DISSERTATION

STOCK PRICES AND THE PREDICTIVE POWER OF MACROECONOMIC VARIABLES: THE CASE OF THE SAUDI STOCK MARKET

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Khalid S. Alkhudairy

Department of Economics

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY KHALID ALKHUDAIRY ENTITLED STOCK PRICES AND THE PREDICTIVE POWER OF MACROECONOMIC VARIABLES; THE CASE OF THE SAUDI STOCK MARKET BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Norman L. Dalsted

Chuen-mei Fan

Robert W. Kling

Adviser: Liang-Shing Fan

Department Head: Steven J. Shulman

ABSTRACT OF DISSERTATION

STOCK PRICES AND THE PREDICTIVE POWER OF MACROECONOMIC VARIABLES: THE CASE OF THE SAUDI STOCK MARKET

A literature review of the relationship between stock market prices and fundamental economic activities showed that there is a disagreement among economists about this relationship. Some studies show that there is a relationship between stock prices and fundamental economic activities, while others do not support this relationship.

Utilizing the technique of cointegration, Granger causality based on the vector-error correction model (VECM), and the innovation analysis, this study investigates the long-run and short-run interactions between stock market prices and measures of aggregate real activity, including real money supply, bank credit, oil price, and the Standard and Poor's 500 Index in Saudi Arabia. Beside the composite index of the Saudi Stock Market, six sectional indexes, namely, the bank sector index, the industry sector index, the cement sector index, the service sector index, the electric sector index, and the agriculture sector index were tested for informational efficiency against these measures.

The results of the cointegration analysis indicates that there exists a positive long-run relationship between stock prices and money supply, bank credit, oil prices and the Standard and Poor's 500 in all indexes. The Granger causality test results indicate that in the long run, there is a unidirectional causality from stock prices to money supply in the cement sector, electric sector, and agriculture sector, while a

bidirectional causality is observed between stock prices and money supply in the composite index, the bank sector, industry sector, and the service sector.

The short-run causality showed different relationships among indices. While all variables: money supply, bank credit, oil price, and the Standard and Poor 500 Index caused movement in stock prices in the general index, none of these variables caused the stock prices in the electric sector index, and the agriculture index.

The innovation analysis tends to suggest that stock prices dynamically interact with their own macroeconomic factors. Most of the variation in stock prices in all indexes can be captured by innovation in itself as well as in money supply, bank credit, oil prices, and Standard and Poor's 500 Index, while the reverse also holds. The analysis suggests that the stock market in Saudi Arabia is not informationally efficient with respect to macroeconomic variables.

Khalid S. Alkhudairy
Department of Economics
Colorado State University
Fort Collins, CO 80523
Spring 2008

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CHAPTER ONE

INTRODUCTION

1.1. Overview

Stock markets play an important role in the financial sector of each economy. A healthy stock market can promote economic growth by stabilizing the financial sector and providing an important investment channel that contributes to attract domestic and foreign capital. Fama (1981) showed that there is a strong relationship between stock prices and industrial production as well as gross national product. In related work, Chang and Pinegar (1989) also concluded that there is a close relationship between the stock market and the domestic economic activity.

Despite the importance of stock markets in the world's economies, stock markets remain unstable. For example, the famous 1929 market decline in the United States prior to the great depression. Other examples include the share market crash in the United States in 1987, which sent shock waves throughout the world's financial market, and, more recently, the crises of the Southeast Asian stock markets in 1997. These crashes and accompanying swings have raised the question what, if anything can be done to moderate volatility in stock prices. A debate has been established concerning the design of monetary policy and possible intervention actions by the central banks to prevent a stock market crisis (Dhakal, Kandil, and Sharma, 1993).

An understanding of the determinants of stock market movement is an essential goal, not only for economists or financial analysts, but also of government offices. Most of the empirical studies regarding the determinants of stock market movements have been centered on two contradicting theories: the quantity theory of money and the efficient market hypothesis.

The quantity theory of money has played a large role in determining the relationship between money supply and various economic variables. On the other hand, in the efficient market hypothesis, new information is rapidly incorporated into the prices of assets held in the market, so current asset prices reflect all currently available information.

The Quantity Theory of Money

The modern quantity theory of money (also known as "monetary portfolio model"), developed by Brunner (1961), Friedman (1961), Friedman and Schwartz (1963), assumed investors reach an equilibrium position in which they hold a number of assets including money in their portfolio. A monetary disturbance, such as an unexpected increase in the growth rate of money supply, causes disequilibrium in portfolios of assets. As a result, asset holders adjust the portion of their portfolio represented by money balances. This adjustment alters the demand for other assets that compete with money balances, including stocks. An increase in the money supply is expected to create an excess supply of money balances and an excess demand for stocks, and, as a result, stock prices are expected to rise. This channel of reaction between changes in money supply and stock prices has been described by advocates of the quantity theory of money as direct channel.

An alternative explanation for the response of stock market prices to unexpected changes in the money supply is based on investors' expectations about the reaction of monetary authority to the surprise. This scenario is known as the "policy anticipation effect." In particular, an unexpected increase in money stock will lead market participants to believe that the authorities will have to tighten credit to offset the rise; the measurement taken by the authorities will involve higher interest rates. This will lead to lower stock prices for two reasons. First, the discount rate will rise to reflect expectations of higher rates. Secondly, expected corporate cash flow will decline if market participants believe that an increase in rates depresses economic activity.

Efficient Markets Theory

According to Fama (1970), a market is efficient if prices rationally, fully, and instantaneously reflect all relevant available information, and no profit opportunities are left unexplained. In an efficient market, past information is of no use in predicting future prices and the market should react only to new information. However, since this is unpredictable by definition, price changes or returns in an efficient market cannot be predicted.

Under the Efficient Market Hypothesis it is true that:

$$E\,[\,(P_t - P^*_t)/I_{t-1}] = 0$$

where:

P_t: is the actual price at time t.

P^*_t: is the expected price which is based on the information.

I_{t-1}: is the information set available at time t-1.

The forecast error $P_t - P^*_t$ is uncorrelated with variables in the information set I_{t-1}. Thus, price changes, under the assumption of a constant equilibrium return and risk neutrality, are uncorrelated with variables in the information set I_{t-1}.

Fama (1970) distinguished three types of market efficiency. A market is said to be a weak form efficient if the history of prices is of no use in predicting future prices changes. A market is of a semi-strong form efficient if all publicly available information—like inflation, money supply, and other publicly available factors—have no predictive power. Finally, a market is a strong form efficient if all information is reflected on prices, including so-called "inside" information.

It is impossible to test the strong form of the Efficient Market Hypothesis, but there have been several studies testing the weak and semi-strong form of the Efficient Market Hypothesis.

1.2 Problem Statement

Extensive studies have examined the variation of financial markets to money supply and selected macroeconomic variables. For example, Malliaris and Urruita (1991) found that changes in money supply lead the changes in stock markets, and the performance of the stock market may be used as a leading indicator for measuring real economic activities in the United States.

On the other hand, those findings are in contrast to studies by Kraft and Kraft (1977), Rozeff (1974), and a large body of empirical evidence which rejects the idea of any type of causal relation between the money supply and change in stock prices. These studies support the stock market efficiency hypothesis that stock prices reflect all available information.

So far only a handful of studies have been devoted to investigate the role of fundamental macroeconomic variables on stock markets in developing countries. Fung and Lie (1990) examined the role of the Taiwan stock market in response to the island's GNP and money supply changes, and they concluded that the Taiwanese stock market is inefficient since it fails to capture information regarding changes in those economic variables. Further, Kwon, Shin, and Bacon (1997) investigated the relationship between the Korean stock market and basic economic factors using a regression analysis. They observed that Korean stock prices are influenced by some significant economic factors.

In the past decade, the Saudi stock market has experienced tremendous growth in both trading volume and market value in accordance with rapid economic development. The Saudi stock market is one of the world's most rapidly growing markets, the largest in the Middle East, and in 2001 became the thirtieth largest stock market in the world in regard to market capitalization.

Recently, numerous institutional investors and researchers have been focusing their attention on the capital market of Saudi Arabia as the Saudi stock market will play a major role in a global financial market. Moreover, this market has been mostly ignored by financial researchers. No one has attempted to study market efficiency of the Saudi stock market with regard to fundamental economic activities. This study will attempt to address this gap in the literature. Furthermore, while most of the existing research on the relationship between stock markets and fundamental economic activity studied general stock market index with these activities, and looked at the total effect, this study will investigate the whole stock market (composite index) with respect to economic activities as well as a cross-sectional analysis.

1.3 The Purpose of the Study

The primary purpose of this dissertation is to determine whether current economic activity, in particular money supply (M1, M2), bank credit, crude oil price, and foreign markets i.e. Standard and Poor's 500 can be used to predict stock prices in Saudi Arabia. In other words, this study intends to test for the informational efficient market hypothesis.

The Saudi economy has been the subject of significant changes in recent years. Like other developing nations, Saudi Arabia has taken significant steps towards the development of its capital market, including opening the market to international investors. Measures have been taken for privatization, economic liberalization, and easing of regulations on operation of financial institutions.

This study would employ the cointegration approach and the Granger causality test to investigate the relation between stock market prices and underlying macro variables. If economic variables significantly and consistently affect the price in stock market, they should be cointegrated.

The cointegration analysis requires two steps: the unit root test to determine nonstationarity, and, when the results indicate that the first difference series of each variable are stationary, a subsequent test to determine whether these two variables are cointegrated.

In addition to the composite index, six sectoral indices were also used to test the relationship between stock prices and underlying economic indicators. Stock prices may vary across sectors based on the sensitivity of the sector to change in general economic activities.

1.4 Importance of the Study

In addition to providing much-needed analysis of the relationship between stock market prices and the underlying fundamental economic activities in Saudi Arabia, this study will add to the small number of empirical studies examining economic data by means of cointegration and causality methodologies. Moreover, the question whether stock prices lead economic activities or otherwise is an important issue and the answer can only be determined through empirical research. If a market is inefficient with respect to information (for example, money supply, bank credit, crude oil price, and Standard and Poor's 500), then it has important implications both at micro and macro levels.

At the micro level, this would imply that the individual investor can earn consistently higher than normal rate of return from the stock market. On the other hand, at the macro level, it would raise serious doubts on the ability of the market to perform its fundamental role of channeling funds to the most productive sectors of the economy.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

Since the late 1960s, numerous empirical studies have focused on the relationship between stock market prices and fundamental economic activities, and the findings have been inconsistent. Some studies show that there is a relationship between stock prices and fundamental economic activities, while others do not support this relationship.

While many of these studies have pioneered new modeling techniques or have explored different hypotheses, many have worked simply to expand important theories to a new set of data or new type of data. Many differ substantially in the type of economies they examine, in the sample size of the study, in the regional area, or in their overall purpose. In this review of the literature on empirical studies of the relationship between stock market prices and fundamental economic activities, studies will be placed in two groups: the first group covers the literature that investigates the relationship between money supply and stock markets, and the second one will investigate the relationship between fundamental economic activities including monetary policy and stock market prices.

2.2. Stock Prices and the Money Supply

The effect of changes in money supply on stock prices has been a matter of controversy among economists for many decades. Those in favor of the presence of links between money market and stock market argue that any change in money supply creates a wealth effect which disturbs the existing equilibrium in the portfolio of investors. When they re-adjust their asset portfolio, a new equilibrium is established in which the price level of various assets is changed.

On the other hand, if the stock market is efficient, it would already have incorporated all the current and anticipated changes in money supply. Consequently, a causal relationship between changes in stock prices will not be established. Moreover, if the change in money supply coincides with a corresponding change in the velocity of money, it will not have any effect on stock price.

Sprinkel (1964) pioneered research on the relationship between money supply and stock market using Standard & Poor's (S & P 425) industrial and M1 in the United States for the period 1918-1963. He concluded that there is a strong relationship between the stock market and money supply.

In light of this study, the money supply-stock market relationship has been widely tested for various economies because of the belief that money supply changes have an important direct effect through portfolio changes, and indirect effects through their effects on real economic activity, which in turn is postulated to be a fundamental determinant of stock prices (Habibullah and Baharumshah, 1996).

Sprinkel's study brought many conceptual and methodological issues in the front. Elaborate statistical techniques were used to explore the relationship between money supply and stock prices. For example, Keran (1971) conducted a study of the effect on equity prices Standard & Poor's Composite 500 (S & P 500) of increased money supply in the United States for the period 1956-1970. He found that past money supply data could be used to predict future stock prices.

Homa and Jaffee (1971) estimated the relationship between the supply of money and stock prices for the United States during the period 1954 to 1969. With the help of regression analysis, they found that a significant and systematic relationship exists between the money supply and the average level of stock prices.

Similarly, Modigliani (1972) concluded his study of the determinants of the stock prices with the following statement: "We still cannot see any direct mechanism through which the rate of change of money could affect market values, except possibly because operators take that variable as an indicator of things to come. But even this explanation is hardly credible except perhaps in the last couple of years when watching every wiggle of the money supply has suddenly become so fashionable."

Hamburger and Kochin (1972) studied the relationship between stock prices (S & P Composite Average) and the money supply in the United States for the period 1956:I – 1970:II. They concluded their study by stating that it is clear that changes in monetary growth have a number of different effects on the stock prices.

Pesando (1974) criticized early economic studies which predict stock market innovations on the grounds of market efficiency. He evaluated the potential contribution of the Keran, Hamburger-Kochin, and Homa-Jaffee models to the problem of forecasting the level of common stock prices. The models are re-estimated using both Canadian and American data, and then subjected to a series of tests designed to measure their structural stability and sensitivity to possible specification error. Pesando reached the conclusion that both theoretical and empirical considerations suggest that the extraordinary success of these models in tracking the behavior of stock prices during the sample period may be illusory. His work supports the claim that stock prices are efficient; that is, the stock prices fully reflect all information (current and anticipated) relevant to the determination of common stock prices. This result suggests that one should not place undue confidence in the quantitative estimates of the impact of fluctuations in the money supply on common stock prices.

Cooper (1974) examined a combination of the quantity theory model and the efficient markets model. He used (S & P 500) index as a measure of the stock prices as well as M1 to represent money supply. The data set covers the period 1947:1 – 1970:12. Findings are summarized as follows:

1. The efficient market hypothesis cannot be rejected because of Sprinkel's findings.
2. Stock prices lead money supply changes.
3. Money supply changes do appear to have an important effect on stock prices.

Rozeff (1974) questioned Cooper's work and conducted an extensive study to examine stock market efficiency with respect to money supply data by testing regression models of stock prices on monetary variables. He used a data set of Fisher's Link Relative Index, (S & P 500), and money supply for the period 1916:8 – 1972:12. He concluded that stock prices are unrelated to past available data on growth rates of the money supply and current stock prices bear a significant relationship to current monetary growth rates which is consistent with efficient market hypothesis.

Using data for the period 1963:1 – 1974:12, Rogalski and Vinso (1977) conducted causality tests for the most common stock prices, (S & P 500), Fisher's Link Relative Index (FIS), Dow-Jones Industrial Average (DJIA). New York Stock

Exchange Index (NYSE), and money supply. These tests of causality indicate rejection of the null hypothesis of stochastic independence between stock prices and money supply.

Berkman (1978) tested the relationship between stock prices and money supply in the United States. He used the Standard & Poor's Composite Average and M1 for the weekly data from 1975 to 1977. Berkman showed that stock prices only react to unanticipated changes.

In another study, by using M1, M2, and the Dow-Jones Industrial Average, Lynge (1981) conducted a study on the effect on stock prices of monetary policy announcements for the period 1976-1979 (weekly data). Lynge did not distinguish between anticipated and unanticipated changes. He found that positive money supply announcements lowered stock prices.

Six Asian-Pacific countries were chosen by Ho (1983) to investigate the causal relationship between money supply and stock prices. Using monthly data, he found that the information on money supply is useful in predicting stock prices in Hong Kong, Japan, the Philippines, Australia and Thailand. However, the efficient markets hypothesis cannot be rejected for the Singaporean case.

Pearce and Roley (1983) re-examined the question of how stock prices react to unanticipated money supply announcements. Using weekly data, 1977-1982, they estimated the following model:

$$\Delta SP = a + b(\Delta M^a_t - \Delta M^e_t) + e_t$$

where:

ΔSP_t = change in stock prices observed after the monetary supply announcement, in percent.

ΔM^a_t = announced change in the money stock, in percent.

ΔM^e_t = expected change in the money stock, in percent.

e = random error term.

The expected change in the money stock was obtained from survey data. They found that stock prices respond only to the unanticipated change in the money supply as predicted by the efficient market hypothesis. They also found that an unanticipated increase in the announced money supply depresses stock prices while an unanticipated decrease elevates stock prices.

