risk, default risk, credit risk, liquidity risk and event risk (Cassell; 1999).

**Variance** is another statistical measure of the dispersion of the returns around the expected value similar to the standard deviation but variance is the weighted average squared deviation from the mean (Radeliffe, 1997).
1.7 Organization of the Research

To achieve the aforementioned objectives, this research is organized in the following manner. Chapter 1, the generalities of the study, will include the identification of the statement of the problems, research objectives, research significance, scope and limitations of the study, and the definitions of terms used in this study. Chapter 2, the background section, will describe Thailand’s economic performance before and after the Asian economic failures, the characteristics and nature of the Thai stock market. In addition, this part will discuss about Thai credit rating agency and its processes and criteria in giving the rating. The main purpose of this section is to enhance the understanding on Thai’s listed stocks and bond rating when discussed in later chapter. Chapter 3, a review of the relevant literatures and related theories, will review twenty-one articles both theoretical and empirical studies ranking according to the publishing time. The Markowitz’s portfolio selection theory is also included here. Chapter 4, research framework, will explain the detail of the research framework, the empirical hypotheses, the variable definitions and the expected results of this research study. Chapter 5, research methodology, begins with the data source and data collection procedures, followed by methodologies employed in this study. The methodologies include estimation model and statistical test of significance of null hypothesis. Chapter 6, data analysis and presentation of the results, presents the empirical results of the hypothesis investigation, ending by the interpretation of these results. Finally, the last chapter, chapter 7, presents the concluding remarks, including a brief summary of findings, conclusions, and the recommendations resulting from the study.
CHAPTER 2

THE STOCK AND BOND MARKET IN THAILAND

The first part of this section is a description of the Thai economic performance before and after the Asian economic failures. The objective of this section is to ground the understanding in the causes of economic crisis and the recent development in the Thai economy, which have direct impacts on the capital market's trading. The second section will discuss about the characteristics and nature of the Thai stock market. The objective of this section is to give the readers clearer concept about the rule and regulation in SET and many developments in Stock Exchange of Thailand. Finally, the last section will describe about the bond rating criteria, rating and monitoring processes for the companies that were rated by Thai Rating and Information Services and the symbols and definitions employed by TRIS in order to make the readers understand more about the criteria in rating the bond, which will be used in this study.

1. Thailand’s Economic Performance

Warr (1999)\(^1\) stated that during the era ending in 1996, the Thai economy was the fastest growing in the world. There was no negative growth of real output per head of population experienced between 1958 and 1996, a unique achievement among all importing developing countries. Also, beginning in 1971 and lasting until 1995, the Thai economy recorded an average growth rate in excess of 7 percent with a moderate inflation rate and a stable exchange rate. The strong growth rate was due to a high savings rate and a tradition of very conservative monetary and fiscal policy. See Figure A1 for the GDP growth rate during 1979-2001. In addition, strong growth in exports, a bright investment outlook, and a private sector-led development strategy encouraged the extended period of growth. The weak economic factor was the high current account deficit due to high investment and over-financed by a huge net capital inflow.

According to the Bank of Thailand research paper entitled "Bank of Thailand Economic Focus on the Thai Crisis," Thailand decided to enter on a course of deregulation and financial liberalization in the beginning of the 1990s. This research stated that Thailand phased in liberalization of capital flows, deregulation in the operational scope of financial institutions, and allowed partial entry of foreign competitors into the domestic financial sector. Liberalization of the financial system without adequate and proper protection, ineffective management of resources, lack of adequate supervisory and financial infrastructure, as well as underestimation of the crisis, have been mainly responsible for the country's problems.

1.1 Causes of Economic Crisis

Dowling (1998)² noted that generally there are three critical factors, which precipitated the crisis in Southeast Asia: a bubble economy resulting from large inflows of foreign capital in 1994 and 1995, a collapse in exports in 1996, and large current account deficits and weaknesses in the financial sector. In addition, Kawai (1998)³ stated that financial deregulation and capital account liberalization preceded speculative currency attacks in Thailand. Many research articles concluded that the economic crisis in Thailand originated from many often-interrelated factors including:

- Surge in capital flows.
- Widening current account deficit.
- Poor export performance.
- Inappropriate credit underwriting practices and high debt-equity ratios.
- Confusing macroeconomic policy mix.
- Supervisory, regulatory and institutional weaknesses.
- Political and social pressure for the status quo.

Many researchers also noted that the exceptionally high growth rate for many years was driven by foreign investment and exports. Overheating in the economy led to an unsustainable large current account deficit, and asset (property and stock market) inflation. Under the pegged exchange rate system, the implementation of monetary policy was undermined by a guarantee of currency value. This guarantee, coupled with financial liberalization, encouraged excessive reliance on external borrowing because of low exchange rate risk.

Also, many research articles noted that part of the foreign capital was allocated to investment projects in unproductive sectors, which were not generating foreign exchange earnings to repay the foreign borrowing. These articles also noted that over-investment in the non-tradable sectors such as property, construction, and real estate consequently increased an asset price bubble and misallocated economic resources.

Overall, the roots of the financial crisis in Thailand lied in the misallocation of resources, financial liberalization without sufficient and proper infrastructure, weakness in macroeconomic policy management, and failure to remain attentive in detecting signals of fundamental weakness of the economy.

1.2 Thailand's Reaction after the Economic Crisis

According to the Bank of Thailand’s Annual Economic Reports for 1998, 1999, 2000 and 2001, after the economic crisis occurred in 1997, the Thai government implemented policies in response to the economic problems as follows:

1. Adopt strict measures to deter short-term capital inflows and change the foreign exchange system from a pegged rate system to a floating rate system.

2. Receive financial aid from various countries and institutions and follow the context of the International Monetary Fund’s economic reform program.

3. Reform and restructure Thailand’s financial system.

4. Establish and modify the legal, institutional and regulatory systems.
Overall, these reports concluded that the current policies have achieved the main objective of economic liberalization. All economic sectors welcome greater foreign participation and also lead the Thai government and regulators to institute an appropriate system to support increased competition and financial innovation. As a result, Thai economic and financial standards will be closer to international norms and practices. In addition, foreign capital will account for a notable share of banking and financial firms' asset, bring strength, know-how and an international reorientation to the culture of banking and financial business.

1.3 Recent Developments in the Thai Economy

According to the Bank of Thailand website, the global trade and economic slump during 1997-1998 in the aftermath of Asia's economic and financial crisis, made economic policy makers around the world worry about an economic recession in 1999. Many economies, therefore, adjusted their monetary and fiscal policies to enhance flexibility and stimulate consumer spending. After suffering a severe blow from the economic crisis of 1998, when the economy contracted 10.4 per cent of GDP, Thailand began to show sign of economic improvement in the first quarter of 1999. Improvement was more apparent in the third quarter of the same year with a year-on year expansion of 7.7 per cent. For the full year of 1999, Thailand economy grew at 4.2 per cent.

The economic recovery was driven by a comeback of the manufacturing sector, which grew at 7.8 per cent per annum, in line with expanded domestic demand and continued improvement in exports. Export industries reported strong growth, particularly vehicles, equipment and cement. Nevertheless, certain sectors, such as construction sector, still contracted and the financial sector remained fragile.

The Thai government's monetary and fiscal policies, implemented during 1999, were aimed at providing a stimulus for Thailand's economic recovery. The reduction of the value-added tax (VAT) from 10 to 7 per cent in March, a budget

---

4 Bank of Thailand Website Address: www.bot.or.th
deficit of 2.9 per cent of GDP, and the government cash deficit of 5.5 per cent of GDP, helped to spur domestic spending. On August 10, 1999, the government further introduced a package to stimulate private investment, comprising reduction of taxes and tariffs, capital financing and restructuring of small to medium-sized enterprises (SMEs), and relevant measures aimed at promoting recovery of the real estate sector. On the monetary side, the Bank of Thailand exercised a relaxed monetary policy leading to a drop in interest rates, which reduced financial costs for businesses and facilitated corporate debt restructuring.

Thailand’s economic recovery in 1999 was also fostered by a strong increase in exports of 7 per cent in terms of US-dollar value, much higher than the anticipated 4 per cent rise. However, the value of imports in US-dollar terms rose faster, jumping 16.7 per cent on added demand for raw materials for export-oriented industries. As a result, the trade and current account surpluses narrowed to US$8.9 billion and US$11.2 billion respectively, compared with the corresponding figures of US$12.2 billion and US$14.3 billion in 1998 (See more detail in Figure A2 and Figure A3).

The significant export revenues helped offset a sizable net capital outflow in 1999, mainly stemming from commercial bank’s repayment of Bangkok International Banking Facility (BIBF) loans. The balance of payments posted a surplus of US$4.6 billion, increasing Thailand’s foreign reserves to US$34.9 billion at year-end (See more detail in Figure A4). The foreign sector improvements helped stabilize the Thai baht, which stood at 37.32 baht per US dollar at the end of 1999, compared with 36.69 baht per dollar at year-end 1998 and 50.24 baht per US dollar at year-end 1997 (See more detail in Figure A5).

Despite the improved signals on various macro-economic fronts, the relatively slow improvement of the financial sector still posed a risk for Thailand’s economy. The high level of non-performing loans (NPLs) and the capital inadequacy of financial institutions hindered commercial banks from extending loans to the real sector. Consequently, overall credit outstanding contracted 1 per cent in 1999, significantly below the forecast credit expansion of 6 per cent (See more detail in Figure A6).
The Thai economy in 2000 remained stable, continuing to undergo its recovery process; The Bank of Thailand forecasted the 2000 economic growth rate to be in a range of 4.0-4.5 percent, which was lower than the earlier projected rate of 4.5-5.0 percent. The lower forecast was primarily the result of weakened domestic factors, which were also burdened with an unhealthy financial sector.

Domestic private consumption and investment, which demonstrated very healthy signals during the first half of the year, were actually rather subdued in the latter half of the year owing to a lack of consumer and investor confidence regarding the recovery. This was reflected in general price levels which only increased by 1.6% despite the fact that oil prices were extremely high almost all year long (See more detail in Figure A7). Nonetheless a strong positive indicator in 2000 was the exports sector, which expanded to 19.6%, close to the targeted 20%. This increase in exports thus helped prop up overall industrial production from the downturn in 1999. From the same period 1998, the seasonally unadjusted industrial production index rose 3.0 percent.

Throughout 2000, liquidity in the money market remained high, as was clearly seen in the continuing growth of saving deposits; however, commercial bank loan growth saw a very different picture as the number of loans fell significantly. This decline in loan growth stemmed from the banks’ problems with Non-Performing Loans (NPLs). Provision for these loan losses became a burden as well as an impediment to efficient new loan granting. In the meantime, the loan demand was rather weak during this period, resulting in a 10.2 percent reduction of outstanding loans, as well as a 9.1 percent reduction of total loans (excluding BIBFs), from the end of 1999. This was reflected in the sluggish domestic loan market wherein the Minimum Lending Rate (MLR) declined from 8.25-8.50 percent at year-end 1999 to 7.50-8.25 percent at year-end 2000 (See more detail in Figure A8).

The low level of domestic interest rates, in contrast to an upward trend in foreign rates, widened the interest rate gap, leading to an acceleration of debt servicing by Thai companies. Capital outflows thus remained high as well. The recovery of the Thai export sector resulted in a current account surplus, which only partially compensated for the outflows. The Balance of Payments showed a deficit of
US$ 1,950 million. Foreign Reserves decreased to US$ 32.7 billion compared to US$ 34.8 billion last year. Nevertheless, the country’s foreign reserves position continues to be considerably strong, equaling six months of imports.

The Thai economy decelerated in 2001 due to contracting export growth of 7% and sluggish private investment reflected by a reduction in import of capital goods of 11.2%. Nevertheless, domestic consumption continued to expand. The Private Consumption Index rose 2.6%. The government’s attempts to stimulate the economy through fiscal policy, which created a budget deficit of baht 121 billion, helped stimulate economic activities and compensate for the detrimental effect of lower exports and private investment. The National Economic and Social Development Board (NESDB) calculated that the Thai economy in 2001 grew at a rate of 1.5%, down from 4.4% in 2000.

The fact that the general economy was in the doldrums, however, had a positive effect on the stability of price levels generally. Despite domestic demand expanding, the degree of expansion was not large enough to put any downward pressure on prices. With regard to production, as oil prices remained low and businesses did not flourish greatly, pressure on production costs was also slight. These conditions then resulted in only 1.6% general, and 1.3% in basic inflation respectively for 2001.

The international financial stance of Thailand in 2001 remained stable, even though exports were in decline due to the impact of the world economic slump-in particular, and the U.S. economy on which Thai exports depend to a large degree. In the meantime, imports decreased as well, especially the import of capital goods and raw material used for export production. In addition, a slowdown of the domestic economy also resulted in decreased imports of consumer goods. Hence in 2001, there was a trade surplus of USD 2,527 million, and current account surplus of USD 6,200 million. The balance of payment in 2001 improved as a result of lessening capital outflows. There was a surplus in the balance of payments of USD 1,317 million, compared to a deficit of USD 1,617 million in 2000; hence the financial position remained strong.
Money market liquidity also remained high throughout 2001. Saving deposits continued to expand from last year, while credits offered by commercial banks decreased. The banks' lending as of December 2001 declined 5.8%, in spite of the downward adjustment of interest rates since 2000 to a considerably lower level throughout the year. At the end of 2001, the one-year fixed deposit rate and the minimum-lending rate (MLR) stood at 2.75-3.00 and 7.00-7.50 respectively.

The government's economic stimulus program concentrated on fiscal policy to induce demand from the community level and on attempting to resolve the problems with the real sector of the economy. Major economic stimulus policies include the People's Bank Project, the Village and Urban Revolving Fund, the Housing Loan policy, etc. Measures to resolve the problems of the financial institutions included the establishment of the Thai Asset Management Corporation (TAMC) as a national asset management corporation to help resolve the problem of non-performing loans (NPLs). Nevertheless, despite an apparent marked decrease in financial institutions' NPLs in 2001, the fact that the problems of the real sector seem unlikely to be resolved soon and, in fact, may see an increase in re-entry NPLs, this may prevent the Thai economy from experiencing a recovery.

2. The Stock Market in Thailand

As in most other developing countries, the stock market arose mainly in response to the requirements of the modern economy's efforts towards industrialization. In Thailand, the stock exchange went through two prominent stages of development in an attempt to establish the stock market: “Bangkok Stock Exchange” and “Stock Exchange of Thailand.”

The evolution of the stock market of Thailand could be traced back to 1953, when Houseman & Co.Ltd., Siamerican Securities Ltd., and Z&R Investment and Consultants began to act as intermediaries for securities transactions. However, their volume of business was negligible and prices did not truly reflect demand and supply.

5 Stock Exchange of Thailand Website Address: www.set.or.th
In 1962, the Bangkok Stock Exchange Co., Ltd. (BSE) was set up as a registered company, and was registered later on with capital funds of 250,000 baht. The stock trading in the Bangkok Stock Exchange was rather inactive. Only seven or eight out of 35 listed securities were frequently traded, however, reflecting tenuous attention from the general public. In 1968 and 1969, a yearly turnover accounted for approximately 160 and 114 million baht, respectively. In 1970 and 1971, trading values fell sharply to 46 and 28 million baht. In 1972, the stock turnover reduced to only 26 million baht, leading to an eventual collapse of the first stock exchange operation of Thailand. After a long period of struggle, the Bangkok Stock Exchange had to cease operation in the early 1970s. The downfall of the first stock exchange was attributable to inadequate government supports, unfamiliarity of the general public with stocks, and reluctance of company founders to release even a small portion of their ownership.

Following the fall of the Bangkok Stock Exchange, an attempt to establish a national stock market was given more serious considerations. For instance, the second National Economics and Social Development plan, covering 1967-1971, broadly spelt out the need for Thailand to form an orderly securities market with appropriate facilities and procedures for securities trading in order to mobilize additional capital to finance economic growth. Following such remark, the Central Bank hired Professor Sidney M. Robins, a former Chief Economist of United States Group on Capital Market Development, to conduct the feasibility study together with the implementation plan for establishing the stock market in Thailand. In 1970, he proposed a comprehensive report entitled “A Capital Market in Thailand,” which centered on a major overhaul of the existing, more informal Bangkok Stock Exchange by a group of local brokers in favor of a central, more regulated institution. His report subsequently became the master plan for the development of Thai capital market.

In 1972, the experiences with the Bangkok Stock Exchange indicated that in order for the national stock market to operate successfully, Thailand needed massive regulatory reforms. Hence, the “Act for control of commercial undertakings affecting public safety and welfare” was modified to extend government control and to regulate the activities of finance and securities companies, which until then had operated freely. The long awaited legislation, which activated the new Securities Exchange of
Thailand Act, was enacted in May 1974. At the end of that year, the Revenue code was revised and motivated investments in the capital markets. On April 30, 1975, the SET started its first day of trading and the government has since then continued to support the SET.

As, the fifth National Economics and Social Development plan (1982-1986) prescribed as a target the wider distribution of share ownership in the SET, the government consequently amended the “Securities Exchange of Thailand Act” in September 1984 to overcome regulatory flaws associated with the SET. On May 16, 1992, the SET Act was overruled by a more comprehensive “Securities and Exchange Act”, which had the following objectives:

1. To provide the services of being a center for trading listed securities and the system and method for securities trading.

2. To undertake any related business, such as acting as a clearinghouse, securities depository center, securities registrar and providing securities data.

3. To undertake any other business given the approval of the SEC.

The mission of the SET is to promote the mobilization of long-term funds for national economic development, to provide systems for the efficient, transparent and fair operations of the securities market, to provide effective investor protection, and to promote the overall development of the Thai capital market. The vision of the SET for the year 2003 is to be one of the most attractive capital markets in Asia by providing quality products and by fairly representing the Thai economy with effective risk management tools and international standards of enforcement and corporate governance.

2.1 Trading System and Trading Hours

Since April 1991, the SET has been operating a fully computerized trading system called the “Automated System for the Stock Exchange of Thailand (ASSET)”. It is able to handle up to 600,000 orders a day effectively. Two principle variations of
trading system that are available to stock brokerage members are “Automated Order Matching (AOM)” and “Screen-Based Trading or Put Through (PT) Transactions. The AOM is the computerized system that allows stock brokerage firms to key in their orders from their offices. The data go online to the SET mainframe computer where the ASSET system arranges the orders according to price-then-time priority. This will execute transactions simultaneously with confirmation back to members’ terminals.

The PT system allows interested stock brokerage members to deal with and negotiate between each other directly. The result of the deal is then to be sent to the ASSET system for SET formal approval. The AOM is used for trading on the main board and the odd lot board, while the PT is applied to trading on the special board and the big lot board. In general, each trading unit, a so-called “Board Lot”, contains 100 units of each security. There are five separate trading boards, which are:

1. The main board: this is for the trading of common stocks, preferred stocks, warrants and unit trusts in full board lots, not exceeding one million units of each security.

2. The foreign board: this is for the trading of stocks registered under a foreigner’s name.

3. The big lot board: this is for the trading of all securities with the minimum volume of one million shares.

4. The odd lot board: this is for the trading of common stocks, preferred stocks, warrants and unit trusts in less than one board lot.

5. The special board: this is for the trading of government and state enterprise securities, such as bonds, debentures and convertible bonds.

6. The business days, normally from Monday to Friday are trading days at SET. On each day, there are two trading sessions, morning and afternoon (See Tables B1 and B2 for more details).
2.2 Floor & Ceiling Price Limits

In December 1997, the SET announced new floor and ceiling price trading limits. The original limits allowed stock prices to move within a range of 10 percent. The new limits allow prices to fluctuate in a range up to 30 percent of any previous closing price. Ceiling and floor limits apply to each trading board that uses the AOM system. In addition, the maximum bid/ask spread, as prescribed by the SET for securities trading, varies according to each market price level (as shown in Table B3).

2.3 Brokerage Commissions and Taxations

On October 1, 2000 the SET announced its measures on the complete liberalization of brokerage fees. There are no minimum and maximum rates for either type of securities or type of customers. The previous negotiable brokerage fee rate had a minimum floor of 0.25 percent for all investor types (foreign investors, local fund managers and local retail investors). Fees depend on the rate that clients have agreed to with their brokerage firms. In addition, all fees are subject to 7 percent value-added tax. All individual investors, including foreign individual investors, are exempt from taxation on capital gains from SET securities trading. However, all investors including foreigners are subject to dividend and interest taxes (See Table B4 for more details).

2.4 Clearing and Settlement

All trading transactions are cleared and settled by the third consecutive business working day following a specific trading day. The clearing and settlement process is managed by the Thailand Securities Depository Company Limited, which is the only securities depository in Thailand and a wholly owned subsidiary of the SET.

2.5 Investor Information and Listed Companies’ Accounting Systems in Thailand

The SET requires all listed companies to disclose information necessary for decision making to the general public in order to ensure faire trading in the stock
market exchange. All listed companies must disclose information online both in Thai and English via the Electronic Company Information Disclosure System in order to conform to international standards. Any information that may affect stock prices, investment decisions, or investor benefits must be divulged (See more details about information required and time scale in Table B5). Information regarding general listing criteria for common shares and active member firms are available in Tables B6 & B7.

Many Thai firms use the same basic framework of accounting standards in Thailand. This commonly corresponds with generally accepted accounting principles (GAAP) in the United States. Especially, listed Thai companies are required to use accounting systems that accord with the Stock Exchange of Thailand’s standards. The minimum accounting standard must comply with the Institute of Certified Accountants and Auditors of Thailand (ICATT) which themselves accord with standards under the International Accounting Standards Council (IAS), the American Institute of Certified Public Accountants (AICPA) or the Financial Accounting Standard Board (FASB).

2.6 Rules and Regulations for Internet Trading

On January 10, 2000, SET allowed securities companies to offer Internet trading service after having obtained approval from SET. SET announced major rules and regulations for Internet trading as follows:

1. Securities trading via the Internet must be carried out through member companies only and trading orders can cover all securities listed on the Stock Exchange of Thailand.

2. Trading orders transmitted via the Internet must be a limited order on a daily basis.

3. Investors can only use cash for Internet trading by opening a separate Internet trading account.
To open an Internet Trading account, investors must fill out an application form available on the brokers’ websites and sign the Internet broker appointment agreement as well as submit all the original documents and supporting materials to the securities companies for approval. Securities brokerage firms must arrange for their clients to be able to check their trading status via the Internet.

2.7 Historical Performance of SET and Market Capitalization

At the end of its first year of operation, there were only 21 SET-listed companies and total trading turnover topped 547.32 million baht. In a survey published by the Hong Kong Unit Trust Association in 1993, Thai equity funds proved the most attractive in the entire Asian region, registering a return for 1992 of 34.3%. By the end of 1993, total annual turnover had reached 2,201.15 billion baht or $86.48 billion on a daily average of 8,984.28 million baht or $353.01 million. On January 4, 1994, the SET market index reached 1,753.73 and the following day recorded its highest-ever trading turnover of 40.01 billion baht or $1.57 billion.

1996: The Optimistic Start-Off, but a Gloomy End

SET started 1996 with heavy trading. The index rose to 1,323.43 points on the first day of trading in January, with a trading value of 12 billion baht. Although several negative developments began to cloud the market in the first half of 1996, SET index continued its rally. Indeed, the index crossed 1,400 – point-barrier on January 31 and on February 6, to close at 1,410.33 points and 1,415.04 points respectively. Negative developments included 1) personal power play and questions of ethics, 2) slight worry about the current account deficit, and 3) increase in margin requirement from 30% to 40%.

The second half of 1996 had seen the SET index move south. From the January’s peak of 1,410.23 points, the index closed on December 13 at 872.67 points. Such dramatic fall was attributed to the political uncertainty and the economic downturn, which worsened the image of the country. On the political front, the ineffective administration of the Banharn’s cabinet and the new election of the Gen. Chaovalit’s seemed to badly shatter investors’ confidence. On top of that, key
financial and economic indicators began to signal the downturn in the economy. For instance, the current account deficits for 1996 widened two percent of GDP. At the same time, export growth was only 0.9 percent, compared with 20 percent for 1995. Also corporate results were below expectations throughout the year. As of the second quarter of 1996, 253, out of 438 listed companies reported a drop in profits. To add insult to injury, Moody’s Investor Services downgraded Thailand’s sovereign ratings for bank deposits and other short-term obligations to Prime 2 from Prime 1.

In October, rumors that Somprasong, one of the leading property developers, was headed for bankruptcy amid cash flow problems focused attention on the property sector. Just over 150 property and real estate-related companies are listed on the Thai share market and the slump in the sector was a major factor, depressing the index, especially since it had a knock-on effect on sectors such as banking, finance, and building materials.

1997: Worsening Fundamentals Deteriorated the SET’s Prospect

<table>
<thead>
<tr>
<th></th>
<th>Open</th>
<th>High</th>
<th>Low</th>
<th>Close</th>
<th>Change</th>
<th>%</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 97</td>
<td>803.13</td>
<td>858.97</td>
<td>787.47</td>
<td>788.04</td>
<td>-43.53</td>
<td>-5.23</td>
<td>91,377.31</td>
</tr>
<tr>
<td>Feb. 97</td>
<td>761.63</td>
<td>765.42</td>
<td>698.06</td>
<td>727.56</td>
<td>-60.48</td>
<td>-7.67</td>
<td>90,129.93</td>
</tr>
<tr>
<td>Mar. 97</td>
<td>707.24</td>
<td>720.27</td>
<td>676.65</td>
<td>705.43</td>
<td>-22.13</td>
<td>-3.04</td>
<td>73,792.96</td>
</tr>
<tr>
<td>Apr. 97</td>
<td>694.74</td>
<td>716.89</td>
<td>658.59</td>
<td>661.29</td>
<td>-44.14</td>
<td>-6.26</td>
<td>57,608.15</td>
</tr>
<tr>
<td>May 97</td>
<td>660.10</td>
<td>660.10</td>
<td>557.87</td>
<td>566.39</td>
<td>-94.90</td>
<td>-14.35</td>
<td>74,060.82</td>
</tr>
<tr>
<td>June 97</td>
<td>560.63</td>
<td>568.61</td>
<td>479.01</td>
<td>482.94</td>
<td>-83.45</td>
<td>-14.73</td>
<td>49,637.81</td>
</tr>
</tbody>
</table>

Source: Stock Exchange of Thailand

As of the first half of 1997, SET’s continual decline seemed inevitable, as bad news overshadowed any of the state’s attempts to pump funds into the market. On the first day of trading, the index reached its bottom of 787.47 points, and continued its downward spiral to close at 482.94 points by the mid of June. Share market investors moved away from the SET as the problems in banking and financial institutions
became more apparent, the economic slowdown seemed hard to recover, and the defense of the speculator’s attack on the baht was an expensive lesson for the Bank of Thailand.

To begin with, many financial institutions encountered mounting bad debts due to property developers who were hit by the economic downturn. In March, the Bank of Thailand ordered ten finance firms to raise their capital or was forced to do so by the authorities. The strategies to defend the baht proved expensive and infertile. Indeed, the Bank of Thailand successfully warded off speculators at the price of eroding reserves. Then, it introduced the two tier exchange rate trading, which created massive arbitrage opportunities, which worsened the baht stability, and worsened investors’ confidence on the baht. Credit ratings were cut, and market players switched to and for between share and currency markets, exploiting perceived weakness in the baht. High interest rates make other instruments attractive alternatives to share but deter productive investment.

1997-1998: When the Bubble Burst

In the 12 months’ period, the stock market lost half of its value falling from the year’s open of 803.13 points to below 400 points. The first sign of the impending stock market crisis appeared in the mid 1996 as pressure grew from speculative attacks on the baht. When the Bank of Thailand floated the baht on July 4, 1997, the SET jumped 41.51 points in heavy trading with many local stocks on the foreign board closing up nearly 70 percent. However, the rally was indeed a short period of time. Within ten days the SET index resumed its fall. Secondly, the SET index dropped sharply following the Bank of Thailand’s (BOT) announcement of its reserve positions, which were only $30 billion cash and $23.4 billion in forward contracts. For the remaining of 1997, the SET index performed poorly due to worsening banking, financial, and corporate sectors, as well as deteriorating world economy. As the baht continued to depreciate, private debts skyrocketed. Besides, high interest rates and the lack of liquidity threatened corporate survival. Also, fears of a worldwide stock market meltdown were sparked when New York’s Dow Jones Index dived 7.18 percent, forcing trading to be suspended 30 minutes ahead of the day’s...
close. The SET lost 6.15 percent to close at 460.8 points. By the end of 1997, the SET index closed at 357.13, reflecting a hard to cure economic ailment.

1998: Slim Chance for Recovery

The Thai stock market, one of the world’s worst performers in 1997, became one of the best in the third quarter of 1998. The market reached its year high of 564.17 points. However, the SET dropped in the second and the third quarters to hit its year’s low at 204.59 points inflation, the SET rebounded in the last quarter to 340-350 points.

In 1998, the Thai business fundamentals did not support the recovery of the SET. In terms of economic factors, Thai manufactured exports suffered from the deflationary pressure from the collapse in demand and the oversupply of products. Domestic investment and consumer spending remained sluggish. On the side of the banking system, consistently rising non-performing loans and worsening international trade environment caused the sharp cutback in new loans. The lack of new loans in turn affects the corporate sector, which needs working capital to sustain their operation.

In an attempt to regain investors’ confidence, both the Securities and Exchange Commission (SEC) and SET played a more active role in 1998, particularly through encouraging corporate governance, accounting and disclosure standards. The SET also allowed the net-settlement rule for the day-trade, which helped lift the market in the last quarter of 1998. In addition to the introduction of the new trading rules, the declining interest rates, and the belief that “the Thai economy has reached its bottom” brought fund back to SET. Its daily volumes surged dramatically from just over one billion baht to between five billion and six billion.

In short, although the SET started off 1998 with sluggish performance, it ended the year with heavier trading. Such improved trading activities could be attributable to the decline in interest rates, the stabilization of the baht. However, the recovery of SET depended primarily on the political environment and the economic situation of 1999.
1999: Sign of Improvement

Thailand began to show sign of economic improvement in the first quarter of 1999. Improvement was more apparent in the third quarter of the same year with a year-on-year expansion of 7.7 per cent. For the full year of 1999, Thailand’s economy grew at 4.2 per cent. Therefore, this sign of economic improvement increased the investor’s confidence, which made the SET Index close at 481.92 points, up 35.4 per cent from the year ending 1998. Total market capitalization at year-end stood at 2.2 trillion baht, up approximately 73 per cent from the previous year. The total value of stocks traded in 1999 was 1.6 trillion baht, or a daily average of 6.57 billion baht, compared with the daily average of 3.50 billion baht in 1998.

