The Effect of Economic Factors on the Performance of the Australian Stock Market

A thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy

by

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DECLARATION

I, Riza ERDUGAN, declare that the PhD thesis entitled the effect of economic factors on the performance of the Australian Stock Market is no more than 100,000 words in length, exclusive of tables, figures, appendices, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Riza Erdugan Date

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A project of this type is completely a team effort. The assistance of some people was particularly helpful in the development of this thesis.

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ABSTRACT

Portfolio theory, created by economists, was a breakthrough in financial economics. This theory looks at the stock market as a whole and analyses how, for a given rate of expected return, assets can be invested efficiently and how risk can be minimized. An effectively diversified portfolio minimizes the *unsystematic risk* which is affected by factors that are specific to the individual firms and, to some extent, the industry in which the firm operates. The unsystematic risk is, therefore, manageable by diversification. The *systematic risk*, however, cannot be managed by a simple approach of diversification. Despite the fact that there are many other factors contributing to the systematic risk of a portfolio, the risk and return of a diversified portfolio is mainly affected by domestic and overseas economic factors.

Macroeconomic variables have systematic effects on stock market returns. Asset prices depend on their exposure to the fundamental variables describing the economy. Any systematic variable that affects the economy at the same time affects the return of a single stock, and consequently the stock market return as a whole. Thus, these variables are the systematic risk factors.

Macroeconomics reduces the complex details of the economy to a few manageable fundamentals. The basis of these fundamentals is the interactions among the major markets, which are: goods and services market (product market), stock market, money market, labour market, natural resources market, foreign exchange market and foreign markets. On the other hand, portfolio theory eliminates the systematic risk determined by firm specific factors.

The Efficient Market Hypothesis (EMH), Rational Expectations and Arbitrage Pricing Theory (APT) are interrelated topics. Tests of the EMH have been performed together with an asset pricing model such as the market model and the APT. EMH and rational expectations are integrated into asset valuation proces through the asset pricing models. This concept is

called the *joint hypothesis theory*.

There are two versions of the semi-strong efficiency of th EMH tests, present in the literature. They are *microeconomic* and *macroeconomic* versions. Microeconomic version uses the microeconomic variables and macroeconomic version uses macroeconomic variables to test semi strong efficiency of stock market.

There are two versions of the APT: factor loading model and macro variable model. Factor loading model uses artificial variables created through the factor analysis technique. While macro variable model uses macroeconomic variables based on the economically interpretable effect on stock prices.

This thesis used the macroeconomic version of the semi strong efficiency of the EMH and macro variable model of the APT to investigate the relationship between stock market return and macroeconomic variables. Consistent with these ideas, this thesis investigated the effects of seven macroeconomic variables which are proposed as the likely sources of systematic risk on aggregate stock returns. These variables are real GDP, inflation, interest rates, wage rate, commodity prices, exchange rate and US stock market. Among these seven variables, real GDP, interest rate and the US stock market were found significant in explaining stock market return in Australia.

CHAPTER 1

1. INTRODUCTION TO STOCK MARKET AND ECONOMY

1.1 Introduction

History has shown that the price of shares and other financial assets are an important aspect of the dynamics of economic activity, performing a vital role in national economies. Stock prices can be an indicator of social mood and are used as a leading indicator of the real economic activity. Rising share prices, for instance, tend to be associated with increased business investment and vice versa. Share prices also affect the wealth of households and their consumption. Therefore, economic policy makers keep an eye on the control and behavior of the stock market, as its smooth and risk free operation is essential for economic and financial stability.

Investment in the stock market with the aim of generating a positive return without risk is complicated and challenging. Investment involves risk and uncertainty and capital market helps managing risk and uncertainty. The smooth functioning of these activities can facilitate economic growth and lower production costs and business risks, thus promoting both the production of goods and services and employment. In this way, a stock market with high return and lower risk contributes to increased prosperity.

The size of transactions in the stock market and its effect on the economy and people is significant. An Australian Stock Exchange (ASX) survey showed that in May 2007, about 47 per cent of the adult population in Australia owned shares directly or indirectly (ASX 2007). As at 30 June 2007, the Australian domestic market capitalization of listed shares was $1.63 trillion and the number of listed companies was 2090. During April 2007, the average transactions per day were 241,161, with a daily average value of 6.1 billion dollars. In 2006/07 financial year new listings of companies were 283, and the capital raised was 77.9

billion dollars (ASX 2008).

Given the importance of risk free operations of the stock markets to the real economy, this thesis is to investigate the effect of the macroeconomic variables on the performance of the Australian Stock Exchange for the period of September 1979- September 1993 using quarterly data. This study develops a multifactor risk management model from the perspective of the Arbitrage Pricing Theory (APT) the efficient market hypothesis (EMH) and rational expectations hypothesis. This model develops seven macroeconomic variables, which are the likely sources of the systematic risk, based on the economically interpretable effect on the stock prices. These macroeconomic variables include real GDP, inflation, interest rates, wage rate, commodity prices, exchange rates and the US stock market.

1.2. Background

Portfolio theory, developed in the 1950s by Harry Markowitz, and complemented by Tobin (1958), was a revolution in financial economics. This theory analyses how, for a given rate of expected return, assets can be combined to minimize total risk, comprising unsystematic and systematic risk. Unsystematic risk can be minimized by diversification but systematic risk cannot be minimized by diversification. Consistent with the diversification and risk minimization essentials of the portfolio theory, modern financial theory has focused on macroeconomic variables as the likely sources of systematic risk.

Subsequent developments in financial theory have resulted in rigorous economic and financial theories including the market equilibrium models such as, the Capital Assets Pricing Model (CAPM) and the APT. The CAPM is called the single factor model and the APT the multifactor model. These two theories integrate portfolio theory (risk and return) to the macroeconomic variables which are systematic risk factors. They are used to determine the market price for risk and the appropriate measure of risk for a single asset or portfolio.

The CAPM has been used extensively by economists and financial practitioners. However, empirical studies seriously questioned the validity of CAPM. Examples of such studies are Friend and Blume (1970), Blume and Friend (1973), Fama and MacBeth (1973) and an Australian study by Durack et al. (2004).

Ross (1976) developed the APT which proposes that actual return on any security or a portfolio is dependent on its expected return plus a series of factors. It is based on the notion that certain macroeconomic factors drive stock returns as well as firm-specific information such as size, earnings, dividends, book to market value, and capital structure.

The APT was an alternative proposal to the CAPM. The CAPM states that the return on a single stock is directly related to a single factor, which is the rate of return on the market portfolio. The APT is based on a similar idea but it is much more general than the CAPM. The CAPM is viewed as a special case of the APT when the market rate of return is the single significant factor.

There are many multifactor asset pricing models developed in the literature. According to Sinclair (1984), many of them can be treated as special theoretical cases of the APT. However, the APT is yet to address the issues of the magnitude of factors and the identification of the common sources of risk.

The APT has been intensively investigated in the US by Roll and Ross (1980), Chen (1983), Chen *et.al.*(1986) and Priestly, (2002). However, there are relatively few empirical investigations on the application of the APT to the pricing of UK stocks, the notable ones being: Clare and Thomas,(1994); Cheng (1995); Cheng (1998). The two most cited empirical studies of APT in Australia are Sinclair (1984) and Groenewold and Fraser (1997).

According to Sinclair (1989) overall acceptance of the APT has been tentative. There are serious unresolved methodological issues involved in testing the APT and the identification of the macroeconomic variables. Unless the number of factors and their identity are universally established, practical application of the APT will be difficult.

Later studies questioned the validity of the APT. Qi and Maddala (1999) argued that stock market prediction is problematic and many of the multifactor models developed are inefficient. According to Nawalkha (2007) from the very beginning many researchers were skeptical, and believed that APT offered too much for too little.

The existing literature fails to identify the significant macroeconomic variables that constitute risk factors in the context of the APT. Therefore, there is a need for continuing research in this area

1.3. **Significance of the Study**Uncertainty of return in stock markets is seen as an important aspect of the aggregate economy as an unstable growth trend in an economy makes it difficult to invest and consume. If the future wealth is uncertain, consumers consume less and business invests less. Given the importance of stock markets to the real economy, the smooth and risk free operation of the stock market has attracted significant attention in the literature.

In understanding total risk, it is useful to consider two aspects of risk: systematic and unsystematic risk. Systematic risk refers to general risk mainly generated by variations in external macroeconomic factors, whereas unsystematic risk is the specific risk generated mainly by microeconomic factors. Systematic risk cannot be minimized by diversification of shares whereas unsystematic risk can be minimized by diversification.

There are multifactor assets pricing models used to manage the systematic risk which is created by the macroeconomic variables. Among these models, the Arbitrage Pricing Theory (APT) is the most widely used risk management model. This model has been developed to minimize the total risk using macroeconomic variables. Many multifactor assets pricing models developed in the literature are different versions of the APT theory.

Many attempts have been made to solve this problem empirically using the APT. However, there is no precise definition of the relationship in the Australian context or elsewhere. The current literature, and widely used asset pricing models, including the APT, does not provide specific direction as to which macroeconomic variables (risk factors) affect stock market return and to what extent (Chen *et.al* (1986); Beenstock and Chan (1988); Chen and Jordan (1993); Groenewold and Fraser (1997)). There are unresolved theoretical and methodological issues. It is expected that the common set of macroeconomic risk factors will be identified from the empirical studies.

The present study tackles this complex challenge by establishing the relationships between stock returns and economic factors by using a multifactor model.

As a common set of factors are expected to emerge from empirical studies coming from a wide range of different time periods and countries, there is a continuing need for research in this area. By investigating the effect of macroeconomic factors on the performance of the Australian stock market, this study aims to contribute to the understanding of the stock market and its systematic risk management in Australia using a macroeconomic approach.

A vast majority of studies approach the problem using a single equation framework and using the US and UK stock market as a base without paying enough attention to the underlying models of the economy. Australia’s product composition is based on mining and agriculture, quite different from the US and UK. It is expected that a different set of macroeconomic data will identify the differences and shed more light on the local situation.

The thesis will make some significant contributions to the literature which is summarized as follows:

- This thesis will contribute to the existing body of knowledge by developing a multifactor valuation (risk management) model based on the APT. In contrast to existing studies; it will apply a different set of macroeconomic data and follow the economic transmission mechanism to ascertain the way that macroeconomic variables affect company profits and stock market return as a whole.

- The proposed approach will identify the macroeconomic variables that affect stock prices, based upon an external analysis of the stock return in Australia.
- A comprehensive quantitative analysis will be applied to measure the effects of economic factors on stock returns in Australia. The proposed quantitative model will measure the historic relationship between stock returns and economic factors.
- The results will contribute to the existing body of knowledge of stock pricing. Most of the reported studies are based on the US and UK markets. Given Australia's particular product composition a more specific model will likely be more relevant to Australia.

1.4. Objectives of the Study

The general aim of this thesis is to investigate the effect of economic factors on the Stock Market return in Australia. It is believed that asset prices react sensitively to economic news and there is a general belief among economists and market participants that the stock return and economic factors are closely correlated. Daily experiences show that stock prices are affected by many expected and unexpected events and these events have a systematic influence on the stock prices. Based on the APT, this thesis will examine this question under the theoretical framework of macroeconomics and finance. The contention is that aggregate stock return is a macroeconomic variable and therefore it should be analyzed within a macroeconomic framework

The specific objectives of this research is to develop a multifactor asset pricing model based on the Macro Variable Model of the APT using a new set of Australian data. The specific relationships and their relative significance for each of the different economic variables affecting stock prices will be determined.

There is a need for a comprehensive qualitative study of the relationship between the stock returns and economic factors. The qualitative objectives can be summarised as follows:

- This research will apply the macroeconomic approach to analyze stock returns.

- Through the price system, the transmission mechanism in which macroeconomic variables affect the stock market return will be identified.
- The significant macroeconomic variables will be identified by economically interpretable effects rather than artificially created variables.
- The proposed quantitative model will measure the historic relationship between stock market returns and macroeconomic factors.

By achieving these objectives we will test the following hypotheses using quantitative techniques so as to solve some of the risk management questions:

1. Aggregate stock return is determined by the variations in GDP, inflation, interest rate, wage rate, commodity prices, exchange rate, and the US stock market.
2. Return on individual stock determines the return on the market; market return has no effect on the return on individual stocks over the long run.
3. The Australian stock market is weak form efficient.
4. The Australian stock market is semi-strong efficient.
5. By achieving these objectives, this thesis will make some significant contributions to the literature.

1.5. Research Methodology

This research involves observation, conceptual analysis and statistical analysis. Consistent with the empirical methodology, which suggests that new theoretical models can be validated from the observed world, the behaviour of the stock market and its participants will be observed. Perceptions and attitudes of market participants are an important determinant of stock market returns. Observing their attitudes and behaviours can help to explore relationships between economic factors and stock market returns. A general idea of market participants' attitudes will be obtained by observing the market and its participants.

There are a variety of unresolved questions based on observation and facts about the economy and the stock market. This thesis will try to answer these questions and interpret the facts. In order to explain such questions, observations will be documented and quantified, and a model will be developed, to explain how the economy and stock market interacts.

To locate the findings from market observation within the macroeconomic framework, a comprehensive conceptual analysis will be carried out. It will involve a review of the literature with the objectives of identifying theoretical framework, important concepts, variables, and to analyse the results of empirical studies.

As a result of observation and conceptual analysis, the economic transmission mechanism in which economic variables affect share prices will be identified. Consistent with these relationships a model based on the APT will be developed and tested using statistical techniques.

To measure the relative significance of each economic variable, particularly those affecting stock prices, statistical analysis will be applied. It will involve the following:

- Collecting time series data on stock prices and economic variables in consideration,
- Using graphical and tabular analysis,
- Applying unit root test, cointegration, vector error correction (VEC), and Engle Granger two stage error correction techniques to measure the statistical significance of the estimates of each factor.

Time series data on most of the economic variables are available in the DX Database. In addition to this, the Australian Bureau of Statistics and Reserve Bank of Australia statistics will be used. A few databases of stock prices are available for commercial purchase. The choice of the period is based on the availability of the data on the economic and financial variables. Data for statistical analysis will range between 1960 and 2009.

1.6. Organization of the Thesis

Chapter 1 provides information about the subject matter of the thesis. This chapter provides background information on stock market return and economic forces. This chapter also provides information on the objectives of the research, significance of study, and research methodology.

The study of the theoretical foundations is a prerequisite to almost any of the case studies in finance and economics. The theoretical framework will be described in chapters 2 and 3.

Chapter 2 outlines the economics of the stock market. The purpose of this section is to present the foundations of some of the economic theories relevant to the financial decision making. Stock prices, from the perspective of the market model, efficient market hypothesis, and rational expectations will be investigated. These theories have come to be the generally accepted ones in relation to economic and financial decision making. They have many applications in the traditional areas of finance and economics. The details of these theories and empirical evidence and other relevant questions will be covered in this chapter.

Chapter 3 describes and discusses the theory of asset pricing through time**.** The stock valuation techniques as well as major equilibrium models will be studied in detail. A brief definition of some of the financial techniques that used to explain stock prices behaviour will be set out. The basis of portfolio theory, the CAPM and APT will be discussed in detail. The empirical results of the multifactor asset pricing models developed in the literature will be evaluated in this chapter.

Chapter 4 explains the rational of selecting macroeconomic variables for the proposed multifactor model. It presents the analytical model developed to analyse the impact of macroeconomic variables on stock market return. Macroeconomic variables will be selected by the economically interpretable effects on the stock market return rather than factor loading model.. As well as describing and defining each of the main indicators, it includes the explanation of the major macroeconomic variables. They have been grouped under the seven main headings: Gross Domestic Product (GDP), inflation, interest rate, wage rate, commodity prices, exchange rate and the US stock market.

Chapter 5 will outline the results of the statistical analysis. A multifactor risk management model of stock market return will be developed in this chapter The significance of the variables will be tested at this section using unit roots, cointegration and error correction model. The model will be based on macro variable version of the APT.

The final chapter will look at the research as a whole and provide a summary of the thesis. Limitations and recommendations for further research will be reported in this section.

CHAPTER 2

2. STOCK MARKET EFFICIENT MARKET HYPOTHESIS AND RATIONAL EXPECTATIONS

2.1. Introduction

In this chapter we overview the major microeconomic concepts to ascertain the way that macroeconomic variables affect stock market return. This will be achieved by analyzing the relationship between the stock market and *the, efficient market hypothesis (EMH), information and the EMH,* and the *rational expectations hypothesis*. The objective is to provide an overview rather than the complicated details of these theories.

The EMH, rational expectations hypothesis and asset pricing models are interrelated topics. In most of the empirical studies, they are studied and tested jointly. This is called "*the joint hypothesis testing*".

Systematic macroeconomic risk factors, which are the basis of this thesis, are integrated into the investment decision making through the equilibrium models such as the CAPM and APT. These models and other multifactor asset pricing models developed in the literature examine the relationship between stock market return and macroeconomic variables from the perspective of the EMH and Rational Expectations Hypothesis. The direction of this thesis will be consistent with the EMH, rational expectations and the APT.

The EMH applies rational expectations to financial markets in general and the stock market in particular. In an efficient stock market, stock prices reflect all available information. Both theories, the EMH and rational expectations, are crucial for equilibrium analysis and there are many empirical studies of market efficiency and rational expectations. Therefore, the results of these empirical studies and their implications will be evaluated to understand and test the efficiency of the Australian stock market.

The idea of the EMH and the rational expectations is based on the idea of the perfect stock market. However, the stock market is not a perfectly competitive market since there are sources of imperfections such as the inelastic supply curve and the imperfect assimilation of the information in the market place.

Analysis of demand and supply of shares, both in the short and long run, implies that the supply of shares is perfectly inelastic (fixed) in the long run. The perfectly inelastic supply of shares suggests that it is independent of interest rates and, hence, the price of the share. However, the demand for shares depends on interest rates and other determinants of demand such as GDP, price level, currencies, commodities, bonds, etc. Only the demand for shares determines the stock prices in the long run from the perspective of a demand and supply analysis. The point here is: what determines the demand for shares at the same time determines the equilibrium price of the stock. Any macroeconomic variables can affect the stock return through the effect on the demand for shares.

The inelastic supply and inefficiency of the stock market has attracted considerable attention in the literature. According to Grossman and Stiglitz (1980), the stock market is not a perfectly competitive market. There are some sources of imperfection such as perfectly inelastic supply curve transaction cost, taxes and, furthermore, informational inefficiency.

2.2. Efficient Market Hypothesis

The stock market is not a perfectly competitive market, and therefore, to study the efficient market hypothesis, it is necessary to consider it in relation to perfect capital market. According to Copeland and Weston (1988) the main characteristics of perfect capital markets can be listed as follows:

- *Markets are perfectly competitive*: i.e. many buyers and sellers, homogenous (identical) product, no barriers to entry and exit, producers supply goods and services at minimum average cost, firms are price takers (no one has an effect on market price), and firms are profit maximisers;

- *Markets are frictionless*: there are no transaction costs, no taxes, all assets are perfectly divisible, all assets are perfectly marketable, there are no constraining regulations;
- *Markets are informationally efficient*: information is costless; all individuals receive it simultaneously; and
- All individuals are rational expected utility maximisers.

When these conditions are satisfied both product market and securities markets are *productively, operationally* and *allocatively* efficient.

However, the efficient capital market does not necessarily mean a perfectly competitive capital market. An efficient market is defined by Fama (1995) as a market where there is a large number of rational, profit maximizing investors. They are actively competing with each other trying to predict future market values of individual securities, and important current information is almost freely available to all participants.

One of the important sources of inefficiency of the markets is the informational inefficiency. According to Fama (1995), security prices adjust quickly to new information. With modern telecommunications, an enthusiastic business press and a large number of buyers and sellers, securities markets are more efficient, but there is still debate about the question: how efficient are they? Advocates of the efficient market hypothesis contend that the markets are absolutely efficient, meaning that all available information is already reflected in prices. The implication is that it is not possible for an investor to beat the market consistently without having access to some inside information. Some investors can beat the market some of the time due to an element of luck. At the other end, value investors argue that intensive research can uncover undervalued stocks that have been overlooked by the market. Many investors evidently accomplish this on a consistent basis.

Fama (1970; 1991) has made a significant contribution in making the efficient market hypothesis testable and operational. Reviewing the theoretical and empirical literature on the efficient markets hypothesis, Fama (1970) identifies three relevant information subsets:

- First, *weak form* test, in which the information set is just historical prices. No investor can make an abnormal profit by applying trading rules based on historical prices. In other words, past price or return patterns are not significant to make an abnormal return.
- Secondly, *semi strong form* tests, in which the concern is whether prices efficiently adjust to other information that is obviously publicly available. No investor can make abnormal return using publicly available information such as annual earning reports, dividend changes and stock split etc.
- Finally, *strong form* tests concerned with whether given investors or groups have monopolistic access to any information relevant for price formations are reviewed. No investor can make abnormal return using publicly available or unavailable information.

A later study by Fama (1991) put forward three alternative relevant information subsets: i) *Return predictability test*: weak form tests concerned with the forecast power of past return. Instead of the weak form test, the first category covers the more general area of tests of return predictability. This subset tests whether it is possible to explain cross-sectional and time series variability in returns. ii) *Events studies*: whether asset price responses to new information as hypothesized. *iii) Test for private information*: whether asset prices are related to the private information.

In the following subsections, the results of theoretical and empirical work on market efficiency tests, namely, weak form test, semi strong form test and strong form test will be discussed.

2.3. Weak form test

The weak form test concerns whether abnormal profit can be earned based on the past information on a security. It examines autocorrelations between past time series data. If there are patterns or autocorrelations in prices then trading strategies can be built on these patterns and abnormal earnings can be made.

According to Fama (1995) there are two opposing theories related to weak form efficiency: the theory of random walks and the theory of technical analysis. The theory of random walks says that successive price changes are independent. On the other hand, technical analysis theory says that there is dependence in successive price changes. Therefore, the past price series can be used to make predictions of the future.

2.3.1. Random walks

Random walk hypothesis and the EMH have been at the centre stage of discussion in the financial literature (Fama 1970). It states that consecutive changes in the prices of securities are independent (i.e. random) and there are no systematic changes. If the random walk theory is valid then the technical and fundamental analysis procedures to predict the stock behaviour are irrelevant.

Despite the fact that there are empirical studies questioning the random walk behaviour of the stock market, Fama (1995) argues that the stock market has an instantaneous adjustment property. In an efficient market, competition will cause the full effects of new information on equilibrium values to be reflected 'instantaneously' in actual prices. Instantaneous adjustment has two implications. First, actual prices will initially overadjust to changes in equilibrium values as often as they will underadjust. Second, the lag in the complete adjustment of actual prices to successive new equilibrium values will itself be an independent, random variable. The instantaneous adjustment property of an efficient market implies that successive price changes in individual securities will be independent. Most simply the theory of random walks implies that the past history of the series cannot be used to predict the future in any meaningful way.

A study by Kleiman *et al*. (2002) performed tests of the random walk hypothesis for international commercial real estate markets using stock market indices of real estate share prices for three geographical regions: Europe, Asia and North America (comprising a total of thirty countries). It employs two different techniques: the augmented Dickey-Fuller and Phillips-Perron unit root tests and the Cochrane variance ratio. These tests found that each of these markets, as well as associated broader stock markets, exhibit random walk behaviour. Moreover, a non-parametric runs test provides support for weak-form market efficiency in the real estate markets.

Abraham *et al*. (2002) examined the random walk properties and weak form efficiency of the three emerging Gulf markets; Kuwait, Saudi Arabia, and Bahrain. They used the variance ratio test for the random walk hypothesis and runs test for weak form efficiency. This study used weekly index values between 1992 and 1998. They concluded that there is a systematic bias toward rejecting the efficient market hypothesis. For all three markets, the apparent weak form inefficiency was observed and it can be attributed to infrequent trading and inefficiency which disappears when one uses the estimated true index corrected for infrequent trading. Abraham *et al.* (2002) further cite that the literature on emerging markets has rejected the EMH. Consistent with the view in the literature for the similar emerging markets, both random walk hypothesis and weak form efficiency are rejected.

Poshakwale (2002) examined and tested the random walk hypothesis in Indian stock market using daily data of individual stocks between January 1990 and November 1998. This study reported the descriptive statistics for the individual stocks and used the ARCH LM statistics to test the random walk behaviour. The statistical evidence in this paper rejects the random walk hypothesis. Daily returns on individual stocks and on an equally weighted portfolio show significant non–linear dependence and persistent volatility effects. The non–linear dependence takes the form of ARCH–type conditional heteroskedasticity and does not appear to be caused by nonstationarity of underlying economic variables. Though conditional volatility is time varying, it does not explain expected returns.

A study by Bouchaud *et al.* (2006) using French stock market data documented the random walk behaviour of the French stock market. They observed the presence of random walks but they also observed strong, long-term positive and negative signs of trades (buys or sells). According to the authors, this positive and negative signs is caused by the availability of all trades and quotes on electronic markets which makes it possible to analyse the mechanism leading to these anomalies. Based on empirical data, the random walk nature of prices is highly important and results from a competition between liquidity providers and liquidity takers. In order not to reveal their strategy, liquidity takers must divide their orders into small trades that are spread in time over several hours to several days. This creates long-range persistence in the sign of the market orders.

The random walk hypothesis has been tested for many different markets of the United States and other countries. Empirical studies used sophisticated statistical methods with different data sets and time periods. However, there are contradicting results on the validity of the random walk hypothesis.

2.3.2. Technical Analysis

Since there are some anomalies of random walk behaviour of the stock prices, some investors use technical and fundamental analysis as an investment strategy to make abnormal returns. Technical analysis is related to the weak form efficiency while fundamental analysis relates to the semi strong efficiency of the EMH. The use of these two approaches is contrary to the proposition of the EMH. Therefore technical trading rules have been used to test the weak form efficiency of the EMH.

Fama (1995) states that the basic assumption of technical theories is that history tends to repeat itself. Past patterns of price behaviour in individual securities will tend to happen again in the future. Thus, to predict stock prices, it is necessary to develop a familiarity with past patterns of prices and recognize similar situations. Chartist techniques attempt to use knowledge of the past behaviour of prices to predict the future behaviour of the series. However, the techniques of the chartists have always been surrounded by a degree of mystery, and as a result most professionals have avoided using them. Thus, the pure chartist is relatively rare among stock market analysts. Rather, the typical analyst adheres to a technique known as fundamental analysis or the intrinsic value method.

Technical trading rules have been the subject of the empirical studies. Brock *et al.* (1992) tested two of the most popular trading rules, moving average and trading range break. A daily collection of the 90 years of the Dow Jones Industrial Average Index from 1897 to 1986 was used. They developed a joint test of significance for their trading rules by utilising bootstrap distributions. Overall results provide strong support for the technical strategies. These trading strategies generate significant returns, which cannot be explained by any other models. Moreover, their results indicate that this phenomenon is inconsistent with the EMH. They report further that the returns obtained from these strategies are not consistent with four popular null models: the random walk, the AR(1), the GARCH-M, and the Exponential GARCH.

Another common technical trading rule is momentum trading which seeks to predict future market trends based on recent price and volume data. It compares the current price of a security to the price of a number of previous periods. This number represents the rate of change of the security's price over that given time period. It allows the analyst to see where the current price stands in relation to historical trends, and to determine strategy based on this analysis.

Momentum trading, like any other trading strategies, cannot make any abnormal returns according to the logic of the EMH. However, it has been widely used in practice and in the literature for testing the efficient market hypothesis. Badrinath and Wahal (2002) documented the trading practices of approximately 1,200 institutions from 1987 through 1995. They classify institutions by trading into, the initiation of new positions (entry), the termination of previous positions (exit), and adjustments to ongoing holdings. They conclude that institutions act as momentum traders when they enter stocks but as contrarian traders when they exit or make adjustments to ongoing holdings. They find significant differences in trading practices among different types of institutions. It is evident that even large institutions do not have uniform valuation methods. Strength of this study is that it documented wide spread usage of the momentum trading contrary to the logic of the EMH. However, this study failed to report whether momentum trading is profitable.

Filter rule, as a technical trading tool, is widely used in stock trading. It is based on the assumption that once a price has changed a given percentage it will continue to move in the same direction. Thus, if a security's price moves up 5%, buy and hold the security until its price moves down at least 5% from its subsequent high, at which time sell (Bishop et al. 2000). There is no limit in the size of the filter of any percentage. In practice, there are the filter techniques for filters ranging from 1 percent to 50 percent.

Filter tests have been widely used in the literature for testing the EMH. Praetz (1976) using the filter test, analysed the rates of return on the filter rules. However, his main conclusion is that filter tests are an insufficient method of testing EMH. This is because of the bias in the expected filter returns, which depends on the proportion of time in which the filter is operating in a short position. A later study by Praetz (1979), developing a new procedure, tested for the presence of a filter effect for a portfolio of securities. This paper developed an exact theoretical test of the presence or absence of a filter effect for a portfolio of securities and a general number of different filter sizes. These expressions showed that expected return from filter strategies is, in fact, less than the return from a buy-and-hold alternative with which filter returns are usually compared. The primary assumption in the test is that the sequence of prices is normally and independently distributed; in other words, it is a random walk.

Fama (1995) states that he tested the filter techniques on individual securities. Again the simple buy-and-hold method consistently beats the profits produced by the different size filters. It seems, then, that at least for the purposes of the individual trader or investor, tests of the filter technique also tend to support the random walk model. According to Fama (1995) filter technique is an attempt to apply more sophisticated criteria to the identification of moves. Although the filter technique does not correspond exactly to any well-known chartists theory, it is closely related to such things as the Dow Theory. Thus, the profitability of filter technique can be used to make inferences concerning the potential profitability of other mechanical trading rules.

A recent study by Bird and Casavecchia (2007) investigated the weak form efficiency of 15 European countries using both value and momentum investing strategies. The analysis is conducted on approximately 8,000 companies from 15 European countries over the period between January 1989 and May 2004. This study proposed that many stocks follow a price cycle made up of somewhat consistent movements towards mis-pricing in either direction. The stocks that become undervalued are often classified as value stocks while those that become overvalued are referred to as growth stocks. This study focused their analysis on a number of value, price and earnings momentum indicators. Contrary to the logic of the EMH, it was found that a number of individual and combinations of, price and earnings momentum factors are able to enhance value portfolios by identifying stocks that will not perform well in the immediate future. It was found that this momentum measure can be used to enhance value and growth in portfolios consisting of all European stocks.

Studies have used technical trading rules to test the weak form efficiency of the EMH. There are continuing discussions on the profitability of the technical trading rules which are contrary to the weak form efficiency of the EMH. However, technical trading rules have been used extensively in practice.

2.3.3. Seasonality of Stock Prices

Another topic area which is connected to the weak form efficiency of the EMH is the seasonality of the stock prices. Studies of the seasonality in stock prices have been used to test the weak form efficiency of the EMH.

The existence of seasonality in stock prices is contrary to the logic of the EMH. However, it has been used widely for profit making. It has been argued that stock prices are subject to seasonality and excess return can be generated using this seasonal pattern. Studies of seasonality include: daily seasonal, weekend effect, monthly seasonal and tax-loss selling hypothesis - January in the US and July in Australia.

Ball and Bowers (1989) investigated the day-of the week seasonality in Australian equity returns. This study was a preliminary study which aimed at stimulating discussion in the area of the seasonality of stock prices. This found that equity return on the Australian stock exchange exhibits a significant day-of-the week seasonal. Some of the seasonal is due to a weekend effect which means returns from the close of trading on Friday to the close of trading on Monday are negative but not significantly different from zero. This suggests an explanation in terms of the negative marginal efficiency of investment on weekends, owing to idle capacity. Much of the daily seasonal pattern is due to a significant, negative mean return on Tuesdays. This covers the period midnight Sunday/Monday to midnight Monday/Tuesday

New York time. The possibility of an international effect cannot be ruled out. Other puzzling regularities have been observed, particularly in the weekend standard deviations. For equities, weekend volatility seems low and for interest rates it seems high relative to weekdays. It is possible that the patterns in standard deviation are related to the seasonal in the mean returns.

The tax-loss selling hypothesis has commonly been used to explain the January effect. Although it is applicable to the US market, empirical studies have studied the effect on other markets. Studies have obtained evidence on the tax-loss selling to examine stock returns patterns in countries with different tax-year ends. For example an Australian study by Brown, Keim *et al*. (1989) studied the tax-loss selling hypothesis. This study reports: *Firstly,* a significant negative relation between abnormal returns and the market value of samples of common stocks. This apparent relationship is reversed over certain time intervals but small firm premiums are always positive in January from 1963 to 1979. *Secondly,* 50 percent of the average annual size effect can be attributed to January and more than 50 percent of January effect occurs during the first week of trading. *Thirdly,* Small firm premium in the first few day of the year is a reaction to tax selling pressure at the end of the tax year for shares of these firms. *Fourthly*, January return is greater for firms with larger price decline. This supports the tax loss selling hypothesis.

According to Brown, Keim *et al*. (1989) empirical studies show consistent but less significant January effect than in the US in most countries. This is evidence for the tax-loss selling hypothesis. Brown, Keim *et al*. (1989) further conclude that U.S. tax laws do not unambiguously predict such an effect. Since Australia has similar tax laws but a July–June financial tax year, the hypothesis predicts a small-firm July premium. Australian returns show December–January and July–August seasonal, and a premium for the smallest-firm decile of about four percent per month across all months. This contrasts with the U.S. data in which the small-firm premium is concentrated in January. They conclude that the relation between the

U.S. tax year and the January seasonal may be more correlation than causation.

Another country with different tax-year end is the UK. Hillier and Marshall (2002) examined the turn-of-the-year (January) effect in the London Stock Exchange using data from January 1, 1986 to March 31, 1997. It is found that the January effect is significant but not persistent through time. In contrast to the US studies, equities of all sizes are affected. Although , this research rejects the hypothesis that seasonality in insider trading are the main determinant of the January effect. In addition, the tax-loss selling hypothesis, which is commonly thought to be a cause of the January effect in the US, is tested with the April year-end for UK investors. Evidence is found of excess abnormal share price returns. However, this does not impact upon excess abnormal share price returns in January. Results are important because they provide an insight into stock return seasonality in the UK and reject some widely held beliefs on this issue.

In summary, empirical studies of the technical trading rules and the stock market seasonality show puzzling results of seasonal effect which can be used to make profit. This finding contradicts to the EMH. In this respect, the existence of seasonality casts doubt on the weak form efficiency of the EMH.

2.4. Semi-Strong Form Test

Studies of the semi-strong form of the EMH involve the effect of newly released information on security prices. Empirical studies relating to this involve fundamental analysis, earning and dividend announcements, and capitalization change. As new information comes into the market, prices should adjust quickly to the new information. The implication of semi strong market efficiency is that stock return cannot be predicted using publicly available information. However, fundamental analysis is widely used and it is more powerful than the weak form (technical analysis) tests in terms of predicting stock return.

There are many studies testing the semi strong form of market efficiency. Effects of many different public announcements are studied to test the semi strong efficiency in the literature. Pioneering work for the semi-strong tests of market efficiency was done by Fama, Fisher *et al*. (1969) who developed the methodology that provided the framework for the empirical studies which followed.

Groenewold and Kang (1993) identified that there are two types of tests of semi-strong efficiency, one using macroeconomic variables such as inflation, the money supply, exchange rates, and the other micro data such as company specific announcements. Furthermore, Groenewold and Kang (1993) cited that there are few macroeconomic tests of the semi-strong EMH for the Australian share market. The results of the studies by Sharpe (1983), Hogan, Sharpe *et al.* (1982) and Saunders (2002) lead to the rejection of the semi-strong form of the EMH.

Fama and French (1996) state that previous work demonstrates that average return on common stocks is related to microeconomic data (or firm characteristics) like size, earnings/price, book-to-market equity, past sales growth, long term past return, and short term past return etc.

In this section, the empirical studies on the semi-strong efficiency are reviewed. Studies are using publicly available microeconomic (company specific) data such as company profitability, dividend, share split and capital structure.

2.4.1. Fundamental Analysis

Use of the fundamental analysis is contrary to the logic of the EMH. As pointed out before there are two different approaches to the valuation of stocks. They are *technical analysis* and *fundamental analysis*. Trading strategy for the semi-strong test is the *fundamental analysis* that is based on the idea that the new information is not reflected in market prices. Using fundamental analysis abnormal return cannot be earned in an efficient stock market.

The fundamental analysis approach holds that stocks like any other assets have a fundamental *economic value* that reflects investors' expectations of future cash flows. The stock prices are determined by investors' collective decisions about the stocks' reasonable investment value.

The implied assumption of the fundamental analysis is that at any time, an individual security has an equilibrium price. Equilibrium price depends on the earning prospect of the security. The earning prospect of the security depends in turn on fundamental factors such as structure of the company, quality of management, outlook for the industry and the economy, international economic and political environment etc. Analysts studying these fundamental factors, in principle, are able to determine whether the actual price of a security is above or below its equilibrium value.

2.4.2. Earning Reports and Dividend Announcement

According to the logic of the EMH, earning and dividend changes should not affect the value of the shares. However, investors and analysts follow these measures very closely.

Studies of the annual profit, dividend and stock prices have a long history. Study areas include the sign and extent of unexpected changes, market response to earnings and dividend announcement and firm specific factors such as predictability of earnings.

Decisions relating to dividends have been the focus of investors, analysts and academics. Dividends are important to shareholders because of their implied relationship to the current and future profitability of the firm. Changes in a stock's dividend rate leads to a change in the price of the stock. It is argued that a change in a firm's dividend rate is likely to be seen as management's view of future profit.

Modigliani and Miller (1958), showed that a firm's value is determined by its investment decisions and not by its financing decisions. In a companion paper, Miller and Modigliani (1961) extended the basic results by showing that, given investment decisions, dividend policy is also irrelevant. Miller and Modigliani`s irrelevance proposition implies that if financial markets are perfect, corporate financial policies including dividend policy, are irrelevant.

Miller and Modigliani (1966), developed the much cited “M&M Theorems” on capital structure and dividend policy that are one of the main foundations of the theory of corporate finance. This theory states that the market value of a firm is independent of the way it chooses to finance its investment or distribute dividends. To expand, a firm can choose between three methods of financing: issuing new shares, borrowing, or keeping profits (as opposed to distributing them to shareholders in dividends).

An outstanding work on the determinant of stock prices was developed by Brown (1970) which was to report some preliminary attempts and methodology. He proposed that the total market value of the firm relates to the firm future earnings. Three types of data was used between 1958 and 1968; annual earnings per share (EPS), EPS announcement dates; and share prices. He studied the factors affecting investment in the electric utility industry and concluded that one major determinant of the stock prices was company earnings.

Brown, Finn *et al.* (1977) examined the relationship between dividend changes, earnings reports and share price behaviour surrounding the time of announcement of annual profit reports. This paper used monthly data between January 1963 and December 1972. During the 60's and early 70's, profit and dividend changes were positively correlated, and were associated with significant share price changes, after abstracting from market effects. When profit and dividend reports gave conflicting signals, share prices tended to decline. They further concluded that the evidence of price behaviour in the periods surrounding the announcement was consistent with the EMH. While unable to separate the informational effects of dividends and earnings on share prices, the results of their study are consistent with the price behaviour implied by the EMH. Brown, Finn *et al*. (1977) report tentative findings on the impact of the annual net profit report on the prices of shares. They stated that the larger the change in dividend or profit is the larger associated change in share prices. There is positive relationship between dividend or profit and stock prices. However, it may also be true that profit and dividend have been proxies for more fundamental informational determinants of share prices; in this case the information effects of dividend and profit may well prove pointless.

Butler and Han (1994) developed a two period model of investment under uncertainty to identify firm specific factors related to market response to earnings surprise, in which the ratio of share price response to earnings surprise is a function of the earnings retention rate, marginal productivity, and the cost of capital. These factors are examined empirically using dividend yield, Tobin's q ratio, and beta as proxies. Empirical results indicate that each of the factors significantly impacts on the return/surprise relation in the direction predicted by the theoretical model, with the exception of dividend yield for positive earnings surprise. The results prevail even after controlling for the information environment.

2.4.3. Capitalisation Changes

Major capitalization changes involve stock split, bonus issues and right issues. According to the logic of the EMH, capitalization changes should not affect the value of the shareholders wealth. However, when there is a change on those measures share prices changes accordingly.

When a company declares a stock split, the price of the stock will decrease, but the number of shares will increase proportionately. A stock split has no affect on the value of what shareholders own. If the company pays a dividend, your dividends paid per share will also fall proportionately. Companies often split their stock when they believe the price of their stock exceeds the amount smaller individual investors would be willing to pay for stock. By reducing the price of stock, companies try to make their stock more affordable to these investors.

There are also two other types of new share issues: bonus and rights issues. A bonus issue is the issue of new ordinary shares at no cost to existing shareholders but out of the company's reserves and given in direct proportion to the number of shares owned. Rights issues are used to enlarge the capital base of the company and may also be used as a means of rewarding its existing shareholders.

Fama, Fisher *et al*. (1969) investigated the process by which common stock prices adjust to the information that is implicit in a stock split. The strength of this paper is that the authors for the first time developed a methodology for an empirical test of the EMH. They studied the performance of the stock splits between 1927 and 1959 in the US stock market. They hypothesized that share split gives information to the market regarding management's future earnings expectations and the market would respond rapidly to the announcement of a share split. To test these hypotheses, they examined share price behaviour in the months surrounding split dates and found that the market takes account of good times (increased earnings reflected in increased dividends) and bad times (decreased earnings reflected in decreased dividends) in the first month following the split. They concluded that information contained in share splits is reflected in prices in the first period following the split.

Ball, Brown *et al.* (1977) studied share price behaviour surrounding the announcement of bonus issues, right issues and stock split. Bonus issues, share splits and rights issues are studied in a replication and extension of the classic Fama *et al*. (1969) study. With data from the Melbourne stock exchange, each category was found to be associated with positive abnormal returns. However, the market does not appear to value bonuses or splits in their own right: prices appear to reflect the information released in the capitalization changes (and associated events). For example, share splits that were not accompanied by effective dividend increases did not experience positive abnormal returns. With one puzzling exception, the market behaviour was efficient.

A study by Byun and Rozeff (2003) studied the post split performance of 12,747 stocks in the US between 1927 to 1996. They used two different methods: size and book-to-market, and calendar-time abnormal returns. They found that the appearance of significant abnormal returns is sensitive to the time period, method of estimation, and sampling. Both methods applied to splits 25 percent or larger did not find performance significantly different from zero. Sub- periods and sub-samples of 2-1 splits by book-to-market displayed positive abnormal returns. However, these samples show small abnormal returns using the calendar-time method. Overall, the stock split evidence against market efficiency is neither pervasive nor compelling.

2.5. Strong Form Test

According to the EMH all information is reflected quickly into the share prices; no abnormal returns can be made from private information and insider trading. Major areas of studies, in terms of strong form efficiency, are the performance of mutual funds and insider trading.

2.5.1. Performance of Mutual Funds

It is worth studying the performance of the mutual funds because managers of these mutual funds have access to private information. The idea behind this is that they visit firms from time to time and they talk with them about the company issues. Therefore, it is expected that these funds can earn abnormal returns using private information.

There are several studies that have examined the performance of the investment funds in terms of strong form tests of the EMH (Fama 1995; Hallahan 1999; Jensen 1968; Malkiel 2005).

Jensen (1968) studied the performance of mutual funds in the US from 1945-1964. The evidence indicates that mutual funds were not able to predict security prices to outperform the market. There is little evidence that any individual fund was able to do significantly better than that which was expected from mere random chance. They also noted that these conclusions hold even when the fund returns gross of management expenses is measured. Thus on average the funds apparently were not quite successful enough in their trading activities to recoup even their brokerage expenses. According to the authors the evidence, reported elsewhere, indicates the funds on average have done an excellent job of minimizing the insurable risk borne by their shareholders. According to Fama (1995), mutual funds usually make two basic claims: (i) because funds pool the resources of many individuals, a fund can diversify more effectively than the small investor; and (ii) because of fund management's closeness to the market, the fund is better able to detect good stocks in individual securities. In most cases the first claim is probably true. The second, however, implies that mutual funds provide a higher return than would be earned by a portfolio of randomly selected securities. Fama (1995) further reported that if the initial loading charges of mutual funds are ignored, on the average the funds do about as well as a randomly selected portfolio. If one takes into account the higher initial loading charges of the funds, however, on the average the random investment policy outperforms the funds. An Australian study by Hallahan (1999) examined the performance of Australian investment funds. Four categories of funds are examined: fixed interest; multi-sector yield; multi-sector balanced; and multi-sector growth. This study extended the performance literature through the use of three methodologies i) regression analysis; ii) non-parametric contingency tables; and iii) top (and bottom) quartile rankings, to explore the information content of fund performance for groups of funds differentiated by investment objective. The results of the regression analysis suggest that there is evidence in support of persistence in performance for the fixed interest funds (particularly when performance is measured in terms of Jensen Alpha) but the evidence in much more ambiguous evidence in relation to the multi-sector funds. Contingency table analysis of fund performance histories of varying lengths reveals quite different results depending upon whether raw or risk-adjusted returns are used. Use of raw returns creates an overall impression of performance reversals, whereas use of risk-adjusted returns suggests the existence of performance persistence. Finally, the use of prior period top-quartile and bottom-quartile ranking is found to show strong evidence of persistence in respect to the risk-adjusted performance of fixed-interest funds.

According to Malkiel (2005), financial economists have increasingly questioned the EMH. If market prices were irrational and if market returns were as predictable as some critics have claimed, then professionally managed investment funds should easily outperform a passive index fund. However, Malkiel's paper shows that professional investment managers, both in the US and elsewhere, do not outperform their index benchmarks, and provides evidence that market prices seem to reflect all available information. Malkiel (2005) further states that there is overwhelming evidence that active equity management is a "loser's game". Switching from security to security does not increase return but increases transactions costs and decreases return. Thus, even if markets are less than fully efficient, stock indices are likely to outperform the active portfolio management. One of the successful investors, Warren Buffett, advised in Malkiel (2005): "Most investors, both institutional and individual, will find that the best way to own common stocks is through an index fund that charges minimal fees. Those following this path are sure to beat the net results (after fees and expenses) of the great majority of investment professionals" (Malkiel 2005 p.90)

The evidence of the above empirical studies is that mutual funds cannot beat the market, implying that markets are strong form efficient in terms of the performance of the mutual funds. However, this is not enough to claim that markets are strong form efficient because of the existence of insider trading activities.

2.5.2. Insider Trading

According to the US Securities and Exchange Commission (SEC), insider trading is defined as a term that is usually associated with illegal conduct, when corporate insiders, officers, directors, and employees, buy and sell stock in their own companies. Illegal insider trading refers to trading a security, in breach of a fiduciary duty or other relationship of trust and confidence, while in possession of material, non-public information about the security.

There have been a number of studies that have documented the relationship between transactions by executives and directors in their firm's stock and the stock's performance (Jaffe 1974; Seyhun 1986).

Jaffe (1974) examined whether insider trading is profitable. He found that insiders earned abnormal returns from their trading. For all of the samples in the study, it was concluded that insiders do possess special information. However, after adjustment for transaction cost, only the intensive trading samples with 8-month holding periods were earning statistically large returns with transaction costs accounting for approximately 40 percent of the gross profits in these samples. Results also indicate that much information contained in the trades remains undiscounted by the publication date in the quarterly summary of insider trading. Including transactions cost eliminated profits for outsiders in all but intensive trading samples, where profits in the order of 2.5 percent could be earned. The data suggest that the best of the trading rules based on information in the *Official Summary* (a monthly report listing of transactions of corporate officials) involve an examination of intensive trading companies, as only these samples possessed residuals greater than the cost of transaction. Furthermore, Jaffe (1974) reports two main points on the extent of insider trading. First, the results indicating that trading on inside information is widespread suggest that insiders actually do violate security regulations. Second, the evidence of information in the intensive trading samples indicates where the law enforcers should search for violators.

Seyhun (1986) shows that insiders beat the market but argues against previous work on insider trading which suggested that investors can earn abnormal profits by trading on the news of insider trading as reported in the *SEC's Official Summary*. Seyhun (1986) justifies his potions: i) many of the trades were previously announced, ii) previous studies had used CAPM to measure expected returns, and iii) previous works had not considered the larger bid-ask spread that occurs as a result of insider trading. This paper looks at previous work whereby an investor was purported to be able to earn abnormal returns by making the same trades as an insider when the SEC reported the insiders' previous trade. As predicted the stocks where insiders sold had outperformed the market prior to the sales, and where they bought, the stock had under-performed. More interestingly there is a pronounced reversal around the trade date: this may be due to superior timing or the timing of other announcements.

2.6. Information and the EMH

Beliefs about inefficiency play a central role in the debate about EMH. The EMH states that market prices fully reflect all publicly available information. It implies that when all information is readily available, nobody can beat another in making money in financial markets. Thus, the information content of the EMH has been attracted special interest in the literature. Examples are: Milgram and Stokey (1982), Grossman and Stiglitz (1980), Bloomfield (2002) and Samuelson (2004).

In the fundamental paper on the information content of the EMH, Milgrom and Stokey (1982) put forward a standard interpretation of the *No-Trade Theorem*. According to this theory the arrival of new private information cannot generate trade between rational traders in an ongoing security market. The usual intuition of this theorem is as follows. Suppose that traders' initial security holdings are Pareto optimal and that some traders receive new information. If this new information generates trade then the trade must be for speculative purposes. But any trader who has not received the information would not want to trade as each such trader would know that he is being taken advantage of by the informed traders.

In any voluntary trading process, if agents have rational expectations, then it is common knowledge among them that the equilibrium trade is feasible and individually rational. This condition is used to show that when risk averse traders begin at a Pareto optimal and then receive private information, they can still never agree to any non-null trade. On markets, information is revealed by price changes. An equilibrium with fully revealing price changes always exists, and even at other equilibrium the information revealed by price changes makes invisible each trader's private information (Milgram and Stokey 1982).

The EMH states that markets are informational efficient. If capital markets are perfectly competitive then the price of shares will be equal to the Net Present Value (NPV). However, it is argued that markets are imperfect and arbitrage profit can be made using some trading techniques. Grossman and Stiglitz (1980) examined the impossibility of informational efficient markets. In efficient capital markets, as defined by Fama(1970), prices reflect all available information promptly and correctly, including the information comprised in financial reports. However, as Grossman and Stiglitz's (1980) study has shown, prices do not fully adjust to all of the information possessed by the informed individuals. As demonstrated by Grossman and Stiglitz (1980) the theoretical solution is to inject into the system an uncertain (noisy) variable, information about which cannot be aggregated by the markets. With such a variable, individuals will still use their own information system in their decision-making and will be willing to pay for such information for their private use. Grossman and Stiglitz (1980) argue that if everybody believes the market is efficient, then the market will not be efficient. When everybody believes the market is efficient then nobody will have an incentive to look for arbitrage profit. On the other hand the EMH relies on the fact that speculators correct any disequilibrium in the market. Therefore, if everybody believes that the market is efficient nobody will detect and correct disequilibrium prices and hence the market will no longer be efficient.

The EMH still remains influential because there is not an alternative theory explaining why there are inefficiencies in financial markets. Without a theory which predicts why financial markets are inefficient, studies showing mispricing can be viewed as a statistical coincidence. Therefore, an alternative to the EMH called the "Incomplete Revelation Hypothesis" (IRH) is presented in a study by Bloomfield (2002). The IRH states that statistics that are more costly to extract from public data are less completely revealed in market prices. The IRH can account for many of the phenomena that are central to financial reporting but inconsistent with the EMH. Overall, the IRH offers a number of novel and testable predictions that distinguish it from the EMH (Bloomfield 2002).

The IRH is based on equilibrium outcomes in "noisy rational expectations" models. In these models rational agents choose whether to collect information about the value of an asset. Because it is derived from models assuming that investors are rational, the IRH clarifies that informational inefficiency need not imply irrationality. The IRH extends the EMH by explicitly recognizing the costs of extracting statistics from public data (Bloomfield 2002).

2.7. Expectations and Stock Prices

In understanding the stock market, another key area to study is that of the theory of expectations. Participants in stock markets, as in most of the economic contexts, formulate expectations about what the future return will be in a stock. Investors, managers and workers of a firm need to forecast the future return from a firm’s share.

Expectations of the economic events and especially the macroeconomic variables have significant effect on the stock market return. However there is not a common method of measuring expectations. Therefore, the first step necessary to empirically test a theoretical asset valuation model, such as APT, is to transform it from expectations or *ex ante* form (expectations cannot be measured) into a form that uses observed data (Elton and Gruber 1991).

The equilibrium models, CAPM and APT, are formulated in terms of expectations. All variables are expressed in terms of future values. The betas (β_s) in the CAPM and APT are the future betas on the security. Furthermore, both the return on the market and the return on the minimum variance zero Beta portfolio are expected future returns (Elton and Gruber 1991).

It is argued that the EMH is one of the more resilient empirical propositions. It does not seem to have a clearly sound theoretical standing. It seems to collapse on one particular objection: namely, that if all information is already contained in prices and investors are fully rational, then not only can one not profit from using one's information, indeed, there might not be any trade at all. These peculiar, contradictory implications of rational expectations were demonstrated by Grossman and Stiglitz (1980) and Milgram and Stokey (1982)

There are two general theories of expectations: adaptive expectations and rational expectations. Economists model the way stock investors form their expectations in these two different ways. Fundamentals of these two alternative theories and the implications of them are crucial for stock market investment.

The adaptive expectations hypothesis states that future expectations of an economic event are based on actual outcomes in the past. It is formed on the past experiences only. This is equivalent to the technical analysis or the weak form test of the EMH. It states that the past experiences determine the future events. For example if two years ago earnings rose 5 percent, the year after another 5 percent, this year they will be expected to be 5 percent. People can change their decisions according to previous information. They make mistakes time to time but they learn from past mistakes (Copeland and Weston 1988) .Expectations are formed on the basis of past experiences only, typically as some kind of weighted average of past observations.