Unlike most previous works, which presumed that the reaction of stock prices was symmetric with respect to unanticipated increases or decreases in money, Hafer (1986) tested for the separate effect of positive and negative unexpected changes in M1. Using weekly data for the period 1974-1984, his findings support the efficient market hypothesis. Based on evidence from several different stock price indexes, unanticipated changes in money have a statistically significant effect on stock prices. Expected changes in money never display a statistically significant effect. One result that does not support the efficient market hypothesis is the finding that the effects of unanticipated money changes are symmetric; only positive values of unanticipated changes in money appear to have a significant impact on the S & P 500 and S & P 400.

Hashemzadeh and Taylor (1988) employed weekly data for the United States covering the period 1980:1 – 1986:7 to test the relationship between money supply and stock prices. They used Granger-Sims' test to determine uni-directional causality. They found that the relationship between the money supply and stock prices is characterized by a feedback system (bidirectional causality) where money supply causes some of the observed variations in stock prices and vice versa.

In another study Mak and Cheung (1991) investigated the relationship between the United States money supply and the Asian-Pacific stock markets, namely Australia, Hong Kong, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Taiwan and Thailand. Their results support the efficient market hypothesis.

Cornelius (1993) investigated whether changes in the money supply were correctly anticipated in stock prices. By applying the Granger causality test, the efficient market hypothesis was tested in six emerging stock markets: Taiwan, Thailand, Korea, Malaysia, India, and Mexico. He found four of these stock markets are inconsistent with the efficient market hypothesis.

Evidence supporting the efficient market hypothesis was found in a study conducted by Lin (1993). Lin found that the growth in money supply can be used to predict the Taiwanese stock market. Lin's work also showed that both the Korean and Singaporean markets are closely related with money supply. For the Korean stock market, money supply leads the stock market, but for the Singaporean stock market, stock market leads money supply.

In another study Lee (1994) examined aggregate stock prices to see if they fully incorporated all available information on the money supply in the United States. Using data set for the period from January 1978 to September 1990, He found evidence of market inefficiency; that is, changes in the money supply unidirectionally caused stock prices.

In two separate studies Darrat and Dickens (1996) and Kearney (1996) investigated the relationship between money supply and stock prices. First, Darrat and Dickens used the same test period and data as Lee's 1994 study. They differ from Lee's work in that they estimated a multivariate model. Their results do not support the efficient market hypothesis. Second, Kearney analyzed the effects of the unanticipated part of money announcements on agents' expectations. He postulates that the magnitude of the stock prices' reaction to these announcements depends on the extent to which the announcement itself has effects on agents' expectations.

Binary variable is employed to measure monetary policy by Jensen, Mercer and Johnson (1996) to indicate the direction of monetary policy. They distinguished between expansive and restrictive monetary policy based on the direction of change in the discount rate. Their data set includes monthly and quarterly data for the period from 1954:2 – 1991:12. They showed that monetary policy changes are significantly related to both stock and bond prices. In particular, they showed that stock prices are significantly higher in periods characterized by an expansive monetary policy than during restrictive monetary periods.

Patelis (1997), using long-horizon regressions and short-horizon vector autoregressions, examines if change in the stance of monetary policy can account for the observed predictability in excess stock prices. The sample period ranged from January 1962 to November 1994 with analysis focused on monthly, quarterly, annual, and biennial horizons. The study concluded that monetary policy variables were significant predictors of stock prices.

Jensen, Johnson, and Bauman (1997) investigated the short-term reaction and long-term performance of sixteen industry stock indices in relation to change in the Federal Reserve monetary policy for the period August 1968 to December 1991. The short-term results indicated that all industrial stock prices except the oil industry reacted positively to monetary policy expansion, and negatively to money supply contraction. Furthermore, the strongest reaction was exhibited by stocks of those industries generally identified as interest rate sensitive: construction and finance. The long-term results also displayed significant return patterns associated with money supply changes. The 16 industry sectors all performed significantly better following an increase in money supply that followed a decrease in money supply. The results, however, displayed a large degree of dispersion across the industries.

Conover, Jensen, and Johnson (1999a) examined the relationship between monetary conditions and global stock prices. They analyzed monthly stock prices for the period 1956:1 – 1995:12. The stock prices came from country stock indexes for Austria, Belgium, Canada, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, South Africa, Sweden, Switzerland, United Kingdom, and United States. They found out that the patterns in international stock prices are related to both U. S. and local monetary conditions. Specifically, stock prices for most countries are higher when monetary conditions are expansive and lower when monetary conditions are restrictive with respect to both U. S. monetary conditions and local monetary conditions. Furthermore, the relationship between monetary conditions and stock prices appears to be somewhat cumulative; the best market performance generally corresponded to periods when U. S. and local monetary conditions were simultaneously expansive, whereas the worst performance frequently occurred when the two were simultaneously restrictive.

In another study Conover, Jensen, and Johnson (1999b) provide evidence indicating that international stock markets also exhibit patterns that are linked to monetary policy changes. They classify the monetary environment as either expansive or restrictive based on the most recent money supply indicators. They used the data set from January 1956 to December 1995 for the same 16 countries that were used in the previous study. They concluded that changes in monetary conditions effectively differentiate periods of differing stock market performance. Fourteen of 16 countries display stock price patterns associated with changes in monetary conditions. For seven countries, local plus U.S. monetary conditions explain 4% or more of the variation in stock prices.

Park and Ratti (2000) re-examined the findings of Geske and Roll (1983), James, Koreisha and Partch (1985), and Kaul (1987). They investigated the dynamic interdependencies among inflation, stock prices, and monetary policy. Their paper used monthly United States data from January 1955 to March 1998, and they used a vector autoregression (VAR) model to conduct this study. They found that contractionary monetary policy shocks generated statistically significant movement in inflation and expected real stock prices, and that these movements go in opposite directions.

Employing generalized variance decomposition methodology within a vector autoregression (VAR) framework, Ewing (2001) examined the validity of efficient market hypothesis. The Standard & Poor stock market composite index is examined to determine how much of the variance in stock prices can be explained by monetary policy. Data set covers the period from 1988:1 – 1997:12. Ewing found that shocks to monetary policy explain a substantial amount of movement in stock prices.

Examining the influence of the monetary policy environment on the mean and conditional variance of value and growth stock prices was the contribution of Black (2002) to this field of study. Her work uses regression analysis and threshold autoregressive conditional heteroscedastic model (TARCH) to see whether different monetary policy regimes (expansive or restrictive) have different effects on the mean and volatility of value stocks and growth stocks. An international data set is used which consists of 17 countries: Australia 1976:1 – 2000:12), Belgium (1989:11 – 2000:12), Denmark (1989:1 – 2000:12), Finland (1988:1 – 2000:12), France (1985:4 – 2000:12), Germany (1981:2 – 2000:12), Hong Kong, Italy (1985:2 – 2000:12), Japan, Netherlands (1979:2 – 2000:12), Norway (1988:1 – 2000:12), Singapore (1982:2 – 2000:12), Spain (1988:9 – 2000:12), Sweden (1984:1 – 2000:6), Switzerland (1984:1 – 2000:12), U.K., U.S.A. (1975:1 – 2000:6).

She found that monetary announcements have a symmetric effect on value and growth stocks. For instance, in France, Germany, the Netherlands, Spain, Sweden, and the U. S., value returns are likely to be around 2 percent lower in a U. S. restrictive monetary policy regime relative to growth stocks. For the other countries, however (most notably the U. K. and the Netherlands), there is no difference between the returns on value stocks in a U. S. restrictive monetary policy regime compared with an expansive U. S. monetary policy regime.

Sixteen countries were used to evaluate the robustness of the relationship between monetary policy and stock price by Durham (2003). He performed sensitivity analysis by dividing the length of 1956-2000 sample period to study this relationship for these countries. The relationship between stock prices and monetary policy was highly sensitive to whether he used raw stock prices or price change as the dependent variable. Only data for the United States for the full 1957-2000 sample support the hypothesis that monetary easing correlates with higher excess prices. Moreover, some data directly contradict the hypothesis. For example, periods of monetary tightening in Canada during 1971-1985 correlated positively with excess prices.

Sari and Malik (2004) examined the impact of monetary policy on stock prices for the case of Turkey. They used monthly data covering the period from January 1987 to September 2000. Istanbul Stock Exchange 100 index is used to measure stock prices, and seasonally adjusted M1, M2 to measure money supply. They estimate a vector autoregression that contains growth rate of stock prices and growth rate of M1 and M2. They found that a shock to growth rate of money supply contains significant information for predicting variance in future forecast errors of stock prices.

More recently, Conover et al. (2005) examined empirical evidence from 38 years of U. S. data to explore the influence of monetary policy on the stock prices to various U. S. sectors as well as several international stock indexes. They concluded that monetary conditions have had and continue to have a strong relationship with stock prices. In particular, periods of expansive monetary policy are associated with strong stock performance, whereas periods of restrictive monetary policy generally coincide with weak stock performance. They studied the influence of companies and found that small-cap companies are more sensitive than large-cap companies to change in monetary conditions. Portfolios of small-cap stocks have economically and statistically significant monetary policy-related patterns that are consistent over time. Finally, U. S. monetary policy has an important influence on global markets. They found significant return patterns related to U. S. monetary policy for five international stock indexes.

2.3. Stock Markets and Fundamental Economic Activities

The claim that macroeconomic variables drive the movement of stock prices is, by now, a widely accepted theory. However, only in the past two decades or so have attempts been made to capture the effect of economic forces in a theoretical setting and to calibrate these effects empirically.

Effects of announcements of discount rate on interest rate and stock prices were the main focus of Waud (1970). He used the data for discount rate and the Standard & Poor's 500 for the period from 1952:6 to 1967:6. He assumed that what is meant by the notion of an announcement effect, associated with Federal Reserve discount rate changes, is an effect that altered the expectations of businessmen, financial institutions, and other economic factors about the future course of the economy. He found a significant and immediate response of stock prices to discount rate changes.

Sellon (1980) discussed how discount rate changes alter bank lending and influence stock prices. First, rate changes may affect prices by impacting the level of borrowing from the Fed; for instance, a rate cut causes increased borrowing from the Fed and a subsequent increase in bank lending. Second, discount rate changes may impact lenders' expectations and, hence, their level of lending even though the amount borrowed from the Fed remains unchanged.

Monthly CPI inflation rate announcements are used to examine the stock market reaction. Schwert (1981) used measure of unexpected inflation rather than just the announced rate. Schwert's results contradict the efficient market hypothesis because they imply a slow adjustment of stock prices to new information on inflation.

Some studies explore the period before and after October 8, 1979 (pre- and post-1979), to determine the effect of monetary policy on stock prices' reaction to discount changes. Roley and Troll (1984) contend no meaningful announcement effects are possible in the pre-1979 period because any effects on market rates would be offset change in the level on nonborrowed reserves. In contrast, in the post-1979 period, discount rate changes are expected to affect interest rates directly via changes in the expected short-run money path. They introduced evidence that stock market yields respond to discount rate changes in the post-1979 period, but not in the pre-1979 period.

Distinguishing between technical discount rate changes and nontechnical changes, Smirlock and Yawitz (1985) studied the relationship between discount rate and stock prices. Technical discount rate changes are endogenous, and nontechnical changes contain some information about monetary policy. For the pre-1979 period they found no evidence of announcement effects. Conversely, for the post-1979 period they found significant negative announcement effect, but only for nontechnical discount rate changes.

Pearce and Roley (1985) examined the daily response of stock prices to announcements about the money supply, inflation, real economic activity (producer price index, unemployment rate, industrial production), and discount rate. Several conclusions follow from their empirical investigations:

- New information related directly to monetary policy significantly affects stock prices. In particular, monetary announcements surprises have a significantly negative effect on stock prices in the sample period beginning in September 1977 to October 1982. In the subsample beginning in October 1979, discount rate changes also have significant effects.
- Only limited evidence supports the view that either inflation or real economic activity surprises affect stock prices. In the pre-October 1979 subsample, announcements of producer price indexes have significant effects on the stock prices, but they are estimated to be offset by the end of one week.
- Empirical results indicate that anticipated components of economic announcements do not significantly affect daily stock prices movement.

Furthermore, Chen, Roll, and Ross (1986) examined the effect of macroeconomic factors, such as industrial production, the money supply, inflation, the exchange rate, and long- and short-term interest rate on the stock market return in the United States using a multivariate arbitrary-pricing model. These variables fundamentally influence either the future cash flow or the risk adjusted discount rate in a standard stock price valuation model, in which the stock price is broadly interpreted as the present value of the expected future cash flow.

Hardouvelis (1987) tested the response of stock prices to the announcement of 15 representative macroeconomic variables (M1, discount rate, surcharge rate, free reserves, consumer price index, producer price index, unemployment rate, industrial production index, personal income, durable goods order, index of lending indicators, consumer credit, retail sales, housing starts, and trade deficit). Hardouvelis' daily data set covers the period from October 11, 1979, to October 5, 1982. He concluded that stock prices respond primarily to monetary news. The strongest reactions were observed from the October 1979 to October 1982 period when the Federal Reserve followed strict annual M1 targets and adopted non-borrowed reserves as both the intra- and inter-week targets. The stock price responses to nonmonetary announcements are very weak. Among the nonmonetary news, stock prices responded to the announcements of the trade deficit, the unemployment rate, and personal income. The response to the unemployment rate is significantly stronger in the post-October 1982 period.

Cook and Hahn (1988) performed an interindustry examination of the relationship between discount rate change and both short- and long-term stock prices. First, cross-industry analysis is performed whereby short- and long-term stock prices associated with discount rate changes are compared and contrasted across 16 industries. Stock prices vary across industries based on the sensitivity of the industry to changes in interest rates and general economic activity. Second, for each industry the short-term stock price movement at the time of a discount rate change is related to the industry's long-term performance. The short-term reaction reflects investors' initial assessment of the impact of a discount rate change will have on the industry, whereas the actual outcome is measured by long-term performance.

In two studies, Baily (1989, 1990) analyzed the effect of U. S. money supply announcements on the stock markets of Canada and the Pacific Rim countries. In the first one, he investigated the weekly effect of unexpected U. S. M1 changes on Canada's markets for common stock, long-term bonds, short-term money, and foreign exchange during the three U. S. monetary regimes of recent times. Data on Canadian financial market and weekly U. S. money supply covers the period from October 7, 1977, to September 26, 1985. The empirical results show the importance of U. S. M1 for Canada's financial market. Unexpectedly high (low) U. S. M1 growth leads to lower (higher) prices of Canadian stocks and bonds and higher (lower) Canadian short-term interest rates.

In the second one, Baily explores variation across Pacific Rim countries in the response of stock prices to unexpected U. S. M1 changes. The Pacific Rim countries are: Australia, Hong Kong, Japan, South Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand. The stock indexes of countries with relatively few barriers to portfolio investment flows exhibit reaction to U. S. money shocks, which are similar to those of the U. S. market. Specifically, unexpected high (low) U. S. M1 is associated with negative (positive) stock returns in those countries. The differing effect of unexpected U. S. M1 changes across countries cannot be explained by differing levels of export to the U.S.A. or by anticipation of the reaction of the U. S. stock market. The evidence also suggests that the combination of low capital flow barriers, unregulated money market rates, and a pegged exchange rate can cause a country's stock market to be particularly sensitive to U.S. money shocks.

Bulmash and Trivoli (1991) investigated the time-lagged interaction between U S. stock prices and selected economic variables. With many independent variables, along with a variety of assumed time lags, their model is large with an extensive degree of statistical multicollinearity or autocorrelation. They used an autoregressive procedure, and their results indicate that the actual inflation measured by the CPI is spurious, the monetary effects (M2) are positively related for short lags but negatively correlated for longer lags. Furthermore, they report that both short-term and long-term interest rates have a negative impact on the stock prices.

Abdullah and Hayworth (1993) examined Granger causality between U. S. stock prices and budget deficit, trade deficit, money growth, industrial product growth, inflation rate, and short-term and long-term interest rate. The results show that past money growth, budget deficits, inflation, and both short- and long-term interest rate are Granger causal to stock prices. These variables also explain a substantial proportion of the forecast error variance of stock prices. It found that stock prices are related positively to inflation and money growth and negatively to budget deficit, trade deficit, and both short- and long-term interest rates.

The interaction between the money supply and the stock price in the U. S. was analyzed by Dhakal, Kandil, and Sharma (1993). A vector autoregressive technique was employed, and the model includes stock prices, money supply, the short-term interest rate, price level, and real output. The results are consistent with a direct causal impact of change in money supply on stock prices. Changes in the money supply have causal impacts on the interest rate and the inflation through the causal impact that these variables have on share prices. On the other hand, their findings suggest that changes in stock prices have a large impact on the rate of growth of industrial real output.

Habibullah and Baharumshah (1996) used a two-step trivariate cointegration approach to check whether money supply and output can be used to predict stock prices in Malaysia. They used monthly data on stock price indexes, money supply, and national output that spans January 1978 to September 1992. The trivariate cointegration analysis suggests that stock indexes and macroeconomic variables, in particular money supply and national output, are not cointegrated. This suggests that stock price indexes in Malaysia have already incorporated all past information on both money supply and output, which is consistent with efficient market hypothesis.