However, the performances of listed companies remained depressed with recorded total losses of 333 billion baht for the first three quarters of 1999. No new companies were listed during the year, while 26 were delisted, including 10 voluntary delistings and 16 mandatory. At year-end, 392 companies were listed on the Stock Exchange of Thailand.

Falling earnings of the listed companies cut the average market dividend yield for the year 1999 to 0.6 percent, compared with 1.3 per cent in 1998. The market’s aggregate price-earnings ratio, on the other hand, increased to nearly 15 times in 1999, compared with 10 times in 1998.

The market conditions in 1999 led to changes in the aggregate transactions of the major investor groups in the SET. Foreign investors in 1999, following a long period of net buying, became net sellers of stocks worth a total of 3.1 billion baht. Local investors, on the other hand, registered a net buy of 6.0 billion baht. Of all groups, local investors transacted the highest trading value for the year at 2.1 trillion baht, or nearly 66 per cent of the total trading. The value of trading by foreign investors amounted to 946.8 billion baht, or nearly 30 per cent of the total trading. Local institutions, including securities companies and mutual funds, were relatively minor participants in the market accounting for a combined value of 157.7 billion baht, or less than 5 per cent of the total trading.
2000: Undergoing Recovery Period

The Thai economy in 2000 remained stable, continuing to undergo its recovery process; The Bank of Thailand forecasted the 2000 economic growth rate to be in a range of 4.0-4.5 percent, which was lower than the earlier projected rate of 4.5-5.0 percent. The lower forecast was primarily the result of weakened domestic factors, which were also burdened with an unhealthy financial sector. Hence, the capital market investment climate in 2000 remained rather cheerless. The lack of investor confidence in economic fundamentals and capital market trends also led to a deceleration of investment in the latter half of 2000. Other contributing factors negatively influencing the market included the down weighting of the Thai stock market in the MSCI Index calculation, the volatility in the U.S. economic and stock market conditions, and the soaring and volatile oil prices in the world market.

At year-end 2000, the SET index closed at 269.19 point, down 44.1 % from 481.92 points at the end of 1999. During the year, stock price trends were generally tilted downwards. The SET Index reached its peak at 498.46 points on 4 January 2000, and bottomed out at its trough of 250.60 points on 11 October 2000. This decline was in line with total market capitalization, which also shrank to 1,279 billion baht in 2000, from 2,193 billion baht in 1999, or equivalent to a 41.7% decline.

Volume and value traded shrank as well. Total trading volume in 2000 was 60,503 million shares, declining 37.2% from 96,323 million shares in 1999. Total trading value was 923,697 million baht, decreasing 42.6% from 1,607,787 million baht in 1999. The daily average value diminished to only 3,740 million baht, from 6,571 million baht in 1999, or a 43.1% decrease.

With regard to investor groups, local investors accounted for the largest proportion, 62% out of the total turnover, amounting to 34,016 million baht. The second largest group of investors was foreigners who traded as much as 32% of the total turnover, and recorded net sales of 33,068 million baht. Local institutional investors accounted for only 6% of total turnover with a net sales value of 948 million baht.
At the end of 2000, the average price to equity ratio (P/E ratio) was recorded at 5.52 times, declining from 14.70 times in 1999 because of continuing downward stock price trends throughout 2000. On the other hand, overall operational performance of listed companies improved, marking a positive change in market dividend yield from 0.61% in 1999 to 1.78% in 2000. At the end of 2000, there were 381 listed companies, two being newly listed and 13 having been de-listed. Of these 13 companies, seven were de-listed voluntarily while the other six were asked to exit as a result of unsuccessful financial restructuring.

**2001: Volatile Yet Active**

Securities’ trading on the SET was volatile, yet active, throughout 2001. Total trading turnover was recorded at baht 1,578 billion, an increase of 71% from the previous year. During the year, both domestic and foreign conditions influenced the investment; important internal factors were the slowdown in the Thai economy due to the adverse impact of the global economic slump on the external sector. For the entire year, a full recovery was restrained by unfavorable export conditions with substantial production capacity remaining unutilized and the demand for new investment in the machinery and equipment was low, especially in export-oriented industries.

Financial institutions were also cautious in extending credits to sectors with lackluster business prospects. Moreover, the General Election in early 2001, and the court case concerning the Prime Minister’s assets lessen the investor’s confidence. The terrorists’ attack further dampened the US economy as well as world economy, and the slack in the world demand led to a sharp fall in oil prices during the last quarter of 2001. The combination of lower oil prices, the stability of the baht, and domestic slowdown caused inflation to decline steadily. For the entire year, headline inflation equaled 1.6 percent, while core inflation of 1.3 percent was well within the monetary policy target corridor of 0 to 3.5 percent (See Figure A9 for the event chart and the SET index during 1992 – 2001).

The volatility of trading turnover was reflected in the movement of the SET Index. In 2001, the SET Index opened at 272.03 points on January 3 and adjusted upward to 334.10 points on February 2 after the General Election. After that, the
Index remained almost dormant in the middle of the year. Then, on September 6, the Index was on its peak at 342.56 before the terrorist attack in the U.S.A. Afterwards, however, the Index plunged to a trough of 265.22 on November 7. The SET Index improved little by little until it closed at 303.85 points at the end of 2001, accounting for a 13% increase from the end of 2000. An upward adjustment of the SET Index plus new listings of large-scale companies such as PTT Public Co., Ltd. resulted in a total market capitalization at the end of 2001 of baht 1,607 billion, compared to baht 1,279 billion at the end of 2000.

The trading of securities in 2001 was more active than the previous year. The daily average turnover was baht 6,440 million, an increase from baht 3,740 million a day in 2000. The highest turnover was on January 26 with trading value of baht 23,223 million, and the lowest turnover fell on November 5 with a trading value of baht 1,063 million. Trading by investor groups showed that local retail investors took the largest portion as net buyers for baht 6,963 million worth of securities while foreign investors and local institutions were net sellers of 6,426 and 538 worth of securities respectively.

### Table 2.2 The Stock Exchange of Thailand Historical Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SET Index</td>
<td>303.86</td>
<td>269.19</td>
<td>481.92</td>
<td>355.81</td>
<td>372.69</td>
<td>831.57</td>
</tr>
<tr>
<td>Total trading turnover (Billion Bht.)</td>
<td>1,577.75</td>
<td>923.70</td>
<td>1,609.79</td>
<td>855.17</td>
<td>929.6</td>
<td>1,303.13</td>
</tr>
<tr>
<td>Average daily turnover (Million Bht.)</td>
<td>6,439.83</td>
<td>3,739.66</td>
<td>6,570.56</td>
<td>3,504.79</td>
<td>3,763.5</td>
<td>5,340.75</td>
</tr>
<tr>
<td>Total market capitalization (Billion Bht.)</td>
<td>1,607.04</td>
<td>1,279.22</td>
<td>2,193.07</td>
<td>1,268.2</td>
<td>1,133.34</td>
<td>2,559.58</td>
</tr>
<tr>
<td>No. of listed companies</td>
<td>382</td>
<td>381</td>
<td>392</td>
<td>418</td>
<td>431</td>
<td>454</td>
</tr>
<tr>
<td>Net Buying – Selling by Customer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign investors (Million Bht.)</td>
<td>(6,426)</td>
<td>(33,068)</td>
<td>(3,134)</td>
<td>30,227</td>
<td>55,437</td>
<td>12,287</td>
</tr>
<tr>
<td>Local institutions (Million Bht.)</td>
<td>(538)</td>
<td>(948)</td>
<td>(2,872)</td>
<td>(3,239)</td>
<td>(22,453)</td>
<td>(17,722)</td>
</tr>
<tr>
<td>Local retail investors (Million Bht)</td>
<td>6,963</td>
<td>34,016</td>
<td>6,006</td>
<td>(26,988)</td>
<td>(32,984)</td>
<td>5,434</td>
</tr>
</tbody>
</table>

3. Thai Rating and Information Services (TRIS)

Thai Rating and Information Services (TRIS), Thailand’s first credit rating agency, was established on July 1993 with the sponsorship from Thai financial institutions. TRIS originally received three years of technical assistance from Standard and Poor’s Rating Group (S&P) in developing its credit rating methodology and administrative matters. TRIS also had a three-year strategic partnership agreement with Fitch IBCA to expand its knowledge and skill in credit rating of new debt instruments and to develop research of interest to investors. Currently, it is refining its rating techniques through joint efforts with the ASEAN Forum of Credit Rating Agencies (AFCRA) which is an association of regional credit rating agencies established to provide additional training and facilitate the exchange of information and ideas concerning credit rating and the bond markets throughout Asia. By incorporating global quality credit rating skills with significant knowledge and insight on the Thai economy and debt market, TRIS is fully committed to providing the best credit rating service available.

TRIS’s primary mission is to provide credit rating service and to disseminate the rating results and other related information in the Thai bond market for the benefit of investors both local and international. Thai bond will be traded in the Stock Exchange of Thailand on the special board, which is the board for the trading of government and state enterprise securities, such as bonds, debentures and convertible bonds.

TRIS has shareholders from various organizations in both the government and business sectors to achieve a broad-based shareholding structure. TRIS’s members of board of directors oversee the company’s policy. The board panel is made up of honorary directors, shareholder representative directors and TRIS’s President. Dr. Panas Simasathien, former Permanent Secretary and Minister of Finance, chairs the board, and Dr. Warapatr Todhanakasem is President.

---

6 Thai Rating and Information Services Website Address: www.tris.co.th
3.1 Rating Criteria

TRIS determines a rating after an in-depth analysis of quantitative and qualitative factors. TRIS's methodology for analyzing issues is divided into two sectors: financial institutions and general corporate. The approach to each analysis is outlined in the analytical framework TRIS developed for each type of entity. To ensure all salient factors are considered, TRIS's analytical framework includes: industry, business and financial analyses. Each analysis (industry, business and financial) utilizes a format that divides the analysis into several key variables. Each variable is rated; however, there is no certain formula for combining these factors. The “rating committee” determines the overall rating judgment. Below are the rating methodology profiles.

3.2 Rating Profile for Corporate

1) Industry Analysis: Each rating analysis begins with an assessment of the company's operating environment. The analysis focuses on industry prospects, pattern of business cycles, and nature of industry, regulatory restrictions and competitive factors that affect the industry.

2) Business Analysis: This area of assessment concentrates on corporate strategy, management evaluation, market position, diversification and operating efficiency.

3) Financial Analysis: In assessing a financial position, TRIS reviews the company's financial policies, profitability and efficiency, capital structure, cash flow adequacy and financial flexibility. For instance, TRIS reviews a company's financial policies pertaining to leverage tolerance, dividends, acquisition and disposition strategies.

4) Additional Specific Analysis for Real Estate Companies: In assessing a real estate company, TRIS focuses on the quality of the real estate investment portfolio. Asset quality considerations encompass the age and physical conditions of the properties, the investment status of the particular properties and type of investment.
Income recognition differentiation of financial statements needs to be adjusted for a clearer picture of the real estate firm's cash stream. All financial ratios are calculated on an adjusted cash flow basis.

3.3 Rating Profile for Financial Institutions

1) Industry Analysis: TRIS assesses the relationship of the industry to the economy and the possible impact of various economic scenarios, including changes of legislation or policies of the Bank of Thailand or the Ministry of Finance.

2) Business Analysis:

- **Asset Quality**: The area of analysis includes: the characteristics of basis receivables (consumer versus commercial, sub portfolios, size, off-balance sheet risk) diversity (geographical, customer base, product type) lending criteria, audit procedures and controls, credit quality, reserve adequacy and liquidity.

- **Asset and Liability Management**: This area includes an examination of the company's philosophy and management of assets and liabilities with regard to maturity and interest rate sensitivity.

- **Ownership/Affiliation**: This area examines the degree of strength derived from the parent companies' support.

- **Management**: This area evaluates management's performance, policies, controls and planning.

- **Financial Analysis**: This area includes analysis of a company's performance based on profitability measures, capital leverage, liquidity, financial policy and flexibility.
Presented below are the key ratios used by TRIS in analyzing credit strength:

- Liquidity ratio
- Capital structure ratio
- Profitability ratio
- Cash flow adequacy ratio
- Growth ratio
- Efficiency/activity ratio
- Industry specific ratio

3.4 Rating Process

The rating process begins after the issuer/company has requested a rating, signed a contract with TRIS and prepared all the necessary information requested in the list of preliminary information. When the contractual agreement is signed, TRIS's administration informs TRIS's analytical team about the case and the company's contact person. The rating manager assigns an analytical team to the case. A lead analyst heads the analytical team and is responsible for coordination and analysis. For a complex case, the rating manager may assign a supporting analyst to assist the lead analyst.

During the rating process, the lead analyst coordinates with the company being rated to obtain information regarding its industry. In some cases, TRIS might request advisory and industry information from its technical advisors. In its initial years, TRIS received technical training and assistance from Standard and Poor's (S&P) and Fitch IBCA. In addition to the information received from the issuer/company, TRIS compiles relevant information from reliable sources and may meet experts in the industry or related company management for supplementary input. After TRIS's analysts have collected the information they need for analysis, the team visits the company's operational site and meets with the company's head management. Meanwhile, TRIS's Management sets up a meeting with the rated company’s top executives to discuss their company's policies.
Next, the lead analyst for the case prepares a detailed report regarding the company. The lead analyst also discusses with TRIS's analytical team and rating managers about assessing the company's business situation by using all the collected information following TRIS's Rating Methodology Profile (RAMP). RAMP is set up for standard analysis to compare the risks among rated companies. TRIS reviews the company's industry, business and financial risks. The company's projection will also be taken into account. In analyzing the company's financial data, TRIS uses financial data collected from all the listed companies on the Stock Exchange of Thailand (SET) as a standard of comparison.

The analytical team assigned to the company then submits its analysis to TRIS's subcommittee, which comprises all of TRIS's analysts and the President. The same presentation will later be submitted to TRIS's rating committee, if the rating is publicly announced, this presentation material is made available to the public. All confidential information is presented in the committee meetings verbally. The rating result mainly focuses on the company's key success factors combined with additional information essential for rating consideration. After the lead analyst's presentation, the subcommittee holds a forum to discuss all aspects of the company. The company is compared to RAMPs of other companies that have already received ratings. The subcommittee then makes a rating recommendation.

Next, the rating result is submitted to the rating committee. The rating committee's voting members are divided into two groups: (1) internal and (2) external. The internal part includes TRIS's President, rating managers and the lead analyst of the case under consideration. The external group includes well-known, honorary experts who are knowledgeable in the area of that industry and who have no conflicts of interest regarding the company being rated. TRIS's President selects the rating committee's external members from a list of around 20 experts. TRIS's President moderates the voting process. Each committee member is allowed one vote. A simple majority vote decides the rating. In the case of a tie, the President will request that the committee revote and further discussions may take place.

TRIS informs the company of the rating result with a letter of notification sent to the company's top executive along with the full analytical report that was presented
to the committee. The company then has three choices: to accept the rating and make it public, to accept the rating and keep it private, or to reject the rating and seek an appeal. In the case of an appeal, the company will provide additional information and the lead analyst will discuss the information with the rating managers. If no new significant information is given, the analyst and rating managers may propose not to accept the appeal. However, if new significant information is provided, the lead analyst will analyze all information relevant to the case and may discuss the information further with the company's executives. The lead analyst will reconsider the rating by resubmitting the case with the new information back to the rating subcommittee and the rating committee. The rating result will be reported to the company. A company can appeal one time.

After the rating committee has assigned a rating and the issuer/company has accepted the rating and permits the results to be announced publicly, the results are published in TRIS's Credit News, which is available in a print edition and online through electronic information service providers.

3.5 Monitoring process

After a credit rating has been assigned by the rating committee and accepted by the issuer or the rated company to be announced publicly and published in TRIS's "Credit News," the monitoring process begins and continues until the debt issue matures or the rating contract ends. During this time, if any significant event occurs that may affect the rating, TRIS will notify the public by issuing 3 types of announcements:

1. **Credit Alert announcement:** a public warning issued by TRIS when significant events have occurred which may affect the rated company's or debt issue's rating already assigned by TRIS because of changing business conditions. Such events could include mergers or new operating developments. Credit Alert announcement means that insufficient information exists to fully assess and reconsider a debt issue's current rating. Credit Alert designations may be "positive," "negative" or "developing," depending on the
likely impact of a particular situation. The existing rating continues unchanged for the time being.

2. **Credit Update announcement**: reviews rating of the rated company or debt issue already assigned by TRIS. Credit Update occurs when the rated company issues a new debt instrument or if significant events have taken place that may impact its current rating. The update will include supplementary information to the previously published rating. After a review, the rating may be "raised," "lowered" or "affirmed." Credit Update may be an extension of Credit Alert when TRIS has received sufficient information to assess the situation.

3. **(Revised) Credit News announcement**: issued when there is sufficient information to fully assess and revise the current rating. TRIS makes a "revised Credit News" announcement to replace its earlier announcement. The revised rating may be "raised," "lowered" or "affirmed." Under its monitoring process, TRIS publishes a revised Credit News within a year of its previous announcement.

3.6 **Symbols & Definitions**

TRIS uses letter-rating symbols for announcing credit rating results for long-term debt. Ratings range from AAA, the highest rating, to D, the lowest rating. The ratings from AA to C may be modified with the addition of a plus (+) or minus (-) sign to show relative standing within a rating category. TRIS does not classify its rating into investment or speculative grade because the local investment community and related regulatory bodies have not specified this preference (See Table B8 for more details about rating symbols and rating definitions).

TRIS's ratings are local currency ratings. These ratings reflect the Thai issuers' ability to fulfill their Thai baht debt obligations, excluding the risk of convertibility of those baht payments into foreign currencies. Therefore, TRIS's ratings are not capped by the (foreign currency) sovereign ceiling of Thailand, which is assigned by international credit rating agencies.
CHAPTER 3

REVIEW OF LITERATURE AND RELATED THEORIES

Before discussing the theoretical framework and methodology for testing the diversification effects on risk and return, it is worthwhile to examine the results of previous studies of portfolio theory and certain empirical studies. This chapter is divided into two main sections. First, it deals with the literature review and the summarized table of literature reviews. Second, it is followed by the related portfolio theory.

3.1 Literature Review

Diversification of investments was a well-established practice long before Markowitz’s portfolio selection theory in 1952. In this section, the review of twenty-one articles will be discussed successively according to the time each was published. First, this paper will start with portfolio theory before 1952, then the father of modern portfolio theory will follow and last many articles of recent portfolio theories will be discussed. In the Merchant of Venice, Shakespeare has the merchant, Antonio say:

“My ventures are not in one bottom trusted,
Nor to one place; nor is my whole estate
Upon the fortune of this present year;
Therefore, my merchandise makes me not sad.”

(Act I, Scene one in Shakespeare’s poem)

Clearly, Shakespeare not only knew about diversification, but also, at an intuitive level, understood covariance. This poem can be applied to this present study in that the investors should not put the total fund into one investment but they should diversify their funds into small portions with many investments so the investors will be happy with the diversification benefits that they will gain.

Hicks (1935) created "The Pure Theory of Portfolio Investment" because of his desire to build a theory of money along the same lines as the existing theory of value. Hicks (1935) introduced risk into his analysis. Specifically, he noted, "The risk factor comes into our problem in two ways: First, as affecting the expected period of investment, and second, as affecting the expected net yield of investment" (p. 7). In a statement applicable to both sources of risk, Hicks explained that where risk is present, the particular expectation of a risk-less situation is replaced by a band of possibilities, each of which is considered more or less probable. It is convenient to represent these probabilities to oneself, in statistical fashion, by a mean value, and some appropriate measure of dispersion. Hicks (1935) never designated standard deviation or any other specific measure as the measure he meant when speaking of risk.

Hicks (1935) concluded that the total risk incurred when more than one risky investment is undertaken does not bear any simple relation to the risk involved in each of the particular investments taken separately. In most cases, the "law of large numbers" comes into play but it did not discuss this in this article. The author noted that the investors could divide up their capitals into small portions, and spreading their risks, the investors would be able to insure themselves against any large total risk on the whole amount. This also means when the number of investment in the portfolio increases, the total risk will reduce. This can be applied to this present study in that when the number of investment increases, the coefficient of determination between the portfolio return and the market return should increase. But in actuality, the cost of investment, making it definitely unprofitable to invest less than a certain minimum amount in any particular direction, closes the possibility of risk reduction along these lines to all those who do not possess command over considerable quantities of capital. Hence, Hicks suggested....By investing only a proportion of total assets in risky enterprises, and investing the remainder in ways which are considered more safe, it will be possible for the individual to adjust his whole risk situation to that which he most prefers, more closely than he could do by investing in any single enterprise..... (p. 9-10).

---

Hicks (1935) was seeking to explain the demand for money as a consequence of the investor's desire for low risk as well as high return. He did not designate standard deviation or any other specific measure of dispersion as representing risk for the analysis; therefore, he could not show a formula relating risk on the portfolio to risk on individual assets. Moreover, Hicks (1935) did not distinguish between efficient and inefficient portfolios, contained no drawing of an efficient frontier, and had no hint of any kind of theorem to the effect that all efficient portfolios that include cash have the same proportions among risky assets.

Marschak (1938)\(^3\) found a “Theory of Money” by integrating it with the General Theory of Prices. Marschak explained that to understand monetary problems required, first, an extension of the concept of human tastes: by taking into account not only men's aversion for waiting but also their desire for safety, and other traits of behavior not present in the world of perfect certainty as postulated in the classical static economics. Second, the production conditions, assumed to be objectively given, become, more realistically, mere subjective on the expectations of the investors. Anyway he thought .....The problem is: to explain the objective quantities of goods and claims held at any point of time, and the objective market prices at which they are exchanged, given the subjective tastes and expectations of the individuals at this point of time..... (p. 312).

Marschak presented the equations of the standard economic analysis of production, consumption, price formation and the investment decision when outcomes are random. No new equations were introduced but Marschak used the prior equations with new meanings .....We may use the previous formal setup if we reinterpret the notation of \(x, y\) shall mean, not future yields, and the parameters of the joint-frequency distribution of future yields. Thus, \(x\) may be interpreted as the mathematical expectation of first year's meat consumption, \(y\) may be its standard deviation, \(z\) may be the correlation coefficient between meat and salt consumption in a given year, \(t\) may be the third moment of milk consumption in second year, etc..... (p. 320).

Marschak noted that people usually like high mean and low standard deviation as they like meat consumption to be accompanied by salt consumption. This means that the investors need the higher return to compensate for the higher risk, which can be applied to this present study in that when the quality of portfolio decreases, the risk will increase and the portfolio should be increased. He noted that people like 'long odds' (i.e., high positive skewness of yields) and for each yield two parameters are involved; that is the mathematical expectation ('lucrativity') and the coefficient of variation ('risk'). Hence, Marschak's article is a forerunner of portfolio theory. The means, standard deviations, and correlations of the analysis, including the means of end products consumed, appear directly in the utility and transformation functions with no analysis of how they combined to form moments of the investor's portfolio as a whole. On the other hand, Marschak's 1938 work is a landmark on the road to a theory of markets whose participants act under risk and uncertainty, as later developed in Tobin and the CAPMs.

Williams (1938)\(^4\) observed that the future dividends of a stock or the interest and principal of a bond might be uncertain. He said that, in this case, probabilities should be assigned to various possible values of the security and the mean of these values used as the value of the security. In particular, in the section titled "Uncertainty and the Premium for Risk" (starting on p. 67 in the chapter on "Evaluation by the Rule of Present Worth"), he used as an example an investor appraising a risky 20-year bond "bearing a four per cent coupon and selling at 40 to yield 12 per cent to maturity, even though the pure interest seems to be only four per cent". His remarks apply to any investor who cannot tell for sure what the present worth is of the dividends or of the interest and principal to be received.

Whenever the value of a security is uncertain and has to be expressed in terms of probability, the correct value to choose is the mean value. The customary way to find the value of a risky security has always been to add a "premium for risk" to the pure interest rate, and then use the sum as the interest rate for discounting future receipts. In the case of the bond under discussion, which at 40 would yield 12 per cent to maturity, the "premium for risk" is eight per cent when the pure interest rate is four

percent. Hence, it should be noted that Williams's "dividend discount model" remains one of the standard ways to estimate the security means needed for a mean-variance analyses. The author suggested the investors add the risk premium when finding the securities' value, which also means that when the value of the investment is uncertain, the rate of return on those securities should be compensated more. Hence, it can apply to this present study in that when the quality of portfolio decreases, the rate of return on the portfolio should be increased in order to compensate for this additional risk.

Williams's prescription also suggested the investors diversify their funds among all those securities or invest in sufficiently many securities, which give maximum expected return. In this way, risk can be virtually eliminated. The law of large numbers will insure that the actual yield of the portfolio will be almost the same as the expected yield. This rule is a special case of the expected returns-variance of returns rule. It assumes that there is a portfolio which gives both maximum expected return and minimum variance, and it commends this portfolio to the investor. But this presumption that the law of large numbers applies to a portfolio of securities cannot be accepted when the returns from securities are too inter-correlated. Diversification cannot eliminate all variance. This theory can also be applied to this present study in that the investors should add the number of investment in portfolio in order to reduce the total risk of the portfolio, which will make the coefficient of determination between the portfolio return and the market return approach one.

Markowitz (1952)\(^5\) is called the father of modern portfolio theory (MPT). Markowitz (1952), on portfolio selection, proposed expected (mean) return, E, and variance of return, V, of the portfolio as a whole as criteria for portfolio selection. The article assumed that beliefs or projections about securities follow the same probability rules that random variables obey. From this assumption, it follows that (1) the expected return on the portfolio is a weighted average of the expected returns on individual securities and (2) the variance of return on the portfolio is a particular function of the variances of, and the covariance between, securities and their weights in the portfolio. From this point, the investors will know how to find the risk on the

return for their own investments and this will help the investors to find the return on each portfolio in the calculation part of this present study.

Markowitz (1952) distinguished between efficient and inefficient portfolios. Subsequently, someone aptly coined the phrase "efficient frontier" for what he referred to as the "set of efficient mean-variance combinations". He had proposed that means, variances, and co variances of securities be estimated by a combination of statistical analysis and security analyst judgment. From these estimates, the set of efficient mean-variance combinations can be derived and presented to the investor for choice of the desired risk-return combination. He used geometrical analyses of three- and four-security examples to illustrate properties of efficient sets, assuming nonnegative investments subject to a budget constraint. In particular, he showed in the 1952 article that the set of efficient portfolios is piecewise linear (made up of connected straight lines) and the set of efficient mean variance combinations is piecewise parabolic. From this efficient, it shows that the return will increase when the risk increases. This can apply to this present study in that the return will increase when the quality of the portfolio decreases.

For the case in which one and only one feasible portfolio minimizes the variance among portfolios with any given feasible expected return. Markowitz (1952) illustrated that the set of efficient portfolios is piecewise linear. It may be traced out by starting with the unique point (portfolio) with minimum feasible variance, moving in a straight line from this point, then perhaps, after some distance, moving along a different straight line, and so on, until the efficient portfolio with maximum expected return is reached. Note that he was discussing the shape of the set of efficient portfolios in "portfolio space". Moreover, Markowitz (1952) introduced the elementary concepts and results of mathematical statistics, including the mean and variance of a sum of random variables. The return (R) on the portfolio as a whole is a weighted sum of random variables (where the investor can choose the weights). From this point forward, Markowitz (1952) was primarily concerned with how to choose the weights $X_i$ so that portfolios will be mean-variance efficient.
Roy (1952)\textsuperscript{6} also proposed making choices on the basis of mean and variance of the portfolio as a whole. Specifically, he proposed choosing the portfolio that maximizes portfolio \((E - d)/\sigma\) where \(d\) is a fixed (for the analysis) disastrous return and \(\sigma\) is standard deviation of return. Roy's formula for the variance of the portfolio, like the one Markowitz presented, included the covariance of returns among securities. The chief differences between the Roy analysis's and Markowitz's analysis were that (1) Markowitz's required nonnegative investments whereas Roy's allowed the amount invested in any security to be positive or negative and (2) Markowitz proposed allowing the investor to choose a desired portfolio from the efficient frontier whereas Roy recommended choice of a specific portfolio. Hence, Roy's (1952) study can be applied to this present study in the same way that Markowitz's (1952) study is applied in that the return will increase when the quality of the portfolio decreases.

Markowitz (1956)\textsuperscript{7} presented the formulas for the straight lines that make up the set of efficient portfolio, but Markowitz (1956) solved a much more general problem than discussed in Markowitz (1952). A portfolio in Markowitz (1952) was considered feasible if it satisfied one equation of the budget constraint and its values of investments were not negative. Markowitz (1956), however, solved the single-period mean-variance portfolio selection problem for a wide variety of possible feasible sets, including the Markowitz's (1952) and Roy's feasible sets as special cases. Specifically, Markowitz (1956) allowed the portfolio analyst to designate some variables, which are subject to non-negativity constraints (as in Markowitz, 1952) and the remaining variables are not subject to non-negative constrained (as in Roy). In addition to the budget constraint, the portfolio analyst could specify zero, one, or more linear equality constraints (weighted sums of variables required to equal some constant) and linear inequality constraints (weighted sums of variables required to be no greater or no less than some constant). A portfolio analyst can set down a system of constraints of these kinds such that no portfolio can meet all constraints. In this case, he said that the model is "infeasible". Otherwise, it is a "feasible model". In addition to permitting any system of constraints, Markowitz (1956) made an assumption that assured that if the model was feasible, then (as in Markowitz 1952)

\textsuperscript{6} Roy, A.D. "Safety First and the Holding of Assets." Econometrica 20, No.3 (July 1952): 431-449.
\textsuperscript{7} Markowitz, Harry M. "The Optimization of a Quadratic Function Subject to Linear Constrains." Naval Research Logistic Quarterly 3 (1956): 111-133.
there was a unique feasible portfolio that minimized variance among portfolios with any given feasible E.