2.7.1. Rational Expectations

Robert Lucas is the founder of the theory of *rational expectations*. This highly mathematical theory dominated all economic thought in the 70s and early 80s, so much so that Lucas attracted a broad following of disciples who raised him to cult leader status. This viewpoint expects individuals to weigh all available evidence, including information concerning the probable effects of current and future economic policy, when they formulate their expectations about future economic events such as the probable future inflation rate (Gwartney and Stroup 1987).

According to Tesfatsion (2005) Rational Expectations have two basic forms: *weak-form rational expectations* and *strong-form rational expectations.* Weak-form rational expectations imply that whatever information people have, they make optimal use of this information in forming their expectations. However, strong form rational expectations suggest the use of all available information in forming expectations. In both forms there is no restriction placed on information.

Rational expectations are equivalent to fundamental analysis or a semi strong form of the efficient market hypothesis. It implies that the best forecast of a future variable can be made if a forecaster uses all available and relevant information, the latest statistical data and the best available economic models. Therefore, there is no systematic error in forecasting. The errors are random.

The theory of rational expectations and the EMH implies that expectations in financial markets are equal to optimal forecasts using all available information (i.e., investors have strong-form rational expectations). Current security prices in a financial market will be set so that the optimal forecast of a security's return rate using all available information equals the security's equilibrium return rate. Believers in rational Expectations insist that the only type of changes in economic variables are unexpected changes that affect the return on the stock market (Tesfatsion 2005).

The efficient markets hypothesis has been described in the literature as the cornerstone of modern financial theory, the centrepiece of neo-classical financial theory, and resting at the heart of rational expectations macroeconomics. However, several Post Keynesian critiques of the efficient markets hypothesis have challenged the normative implication that efficient market prices give the right incentives for the firms' production and investment decisions and for investors' portfolio decisions. Institutional support for the Post Keynesian challenges is offered by observing that Veblenian stock markets, heavily influenced by folk psychology and subject to episodes of speculative inflation that end in financial crises, reinforce the existing critique of the efficient markets hypothesis within the Post Keynesian literature (Raines and Charles 1996).

According to Elton, Gruber *et al*. (1981), it is generally believed that security prices are determined by expectations concerning firm and economic variables. This paper examined how expectations concerning earning per share affect share price. They first showed that knowledge concerning an analyst's forecasts of earnings per share could not by itself lead to excess returns. Any information contained in the consensus estimate of earnings per share is already included in the share price. Investors or managers who buy high growth stocks where high growth is determined by consensus beliefs should not earn an excess return. This is not due to earnings having no effect upon share price since knowledge of actual earnings leads to excess return. Much larger excess returns are earned if one is able to determine those stocks for which analysts most underestimate return. Finally, the largest returns can be earned by knowing which stocks for which analysts will make the greatest revision in their estimates. This pattern of results suggests that share price is affected by expectations about earnings per share. Given any degree of forecasting ability, managers can obtain the best results by acting on the differences between their forecasts and consensus forecasts.

A later study by Elton, Gruber *et al*. (2004) examined the rational behaviour of S&P 500 index funds. These funds represent one of the simplest vehicles for examining rational behaviour. They hold virtually the same securities, yet their returns differ by more than 2 percent per year. Although the relative returns of alternative S&P 500 funds are easily predictable, the relationship between cash flows and performance is weaker than rational behaviour would lead us to expect. They show that selecting funds based on low expenses or high past returns outperforms the portfolio of index funds selected by investors. Their results exemplify the fact that, in a market where arbitrage is not possible, dominated products can prosper.

Economists have been sceptical about the technical analysis and trading rules. It is argued that rational investors would eliminate any pattern in time series data. The assumption is that investors form expectations rationally. However, technical analysis and trading rules are important tools for professional investors. This indicates that investors do not have a common way of forming expectations. Fyfe, Marne *et al*. (1999) argue that investors do not have a common objective model of expectations formation, they have not a common way of anticipating other agents' expectations about stock market movements, and intelligent agents cannot form expectations in a determinate deductive way. Similarly, Badrinath and Wahal (2002) found significant differences in trading practices among different types of institutions. Thus it is evident that even large institutions do not have a uniform valuation method and cannot anticipate *markets expectations.*

2.8. Summary

This chapter reviewed the major economic concepts related to the economics of the stock market: equilibrium analysis of the stock market, the EMH and the theories of the expectations. The EMH and the rational expectations are interrelated topics. The majority of the empirical studies are using the joint hypothesis approach to test the EMH. They develop an econometric model and test those models jointly, by studying the EMH and the rational expectation hypothesis. However, studies are reporting tentative results on the EMH. It is not clear whether the model developed; the EMH hypothesis or the rational expectations are responsible for the inefficiencies.

In the long run, the supply of shares is inelastic meaning it is independent of interest rates and the price of the stock. However, the demand for shares is elastic and depends on interest rates and the other determinants of demand. Common valuation models, NPV, CAPM, ICAPM, APT and the Portfolio Theory, all relate to the demand side of equilibrium in the stock market. These valuation models will be studied in the next chapter.

Empirical tests support the weak-form EMH and generally reject the strong-form hypothesis. There is no agreement on the results of the tests used for the semi strong form EMH. Empirical tests give evidence that markets are not always semi strong form efficient.

There is enough evidence that markets are weak form efficient, particularly in favour of the random walk model. Although technical analysts claim that the evidence is not sufficient to support the validity of the random walk theory. Despite the fact that there are some empirical studies rejecting the random walk behaviour of the stock market return, it is argued that those studies are criticizing and rejecting the random walk behaviour rather than the EMH.

Studies of the semi strong form of the EMH have two different approaches: microeconomics and macroeconomics. Most of the studies using the microeconomic approach suggest the rejection of the semi-strong form efficiency. However, there is not enough empirical support on the macroeconomic approach to semi-strong efficiency.

There are two different methods of testing the semi-strong efficiency: the microeconomic approach and the macroeconomic approach. The microeconomic approach uses microeconomic data such as company profitability, dividend, and share split. The macroeconomic approach uses macroeconomic variables such as GDP, inflation, interest rates, and exchange rates. The results of the empirical studies, based on the microeconomic approach, lead to the rejection of the semi-strong form of the EMH. However, there is not sufficient empirical study on the macroeconomic approach to semi-strong efficiency. Thus, this thesis will test the semi strong form efficiency using the macroeconomic approach by developing a valuation model. This model will be an attempt to integrate the theory and practice of asset pricing and the macroeconomic variables in the remaining part of this thesis.

The results of empirical studies show that mutual funds that have access to private information do not exhibit superior performance. Investment analysts and mutual funds do not persistently beat the market. They can earn the average return on the stock market indices. It can be said that markets are strong form efficient. However, there is not sufficient evidence to conclude that the market is strong form efficient due to the existence of profits from insider trading. Insider traders can make abnormal profits and they can beat the market. It can be concluded that markets are strong form inefficient.

There are some studies reporting anomalies of efficiency. However some of them disappear when model data set and the statistical models change. It is not clear which one caused the stock return anomalies. Another point is that the mature markets are generally more efficient than the emerging markets.

Expectations have effect on all economic events. Participants in stock markets formulate expectations about what the future return will be in a stock. If the announcement is close to market expectations, the market is unaffected by the announcement. There are two general theories of expectations: adaptive expectations and rational expectations. Economists model the way stock investors form their expectations in these two different ways. The adaptive expectations hypothesis states that the future expectations of an economic event are based on actual outcomes in the past. Rational expectations imply that the best forecast of a future variable can be made if a forecaster uses all available and relevant information, the latest statistical data and the best available economic models.

In the long run, the supply of shares is inelastic meaning it is independent of interest rates and the price of the stock. However, the demand for shares is elastic and depends on interest rates and the other determinants of demand. Common valuation models, NPV, CAPM, APT and the Portfolio Theory, all relate to the demand side of equilibrium in the stock market.

In next chapter the results of the most common valuation techniques are evaluated, and the best model, to analyse the relationship between economic variables, stock market return, the EMH and the rational expectations hypothesis will be selected.

CHAPTER 3

3. THEORY AND PRACTICE OF ASSET PRICING

3.1. Introduction

The EMH, rational expectations hypothesis and asset pricing models are interrelated topics. These theories are crucial for equilibrium analysis in the financial markets and stock market in particular. Therefore, evaluation of these theories and the results of the empirical studies and their implications will be evaluated to understand and test the efficiency of the Australian stock market. Empirical studies studied these major concepts and tested jointly. This is called "*the joint hypothesis testing*". Moreover, macroeconomic risk factors integrated into the stock valuation process through the stock valuation models.

The objective of this thesis is to investigate the relationship between macroeconomic variables and the stock market return. Systematic macroeconomic risk factors are integrated into the investment decision making through the stock valuation models. Major valuation techniques: the NPV, the portfolio theory, the CAPM, and the APT, incorporate the EMH and the rational expectations hypothesis and macroeconomic variables into the stock market valuation process.

In Chapter 2 we overviewed the EMH and the rational expectations. In this chapter we overview the major assets pricing models to ascertain the way that macroeconomic variables integrated to stock market return. This will be achieved by discussing the methods of the stock valuation models and evaluation of the empirical studies. The theoretical and empirical works of these valuation models in general, and with reference to Australia in particular, will be evaluated. Asset valuation models will be presented to predict the way that economic and financial variables affect the stock market return in general.

The stock market index or portfolio consists of individual stocks; and hence any variable affecting individual stocks will affect stock market return as well. Economic variables affect individual stock prices directly or indirectly through the valuation models, which will be examined in this chapter. This is called as nominator and denominator effect on stock prices through the effect on nominator and denominator of valuation formula.

Microeconomic variables have an effect on the return of specific firms and are the sources of unsystematic risk, which can be eliminated through diversification. For example, the price of copper only affects the firms with exposure to copper prices. However, macroeconomic variables affect all of the stock market and are the source of systematic risk which cannot be eliminated through diversification. For example, interest rates affect any individual stock through the effect on the cost of firm and the present value of the stocks because they are a discount factor in the NPV model.

In the previous chapter, studies shows that that markets are imperfect and inefficient (Grossman and Stiglitz 1980) from an information aspect and that investors do not behave rationally. Thus, there is a situation where arbitrage profit can be made using certain strategies. To make an arbitrage profit it is necessary to ascertain the way in which economic variables affect stock returns. In practice, there are three different approaches to the valuation of stocks. They are:

- **Technical analysis**: related to the weak form efficiency of the EMH. This analysis concentrates on stock market, price movements and investors' psychology, and uses past price behaviour to predict future prices.
- **Fundamental analysis**: related to the semi strong efficiency - microeconomic version - of the EMH. This analysis concentrates on the return of individual stock, industry and firm's profitability, and growth. It uses publicly available firm specific or microeconomic information.

- **Macroeconomic analysis**: related to the semi strong efficiency - macroeconomic version – of the EMH. This analysis concentrates on the portfolio return rather than return in individual stocks. It uses publicly available macroeconomic information to predict stock return. It is also used to test the semi strong efficiency of financial markets.

The proposed model in this thesis will be based on macroeconomic analysis. It will be consistent with the semi strong form of the EMH and the macro variable version.

3.2. Capital budgeting

Capital budgeting is about how returns are generated and the supply of shares increased or decreased. It relates to the supply side of shares and valuation models relate to the demand side of the shares. They all integrate the effects of economic risk factors on the investment evaluation process.

There are four commonly used capital budgeting methods: i) the payback method, ii) the accounting rate of return (ARR), iii) the net present value (NPV), and iv) the internal rate of return (IRR). There are two surveys of large corporations conducted by Klammer (1972) and Schall *et al*. (1978). These papers have provided some statistics about the usage of these different valuation techniques. According to Klammer (1972) 57 percent use discounting (NPV and IRR), 26 percent ARR, 12 percent payback method and 5 percent other methods. A similar study by Schall *et al*. (1978) found that 86 percent of firms use discounted cash flow methods (NPV and IRR), most of them combined with a payback or ARR analysis.

The most common valuation techniques are the NPV and the IRR. These techniques incorporate the effects of economic variables into the share prices and therefore stock market return as a whole. The discounted cash flow model or the NPV model has the following form:

$$NPV = \sum_{t=1}^{N} \frac{NCF_t}{(1+k)^t} - I_0 \qquad (3.1)$$

Where NCF_t is the net cash flow in time period t, I_0 is the initial cash outlay, k is the firm's weighted average cost of capital (WACC), and N is the number of years.

The internal rate of return (IRR) is defined as the rate that equates the present value of the cash outflows and inflows: the rate that makes the NPV equal to zero. The IRR has the following form:

$$NPV = 0 = \sum_{t=1}^{N} \frac{NCF_t}{(1+IRR)^t} - I_0 \qquad (3.2)$$

The NPV and the IRR techniques of capital budgeting are the most sophisticated of the four commonly used methods. They both consider cash flows and discount them to take into account the time value of money. These two techniques integrate the effect of the economic variables into the stock prices through the effect on the nominator and denominator of these two capital budgeting models.

3.3. Valuation of Individual Shares

Capital budgeting relates to the *supply* of shares while stock valuation models relate to the *demand* for shares. We concluded in chapter 2 that supply of shares is fixed, independent of price and interest rates. Therefore, valuation of shares analyses the demand side of the stock market. This thesis is to analyse the fundamental valuation models and its relationships with macroeconomic variables in the way that they are affecting stock market return.

The first step in valuation is to determine the stream of expected return. It involves the expectation of future possible return and discounting the expected future cash flow. Hence the theory of expectations plays an important role from the beginning of the stock valuation process.

According to Peirson *et al.* (2006) if a company is assumed to have an infinite life, and the dividends are assumed to continue indefinitely, the current market price of its shares can be expressed as the present value of an infinite stream of dividends. Even in a market where investors are seeking capital gains, the valuation formula may be written as follows:

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t} \tag{3.3}$$

Where,

P_0 is the selling price today;

D_t is the dividend per share in period t;

r is the discount rate;

The present value approach to common-stock valuation will be compared with the multiplier approach. The multiplier is a shortcut computation to find the present value. The *price-earning (P/E) ratio* is commonly used by investors. Financial analysts estimate earnings per share for the year ahead and then divide the current market price by the estimated earnings per share. The terms *multiplier* and *price-earnings ratio* (P/E) are used interchangeably. Therefore:

$$P/E\,ratio = \frac{Current\,market\,price}{Estimated\,earnings\,pershare} \tag{3.4}$$

Valuation of individual stocks, both from supply side and demand side, uses the above valuation formulas (equations 3.1- 3.4). The underlying economic forces are the primary influences on the stock market return through their effects on the nominator and denominator of the valuation formulas over time. The underlining macroeconomic forces influence cash flow, capital gains, discount rates and causes variations in these variables over time. In other words what affects the nominator or denominator of the above equations has effect on stock returns. There are many studies examining these three sources effect on stock returns [see e.g., Chen *et al*. (1986), Fama (1981), Fama (1990), Roll and Ross (1995)].

According to Ben-Shahar and Ascher (1967) there were attempts to integrate the hypothesis of capital budgeting and stock valuation into one comprehensive theory. The general idea is that this purpose of valuation can be achieved by replacing "the single equation nature of capital budgeting and security valuation models" with a multiple equation model. Therefore, the equilibrium price of the securities can be identified both from the supply side and the demand side.

The selection of a portfolio would follow from valuing individual securities. Portfolio theory is the bases of the equilibrium asset pricing models (CAPM and APT). So far this thesis has covered stock market behaviour as a whole and the valuation of individual securities. The rest of the thesis deals with portfolio theory and its extensions, the CAPM, APT and effect of macroeconomic variables on the stock market return.

3.4. Portfolio Theory

Portfolio Theory was a very significant contribution in financial economics developed, in the early 1950s, by Harry Markowitz and contributed to by Tobin (1958). This theory analyses how assets can be invested optimally and how risk can be minimized under a set of assumptions.

Modern portfolio theory is the philosophical opposite of traditional stock picking. It is based on principle which attempt to understand the market as a whole. It provides a broad context for the interactions of *systematic risk* and return.

An effectively diversified portfolio minimizes the *unsystematic risk,* which is affected by microeconomic factors specific to the individual firms. The *systematic risk,* which is mainly created by macroeconomic factors, cannot be eliminated by diversification. Therefore, one can say that risk and return on a diversified portfolio depend on domestic and foreign economic and financial variables. This is the area of concentration for this thesis.

Modern portfolio theory was introduced by Markowitz (1952). This article covers the highlights of portfolio theory. It describes how risk and its effects on return are measured. While investors before then knew intuitively that it was smart to diversify (i.e. don’t put all your eggs in one basket), Markowitz was among the first to attempt to quantify risk and demonstrate quantitatively why and how portfolio diversification reduces risk. He formulated the theory of optimal portfolio selection in the context of trade-offs between risk and return, focusing on diversification as a method of reducing risk. Markowitz (1952) realized that, as the fundamentalist notion relied on *expectations* of the future, then the element of risk must come into play and thus profitable use could be made of the newly developed expected utility theory.

It was a logical step for James Tobin (1958) to add money to Markowitz's story and thus obtain the famous "two-fund separation theorem". Effectively, Tobin argued that agents would diversify their savings between a risk-free asset (money) and a single portfolio of risky assets (which would be the same for everyone). Tobin contended that different attitudes towards risk would merely result in different combinations of money and that unique portfolio of risky assets.

Portfolio theory of Markowitz (1952) and Tobin (1958) has strongly shaped how institutional portfolios are managed, and motivated the use of passive investment management techniques. The mathematics of portfolio theory is used extensively in financial risk management and was a theoretical precursor for today's *value-at-risk* measures.

Performance of portfolios has been tested empirically. Fama and MacBeth (1973) tested the relationship between average return and risk for New York Stock Exchange common stocks. The basis of the test is the two-parameter portfolio model of Markowitz (1952) and Tobin (1958), and models of market equilibrium derived from the two-parameter portfolio model. They concluded that the pricing of common stocks reflects the attempts of risk-averse investors to hold portfolios that are efficient in terms of expected value and dispersion of return. Specifically, there seems to be a positive trade-off between risk and return, with risk measured from the portfolio viewpoint. Moreover, the observed "fair game" properties of the coefficients and residuals of the risk-return regressions are consistent with an efficient capital market; that is, a market where prices of securities fully reflect available information. In the two-parameter portfolio model, the capital market is assumed to be perfect.

Investment funds use all theoretical and technical measures including portfolio theory and it is expected they will outperform the market. However, there are empirical studies reporting the opposite. For example Elton, Gruber and Blake (1996) reported that there is overwhelming evidence that, post expenses, mutual fund managers on average underperform a combination of passive portfolios of similar risk. This article examines mutual fund predictability for common stock funds and measures performance using risk-adjusted returns. A more recent study by Low (2007) found similar results studying the Malaysian unit trust performance. The findings in this paper indicate that, on average, the funds display negative overall performance with benchmark indexes. In addition, there is little variation in the manager's market-timing and selectivity performance across alternative market benchmarks. It is also reported that a manager's poor timing ability contributes significantly to the fund's negative overall performance. These results are inconsistent with Markowitz’s concept of an efficient portfolio and efficient frontier.

Portfolio theory integrates the EMH and rational expectations hypothesis. The natural extensions of the portfolio theory are the equilibrium asset pricing models such as CAPM and the APT which integrate macroeconomic risk factors into the stock valuation process to minimize the systematic risk that cannot be minimized by diversification of stocks.

3.5. Capital Assets Pricing Model

The CAPM is known as the single factor (or single index) asset pricing model which integrates only one macroeconomic variable, the return on the market, to the return on individual stock through the value of the beta (β).

Portfolio theory was not very practical to minimize the systematic risk and it required too many calculations to estimate the benefits of diversification. Diversification minimizes the unsystematic risk however, it cannot minimize the systematic risk generated by macroeconomic variables. Therefore, the CAPM is an attempt to minimize systematic risk by using the market return.

Because of these calculation difficulties Sharpe (1963) extended Markowitz's portfolio theory by developing a simplified portfolio selection model on the second stages of the portfolio selection process. The model developed in Sharpe (1963) is also called the *Market Model* or *Single Index Model*. He suggested abandoning the covariance between each security and related each security to the market. This model, to obtain the same results with much larger relationships between securities, uses relatively few parameters. Benefits are low cost and less information is needed to establish an effective portfolio. In Sharpe's (1963) suggestion, the return for any security is given by the following equation.

$$R_i = \alpha_i + \beta_i I + \varepsilon_i \tag{3.5}$$

Where

R_i = the return on security i;

α_i and β_i = parameters;

ε_i = a random variable;

I = return on market index.

The rate of return on any security is dependent on a constant plus slope coefficient (β) multiplied by market return plus a random element. The benefit of this equation is that the covariance between pairs of assets can be estimated using the beta (β).

The Capital Asset Pricing Model (CAPM) was developed by Sharpe (1964), and contributed to by Lintner (1965a) and Mossin (1966). However, William Sharpe was the leading figure. Sharpe (1964) used Markowitz's portfolio theory and developed the CAPM. The CAPM has the following form:

$$R_{it} - r_t = \alpha_i + \beta_i (R_{mt} - r_t) + u_{it} \qquad (3.6)$$

Where

R_{it} is the actual return on stock i in each past period t;

R_{mt} is the actual return on a market index;

r_t is the yield on bonds;

and u_{it} is a random error;

α_i *and* β_i are parameters.

Varian (1993 pp.165) states that Sharpe's two major contributions, the single factor model and the CAPM**,** are often confused. The first is a "supply side" model of how returns are generated; the second is a "demand side" model. The models can hold independently, or separately, and both are used in practice.

But how effective is the CAPM in practice? Performance of the CAPM has been the subject of empirical studies. The most cited papers are Friend and Blume (1970), Blume and Friend (1973) and Fama and MacBeth (1973). A recent Australian study by Durack *et al.* (2004) and more recent studies by Ang and Chen (2005), Fama and French (2006)and

Kassimatis (2008) investigated the performance of the CAPM. Studies have found evidence of irregularities in the performance of the CAPM.

Friend and Blume (1970) exploring a theory of portfolio performance measurement under uncertainty, tested the CAPM. They concluded that the Sharpe, Treynor and Jensen one-parameter measures of portfolio performance based on this theory seemed to yield seriously biased estimates of performance, with the magnitudes of the bias related to portfolio risk. They further wrote that the numerous studies of mutual fund performance based on these one-parameter measures are suspect when they attempt to appraise individual portfolios, or when the average risk of these portfolios differs from that of the market as a whole.

Blume and Friend (1973) examined the CAPM both theoretically and empirically in greater depth what was done previously by the authors. The reason for this is the market line theory does not adequately explain differential returns on financial assets. The empirical results cast serious doubt on the validity of the market line theory in either its original form or as recently modified. On the other hand, their results show the linearity of the relationship for NYSE stocks. Blume and Friend (1973) concluded that the evidence in their paper seems to require a rejection of the CAPM as an explanation of the observed returns on all financial assets, if return generating process for common stocks takes the general form.

Fama and MacBeth (1973), using a cross-sectional regression between 1935 to 1968, developed a model to test CAPM. Their results support the testable implications of the two-parameter model. They cannot reject the hypothesis that average returns on common stocks reflect the attempts of risk averse investors to hold efficient portfolios. Specifically, on average there seems to be a positive trade-off between risk and return. In addition, although there are stochastic non-linearities from period to period, they cannot reject the hypothesis that on average their effects are zero and unpredictable, different from zero from one period to the next. Thus, they cannot reject the hypothesis that in making a portfolio decision, an investor should assume that the relationship between a security's portfolio risk and its expected return is linear, as implied by the two-parameter model. They also cannot reject the hypothesis that the two-parameter model that has no measure of risk, in addition to portfolio risk, systematically affects average returns. Finally, the observed fair game properties of the coefficients and residuals of the risk return regressions are consistent with efficient capital markets.

Durack *et al.* (2004), using Australian data, tested the Conditional Capital Asset Pricing Model (betas and the market risk premium vary over time). Their results support the model, which performs well compared to a number of different asset pricing models. However, they found that the inclusion of the market for human capital does not save the concept of the time-independent market beta (it remains insignificant). They found support for the role of a small-minus-big factor in pricing the cross-section of returns and find grounds to disagree with the argument that this factor proxies for misspecified market risk.

Ang and Chen (2005) examined the performance of the CAPM over the period of 1926 -1963 and post 1963-2001 and 1926–2001 using the book-to-market effect. This paper demonstrated that the CAPM can explain US value premium over this long period. The book-to-market effect appears to be a strong CAPM anomaly that many researchers consider to be a significant risk factor. The post-1963 book-to-market premium appears to be highly statistically significant. In contrast, over the pre-1963 sample, the book-to-market is not statistically significant. The difference across the two samples can be attributed to *time-varying betas* in which betas change slowly over time. The authors proposed and directly estimated a conditional CAPM with time-varying conditional betas and stochastic systematic volatility. They found that the conditional alpha of the book-to-market strategy is positive both over the long run, from 1927-2001, and over the post-1963 sub-sample. Using an effectively uninformative prior, there is little evidence to conclude that the conditional alpha of the book-to-market strategy is different from zero.

Fama and French (2006), using the US stock market data between 1926 and 2004, examined whether variations in beta are related to observed returns in a way that is consistent with the CAPM. For the entire 1926–2004 period, small companies have higher betas than large companies and the CAPM explains much of the higher return associated with small companies. From 1926 to 1963, value stocks have higher betas than growth stocks do, and again, the CAPM is consistent with the value premium. For the 1963–2004 periods, however, value stocks have lower betas than growth stocks do, and the CAPM is inconsistent with the observed value premium. For the entire 1926–2004 period, if portfolios are sorted on the basis of company size and book-to-market, returns and betas are not associated as indicated by the CAPM. The authors conclude that it is not beta but company size and book-to-market, or the risks related to them, that are compensated in the form of higher returns.

A recent study of the Australian stock market by Kassimatis (2008) examined the significance of the size, book-to-market and momentum risk factors in explaining portfolio returns, and compared them to the CAPM. He used the data between July 1992 to June 2005 and constructed different portfolios to analyze the year to year returns. They found that the additional factors have significant explanatory power rather than just market factor. According to the author the CAPM does not perform adequately in explaining realized returns.

Empirical studies criticized the validity of the CAPM, the single macrovariable model. Beta should be the only factor that explains the rate of return. However, factors other than beta are successful in explaining security return. There is no practical solution to minimize the systematic risk thus this gave rise to the usage of alternative multifactor assets pricing models such as the Intertemporal Capital Asset Pricing Model (ICAPM) and the APT.

3.6. Intertemporal Capital Asset Pricing Model

The CAPM has been challenged empirically in a series of papers. One of the alternatives offered was the ICAPM of Merton (1973). Based on Merton's (1973) approach and the assumption of rational expectations, Cox et al. (1985a) developed the partial differential equation for asset prices which is similar to Lucas' (1978) theory of asset pricing.

Lucas' (1978) paper is regarded as a theoretical examination of the stochastic behaviour of equilibrium asset prices in a one-good, pure exchange economy with identical consumers. The random output of these processes is exogenously determined and consumable. Assets are defined as claims to all or a part of the output of a process and the equilibrium determines the asset prices. A general method of constructing equilibrium prices is developed and applied to a series of examples.

Although the CAPM has had significant impact on the non-academic financial community, it is still subject to theoretical and empirical criticism. The model assumes that investors choose their portfolios according to Markowitz's mean-variance criterion. There are, however, theoretical objections to this criterion (Merton 1973).

An intertemporal model for the capital market is deduced from the portfolio selection behaviour by an arbitrary number of investors who act to maximize the expected utility of lifetime consumption and who can trade continuously in time. Explicit demand functions for assets are derived, and it is shown that, unlike the one period model, current demands are affected by the possibility of uncertain changes in the future investment opportunities. After aggregating demands and requiring market clearing, the equilibrium relationships among expected returns are derived, and contrary to the classical capital asset pricing model, expected return on risky assets may differ from the riskless rate even when they have no systematic or market risk (Merton 1973).

Cox *et al* (1985a) developed a general equilibrium asset pricing model to use in applied research. This theory employs some characteristics of Merton (1973) and Lucas (1978). The most significant feature of the model is the integration of real and financial variables. It is also fully consistent with the rational expectations and maximizing behaviour of all agents. It determines the stochastic process followed by the equilibrium price of any financial asset and the underlying real variables. The model can be extended in a number of ways and it is well suited to a wide variety of applications.

Cox, *et al*. (1985b) used the model to develop a theory of the term structure of interest rates. This article reviewed and applied the general equilibrium model of Cox *et al*. (1985a). It uses an intertemporal general equilibrium asset pricing model to study the term structure of interest rates. In this model, expectations, risk attitude, investment alternatives, and preferences play a role in determining bond prices. Many of the factors are influencing the term structure and are therefore included in a way which is consistent with maximizing behaviour and rational expectations hypothesis. The model develops specific formulas for bond pricing which are convenient for empirical testing.

Merton (1973) developed the ICAPM using utility maximization to get exact multifactor predictions of expected security returns. Fama (1996) built Merton's ICAPM on similar intuition. The ICAPM risk return relation is a natural generalization of the CAPM. It adds risk premiums for the sensitivities of R_i to the returns, R_s, s=1,…,S, on the (economic) state- variable related portfolios. The ICAPM has the following form:

$$R_{it} - r_t = \alpha_i + \beta_i \, (R_{mt} - r_t) + \sum_{s=1}^{S} \beta_{is} (R_{st} - r_t) + u_{it} \tag{3.7}$$

where, β_i and β_{is}, are the slopes from the multiple regression of R_i and R_m and R_s. As in the CAPM, the relation between expected return and multifactor risks in the ICAPM is the condition on the weights for securities that holds in any multifactor-efficient portfolio.

Fama (1998) presented a study which aimed to determine the number of priced state variables in the ICAPM. He tried to answer the questions that go to the heart of the economics of the ICAPM. Specifically, given ICAPM asset pricing, and given that there is a total of S state variables potentially of hedging concern to investors, i) how can we determine which of these state variables are in fact of hedging concern, and ii) in what sense do these state variables produce special risk premiums in expected returns. According to Fama (1998) it is possible to find the set of priced variables when the state variables are identified (named). When the number of state variables is known, but their names are not, confident conclusions about even the number of them that produce special risk premiums are probably impossible. However, the existing literature fails in identifying the specific state variables that produce risk in the context of ICAPM.

A study by Brennan *et al*. (2004) developed and estimated a simple valuation model. The investment opportunity set is completely described by the real interest rate and the maximum Sharpe ratio. Bond yields are linearly related to the state variables, the real interest rate and the maximum Sharpe ratio. Bond yields and expected inflation were used to estimate state variables and the parameters. The estimated real interest rate and the Sharpe ratio both show strong business cycle-related variations. The model parameters and time series of the state variables are estimated using U.S economic variables. Treasury bond yields and expected inflation from January 1952 to December 2000, and as predicted, the estimated maximum Sharpe ratio are related to the equity premium. In cross-sectional asset-pricing tests, both state variables have significant risk premium, which is consistent with Merton's ICAPM. Brennan *et al* (2004) claim that their results with ICAPM are encouraging further empirical investigation.

A recent study by Gerard and Guojun (2006) developed a simple ICAPM, estimated it and tested this model. They analysed the statistical and economic relevance of intertemporal risk in explaining the dynamics of the premium for holding stocks and bonds. They tested a conditional asset pricing model that includes long-term interest rate risk as a priced factor for four asset classes: large stocks, small stocks, and long-term Treasury and corporate bonds. They found that the interest risk premium is the main component of the risk premiums for bond portfolios, while representing a small fraction of total risk premiums for equities. This suggests that stocks, especially small stocks, are hedges against variations in the investment opportunity set. They also estimate that, at average market volatility levels, investors earn annual premiums between 3.6% during expansions and 5.8% during recessions for bearing intertemporal risk alone.

The existing literature fails in identification of the specific state variables which are the likely sources of risk. There is no practical solution to manage the systematic risk and identify significant macroeconomic variables in the context of ICAPM, thus this gave rise to the usage of alternative multifactor assets pricing models such as the APT.

3.7. Arbitrage Pricing Theory

The objective of this section is to survey briefly the major empirical studies of multifactor Asset-pricing models developed in the literature.

Multifactor asset-pricing models are based on the APT and they deal with a multifactor equilibrium in which there are sources of risk other than market factor. Consistent with the portfolio theory and diversification, modern financial theory has focused on systematic effects as the likely sources of risk.

Ross (1976) developed the APT and Roll and Ross (1995) provided a more intuitive explanation of the APT and discussed its merits for portfolio management. The APT is an alternative approach to the CAPM that has become the major analytic tool for explaining the phenomena observed in capital markets. The APT model has the following form:

$$R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \ldots + \beta_{ik}F_k + u_i \qquad (3.8)$$

Where, R_i is the actual (realized) return on security *i*, $E(R_i)$ is its expected return, β_{ij} is the sensitivity of actual return on *i*th asset to the *j*th risk factor (F_j), and u_i is the random error term. Return on any security or portfolio is dependent on expected return on security plus a series of macroeconomic factors.

The model begins with the assumption that actual return on any security is equal to its expected return plus a series of impacts on return (i.e. macroeconomic variables). It breaks up the single factor CAPM into several components. The CAPM predicts that security rates of return are linearly related to a single common factor, the rate of return on the market portfolio. The APT is based on a similar intuition but is much more general. The CAPM is viewed as a special case of the APT when the market rate of return is the single relevant factor.

The APT is an alternative asset-pricing model to the CAPM differing in its assumptions and explanation of risk factors associated with the risk of an asset. The CAPM specifies returns as a linear function of only systematic risk. The APT specifies returns as a linear function of more than a single factor. It predicts a relationship between the returns of portfolio and the returns of a single asset through a linear combination of variables. The APT approach moved away from the risk versus return logic of the CAPM, and exploited the notion of "pricing by arbitrage" to its fullest possible extent. As Ross (1976) himself has noted, arbitrage-theoretic reasoning is not unique to his particular theory but is in fact the underlying logic and methodology of virtually all of finance theory.

There are many multifactor assets pricing models developed in the literature. According to Sinclair (1984), all of the multifactor asset pricing models developed in the literature can be treated as special theoretical cases of the APT.

The APT has been empirically investigated in the US and elsewhere. Examples are: Roll and Ross (1980), Chen (1983), Chen *et.al* (1986), Priestly (2002), Clare and Thomas

(1994), Cheng (1995), Cheng (1998), Chen and Jordan (1993), Merville *et al*. (2001), Chen *et al*. (1997), Beenstock and Chan (1986), Cho *et al*. (1984), an Priestley (1996). There are a number of empirical studies of APT using Australian data, such as: Sinclair (1984); Groenewold and Fraser (1997), Faff and Chan (1998).

A study by Qi and Maddala (1999) argued that stock market prediction is problematic and many of the models developed are inefficient. Since many financial and economic variables are non-linear, Qi and Maddala (1999) used artificial neural networks to improve the predictability of stock returns. They demonstrated that a neural network could improve the predictability of stock market return.

A recent paper by Nawalkha (2007) questions the validity of the APT by asking whether the APT is dead. According to the author, from the very beginning many researchers were skeptical, and believed that APT offered too much for too little. One of the initial criticisms of APT has been the empirical randomness of factor identification. Nawalkha (2007) questions the validity of the APT by deriving a *multibeta representation theorem*. This theory can price assets using random variables that are not the true factors. Under this theorem, the upper bound on pricing deviations depends upon the correlations not only between the reference variables and the factors but also between the reference variables and the residual risks. A new concept of a well-diversified variable is introduced, which though free of residual risk, may be less than perfectly correlated with the true factors. Well-diversified variables correlated with the factors play a key role in the pricing of assets, since these variables can replace the factors without any loss in pricing accuracy under all linear asset pricing theories. A set of corollaries to the multibeta representation theorem are derived, which are fatal for both the APT as well as the equilibrium APT. Both these theories lead to pricing of arbitrary reference variables, which allows rejection of these theories based on casual empiricism. Since Merton's ICAPM does not suffer from such arbitrary pricing, it represents a viable theoretical framework for the empirical multifactor asset pricing models, such as the 3-factor Fama and French model.

The APT is one of the alternative multifactor valuation models. However, there is no research identifying the variables that constitute risk factors in the context of the APT. The existing literature fails in identifying the significant variables that produce risk.

3.8. Factor Loading Model versus Macro Variable Model of the APT

According to Chen (1983) there are two ways to determine the factors of APT. The first is to make assumptions and produce a theory specifying the variables of the equation, and then test this theory. The second way is to examine assets realized returns and determine empirically which macro variables correspond. The APT is more in the spirit of the second approach, which is the macro variable approach. Chen (1983) states that this is the most important direction for future research – an economic interpretation of the common factors. However, the author did not name any macroeconomic variables affecting stock return.

There are two different versions of APT: the factor loading model and the macro variable model. These two empirical models are used to implement and test the APT. The factor loading model uses artificial variables while macro variable model avoids artificial factors and uses macroeconomic variables based on the economic transmission mechanism (Groenewold and Fraser 1997).

The APT does not provide a guideline as to how many pricing factors should be chosen and, more importantly, what those factors are. In application, researchers have relied either on a statistical method, such as factor analysis, and pre-specified macroeconomic variables, or on fundamental variables (Merville *et al.* (2001).

In many of the empirical studies factors are artificially created using principal components analysis (or factor analysis) rather than using an economic transmission mechanism. Naturally they have no real-world explanation (Groenewold and Fraser 1997).

There are a number of studies comparing the two different versions of the APT. For example: Chen and Jordan (1993), Chen *et al*. (1997), and Groenewold and Fraser (1997)

Chen and Jordan (1993) used two empirical models of the APT: the factor loading model and the macro variable model to predict portfolio returns over the period 1971-1986. Based on their test results they have drawn a key conclusion that little is lost in moving from the factor loading model to the macro variable model. And the macro variable model may turn out to be the better model when the two are tested against a holdout sample or against a test period. This finding is very promising because the macro variable model has several advantages, including economically interpretable factors. In addition, no attempt is made in this study to determine the best set of macroeconomic variables or how to best measure the ones selected; the possible performance of the macro variable model is probably understated. In other words, it may be that a different set of macro variables or better measures of the ones used in this study will improve the performance of the macro variable model. This serves as an immediate avenue for future research.

Chen *et al*. (1997) presents information on a study conducted on the factor loading model and the macro variable model in relation to returns of real estate investment trusts. This study compares the ability of these two models to explain real estate returns. The results show that while the two models perform equally well during the period 1974-1979, the macro variable model outperforms the factor loading model over the periods 1980-1985 and 1986-1991.

Groenewold and Fraser (1997) compared the factor loading model and the macro variable model of the APT and the CAPM. Both versions of the APT were found to clearly outperform the CAPM, but neither version of the APT was clearly superior to the other in terms of both within and out-of-sample explanatory power.

3.8.1. Factor Loading Model

The factor loading model uses factor analysis technique based on artificial factors to identify the number of factors and their significance in estimating the responsiveness of individual securities to different systematic risk factors. The macro variable model uses an alternative methodology avoiding artificial factors. The macro variable model is based on economic interactions and it tries to explain the relationship between the stock market and the economy in terms of what economic theory suggests.

Roll and Ross (1980), as suggested by Ross (1976) tested the APT using the factor analysis technique with artificial variables. It has become a classic article on testing the APT. They found that there are at least three and probably four significant factors. However, they could not determine which macroeconomic variables were significantly priced. Dhrymes *et al*.(1984) criticised the test of Roll and Ross (1980) particularly the factor analytic technique. They argued that, in the factor analytic technique, as the amount of stocks increases then the number of artificial factors increases. Roll and Ross's article (1984) was a response to these critics. Their purpose was to present a brief explanation and nontechnical comment. They concluded that their paper (Roll and Ross 1980) was not the definitive test of the APT but suggested. It was merely a first step and others have extended their work by constructive suggestions for improving the testing procedures. Beenstock and Chan (1986), using the factor analytic technique similar to Chen (1983), found results similar to Dhrymes *et al.* (1984) in the UK stock market. They described 20 risk factors in the UK stock market. Furthermore, they reported that the number of factors is proportionate to the sample size.

Chen (1983) estimated the parameters of the APT using the factor analytic technique. This study can be regarded as a step to determine the expected return on assets. He compared the evidence on the APT and the CAPM as implemented by market indices and found that the APT performs well. The theory is further supported in that estimated expected returns depend on estimated factor loadings, and variables such as own variance and firm size do not contribute additional explanatory power to that of the factor loadings. However, the author did not specify which macrovariables are significant.

Cho *et al*. (1984) examined the results produced by the Roll and Ross (1980) procedure. They found that, while the test procedure of Roll and Ross overstates the number of factors in the return generating process, the procedure has at most a slight tendency to overestimate the number of factors influencing equilibrium returns. Furthermore, for simulated data, there were fewer factors identified as generating returns and fewer factors required to explain equilibrium returns than the numbers corresponding to actual data. Therefore, there appear to be influences in the market that generate returns beyond those depicted in the zero beta (risk free) CAPM.

Sinclair (1984), using factor loading model, explored factor structure of the Australian market. He found that there is clearly a market factor. However, Sinclair (1984) fails to identify the variables which are the sources of the systematic risk.

Huang and Jo (1995) tested the APT. They stated that determining the number of factors that explain stock returns plays an important role in empirical tests of the Arbitrage Pricing Theory. The sensitivity of the number of factors to different data frequencies using daily, weekly, and monthly returns is examined. The empirical results are consistent with the null hypothesis that the number of factors is the same for different data frequencies once daily returns are adjusted for nonsynchronous trading. The evidence also identifies only one or 2 factors.

Shukla and Trzcinka (1990) examined the cross-sectional pricing equation of the APT using the elements of eigenvectors and the maximum likelihood factor loadings of the covariance matrix of returns as measures of risk. Their results indicate that, for data assumed stationary over twenty years, the first vector is a surprisingly good measure of risk when compared with either a one or a five factor model or a five vector model.

Bahri and Leger (2001) examined the stability of risk factors in the UK stock market over time and across stock samples. They identified risk factors by principal components analysis. Stability was examined by estimating the predictability of superfactor loadings and superfactor scores over 20 years. They concluded that only one stable market-wide risk factor emerged. Other components seemed to be sample-specific and unstable across time.

According to Merville *et al*. (2001) construction of a statistical method (like factor analysis) explains most of the cross-sectional variations of equity returns, however, it adds little understanding as to why equity returns differ. Economic factors, on the other hand, are important in sorting out the determinants of equity returns, yet these factors usually do not have much explanatory power.

3.8.2. Macro Variable Model

The Macro Variable version of the APT uses observed factors assuming that stock prices react to news about macroeconomic and financial variables. Following the pioneering work of Chen *et al* (1986), there has been significant work in the literature. These works confirmed that stock market return is affected by macroeconomic and financial variables.

As most recent studies used this framework, it is important to first understand the true factor structure of this study. According to Chen *et al.* (1986) economic state variables have systematic effects on stock returns. From the perspective of the efficient market hypothesis and rational expectations, asset prices should depend on their exposures to the state variables that describe the economy.

Chen *et al.* (1986) correlated various macroeconomic variables with returns on five portfolios. They found that four macroeconomic variables were significant:

- Industrial production;

- Unanticipated inflation;
- Twists in the yield curve; and
- Changes in risk premium (spread between low grade bonds and high grade bonds).

Chen *et al.* (1986) chose a set of economic state variables as candidates for sources of systematic asset risk. Several of these economic variables were found to be significant in explaining expected stock returns. The authors did not completely investigate the significant macroeconomic variables but selected some variables that showed some significance compared to other possible macro variables.

Beenstock and Chan (1988) presented a study proposing an alternative methodology for testing Arbitrage Pricing Theory (APT) in the context of the market for British securities. Using the macro variable model, they identified four macroeconomic variables for the UK market:

- Interest rates;
- Fuel and material costs;
- Money supply;
- Inflation.

The arbitrage pricing theory (APT) with macroeconomic factors, put forward by Chen *et al*. (1986), was tested by Groenewold and Fraser (1997) using monthly Australian sectoral share-price indexes for the period 1980-1994. The inflation rate was found to be consistently priced. The significance of other factors was found to depend on their choice of sample period and estimation model. They found that: the rate of inflation, the short-term interest rate, and the money growth rate are priced factors. They found less support for output, employment, exchange rates and balance of payments.

Different sectors have a different factor structure in terms of APT. For example Faff and Chan (1998) identified a different set of variables determining gold industry stock. This paper incorporates into one multifactor model three such variables - gold prices, interest rates and foreign exchange rates. Their paper applied this model over the period 1979 to 1992. They found that the only variables of significant explanatory power are the market and gold price factors.

He and Ng (1994) investigated whether size and book-to-market values of equity are proxying for macroeconomic risks found in Chen *et al.* (1986) multifactor models or are measures of stocks' risk exposure to relative distress. They found that the role of size includes stocks' risk exposures associated with the Chen *et al.* (1986) factors and that the Chen *et al.* (1986) multifactor model does not explain the book-to-market effect. They also found that size and book-to-market are related to relative distress and that relative distress can explain the size effect, but only partially the effect of book-to-market, on average stock returns.

Merville *et al*. (2001) examined the fundamental factors influencing the returns of constructed portfolios and selected equity mutual funds. Their results indicate that there are most likely three factors. These three stock returns factors can be associated with 1) market return, which also includes idiosyncratic return; 2) market capitalization; and 3) the investment opportunity set. Higher-order factors can also be uniquely identified with macroeconomic variables.

Shanken and Weinstein (2006) re-examined and tested the validity of the pricing of the five Chen *et al.* (1986) macrovariable factors. They found them to be surprisingly sensitive to reasonable alternative procedures for generating size portfolio returns and estimating their betas. Strong evidence of pricing is obtained only for the industrial production growth factor and, in another contrast, for the market index. In particular, the corporate-government bond return spread, an important factor in Chen *at al.* (1986) study, is insignificantly negative for the 1958-1983 period, corroborating the cross-sectional regression results.

Tursoy *et al.*, (2008) tested the APT in the Istanbul Stock Exchange (Turkey) using monthly data between February 2001 and September 2005. In this paper, various macroeconomic variables which represent the basics of an economy were employed. They are: money supply, industrial production, oil price, consumer price index, import, export, gold price, exchange rate, interest rate, GDP, foreign reserve, unemployment rate and a market pressure index which is built by the authors. They tested these macroeconomic variables against 11 industry portfolios using ordinary least square technique. Their result indicates that there is not a significant relationship between stock return and these macroeconomic variables. However, each macroeconomic variable affects different industry portfolios to a different degree.

Humpe and Macmillan (2009) examined the effect of several macroeconomic variables on the stock prices in the US and Japan using monthly data between 1965 and 2005. They studied the relationship within the framework of a standard discounted value model and they applied cointegration analysis between industrial production, the consumer price index, money supply, long term interest rates and stock prices in the US and Japan. Using the US data they found a single cointegrating vector, between stock prices, industrial production, inflation and the long term interest rate. Stock prices are positively related to industrial production and negatively related to both the consumer price index and a long term interest rate. They also found an insignificant but positive relationship between US stock prices and the money supply. Using the Japanese data Humpe and Macmillan (2009) found two cointegrating vectors. For the first vector, stock prices were influenced positively by industrial production and negatively by the money supply. For the second cointegrating vector, industrial production was negatively influenced by the consumer price index and a long term interest rate. This study gives contrasting results and they explained these contrasting results by the slump in the Japanese economy during the 1990s and consequent liquidity trap in the late 1990s and early 2000s.

The methodology of Chen *et al.* (1986), the macro variable model of the APT, is considered as the best and the most economically interpretable model. However, the evidence from the empirical studies above shows that this method does not explaining precisely the relationship between stock market return and the macroeconomic variables. The proposed multifactor model in this thesis follows the same methodology by applying a different set of data and tests the significance of the relationship.

3.9. International APT

The portfolio theory has been extended and empirically tested by Grubel (1968). This article introduced the benefits of wider international diversification and reported three important results. First, international diversification of portfolios is the source of new welfare gains from international economic relations. Second, the theoretical model shows that international capital movements are a function not only of interest rate differentials but also of rates of growth in total asset holdings in two countries. As a result, capital may flow between countries when interest rate differentials are zero or negative and may not flow when a positive interest differential exists. Third, the analysis has some important policy implications in a growing world where monetary and fiscal policies are mixed to achieve internal and external balance. This paper also demonstrated that the benefits of international diversification are mathematically correct. Since the work of Grubel (1968), international market linkages have been more effective and beneficial.

Deregulation of the financial markets was another factor contributing to the international economic and financial linkages. Since the 1980s, financial markets have been deregulated, capital movements have been liberalized and national markets have securitized and multinational companies have been cross-listed. These phenomena have affected the correlation structure of stock market returns. The globalisation phenomenon stimulates the study of international market linkages and economic factors. As a result, there has been an emerging literature on the international APT which analyses the effect of international macroeconomic variables on the stock market return.

There are a couple of studies testing the international APT. For example, Cho *et al*. (1986) have provided an empirical investigation and tested the arbitrage pricing theory (APT) in an international setting. The inter-battery factor analysis results have shown that there are about three or four worldwide common factors and that the number of common factors between two countries ranges from one to five depending on the degree of their economic integration. The cross-sectional test results lead to the rejection of the joint hypothesis that the international capital market is integrated and that the APT is internationally valid. However, the authors do not rule out the possibility that the APT holds locally or regionally in segmented capital markets.

Eun and Shim (1989) investigated the international transmission mechanism of stock market movements. They confirmed the importance of the US market in driving market movement elsewhere. A significant interaction is detected between national stock markets. Changes in the U.S. are quickly transmitted to other markets in a recognizable fashion. However, the author found that no single foreign market can significantly explain the U.S. market movements.

Since stock markets have become more open, there has been increasing interest in international linkages. According to Dickinson (2000) the recent literature has investigated this issue and generally has found there to be greater links between stock markets in recent years with the US causing other market movements. There has been work to identify the underlying economic variables which cause stock index movements. This research has uncovered a number of key macroeconomic variables (e.g. output, inflation, interest rates) as significant determinants of stock market movements. This paper considers the extent to which correlations between international stock markets are a result of globalisation of financial markets or whether they reflect the increasingly integrated nature of the world real economy, as represented by co-movements between key macroeconomic variables.

3.10. Summary

Assets pricing procedure starts with the valuation of single stocks mostly based on accounting data. Portfolio theory refers to the valuation of groups of stocks. Equilibrium asset pricing models, CAPM and APT, refer to the valuation of stocks based on macroeconomic variables. The objective of these valuation steps is to maximise return and minimize the total risk.

Efficient market hypothesis and rational expectation hypothesis suggest that people use all the available information and use the best valuation model. There are many studies trying to identify the number of significant variables in the context of multifactor models. The most widely used valuation model is the macro variable version of APT. However, the acceptance of the APT has not been complete. There are methodological and conceptual issues related to it, and there are serious deficiencies in the empirical evidence to formulate any meaningful valuation model.

The existing literature fails in identifying the specific state variables that produce risk in the context of APT. Alternative multifactor asset pricing models have been proposed to the CAPM, but they do not give any greater clarity than the CAPM. This situation gives rise to the need for further research in this area. In the next sections we try to develop a multifactor valuation model based on the APT. The macro variable version of the APT will be used because it has several advantages, such as economically interpretable factors. Moreover, empirical studies show that the macro variable model outperforms the factor loading version of the APT as well as CAPM.

CHAPTER 4

4. ECONOMIC VARIABLES AND STOCK PRICES

4.1. Introduction

The effects of macroeconomic variables on stock prices have been analysed using the assets pricing models reviewed in chapter 3. These models, the EMH and the rational expectations hypothesis, are interrelated topics. Empirical studies have analysed the stock market behaviour from the perspective of the EMH, rational expectations and the theory of asset pricing. In this chapter, the effects of macroeconomic variables on stock market return are discussed, and a multifactor model will be developed by identifying the likely source of systematic risk. This newly developed model will be consistent with the macro variable version of the APT and the semi-strong form efficiency of the EMH.

Macroeconomics analyses the behaviour of the aggregate variables. It simplifies the complicated details of the economy using a few basic fundamentals. The core of these fundamentals is the connections among the major markets. The major markets that coordinate the macroeconomic activities are: the goods and services market (product market), stock market, money market, labour market, natural resources market, foreign exchange market, and foreign markets. Decisions in these markets are coordinated through prices. Any change in market demand and supply is reflected in prices. Unlike previous studies the significant variables are selected by following the price system taking the price from every market.

4.1.1. Profit and Stock Prices

A market portfolio or a market index consists of individual stocks. Valuation of individual stocks (both from supply and demand sides) uses the valuation formulas (equations 3.1 – 3.4). These valuation techniques, from both supply and demand sides, reflect the effects of these three points:

- Profit (or cash flow);
- Time value (interest rates);
- Risk (and uncertainty).

Measuring the total return, which is explained by a combination of variables effecting variations in these variables over time, is a logical way to explain the behaviour of stock prices. It is assumed that the economic variables affecting the nominator or denominator of those valuation equations at the same time affect the stock market return as a whole.

The main driver of the stock prices is the profitability of the firm. Shares are valued on the basis of future earnings prospects. That which affects company profitability at the same time affects the stock returns as a whole. Other events are considered as catalysts to bring the profitability of the firm into consideration.

There are two different types of profit: Accounting profit and Economic profit. Copeland and Weston (1988) state that, frequently, there is some confusion about what is meant by profits. In economic terms, profit means rate of return in excess of opportunity cost. To estimate economic profit, the exact time pattern of cash flow and opportunity cost of capital must be known. The cash flow is the same concept as the stream of dividends paid by the firms to its owners. Therefore, the appropriate profits are the discounted stream of cash flows to shareholders – in other words, dividends. However, dividends should be interpreted very broadly. Dividends include any cash payout to shareholders. In addition to the ordinary definition of dividends, the general definition includes capital gains, spin-offs to shareholders, payments in liquidation or bankruptcy, repurchase of shares, awards in shareholders’ lawsuits, and payoffs resulting from mergers or acquisition. Stock dividends, which do not involve any cash flow, are not included in the definition of dividends.