Using a nonlinear, seemingly unrelated regression technique, Thorbecke and Coppack (1995) investigated whether fluctuations in industry stock prices are due to industry-specific shocks or to monetary and other macroeconomic factors. They used monthly two sub-periods, from 1974:9 to 1979:9 and 1982:8 to 1987:9, and they cut the sample at September to avoid anomalous effects that could arise from including the October 1987 stock market crash in their sample. They employed industrial production, CPI inflation rate, index of commodity prices, funds rate, nonborrowed reserves, and total reserves as macro-economic factors. The results of their work indicate that on average 32 percent of the variation in stock prices is explained by macroeconomic factors. They found that in 96 percent of the cases examined a monetary tightening depresses stock prices. This result supports monetary business cycle models over those emphasizing real factor alone.

Two measures (Federal fund rate, nonborrowed reserves) of monetary policy and several empirical techniques (impulse-response function, variance decomposition, generalized method of moments estimation, nonlinear seemingly unrelated regression estimation) are employed by Thorbecke (1997) to examine how stock prices data respond to monetary policy shocks. This study is performed over the period 1967:1 – 1990:12 (October 20, 21 are deleted from the estimation). His results present evidence that monetary policy has large effects on stock prices. Results from portfolios size indicate that monetary shocks have larger effects on small firms than large firms. This evidence supports the hypothesis that monetary policy matters partly because it affects firm's access to credit.

Abdullah (1998) used a seven variable vector autoregression system to analyze the effect of money growth variability on British stock prices using the London share price index. He used M1, budget deficit, budget surplus, industrial production, consumer price index, and long-term interest rate. Variance decompositions results showed that money growth variability accounts for 22.82% of variance of interest rate, and 19.53% of the variance of stock prices.

Lastrapes (1998) estimated the vector autoregression representation of an index of stock prices, interest rate, output, the price level, and the nominal money stock for eight industrialized countries (the G-7 countries and the Netherland). The sample data cover the period from 1959:1 to 1994:3, and the results indicate that a real liquidity effect exists in the stock market for most of the countries in the sample, although there is a substantial variation in the magnitude of the effects across countries.

Niarchos and Alexakis (2000) investigated whether it is possible to predict stock market prices with the use of macroeconomic variables in the Athens Stock Exchange. Macroeconomic variables include inflation rate measured by CPI, the money supply measured by M2, and the Greek Drachmae/U.S. dollar exchange rate. The time period under investigation was from January 1984 to December 1994 on a monthly basis. Using cointegration technique and causality test, their statistical findings lead them to reject statistically the efficient market hypothesis. The statistical evidence suggests that monthly stock prices in the Athens Stock Exchange are positively correlated to those variables.

Using Johansen's vector error-correction model, Maysami and Koh (2000) examined relations between macroeconomic variables and Singapore stock markets, as well as the association between the U.S. and Japanese stock market and the Singapore stock exchange. The macroeconomic variables employed in this study are exchange rate, short- and long-term interest rates, inflation, money supply, domestic export, and industrial production, and the data cover the period from 1988:1 to 1995:1. Their results show that inflation, money supply growth, change in short- and long-term interest rate, and variations in exchange rate do form a cointegration relation with changing in Singapore's stock market levels. Based on tests of linear restrictions, they found that while inflation and money supply growth were not significant in the cointegration relations, changes in interest rates and exchange rates were. Moreover, they found U.S., Japan, and Singapore stock markets are highly cointegrated.

Wanter and Georges (2001) tested the credit view of the monetary policy transmission mechanism using stock market prices. They studied Fed policy and the stock market's response during two periods from the 1990s—one expansionary and one contractionary policy period—in which the Federal Reserve was actively manipulating interest rates. They concluded that there is a consistent relationship between stock prices and credit constraint.

To examine the interdependence between stock markets and fundamental macroeconomic factors in the five South East Asian countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) was the main purpose of Wongbangpo and

Sharma (2002). Monthly data from 1985 to 1996 is used in this study to represent GNP, the consumer price index, the money supply, the interest rate, and the exchange rate for the five countries. Their results showed that high inflation in Indonesia and Philippines influences the long-run negative relation between stock prices and the money supply, while the money growth in Malaysia, Singapore, and Thailand induces the positive effect for their stock markets. The exchange rate variable is positively related to stock prices in Indonesia, Malaysia, and Philippines, yet negatively related in Singapore and Thailand.

Chaudhuri and Smiles (2004) investigated the long-run relationship between real stock price and measures of aggregate real activity including real GDP, real private consumption, real money, and the real price of oil in the Australian market. They used multivariate cointegration methodology for quarterly data from 1960:1 to 1998:4. They concluded, based on the statistical result, that there exists a long-run relationship between real stock prices and real activity. The results from the error correction mechanism indicate that real stock prices are in general related to changes in real macroeconomic variables along with the deviations from the observed long-run relationship.

CHAPTER THREE

METHODOLOGY OF THE STUDY

The last chapter covered existing theoretical and empirical studies that emphasize the relationship between stock market prices and fundamental economic activities. Many studies have focused on this relationship using different techniques, including different variables, examining different sample sizes, as well as testing across countries. Generally, the results of these studies do not substantiate the relationship between stock market prices and fundamental economic activities. Some of them support the efficient market hypothesis in that current as well as past information on the growth of economic activities are fully reflected in stock prices, while others found contradictory results in that some economic activities can be used to predict stock market prices.

The objective of this dissertation is to investigate the long- and short-run relationship between stock market prices in Saudi Arabia and money supply (M1) (M2), bank credit, crude oil price, and Standard and Poor's 500 for the monthly data from 1995 to 2004. The study will cover both composite index of the Saudi stock market as well as a sectoral analysis of six sectors.

3.1. Econometric Methodology

Most economic time series tend to be non-stationary, which means they contain a unit root, and thus the results based on the classical regression techniques cannot be accurate. Nonsensical results can be found if we regress one non-stationary variable against another one.

To avoid violating the assumptions of a linear regression model, non-stationary series should be detrended if a time series is trend stationary, or differenced if a time series is difference stationary, and the unit root test will determine the appropriate method.

Macroeconomists know that certain pairs of economic variables should be linked by a long-run equilibrium relationship. If it happened that one of these variables drifts away, economic force will restore equilibrium relation by tying the individual series together as represented by the linear combination of those series. In particular, economic time series are said to be cointegrated if these series are integrated of order one I (1) before differencing but are stationary I (0) after differencing, and a linear combination of the I (1) series is stationary. Therefore, there is a long-run equilibrium relationship between these series because they do not drift too far apart from each other over time. On the other hand, there is no long-run relationship between them if series are not cointegrated they can continue to drift apart from each other as time goes on.

The goal of this chapter is to briefly present the theory of co-integration, including error correction model (ECM).

3.2. Stationary and Non-stationary Series

When a variable is observed sequentially over time, the observation constitutes a time series. A time series is called stationary if its statistical properties remain constant over time. This means that when we consider two different time intervals, the sample mean and sample covariance of the time series over the two time intervals will be almost the same. An example of stationary time series can be represented as:

$$X_t = \delta + \lambda X_{t-1} + \varepsilon_t \tag{3-1}$$

where $0 < \lambda < 1$

When economic variables are non-stationary, we will see some trends in the data; for example, the mean changes over time. The mean of a non-stationary series tends to wander widely. A non-stationary series has an infinite variance; it grows over time. Shocks are permanent and its autocorrelation tend to one (Kennedy 1992). If the data are not stationary, applying "Least Square" to the model leads to invalid estimation and testing procedures. That is, if the data are not stationary and we regress one data set on the others, the estimates that we get will not have normal distribution asymptotically, and the test statistics will not be valid. Running regression with such data will produce spurious results.

An example of non-stationary time series can be represented as follows:

$$X_t = \frac{\delta}{1-\lambda} + \varepsilon_t + \lambda \varepsilon_{t-1} + \lambda^2 \varepsilon_{t-2} \tag{3-2}$$

3.3. Testing for Co-integration

Nelson and Plosser (1982) have pointed out that many macroeconomic variables are non-stationary in levels and contain in themselves a unit root (stochastic trend).

If two or more variables are found to be non-stationary, the linear combination of these variables is most likely to occur. In specific, a vector of variables, which all achieve stationarity after differencing, could have linear combinations which are stationary in levels. This linear combination is known as the cointegration equation and may be interpreted as long-run equilibrium relationship among the variables. The cointegration technique has been used to analyze the long-run relationship and stock prices and some fundamental macroeconomic variables. For example, Gallinger (1994) observed that stock prices (S & P 500) and behavior of these factors were cointegrated. On the other hand, Bahmani-Oskooee and Sohrabian (1992) show that there is no cointegration between the S & P 500 and the effective exchange rate of the dollar.

The cointegration analysis requires two steps: the unit root test to determine non-stationarity, and when the results indicate that the first difference series of each of the variables is stationary, a subsequent test to determine whether these variables are co-integrated.

3.3.1. Unit Root Test

The first step to implement co-integration procedure is to determine the order of integration for multivariate series. Co-integration requires that the series must be non-stationary and integrated of the same order. There are several variations of the unit root test: the Augmented Dickey-Fuller (1979, 1981), Phillip-Perron (1988), and Kwiatkowski, Schmidt and Shin (1992).

The Augmented Dickey-Fuller (ADF) test has been the most popular test used to check data stationarity in empirical research. This test is applied in higher-order models and models where the error terms are serially correlated. The ADF tests are based on the following three regression models:

Model I (without any constant and trend)

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{p} \delta \Delta y_{t-i} + e_t \tag{3-3}$$

Model II (with constant, but no trend)

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{i=1}^{p} \delta \Delta y_{t-i} + e_t \tag{3-4}$$

Model III (with constant and trend)

$$\Delta y_t = \alpha + \beta_t + \rho y_{t-1} + \sum_{i=1}^{p} \delta \Delta y_{t-i} + e_t \tag{3-5}$$

where y_t is the series being tested, α is a constant, t represents a time series, and p is the lag truncation parameter.

The ADF is achieved under the assumption that a unit root exists, the null hypothesis of unit root ($\rho = 0$) and the alternative hypothesis states that the series are stationary ($\rho < 0$). If the calculated statistics is higher than the critical value, we do not reject the null hypothesis, and consider variable is nonstationary; if null hypothesis is rejected, then the variable is considered to be stationary. If it is determined that a series is stationary, the co-integration is not appropriate, and another techniques such as Least Square Model can be used.

3.3.2. Co-integration Test

There are more techniques for performing co-integration tests: Engle and Granger (1988), Johansen (1988), and Johansen and Juselius (1990) proposed test statistics to test for the number of co-integration vectors among variables. Two or more variables are said to be co-integrated if they share common trend(s). The presence of a co-integration also implies that Granger causality must exist either unidirectionally or bidirectionally (Granger and Weiss, 1986).

The Johansen (1988) and Johansen and Juselius (1990) procedure is based on maximum likelihood. Consider a vector autoregressive (VAR) of order p

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-p} + B x_t + \varepsilon_t \tag{3-6}$$

where A_i are (K×K) matrices of parameters, x_t is a (K×1) deterministic vector, ε_t is a vector of error term.

The previous VAR can be written as:

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + ... + \Gamma_{p-1} \Delta y_{t-p+1} + \Pi y_{t-p} + B x_t + \varepsilon_t \tag{3-7}$$

$$\Gamma_i = \sum_{i=1}^{p-1} A_i - I_k \tag{3-8}$$

$$\Pi = \sum_{j=1}^{i} A_j - I_k \qquad (3\text{-}9)$$

Equation (3.8) captures the short-run dynamics and the (K×K) matrix.

Equation (3.9) contains information about long-run relationship between variables.

The numbers of cointegration vector are indicated by the rank (r) of Π. If Π has a rank of zero, Equation (3.7) is the usual VAR model in first difference and variables are not cointegrated. Furthermore, if Π is of full rank, all series are themselves stationary and thus nostationary long-run relationships are present. Only if Π has rank r ($0<r<K$) does there exist a cointegration vector β, such that βY_t is stationary. As for the existence of cointegration, it can be factored as $\Pi = \alpha\beta$ where α and β are (K×r) matrices. The value of α represents the speed of adjustment in Δ Y.

The Johansen methodology uses two likelihood ratios (LR) test statistics to determine the unique cointegration vectors for equation (3.7).

The first test statistic is the trace test:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1-\lambda_i) \qquad (3\text{-}10)$$

Where λ_i is the estimated value of characteristic roots obtained from estimated Π matrices, n is the number of characteristic root of Π, and T is the number of observations.

This statistics evaluates the null hypothesis of at most r cointegrating vector against the general hypothesis of p cointegrating vectors.

The second test statistics is the maximum eigenvalue test:

$$\lambda_{\max} = -T \ln(1 - \lambda_i) \qquad (3\text{-}11)$$

This statistics evaluates the null hypothesis of r cointegrating vectors against alternative hypothesis of r+1 cointegrating vectors.

3.3.3. Vector Error Correction Model (VECM)

Although cointegration indicates the presence or absence of Granger causality, cointegration does not have sufficient information to indicate lead-lag relationship between variables. According to Engle and Granger (1987) if a number of variables are found to be cointegrated, there always exist a corresponding error-correction representation in which the short-run dynamics of the variables in the system are influenced by the deviation from equilibrium. The VECM implies that change in the dependent variables are a function of the level of disequilibrium in the cointegrating relationship captured by the error correction term (ECM), as well as changes in other independent variables.

A VECM is a restricted VECM that include cointegration relations between nonstationary variables into it. In this VECM, the variables are restricted to their long-run relationship while allowing for short-run adjustment.

According to Granger (1988), if the series are found to be nonstationary and cointegrated, standard Granger causality can produce misleading results and the VECM should be used rather than a causality test.

The VECM can be expressed as :

$$\Delta y_{.t} = \alpha_1 + \beta_i ECT_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta x_{t-i} + \varepsilon_{1t} \tag{3-12}$$

$$\Delta x_{.t} = \alpha_2 + \beta_i ECT_{t-1} + \sum_{i=1}^{n} \mu_i \Delta y_{t-i} + \sum_{i=1}^{n} \lambda_i \Delta x_{t-i} + \varepsilon_{2t} \tag{3-13}$$

where ECT_{t-1} is error correction term lagged one period.

The VECM is useful for detection of the direction of Granger causality when the variables are cointegrated. Either the statistical significance of the t-tests of the lagged-error correction terms and/or F-test to the joint significance of coefficients of the lags of each independent variable, present evidence of Granger causality.

3.3.4 Impulse Response Function (IRF)

In general, if there are more than one cointegrating equations in multivariate systems, the interpretation of individual coefficients in the error correction model is difficult. The impulse response function is used to depict the adjustment dynamics among variables by indicating the dynamic response of a variable to one standard deviation shock to another variable.

According to Sims (1980), it is difficult to make sense of the estimates of unconstrained vector auto-regressions by examining the coefficients in the regression equations themselves. The impulse response functions should be computed from the unconstrained vector auto-regressions to understand the dynamics of the system. A moving average VAR could be written in vector form as:

$$y_t = \mu + \epsilon_t + \Psi_1 \epsilon_{t-1} + \Psi_2 \epsilon_{t-2} + \ldots \qquad (3\text{-}14)$$

Where

$$\Psi_S = \partial y_{i,t+s} / \partial \epsilon_t$$

The row i, column j element of Ψs identifies the consequences of one unit increase in the j^{th} variable's innovation at date t for the value of the i^{th} variable at time t + s, holding all other innovations at all dates constant. A plot of the row i, column j, element of Ψs, as a function of s is called the impulse response function. It describes the response of $y_{i,t+s}$ to a one-time impulse in y_{jt} with all other variables dated t or earlier held constant.(Hamilton,1994).

3.3.5 Forecast error variance decomposition (FEVD), and causal relatives

The Granger causality test described above can be interpreted as within sample causality test. It can only indicate the existence or non existence of Granger causality within the sample period. Hence it does not provide an indication of the dynamic properties of the system, nor does it allow it to gauge the strength of the causal effect that each variable has on growth beyond the sample period. An indication of these relatives can be obtained by partitioning the variance of the forecast error of stock prices into proportions attributable to innovations in each variable in the system including its own.

The innovation analysis is likely to be sensitive to the ordering of the variables. The variables are arranged as follows: stock price is first because it is the primary variable of the study. Other variables are money supply 1(M1), money supply 2(M2), bank credit (BC), oil price (OP), Standard & Poor's 500 index (S&P500). The OP and S&P500 are considered exogenous and are placed last.