Markowitz (1956) showed that the set of efficient portfolios is piecewise linear in the general model, as in the special case of Markowitz (1952). This article can be applied to this present study in the same way as Markowitz's (1952) but this article will also present the formula to calculate the set of efficient portfolio with any constraints, which solve a much more general problem than discussed in Markowitz (1952). Depending on the constraints imposed by the portfolio analyst, one of the linear pieces of the efficient set could extend without ending in the direction of increasing E, as in the case of Roy's model. Markowitz (1956) presented a computing procedure, the "critical line algorithm", that computes each corner portfolio in turn and the efficient line segment between them, perhaps ending with an efficient line "segment" on which feasible E increases without ending. The formulas for the efficient line segments are the same pattern. Along a given "critical line", some of the variables that are required to be nonnegative are said to be OUT and are set to zero; the others are said to be IN and are free to vary. Variables not constrained to be nonnegative are always IN. On the critical line, some inequalities are called SLACK and are ignored; the others are BINDING and are treated (in the formula for the particular critical line) as if they were equalities. With its particular combination of BINDING constraints and IN variables, the formula for the critical line is the same as if the problem were to minimize V for various E subject to only equality constraints. In effect, OUT variables and SLACK constraints are deleted from the problem.

At each step, the algorithm uses the formula for the current critical line for easy determination of the next corner portfolio. The next critical line, which the current critical line meets at the corner, has the same IN variables and BINDING constraints as the current line except for one of the following-one variable moves from OUT to IN or moves from IN to OUT or one constraint moves from BINDING to SLACK or from SLACK to BINDING. This similarity between successive critical lines greatly facilitates the solution of one line when given the solution of the preceding critical line.
Tobin (1958) was concerned with the demand for money as distinguished from the other monetary assets. Monetary assets, including cash, were defined by Tobin as "marketable, fixed in money value, free of default risk". Tobin stated..... Liquidity preference theory takes as given the choices determining how much wealth is to be invested in monetary assets and concerns itself with the allocation of these amounts among cash and alternative monetary assets..... (p. 66)

Tobin assumed that the investor seeks a mean variance-efficient combination of monetary assets. He justified the use of expected return and standard deviation as criteria on either of the two bases: Utility functions are quadratic, or probability distributions are from some two-parameter family of return distributions. Tobin’s conclusion can be applied to this present study in that when the risk of investment increases, the rate of return of investment will also be increased, which means that when the quality of the portfolio decreases, the rate of return on the portfolio will be increased.

Tobin presented the “Tobin Separation Theorem” that is a portfolio selection model with n risky assets and one risk-less asset, cash. Because these assets were monetary assets, the risk was systematic risk, not default risk. Holdings had to be nonnegative. Borrowing was not permitted. Implicitly, Tobin assumed that the covariance matrix for risky assets is nonsingular. Tobin showed that these premises imply that for a given set of means, variances, and co-variances among efficient portfolios containing any cash at all, the proportions among risky stocks are always the same.....the proportionate composition of the non-cash assets is independent of their aggregate share of the investment balance. This fact makes it possible to describe the investor’s decisions as if there were a single non-cash asset, a composite formed by combining the multitude of actual non-cash assets in fixed proportions..... (p. 84)

Markowitz (1959) made more general mean-variance analysis. The central focus of this article was to explain portfolio theory to a reader who lacked advanced

---

mathematics. The first four chapters introduced and illustrated mean-variance analysis, defined the concepts of mean, variance, and covariance, and derived the formulas for the mean and variance of a portfolio. Chapter seven defined mean-variance efficiency and presented a geometric analysis of efficient sets. Chapter eight introduced the reader to some matrix notation and illustrated the critical line algorithm in terms of a numerical example. Here, the result was more general than that in Markowitz (1956). The result in Markowitz (1956) made an assumption sufficient to assure that a unique feasible portfolio would minimize variance for any given E. Markowitz (1959) made no such assumption; rather, it demonstrated that the critical line algorithm would work for any covariance matrix. The reason it works is as follows: Recall that the equations for a critical line depend on which variables are IN and which are OUT. Appendix A of the article showed that each IN set encountered in tracing out the efficient frontier is such that the associated equations for the critical line are solvable.

- **Models of Covariance.** Markowitz (1959, p. 96-101) argued that analysis of a large portfolio consisting of many different assets has too many covariances for a security analysis team to carefully consider them individually, but such a team can carefully consider and estimate the parameters of a model of covariance. This point was illustrated in terms of what is now called a single-index or one-factor (linear) model. The 1959 discussion briefly noted the possibility of a more complex model—perhaps involving multiple indexes, nonlinear relationships, or distributions that vary through time. This model is similar to the forth hypothesis of this present study that when the number of investment in portfolio increases the coefficient of determination between the portfolio return and the market return will increase, so the total risk will reduce as a portfolio composed of many assets together.

- **The Law of the Average Covariance.** Chapter five of Markowitz (1959) considered, among other things, what happens to the variance of an equally weighted portfolio as the number of investments increases. It showed that the existence of correlated returns has major implications for the efficacy of diversification. With uncorrelated returns, portfolio risk approaches zero as
diversification increases. With correlated returns, even with unlimited diversification, risk can remain substantial. Specifically, as the number of stocks increases, the variance of an equally weighted portfolio approaches the "average covariance" (i.e., portfolio variance approaches the number is gotten by adding up all covariance and then dividing by the number of them). He referred to this as the "law of the average covariance". Clearly, there is a qualitative difference in the efficacy of diversification depending on whether one assumes correlated or uncorrelated returns.

- **Semi deviation.** Semi variance is defined like variance (as an expected squared deviation from something) except that it counts only deviations below some value. This value may be the mean of the distribution or some fixed value, such as zero return. Semi deviation is the square root of semi variance. Chapter nine of Markowitz (1959) defined semi variance and presented a three-security geometric analysis illustrating how the critical line algorithm can be modified to trace out mean semi deviation-efficient sets.

**Hicks (1962)**\(^{10}\) titled the pure theory of portfolio investment. He presented a mathematical model that is almost exactly the Tobin model with no reference to Tobin. The difference between the Hicks and Tobin models is that Hicks assumed that all correlations are zero whereas Tobin permitted any nonsingular covariance matrix. Specifically, Hicks presented the general formula for portfolio variance written in terms of correlations, rather than co-variances. Hence, Hicks (1962) derived the Tobin conclusion that among portfolios that include cash, there is a linear relationship between portfolio mean and standard deviation and that the proportions among risky assets remain constant along this linear portion of the efficient frontier. In other words, Hicks presented what we call the Tobin Separation Theorem.

Hicks also analyzed the efficient frontier beyond the point where the holding of cash goes to zero. In particular, he noted that as we go out along the frontier in the direction of increasing risk and return, securities leave the efficient portfolio and do not return. As the consequence, the Hick article can be applied to this present study.

similar to Tobin (1952) that when the risk of portfolio increases, the rate of return on portfolio will also increase.

Sharpe (1964)\textsuperscript{11} focused the same as Tobin. Tobin and Sharpe are also similar in postulating a model with \textit{n} risky and one risk-less security. The principal differences between the two are (1) a difference in assumption between their mathematical models and (2) the economic phenomena concerning which the respective models are asserted. As for assumptions, Tobin assumed that one could invest (i.e., lend) at the risk-free rate. Sharpe assumed that the investors could either borrow or lend at the same rate. (Tobin usually assumed that the rate is zero, but he noted that this assumption is not essential.) This difference between the two models makes for a substantial difference in their conclusions. First, if investors can borrow or lend all they want at the risk-free rate (and the covariance matrix among the \textit{n} risky stocks is nonsingular), then all efficient portfolios consist of one particular combination of risky assets, perhaps plus borrowing or lending. The implication is that, in equilibrium, the market portfolio (plus borrowing or lending) is the only efficient portfolio. In the Tobin model, in contrast, if investors have heterogeneous risk tolerances so some hold cash and others do not the market portfolio can be quite inefficient, even when all investors have the same beliefs and all hold mean-variance-efficient portfolios.

The most remarkable conclusion Sharpe drew from his premises was that in CAPM equilibrium, the expected return of each security is linearly related to its beta and only its beta. The second major difference between the two works is that Sharpe postulated that his model applied to all securities, indeed all "capital assets", whereas Tobin postulated only that his model applied to "monetary asset". In fact, Tobin expressed doubts that cash should be considered risk free. After getting the Sharpe's premises in CAPM equation, the investors will know how to price the systematic risk, which can be applied to this present study that when the quality of investment reduces, the risk of investment will increase, so the beta of investment should be increased.

Wagner and Lau (1971) examined the rate of return on well-diversified low-risk portfolios and rate of return on well-diversified high-risk portfolios. This article also showed how diversification could be utilized to offset the riskiness of individual securities. To demonstrate the effect of changing the number of issues held in a portfolio, random sample portfolios were constructed holding from one to twenty securities, portfolios were formed for each quality class as of the beginning of June 1960. The performance of these portfolios was simulated for five years into the future and ten year into the future (composition remaining unchanged). In order to reduce the dependence on single samples, the exercise was repeated ten times with different random selections. The authors would not include the five-year period 1965-1970 because there was virtually no net change in market level during that period. The author applied the Capital Asset Pricing Model to measure the risk of a security by using beta to measure the un-diversifiable or systematic risk. They used the stock quality rating rather than bond quality rating to measure the risk of corporations.

To perform the test, the following data was collected on a sample of over two hundred securities: 1) the stock quality rating as of June 1960, June 1965; 2) the individual stock betas as of those points in time; and, 3) the total rate of return for each of individual issue during June 1960-1970. Securities included in the sample were those maintained on the S&P stock rating list for the ten year period, and also were on the monthly returns tape of University of Chicago Center for Research in Securities Prices for the same period. Although this procedure potentially introduced an ex-post bias in that companies were selected as of 1960, which were known to be in existence in 1970, they did not believe that this leaded to a significant distortion of results of the study.

From the study, five major conclusions could be drawn as the higher the quality rating of the portfolio, the lower the beta; The average return on the portfolio increases as the quality of the individual issues declines; The standard deviation declines as the number of holdings increases; Increasing the number of holdings does not, in and of itself, increase or decrease the rate of return on the portfolio; And the correlation of the portfolio to the market index rises as the number of holdings

increases. From these conclusions will apply to four hypotheses of this present study that the higher the quality rating of the portfolio, the lower the beta; The average return on the portfolio increases as the quality of the individual issues declines; Increasing the number of holdings does not increase or decrease the rate of return on the portfolio; And the coefficient of determination between the portfolio to the market index rises as the number of holdings increases.

Sharpe and Cooper (1972) examined whether following alternative strategies, with respect to risk over long periods of time, would be consistent with modern capital theory. In order to get portfolios with different betas they divided stocks into deciles once a year on the basis of the beta of each security. To be more precise, beta at a point in time was measured using 60 months of previous data. Once a year, for each year 1931 – 1967, all New York Stock Exchange stocks were divided into deciles based on their rank by beta. An equally weighted portfolio was formed of the stocks that comprised each decile. A strategy consisted of holding the stocks of particular deciles over the entire period. The stocks that made up a particular deciles change as the decile’s composition was revised once a year. The investors could actually follow notice that the strategy outlined by Sharpe and Cooper. Each year the investors just divide stock into deciles by beta based on the their ranks by beta. If investors want to pursue the high beta strategy, they simply divide their funds equally among the stocks in the highest beta deciles. They do this every year and observe the outcome.

While the relationship between strategy and return is not perfect; however, it is very close. In general, stocks with higher betas have produced higher future returns. Their work presented rather clear and easily interpreted evidence as general equilibrium theory suggests. There is a positive relationship between the return and beta. Hence, when the risk of the portfolio increases, the beta of the portfolio will increase and when the beta of portfolio increases, the return of portfolio will increase, which means this relationship can be applied to the first and the second hypothesis of this present study.

Most of the empirical studies of the CAPM would apply a time series (first pass) regression to estimate betas and apply a cross-sectional (second pass) regression to test the hypotheses such as the early study performed by Lintner (1965) and reproduced in Douglas (1968). Lintner estimated betas of 301 common stocks by regression of yearly securities and market returns during 1954 – 1963 and then performed second-pass regression. His empirical results seem to violate the CAPM in that the coefficient for the residual variance was generally significant, whereas the coefficient for beta was typically significant. Douglas employed a similar methodology and found the similar result.

Miller and Scholes (1972) noted that Douglas’s result could be caused by statistical problems inherent in all empirical tests of CAPM, so they conducted a series of carefully constructed simulation designed to measure the extent to which certain previous studies have produced results that were biased by these statistical problems. The statistical bias was due to misspecification of the basic estimation equations. One of the first considerations here was that, if return was really generated by simple form of the CAPM, then the time series equation used to estimate betas should be consistent with the CAPM. The CAPM in time series form is:

\[ R_t = (1 - \beta_i) R_m + \beta_i R_{mt} \]

But the equation used by Lintner and Douglas is the market model:

\[ R_t = \alpha_i + \beta_i R_{mt} \]

If \( R_F \) is a constant over the estimation period, there will be no problem and the estimate of \( \alpha_i \) should be equal \( (1 - \beta_i) R_m \). However, if \( (1 - \beta_i) R_f \) fluctuates over time and, if it is correlated with \( R_{mt} \), a classic case of missing variable bias and \( \beta_i \) will be a

---

biased estimate of true $\beta_i$. Furthermore, Miller and Scholes proved that if $R_F$ and $R_M$ are negatively correlated, then this will have the effect of biasing the intercept of the second-pass regression upward and its slope downward and this could, in part, explain the inconsistencies found by Lintner and Douglas. Miller and Scholes examined historical data and found a negative correlation. This is not surprising, for the stock market usually declines when interest rate goes up. They tested for the importance of this to explain the Lintner's findings. Although they found the influence in the direction discussed herein, the order of magnitude of the bias is so small that it has almost no effect on Lintner's results.

The second source of misspecification was that an intercept is too high and a slope is too low if the relationship between expected return and beta is, in reality, nonlinear. However, Miller and Scholes proved that any nonlinear does not lead to the increase in intercept and decrease in slope.

**Fama and MacBeth (1973)**\(^{17}\) tested the CAPM through the SML. They formed 20 portfolios of securities to estimate beta from a first-pass regression. They employed five years of monthly data to estimate betas, and ranked stocks into deciles (from highest to lowest). Each decile was considered as the portfolio in the next year (e.g., sixth year). Then data for the second through sixth year were used to rank stocks and form deciles that were considered portfolio for the 7th year. This was done until deciles and return for each decile was computed for 29 years. Then the return for deciles one in each year was considered as a series of returns from a portfolio one, a return for deciles two in each considered a series of returns on a portfolio two, and so forth. They performed the second-pass regression for each month over the time period 1935 to 1968. They set hypotheses that residual risk does not affect return, there is no non-linearity in SML and there is a positive price of risk in the capital markets. From the empirical results, they concluded that neither non-linearity is SML nor residual risk has an influence on returns, and they also concluded that there is the evidence that the relationship between expected return and beta is positive as well as linear. The vertical intercept from the second-pass regression is generally greater than risk-free rate ($R_F$) and the slope is generally less than market risk-premium ($R_M - R_F$).

On the basis of the preceding surveys of empirical studied on CAPM, the following summary statements might now be appropriately offered. The capital asset pricing model (CAPM) being of the most widely known theories of asset pricing, uses a rather lengthy set of simplifying assumptions, and it sets forth the equilibrium relationship that should exist between expected return and risk for all securities and portfolios. Although the assumptions used in the CAPM may be questioned in terms of their reasonableness, the real test of any model is how well it describes the actual relationship that it predicts.

The empirical results, summarized in the foregoing paragraphs, indicate that there is a positive linear relationship between the average returns for securities and their estimated beta coefficients, which measure the systematic risk. Hence, it can be applied to the second hypothesis this present study that the higher the risk, the higher the beta. However, the estimated coefficient from these empirical tests were significantly different from the values hypothesized in the underlying CAPM equation:

\[ E(R_i) = R_F + (E(R_M) - R_F) \beta_i \]

In particular a consistent result in empirical tests of the CAPM was the finding that the estimated intercept exceed its theoretical value \( R_F \) and the estimated slope was less than its theoretical value \( R_M - R_F \). Therefore, one can conclude that recent studies of CAPM risk-return issue have provided mixed and unconscious result.

Kaewsing (1992)\(^\text{18}\) studied the relationship between return and risk of banking securities. The purpose of the study was to find out the return and risk of securities in banking industry by using the capital asset pricing model (CAPM).

The data used is a monthly report of SET, which is composed of SET index, industry index of banking sector and dividend. Data of all banking securities listed in SET for that period from January 1988 to December 1992 were collected. The 180-day Treasury bill was used as risk-free security. The result of testing the relationship between the securities return and the risk-premium by using the risk-premium form of

CAPM, defined as $R_i = R_f + \beta_i (R_m - R_f)$, was that security return has a linear relationship with risk–premium at the level of significance of 0.05. Additionally, the return of securities in banking sector has the same direction with the return on the market at the confidence coefficient of 99 percent. From this point, it can apply to the first and the second hypothesis of this present study, that when the risk increases, the beta will increase. And the rate of return on the portfolio will increase as the risk of the portfolio measured in term of quality of portfolio decreases.

Kaewsing calculated the return and risk of the banking sector, SET and risk-free security shown below in the Table 3.1.

**Table 3.1: Risk and Return of Banking Securities, SET and Risk-Less Security**

<table>
<thead>
<tr>
<th></th>
<th>Banking Sector</th>
<th>SET</th>
<th>Risk-free Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk (beta)</td>
<td>0.6729</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Observed monthly return</td>
<td>2.7262%</td>
<td>2.5906%</td>
<td>0.6945%</td>
</tr>
</tbody>
</table>

If the banking-sector security has no risk, the return from the banking sector should be equal to the risk-free security, that is 8.33% per year. If the banking-sector security has the same risk as the market, the return will be 31.08% per year. After an analysis of historical data of the sixty months, the true return of baking-sector security that has lower risk of 0.6726 than the market provides a higher expected return. That is, the return of the banking sector was 32.71% whereas the return on the market was 31.08%. The reasons behind are that, first at the period of the study (1988-1992) the growth of banking business trended to increase. Second, the investors saw that a banking business had stability so it would create the attractiveness to invest in this sector. The last one is that the change in fiscal and monetary policies which supported the growth of the banking business.
Sharpe (1995) explained that the primary source of risk for an individual security is uncertainty about its future price. As well as the primary source of risk for a portfolio is uncertainty about its future market value. He divided the source of risk into two components. First source of risk can be termed as the security's market risk. This risk makes the future level of the overall market difficult to predict. But even if the future course of the market were known, some risk would remain. The price of a security depends at least partly on the fortunes of the issuer--independent of the course of the market or overall economy. This source can be termed the security's non-market risk. In addition, the market risk of a security or portfolio depends on the extent to which its price is sensitive to market swings. Sharpe's first measure was intended to quantify this relationship. The non-market risk of a portfolio depends to a considerable extent on its diversification. His second measure was intended to quantify this relationship. It was designed that two portfolios with comparable "diversification" will be likely to have comparable amounts of non-market risk.

This article also explained about the market sensitivity that it is a rare security indeed that does not go along, to a greater or lesser extent. A market swing generally results when investors change their opinions about the future of the economy. The author used the simple example to express this relationship quantitatively that if the market goes up one per cent more than expected, the price of XYZ will be--percent greater than expected the number used to fill in the blank can be defined as XYZ's market sensitivity. If the value is less than 1.0, the security is defensive--it moves less than the typical stock in market swings. Conversely, if the market sensitivity is greater than 1.0, the security is aggressive--it moves more than a typical stock in market swings.

The author agreed with the investment manager to advocate at least some diversification when constructing a portfolio to reduce risk. More precisely: it can reduce non-market risk. When one security does worse than expected (given the market's overall behavior), another is likely to do better than expected. The more securities in a portfolio, the greater the likelihood that sufficient good fortune will

---

appear to balance off the bad fortune. Some securities have more non-market risk than others. A portfolio of ten securities, each of which has a large amount of this type of risk, is likely to offer less effective diversification than another with ten securities, each of which has a small amount of non-market risk. To make it clearer, he gave the example that a portfolio of ten chemical securities is likely to offer less effective diversification than one of ten securities, each from a different industry. Sharpe estimated each security's non-market risk, relative to that of a typical security. A value of 1.0 indicates that a security is typical in this respect. A value of .5 indicates that it has half as much non-market risk as a typical security. A value of 2.0 indicates it has twice as much, etc. From his conclusion, it can apply to this present study that the investors should hold more than one investment in a portfolio in order to reduce the un-systematic risk, as the good fortune will balance off the bad fortune.

Sompong (1995) studied the risk and return of finance securities on the basis of the Capital Asset pricing Model. The study was divided into two parts, the first part dealt with the testing of consistency of financial securities and the CAPM theory and the second part has shown the analysis of return and risk in each time period. Sompong employed weekly return from January 1992 to December 1994 of eleven securities and used weekly market index as a return from the market. The one-year fixed deposit rate of bank was used as a risk-less security.

The covariances of stocks were relatively high and positive. The correlation coefficients were between 0.128 and 0.837. FIN-1, NAVA and CMIC stocks, which had the highest trading volume showed the highest correlation coefficients. He suggested that the investors who wanted to reduce risk should not invest only in these groups of securities at the same time.

Sompong investigated financial securities by using risk-premium form of the CAPM, that is, \( \text{ER}_i - R_F = \alpha + \beta_i (\text{ER}_m - R_F) \). The results revealed that there were ten securities, whose \( \alpha \) value insignificantly differed from zero and one security whose \( \alpha \) value significantly differed from zero. Thus this could not be concluded that securities in the financial sector were consistent with the CAPM theory. Moreover, the \( R^2 \) of

---

securities were very low implying that risk-premium was not a good variable to explain the expected return of security.

Finally, the finding showed that the beta coefficients, standard deviation and the expected return of securities changed over time. The limitation of this study is that it confined its analysis to only financial securities, and thus, generalization regarding CAPM cannot be achieved.

Putnam (1999)²¹ noted that the complex mathematics of portfolio optimization with mean-variance analysis does not always lead to an easy understanding of the critical nature of correlation analysis. To achieve a more intuitive understanding of the interrelationship of risk and correlation, he turned to simple two and three asset cases that lend investors to geometric interpretations that are more easily visualized. This article focused on using simple geometric representations to illustrate some key points in risk analysis to provide an intuitive understanding of the importance of correlation analysis.

In this case, he used the standard deviation of expected returns from the particular asset or the particular portfolio to measure the risk and geometric perspective risk is represented by the length of the line. The longer the line is, the greater the risk is, in terms of a higher standard deviation of expected returns. He explained that in the case of two assets or two portfolios, the correlation between the expected returns of each portfolio is represented by the angle one creates between the two lines representing the risk of each asset or portfolio. Correlation coefficients runs from positive 1.0, a perfect and positive correlation, to 0.0, an independent relationship between the two assets, to negative 1.0, indicate a perfectly opposite or negative relationship. The corresponding angles are 0-degrees for a negative 1.0 correlation, 90-degrees for a 0.0 correlation, and 180-degrees for a positive 1.0 correlation. For the graphically explanation he designated one asset as the first asset, and a line is drawn horizontally to represent the risk moving to the right away from the risk-zero point. In the case where portfolios instead of assets were being analyzed, the benchmark portfolio or primary portfolio was designated as the first portfolio or

asset. The line representing the risk of the second asset or portfolio is drawn starting from the end of the line representing the first asset or portfolio. The angle between the two lines is a function of the cosine of the correlation coefficient. The total risk of the combined portfolio, that is the total risk of combining two assets or two portfolios, is represented by connecting the risk zero point (starting point for the first asset) and the end-point of the second line representing the risk of the second asset. The length of the total risk line (the hypotenuse) represents the standard deviation of the combined portfolio of both assets or of both portfolios.

Three simple cases of two asset classes were used for analyzing. Supposed asset A is assigned an expected standard deviation of 4%. A line is drawn from the risk-zero point for a length of four units, representing the standard deviation of 4%. Asset A is representing a $100 investment. There powerful conclusions that can be drawn from the geometric representation concerning the use of leverage. For the case of pure leverage, total risk will reduce as the second investment is 75% leverage but the risk reduction benefit will not be significant. For the perfect hedging case, the second investment involves taken a short position in asset A 75% which make the correlation coefficient become negative one. This perfect hedge will make the risk reduction become significant, as one asset’s risk will be offset by another asset’s risk. In the last case, when the expect returns from asset A and asset B are independent of each other or are expected to have a zero correlation, the risk will reduce less than the negative correlation coefficient of two assets but more than the positive correlation coefficient of two assets.

Moreover, Putnam (1999) concluded that to achieve a well-diversified portfolio, correlations that are relatively high, say 0.80 or higher, are considerably less able to provide diversification effects that correlations in the middle zone, say 0.5 to 0.6. On the other hand, while a 0.3 correlation provides more diversification and risk-reducing potential than a correlation of 0.6, there is less of difference between these two correlations than between 0.9 and 0.6. Indeed, in the extreme, there is a truly huge difference between a correlation of 1.0 and 0.99. A perfect correlation is one thing, actually the same thing, but once the correlation falls below 1.0 there is some opportunity for different behavior and for risk reduction in a portfolio context.
Olsoo (2001) explained the power of diversification by taking the pension fund as his case. He stated that diversification offers a way for a pension fund to have its cake and eat it, too - to have higher-risk plus higher-return assets without increasing the volatility of its overall portfolio. This can apply to the forth hypothesis of this present study that when the number of issue in the portfolio increases, the risk of portfolio will decrease as the coefficient of determination between the portfolio return and the market return approaches to one. As the pension fund holds more than one investment in the portfolio, so the pension fund will gain more diversification benefit than the individual investment. Moreover he explained that assembling a portfolio of asset classes that march to somewhat different drummers (that have a low correlation with one another), a fund could increase its expected return at any given level of expected volatility. To illustrate the portfolio's aggregate volatility, not the volatility of each asset or each asset class, he gave the example of a portfolio of only two assets, both extremely volatile, but with returns that move exactly opposite to one another that is, with a correlation of -1. That means when asset A goes up by X+Y percent, asset B returns X-Y percent, and vice versa. The aggregate volatility of the portfolio would be nil - producing a very high-returning portfolio with no volatility. Three components that he needed the pension fund managers to consider if they wanted to get a success investment.

1. Expected Return. Return is defined by the compound annual return expected over the next 10 or 20 years. The expected long-term returns are studied from the historical returns. For common stocks, total return must equal dividend yield plus the rate of earnings growth, adjusted for change in the price/earnings ratio. The fund's expectation of the long-term growth rate of U.S. gross domestic product (GDP) is the approximation of the stock growth rate.

---

2. *Expected Risk.* The most helpful measure of the risk of an asset class is its volatility - its standard deviation of annual returns. A pension fund forecasts volatility by letting plan sponsors to apply common sense and run sensitivity tests to see how serious it will be when they are wrong.

3. *Expected Correlations.* Historical correlation data is available for some asset classes. But for other asset classes where there is no meaningful data, the only option is to guess and relates those asset classes to others for which correlation data is available.

This case would allow pension funds can hold other asset classes such as foreign, emerging markets and small stocks, and venture capital, distressed securities, bonds, real estate, timberland and arbitrage (market neutral) programs. Moreover, Olsoo noted that the lower the correlation among asset classes, the better for the pension fund. In addition the author also noted that some of the asset classes that are expected to be highly uncorrelated would become more closely correlated over time and vice versa. Moreover, the author noted that to achieve the highest benefit of diversification. The plan sponsors should:

1. First, to move the efficient frontier line as high as possible. The larger the number of diverse asset classes included in the optimizer, the higher the efficient frontier line is likely to be - and the higher the expected return that can be achieved at any given volatility level.

2. Then, to develop a target asset allocation that will get as close to the efficient frontier line as possible at the chosen volatility constraint.

The author also suggested that the plan sponsors should target a portfolio that has the highest probability of the lowest present value of future amount of contributions that must be made to the pension fund - or more precisely, the lowest present value within an acceptably low probability of extremely large contributions. And a key advantage of a defined benefit pension plan is its long time horizon. The average duration of the benefit obligations of a traditional pension fund ranges from 10 to 15 years.
Vladimir (2001) analyzed the risk of the portfolios with different levels of holdings by using the Monte Carlo technique to simulate total return of equity portfolio and the universe is based on the original constituents of the Russell 1000 at year-end 1992 and their total return performance (capital appreciation plus dividend reinvestment) through December 1999. For companies that did not survive for entire period, he recognized the total return from December 1992 until the last reported stock price. In addition, Vassal (2001) assumed that the proceeds from the retiring stock would be reinvested into another stock, randomly selected from the original constituents of the Russell 1000 index. The total returns from the original and reinvestment stocks were then combined on the compounded basis to determine the total return for the full seven-year period.

The results of this article concluded that if an individual investor had randomly bought one stock at the end of year 1992, there was a one-in-six chance that the equity investment would have lost value by year-end 1999, while the Russell 1000 was more than tripling in value. This example highlighted the potential risk of investing in only one stock. Next he tested the risk benefits of adding additional stocks to a portfolio by using a Monte Carlo simulation program to randomly select multiple combinations of individual stocks from Russell 1000 as of year-end 1992. As the first step, Vassal (2001) assigned a numerical value (1 to 1000) to represent each stock in Russell 1000 universe. Next, for determining two stock portfolios, Vassal (2001) computed 10,000 pairs of random number (integers ranging from 1-1000 with equal probability). Each pair of random numbers would then correspond to pre-assigned numerical values of two stocks in the original Russell 1000 index. After generating the multiple stock portfolios, he created frequency distributions with the total return results.

Another conclusion from this article was a conservative investor who wants no greater than a 40% probability of under-performing the market by 25% should own a minimum 50 stocks. A less risk-averse investor may be satisfied with a lower downside constraint of under-performing the market; this investor's portfolio should

---

include about 15 stocks (38% frequency of underperformance). If the investors want to limit the probability of a 50% relative return to 30%, a minimum portfolio of about 30 stocks would be appropriated. The investor with the low risk tolerance of underperforming the market would turn to an indexed or enhanced index portfolio. Hence, increasing the number of stocks held can significantly reduce the risk of underperforming inflation and the stock market. From this conclusion, 15 stocks will be sufficient to offer the diversification benefit to the investors with 38% frequency of underperformance. In this present study uses 18 stocks per one portfolio, so the unsystematic risk will be taken out and the return of each portfolio should be enough to compensate for the systematic risk.