4.1.2. Characteristics of the Multifactor Macroeconomic Models

To identify the functional relationship between economic variables and the stock market, it is necessary look at the main characteristics of the multifactor macroeconomic models. There are many models which use qualitative and quantitative analyses to determine the interactions of variables with each other and variables between different markets (i.e. product market and other major market). These models have used variables interchangeably to predict the outcome in one market by using the variations in other markets.

A well-known model of the Australian economy is the Murphy model (Murphy 1988). It combines traditional *Keynesian* elements with *rational expectations* in *financial markets*. The model is being used for general forecasting exercises. The empirical performance of the model appears to be good judging by the single equations models. It is a small quarterly macro econometric model of the Australian economy designed for policy analysis and forecasting. Five sectors are distinguished for the purposes of tracing the flow of goods and services in the model. The five sectors are: i) household sector, ii) dwelling sector, iii) business sector, iv) general government sector, v) foreign sector. It uses 16 stochastic equations to measure the flow of goods and services.

Another well known model of the Australian economy is that developed by Dungey and Pagan (2000). This model is focused on the structural vector autoregressive (SVAR) model of the Australian economy. The model has 11 variables and includes the overseas sector for distinguishing goods and assets markets. These variables can be used interchangeably to predict the outcome of one variable using other variables. Moreover, this model adopts the estimated SVAR in decomposing the growth cycle in GDP. However, the effects of some variables such as import are ignored, and the effect of some variables overestimated. An example of overestimation is that brought about by using two variables from the product market, GDP and GNE. These two variables have a high level of correlation and including both of them would be over emphasising the effects of the product market.

There are several studies which have developed the multifactor asset pricing model. For example: Chen *et al.* (1986), Beenstock and Chan (1988), Asprem (1989), Clare and Thomas (1994), Cheng (1995), Priestley (1996), Groenewold and Fraser (1997). These studies have correlated the macroeconomic variables with the stock market return. However, there are other studies which have correlated both micro and macroeconomic variables. For example a recent Australian study by Kazi (2009) identified the influential risk factors for the Australian stock market. The risk factors identified to explain the stock market return were interest rate, corporate profitability, dividend yield, industrial production and global market to explain the Australian stock market return. Kazi (2009) used quarterly data between 1983 and 2002 and applied the cointegration technique.

The significance of these studies lies in their method of analysing the relationship between stock market and the macroeconomic variables. However, these studies have limitations.. They do not follow the market (price) system and do not consider the relationships between major markets and the stock market in a meaningful way. This thesis will contribute to the existing body of knowledge by following the market transmission mechanism and interpreting the economic statistics.

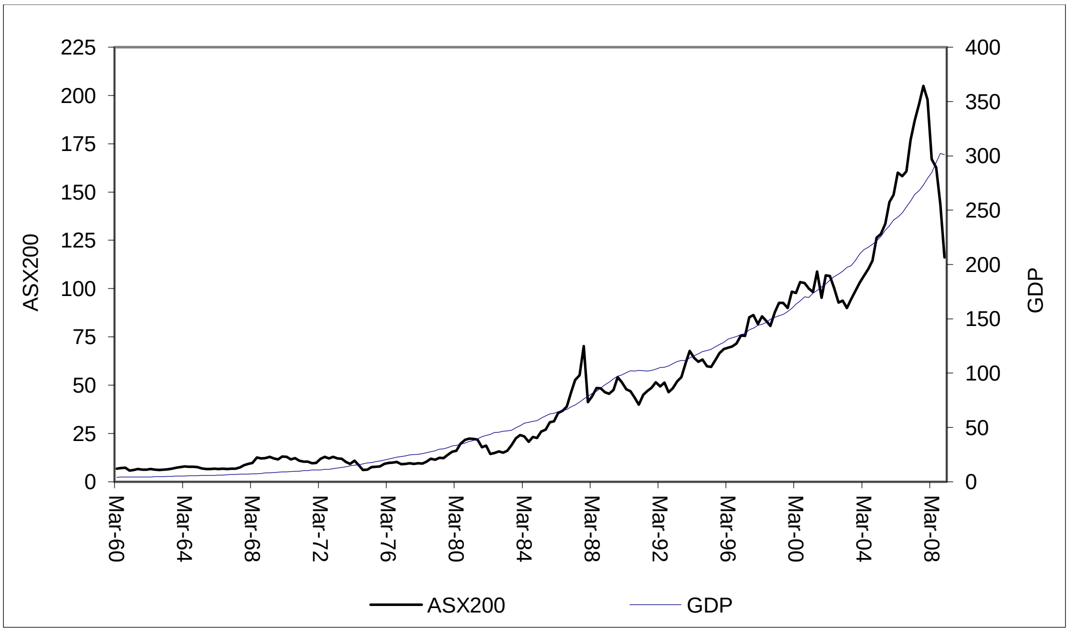
Keynesian economic analysis is the most widely used model of economic analysis. The research for this thesis will be consistent with the Keynesian model. Valuation models, the NPV, Portfolio Theory, CAPM and APT all relate to the demand of the financial markets. On the other hand, the Keynesian Model analyses the economy from the demand side. For this thesis macroeconomic variables will be selected using the Keynesian Expenditure approach to measuring GDP.

4.1.3. The Stock Market and the Economy

Figure 4.1 illustrates the relationship between the stock market index and nominal GDP between March 1960 and December 2008. As can be seen in figure 4.1 both variables move in the same direction. There are close relationships between the stock market and the economy. The correlation coefficient between these two variables is 0.98. This close relationship is meaningful and implies the following points:

- The stock market reflects the effect of economy;
- GDP and ASX200 index follow the same trend over time;
- Stock market predicts the economic activity for the next 6 to 12 months.
- Expectations of economic outcome determine stock prices.
- There is a lagged relationship between stock market and the economy.
- Stock market contracted heavily because of the recessions of 1982-83 and 1990-91;and contractions in 2000 and 2008.

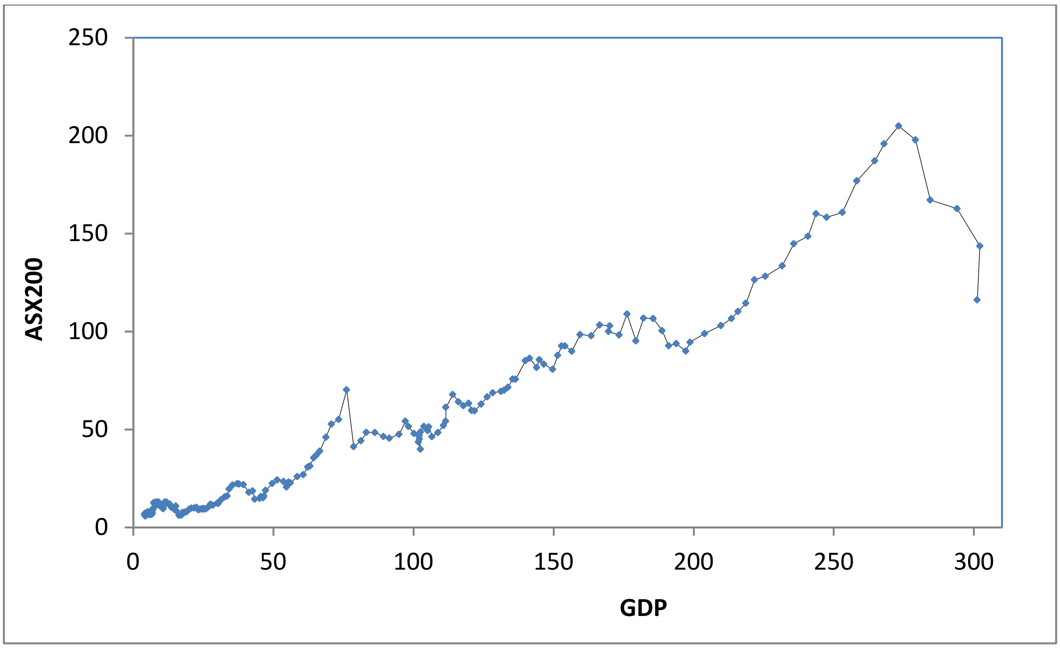
Figure 4.1. ASX200 Index (2000=100) and GDP current prices, quarterly, Mar 60 – Dec 08



Data source: DX Database

Figure 4.2 also depicts the relationship between ASX200 index and nominal GDP on a scatter diagram. Figure shows that there is a positive correlation between GDP and the ASX200 if GDP increases, stock prices increases.

Figure 4.2. ASX200 Index and GDP, Mar 60 – Dec 08

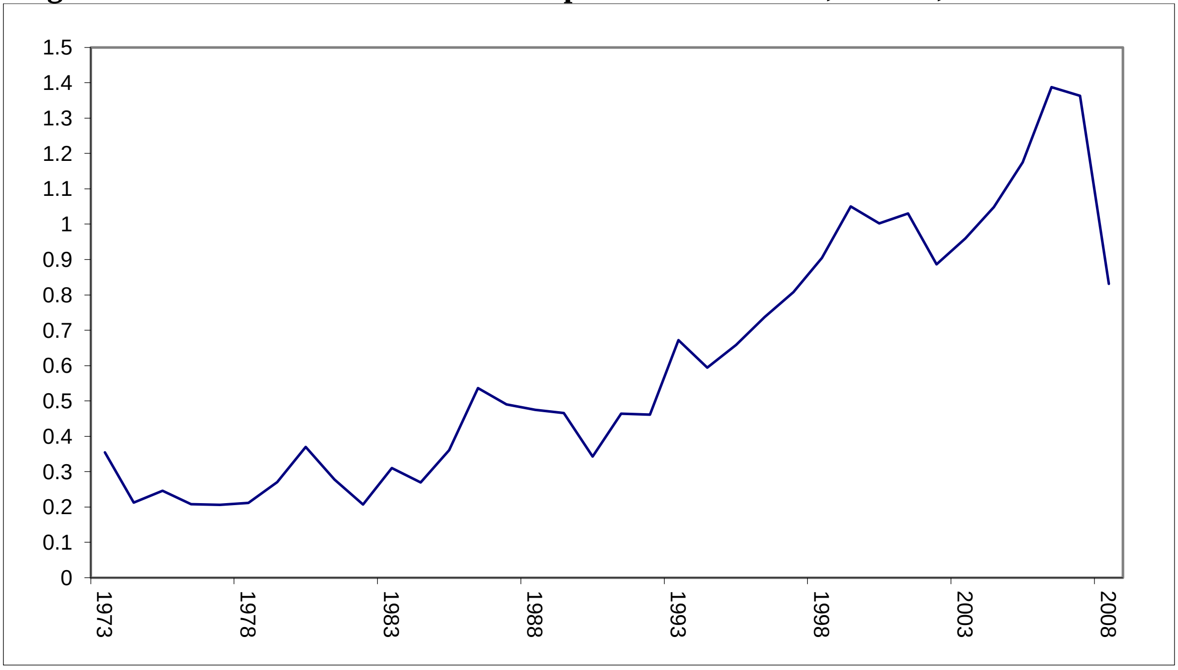


Data source: DX Database

The literature has been placing increasing importance on the relationship between the stock market and GDP (Groenewold 2004). Figure 4.3 illustrates the ratio of share market capitalization to GDP over 1973 and 2008, in Australia. The ratio was 20 percent in December 1974 and has increased to 139 percent in December 2006. At the end of 2008 the ratio was 83 percent.

Figure 4.3 shows that the share market increased relative to the real economy and the inter-relationship between them has strengthened over time. Groenewold (2004) argues that it has always been recognized that the share market reflects, to some extent, what is happening in the rest of the economy , but recently there has been widespread recognition that the influence is also in the opposite direction – dramatic events in the share market are likely to have impact upon the real economy.

Figure 4.3. The ratio of share market capitalisation to GDP, annual, Dec 74 – Dec 08



Data source: DX Database

Deb and Mukherjee (2008), using Indian data between 1996 and 2007, examined the causal relationship between stock market development and economic growth by applying the techniques of unit-root tests and the long-run Granger non-causality. The study evolved around two major questions: i) whether any relationship exists between stock market development and economic growth, and ii) what is the nature and direction of the causal relationship. Their results show that are there is strong causal flow from the stock market development to economic growth. A bi directional causal relationship has been observed between real GDP growth rate and the real market capitalization ratio. The results also suggest that there is a unidirectional causality from both stock market activity and volatility to real GDP.

4.2. Product Market Variables and Stock Market Return

It is expected that there is a positive relationship between the product market and the stock market. The positive relationship is attributed to changes in the nominator effect in a valuation model. Higher Output means higher revenue for the firm and therefore more return on the stock market. However, there may also be a denominator effect on the discount factor since higher output leads to higher interest rates. Changes in interest rates are negatively related to subsequent earnings, but the change in earnings is expected to be large enough to cover the change in the required return. Therefore, the net effect on equity value is expected to be positive. However, the net effect is dependent upon how the other macroeconomic variables are affecting the revenue and the cost of the firms as a whole, namely, inflation, interest rates, wage rate, commodity prices, exchange rate and foreign markets return.

Chaudhuri and Smiles (2004) state that the majority of companies included in the All Ordinaries Index conduct their primary businesses in Australia. Consequently, the state of Australia's economy and long-term trends in Australia's economic performance will affect these companies' cash flows and, subsequently, affect the NPV of their future cash flows.

There are plenty of variables of the product market and other variables relevant to predict the behaviour of the product market variables. However, the main product market variables include GDP and its components and cyclical indicators of the economy. These variables and indicators are closely watched in financial markets because of the effects on stock market return. The definition of the variables and empirical studies of the relationship between these variables and stock market is explained in this section.

4.2.1. GDP and Stock Market

GDP is the overall measure of the performance of an economy and there is a close and meaningful relationship between GDP and stock market return. There are studies that have investigated the effects of GDP on stock returns empirically. The most cited studies are Fama (1990) and Schwert (1990).

Fama (1990) investigated the relationship between GDP and the stock market return using US data between 1953 and 1987. According to Fama (1990) the standard valuation model posits three sources of variation in stock returns: i) shocks to expected cash flow, ii) predictable return variation due to variation through time in the discount rate that price expected cash flows, and iii) shocks to discount rates. He found that variables that are proxy for expected returns and expected-return shocks capture 30 percent of the variance of annual NYSE value-weighted returns. Growth rates of production, used to proxy for shocks to expected cash flows, explain 43 percent of the return variance. The combined explanatory power of the variables is about 58 percent.

According to Fama (1990), empirical studies show that, on average, large fractions of the (often more than 50 percent) of annual stock return variances can be traced to forecasts of variables such as real GNP, industrial production, and investments that are important determinants of the cash flows to firms. Schwert (1990) analyzed the relationship between real stock returns and real activity using US data between 1889 and 1988. This study, covering an additional 65 years found results similar to Fama's (1990). Schwert maintains that Fama's results are supported over a much longer period that Fama suggests, and future production growth rates explain a large fraction of the variation in stock returns.

Australian studies Groenewold and Fraser (1997), Chaudhuri and Smiles (2004) and Groenewold (2004)) have investigated the relationship between the stock market and the product market variables.

Groenewold and Fraser (1997) tested the APT using Australian data between 1980 and 1994. They argue that there was less empirical support for measures of economic activity such as output and employment and open economy variables. This study found that the inflation rate is a significant variable to explain stock market return.

Chaudhuri and Smiles (2004), using the multivariate cointegration methodology, investigated the long-run relationships between real stock price and variables of aggregate real activity including real GDP, real private consumption, real money and the real price of oil in the Australian market. This study used quarterly data between 1960 and 1998. They found that real stock return in Australia is related to temporary departures from the long-run relationship and to changes in real macroeconomic activity. Their results also documented that the information provided by the cointegration method contains some additional information that is not already present in other sources of return variation such as term spread, future GDP growth or shocks to term spread. Chaudhuri and Smiles also found that the influence of other markets, especially stock return variation in the US and New Zealand markets, significantly affect Australian stock return movements.

A study by Groenewold (2004) analyzed the interrelationships between the share market and the product market using a structural vector autoregressive (SVAR) model. The model has two variables, real share prices and real output, and uses a distinction between temporary and permanent shocks to identify macroeconomic and share market-shocks. The identification of the SVAR is based on a simple theoretical model of the two-way linkage between output and share prices. In one direction, a version of the net-present-value model is used, and in the other direction, the wealth effect is relied on as the basis for the influence of share prices on output. The estimated model is used to examine the dynamic interaction between the two variables. Groenewold (2004) concluded that the direction of the relationships can be in either direction. A positive macroeconomic shock was found to have a positive effect on both real output and real share prices. A positive stock market shock was found to boost share prices but depress output initially although the output effect was only temporary.

4.2.2. Consumption

Although consumption is statistically a sub component of GDP, there are some empirical studies examining the relationships between stock market return and consumption. For example, Chen *et al.* (1986) state that their results were quite disappointing in relation to consumption-based asset-pricing theories. The consumption variable was never significant; the aggregate consumption did not have a significant influence on stock prices.

Grossman and Shiller (1981) argue that consumption variability may induce stock price variability whose magnitude depends on the degree of risk aversion. They showed that if current consumption and dividends were the best predictors of future consumption and dividends, then the discount factor applied to stock prices would not vary. Only changes in consumption determine the changes in stock prices.

In most of the studies, the direction of effect in which macroeconomic variables affect stock prices is one way. It has always been recognized that the share market reflects, to some extent, the goings on in the rest of the economy. However, it is expected that stock prices affect the economy and macroeconomic variables such as consumption and investment. The influence is also in the opposite direction – dramatic events in the share market are likely to have impact upon the real economy. This reverse relationship has attracted considerable attention in the literature; examples are: Dungey and Pagan (2000) and Groenewold (2004).

Groenewold (2004) argues that this effect happens through the so called *wealth effect*. Share prices affect the consumption through wealth effect. Variations in share prices affect the aggregate consumption and aggregate demand. An increase in the stock market makes people wealthier, and fuels consumption and growth beyond the economy's capacity. Those high prices, fuelled by productivity gains and fat profits, are giving consumers more confidence, but a//lso raising the prospect that the economy cannot keep up with the demand they are creating.

Tan and Voss (2000) argue that the two remarkable features of the Australian economy over recent years (80s and 90s) have been strong growth in private consumption expenditure and growth in household wealth. Their paper examines the relationship between consumption and wealth in an effort to better understand aggregate consumption behaviour. They found a reasonably robust steady-state relationship between non-durables consumption, labour income and aggregate household wealth for the period between 1988 and1999. Based upon this relationship, an increase in per capita wealth of one dollar is eventually associated with a rise in annual non-durables consumption of approximately four cents. They also found that changes in both non-financial and financial assets have significant effects on consumption. The above-trend growth of wealth in the last three decades has contributed significantly to growth in consumption over this time. A further noteworthy result concerns the recent demutualization and share floats in Australia; perhaps surprisingly, Tan and Voss (2000) found no evidence that these events had a significant effect on consumption growth. Finally, the researchers place their results within the broader empirical literature and examine whether they are consistent with standard economic theories of consumption.

ABS measures Consumption as part of GDP figures on a quarterly basis. It is about 60 percent of GDP (ABS Catalogue 5206, June 2004). However, there are three *monthly* time series data, which predict the movement in consumption, closely watched by market participants. They are:

- Consumer confidence;
- Retail Trade and;
- Motor vehicle registration.

The consumer confidence index is closely watched because it drives consumer spending, which accounts for about 60 percent of the nation's economic activity. Westpac Melbourne Institute's consumer sentiment index survey began in 1974. The consumer confidence index is based on a survey of 1,200 people. Householders were asked about family finances and the state of the economy, and the confidence index is a compilation of the answers. A reading higher than 100 indicates that optimists outnumber pessimists. A reading above 100 indicates most people are optimistic about the economy. A reading below 100 indicates more consumers are pessimistic than optimistic. Consumer sentiment measures the consumers' assessments of their present situations.

The ABS compiles *Retail Trade* statistics in Australia (ABS Cat. No.8501.0). It presents monthly estimates (collected in the Retail Business Survey) of the value of turnover for retail and selected service businesses. The turnover of these businesses is defined as including retail sales; wholesale sales, takings from repairs, meals and hiring of goods, commissions from agency activity; and net takings from gaming activities. The principal objective of the Retail Business Survey is to show the month-to-month movement of turnover for retail and selected service industries. The Retail Trade series are members of a sub annual ABS main economic indicators. Retailers, industry associations, economists, government and media use Retail Trade statistics to analyze current consumer spending behaviour and, in conjunction with other economic indicators, to help assess current Australian economic performance. Quarterly Retail Trade estimates, along with other data, are used in the calculation of household final consumption expenditure in the Australian national accounts.

Retail spending is the important part of consumption. It is the key to the economy's performance because consumption accounts for 60 percent of the nation's output. A rise in consumer spending (retail spending) helps companies such as Coles Myer and Woolworths and Harvey Norman, which are the Australia's largest retailers.

Another closely watched variable is the *Motor Vehicle Registration* (ABS Cat. No.9303.0). There exists a connection between the performance of the stock market and the willingness of consumers to buy *big-ticket* items such as cars. The ABS keeps statistics of motor vehicle registration on a monthly basis. This collection is a main economic indicator. It is used as a proxy for sales of new vehicles, a significant activity in the economy. The main aggregates (including the seasonally adjusted and trend estimated series) are used for analytical purposes by government policy areas and economic analysts. The National Income and Expenditure Section, as input to the National Accounts, also use this data. More detailed data are used for industry and market analysis purposes.

4.2.3. Investment

The effect of investment on stock prices is related to the supply of shares rather than the demand side. The stock market and investment are integrated through Tobin's *q* ratio and capital budgeting. This relationship between stock prices and investment has received considerable attention in the literature. The direction of influence is from the economy to the share market. There are empirical studies which study the effect of the stock market on investment. This type of studies uses Tobin's q-theory of investment. The question is whether firms, in making investment decisions, do pay attention to share prices.

Business spending (investment) is a sub component of the GDP. About 21 percent of the GDP is business investment (ABS, Catalogue 5206, June 2004). It is expected that stock prices will have a strong relationship with the level of investment. This relationship is investigated empirically in the literature. Examples are Barro (1990), Dow and Gorton (1997) and Branston and Groenewold (2004).

One of the most cited papers in this relationship is Barro (1990). He documented that changes in stock prices have substantial explanatory power for U.S. investment, especially for long-term samples, and even in the presence of cash flow variables. The stock market dramatically out-performs a standard q-variable because the market-equity component of this variable is only a rough proxy for stock market value. Although the stock market did not predict investment accurately after the crash of October 1987, the errors were not statistically significant. Parallel relationships for Canada raise the puzzle that Canadian investment appears to react more to the U.S. stock market than to the Canadian market (Barro 1990).

According to Dow and Gorton (1997) there are two approaches for analysing stock prices and investment decisions. They are: *Tobin's Q theory* in economics and *capital budgeting* in finance.

Tobin's Q theory is the ratio of current market value of the assets to their cost:

$$Q = \frac{MarketValue}{Cost} \tag{4.1}$$

If Q is greater than 1, the firm increases its capital stock. Dow and Gorton (1997) state that current stock prices play a very important role in determining the level of new investment. The stock market is a predictor of the level of corporate investment. Rising stock prices increase the level of investment. In fact, lagged stock returns outperform Q in predicting investment. The empirical evidence is consistent with this view: investment in new plants and equipment increases following a rise in stock prices in all countries that have been studied.

A study by Branston and Groenewold (2004), using quarterly U.S. data from 1953 to 2000, investigates the effects of share-price changes on investment. They focused on the distinction between speculative and fundamental components of share-price movements and they contributed to the literature by evaluating four alternative methods of decomposing share-price movements into these two components. The four methods are: 1) a decomposition based on regressing share returns on a set of variables designed to capture fundamentals; 2) the use of the price-earnings ratio; 3) the use of the dividend yield and 4) a structural vector-autoregressive model (SVAR) based on the dividend-discount equation. They found that, no matter what the method of decomposition is, shocks to both fundamental and speculative components have positive effects on investment and that, in contrast to the earlier literature, the effect of the speculative shock is at least as large as that of a shock to fundamentals.

Although the main variable is investment, which is a part of GDP, there are two groups of significant time series statistics related to the investment, and the market watches these very closely. They are: the housing statistics and the Business Confidence Indexes. These variables are trying to predict the behaviour of the Investment. The housing statistics involve the following series:

- Building permits;
- Housing Starts;
- Existing Home Sales;
- New Home Sales;
- Housing finance.

There are a couple of business confidence surveys in Australia, such as Dunn and Bradstreet and the NAB business confidence index. Financial market participants closely watch National Australia Bank’s business confidence index. It surveys 900 non-farm companies about their outlook for profit, sales and employment in the quarter. A reading above zero indicates that more companies expect business to improve than those predicting things to worsen. The survey's business conditions index measures profits, sales and employment in the quarter. Again this series is used to predict the behaviour of investment spending which is a subcomponent of GDP.

4.2.4. Cyclical Indicators of the Economy

Cyclical indicators have been watched closely in financial markets. However, these variables are integrating the major economic and financial variables. They are to identify the peaks and troughs in the business cycle for the economy.

There are three common cyclical indicators of the economy: the *Leading Index*, *Coincidence Index* and the *Lagging Index*. In the US, the Conference Board publishes leading, coincident, and lagging indexes designed to signal peaks and troughs in the business cycle for nine countries including Australia. In Australia the Westpac-Melbourne Institute publishes the Leading Index of Economic Activity. The index indicates the likely pace of economic activity in 3-9 months' time. *The leading index* of the Westpac-Melbourne Institute is usually closely watched because it indicates where the overall economy is headed in the next three to six months. There are 10 components of the leading index in the US. They are:

- Average weekly manufacturing hours;
- Index of consumer expectations;
- Stock prices;
- Vendor performance;
- Interest-rate spread;
- Average weekly initial claims for unemployment insurance and building permits;
- Money supply;
- Manufacturers' new orders for non-defence capital goods;
- Manufacturers' new orders for consumer goods and;
- Materials held steady for the month.

The coincident index, in the US, measures current economic activity. Coincident indicators include the following variables:

- Personal income less transfer payments;
- Manufacturing and trade sales;
- Industrial production;
- Employees on non-agricultural payrolls.

The Lagging Indicator has the following variables:

- Commercial and industrial loans outstanding;
- Average duration of unemployment;
- Change in CPI for services;
- Change in labour cost per unit of output;
- Average prime rate charged by banks;
- Ratio of consumer instalment credit to personal income;
- Ratio of manufacturing and trade inventories to sales.

As can be seen in the above listings, the cyclical indicators measure the movements in major macro-economic markets. All major variables are included for cyclical analysis, therefore, these variables in the proposed equation will not be included. These variables are meaningful when tracking the movements in business cycle; but they are insignificant given the logic of the market model and the direction of this thesis.

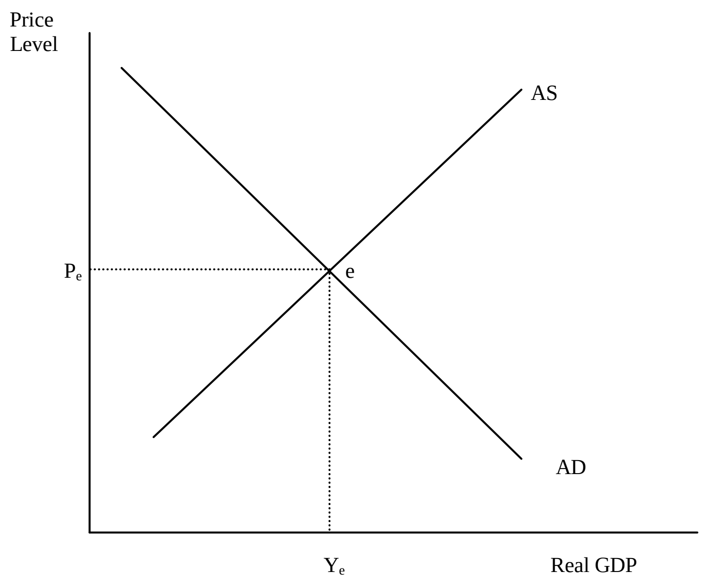
4.2.5. The Stock Market and Real GDP

Stock price is equal to the NPV of the future cash flows. It is subject to two different effects. One is cash flow, which is affected by increase in output, and the other is the interest rate, which is the discount factor. Stock prices will decline when the expected cash flow decreases or the interest rate increases. The level of real economic activity directly affects cash flow, and higher economic activity means higher cash flow. However, if inflation is rising as a result of higher output, then contractionary policies reduce demand for company products and this lower demand offsets the positive effect of cash flow by raising interest rates.

There are many product market variables and other variables relevant to predict the behaviour of these product market variables. Among these, real GDP is the most cited overall measure of the performance of one economy. It is the most comprehensive available measure of economic activity. However, real GDP does not explain completely what is happening in an economy but represents only the measured part of the total output. It is based on a survey of a sample representing the Australian economy. According to Waud *et al*. (1996), officially reported GDP estimates do not include some productive market and non-market activities.

Figure 4.4 illustrates the equilibrium in the product market. The product market coordinates the economic decisions through prices. Presumably prices reflect all available information about the economy. The general price level represents price in the product market.

Figure 4.4. Equilibrium in an economy



From the above equilibrium model, there are three important variables in the product market from the point of view of multifactor asset valuation models. They are:

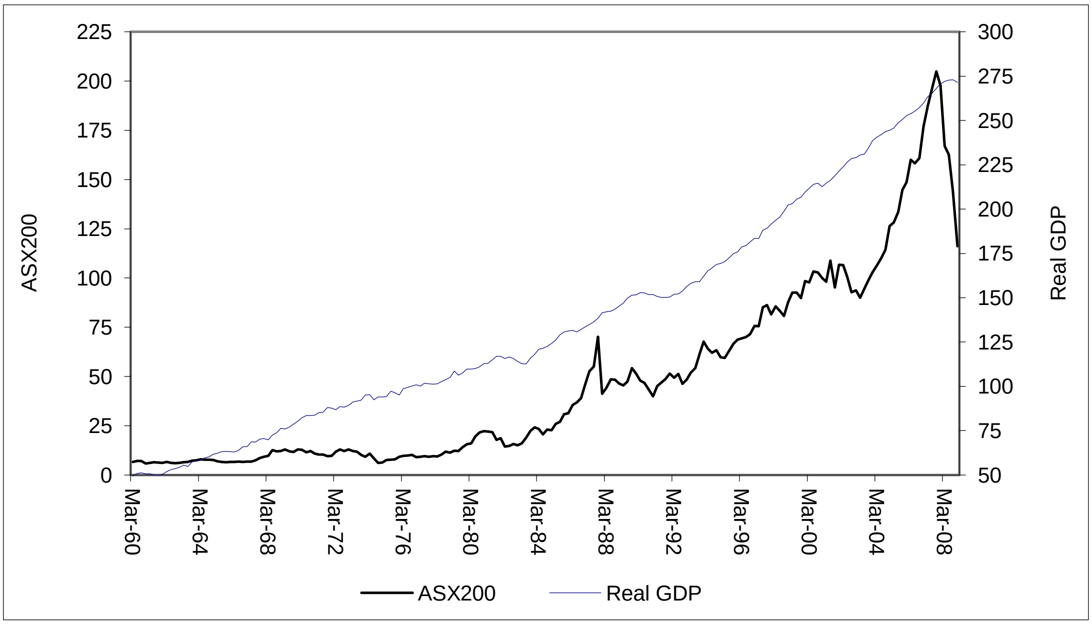
- Nominal GDP;
- Real GDP and;
- Price level.

The significance of the equilibrium model for this thesis is that macroeconomic variables will be selected following the implications of the market model. Therefore, the market model suggests that there are two significant variables from the product market. One is the real GDP and the other is the price level. Empirical studies suggest that the growth rate in real GDP and changes in the inflation rate are affecting stock market return. Examples are: Fama (1981), Fama (1990), Schwert (1990), and Chaudhuri and Smiles (2004). It is assumed that the effects of any other product market variables are reflected on the Aggregate Supply (AS) and Aggregate Demand (AD) and, therefore, equilibrium price level and equilibrium real GDP. As proposed in this thesis, we will take the real GDP instead of the nominal GDP as an explanatory variable.

Although the price level is a product market variable, because inflation is a very significant macroeconomic variable having an effect on most of the economic and financial variables it will be analysed separately in the following section(4.3).

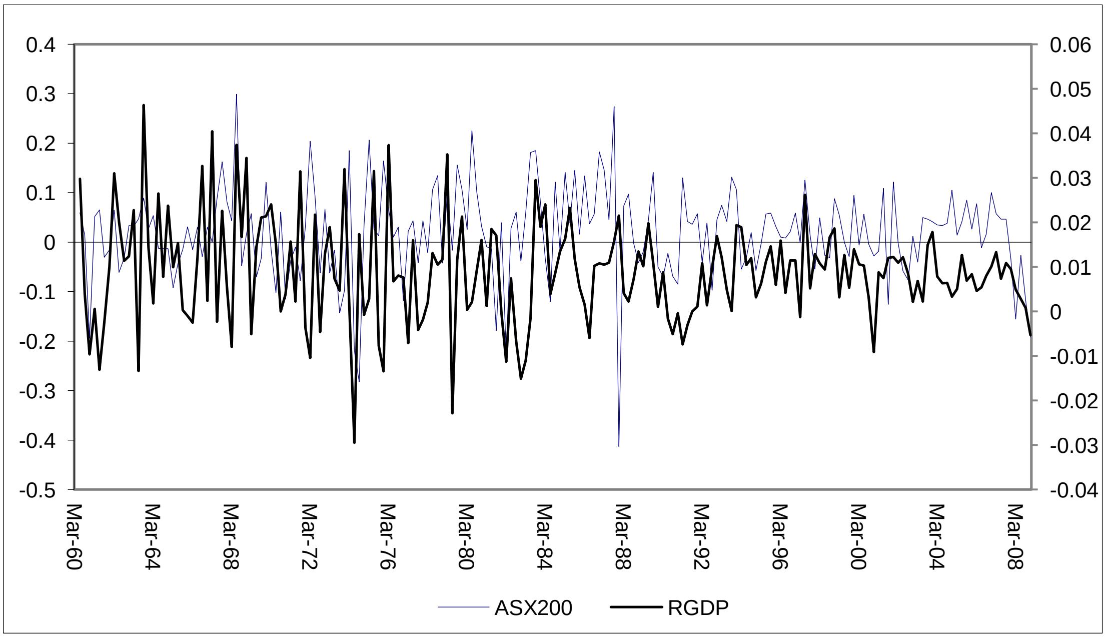
Figure 4.5 demonstrates that the ASX200 index and real GDP followed a similar trend between March 1960 and December 2008. Figure 4.6 shows that the percentage changes in the same period shows the same relationship. The statistical relationship between the stock market and the real GDP will be further investigated. Cointegration analysis and other methods, to investigate the combined effects of the selected macroeconomic variables, will be applied.

Figure 4.5. ASX200 Index and real GDP, trend, quarterly, Mar 60 – Dec 08



Data source: DX Database

Figure 4.6. ASX200 Index and real GDP, percentage change, quarterly, Mar 60 – Dec 08



Data source: DX Database

4.3. Inflation and Stock Market

A common expectation is that the stock prices and inflation should positively relate, and that common stocks are a hedge against inflation because stocks represent the ownership of the real assets. The relationship between stock prices and inflation has been investigated extensively in the literature. Examples are Jaffe and Mandelker (1976), Fama and Schwert (1977), Schwert (1981), and Boudoukh and Richardson (1993). The empirical studies suggest that there are anomalies in stock return and inflation relationship but there is not enough explanation of the negative relationship in the literature. There are several hypotheses about the negative relationship between inflation and stock prices. According to Jorgenson and Terra (2003), well-known theories on stock prices and inflation are:

- Fisher Effect Hypothesis;
- Proxy Hypothesis;
- Tax Effect Hypothesis and;
- Reverse Causality Hypothesis.

The following subsections will review the empirical studies and explanations of the stock market return and inflation in the context of these theories.

4.3.1. Fisher Effect

In the 1930s Irving Fisher hypothesized that the interest rate should fully anticipate movements in expected inflation in order to yield the equilibrium real interest rates. The expected real interest rate is determined by real factors such as the productivity of capital and preference of consumers, and is independent of the expected inflation rate. In principle, the Fisher hypothesis could be extended to any asset, such as real estate, common stock, and other risky securities (Juttner 1994).

The empirical relationship between inflation and the stock market was first investigated by Jaffe and Mandelker (1976) in the US. This study found a negative relationship between the returns in the stock market and inflation. However, they found a positive relationship between the two variables over a much longer period. For the period of 1953-1971, the returns on stocks had been negatively related to the anticipated inflation. However, for the period between 1875 and 1970, the yearly returns on stocks were independent of past rates of inflation. Jaffe and Mandelker's (1976) result suggests a negative relationship, in the short run, between unanticipated inflation and the returns to common stock, a result that is consistent with previous empirical work. However, the Fisher Hypothesis (positive relationship) holds in the long run.

Following this pioneering study by Jaffe and Mandelker (1976), Fama and Schwert (1977) investigated the inflation effect on asset returns for a number of assets using the US data. They documented a negative relationship between stock returns and both expected and unexpected inflation. Fama and Schwert (1977) concluded that common stocks seem to perform poorly as a hedge against both expected and unexpected inflation. They also examined the qualities of various assets as hedges against the expected and unexpected components of the inflation rate during the 1953-71 periods. They found that US government bonds and bills were a complete hedge against expected inflation, and private residential real estate was a complete hedge against both expected and unexpected inflation. Labour income showed little short-term relationship with either expected or unexpected inflation. The most anomalous result is that common stock returns were negatively related to the expected component of the inflation rate, and probably also to the unexpected component. While the negative relationship of the stock return with expected inflation does not account for a large portion of the variation in stock returns, and although it does not seem to imply profitable trading rules, the existence of the relationship is nonetheless anomalous.

Saunders and Tress (1981) discussed the effects of inflation in a rational investor valuation framework in Australia. They argued that the empirical tests suggest that the nominal stock returns and inflation are related in a significantly negative manner. This implies that stocks were extremely poor hedges against inflation for investors over the period of 1965 and 1979. Saunders and Tress (1981) offered two explanations for the negative relationship between inflation and stock return. Firstly, investors act rationally relying on historic cost accounting. Secondly, investors become aware of the effect of inflation with a considerable time lag. These points would explain the initial negative effects of inflation on returns and the following positive adjustments that appear after about two quarters. This lagged explanation, however, casts doubts on the efficiency of the Australian stock market. According to Saunders and Tress (1981) the conventional wisdom held by most investment analysts was that shares provided investors with a relatively safe hedge against inflation. A theoretical justification for this belief could be found in an extension of the so-called Fisher effect, and in a number of other models of rational investor behaviour.

Gultekin (1983) investigated the relationship between common stock returns and inflation in twenty-six countries for the period between 1947 and 1979 using time series and cross-sectional data. Time series results did not support the Fisher hypothesis, and cross-sectional data studies found that countries with high inflation are associated with high nominal stock returns. He argued that international tests of the Fisher Hypothesis and its explanation have also not reached consensus. Gultekin's (1983) results do not support the Fisher Hypothesis, which states that real rates of return on common stocks and expected inflation rates are independent and that nominal stock returns vary in one-to-one correspondence with expected inflation. There is a consistent lack of positive relation between stock returns and inflation in most of the 26 countries.

Boudoukh and Richardson (1993), using almost two centuries of US annual data on inflation, stock returns, and interest rate over 1802-1990, examined the relationship between stock return and inflation in the long-term. They found that the long-term stock return relates positively to a change in inflation. Their paper provides strong support for a positive relationship between nominal stock returns and inflation in the long run. However, the coefficient of the relationship is less than 1. Boudoukh and Richardson. (1993) further claimed that Fisher's theory does not appropriately take into account real world complications and the Fisher effect reappears in cross-section data, together with the use of the inflation expectations.

Groenewold *et al.* (1997) examined the relationship between stock market return and inflation using Australian data between 1960 and 1991in the framework of a small empirical macroeconomic model. The negative sign survives the extension to the full model and the source of the puzzle is found in the macroeconomic interactions: a rise in the expected inflation rate raises equilibrium real output which has a negative impact on stock returns. According to Groenewold *et al.* (1997), one way of looking at the relationship is to say that the Fisher Hypothesis should apply to returns on all assets (not only interest rates). Therefore, the expected nominal return on stocks should be equal to the expected (required) real return on stocks plus expected inflation. Inflation should not affect real stock prices; nominal stock prices are indexed to the general price level. *Ex post*, it is expected that stocks will prove to be an effective hedge against inflation since they are a claim on real assets, the productivity of which should be independent of the inflation rate. In its *ex ante* form, it is clearly an application of the Fisher Hypothesis to stocks.

A study by Kim and Shukla (2006) examined the relation between international security returns and expected inflation using data between 1988 and 2002. They hypothesized that the inflation sensitivity of a security is negatively related to its stock characteristic (sensitivity to a stock factor) and positively related to its bond characteristic (sensitivity to a bond factor). This paper shows the inflation sensitivity of a security is positively related to its sensitivity to the world bond index and negatively to the world stock index. The results of the tests with the international stock returns of 23 countries and 83 international equity mutual funds support the hypothesis. Therefore, the sensitivities of securities' returns to bond and stock market returns may be used to assess their sensitivities to inflation.

A recent study by Hoesli *et al*. (2008) investigated the hedging characteristics of UK and US investment between 1977 and 2003 using the error correction approach. They found that the inflation hedging properties of stocks have produced anomalous results, with stocks often appearing to offer a perverse hedge. The authors attributed the anomalous result to the impact of real and monetary shocks to the economy, which influence both inflation and asset returns. This paper also investigated the relationship between commercial real estate returns and inflation for US and UK markets. It demonstrated that, in the long run, in both the UK and the US, asset returns are positively linked to anticipated inflation but not to inflation shocks.

Hasan (2008) examined the Fisher hypothesis about stock returns and inflation in the UK using the data between 1968 and 2003. This study used cointegration and a vector error correction model. Consistent with the Fisherian hypothesis, the regression results suggest a positive and statistically significant relationship between stock return and inflation. The results based on the unit root and cointegration tests indicate a long-run reliable relationship between price levels, share prices, and interest rates, which could be interpreted as the long-run determinants of stock returns. Results from the vector error correction model also suggest a bidirectional relationship between stock returns and inflation.

The Fisher effect postulates that the expected nominal interest rate is the sum of the expected real interest rate and the expected inflation rate. Empirical evidence indicates that stock returns are negatively related to expected inflation. Many studies find negative relationships between stock returns and inflation for most of the industrialized countries. The empirical literature on the Fisher Hypothesis has been rich and the findings of many studies have been quite similar. The Fisher effect in stock prices is rejected in the short run. However, the Fisher Effect Hypothesis found support in a longer time frame. The long run relationship between inflation and stock return is positive as the Fisher Hypothesis suggests but the coefficient of relationship is not 1:1 in the long run.

4.3.2. Proxy Hypothesis

Many studies have documented that there is a negative relationship between real stock returns and inflation. The first and well accepted explanation of the negative relationship is Fama's (1981) Proxy Hypothesis**.** Fama (1981) investigated the relationship between the stock market and inflation, in the US, using the data between 1954 and 1977. He claimed that there was much evidence that common stocks returns and inflation had been negatively related during the period between 1954 and 1977. In addition to the investigation he provided an explanation: this negative relationship between stock return and inflation is not a causal relationship but is the consequence of the proxy effects. Stock returns are determined by forecasts of more relevant real variables, and negative relations are induced by negative relations between inflation and real activity. Fama's explanation implies that measures of real activity should dominate measures of inflation when both are used as explanatory variables. In real stock return regression in monthly, quarterly, and annual data, growth rates of money and real activity eliminate the negative relations between real stock returns and expected inflation rates. In annual stock return regressions unexpected inflation also loses its explanatory power when placed in competition with future real activity.

Later studies support this hypothesis by showing that real stock returns are related positively to future production growth rates. Lee (1992) found results compatible with

Fama's explanation (proxy hypothesis) for the negative relationship. The author investigated causal relations and dynamic interactions among asset returns, real activity and inflation in the US between 1947 and 1987 using a multivariate vector-autoregression approach. He examined changes in inflationary expectations, and variation in real activity. The finding of this paper of Lee (1992) seems more compatible with the Proxy Hypothesis explanation for the negative stock return and inflation relation. There is no causal linkage between stock returns and money supply growth and, hence, no causal relation between stock returns and inflation. One of the practical implications of these findings is that the negative correlation between stock returns and inflation observed for the post war period may not be a reliable (that is, causal) relation for purposes of prediction.

Park (1997) examined the effects of real economic variables on stock returns, future corporate cash flow and future inflation in the US using data between 1956 and 1995. According to Park (1997), stock prices frequently respond negatively to positive news about real economic activity. The Proxy Hypothesis can be reconciled with the negative response of stock prices to positive economic news by considering policy responses. Indeed, the financial press often explains the negative response based on policy reaction to inflation as follows: strong economic activity causes inflation and induces policy makers to implement a counter cyclical macroeconomic policy. Many academic studies also support the importance of policy responses in explaining stock returns, although they do not explicitly deal with the effect of economic strength on stock returns. Park's study examines the validity of that explanation. A negative stock price response to news of an improving economy is justified only if the expected effect of a contractionary policy induced by the news is greater than the output gain the news suggests. In other words, news of an expanding economy mainly signals rising inflation rather than improving corporate cash flows. Considering that macroeconomic variables are serially correlated, news of brisk economic activity typically forecasts a strong economy. Thus, the negative stock price response should be observed only in some restricted circumstances. Park's (1997) finding rejected Fama's Proxy Hypothesis explanation of the negative relationship between stock prices and inflation.

Merikas and Merika (2006), using annual data between 1960 and 2000 on the German economy, re-examined Fama's proxy hypothesis which states that inflation is negatively related to real economic activity and that the negative relationship between stock returns and inflation reflects the positive impact of real variables on stock returns. This paper discussed whether there is a relationship between real and financial sectors and investigated the type of relationship when present. The authors built a VAR model and tested the negative impact of real economic activity on stock returns. They found that employment growth has a negative impact on stock returns and affects inflation positively, the reason being that employment growth affects inflation and it reduces a firm's profits and therefore, reduces stock returns.

4.3.3. Tax Effect

The Tax-Effect Hypothesis proposed by Feldstein (1980) argues that inflation generates artificial capital gains due to the valuation of depreciation and inventories (usually nominally fixed) subject to taxation. This situation increases corporate tax liabilities and thus reduces real after-tax earnings. Rational investors would take into account this effect of inflation by reducing common stock valuation. In this sense, inflation causes movements in the stock prices. According to Feldstein (1980) the Tax-Effect Hypothesis depends on the US tax regime, and there is evidence of negative stock returns and inflation relationships in countries with different tax laws, in which adjusted values of inventories and depreciation are considered for tax purposes.

Schwert (1981) studied the relationship between stock return and inflation in the US. He analysed the reaction of stock prices to the information about inflation. This study extended the existing evidence that stock returns are negatively related to the inflation. His analysis was based on daily returns on the Standard and Poor's composite portfolio from 1953-78. He found that the stock market reacts negatively to the announcement of unexpected inflation in the CPI. However, the magnitude of the reaction is small. The stock market seems to react at the time of the announcement of the CPI, approximately one month after the price data are collected by the Bureau of Labour Statistics.

One hypothesis, closely related to the tax effect, that is put forward is the Net Debtor Creditor Hypothesis (Schwert 1981). Unanticipated inflation is to the benefit of the stockholders of firms that are net debtors. Unexpected inflation benefits net debtors at the expense of creditors when contracts are written in nominal terms; hence, the stock returns of net creditors should be negatively related to the current unexpected inflation rate. In more general terms, unanticipated inflation should benefit the common stock of firms that have made more long-term commitments to pay fixed nominal amounts to receive them. According to Schwert (1981), similar to the net debtor creditor hypothesis, there are distributive tax effects as a result of unanticipated inflation. Since depreciation and inventory expense are based on historical costs, rather than replacement costs, unexpected inflation, which affects all prices simultaneously, increases revenues without an offsetting increase in depreciation and inventory expense, thus increasing the real tax burden.

4.3.4. Reverse Causality

Elaborating on Fama’s (1981) work, Geske and Roll (1983) propose that, besides money demand, a money supply linkage may help to explain the negative relationship between inflation and stock prices. They suggest that the stock prices’ reaction in anticipation of future economic activity (Fama’s model) is highly correlated with government revenue, so that the government faces a deficit when economic output declines. In order to balance the budget, the Treasury either borrows or issues money through the central bank, causing inflation. Thus stock returns and inflation are negatively related due to a fiscal and monetary linkage – the

Reverse Causality Hypothesis. The authors find some evidence in support of their hypothesis, especially the signaling from stock return to changes in nominal interest rates and changes in expected inflation. They also find little evidence for a real interest rate effect.

Lee (1992) investigated the causal relations and dynamic interactions among asset returns, real activity and inflation in the post war United States using a multivariate VAR approach. His major findings are: i) stock return appears to be Granger-causally prior and helps explain real activity, ii) with interest rates in the VAR, stocks explain little variation in inflation, although interest rates explain a substantial fraction of the variation in inflation, and iii) inflation explains little variations in real activity. His findings seem more compatible with Fama (1981). There are no causal linkages between stock returns and money supply, and no causal relation between stock returns and inflation. Lee (1992) found no support for the Geske and Roll (1983) explanation for the negative relationship between inflation and stock return. There is no causal linkage between stock returns and inflation. One of the practical implications of this finding is that the negative correlation between stock return and inflation observed for the post war period may not be a reliable (that is, causal) relation for purposes of prediction.

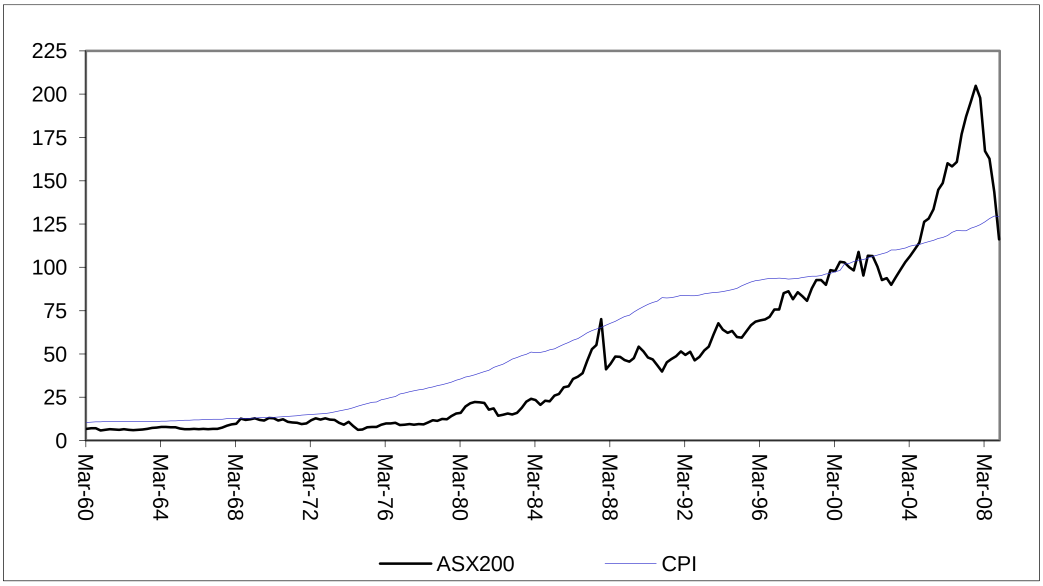
4.3.5. The Stock Market Return and Inflation in Australia

When inflation increases, the revenue of the firms increase because product prices increase, assuming product prices are increasing faster than cost prices. Therefore, it is expected that there will be a positive relationship between stock prices and inflation.

The Consumer Price Index (CPI) is a commonly used and widely recognized measure of the general level of prices in the economy. It is a price index that is constructed as a weighted average of the prices of a market basket of goods and services, purchased by a typical urban worker’s family.

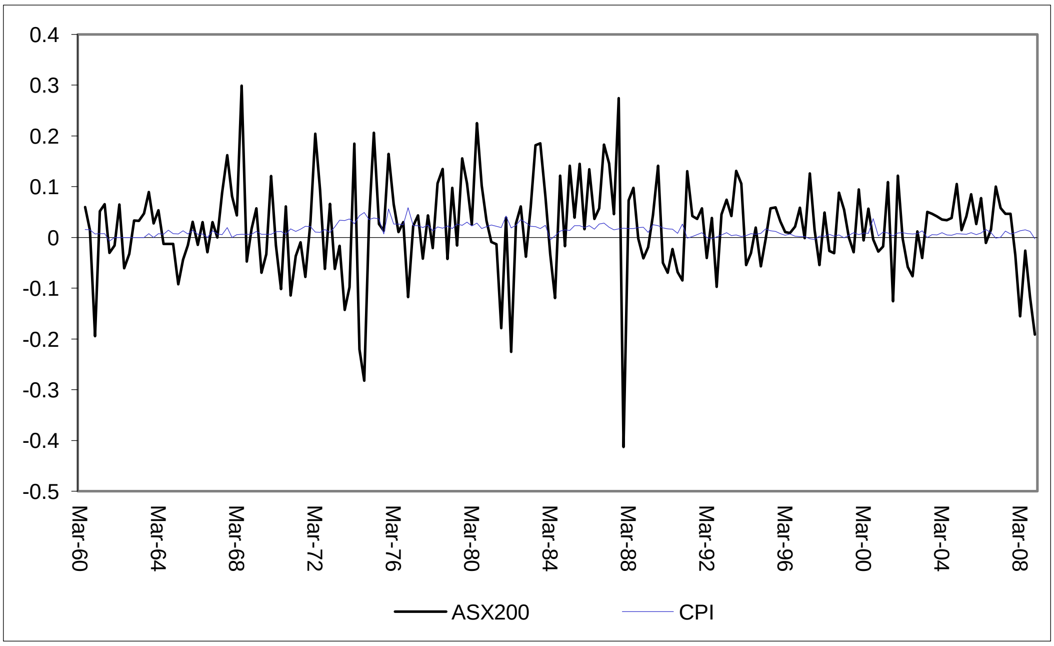
Empirical studies generally model the nominal stock return and CPI. Examples are: Saunders and Tress (1981), Sharpe (2002).