3.4 The Model

The structural relationship between stock market prices and other macroeconomic variables—such as money supply, bank credit, and oil prices—has been subject to intensive investigation over decades. There is no consensus of any established model so far and researchers continue their research for a satisfactory model. Thus the model used in this study is based on the following model:

$$\mathbf{F\ (SP, M1, M2, BC, OP, S\&P\ 500) = 0} \qquad (3\text{-}15)$$

Given that only the model with stock price as a dependent variable is of interest, estimated cointegration vector can be represented as follows:

$$SP_t = \beta_0 + \beta_1\, M1_t + \beta_2\, M2_t + \beta_3\, BC_t + \beta_4\, OP_t + \beta_5\, S\&P\ 500_t + \epsilon_t \qquad (3\text{-}16)$$

Where SP_t represent stock market price, $M1_t$ is the narrow definition of money supply, $M2_t$ is a broad definition of money supply, BC_t is the bank credit, OP_t is the oil price, $S\&P\ 500_t$ is the Standard & Poor's 500 index, and ϵ_t is the error term.

The Johansen cointegration procedure will be applied to our model to answer the question of whether or not there is a long-run relationship between stock market price and the underlying macroeconomic variables, whether or not they are cointegrated.
Using the Johansen test, the null hypothesis of r cointegrating vector is tested against the alternative r+1 cointegrating vectors. Therefore according to equation (3.15), if the variables are found to be nonstationary, then the cointegration vector will include five stationary variables (k=5) implying that the null hypothesis r=0 is tested against the alternative of r=1, the null hypothesis r=1 against the alternative r=2, the null hupothesis r=2 against the alternative r=3, and the null hypothesis r=3 against the alternative r=4 (i.e. r = k-1).

CHAPTER FOUR

THE SAUDI ARABIAN ECONOMY AND ITS CAPITAL MARKETS

4.1 Overview

In order to explore the effect of macroeconomic variables on the stock market in Saudi Arabia, it is important to understand the economic environment in which the stock market exists. This chapter is divided into two main parts. The first one is devoted to a brief review of the economic structure of Saudi Arabia, exploring the role of oil in this economy as well as some economic indicators such as GDP, exchange rate, money supply, inflation, and budget deficits. The second part of this chapter is devoted to analyzing the history and performance of the Saudi stock market.

4.2 Brief history of the economy

Saudi Arabia is characterized as an oil-based economy. The history of this economy went through several stages. The first period started before discovery of oil in 1930, where the major income came from agriculture and fishing. Before it was unified, Saudi Arabia was composed of several regions that lived off specified resources and differentiated human activities. The Western region's economy was largely dependent on the annual pilgrimage to the two holy cities, Makkah and Al Madinah. Dates and some other basic crops in the Southern and Central regions, and finally, fishing, were the main sources of living in the Eastern region.

The second period followed the unification of the Kingdom of Saudi Arabia in 1932 and the discovery of oil in 1938. This era was characterized by building government institutions and the direct foreign investment that took place in the country. The third period has been in place since 1973, particularly since the dramatic increase in international petroleum prices, when oil prices increased to four times their former level because of the Arab oil embargo. Since that time, the Saudi economy has witnessed a considerable transformation in economic and social aspects of life.

Now, oil and natural gas products account for roughly 75% of budget revenues, 45% of GDP, and 90% of export earnings. The non-oil economy is devoted to agriculture, industry, and service sectors. Agriculture produces wheat, dates, fruits, vegetables, eggs, and poultry, in most of which the Kingdom is now self-sufficient.

The Saudi government has invested huge funds in the industrial sector. Basically, the industrial sector produces petrochemicals, steel, iron, and oil refineries. The fastest-growing sector now is the service sector, especially in the area of finance and business, with new regulations that allow foreign banks to operate in the country. Table 4.1 shows the share of each sector to the GDP.

The Saudi government has used oil revenues to finance ambitious programs of development through its ongoing five-year development plans. Since the early stages of the five-year development plans were launched 35 years ago, the economic development process has been based on primary objectives of all of the plans as well as different specific objective and different strategies for each plan. Figure 4.1 illustrates the actual expenditure of the development plans from 1970 to 2000.

The primary objectives of all the five-year plans are:

1. Diversification of the sources of government revenue, especially away from dependence on oil.
2. Increasing the number of employment opportunities for citizens in both the public and private sectors.
3. Encouragement of privatization of government-owned entities.
4. Enhanced efficiency of the bureaucracy while ensuring improved control of government spending.

The first plan began in 1970, concentrating on economic and social aspects of development with a limited budget. The end of the first plan and the beginning of the second five-year plan (1975–1979) coincided with the rise of oil prices; hence, the second plan was devoted to increasing the capacity of oil production. A major feature of the second plan was a project to increase industrial output, creating two new industrial cities, Al Jubail at the Arabian Gulf and Yanbu on the Red Sea. Development of the two cities took more than ten years and cost around $70 billion. Al Jubail contains three petroleum refineries, six petrochemical plants, and an aluminum smelter and steel mill as well as an industrial port. Yaubu is smaller than Al Jubail, containing two petroleum refineries, a natural gas processing plant, a petrochemical complex, and an industrial port. The two industrial cities are operated by the Arabian American Oil Company (ARAMCO) and Saudi Basic Industries Corp. (SABIC).

Table (4.1) Gross Domestic Product by Sectors

Year	MILLIONS RIYALS AT CURRENT PRICES				
	GDP	Oil Sector	Non-oil Sector		
			Total	a) Private	b) Govt.
1970	22,279	10,390	11,889	7,270	4,619
1971	30,124	17,031	13,094	8,016	5,078
1972	37,819	22,450	15,369	9,629	5,740
1973	53,047	33,217	19,831	12,935	6,896
1974	159,276	126,320	32,956	24,580	8,376
1975	163,156	104,876	58,280	46,879	11,401
1976	224,441	137,999	86,442	70,469	15,973
1977	259,548	146,758	112,789	90,227	22,562
1978	270,439	130,552	139,888	109,812	30,076
1979	373,309	203,623	169,686	132,474	37,212
1980	544,069	341,641	202,428	155,724	46,704
1981	619,538	380,798	238,739	181,436	57,303
1982	520,949	254,737	266,213	199,035	67,178
1983	441,533	163,118	278,414	206,288	72,126
1984	416,416	140,671	275,745	200,507	75,238
1985	372,408	104,451	267,957	188,756	79,201
1986	318,775	72,666	246,109	167,301	78,808
1987	317,478	78,775	238,703	160,486	78,217
1988	322,283	76,738	245,545	163,120	82,425
1989	350,325	98,652	251,672	167,118	84,554
1990	430,334	158,693	271,641	175,387	96,254
1991	484,853	179,572	305,281	186,754	118,527
1992	501,359	199,856	301,503	197,270	104,233
1993	485,630	170,012	315,617	205,637	109,980
1994	494,766	169,438	325,328	213,191	112,137
1995	526,004	187,718	338,285	218,599	119,686
1996	581,873	226,476	355,397	230,509	124,888
1997	608,802	228,250	380,552	241,304	139,248
1998	536,635	152,829	383,805	245,603	138,202
1999	593,955	198,988	394,967	255,200	139,767
2000	697,007	289,165	407,842	264,873	142,969
2001	679,163	255,510	423,654	275,118	148,536
2002	699,680	263,511	436,169	285,682	150,487
2003	796,561	330,389	466,172	298,985	167,187
2004	929,946	424,104	505,842	321,299	184,543

Source: Central Department of Statistics & Information, Ministry of Economy and Planning.

The third plan (1980–1984) was intended to shift the emphasis from infrastructure projects to the productive sectors, with particular importance accorded to agriculture and to achieving food self-sufficiency in order to be less dependent on imported foodstuffs. Also, the third plan emphasized training to reduce reliance on foreign labor.

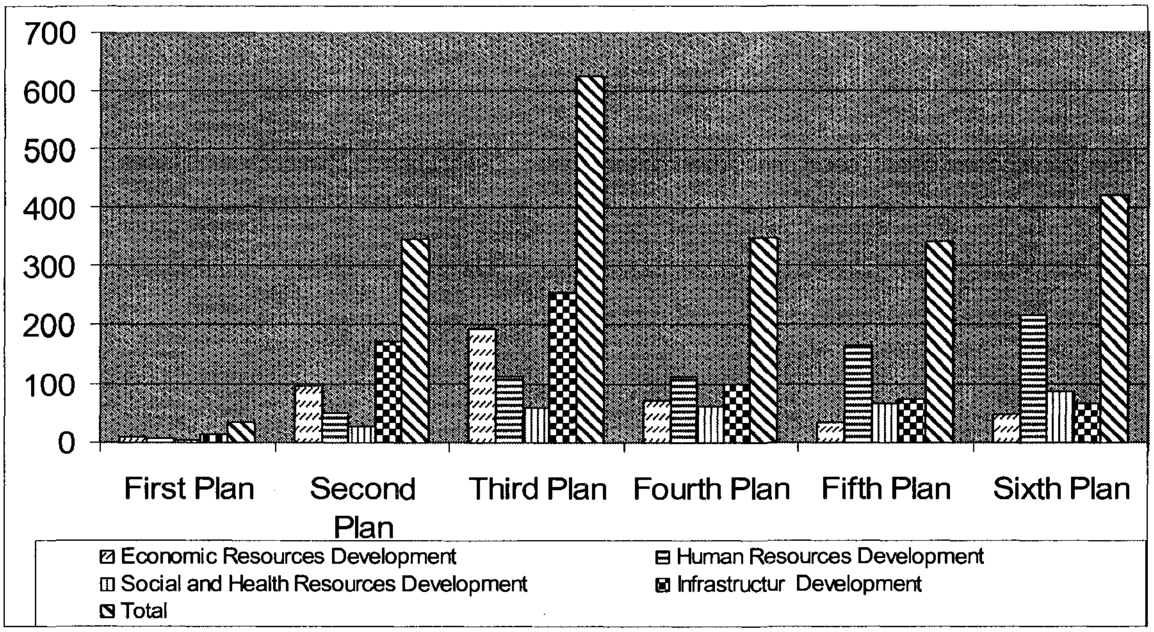
The civilian sector was the emphasis of the fourth plan (1985–1989). Four policies were designed for that plan:

1. Greater operational efficiency.
2. An emphasis on non-oil revenues, particularly industry, agriculture, and financial services.
3. A campaign to develop the private sector.
4. Further economic and social integration among the countries of the Co-Operation Council of the Arab States of the Gulf (GCC).

Within the details of the plan, considerable emphasis was also given to raising desalination capacity. By mid-1988, the fourth development plan was widely considered to have fallen short of its targets, mainly as a result of the steep decline in oil prices.

The fifth development plan (1990–1994) coincided with the Iraqi invasion of Kuwait and the ensuing of Gulf War. In this plan, Saudi Arabia increased military spending, and about one-third of total government expenditure was devoted to defense. This plan was characterized by generating revenue from the non-oil sector and increased reliance on the private sector. Under this plan, the Saudi government tried to encourage the industrial sector by allowing 30% of the value of government contracts to be given to Saudi companies.

Figure (4.1) Expenditure of Development Plans (Billions of Riyals)



Source: Ministry of Economic and Planning (Achievement of the Development Plans)

The sixth plan (1995–1999) continued the goal of diversifying the country's income sources by encouraging the private sector to take a prominent role in economic and social development. Other goals of this plan were to continue privatization programs and as to increase the proportion of Saudi nationals in the private sector workforce. At the end of this plan, most of the objectives hadn't been satisfied due to oil price fluctuation. In 1999, a supreme economic council (SEC) was formed to advise upon and accelerate structural reforms.

The seventh plan (2000–2004) started aiming toward the following objectives:

1. Promote average annual GDP growth to be about 3%.
2. Economic diversification leading to the non-oil sectors attaining a 70% share of GDP at the end of the plan.

3. Employment of 800,000 Saudi workers by the end of the plan, partly through Saudization (the replacement of expatriate workers by locals), and partly through new job creation.
4. Attainment and maintenance of budget and current account surplus through the plan period.
5. Further infrastructural development to meet needs of the rapidly growing population, including schools, hospitals, and utilities.

To fulfill these goals and to promote foreign investment in the country, the Saudi Arabian General Investment Authority (SAGIA) was formed at the beginning of this plan to act as a "one-stop shop" for global, regional, and domestic investors.

The country currently is in its eighth five-year plan, which began in 2005 and has as its general objectives:

1. Continue improving the services provided to the visitors of the Two Holy Cities of Makkah, and Almadinah.
2. Raise the standard of living, improve the quality of life, and provide job opportunities to citizens by accelerating the development process and increasing the rate of economic growth while ensuring enhancement in the quantity and quality of education, health, and social services.
3. Develop human resources, upgrade their efficiency, and increase the supply of manpower needed to meet the requirement of the national economy.
4. Diversify the economic base with due emphasis on promising areas such as manufacturing industries, particularly energy and related derivative-intensive industries, mining, tourism, and information technology industries.

5. Improve the productivity of the national economy, enhance its competitiveness and prepare it to adjust in a more flexible and efficient manner to economic changes and developments at the national, regional, and international levels.
6. Protect the environment and develop suitable systems in the context of sustainable development requirements.(Ministry of Economic and Planning 2003)

4.3 Oil Industry

When the Saudi economy is analyzed, the oil industry must figure prominently in the analysis. One reason for this is that the Saudi economy is characterized as being an oil-based economy. Saudi Arabia is the largest exporter of oil and has the largest reserves of oil in the world. Saudi Arabia possessed about 262.8 billion barrels of oil reserves as of 2003, which account for 25% of the world's proven total petroleum reserves.

Another reason for emphasizing the oil industry in Saudi Arabia is that oil price changes have an impact on the rest of the economy because the oil sector is the driving force for other sectors. Oil revenues are the main source of Saudi's foreign exchange earning and they generate most of the government's revenues.

Developing the oil sector was crucial to Saudi Arabia as well as the world's industrial countries. Oil production increased from about 1.3 million barrels per day (mbd) in 1960 to 3.8 mbd in 1970, and then to 8.5 mbd in 1974. This oil production growth was accompanied by rising prices in 1973–74 that generated a huge income for the government at that time. Saudi Arabia plays a leading role in the Organization of the Petroleum Exporting Countries (OPEC), and the stability of global energy markets rests heavily upon Saudi Arabia, which acts as a swing producer within OPEC. Saudi crude oil production is illustrated in Table (4.2).

In 2004, Saudi oil production of 8.9 mbd represented about one-third of OPEC's aggregate of 29.5 mbd. In the first half of 2005, crude oil production of 9.34 mbd can be compared with 11 mbd as a maximum production capacity.

Table (4.2) Annual and Daily Saudi Crude Oil Production in Millions of Barrels

Year	Annual Total	% Change	Daily Average
1970	1,386.67	18.13	3.80
1971	1,740.68	25.53	4.77
1972	2,201.96	26.50	6.02
1973	2,772.61	25.92	7.60
1974	3,095.09	11.63	8.48
1975	2,582.53	-16.56	7.08
1976	3,139.28	21.56	8.58
1977	3,357.96	6.97	9.20
1978	3,029.90	-9.77	8.30
1979	3,479.15	14.83	9.53
1980	3,623.80	4.16	9.90
1981	3,579.89	-1.21	9.81
1982	2,366.41	-33.90	6.48
1983	1,656.88	-29.98	4.54
1984	1,492.90	-9.90	4.08
1985	1,158.80	-22.38	3.17
1986	1,746.20	50.69	4.78
1987	1,505.40	-13.79	4.12
1988	1,890.10	25.55	5.16
1989	1,848.50	-2.20	5.06
1990	2,340.50	26.62	6.41
1991	2,963.00	26.60	8.12
1992	3,049.40	2.92	8.33
1993	2,937.40	-3.67	8.05
1994	2,937.90	0.02	8.05
1995	2,928.54	-0.32	8.02
1996	2,965.45	1.26	8.10
1997	2,924.28	-1.39	8.01
1998	3,022.27	3.35	8.28
1999	2,761.10	-8.64	7.56
2000	2,962.60	7.30	8.09
2001	2,879.46	-2.81	7.89
2002	2,588.98	-10.09	7.09
2003	3,069.74	18.57	8.41
2004	3,256.30	6.08	8.90
2005	3,409.10	4.69	9.34

Source: Saudi Arabian Monetary Agency.

4.4 Economic Indicators

4.4.1 Gross Domestic Product (GDP)

In the last three decades, the Saudi economy has experienced swings in overall GDP growth resulting from fluctuations in oil prices and level of production levels.

For the period 1970 to 1980, because of the high oil prices, the GDP experienced high average annual growth, about 10% a year. For the period 1980–1990, the average annual growth of GDP declined to 1.2 % per year, largely because oil export declined from about 10 mbd in 1980 to about 3.6 mbd in 1985. Even though the production of oil in Saudi Arabia reached 5 mbd in 1988 and 1989, the low international oil prices of that period resulted in substantially reduced revenue and, as a result, slowed the GDP growth. For the period 1990–1999, real GDP growth increased by an average 1% per year. For the period 1990–2002, the average annual growth of real GDP was about 2.1% a year, reflecting a negative growth rate for the sub-period 1993–1995 because of the oil price drop, and the sub-period 1997-1998, due to the Asian Crisis, and slow economic activities in Japan and Europe. On the other hand, in 1999–2002, a reduction in oil production in the countries of OPEC enabled oil prices to rise, causing an increase in the share of oil sector to GDP.