Table 3.2 Summary of Literature Reviews

<table>
<thead>
<tr>
<th>Literature</th>
<th>Abstract</th>
</tr>
</thead>
</table>
• The author explained that risk would affect the expected investment period and expected net yield from investment.  
• Hicks suggested the investors to divide up their total capital into small portion in order to spread risk.  
• The author explained that the investors desire low risk and high return because the demand for money. |
• Marschak explained the concept of human taste that investors are averted to wait and desire for safety.  
• The author explained that different people would have different taste and expectation so the price and the quantity of good at specific time are different.  
• Marschak noted that people like high meat consumption (mean), low salt consumption (risk), and long odds (positive skewness of yield). |

- Williams (1938) explained that the future value of stock and bond are uncertain so the investors should value the security by assigning the probability and find the mean return.
- To find the value of the risky assets, the investors should add the risk premium to pure interest rate, which is the foundation for today 'Dividend Discount Model'.
- Williams suggested the investor to hold more securities to reduce risk but he explained that when the returns are too inter-correlated, the risk could not be diversified away.


- Markowitz (1952) proposed the expected return, variance of return as the criteria for the portfolio selection.
- Markowitz explained that the efficient portfolio as the portfolio along the efficient frontier that refers to the set of efficient mean-variance combination plus own indifferent curve in order to get one investment choice.
- The author noted that the set of efficient portfolio is piecewise linear and the set of efficient mean-variance combinations is piecewise parabolic.


- Roy (1952) proposed the basic for the portfolio selection by considering the returns; standard deviation, variance and covariance of return similar to Markowitz but Roy did not require non-negative investment assumption.
- The author recommended choice of a specific portfolio instead of a set of efficient portfolio.
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Markowitz (1956) presented the formulas to create the efficient portfolio with one budget constraint and value of investment are not subject to non negative investment assumption.</td>
</tr>
<tr>
<td>• Markowitz presented the critical algorithm to compute each corner portfolio in order to find the efficient portfolio.</td>
</tr>
<tr>
<td>• Markowitz explained that the infeasible model would occur when the portfolio cannot meet all constraints.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tobin (1958) explained that with the demand of money, liquidity preference would determine how to allocate the monetary asset among cash and alternative monetary asset.</td>
</tr>
<tr>
<td>• The author presented the ‘Tobin Separation Theorem’ to select the portfolio with n risky asset and one riskless asset.</td>
</tr>
<tr>
<td>• Tobin found that with a given set of mean, variance and covariance among the efficient portfolio, the portions among risky assets would be the same.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Markowitz (1959) made the portfolio theory in more general analysis by easily explaining the concept of mean, variance, and covariance of portfolio.</td>
</tr>
<tr>
<td>• He introduced the ‘Model of Covariance’, which is similar to today single index model to use in analyzing the portfolio that consists of many different assets.</td>
</tr>
<tr>
<td>• Markowitz illustrated the ‘Law of Average Covariance’ that if the returns are uncorrelated, the portfolio risk will approach zero and the diversification will increase because when the number of stocks increase, the variance of portfolio will approach the average covariance.</td>
</tr>
</tbody>
</table>
| 9. Hicks, J.R.          | • Hicks (1962) titled the pure theory of portfolio investment similar to Tobin but he presented the portfolio variance written in terms of correlation rather than in terms of covariance.  
|------------------------|----------------------------------------------------------------------------------|
| 10. Shape, William F.  | • Sharp (1964) explained a portfolio model with n risky securities and one risk-free security, which is similar to Tobin but he proposed the different assumption.  
|                        | • He focused on capital asset rather than monetary asset.  
                           | • Sharp came up with the CAPM equilibrium that the expected return of a security is linearly related to its beta. |
| 11. Wagner, Wayne H.,  | • Wagner and Lau (1971) conducted the empirical study to show the diversification effect on risk by using the stocks that were listed on New York Stock Exchange during June 1960-1970 to construct six portfolios that divided by their own quality class.  
|                        | • From the study, the researchers found that the higher the quality rating of the portfolio, the lower the beta; the average return on the portfolio increases as the quality of the individual issues declines. |
|                        | • Moreover, the researchers found that the standard deviation declines as the number of holding increases; increasing the number of holding does not, in and of itself, increase or decrease the rate of return on the portfolio; and the correlation of the portfolio to the market index rises as the number of holdings increases. |
| 12. Shape, William F. and Copper.  
|---|
| • Sharpe and Copper conducted the empirical study to test the relationship between the risk and return.  
• In order to get the portfolios with different betas they divided all New York Stock Exchange stocks during 1931 – 1967 into deciles once a year on the basis of the beta of each security.  
• To be more precise, beta at a point in time was measured using 60 months of previous data.  
• From the study, they found that there is a positive relationship between the return and beta.  |

“Security Prices, Risk, and the Maximal Gains from Diversification.”  
|---|
| • Lintner (1965) conducted the empirical study of the CAPM by the use of a time series (first pass) regression to estimate betas and the use of a cross – sectional (second pass) regression to test the relationship between risk and return of securities.  
• His empirical results seem to violate the CAPM in that the coefficient for the residual variance was generally significant, whereas the coefficient for beta was typically significant.  |

| 14. Miller, M.H. and Scholes, M.  
*Rate of Return in Relation to Risk: A Re-examination of Some Recent Findings in studies in the Theory of Capital Market.*  
Chicago: N  |
|---|
| • Miller and Scholes (1972) noted that with the market model of Douglas would create problem, if \((1 - \beta_i) R_f\) fluctuates over time and, if it is correlated with \(R_{Mu}\) a case of missing variable bias and \(\beta_i\) will be a biased estimate of true \(\beta_i\).  
• Furthermore, Miller and Scholes proved that any nonlinear between expected risk and return does not lead to the increase in intercept and decrease in slope effect of biasing the intercept of the second-pass  |

75

regression upward and its slope downward and this could, in part, explain the inconsistencies found by Lintner and Douglas.

- Moreover, Miller and Scholes proved that any nonlinear does not lead to the increase in intercept and decrease in slope.

|---|
| • Fama and Mac Beth (1973) conducted the empirical tested the CAPM through the SML. They formed 20 portfolios of securities to estimate beta from a first-pass regression.  
  - Fama and Mac Beth employed five years of monthly data during 1930-1934 to estimate betas, and rank stocks into deciles (from highest to lowest).  
  - The researchers performed one second-pass regression for each month over the time period 1935 to 1968.  
  - From the empirical results, they concluded that neither non-linearity is SML nor residual risk has an influence on returns; that the relationship between expected return and beta is positive as well as linear and evidence the vertical intercept from the second-pass regression is generally greater than risk-free rate ($R_F$) and the slope is generally less than market risk-premium ($R_M - R_F$). |

|---|
| • Kaewsing (1992) studied the relationship between return and risk of banking securities by using the capital asset pricing model (CAPM).  
  - Data of all banking securities listed in SET for that period from January 1988 to December 1992 were collected.  
  - The result of testing the relationship between the securities return and the risk-premium by using the |
risk-premium form of CAPM was that security return has a linear relationship with risk – premium at the level of significant of 0.05.

- Additionally, the return of securities in banking sector has the same direction with the return on the market at the confidence coefficient of 99 percent.


- Sharp (1995) explained the concept of market and non-market risk by referring to his previous study that the non-market risk of a portfolio depends to a considerable extent on its diversification and two portfolios with comparable "diversification" will be likely to have comparable amounts of non-market risk.

- He also reviewed the concept of diversification that the more securities in the portfolio, the greater chance for the good fortune will balance off the bad fortune.


- Sompong studied the risk and return of finance securities on the basis of the Capital Asset pricing Model.

- This study could not be concluded that securities in the financial sector were consistent with the CAPM theory.

- Moreover, the $R^2$ of securities were very low implying that risk-premium was not a good variable to explain the expected return of security.

- Finally, the finding showed that the beta coefficients, standard deviation and the expected return of securities changed over time.
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>“Visualizing Risk and Correlation.”</td>
</tr>
</tbody>
</table>

- Putnam (1999) focused on using the simple representation to explain the concept of risk and correlation of the portfolio.
- Putnam used the standard deviation to measure risk and represented it by the length of line then he concluded that the longer the line, the greater the risk, in terms of a higher standard deviation of expected return.
- Moreover, he explained that the lower the correlation between the stocks in the portfolio, the greater the diversification benefit.

<table>
<thead>
<tr>
<th>20. Olsoo, Russell L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Power of Diversification.”</td>
</tr>
</tbody>
</table>

- Olsoo (2001) explained the concept of diversification by taking the pension as his case.
- Olsoo explained the concept of expected return, expected risk and expected correlation of securities then he noted that the lower the correlation among asset classes, the better for the pension fund.
- Olsoo also noted that some of the asset classes that are expected to be highly uncorrelated would become more closely correlated over time and vice versa.

<table>
<thead>
<tr>
<th>21. Vassal, Vladimir De.</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Risk Diversification Benefits of Multiple-Stock Portfolios.”</td>
</tr>
</tbody>
</table>

- Vassal (2001) analyzed the risk of the portfolios with different levels of holdings by using the Monte Carlo technique to simulate total return of equity portfolio and the universe is based on the original constituents of the Russell 1000 at year-end 1992 through 1999.
- Then Vassal concluded that if an individual investor had randomly bought one stock at the end of year 1992, there was a one-in-six chance that the equity investment would have lost value by year-end 1999, while the Russell 1000 was more than tripling in value.
- Vassal suggested that the conservative investors should own minimum 50 stocks if they want less than a 40% probability of under performing the market and less risk-averse investor should hold 15 stocks.
3.2 Related Theory

The preceding summaries of studies on portfolio theory in order to pursue the objectives of the present study and to carry out and empirical test of diversification effects on risk and return, based on specific hypotheses, specified in chapter 1, it will now be necessary that a proper theoretical foundation is developed. In the following sections of the chapter, the concepts of the portfolio theory, capital market line (CML) and the capital asset pricing model (CAPM) would be introduced. This chapter is divided into five sections. The first section presents the modern portfolio theory, which is a method for identifying the investor’s optimal portfolio. The second section deals with the capital market line (CML). The third section focuses on the capital asset pricing model (CAPM) of the general equilibrium relationship for asset return which was pioneered and developed by Sharpe\textsuperscript{24}, Lintner\textsuperscript{25} and Mossin\textsuperscript{26}. The fourth section involves the security market line (SML). Finally, the application of the capital asset pricing model is discussed.

3.2.1 Portfolio Theory

Portfolio theory has been developed by Harry M. Markowitz\textsuperscript{27} in 1952. It hypothesizes a rational investor forms a portfolio of securities to maximize the expected return for a given level of risk and to minimize risk for a given level of expected return. The theory is concerned with a construction of investment portfolio. In order to achieve an optimum portfolio by using indifference curve, an investor would evaluate alternative portfolios on the basis of their expected returns and risks.

Markowitz demonstrated that the opportunity set under uncertainty must be characterized by summary measures form a probability distribution of return. Two important summary measures of a return distribution are the expected return, or mean—a measure of a central tendency, and the variance— a measure of the tendency

\textsuperscript{27} Markowitz, Harry M. “Portfolio Selection.” Journal of Finance 7, No.1 (March 1952): 77-91.

of asset returns to deviate from the expected value. The security's expected return value is a weighted average of probabilities and the related returns. Measures of the dispersion taking the form of variance or standard deviation serve as a proxy for security risk.28

Based on these measures and securities weights, the risk and return of the portfolio can be calculated. The portfolio expected return is the weighted average of the component securities' expected returns. The calculation of portfolio variance must take into account the correlation coefficient between the returns of pairs of assets included into the portfolio. The correlation coefficient ranges from −1 to +1. One of the tenet's of the Markowitz portfolio theory is that the risk of the portfolio is commonly less than the risk of any of the component securities, provided the returns of these component securities are not perfectly positively correlated.29 This constitutes risk reduction properties of diversification.

Before moving into the mathematics of why diversification works, it is a good time to point out two concepts that can be seen in the results of naïve diversification or random diversification through the purchase of a large number of securities without regard to the firm size, industry classification, expected return or standard deviations of potential returns.

1. Some risk cannot be eliminated by diversification. There is an underlying volatility of returns that is systematic to all risky securities. Diversification cannot eliminate this systematic risk. It can only eliminate return uncertainties that are unique to individual securities-unsystematic risk.

2. Individual securities have differing amounts of this non-diversifiable, systematic risk. Systematic risk is often referred to as market risk or non-diversifiable risk-uncertainties about returns that affect all securities. It is created by the sensitivity of a security's return to broad economic forces such as inflation, economic growth, changes in interest rates, and world political conditions.

29 ibid., p. 36.
Systematic risk is commonly measured by beta. But unsystematic risk or firm-unique risk is the uncertainties about returns on one firm that can be offset by holding securities of other firms in the portfolio. For example, a labor strike at one firm might reduce its profits but lead to higher profits at other firms. Figure 3.1 displays the results when a naïve diversification strategy is applied to stocks contained in the S&P 500.

**Figure 3.1 Risk and Naïve Diversification Using Real S&P 500 Returns**

![Graph showing risk and diversification](image)


The horizontal axis shows the number of stocks in the randomly selected portfolio, and the vertical axis shows the average standard deviation (of annualized return) that results from a portfolio of a given size. When only one stock is held, the portfolio standard deviation is identical to the standard deviation of the average stock. However, as additional stocks are held, the standard deviation of the portfolio falls substantially. Reductions in portfolio risk caused by adding the first few stocks to the portfolio are dramatic, whereas the marginal risk reduction of adding a new stock to a larger portfolio appears to be small. Although the marginal reduction in risk decreases as the portfolio size increases, adding on more stock to any portfolio will (on average) continue to reduce the portfolio the portfolio risk.
In Markowitz portfolio theory examines how the portfolio return and its risk responds to various degrees of correlation between the returns of the assets in the portfolio to assess the effectiveness of diversification on portfolio risk. Consider a two-security portfolio, the expected portfolio return, \( E(r_p) \), is:

\[
E(r_p) = w_1 E(r_1) + (1-w_1) E(r_2) \quad (3.2.1)
\]

Where: \( w_1 \) and \( w_2 \) are the percentage of the portfolio invested in securities 1 and 2, respectively,

\[
E(r_1) \text{ and } E(r_2) = \quad \text{the expected return of the two securities.}
\]

The portfolio variance takes into account not only the component security return variances but also covariance terms, which provide a measure of interaction between the securities in the portfolio. The variance of a two-security portfolio, \( \sigma_p^2 \), is:

\[
\sigma_p^2 = w_1^2 \sigma_1^2 + (1-w_1)^2 \sigma_2^2 + 2w_1(1-w_1)\rho_{12}\sigma_1\sigma_2 \quad (3.2.2)
\]

where:

\[
\sigma_1^2, \sigma_2^2 = \quad \text{the variance of securities 1 and 2,}
\]

\[
\sigma_1, \sigma_2 = \quad \text{the standard deviation of securities 1 and 2,}
\]

\[
\rho_{12} = \quad \text{the correlation coefficient between the return of the two securities.}
\]

The \( \rho_{12}\sigma_1\sigma_2 \) term in Equation (3.2.2) is known as the covariance between stock 1 and 2. Notice that it is determined in part by the correlation coefficient. The maximum that two securities can be correlated is +1.0 (perfect positive correlation) and the minimum is -1.0 (perfect negative correlation). Portfolio variance and standard deviation are the greatest where \( r = +1.0 \), the portfolio standard deviation is a weighted average of the individual security standard deviations. Real securities, however, rarely have returns that are perfectly correlated. Whenever the correlation coefficient is less than +1.0, the portfolio standard deviation is less than the weighted average of the security standard deviation. Individual security risks are offsetting. The three panels in Figure 3.2 illustrate various degrees of correlation.
Figure 3.2 Illustrations of Various Correlation Coefficients

In panel A, returns on stocks i and j always move in the same direction. Stock is twice as volatile as stock j and thus has the larger standard deviation. Nonetheless, return on stocks are perfectly correlated, \( r = +1.0 \). In panel B, a relationship between the returns on i and j doesn’t exist. Returns on each are totally uncorrected, \( r = 0.0 \). In panel C, the returns consistently move counter to each other. They are perfectly inversely correlated, \( r = -1.0 \). Hence, holding only two assets, if their returns are perfectly negatively correlated can eliminate the portfolio risk. However, that risk can theoretically be eliminated if security return’s correlations are equal to zero. Like a

-1.0 correlation, this is not the case for most stocks. Returns on actual stocks typically have correlation coefficients between 0.3 and 0.5.

At the core of the Markowitz portfolio theory lies the fundamental principle of minimum-variance portfolio (MVP).\textsuperscript{30} By addressing the return and risk combination for securities with various degrees of correlation, the Markowitz theory identifies portfolio weights that minimize the risk of a two-security portfolio; that is, the combination of \( w_1 \) and \( (1 - w_1) \) produces the minimum – variance portfolio which is obtained as follows.

First, the objective of MVP is to minimize the portfolio variance or to minimize the standard deviation. To accomplish this task, the derivative of the variance with respect to the weight of security 1 is taken, and the result is set to zero.\textsuperscript{31}

\[
\frac{d\sigma_p^2}{dw_1} = 2w_1^2\sigma_1^2 - 2\sigma_1^2 + 2w_1\sigma_2^2 + 2\rho_{12} \rho_1 \sigma_1 \sigma_2 = 0
\]

Solving for the weights of security 1 yields:

\[
w_1 = \frac{w_1(\sigma_1^2 + \sigma_2^2 + 2\rho_{12} \rho_1 \sigma_1 \sigma_2) - \rho_{12} \sigma_1 \sigma_2 - \sigma_2^2}{0}
\]

or,

\[
w_1 = \frac{\sigma_2^2 - 2\rho_{12} \rho_1 \sigma_1 \sigma_2}{\sigma_1^2 + \sigma_2^2 - 2\rho_{12} \rho_1 \sigma_1 \sigma_2} \quad (3.2.3)
\]

and,

\[
w_2 = 1 - w_1 \quad (3.2.4)
\]

The Markowitz theory based on minimum – variance portfolio has demonstrated that diversification gains effectiveness as the correlation between securities decreased, and in fact, the decision rule for evaluating risky investment alternatives is the mean – variance rule, or the E-V rule.\textsuperscript{32} The E-V rule states that portfolio A is preferred to or dominate to portfolio B if

\textsuperscript{30} ibid., p. 47.
\textsuperscript{31} ibid., p. 49.
\textsuperscript{32} ibid., p.49.
1. The expected return of portfolio A is greater than or equal to the expected return of portfolio B, and the variance of A is less than the variance for portfolio B, or

2. The expected return of portfolio A is greater than the expected return of B, and the variance of portfolio A is less than or equal to the variance of B.

In other words, investors who decide to invest in any portfolio would choose his or her optimal portfolio from the set of portfolio that offers a maximum expected return for given levels of risk, and offers a minimum risk for given levels of expected return. The set of portfolios meeting these two conditions is known as "the efficient set or the efficient frontier (EF)" as shown in Figure 3.3. By applying the efficient set theorem to this feasible set, the efficient frontier could be constructed if two following conditions are satisfied. First, the set of portfolios that meets the first condition of the efficient set theorem must be identified. Looking at Figure 3.3, there is no portfolio offering more risk than that of portfolio F so it provides highest expected return. Thus, the set of portfolio offering maximum expected return for a given level of risk is the set of portfolios lying on the "northern" boundary of the feasible set between point E and F.

For the second condition, it would see that, there are not any portfolios offering an expected return greater than portfolio F. Similarly, there are not any portfolios offering a lower expected return than portfolio E. Therefore, the set of portfolios offering minimum risk for varying level of expected return is the set of portfolio lying on the "western" boundary of the feasible set between points E and F. The portfolios that lie on the north-west boundary between point E and F are able to meet the two said conditions of efficient frontier. These portfolios clearly form the efficient set-the set of efficient portfolios that the investors could identify their optimal portfolio by moving to the position where their indifferent curves are just tangent to the efficient frontier. Portfolio F on indifference curve Io in Figure 3.3, as a tangency point. Accordingly, the optimum portfolio of each investor depends on his indifference curve.

For a portfolio that consists of various securities, it seems logical that the expected return and risk of a portfolio should depend on the expected return and risk of each security contained in it.\(^{34}\) The expected return of a portfolio is a weighted average of its component securities. The relative market values of securities in the portfolio are used. For a portfolio consisting of \(n\) securities, the expected return could be defined as follows:\(^{35}\)

\[
\bar{r}_p = \sum_{i=1}^{n} X_i \bar{r}_i
\]  

(3.2.5)

Where:

\(\bar{r}_p\) = the expected return of the portfolio,

\(X_i\) = the proportion of the portfolio’s initial value invested in security \(i\),


\(^{35}\) ibid., p. 175-176.
\[ r_i = \text{the expected return of security } i, \]
\[ n = \text{the number of securities in the portfolio.} \]

The measure of risk should somehow estimate the extent to which the actual return is likely to diverge from the expected outcome. Statistically, the measure of risk would be represented by a standard deviation of a portfolio. The standard deviation for a portfolio consisting of \( n \) securities could be calculated as follows:\(^{36}\)

\[ \sigma_p = \sqrt{\sum_{i=1}^{N} x_i^2 \sigma_i^2 + 2 \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} x_i x_j \sigma_{ij}} \quad (3.2.6) \]

where:

\[ \sigma_p = \text{standard deviation of a portfolio,} \]
\[ \sigma_{ij} = \text{covariance of return between security } i \text{ and security } j, \]
\[ x_i, x_j = \text{the proportion of the portfolio's initial value invested in security } i \text{ and } j, \text{ respectively.} \]

### 3.2.2 Capital Market Line: CML

Now the efficient frontier is identified, the role of a capital market can be analyzed. When a capital market is introduced, investors are able to borrow and lend funds at a risk-free rate of interest. The risk-free asset\(^{37}\) is defined as one that has a known return with zero standard deviation or the assets issued with a rate of certainty, no risk of default. With the introduction of risk-free asset, a rational investor is able to combine a risk-free asset with a portfolio of risky assets. This is accomplished by lending or borrowing a risk-free rate, which results in a new opportunity line. Thus, the introduction of a capital market which allows the possibility of borrowing and lending funds alters the efficient opportunity to a new straight line, not a curvature EF, drawn from the risk-free rate \( R_F \) to the risk-expected return space and this line is tangent to the original efficient frontier EF. This line is called the Capital Market Line.

---

\(^{36}\) Ibid., p. 179.

(CML). It is shown in Figure 3.4 as line $R_fZ$. The capital market line is constructed by the fact that the risk-free asset is important in the sense that risk-free rate has zero variance and zero covariance with all other risky assets. The risk-free rate plays a crucial role in determining the shape of the new efficient set reflected by the CML and the risk-free asset has an effect on the investor’s selection of optimum or equilibrium portfolio.

Assuming risk aversion, each investor holds a portfolio along the new efficient frontier. This means that the optimal portfolio locates at the tangency point between indifferent curve and the capital market line shown in Figure 3.4. For a given investor, the optimum portfolio locates at the tangency between his indifference curve and the capital market line shown in Figure 3.4. But for a diverse group of investors, their utility curves differ, and each may prefer a different optimal point along the capital market line.

Given the possibility of investing in the risk-free asset, investors can create a new portfolio that combines the risk-free asset with a portfolio of risky assets. This enables them to achieve the combinations of risk and return that lie along the straight line connecting $R_f$ with $M$, the point of tangency between that straight line and the Markowitz’s efficient frontier. All portfolios on the line $R_fMZ$ are preferred to the other risky portfolios on the efficient frontier ENMF, so the points on the line $R_fMZ$ now represent the best attainable combination of risk and return; thus, the efficient frontier is now changed from ENMF to $R_fMZ$.

Under the assumption that funds may be either borrowed or lent of a risk-free interest rate, the capital market line can be divided into two segments. Portfolios on the line segment $R_fM$ are lending portfolios, which is a combination of a risk-free asset with a portfolio of risky assets. Portfolio of the segment $MZ$ indicates that investors are borrowing at the risk-free rate and use proceeds from borrowed money to invest in risky assets. The tangency point $M$ represents the most efficient portfolio

---

because every rational investor must include part of portfolio at M into his or her portfolio. This tangency portfolio provides for the highest expected return for a given risk level.\textsuperscript{40} This implies that by borrowing and lending at the risk-free rate, $R_f$, investors can alter the risk and expected return profile of any efficient portfolio to meet personal preferences for the risk and expected return.\textsuperscript{41} However, as Figure 3.4 illustrates, regardless of whether investors want to borrow or lend, the portfolio M is the most efficient portfolio.\textsuperscript{42} This is because investors can invest in portfolio M and then borrow or lend at $R_f$ to suit their preferences. This means by borrowing and lending at $R_f$ in conjunction with investing in portfolio M, they are able to create portfolio combinations along the line RMZ, which dominate portfolio along other lines.

\textbf{Figure 3.4 Investment Equilibrium: Combining the Risk-Free Assets with the Market Portfolio}

\begin{center}
\includegraphics[width=0.8\textwidth]{figure3.4.png}
\end{center}


\textsuperscript{40} ibid., p. 265.
\textsuperscript{41} ibid., p. 246.
\textsuperscript{42} ibid., p. 246.
In this connection it will be appropriate to derive the new efficient frontier characterized by the capital market line. The equation for the capital market line can be derived as follows:

A portfolio is composed of a fraction $X$ of funds that the investor places in a risky portfolio $M$ and a fraction $(1-X)$ of funds that are placed in a risk-free asset. The expected return on the combination of the risk-free asset and risky portfolio is given by:

$$E(R_p) = (1-X)R_f + XR_m$$  \hspace{1cm} (3.2.7)

The risk on the combination is:

$$\sigma_p = \left((1-X)^2 \sigma_{RF}^2 + X^2 \sigma_m^2 + 2X(1-X)\sigma_{RF} \sigma_{RF,m}\right)^{1/2}$$  \hspace{1cm} (3.2.8)

By virtue of its feature, the variance of risk-free asset ($\sigma_{RF}$) is zero and its covariance with the market portfolio is also zero.

$$\sigma_p^2 = X^2 \sigma_m^2$$  \hspace{1cm} (3.2.9)

$$\sigma_p = (X^2 \sigma_m^2)^{1/2}$$  \hspace{1cm} (3.2.10)

$$\sigma_p = X \sigma_m$$  \hspace{1cm} (3.2.11)

By Substituting $X$ into the equation (3.2.7), the equation (3.2.12) is obtained as:

$$E(R_p) = (1 - \sigma_p / \sigma_m) R_f + \left(\sigma_p / \sigma_m\right) R_m$$  \hspace{1cm} (3.2.12)

Rearranging terms

$$E(R_p) = R_f + (R_m - R_f) \left(\sigma_p / \sigma_m\right)$$  \hspace{1cm} (3.2.13)

---

\(^{43}\) Fabozzi, Frank J. *op.cit.*: 85-86.
The equation (3.2.13) is the capital market line. It states that the expected rate of return on any efficient portfolios is equal to the risk-free rate plus a market risk premium, which is equal to \((R_m - R_f) / \sigma_m\) multiplied by the portfolio’s standard derivation, \(\sigma_p\). Thus, the CML specifies a linear relationship between portfolio expected return and portfolio risk, and its slope equal to the expected return on the portfolio of risky assets, \(R_m\), minus the risk-free, all divided by the standard deviation of returns on the market portfolio.

It should emphatically be noted that the capital market line provides a risk-return relationship for efficient portfolios, which are plotted on an efficient opportunity line. In particular, the appropriate measure of risk for an efficient portfolio is the standard deviation of the portfolio. It also indicates that there will be a linear relationship between portfolio risk as measured by the standard deviation and expected return for the efficient portfolios.

However, the foregoing discussion above focuses exclusively on the efficient portfolio lying on the capital market line, and fail to take into account the risk and expected return on individual securities and inefficient portfolios. In this connection, it will be proper to indicate the relevant risk for an individual security or an efficient portfolio. In fact William Sharpe who has formulated the single index model has taken up this issue. He tried to simplify the model. Instead of lying on considerable covariance of each pair of stocks, the stock return is regressed against the market index. Here, the single index model, which is developed by Sharpe (1963) is presented as follows:

\[
R_i = \alpha_i + \beta_i R_m + \epsilon_i
\]  

\[\text{(3.2.14)}\]

---

44 Elton, Edwin J.and Gruber, Martin J. op.cit.: 265.
Where: \( R_{it} \) = the return on asset as a given period,

\( R_{m} \) = the return onboard-based market index at the same period,

\( \alpha_{i} + \beta_{i} \) = the parameters for asset \( i \) which best describe the linear relationship between \( R_{i} \) and \( R_{m} \)

\( e_{i} \) = random error terms for asset.

This simple linear regression model determines the parameters \( \alpha_{i} \) and \( \beta_{i} \) so that the risk of individual securities can be estimated using the basic regression analysis. And in regression analysis, the parameters \( \alpha_{i} \) and \( \beta_{i} \) are determined by the method of least squares, which requires that \( e_{it} \) will have the following properties:\(^{47}\)

The random-error term is uncorrected with the market index:

\[
\text{COV} \left( e_{i}, R_{m} \right) = 0. 
\]

The random-error term is not serially correlated overtime:

\[
\text{COV} \left( e_{i}, e_{i+n} \right) = 0. 
\]

The random-error term for asset \( j \) is not correlated with any other project’s random error term:

\[
\text{COV} \left( e_{i}, e_{j} \right) = 0. 
\]

Expected value of \( e_{i} \) is constant. Thus, the expected value and the variance of equation (3.2.14) is\(^{48}\)

\[
E \left( R_{i} \right) = \alpha_{i} + \beta_{i} \left( E \left( R_{m} \right) \right) \quad (3.2.15)
\]

---


\[ \text{Var} \left( R_i \right) = \text{Var} \left( \alpha_i + \beta_i \left( R_m \right) + e_i \right) \]
\[ = \text{Var} \left( \alpha_i \right) + \text{Var} \left( \beta_i \left( R_m \right) \right) + \text{Var} \left( e_i \right) \]
\[ \text{Var}(R_i) = \beta_i^2 \sigma_m^2 + \sigma_i^2 \]

Where \( \sigma_m^2 \) and \( \sigma_i^2 \) are, respectively, the variance on the market index and variance on the random-error term.\(^{49}\)

The variance of the return on asset \( j \) can be attributed to two distinct types of risk:

1. The risk associated with asset \( i \)'s response to the market index multiplied by the variability in the market index itself: \( \sigma_{i,m} / \sigma_m^2 \). This risk is called systematic risk.\(^{50}\) It cannot be diversified away since it results from general market and economic conditions such as inflation, recession, and changes in interest rate.

2. The risk associated with the random-error term of asset \( i \) is known as unsystematic risk.\(^{51}\) This is the risk that is unique to a company such as strike, the outcome of unfavorable litigation or a natural catastrophe. It can be diversified away through the selection of other risky assets which are relatively negatively correlated with the asset in question. Therefore,

\[ \text{Total risk} = \text{systematic risk} + \text{unsystematic risk} \]

The implication of single index model is that the relevant risk for any individual asset is its contribution to market portfolio measured by beta. The next related question is: given the systematic risk as measured by beta what the relevant expected return on an individual asset would be. The answer to this question raised on financial theory known as the capital asset pricing model will be discussed in the next section.