Figure 4.7. ASX200 Index (2000=100) and CPI (2000=100) , quarterly, trend, Mar 60 – Dec 2008



Data source: DX Database

Figure 4.8. ASX200 Index and CPI, quarterly, percentage change, Mar 60 – Dec 08



Data source: DX Database

Figure 4.7 compares the movement in the ASX200 index and the CPI between March 1960 and December 2008. Both variables move in the same direction. Figure 4.8 compares the percentage changes over the same period. There is not a clear relationship in terms of percentage changes.

In Chapter 5, the statistical relationships between the ASX200 Index and CPI will be further investigated; they will be investigated together with the other macroeconomic variables applying certain statistical techniques.

4.4. Money Market Variables and Stock Market

Money market variables and the stock market are closely related. Major money market variables that are closely watched in the markets include: interest rate and money supply.

There are some empirical studies investigating the relationship between the stock market and the money market variables. For example, money supply and interest rates are considered as a risk factor for stock return by Beenstock and Chan (1988). Thorbecke and Alami (1992) demonstrated that the funds rate is a priced factor in the arbitrage pricing model and that unanticipated increases (decreases) in the funds rate lower (raise) stock prices. This finding indicates that market participants believe that monetary policy is a state variable that affects economic activity.

Figure 4.9. Equilibrium in money market

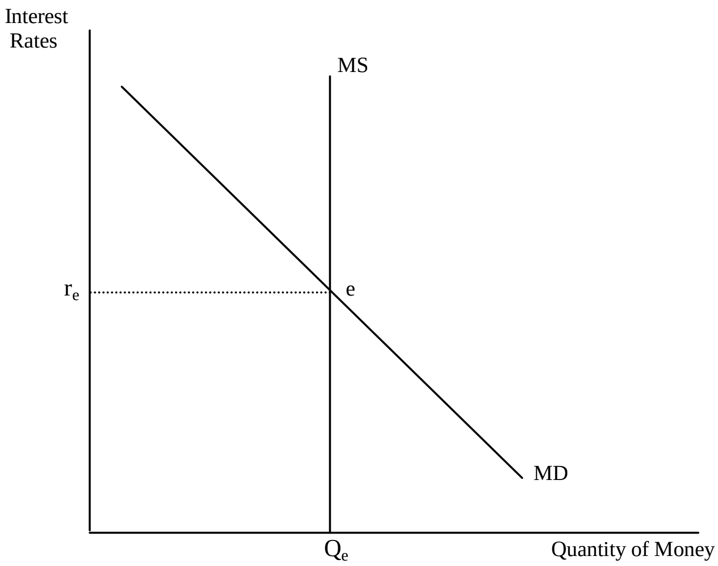


Figure 4.9 illustrates the equilibrium in the money market. As in all market models, decisions are coordinated through prices. Price in the money market is represented by the

interest rate. Interest rate (price) coordinates the decisions in the money market and it affects all of the markets in the economy, especially the product market through the effect on the demand for investment. In an efficient money market, interest rates reflect all the available information. Therefore, price (interest rate) in the money market affects stock market return.

Equilibrium analysis in the money market suggests two macroeconomic variables, the interest rate and the money supply. Real interest rates will be added to the proposed model, because the interest rate represents the price in the money market, and moreover, there is a close relationship between money supply and GDP. Since GDP and inflation are included in the proposed equation, money supply and nominal interest rates are not being included.

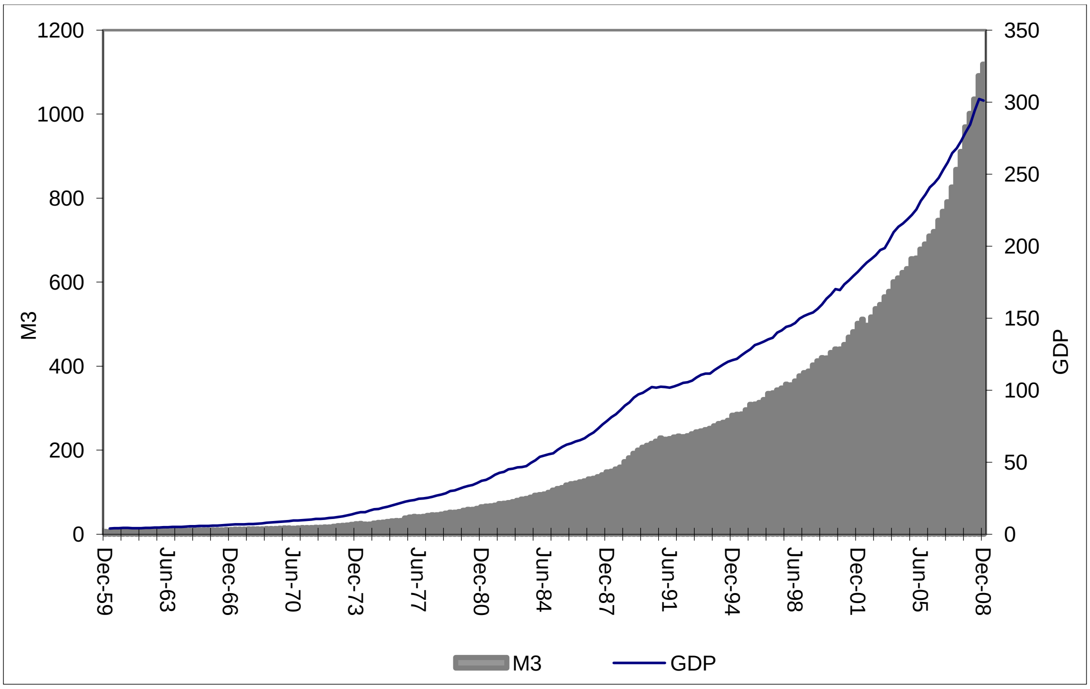
4.4.1. Money Supply and GDP

The relationship between money supply and the stock market has been investigated empirically. Money supply was found to be a significant variable by some papers: Beenstock and Chan (1988), Clare and Thomas (1994), Cheng (1995), and Groenewold (1997). However, a paper by Lee (1992) found that there are no causal linkages between stock returns and money supply and no causal relation between stock returns and inflation.

Figure 4.10 shows the relationship between money supply (M3) and GDP in trend terms over the period December 1959 and December 2008 on a quarterly basis. Figure 4.9 implies that there are close relationships between the money supply and the GDP.

According to Waud *et al*. (1996), there is a striking parallel in the movements of the money supply (M3) and money GDP. Monetarists cite this as evidence to support their claim that the money supply is an important causal determinant of money GDP. Keynesians claim that this parallel movement is equally supportive of the view that causation runs in the opposite direction – from money GDP to money supply.

Figure 4.10. Money supply (M3) and GDP, trend, quarterly, Dec 59-Dec 08



Data source: DX Database

The monetarist economists argue that increases in the money supply will lead to increased economic activity and possibly accelerating prices. This relationship is meaningful and has been linked to the *Quantity Theory* (Baumol and Blinder 1988).

Quantity theory analyses the relationships between the product market and the money market. It is based on the following relationship:

$$M * V = P * Y \qquad (4.2)$$

Where,

M = transactions money demand (the quantity of money in circulation - money supply);

V = velocity of money;

P = price level;

Y = real income (real GDP; the level of transactions).

According to quantity theory each transaction in the economy requires a certain amount of money to carry out the economic activities. The amount of money will depend on the structure of the economy. It is argued, however, that the amount of money for transactions will be stable in the short run. As a result, the number of transactions will be proportional to production (GDP which is, P*Y). There is a functional relationship between the production (GDP), and the quantity of money. An increase in the price level would accordingly increase the amount of money needed.

The story of the Quantity Theory then goes further. It is argued that V and Y are constant and the demand for money is an institutional arrangement. Only the variables M and P are subject to change. If the equation remains, then any increase in the supply of money (M) will result in a proportionate increase in the price level (P). When M rises, P will rise by the same amount. Therefore, money supply increases only cause inflation. This is what Fisher (1911) identifies as the Quantity Theory of money.

As a quantity theorist, Fisher felt that the real and monetary sectors of the economy are largely independent. Thus, he hypothesised that the expected real return is determined by real factors: the productivity of capital, investors' time preferences, and tastes for risk, and that the expected real return and the expected inflation rate are unrelated (Fama *et al.* 1977).

Fama (1981) investigates the anomalous stock return-inflation relations. This study is the combination of money demand theory and the quantity theory of money. According to Fama (1981), negative stock return and inflation relations are induced by negative relations between inflation and real activity, which in turn are explained by a combination of money demand theory and quantity theory of money.

Early works on quantity theory generally assumed that V is a constant over time. The implication of this is that the demand for money is proportional to nominal income. However, this hypothesis has been tested against serious questions raised in the literature, and recent studies suggest that V is not constant over time (Waud *et al*. 1996).

A summary of this section suggests that there is a close relationship between GDP and money supply. This relationship is conceptualized with the *Quantity Theory*. Therefore, money supply and GDP should not be included in the multifactor asset pricing model together.

4.4.2. Stock Prices and Interest Rates

The interest rate is the most significant variable affecting the stock market. It is the cost of money (capital), which is used as one of the factors of production. It is also a discount factor in valuation models. Therefore, interest rates have a direct effect on cost and, as a result, profits of the firm and on the NPV of the future cash flows. Higher interest rates lead to lower profits affecting the nominator and denominator of the valuation formula. Almost all individual stocks are sensitive to variations in interest rates.

A central theme of macro economy throughout the twentieth century has been the sensitivity of the capital formation to interest rates in financial markets (Tobin and Brainard 1977). According to Fama (1990) standard valuation models posit three sources of variation in stock return:

- Shocks to expected cash flows,
- Shocks to discount rate,
- Variation in the discount rates through time.

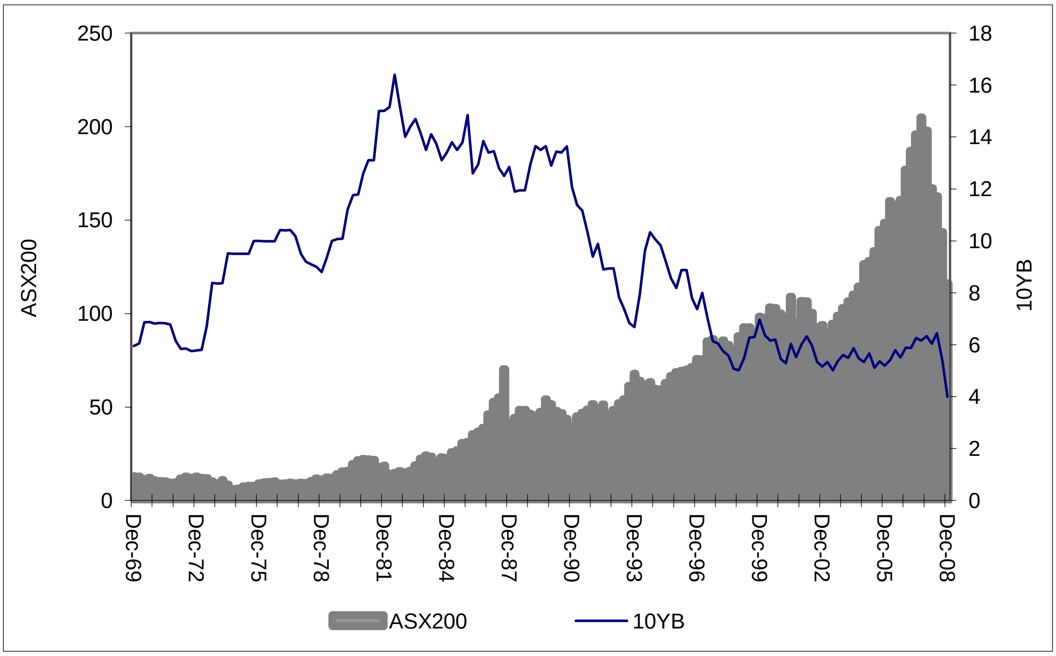
Therefore, a large part of the variation in stock returns can be attributed to the interest rate factor: as a discount factor on cash flow, and for its effect on cost of the firm.

Given the functional relationships there is an inverse relationship between stock prices and interest rates. Stock prices rise (fall) when interest rate falls (rise). The way in which interest rates affect stock prices can be listed as follows:

- Interest rates are the discount factor in the valuation models. There is an inverse relationship between the value of stock and the interest rates.
- Interest rates are cost factors and affect the cost of the firm. Higher interest rates increase the company-borrowing cost.
- Stocks and fixed interest investments (such as bonds and fixed term deposits) are substitutes in terms of investment. Higher rates make shares less attractive than fixed investments, because of their lower risk characteristics. Stocks usually fall when interest rates rise as investors demand higher returns to justify the risk of owning shares.
- Almost all of the companies hold financial assets and debt; rising interest rates depress the value of a firm's financial holdings and increase the debt payout. And rising rates may lessen the demand for financial services.
- Long-term interest rates influence mortgage rates, which affect the housing activity in the economy.
- Interest rates affect consumer and business confidence. An increase in rates means consumers and businesses eventually will borrow and spend less. Lower interest rates increase consumer and business spending, increasing company profits.

Figure 4.11 shows a clear relationship between the major interest rate trend and movements in the prices of major stocks. Data shows that up to June 1982, there was not a clear negative relationship between interest rates and the stock market index but after 1982, there is a definite inverse relationship.

Figure 4.11 All Ordinaries Index and 10 year bond yield, quarterly, Dec 69 – Dec 08



Data source: DX Database

Effects of interest rates on stock returns have been investigated empirically. For example, Hogan *et al.* (1982) examined the efficiency of the Australian share market in relating interest rate and monetary aggregate information to share prices. They found a strong relationship between medium-term government security yields and equity returns. A significant but weaker link is displayed between short term commercial bill yields and equity returns.

According to Nissim and Penman (2003), various studies have acknowledged that stock returns and interest rates are negatively related. The negative relation is often attributed to changes in the discount rate, a denominator effect in a valuation model. Stock valuation involves discounting expected cash flows and interest rates affect discount rates (riskless interest rate). However, there is also a numerator effect on the expected cash flow. Nissim and Penman (2003) examined the relationship between a change in the interest rate, earnings and stock return using US data between 1964 and 2001. The authors found that unexpected changes in interest rates are positively related to unexpected earnings in the year of the interest rate change and in the following year. This relationship is due to a positive association between interest rates and operating income, which is only partially offset by the positive association between interest rates and net interest expense (earning equal operating income minus net interest expense). The positive relationship with operating income is due to a large positive effect on revenues, which is partially offset by a positive effect on operating expenses. These results indicate that unexpected changes in interest rates should revise expectations.

4.4.3. Interest Rate and Inflation

The movements in interest rates are related to the movement in the inflation rate. Inflation and interest rates are related to each other through the “Fisher Effect”. The Fisher effect is the cornerstone of many theoretical models of money neutrality and it is important for understanding the movements in nominal interest rates. Low inflation means lower nominal interest rates. Inflation and interest rates are related through the influence of monetary policy. In an economy with inflation, this affects real interest rates and therefore real required returns on stocks as well.

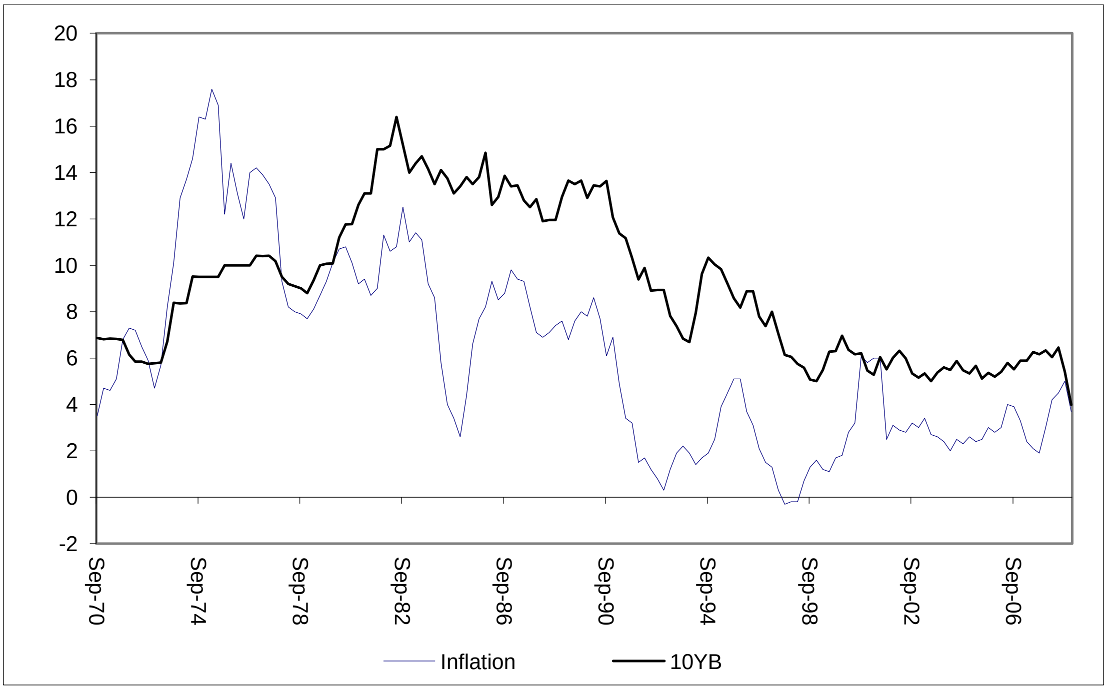
The nominal interest rates can be expressed as the sum of an expected real return and the expected inflation rate. The proposition that expected nominal returns contain market assessments of expected inflation rates can be applied to all assets.

The nominal interest rate is the interest rate, which is uncorrected for inflation. The real interest rate is the nominal interest rate minus inflation:

$$\text{Nominal interest Rate} = \text{Real Interest rate} + \text{Inflation Rate}$$

Figure 4.12 illustrate the movement in nominal interest rates and inflation. The figure shows that the longer-term rise in interest rates in the 1970s and consequent long-term decline were partly due to changes in the inflation rate. The difference between the nominal interest rate and inflation is the real interest rate. It is a better measure of the interest rates.

Figure 4.12. Inflation and 10 year bond yield, quarterly, percentage change, Sep 70–Mar 08



Data source: DX Database

The Fisher hypothesis suggests that a 1 percent increase in the inflation rate will be reflected by a 1 percent increase in the interest rates. The nominal interest rates are the sum of real interest rates and the inflation rate. The Fisher hypothesis suggests that real interest rates do not fluctuate over time. Higher inflation leads to higher nominal interest rates to maintain the equilibrium real interest rate. However, figure 4.12 shows that the relationship between inflation and interest rate is not 1:1.

Mishkin and Simon (1995) examined the Fisher effect in Australia using data between 1963 and 1995. They assumed that the level of expected inflation and interest rates are correlated .Their result indicates that Inflation and the short-term nominal interest rate are correlated and this is the result of long run Fisher effect in Australia. Contrary to this expectation, their test results indicate that while a long-run Fisher effect seems to exist there is no evidence of a short-run Fisher effect. Inflation and interest rates trends move together in the long run rather than the short run. These findings have important implications for policy makers. They indicate that the level of short-term interest rates can be an inappropriate guide for monetary policy. This suggests that, while short-run changes in interest rates reflect changes in monetary policy, longer-run levels indicate inflationary expectations. Thus, the longer-run level of interest rates should not be used to characterize the stance of monetary policy.

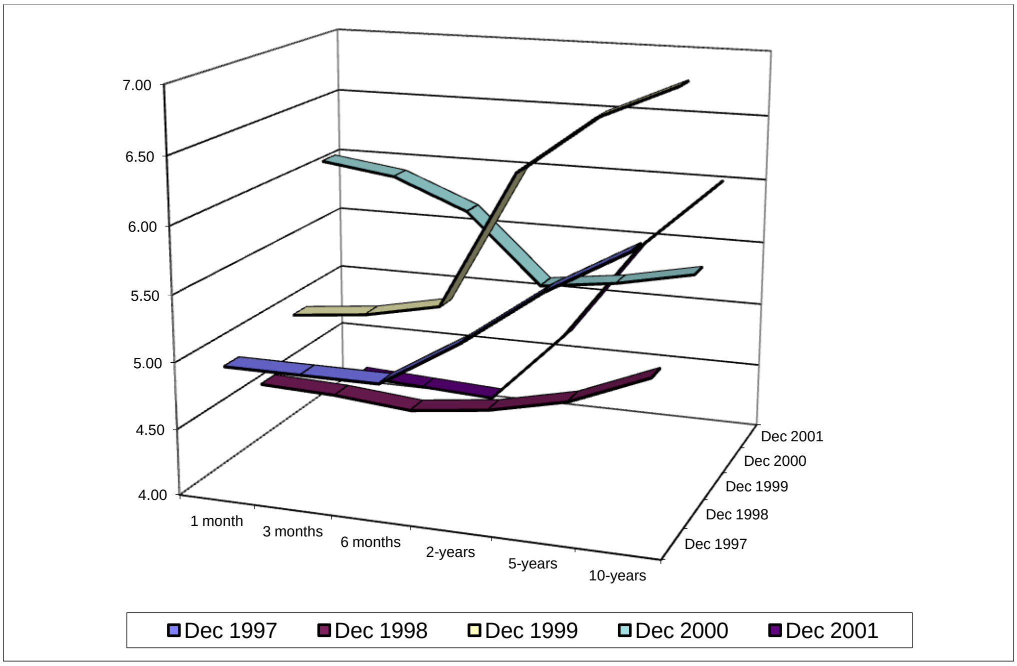
4.4.4. Term Structure of Interest Rate

The term structure of interest rates is also known as the *yield curve* and it has been watched closely in the financial markets. It is a very common bond valuation method and is widely used to discount the future cash flow of individual shares. The yield curve is a measure of the market's expectations of future interest rates given the current market conditions.

The curve plots the relationship between yields of varying Treasury maturities. The federal government issues Treasury bills and bonds which are considered risk-free. Their yields are often used as the benchmarks for fixed-income securities with the same maturities. So if the normal yield curve (upward sloping) changes shape, it tells investors that they may need to change their outlook on the economy.

Figure 4.13 shows the yield curve (term structure of interest rates) of Australia between December 1997 and December 2001 on a 3D chart. The shape of the yield curve changes continuously. The yield curve is used by stock analysts to discount the future cash flows of the corresponding years yield.

Figure 4.13. Australian yield curve Dec 97 – Dec 01



Data source: RBA, www.rba.gov.au/statistics

There are three main patterns created by the term structure of interest rates: normal yield curve, flat yield curve, inverted yield curve.

Normal Yield Curve is seen in normal market conditions. Investors believe that there will be no significant changes in the economy, such as in inflation rates, and the economy will grow at a normal rate. During normal times, investors expect higher yields with long-term maturities because short-term instruments generally hold less risk than long-term instruments.

Flat Yield Curve indicates that the bond market is sending mixed signals about the future; that the interest rate can move in various ways. During this time, it is difficult for the market to determine whether interest rates will move significantly up or down. In some times if long-term interest rates decline, a flat curve can be an inverted curve.

Inverted Yield Curve occurs sometimes in extraordinary economic conditions where the expectations are the inverse of the normal yield curve. In such environments, bonds with longer maturity are expected to give lower yields than short maturity bonds. It indicates that the market currently expects interest rates to decline in the future, which in turn affects the yields.

4.4.5. The Stock Market and Real Interest Rates on 10 Year Bond Rate

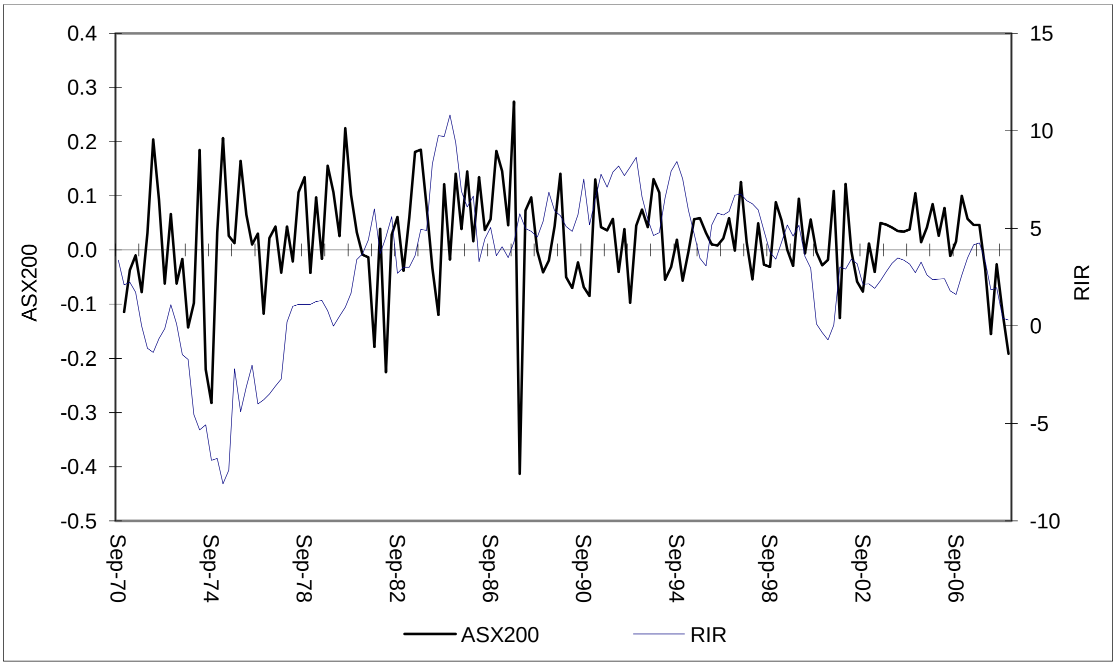
Equilibrium analysis (figure 4.9) in the money market suggests that there are two variables that can affect the stock market return: interest rates and money supply. However, money supply and GDP are highly correlated. As it was decided that GDP would be included in the proposed equation as will interest rate, but not money supply. Including money supply would overemphasize the effect of the money market.

There are many interest rates in the money market: cash rate, mortgage interest rate, saving interest rate, Treasury note and bond rate. However, the 10 year Treasury bond yield is the benchmark interest rate. The financial market participants use the 10 year bond yield as the riskless interest rates.

Interest rates fluctuate with inflation. Since inflation will be included in the proposed equation, to include the nominal interest rate would overestimate the effects of inflation. Instead, real interest rates as opposed to nominal interest rates will be included for 10 year Treasury bonds.

Figure 4.14 illustrates the relationship of the return between the ASX200 Index and real interest rates on 10 year Treasury bond yields on a quarterly basis. It seems that there is not a clear relationship between these two variables. However, the interest rate is not the only explanation of the stock return. There are other risk factors contributing to the return on the stock market. In chapter 5 all of the risk factors with interest rates will be considered in the multifactor model.

Figure 4.14. ASX200 Index and real interest rates on 10 year bond yield, percentage change, quarterly, Dec 70 – Dec 08



Data source: DX Database

Stock prices and bond prices rise as interest rates fall with the fixed return of bonds and the dividend on stocks becoming more attractive. A fall in interest rates may also increase company profits and dividends as it can reduce the cost of debt and encourage customers to buy more goods and services as the cost of credit falls. Cost reductions may open up new markets. This situation gives the investors a further incentive to buy shares and the share prices of the companies are likely to benefit. Rising interest rates have the opposite effect, so a rise or the probability of a rise normally sends share and bond values down.

4.5. Labour Market variables and Stock Market

Movement in labour cost is a risk factor for a firm's profitability and therefore, for stock market return as a whole. Labour is used as the major factor of production and constitutes a large proportion of the total cost for the firms. It affects the nominator of the valuation equation through the effect on the cost. Higher labour cost leads to the higher total cost and thus, lower profit.

Figure 4.15. Non-farm wages share of non-farm GDP, Percent, Sep 59 – Dec 08

Data source: DX Database

Figure 4.15 shows the percentage share of non-farm wages to the non-farm GDP over the period of September 1959 to December 2008. The share of wages was 58.1 percent on September 1959 and reached a high of 67 percent on March 1975. The latest statistics show that the share of wages on December 2008 was 54.2 percent.

As the stocks listed in the Australian Stock Exchange are a good sample of the productive capacity of the Australian economy; the percentage of labour cost in the total cost of firms would be similar to these statistics. These figures imply that a large portion of business cost in Australia is labour cost.

Given the importance of labour costs in firms' total costs, wage increases are a major factor determining company profits. An effective evaluation of the wage rate and the relationships between the wage rate and the profitability of firms is important for the return on the stock market.

Major variables related to the labour market include: employment, unemployment rate, participation rate, average hourly earnings, average weekly earnings, job advertisements, labour cost index, and wage rate. The effects of some labour market variables on stock returns have been investigated empirically. For example, Cheng (1995) found that the security returns are positively related to the unemployment rate. Park (1997) found that employment growth shows the strongest negative effects on stock returns. Employment growth is related more negatively with future corporate cash flows and more positively with future inflation.

Figure 4.16. Equilibrium in Labour Market

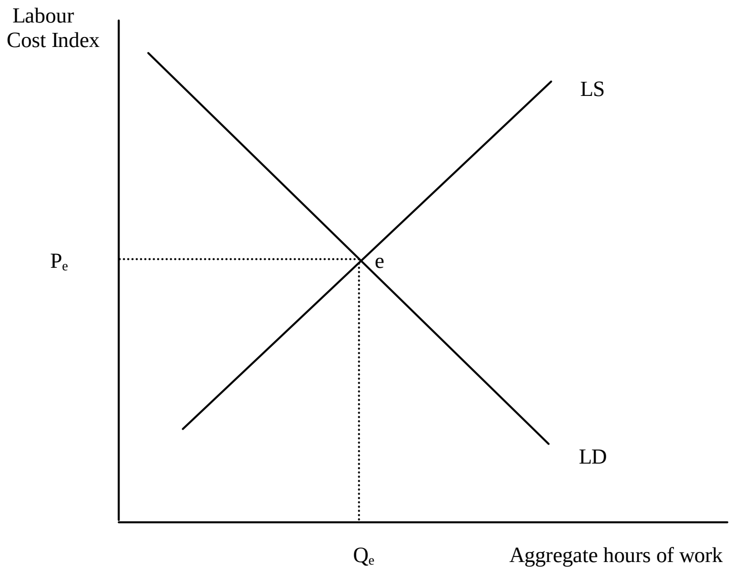


Figure 4.16 shows the equilibrium in the labour market. The labour cost index represents the general price level and aggregate level of employment which is represented by the aggregate

level of hours of work in the labour market. Percentage changes in the labour cost index are also called the changes in the wage rate. In an efficient labour market, economic decisions are coordinated through prices (changes in the labour cost index). Presumably, price reflects the effects of all available information and events in the labour market. Labour cost affects company profits through the effect on cost, thus, profit and return on the stock market.

Following the implication of the market equilibrium model, two variables are candidates to interact with the stock market return. They are the labour cost index and the level of aggregate employment. However, there are many studies suggesting a high level of correlation between the level of employment and the GDP. Since it was decided to include the GDP in the proposed model the level of employment is not being included. The next section evaluates the relationship between the level of employment and the GDP.

4.5.1. Employment and GDP

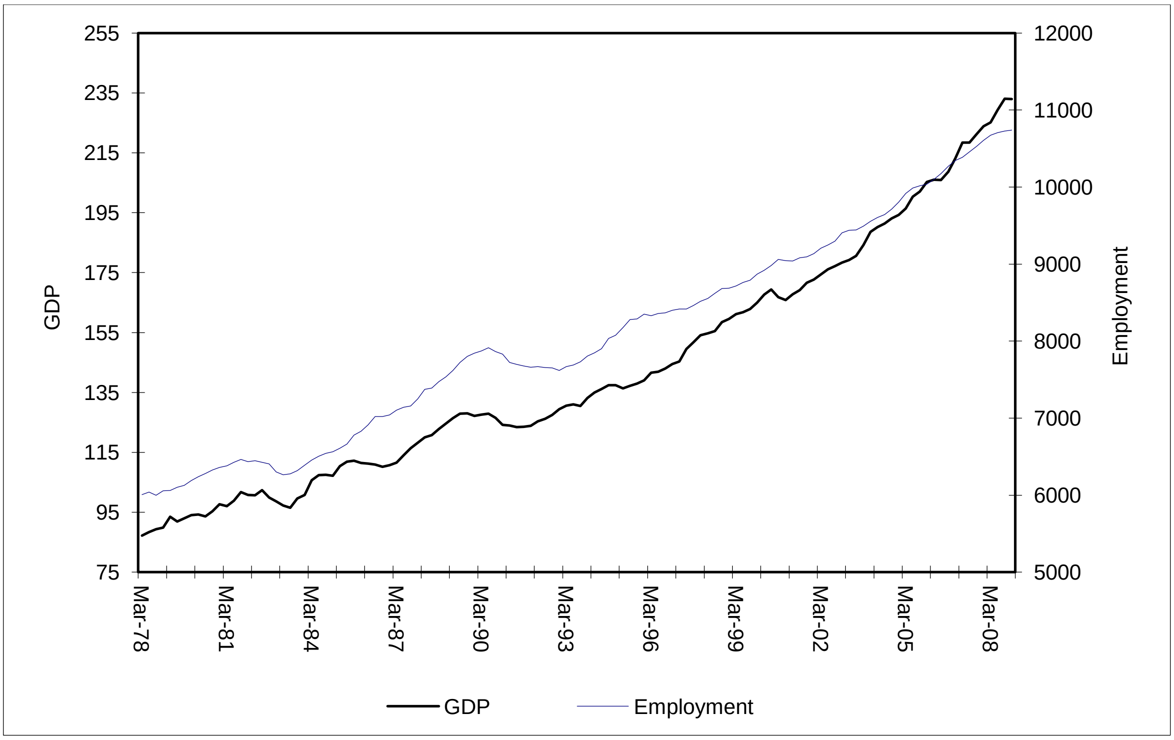
There has been considerable interest in the relationship between the product market and the labour market. Movements in the product market are represented by the GDP and movements in the labour market are represented by the level of employment (ABS 2005).

According to Taylor and Moosa (2000), aggregate hours of labour is the most comprehensive measure of labour input (or level of employment). However, there are no available statistics regarding the aggregate hours of work. Therefore, the number of people employed is used as the measure of level of employment.

Figure 4.17 shows the relationships between the real GDP (in billions) and the level of employment (total number of people employed in thousands), over the period of March 1978 to December 2008 on a quarterly basis in terms of trend. Employment and the GDP follow a similar trend. The SPSS package yields that the correlation coefficient (r) is 0.993 between GDP and employment.

According to the ABS (2005) there is a lagged relationship between GDP growth and employment growth. Employment grows prior to the growth in the GDP. Moreover, the nature of the relationship between these two variables evolves over time, both in terms of the length of the lag and the strength of the correlation; a lag of three or four quarters in the most recent business cycles is a usual outcome.

Figure 4.17. GDP and employment, quarterly, trend, Mar 78 – Dec 08



Data source: DX Database

According to the ABS (2005) the existence of a lag between GDP and employment growth can be explained in broad terms. Initially, when a firm looks to increase production it is likely to do so by more fully utilizing its current employees, and it is only when it is clear that the increase in production is to be sustained that extra employees will be taken on. In part this reflects the costs of training and incorporating new employees into a firm, but there is also the time it takes to employ extra people. The reverse is also true when a fall in production occurs. It is only when such a fall is considered more permanent that the shedding of labour would occur. While this broad explanation is a starting point there are many factors that may impact on the length and depth of the relationship at any particular point in time.

The analysis in this section suggests that there is a close relationship between the GDP and the level of employment. Since GDP is being added into the proposed equation employment will not be used as an explanatory variable of the stock market return.

4.5.2. Inflation and Labour Cost

On the inflation front, the CPI and the Labour Cost Index (LCI) are monitored very closely. The LCI is also called the Employment Cost Index. It is considered as one of the best measures of labour cost and benefit.

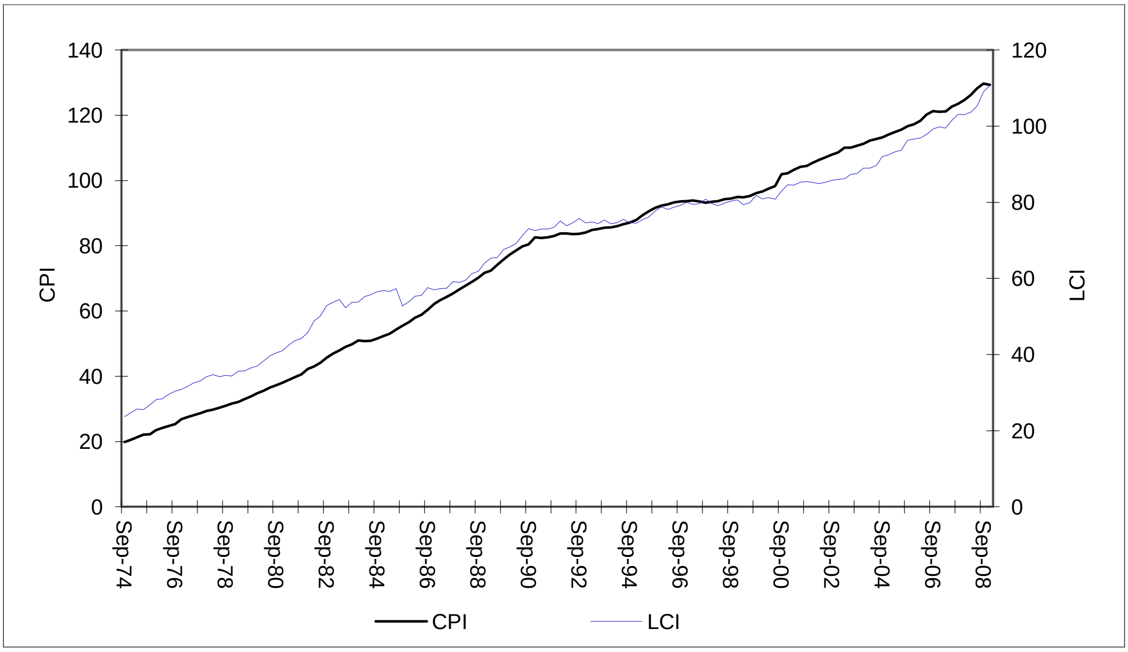
The Labour cost index is the measure of wages preferred by the Reserve Bank of Australia (RBA). An accurate assessment of wage developments and an understanding of the relationships between inflation and wages are obviously important. Given the importance of labour costs in firms' total costs, wage increases are a major factor determining inflation. However causation also runs the other way, as actual and expected inflation influence wage outcomes (RBA 1996).

It is commonly believed that labour costs are a key determinant of inflation, because they represent 55 percent of the total costs to private businesses. This view is consistent with the cost-push explanation of inflation, which is based on the idea that the primary determinant of higher prices is higher costs. An alternative view is that firms will charge whatever the market will bear, regardless of their actual costs. If the market's acceptance of higher prices is the dominant determinant of inflation, the cost-push model would have less validity.

When labour cost increases, this increase undermines inflation (increase in CPI) because labour cost is a large proportion of the firms total cost. When the cost of a product increases, firms try to pass increased costs to the customers by increasing product prices. However, they cannot pass the effect of cost fully to the customers because retail markets are more competitive than the wholesale and the labour market. The net effect of wage cost increases on stock prices depends on the effect on the profit of the firms.

Figure 4.18 compares the CPI and the nominal non-farm unit LCI. Both variables follow a similar trend over the long term. From the point of view of the stock market return, only the margins between consumer price inflation and cost price inflation (such as LCI) determine the level of profit. This margin also determines the level of economic activity through the effects on firms' profitability.

Figure 4.18. CPI and labour cost index, quarterly, trend, Sep 74–Dec 08



Data source: DX Database

Although there is a high level of correlation between CPI and LCI, the relationships of these variables to the stock return are different. Both CPI and LCI relate to the nominator of the NPV model. CPI affects the firms' revenue while the LCI affects the firms' cost . Thus, the margin between these two variables contributes to the profitability of firms. Therefore, these variables will be taken independently as nominal values.

A tight labour market initiates wage increases in some industries. Economists worry that the tight labour market could be a recipe for inflation as employers compete for scarce workers offering them higher compensation and then passing the costs on to consumers.

4.5.3. The Stock Market and Labour Cost Index

It is expected that labour cost and the profitability of the firms be related negatively. There should be a negative relationship because labour cost affects the total cost of the firm. Higher cost is the lower profit of the firm. This is called the nominator effect.

The LCI is a price index, which measures the changes in wage and salary costs. Economists consider the labour cost with productivity growth and unit labour cost. Strong productivity growth tends to keep inflation down because it allows employers to raise wages without passing on the higher cost to consumers. However reduction in productivity growth drives up labour costs in the process. Even when labour cost is increasing, if productivity increases then unit labour cost decreases. At the end it would be good for the firm's profit because the higher the wages the higher the demand for the goods and services and the lower the unit cost in the process.

According to RBA (1996) the three most comprehensive measures of overall labour costs are *average total earnings, average weekly earnings* , and *labour cost index*, based on the ABS survey:

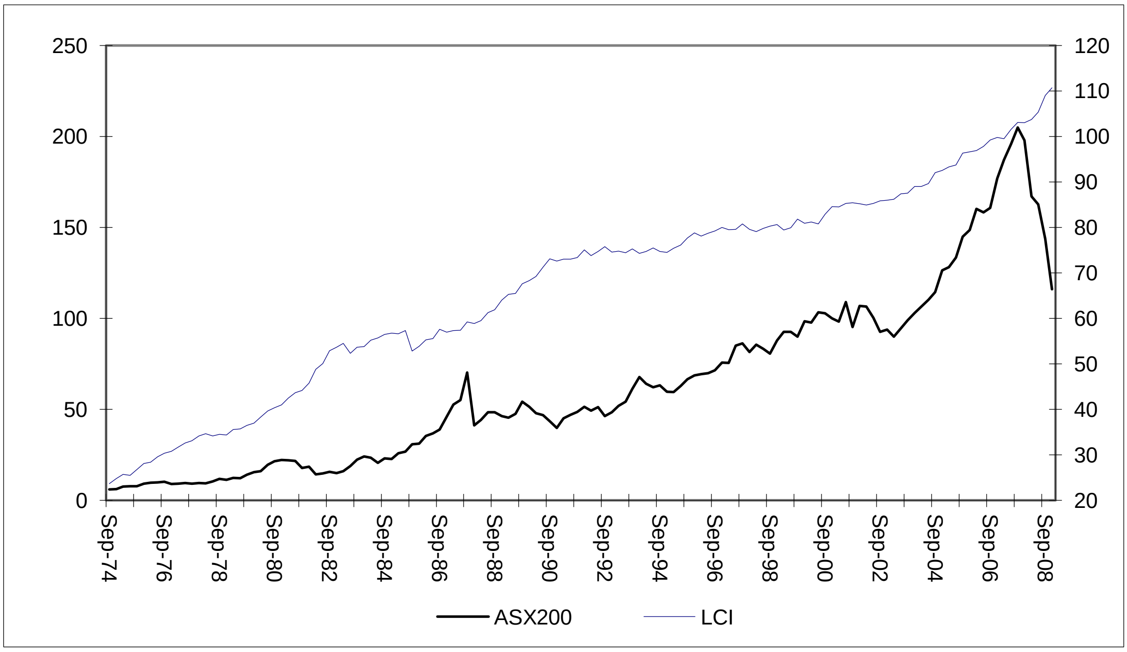
- The *average total earnings* measures wages, salaries and supplements per non-farm wage and salary earner and includes irregular bonuses, worker's compensation, and superannuation and redundancy payments.

- The *average weekly earnings* measure has similar comprehensive coverage of the labour force, but does not include costs such as superannuation and redundancy payments.
- The *labour cost index* includes wages, salaries, superannuation, redundancy payments, and all other costs.

RBA's policy consideration focus on the index of labour costs, and is comprehensive in its coverage. This index is based on a constant representative sample of the labour force (RBA 1996).

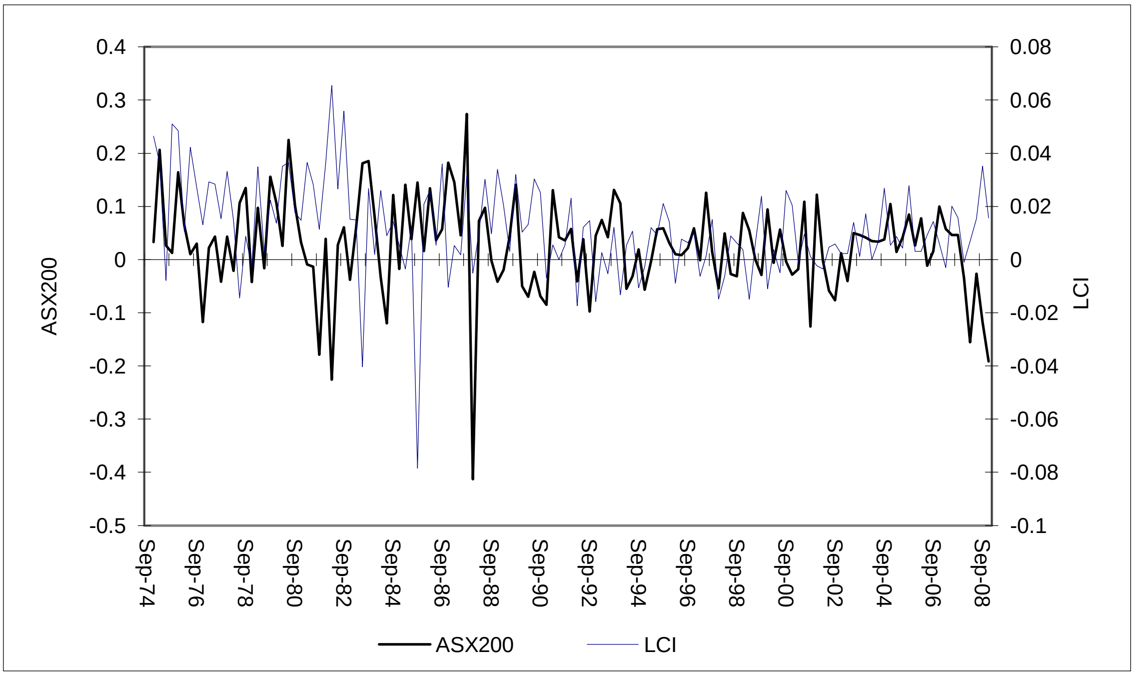
Figure 4.19 shows that the ASX200 index and the labour cost index followed a similar trend between September 1974 and December 2008. However, the percentage changes in figure 4.20 in the same period do not show the same relationship. In the proposed multifactor model the LCI will be an independent variable and the relationship will be investigated by using the appropriate statistical techniques.

Figure 4.19. ASX200 Index and labour cost index, quarterly, trend, Sep 74–Dec 06



Data source: DX Database

Figure 4.20. ASX200 Index and labour cost index, quarterly, percentage change, Sep 74–Dec 06



Data source: DX Database

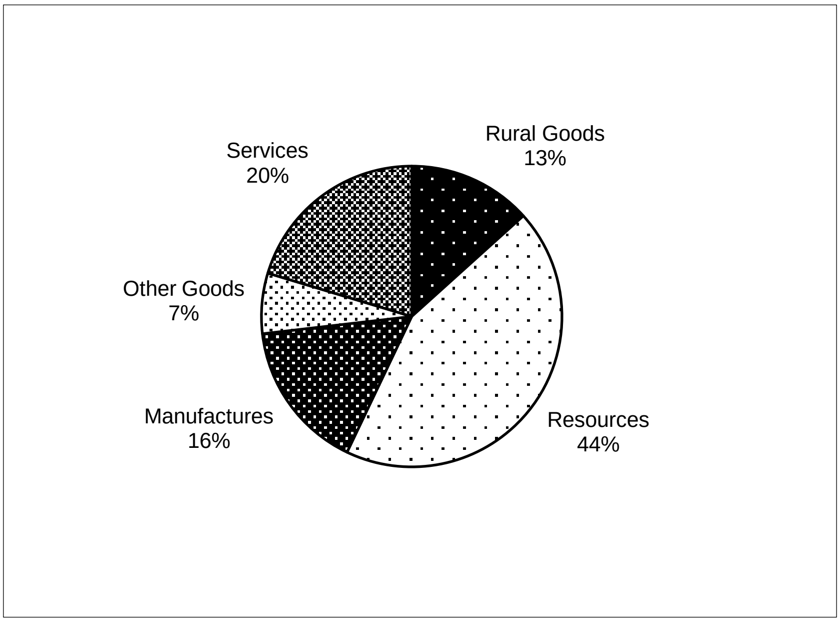
4.6. Resources Market and Stock Market

Movements in resource prices are risk factors in terms of firms' profitability and stock market return. The profitability of firms is affected by the change in commodity prices. Commodity prices impact on all companies in Australia directly or indirectly. However, the effect of commodity prices is different for different firms. Especially these prices affect resources companies because commodity prices are the dominant factor in these stocks.

In terms of the effect of commodity prices, firms can be classified as explorer, producer or user of the commodity. If a firm is an explorer of the commodity there will be a positive relationship between commodity prices and the profit because higher product prices result in higher revenue for those firms. If the firm is the producer of the commodity, again there will be a positive relationship between commodity prices and the profit of the firm because higher commodity prices mean higher revenue and thus higher profit. However, if the firm is using the commodity as an intermediate good, there will be a negative relationship between commodity prices and the profit of the firm because higher commodity prices mean higher cost for such firms.

Figure 4.21 shows the breakdown of the components of export as of June 2006. Australia earns about 58 percent of its export earnings from commodities – rural and resources. The value of the exports was 48.233 million dollars in the March 2006 quarter. Australia is the largest exporter of coal, iron ore, wool, beef and zinc. Resources stocks make up about 15 percent of the equity market. Figure 4.26 shows that 44 percent of exports come from resources. The implication of this data is that production, usage and export of commodities comprises a significant part of domestic economy and therefore, affects stock market return in Australia.

Figure 4.21. Composition of export, June 2006



Data source: RBA Bulletin Database, www.rba.gov.au/statistics

There are empirical studies investigating the relationship between stock market return and resources market variables. Two commodities, oil and gold, are important and have attracted considerable attention in the literature.

Higher oil prices affect the spending of every family directly because they comprise a significant part of household disposable income. They also affect company costs because they are used as an input. However, Australia is a producer of oil. Oil prices on average might not affect stock prices because when the oil price increases the revenue of some companies such as BHP increases as well.

Chaudhuri and Smiles (2004), using the multivariate co integration methodology, documented evidence of long-run relationships between real stock price and the real price of oil in the Australian market. The authors also found that real GDP, real private consumption and real money are significant in explaining stock return.

Australia is one of the world's big producers of gold. It is Australia's number two commodity exports after coal. It is also an alternative investment to the stock market and other investment asset classes. Gold generally moves inversely to stocks especially with financial stocks.

Chan and Faff (1998) investigated the market sensitivity of Australian industry equity returns to the gold price factor over the period 1975 to 1994. They found that, over the full sample period, there was a widespread sensitivity of Australian industry returns to gold price returns, over and above market returns. The sensitivity is found to be a positive sign for resource and mining sector industries but it is a negative sign for the industrial sector. Further, there appears to be a change in importance of the gold price factor over time, as reflected by a comparison of sub-period gold price sensitivity estimates.

These studies analysed the relationship between stock market return and prices of individual commodities such as gold and oil. However, in the proposed model the aggregate prices of the commodities represented by the commodity price index will be used.

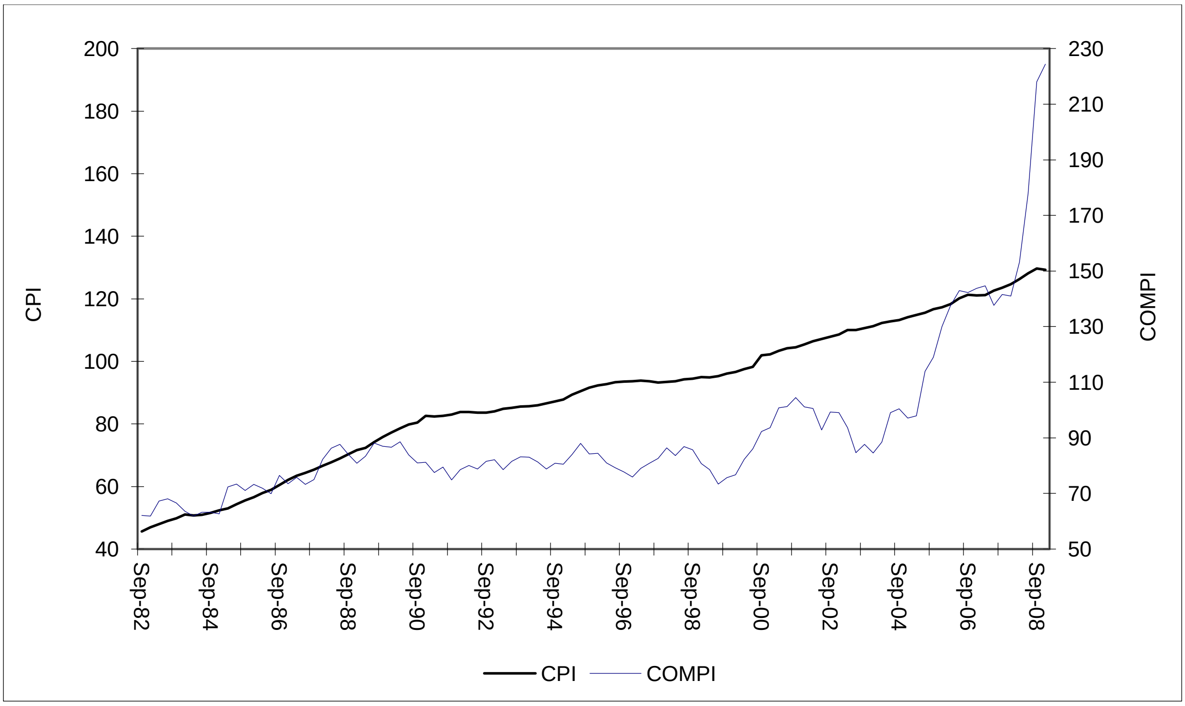
4.6.1. Inflation and Commodity Price Index

It is expected that there is a close relationship between CPI and the Commodity Price Index (COMPI) because commodities are a large proportion of GDP. As well they are also the second largest cost factor in production after labour cost.