In 2003, real GDP grew by 7.7%, the strongest expansion since 1981, driven by increased hydrocarbons production. During 2004, the economy benefited from private-sector investment as well as increased government spending to maintain GDP growth rate at the 5.29% level.

4.4.2 Money Supply

Table 4.3 depicts money supply growth since 1970. M1, which consists of currency in circulation and demand deposits, witnessed enormous growth between 1973 and 1977. It grew from 6,570 million in 1973 to 10,684 in 1974, and then to 45,297 in 1977, with an average annual growth of about 62%, reflecting the huge change in the money sector due to the sharp increase in oil prices in the mid-1970s. During the 1990s, M1 grew at an average rate of 6% a year.

M2, comprising M1 and time and savings deposits, grew at an annual average rate of 11% during 1970–1973, then increased dramatically for the period of 1974–1978 at a rate of 45%. After 1980, the growth rate of M2 showed a sharp decline to 7% in 1980 and then a negative growth rate in 1984. In the 1990s, the growth rate of M2 started at a rate of 16% in 1991 and then fell to a steady growth rate of 5.5% thereafter.

M3, which consists of M2 and other quasi-monetary deposits such as residents' foreign currency deposits and guarantees and outstanding remittances, increased at a rate of 15% in 1991 due to enlarged domestic expenditure of private sector and military expenditure during the second Gulf War. The proportional share of currency in circulation in the broadly defined money supply M3, which had gone up to 23% in 1990, declined to 13% in 2003, reflecting the mediation of payment systems such as checks and ATM card machines.

Table (4.3) Money Supply (Millions of Riyals)

Year	Currency	Demand Deposits	M1	Time & Saving Deposit	M2	M3
1970	1,642	968	2,610	565	3,175	3,518
1971	1,951	1,309	3,261	738	3,998	4,481
1972	2,488	2,259	4,747	814	5,561	6,218
1973	3,374	3,195	6,570	914	7,483	8,731
1974	5,052	5,633	10,684	1,539	12,223	14,060
1975	8,559	11,012	19,570	1,572	21,142	24,453
1976	13,607	17,610	31,217	1,811	33,027	37,335
1977	17,970	27,327	45,297	3,060	48,357	53,617
1978	21,010	29,476	50,486	4,165	54,651	61,380
1979	25,199	30,449	55,647	11,630	67,277	74,789
1980	26,144	37,265	63,409	19,994	83,403	94,380
1981	30,421	46,167	76,588	26,367	102,955	119,445
1982	35,281	51,762	87,043	29,050	116,093	134,398
1983	34,655	51,667	86,321	33,575	119,897	143,948
1984	34,750	48,361	83,111	36,589	119,700	148,896
1985	36,868	46,171	83,039	39,682	122,721	150,240
1986	38,604	47,247	85,850	41,089	126,939	163,736
1987	39,396	49,926	89,323	39,697	129,020	164,360
1988	35,945	57,719	93,664	40,479	134,143	178,418
1989	33,877	57,875	91,752	44,662	136,414	180,181
1990	44,776	57,488	102,265	39,281	141,545	188,438
1991	44,620	75,850	120,470	44,623	165,093	215,843
1992	43,772	81,692	125,464	46,333	171,796	223,005
1993	42,623	78,880	121,503	47,892	169,395	228,651
1994	44,965	80,679	125,645	51,417	177,062	236,439
1995	43,087	81,384	124,471	61,223	185,694	241,970
1996	43,038	89,890	132,928	71,081	204,009	258,511
1997	45,823	95,361	141,184	77,166	218,349	272,702
1998	45,019	95,253	140,272	83,436	223,708	283,589
1999	55,060	101,605	156,665	85,341	242,006	305,941
2000	51,019	114,481	165,500	90,832	256,332	319,235
2001	49,203	130,192	179,396	91,685	271,080	340,196
2002	52,329	150,010	202,339	108,028	310,367	390,427
2003	55,445	167,577	223,022	113,382	336,404	417,465
2004	60,133	211,170	271,303	136,673	407,976	496,098
2005	64,288	219,251	283,539	165,266	448,805	553,675

Source: Saudi Arabian Monetary Agency.

Both shares of demand deposits and time and savings deposits in M3 went up from 30% in 1990 to 45% in 2003 for the first one, and from 20% in 1990 to 28% in 2003 for the second one. One reason for the low ratio of time and savings deposits in M3 is the prohibition regarding paying and receiving interest that is followed by the majority of people. (SAMA 2004)

4.4.3 Exchange Rate

Table 4.4 presents the exchange rate of the Saudi Riyal against the U.S. dollar, and the International Monetary Fund's Special Drawing Rights (SDRs) unit of account for the fund.

For the period 1954–1959, the Riyal was pegged to the U.S. dollar at an exchange rate of SR 3.75 for $1. After that, the official exchange rate devaluated to SR 4.5 to $1 as a result of monetary policy reform in 1959.

In 1971, the U.S. dollar departed from the gold standard, and therefore the SDR departed from SDR 1= $1 to SDR 1 = $1.085 in December 1971. As a result, the Saudi Riyal appreciated from SR 4.5 to SR 4.1448 for each $1. The dollar continued to depreciate against the SDR to be SDR 1= $1.206, and hence the Saudi Arabian Monetary Agency (SAMA) decided to peg its currency to the SDR basket. The reason for SAMA to shift from the U.S. dollar to the SDR is the high fluctuations of the dollar against other currencies in light of the final collapse of the Bretton Woods agreement in 1973, as well as the high inflation rates of the U.S. dollar at the end of the 1970s.

In the beginning of the 1980s, and after the Federal Reserve of the U.S.'s success in keeping inflation under control, SAMA chose to peg the SR to the U.S. dollar again. From 1981, the SR kept depreciating against U.S. dollar until it reached SR 3.75 for $1 in 1986; it maintains this exchange rate to the present time. Saudi monetary authorities have chosen to peg the Saudi currency to the U.S. dollar because the oil is traded in U.S. dollars, to minimize the exchange risk for the private sector, and to facilitate long-term planning.

Table (4.4) Currency Equivalents

Year	Exchange rate
1954-1959	1USD = SR 3.75
1960 – 1970	1USD = SR 4.50
1971	1USD = SR 4.48
1972	1USD = SR 4.14
1973	1USD = SR 3.70
1974	1USD = SR 3.55
1975	1USD = SR 3.51
1976 -1980	1 SDR = SR 3.50
1981	1USD = SR 3.41
1982	1USD = SR 3.44
1983	1USD = SR 3.49
1984	1USD = SR 3.57
1985	1USD = SR 3.64
1986-Present	1USD = SR 3.75

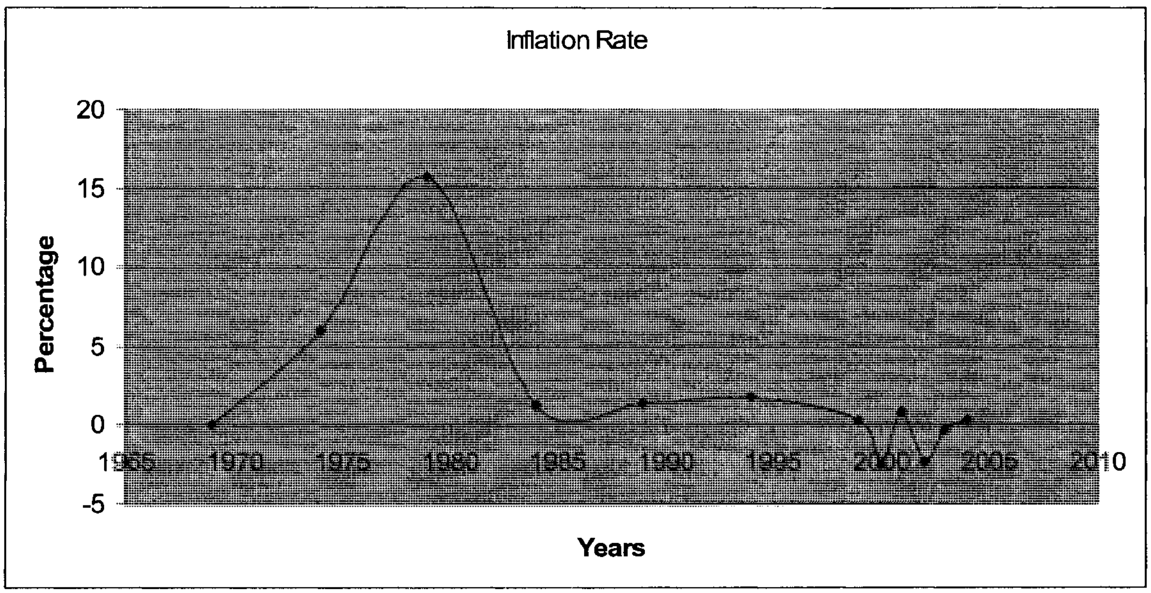
Source: Ministry of Economic and Planning (Achievement of the Development Plans)

In 2003, the Gulf Cooperation Council members (GCC) decided to adopt the U.S. dollar as the nominal anchor for their currencies in preparation for adopting a unified currency for the Arabic Gulf Countries by 2010. (SAMA 2003)

4.4.4 Inflation

In general, the Saudi economy is characterized by a low inflation rate. However, the rapid economic growth during the 1970s and early 1980s was accompanied by significant inflation. For the period 1970–1975, the annual inflation rate exceeded 6%, while it reached 15% per year on average for the period 1976–1980 due to sudden huge government expenditures during that time, which sharply increased the demand for goods and services with limited supply capability. For the period from 1981–1990, the government successfully brought the cost of living under control through strict monetary policies and brought the inflation rate down to about 1.2% a year.

Figure (4.2) Average Annual Inflation Rates as Measured by Consumer Price Index



Source : Ministry of Economic and Planning(Achievement of the Development Plans)

During the second Gulf War in 1990–1991, prices increased sharply due to a sudden increase in demand for essential goods and services. In 1992, the government tried to keep inflation under control by lowering the prices of utilities and fuel, which helped to maintain mild inflation at a rate of about 1.3% per year until 2000. According to IMF's estimations, the consumer price index (CPI) decreased by an average of 0.37%

per year during 2000 to 2003; however, the index increased by some 0.3% in 2004. Figure 4.2 depicts the inflation rate from 1970 to 2004.

4.4.5 Budget Deficit

Despite its wealth, the Saudi government suffered a long period of budget deficits. The fall in the prices of oil in the mid-1980s substantially reduced revenue from oil and brought a deficit in the government's budget. Table 4.5 illustrates nominal and real oil prices from 1970 to 2004. In 1986, the deficit reached 19.4 % of GDP. The second Gulf War, in 1990–1991, resulted in a substantial increase in defense-related spending and the government expanded its borrowing from international and local banks, which caused the government debt to reach about 95% of GDP in 2000.

Gross public debt stood at SR 650,000 million (about 83% of GDP) by the end of 2003, down from SR 680,000 million in 2002. The government had to cut part of its expenditures, and at the same time, initiate some policies to enhance tax collection and increase the share of non-oil revenues. Besides borrowing, the government sold part of its reserves of foreign assets in order to reduce the budget deficit and the accumulated debt. Lately, the government has started to issue government bonds to foreign and domestic lenders as a way of financing its debt. The 2003 and 2004 fiscal balance enjoyed a $12 and $24 billion surplus, respectively, of which half goes to public debt, and the rest to support funding for specialized development institutions such as the Industrial Development Fund, the Agriculture Bank, the Real Estate Development Fund, the Credit Bank, and the Public Investment Fund.

Table (4. 5) Nominal and d Real Oil Price in USD pre Barrel

Year	NOMINAL OIL PRICE		REAL OIL PRICE *	
	Arabian Light	North Sea (Brent Blend)	Arabian Light	North Sea (Brent Blend)
1970	1.30	2.23	1.30	2.23
1971	1.65	3.21	1.57	3.05
1972	1.90	3.61	1.73	3.28
1973	2.70	4.25	2.28	3.58
1974	9.76	12.93	7.27	9.63
1975	10.72	11.50	7.18	7.70
1976	11.51	13.14	7.11	8.11
1977	12.40	14.31	7.05	8.14
1978	12.70	14.26	6.73	7.56
1979	17.26	32.11	8.37	15.57
1980	28.67	37.89	12.40	16.39
1981	34.23	36.68	13.44	14.40
1982	31.74	33.42	11.58	12.19
1983	28.77	29.83	9.98	10.34
1984	28.06	28.80	9.29	9.54
1985	27.54	27.33	8.76	8.69
1986	13.73	14.50	4.26	4.50
1987	17.23	18.34	5.20	5.53
1988	13.40	14.97	3.91	4.37
1989	16.21	18.22	4.53	5.09
1990	20.82	23.99	5.54	6.38
1991	17.43	19.99	4.44	5.10
1992	17.94	19.33	4.44	4.79
1993	15.68	17.00	3.78	4.10
1994	15.39	15.80	3.63	3.72
1995	16.73	17.01	3.85	3.91
1996	19.91	20.70	4.48	4.65
1997	18.71	19.06	4.12	4.20
1998	12.20	12.71	2.61	2.72
1999	17.45	17.91	3.68	3.78
2000	26.81	28.44	5.53	5.87
2001	23.06	24.46	4.62	4.90
2002	24.32	25.03	4.79	4.93
2003	27.69	28.81	5.35	5.56
2004	34.53	38.23	6.54	7.24

*Real prices have been calculated by using the Consumer Price Index (base year: 2003) in industrial countries.
Source: Saudi Arabian Monetary Agency.

4.5 Stock Market

The Saudi Stock Market (SSM) is a recent development compared to developed countries. The Saudi Stock Market development can be divided into three distinct phases. The first phase covered the period between 1935 and 1984. It started when the first stock company, the Arab Automobile Company, went public in 1935; thereafter, the Arabian Cement Company went public in 1954. The main characteristics of this phase are as follows:

- The market was informal and unregulated.
- Only Saudi nationals were allowed to trade in this market.
- Government played an important role in this phase to develop the stock market by privatization of three electric companies in the 1960s.
- The largest increase in the number of publicly traded companies took place between 1976 and 1980, corresponding to a period of economic prosperity in the country when 19 new companies were offered to the public.
- At the end of this phase, the number of traded companies was 50 companies in 1984.
- Due to the lack of trading regulation, stock trading was run by about 80 unlicensed stockbrokers.

The financially very conservative Saudi Authority, driven by the fear of the Kuwaiti Stock Market crisis in 1982 and the effort to protect the Saudi public from runaway speculation, took regulatory action in 1984. This period from 1984 to 2003 is called the post-market regulation. In 1983, a royal decree was issued to establish a special joint committee formed by the Ministry of Finance, Ministry of Commerce, and the Saudi Arabian Monetary Agency (SAMA) to draft regulations for the stock market.

The new regulations transferred share trading from unregulated brokers to the Saudi banks under the supervision of SAMA. While banks conduct share trading, they are not allowed to hold position in stocks, but they are allowed to charge a maximum commission of 1% of the transaction value.

In 1985, the Saudi banks formed the Saudi Shares Registration Company (SSRC) to coordinate the brokerage activities and to serve as a clearinghouse. Saudi banks are required to time-stamp and report trades to the SSRC clearing system but are not required to trade through the SSRC central exchange. The SSRC reports trades on a daily basis to the Share Control Administration Department of the Saudi Arabian Monetary Agency. (Butler and Malaikah, 1992).

In 1990, SAMA introduced the Electronic Securities Information System (ESIS) to serve as an electronic trading system, replacing the conventional system. After launching the ESIS, the commercial banks established Central Trading Units (CTUs) which are connected to the Central System at SAMA to facilitate transferring share ownership electronically on a daily basis.