\(^{49}\) Shape, William F., Alexander, Gordon J. and Bailey, Jefferey V. op.cit.: 274-275.

\(^{50}\) ibid., p. 278.

\(^{51}\) ibid., p. 278.

\(^{52}\) ibid., p. 278.
3.2.3 Capital Asset Pricing Model: CAPM

As a conceptual aspect of general equilibrium, the capital asset pricing model attempts to determine how the investors in aggregate make decisions within the risk and the expected return. The capital asset pricing model has been developed by Sharpe (1964), Lintner (1965) and Mossin (1967) laid the basis for the capital asset pricing model (CAPM) as a model of general equilibrium in the market. The CAPM provides explicit implications with respect to (1) the behavior of security price, (2) the sort of risk-return relationship that one would expect, and (3) the appropriate measure of risk for securities. The CAPM has, in turn, a wide-ranging impact on such areas of the investment profession as security valuation, risk analysis and performance measurement.

The assumptions underlying the capital asset pricing model are as follows:

1. Investors evaluate portfolios by looking at the expected return and standard deviation of the portfolios over a one-period horizon.

2. Investors are never satiated, so when given a choice between two otherwise identical portfolios, they will choose the one with the higher expected return given risk level.

3. Investors are risk-averse, so when given a choice between two otherwise identical portfolios, they will choose the one with lower standard deviation given the expected return.

4. Individual assets are infinitely divisible, meaning that an investor can buy a fraction of a share if he or she so desires.

---


5. There is a risk-free rate at which investors can lend or borrow money.

6. Taxes and transaction costs are not considered.

7. Information is freely and instantly available to all investors.

8. Investors have homogeneous expectation, meaning that they have the same perceptions in regard to the expected returns, standard deviations, and covariance’s of securities.

9. The capital market is in equilibrium and all investors are price takers implying that no single investor can influence stock price.

Using calculus can perform the derivation of the capital market line. From the foregoing discussion about the capital market line, the efficient investment must on the efficient opportunity line RMZ in Figure 3.4. The capital market line provides a risk-return relationship for efficient portfolios, which are plotted on an efficient opportunity line. This is illustrated as Figure 3.5.

According to Figure 3.5, consider any portfolio denoted by p, that consists of the proportion $X_i$ invested in security i and the proportion $(1-X)$ invested in the market portfolio M. Such a portfolio will have an expected return equal to:

$$
\overline{R_p} = X_i \overline{R_i} + (1-X_i) \overline{R_M}
$$

(3.2.17)

And a standard deviation equal to:

$$
\sigma_p^2 = [X_i^2 \sigma_i^2 + (1-X_i)^2 \sigma_M^2 + 2 X_i (1-X_i) \sigma_M \sigma_i]^{1/2}
$$

(3.2.18)

All such portfolios will lie on a curved line connecting i and M. The depiction will show as followed:

---

56 Shape, William F. and Alexander, Gordon J. op. cit.: 287-289.
Figure 3.5 Derivation of the Security Market Line

\[ R_p \]
\[ R_t \]
\[ \sigma_p \]

The slope of this curved line is of relevant interest. Since it is a curved line, its slope is not a constant. However, its slope can be determined with the use of calculus. First, taking the derivative of \( \overline{R}_p \) with respect to \( X_i \) we get:

\[
\frac{d\overline{R}_p}{dX_i} = \frac{\overline{R}_t - \overline{R}_M}{X_i} \tag{3.2.19}
\]

Second, using equation (3.2.18), the derivative of \( \sigma_p \) with respect to \( X_i \) is considered:

\[
\frac{d\sigma_p}{dX_i} = \frac{X_i^2 \sigma_i^2 - \sigma_M^2 + X_i \sigma_M \sigma_i + 2X_i \sigma_i \sigma_M}{[X_i^2 \sigma_i^2 + (1-X_i)^2 \sigma_M^2 + 2X_i (1-X_i) \sigma_M \sigma_i]^{\frac{3}{2}}} \tag{3.2.20}
\]

Third, noted that the slope of the curved line \( \overline{iM} \), \( \frac{d\overline{R}_p}{d\sigma_p} \) can be written as:

\[
\frac{d\overline{R}_p}{d\sigma_p} = \frac{d\overline{R}_p}{dX_i} \tag{3.2.21}
\]
This means that the slope of \( iM \) can be calculated by substituting equations (3.2.19) and (3.2.20) into the numerator and denominator of equation (3.2.21), respectively:

\[
\frac{\bar{dR}_p}{\bar{d}\sigma_p} = \frac{(R_i - R_M) [X_i^2 \sigma_i^2 + (1-X_i)^2 \sigma_M^2 + 2X_i (1-X_i)\sigma_{iM}]}{X_i^2 \sigma_i^2 - \sigma_M^2 + X_i \sigma_M^2 + \sigma_{iM} + 2X_i \sigma_{iM}} \tag{3.2.22}
\]

The slope of the curved line \( iM \) at the endpoint \( M \) is of interest. Because the proportion \( X_i \) is zero at this point, the slope of \( iM \) can be calculated by substituting zero for \( X_i \) in equation (3.2.22). After doing so, many terms are dropped out, hence:

\[
\frac{\bar{dR}_p}{\bar{d}\sigma_p} = \frac{\bar{R}_M - \bar{R}_f}{\sigma_{iM}} \tag{3.2.23}
\]

At point \( M \) the slope of the CML, \( (R_m - R_f) / \sigma_m \) must be equal to the slope of the curved line \( iM \). This is because the slope of the curved line \( iM \) increases when moving from the endpoint \( i \), converging with the slope of the CML at the endpoint \( M \). Accordingly, the slope of the curved line \( iM \) at \( M \), as shown on the right hand side of equation (3.2.23), is set equal to the slope of the CML:

\[
\frac{\bar{R}_M - \bar{R}_f}{\sigma_{iM}} = \frac{\bar{R}_m - \bar{R}_f}{\sigma_m} \tag{3.2.24}
\]

Solving equation (3.2.24) for \( \bar{R}_m \), results in the covariance version of the SML:

\[
\bar{R}_i = \bar{R}_f + \frac{\bar{R}_m - \bar{R}_f}{\sigma_{iM}} \tag{3.2.25}
\]

The beta version of the SML is derived by substituting \( \beta_{iM} \), for \( \sigma_{iM} / \sigma_M^2 \) in equation (3.2.24) resulting in the equation (3.2.25):

\[
\bar{R}_i = \bar{R}_f + [\bar{R}_m - \bar{R}_f] \beta_{iM} \tag{3.2.26}
\]
The final equation (3.2.26) states that the expected rate of return on any individual asset or an inefficient portfolio lying below the CML is equal to the risk-free rate plus the market-risk premium \((R_m - R_f)\) multiplied by its beta coefficient. According to the capital asset pricing model, the beta of a stock measures the stock’s contribution to the variance of the market portfolio as a fraction of total portfolio variance. Hence, for any asset or inefficient portfolio the required risk premium is a function of beta. According to the capital asset pricing model starting further that the security’s risk premium is directly proportional to both the beta and the risk premium of the market portfolio and it is equal to \(\beta (R_m - R_f)\). If we plot the expected return on any stock against its beta (systematic market risk), we would obtain the security market line. Therefore, the security market line exhibits the expected return and beta relationship for any security or portfolio.

### 3.2.4 Security Market Line (SML)

While the capital market line (CML) shows the appropriate measure of risk and the risk-return relationship for efficient portfolio, it does not indicate the risk-return trade-off for other portfolio and individual securities. This because these portfolios and securities are inefficient as illustrated by the fact that they are plotted below the CML. Correspondingly, the standard deviation of return is not an appropriate measure of risk of inefficient portfolios and individual securities.\(^{57}\) There is a component of risk in total (as measured by standard deviation) that is unnecessary: it can be diversified away and thus will not be rewarded in the market.

Risk-averse investors measure the risk of the optimal risky portfolio by its variance. It would expect the risk premium on individual assets to depend on the risk that an individual asset contributes to the portfolio.\(^{58}\) The beta of a stock that measures the stock’s contribution to the variance of the market portfolio as a fraction of the total portfolio variance. Hence, for any asset of portfolio, the required risk premium is a function of beta. The CAPM confirms this intuition, starting further that


the security's risk premium is directly proportional to both the beta and the risk premium of the market portfolio; that is, the risk premium equals $\beta (R_m - R_F)$.

The expected return-beta relationship can be portrayed graphically as the SML in Figure 3.6 and the SML equation can be derived as follows:\(^{59}\)

The equation of a straight line of SML is given as:

$$R_i = a + b\beta_i$$  \hspace{1cm} (3.2.27)

One point on the line is the risk-free asset with a zero beta.

Thus, $$R_F = a + b(0),$$

Therefore, $$R_F = a$$  \hspace{1cm} (3.2.28)

A second point on the line is the market portfolio with a beta of one.\(^{60}\)

Thus, $$R_m = a + b(1),$$

and, $$R_m - a = b$$  \hspace{1cm} (3.2.29)

Substituting equation (3.2.28) and (3.2.29) into equation (3.3.27) yields:

$$R_i = R_F + \beta_i (R_m - R_F)$$  \hspace{1cm} (3.2.30)

$$\beta_i = \frac{\text{COV}(R_i, R_m)}{\sigma_M^2}$$  

$$= \frac{\sigma_i}{\sigma_M^2}$$  \hspace{1cm} (3.2.31)

Substitute Equation (3.2.31) into Equation (3.2.30) yields the SML equation

$$R_i = R_F + (R_m - R_F) \frac{\sigma_m}{\sigma_m^2}$$  \hspace{1cm} (3.2.32)

---


\(^{60}\) $b_i = \frac{\text{COV}(r_i, r_m)}{\sigma_M^2} = \sigma_i^2 / \sigma_M^2 = 1$
where: 

\[ R_i \] = the required rate of return on the \( i \) stock, \\
\[ R_m \] = the required rate of return on a portfolio consisting of all stocks, \\
\[ \beta_i \] = the beta coefficient of the stock \( i \), \\
\[ \sigma_{im} \] = the covariance of return on security \( i \) with the market portfolio return, \\
\[ \sigma_m^2 \] = variance of market return.

The expected rate of return on each stock is equal to the risk-free rate of interest plus a risk premium, and the risk premium is equal to \( (R_m - R_f) / \sigma_m^2 \) multiplied by the covariance of security \( i \) with the market portfolio, \( \sigma_{im} \). Thus, the SML specifies a relationship between the expected return and risk with a vertical intercept of \( RF \) and a slope of \( (R_m - R_f) / \sigma_m^2 \).

Figure 3.6 The Security Market Line

3.2.5 Some Applications of the CAPM in Investment Decision

Having derived the capital asset pricing model equation, it is now in a position to apply this equation for empirical verification. In this part some applications of the CAPM in investment decision are discussed. One of the most important applications in the CAPM is that it is used to estimate the required rate of return on a security. If we know the risk-free rate, an expected market return and the appropriate systematic risk, beta value, of security, it is possible to compute the expected rate of return. Since it is assumed that the capital market is in equilibrium, it implies that the expected return on any security must be equal to its required rate of return. This means in equilibrium any security return must be plotted along the security market line given its beta value.

Thus, the security market line provides a framework for evaluating the relative attractiveness of securities. In particular, high-risk stocks are expected to offer high-expected return. The question is whether they are offering return more or less than proportional to their risk. Conversely, low-risk stocks are expected to offer lower expected return by virtue of a lower risk level. Again, the question is whether they are offering returns more or less than proportional to their risk. As a result, investors can use these as criteria for an investment decision-making on some stocks specially selected. Figure 3.7 illustrates the expected return and risk for a number of stocks and the security market line. Two selection methods to determine whether stock is undervalued fair or overvalued. First using the risk-premium version of the CAPM, the following would result.

\[ R_i - R_f = \alpha_i + (R_m - R_f) \beta_i + \epsilon_i \]

where:
- \( R_i \) = the return on asset at a given period,
- \( R_m \) = the return on broad-based market index at the same period,

---

\[ R_f = \text{the return on risk-free asset}, \]

\[ \beta_i = \text{beta parameter for asset } i, \]

\[ \alpha_i = \text{a constant term of the equation}, \]

\[ e_i = \text{random error term for asset}. \]

In this equation, the term \((R_i - R_f)\) is regressed against \((R_m - R_f)\). Alpha is used as a benchmark, that is, the stock with positive alpha is interpreted as attractive or undervalued stock while negative alpha is considered as unattractive or overvalued stock.

The other approach that is used to determine the overvaluation or undervaluation of stock return around the security market line can be adopted by using a graphical approach. The procedure starts with plotting the security market line and each security in risk-return space to determine which stock is undervalued, fair or overvalued.

**Figure 3.7 The Expected Return and Risk for a Universe of Stocks**

CHAPTER 4

RESEARCH FRAMEWORK

This chapter presents the conceptual framework that gives a map of ideas of this study. Here the research framework and related variables are explained clearly. In the first part, the conceptual framework of the study is presented. The definitions of the variables in the framework are given in the second part. The third part indicates the research hypotheses that are used to analyze the study and for the last part, the expected outcome of the study is discussed.

4.1 Conceptual Framework

This conceptual framework is based on the empirical evidence of the study conducted by Wagner and Lau (1971) in the study of the effect of diversification on risk and also on other related concepts and theories.

![Figure 4.1 Conceptual Framework]

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Rating of each Portfolio</td>
<td>Beta of Portfolio</td>
</tr>
<tr>
<td></td>
<td>Average Return of Portfolio</td>
</tr>
<tr>
<td>Number of Securities in the Portfolio</td>
<td>Average Return of Portfolio</td>
</tr>
<tr>
<td></td>
<td>Coefficient of Determination between Portfolio Return and Stock Index Return</td>
</tr>
</tbody>
</table>
Modern portfolio theory emphasizes that investors who hold portfolios of riskier stocks should expect higher returns than more conservative investors. In addition, the theory indicates that, by diversifying their portfolios, investors can reduce risk without sacrificing the expected return. Hence, this framework is created to examine the rate of return on low risk portfolio relative to the return on high-risk portfolio. Moreover, many theorists explained about the law of large number in that the more numbers of securities in the portfolio there are, the better it is for the diversification benefit. Consequently, this framework is also created to examine the effect of including large numbers of securities in the portfolio. The empirical research on the effect of diversification on risk in New York Stock Exchange conducted by Wagner and Lau (1971)\(^1\) presents the evidence that the rate of return on well diversified low risk portfolios is indeed significantly lower than the return on well diversified higher risk portfolios using their actual investment experiences. They explained that diversification could be utilized to offset the riskiness of the individual securities, so that portfolios consisting of large numbers of higher risk securities are less risky than portfolios consisting of small numbers of low risk securities, yet earning a substantially higher rate of return.

The framework of this study is defined to give a picture of the concerned portfolio, the period used, and the indexed used. In addition, the framework should be clarified as follows:

To demonstrate the effects of diversification on risk and return, fifty-four securities whose prices were quoted continuously on the SET during January 1996 through December 2001 are selected for analysis. (See Table B9 for the listed companies during the sampled period.) During the period of January 1996 through December 2001, there were three hundred and eighty two securities traded on the Stock Exchange of Thailand, so the total population is three hundred and eighty two securities. Among three hundred and eighty two securities, there are only fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS) and have a complete set of data during January 1996 through December 2001. Therefore, the sampled size is fifty-four securities.

---


104
Then this study will use these fifty-four securities to construct two types of portfolio. The first classification of portfolios involves dividing the fifty-four securities into three equal groups based on their corporate bond rating by the Thai Rating and Information Services (TRIS). Eighteen securities with class A bond rating will be grouped in portfolio A. Eighteen securities with class B bond rating will be grouped in portfolio B. Eighteen securities with class C bond rating or the securities under rehabilitation specified by Stock Exchange of Thailand will be grouped in portfolio C. Further, the second classification of the portfolio will be constructed to show the effect of the changing number of stocks in the portfolio, so eighteen stocks will be selected from class A quality stocks to create one-stock portfolio to eighteen-stock portfolio.

The period of study is during January 1996 through December 2001, which includes all types of the trading volume whether high or low. There was a high volatility in this period as the result of the changing macro economic factors as discussed in chapter two so this period would confront with the high level of the systematic risk, which is the important variable for this study because the level of systematic risk can be measured by beta and beta will be used in testing the second hypothesis. Hence, this period will be the appropriate period for conducting this empirical study. Moreover, the period of the study will be examined as a single period without subdividing into two periods because the monthly data for each three-year period (thirty six months’ data) will not be significant.

In order to yield the empirical results, the benchmarks for the study are defined. These are security return and market return. Theoretically, security return is composed of two components: capital gain and dividend yield. The monthly security returns excluding dividend are used as the security return due to the fact that average yearly stock’s dividend yield is quite low, at 2.36% for 1997-2001\(^2\) and due to the lack of available monthly dividend information. Also, most Thai stock declared ex-dividend date is at the beginning or the middle of the month, which is not the same period as the price at the end of the month that is used in this study. Therefore, this study assumes the dividend will be reinvested 100% and the relevant rate of return is the price change only.

The return on the market, which is the benchmark for the market return, is calculated from the SET index. The SET index is an acceptable index for the analysis because it is broadly based and represents the market in general. Actually, the market portfolio must include all risky assets in the economy but there is not such an index in reality. Thus, it is reasonable to use a broad market index like the SET index to compute market return.

4.2 Definition of the Variables

For better understanding of the key terms employed in this framework, these key terms will be defined as follows:

**Beta** or the slope of a security characteristic line measures the sensitivity or responsiveness of the security’s excess return to that of the market portfolio. In other word, beta ($\beta_{im}$) measures the expected change in its excess return per 1% change in the excess return on the market portfolio. In addition, it is a standardized measure of systematic risk because it relates the covariance of any asset $i$ to the market portfolio. As a result, market portfolio has a beta of 1 (Sharpe; 1981).

**Coefficient of Determination** (R-square) is the statistical method to indicate how much of one variable is associated with another variable. More specifically, the correlation of the portfolio to the market indicates how much of the variability in the return on the portfolio is associated with the variability in the market. The higher R-square, the more perfectly diversified the portfolio. The R-square equals to one would indicate the perfect correlation between two variables (Wagner and Lau; 1971).

**Listed Security** is a security that is listed for trading on the stock exchange (SET website).

---

4 Stock Exchange of Thailand Website Address: www.set.or.th
Portfolio is a list of holdings of 2 or more securities owned by an investor. The purpose of a portfolio is to reduce the owner's investment risks through diversified holding of several securities asset classes (SET website).

**Quality Rating of Portfolio** is the riskiness of each security grouped in a portfolio (Wagner and Lau; 1971).

**Quality Rating of Security** is the riskiness of a security that depends on a credit rating for that company which has been assigned by the rating committee and accepted by the issuer or the rated company to be announced publicly and published in TRIS's "Credit News" TRIS uses letter rating symbols for announcing credit rating results for long-term debt. Ratings range from AAA, the highest rating, to D, the lowest rating (TRIS website)\(^5\).

**Rate of Return** or the percentage return is the standardization of return by considering the return per unit of investment. It is the way to express the investment return without the scale and timing problems (Brigham, Gapenski, Ehrhardt; 1999)\(^6\).

**Rate of Return for the Portfolio** is the weight average of the rates of return for the individual investments in the portfolio and the weights are the proportion of the total value for each of the individual investment (Brigham, Gapenski, Ehrhardt; 1999).

**SET Index** is a composite index calculated based on stock prices on the Main Board of SET. It is a market capitalization weighted index which compares the current market value of all listed common stocks with the value on a base date of April 30, 1975, when the SET Index was first calculated and set at 100 points. Its calculation is adjusted in line with new listings, de-listings, and capitalization changes (SET website).

---

\(^5\) Thai Rating and Information Services Website Address: [www.tris.co.th](http://www.tris.co.th)

4.3 Research Hypothesis

Based on the literature and the reality of stock exchange of Thailand, statistical hypothesis is proposed. The way to test the statistical hypothesis is to check whether a given observation or finding is compatible with some stated hypothesis. If the given observation is sufficiently close to the hypothesized value, the stated hypothesis shall not be rejected. Statistically, the stated hypothesis is known as the null hypothesis, which is denoted by the symbol $H_0$. The null hypothesis is usually tested against an alternative hypothesis denoted by $H_1$. Four hypotheses are proposed based on the above-mentioned framework to test the effects of diversification on risk and return.

1. Fifty-four stocks listed in the Stock Exchange of Thailand whose prices were quoted continuously on SET during January 1996 through December 2001 are divided into three equal groups based on their corporate bond rating by Thai Rating and Information Services. Then, a regression is run between monthly return on class A portfolio (or class B portfolio or class C portfolio) and monthly return on the market index to find beta. The first hypothesis will then be drawn out as follows:

$H_0$ : There is a positive or no relationship between the quality rating of portfolio and the risk of portfolio, measured by beta. That is $\gamma_1 \geq 0$.

$H_1$ : There is a negative relationship between the quality rating of portfolio and the risk of portfolio, measured by beta. That is $\gamma_1 < 0$.

2. The average return of the stock will be found by finding the geometrical means of the percentage change in the closing stock price. The cash flow during the period, the dividend, is ignored due to the fact that the dividend's yield is quite low, at 2.36% for 1997-2001 and due to the lack of available monthly dividend information. Then average return of three portfolios that are grouped by the Thai Rating and Information Services will be found by weighting of the return on each stock in each risk class equally and then the second hypothesis is derived as:
H₀ : There is a positive or no relationship between the quality rating of each portfolio and the average return of each portfolio. That is \( \gamma_1 \geq 0 \).

H₁ : There is a negative relationship between the quality rating of each portfolio and the average return of each portfolio. That is \( \gamma_1 < 0 \).

3. The effect of the changing number of stocks held in a portfolio will be demonstrated. The portfolios under study were constructed from holding of one to eighteen stocks from class A quality stocks. The average return for the eighteen portfolios will be found and used to test the third hypothesis that is:

H₀ : There is no significant relationship between the number of issues in the portfolio and the average return of each portfolio. That is \( \rho_{R_p, N_{ump}} = 0 \).

H₁ : There is a significant relationship between the number of issues in the portfolio and the average return of each portfolio. That is \( \rho_{R_p, N_{ump}} \neq 0 \).

4. The coefficient of determination between the monthly return on one-stock portfolio (to eighteen-stock portfolio) and the monthly return on market index will be found and tested with the number of stocks in the portfolio as follows:

H₀ : There is a negative or no relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market return. That is \( \rho_{R^2, N_{ump}} \leq 0 \).

H₁ : There is a positive relationship between the numbers of stock in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market return. That is \( \rho_{R^2, N_{ump}} > 0 \).
4.4 Expected Outcome

For the first hypothesis, in which the relationship between the quality rating of the portfolio and the beta will be tested, the beta for the portfolios with different classes will be observed over a six year period. The empirical research of Wagner and Lau (1971), in which this study is based, has found that the higher the quality rating of the portfolio, the lower the beta. However, there were some minor deviations in their study to this rule caused by random sampling, or perhaps incorrect stock quality codes. The present study examines the relationship between the quality rating of the portfolio and beta by using bond quality rating by the Thai Rating and Information Services, constructing the portfolios by selecting the securities in Stock Exchange of Thailand whose prices were quoted continuously on SET during January 1996 through December 2001. The empirical result is expected to be the same as that of the previous study in that the higher the quality rating of the portfolio, the lower the beta.

Markowitz (1952)\(^7\) estimated the set of efficient means-variance combinations and presented the results to the investors for the choice of the desired risk-return combination. He used geometrical analyses of three and four security examples to illustrate properties of efficient sets and showed that the set of efficient portfolios is piecewise linear (made up of connected straight lines) and the set of efficient mean variance combinations is piecewise parabolic. Wagner and Lau (1971) also concluded that the average return of the portfolio increases as the quality of the individual issue declines. They observed the mean return of the portfolios of twenty issues in New York Stock Exchange based on the data from June 1960 – June 1970 and they saw that the rate of returns was quite steady as the quality of the individual issues declines and returns increase as additional risk was taken. In this present study, fifty-four securities whose prices were quoted continuously on SET during January 1996 through December 2001 are divided into three equal groups based on their corporate bond rating by Thai Rating and Information Services. Hence, the empirical result of the second hypothesis of this study is expected to be the same as the previous case in that the lower the quality class or the higher the risk, the higher the return the investors need to compensate.

For the third hypothesis, in which the relationship between the number of securities in the portfolio and the average return for the portfolio will be tested. Wagner and Lau (1971) found that increasing the number of holding does not, in and of itself, increase nor decrease the rate of return on the portfolio. Portfolios composed of different number of securities in the same quality class have the same level of systematic risk; even the level of unsystematic risk varies. The return of the portfolio relates only to that risk, which cannot be diversified away, i.e., the systematic risk. In this present research, portfolios are constructed for investors holding from one to eighteen securities in the same bond quality class, which have the same level of systematic risk. Therefore, increasing the number of holding should not, in and of itself, increase or decrease the rate of return on the portfolio.

In the last hypothesis, the relationship between the number of issues in the portfolio and the coefficient of determination between the monthly portfolio return the monthly market index return, measured by R-square, will be tested. R-square indicates how much variability in the returns on the portfolio is associated with the variability in the market. The higher R-square (R²), the more perfectly diversified the portfolio. Wagner and Lau found that the coefficient of determination rises as the number of holding increases. The portfolios of a small number of securities are very undiversified, whereas the portfolios of as few as fifteen to twenty securities have a strong relationship with market index. This present study is based on Wagner and Lau’s study, so the last hypothesis is expected to show that diversification is increasing quite rapidly by increasing the number of issues.
CHAPTER 5

RESEARCH METHODOLOGY

In this chapter, in the first part, the description of the data source and data collection will be given. Also, in the second section, the variables used in this study will be estimated. In the third part, the empirical testing procedure will be presented and this will be followed by the operational procedures in the forth part. Then, finally the fifth part, the methodologies, which will be applied to test four hypotheses stated in the fourth chapter will be discussed.

5.1 Data Source and Data Collection

The sample sizes are fifty-four securities whose prices were quoted continuously on SET during January 1996 through December 2001. These are selected for analysis. During the period of January 1996 through December 2001, there were three hundred and eighty two securities traded on the Stock Exchange of Thailand, so the total population is three hundred and eighty two securities. Among three hundred and eighty two securities, there are only fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS) and have a complete set of data during January 1996 through December 2001. Hence, the sample size is fifty-four securities.

The period of study is during January 1996 through December 2001, which includes all types of the trading volume whether high or low. There was a high volatility in this period as the result of changing macro economic factors as discussed in chapter two so this period would confront with the high level of the systematic risk, which is the important variable for this study because the level of systematic risk can be measured by beta and beta will be used in testing the second hypothesis. Hence, this period will be the appropriate period for conducting this empirical study. Moreover, the period of the study will be examined as a single period without subdividing into two periods because the monthly data for each three years’ period (thirty six months’ data) will not be significant.

112
The data used in this study are time series of monthly closing prices on the Stock Exchange of Thailand (SET) index and fifty-four stocks during January 1996-December 2001. The source of the closing SET index and the closing listed stock prices derived from the research department of the SET in the form of CD-ROMS during the period of January 1996 through December 2001.

5.2 The Variable Estimation

This section involves with the way to estimate the beta for the stock and portfolio. The method to calculate the monthly return of the market, security and the risk-free asset will be shown. In addition, the formula used to find the correlation of the portfolio to the market index will be explained here.

5.2.1 Beta Estimation

From the theoretical framework developed in the fourth chapter, the CAPM risk-return as described by the security market line (SML) equation is expected or the ex-ante relationship, while the beta that it refers to is derived from the expected covariance and variances of the return. That is, the relationship is forward rather than backward looking and should embody investors’ expectations.¹ To test CAPM, one would like to have data on expected return and expected beta value for the individual securities or the portfolio of securities. Expectations, however, are difficult to observe, especially with respect to the risk attributes of securities. Consequently, in using the CAPM equation as a way to find the beta, this present study relies on realized or historical data as inputs. The critical assumption here is that ex post returns and ex-post betas will, on average, approximate investors’ expectations regarding risk and return. The equation for the CAPM risk-return relationship² is:

\[ R_i = R_f + (R_m - R_f) \beta_i + \epsilon_i \]  

(5.1)

Where the risk-free rate $R_f$ becomes analogous to the intercept term, while the market model $\beta_i$ stands for the CAPM beta. The term $(R_m - R_f)$ is defined as the market risk premium and the term $e_i$ is denoted as the error term. The excess return on the market is expressed in the risk premium form $(R_m - R_f)$, whereas $(R_m - R_f) \beta_i$ is regarded as the risk premium for the individual stock. Thus, the term $(R_m - R_f)$ is common to all securities, the difference with respects to the risk on the individual stock must come from beta, $\beta_i$.

For individual asset, beta is estimated using a time-series of the return on the assets and return of the market portfolio. The statistical technique used is regression analysis, which estimates the relationship between two variables. Thus, beta is estimated using the market model that is developed by Sharpe (1964) as follows:

$$R_i = \alpha_i + \beta_i (R_m) + e_i \quad (5.2)$$

Where:

- $R_i$ = the expected return on asset for a given period;
- $R_m$ = the expected return on the broad-based market index at the same period;
- $\alpha_i, \beta_i$ = the parameters for the asset $i$ which best describe the linear relationship between the return $R_i$ and $R_m$;
- $e_i$ = random error term for the asset.

This equation is popularly referred to the characteristic line of the security. By applying a least square method, one can obtain beta value for individual security. In addition, for a group of asset, beta is estimated by using a time-series of the return on the security portfolio and return of the market portfolio. The statistical technique used

---

is regression analysis, which estimates the relationship between two variables. Thus, beta is estimated by using the market model that is developed by Sharpe (1964) as follows:

\[ R_p = \alpha_p + \beta_p (R_m) + e_p \]  \hspace{1cm} (5.3)

Where:

- \( R_p \) = the expected return on a portfolio for a given period;
- \( R_m \) = the expected return on the broad-based market index at the same period;
- \( \alpha_p, \beta_p \) = the parameters for the portfolio which best describe the linear relationship between the return \( R_p \) and \( R_m \);
- \( e_p \) = random error term for the portfolio.