According to RBA (2003) Australia's export earnings make up around 20 per cent of total domestic income on average, and thus have a significant influence on economic activity. The RBA's monthly Index of Commodity Prices is designed to provide a timely indicator of movements in the prices of primary commodities, which account for more than half of Australia's export earnings. The Index is constructed from the prices of 17 of Australia's major commodity exports. These 17 commodities account for around three-fifths of primary commodity export earnings.

Figure 4.22 illustrate the relationship between CPI and Commodity price Index (COMPI) in terms of trend. The direction of the trend is similar; however increase in commodity price index has exceeded the increase in CPI in the last couple of years.

Figure 4.22. CPI and commodity price index, trend, Sep 82 – Dec 08



Data source: DX Database

Although there is a high level of correlation between CPI and the commodity price index, the relationship of these variables to the stock return is different. CPI relates to the revenue of firms but commodity prices affect both revenue and the cost. The effect of commodity prices on the profitability of firms depends on the activities of the firms. The commodity price index relates to the nominator of the NPV model affecting both revenue and the cost of the firm.

4.6.2. The Stock Market the Commodity Price Index

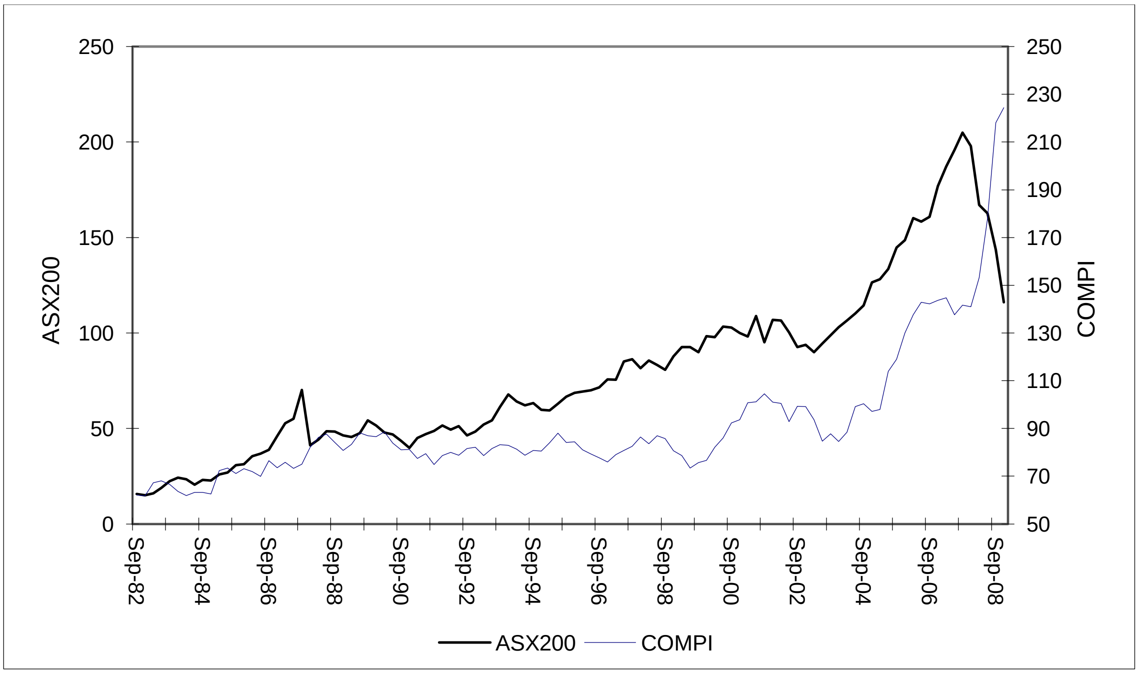
The return on some firms is negatively related to the level of the commodity prices while others are positively related to it and some not at all. Thus, regressing return on stock market against commodity prices is not likely to yield a significant coefficient of the relationship.

However, using the return on the resources index or individual resource companies against commodity price index is likely to yield a significant result.

It is expected that there will be a positive relationship between the Stock market and the commodity price index because Australia is a significant producer and exporter of commodities. The effect for producer firms is clearly positive. However, some firms use the commodities as an intermediate good. For those companies the relationship is a negative one.

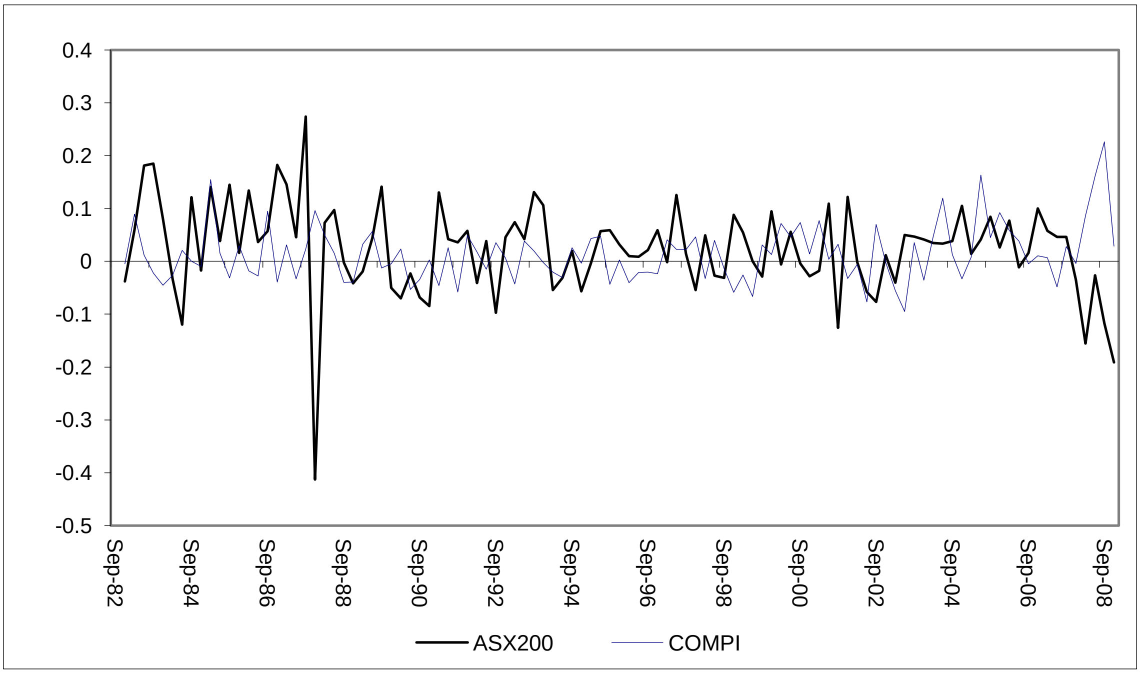
However, figures 4.23 and 4.24 shows that there is a positive relationship between the two variables. Figure 4.23 shows that there is a clear positive relationship in that they both follow a similar trend. Figure 4.24 shows the positive relationships in term of percentage changes.

Figure 4.23. All Ordinaries Index and commodity price index, trend, quarterly, Sep 82 – Dec 06



Data source: DX Database

Figure 4.24. All Ordinaries Index and commodity price index, trend quarterly, Sep 82 – Dec 06



Data source: DX Database

4.7. Foreign Exchange Market and Stock Market

The Australian economy is a relatively open economy. It is expected that the firm value is related to the open economy variables. The major open economy variables are:

- Exchange rate;
- Balance of trade;
- Balance of payments;
- Current account deficit;
- Terms of trade.

Effects of these variables on the stock market return have been investigated empirically. According to Adler and Dumas (1984) US corporations, including those with no foreign operations and no foreign currency assets, liabilities or transactions, are generally exposed to foreign currency risk.

Donnelly and Sheehy (1996) found a relationship between the foreign exchange rate and the market value of large exporters in Great Britain. This article incorporated some of the implications of foreign currency movements into share prices. Contrary to prior research, this UK based study found a significant relation between the foreign exchange rate and the market value of large exporters. They also found a weak lagged relationship, which suggests that the stock market takes time to incorporate all of the implications of foreign currency movements into share prices.

The current account deficit has attracted considerable attention in the literature. It is the broadest measure of the flow of goods, services and investment into and out of a country. Economists carefully watch the current-account deficit because of its implications for the currency and domestic economic growth. Increasing the deficit means that the economy must borrow abroad to finance its imports. When the current account deficit is increasing, foreigners will lose faith that they will get their money back and will worry about buying the country’s stocks, bonds and other assets. The implication could be that the currency will depreciate, interest rates will rise and the economy will stall.

Thorbecke (1994), using the APT, in the US, demonstrated that the trade deficit was a source of systematic risk and unexpected increases in the trade deficit reduced equity returns. According to Thorbecke (1994) there are several reasons why the trade deficits might be a source of systematic risk affecting asset returns.

- *First*, an increase in the trade deficit might have implied a drop in demand for Australian goods and thus in the cash flow of Australian companies.
- *Second*, a larger trade deficit might cause investors to expect protectionism, such as restriction on imports or a high interest rate.
- *Third*, the trade deficit might ultimately raise the price of foreign goods and cause inflation. Many have demonstrated that inflation affects stock prices.
- *Fourth*, to finance these massive deficits foreigners had to hold more and more Australian stocks and bonds. According to the principle of portfolio diversification they would have become increasingly reluctant to allocate additional wealth into dollar assets. Thus, because the trade deficit forced foreigners to hold more dollars, it might have raised the risk premium on Australian assets.
- *Fifth*, news of higher trade deficits depreciates the dollar, raises interest rates, and increases fear among Australian investors that foreign investors would sell dollar-denominated stocks. For all these reasons news of large trade deficits could have increased the perception of the systematic risk in holding Australian equities.

Thorbecke (1994) has also suggested that news of a larger than expected *trade deficit* caused the October 1987 stock market crash. This argument would be more compelling if the trade deficit were a source of systematic risk.

Although the current account deficit has been considered as a risk factor in explaining stock return, it will not be included as an explanatory variable in the proposed multifactor equation. Both variables, the exchange rate and the current account deficit, are open economy variables and they have a similar effect on stock return. However, there are close and meaningful relationships between the exchange rate and the profitability of the firms. Since it is proposed to use the exchange rate, it is not appropriate to use the current account deficit in the multifactor equation. Including the current account deficit will be overestimating the effect of open economy variables.

4.7.1. Exchange Rate and Macroeconomic Variables

The exchange rate is the price of one currency in terms of another currency. As in any demand and supply model for goods and services, the exchange rate is determined in a freely operating market by the demand and the supply forces. From the perspective of the efficient market hypothesis exchange rates reflect all the information regarding the overseas influences on Australian economy. The level of the Australian dollar (presumably) reflects the economy's fundamentals.

According to Jackson and McIver (2001) the major determinants which cause the demand and the supply change of the currency are as follows:

- Preferences;
- GDP differentials;
- Inflation differentials;
- Interest rate differentials and;
- Speculation.

Any change in the *preferences and tastes* of the consumers for the product of a country will alter the demand and supply functions of the currency; and it changes its exchange rate. For example, over the last decade, consumer preferences have changed towards Australian meat and the Australian dollar has appreciated.

If the domestic prices rise faster than in the other countries, inflation differentials increase, then the supply of the $AU increases to exchange other currencies to buy cheaper overseas products. Overseas consumers demand less Australian products because of relatively high prices, and then they reduce the supply of foreign currency. This phenomenon depreciates the value of the $AU. The falling value of the Australian dollar is one of the drivers of inflation. A lower dollar can fuel inflation by making imports more expensive when translated into domestic currency. There is enough evidence to suggest that the low exchange rate is fuelling inflation. A weak currency can also affect future inflation.

A strong economy and rising interest rates are usually positive for the exchange rate as they make our share market and interest rates attractive to foreign investors. Related to the exchange rate, GDP differential and interest rates differentials are important variables.

GDP differentials are an indicator of the potential money flows between countries as they indicate how much yield premium $AU variable income assets (such as stocks) are offering over foreign variable income assets, or vice versa. GDP differentials give indications of potential currency movements because investors are looking for assets with higher yields. When the growth fundamentals in Australia are better than other countries, the Australian dollar appreciates against the currencies of those countries.

The *US Economy* is the biggest economy in the world. The Australian dollar drops if the world's biggest economy (US) grows faster than expected, reducing prospects for non-U.S. assets and the currencies used to buy them. A strong US economy means strong assets, and therefore a strong (US) dollar. The US is Australia's second biggest trading partner. The Australian dollar falls when the domestic economy is slowing faster than the US, reducing demand for Australian-dollar assets.

However, Jackson and McIver (2001) take a different view of the effect of the GDP differentials on the exchange rates. They argue that if the growth of a nation is faster than the other countries, its currency is likely to depreciate the reason being that a country’s imports change directly with its level of income. For instance, if the Australian economy is expanding faster than that of the UK, the Australian imports of the British goods increase and the $ AU depreciates.

Interest rate differentials (risk premium) between the cash rates of Australia and the short-term interest rates of other industrialized countries are closely followed by financial market participants. Interest rate differentials can be a good indicator of the potential money flows as they indicate how much yield premium $AU short term fixed income assets are offering over foreign short term fixed income assets, or vice versa. This differential provides traders with indications of potential currency movements, as investors are always looking for the assets with the highest yields.

Australia's higher interest rates make its bonds more attractive to investors, forcing up the demand for the currency needed to buy them. Overseas investors buy Australian dollars to take advantage of the interest rate advantage over the other countries. A narrower interest rate differential may reduce demand for Australian dollar-denominated debt.

Speculation is another determinant of the exchange rate. If it is believed that the Australian economy will grow faster than the other economies then the demand for the $AU will increase. The reason is that overseas investors buy $AU expecting a higher return from the variable investments such as shares and real estate.

As can be seen in the equilibrium analysis, the exchange rate (price of the currency) incorporates the effect of many macroeconomic variables both in the domestic economy and the other economies. Any influence on the supply and the demand functions is reflected in the price of the currency.

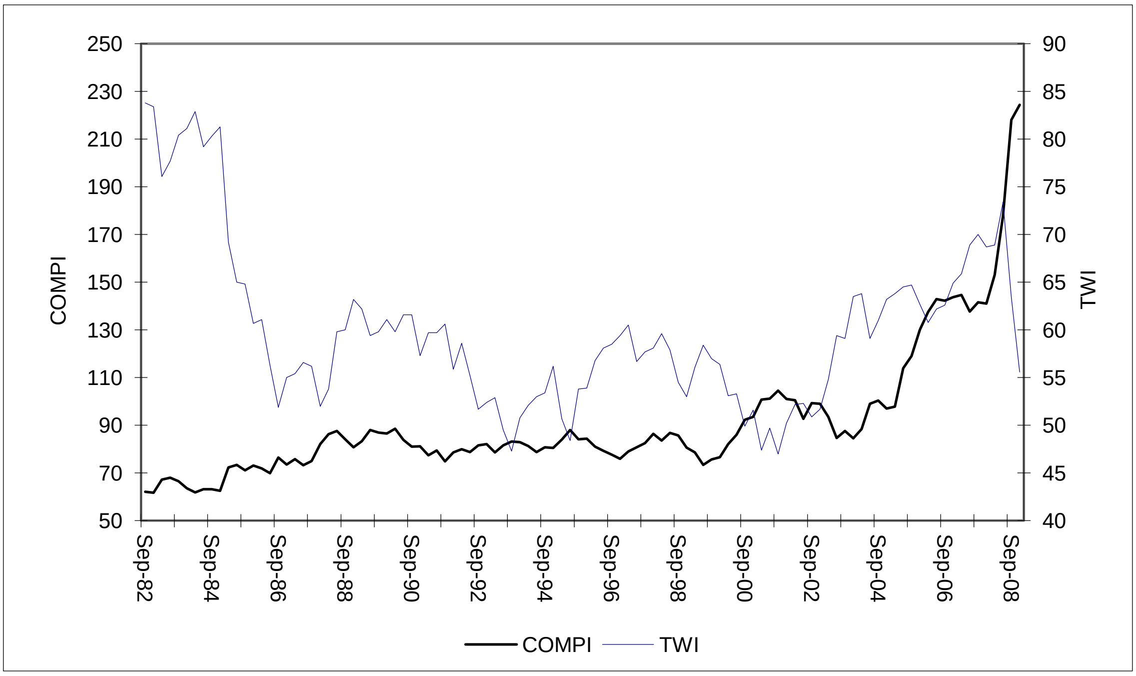
4.7.2. Commodity Prices and Trade Weighted Index (TWI)

The Australian dollar is looked upon as a *commodity linked currency* and a currency carries the *trade effect*. It is also looked on as a very good leading indicator of the global economy because of its dependency on exporting commodities. The Australian dollar, as a fairly liquid currency, is one of the most popular currencies to buy commodities.

Australian stocks rise through the optimism of overseas economic growth such as in the US, Japan or Europe. When the GDP of the other countries grows, global economy drives the demand for commodity prices. As a result, the demand for commodities and the demand for the Australian dollar increase.

The US is the world's biggest consumer of base metals, and commodity prices are denominated in US dollars, but the US is not the only consumer of the commodities. The TWI index is the meaningful indicator to investigate the relationship between the exchange rate and the commodity prices.

Figure 4.25. Commodity price index and the TWI, quarterly, Sep 82 – Dec 08



Data source: DX Database

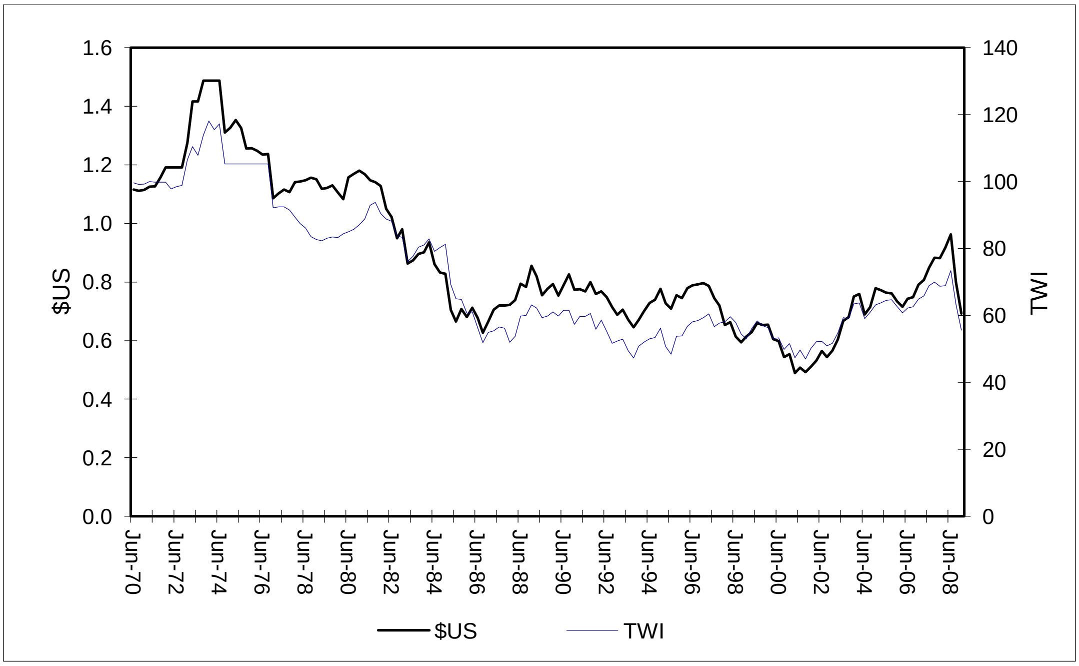
The common belief is that there is a positive relationship between the exchange rate and commodity prices. This is because Australia is one of the largest commodity producers in the world and the world's biggest exporter of coal, iron ore, beef, wool, alumina and zinc. Commodities account for about 60 percent of Australia's exports, with three-fifths shipped to Asia. Therefore, currency benefits when commodity prices increase and decreases when commodity prices decline. Contrary to these expectations, Figure 4.25 shows that there is an inverse relationship between COMPI and TWI.

4.7.3. The Stock market and Exchange Rate

There are two major variables measuring the movements in the exchange rate: the US dollar and the TWI. The US dollar is the most common currency in the world and most of the international transactions have been US dollar denominated. On the other hand, the TWI is the index value of the $AU based on the currencies of the major trading partners. The RBA calculates the TWI in Australia. It is the weighted average of the values of the $AU against currencies of 24 countries.

Figure 4.26 compares the TWI index and the $US. They have been following a similar trend over time. Using one of these two measures does not make much difference in terms of the effect on the stock return. However, the TWI is more appropriate and meaningful because it carries the effect of trade of Australia with major trading partners.

Figure 4.26. TWI and $AU/$US, quarterly, Jun 70 – Dec 08



Data source: DX Database

Australian economy is an open economy and thus the stock market return will be related to the exchange rate movements. Even if a firm's entire operations are domestic it may be affected by the movement in the exchange rates. The reason for this situation is because, if at least one of their input prices, output prices or demand for their products can be influenced by the currency movements, then the value of the firm is affected. The returns of some firms will be negatively related to the value of the home currency while others will be positively related to it and some not at all. Thus, regressing returns against exchange rates using a randomly selected cross-section of firms is unlikely to yield an overall significant exposure coefficient (Donnelly and Sheehy 1996).

Much of the earnings of Australian companies are sourced from overseas and they have exposure to the currency movements. Companies continue to target overseas operations to achieve earnings growth. In recent years, revenue from overseas operations has grown significantly. This has resulted in earnings becoming more exposed to currency fluctuations.

Some of the companies' earnings and costs are based in different currencies. For example BHP Billiton and RIO Tinto's cost base is mostly in $AU but their revenue is in $US. Some companies such as Ansell have a cost base in $US but revenue in $AU.

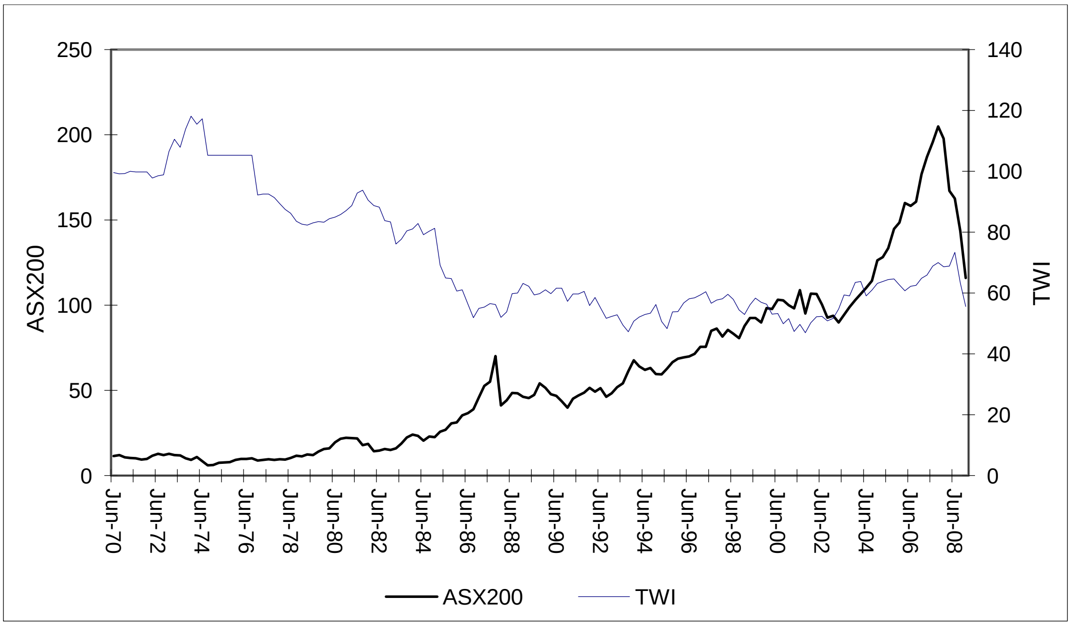
The strength of the $AU will be felt most in sectors such as resources, wine and building materials, property and media groups, as most of their earnings are in $US but their cost in $AU. When $AU rise, the revenues and profit of those companies with $US income and $A cost, such as BHP and RIO Tinto, decrease and vice versa for companies with a US cost base such as Ansell.

A similar principle applies to importers and exporters. The costs of importers are based on the TWI and revenue is based on the $AU. The costs of exporters are based on $AU and revenue is in TWI. Appreciation of the $AU increases the profit of the importing firms while reducing the profit of exporters. Depreciation of the currency has the opposite effect on importers and exporters.

When the $AU rises, the earnings of companies with US revenue and Australian costs decrease because of the translation effect when $US revenues are converted to $AU. However, companies that have a strong import base will benefit from the rising $AU as the cost of imports decreases as their costs (costs of import) is in $US and their revenue is in $AU.

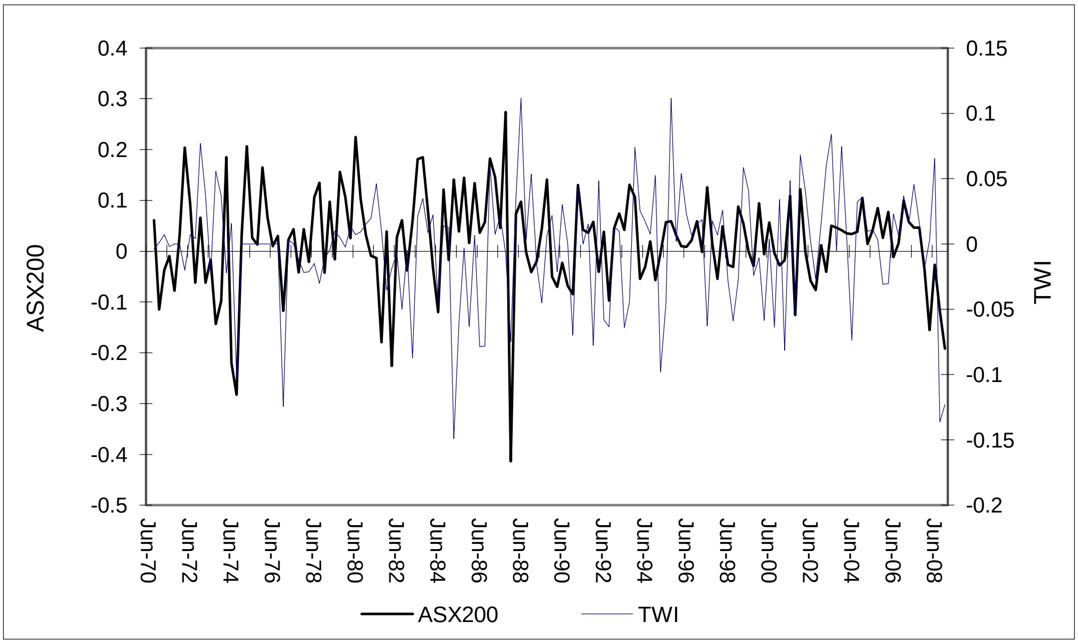
The relationship between the ASX200 index and the TWI over the period from June 1970 and December 2008 is shown is Figure 4.27. There is an inverse relationship between the two variables with the correlation coefficient being –0.74. Figure 4.28 shows the same relationship in terms of percentage changes. This figure also shows an inverse relationship of the two variables.

Figure 4.27. ASX200 Index and the TWI, trend, quarterly, Jun 70 – Dec 08



Data source: DX Database

Figure 4.28. ASX200 Index and TWI, percentage change, quarterly, Jun 70 – Jun 08



Data source: DX Database

4.8. The US Stock Market and the Australian Stock Market

The objective of this section is to conceptualize the effect of the US stock market on the Australian stock market. For this purpose the following topics will be evaluated: the US macroeconomic variables, international stock market linkages, the American Depository Receipts (ADRs), and the relationship between the Australian stock market and the US stock market.

4.8.1. The US Macroeconomic Variables

The US macroeconomic variables are very important for the financial markets. What happens in the US affects the financial markets all over the world. The most important macroeconomic variables are: Gross National Product (GNP), interest rates, the US dollar, and the US stock market.

The financial market participants closely watch the US economy. It is the largest economy and makes up about 25 % percent of the world economy. The US uses Gross National Product (GNP) instead of Gross Domestic Product (GDP) to measure the overall performance of the economy. GDP measures the total value of final goods and services produced by an economy, that is, within its borders. However, GNP measures the total value of final goods and services produced by a country's residents. National (in GNP) indicates that it measures residents' incomes from economic activities carried on abroad as well as at home. It excludes income produced at home but belonging to non-residents. Most of the US corporations engage in production all over the world. In this sense the US GNP provides information about how the world economy is doing.

The US Treasury bond yields and the other interest rates such as the Federal Reserve rate are the benchmark for global credit and bond markets. The US interest rates affect the international barrowing cost. Decrease in US interest rates also stimulates demand for commodities through the increased economic activity. Higher US rates may damp global growth, a key driver of prices for commodities.

The US currency has been used as if it was the world's common currency as the international borrowing and lending, export and import of goods and services are US dollar denominated. A high proportion of international transactions are carried out with the US dollar whilst much of the fixed and the variable investment are in US dollar assets. Therefore, the US dollar affects the international movements of goods and services and the investment capital.

Although, there are various macroeconomic variables of the US interacting with the Australian stock market, the stock market movement in the US is the most closely watched in Australia and elsewhere. Given the direction of the thesis, it is assumed that the return on the US stock market will represent the effect of the economic factors in the US and to some extent in the world. The stock market is a mirror reflection of the US economy and it is also a barometer of how the US economy is doing.

4.8.2. International Stock Market Linkages

One of the most cited articles in international diversification is Grubel's (1968) which introduced the benefit of international diversification. He demonstrated that the benefits of international diversification are mathematically correct. Since the work of Grubel (1968) international market linkages has been more effective. There are some studies which have examined integration of the stock markets worldwide; examples, being Agmon (1972), Agmon (1973), Webb *et al.* (1995) and Kazi (2009).

Agmon (1972) identified two different approaches to the international capital markets to explain the equity market linkages: *segmented market approach* , and *one multinational perfect capital market approach.* According to the segmented market approach the capital markets are separated entities, and they are almost not related to each other. Under the assumption of market segmentation, capital market returns may differ in different national markets. Market segmentation approach has a large following but it is not the only explanation of the international capital markets. The alternative hypothesis is the *one multinational perfect capital market* approach. It considers world capital markets as an integrated one capital market. The prices of capital assets in the international market behave as if there is one multinational perfect capital market.

The one market hypothesis is consistent with many generally accepted economic theories. It is also consistent with the international APT, which is becoming more popular in the literature. The one market hypothesis is unambiguous where market segmentation can stand for any number of specific imperfect market formations.

It can be argued that market segmentation is the only possible structure of the international capital market. As there are many different currency areas, political groupings and trade blocks. These can be an evidence of the segmented international capital market. However, a close observation of the capital market movements around the world shows that the market is behaving as one global capital market. Agmon (1972) noted, however, that a certain body of data can be consistent with both the one market hypothesis and any one of several specific forms of market segmentation. Agmon (1972) supported the validity of the one market approach for the multinational equity market. The study concludes that markets are reasonably well integrated internationally, but with continuing evidence of mild segmentation and lag/lead relationships between the US and other stock market indices.

Since the late 1970s the survival of economic liberalism has been the dominant factor in world economies. Financial markets have been deregulated, most currencies floated, capital movements have been liberalized, and investments and cross listings of financial assets have been freed up. These phenomena have contributed to the further linkages of the world financial markets. Moreover, the more recent literature concentrates on the international APT and overseas economic variables on the stock market returns.

A study by Kleiman *et al.*(2002) documented similar results to Agmon (1972). They employed the Johansen-Juselius co-integration analysis. The study reveals that all three regions' markets, Europe, Asia and North America (comprising a total of thirty countries), appear co-integrated and share a common long-run stochastic trend. Results of co-integration analyses and vector error correction models suggest that diversification benefits through international real estate securities which can only be achieved in the short run.

Eun and Shim (1989), investigating the international transmission mechanism of stock market movements, found that there is a significant interaction between national stock markets. The US market movement is clearly affecting the others. However, no single foreign market can significantly affect the U.S. market movements. In a similar paper Dickinson (2000) found that there have been greater links between stock markets in recent years with the US causing other market movements.

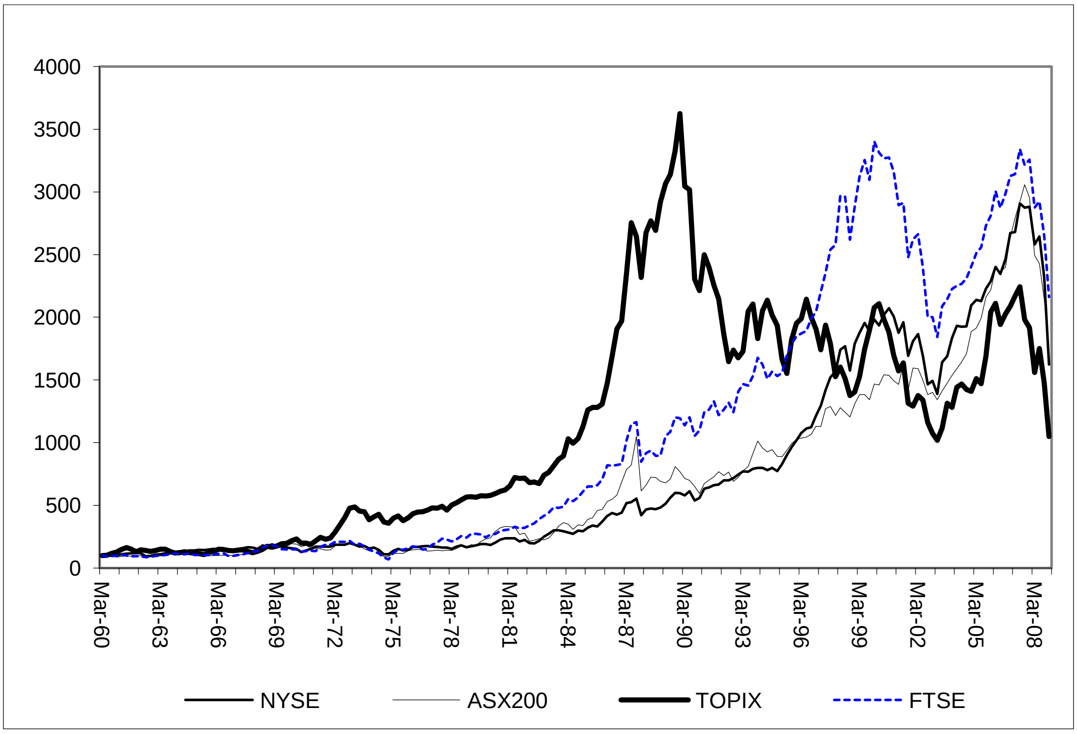
The October 1987 stock market crash is a good example of the international stock market linkages. King and Wadhwani (1990) investigated why, in October 1987, almost all stock markets fell together despite all of them being in the different economic regions. They constructed a model in which "contagion" between markets occurs as a result of attempts by rational agents to infer information from price changes in other markets providing a channel through which a "mistake" in one market can be transmitted to other markets. They offer supporting evidence for contagion effects using two different sources of data. The authors examined the linkages between equity markets.

Kortian and O'Reagan (1996) using daily data between 1987 to 1996, examined the behaviour of price movements in the Australian bond market, stock market and foreign exchange markets and international market linkages. The paper did not find any compelling evidence of the presence of a trend increase over the period. However there is evidence of quite significant cross-country 'contagion' or 'spillover' effects on Australia's bond and equity markets. The predominant foreign market influence appears to be the US on the both bond and stock market. The authors argue that Australian bond and share market volatility is higher in bear markets than in bull markets, and higher following a market fall than a market rise.

A recent Australian study by Kazi (2008) examined the relationship between the Australian stock market and the stock markets of its major trading partners, namely, UK, USA, Canada, Germany, France, and Japan using annual data between 1945 and 2002. This paper applied both ordinary least squares and generalized method of moments. Results of the ordinary least squares indicate that UK, Canada and France stock market returns were significant. Alternatively, the result of generalized method of moments indicates that four market: UK, Canada, France and Germany, were significant. Accordingly, Kazi (2009) concluded that the Australian stock market was related to that of its trading partners; and it was been affected four markets of which the UK is the most significant.

Figure 4.29 shows the relationships between the major international stock market indices. There are relationships but they are not one by one. For example Japan’s Topix index is going into different directions than the other major indices. As is argued by some authors (Agmon 1972) there is no evidence that the international markets are behaving as one perfect stock market. There is no compelling evidence of a clear trend relationship over the period. This situation supports the contagion theory of King and Wadhwani (1990). There is a clear evidence of 'contagion' or 'spillover' effects on international market indices.

Figure 4.29. International stock market linkages, Mar 60 – Dec 08, (Mar 60 = 100)



Data source: DX Database

4.8.3. The American Depository Receipts

The US stock market is the largest stock market in the world. Almost all of the largest corporations in the world are listed in the US stock market as the American Depository Receipts (ADRs). In this sense the US stock market is a good sample of the world stock market. It reflects the economic and the financial fundamentals of the world economy.

An American Depositary Receipt (ADR) is a share of a stock of a non-US corporation. They are the US dollar denominated receipts for full or partial non-US shares traded on a US exchange. The number of stocks and the volume of the ADR have increased significantly over time. ADRs provide a mechanism to invest in international stock markets using the US stock markets. This mechanism makes it straightforward for a US and other investor to invest in a foreign issue.

Webb *at al.* (1995), using daily data, estimated the relationship between the US stock market and ADRs in the late 1980s. The number of foreign companies represented by ADRs being traded on the US market has risen significantly reflecting the growing interest of both institutional and small investors in foreign countries. The authors found that there is a strong significant relationship between ADR and US market daily returns on a contemporaneous and a one-day lagged basis thus indicating a lead/lag relationship among equity markets. The US market is acting as the leading market in equity pricing. The authors also tested whether the relationship changes according to the ADR country. They examined the relationship across time between regional ADR portfolio returns. The same structural relationship holds for the regional groupings. The linkage is greater for the UK ADR portfolio.

4.8.4. Australian Stock Market and the US Stock Market

The relationships between international financial markets are significant and well documented in the literature as explained in previous subsections. However, as outlined before in this paper, the main driver of the stock market movements over the long run is the profitability of the firms. In this sense, the main question here is to what extent and in which way the US market affects the profitability of Australian companies.

Observation of the markets shows that the Australian stock market maintained its tight correlation with the S&P500 index. This is because both rely on the expectations for the global growth outlook. Financial market participants look to signals about the performance of the US stock market to determine if the stock market and AU dollar will rise.

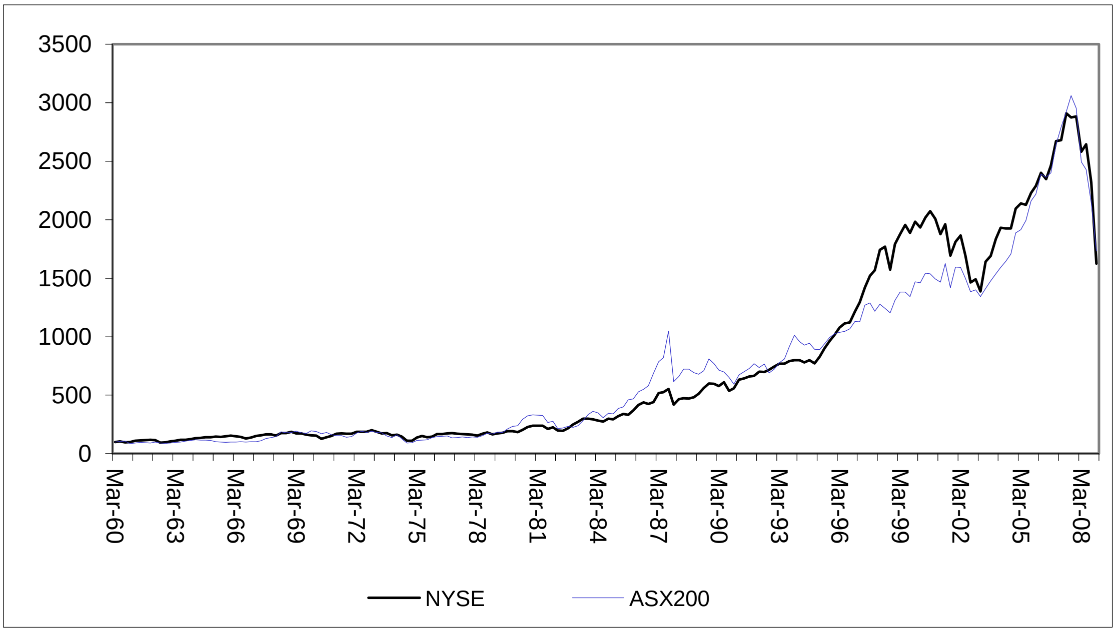
As explained in this paper before, the widely used stock valuation model – NPV – for individual stocks carries the effects of all of the macroeconomic variables. Therefore, the S&P500 index will be included in the equation, because US corporations make production in most countries and stock prices are affected by the world economic developments. When the

US market moves because of a change in fundamental economic variables, the Australian market and other world markets follow. The movement in the US market is a good indicator of the global economic movements, which have significant effect on the profitability of the Australian companies. The higher global output creates the higher demand for Australian goods and services and investment assets such as shares and bonds. Therefore, the S&P500 index has a direct effect on the profitability of the firms.

Some companies' earnings depend mostly on the US economy. For example, News Corporation., CSL, CSR, James Hardie, and Southcorp are the companies with larger exposure to the US. They benefit from a stronger economy in the US. Many more companies' earnings are dependent on the global economy. Any increase in the global economy is seen as positive for the Australian dollar and the Australian stock market. The explanation is that when the world economy grows, the demand for commodities and other exported goods and services increases, pushing their prices higher and thus in turn affecting stock market return.

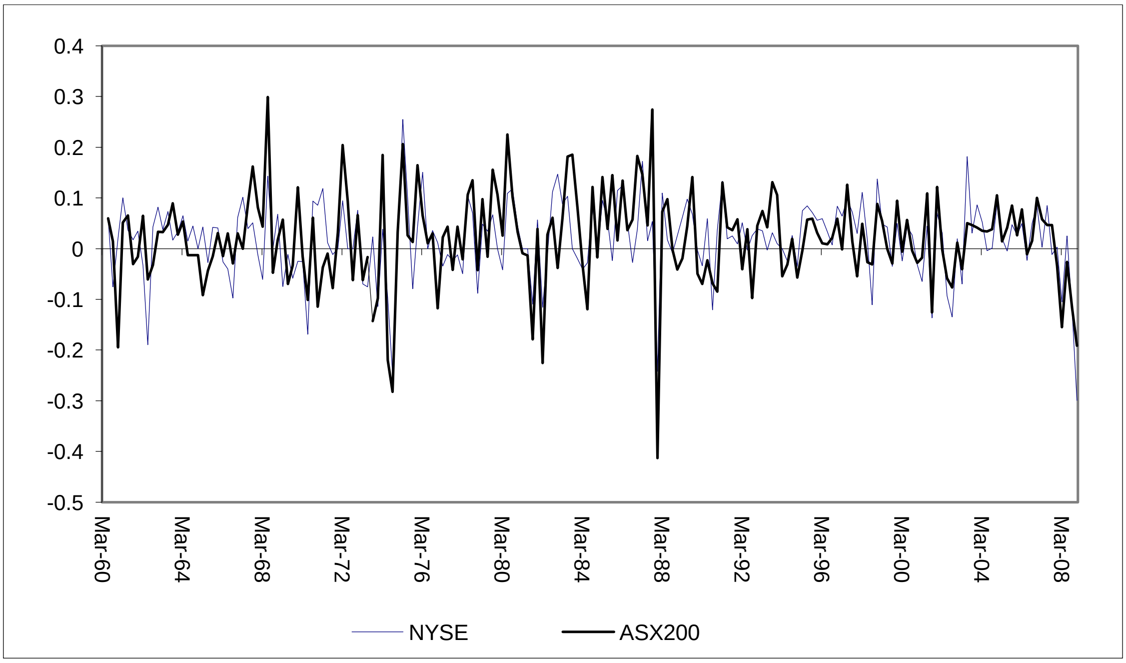
Another area of concern is the correlation of the business cycles between the economies. De Ross and Russell (1996) identified two transmission mechanisms to explain the well-documented correlation between Australian and foreign business cycles. The first is through exports and the second is the stock market. The authors found that the US and Japan have a high output elasticity of demand for Australia's exports. Consequently, their business cycles have a larger impact on Australia's exports than that suggested by their market shares. The second transmission mechanism is through the share market. Both the US and the Australian stock markets have a significant impact on Australian activity. Evidence is also found that the responses of investment to the share market in the two countries are remarkably similar. Given that the share markets are highly correlated, the similarity in response lags may help to explain the correlation in business cycles.

Figure 4.30. ASX 200 Index and NYSE index (1990 = 100), trend, quarterly, Mar 60 – Dec 08



Data source: DX Database

Figure 4.31. ASX 200 index and NYSE index, percentage changes, quarterly, Mar 60 – Dec 08



Data source: DX Database

Figure 4.30 shows a clear relationship between the ASX200 Index and the NYSE index between March 1960 and December 2008. Although, there are diversions between these two indices, movement is in the same direction. As expected there is a positive relationship. Figure 4.31 shows a definite relationship in terms of percentage changes over the same period. Compared to previously selected macroeconomic variables this relationship looks more significant because the direction and the magnitude of the percentage changes are very close. Therefore, the US stock index will be an independent variable and further statistical techniques will be applied in the next chapter.

4.9. Summary

This chapter studied the relationship between major macroeconomic variables with each other and with the stock market return in Australia. Independent variables, which are likely sources of the systematic risk, have been selected by following the market process and the economically interpretable effects.

Two variables of product market GDP and CPI is selected as the likely source of the systematic risk. CPI represents the general price level in the product market while real GDP represent the quantity of goods and services in the product market. Total revenue of the firms is proportional to the changes in the CPI and real GDP.

Other variables selected from major market based on the equilibrium analysis and prices are considered as the likely significant variables to explain the systematic risk.

The next chapter will study the relationship between these variables and stock market return in Australia. The relationship will be investigated further in the context of the macro variable version of the APT.

CHAPTER 5

5. STATISTICAL ANALYSIS OF STOCK MARKET RETURN

5.1. Introduction

In chapter 4, a detailed qualitative analysis of the relationship between stock market return and major macroeconomic variables was undertaken, and likely sources of the systematic risk factors were selected following the implications of the market model. The objective of this chapter is to investigate the statistical relationship between the stock market return and the selected macroeconomic variables. If all variables are integrated at order one – $I(1)$ – the cointegration and the error correction model will be used to test the significance of the relationship between stock market and macroeconomic variables.

The EMH suggests that rational investors use all available information, and use the best valuation models and theories that explain asset pricing. Chen *et al.* (1986) developed the Macro Variable Model of the APT. The present thesis will apply a different set of Australian macroeconomic data.

The macro variables model of the APT is looked as the best model of stock pricing. It integrates the EMH, rational expectations and the APT. Moreover analyzing the performance of this model at the same time implies the analysis of the performance of rational expectations and the EMH.

According to Fama (1991) the EMH cannot be tested itself, but is tested jointly with an asset pricing model. The advantage of multifactor models is to eliminate the *joint hypothesis* problem so that market efficiency can be tested jointly with an asset pricing model. The EMH is tested jointly with an asset pricing model, for example, the semi strong form efficiency test performed with a single factor model such as the CAPM and a multifactor model such as the APT.

The EMH states that it is impossible to obtain returns higher than the market on the average because existing share prices always reflect all relevant information. Stocks are assumed to trade at their equilibrium value. Therefore, it is impossible to make abnormal profit by buying undervalued stocks or sell overvalued stocks for inflated prices. The EMH contains 3 information sets that can be linked to the stock market evaluation philosophy: weak form efficiency, semi strong form efficiency and strong form efficiency

Weak form efficiency claims that all past prices of a stock are reflected in today's stock price. Therefore, technical analysis cannot be used to predict and beat a market. Weak form efficiency advocates assert that fundamental analysis can be used to identify stocks that are undervalued and overvalued. Therefore, keen investors looking for profitable companies can earn profits by researching financial statements and public announcement.

Semi strong form efficiency involves analyzing the underlying economic factors (micro and macro) that determine stock price movements. It implies that all public information is calculated into a stock's current share price and therefore, neither fundamental nor technical analysis can be used to make abnormal gains.

S*trong form efficiency* concerns with the effect of private information and insider trading. The strong form efficiency states that all information in a market, whether public or private, is accounted for in a stock price. Even insider information cannot give an advantage to make abnormal profit.

Returns on the ASX200 index will be dependent variables in the proposed equation and an investigation will be carried out to ascertain whether the consecutive returns of ASX200 index are serially correlated (if there is autocorrelation). The existence of autocorrelation is an important ramification in terms of the weak form efficiency of the EMH. In this respect the weak form efficiency of the Australian stock market will be tested using quarterly data.

Most of the multifactor asset pricing models reviewed in this thesis are based on the APT. Moreover, there are two different versions of the multifactor models: micro and macro variable models. Since the proposed model is a macro variable model, testing the significance of this model implies the semi strong form efficiency of the EMH. If the proposed model is correct and reflects the effect of all available macroeconomic data efficiently, then the selected variables should explain the stock market return significantly. If not, the results cast doubt on the efficiency of the Australian stock market. In this respect, the semi strong form efficiency of the Australian stock market, using quarterly macroeconomic data, will be tested.

5.2. Profit and the Macroeconomic Variables

Investors consider the profit of a firm as the main driver of the value of an individual stock. The other variables are seen as indicators or catalysts bringing future levels of profit into consideration. Profit (return) in stock market is viewed as economic profit (dividend plus capital gains) rather than accounting profit. Accounting profit can be described as the difference between total revenue and total cost.

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost} \qquad (5.1)$$

A portfolio (or market as a whole) is a combination of individual stocks. Certain macroeconomic variables should affect the aggregate profit of the stock market. What affects individual stocks also affects the stock market return as a whole through the effect on total revenue or total cost.

In chapter 4, sufficient evidence of the relationships between the stock market and variables of other macroeconomic markets, was set out. Seven macroeconomic variables were identified as the likely sources of systematic risk. Moreover, the effect of the selected variables on the profitability of the stock market was analyzed in this chapter. Selected variables, except real GDP, represent the prices from major macroeconomic markets because in a market system economic decisions are coordinated through prices. Any factor affecting demand and supply is reflected in prices, and these variables are proxies for the underlying risk factors for the profitability of individual firms (affecting the numenator or denominator of the valuation model) and therefore, the stock market return as a whole. Table 5.1 shows the selected macroeconomic variables and expected signs (positive or negative) of the relationship with the stock market index (ASX200).

Table 5.1. Selected macroeconomic factors and the expected sign of the relationship

RGDP	Real GDP	+
CPI	Consumer price index	+
10YB	Yield on 10 year bond	-
LCI	Labour cost index	-
CP	Commodity price index	+
TWI	Trade weighted index	+
NYSE	US NYSE Index	+

The total revenue of a firm is affected by: real GDP, inflation, commodity prices, exchange rate and return on foreign markets, while total cost is affected by: interest rates, wage rate, commodity prices and exchange rate. Therefore, stock market return should have exposure to these variables.

GDP was included in the proposed equation as a measure of the overall economic activity affecting the stock market return, through the effect on firms' cash flow (numerator effect). Real GDP is the most comprehensive measure of the overall performance of the economic activity. It is expected that there will be a positive relationship between real GDP and the stock market return. The positive relationship is attributed to changes in the numerator effect in a valuation model. Higher real GDP means higher demand for goods and services, therefore higher revenue for the firm and higher stock prices[1].

It is expected that the *inflation rate* and stock market return to be correlated in the same direction. There is a general expectation that the relationship between stock return and inflation (actual and expected) is positive because higher inflation means higher product prices for the firms and therefore higher revenue. Another point of view is that stock prices will be a hedge against inflation because they are claims on real assets[2].

The *interest rate* is related to the stock market return in several ways. Firstly, interest bearing assets such as bonds and stocks are substitutes, in terms of portfolio investment. Portfolio theory suggests that an increase in interest rates leads to a portfolio shift from non-interest bearing money to interest bearing financial assets, such as bonds. Higher interest rates mean lower stock prices as a result of the substitution effect. Secondly, interest is a cost factor of the firms and it affects the cash flow of the firms (numerator effect). Higher interest rates mean lower profit. Finally, the interest rate is the discount factor (denominator effect). Cash flow over time is discounted using interest rates. Higher interest rates mean a lower net present value of the investment[3].

About 55 per cent of the total cost for firms in Australia is comprised of *labour costs*. It is expected that there will be a negative relationship between stock return and labour costs because higher labour costs mean lower profit for the firm. Labour costs affect the stock return through the numerator effect[4].

Commodity prices are included to provide for the possible effects on the stock market through both the numerator and the denominator effect. The inclusion of this variable is meaningful in the Australian context, given the importance of commodities to the Australian

[1] See section 4.2
[2] See section 4.3
[3] See section 4.4
[4] See section 4.5

economy. An increase in commodity prices will lead to an increase in the cost of production for some firms, while increasing revenue of commodity-producing firms. However, the expected net effect of commodity prices on the stock market return as a whole is indeterminate.[5]

It is expected that the firm value would be related to the *exchange rate* because at least one of the input and output prices, or demand for its products, can be affected by the exchange rate, and hence, the value of the firm. Some firms will be negatively related to the exchange rate and others will be positively related to it and some not at all. Thus, it is expected that, as a priori, exchange rates are unlikely to yield a significant coefficient[6].

The relationship between the Australian and the *US stock market* has been significant from several aspects. Firstly, the movement in the US market is a good indicator of global economic growth which in turn affects Australian stocks. This is because the US economy is about 25 per cent of the world economy and US firms have worldwide interest. Secondly, some Australian companies' earnings depend on the US economy. Thirdly, Australia and the US follow a similar business cycle. For those reasons it is expected that there will be a positive significant relationship between Australian and the US stock market[7].