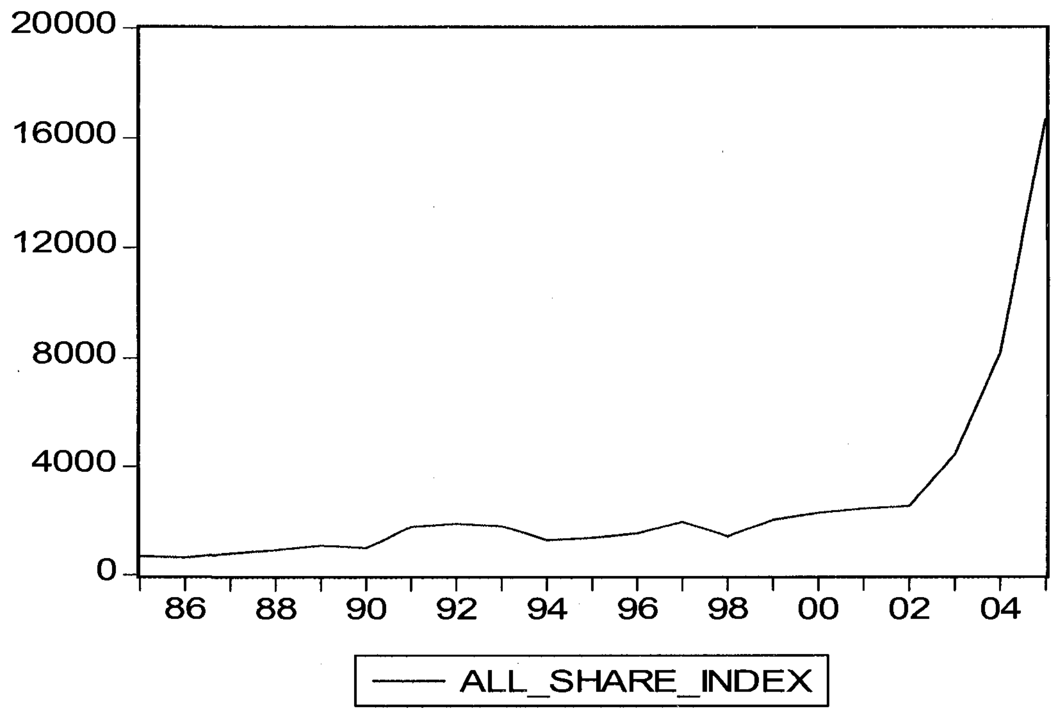
In 2001, the ESIS was replaced by a new trading system called Tadawul, which is a new online high-tech service for instantaneous share trading. The new trading system differs from the old one in that it will transfer shares as soon as the transaction takes place.

Equity ownership in the Saudi Stock Market is limited to Saudi citizens in this phase with some exceptions for citizens of other Gulf Cooperation Council countries.

However, foreign investors are allowed to participate in the Saudi Stock Market through open-ended mutual funds offered by Saudi banks.

The most recent phase began in 2003, when the Capital Market Authority (CMA) was established by the Capital Market Law. In June 2003, a royal decree stated that the CMA is a government organization with financial, legal, and administrative independence that reports directly to the Prime Minister (CMA, 2006).

Figure (4. 3) All Share Index from 1985 to 2005



Source: Tadawul - Capital Market Authority.

The duties and authorities of the CMA as stated on the CMA website are:

- Regulate and develop the capital market.

- Protect investors and the general public from unfair and unsound practices involving fraud, deceit, cheating, manipulation and insider trading.
- Achieve fairness, efficiency and transparency in securities transactions.
- Develop measures to reduce the risk pertaining to securities transactions.
- Develop, regulate and monitor the issuance and trading in securities.
- Regulate and monitor the activities of entities subject to the control of the CMA.
- Regulate and monitor full disclosure of information related to securities and their issuers.
- Regulate proxy and purchase requests and public share offerings.

Based on the Capital Market Law, an independent private company, the Saudi Stock Exchange, will be established and be the sole entity authorized to carry out trading in the Saudi Stock Market, and will replace the existing trading system, the Tadawul.

The main features of this phase are allowing foreign investors to directly participate in the stock market and the reduction of the initial share price from SR 50 to SR 10.

Table (4.6) Market Capitalization and All Share Index from 1995 to 2004

Year	Market Capitalization (SR Billion)	% Change	All Share Index	% Change
1995	153.39	5.71%	1,367.60	6.68%
1996	171.98	12.12%	1,531.00	11.95%
1997	222.7	29.49%	1,957.80	27.88%
1998	159.91	-28.19%	1,413.10	-27.82%
1999	228.59	42.95%	2,028.53	43.55%
2000	254.46	11.32%	2,258.29	11.33%
2001	274.53	7.89%	2,430.11	7.61%
2002	280.73	2.26%	2,518.08	3.62%
2003	589.93	110.14%	4,437.58	76.23%
2004	1148.60	94.70%	8,206.23	84.93%

Source: Tadawul - Capital Market Authority.

4.5.1 The performance of the Saudi Arabia Stock Market

The Saudi Stock Market is ranked number 30 out of 109 in both developed and emerging markets in 2001. The Saudi Stock Market is the largest in the Middle East in terms of market capitalization (Alsuhaihani, 2004). In terms of market value of shares, the Saudi Stock Market is ranked 16 out of the largest 50 stock markets in the world. (Tadawul 2005). Table 4.6 shows the market capitalization of the Saudi Stock Market.

The Saudi Stock Market contained 81 companies at the end of 2005, divided into eight sectors: Banking, Industry, Cement, Service, Electricity, Communications, Insurance, and Agriculture.

The performance of the Saudi Stock Market has witnessed a tremendous growth in the last three years. The Tadawul All Share Index (TASI) closed at (16,712.64) on December 31, 2005, compared to (2,518.08) at the same date of 2002, increasing at a rate of 563.71% in three years. Figure 4.3 depicts All Share Index from 1985 to 2005.

The total value of shares traded during 2005 was about USD 1.104 trillion compared to USD 35.68 billion in 2002. The average daily volume was USD 13.84 billion in 2005 compared to USD 117.7 million in 2002. The average daily turnover of shares was 41.1 million in 2005 compared to 5.73 million in 2002. The daily average number of transactions was 156,000 in 2005 compared to 3,411 in 2002.

Statistics from 2005 show that the most active sector in terms of shares traded was the industry sector, with .2 billion shares, consisting 33.9% of total traded shares. The industry sector is also the most active sector in terms of value traded. The value of shares traded in this sector was USD 506.67 billion, 44.8 % of the total market. Table 4.7 summarizes the Saudi Stock Market activities from 1985 to 2005.

Table (4.7) Stock Market activity from 1985 to 2005

Year	Shares Traded	% Change	Value	% Change	# of Transactions	% Change
	(Million)		(SR Million)			
1985	3.94		759.97		7,842	
1986	5.26	33.50%	830.75	9.31%	10,833	38.14%
1987	12.01	128.33%	1,685.52	102.89%	23,267	114.78%
1988	14.64	21.90%	2,036.79	20.84%	41,960	80.34%
1989	15.27	4.30%	3,363.69	65.15%	110,030	162.23%
1990	16.94	10.94%	4,403.24	30.91%	85,298	-22.48%
1991	30.76	81.58%	8,527.31	93.66%	90,559	6.17%
1992	35.20	14.43%	13,698.83	60.65%	272,075	200.44%
1993	60.31	71.34%	17,360.03	26.73%	319,582	17.46%
1994	152.09	152.18%	24,871.08	43.27%	357,180	11.77%
1995	116.62	-23.32%	23,226.59	-6.61%	291,742	-18.32%
1996	137.83	18.19%	25,397.33	9.35%	283,759	-2.74%
1997	312.00	126.37%	62,060.36	144.36%	460,056	62.13%
1998	293.00	-6.09%	51,510.00	-17.00%	376,617	-18.14%
1999	528.00	80.20%	56,578.00	9.84%	438,226	16.36%
2000	555.00	5.11%	65,292.00	15.40%	498,135	13.67%
2001	691.00	24.50%	83,602.00	28.04%	605,035	21.46%
2002	1,735.70	151.19%	133,786.70	60.03%	1,033,669	70.84%
2003	5,566.00	220.68%	596,510.00	345.87%	3,763,403	264.08%
2004	10,298.00	85.02%	1,773,858.00	197.37%	13,319,523	253.92%
2005	12,281.00	19.26%	4,138,695.00	133.32%	46,607,951	249.92%

Source: Tadawul - Capital Market Authority.

CHAPTER FIVE

EMPIRICAL ANALYSIS I

5.1 Introduction

The goal of this and the following chapter is to present the empirical results of this study, and to analyze the findings based on the methodology explained in chapter three. Interpretations of these findings will help in analyzing the impact of fundamental macroeconomic variables on stock prices. This chapter is organized as follows:

Section 5.2 presents a brief description of the variables used in this study. Section 5.3 goes over the unit root results. Section 5.4 illustrates the findings of the Johansen cointegration test. A causality test based on an error correction model is presented in Section 6.1. In Section 6.2, variance decomposition and impulse response function techniques were used to determine the effect of macroeconomic variables on stock prices. The final section 6.3 contains the conclusion of these two chapters.

5.2 Data Description

Monthly data for the period 1995-2004 on real stock prices, real money supply, real bank credit, real oil prices, and Standard and Poor's 500 were used. The data on those measures were taken from the Saudi Arabian Monetary Agency (SAMA), the International Monetary Fund (IMF), the International Financial Statistics Yearbook, and the World Development Indicator 2004 (WDI).

5.2.1 Money Supply:

Two measures of money supply were used in this study:

M1: Currency in Circulation + Demand Deposits

M2: M1 + Time Deposits + Residence Foreign Currency Deposits

The money supply is related to the stock market in several ways. Portfolio theory suggests that an increase in money supply leads to a portfolio shift from non-interest-bearing money to financial assets, including stocks. Furthermore, money supply fluctuations can also affect the stock market through a policy anticipation mechanism (Urich and Watchel 1981).

5.2.2 Bank Credit:

Over the past six decades, bank credit has increased significantly due to the structural changes of banks and new regulations for banks that allowed foreign banks to operate in the Saudi economy. According to Fan and Fan (1994), the main reason for the skyrocketing of land, real state value, and stock shares in Japan in the late 1980s was the pumping of loans by bank and non-bank institutions, which was aimed to provide easier credit for industrial and reconstruction purposes. On the other hand, when the Bank of Japan raised the cost of interest and tightened credit, the stock market bursted.

5.2.3 Oil Price:

The Saudi economy is an oil-based economy; therefore, oil prices play an important role in this economy. Oil prices in oil-based economy have a positive impact and hence a positive relationship is expected to occur between oil prices and stock prices. In contrast, oil prices are usually expected to have a strong negative impact in industrialized economies. Andersen and Subbaraman (1996) supported inclusion of this variable in the Australian context. An increase in oil price will lead to an increase in production costs and hence to decreased future cash flow, leading to a negative impact on the stock market.

5.2.4 Standard and Poor's 500:

Standard & Poor's 500 index is designed to reflect the U.S. equity markets and, through the markets, the U.S. economy. It consists of 500 stocks selected by market size, liquidity, and industry group representation. Based on the semi-strong form of the efficient markets hypothesis, indexing has become a very successful strategy of investment.

Although the 500 companies in the list are among the largest in the US, it is not simply a list of the 500 biggest companies. The companies are carefully selected to ensure that they are representative of various industries in the US economy. In addition, companies which are privately held and stocks which do not have sufficient liquidity are not in the index.

Now, the S & P 500 index is one of the most heavily tracked indices by worldwide investors. Alsuhaibani(2004) concluded that movement on stock market in the US (Standard and Poor's 500) have effect on Saudi stock market.

5.2.5 Stock Market:

The data on stock prices were taken from the Saudi stock market index. In addition to the general index, six sectoral indices were used for six main sectors. These are:

1. Banking
2. Industry
3. Cement
4. Service
5. Electricity
6. Agriculture

5.3 Unit Root Test:

In the previous section, we discussed the variables that will be used in studying the relationship between stock market prices and macroeconomic variables, and in this section we will examine the time series properties of the data.

In order to implement cointegration between the time series, we need to pretest the variables for their order of integration. It is necessary to show that they integrated in the same order.

For each of the variables, the Augmented Dickey-Fuller (ADF) unit root test was used with constant and with constant and time trend for all variables in their levels and then in their first difference using a four lags based on the Schwarz Information Criterion (SIC). In this test, the null hypothesis Ho: $\sigma = 0$ is that the variable under study contains a unit root against the alternative that it does not contain a unit root. Therefore, the failure to reject the null hypothesis means that the variable is non-stationary, while the rejection of the null hypothesis reflects the absence of a unit root, which means that the variable is stationary. If the null hypothesis is not rejected for the variable in its level and rejected for the variable in its first difference, then we can conclude that the variable is integrated I (1). If the null hypothesis is rejected for the variable in its level then it can be said the variable is stationary I (0).

The Augmented Dickey-Fuller test results are shown in Table 5.1 with the constant and in Table 5.2 for the case where we have constant and time trend. Comparing the ADF t-values of the level series with 1 and 5% critical value, which is reported at the bottom of each table, the results suggest that all market indices as well as macroeconomic variables are I (1), where the first differences are integrated of order zero I (0). We fail to reject the null hypothesis of the existence of a unit root in levels, but reject the same null hypothesis in the first difference of the series.

Table 5.1: ADF Unit Root Test on Series with Constant.

Variable	ADF Test Statistics		
	Level	First Difference	Result
Composite Index	6.741	-6.843	I (1)*
Agriculture Index	1.442	-10.021	I (1)*
Bank Index	3.484	-6.762	I (1)*
Cement Index	2.422	-10.764	I (1)*
Electric Index	1.124	-10.480	I (1)*
Industry Index	7.317	-6.167	I (1)*
Service Index	2.133	-10.444	I (1)*
M1	3.069	-8.717	I (1)*
M2	4.875	-8.561	I (1)*
BC	3.865	-11.970	I (1)*
OP	-.960	-8.495	I (1)*
S&P 500	-1.949	-11.119	I (1)*

Critical value for the level of the variable at 1% and 5% are -3.48 and -2.88, respectively
Critical sale for the first difference of the variable at 1%, and 5% are -3.488 and -2.88, respectively
*, denotes significance at 1%.
I (1): Stationary after first differencing

Table: 5.2 ADF Unit Root Test on Series with Constant and Time Trend.

Variable	ADF Test Statistics		
	Level	First Difference	Result
Composite Index	4.342	-7.691	I (1)*
Agriculture Index	.367	-10.563	I (1)*
Bank Index	5.086	-7.341	I (1)*
Cement Index	.228	-11.428	I (1)*
Electric Index	-.787	-10.820	I (1)*
Industry Index	5.345	-7.257	I (1)*
Service Index	.412	-11.385	I (1)*
M1	.331	-9.380	I (1)*
M2	2.141	-9.770	I (1)*
BC	1.758	-12.960	I (1)*
OP	-2.25	-8.495	I (1)*
S&P 500	-1.550	-11.202	I (1)*

Critical value for the level of the variable at 1% and 5% are -3.48 and -2.88, respectively

Critical sale for the first difference of the variable at 1%, and 5% are -3.488 and -2.88, respectively

*, denotes significance at 1%.

I (1): Stationary after first differencing

5.4 Johansen's Cointegration Test

The results in the past sections show that all the variables in our models are non-stationary and cointegrated of the same order I (1). The next step is to estimate the long-run equilibrium relationship among the various sets of variables. The Johansen test can determine the number of cointegrating equations, which is called the cointegrating rank. If we have N endogenous variables, each of which is first order integrated, there can be from zero to N-1 linearly independent cointegrating vectors. The long-run equilibrium relationship is attained by using two test statistics, the trace statistic (λ_{trace}), and the max-eigenvalue statistic (λ_{max}). The trace statistic tests the null hypothesis that the number of the cointegrating vector is less than or equal to r against a general alternative. The max eigenvalue tests the null hypothesis that the number of cointegration vectors is r against the alternative of r + 1 cointegration vectors.

The results for λ_{trace} and λ_{max} statistics are reported in Tables 5.3 through 5.9. Kasa (1992), and Serletis and King (1997) argue that λ_{trace} tends to be more powerful than λ_{max} since it takes into account all (n-r) of the smallest eigenvalue. On the other hand, some analysts rely on λ_{max} in their analysis (Enders, 1995). Johansen and Juselius (1990) emphasize the use of λ_{trace} statistics in cases where a conflict between these two test statistics occurs. In this study, we consider both test statistics.

According to Dickey, Jansen and Thornton (1991), the greater the number of cointegration vectors in the system, the more stable the system is. Therefore, we observe that at the 5% level of significance, there are two cointegrating vectors significant for λ_{trace} and one cointegrating vector significant for λ_{max} in the composite index, and two cointegrating vectors for both λ_{trace} and λ_{max} in the bank sector index and one cointegrating equation for both λ_{trace} and λ_{max} in the industry sector index as well as in the cement sector index. In the service sector index, there are two cointegrating vectors significant in both statistics tests, where there are three cointegrating vectors for the λ_{trace} and only one for the λ_{max} statistics in the electric sector index. Finally, there are two cointegrating vectors for both test statistics in the agriculture sector index.

Johansen and Juselins (1990) noted that the first cointegrating vector corresponding to the largest eigenvalue is the most highly correlated with the stationary part of the model, and hence is most useful. Moreover, the coefficients in the first cointegrating vector seem to possess the signs consistent with our prediction. Hence, we premise our long-run and short-run analyses on the first cointegrating vector.