### 5.2.2 Monthly Return Estimation

There are two variables for the monthly returns that need to be understood. The first one is the monthly return of the SET index, which is used as the benchmark for the return of the portfolio. The market rate of return is calculated by the change in the value of the SET index for the beginning of the month and the end of the month. The formula is shown below:

\[ R_{m,t} = \frac{(SET_t - SET_{t-1})}{SET_{t-1}} \]  \hspace{1cm} (5.4)

---

Where:

\[ R_{m,t} = \text{a return on the market at the end of the month;} \]

\[ \text{SET}_{t-1} = \text{SET index value in the previous period;} \]

\[ \text{SET}_t = \text{SET index value in the current period.} \]

In addition, the second one is the monthly return of the security, which is calculated by the change in price of security from the beginning of the month and the end of the month. The formula is shown below\(^5\):

\[ R_{i,t} = \frac{P_t - P_{t-1}}{P_{t-1}} \]  \( (5.5) \)

Where:

\[ R_{i,t} = \text{a rate of return of stock } i; \]

\[ P_{t-1} = \text{security price in the previous period;} \]

\[ P_t = \text{security price in the current period.} \]

5.2.3 The Estimation of the Correlation (Coefficient of Determination)

The coefficient of determination measured by R-square indicates how much of the variability in dependent variable is associated with the variability in independent variable, so the correlation of the portfolio to the market indicates how much of the variability in the returns on the portfolio is associated with variability in the market. The value of the coefficient of determination can range from zero to one; the higher \( R^2 \) equals to one would indicate perfect correlation. The coefficient of determination can be explained as\(^6\):

---


\[
R^2 = \frac{\text{Error of Estimation Explained by Regression}}{\text{Total Error of Estimation}} \quad (5.6)
\]

\[
= \frac{\sum (\hat{y} - \bar{y})^2}{\sum (y - \bar{y})^2} \quad (5.7)
\]

\[
= \frac{\text{Sum of Square Error}}{\text{Sum of Square Total}} \quad (5.8)
\]

Where \( y \) is the dependent variable, \( \hat{y} \) is the expected value for the dependent variable and \( \bar{y} \) is the mean value of the dependent variable.

5.3 Empirical Testing Procedure

After the estimation of the variables, the next section explains the testing procedures. The testing procedures are divided into six main steps. It begins with the calculation of the return on the security and return on the market. Next, the average monthly returns are computed. Subsequently, the estimation of the betas and the coefficient of determination between the monthly portfolio return and the monthly market return are obtained. From this point, the inputs are now ready for testing. To be more specific, the testing procedures are:

1. Calculating the monthly return of fifty-four securities and the monthly return of the market index as stated in the monthly return estimation.

2. Constructing two categories of portfolios. The first category of the portfolios involves dividing the fifty-four securities into three equal groups based on their corporate bond rating by Thai Rating and Information Services (TRIS). Portfolio A consists of eighteen companies with class A bond rating. Portfolio B consists of eighteen companies with class B bond rating. Portfolio C consists of eighteen companies with class C bond rating or the companies under rehabilitation specified by Stock Exchange of Thailand. Hence, there are three portfolios for the first category of portfolio. In addition, the second
category of the portfolio will be constructed to show the effect of changing number in the portfolio, eighteen stocks from class A portfolio will be selected to construct one-stock portfolio to eighteen-stock portfolio. Hence, there are eighteen portfolios for the second category of portfolio.

3. Calculating the average return for the stock and return for portfolio. The average returns on three portfolios divided according to their quality class must be found. Then the average returns for one-stock portfolio to eighteen-stock portfolio must be found.

4. Estimating the beta by using a time-series of the monthly return for class A portfolio (or class B portfolio or class C portfolio) and the monthly index return. The statistical technique used is the regression analysis, which estimates the relationship between two variables.

5. Estimating the coefficient of determination between the monthly return on one-stock portfolio (to eighteen-stock portfolio) to the monthly return on market index, measured by R-square, to indicate how much of the variability in the returns on the portfolio is associated with the variability in the market.

6. Choosing the methodology applied for each hypothesis and using all inputs to test the four hypotheses, which will be discussed in the next section.

5.4 Operational Procedure

After all the necessary inputs have already been calculated, the operationalization of the variables will specify the nature of each variable in the four hypotheses. Then the operational procedure will clarify the steps in choosing the methodologies for hypothesis testing.
Table 5.1 Operationalization of Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Operationalized by</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Rating of Portfolio</td>
<td>Risk Class</td>
<td>Ordinal</td>
</tr>
<tr>
<td>Number of issues in Portfolio</td>
<td>Number of Stocks</td>
<td>Ratio</td>
</tr>
<tr>
<td>Risk of Portfolio</td>
<td>Beta</td>
<td>Ratio</td>
</tr>
<tr>
<td>Average Return of Portfolio</td>
<td>Means Return of Portfolio</td>
<td>Ratio</td>
</tr>
<tr>
<td>Coefficient of Determination between the Portfolio Return and Market Return</td>
<td>R-square</td>
<td>Ratio</td>
</tr>
</tbody>
</table>

There are four hypotheses that are focused in this empirical study. The first hypothesis is: There is a negative relationship between the quality rating of portfolio and the risk of the portfolio, measured by beta. The second hypothesis is: There is a negative relationship between the quality rating of each portfolio and the average return of each portfolio. The third hypothesis is: There is a significant relationship between the number of issues in the portfolio and the average return of each portfolio. Finally, the fourth hypothesis is: There is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return. In order to clarify the methodologies applied to these four hypotheses, the operational procedure helps explain the steps in and the reasons for choosing each methodology.

1. In the first hypothesis, the relationship between the quality of the portfolio and the risk of the portfolio as measured by beta will be tested. The suitable methodology is One-Way Anova. Anova is a statistical technique that tests the relationship between the ordinal scale of an independent variable and ratio scale of a dependent variable by giving the F value to indicate area of reject or fail to reject null hypothesis. F value can be calculated as⁷:

\[
F = \frac{MSR}{MSE} \quad (5.9)
\]

\[
= \frac{\sum(y - \overline{y})^2}{[\sum(y - \overline{y})^2]/(n-1)} \quad (5.10)
\]

Where \( y \) is the dependent variable, \( \overline{y} \) is the mean value of dependent variable, \( \hat{y} \) is the expected value of dependent variable and \( n \) is the number of sample size.

2. In the second hypothesis, the relationship between the quality rating of the portfolio and the average return of the portfolio will be tested. One-Way Anova is the suitable test for this hypothesis. \( F \) value can be calculated as for the first hypothesis.

3. The relationship between the number of stocks in the portfolio and the average return of each portfolio will be tested in the third hypothesis. The suitable methodology in testing this hypothesis is Pearson Correlation. Pearson Correlation is a statistical method used to find the correlation between the ratio scale data of an independent variable and the ratio scale data of a dependent variable by using the symbol "R" to indicate the direction of the relationship. \( R \)-value can be calculated as:

\[
R = \frac{\Sigma xy - (\Sigma x)(\Sigma y)/n}{\sqrt{\Sigma x^2 - (\Sigma x)^2/n} \sqrt{\Sigma y^2 - (\Sigma y)^2/n}} \quad (5.11)
\]

Where \( x \) is the independent variable, \( y \) is the dependent variable and \( n \) is the sample size.

4. In the last hypothesis, the relationship between the number of issues in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly index return will be tested. Pearson Correlation is the suitable methodology for this hypothesis. \( R \)-value can be calculated as the third hypothesis.

---

5.4 Hypothesis Testing

From the empirical testing procedure and the operational procedure, all necessary inputs and the appropriate methodologies are now ready for testing these four hypotheses. In order to simplify the process, the detail of how to test each hypothesis is discussed.

The Testing of Hypothesis 1: There is a negative relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta.

For this hypothesis testing, the statistical method of one-way Anova will be applied. The simple regression equation below is examined.

\[ \text{Beta}_p = \gamma_0 + \gamma_1 \text{Rate}_p + u_p \quad (5.12) \]

Where the \( \text{Rate}_p \) is the quality rating of the portfolio and \( \text{Beta}_p \) is the beta value of the portfolio. The coefficient \( \gamma_0, \gamma_1 \) are the regression coefficients and \( u_p \) is the residual term or the deviation from the regression line. The null and alternative hypotheses are defined as follows:

\[ H_0 : \gamma_1 \geq 0 \]
\[ H_1 : \gamma_1 < 0 \]

The null hypothesis is rejected when F-computed is less than F-table at 1,n-2 degree of freedom or when the significant level (2-tailed) of F divided by 2 is less than the specified significant level. The rejection of null hypothesis leads to the acceptance of the alternative hypothesis \( H_1 : \gamma_1 < 0 \), which means that there is a negative relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta. But the acceptance of the null hypothesis \( H_0 : \gamma_1 \geq 0 \) means that there is a positive or no relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta.
The Testing of Hypothesis 2: There is a negative relationship between the quality rating of each portfolio and the average return of each portfolio.

For this hypothesis testing, the one-way Anova method will be applied. The simple regression equation below is examined:

\[
\bar{R}_p = \gamma_0 + \gamma_1 \text{Rate}_p + u_p \tag{5.13}
\]

Where the Rate\(_p\) is the quality rating of the portfolio and \(\bar{R}_p\) is the average return of the portfolio, the coefficient \(\gamma_0, \gamma_1\) are the regression coefficients and \(u_p\) is the residual term or the deviation from the regression line. The null and alternative hypotheses are defined as follows:

\[H_0 : \gamma_1 \geq 0\]
\[H_1 : \gamma_1 < 0\]

The null hypothesis is rejected when F-computed is less than F-table at 1, n-2 degree of freedom or when the significant level (2-tailed) of F divided by 2 is less than the specified significant level. The rejection of null hypothesis leads to the acceptance the alternative hypothesis \(H_1: \gamma_1 < 0\), which means there is a negative relationship between the quality rating of portfolio and the average return of the portfolio. But the acceptance of the null hypothesis \(H_0: \gamma_1 \geq 0\) means that there is a positive or no relationship between the quality rating of the portfolio and the average return of the portfolio.

The Testing of Hypothesis 3: There is a significant relationship between the number of issues in the portfolio and the average return of each portfolio.

For this hypothesis testing, the Pearson correlation is the statistical method and the simple regression equation below is examined.

\[
\bar{R}_p = \gamma_0 + \gamma_1 \text{Num}_p + u_p \tag{5.14}
\]
Where $R_p$ is the average return of each portfolio and Num$_p$ is the number of securities holding in each portfolio, the coefficient $\gamma_0$, $\gamma_1$ are the regression coefficients and $u_p$ is the residual term or the deviation from the regression line. The null and alternative hypotheses are defined as follows:

$$H_0 : \quad \rho_{R_p, \text{Num}_p} = 0$$

$$H_1 : \quad \rho_{R_p, \text{Num}_p} \neq 0$$

The null hypothesis is rejected when $t$ value (t-computed) is greater than $t_{1-\alpha/2}$ (t-table) or $t$ value (t-computed) is less than $-t_{1-\alpha/2}$ (t-table) at $n-2$ degree of freedom or when the significant level (2-tailed) of $t$ is less than the specified significant level. The rejection of null hypothesis leads to the acceptance of the alternative hypothesis $H_1: \rho_{R_p, \text{Num}_p} \neq 0$, which means that there is a significant relationship between the number of issues in the portfolio and the average return of each portfolio. But the acceptance of the null hypothesis $H_0: \rho_{R_p, \text{Num}_p} = 0$ means that there is no significant relationship between the number of holding in the portfolio and the average return of each portfolio at a specified significant level.

**The Testing of Hypothesis 4:** There is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return.

For this hypothesis testing, Pearson correlation is the statistical method and the simple regression equation below is examined.

$$R^2_{p,m} = \gamma_0 + \gamma_1 \text{Num}_p + u_p \quad (5.15)$$

Where the $R^2_{p,m}$ is the coefficient of determination between the portfolio return to the market index return and Num$_p$ is the number of securities holding in each portfolio. The coefficient $\gamma_0$, $\gamma_1$ are the regression coefficients and $u_p$ is the residual term or the deviation from the regression line. The null and alternative hypotheses are defined as follows:

$$H_0 : \quad \rho_{R^2, \text{Num}_p} \leq 0$$

$$H_1 : \quad \rho_{R^2, \text{Num}_p} > 0$$

123
The null hypothesis is rejected when t value (t-computed) is greater than t \( _{1-\alpha} \) (t-table) at \( n-2 \) degree of freedom or when the significant level (2-tailed) of t divided by two is less than the specified significant level and t value (t-computed) has a positive value. The rejection of the null hypothesis leads to the acceptance of the alternative hypothesis \( H_1: \rho \neq 0 \) which means that there is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return. But acceptance of the null hypothesis \( H_0: \rho = 0 \) means that there is a negative or no relationship between the number of holding in the portfolio and coefficient of determination between the monthly portfolio return and the monthly market index return at a specified significant level.
CHAPTER 6

DATA ANALYSIS AND PRESENTATION OF THE RESULTS

Having illustrated the theoretical framework in the fourth chapter and the methodology in the fifth chapter, hence the study will present the empirical results of the data analyses based on the portfolio theory. The results will be divided into two main sections. The first section includes the general finding of security’s return, its beta and its standard deviation on each portfolio. The second section involves the empirical test of the diversification effects on risk and return.

6.1 The General Results

The result of the present study indicates that the return on the market measured by Stock Exchange of Thailand (SET) index during January 1996 to December 2001 is 1.4 percent per month or 16.8 percent annually. The average return, beta and standard deviation of each security are shown in Tables C1, C2 and C3 in Appendix C. For the class A securities, Saha Pathana Inter-Holding Public Company Limited (SPI) provides the highest monthly return followed by The Samaggi Insurance Public Company Limited (SMG) and The Industrial Finance Corporation Of Thailand (IFCT) with the monthly returns of 1.48, 1.39, and 1.3 percent respectively. This class A securities provide returns lower than the market return because during this testing period Thailand faced an economic downturn, which makes the performance of each firm become lower. Especially for the company that has the high credit quality rating; the risk of each company measured by beta and standard deviation is lower compared to class B securities, so the average return of securities in this class becomes lower compared to that of the market. The risk of class A securities can be measured by beta and standard deviation. The Industrial Finance Corporation Of Thailand (IFCT) provides the highest standard deviation and followed by The Siam Commercial Bank (SCB) and Shin Corporation Public Company Limited (SHIN) with the monthly standard deviation of 0.38, 0.26 and 0.27 respectively. The betas of these securities are 2.47,1.89 and 1.55

125
respectively. Markowitz (1952)\(^1\) used standard deviation to measure the total risk (both systematic risk and non-systematic risk) of securities. Sharpe (1963)\(^2\) used beta to measure the systematic risk of each security, so these two methods used to measure risk will show a similar result in that the high-risk securities will provide the high beta and high standard deviation.

For class B securities, Seamico Securities Public Company Limited (Z-MICO) provides the highest monthly return accompanied by Siampanich Leasing Public Company Limited (SPL) and Vinythai Public Company Limited (VNG) with the monthly returns of 6.9, 5.28, and 3.89 percent respectively. This is because during the time period of study the finance and securities sector was growing compared to the overall market so the investors’ demand for the securities were relatively high causing the prices and returns of the stock to increase substantially. Table C4 in Appendix C shows that during the period of 1997 to 2001, the overall performances of Seamico Securities Public Company Limited (Z-MICO) and Siampanich Leasing Public Company Limited (SPL) were superior to the market performance as the earning per share ratio, the return on asset ratio, and the return on equity ratio of these two companies were above SET and the finance and securities sector. The lowest average monthly return is The Thai Military Bank Public Company Limited (TMB) with the value of −1.63 percent per month, which is the under-market performance. In this empirical testing, the average return of 1.72 percent monthly on class B portfolio is higher than the average return of −0.23 percent monthly on class A portfolio. This shows a similar result to Wagner and Lau’s (1971) study with which the average return of the portfolio increases as the quality of the individual issue declines. Moreover, for the risk of class B securities, Seamico Securities Public Company Limited (Z-MICO) provides the highest standard deviation followed by Siampanich Leasing Public Company Limited (SPL) and Quality House Public Company Limited (QH) with the monthly standard deviation of 0.52, 0.45 and 0.42 respectively. The higher level of risk should be compensated by the higher level of return as Seamico Securities Public Company Limited (Z-MICO) and Siampanich Leasing Public Company

---


Limited (SPL) are the companies that have the high level of risk, so they compensate the investors by offering the highest level of return in class B portfolio. Each company faces the different level of systematic risk. The company that faces the highest level of systematic risk is Quality House Public Company Limited (QH) followed by Kiatnakin Finance and Securities Public Company Limited (KK) and Siampanich Leasing Public Company Limited (SPL) with the beta values of 2.53, 2.33 and 2.11 respectively.

The average return of 0.18 percent monthly in class C portfolio is higher than the average return of -0.23 percent monthly in class A portfolio as the lower risk class provides the higher average return. But the average returns on class C portfolio are lower than the average return on class B portfolio. For the individual securities in class C portfolio, Tanayong Public Company Limited (TYONG) provides the highest monthly return and it is followed by Thai Heat Exchange Public Company Limited (THECO) and Krisda Mahanakorn Public Company Limited (KMC) with the monthly returns of 2.89, 2.54, 2.36 percent respectively. For the total risk of each security measured by the standard deviation, it is found that Tanayong Public Company Limited (TYONG) provides the highest standard deviation and it is followed by Thai Heat Exchange Public Company Limited (THECO) and Krisda Mahanakorn Public Company Limited (KMC) with the standard deviations of 0.58, 0.54, 0.46 respectively. As the total risk of these companies measured by standard deviation are high compared to the other securities in class C portfolio, the monthly return of these companies are also high compared to the other securities in the class C portfolio. This result is also supported by Markowitz (1952) who found that there is a positive relationship between the mean and the variance of each security.

In this research, portfolios are constructed holding from one to eighteen securities in the same bond quality class to show the effect of changing number of issues held in the portfolio. From the concept of naïve diversification or random diversification through the purchase of a large number of securities, there are some risks that cannot be eliminated by diversification. This underlying volatility of returns is systematic to all risky securities. When adding more number of securities in the portfolio, diversification can eliminate return uncertainties that are unique to individual securities-unsystematic risk.
The coefficient of determination between the portfolio return and the market return is low, when only one stock is held in a portfolio. When additional stocks are held, the coefficient of determination between the portfolio return and the market return will approach one. The correlation between the portfolio return and the market return rises as the number of holding increases. Therefore, the unsystematic risk will be diversified away when investors hold more number of securities in the portfolio. The extension in the correlation between the portfolio return and the market return caused by adding the first few stocks to the portfolio are dramatic, whereas the marginal benefit of adding a new stock to a larger portfolio appears to be small. Portfolios of fourteen to eighteen securities have a strong relationship with the market index as shown in Figure 6.1.

Figure 6.1 R-Square VS Number of Issues in Portfolio for Class A Portfolio

A portfolio composed of different numbers of securities in the same quality class has the same level of systematic risk, even though the level of unsystematic risk varies. Since unsystematic risk can be diversified away no compensation is rewarded for bearing such risk, so the portfolio of few numbers of securities will provide the low rate of return whereas the portfolio of fourteen to eighteen securities provides a better rate of return for the investors compared to the other numbers of securities in one portfolio as shown in Figure 6.2.
Moreover, an important concept in this study is how portfolio diversification can be used to offset the individual riskiness of stocks held. As a result, portfolios consisting of large numbers of higher risk securities may be less risky than portfolios consisting of small numbers of low risk stocks, yet earn a substantially higher rate of return. Figure 6.3 shows that class B portfolio provides average return higher than that of class A portfolio as class B portfolio is riskier than class A portfolio.

Figure 6.3 Average Return on Portfolio

VS Number of Issues for Two classes of Portfolio
Figure 6.3 shows that when the investor increases the number of issues held in the portfolio, class B portfolio earns a higher rate of return than class A portfolio. The returns increase as additional risk is taken, so return will compensate for additional risk when holding class B portfolio instead of class A portfolio. Moreover, when the investor increases the number of issues in the portfolio, the higher risk class portfolio will gain more diversification benefit than the lower risk class portfolio as shown below:

Figure 6.4 R-Square VS Number of Issues for Two Classes of Portfolio

Figure 6.4 shows that the coefficients of determination between monthly class B portfolio return and monthly market return are higher than the coefficients of determination between monthly class A portfolio return and monthly market return. This means that the market return can explain the percentage change in class B portfolio return more than the percentage changes in class A portfolio return. Hence, when the investors increase the number of holdings, the higher risk class portfolio will gain diversification benefit more than the lower risk class portfolio.
6.2 The Empirical Results of Portfolio Theory

After the general results have already been discussed, the empirical results of diversification effect on risk and return are presented in this section. To provide some evidence concerning the portfolio theory, the monthly return on fifty-four stocks and return from the market during the period January 1996 through December 2001 are analyzed. The present study focuses on four types of relationship. As stated, first there is a negative relationship between the quality rating of portfolio and the risk of portfolio, measured by beta. Second, there is a negative relationship between the quality rating of each portfolio and the average return of each portfolio. Third, there is a significant relationship between the number of issues in the portfolio and the average return of each portfolio. Finally, there is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return. In the examination of these relationships, the inferential statistics are used to test the stated hypotheses, which were presented in the previous chapter. The empirical results begin with the test of hypotheses 1, 2, 3 and 4 respectively.

The Testing of Hypothesis 1: There is a negative relationship between the quality rating of portfolio and the risk of portfolio, measured by beta. The simple regression equation used is:

\[
\text{Beta}_p = \gamma_0 + \gamma_1 \text{Rate}_p + u_p
\]

Where the Rate\(_p\) is the quality rating of the portfolio and Beta\(_p\) is the beta value of the portfolio. The coefficient \(\gamma_0, \gamma_1\) are the regression coefficients and \(u_p\) is the residual term or the deviation from the regression line. The null and alternative hypotheses are defined as follows:

\[
\begin{align*}
H_0 & : \quad \gamma_1 \geq 0 \\
H_1 & : \quad \gamma_1 < 0
\end{align*}
\]
The results of one-way Anova are shown below:

Table 6.1.1

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quality Rating of Portfolio</td>
<td>.</td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. All requested variables entered.

b. Dependent Variable: Beta of portfolio

Table 6.1.1 indicates the way to choose the independent variable. In the case of one independent variable, the end-user of the software can choose any method. In this case, the method is Enter and the independent variable is quality rating of the portfolio.

Table 6.1.2

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.310&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.096</td>
<td>.079</td>
<td>.77067051</td>
<td>1.670</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Quality Rating of Portfolio

b. Dependent Variable: Beta of portfolio

Table 6.1.2 shows the statistical value of regression equation as follows: R stands for the coefficient of correlation, which is the statistical method to indicate the direction of the relationship. The R-value is between −1 to 1. In this case, R-value equals to 0.310. \( R^2 \) stands for the coefficient of determination. In this case, \( R^2 \) equals to 9.6%, which means the percentage change in beta of portfolio can be explained by the quality of the portfolio at 9.6%. Adjusted R Square is the adjusted value of R Square when adding the
independent variable into the regression equation, which makes the R Square decrease. Hence, the end-user of the software can adjust the R Square more correctly by using the adjusted R Square value.

Std. Error of the Estimate stands for the Standard Error of the Estimate, which can be calculated by square rooting MSE in Anova Table. This value equals to $0.594^{1/2}$ or 0.7706. This value is used to measure the dispersion of error term around the $\hat{Y} = a + bx$ and it has the unit as beta of the portfolio (dependent variable). Durbin-Watson test statistic tests the null hypothesis that the residuals from an ordinary least-squares regression are not auto correlated against the alternative hypothesis. The Durbin-Watson statistic ranges in value from 0 to 4. A value near 2 indicates non-auto correlation; a value toward 0 indicates positive autocorrelation; a value toward 4 indicates negative autocorrelation. In this case, Durbin-Watson value equals 1.67, so it can be conclude that the value of residual error term is independent.

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>3.282</td>
<td>1</td>
<td>3.282</td>
<td>5.526</td>
<td>.023*</td>
</tr>
<tr>
<td>Residual</td>
<td>30.885</td>
<td>52</td>
<td>.594</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34.167</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.1.3

a. Predictors: (Constant), Quality Rating of Portfolio
b. Dependent Variable: Beta of portfolio

Table 6.1.3 shows that the F value is 5.526. When the significant (2-tailed) level of F divided by 2 (0.023/2 = 0.0115) is less than the specified significant level (0.05), the rejected null hypothesis will make the alternative hypothesis $H_1: \gamma_1 < 0$ acceptable, which means that there is a negative relationship between the quality rating of portfolio and the risk of the portfolio, measured by beta.
Table 6.1.4

Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Standardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>0.274</td>
<td>0.277</td>
<td>.989</td>
<td>0.327</td>
<td>-0.282</td>
</tr>
<tr>
<td></td>
<td>Quality Rating</td>
<td>0.302</td>
<td>0.128</td>
<td>0.310</td>
<td>2.351</td>
<td>0.023</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Beta of portfolio

Table 6.1.4 shows the estimated coefficient of regression of equation as follows:

\[ a = 0.274 \quad \text{SE. (a)} = 0.277 \]
\[ b = 0.302 \quad \text{SE. (b)} = 0.128 \]

The Testing of Linear Relationship

\( H_0 \): There is no linear relationship between quality rating of the portfolio and the risk of the portfolio, measured by beta. That is \( y_1 = 0 \).

\( H_1 \): There is a linear relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta. That is \( y_1 \neq 0 \).

From Table 6.1.4, the significant level of \( t \) (0.023) is less than 0.05, so the rejection of the null hypothesis means that there is a linear relationship between quality rating of the portfolio and the risk of the portfolio, measured by beta.

The Testing of \( y \) Intercept

\( H_0 \): The intercept term is not statistically significantly different from zero. That is \( y_0 = 0 \).

\( H_1 \): The intercept term is statistically significantly different from zero. That is \( y_0 \neq 0 \).
From Table 6.1.4, the significant level of t (0.327) is greater than 0.05, this implies that the intercept term is not statistically significantly different from zero.

From the F value of Anova Table and t value of Coefficient Table, it can be summarized that the linear regression equation for the relationship between the quality rating of the portfolio and the risk of the portfolio, as measured by beta is:

\[
\beta_p = -\gamma_1 \text{Rate}_p \quad (6.2)
\]

\[
= -0.302 \text{Rate}_p 
\quad (6.3)
\]

<table>
<thead>
<tr>
<th>Residuals Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
</tr>
<tr>
<td>Predicted Value</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Std. Predicted Value</td>
</tr>
<tr>
<td>Std. Residual</td>
</tr>
</tbody>
</table>

\(a.\) Dependent Variable: Beta of portfolio

Table 6.1.5 shows the residual value of the beta of the portfolio and the predicted value of the beta of the portfolio. The mean value of the beta of the portfolio equals 0.87836022. The minimum value of the beta of the portfolio equals 0.57641727. The maximum value of the beta of the portfolio is 1.18030322. Moreover, this table shows the mean value, the minimum value and the maximum value of Residual, Standard Predicted Value, and Standard Residual.
The Testing of Hypothesis 2: There is a negative relationship between the quality rating of the portfolio and the average return of the portfolio. The simple regression equation used is:

\[ \bar{R}_p = \gamma_0 + \gamma_1 \text{Rate}_p + u_p \]  

(6.4)

Where the \( \text{Rate}_p \) is the quality rating of the portfolio and \( \bar{R}_p \) is the beta value of the portfolio. The coefficient \( \gamma_0, \gamma_1 \) are the regression coefficients and \( u_p \) is the residual term or the deviation from the regression line. The null hypothesis defined is as follows:

\[ H_0 : \gamma_1 \geq 0 \]
\[ H_1 : \gamma_1 < 0 \]

The results of one-way Anova are shown below:

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quality Rating of Portfolio</td>
<td>( a )</td>
<td>Enter</td>
</tr>
</tbody>
</table>

\( a \). All requested variables entered.

\( b \). Dependent Variable: Average Return of Portfolio

Table 6.2.1 indicates the way to choose the independent variable. In the case of one independent variable, the end-user of the software can choose any method. In this case, the method is Enter and the independent variable is the quality rating of the portfolio.
### Table 6.2.2

**Model Summary**

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.087*</td>
<td>0.008</td>
<td>-0.012</td>
<td>1.9788639E-02</td>
<td>1.534</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Quality Rating of Portfolio  

b. Dependent Variable: Average Return of Portfolio

Table 6.2.2 shows the statistical value of regression equation as follows: R stands for the coefficient of correlation, which is the statistical method to indicate the direction of the relationship. The R-value is between -1 to 1. In this case, R-value equals to 0.087. R² stands for the coefficient of determination. In this case, R² equals 0.8%, which means the percentage change in the beta of the portfolio can be explained by the quality of the portfolio by 0.8%. Adjusted R Square is the adjusted value of R Square when adding the independent variable into the regression equation, which makes the R Square decrease. Hence, the end-user of the software can adjust the R Square more correctly by using the adjusted R Square value.

Std. Error of the Estimate stands for the Standard Error of the Estimate, which can be calculated by square rooting MSE in Anova Table. This value equals 1.9788639E-02. This value is used to measure the dispersion of error term around the Ŷ = a+bx and it has the unit as the beta of the portfolio (dependent variable). Durbin-Watson test statistic tests the null hypothesis that the residuals from an ordinary least-squares regression are not auto correlated against the alternative hypothesis. The Durbin-Watson statistic ranges in value from 0 to 4. A value near 2 indicates non-auto correlation; a value toward 0 indicates positive autocorrelation; a value toward 4 indicates negative autocorrelation. In this case Durbin-Watson value equals 1.534, so it can be concluded that the value of residual error term is independent.
Table 6.2.3

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>1</td>
<td>1.540E-04</td>
<td>.393</td>
<td>.533</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>52</td>
<td>3.916E-04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.052E-02</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Quality Rating of Portfolio
b. Dependent Variable: Average Return of Portfolio

Table 6.2.3 shows that the significant level of F value is 0.533. When the significant (2-tailed) level of F divided by 2 (0.533/2 = 0.2665) is greater than the specified significant level (0.05), so the failure to reject the null hypothesis $H_0: \gamma_1 \geq 0$ means that there is a positive or no relationship between the quality rating of the portfolio and the average return of the portfolio.