5.3. Data

This study uses quarterly data relating to the Australian economy, covering the years 1982:3 – 2009:3. It builds a multifactor model based on the APT to test the impact of macroeconomic variables on stock returns and to test the the weak and the semi strong form efficiency of the Australian Stock Market.

Data on GDP, CPI and labour cost index are available on a quarterly basis. Data on interest rate, commodity price index, exchange rate and US stock index are available on a

[5] See section 4.6
[6] See section 4.7
[7] See section 4.8

monthly basis on the DX Database. Therefore, quarterly data is used by transforming monthly data to quarterly, as data from shorter time frames, such as monthly, weekly or even daily, is unavailable. All the variables are expressed in natural logaritmic forms.

5.4. Weak Form Efficiency of the Australian Stock Market

The first step in regression analysis is to check the dependent variable and investigate whether there is autocorrelation (or serial correlation) of the consecutive return of time series data. The existence of autocorrelation has an important meaning in terms of the EMH. If the consecutive changes are correlated then we say the market is weak form inefficient.

Stock prices will be a dependent variable and the other selected macroeconomic variables will be independent variables in the proposed equations. Although there are many indexes in the Australian stock market, the ASX200 index will be used in the proposed model because it is a benchmark index and covers a large proportion of the stock market in Australia.

There is overwhelming support for the theory that the stock market is weak form efficient (Fama 1970). However, there are inconsistencies with the EMH. According to Fyfe *et al.* (1999), there are studies in the literature that report inconsistent phenomena with the EMH, including:

- Negative serial correlation for individual stocks and portfolios over a three to ten year period;
- Predictable return reversals on a monthly basis for individual securities;
- Negative serial correlation for lags up to two months and positive serial correlation for longer lags for individual securities;
- Positive serial correlation for weekly returns on portfolios and indices, and negative serial correlation for individual stocks;
- Negative serial correlations for individual securities' weekly and daily returns;

- Positive correlation of monthly returns over a three to five year period.

Fyfe *et al* (1999) further state that a number of studies show that, inconsistent with the EMH, trading volume and price volatility are large, and these both imply significant autocorrelation.

Quarterly data obtained from the DX database between June 1960 and December 2008 will be used to test whether there is an autocorrelation on the ASX200 index in terms of the return ($\log X_t - \log X_{t-1}$). The following hypothesis will be tested:

Null Hypothesis: H_o: ASX200 index returns are not independent – (i.e. autocorrelation)

Alternative Hypothesis: H_1: ASX200 index returns are independent (i.e.no autocorrelation)

Using Microfit 4 computer package, the Autocorrelation coefficients of the ASX200 index was estimated up to order fourteen[8]. According to Pesaran and Pesaran (1997), the autocorrelation coefficients, the Box-Pierce and Ljung-Box Q statistics can be used to investigate whether there is autocorrelation or not. The Ljung-Box Q statistics is more reliable for small samples. The figures in parenthesis are the probabilities of falsely rejecting the null hypothesis of no serial correlation. A high *p*-value indicates that there is no serial correlation, while, a small *p*-value provides evidence that ASX200 index return is serially correlated. For the returns on ASX200 index, in appendix A, the *p*-values are quite high indicating an absence of serial correlation. The autocorrelation coefficients from 1 to 14 order are not large relative to their standard errors. Therefore we reject the null hypothesis and conclude that ASX200 returns are independent.

The existence of autocorrelation indicates the inefficiency of the market in term of the EMH. Since there is no autocorrelation of the consecutive return of time series data, we can conclude that the Australian stock market is weak form efficient.

[8] See Appendix A

5.5. Basic Unit Root Theory

The time series properties of the economic variables can strongly influence the outcome of the estimation. For example, if a series is a non-stationary, persistence of shocks will be infinite. If two variables are trending over time, a regression of one on the other could have a high R^2 even if the two variables have not intuitive relationship. This is called a spurious regression. If the variables in the regression model are not stationary, it shows that the standard assumptions for asymptotic analysis will not be valid. In other words, the usual "*t*-ratios" will not follow a *t*-distribution, so we cannot validly undertake hypothesis tests about the regression parameters (Brooks 2002).

Since many of the macroeconomic variables seem non-stationary, the first step in cointegration analysis is to check for the stationarity of the variables and determine the order of integration. For cointegration analysis, all variables must be integrated in the same order. The order of integration of a series refers to the number of times the series must be differenced in order to make it stationary. A series is integrated in order of d, I(d), if it has to be differenced d times to become stationary. If a variable becomes stationary after differencing once it is said it is integrated order 1, I(1).

According to Brooks (2002), a unit root test analyses whether a time series variable is non-stationary using an autoregressive model. There are several unit root tests to examine stationarity of the time series. The most famous test is the augmented Dickey–Fuller test (ADF). Another test is the Phillips–Perron (PP) test. Both these tests use the existence of a unit root as the null hypothesis (H_0: $y_t \sim I(1)$). However, another popular test, the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test use the existence of a unit root as the alternative hypothesis (H_1: $y_t \sim I(1)$). It is assumed that the series are stationary under the null (H_0: $y_t \sim I(0)$). In this thesis, we apply the ADF, PP and KPSS unit root tests to examine the stationarity of the macroeconomic variables.

The standard Dickey Fuller (DF) test is carried out by estimating the following equation:

$$\Delta y_t = \delta x_t + \alpha y_{t-1} + u_t, \qquad (5.2)$$

Where, x is time trend, y *is* a nonstationary series, α and δ are parameters, t is time, Δ represents changes and u_t is the error term assumed to be white noise.

The null and alternative hypotheses may be written as,

$$\begin{aligned} H_0&: \alpha = 0 \\ H_1&: \alpha < 0 \end{aligned} \qquad (5.3)$$

And hypothesis is evaluated using the conventional t – ratio for α:

$$t_\alpha = \acute{\alpha}/(se(\acute{\alpha})) \qquad (5.4)$$

where $\acute{\alpha}$ is the estimate of α , and se$(\acute{\alpha})$ is the standard error.

5.6. Augmented Dickey Fuller (ADF) Test

The standard DF test above is only valid if u_t is white noise - AR(1) process. If the series are correlated at higher order lags, the assumption of white noise disturbances u_t is violated. In particular, u_t will be autocorrelated if there was autocorrelation in the dependent variable of the regression (Δy_t). The solution is the ADF test using p lags of the dependent variable. The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the y series follows an AR(p) process and adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression. The ADF tests involve estimating the following equation:

$$\Delta y_t = \gamma + \delta x_t + \alpha y_{t-1} + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots\ldots + \beta_p \Delta y_{t-p} + v_t, \qquad (5.5)$$

Where, γ is constant α, β and δ are the parameters, p is the lag order of the autoregressive process and v is the error term.

By including lags of the order p the ADF formulation allows for higher-order autoregressive processes. This means that the lag length p has to be determined when applying the test. The unit root test is then carried out under the null hypothesis $\beta = 0$ against the alternative hypothesis of $\beta<0$.

5.7. Phillips Perron (PP) Test

Phillips and Perron (1988) have developed a more comprehensive theory of unit root on stationarity. It is used to test the null hypothesis that a time series is $I(1)$. The tests are similar to ADF tests, but they incorporate an automatic correction to the DF procedure to allow for autocorrelated residuals. The PP method uses the standard DF test and modifies the t – ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic.

The PP test usually gives the same conclusions as the ADF tests, and the calculation of the test statistics is complex. The main criticism is that the power of the tests is low if the process is stationary but with a root close to the non-stationary boundary. For example, the tests are poor at deciding if α=1 or α=0.95, especially with small sample sizes (Brooks 2002).

5.8. Kwiatkowski, Phillips, Schmidt and Shin (KPSS) Test

KPSS tests are used for testing a null hypothesis that an observable time series is stationary around a deterministic trend. The null hypothesis is that an observable series is stationary around a deterministic trend. The series is expressed as the sum of deterministic trend, random walk, and stationary error. The test is the LM (Lagrange Multiplier) test of the hypothesis that the random walk has zero variance. KPSS type tests are intended to complement unit root tests, such as the Dickey–Fuller tests.

By testing both the unit root hypothesis and the stationarity hypothesis, one can distinguish series that appear to be stationary, series that appear to have a unit root, and series for which the data (or the tests) are not sufficiently informative to be sure whether they are stationary or integrated (Brooks 2002).

The KPSS has stationarity under the null and non-stationarity under the alternative:

$$H_0: y(t) \sim I(0)$$
$$H_1: y(t) \sim I(1) \qquad (5.6)$$

It has exactly the opposite problems of unit root tests and it may not reject the null of stationarity even when the true process is $I(1)$. The test statistics is higher than the critical values, so the process is not level stationary (Brooks 2002)

5.9. Order of Integration

A series x_t is *integrated of order d* (we call it I(d) process) if the series becomes stationary after differencing *d* times. Two series *x* and *y* are cointegrated if both series are of the same order *d*. A linear combination of the two series is integrated to the order *b (b<d).*

Only integrated variables of the same order can be cointegrated, therefore the first step is to determine the order of integration of the variables. ADF, PP and KPSS statistics were used to test for the unit roots.

The null hypothesis for ADF and PP test is different than KPSS. Variable *x* contains unit root is the null hypothesis for ADF and PP test. On the other hand, KPSS has null hypothesis where the variable *x* is stationary. The hypotheses are in the following form:

ADF / PP	KPSS	
$H_0: y_t \sim I(1)$	$H_0: y_t \sim I(0)$	(5.7)
$H_1: y_t \sim I(0)$	$H_1: y_t \sim I(1)$	

For ADF and PP, if test statistics are not smaller (more negative) than the critical value, it is not stationary and if test statistics is smaller it is stationary. The null hypothesis of a unit root is rejected in favour of the stationary alternative in each case if the test statistic is smaller (more negative) than the critical value. For KPSS, the test statistics is higher than the critical values, so the process is not level stationary.

Table 5.2. Results from ADF, PP and KPSS test (All variables in log form)

		Level	
	ADF	**PP**	**KPSS**
LNASX200	-3.183194	-3.233126	0.100425
LNRGDP	-2.470193	-2.014153	0.239502
LNCPI	-2.395473	-2.266524	0.234622
LN10YB	-2.782221	-2.901142	0.1608
LNLCI	-1.989427	-2.266524	0.107436
LNCP	-2.530414	-1.994629	0.234311
LNTWI	-2.473347	-2.391113	0.232082
LNNYSE	-1.192716	-1.918804	0.205528
		First Differenced	
	ADF	**PP**	**KPSS**
LNASX200	-10.37683	-10.37716	0.188207
LNRGDP	-6.808797	-7.567762	0.100622
LNCPI	-4.057421	-11.62255	***0.652391***
LN10YB	-9.666756	-9.939722	0.079982
LNLCI	-11.5162	-11.62255	0.071996
LNCP	-7.957084	-7.597435	0.103343
LNTWI	-9.880262	-9.888287	0.312065
LNNYSE	-9.34792	-9.109064	0.279117

Notes: Critical value for ADF and PP: For the model with trend and intercept (level): -3.451959 and model with intercept (first differenced): -2.888669 at the 5% level
Critical value for KPSS: For the trend stationary(level) model : 0.146 and for the level stationary (first differenced) model: 0.463000 at the 5% level

Table 5.2 shows the results of the unit root tests[9] where both a time trend and intercept were included on the level and only the intercept was included on the first differences of the series. Both level and first difference results are included in table 5.2 and the results in table 5.2 indicate that at 5 per cent significance level, the null hypothesis of a unit root (i.e., nonstationarity) cannot be rejected when the variables are in levels, but the null is rejected after first differences. The results show that ADF and PP test results shows that all variables

[9] See appendix B for ADF, appendix D for PP and appendix E for KPSS test results.

are $I(1)$ meaning that they are integrated at order 1. However, KPSS test shows that CPI is not stationary after the first difference. Since ADF and PP are the most widely used and powerful unit root test, we can consider all variables are $I(1)$.

According to Brooks (2002) the majority of economic and financial series contain a single unit root, although some are stationary and consumer prices have been argued to have 2 unit roots. KPSS test result on CPI confirms the results of the Brooks (2002).

Unit roots test were applied using Eviews 6.0 and ADF, PP and KPSS methods. Results in table 5.2 shows that variables used in this study: AS200, RGDP, CPI, LCI, CP, TWI and NYSE are integrated at order 1.

5.10. Testing for Cointegration

As the first step, unit-root tests were applied to the data set and we find that all variables are $I(1)$. The next step is to apply cointegration test and estimate the appropriate cointegrating vectors using the variables on the proposed equation.

If there is a cointegration relationship there is a long-run equilibrium relationship between economic variables. In this case, if the stock market index and macroeconomic variables are cointegrated and they are each $I(1)$ then there is a linear combination of them being $I(0)$.

Johansen and Juselius (1990) approach is applied to test for cointegration. The Johansen and Juselius (1990), method uses trace and maximum eigenvalue test statistics to determine the number of cointegrating vectors. The trace test statistic, for the null, hypothesizes that there are at most r number of cointegrating vectors. On the other hand, the maximum eigenvalue test statistic hypothesizes the null hypothesis as at most r cointegrating vectors, and the alternative hypothesis as $r+1$ cointegrating vectors. The following equation was tested using Johansen and Juselius (1990) approach:

$$logASX200 = \alpha + \beta_1 logRGDP + \beta_2 \, logCPI + \beta_3 \, log10YB + \beta_1 logLCI + \beta_1 logCP + \beta_1 TWI + \beta_1 logNYSE + \epsilon \quad (5.8)$$

Table 5.3. Results from Johansen's Cointegration Test, (Trace and Maximum Eigenvalue Test)

Unrestricted Cointegration Rank Test (Trace)

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r \geq 1$	0.613421	282.2535*	159.5297	0.0000
$r \leq 1$	$r \geq 2$	0.476486	183.4099*	125.6154	0.0000
$r \leq 2$	$r \geq 3$	0.314397	116.1019*	95.75366	0.0010
$r \leq 3$	$r \geq 4$	0.218600	76.84644*	69.81889	0.0123
$r \leq 4$	$r \geq 5$	0.199047	51.19298*	47.85613	0.0235
$r \leq 5$	$r \geq 6$	0.148359	28.10984	29.79707	0.0773
$r \leq 6$	$r \geq 7$	0.101112	11.40848	15.49471	0.1876
$r \leq 7$	$r \geq 8$	0.003095	0.322351	3.841466	0.5702

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r = 1$	0.613421	98.84356*	52.36261	0.0000
$r \leq 1$	$r = 2$	0.476486	67.30801*	46.23142	0.0001
$r \leq 2$	$r = 3$	0.314397	39.25549	40.07757	0.0617
$r \leq 3$	$r = 4$	0.218600	25.65345	33.87687	0.3422
$r \leq 4$	$r = 5$	0.199047	23.08315	27.58434	0.1699
$r \leq 5$	$r = 6$	0.148359	16.70136	21.13162	0.1866
$r \leq 6$	$r = 7$	0.101112	11.08613	14.26460	0.1499
$r \leq 7$	$r = 8$	0.003095	0.322351	3.841466	0.5702

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5.3 shows the results of Johansen-Juselius cointegration tests for the proposed equation[10]. Critical values for the test statistics comes from Johansen and Juselius (1990). First part of table 5.3 shows results of the trace test which indicates that there are 5 cointegrating equations (vectors) at 5 per cent level. Second part of table 5.3 shows the results of the maximum eigenvalue statistics which indicate that there are exactly two cointegrating

[10] For full result see appendix E.1

equations (vectors) in the model at 5 per cent level. Thus, we consider two cointegrating relationships.

Table 5.4. Normalised Cointegrating Coefficients

1 Cointegrating Equation: Log likelihood 1960.583

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LN10YB	LNLCI	LNCP	LNTWI	LNNYSE
	-11.73816*	16.23993*	2.852612*	0.712948	-3.800275*	7.339710*	0.764572*
	(3.06697)	(2.93101)	(0.92663)	(3.17900)	(0.98732)	(1.56115)	(0.41827)
	[-3.82728]	[5.54072]	[3.07848]	[0.22426]	[-3.84908]	[4.70147]	[1.82793]

2 Cointegrating Equation(s): Log likelihood 1994.237

LNASX200	LNCPI	LN10YB	LNLCI	LNCP	LNTWI	LNNYSE
	1.290341*	1.624453*	2.894515*	-2.449225*	0.715752*	-0.277089*
	(0.69943)	(0.22160)	(0.99717)	(0.25409)	(0.32481)	(0.12675)
	[1.84484]	[7.33056]	[2.90272]	[-9.63920]	[2.20360]	[-2.18610]
LNRGDP	-1.273588*	-0.104630*	0.185853	0.115099*	-0.564310*	-0.088741*
	(0.13805)	(0.04374)	(0.19681)	(0.05015)	(0.06411)	(0.02502)
	[-9.2255]	[-2.39201]	[0.94432]	[2.29509]	[-8.8022]	[-31.2197]

Notes: Standard errors in parenthesis while t-values are in square brackets.
*Denotes significance at the 5 % level

In addition to trace and the maximum Eigenvalue statistics, table 5.4 represents the estimated two cointegrating vectors after normalizing on variables. It was tested whether macroeconomic variables are significant components in the cointegrating vector normalized on stock prices with the aid of a likelihood ratio test. These statistics suggest that macroeconomic variables enter significantly in the cointegrating vector normalized on stock prices.

5.11. Vector Error Correction Model (VECM)

Cointegrated variables have an error correction system. The above unit root tests and the cointegration test results also imply that the dynamic modeling of stock prices and macroeconomic variables have a valid error correction representation. The VECM estimates provide important information about the short run relationship between stock return and macroeconomic variables while a negative and significant error correction term signifies the speed of adjustment to the long run equilibrium level.

In addition to learning about a potential long-run relationship between two series, the concept of cointegration will be analyzed with a VECM. If Y_t and X_t are $I(1)$ process we might estimate a VECM in first differences.

VECM is linked in to Johansen (1980) methodology related to Cointegration. Consider a vector auto regression (VAR) with p lags.

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \ldots\ldots + A_p y_{t-p} + \epsilon_t \qquad (5.9)$$

where y_t is a $K \times 1$ vector of variables, v is a $K \times 1$ vector of parameters, A_1-A_p are $K \times K$ matrices of parameters, and ϵ_t is a $K \times 1$ vector of disturbances. ϵ_t has mean 0, has covariance matrix Σ, independent and identically distributed (i.i.d.) normal over time. Using algebra any VAR(p) can be written as a VECM as in the following equation:

$$\Delta y_{\mathbf{t}} = \upsilon + \Pi\, y_{t-1} + \sum_{i-1}^{p-1} \Gamma_i\, \Delta y_{t-i} + \varepsilon_t \qquad (5.10)$$

Where Π is to be interpreted as is Johansen (1988). Assume that Π has reduced rank $0<r<K$ so that it can be expressed as $\Pi = \alpha\beta'$, where, α and β are both K x r matrices of rank r.

The principle behind this model is that there often exists a long run equilibrium relationship between two economic variables. In the short run, however, there may be disequilibrium. With the error correction mechanism, a proportion of the disequilibrium is corrected in the next period. The error correction process is thus a means to reconcile short-run and long run behaviour.

Table 5.5. Results of Vector Error Correction Estimate

Error Correction: Δ LNASX200

Variables	**Coefficient**	**Std. Error**	**t statistics**
ECT_1	-0.185448	0.08554	2.16792*
ECT_2	-0.048628	0.29120	-0.16699
$\Delta LNASX200_{t-1}$	-0.270975	0.15007	-1.80567**
$\Delta LNCPI_{t-2}$	-3.11.013	1.71113	-1.73679**
$\Delta LNTWI_{t-2}$	-0.461943	0.24580	-1.87938**
$\Delta LNNYSE_{t-1}$	0.452093	0.16632	2.71817*
C	0.060802	0.03053	1.99140*
R-squared	0.280947		
F-statistic	1.888468		
Akaike AIC	-1.873089		
Schwarz SC	-1.395680		

*Denotes significance at the 5 % level
**Denotes significance at the 10 % level

Applying the above formula to proposed equation Eviews yielded the results in Table 5.5. Where $ECT_{i,}$s is the error correction term which comes from the two long run cointegration equations (i.e. residuals). First error term is negative and significant at 5 per cent level which is a good result. Second error correction term is negative but insignificant. ASX200 index lagged by 1 period has negative sign and significant at 10 per cent significant level. CPI lagged by 1 period has a negative relationship contrary to the expectation in the thesis and it is significant at 10 per cent level. This negative relation can be attributed to effect of inflation on interest rate. When interest rates go up stock prices goes down. TWI lagged by 2 periods has a negative sign and significant at 10 per cent level. This negative relationship can be attributed to the demand for Australian commodities. When exchange rate goes up, earnings of mining companies decrease. NYSE index has positive sign and significant at 5 per cent level.

The R^2 value of 0.28 indicates that about 28 per cent of the variation in stock prices is explained by CPI, TWI and NYSE. The remaining 72 per cent is explained by other factors. The F value of 1.88 is insignificant at 5 percent level of significance.

Although there are two cointegration vectors, the VECM based on those cointegration equations did not yield a significant result[11]. Error terms become insignificant and positive. If the VECM based on the cointegration equation is valid then error terms must be negative and significant. Moreover, R^2 is so small and F statistics is insignificant. Therefore, we apply Engel and Granger approach to error correction model in the next section.

5.12. Engle and Granger Two Stage Error Correction Model

The concept of cointegration will be analyzed with an error correction model (ECM). If Y_t and X_t are $I(1)$ process we might estimate an ECM in first differences. The above unit root tests and the cointegration test results also imply that the dynamic modelling of stock prices and macroeconomic variables have a valid error correction representation. It is established that the dynamic structure of the variables can be investigated further by utilizing the error correction model (ECM) suggested by Engle and Granger (1987). Engel and Granger show that cointegration implies the existence of an error correction model of the variables involved. ECM integrates the short and long run information in the modelling process.

The Engle-Granger method has several limitations. First of all, it identifies only a single cointegrating relation, among what might be many such relations. This requires one of the variables, y_{1t} to be identified as first among the variables in $\boldsymbol{y}_t$. This choice, which is usually arbitrary, affects both test results and model estimation.

Another limitation of the Engle-Granger method is that it is a two-step procedure, with one regression to estimate the residual series, and another regression to test for a unit root. Errors in the first estimation are necessarily carried into the second estimation. The estimated,

[11] See appendix E.2

rather than observed, residual series requires entirely new tables of critical values for standard unit root tests.

Finally, the Engle-Granger method estimates cointegrating relations independently of the VEC model in which they play a role. As a result, model estimation also becomes a two-step procedure. In particular, deterministic terms in the VEC model must be estimated conditionally, based on a predetermined estimate of the cointegrating vector.

However, the ECM model estimates provide important information about the short run relationship between stock return and macroeconomic variables while a negative and significant error correction term signifies the speed of adjustment to the long run equilibrium level. As an example, ECM model consider the following equation:

$$\Delta Y_t = \beta_0 + \sum_{j=1}^{k} \beta_j \Delta X_{1t-j} + \sum_{j=1}^{h} \alpha_j \Delta Y_{t-j} + \delta\, U_{t-1} + \varepsilon_t \tag{5.11}$$

Here Y_t is the dependent variable (represents the log of the ASX200 index), and X_t represents the independent variables (log of the macroeconomic variables listed in table 5.1). U_t *is* the one-period lagged value of the estimated error of the cointegrating regression obtained from OLS estimation; this term is called the error correction term. And ϵ_t is the error term. The principle behind this model is that there often exists a long run equilibrium relationship between economic variables. In the short run, however, there may be disequilibrium. With the error correction mechanism, a proportion of the disequilibrium is corrected in the next period. The error correction process is thus a means to reconcile short-run and long run behaviour. Therefore, in the error correction model, the right hand side contains the short-run dynamic coefficients (i.e., α_i, β_i) as well as the long-run coefficient (i.e., δ). The absolute value of δ decides how quickly the equilibrium is restored.

Table 5.6. Specific Error Correction Model Estimate

Dependent Variable: Δ LNASX200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000478	0.007803	0.061297	0.9512
ΔLNRGDP	1.150000	0.564132	2.038529	0.0441
ΔLNLCI	-0.792307	0.315500	-2.511274	0.0136
ΔLNNYSE	0.783311	0.074070	10.57529	0.0000
Ut(-1)	-0.278955	0.070094	-3.979704	0.0001

R-squared	0.567187	Mean dependent var	0.020770
Adjusted R-squared	0.550378	S.D. dependent var	0.093281
S.E. of regression	0.062548	Akaike info criterion	-2.660565
Sum squared resid	0.402966	Schwarz criterion	-2.536392
Log likelihood	148.6705	Hannan-Quinn criter.	-2.610217
F-statistic	33.74445	Durbin-Watson stat	1.884408
Prob(F-statistic)	0.000000		

Note: All variables are in log form, Δ denotes first differences

Applying the above formula to proposed equation Eviews yielded the error correction model results in Table 5.6. Where, U_t is the error correction term which comes from the long run cointegration equation (i.e. residual).

This specific error correction model is estimated using the following steps:

- Identified order of integration applying unit root tests[12].
- Identified the cointegration relationships using the Johanson's maximum likelihood technique.
- Run a cointegration equation using OLS[13].
- Tested residual from this equation for unit roots using ADF, PP and the KPSS tests[14].
- If residual is stationary, stock market index and macroeconomic variables are cointegrated and there is a valid error correction model.

[12] See Appendices A_s B_s and C_s
[13] See appendix E.3
[14] See appendixes E.4, E.5 and E.6

- Estimated the general error correction model[15].
- Dropped insignificant variables one by one, applied different combinations of variables and lags, obtained the specific error correction model[16] given in table 5.6.

These are the most common procedures in the literature. See for example Engle and Granger (1987), Kulendran (1996), Paseran *et al* (2000) and Kazi (2009).

Real GDP has positive sign as expected because higher GDP means higher demand for all goods and services therefore higher profit for the firms. And coefficient of real GDP is significant at 5 percent significance level. LCI has a negative relationship as expected and it is significant at 5 per cent level. This negative relationship can be attributed to effect of labour cost to firm's profitability. When labour cost goes up profit goes down, therefore, share prices go down. NYSE index has positive sign as expected and significant at 5 per cent level. The significance of NYSE implies the effect of overseas economic factors on the Australian stock market. However, this study found that CPI, 10 year bond yield, commodity price index and exchange rate (TWI) were not significant.

The error correction term is highly significant at 1 per cent level of significance and negative indicating the importance of long run relationship between stock market and the macroeconomic variables. It also implies that the system has a tendency to come back to their long run relationship. With the error correction mechanism a proportion of disequilibrium is corrected in the next period. The absolute value of the coefficient of error term (δ) decides how quickly the equilibrium is restored. Results in table 5.6 shows that 27 per cent of the divergence from the long run equilibrium is corrected in the next quarter.

The R^2 means how much independent variables jointly can influence the dependent variable. The R^2 value of 0.56 indicates that about 56 per cent of the variation in stock prices is explained by RGDP, LCI and NYSE. The remaining 44 per cent is explained by other

[15] See appendix E.7
[16] See Appendix E.8

independent factors which are not here. In other words, 0.56 percent of fluctuations in AS200 index can be explained by RGDP, LCI and NYSE. The rest 44 percent fluctuation in ASX200 index can be explained by other variables or residuals.

F statistics talks about joint hypothesis of independent variables that means whether independent variables jointly can influence dependent variables or not. We can say from F statistics whether independent variables jointly can influence dependent variable.

The *F* value of 33.74 and corresponding probability value is statistically significant at 1 per cent level of significance. Here is p value is 0.000 percent which is less than 5 percent so RGDP, LCI and NYSE jointly can influence our dependent variable which is ASX200 index. This shows that the developed model is valid and that these three variables have an effect on the performance of the stock market in Australia.

The Durbin-Watson test for autocorrelation' is a statistic that indicates the likelihood that the deviation (error) values for the regression have a first-order autoregression component. The regression models assume that the error deviations are uncorrelated. Durbin-Watson statistics shows that the model does not have an autocorrelation problem (DW = 1.88).

5.13. Residual Analysis

For a good regression model the residual should be homoscedastic (no heteroscedasticity), not be serially correlated and normally distributed. Although it is not the primary goal of the models, the diagnostics test of residual for autocorrelation, heteroscedasticity and normality tests are carried out to test the significance of the relationship.

The autocorrelation coefficients of the residual were estimated up to order 36. Eviews produces the Ljung-Box Q statistics which can be used to investigate whether there is autocorrelation or not. A high *p*-value indicates that there is no serial correlation, while, a small *p*-value provides evidence that residual is serially correlated. For the residual, the *p*-

values are quite high indicating an absence of serial correlation. The autocorrelation coefficients from 1 to 36 order are not large relative to their standard errors. Therefore we reject the null hypothesis of serial correlation and conclude that residuals are independent[17].

The ARCH LM test statistics for the residual is computed to test the null hypothesis that there is no ARCH in the residuals. Test results show that the ARCH LM test *F*-statistics test (Lagrange multiplier chi-square statistics) supports the presence of ARCH in the residuals[18]. White heteroscedasticity test *F*- statistic to test the null of homoscedasticity (no heteroscedasticity) is rejected as well[19]. Test results show that there is heteroscedasticity in the residuals. However, in cointegration and ECM model ARCH effects is not allowed (Sreedharan 2004). Intention of these model developed is to consider unconditional distributions. Furthermore, the focus of this thesis is the error correction process. However, other approaches can be taken to remove the ARCH effects such as GARCH model.

The normality test statistics is computed to test the null of normality. Jarque-Bera normality test results indicate that residual is not normally distributed. The null of normality is rejected at 5 percent level of significance[20]. This non-normality can be caused by the 1987 stock market crash. After dropping two observations in 1987 normality is restored. Jarque-Bera test statistics shows that residual is normally distributed[21].

5.14. Granger Causality

The objective of this section is to determine the appropriate lag structure and the exogeneity of the macroeconomic variables. Correlation does not necessarily mean causation in any meaningful way. Granger causality approach to the relationship between variables is meaningful than correlation.

[17] See Appendix E.9
[18] See Appendix E.10
[19] See Appendix E.11
[20] See Appendix E.12
[21] See Appendix E.21

Eviews runs the following bivariate regressions for all possible pairs of variables in the model:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{-l} + \epsilon_t$$
$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{-l} + \epsilon_t \qquad (5.\ 12)$$

The reported F-statistics are the Wald statistics for the joint hypothesis for each equation:

$$\beta_1 = \beta_1 = \ldots \beta_1 = 0 \qquad (5.\ 13)$$

The question is that whether x causes y or y causes x? The null hypothesis for first equation is that x does not Granger cause y. and that y does not Granger cause x in the second equation. Alternative hypothesis is that x does Granger cause y for the first equation and y does Granger cause x in the second equation. The null and the alternative hypothesis can be written as in the following for first and second equation of 5.12

H_0: x does not Granger cause y or vice versa

H_1: x does Granger cause y or vice versa

Using Granger causality model we can test whether dependent variable (ASX200) affect independent (macroeconomic) variables or vice versa. We can check it by using Granger causality test results. We can test the null hypothesis using these F statistics. The guideline is that the p value of the F statistics is more than 0.05 we cannot reject the null hypothesis rather we accept null hypothesis. If the p value is less than 0.05 we can reject the null meaning that we accept the alternative hypothesis.

Table 5.7 shows the result of Granger causality F test results for dependent and independent variables one by one for 1 to 4 lag periods.[22] There are seven instances where we can reject the null hypothesis meaning that one variables Granger causes to another at 5 percent level of significance. There are 4 instances where Granger causality runs one way from independent variables to dependent variable. RGDP causes ASX200 index with lag 1

[22] See Appendix E.14-E.17

and 2 and LCI and NYSE causes ASX200 index with lag 1 respectively. And there are 3 instances where Granger causality runs from dependent variables to the independent variable. ASX200 index causes RGDP with lags 2,3 and 4. Since we use quarterly data in this thesis a quarter is long enough to make decision in an efficient market. Therefore Granger causality test result proves that there are 3 endogenous variables with lag 1 which are RGDP, LCI and NYSE.

Table 5.7. Granger Causality F-Statistics for Various Lag Specifications

Dependent Variable/ Independent Variable	Number of Lags 1	2	3	4
DLNASX200/DLNRGDP	4.42*	3.50*	1.95	1.06
DLNRGDP/DLNASX200	1.23	4.86*	2.86*	2.81*
DLNASX200/DLNCPI	1.18	0.82	0.78	0.82
DLNCPI/DLNASX200	0.28	0.08	0.11	0.14
DLNASX200/DLN10YB	0.19	0.23	1.06	0.59
DLN10YB/DLNASX200	0.61	0.33	0.96	0.61
DLNASX200/DLNLCI	4.27*	2.23	0.78	1.10
DLNLCI/DLNASX200	0.05	0.11	0.11	1.10
DLNASX200/DLNCP	1.17	0.56	1.64	0.86
DLNCP/DLNASX200	0.60	0.66	0.87	1.30
DLNASX200/DLNTWI	0.33	2.15	1.00	1.93
DLNTWI/DLNASX200	0.06	0.65	1.48	0.43
DLNASX200/DLNNYSE	5.19*	2.51	1.87	2.29
DLNNYSE/DLNASX200	2.64	1.28	0.48	1.70

* denotes significance at the 5 percent level, LN denotes log of variable and D denotes first differences

Based on the Granger causality test results, Engle and Granger error correction model is estimated with the suggested lags. However, results are not promising. R^2 is very small (0.12) and independent variables are insignificant at 5 percent level of significance[23].

[23] See Appendix E.18

5.15. Semi-strong Efficiency of Macroeconomic Data

As discussed earlier in Chapters 3 and 4, Rational Expectations, EMH, CAPM and the APT are interrelated theories. Moreover, the efficiency of the markets is tested jointly with an equilibrium asset pricing model such as the market model, the CAPM and the APT. This is called '*the joint hypothesis testing*". Almost all of the multifactor assets pricing models developed in the literature are based on the APT. Furthermore, the semi strong form tests of the EMH have been performed by the joint test of the APT using a linear regression model. In this sense, testing the significance of the developed multifactor model implies testing the semi strong efficiency of the Australian stock market using macroeconomic variables.

There are some studies which have used the joint hypothesis method in the literature: examples are Sharpe (1983), and the more detailed survey of such studies given by Fama (1991) and a later study by Groenewold and Kang (1993).

Sharpe (1983), through the use of multivariate autoregressive and transfer function modeling techniques, investigated the relationship between weekly Australian equity returns and a group of domestic and external financial variables. The joint hypothesis of market efficiency and the assumed equity market equilibrium pricing relationship was tested. There seemed to be a strong positive relationship between US equity returns and Australian equity returns. No significant relationship was observed between equity returns and the Eurodollar rate, 90-day Australian commercial bill rate, the US dollar proxied by the deutsche mark/US dollar exchange rate. The joint hypothesis of market efficiency and constancy of equilibrium expected equity returns was strongly rejected.

Groenewold and Kang (1993) used the joint hypothesis methodology and, identified that there are two types of tests of semi-strong efficiency, one using macroeconomic variables such as inflation, the money stock, exchange rates, and the other based on micro data such as company specific announcements, company profitability, dividend, share split and etc.

Furthermore, Groenewold and Kang (1993) cited that there are few macroeconomic tests of the semi-strong EMH for the Australian share market. The results of the studies by Sharpe (1983), Hogan *et al* (1982) and Saunders *et al* (2002) lead to the rejection of the semi-strong form of the EMH.

The EMH suggests that rational investors use all available information and use the best valuation models and theories that explain asset pricing. The most common model of the testing the EMH in the literature is the macro variable model of the APT. If markets are efficient and people expect the future earnings of the firms using the rational expectations hypothesis then the markets should reflect any effects through prices and it is expected that the regression result will be significant.

Null Hypothesis: H_0: No cointegration, so that the macroeconomic variables have no impact on stock returns, implying that the Australian stock market is efficient

Alternative Hypothesis: H1: Cointegration, so that the macroeconomic variables do have an impact on stock returns, implying that the Australian stock market is inefficient

Using publicly available macroeconomic data and based on the Macro Variable Model of the APT this study is tested the semi strong for efficiency of the Australian stock market. The results of the studies in section 5.12 lead to the rejection of the semi-strong form of the EMH. This is because if cointegration is found, then at least one macroeconomic variable can Granger-cause, or forecast, stock returns, indicating that the Australian stock market is not efficient. Since some of the selected macroeconomic variables in this thesis do significantly explain the return on stock market, it can be concluded that the Australian stock market is semi strong form inefficient.

According to Fama (1991), the joint hypothesis testing has a serious problem. Market efficiency is not testable itself; it must be tested jointly with an equilibrium asset pricing model. This means that it can only be tested when information is properly reflected in stock prices in the context of a pricing model that defines the relationship properly. As a result, when anomalous evidence on the behaviour of returns is found, the way it should be split between market inefficiency and a bad model of market equilibrium is ambiguous.

Although the analysis in this section cast doubts on the semi strong efficiency of the Australian stock market, it could be a result of weak model, inconsistent (quarterly) time series data or some other factors rather than macroeconomic factors.

5.16. Summary

A multifactor model of stock market return has been developed in this thesis and it has been tested and in this section using unit roots, cointegration and error correction model. The model is based on macro variable version of the APT. Macroeconomic variables selected by the economically interpretable effects on the stock market return rather than factor loading model.

This study investigates whether stock market and macroeconomic variables are cointegrated. Quarterly stock index and macro economic variables are used in the analysis. All of the series is tested for the existence of unit roots in their autoregressive representations. It is found that each series are integrated at order one – $I(1)$. ASX200 index is tested for the existence of a long run relationship and it is found that stock market index and macroeconomic variables are cointegrated. This thesis found three significant macroeconomic variables to explain stock market return in Australia. They are real GDP, labour cost index and the US stock market. However, this study found that CPI, 10 year bond yield, commodity price index and Trade weighted index are insignificant.

CHAPTER 6

6. SUMMARY AND CONCLUSION

This concluding chapter has three main functions. The first is to present a summary of the evidence which has been set forth throughout the thesis. The second is an attempt to relate the process of stock valuation in answer to the research questions set out in Chapter 1. Finally we will report the major limitations which contributed to the research process are reported upon. As well, recommendations for further research that should yield statistically significant results are provided.

6.1. Summary

The stock market is not a perfectly competitive market. There are some sources of imperfection such as the perfectly inelastic supply curve, transaction costs, taxes and informational inefficiency.

The inelastic supply is one of the sources of the inefficiency of the stock market. The inelastic supply curve suggests that the supply is independent of interest rates (profit). On the other hand, the demand is dependent on interest rates and other macroeconomic variables. Therefore, demand and supply analysis suggests that the demand determines the stock prices in the long run. What determines the demand at the same time determines the stock return. The valuation techniques: NPV, portfolio theory, CAPM, ICAPM and APT, all relate to the demand side of the stock market.

An efficient capital market does not necessarily mean a perfect capital market. There is not any market structure satisfying the conditions of perfect capital markets. However, the financial markets, including the stock market, are very close to perfectly competitive markets, but they fail especially in terms of the information aspect of the perfectly competitive markets.

6.1.1. Validity of EMH

The EMH has been the central proposition of financial economics and it is one of the most contoversial and well-studied propositions. Regardless of whether or not one believes that markets are efficient, the EMH is the right position to start from when studying the financial markets.

A review of the empirical studies suggest that there is still no consensus among economists about the validity of the EMH. Despite many advances in statistical analysis, databases and theoretical models, it is still complicated to resolve the main arguments of the proponents on each side of the debate.

The *weak form* of the EMH claims that all past prices of a stock are reflected in today's stock price. Therefore, technical analysis cannot be used to beat a market. Weak form efficiency advocates assert that fundamental analysis can be used to identify stocks that are undervalued and overvalued. Empirical tests performed in the literature support *the weak-form efficiency* of the EMH. The result in this thesis also support the weak form efficiency.

The *semi strong form* of the EMH implies that all public information is inherent in current share price, meaning that neither fundamental nor technical analysis can be used to achieve superior gains. This class of EMH suggests that only information that is not publicly available can benefit investors seeking to earn abnormal returns on investments. All other information is accounted for in the stock prices and, regardless of the amount of fundamental and technical analysis one performs, can not earn above the normal returns.

There are two different versions of tests of the semi-strong efficiency, put forward in the literature. They are the *microeconomic version* which uses the microeconomic variables, and the *macroeconomic version* which uses macroeconomic variables. Tests of the EMH have been performed together with an asset pricing model such as the market model and the APT. This concept is called the *joint hypothesis theory*. This thesis used the macroeconomic version of the APT to test both the APT and the semi strong efficiency of the Australian stock market. The results of the empirical studies lead to the rejection of the semi-strong form of the EMH. Moreover, the results of this study, presented in this thesis, cast doubt on the validity of the APT and the semi strong form efficiency of the EMH.

There are studies that show institutions like mutual funds and portfolio managers which have access to private information can not persistently beat the market to generate return. They earn the average return on the stock market. This is evidence that the market is *strong form efficient* in terms of private information. However, there is not enough evidence that the market is strong form efficient due to the existence of *insider trading*. Insider traders can beat the market and generate excess return therefore, we can say that markets are strong form inefficient.

There is compelling support for the proposition that the stock market is weak form efficient. However, there are many studies that reject semi-strong market efficiency. Moreover, strong form efficiency is rejected by a number of studies, although insider trading is insignificant given the large volume of money traded in the market place.

The EMH especially fails on the information content and this has attracted much interest in the literature as it is argued that an informationally efficient market is impossible because of the cost of information and the assimilation of information.

In spite of the continuing discussion on the validity of the EMH, the EMH is a useful hypothesis with some deficiencies. However, there is sufficient evidence to justify that EMH is not a universally accepted phenomenon. Although there are successful technical trading strategies, this is not enough to deny the EMH. There is also a rationale for the possible existence of successful trading rules, which is not enough to reject completely the validity of the EMH.

Economics is concerned with the behaviour of people. Investors make decisions on the basis of expected future earnings from a financial asset. Therefore, expectations have an important influence on economic decision making. The EMH, the equilibrium asset pricing models (the CAPM and the APT) and the rational expectations are closely related concepts. Those theories are studied and tested jointly in the literature. Since expectations are the key concept for understanding the economic phenomena they have been incorporated into the investment decision making. Throughout the literature the theory of expectations is incorporated into the EMH and the theory of asset pricing.

6.1.2. Theory of Asset Pricing

The common asset valuation models studied in this thesis are the valuation of shares, portfolio theory, the CAPM, the ICAPM and the APT. These models have been studied to determine the way in which macroeconomic variables affect the stock market return. These common asset valuation models integrate the EMH, rational expectations and the micro and macroeconomic risk factors. The valuation of a single asset is based on the accounting (microeconomic) data. However, portfolio theory is concerned with the valuation of a group of stocks. Equilibrium models, such as the CAPM and APT, deal with the valuation of stocks using macroeconomic variables.

Microeconomic factors have been considered as the sources of unsystematic risk which can be minimized by diversification. On the other hand a macroeconomic variable has been considered as the likely source of the systematic risk, which cannot be eliminated by the simple approach of diversification.

Portfolio theory is the opposite of traditional valuation of the individual stocks. It looks at the stock valuation at the macro level rather than the micro. It has been created by economists to look at the market as a whole. Portfolio theory analyses the market in a broader context in order to understand and manage the *systematic risk* and return. The mathematics and mechanics of portfolio theory are used extensively in financial risk management providing a theoretical base for today's risk management measures.

Portfolio theory analyses how assets can be invested optimally and how risk can be minimized. On the other hand, market equilibrium models, which integrate macroeconomic variables with stock valuation such as the CAPM and the APT, are based on portfolio theory. The extensions of the portfolio theory are the CAPM and the APT.

The CAPM has been the dominant single factor in asset pricing theory, and it is a benchmark valuation model for alternative multifactor models. The assumption underlying this model is that stock prices move together only because of common co-movement with the market. However, many researchers have found that there are influences beyond the market that cause stocks to move together.

The basic CAPM relates only one factor to the value of single assets. It omits variables that are used in pricing assets. The APT allows for a set of factors and is consistent with capital market equilibrium. In the APT the expected return on any asset is a function of several independent factors rather than a single market factor. The APT suggests that return on any security or a portfolio of stocks is dependent on its expected return plus a series of factors on return. Specifically, certain macroeconomic factors determine stock returns together with firm-specific fundamentals such as size, earnings, dividends, and book to market value.

The APT has two different versions: the factor loading model and the macro variable model. These two empirical models are used to implement and test the APT and the EMH using the joint hypothesis theorem. The factor loading model uses artificial variables while the macro variable model uses macroeconomic variables based on the economically interpretable effects. The macro variable version of the APT is the most widely used valuation method. However, both versions of the APT do not provide any guidelines about the factor structure of the stock market return.

6.1.3. Macroeconomic Variables

The logical extension of the portfolio theory, the CAPM and the APT is the identification of the common macroeconomic variables which are the sources of the systematic risk. This thesis has discussed the effects of macroeconomic variables on the stock market return in Australia consistent with the macro variable version of the APT and the semi-strong form efficiency of the EMH.

Macroeconomics integrates the complicated details of the many variables in the economy with a few basic fundamentals and analyses the behaviour of these macroeconomic variables. Markets coordinate the decisions through prices. The major markets that coordinate the macroeconomic activities are: goods and services market (product market), stock market, money market, labour market, natural resources market, foreign exchange market, and foreign markets. Macroeconomic variables used in the developed statistical model represent the effect of these markets.

The stock market return is related to the product market and there are close relationships between the stock market and the product market variables. Although there are many variables in the product market *real GDP* is the overall measure of the economic activity representing the product market. There are many variables related to the product market. Some of those are direct components of GDP or trying to predict the behavior of those variables. However, real GDP is the most cited variable in the literature in explanation of stock return.

Inflation affects many variables including the stock market. The expected relationship between the stock market and inflation is positive because stocks are a claim on real assets and a hedge against inflation. However, contrary to these expectations, the statistical analysis in this paper and the results of the empirical studies show that there is an inverse relationship between inflation and stock prices in Australia.

Empirical studies show that different money market variables (such as the money supply interest rate) are significant in relation to the stock prices. However, following the equilibrium analysis in money markets (i.e. interest rates represents the price), the *10 year bond yield* has been selected as the likely risk factor. Interest rates are a discount factor in the valuation model and also a cost factor of the firms, thus they have both a nominator and denominator effect in the valuation model. As expected, yield on 10 year treasury bonds became a significant variable.

Labour cost represents the biggest item in the firms' costs and therefore there is relationship between the labour market and the stock market. It affects the stock return through the nominator, through the effect on the cost of the firm. There should be a negative relationship between stock return and the labour cost. The wage rate represents the price (which coordinates the decisions) in the labour market. Although there are many variables in the labour market, the labour cost index has emerged as the best measure of the labour cost changes. The labour cost index is compiled by the RBA and it is the preferred measure of the labour cost movements. Contrary to expectations labour cost index is insignificant in relation to the stock market return.

Australia is a commodity producing country. Commodity prices affect all of the companies directly or indirectly. Therefore, the relatioship between stock market and commodity prices has been expected to be strong. Empirical studies have considered the relationship of single commodity prices to the stock market return such as gold and oil. There is not much Australian research analysing the relationship between aggregate commodity prices and the stock market in the context of multifactor models. Effect of commodity prices on the stock market has bee found insignificant in this thesis.

Australian economy is an open economy and at least one of the firms' inputs, output or any other variables is affected by the exchange rate, thus the value of the firm is related to the exchange rate. However, the effect on the return could be different for different firms. Some firms are affected negatively and others positively and some not at all. Overall the net effect of the exchange rate on the stock market as a whole is not significant.

International financial markets are highly integrated. The relationship is significant and well documented in the literature. Overseas economic variables have a direct effect on the Australian stock market through the direct effect on the profitability of the firms rather than the indirect effect through the exchange rate. Empirical studies have investigated the effect of the US macroeconomic variables in the way that they affect the profitability of the Australian firms. The US stock index is used to carry the effect of the US macroeconomic variables on the return of the Australian stock market. As expected there are highly significant relationship between US stock market return and Australian stock market.

6.2. Conclusion

The main objective of this thesis was to investigate and test in which way and to what extent the selected macroeconomic variables affect the stock market return in Australia. The test have been performed by following the price system in the macroeconomic markets and the semi strong efficiency of the EMH, based on the macrovariable version of the APT.

Although there are many events which affect stock market return, based on the APT the main determinants of the stock market return are macroeconomic variables. There are a number of systematic macroeconomic factors affecting the returns on financial assets. A natural extension of the research on the area is to include the macroeconomic variables into portfolio analysis as many empirical studies have done. Moreover, using the aggregation property of the macroeconomics and following the price system in macroeconomics was the missing part, because theories and concepts are giving reference to the market system. In this sense, this paper contributes to the existing body of knowledge by introducing the price system into the macro variable version of the APT, which is the most widely used and economically meaningful valuation model.

Compared to other studies, this thesis examined the relationship in a larger framework considering most of the macrovariables and classifying them into the groups . It developed a complete specification compared to previous studies. Therefore, this has very important implications for further studies to investigate the relationship between stock market and the macroeconomic variables.

This thesis contributed to the literature in the following areas:

- A comprehensive qualitative analysis of relationships between stock returns and macroeconomic factors.
- Through price system, the ways that the macroeconomic variables affect the stock market return have been identified.
- A different set of macroeconomic variables are selected by economically interpretable effects rather than randomly selected variables.
- A comprehensive quantitative analysis has been applied to test the effects of macroeconomic factors on the stock market return.
- The proposed quantitative model has measured the historic relationship between stock market returns and macroeconomic factors.
- The results contributed to the existing body of knowledge of stock pricing.

6.2.1. Research Questions

The objective of this thesis has been stated in th first chapter. The *first question* of this paper was to investigate whether aggregate stock return is affected by the variations in: GDP, inflation, interest rate, wage rate, commodity prices, exchange rate, and US stock index. This objective has been achieved. As proposed these variables do have impact on stock market return. Of these variables, real GDP, labour cost index and the US stock market have a statistically significant effect.. Although the stock prices are affected by these variables, the impact is not one by one. As stated in the literature, there are factors which affect the price movements of individual stocks.

The *second question* to be investigated was whether the return on individual stock determines the return on the market. The CAPM states that there is a market factor affecting individual stocks and portfolios, but directions of the recent empirical studies of the APT or multifactor asset pricing models including this paper suggests that there is no market factor affecting portfolio return. The market factor in the CAPM is actually the combined effect of the common macroeconomic risk factors. As many empirical studies suggest, the market does not have a significant effect on the prices of individual stocks. The influence operates from the opposite side, from stocks to the market index. The essence of this idea is that most of the stocks move together because macroeconomic variables affect the return on all of the stocks. For example, interest rates affect the prices of all individual stocks, portfolios and the all market indexes. This is because the interest rate is a discount factor on the NPV model. In this paper the view was taken that the return on individual stocks determines the stock market return because market index carries the effects of individual stocks.

The *third question* was whether the Australian stock market is weak form efficient. The weak form efficiency of the Australian stock market has been tested using the quarterly data. The return on the ASX200 index is the dependent variable in the proposed equation.

Therefore, the existence of autocorrelation between past time series data using the Box-Pierce and Ljung-Box Q statistics has been studied. The test results suggest that there is not any evidence of autocorrelation. Since there is no autocorrelation of the consecutive return of time series data, it can be concluded that the Australian stock market is weak form efficient. In this sense, this thesis contributed to the existing body of knowledge in this area of the weak form efficiency using quarterly Australian data.

The *fourth question* was whether the Australian stock market is semi-strong efficient. The results of this thesis cast doubts on the semi strong efficiency of the EMH. The EMH, rational expectations and the theory of asset pricing are interrelated topics. Empirical studies show that they are studied and tested jointly. This phenomenon is called as the *joint hypothesis theory*. Any test of efficiency assumes that an equilibrium model defines normal security returns. If efficiency is rejected, this could be because the market is truly inefficient or because an incorrect equilibrium model has been assumed. This *joint hypothesis* problem means that market efficiency can never be rejected. For this reason the EMH can not be rejected based on the analysis in this thesis.

This thesis makes a contribution to the literature on estimation of the models by using a procedure that is consistent with the mainstream theories in this area. The economic variables covering the sample period March 1960 to December 2008 were used in this study. Similar to the earlier findings, evidence has documented supporting the relationship between macroeconomic variables and the stock market return in Australia.

In this thesis the macroeconomic version of the APT is used to jointly test the APT and the semi strong efficiency of the Australian stock market using quarterly data. The results of this thesis cast doubt on the validity of the APT and the semi strong form efficiency of the EMH.

6.2.2. Implications

In this thesis, following the findings in the literature, a multifactor asset pricing model was developed and tested for its efficiency using the most common techniques. As a result of a detailed quantitative analysis (tabular, graphical and statistical), a quantitative model was developed which measured the relationship over time investigating the relationship between the stock market return and the macroeconomic variables. In this sense, the results of the statistical analysis contributed to the existing body of knowledge in the area of stock pricing by using a different set of Australian data.

The proposed model used the real GDP, CPI, interest rate, labour cost, commodity prices, exchange rate and the US stock market as the dependent variables in explaining stock market return in Australia. Although all of the variables have an economically interpretable relationship, the results of statistical analysis demonstrated that the proposed multifactor model did not yield asignificant results as it is demonstrated in chapter 5. These insignificant results can be attributable to the inefficiency of the markets, inappropriate data set and other factors affecting stock market return. However, this thesis found that real GDP, interst rates and the US stock market are significant variables affecting stock market return in Australia.

The findings of the thesis have some valuable implications. It could give some insight about the possible linkages between stock market and the other major markets of the economy. From an empirical perspective, this is perhaps the first paper in the Australian context to apply the market and the price system to examine the relationship between stock price and macroeconomic variables..