The Composite Index (TASI)

Table 5.3 summarizes the results of the Johansen cointegration test for the composite index. The trace statistic shows that the null hypothesis of "no cointegration" is rejected at both the 5 and 1 percent significance levels. The trace statistic of 142.8 exceeds the critical value of trace at 5% (94.15), and at 1% (103.18). However, the null hypothesis of at most one cointegration equation is rejected at the 5% level and is not rejected at the 1% level, yet the null hypothesis of at most two cointegration equations is not rejected at both levels of significance.

On the other hand, the max-eigen statistic indicates one cointegration vector at both the 5 and 1 percent significance levels since the max-eigen statistic of 71.06

exceeds the critical value of max-eigen at the 5% and 1% levels of significance, which are 39.37 and 45.10, respectively. However, the null hypothesis of $r \leq 1$ is rejected at both the 5% and 1% levels of significance as the max-eigen statistic (31.88) is less than the critical value at 5% (33.46), and 1% (38.77). Both tests' statistics indicate the existence of one cointegrating equation at the 5% and 1% levels of significance.

After normalizing the coefficient of the stock price to one, the long-run relationship between stock price and macroeconomic variables for the composite index can be expressed as:

$$SMP - 0.394\ M1 - 0.275\ M2 - 0.099\ BC - 2.575\ OP - 0.328\ S\&P500 = ECT_{t-1} \quad (5.1)$$

This equation is normalized on SMP and the signs are reserved.

According to this equation, it appears that there is a long-run relationship between SMP, M1, M2, BC, OP, S&P500, however the signs of M1, M2, BC, OP, and S&P500 in equation 5.1 are negative, suggesting, since the signs are reversed, a positive relationship between stock prices and the fundamental macroeconomic variables that is consistent with economic relations.

The Bank Sector Index (TBSI)

Table 5.4 reports the Johansen multivariate cointegration for the bank sector index. Based on both the trace and the max-eigen statistics, the null hypothesis of "no cointegration" is rejected at the 5% level of significance since the trace statistic is 148.64, which is larger than the corresponding critical value of 95.75. The null hypothesis of "at most one cointegration equation" is rejected at the 5% level for the two tests statistics as the max-eigen statistic is 44.49, which is greater than the corresponding critical value of 33.87, and the null hypothesis of "at most two cointegration equation" is not rejected at any level of significance.

The multivariate cointegrating equation for testing the long-run relationship between stock prices in the bank sector index and the macroeconomic variables is:

$$SMPBANK - 0.690\ M1 - 0.445\ M2 - 0.127\ BC - 2.898\ OP - 3.666\ S\&P500 = ECT_{t-1} \quad (5.2)$$

This equation is normalized on SMPBank and the signs are reversed.

It is clear from the above equation that a positive long-run relationship exists between the SMPbank and the macroeconomic variables, which is consistent with economic relations.

The industry sector index (TISI)

The finding of the Johansen test indicates that cointegration exists among the variables in the industry sector index at the 5 and 1% levels of significance (Table 5.5). The trace and max–eigen statistics of the Johansen test were found to be greater than critical values at both levels of significance, implying the existence of a long-term relationship between the industry sector index and M1, M2, BC, OP, S&P500. The first normalized eigenvector is:

$$SMPINDUSTRY - 0.945\ M1 - 0.726\ M2 - 0.297\ BC - 7.357\ OP - 0.185\ S\&P500 = ECT_{t-1} \quad (5.3)$$

This equation is normalized on SMPIndustry and the signs are reversed.

From equation (5.3), it appears that there is a positive long-run relationship between SMPIndustry and M1, M2, BC, OP, and a negative one with the S&P500.

The Cement Sector Index (TCSI)

A long-term relationship between the cement sector index and macroeconomic variables exists, as shown in Table 5.6. This result is derived from the fact that there are two cointegration equations at the 5 and 1% levels of significance. The null hypothesis of "no cointegration," and "at most one cointegration equation" are rejected at both the 5% and 1% significance levels, where the trace statistic (142.37) is greater than the critical value at 5% (94.15) and 1% (103.18), and where the max-eigen statistic (45.04) is greater than the critical value at 5% (33.46) and 1% (38.77).

After normalizing the coefficient of SMPCement to one, the long-run relationship between stock prices and macroeconomic variables for the cement sector index can be expressed as:

$$SMPCEMENT - 0.553\ M1 - 0.331\ M2 - 0.066\ BC - 2.047\ OP - 0.750\ S\&P500 = ECT_{t-1} \quad (5.4)$$

This equation shows that there is a long-run relationship between SMPCement and macroeconomic variables, and this long-term relationship is positive between SMPCEMENT and M1, M2, BC, OP, and the S&P500 since the signs are reversed.

The Service Sector Index (TSSI)

Table 5.7 reports the Johansen multivariate cointegration test using the service sector index. The null hypothesis of "no cointegration" is rejected at both the 5% and 1% levels of significance. Moreover, the hypothesis if "at most one cointegration equation" is rejected at the 5% and 1% level for the trace statistic and rejected at the 5% level of significance for the max-eigen statistic where the max-eigen statistic is 37.50, which is larger than the corresponding critical values if 33.46 at the 5% level and smaller than the critical value of 38.77 at the 1% level of significance.

The multivariate cointegrating equation for testing the long-run relationship between SMPSERVICE and macroeconomic variables is as follows:

$$SMPSERVICE - 0.303\ M1 - 0.201\ M2 - 0.053\ BC - 1.278\ OP - 0.452\ S\&P500 = ECT_{t-1} \quad (5.5)$$

This equation is normalized on SMPSERVICE and the signs are reversed.

According to this equation, it is clear that there is a long-run relationship between SMPService and the macroeconomic variables; however, the signs of M1, M2, BC, OP, and S&P500 in this equation are negative, suggesting, since the signs are reversed, a positive relationship between these variables and the stock prices in this index, which is consistent with economic relations.

The Electric Sector Index (TESI)

By looking at the trace statistic in Table 5.8, we reject the null hypothesis of "no cointegration" and "at most one cointegration equation" in this sector, while in the max-eigen statistic, we only reject the hypothesis of "no cointegration" since we have a max-eigen statistic of 77.37, which is greater than both 5% (39.37) and 1% (45.10).

The first normalized Eigen vector is

$$\text{SMPELECTRIC} - 0.642\text{ M1} - 0.420\text{ M2} - 0.103\text{ BC} - 2.537\text{ OP} - 1.887\text{ S\&P500} = ECT_{t-1} \quad (5.6)$$

This equation is normalized on SMPElectric and the signs are reversed.

This equation confirms the positive long-run relationship between SMPElectric and M1, M2, BC, OP and the S&P500, which is consistent with economic relations.

The Agriculture Sector Index (TGSI)

In the case of the agriculture sector index, a long-run relationship between variables exists in this model. We concluded that because there is one cointegration equation at the 5% and 1% levels of significance (Table 5.9). The null hypothesis is rejected at both 5% and 1% where the trace statistic (132.41) is greater than the critical values at 5% (94.15) and 1% (103.18), and the max-eigen statistic (68.71) is greater than the critical values at 5% (39.37) and 1% (45.10), respectively.

The multivariate cointegrating equation for testing the long-run relationship between SMPAGRICULTURE and macroeconomic variables is as follows:

$$SMPAGRICULTURE - 0.374\,M1 - 0.258\,M2 - 0.073\,BC - 1.570\,OP - 0.619\,S\&P500 = ECT_{t-1} \quad (5.7)$$

This equation is normalized on SMPAgriculture and the signs are reversed.

Equation 5.7 illustrates a positive long-run relationship between SMPAgriculture and M1, M2, BC, OP, and the S&P500.

The equilibrium relations between stock prices and macroeconomic variables are all positive. Money supply changes and stock returns in all seven indices are positively related, which is supported by Bulmash and Trivoli (1991) for the U.S, and Mukherjee and Naka (1995) for Japan. One possible explanation for this result suggested by Mukherjee and Naka (1995) is that the injection of money supply has an expansionary effect that boosts corporate earnings. Another explanation follows from Fama (1981) comments on inflation; increased real activity that drive stock returns also stimulates the demand for money via the simple quantity theory model, thus creating the positive relation between money supply and stock prices. Consistent with economic theory, the positive link between the long run bank credit and stock prices is explained by the liquidity effect on stock prices.

Oil price positively affect stock prices. As an oil-based economy, an increase in oil price boost oil sector earnings and generate positive movement in stock prices, and this is also consistent with the findings for the oil-based economies (Andersen and Subbaraman,1996). It appears that U.S. stock market play a dominant role in explaining the real stock prices in Saudi Arabia. This result is supported by the findings of Chaudhuri and Smiles (2004) who found a clear link between the Australia an U.S. share markets.

Table 5.3. Johansen Cointegration Test for TASI.

Trend assumption: Linear deterministic trend Series: SMP1 M1 M2 BC OP S&P 500 Lags interval (in first differences): 1 to 4				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4609	142.1876	94.15	103.18
At most 1 *	0.2421	71.1256	68.52	76.07
At most 2	0.2171	39.2408	47.21	54.46
At most 3	0.0527	11.0953	29.68	35.65
Trace test indicates 2 cointegrating equation(s) at the 5% level Trace test indicates 1 cointegrating equation(s) at the 1% level *(**) denotes rejection of the hypothesis at the 5%(1%) level				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4609	71.0620	39.37	45.10
At most 1	0.2421	31.8848	33.46	38.77
At most 2	0.2171	28.1454	27.07	32.24
At most 3	0.0527	6.2319	20.97	25.52
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels. *(**) denotes rejection of the hypothesis at the 5%(1%) level				

Table 5.4. Johansen Cointegration Test for TBSI.

Trend assumption: Linear deterministic trend
Series: SMPBANK M1 M2 BC OP S&P 500
Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.4540	148.6484	95.7537	0.0000
At most 1 *	0.3208	79.0583	69.8189	0.0076
At most 2	0.1749	34.5662	47.8561	0.4711
At most 3	0.0667	12.4548	29.7971	0.9149

Trace 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

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.4540	69.5901	40.0776	0.0000
At most 1 *	0.3208	44.4922	33.8769	0.0019
At most 2	0.1749	22.1114	27.5843	0.2147
At most 3	0.0667	7.9369	21.1316	0.9075

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 5.5. Johansen Cointegration Test for TISI..

Trend assumption: Linear deterministic trend
Series: SMPINDUSTRY M1 M2 BC OP S&P 500
Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4554	138.0908	94.15	103.18
At most 1	0.2473	68.2104	68.52	76.07
At most 2	0.1908	35.5344	47.21	54.46
At most 3	0.0542	11.1881	29.68	35.65

Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4554	69.8804	39.37	45.10
At most 1	0.2473	32.6760	33.46	38.77
At most 2	0.1908	24.3462	27.07	32.24
At most 3	0.0542	6.4096	20.97	25.52

Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Table 5.6. Johansen Cointegration Test for TCSI.

Trend assumption: Linear deterministic trend
Series: SMPCEMENT M1 M2 BC OP S&P 500
Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4182	142.3725	94.15	103.18
At most 1 **	0.3241	80.0925	68.52	76.07
At most 2	0.1393	35.0490	47.21	54.46
At most 3	0.0673	17.8036	29.68	35.65

Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4182	62.2801	39.37	45.10
At most 1 **	0.3241	45.0435	33.46	38.77
At most 2	0.1393	17.2454	27.07	32.24
At most 3	0.0673	8.0075	20.97	25.52

Max-eigenvalue test indicates 2 cointegrating equation(s) at
Both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Table 5.7. Johansen Cointegration Test for TSSI.

Trend assumption: Linear deterministic trend Series: SMPSERVICE M1 M2 BC OP S&P 500 Lags interval (in first differences): 1 to 4				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4057	138.9972	94.15	103.18
At most 1 **	0.2783	79.1487	68.52	76.07
At most 2	0.1616	41.6470	47.21	54.46
At most 3	0.1017	21.3802	29.68	35.65
Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels *(**) denotes rejection of the hypothesis at the 5%(1%) level				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4057	59.8485	39.37	45.10
At most 1 *	0.2783	37.5017	33.46	38.77
At most 2	0.1616	20.2669	27.07	32.24
At most 3	0.1017	12.3377	20.97	25.52
Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level Max-eigenvalue test indicates 1 cointegrating equation(s) at the 1% level *(**) denotes rejection of the hypothesis at the 5%(1%) level				

Table 5.8. Johansen Cointegration Test for TESI.

Trend assumption: Linear deterministic trend
Series: SMPELECTRIC M1 M2 BC OP S&P 500
Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4868	154.4798	94.15	103.18
At most 1 **	0.2314	77.1069	68.52	76.07
At most 2	0.1709	46.5824	47.21	54.46
At most 3	0.1272	24.8469	29.68	35.65

Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4868	77.3729	39.37	45.10
At most 1	0.2314	30.5245	33.46	38.77
At most 2	0.1709	21.7355	27.07	32.24
At most 3	0.1272	15.7881	20.97	25.52

Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Table 5.9. Johansen Cointegration Test for TGSI.

Trend assumption: Linear deterministic trend Series: SMPAGRICULTURE M1 M2 BC OP S&P 500 Lags interval (in first differences): 1 to 4				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4470	132.4183	94.15	103.18
At most 1	0.2175	63.7059	68.52	76.07
At most 2	0.1478	35.2526	47.21	54.46
At most 3	0.0948	16.7042	29.68	35.65
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels *(**) denotes rejection of the hypothesis at the 5%(1%) level				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.4470	68.7124	39.37	45.10
At most 1	0.2175	28.4532	33.46	38.77
At most 2	0.1478	18.5484	27.07	32.24
At most 3	0.0948	11.5574	20.97	25.52
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels *(**) denotes rejection of the hypothesis at the 5%(1%) level				

CHAPTER SIX

EMPIRICAL ANALYSIS II

6.1 Causality Analysis

In a cointegrated set of variables, Granger (1988) suggests that the causal relationship between these variables should be examined within the framework of the vector error correction model (VECM).

Cointegration tests in the last chapter show that there is a long-run relationship between variables, but they do not indicate the causality of this relationship. Although cointegration indicates the presence or absence of a relationship, cointegration does not have sufficient information to indicate the direction of this relationship. The VECM derived from the long-run cointegration vectors can detect the direction of Granger Causality in the sense that the VECM can capture both the short-run and the long-run relationships.

The error correction representation of the cointegration equation for the stock market price indexes, M1, M2, BC, OP, and S&P500 follows:

$$\Delta SMP_t = \beta 1 + \sum_{i=1}^{p} \delta 1i \, \Delta \, SMP_{t-i} + \sum_{i=1}^{p} \theta 1i \, \Delta \, M1_{t-i} + \sum_{i=1}^{p} \xi 1i \, \Delta \, M2_{t-i} + \sum_{i=1}^{p} \rho 1i \, \Delta \, BC_{t-i} +$$

$$\sum_{i=1}^{p} \omega 1i \, \Delta \, OP_{t-i} + \sum_{i=1}^{p} \tau 1i \, \Delta \, S\&P500_{t-i} + \lambda \, ECTt\text{-}1 + \varepsilon_t^{SP} \qquad (6\text{-}1)$$

Where $\lambda, \delta, \theta, \rho, \omega, \tau, and \xi$ are parameters to be estimated, p is the lag length; ε_t^{SP} are stationary random process with mean zero and constant variance. The VECM for other variables can be written similarly.

Granger notes that a VECM provides two channels through which the causality can be detected. The t–statistics on the error correction term indicate the existence of a long-run causality. On the other hand, the probability values χ^2 indicate the presence of a short-run causality.

The methodology of the direction of Granger causality derived from the VECM was discussed in chapter 3, where we discussed the four possible patterns of the test. First, there is unidirectional causality from x to y. Second, there is unidirectional causality from y to x. Third is bi-directional (bilateral) causality, which means two-way causality, i.e., x to y and y to x. Fourth is no causality (x, and y are independent). Considering the stock price equation, Table 6.1 indicates the causal relationship results for both the short- and long-run relationships.

For the general index (TASI), the right columns of Table 6.1 depict the results of the error correction model. By comparing the sign of the error correction term with the sign of cointegration equations and the t-statistic in the same table, the results indicates that (SMP) and (M2) were statistically significant at the 1% and 5% levels of significance and have the correct sign, indicating that in the case of disequilibrium, these two variables will adjust to return to the long-run equilibrium.

This result suggests a bidirectional long-run causal relationship between stock prices and M2. The variables M1 and S&P500 are not statistically significant, but they have the correct sign. Therefore, M1 and S&P500 Granger-cause stock prices in the long run. Furthermore, bank credit and oil price are not statistically significant and they have the wrong sign, which means that they do not adjust, and hence no causal relationship between them and stock prices exists in the long run. The short-term relationship between stock prices and other macroeconomic variables reflected in the P-value of the Wald test show bidirectional causality between stock prices and bank credit at both the 1% and 5% levels of significance and a unidirectional causality (i.e., one-way causality) from M1, M2, OP, S&P500 to SMP at the 1% and 5% levels of significance.