Table 6.2.4

Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>Sig.</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>9.723E-03</td>
<td>.007</td>
<td>1.365</td>
<td>.178</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>Quality Rating</td>
<td>2.068E-03</td>
<td>.003</td>
<td>-0.087</td>
<td>-.627</td>
<td>-.533</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Average Return of Portfolio

Table 6.2.4 shows the estimated coefficient of regression of equation as follows:

\[ a = 9.723E-03 \quad SE.\ (a) = 0.007 \]
\[ b = -2.068E-03 \quad SE.\ (b) = 0.003 \]
The Testing of Linear Relationship

$H_0$ : There is no linear relationship between the quality rating of the portfolio and the average return of the portfolio. That is $y_1 = 0$.

$H_1$ : There is a linear relationship between the quality rating of the portfolio and the average return of the portfolio. That is $y_1 \neq 0$.

From Table 6.2.4, the significant level of $t$ (0.533) is greater than 0.05, so the failure to reject the null hypothesis means there is no linear relationship between the quality rating of the portfolio and the average return of the portfolio.

The Testing of $y$ Intercept

$H_0$ : The intercept term is not statistically significantly different from zero. That is $y_0 = 0$.

$H_1$ : The intercept term is statistically significantly different from zero. That is $y_0 \neq 0$.

From Table 6.2.4, the significant level of $t$ (0.178) is greater than 0.05, this implies that the intercept term is not statistically significantly different from zero.

From the F value of Anova Table and t value of Coefficient Table, it can be concluded that there is no significant relationship between the quality rating of the portfolio and the average return of the portfolio.
Table 6.2.5

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Std. Residual</th>
<th>Average Return of Portfolio</th>
<th>Predicted Value</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>3.204</td>
<td>.068985</td>
<td>5.5866175E-03</td>
<td>6.3397900E-02</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Average Return of Portfolio

Table 6.2.5 shows which case has an abnormal value. In this case, it shows that the thirty-sixth case has an abnormally high value because the value of Standard Residual equals 3.204, which is greater than 3. The average return of the portfolio equals 6.8985 percent each month.

**The Testing of Hypothesis 3:** There is a significant relationship between the number of issues in the portfolio and the average return of each portfolio.

For this hypothesis testing, Pearson correlation is the statistical method used and the simple regression equation below is applied.

\[ \bar{R}_p = \gamma_0 + \gamma_1 \text{Num}_p + u_p \quad (6.5) \]

Where \( \bar{R}_p \) is the average return of each portfolio and \( \text{Num}_p \) is the number of securities holding in each portfolio, the coefficient \( \gamma_0, \gamma_1 \) are the regression coefficients and \( u_p \) is the residual term or the deviation from the regression line. The null hypothesis is defined as follows:

\[ H_0 : \rho_{\bar{R}_p, \text{Num}_p} = 0 \]
\[ H_1 : \rho_{\bar{R}_p, \text{Num}_p} \neq 0 \]
The results of Pearson Correlation are shown below:

**Table 6.3.1**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average return of each portfolio</td>
<td>-5.76089828E-03</td>
<td>3.0599421E-03</td>
<td>18</td>
</tr>
<tr>
<td>Number of stock in each portfolio</td>
<td>9.50</td>
<td>5.34</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 6.3.1 shows that the average return of the portfolio equals −0.00576 or −0.576 percent each month and the standard deviation of the average return on each portfolio equals 0.0030599 or 0.30599 percent each month. The total sample size is eighteen portfolios.

**Table 6.3.2**

<table>
<thead>
<tr>
<th></th>
<th>Average return of each portfolio</th>
<th>Number of stock in each portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1.000</td>
<td>0.300</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.</td>
<td>0.226</td>
</tr>
<tr>
<td>N</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Average return of each portfolio</th>
<th>Number of stock in each portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>0.300</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.226</td>
<td>.</td>
</tr>
<tr>
<td>N</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>
Table 6.3.2 shows that the significant (2-tailed) level of $t$ (0.226) is greater than the specified significant level (0.05) and Pearson correlation equals 0.3 so the failure to reject the null hypothesis $H_0: \rho_{\bar{R}_p, \text{Num}_p} = 0$ means that there is no significant relationship between the number of holding in the portfolio and the average return of each portfolio at a specified significant level.

**The Testing of Hypothesis 4:** There is a positive relationship between the number of holding in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return.

For this hypothesis testing, Pearson correlation is the statistical method used and the simple regression equation below is examined.

$$R^2_{p,m} = \gamma_0 + \gamma_1 \text{Num}_p + u_p \quad (6.6)$$

Where $R^2_{p,m}$ is the coefficient of determination between the portfolio return to the market index return and $\text{Num}_p$ is the number of securities holding in each portfolio, the coefficient $\gamma_0$, $\gamma_1$ are the regression coefficients and $u_p$ is the residual term or the deviation from the regression line. The null hypothesis is defined as follows:

$H_0: \rho R^2_{p,m} \leq 0$

$H_1: \rho R^2_{p,m} > 0$

The results of Pearson Correlation are shown below:

**Table 6.4.1**

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stock in each portfolio</td>
<td>9.50</td>
<td>5.34</td>
<td>18</td>
</tr>
<tr>
<td>R2 between portfolio and market return</td>
<td>0.69594575</td>
<td>0.25109748</td>
<td>18</td>
</tr>
</tbody>
</table>
Table 6.4.1 shows that the mean value of coefficient of determination between the monthly portfolio returns and the monthly index returns equals 0.6959 and the standard deviation of coefficient of determination between the monthly portfolio returns and the monthly index returns equals 0.25109. The total sample size is eighteen portfolios.

### Table 6.4.2

**Correlations**

<table>
<thead>
<tr>
<th>Number of stock in each portfolio</th>
<th>Pearson Correlation</th>
<th>R2 between portfolio and market return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stock in each portfolio</td>
<td>.000</td>
<td>.837**</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R2 between portfolio and market return</th>
<th>Pearson Correlation</th>
<th>Sig. (1-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>.837**</td>
<td></td>
<td>.000</td>
<td>18</td>
</tr>
<tr>
<td>1.000</td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (1-tailed).

Table 6.4.2 shows that the significant (1-tailed) level of $t$ is less than the specified significant level or 0.000 is less than 0.05 so the rejection of the null hypothesis means acceptance of the alternative hypothesis $H_1$: $\rho_{R^2,p,\text{Nump}} > 0$ which also means there is a positive relationship between the number of holding in the portfolio and coefficient of determination between the monthly portfolio return and the monthly market index return. Moreover, Pearson correlation equals 0.837, which indicates that the degree of relationship between the number of holding in the portfolio and coefficient of determination between the monthly portfolio return and the monthly market index return is very strong.

---

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

There are two sections presented in this chapter. The first section deals with conclusions and the second section provides the recommendations. The conclusions section summarizes the empirical results on the hypothesis testing comparing the results with the earlier studies based on Wagner and Lau’s (1971)\(^1\) study on the diversification effect on risk. Finally, some recommendations are provided for further studies.

7.1 Conclusions

Based on the portfolio theory, the objectives of this study are to examine whether the rate of return on well-diversified low risk portfolios is indeed significantly lower than the return on well-diversified higher risk portfolios and to show how diversification can be utilized to offset the riskiness of individual securities, so that portfolios consisting of large numbers of higher risk securities are less risky than portfolios consisting of small numbers of low risk securities, and yet earn a substantially higher rate of return.

The study includes fifty-four securities whose prices were quoted continuously on SET during January 1996 through December 2001. Fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS), are used to construct two types of portfolio. The first classification of portfolios involves dividing the fifty-four securities into three equal groups based on their corporate bond rating by Thai Rating and Information Services (TRIS). Eighteen securities with class A bond rating will be grouped in portfolio A. Eighteen securities with class B bond rating will be grouped in portfolio B. Eighteen securities with class C bond rating or the securities under rehabilitation specified by Stock Exchange of Thailand will be grouped in portfolio C. In addition, the second classification of the portfolio will be constructed to show the effect of the changing number of stocks in the portfolio, so

---
eighteen stocks will be selected from class A quality stocks to create one-stock portfolio to eighteen-stock portfolio. The findings of the study are given below.

First, in the testing of the relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta, the present study finds that there is a negative relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta. Moreover, in testing the y intercept of this equation, the intercept term is not statistically significantly different from zero. Therefore, the equation for this relationship can be explained as:

\[ \text{Beta}_p = -\gamma_1 \text{ Rate}_p \]

\[ = -0.302 \text{ Rate}_p \]

Where Beta\(_p\) is the risk of the portfolio measured by the beta. Rate\(_p\) is the quality rating of the portfolio, and -\(\gamma_1\) is the slope of the equation. The slope of the portfolio shows the negative numbers, which means when the quality rating of the portfolio increases, the risk of the portfolio measured by beta will decrease. This result supports Wagner and Lau's (1971) finding that the higher the quality rating of the portfolio, the lower the beta. However, there were some minor deviations in their study to this rule caused by random sampling, or perhaps incorrect stock quality codes.

Second, in testing the relationship between the quality rating of the portfolio and the average return of the portfolio. The present study finds that there is no significant relationship between the quality rating of the portfolio and the average return of the portfolio as the significant level of F value in one-way Anova testing is greater than the specified significant level. Although the average returns on class B portfolio are greater than the average returns on class A portfolio, the average return on class C portfolio are not greater than the average returns on class B portfolio. The result of this finding may be caused by a high fluctuation in class C portfolio whose returns tend to be negative returns rather than positive returns. Hence, when the quality rating of the portfolio decreases, the average returns of the portfolio may not increase if the investors want to invest in the stocks that have the potential to grow. As these class C securities are the companies that face the problem in debt repayment,
the credit risk of these companies is very high so there are no demands for holding this class of securities causing the price and returns of stock to decrease. As the companies do not have the potential to grow and cannot provide the attractive returns for the investors, the companies would become rehabilitated finally.

This result contradicts Wagner and Lau's (1971) study, as they found that the average return of the portfolio increases as the quality of the individual issue declines. Wagner and Lau observed the mean return of the portfolios of twenty issues in New York Stock Exchange based on the data from June 1960 – June 1970 and they saw that the rate of returns was quite steady as the quality of the individual issues declines and returns increase as additional risk was taken. In their study, they created six classes of portfolio, which consisted of class A+ portfolio, class A portfolio, class A-portfolio, class B+ portfolio, class B portfolio, and class B- portfolio. Their lower class portfolios still have the potential to provide the attractive return, which is opposite to class C securities in Thailand that have a low potential to provide the attractive return to the investors. Moreover, the result of the high-risk securities that provide the attractive return to the investor in New York Stock Exchange are also supported by Markowitz’s (1952) finding that the set of efficient portfolios is piecewise linear (made up of connected straight lines) and the set of efficient mean variance combinations is piecewise parabolic. Conversely, in Thai capital market the highest-risk class security ( class C security) cannot provide better return than the lower-risk class security ( class A security and class B security) but, the class B security still can provide a better return than class A security.

Third, in the testing of the relationship between the number of securities in the portfolio and the average return for the portfolio, the present study finds that there is no significant relationship between the number of holdings in the portfolio and average return of each portfolio at a specified significant level as the significant (2-tailed) level of t in Pearson correlation testing is greater than the specified significant level. This result supports Wagner and Lau’s (1971) finding that increasing the number of holding does not, in and of itself, increase and decrease the rate of return on the portfolio. Portfolios composed of different number of securities in the same quality class have the same level of systematic risk. The return of the portfolio

---

relates only to that risk, which cannot be diversified away. In this research, portfolios are constructed holding from one to eighteen securities in the same bond quality class that have the same level of systematic risk. Hence, increasing the number of holding should not, in and of itself, increase or decrease the rate of return on the portfolio.

Finally, in the testing of the relationship between the number of issues in the portfolio and the coefficient of determination between the monthly portfolio return and the monthly market index return, measured by R-square. R-square indicates how much of the variability in the returns on the portfolio is associated with the variability in the market. The higher R-square (R²), the more perfectly diversified the portfolio. The present study finds that there is a positive relationship between the number of holding in the portfolio and coefficient of determination between the monthly portfolio return and the monthly market index return at the significant (1-tailed) level of 0.01 as Pearson correlation testing is less than the specified significant level. This result supports Wagner and Lau’s (1971) finding that the coefficient of determination raises as the number of holding increases. In this present study, portfolios of a small number of securities are very undiversified, whereas portfolios of as few as fourteen to eighteen securities have a strong relationship with market index. Therefore, this conclusion provides a superior investment strategy that can identify and reduce those risks that bear no compensation through the means of diversification in which the unsystematic risk can be reduced simply and effectively. These conclusions provide the significance of this study as stated in the first chapter of this empirical study.

Moreover, when analyzing the general results of this study, it shows that when the investor increases the number of issues held in the portfolio, class B portfolio earns a rate of return more than class A portfolio. The returns increase as additional risk is taken, so return will compensate for additional risk when holding class B portfolio instead of class A portfolio. Consequently, the investors will understand that the rate of return on well-diversified low risk portfolios is indeed significantly lower than the return on well-diversified higher risk portfolios, so the first objective for this empirical study, which was stated in the first chapter, is fulfilled. Moreover, when the investor increases the number of issue in the portfolio, the higher risk class portfolio will gain more diversification benefit than the lower risk class portfolios as the coefficients of determination between monthly class B portfolio return and monthly
market return are higher than the coefficients of determination between monthly class A portfolio return and monthly market return. This means the market return can explain the percentage change in class B portfolio return more than the percentage changes in class A portfolio return. Hence, when the investors increase the number of holdings, the higher risk class portfolio will gain diversification benefit more than the lower risk class portfolio. As a consequence, the second objective of this empirical study that portfolios consisting of large numbers of higher risk securities are less risky than portfolios consisting of small numbers of low risk securities is clarified.

**Table 7.1 Summarized Results of Four Hypotheses**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Empirical Results</th>
<th>Related Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- There is a negative relationship between the quality rating of the portfolio and the risk of the portfolio, measured by beta.</td>
<td>- This result supports Wagner and Lau’s (1971) finding that the higher the quality rating of the portfolio, the lower the beta.</td>
</tr>
<tr>
<td>2</td>
<td>- There is no significant relationship between the quality rating of the portfolio and the average return of the portfolio.</td>
<td>- This result contradicts Wagner and Lau’s (1971) study, as they found that the average return of the portfolio increases as the quality of the individual issue declines.</td>
</tr>
<tr>
<td>3</td>
<td>- There is no significant relationship between the number of holdings in the portfolio and the average return of each portfolio.</td>
<td>- This result supports Wagner and Lau’s (1971) finding that increasing the number of holding does not, in and of itself, increase and decrease the rate of return of the portfolio.</td>
</tr>
<tr>
<td>4</td>
<td>- There is a positive relationship between the number of holding in the portfolio and coefficient of determination between the monthly portfolio return and the monthly market index return.</td>
<td>- This result supports Wagner and Lau’s (1971) finding that the coefficient of determination raises as the number of holding increases.</td>
</tr>
</tbody>
</table>
7.2 Limitations and Recommendations

The foregoing section concludes the empirical results of the study. This section will discuss about the limitations and recommendations that are beneficial for future studies.

First, due to the limitation of bond quality rating data, the securities can be divided into only three classes of portfolio, so some results of the study such as the second hypothesis may not be comparable to the international capital market. Moreover, there are only fifty-four securities, which have an assigned bond rating by Thai Rating and Information Services (TRIS) and have complete set of data during January 1996 through December 2001, so the sample size is small and the research cannot randomly select the security, so this may cause some errors in sampling. To get a clearer picture, further studies should test on the Asian capital market such as Nikkei Stock Market in Japan, Hang Seng Stock Market in Hong Kong because these stock markets in the developed countries provide the better data base and more complete set of information.

Second, the return of the security is proxied by the capital gain only, which may differ from the actual return. Since actual return is composed of capital gain and dividend yield, the stock’s dividend at date \( t \) is ignored due to the fact that the average yearly stock’s dividend yield is quite low, at 2.36% for years 1997 – 2001\(^3\) and also due to the lack of available monthly dividend information. Also, most Thai stocks declared ex dividend date at the beginning or middle of the month, which is not the same as the price at the end of the month that is used in this study. Thus, if the dividend data is available, future studies should pay more attention to more suitable variables closely representing the stock return.

Third, in theory, the market portfolio is composed of a proportional share of all the assets in the economy\(^4\). In addition to stocks and bonds, this includes


investments in assets such as real estate, diamond and gold, in short, every possible investment. Since it is not possible to construct such a market portfolio, this present study uses the return on some broadly based index of stock return. If it is possible, subsequent studies should include the other assets rather than stocks so that better estimates of diversification benefit on risk and return can be achieved.

Fourth, even though the empirical results seem to conform to the portfolio theory in the sense that the higher risk class portfolio gain more diversification benefits than the lower risk class portfolios when the investor increases the number of issues in the portfolio, it may not ensure that it will be applicable to all cases. Since the number of securities and the period of study are not intensive enough due to the ineffective database management in Thailand, all data is not kept in the database that provides permission for direct access by the public. Most available data were kept in the secondary source such as monthly trading report of SET. This makes the difficulty in collecting the data and this might bring about some errors. Therefore, if in the future, the database management in Thailand is more effective, more number of securities and more periods of study should be utilized.

Finally, the recommendations for the investors in the investment decision will be discussed. This empirical finding would be helpful for the investors by providing a superior investment strategy that can identify and reduce those risks that bear no compensation through the means of diversification in which the unsystematic risk can be reduced simply and effectively. At the same time, this present study would be beneficial to the investors to improve the investment performance by expanding the list of qualified securities to include the higher return, the higher risk securities, while offsetting the increase in market risk through more effective diversification by holding about fourteen to eighteen securities in one portfolio. Small accounts should be encouraged to pool their accounts to exploit these possibilities. Consequently, these recommendations fulfill the significance of this study as stated in the first chapter of this empirical study.
BIBLIOGRAPHY

Articles


Elton, Edwin J. and Gruber, Martin J. op. cit.: 265.

Fabozzi, Frank J. op. cit.: 85-86.


Shape, William F. and Alexander, Gordon J. *op.cit.*: 287-289.

Shape, William F., Alexander, Gordon J. and Bailey, Jefferey V. *op.cit.*: 274-275, 293.


**Books**


**Websites** (Visited period is July - August 2002)

Bank of Thailand Website Address: [www.bot.or.th](http://www.bot.or.th)

Stock Exchange of Thailand Website Address: [www.set.or.th](http://www.set.or.th)

Thai Rating and Information Services Website Address: [www.tris.co.th](http://www.tris.co.th)
Gross Domestic Products Growth of Thailand's Economy during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Thailand's International Trade during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Figure A5

Thailand's International Trade in Percentage Change during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Figure A4

Thailand's International Reserve and Balance of Payment during 1979-2001

Source: Bank Of Thailand website address: www.bot.or.th
Loan and NPLS Outstanding in Thailand during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Figure A7

Inflation Rate in Thailand during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Annual Interest Rate in Thailand during 1979-2001

Source: Bank of Thailand website address: www.bot.or.th
Event Chart of the SET Index Monthly Movements during 01/1992-12/2001

- The historical peak of the SET index at 1,682.85 on December
- February 1994: Abolishing the limit on the maximum amount of foreign currencies that may be taken out of the country when travelling abroad
- November 1993: Allowing insurance companies to invest up to 60% of total assets in stock and unit trusts
- The terrorist attacks that negatively affected investor confidence all over the world - including Thailand
- The general election and the court case concerning the Prime Minister’s Assets
- Downweighting of the Thai stock market in MSCI Index Calculation and Volatile oil prices in the world
- The democratic general election in September 1992
- Unwinding of onshore swap transactions of US$ 1.7 billion used by BoT to inject liquidity into the Bank sector prior to the Y2k period

Source: Bank of Thailand and Stock Exchange of Thailand
APPENDIX B
### Table B1

**Trading Hours of the Stock Exchange of Thailand**

Trading at the SET is conducted on all bank business days, normally from Monday through Friday. Each day there are two trading sessions, morning and afternoon.

<table>
<thead>
<tr>
<th>Trading Session</th>
<th>Trading Method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-opening 9:30 - T1</td>
<td>Call Market</td>
<td>T1 is the random opening time during 9:55-10:00 for calculating the opening price in the morning trading session.</td>
</tr>
<tr>
<td>Morning Trading Session T1 - 12:30</td>
<td>AOM, PT</td>
<td>-</td>
</tr>
<tr>
<td>Intermission 12:30 - 14:00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pre-opening II 14:00 - T2</td>
<td>Call Market</td>
<td>T2 is the random opening time during 14:25 - 14:30 for calculating the opening price in the afternoon trading session.</td>
</tr>
<tr>
<td>Afternoon Trading Session T2 - 16:30</td>
<td>AOM, PT</td>
<td>The trading system stops matching all orders at 16:30; however orders can still be sent for queueing until the market closes (T3).</td>
</tr>
<tr>
<td>16:30 - T3</td>
<td>Call Market, PT</td>
<td>T3 is the random closing time during 16:35 - 16:40 for calculating the closing price of each day.</td>
</tr>
<tr>
<td>Off-hour Trading T3 - 17:00</td>
<td>PT</td>
<td>The trading system allows only PT transactions to be recorded.</td>
</tr>
</tbody>
</table>

Source: Stock Exchange of Thailand website address: [www.set.or.th](http://www.set.or.th)
Table B2

Rules and Regulations of Off-Hours Trading

Off-hours trading is the extra trading period after the closing of the regular trading session. This facility enables investors, especially institutional investors and foreign investors, to adjust their positions. It also serves as a tool for traders to adjust error transactions or cover the transactions executed in the regular session. Off-hours trading starts from the random closing time until 17:00 hours. Only Put-Through transactions can be recorded on the main board, big lot board and foreign board, as specified in the following rules:

<table>
<thead>
<tr>
<th>Trading Boards</th>
<th>Volume/Value</th>
<th>Price</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Board</td>
<td>Each transaction must be in board lots with a volume less than 1 million shares and a value less than 3 Million baht.</td>
<td>Closing price or average price* of that trading day. If neither is available, the last closing price will be used.</td>
<td>Trading both 1 firm and 2 firm PT, Advertisement via trading system is allowed.</td>
</tr>
<tr>
<td>Big-Lot Board</td>
<td>Each transaction must have a minimum volume of at least 1 million shares or a minimum value of at least 3 million baht.</td>
<td>No spread and no daily price limit.</td>
<td>Trading both 1 firm and 2 firm PT, Advertisement via trading system is allowed.</td>
</tr>
<tr>
<td>Foreign Board</td>
<td>No minimum volume and value requirement.</td>
<td>No spread and no daily price limit.</td>
<td>Trading both 1 firm and 2 firm PT, Advertisement via trading system is allowed.</td>
</tr>
</tbody>
</table>

Remark: * The average price of local or foreign shares is the value-weighted average from transactions executed by the Automatic Order Matching Method of that trading day on the main board, or the foreign board, respectively (including opening and closing prices).

Source: Stock Exchange of Thailand website address: www.set.or.th
Table B3

Price Regulations

Floor & Ceiling Limits

On 1 December 1997, the SET introduced new floor and ceiling price limits for trading. The former limits allowed stock prices to fluctuate within a range of 10 per cent, while the current limits allow prices of a stock to fluctuate within a range of 30 per cent of the previous closing price on the main board; however, if the market price is less than 1 baht, stock prices can fluctuate within a range of 100 per cent. Ceiling and floor limits apply to each trading board utilizing the AOM system, except for the foreign board.

Price Spreads

Price movements, as prescribed by the SET for securities trading, vary according to each market price level as follows:

<table>
<thead>
<tr>
<th>Market Price Level (baht)</th>
<th>Spread (baht) (effective from Nov 5, 2001 onwards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2</td>
<td>0.01</td>
</tr>
<tr>
<td>2 up to less than 5</td>
<td>0.02</td>
</tr>
<tr>
<td>5 up to less than 10</td>
<td>0.05</td>
</tr>
<tr>
<td>10 up to less than 25</td>
<td>0.10</td>
</tr>
<tr>
<td>25 up to less than 50</td>
<td>0.25</td>
</tr>
<tr>
<td>50 up to less than 100</td>
<td>0.50</td>
</tr>
<tr>
<td>100 up to less than 200</td>
<td>1.00</td>
</tr>
<tr>
<td>200 up to less than 400</td>
<td>2.00</td>
</tr>
<tr>
<td>400 up to less than 800</td>
<td>4.00</td>
</tr>
<tr>
<td>800 up</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Source: Stock Exchange of Thailand website address: www.set.or.th
Table B4

Taxation on Dividends and Interest

Thai and foreign investors are subject to taxation on dividends and interest earned from their securities investment in Thailand, according to the following types of income.

<table>
<thead>
<tr>
<th>Type of Income</th>
<th>Tax Rate</th>
</tr>
</thead>
</table>
| 1. Income from direct investment in the SET Dividends,  
  - Individual investor  
  - Juristic investor  
  Interest  
  - Individual investor  
  - Foreign juristic investor who does not operate in Thailand**  
  - Other juristic investors | 10% withholding tax  
  10% withholding tax  
  15% withholding tax  
  15% withholding tax  
  Tax free |
| 2. Income from investment in the foreign investment fund registered in Thailand Dividends.  
  - Individual investor  
  - Juristic investor | 10% withholding tax  
  10% withholding tax |

** In case of a foreign juristic investor not operating business in Thailand, but who resides in a country with double tax treaties with Thailand, will be exempt or given special privilege from the withholding tax of 15%.

Source: Stock Exchange of Thailand website address: www.set.or.th
Table B5

Information Disclosure Requirements of the Stock Exchange of Thailand

<table>
<thead>
<tr>
<th>Information Required</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Financial Statements</td>
<td>Within 30 days from the end of the accounting period</td>
</tr>
<tr>
<td>- Unreviewed and unaudited financial statements</td>
<td>Within 45 days from the end of each quarter</td>
</tr>
<tr>
<td>- Reviewed quarterly financial statement</td>
<td>Within 3 months from the end of the accounting period, or</td>
</tr>
<tr>
<td>- Audited annual or semi-annual financial statement</td>
<td>Within 60 days to obviate submitting quarterly financial statement</td>
</tr>
<tr>
<td>2. Annual report</td>
<td>Within 4 months from the end of the accounting period</td>
</tr>
<tr>
<td>3. Disclosure report of additional information</td>
<td>Within 3 months from the end of the accounting period</td>
</tr>
<tr>
<td>4. Price-sensitive information on operational and financial structure</td>
<td>At least one hour prior to next trading session. If reported during a trading session, trading in the stock will be halted until the information is thoroughly disclosed to the public.</td>
</tr>
</tbody>
</table>

Source: Stock Exchange of Thailand, *Fact Book 2001*
<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of the applicant</td>
<td>Public limited company or corporation established under special law</td>
</tr>
<tr>
<td>Nature of business</td>
<td>Be economically and socially benefit to the country</td>
</tr>
<tr>
<td>Paid-up capital for common shares (after public offering)</td>
<td>Greater than or equal to 200 million bath</td>
</tr>
<tr>
<td>Distribution of minor share holding</td>
<td>Greater than or equal to 600 million bath</td>
</tr>
<tr>
<td>- Number of minor share holders</td>
<td>Greater than 20 percent of paid-up capital</td>
</tr>
<tr>
<td>Number of shares held by minor shareholders</td>
<td>Greater than 15 percent or 10 million shares</td>
</tr>
<tr>
<td>- Paid-up capital less than 500 million bath</td>
<td>Greater than 12.5 percent or 15 million shares</td>
</tr>
<tr>
<td>- Paid-up capital between 500-999 million bath</td>
<td>Greater than 10 percent or 125 million shares</td>
</tr>
<tr>
<td>- Paid-up capital between 1,000-9,999 million bath</td>
<td></td>
</tr>
<tr>
<td>- Paid-up capital more than 10,000 million bath</td>
<td></td>
</tr>
<tr>
<td>Public offering</td>
<td>Has been granted approval by the SET</td>
</tr>
<tr>
<td>- Approval</td>
<td></td>
</tr>
<tr>
<td>Number of shares cumulatively offered for sale</td>
<td>Greater than 15 percent of paid-up capital</td>
</tr>
<tr>
<td>- Paid-up capital less than 500 million bath</td>
<td>Greater than 10 percent or 7.5 million shares</td>
</tr>
<tr>
<td>- Paid-up capital greater than 500 million bath</td>
<td>Offering through an underwriter</td>
</tr>
<tr>
<td>- Method of public offering</td>
<td></td>
</tr>
<tr>
<td>Track record and market capitalization</td>
<td>The business must be in operation for at least 3 years</td>
</tr>
<tr>
<td>Dividend</td>
<td>Dividend policy must be clearly stated</td>
</tr>
</tbody>
</table>