6.3. Limitations

This thesis has limitations. Its major limitation is the use of quarterly data as a proxy for economic activity. This situation is of course due to the non-availability of variables such as

GDP and CPI at shorter time intervals. Some variables are available for shorter period (i.e. monthly). In stock market evaluation three months is a very long time, This time limitation therefore contributed to the insignificant results for the explanation of the stock prices. It would have been of interest to use monthly data as such a time scale may have found the relationship significant. Using monthly statistics rather than quarterly will give significant results. There are some monthly variables compatible with quarterly variables. For examples leading indicators, retail trade, motor vehicle registration can be used to represent GDP.

Another limitation is the anavailability of the data measuring the expected value of the variables as the APT is based on the expectations or the expected value of the economic variables. However there are no statistics of expected value of the macroeconomic variables. This is one of the limitations in this thesis.

In this thesis ASX200 index used as the dependent variable. It is important to note that not all of the companies listed on the Australian Stock Exchange make up the SX200 index. On the other hand, the APT is based on the perfectly selected portfolios in terms of the effects of the macroeconomic variables.

APT is more appropriate for the risk management of individual stocks (or industries) rather than portfolio or stock market as a whole. Different firms (industries) has different factor structure as the likely source of risk in terms of the macroeconomic variables. For example banking industry stocks are heavily affected by interest rates because their business is selling money. Similarly oil industry stock are largely affected by crude oil prices. The summary of the empirical literature and the findings of this thesis suggests that several different variables are potentially important in explaining the return on different stocks.

6.4. Further Research Implications

In this paper the ASX200 index was used as the dependent variable. However, this index is the average of the 200 stocks only. It would be recommended to set up different portfolios of stocks which have exposure to the selected macroeconomic variables and investigate the relationship following the direction and the methodology of this thesis. It is expected that it will produce a significant result.

The factor analysis techniques has been widely used in testing the APT. This method can be used to select the most significant variables representing the effect of one group of variables. For example, the are many variables in the money market (money supply, cash rate 90 day bill 10 year bonds etc), showing similar effect on the stock prices. Using the factor analysis technique, the selected variables is expected to explain stock return significantly.

In this thesis actual past data used for statistical analysis. However the APT theory is based on the expected variables. It could be another research topic to transform the actul past data to the expected form and estimate the relationship. Expected variables may be measured in several ways. One of the ways of obtaining expected data from one-period-ahead forecasts of the time-series regression of the current data set on past data set with an appropriate lags.

This thesis studied the relationship with the framework of the EMH and the Rational Expectations Hypothesis, However it can be extended into the context of other theries in economics such an option framework, life cycle hypothesis: international arbitrage theory. Moreover, putting this relationship over the much longer time period could yield a significant result.

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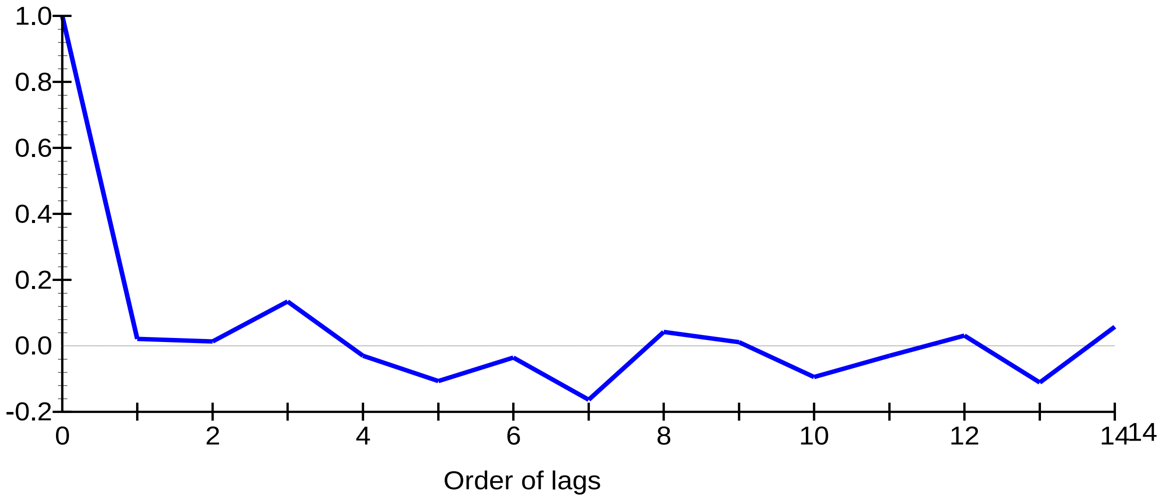
APPENDIXES

Appendix A. Autocorrelation Function

```
Sample period     :1960Q2 to 2008Q4
 Variable(s)       :  RASX200
 Maximum           :     .26157
 Minimum           :   -.53291
 Mean              :   .014627
 Std. Deviation    :   .095428
 Skewness          :   -1.3550
 Kurtosis - 3      :    5.9155
 Coef of Variation:     6.5239
```

```
          Variable RASX200             Sample from 1960Q2 to 2008Q4
****************************************************************************
     Order   Autocorrelation     Standard   Box-Pierce     Ljung-Box
               Coefficient        Error     Statistic      Statistic
****************************************************************************
       1        .021084         .071611     .086683[.768]   .088024[.767]
       2        .013568         .071643      .12258[.941]    .12467[.940]
       3         .13413         .071656      3.6309[.304]    3.7243[.293]
       4       -.029563         .072933      3.8013[.434]    3.9001[.420]
       5        -.10636         .072994      6.0072[.306]    6.1873[.288]
       6       -.035317         .073785      6.2504[.396]    6.4408[.376]
       7        -.16361         .073871     11.4703[.119]   11.9106[.104]
       8        .041859         .075707     11.8120[.160]   12.2705[.140]
       9        .011201         .075825     11.8365[.223]   12.2965[.197]
      10       -.094690         .075834     13.5849[.193]   14.1583[.166]
      11       -.030503         .076438     13.7663[.246]   14.3525[.214]
      12        .031044         .076500     13.9542[.304]   14.5548[.267]
      13        -.11067         .076565     16.3425[.231]   17.1399[.193]
      14        .058006         .077381     16.9986[.256]   17.8540[.214]
```

Autocorrelation function of RASX200, sample from 1960Q2 to 2008Q4



Appendix B: Augmented Dickey-Fuller Unit Roots Tests

B.1. ADF Unit Roots Test on LOGASX200

Null Hypothesis: LNASX200 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.183194	0.0933
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNASX200)
Method: Least Squares
Date: 01/16/10 Time: 19:10
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNASX200(-1)	-0.147262	0.046262	-3.183194	0.0019
C	1.021563	0.308852	3.307611	0.0013
@TREND(1982Q3)	0.002375	0.000900	2.638911	0.0096

R-squared	0.100771	Mean dependent var	0.020770
Adjusted R-squared	0.083643	S.D. dependent var	0.093281
S.E. of regression	0.089294	Akaike info criterion	-1.966371
Sum squared resid	0.837217	Schwarz criterion	-1.891867
Log likelihood	109.1840	Hannan-Quinn criter.	-1.936163
F-statistic	5.883350	Durbin-Watson stat	1.941098
Prob(F-statistic)	0.003786		

B.2. ADF Unit Roots Test on First Differences of LOGASX200

Null Hypothesis: D(LNASX200) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.37683	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNASX200,2)
Method: Least Squares
Date: 01/16/10 Time: 19:14
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNASX200(-1))	-1.025104	0.098788	-10.37683	0.0000
C	0.021787	0.009282	2.347337	0.0208

R-squared	0.506297	Mean dependent var	0.002039
Adjusted R-squared	0.501595	S.D. dependent var	0.133106
S.E. of regression	0.093970	Akaike info criterion	-1.873175
Sum squared resid	0.927181	Schwarz criterion	-1.823216
Log likelihood	102.2149	Hannan-Quinn criter.	-1.852922
F-statistic	107.6785	Durbin-Watson stat	1.964781
Prob(F-statistic)	0.000000		

B.3. ADF Unit Roots Test on LOGRGDP

Null Hypothesis: LNRGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.470193	0.3422
Test critical values:	1% level	-4.046072	
	5% level	-3.452358	
	10% level	-3.151673	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRGDP)
Method: Least Squares
Date: 01/16/10 Time: 19:16
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRGDP(-1)	-0.067989	0.027524	-2.470193	0.0151
D(LNRGDP(-1))	0.426190	0.088904	4.793812	0.0000
C	0.768128	0.308959	2.486184	0.0145
@TREND(1982Q3)	0.000522	0.000215	2.425144	0.0170

R-squared	0.202205	Mean dependent var	0.007742
Adjusted R-squared	0.178968	S.D. dependent var	0.010626
S.E. of regression	0.009628	Akaike info criterion	-6.411525
Sum squared resid	0.009549	Schwarz criterion	-6.311606
Log likelihood	347.0166	Hannan-Quinn criter.	-6.371019
F-statistic	8.701931	Durbin-Watson stat	2.043304
Prob(F-statistic)	0.000034		

B.4. ADF Unit Roots Test on First Differences of LOGRGDP

Null Hypothesis: D(LNRGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.808797	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRGDP,2)
Method: Least Squares
Date: 01/16/10 Time: 19:18
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDP(-1))	-0.608271	0.089336	-6.808797	0.0000
C	0.004719	0.001173	4.023640	0.0001

R-squared	0.306288	Mean dependent var	2.59E-05
Adjusted R-squared	0.299682	S.D. dependent var	0.011729
S.E. of regression	0.009816	Akaike info criterion	-6.391157
Sum squared resid	0.010116	Schwarz criterion	-6.341198
Log likelihood	343.9269	Hannan-Quinn criter.	-6.370904
F-statistic	46.35972	Durbin-Watson stat	1.995298
Prob(F-statistic)	0.000000		

B.5. ADF Unit Roots Test on LOGCPI

Null Hypothesis: LNCPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.395473	0.3798
Test critical values:	1% level	-4.046072	
	5% level	-3.452358	
	10% level	-3.151673	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCPI)
Method: Least Squares
Date: 01/16/10 Time: 20:14
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCPI(-1)	-0.023169	0.009672	-2.395473	0.0184
D(LNCPI(-1))	0.362005	0.088537	4.088722	0.0001
C	0.108135	0.041402	2.611839	0.0104
@TREND(1982Q3)	0.000131	8.40E-05	1.558222	0.1222

R-squared	0.364653	Mean dependent var	0.009609
Adjusted R-squared	0.346147	S.D. dependent var	0.008004
S.E. of regression	0.006472	Akaike info criterion	-7.206011
Sum squared resid	0.004314	Schwarz criterion	-7.106092
Log likelihood	389.5216	Hannan-Quinn criter.	-7.165506
F-statistic	19.70535	Durbin-Watson stat	2.129136
Prob(F-statistic)	0.000000		

B.6. ADF Unit Roots Test on First Differences of LOGCPI

Null Hypothesis: D(LNCPI) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.057421	0.0017
Test critical values:	1% level	-3.493129	
	5% level	-2.888932	
	10% level	-2.581453	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCPI,2)
Method: Least Squares
Date: 01/16/10 Time: 20:16
Sample (adjusted): 1983Q2 2009Q3
Included observations: 106 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCPI(-1))	-0.368129	0.090730	-4.057421	0.0001
D(LNCPI(-1),2)	-0.261998	0.092704	-2.826186	0.0057
C	0.003368	0.001091	3.085629	0.0026

R-squared	0.302876	Mean dependent var	-0.000111
Adjusted R-squared	0.289339	S.D. dependent var	0.007855
S.E. of regression	0.006621	Akaike info criterion	-7.169098
Sum squared resid	0.004516	Schwarz criterion	-7.093718
Log likelihood	382.9622	Hannan-Quinn criter.	-7.138546
F-statistic	22.37493	Durbin-Watson stat	2.074556
Prob(F-statistic)	0.000000		

B.7. ADF Unit Roots Test on LN10YB

Null Hypothesis: LN10YB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.782221	0.2071
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LN10YB)
Method: Least Squares
Date: 01/16/10 Time: 20:22
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN10YB (-1)	-0.145318	0.052231	-2.782221	0.0064
C	0.804684	0.295033	2.727437	0.0075
@TREND(1982Q3)	-0.001570	0.000646	-2.429989	0.0168

R-squared	0.070096	Mean dependent var	-0.009660
Adjusted R-squared	0.052384	S.D. dependent var	0.079592
S.E. of regression	0.077479	Akaike info criterion	-2.250233
Sum squared resid	0.630316	Schwarz criterion	-2.175729
Log likelihood	124.5126	Hannan-Quinn criter.	-2.220024
F-statistic	3.957465	Durbin-Watson stat	1.738451
Prob(F-statistic)	0.022029		

B.8. ADF Unit Roots Test on First Differences of LN10YB

Null Hypothesis: D(LN10YB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.666756	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LN10YB,2)
Method: Least Squares
Date: 01/16/10 Time: 20:24
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LN10YB (-1))	-0.938132	0.097047	-9.666756	0.0000
C	-0.008395	0.007776	-1.079585	0.2828

R-squared	0.470889	Mean dependent var	0.000493
Adjusted R-squared	0.465850	S.D. dependent var	0.109291
S.E. of regression	0.079876	Akaike info criterion	-2.198166
Sum squared resid	0.669920	Schwarz criterion	-2.148207
Log likelihood	119.6019	Hannan-Quinn criter.	-2.177913
F-statistic	93.44617	Durbin-Watson stat	1.962462
Prob(F-statistic)	0.000000		

B.9. ADF Unit Roots Test on LOGLCI

Null Hypothesis: LNLCI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.989427	0.6002
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNLCI)
Method: Least Squares
Date: 01/16/10 Time: 20:46
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLCI(-1)	-0.071187	0.035782	-1.989427	0.0493
C	0.290924	0.142639	2.039578	0.0439
@TREND(1982Q3)	0.000434	0.000230	1.885622	0.0621

R-squared	0.037012	Mean dependent var	0.006479
Adjusted R-squared	0.018669	S.D. dependent var	0.015909
S.E. of regression	0.015760	Akaike info criterion	-5.435271
Sum squared resid	0.026080	Schwarz criterion	-5.360767
Log likelihood	296.5046	Hannan-Quinn criter.	-5.405062
F-statistic	2.017809	Durbin-Watson stat	2.152901
Prob(F-statistic)	0.138069		

B.10. ADF Unit Roots Test on First Differences of LOGLCI

Null Hypothesis: D(LNLCI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.51620	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNLCI,2)
Method: Least Squares
Date: 01/16/10 Time: 20:43
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLCI(-1))	-1.115672	0.096878	-11.51620	0.0000
C	0.007156	0.001665	4.297019	0.0000

R-squared	0.558123	Mean dependent var	-0.000140
Adjusted R-squared	0.553915	S.D. dependent var	0.023852
S.E. of regression	0.015931	Akaike info criterion	-5.422628
Sum squared resid	0.026648	Schwarz criterion	-5.372669
Log likelihood	292.1106	Hannan-Quinn criter.	-5.402375
F-statistic	132.6229	Durbin-Watson stat	2.010140
Prob(F-statistic)	0.000000		

B.11. ADF Unit Roots Test on LOGCP

Null Hypothesis: LNCP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.530414	0.3132
Test critical values:	1% level	-4.046072	
	5% level	-3.452358	
	10% level	-3.151673	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCP)
Method: Least Squares
Date: 01/17/10 Time: 11:35
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCP(-1)	-0.089427	0.035341	-2.530414	0.0129
D(LNCP(-1))	0.292010	0.094723	3.082769	0.0026
C	0.302255	0.118606	2.548399	0.0123
@TREND(1982Q3)	0.000708	0.000319	2.222046	0.0285

R-squared	0.115978	Mean dependent var	0.008184
Adjusted R-squared	0.090230	S.D. dependent var	0.061038
S.E. of regression	0.058219	Akaike info criterion	-2.812528
Sum squared resid	0.349119	Schwarz criterion	-2.712609
Log likelihood	154.4702	Hannan-Quinn criter.	-2.772022
F-statistic	4.504305	Durbin-Watson stat	1.983708
Prob(F-statistic)	0.005191		

B.12. ADF Unit Roots Test on First Differences of LOGCP

Null Hypothesis: D(LNCP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.957084	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCP,2)
Method: Least Squares
Date: 01/17/10 Time: 11:36
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCP(-1))	-0.753771	0.094730	-7.957084	0.0000
C	0.006117	0.005802	1.054309	0.2942

R-squared	0.376170	Mean dependent var	-0.000213
Adjusted R-squared	0.370229	S.D. dependent var	0.074908
S.E. of regression	0.059446	Akaike info criterion	-2.788998
Sum squared resid	0.371046	Schwarz criterion	-2.739038
Log likelihood	151.2114	Hannan-Quinn criter.	-2.768745
F-statistic	63.31519	Durbin-Watson stat	1.955345
Prob(F-statistic)	0.000000		

B.13. ADF Unit Roots Test on LOGTWI

Null Hypothesis: LNTWI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.473347	0.3406
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTWI)
Method: Least Squares
Date: 01/17/10 Time: 11:40
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTWI(-1)	-0.093013	0.037606	-2.473347	0.0150
C	0.369764	0.156045	2.369600	0.0196
@TREND(1982Q3)	0.000152	0.000161	0.945988	0.3463

R-squared	0.075958	Mean dependent var	-0.001911
Adjusted R-squared	0.058357	S.D. dependent var	0.052215
S.E. of regression	0.050669	Akaike info criterion	-3.099634
Sum squared resid	0.269568	Schwarz criterion	-3.025131
Log likelihood	170.3803	Hannan-Quinn criter.	-3.069426
F-statistic	4.315615	Durbin-Watson stat	1.902541
Prob(F-statistic)	0.015806		

B.14. ADF Unit Roots Test on First Differences of LOGTWI

Null Hypothesis: D(LNTWI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.880262	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTWI,2)
Method: Least Squares
Date: 01/17/10 Time: 11:41
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTWI(-1))	-0.968812	0.098055	-9.880262	0.0000
C	-0.001808	0.005099	-0.354635	0.7236

R-squared	0.481787	Mean dependent var	0.000540
Adjusted R-squared	0.476852	S.D. dependent var	0.072839
S.E. of regression	0.052684	Akaike info criterion	-3.030498
Sum squared resid	0.291438	Schwarz criterion	-2.980538
Log likelihood	164.1316	Hannan-Quinn criter.	-3.010245
F-statistic	97.61957	Durbin-Watson stat	1.956126
Prob(F-statistic)	0.000000		

B.15. ADF Unit Roots Test on LOGSP500

Null Hypothesis: LNSP500 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.192716	0.9066
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNSP500)
Method: Least Squares
Date: 01/17/10 Time: 11:44
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSP500(-1)	-0.037496	0.031437	-1.192716	0.2357
C	0.194706	0.124775	1.560461	0.1217
@TREND(1982Q3)	0.000343	0.000748	0.458305	0.6477

R-squared	0.047200	Mean dependent var	0.020105
Adjusted R-squared	0.029051	S.D. dependent var	0.083825
S.E. of regression	0.082599	Akaike info criterion	-2.122264
Sum squared resid	0.716365	Schwarz criterion	-2.047761
Log likelihood	117.6023	Hannan-Quinn criter.	-2.092056
F-statistic	2.600752	Durbin-Watson stat	1.791131
Prob(F-statistic)	0.078994		

B.16. ADF Unit Roots Test on First Differences of LOGSP500

Null Hypothesis: D(LNSP500) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.347920	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNSP500,2)
Method: Least Squares
Date: 01/17/10 Time: 11:45
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNSP500(-1))	-0.905823	0.096901	-9.347920	0.0000
C	0.017060	0.008252	2.067323	0.0412

R-squared	0.454215	Mean dependent var	-0.000140
Adjusted R-squared	0.449017	S.D. dependent var	0.112105
S.E. of regression	0.083213	Akaike info criterion	-2.116302
Sum squared resid	0.727069	Schwarz criterion	-2.066343
Log likelihood	115.2222	Hannan-Quinn criter.	-2.096049
F-statistic	87.38360	Durbin-Watson stat	2.001860
Prob(F-statistic)	0.000000		

Appendix C: Philips Perron (PP) Unit Roots Tests

C.1. PP Unit Roots Test on LOGASX200

Null Hypothesis: LNASX200 has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.233126	0.0835
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.007752
HAC corrected variance (Bartlett kernel)	0.008197

Phillips-Perron Test Equation
Dependent Variable: D(LNASX200)
Method: Least Squares
Date: 02/22/10 Time: 11:49
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNASX200(-1)	-0.147262	0.046262	-3.183194	0.0019
C	1.021563	0.308852	3.307611	0.0013
@TREND(1982Q3)	0.002375	0.000900	2.638911	0.0096

R-squared	0.100771	Mean dependent var	0.020770
Adjusted R-squared	0.083643	S.D. dependent var	0.093281
S.E. of regression	0.089294	Akaike info criterion	-1.966371
Sum squared resid	0.837217	Schwarz criterion	-1.891867
Log likelihood	109.1840	Hannan-Quinn criter.	-1.936163
F-statistic	5.883350	Durbin-Watson stat	1.941098
Prob(F-statistic)	0.003786		

C.2. PP Unit Roots Test on First Differences of LOGASX200

Null Hypothesis: D(LNASX200) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.37716	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.008665
HAC corrected variance (Bartlett kernel)	0.008718

Phillips-Perron Test Equation
Dependent Variable: D(LNASX200,2)
Method: Least Squares
Date: 02/22/10 Time: 11:51
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNASX200(-1))	-1.025104	0.098788	-10.37683	0.0000
C	0.021787	0.009282	2.347337	0.0208

R-squared	0.506297	Mean dependent var	0.002039
Adjusted R-squared	0.501595	S.D. dependent var	0.133106
S.E. of regression	0.093970	Akaike info criterion	-1.873175
Sum squared resid	0.927181	Schwarz criterion	-1.823216
Log likelihood	102.2149	Hannan-Quinn criter.	-1.852922
F-statistic	107.6785	Durbin-Watson stat	1.964781
Prob(F-statistic)	0.000000		

C.3. PP Unit Roots Test on LOGRGDP

Null Hypothesis: LNRGDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.014153	0.5868
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000126
HAC corrected variance (Bartlett kernel)	0.000186

Phillips-Perron Test Equation
Dependent Variable: D(LNRGDP)
Method: Least Squares
Date: 02/22/10 Time: 11:52
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRGDP(-1)	-0.050801	0.030116	-1.686814	0.0946
C	0.578054	0.338815	1.706104	0.0909
@TREND(1982Q3)	0.000424	0.000241	1.764146	0.0806

R-squared	0.030217	Mean dependent var	0.007799
Adjusted R-squared	0.011745	S.D. dependent var	0.011459
S.E. of regression	0.011391	Akaike info criterion	-6.084584
Sum squared resid	0.013624	Schwarz criterion	-6.010081
Log likelihood	331.5676	Hannan-Quinn criter.	-6.054376
F-statistic	1.635848	Durbin-Watson stat	1.344262
Prob(F-statistic)	0.199712		

C.4. PP Unit Roots Test on First Differences of LOGRGDP

Null Hypothesis: D(LNRGDP) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.567762	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000116
HAC corrected variance (Bartlett kernel)	0.000107

Phillips-Perron Test Equation
Dependent Variable: D(LNRGDP,2)
Method: Least Squares
Date: 02/22/10 Time: 11:53
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDP(-1))	-0.702276	0.091872	-7.644072	0.0000
C	0.005645	0.001275	4.426670	0.0000

R-squared	0.357530	Mean dependent var	0.000111
Adjusted R-squared	0.351412	S.D. dependent var	0.013485
S.E. of regression	0.010860	Akaike info criterion	-6.188949
Sum squared resid	0.012384	Schwarz criterion	-6.138989
Log likelihood	333.1088	Hannan-Quinn criter.	-6.168696
F-statistic	58.43184	Durbin-Watson stat	2.015457
Prob(F-statistic)	0.000000		

C.5. PP Unit Roots Test on LOGCPI

Null Hypothesis: LNLCI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.266524	0.4481
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000356
HAC corrected variance (Bartlett kernel)	0.000332

Phillips-Perron Test Equation
Dependent Variable: D(LNLCI)
Method: Least Squares
Date: 02/22/10 Time: 11:55
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLCI(-1)	-0.101502	0.043287	-2.344896	0.0209
C	0.405168	0.170568	2.375408	0.0193
@TREND(1982Q3)	0.000651	0.000275	2.364237	0.0199

R-squared	0.050782	Mean dependent var	0.006409
Adjusted R-squared	0.032701	S.D. dependent var	0.019468
S.E. of regression	0.019147	Akaike info criterion	-5.045938
Sum squared resid	0.038495	Schwarz criterion	-4.971434
Log likelihood	275.4806	Hannan-Quinn criter.	-5.015729
F-statistic	2.808674	Durbin-Watson stat	2.129254
Prob(F-statistic)	0.064821		

C.6. PP Unit Roots Test on First Differences of LOGCPI

Null Hypothesis: D(LNLCI) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-11.62255	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000372
HAC corrected variance (Bartlett kernel)	0.000354

Phillips-Perron Test Equation
Dependent Variable: D(LNLCI,2)
Method: Least Squares
Date: 02/22/10 Time: 11:56
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLCI(-1))	-1.121737	0.096825	-11.58525	0.0000
C	0.007079	0.001980	3.575109	0.0005

R-squared	0.561070	Mean dependent var	-1.53E-05
Adjusted R-squared	0.556889	S.D. dependent var	0.029262
S.E. of regression	0.019479	Akaike info criterion	-5.020480
Sum squared resid	0.039839	Schwarz criterion	-4.970520
Log likelihood	270.5957	Hannan-Quinn criter.	-5.000227
F-statistic	134.2179	Durbin-Watson stat	2.019384
Prob(F-statistic)	0.000000		

C.7. PP Unit Roots Test on LN10YB

Null Hypothesis: LN10YB has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.901142	0.1664
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.005836
HAC corrected variance (Bartlett kernel)	0.006346

Phillips-Perron Test Equation
Dependent Variable: D(LN10YB)
Method: Least Squares
Date: 02/22/10 Time: 11:57
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN10YB (-1)	-0.145318	0.052231	-2.782221	0.0064
C	0.804684	0.295033	2.727437	0.0075
@TREND(1982Q3)	-0.001570	0.000646	-2.429989	0.0168

R-squared	0.070096	Mean dependent var	-0.009660
Adjusted R-squared	0.052384	S.D. dependent var	0.079592
S.E. of regression	0.077479	Akaike info criterion	-2.250233
Sum squared resid	0.630316	Schwarz criterion	-2.175729
Log likelihood	124.5126	Hannan-Quinn criter.	-2.220024
F-statistic	3.957465	Durbin-Watson stat	1.738451
Prob(F-statistic)	0.022029		

C.8. PP Unit Roots Test on First Differences of LN10YB

Null Hypothesis: D(LN10YB) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.939722	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006261
HAC corrected variance (Bartlett kernel)	0.003368

Phillips-Perron Test Equation
Dependent Variable: D(LN10YB,2)
Method: Least Squares
Date: 02/22/10 Time: 11:58
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LN10YB (-1))	-0.938132	0.097047	-9.666756	0.0000
C	-0.008395	0.007776	-1.079585	0.2828

R-squared	0.470889	Mean dependent var	0.000493
Adjusted R-squared	0.465850	S.D. dependent var	0.109291
S.E. of regression	0.079876	Akaike info criterion	-2.198166
Sum squared resid	0.669920	Schwarz criterion	-2.148207
Log likelihood	119.6019	Hannan-Quinn criter.	-2.177913
F-statistic	93.44617	Durbin-Watson stat	1.962462
Prob(F-statistic)	0.000000		

C.9. PP Unit Roots Test on LOGLCI

Null Hypothesis: LNLCI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.266524	0.4481
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000356
HAC corrected variance (Bartlett kernel)	0.000332

Phillips-Perron Test Equation
Dependent Variable: D(LNLCI)
Method: Least Squares
Date: 02/22/10 Time: 12:01
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLCI(-1)	-0.101502	0.043287	-2.344896	0.0209
C	0.405168	0.170568	2.375408	0.0193
@TREND(1982Q3)	0.000651	0.000275	2.364237	0.0199

R-squared	0.050782	Mean dependent var	0.006409
Adjusted R-squared	0.032701	S.D. dependent var	0.019468
S.E. of regression	0.019147	Akaike info criterion	-5.045938
Sum squared resid	0.038495	Schwarz criterion	-4.971434
Log likelihood	275.4806	Hannan-Quinn criter.	-5.015729
F-statistic	2.808674	Durbin-Watson stat	2.129254
Prob(F-statistic)	0.064821		

C.10. PP Unit Roots Test on First Differences of LOGLCI

Null Hypothesis: D(LNLCI) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-11.62255	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000372
HAC corrected variance (Bartlett kernel)	0.000354

Phillips-Perron Test Equation
Dependent Variable: D(LNLCI,2)
Method: Least Squares
Date: 02/22/10 Time: 12:02
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLCI(-1))	-1.121737	0.096825	-11.58525	0.0000
C	0.007079	0.001980	3.575109	0.0005

R-squared	0.561070	Mean dependent var	-1.53E-05
Adjusted R-squared	0.556889	S.D. dependent var	0.029262
S.E. of regression	0.019479	Akaike info criterion	-5.020480
Sum squared resid	0.039839	Schwarz criterion	-4.970520
Log likelihood	270.5957	Hannan-Quinn criter.	-5.000227
F-statistic	134.2179	Durbin-Watson stat	2.019384
Prob(F-statistic)	0.000000		

C.11. PP Unit Roots Test on LOGCP

Null Hypothesis: LNCP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.994629	0.5974
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003467
HAC corrected variance (Bartlett kernel)	0.003909

Phillips-Perron Test Equation
Dependent Variable: D(LNCP)
Method: Least Squares
Date: 02/22/10 Time: 12:04
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCP(-1)	-0.066654	0.035512	-1.876961	0.0633
C	0.226682	0.119256	1.900795	0.0601
@TREND(1982Q3)	0.000572	0.000322	1.777862	0.0783

R-squared	0.034014	Mean dependent var	0.008092
Adjusted R-squared	0.015614	S.D. dependent var	0.060188
S.E. of regression	0.059716	Akaike info criterion	-2.771050
Sum squared resid	0.374430	Schwarz criterion	-2.696547
Log likelihood	152.6367	Hannan-Quinn criter.	-2.740842
F-statistic	1.848618	Durbin-Watson stat	1.444032
Prob(F-statistic)	0.162543		

C.12. PP Unit Roots Test on First Differences of LOGCP

Null Hypothesis: D(LNCP) has a unit root
Exogenous: Constant
Bandwidth: 14 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.597435	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003389
HAC corrected variance (Bartlett kernel)	0.001730

Phillips-Perron Test Equation
Dependent Variable: D(LNCP,2)
Method: Least Squares
Date: 02/22/10 Time: 12:05
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCP(-1))	-0.746321	0.094662	-7.884064	0.0000
C	0.006052	0.005738	1.054613	0.2940

R-squared	0.371854	Mean dependent var	-0.000313
Adjusted R-squared	0.365871	S.D. dependent var	0.073799
S.E. of regression	0.058768	Akaike info criterion	-2.811925
Sum squared resid	0.362636	Schwarz criterion	-2.761966
Log likelihood	152.4380	Hannan-Quinn criter.	-2.791672
F-statistic	62.15847	Durbin-Watson stat	1.957353
Prob(F-statistic)	0.000000		

C.13. PP Unit Roots Test on LOGTWI

Null Hypothesis: LNTWI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.391113	0.3821
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002496
HAC corrected variance (Bartlett kernel)	0.002231

Phillips-Perron Test Equation
Dependent Variable: D(LNTWI)
Method: Least Squares
Date: 02/22/10 Time: 12:09
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTWI(-1)	-0.093013	0.037606	-2.473347	0.0150
C	0.369764	0.156045	2.369600	0.0196
@TREND(1982Q3)	0.000152	0.000161	0.945988	0.3463

R-squared	0.075958	Mean dependent var	-0.001911
Adjusted R-squared	0.058357	S.D. dependent var	0.052215
S.E. of regression	0.050669	Akaike info criterion	-3.099634
Sum squared resid	0.269568	Schwarz criterion	-3.025131
Log likelihood	170.3803	Hannan-Quinn criter.	-3.069426
F-statistic	4.315615	Durbin-Watson stat	1.902541
Prob(F-statistic)	0.015806		

C.14. PP Unit Roots Test on First Differences of LOGTWI

Null Hypothesis: D(LNTWI) has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.888287	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002724
HAC corrected variance (Bartlett kernel)	0.002152

Phillips-Perron Test Equation
Dependent Variable: D(LNTWI,2)
Method: Least Squares
Date: 02/22/10 Time: 12:10
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTWI(-1))	-0.968812	0.098055	-9.880262	0.0000
C	-0.001808	0.005099	-0.354635	0.7236

R-squared	0.481787	Mean dependent var	0.000540
Adjusted R-squared	0.476852	S.D. dependent var	0.072839
S.E. of regression	0.052684	Akaike info criterion	-3.030498
Sum squared resid	0.291438	Schwarz criterion	-2.980538
Log likelihood	164.1316	Hannan-Quinn criter.	-3.010245
F-statistic	97.61957	Durbin-Watson stat	1.956126
Prob(F-statistic)	0.000000		

C.15. PP Unit Roots Test on LOGSP500

Null Hypothesis: LNNYSE has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.918804	0.6379
Test critical values:	1% level	-4.045236	
	5% level	-3.451959	
	10% level	-3.151440	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006349
HAC corrected variance (Bartlett kernel)	0.007409

Phillips-Perron Test Equation
Dependent Variable: D(LNNYSE)
Method: Least Squares
Date: 02/22/10 Time: 12:13
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNNYSE(-1)	-0.067890	0.039419	-1.722277	0.0880
C	0.219206	0.103511	2.117703	0.0366
@TREND(1982Q3)	0.001105	0.000915	1.207406	0.2300

R-squared	0.051368	Mean dependent var	0.020566
Adjusted R-squared	0.033299	S.D. dependent var	0.082190
S.E. of regression	0.080810	Akaike info criterion	-2.166048
Sum squared resid	0.685677	Schwarz criterion	-2.091544
Log likelihood	119.9666	Hannan-Quinn criter.	-2.135839
F-statistic	2.842854	Durbin-Watson stat	1.710357
Prob(F-statistic)	0.062753		

C.16. PP Unit Roots Test on First Differences of LOGSP500

Null Hypothesis: D(LNNYSE) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.109064	0.0000
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006536
HAC corrected variance (Bartlett kernel)	0.006254

Phillips-Perron Test Equation
Dependent Variable: D(LNNYSE,2)
Method: Least Squares
Date: 02/22/10 Time: 12:14
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNNYSE(-1))	-0.884609	0.096871	-9.131861	0.0000
C	0.017214	0.008113	2.121844	0.0362

R-squared	0.442648	Mean dependent var	-3.90E-05
Adjusted R-squared	0.437340	S.D. dependent var	0.108798
S.E. of regression	0.081610	Akaike info criterion	-2.155210
Sum squared resid	0.699324	Schwarz criterion	-2.105250
Log likelihood	117.3037	Hannan-Quinn criter.	-2.134957
F-statistic	83.39089	Durbin-Watson stat	1.988786
Prob(F-statistic)	0.000000		

Appendix D: KPSS Unit Roots Tests

D.1. KPSS Unit Roots Test on LOGASX200

Null Hypothesis: LNASX200 is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.100425
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.034607
HAC corrected variance (Bartlett kernel)	0.173260

KPSS Test Equation
Dependent Variable: LNASX200
Method: Least Squares
Date: 02/22/10 Time: 12:18
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.688051	0.035722	187.2235	0.0000
@TREND(1982Q3)	0.018412	0.000572	32.21357	0.0000

R-squared	0.906527	Mean dependent var	7.682324
Adjusted R-squared	0.905653	S.D. dependent var	0.611280
S.E. of regression	0.187760	Akaike info criterion	-0.489123
Sum squared resid	3.772172	Schwarz criterion	-0.439740
Log likelihood	28.65718	Hannan-Quinn criter.	-0.469096
F-statistic	1037.714	Durbin-Watson stat	0.246977
Prob(F-statistic)	0.000000		

D.2. KPSS Unit Roots Test on First Differences of LOGASX200

Null Hypothesis: D(LNASX200) is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.188207
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.008621
HAC corrected variance (Bartlett kernel)	0.007707

KPSS Test Equation
Dependent Variable: D(LNASX200)
Method: Least Squares
Date: 02/22/10 Time: 12:21
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.020770	0.008976	2.313969	0.0226

R-squared	0.000000	Mean dependent var	0.020770
Adjusted R-squared	0.000000	S.D. dependent var	0.093281
S.E. of regression	0.093281	Akaike info criterion	-1.897190
Sum squared resid	0.931038	Schwarz criterion	-1.872356
Log likelihood	103.4483	Hannan-Quinn criter.	-1.887121
Durbin-Watson stat	2.017596		

D.3. KPSS Unit Roots Test on LOGRGDP

Null Hypothesis: LNRGDP is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.239502
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.001315
HAC corrected variance (Bartlett kernel)	0.009357

KPSS Test Equation
Dependent Variable: LNRGDP
Method: Least Squares
Date: 02/22/10 Time: 12:23
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.25756	0.006963	1616.682	0.0000
@TREND(1982Q3)	0.007909	0.000111	70.98220	0.0000

R-squared	0.979205	Mean dependent var	11.68463
Adjusted R-squared	0.979011	S.D. dependent var	0.252630
S.E. of regression	0.036600	Akaike info criterion	-3.759343
Sum squared resid	0.143335	Schwarz criterion	-3.709961
Log likelihood	206.8842	Hannan-Quinn criter.	-3.739317
F-statistic	5038.472	Durbin-Watson stat	0.098024
Prob(F-statistic)	0.000000		

D.4. KPSS Unit Roots Test on First Differences of LOGRGDP

Null Hypothesis: D(LNRGDP) is stationary
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.100622
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000130
HAC corrected variance (Bartlett kernel)	0.000169

KPSS Test Equation
Dependent Variable: D(LNRGDP)
Method: Least Squares
Date: 02/22/10 Time: 12:24
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007799	0.001103	7.073568	0.0000

R-squared	0.000000	Mean dependent var	0.007799
Adjusted R-squared	0.000000	S.D. dependent var	0.011459
S.E. of regression	0.011459	Akaike info criterion	-6.090938
Sum squared resid	0.014049	Schwarz criterion	-6.066104
Log likelihood	329.9107	Hannan-Quinn criter.	-6.080869
Durbin-Watson stat	1.372078		

D.5. KPSS Unit Roots Test on LOGCPI

Null Hypothesis: LNCPI is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 9 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.234622
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.004632
HAC corrected variance (Bartlett kernel)	0.039723

KPSS Test Equation
Dependent Variable: LNCPI
Method: Least Squares
Date: 02/22/10 Time: 12:25
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.245997	0.013068	324.9035	0.0000
@TREND(1982Q3)	0.008669	0.000209	41.45950	0.0000

R-squared	0.941398	Mean dependent var	4.714138
Adjusted R-squared	0.940851	S.D. dependent var	0.282433
S.E. of regression	0.068689	Akaike info criterion	-2.500264
Sum squared resid	0.504852	Schwarz criterion	-2.450882
Log likelihood	138.2644	Hannan-Quinn criter.	-2.480238
F-statistic	1718.890	Durbin-Watson stat	0.014424
Prob(F-statistic)	0.000000		

D.6. KPSS Unit Roots Test on First Differences of LOGCPI

Null Hypothesis: D(LNCPI) is stationary
Exogenous: Constant
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.652391
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	6.62E-05
HAC corrected variance (Bartlett kernel)	0.000273

KPSS Test Equation
Dependent Variable: D(LNCPI)
Method: Least Squares
Date: 02/22/10 Time: 12:30
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009785	0.000786	12.44198	0.0000

R-squared	0.000000	Mean dependent var	0.009785
Adjusted R-squared	0.000000	S.D. dependent var	0.008173
S.E. of regression	0.008173	Akaike info criterion	-6.766710
Sum squared resid	0.007148	Schwarz criterion	-6.741876
Log likelihood	366.4024	Hannan-Quinn criter.	-6.756641
Durbin-Watson stat	0.913883		

D.7. KPSS Unit Roots Test on LN10YB

Null Hypothesis: LN10YB is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.160800
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.020529
HAC corrected variance (Bartlett kernel)	0.110833

KPSS Test Equation
Dependent Variable: LN10YB
Method: Least Squares
Date: 02/22/10 Time: 12:32
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.626295	0.027513	204.4924	0.0000
@TREND(1982Q3)	-0.011389	0.000440	-25.87129	0.0000

R-squared	0.862171	Mean dependent var	5.011272
Adjusted R-squared	0.860883	S.D. dependent var	0.387721
S.E. of regression	0.144614	Akaike info criterion	-1.011320
Sum squared resid	2.237711	Schwarz criterion	-0.961938
Log likelihood	57.11694	Hannan-Quinn criter.	-0.991294
F-statistic	669.3237	Durbin-Watson stat	0.303056
Prob(F-statistic)	0.000000		

D.8. KPSS Unit Roots Test on First Differences of LN10YB

Null Hypothesis: D(LN10YB) is stationary
Exogenous: Constant
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.079982
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.006276
HAC corrected variance (Bartlett kernel)	0.003824

KPSS Test Equation
Dependent Variable: D(LN10YB)
Method: Least Squares
Date: 02/22/10 Time: 12:32
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.009660	0.007659	-1.261288	0.2099

R-squared	0.000000	Mean dependent var	-0.009660
Adjusted R-squared	0.000000	S.D. dependent var	0.079592
S.E. of regression	0.079592	Akaike info criterion	-2.214595
Sum squared resid	0.677829	Schwarz criterion	-2.189761
Log likelihood	120.5881	Hannan-Quinn criter.	-2.204526
Durbin-Watson stat	1.867947		

D.9. KPSS Unit Roots Test on LOGLCI

Null Hypothesis: LNLCI is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.107436
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.001803
HAC corrected variance (Bartlett kernel)	0.012095

KPSS Test Equation
Dependent Variable: LNLCI
Method: Least Squares
Date: 02/22/10 Time: 12:38
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.945172	0.008154	483.8186	0.0000
@TREND(1982Q3)	0.006229	0.000130	47.74517	0.0000

R-squared	0.955166	Mean dependent var	4.281560
Adjusted R-squared	0.954747	S.D. dependent var	0.201477
S.E. of regression	0.042860	Akaike info criterion	-3.443596
Sum squared resid	0.196553	Schwarz criterion	-3.394214
Log likelihood	189.6760	Hannan-Quinn criter.	-3.423570
F-statistic	2279.602	Durbin-Watson stat	0.206343
Prob(F-statistic)	0.000000		

D.10. KPSS Unit Roots Test on First Differences of LOGLCI

Null Hypothesis: D(LNLCI) is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.071996
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000375
HAC corrected variance (Bartlett kernel)	0.000288

KPSS Test Equation
Dependent Variable: D(LNLCI)
Method: Least Squares
Date: 02/22/10 Time: 12:39
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006409	0.001873	3.421276	0.0009

R-squared	0.000000	Mean dependent var	0.006409
Adjusted R-squared	0.000000	S.D. dependent var	0.019468
S.E. of regression	0.019468	Akaike info criterion	-5.030858
Sum squared resid	0.040554	Schwarz criterion	-5.006024
Log likelihood	272.6664	Hannan-Quinn criter.	-5.020789
Durbin-Watson stat	2.238098		

D.11. KPSS Unit Roots Test on LOGCP

Null Hypothesis: LNCP is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.234311
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.026051
HAC corrected variance (Bartlett kernel)	0.171795

KPSS Test Equation
Dependent Variable: LNCP
Method: Least Squares
Date: 02/22/10 Time: 12:41
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.347809	0.030993	108.0178	0.0000
@TREND(1982Q3)	0.007488	0.000496	15.09881	0.0000

R-squared	0.680572	Mean dependent var	3.752139
Adjusted R-squared	0.677587	S.D. dependent var	0.286896
S.E. of regression	0.162903	Akaike info criterion	-0.773141
Sum squared resid	2.839514	Schwarz criterion	-0.723758
Log likelihood	44.13617	Hannan-Quinn criter.	-0.753114
F-statistic	227.9740	Durbin-Watson stat	0.136521
Prob(F-statistic)	0.000000		

D.12. KPSS Unit Roots Test on First Differences of LOGCP

Null Hypothesis: D(LNCP) is stationary
Exogenous: Constant
Bandwidth: 10 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.103343
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.003589
HAC corrected variance (Bartlett kernel)	0.002885

KPSS Test Equation
Dependent Variable: D(LNCP)
Method: Least Squares
Date: 02/22/10 Time: 12:42
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008092	0.005792	1.397193	0.1652

R-squared	0.000000	Mean dependent var	0.008092
Adjusted R-squared	0.000000	S.D. dependent var	0.060188
S.E. of regression	0.060188	Akaike info criterion	-2.773481
Sum squared resid	0.387614	Schwarz criterion	-2.748647
Log likelihood	150.7680	Hannan-Quinn criter.	-2.763412
Durbin-Watson stat	1.489424		

D.13. KPSS Unit Roots Test on LOGTWI

Null Hypothesis: LNTWI is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.232082
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.016983
HAC corrected variance (Bartlett kernel)	0.111591

KPSS Test Equation
Dependent Variable: LNTWI
Method: Least Squares
Date: 02/22/10 Time: 12:47
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.136745	0.025025	165.3065	0.0000
@TREND(1982Q3)	-0.000931	0.000400	-2.324929	0.0220

R-squared	0.048088	Mean dependent var	4.086476
Adjusted R-squared	0.039191	S.D. dependent var	0.134188
S.E. of regression	0.131533	Akaike info criterion	-1.200945
Sum squared resid	1.851191	Schwarz criterion	-1.151562
Log likelihood	67.45148	Hannan-Quinn criter.	-1.180918
F-statistic	5.405297	Durbin-Watson stat	0.157645
Prob(F-statistic)	0.021963		

D.14. KPSS Unit Roots Test on First Differences of LOGTWI

Null Hypothesis: D(LNTWI) is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.312065
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.002701
HAC corrected variance (Bartlett kernel)	0.002244

KPSS Test Equation
Dependent Variable: D(LNTWI)
Method: Least Squares
Date: 02/22/10 Time: 12:48
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001911	0.005024	-0.380272	0.7045

R-squared	0.000000	Mean dependent var	-0.001911
Adjusted R-squared	0.000000	S.D. dependent var	0.052215
S.E. of regression	0.052215	Akaike info criterion	-3.057673
Sum squared resid	0.291727	Schwarz criterion	-3.032839
Log likelihood	166.1144	Hannan-Quinn criter.	-3.047604
Durbin-Watson stat	1.927905		

D.15. KPSS Unit Roots Test on LOGSP500

Null Hypothesis: LNNYSE is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.205528
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.040730
HAC corrected variance (Bartlett kernel)	0.234413

KPSS Test Equation
Dependent Variable: LNNYSE
Method: Least Squares
Date: 02/22/10 Time: 12:50
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.626874	0.038754	67.78382	0.0000
@TREND(1982Q3)	0.022080	0.000620	35.60875	0.0000

R-squared	0.922181	Mean dependent var	3.819207
Adjusted R-squared	0.921454	S.D. dependent var	0.726800
S.E. of regression	0.203694	Akaike info criterion	-0.326219
Sum squared resid	4.439556	Schwarz criterion	-0.276837
Log likelihood	19.77894	Hannan-Quinn criter.	-0.306193
F-statistic	1267.983	Durbin-Watson stat	0.162866
Prob(F-statistic)	0.000000		

D.16. KPSS Unit Roots Test on First Differences of LOGSP500

Null Hypothesis: D(LNNYSE) is stationary
Exogenous: Constant
Bandwidth: 0 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.279117
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.006693
HAC corrected variance (Bartlett kernel)	0.006693

KPSS Test Equation
Dependent Variable: D(LNNYSE)
Method: Least Squares
Date: 02/22/10 Time: 12:52
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.020566	0.007909	2.600429	0.0106

R-squared	0.000000	Mean dependent var	0.020566
Adjusted R-squared	0.000000	S.D. dependent var	0.082190
S.E. of regression	0.082190	Akaike info criterion	-2.150351
Sum squared resid	0.722806	Schwarz criterion	-2.125516
Log likelihood	117.1189	Hannan-Quinn criter.	-2.140281
Durbin-Watson stat	1.735912		

Appendix E: Cointegration and Error Correction Model Outputs

E.1. Johansen Cointegration Test

Date: 02/01/10   Time: 20:14
Sample (adjusted): 1983Q4 2009Q3
Included observations: 104 after adjustments
Trend assumption: Linear deterministic trend
Series: LNASX200 LNRGDP LNCPI LNBINDEX LNLCI LNCP LNTWI LNNYSE
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.613421	282.2535	159.5297	0.0000
At most 1 *	0.476486	183.4099	125.6154	0.0000
At most 2 *	0.314397	116.1019	95.75366	0.0010
At most 3 *	0.218600	76.84644	69.81889	0.0123
At most 4 *	0.199047	51.19298	47.85613	0.0235
At most 5	0.148359	28.10984	29.79707	0.0773
At most 6	0.101112	11.40848	15.49471	0.1876
At most 7	0.003095	0.322351	3.841466	0.5702

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.613421	98.84356	52.36261	0.0000
At most 1 *	0.476486	67.30801	46.23142	0.0001
At most 2	0.314397	39.25549	40.07757	0.0617
At most 3	0.218600	25.65345	33.87687	0.3422
At most 4	0.199047	23.08315	27.58434	0.1699
At most 5	0.148359	16.70136	21.13162	0.1866
At most 6	0.101112	11.08613	14.26460	0.1499
At most 7	0.003095	0.322351	3.841466	0.5702

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
2.162398	-25.38258	35.11719	6.168484	1.541677	-8.217708	15.87138	1.653309
11.39742	49.20009	-47.95411	13.36678	42.13396	-22.25196	-19.60637	-7.524189
-22.20747	32.96947	8.614312	17.30252	-40.04090	13.46667	-14.30799	15.37142
5.317795	-16.13503	27.03088	-3.503445	-41.81234	2.086785	20.19256	-1.252904
8.164226	-24.35810	-29.01697	-1.711553	49.38402	-3.424066	1.610773	-0.017754
-1.237018	16.17723	3.718129	0.844445	6.711242	-10.43263	5.818273	-3.389982
-2.061356	4.162381	7.981082	1.799181	-34.34552	7.082867	7.162760	5.814587
3.482425	-1.832789	1.961736	-2.019571	1.223897	5.213761	1.492073	-5.572006

Unrestricted Adjustment Coefficients (alpha):

D(LNASX200)	-0.032297	-0.011131	-0.001443	0.002773	-0.017899	0.012525	-0.000413	-0.001704
D(LNRGDP)	-0.001597	-0.001674	-0.001796	0.001748	0.001500	-0.000619	0.000347	-0.000229
D(LNCPI)	-0.001312	0.002661	0.000810	0.000445	-0.000768	-0.000117	0.000251	5.61E-05
D(LNBINDEX)	-0.019348	0.005143	-0.022626	-0.000157	-0.008791	-0.001552	-0.002520	0.001857
D(LNLCI)	0.004294	-0.004102	0.000470	0.002457	-0.002266	-0.000818	0.002414	0.000135
D(LNCP)	0.000847	0.010177	-0.002080	0.001465	0.006706	0.007170	0.009872	0.000163
D(LNTWI)	0.003365	-0.001019	-0.010889	-0.005433	-0.011175	-0.006917	-0.002673	-0.000792
D(LNNYSE)	-0.004767	0.001649	-0.008430	0.014722	-0.016961	0.010664	-0.006912	-0.001105

1 Cointegrating Equation(s):	Log likelihood	1960.583					

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	-11.73816	16.23993	2.852612	0.712948	-3.800275	7.339710	0.764572
	(3.06697)	(2.93101)	(0.92663)	(3.17900)	(0.98732)	(1.56115)	(0.41827)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.069840
	(0.01747)
D(LNRGDP)	-0.003454
	(0.00206)
D(LNCPI)	-0.002836
	(0.00126)
D(LNBINDEX)	-0.041837
	(0.01529)
D(LNLCI)	0.009286
	(0.00336)
D(LNCP)	0.001832
	(0.01092)
D(LNTWI)	0.007277
	(0.01080)
D(LNNYSE)	-0.010308
	(0.01698)

2 Cointegrating Equation(s):	Log likelihood	1994.237					

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	0.000000	1.290341	1.624453	2.894515	-2.449225	0.715752	-0.277089
		(0.69943)	(0.22160)	(0.99717)	(0.25409)	(0.32481)	(0.12675)
0.000000	1.000000	-1.273588	-0.104630	0.185853	0.115099	-0.564310	-0.088741
		(0.13805)	(0.04374)	(0.19681)	(0.05015)	(0.06411)	(0.02502)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.196707	0.272132
	(0.09242)	(0.44104)
D(LNRGDP)	-0.022531	-0.041806
	(0.01082)	(0.05165)

D(LNCPI)	0.027496	0.164226
	(0.00564)	(0.02692)
D(LNBINDEX)	0.016779	0.744123
	(0.08174)	(0.39006)
D(LNLCI)	-0.037470	-0.310831
	(0.01711)	(0.08165)
D(LNCP)	0.117820	0.479181
	(0.05688)	(0.27143)
D(LNTWI)	-0.004335	-0.135543
	(0.05790)	(0.27632)
D(LNNYSE)	0.008487	0.202129
	(0.09107)	(0.43461)

3 Cointegrating Equation(s): Log likelihood 2013.865

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	0.000000	0.000000	0.699305	2.599659	-1.721195	0.387024	-0.474790
			(0.13411)	(0.40118)	(0.15244)	(0.10195)	(0.07530)
0.000000	1.000000	0.000000	0.808507	0.476880	-0.603479	-0.239850	0.106392
			(0.07998)	(0.23924)	(0.09091)	(0.06080)	(0.04491)
0.000000	0.000000	1.000000	0.716979	0.228510	-0.564215	0.254760	0.153216
			(0.08261)	(0.24711)	(0.09390)	(0.06280)	(0.04638)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.164661	0.224557	-0.612834
	(0.19955)	(0.51320)	(0.47834)
D(LNRGDP)	0.017354	-0.101020	0.008700
	(0.02275)	(0.05850)	(0.05452)
D(LNCPI)	0.009518	0.190915	-0.166704
	(0.01194)	(0.03070)	(0.02862)
D(LNBINDEX)	0.519255	-0.001859	-1.120967
	(0.16301)	(0.41922)	(0.39074)
D(LNLCI)	-0.047916	-0.295322	0.351575
	(0.03693)	(0.09496)	(0.08851)
D(LNCP)	0.164003	0.410617	-0.476167
	(0.12268)	(0.31552)	(0.29408)
D(LNTWI)	0.237481	-0.494546	0.073230
	(0.12073)	(0.31049)	(0.28940)

D(LNNYSE)	0.195691	-0.075797	-0.319094	
	(0.19506)	(0.50166)	(0.46758)	

4 Cointegrating Equation(s):		Log likelihood	2026.692

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	0.000000	0.000000	0.000000	-0.191843	-0.857021	0.767590	-0.534261
				(0.54449)	(0.19713)	(0.14708)	(0.08219)
0.000000	1.000000	0.000000	0.000000	-2.750535	0.395642	0.200143	0.037634
				(0.61416)	(0.22235)	(0.16590)	(0.09270)
0.000000	0.000000	1.000000	0.000000	-2.633543	0.321799	0.644944	0.092241
				(0.52684)	(0.19074)	(0.14231)	(0.07952)
0.000000	0.000000	0.000000	1.000000	3.991822	-1.235760	-0.544205	0.085044
				(0.79865)	(0.28915)	(0.21573)	(0.12055)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.149917	0.179819	-0.537885	-0.382696
	(0.20382)	(0.52859)	(0.52410)	(0.18292)
D(LNRGDP)	0.026651	-0.129228	0.055958	-0.069427
	(0.02263)	(0.05869)	(0.05819)	(0.02031)
D(LNCPI)	0.011883	0.183742	-0.154686	0.039932
	(0.01213)	(0.03145)	(0.03119)	(0.01088)
D(LNBINDEX)	0.518418	0.000682	-1.125224	-0.441544
	(0.16664)	(0.43216)	(0.42849)	(0.14955)
D(LNLCI)	-0.034850	-0.334968	0.417993	-0.028814
	(0.03699)	(0.09593)	(0.09512)	(0.03320)
D(LNCP)	0.171795	0.386974	-0.436557	0.100139
	(0.12534)	(0.32505)	(0.32229)	(0.11248)
D(LNTWI)	0.208590	-0.406886	-0.073626	-0.162234
	(0.12229)	(0.31715)	(0.31446)	(0.10975)
D(LNNYSE)	0.273982	-0.313344	0.078866	-0.204797
	(0.19425)	(0.50376)	(0.49949)	(0.17433)

5 Cointegrating Equation(s):		Log likelihood	2038.233

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE

1.000000	0.000000	0.000000	0.000000	0.000000	-0.902796	0.727260	-0.552369
					(0.10298)	(0.13023)	(0.04160)
0.000000	1.000000	0.000000	0.000000	0.000000	-0.260653	-0.378082	-0.221989
					(0.08079)	(0.10217)	(0.03264)
0.000000	0.000000	1.000000	0.000000	0.000000	-0.306580	0.091312	-0.156339
					(0.08457)	(0.10694)	(0.03416)
0.000000	0.000000	0.000000	1.000000	0.000000	-0.283287	0.294967	0.461832
					(0.14771)	(0.18680)	(0.05967)
0.000000	0.000000	0.000000	0.000000	1.000000	-0.238606	-0.210223	-0.094390
					(0.06536)	(0.08266)	(0.02640)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.296052	0.615816	-0.018497	-0.352060	-1.460898
	(0.20605)	(0.54228)	(0.55163)	(0.17667)	(0.66678)
D(LNRGDP)	0.038900	-0.165774	0.012422	-0.071994	-7.75E-05
	(0.02326)	(0.06121)	(0.06226)	(0.01994)	(0.07526)
D(LNCPI)	0.005615	0.202441	-0.132411	0.041246	0.021196
	(0.01249)	(0.03287)	(0.03343)	(0.01071)	(0.04041)
D(LNBINDEX)	0.446643	0.214824	-0.870125	-0.426497	0.665278
	(0.17260)	(0.45426)	(0.46209)	(0.14800)	(0.55856)
D(LNLCI)	-0.053351	-0.279770	0.483749	-0.024936	-0.399709
	(0.03814)	(0.10037)	(0.10210)	(0.03270)	(0.12341)
D(LNCP)	0.226543	0.223631	-0.631141	0.088662	0.783252
	(0.12977)	(0.34154)	(0.34743)	(0.11127)	(0.41996)
D(LNTWI)	0.117354	-0.134681	0.250642	-0.143107	0.073555
	(0.12323)	(0.32432)	(0.32991)	(0.10566)	(0.39878)
D(LNNYSE)	0.135508	0.099797	0.571027	-0.175768	-1.053519
	(0.19646)	(0.51704)	(0.52596)	(0.16845)	(0.63575)

6 Cointegrating Equation(s): Log likelihood 2046.584

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-2.105502	-0.623449
						(0.71413)	(0.17485)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	-1.195950	-0.242511
						(0.27542)	(0.06743)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	-0.870664	-0.180477
						(0.31512)	(0.07715)

0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	-0.593921	0.439528
						(0.19649)	(0.04811)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	-0.958913	-0.113176
						(0.24191)	(0.05923)
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	-3.137766	-0.078733
						(0.81552)	(0.19967)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.311546	0.818436	0.028073	-0.341484	-1.376839	0.430076
	(0.20229)	(0.54556)	(0.54173)	(0.17339)	(0.65589)	(0.22159)
D(LNRGDP)	0.039666	-0.175794	0.010119	-0.072518	-0.004234	0.031157
	(0.02320)	(0.06255)	(0.06212)	(0.01988)	(0.07520)	(0.02541)
D(LNCPI)	0.005760	0.200548	-0.132847	0.041147	0.020410	-0.032762
	(0.01250)	(0.03370)	(0.03346)	(0.01071)	(0.04051)	(0.01369)
D(LNBINDEX)	0.448562	0.189721	-0.875894	-0.427807	0.654864	-0.214188
	(0.17271)	(0.46579)	(0.46251)	(0.14803)	(0.55998)	(0.18919)
D(LNLCI)	-0.052339	-0.293009	0.480706	-0.025627	-0.405202	0.083755
	(0.03809)	(0.10271)	(0.10199)	(0.03264)	(0.12348)	(0.04172)
D(LNCP)	0.217674	0.339619	-0.604483	0.094717	0.831370	-0.356123
	(0.12785)	(0.34479)	(0.34237)	(0.10958)	(0.41451)	(0.14004)
D(LNTWI)	0.125910	-0.246579	0.224924	-0.148948	0.027134	-0.052532
	(0.12134)	(0.32723)	(0.32493)	(0.10400)	(0.39341)	(0.13291)
D(LNNYSE)	0.122317	0.272304	0.610675	-0.166763	-0.981954	-0.133493
	(0.19365)	(0.52226)	(0.51859)	(0.16598)	(0.62787)	(0.21212)

7 Cointegrating Equation(s): Log likelihood 2052.127

Normalized cointegrating coefficients (standard error in parentheses)

LNASX200	LNRGDP	LNCPI	LNBINDEX	LNLCI	LNCP	LNTWI	LNNYSE
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.555038
							(0.40292)
0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.426883
							(0.22560)
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.306850
							(0.17538)
0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.771956
							(0.10759)
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.423545
							(0.18489)

0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	1.677531
							(0.58969)
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.559718
							(0.17876)

Adjustment coefficients (standard error in parentheses)

D(LNASX200)	-0.310694	0.816717	0.024777	-0.342227	-1.362655	0.427151	-0.176642
	(0.20288)	(0.54645)	(0.54503)	(0.17391)	(0.70486)	(0.22789)	(0.27481)
D(LNRGDP)	0.038951	-0.174348	0.012890	-0.071893	-0.016160	0.033617	0.069765
	(0.02324)	(0.06258)	(0.06242)	(0.01992)	(0.08073)	(0.02610)	(0.03147)
D(LNCPI)	0.005242	0.201593	-0.130842	0.041599	0.011784	-0.030983	-0.075718
	(0.01251)	(0.03368)	(0.03360)	(0.01072)	(0.04345)	(0.01405)	(0.01694)
D(LNBINDEX)	0.453757	0.179230	-0.896009	-0.432341	0.741425	-0.232039	-0.128589
	(0.17303)	(0.46604)	(0.46483)	(0.14832)	(0.60114)	(0.19436)	(0.23437)
D(LNLCI)	-0.057316	-0.282959	0.499976	-0.021283	-0.488125	0.100856	0.200353
	(0.03739)	(0.10072)	(0.10046)	(0.03205)	(0.12992)	(0.04200)	(0.05065)
D(LNCP)	0.197324	0.380711	-0.525692	0.112478	0.492303	-0.286199	-0.003503
	(0.12420)	(0.33453)	(0.33367)	(0.10647)	(0.43151)	(0.13951)	(0.16824)
D(LNTWI)	0.131420	-0.257703	0.203594	-0.153756	0.118926	-0.071461	0.042091
	(0.12139)	(0.32695)	(0.32610)	(0.10405)	(0.42173)	(0.13635)	(0.16442)
D(LNNYSE)	0.136564	0.243534	0.555512	-0.179198	-0.744568	-0.182448	0.295124
	(0.19294)	(0.51966)	(0.51831)	(0.16538)	(0.67030)	(0.21672)	(0.26133)

E.2. Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 02/26/10 Time: 10:39
Sample (adjusted): 1983Q2 2009Q3
Included observations: 106 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
LNASX200(-1)	1.000000	0.000000
LNRGDP(-1)	0.000000	1.000000
LNCPI(-1)	-0.941036	-0.378036
	(0.40859)	(0.14037)
	[-2.30311]	[-2.69315]
LN10YB(-1)	0.155131	0.324426
	(0.11369)	(0.03906)
	[1.36452]	[8.30648]
LNLCI(-1)	2.719732	-0.085149
	(0.57419)	(0.19726)
	[4.73667]	[-0.43166]
LNCP(-1)	-1.343762	-0.210133
	(0.12045)	(0.04138)
	[-11.1565]	[-5.07830]
LNTWI(-1)	0.288935	-0.268565

	(0.19942)	(0.06851)					
	[1.44884]	[-3.92003]					
LNNYSE(-1)	-0.568135	0.003200					
	(0.08455)	(0.02905)					
	[-6.71944]	[0.11018]					
C	-9.188399	-8.346383					

Error Correction:	D(LNASX200)	D(LNRGDP)	D(LNCPI)	D(LN10YB)	D(LNLCI)	D(LNCP)	D(LNTWI)
CointEq1	-0.185448	0.007351	-0.016061	0.018546	-0.003295	0.230784	-0.003686
	(0.08554)	(0.00961)	(0.00520)	(0.07276)	(0.01802)	(0.04832)	(0.04995)
	[-2.16792]	[0.76478]	[-3.09148]	[0.25489]	[-0.18288]	[4.77587]	[-0.07379]
CointEq2	-0.048628	-0.116209	0.128580	-0.200317	0.100158	0.081303	-0.275220
	(0.29120)	(0.03272)	(0.01769)	(0.24768)	(0.06133)	(0.16450)	(0.17003)
	[-0.16699]	[-3.55168]	[7.27046]	[-0.80876]	[1.63305]	[0.49424]	[-1.61865]
D(LNASX200(-1))	-0.270975	0.002830	0.019451	0.251513	-0.000768	-0.186264	-0.023711
	(0.15007)	(0.01686)	(0.00911)	(0.12764)	(0.03161)	(0.08477)	(0.08762)
	[-1.80567]	[0.16781]	[2.13415]	[1.97045]	[-0.02431]	[-2.19717]	[-0.27059]
D(LNASX200(-2))	0.129586	0.042560	0.003812	0.094211	-0.015675	-0.085780	-0.014119
	(0.15342)	(0.01724)	(0.00932)	(0.13050)	(0.03231)	(0.08667)	(0.08958)
	[0.84463]	[2.46886]	[0.40914]	[0.72195]	[-0.48507]	[-0.98973]	[-0.15760]
D(LNRGDP(-1))	-0.274510	0.253794	-0.088418	0.840159	-0.023674	-0.351134	0.800069
	(0.99363)	(0.11165)	(0.06035)	(0.84514)	(0.20928)	(0.56131)	(0.58018)
	[-0.27627]	[2.27322]	[-1.46519]	[0.99410]	[-0.11312]	[-0.62557]	[1.37901]
D(LNRGDP(-2))	-1.533192	0.137572	-0.092639	0.932729	-0.427906	0.822356	0.142049
	(0.96508)	(0.10844)	(0.05861)	(0.82085)	(0.20326)	(0.54517)	(0.56350)
	[-1.58867]	[1.26869]	[-1.58056]	[1.13629]	[-2.10518]	[1.50843]	[0.25208]
D(LNCPI(-1))	0.234338	0.361312	-0.177446	1.199767	0.063712	0.184300	2.398065
	(1.95073)	(0.21919)	(0.11847)	(1.65922)	(0.41086)	(1.10198)	(1.13903)
	[0.12013]	[1.64842]	[-1.49777]	[0.72309]	[0.15507]	[0.16725]	[2.10536]
D(LNCPI(-2))	-3.110813	0.380065	-0.158079	0.081340	-0.249537	3.327535	-1.131796

	(1.79113)	(0.20125)	(0.10878)	(1.52346)	(0.37725)	(1.01182)	(1.04583)
	[-1.73679]	[1.88849]	[-1.45320]	[0.05339]	[-0.66147]	[3.28868]	[-1.08219]
D(LN10YB(-1))	0.000847	0.020295	-0.004219	0.067851	-0.035662	-0.053108	0.053754
	(0.14250)	(0.01601)	(0.00865)	(0.12120)	(0.03001)	(0.08050)	(0.08321)
	[0.00594]	[1.26752]	[-0.48744]	[0.55981]	[-1.18822]	[-0.65973]	[0.64604]
D(LN10YB(-2))	0.211813	0.029856	-0.012317	-0.065417	-0.027573	-0.030920	0.043073
	(0.13975)	(0.01570)	(0.00849)	(0.11887)	(0.02943)	(0.07895)	(0.08160)
	[1.51565]	[1.90135]	[-1.45121]	[-0.55034]	[-0.93675]	[-0.39166]	[0.52786]
D(LNLCI(-1))	-0.449318	0.037658	0.030686	0.009111	-0.205337	-0.599160	0.169254
	(0.51669)	(0.05806)	(0.03138)	(0.43947)	(0.10882)	(0.29188)	(0.30169)
	[-0.86962]	[0.64865]	[0.97791]	[0.02073]	[-1.88688]	[-2.05278]	[0.56102]
D(LNLCI(-2))	0.436121	0.029527	-0.000264	1.068908	-0.101714	-0.168108	-0.020370
	(0.51884)	(0.05830)	(0.03151)	(0.44131)	(0.10928)	(0.29309)	(0.30295)
	[0.84057]	[0.50648]	[-0.00838]	[2.42215]	[-0.93078]	[-0.57356]	[-0.06724]
D(LNCP(-1))	-0.140439	0.046842	0.021655	-0.348945	0.058837	0.321870	-0.117896
	(0.20714)	(0.02327)	(0.01258)	(0.17618)	(0.04363)	(0.11701)	(0.12095)
	[-0.67800]	[2.01261]	[1.72140]	[-1.98058]	[1.34864]	[2.75073]	[-0.97477]
D(LNCP(-2))	-0.159801	-0.042081	0.020326	-0.429655	0.045674	0.179527	-0.330542
	(0.23896)	(0.02685)	(0.01451)	(0.20325)	(0.05033)	(0.13499)	(0.13953)
	[-0.66874]	[-1.56731]	[1.40059]	[-2.11395]	[0.90751]	[1.32995]	[-2.36904]
D(LNTWI(-1))	-0.092699	0.034439	0.032841	-0.100295	0.119974	-0.032052	-0.055271
	(0.25086)	(0.02819)	(0.01524)	(0.21337)	(0.05284)	(0.14171)	(0.14648)
	[-0.36953]	[1.22183]	[2.15560]	[-0.47005]	[2.27070]	[-0.22618]	[-0.37734]
D(LNTWI(-2))	-0.461943	-0.012087	0.007899	-0.216436	0.196193	0.126418	-0.345020
	(0.24580)	(0.02762)	(0.01493)	(0.20906)	(0.05177)	(0.13885)	(0.14352)
	[-1.87938]	[-0.43766]	[0.52913]	[-1.03526]	[3.78977]	[0.91046]	[-2.40400]
D(LNNYSE(-1))	0.452093	0.014421	-0.012925	-0.260809	-0.020320	0.218411	-0.018249
	(0.16632)	(0.01869)	(0.01010)	(0.14147)	(0.03503)	(0.09396)	(0.09712)
	[2.71817]	[0.77168]	[-1.27955]	[-1.84360]	[-0.58005]	[2.32460]	[-0.18791]
D(LNNYSE(-2))	0.085244	-0.028994	0.007567	-0.201429	-0.023867	0.056447	-0.096769

	(0.17846)	(0.02005)	(0.01084)	(0.15179)	(0.03759)	(0.10081)	(0.10420)
	[0.47766]	[-1.44591]	[0.69820]	[-1.32699]	[-0.63496]	[0.55991]	[-0.92865]
C	0.060802	-0.002576	0.013198	-0.034767	0.014114	-0.031047	-0.014381
	(0.03053)	(0.00343)	(0.00185)	(0.02597)	(0.00643)	(0.01725)	(0.01783)
	[1.99140]	[-0.75089]	[7.11770]	[-1.33877]	[2.19475]	[-1.80007]	[-0.80669]
R-squared	0.280947	0.359756	0.630531	0.281745	0.267721	0.442592	0.198979
Adj. R-squared	0.132177	0.227292	0.554089	0.133140	0.116215	0.327266	0.033250
Sum sq. resids	0.666298	0.008412	0.002458	0.482035	0.029557	0.212626	0.227164
S.E. equation	0.087513	0.009833	0.005315	0.074435	0.018432	0.049437	0.051099
F-statistic	1.888468	2.715870	8.248500	1.895935	1.767065	3.837746	1.200629
Log likelihood	118.2737	349.9940	415.2086	135.4309	283.3905	178.8104	175.3051
Akaike AIC	-1.873089	-6.245169	-7.475634	-2.196810	-4.988500	-3.015290	-2.949152
Schwarz SC	-1.395680	-5.767760	-6.998225	-1.719401	-4.511092	-2.537882	-2.471744
Mean dependent	0.020989	0.008198	0.009499	-0.009332	0.006228	0.007489	-0.001037
S.D. dependent	0.093942	0.011186	0.007959	0.079948	0.019606	0.060274	0.051970

Determinant resid covariance (dof adj.)	1.94E-25
Determinant resid covariance	4.00E-26
Log likelihood	1896.279
Akaike information criterion	-32.60904
Schwarz criterion	-28.38774

E.3. Cointegration Regression

Dependent Variable: LNASX200
Method: Least Squares
Date: 02/24/10 Time: 20:42
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.737911	2.478292	-0.297750	0.7665
LNRGDP	0.425114	0.289268	1.469617	0.1448
LNCPI	1.507342	0.290952	5.180717	0.0000
LN10YB	0.218670	0.084037	2.602056	0.0107
LNLCI	-1.995515	0.348190	-5.731107	0.0000
LNCP	0.432590	0.106508	4.061582	0.0001
LNTWI	0.104003	0.154844	0.671665	0.5033
LNNYSE	0.623928	0.057515	10.84809	0.0000

R-squared	0.977138	Mean dependent var	7.682324
Adjusted R-squared	0.975554	S.D. dependent var	0.611280
S.E. of regression	0.095575	Akaike info criterion	-1.787250
Sum squared resid	0.922592	Schwarz criterion	-1.589720
Log likelihood	105.4051	Hannan-Quinn criter.	-1.707145
F-statistic	616.7011	Durbin-Watson stat	0.749473
Prob(F-statistic)	0.000000		

E.4. ADF Test on Residual

Null Hypothesis: RESID01 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.891381	0.0001
Test critical values:	1% level	-3.491928	
	5% level	-2.888411	
	10% level	-2.581176	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID01)
Method: Least Squares
Date: 02/24/10 Time: 20:59
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-0.374044	0.076470	-4.891381	0.0000
C	0.001083	0.007019	0.154322	0.8776

R-squared	0.184148	Mean dependent var	0.001473
Adjusted R-squared	0.176452	S.D. dependent var	0.080374
S.E. of regression	0.072939	Akaike info criterion	-2.380033
Sum squared resid	0.563935	Schwarz criterion	-2.330364
Log likelihood	130.5218	Hannan-Quinn criter.	-2.359894
F-statistic	23.92560	Durbin-Watson stat	1.894719
Prob(F-statistic)	0.000004		

E.5. PP Test on Residual

Null Hypothesis: RESID01 has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.823193	0.0001
Test critical values:	1% level	-3.491928	
	5% level	-2.888411	
	10% level	-2.581176	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.005222
HAC corrected variance (Bartlett kernel)	0.005006

Phillips-Perron Test Equation
Dependent Variable: D(RESID01)
Method: Least Squares
Date: 02/24/10 Time: 20:59
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-0.374044	0.076470	-4.891381	0.0000
C	0.001083	0.007019	0.154322	0.8776

R-squared	0.184148	Mean dependent var	0.001473
Adjusted R-squared	0.176452	S.D. dependent var	0.080374
S.E. of regression	0.072939	Akaike info criterion	-2.380033
Sum squared resid	0.563935	Schwarz criterion	-2.330364
Log likelihood	130.5218	Hannan-Quinn criter.	-2.359894
F-statistic	23.92560	Durbin-Watson stat	1.894719
Prob(F-statistic)	0.000004		

E.6. KPSS Test on Residual

Null Hypothesis: RESID01 is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.067696
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.008464
HAC corrected variance (Bartlett kernel)	0.022037

KPSS Test Equation
Dependent Variable: RESID01
Method: Least Squares
Date: 02/24/10 Time: 20:45
Sample: 1982Q3 2009Q3
Included observations: 109

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.57E-16	0.008853	-1.77E-14	1.0000

R-squared	0.000000	Mean dependent var	-1.63E-16
Adjusted R-squared	0.000000	S.D. dependent var	0.092426
S.E. of regression	0.092426	Akaike info criterion	-1.915691
Sum squared resid	0.922592	Schwarz criterion	-1.891000
Log likelihood	105.4051	Hannan-Quinn criter.	-1.905678
Durbin-Watson stat	0.749473		

E.7. General ECM (Dynamic) Model

Dependent Variable: DLNASX200
Method: Least Squares
Date: 02/24/10 Time: 21:06
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.012617	0.014169	-0.890465	0.3756
DLNASX200(-1)	0.012613	0.114073	0.110568	0.9122
DLNRGDP	1.418156	0.686738	2.065061	0.0418
DLNCPI	1.406750	1.066046	1.319595	0.1903
DLN10YB	-0.083068	0.093313	-0.890208	0.3757
DLNLCI	-0.767242	0.329039	-2.331769	0.0219
DLNCP	0.050544	0.148463	0.340447	0.7343
DLNTWI	0.242781	0.158943	1.527474	0.1302
DLNNYSE	0.748919	0.089514	8.366519	0.0000
DLNRGDP(-1)	-0.143782	0.650357	-0.221082	0.8255
DLNCPI(-1)	-0.102656	0.997490	-0.102914	0.9183
DLN10YB(-1)	-0.085120	0.087673	-0.970877	0.3342
DLNLCI(-1)	-0.315240	0.356538	-0.884169	0.3790
DLNCP(-1)	-0.106082	0.149301	-0.710525	0.4792
DLNTWI(-1)	-0.210468	0.162067	-1.298654	0.1974
DLNNYSE(-1)	0.099811	0.130339	0.765776	0.4458
RESID01(-1)	-0.256931	0.089870	-2.858931	0.0053

R-squared	0.622734	Mean dependent var	0.021303
Adjusted R-squared	0.555664	S.D. dependent var	0.093554
S.E. of regression	0.062362	Akaike info criterion	-2.566990
Sum squared resid	0.350009	Schwarz criterion	-2.142335
Log likelihood	154.3340	Hannan-Quinn criter.	-2.394841
F-statistic	9.284887	Durbin-Watson stat	2.006983
Prob(F-statistic)	0.000000		

E.8. Specific ECM (Dynamic) Model

Dependent Variable: DLNASX200
Method: Least Squares
Date: 02/24/10 Time: 21:15
Sample (adjusted): 1982Q4 2009Q3
Included observations: 108 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000478	0.007803	0.061297	0.9512
DLNRGDP	1.150000	0.564132	2.038529	0.0441
DLNLCI	-0.792307	0.315500	-2.511274	0.0136
DLNNYSE	0.783311	0.074070	10.57529	0.0000
RESID01(-1)	-0.278955	0.070094	-3.979704	0.0001

R-squared	0.567187	Mean dependent var	0.020770
Adjusted R-squared	0.550378	S.D. dependent var	0.093281
S.E. of regression	0.062548	Akaike info criterion	-2.660565
Sum squared resid	0.402966	Schwarz criterion	-2.536392
Log likelihood	148.6705	Hannan-Quinn criter.	-2.610217
F-statistic	33.74445	Durbin-Watson stat	1.884408
Prob(F-statistic)	0.000000		

E.9. Correlogram of residual

Date: 12/31/11 Time: 00:25
Sample: 1982Q4 2009Q3
Included observations: 108

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	0.028	0.028	0.0876	0.767
.|. |	.|. |	2	0.056	0.055	0.4351	0.804
.|. |	.|. |	3	0.054	0.051	0.7643	0.858
.|. |	.|. |	4	-0.054	-0.060	1.1011	0.894
.|. |	.|. |	5	0.002	-0.001	1.1016	0.954
.|. |	.|. |	6	0.050	0.054	1.3908	0.966
.|. |	.|. |	7	-0.044	-0.042	1.6236	0.978
.|* |	.|* |	8	0.185	0.181	5.7089	0.680
.|. |	*|. |	9	-0.055	-0.071	6.0739	0.732
*|. |	*|. |	10	-0.105	-0.116	7.4130	0.686
.|. |	.|. |	11	-0.050	-0.061	7.7218	0.738
.|* |	.|* |	12	0.126	0.178	9.6855	0.644
*|. |	*|. |	13	-0.151	-0.161	12.551	0.483
.|. |	.|. |	14	-0.016	-0.052	12.584	0.560
.|. |	.|. |	15	-0.058	-0.038	13.013	0.601
*|. |	*|. |	16	-0.119	-0.117	14.845	0.536
*|. |	*|. |	17	-0.096	-0.088	16.037	0.521
*|. |	.|. |	18	-0.104	-0.062	17.478	0.491
.|. |	.|. |	19	-0.010	0.051	17.491	0.557
.|* |	.|. |	20	0.134	0.053	19.927	0.463
.|. |	.|. |	21	-0.054	-0.001	20.322	0.501
*|. |	*|. |	22	-0.075	-0.083	21.093	0.515
.|. |	.|. |	23	-0.048	-0.055	21.412	0.556
.|. |	.|. |	24	0.030	0.064	21.539	0.607
.|* |	.|* |	25	0.123	0.205	23.698	0.537
.|. |	.|. |	26	-0.000	-0.060	23.698	0.593
.|. |	.|. |	27	0.070	0.002	24.409	0.608
.|* |	.|. |	28	0.103	0.071	25.989	0.574
.|. |	.|* |	29	0.042	0.077	26.257	0.612
.|. |	.|. |	30	-0.028	-0.031	26.379	0.656
.|. |	.|. |	31	0.014	-0.032	26.409	0.702
.|. |	.|. |	32	0.018	-0.053	26.460	0.743
.|. |	.|. |	33	0.029	-0.028	26.594	0.777
.|. |	.|. |	34	-0.032	-0.011	26.757	0.807
.|. |	.|. |	35	-0.038	-0.051	26.993	0.832
.|. |	.|. |	36	-0.016	-0.056	27.033	0.860

E.10. Heteroskedasticity test: ARCH

Heteroskedasticity Test: ARCH

F-statistic	17.16473	Prob. F(1,105)	0.0001
Obs*R-squared	15.03401	Prob. Chi-Square(1)	0.0001

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/31/11 Time: 00:32
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002238	0.000790	2.833064	0.0055
RESID^2(-1)	0.370355	0.089392	4.143034	0.0001

R-squared	0.140505	Mean dependent var	0.003608
Adjusted R-squared	0.132319	S.D. dependent var	0.007965
S.E. of regression	0.007419	Akaike info criterion	-6.950898
Sum squared resid	0.005780	Schwarz criterion	-6.900938
Log likelihood	373.8730	Hannan-Quinn criter.	-6.930645
F-statistic	17.16473	Durbin-Watson stat	1.803303
Prob(F-statistic)	0.000070		

E.11. Heteroscedasticity test: White

Heteroskedasticity Test: White

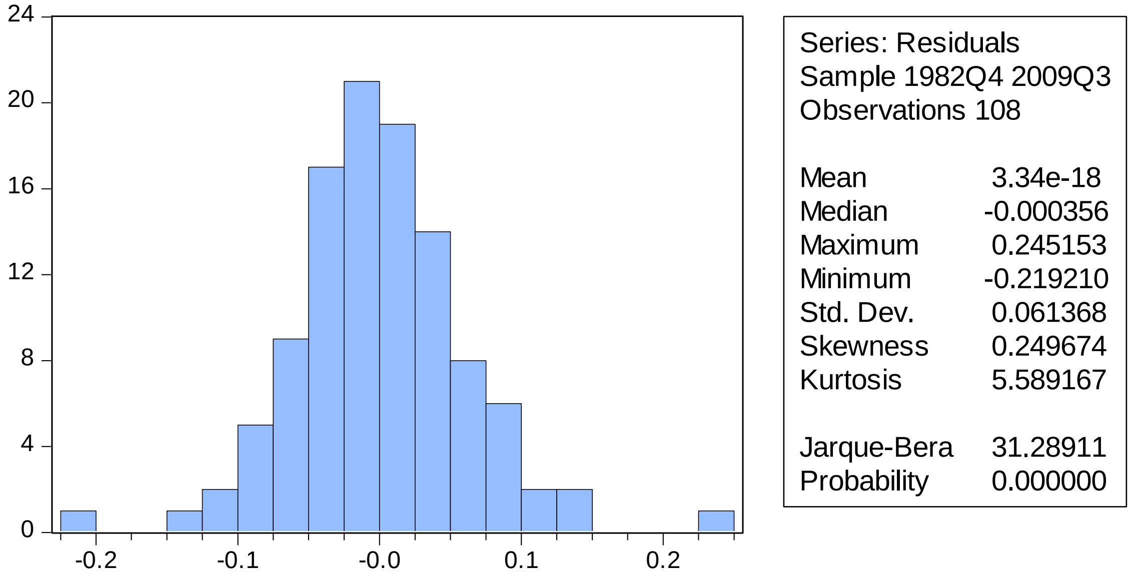
F-statistic	5.129796	Prob. F(14,93)	0.0000
Obs*R-squared	47.05974	Prob. Chi-Square(14)	0.0000
Scaled explained SS	98.21557	Prob. Chi-Square(14)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/31/11 Time: 00:34
Sample: 1982Q4 2009Q3
Included observations: 108

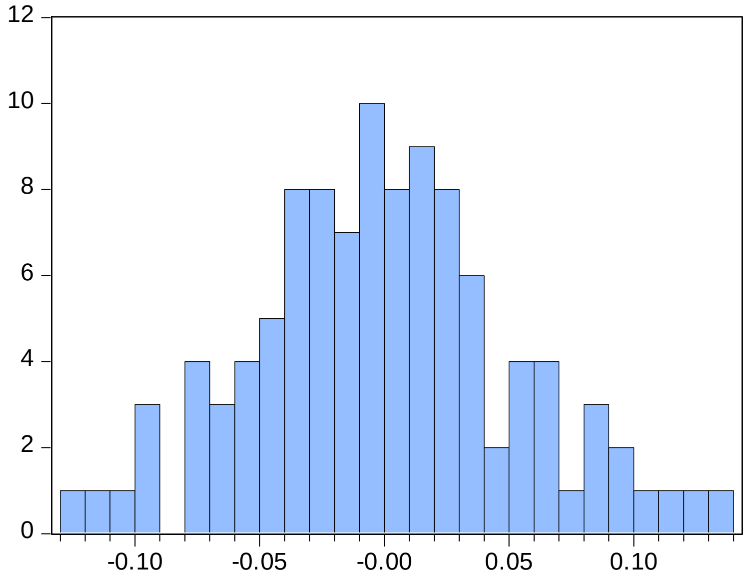
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000259	0.001187	0.217821	0.8280
DLNRGDP	-0.008712	0.106209	-0.082024	0.9348
DLNRGDP^2	2.995321	3.823135	0.783472	0.4353
DLNRGDP*DLNLCI	-5.142355	4.957432	-1.037302	0.3023
DLNRGDP*DLNNYSE	-0.448398	0.794508	-0.564372	0.5739
DLNRGDP*RESID01(-1)	-0.660147	0.805806	-0.819238	0.4147
DLNLCI	0.160545	0.056296	2.851775	0.0054
DLNLCI^2	1.667884	0.661100	2.522892	0.0133
DLNLCI*DLNNYSE	1.265909	0.741057	1.708248	0.0909
DLNLCI*RESID01(-1)	1.906726	0.650436	2.931456	0.0042
DLNNYSE	-0.000270	0.010042	-0.026910	0.9786
DLNNYSE^2	0.091933	0.055160	1.666674	0.0989
DLNNYSE*RESID01(-1)	-0.023980	0.077309	-0.310185	0.7571
RESID01(-1)	0.014621	0.011661	1.253855	0.2130
RESID01(-1)^2	0.168534	0.070095	2.404368	0.0182

R-squared	0.435738	Mean dependent var	0.003731
Adjusted R-squared	0.350796	S.D. dependent var	0.008030
S.E. of regression	0.006470	Akaike info criterion	-7.114953
Sum squared resid	0.003893	Schwarz criterion	-6.742435
Log likelihood	399.2075	Hannan-Quinn criter.	-6.963910
F-statistic	5.129796	Durbin-Watson stat	1.875042
Prob(F-statistic)	0.000000		

E.12. Histogram normality test



E.13. Histogram Normality test Without 1987



Series: RESID02
Sample 1982Q3 2009Q3
Observations 106

Mean	-0.000245
Median	-0.000356
Maximum	0.139432
Minimum	-0.129985
Std. Dev.	0.052988
Skewness	0.139069
Kurtosis	3.030097
Jarque-Bera	0.345680
Probability	0.841272

E.14. Granger causality between ASX200 and independent variables with lag 1

Pairwise Granger Causality Tests
Date: 12/30/11 Time: 23:17
Sample: 1982Q3 2009Q3
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNRGDP does not Granger Cause DLNASX200	107	4.42125	0.0379
DLNASX200 does not Granger Cause DLNRGDP		1.23042	0.2699
DLNCPI does not Granger Cause DLNASX200	107	1.18913	0.2780
DLNASX200 does not Granger Cause DLNCPI		0.28115	0.5971
DLN10YB does not Granger Cause DLNASX200	107	0.19925	0.6563
DLNASX200 does not Granger Cause DLN10YB		0.61339	0.4353
DLNLCI does not Granger Cause DLNASX200	107	4.27446	0.0412
DLNASX200 does not Granger Cause DLNLCI		0.05238	0.8194
DLNCP does not Granger Cause DLNASX200	107	1.17072	0.2818
DLNASX200 does not Granger Cause DLNCP		0.60561	0.4382
DLNTWI does not Granger Cause DLNASX200	107	0.33910	0.5616
DLNASX200 does not Granger Cause DLNTWI		0.06287	0.8025
DLNNYSE does not Granger Cause DLNASX200	107	5.19360	0.0247
DLNASX200 does not Granger Cause DLNNYSE		2.64510	0.1069
DLNCPI does not Granger Cause DLNRGDP	107	0.15209	0.6973
DLNRGDP does not Granger Cause DLNCPI		0.55062	0.4597
DLN10YB does not Granger Cause DLNRGDP	107	1.87774	0.1735
DLNRGDP does not Granger Cause DLN10YB		0.10185	0.7503
DLNLCI does not Granger Cause DLNRGDP	107	0.92784	0.3377
DLNRGDP does not Granger Cause DLNLCI		0.02118	0.8846
DLNCP does not Granger Cause DLNRGDP	107	0.30883	0.5796
DLNRGDP does not Granger Cause DLNCP		0.44928	0.5042
DLNTWI does not Granger Cause DLNRGDP	107	3.33927	0.0705
DLNRGDP does not Granger Cause DLNTWI		0.05049	0.8226
DLNNYSE does not Granger Cause DLNRGDP	107	1.16805	0.2823
DLNRGDP does not Granger Cause DLNNYSE		2.87870	0.0927
DLN10YB does not Granger Cause DLNCPI	107	2.17564	0.1432
DLNCPI does not Granger Cause DLN10YB		0.80972	0.3703
DLNLCI does not Granger Cause DLNCPI	107	0.24736	0.6200
DLNCPI does not Granger Cause DLNLCI		1.24072	0.2679
DLNCP does not Granger Cause DLNCPI	107	0.28898	0.5920

DLNCPI does not Granger Cause DLNCP		0.03994	0.8420
DLNTWI does not Granger Cause DLNCPI	107	0.00763	0.9305
DLNCPI does not Granger Cause DLNTWI		0.07568	0.7838
DLNNYSE does not Granger Cause DLNCPI	107	0.01307	0.9092
DLNCPI does not Granger Cause DLNNYSE		0.00254	0.9599
DLNLCI does not Granger Cause DLN10YB	107	1.24891	0.2663
DLN10YB does not Granger Cause DLNLCI		0.22642	0.6352
DLNCP does not Granger Cause DLN10YB	107	8.69530	0.0039
DLN10YB does not Granger Cause DLNCP		0.34347	0.5591
DLNTWI does not Granger Cause DLN10YB	107	1.83976	0.1779
DLN10YB does not Granger Cause DLNTWI		0.61585	0.4344
DLNNYSE does not Granger Cause DLN10YB	107	0.51625	0.4741
DLN10YB does not Granger Cause DLNNYSE		1.28811	0.2590
DLNCP does not Granger Cause DLNLCI	107	0.20516	0.6515
DLNLCI does not Granger Cause DLNCP		0.23909	0.6259
DLNTWI does not Granger Cause DLNLCI	107	1.22832	0.2703
DLNLCI does not Granger Cause DLNTWI		0.00018	0.9892
DLNNYSE does not Granger Cause DLNLCI	107	0.04565	0.8312
DLNLCI does not Granger Cause DLNNYSE		5.45772	0.0214
DLNTWI does not Granger Cause DLNCP	107	5.68226	0.0190
DLNCP does not Granger Cause DLNTWI		2.39435	0.1248
DLNNYSE does not Granger Cause DLNCP	107	7.91751	0.0059
DLNCP does not Granger Cause DLNNYSE		4.43575	0.0376
DLNNYSE does not Granger Cause DLNTWI	107	0.24156	0.6241
DLNTWI does not Granger Cause DLNNYSE		0.23875	0.6261

E.15. Granger causality between ASX200 and independent variables with lag 2

Pairwise Granger Causality Tests
Date: 12/30/11 Time: 23:27
Sample: 1982Q3 2009Q3
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNRGDP does not Granger Cause DLNASX200	106	3.50205	0.0338
DLNASX200 does not Granger Cause DLNRGDP		4.86123	0.0096
DLNCPI does not Granger Cause DLNASX200	106	0.82853	0.4396
DLNASX200 does not Granger Cause DLNCPI		0.08235	0.9210
DLN10YB does not Granger Cause DLNASX200	106	0.23042	0.7946
DLNASX200 does not Granger Cause DLN10YB		0.33329	0.7173
DLNLCI does not Granger Cause DLNASX200	106	2.23777	0.1120
DLNASX200 does not Granger Cause DLNLCI		0.11555	0.8910
DLNCP does not Granger Cause DLNASX200	106	0.56664	0.5692
DLNASX200 does not Granger Cause DLNCP		0.66002	0.5191
DLNTWI does not Granger Cause DLNASX200	106	2.15962	0.1207
DLNASX200 does not Granger Cause DLNTWI		0.65844	0.5199
DLNNYSE does not Granger Cause DLNASX200	106	2.51855	0.0856
DLNASX200 does not Granger Cause DLNNYSE		1.28008	0.2825
DLNCPI does not Granger Cause DLNRGDP	106	0.21389	0.8078
DLNRGDP does not Granger Cause DLNCPI		0.40535	0.6678
DLN10YB does not Granger Cause DLNRGDP	106	1.05915	0.3506
DLNRGDP does not Granger Cause DLN10YB		0.58570	0.5586
DLNLCI does not Granger Cause DLNRGDP	106	0.57948	0.5620
DLNRGDP does not Granger Cause DLNLCI		1.18879	0.3088
DLNCP does not Granger Cause DLNRGDP	106	0.86258	0.4252
DLNRGDP does not Granger Cause DLNCP		0.92844	0.3985
DLNTWI does not Granger Cause DLNRGDP	106	3.16265	0.0465
DLNRGDP does not Granger Cause DLNTWI		0.13403	0.8747
DLNNYSE does not Granger Cause DLNRGDP	106	1.97573	0.1440
DLNRGDP does not Granger Cause DLNNYSE		1.69837	0.1882
DLN10YB does not Granger Cause DLNCPI	106	2.09840	0.1280
DLNCPI does not Granger Cause DLN10YB		0.34906	0.7062
DLNLCI does not Granger Cause DLNCPI	106	0.69047	0.5037
DLNCPI does not Granger Cause DLNLCI		0.56176	0.5720
DLNCP does not Granger Cause DLNCPI	106	0.35099	0.7048
DLNCPI does not Granger Cause DLNCP		0.95598	0.3879
DLNTWI does not Granger Cause DLNCPI	106	0.35403	0.7027
DLNCPI does not Granger Cause DLNTWI		3.14729	0.0472

DLNNYSE does not Granger Cause DLNCPI	106	0.11988	0.8872
DLNCPI does not Granger Cause DLNNYSE		1.03414	0.3593
DLNLCI does not Granger Cause DLN10YB	106	2.77116	0.0674
DLN10YB does not Granger Cause DLNLCI		0.66634	0.5158
DLNCP does not Granger Cause DLN10YB	106	4.55535	0.0128
DLN10YB does not Granger Cause DLNCP		2.00281	0.1403
DLNTWI does not Granger Cause DLN10YB	106	1.02413	0.3628
DLN10YB does not Granger Cause DLNTWI		0.53571	0.5869
DLNNYSE does not Granger Cause DLN10YB	106	0.94219	0.3932
DLN10YB does not Granger Cause DLNNYSE		0.81028	0.4476
DLNCP does not Granger Cause DLNLCI	106	1.16181	0.3171
DLNLCI does not Granger Cause DLNCP		0.40325	0.6692
DLNTWI does not Granger Cause DLNLCI	106	7.59713	0.0008
DLNLCI does not Granger Cause DLNTWI		0.14604	0.8643
DLNNYSE does not Granger Cause DLNLCI	106	0.00138	0.9986
DLNLCI does not Granger Cause DLNNYSE		2.78019	0.0668
DLNTWI does not Granger Cause DLNCP	106	5.39165	0.0060
DLNCP does not Granger Cause DLNTWI		2.66274	0.0747
DLNNYSE does not Granger Cause DLNCP	106	4.54294	0.0129
DLNCP does not Granger Cause DLNNYSE		4.59784	0.0123
DLNNYSE does not Granger Cause DLNTWI	106	2.39212	0.0966
DLNTWI does not Granger Cause DLNNYSE		0.27817	0.7577

E.16. Granger causality between ASX200 and independent variables with lag 3

Pairwise Granger Causality Tests
Date: 12/30/11 Time: 23:28
Sample: 1982Q3 2009Q3
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNRGDP does not Granger Cause DLNASX200	105	1.95568	0.1257
DLNASX200 does not Granger Cause DLNRGDP		2.86217	0.0407
DLNCPI does not Granger Cause DLNASX200	105	0.78675	0.5041
DLNASX200 does not Granger Cause DLNCPI		0.11521	0.9510
DLN10YB does not Granger Cause DLNASX200	105	1.06633	0.3670
DLNASX200 does not Granger Cause DLN10YB		0.96835	0.4109
DLNLCI does not Granger Cause DLNASX200	105	1.64570	0.1838
DLNASX200 does not Granger Cause DLNLCI		0.87510	0.4568
DLNCP does not Granger Cause DLNASX200	105	1.00806	0.3926
DLNASX200 does not Granger Cause DLNCP		1.48811	0.2225
DLNTWI does not Granger Cause DLNASX200	105	1.87205	0.1393
DLNASX200 does not Granger Cause DLNTWI		0.48742	0.6918
DLNNYSE does not Granger Cause DLNASX200	105	1.70857	0.1702
DLNASX200 does not Granger Cause DLNNYSE		1.29670	0.2799
DLNCPI does not Granger Cause DLNRGDP	105	0.58083	0.6290
DLNRGDP does not Granger Cause DLNCPI		1.49755	0.2200
DLN10YB does not Granger Cause DLNRGDP	105	0.87680	0.4559
DLNRGDP does not Granger Cause DLN10YB		0.33976	0.7966
DLNLCI does not Granger Cause DLNRGDP	105	0.97240	0.4090
DLNRGDP does not Granger Cause DLNLCI		1.90895	0.1331
DLNCP does not Granger Cause DLNRGDP	105	0.94548	0.4218
DLNRGDP does not Granger Cause DLNCP		0.56951	0.6364
DLNTWI does not Granger Cause DLNRGDP	105	3.44611	0.0196
DLNRGDP does not Granger Cause DLNTWI		0.48016	0.6968
DLNNYSE does not Granger Cause DLNRGDP	105	1.84331	0.1443
DLNRGDP does not Granger Cause DLNNYSE		0.89115	0.4486
DLN10YB does not Granger Cause DLNCPI	105	2.91870	0.0379
DLNCPI does not Granger Cause DLN10YB		0.98350	0.4039
DLNLCI does not Granger Cause DLNCPI	105	0.94627	0.4214
DLNCPI does not Granger Cause DLNLCI		1.04786	0.3750
DLNCP does not Granger Cause DLNCPI	105	0.75277	0.5233
DLNCPI does not Granger Cause DLNCP		4.20305	0.0077
DLNTWI does not Granger Cause DLNCPI	105	0.47318	0.7017
DLNCPI does not Granger Cause DLNTWI		4.53918	0.0051

DLNNYSE does not Granger Cause DLNCPI	105	0.18671	0.9052
DLNCPI does not Granger Cause DLNNYSE		0.96664	0.4117
DLNLCI does not Granger Cause DLN10YB	105	1.92892	0.1299
DLN10YB does not Granger Cause DLNLCI		0.38460	0.7643
DLNCP does not Granger Cause DLN10YB	105	5.67875	0.0013
DLN10YB does not Granger Cause DLNCP		4.20609	0.0076
DLNTWI does not Granger Cause DLN10YB	105	1.27123	0.2885
DLN10YB does not Granger Cause DLNTWI		1.72949	0.1659
DLNNYSE does not Granger Cause DLN10YB	105	0.70248	0.5528
DLN10YB does not Granger Cause DLNNYSE		0.94401	0.4225
DLNCP does not Granger Cause DLNLCI	105	1.37514	0.2549
DLNLCI does not Granger Cause DLNCP		0.23057	0.8749
DLNTWI does not Granger Cause DLNLCI	105	5.32794	0.0019
DLNLCI does not Granger Cause DLNTWI		1.51213	0.2162
DLNNYSE does not Granger Cause DLNLCI	105	0.79304	0.5006
DLNLCI does not Granger Cause DLNNYSE		1.94040	0.1281
DLNTWI does not Granger Cause DLNCP	105	4.18236	0.0079
DLNCP does not Granger Cause DLNTWI		2.01454	0.1169
DLNNYSE does not Granger Cause DLNCP	105	3.77254	0.0131
DLNCP does not Granger Cause DLNNYSE		3.03965	0.0326
DLNNYSE does not Granger Cause DLNTWI	105	2.03368	0.1141
DLNTWI does not Granger Cause DLNNYSE		1.51066	0.2165

E.17. Granger causality between ASX200 and independent variables with lag 4

Pairwise Granger Causality Tests
Date: 12/30/11 Time: 23:28
Sample: 1982Q3 2009Q3
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNRGDP does not Granger Cause DLNASX200	104	1.06676	0.3774
DLNASX200 does not Granger Cause DLNRGDP		2.81348	0.0296
DLNCPI does not Granger Cause DLNASX200	104	0.82768	0.5108
DLNASX200 does not Granger Cause DLNCPI		0.14397	0.9652
DLN10YB does not Granger Cause DLNASX200	104	0.59457	0.6674
DLNASX200 does not Granger Cause DLN10YB		0.61946	0.6497
DLNLCI does not Granger Cause DLNASX200	104	1.10652	0.3581
DLNASX200 does not Granger Cause DLNLCI		1.10062	0.3609
DLNCP does not Granger Cause DLNASX200	104	0.86921	0.4855
DLNASX200 does not Granger Cause DLNCP		1.30943	0.2721
DLNTWI does not Granger Cause DLNASX200	104	1.93673	0.1106
DLNASX200 does not Granger Cause DLNTWI		0.43649	0.7819
DLNNYSE does not Granger Cause DLNASX200	104	2.29253	0.0651
DLNASX200 does not Granger Cause DLNNYSE		1.70071	0.1563
DLNCPI does not Granger Cause DLNRGDP	104	1.04946	0.3860
DLNRGDP does not Granger Cause DLNCPI		1.74059	0.1475
DLN10YB does not Granger Cause DLNRGDP	104	0.51612	0.7240
DLNRGDP does not Granger Cause DLN10YB		0.28777	0.8853
DLNLCI does not Granger Cause DLNRGDP	104	1.72758	0.1503
DLNRGDP does not Granger Cause DLNLCI		2.18172	0.0769
DLNCP does not Granger Cause DLNRGDP	104	1.08891	0.3665
DLNRGDP does not Granger Cause DLNCP		0.37017	0.8294
DLNTWI does not Granger Cause DLNRGDP	104	2.92907	0.0248
DLNRGDP does not Granger Cause DLNTWI		0.34090	0.8497
DLNNYSE does not Granger Cause DLNRGDP	104	1.13755	0.3436
DLNRGDP does not Granger Cause DLNNYSE		0.87841	0.4800
DLN10YB does not Granger Cause DLNCPI	104	2.22597	0.0719
DLNCPI does not Granger Cause DLN10YB		0.66501	0.6178
DLNLCI does not Granger Cause DLNCPI	104	0.82602	0.5118
DLNCPI does not Granger Cause DLNLCI		0.90491	0.4644
DLNCP does not Granger Cause DLNCPI	104	0.70125	0.5930
DLNCPI does not Granger Cause DLNCP		3.18520	0.0168
DLNTWI does not Granger Cause DLNCPI	104	0.41240	0.7993

DLNCPI does not Granger Cause DLNTWI		3.33282	0.0134
DLNNYSE does not Granger Cause DLNCPI	104	0.83949	0.5035
DLNCPI does not Granger Cause DLNNYSE		0.81872	0.5164
DLNLCI does not Granger Cause DLN10YB	104	1.63588	0.1716
DLN10YB does not Granger Cause DLNLCI		0.45384	0.7694
DLNCP does not Granger Cause DLN10YB	104	3.55546	0.0095
DLN10YB does not Granger Cause DLNCP		3.01441	0.0218
DLNTWI does not Granger Cause DLN10YB	104	0.83999	0.5032
DLN10YB does not Granger Cause DLNTWI		1.26460	0.2894
DLNNYSE does not Granger Cause DLN10YB	104	0.52016	0.7211
DLN10YB does not Granger Cause DLNNYSE		0.81779	0.5169
DLNCP does not Granger Cause DLNLCI	104	1.55350	0.1931
DLNLCI does not Granger Cause DLNCP		0.28503	0.8870
DLNTWI does not Granger Cause DLNLCI	104	4.46897	0.0024
DLNLCI does not Granger Cause DLNTWI		1.26939	0.2875
DLNNYSE does not Granger Cause DLNLCI	104	1.18964	0.3204
DLNLCI does not Granger Cause DLNNYSE		1.91688	0.1139
DLNTWI does not Granger Cause DLNCP	104	3.41379	0.0118
DLNCP does not Granger Cause DLNTWI		2.19228	0.0757
DLNNYSE does not Granger Cause DLNCP	104	3.16059	0.0174
DLNCP does not Granger Cause DLNNYSE		2.41288	0.0543
DLNNYSE does not Granger Cause DLNTWI	104	1.75612	0.1442
DLNTWI does not Granger Cause DLNNYSE		1.11988	0.3518

E.18. Error Correction Model Based on Granger Causality Test Results

Dependent Variable: DLNASX200
Method: Least Squares
Date: 01/21/12 Time: 13:32
Sample (adjusted): 1983Q1 2009Q3
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.028969	0.011347	2.553133	0.0122
DLNRGDP(-1)	-0.815288	0.805552	-1.012086	0.3139
DLNLCI(-1)	-0.724278	0.448185	-1.616025	0.1092
DLNNYSE(-1)	0.164194	0.106640	1.539697	0.1267
RESID01(-1)	-0.222377	0.100372	-2.215524	0.0289

R-squared	0.128758	Mean dependent var	0.021303
Adjusted R-squared	0.094591	S.D. dependent var	0.093554
S.E. of regression	0.089020	Akaike info criterion	-1.954320
Sum squared resid	0.808296	Schwarz criterion	-1.829422
Log likelihood	109.5561	Hannan-Quinn criter.	-1.903688
F-statistic	3.768546	Durbin-Watson stat	2.169495
Prob(F-statistic)	0.006699		