Source: Stock Exchange of Thailand Listing Department, Fact Book 2001
<table>
<thead>
<tr>
<th>Broker No.</th>
<th>Name and Address</th>
<th>Symbols</th>
<th>Telephone</th>
</tr>
</thead>
</table>
| 2         | TISCO Securities Company Limited  
48/2 TISCO Tower, North Sathon Road,  
Bangrak, Bangkok, 10500  
http://www.tiscosec.com | TSC | 66-2633-6999 |
| 3         | Adkinson Securities Public company Limited  
132 Sindhom Building, 2/F, Wireless Road,  
Lumpini, Pathumwan, Bangkok, 10330  
http://www.asl.co.th | ASL | 66-2263-3733 |
| 4         | DBS Vickers Securities (Thailand) Company Ltd.  
989 Siam Tower Building, 14th-15th Floor,  
Rama I Road, Pathumwan, Bangkok, 10330  
http://www.th-dbsvickers.com | DBSV | 66-2658-1222 |
| 5         | SICCO Securities Public Company Limited  
130-132 Sindhom Tower 2, 1-2/F, Wireless Road, Lumpini, Pathumwan, Bangkok, 10330  
http://www.sicco.com | SICSEC | 66-2627-3100 |
| 6         | Merrill Lynch Phatra Securities company Limited  
252/6 Muangthat-Phatra Office Tower 1, 6-11/F  
Rachadapisak Road, Huaykwang, Bangkok, 10320  
http://www.ml.com | MLP | 66-2305-9000 |
| 7         | BT Securities Company Limited  
44 Bankthai Building, G Floor, 24-26 Soi Lang Suan, Plenchit Rod, Lumpini, Phatumwan, Bangkok, 10330  
http://www.bt.securities.co.th | BTSEC | 66-2657-9000 |
| 8         | ABN Amro Asia Securities Public Company Limited  
175 Sathorn City Tower, 3/F, South Sathon Rd,  
Tungmahamek, Sathon, Bangkok, 10120  
http://www.ast.co.th | AST | 66-2285-1666 | 66-2285-1777 | 66-2679-6888 |
<table>
<thead>
<tr>
<th>No.</th>
<th>Company Name</th>
<th>Contact</th>
<th>Address</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Indosuez W.L.Carr Securities (Thailand) Limited</td>
<td>IWICS</td>
<td>6/F, Indosuez, House, 152 Wireless Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td>66-2256-7888 66-2256-7999</td>
</tr>
<tr>
<td>12</td>
<td>Yuanta Securities (Thailand) Company Limited</td>
<td>YUANTA</td>
<td>540 Mercury Tower (One Place Building), 8-10/F Ploenchit Road, Pathumwan, Bangkok, 10330</td>
<td>66-2658-6300</td>
</tr>
<tr>
<td>13</td>
<td>KGI Securities (Thailand) Public Company Limited</td>
<td>KGI</td>
<td>323 United Center Building, 23/F, Silom Road, Bangkok, 10500</td>
<td>66-2231-1111</td>
</tr>
<tr>
<td>14</td>
<td>Capital Nomura Securities Public Company Limited</td>
<td>CNS</td>
<td>21/3 Thai Wah Tower, Ground Floor, south Sathorn Road, Sathon, Bangkok, 10120</td>
<td>66-2285-0060 66-2677-3333</td>
</tr>
<tr>
<td>15</td>
<td>SG Asia Credit Securities Company Limited</td>
<td>SGACS</td>
<td>622 The Emporium Tower, 11/F, Sukhumvit 24 Road, Klongton, Klongtoey, Bangkok, 10110</td>
<td>66-2658-9000</td>
</tr>
<tr>
<td>16</td>
<td>National Securities Company Limited</td>
<td>NATSEC</td>
<td>444 MBK Tower, 14/F, Phayathai Road, Wang Mai, Pathumwan, Bangkok, 10330</td>
<td>66-2217-9595 66-2217-9622 66-2217-8888</td>
</tr>
<tr>
<td>19</td>
<td>Kiatnakin Securities Company Limited</td>
<td>KKS</td>
<td>500 Amarin Tower, 7/F, Ploenchit Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td>66-2256-9898 66-2256-9899</td>
</tr>
<tr>
<td>22</td>
<td>Trinity Securities Company Limited</td>
<td>TRINTY</td>
<td>179/109-110 Bangkok City Tower Building, 25/F, South Sathon Road, Tungmahamek, Sathon, Bangkok, 10120</td>
<td>66-2286-3999</td>
</tr>
<tr>
<td>23</td>
<td>SCB Securities Company Limited</td>
<td>SCBS</td>
<td>130 Sindhorn Building, Tower 3, 26/F, Wireless Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td>66-2263-3500</td>
</tr>
<tr>
<td>No.</td>
<td>Company Name</td>
<td>Abbreviation</td>
<td>Phone Numbers</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------</td>
<td>--------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>UOB Kay Hian Securities (Thailand) Company Limited</td>
<td>UOBKST</td>
<td>66-2659-8000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>130-132 Sindhorn Tower, Wireless Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>BFIT Securities Company Limited</td>
<td>BFITSEC</td>
<td>66-2677-4330</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25 Bangkok Insurance Building, 22/F, South Sathon Road, Sathon, Bangkok, 10120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.bfit.co.th">http://www.bfit.co.th</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>ING Securities (Thailand) Limited</td>
<td>INGT</td>
<td>66-2263-2888</td>
<td></td>
</tr>
<tr>
<td></td>
<td>130-132 Sindhorn Tower 1, 8/F, Wireless Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td></td>
<td>66-2263-2889</td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.ing.com">http://www.ing.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Ayadhya Securities Company Limited</td>
<td>AYS</td>
<td>66-2658-6767</td>
<td></td>
</tr>
<tr>
<td></td>
<td>898 Ploenchit Tower, 4/F, Ploenchit Road, Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.ays.co.th">http://www.ays.co.th</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Intel Vision Securities Company Limited</td>
<td>IVS</td>
<td>66-2658-5800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mercury Tower, 17th Floor, 540 Ploenchit Road, Lumpini, Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Phillip Securities (Thailand) Public Company Limited</td>
<td>PHILIP</td>
<td>66-2268-0999</td>
<td></td>
</tr>
<tr>
<td></td>
<td>849 Vorawat Building, 15/F, Silom Road, Bangkok, 10500</td>
<td></td>
<td>66-2635-1700</td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.philip.co.th">http://www.philip.co.th</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>United Securities Public Company Limited</td>
<td>US</td>
<td>66-2207-0038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1550 Grand Amarin Tower, 4-5/F, New Petchburi Road, Rachathewi, Bangkok, 10310</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.unitedsec.com">http://www.unitedsec.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>J.P. Morgan Securities (Thailand) Limited</td>
<td>JPM</td>
<td>66-2684-2600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 Bupphajit Building, 2-3 Floor,North Sathon Road, Silom, Bangrak, Bangkok, 10500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>KIM ENG Securities (Thailand) Company Limited</td>
<td>KIMENG</td>
<td>66-2658-6300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>540 Mercury Tower, 8-10/F, Ploenchit Road, Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.kimeng.co.th">http://www.kimeng.co.th</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>BNP Paribas Peregrine Securities (Thailand) Company Limited</td>
<td>BNPPP</td>
<td>66-2217-9711</td>
<td></td>
</tr>
<tr>
<td></td>
<td>444 MBK Tower, 19/F, Phayathai Road, Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Company Name</td>
<td>Code</td>
<td>Phone</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Seamico Securities Public Company Limited</td>
<td>Z-MICO</td>
<td>66-2695-5000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>287 Liberty Square, 16/F, Silom Road,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bangkok, Bangkok, 10500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.seamico.com">http://www.seamico.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>UBS Warburg Securities Company Limited</td>
<td>UBSW</td>
<td>66-2252-3867</td>
<td></td>
</tr>
<tr>
<td></td>
<td>93/1 Diethelm Tower A, 13/F, Wireless Road,</td>
<td></td>
<td>66-2651-5700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pathumwan, Bangkok, 10330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.ubswasburg.com">http://www.ubswasburg.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Table B8

### Bond Rating Symbols and Bond Rating Definitions

<table>
<thead>
<tr>
<th>Ratings Symbols</th>
<th>Rating Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AAA</strong></td>
<td>The highest rating with smallest degree of investment risk, extremely strong capacity to pay interest and repay principal on time, and unlikely to be affected by adverse changes in business, economic or other external conditions.</td>
</tr>
<tr>
<td><strong>AA</strong></td>
<td>The debt instrument with very low degree of investment risk, very strong capacity to pay interest and repay principal on time, but somewhat susceptible to the adverse changes in business, economic or other external conditions than the AAA rated issues.</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>The debt instrument with low investment risk, strong capacity to pay interest and repay principal on time, but more susceptible to the adverse changes in business, economic or other external conditions than debt in higher rated categories.</td>
</tr>
<tr>
<td><strong>BBB</strong></td>
<td>The debt instrument with moderate investment risk, moderate capacity to pay interest and repay principal on time, but is more vulnerable to adverse changes in business, economic or other external conditions which is likely to weaken the capacity to pay interest and repay principal than debt in higher rated categories.</td>
</tr>
<tr>
<td><strong>BB</strong></td>
<td>The debt instrument with high investment risk, less than moderate capacity to pay interest and repay principal on time, and can be significantly affected by adverse changes in business, economic or other external conditions with lower creditors’ protection than provided by higher ratings.</td>
</tr>
<tr>
<td>Ratings Symbols</td>
<td>Rating Definitions</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>B</td>
<td>The debt instrument with very high investment risk, low capacity to pay interest and repay principal on time. Adverse changes in business, economic or other external conditions would lead to lack of ability or willingness to pay interest and repay principal.</td>
</tr>
<tr>
<td>C</td>
<td>The debt instrument with highest risk of default than debt in higher categories, significant inability to pay interest and repay principal on time and dependent upon favorable business, economic or other external conditions in order to meet its obligations.</td>
</tr>
<tr>
<td>D</td>
<td>The debt instrument which payment is in default</td>
</tr>
</tbody>
</table>

Source: Thai Rating and Information Services website address: www.tris.or.th
Table B9

Listed Companies during 1996-2001

<table>
<thead>
<tr>
<th>Listed Companies</th>
<th>Symbols</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.AGRIBUSINESS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Charoen Pokphand Foods Public Company Limited</td>
<td>CPF</td>
<td>A+</td>
</tr>
<tr>
<td>313 C.P. Tower, 15th Fl., Silom Rd., Bangkok, 10500</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.BANKING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Bank of Ayudhya Public Company Limited</td>
<td>BAY</td>
<td>BBB+</td>
</tr>
<tr>
<td>1222 Rama III Rd., Bangpongpong, Yannava, Bkk. 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Bangkok Bank Public Company Limited</td>
<td>BBL</td>
<td>A-</td>
</tr>
<tr>
<td>333 Silom Rd., Bangrak, Bangkok, 10500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Bank of Asia Public Company Limited</td>
<td>BOA</td>
<td>A-</td>
</tr>
<tr>
<td>191 South Sathorn Rd., Bangkok, 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) The Industrial Finance Corporation of Thailand</td>
<td>IFCT</td>
<td>A+</td>
</tr>
<tr>
<td>1770 New Petchburi Rd., Bangkok, 10310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Krung Thai Bank Public Company Limited</td>
<td>KTB</td>
<td>A-</td>
</tr>
<tr>
<td>35 Sukhumvit Rd., Klongtoei Nua, Wattana, 10110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) The Siam Commercial Bank Public Co., Limited</td>
<td>SCB</td>
<td>A-</td>
</tr>
<tr>
<td>9 Rajdamri Rd., Jatujak, Bangkok, 10900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) The Thai Military Bank Public Company Limited</td>
<td>TMB</td>
<td>BBB</td>
</tr>
<tr>
<td>3000 Phaholyothin Rd., Jatujak, Bangkok, 10900</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3.BUILDING &amp; FURNISHING MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9) Vanachai Group Public Company Limited</td>
<td>VNG</td>
<td>BB+</td>
</tr>
<tr>
<td>2/1 Sunun Bldg., Pibulsongkram Rd., Bangsur, 10800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CHEMICALS, PLASTICS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>10) National Petrochemical Public Company Limited</td>
<td>NPC</td>
<td>BBB+</td>
</tr>
<tr>
<td>123 Sun Towers Bldg., 31st Fl., Vibhavadee Rd., 10900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11) Vinythai Public Company Limited</td>
<td>VNT</td>
<td>BBB</td>
</tr>
<tr>
<td>3656/41 Green Tower Bldg., 14th Fl., Rama 4 Rd., 10110</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. COMMERCE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12) Berli Jucker Public Company Limited</td>
<td>BJC</td>
<td>AA-</td>
</tr>
<tr>
<td>99 Sukhumvit 42 Rd., Bangkok, 10110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13) I.C.C. International Public Company Limited</td>
<td>ICC</td>
<td>AA-</td>
</tr>
<tr>
<td>757/10 Soi Pradoo 1, Sathupradit Rd., Bangkok, 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14) Saha Pathana Inter-Holding Public Co., Limited</td>
<td>SPI</td>
<td>A</td>
</tr>
<tr>
<td>2156 New Petchburi Rd., Bangkapi, Huaykwang, 10310</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. COMMUNICATION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15) Advanced Info Service Public Company Limited</td>
<td>ADVANC</td>
<td>AA-</td>
</tr>
<tr>
<td>414 Phaholyothin Rd., Phayathai, Bangkok, 10400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16) Shinawatra Satellite Public Company Limited</td>
<td>SATTEL</td>
<td>BBB+</td>
</tr>
<tr>
<td>41/103 Ratanathibate Rd., Nonthaburi, 11000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17) Shin Corporation Public Company Limited</td>
<td>SHIN</td>
<td>A+</td>
</tr>
<tr>
<td>414 Phaholyothin Rd., Phayathai, Bangkok, 10400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18) Telecomasia Corporation Public Company Limited</td>
<td>TA</td>
<td>BBB</td>
</tr>
<tr>
<td>Telecom Tower., 18 Rachadapisek Rd., Huaykwang, 10320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19) United Communication Industry Public Co., Ltd.</td>
<td>UCOM</td>
<td>BBB-</td>
</tr>
<tr>
<td>499 Moo 3, Vibhavadee-Rangsit Rd., Jatujak, Bkk. 10900</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. ENERGY</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20) Banpu Public Company Limited</td>
<td>BANPU</td>
<td>A-</td>
</tr>
<tr>
<td>1550 Grand Amarin Tower Bldg., 8th Fl., Petchburi Road, Bangkok, 10310</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

178
<table>
<thead>
<tr>
<th></th>
<th>Company Name</th>
<th>Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>The Cogeneration Public Company Limited</td>
<td>COCO</td>
<td>BBB+</td>
</tr>
<tr>
<td></td>
<td>Empire Tower, 38th Fl., South Sathorn Road, Yannawa, 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Electricity Generating Public Company Limited</td>
<td>EGCOMP</td>
<td>AA+</td>
</tr>
<tr>
<td></td>
<td>EGCO Tower, 222 Moo 5, Vibhavadi Rd., Laksi, 10210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>PTT Exploration and Production Public Co., Ltd.</td>
<td>PTTEP</td>
<td>AA+</td>
</tr>
<tr>
<td></td>
<td>555 PTTEP Office Bldg., Vibhavadee Rd., Jatujak, 10900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Kiatnakin Finance and Securities Public Co., Ltd.</td>
<td>KK</td>
<td>BBB+</td>
</tr>
<tr>
<td></td>
<td>Amarin Tower, FL12, 500 Ploenchit Rd., Pathum Wan, Bangkok, 10330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Siam Panich Leasing Public Company Limited</td>
<td>SPL</td>
<td>BBB+</td>
</tr>
<tr>
<td></td>
<td>32/24-26, 53 Sukhumvit 21 Rd., Wantana, Bkk., 10110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Seamico Securities Public Company Limited</td>
<td>Z-MICO</td>
<td>BBB-</td>
</tr>
<tr>
<td></td>
<td>287 Liberty Square Bldg., 16th-18th Fl., Silom Rd. 10500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>The Ayudhya Insurance Public Company Limited</td>
<td>AYUD</td>
<td>AA-</td>
</tr>
<tr>
<td></td>
<td>898 Ploenchit Tower Bldg., 7th Fl., Patumwan, 10330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Bangkok Insurance Public Company Limited</td>
<td>BKI</td>
<td>AA</td>
</tr>
<tr>
<td>29</td>
<td>The Safety Insurance Public Company Limited</td>
<td>SAFE</td>
<td>A-</td>
</tr>
<tr>
<td></td>
<td>26/18 Orakarn Bldg., 6th Fl., Chidlom Rd., Bkk., 10330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>The Samaggi Insurance Public Company Limited</td>
<td>SMG</td>
<td>A-</td>
</tr>
<tr>
<td></td>
<td>2/4 Samaggi Insurance Tower, 12th Fl., Vibhavadi-rangsit Road, Bangkok, 10210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>National Multimedia Group Public Co., Limited</td>
<td>NATION</td>
<td>BBB</td>
</tr>
<tr>
<td></td>
<td>44 Moo 10 Bangna-Trad Rd. (KM.4.5), Bangkok, 10260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company Name</td>
<td>Code</td>
<td>Rating</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Se-Education Public Company Limited</td>
<td>SE-ED</td>
<td>BBB</td>
<td></td>
</tr>
<tr>
<td>46/87-90 Bangna-Trad Rd., Bangna, Bangkok, 10260</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>11. PROPERTY DEVELOPMENT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Pattana Public Company Limited</td>
<td>CPN</td>
<td>BBB+</td>
<td></td>
</tr>
<tr>
<td>1693 Central Plaza Ladprao Bldg., Phaholyothin Road, Jatujak, Bangkok, 10900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land and House Public Company Limited</td>
<td>LH</td>
<td>BBB+</td>
<td></td>
</tr>
<tr>
<td>Q.House Convent Bldg., 4-5th Fl., Silom, Bkk., 10500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality-Houses Public Company Limited</td>
<td>QH</td>
<td>BBB</td>
<td></td>
</tr>
<tr>
<td>11 Q.House Sathorn Bldg., G-M Fl., South Sathorn Road, Bangkok, 10120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>12. PULP, PAPER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Siam Pulp &amp; Paper Public Company Limited</td>
<td>SPP</td>
<td>BBB</td>
<td></td>
</tr>
<tr>
<td>1 Siam Cement Rd., Bangkok, 10800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>13. COMPANIES UNDER REHABILITATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abico Holdings Public Company Limited</td>
<td>ABICO</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>401/1 Abico Bldg., 5th Fl, Phaholyothin Road, Pathumthani, Bangkok, 12130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia Hotel Public Company Limited</td>
<td>ASIA</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>296 Phayathai Rd., Bangkok, 10400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.Grimm Engineering Systems Public Company Ltd.</td>
<td>BGES</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>33 Soi Lertnava, Krungthepkreetha Rd., Bangkok, 10240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Bumrungrad Hospital Public Company Limited</td>
<td>BH</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>210 Soi Reunrudee, Sukhumvit Rd., Khlongtoei, 10110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangkok Steel Industry Public Company Limited</td>
<td>BSI</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>205 United Flour Mill Bldg., Rajawong Rd., Bkk., 10100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distar Electric Corporation Public Company Limited</td>
<td>DISTAR</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>214, 5th Fl., Wongviyai, Ladya, Klongsan, Bkk, 10600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Company Name</td>
<td>Company Code</td>
<td>Country</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>43</td>
<td>General Engineering Public Company Limited</td>
<td>GEL</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>44/2 Moo 2, Bangkae, Pathumthani, 12000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Inter Fareast Engineering Public Company Limited</td>
<td>IFEC</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>29 Soi Chitraranukroh (Ramkhamheng 22), Bkk., 10240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Krisda Mahanakorn Public Company Limited</td>
<td>KMC</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>97/4 Sukhothai Rd., Dusit, Bangkok, 10300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Prasit Patana Public Company Limited</td>
<td>PYT</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>364/1 Sri Ayudhya Rd., Rajthavee, Bangkok, 10400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>The Royal Ceramic Industry Public Co., Limited</td>
<td>RCI</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>50 Soi Sukhumvit 62 Yak 8, Sukhumvit 62 Rd., 10250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Robinson Department Store Public Co., Limited</td>
<td>ROBINS</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>139 ratchadapisek Rd., Dindaeng Bangkok, 10320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Sikarin Public Company Limited</td>
<td>SIKRIN</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>4/29 Srinakarin Rd., Phakanong, Bangkok, 10260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Sino-Thai Engineering &amp; Construction PLC., Ltd.</td>
<td>STECON</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>32/59-60 Sino-Thai Tower, Sukhumvit 21 Rd., 10110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Thai Heat Exchange Public Company Limited</td>
<td>THECO</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>1364 Ramkhamheng Rd., Suan Luang, Bangkok, 10250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Thai Petrochemical Industry Public Co., Limited</td>
<td>TPI</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>26/56 TPI Tower Bldg., 8th Fl., Chan Tat Mai Rd.,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sathon, Bangkok, 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Thai-Wah Public Company Limited</td>
<td>TWC</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>21/63-66 Thai Wah Tower, South Sathorn, Bkk., 10120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Tanayong Public Company Limited</td>
<td>TYONG</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>100-100/1 Moo4, KM.4, Bangna-Trat RD., Samutprakarn, Bangkok, 10540</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Research Department of Kiatnakin Finance & Securities Public Company Limited
Table C1

Average Return, Beta, and Standard Deviation
for Class A Securities during January 1996 to December 2001

<table>
<thead>
<tr>
<th>Stock Symbol</th>
<th>Average Return</th>
<th>Beta</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANC</td>
<td>-0.00136</td>
<td>0.830669</td>
<td>0.200953</td>
</tr>
<tr>
<td>AYUD</td>
<td>-0.00383</td>
<td>-0.15344</td>
<td>0.096621</td>
</tr>
<tr>
<td>BANPU</td>
<td>-0.0217</td>
<td>0.969192</td>
<td>0.200551</td>
</tr>
<tr>
<td>BBL</td>
<td>-0.01197</td>
<td>1.203678</td>
<td>0.177607</td>
</tr>
<tr>
<td>BJC</td>
<td>0.004616</td>
<td>0.478646</td>
<td>0.177587</td>
</tr>
<tr>
<td>BKI</td>
<td>-0.00622</td>
<td>0.44879</td>
<td>0.113238</td>
</tr>
<tr>
<td>BOA</td>
<td>-0.01493</td>
<td>1.085945</td>
<td>0.215725</td>
</tr>
<tr>
<td>CPF</td>
<td>-0.00846</td>
<td>0.825645</td>
<td>0.209012</td>
</tr>
<tr>
<td>EGCOMP</td>
<td>-0.00677</td>
<td>0.601785</td>
<td>0.116583</td>
</tr>
<tr>
<td>ICC</td>
<td>0.011597</td>
<td>0.461686</td>
<td>0.179268</td>
</tr>
<tr>
<td>IFCT</td>
<td>0.012955</td>
<td>2.4756</td>
<td>0.381822</td>
</tr>
<tr>
<td>KTB</td>
<td>-0.01187</td>
<td>1.571972</td>
<td>0.229129</td>
</tr>
<tr>
<td>PTTEP</td>
<td>-0.00263</td>
<td>0.660843</td>
<td>0.144654</td>
</tr>
<tr>
<td>SAFE</td>
<td>0.004878</td>
<td>0.769295</td>
<td>0.234095</td>
</tr>
<tr>
<td>SCB</td>
<td>-0.00993</td>
<td>1.894968</td>
<td>0.268802</td>
</tr>
<tr>
<td>SHIN</td>
<td>-0.00443</td>
<td>1.549794</td>
<td>0.259452</td>
</tr>
<tr>
<td>SMG</td>
<td>0.013908</td>
<td>0.22587</td>
<td>0.168441</td>
</tr>
<tr>
<td>SPI</td>
<td>0.014783</td>
<td>0.510162</td>
<td>0.149785</td>
</tr>
<tr>
<td>Average</td>
<td>-0.0023</td>
<td>0.911728</td>
<td>0.19574</td>
</tr>
</tbody>
</table>
Table C2

Average Return, Beta, and Standard Deviation
for Class B Securities during January 1996 to December 2001

<table>
<thead>
<tr>
<th>Stock Symbol</th>
<th>Average Return</th>
<th>Beta</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAY</td>
<td>-0.01399</td>
<td>1.818718</td>
<td>0.278613</td>
</tr>
<tr>
<td>COCO</td>
<td>-0.00869</td>
<td>0.933669</td>
<td>0.186589</td>
</tr>
<tr>
<td>CPN</td>
<td>0.025706</td>
<td>0.804606</td>
<td>0.301863</td>
</tr>
<tr>
<td>KK</td>
<td>0.037947</td>
<td>2.330315</td>
<td>0.395277</td>
</tr>
<tr>
<td>LH</td>
<td>0.01002</td>
<td>1.705364</td>
<td>0.300746</td>
</tr>
<tr>
<td>NATION</td>
<td>0.00257</td>
<td>0.740101</td>
<td>0.203004</td>
</tr>
<tr>
<td>NPC</td>
<td>0.020833</td>
<td>1.314203</td>
<td>0.239316</td>
</tr>
<tr>
<td>QH</td>
<td>0.024541</td>
<td>2.527524</td>
<td>0.421991</td>
</tr>
<tr>
<td>SATTEL</td>
<td>0.02397</td>
<td>1.563804</td>
<td>0.321157</td>
</tr>
<tr>
<td>SE-ED</td>
<td>0.028429</td>
<td>0.371278</td>
<td>0.160258</td>
</tr>
<tr>
<td>SPL</td>
<td>0.052848</td>
<td>2.211435</td>
<td>0.449049</td>
</tr>
<tr>
<td>SPP</td>
<td>0.019722</td>
<td>0.327168</td>
<td>0.115324</td>
</tr>
<tr>
<td>TA</td>
<td>0.003458</td>
<td>1.867233</td>
<td>0.28546</td>
</tr>
<tr>
<td>TMB</td>
<td>-0.0163</td>
<td>1.766124</td>
<td>0.262104</td>
</tr>
<tr>
<td>UCOM</td>
<td>-0.00949</td>
<td>1.5832</td>
<td>0.253239</td>
</tr>
<tr>
<td>VNG</td>
<td>0.038949</td>
<td>0.722898</td>
<td>0.37228</td>
</tr>
<tr>
<td>VNT</td>
<td>0.000424</td>
<td>1.095804</td>
<td>0.243874</td>
</tr>
<tr>
<td>Z-MICO</td>
<td>0.068985</td>
<td>1.795747</td>
<td>0.518229</td>
</tr>
<tr>
<td>Average</td>
<td>0.017219</td>
<td>1.415511</td>
<td>0.29491</td>
</tr>
</tbody>
</table>
Table C3

Average Return, Beta, and Standard Deviation
for Class C Securities during January 1996 to December 2001

<table>
<thead>
<tr>
<th>Stock Symbol</th>
<th>Average Return</th>
<th>Beta</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABICO</td>
<td>-0.00157</td>
<td>-0.61589</td>
<td>0.356612</td>
</tr>
<tr>
<td>ASIA</td>
<td>-0.00476</td>
<td>0.108415</td>
<td>0.151645</td>
</tr>
<tr>
<td>BGES</td>
<td>-0.01036</td>
<td>-0.21878</td>
<td>0.367653</td>
</tr>
<tr>
<td>BH</td>
<td>-0.02902</td>
<td>0.236002</td>
<td>0.175861</td>
</tr>
<tr>
<td>BSI</td>
<td>-0.01643</td>
<td>0.089505</td>
<td>0.272272</td>
</tr>
<tr>
<td>DISTAR</td>
<td>-0.01189</td>
<td>-0.27057</td>
<td>0.27592</td>
</tr>
<tr>
<td>GEL</td>
<td>0.017801</td>
<td>1.118799</td>
<td>0.369402</td>
</tr>
<tr>
<td>IFEC</td>
<td>-0.00529</td>
<td>0.236954</td>
<td>0.218465</td>
</tr>
<tr>
<td>KMC</td>
<td>0.023589</td>
<td>-0.05094</td>
<td>0.459482</td>
</tr>
<tr>
<td>PYT</td>
<td>-0.03013</td>
<td>0.352626</td>
<td>0.17483</td>
</tr>
<tr>
<td>RCI</td>
<td>0.009664</td>
<td>0.983917</td>
<td>0.33928</td>
</tr>
<tr>
<td>ROBINS</td>
<td>0.013292</td>
<td>-0.31911</td>
<td>0.355282</td>
</tr>
<tr>
<td>SIKRIN</td>
<td>-0.00279</td>
<td>0.064254</td>
<td>0.272887</td>
</tr>
<tr>
<td>STECON</td>
<td>-0.00062</td>
<td>-0.21929</td>
<td>0.289798</td>
</tr>
<tr>
<td>THECO</td>
<td>0.025354</td>
<td>0.375955</td>
<td>0.541887</td>
</tr>
<tr>
<td>TPI</td>
<td>0.006011</td>
<td>1.952544</td>
<td>0.317777</td>
</tr>
<tr>
<td>TWC</td>
<td>0.02135</td>
<td>1.83245</td>
<td>0.410735</td>
</tr>
<tr>
<td>TYONG</td>
<td>0.028899</td>
<td>-0.11567</td>
<td>0.576807</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.001839</strong></td>
<td><strong>0.307842</strong></td>
<td><strong>0.329255</strong></td>
</tr>
</tbody>
</table>
Table C4
Key Financial Ratios of SPL and Z-MICO

<table>
<thead>
<tr>
<th>Earning Per Share (Baht)</th>
<th>SET</th>
<th>Finance and Security Sector</th>
<th>SPL</th>
<th>Z-MICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>3.59</td>
<td>1.39</td>
<td>3.39</td>
<td>-4</td>
</tr>
<tr>
<td>2000</td>
<td>0.74</td>
<td>-0.62</td>
<td>3.07</td>
<td>-3.81</td>
</tr>
<tr>
<td>1999</td>
<td>-3</td>
<td>-4.79</td>
<td>4.27</td>
<td>4.49</td>
</tr>
<tr>
<td>1998</td>
<td>0.12</td>
<td>-8.38</td>
<td>-5.32</td>
<td>2.84</td>
</tr>
<tr>
<td>1997</td>
<td>-14.91</td>
<td>-18.35</td>
<td>-11.09</td>
<td>-6.18</td>
</tr>
<tr>
<td>Average</td>
<td>-2.692</td>
<td>-6.15</td>
<td>-1.136</td>
<td>-1.332</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return on Asset (%)</th>
<th>SET</th>
<th>Finance and Security Sector</th>
<th>SPL</th>
<th>Z-MICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2.03</td>
<td>1.46</td>
<td>4.9</td>
<td>-13.17</td>
</tr>
<tr>
<td>2000</td>
<td>-0.97</td>
<td>0.49</td>
<td>5.9</td>
<td>-12.55</td>
</tr>
<tr>
<td>1999</td>
<td>-5.34</td>
<td>-7.47</td>
<td>6.9</td>
<td>10.77</td>
</tr>
<tr>
<td>1998</td>
<td>-3.07</td>
<td>-8.47</td>
<td>-0.08</td>
<td>10.33</td>
</tr>
<tr>
<td>1997</td>
<td>-7.06</td>
<td>-7.66</td>
<td>-0.13</td>
<td>-0.11</td>
</tr>
<tr>
<td>Average</td>
<td>-2.882</td>
<td>-4.33</td>
<td>3.498</td>
<td>-0.946</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return on Equity (%)</th>
<th>SET</th>
<th>Finance and Security Sector</th>
<th>SPL</th>
<th>Z-MICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>19.5</td>
<td>6.56</td>
<td>19.19</td>
<td>-23.79</td>
</tr>
<tr>
<td>2000</td>
<td>-9.53</td>
<td>2.22</td>
<td>21.32</td>
<td>-17.14</td>
</tr>
<tr>
<td>1999</td>
<td>-47.77</td>
<td>-34.45</td>
<td>24.75</td>
<td>15.51</td>
</tr>
<tr>
<td>1998</td>
<td>-29.62</td>
<td>-88.92</td>
<td>-2.24</td>
<td>29.34</td>
</tr>
<tr>
<td>1997</td>
<td>-77.68</td>
<td>-83.65</td>
<td>-1.44</td>
<td>0.27</td>
</tr>
<tr>
<td>Average</td>
<td>-29.02</td>
<td>-39.648</td>
<td>12.316</td>
<td>0.838</td>
</tr>
</tbody>
</table>

St. Gabriel's Library, Au