The causality relationships in this section support the findings of Engle and Granger (1991) that, theoretically, if variables are cointegrated, causality should exist in at least one direction.

For the Bank Sector Index (TBSI), the results of the causality test show that the error correction term is statistically significant at 1% for SMP and at 5% for M1 and M2 and have the correct signs, indicating that in the case of disequilibrium, these three variables will adjust to return to long-run equilibrium. Therefore, bidirectional causality is found between SMP and M1, and SMP and M2 at the same time. The S&P500 is not significant but it has the correct sign; therefore, there is a unidirectional causality from the S&P500 to SMP. Bank credit and oil prices are not significant and have the wrong signs, indicating that the long-run causality between BC and SMP, as well as OP and SMP, do not exist. These results are consistent with the hypothesis that money supply is important in determining stock prices, but that change in results may actually lead money changes.

As Table 6.1 illustrates, in the short-run, the causality between SMP and M1, M2 is unidirectional, running from M1 to SMP, and M2 to SP. The causality between SMP and BC is unidirectional, running from SMP to BC.

In the case of the Industry Sector Index (TISI), the results show that the error correction term for SMP and M2 are significant and have the correct sign, indicating that, in the case of disequilibrium, these two variables will adjust to return to the long-run equilibrium. This means that there is a bidirectional causality between stock prices and M2 at the 1% level of significance. M1 Granger cause SMP, but BC, OP, S&P 500 do not since they have wrong signs and hence will not adjust to return to long-run equilibrium. In the short term, the findings suggests that a causal relationship runs from oil prices to stock prices and a causal relationship runs from the Standard and Poors 500 Index to stock prices in this sector.

It is clear that this sector is sensitive to movement of oil price in the short run, and this result is justified since this sector contains the petrochemical firms.

The results, in the case of the Cement Sector Index (TCSI), show that only the error correction term for M2 is significant and has the correct sign. Accordingly, in the case of disequilibrium, only M2 will adjust to return to the long-run equilibrium. Therefore, only unidirectional causality exists in this case, running from stock prices to M2. On the other hand, there is only a unidirectional causality in the short run running from bank credit to stock prices.

The major impact of money is via M2, as would be expected because this monetary measure includes money market mutual fund balances, money market deposit accounts, and small time deposit.

In the case of the Service Sector Index (TSSI), with respect to the long-run causality, bidirectional causality is found between stock prices and M2 at the 5% and 1% levels of significance, respectively. Furthermore, there are two unidirectional causalities running from M1 to SMP as well as one running from the S&P500 to SMP. For the BC and OP, they were statistically not significant and have the wrong sign, which means that there is no causal relationship between them and stock prices. In the short run, the results suggest that there are two unidirectional causalities. The first one runs from M1 to stock prices, and the second one runs from stock prices to bank credit.

Unidirectional causality runs from stock prices to M2 in the case of Electric Sector Index (TESI). The results indicate that M2 is the only variable that adjusts to return to equilibrium. The error correction term in stock prices is not significant in this sector. In the short run, none of the macroeconomic variables cause the stock prices, but the stock prices in this sector Granger cause the bank credit.

Finally, for the Agriculture Sector Index (TGSI), movement on the stock prices was found to affect M1 and M2 at the 5% and 1% levels of significance, respectively. There are only two one-direction causalities in the long run, one from stock prices to M1 and another one from stock prices to M2. With respect to the short run, stock prices Granger-cause bank credit.

Table 6.1 Granger Causality Test Results Based on VECM.

	Dependent Variable	Short-run Causality (P-Value)						Adjustment Coefficients	
		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
The General Index	ΔSMP	--	.0264**	.0455**	.017**	.039**	.009**	-.054	-3.44**
	ΔM1	.495						.310	1.18
	ΔM2	.677						1.029	3.001**
	ΔBC	.049**						-1.298	-2.065
	ΔOP	.625						-.036	-1.63
	Δ S&P	.728						.007	1.135
The Bank Sector Index		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
	ΔSMP	--	.0095**	.0046**	.387	.085	-.083	-.094	-3.15**
	ΔM1	.890						.387	2.048*
	ΔM2	.881						.586	2.27*
	ΔBC	.027**						-.901	-1.98
	ΔOP	.427						-.032	-2.05
	Δ S&P	.911						-.0004	.086

*, ** indicates that a test statistics is significant at 5%, and 1% level of significance respectively.

Table 6.1 (Continued)

	Dependent Variable	Short-Run Causality (P-Value)						Adjustment Coefficients	
		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
The Industry Sector Index	ΔSMP	--	.037**	.274	.062	.016**	.010**	-.048	-3.502**
	ΔM1	.094						.132	1.39
	ΔM2	.159						.380	2.89**
	ΔBC	.068						-.528	-2.10
	ΔOP	.692						-.013	-1.49
	Δ S&P	.399						.002	1.11
		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
The Cement Sector Index	ΔSMP		.140	.180	.0001**	.829	.567	-.014	-1.29
	ΔM1	.063						.252	1.39
	ΔM2	.248						.560	2.26*
	ΔBC	.655						-1.535	-3.435
	ΔOP	.756						-.036	-2.32
	Δ S&P	.565						.0048	1.074

*, ** indicates that a test statistics is significant at 5%, and 1% level of significance respectively.

Table 6.1 (Continued)

	Dependent Variable	Short-Run Causality (P-Value)						Adjustment Coefficients	
		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
The Service Sector Index	ΔSMP		.039**	.787	.073	.082	.578	-.022	-2.04*
	ΔM1	.307						.446	1.18
	ΔM2	.629						1.365	2.72**
	ΔBC	.0004**						-1.608	-1.86
	ΔOP	.0914						-.045	-1.47
	Δ S&P	.9830						.013	1.44
The Electric Sector Index		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
	ΔSMP		.302	.385	.922	.169	.516	-.009	-.97
	ΔM1	.376						.231	1.27
	ΔM2	.808						.660	2.68**
	ΔBC	.001**						-1.459	-3.49
	ΔOP	.423						-.030	-1.97
	Δ S&P	.801						-.006	1.38

*, ** indicates that a test statistics is significant at 5%, and 1% level of significance respectively.

Table 6.1 (Continued)

	Dependent Variable	Short-Run Causality (P-Value)						Adjustment Coefficients	
		ΔSP	ΔM1	ΔM2	ΔBC	ΔOP	ΔS&P	ECt-1	t-stat
The Agriculture Sector Index	ΔSMP		.259	.673	.189	.898	.752	-.026	-1.75
	ΔM1	.200						.744	2.34**
	ΔM2	.542						1.019	2.28*
	ΔBC	.001**						-.522	-.77
	ΔOP	.303						-.025	-.982
	Δ S&P	.683						.012	1.48

*, ** indicates that a test statistics is significant at 5%, and 1% level of significance respectively.

6.2 Forecast Error Variance Decomposition (FEVD), and Impulse Response Function (IRF)

The decomposition of the forecast error variance for the composite index (TASI) is reported in Table (6.2). This table represents the variance decomposition results for the real stock prices at six month intervals to 36 months. The shocks associated with real money supply, real bank credit, and real oil price plays an important role in explaining real stock price variations over the short as well as medium run, and at the same time the percentage of variation in SMP is explained by its decrease over time. At period 36, about 36.3% percent of the forecast error is explained by innovations in SMP; the remainder is explained by innovations in the other variables. From these results, we can ascertain that stock prices growth is endogenous in the sense that it allows the other variables to contribute to its explanation. On the other hand, the results of the FEVD indicate that oil price and the Standard and Poors 500 Index are more relatively exogenous since their variations explain more than 65% in the long run.

Moreover, the movements in stock prices do seem to explain forecast error variance of money supply and bank credit. The findings of Granger causality tests and variance decomposition analysis are not contradictory.

Figure 6.1 represents the generalized impulse response function of stock price to one standard deviation shock in SMP, M1, M2, BC, OP and S&P500. All six functions indicate that a positive shock in each of these macroeconomic variables, including the variable itself, has a strong positive impact on stock price. As expected, a positive shock in stock price will have an immediate and strong increasing impact on itself.

Stock prices respond intensively to a shock in M1, BC, and OP. However, the positive impact of a positive shock in M2 and the S&P500 counts for less than the positive impact of a positive shock in other variables. Overall, variance decomposition as well as the impulse response function appear not to be consistent with the efficient market hypothesis, i.e., shocks of macroeconomic variables have significant effect on stock prices.

The FEVD of the bank sector index in Table 6.3 shows that stock price innovations are able to explain more than 34% of the index's fluctuations. Money supply and bank credit play important roles in explaining the variation of stock price, where the first one explain more than 20% of the variation. Oil price explains more than 84% of its fluctuations, which confirms that OP is an exogenous variable in this index. The S&P500 explains about 50% of its variation.

The generalized impulse response functions of stock price in the bank sector index to one standard deviation shock in other macroeconomic variables are presented in Figure 6.2. This shows that a positive shock in SP will have a strong, positive, and increasing impact on itself immediately.

Table 6.4 shows that bank credit and oil price explain more variation in stock price of the industry sector index (TISI) over time, which means that both BC and OP are becoming more significant in explaining variation in stock prices of this index. However, bank credit explains a larger percentage of variation in SMP than any other variable in the system. This result confirms our earlier result in section 6.1, that bank credit and oil prices Granger cause stock prices in the industry sector index. More than 48% of variation of SMP is explained by its own variation, which confirms the endogenous nature of this variable in this index. On the other hand, variation of stock prices explains more than 40% percent of the money supply variation as well as more than 42% of the bank credit variation, confirming the interaction between stock prices and the monetary variables.

Figure 6.3 illustrates the impulse response function results of SMP of the Industry Sector Index to one standard deviation shock in the macroeconomic variable. These results show that, besides SMP to itself, M1, BC, and OP have an increasing positive effect on SMP. For the reaction of SMP to a positive shock in both M2, and S&P500, the figure shows that it is very small and insignificant for the first one and small for the second one.

In general, the ability of each variable in each index to explain itself declines over time, but unlike the previous indices, the stock price innovations of the Cement Sector Index (TCSI) are able to explain less than 24% of its fluctuations, which confirms that SMP in this index is a strongly endogenous variable and other macroeconomic variables explain more of its variations over time. Table 6.5 shows that BC explains more than 37% of SMP variation, which confirms the result we found in the Granger causality in section 6.1, where bank credit Granger-caused SMP in the cement sector index. Oil price and the Standard and Poor's 500 Index are considered exogenous in this index since their variation explains more than 85% for the first one and about 75% for the second one.

On the other hand, to investigate whether SMP is explained by the variation in the other macroeconomic variables, it is clear that SMP does not explain the variation of BC since it explains less than 1.2% of BC variation, but it does explain about 8% of the money supply which is far smaller than the effect of BC and OP in the money supply. Thus, it should be considered an explanation of the unidirectional causality between SMP and BC.

The generalized impulse response function of SMP to one standard deviation shock in the Cement Sector Index (Figure 6.4) has some interesting implications. First, the response of SMP to its own shock is constant over time compared to an increasing measure for the other indices. Second, a positive shock in M2 will lead to a negative effect in the first three periods and will then return to the positive pattern. A positive shock in the other variables will lead to a large increasing and positive effect on stock prices.

Table 6.6 represents the percentage of forecast error variance of stock price in the Service Sector Index (TSSI). As the table shows, the SMP is capable of explaining about 60% of its variations. It is evident that money supply explains a larger percentage of variation in SP than any other variable in the model. This is consistent with the Granger causality results in section 6.1, where we found that there is a short-run as well as long-run relationship between stock prices and money supply. Moreover, looking at the effect of SP in this index on the other macroeconomic variables, we found that variation of SP explains about 26% of the money supply as well as 37.5% of variation of bank credit, confirming the earlier results of the Granger causality tests.

The impulse response function in Figure 6.5 shows that, besides SMP to itself, M1 has an increasing positive effect on stock prices. As expected, a positive shock in SMP will have an immediate and strong increasing impact on itself. Furthermore, a positive shock in M1 will have a strong positive increasing impact on SMP starting from the first period. A positive shock in bank credit will have a weak and negative effect on SMP until it reaches the 10^{th} period, and then start a permanent, positive effect on stock prices. Again, this is consistent with the results that we obtained in the variance decomposition analysis, where M1 was the most influential variable on stock prices. Also, stock prices will respond to a positive shock in M2, OP, S&P500 gradually, starting from the first period and increasing after that.

Entries in Table 6.7 provide the percentage of variance of stock price to earlier shocks from other macroeconomic variables, including innovations of itself for the Electric Sector Index (TESI). As for the short run, SMP accounts for the majority of its own variance. In this index, stock price explain about 76% of its variation. Money supply comes into play as the major explanatory variable in explaining SMP variation, especially in the long run. Other variables are not significant in explaining variation in SMP since each one explains less than 3% of the variation. Considering the effect of SMP variation on other variables in this model, we found that innovation in SMP explain more than 10% of variance decomposition of BC, where it to be considered the only one that exceeds 10%, which confirms the early results of the Granger causality test in section 6.1.

Consequently, the impulse response function of stock prices to one standard deviation shock on itself and other macroeconomic variables is illustrated in Figure 6.6. It shows that a positive shock in SMP will lead to an abrupt, large, permanent and positive effect on itself. Also, it shows that there is a strong relationship between M1 and SMP. Furthermore, SMP react negatively and then positively to a positive shock in M2. These results demonstrate the result of variance decomposition.

Finally; Table 6.8 shows the variance decomposition of stock price of the Agriculture Sector Index (TGSI). Stock price innovations in this sector are able to explain more than 81% of its fluctuations, which confirms that SMP in this index is an exogenous variable. At the same time, SMP explains more than 61% of money supply variation as well as more than 58% for the bank credit, confirming the long-term relationship between money supply and stock prices and the Granger causality of stock prices to bank credit.

An impulse response analysis for a horizon of 36 months illustrates the response of the stock price to a one standard deviation shock to all macroeconomic variables as reported in Figure 6.7. Over the 36 periods, the effect remains substantial for SMP, M1, BC, OP, and S&P500, but weak for M2. It is clear from the figure that a positive shock in SMP will have a strong, positive, and increasing impact on itself immediately, which demonstrates the result of variance decomposition. The response of the stock price to a one standard deviation shock to all other macroeconomic variables is identical for all of the variables (positive and permanent), and very small and insignificant for M2.

Table 6.2 Forecast Error Variance Decomposition for TASI

Variance Decomposition of SMP						
Period	SMP	M1	M2	BC	OP	S_P_500
6	79.2752	1.8816	1.9611	2.3909	1.7450	12.7462
12	66.5402	3.7462	3.8431	7.6941	6.2284	11.9481
24	46.3185	7.5834	6.2003	18.3553	14.3807	7.1618
36	36.8681	9.1619	7.0870	23.7021	18.0997	5.0813
Variance Decomposition of M1						
Period	SMP	M1	M2	BC	OP	S_P_500
6	14.1245	74.0581	2.5790	2.3406	6.6177	0.2802
12	18.9116	57.6840	2.1124	9.8764	10.7765	0.6390
24	24.1425	31.7144	3.1419	20.8743	18.7014	1.4256
36	25.2604	21.4641	4.8778	25.4754	20.9447	1.9776
Variance Decomposition of M2						
Period	SMP	M1	M2	BC	OP	S_P_500
6	6.0843	58.0555	14.8825	6.1235	13.7648	1.0894
12	10.7913	34.6698	4.8627	23.5136	24.6180	1.5446
24	19.3319	19.9083	3.8266	29.1105	25.5722	2.2505
36	22.2334	15.4372	5.2931	30.0560	24.4732	2.5072
Variance Decomposition of BC						
Period	SMP	M1	M2	BC	OP	S_P_500
6	11.0092	1.7202	5.9612	79.3544	0.2893	1.6656
12	21.6950	2.1964	7.5874	64.8809	2.2260	1.4144
24	26.1006	5.5516	8.3953	48.0186	9.8356	2.0982
36	26.3187	7.7379	8.3557	40.2609	14.9066	2.4202
Variance Decomposition of OP						
Period	SMP	M1	M2	BC	OP	S_P_500
6	1.5704	3.3164	0.4962	1.2376	83.1124	10.2670
12	1.2036	1.7097	0.3804	1.3910	83.3620	11.9533
24	3.0688	0.7495	1.1998	4.6445	78.2777	12.0598
36	6.8063	1.1930	2.4588	9.4835	69.3925	10.6659
Variance Decomposition of S_P_500						
Period	SMP	M1	M2	BC	OP	S_P_500
6	5.9180	1.7224	3.7490	0.3340	5.5287	82.7479
12	5.2853	2.4876	2.5817	0.2738	13.0411	76.3305
24	4.2855	3.0388	3.1569	1.4925	20.2477	67.7786
36	2.6919	4.6128	4.4407	4.6091	26.4582	57.1873

Figure 6.1: Impulse Response Function for TASI.

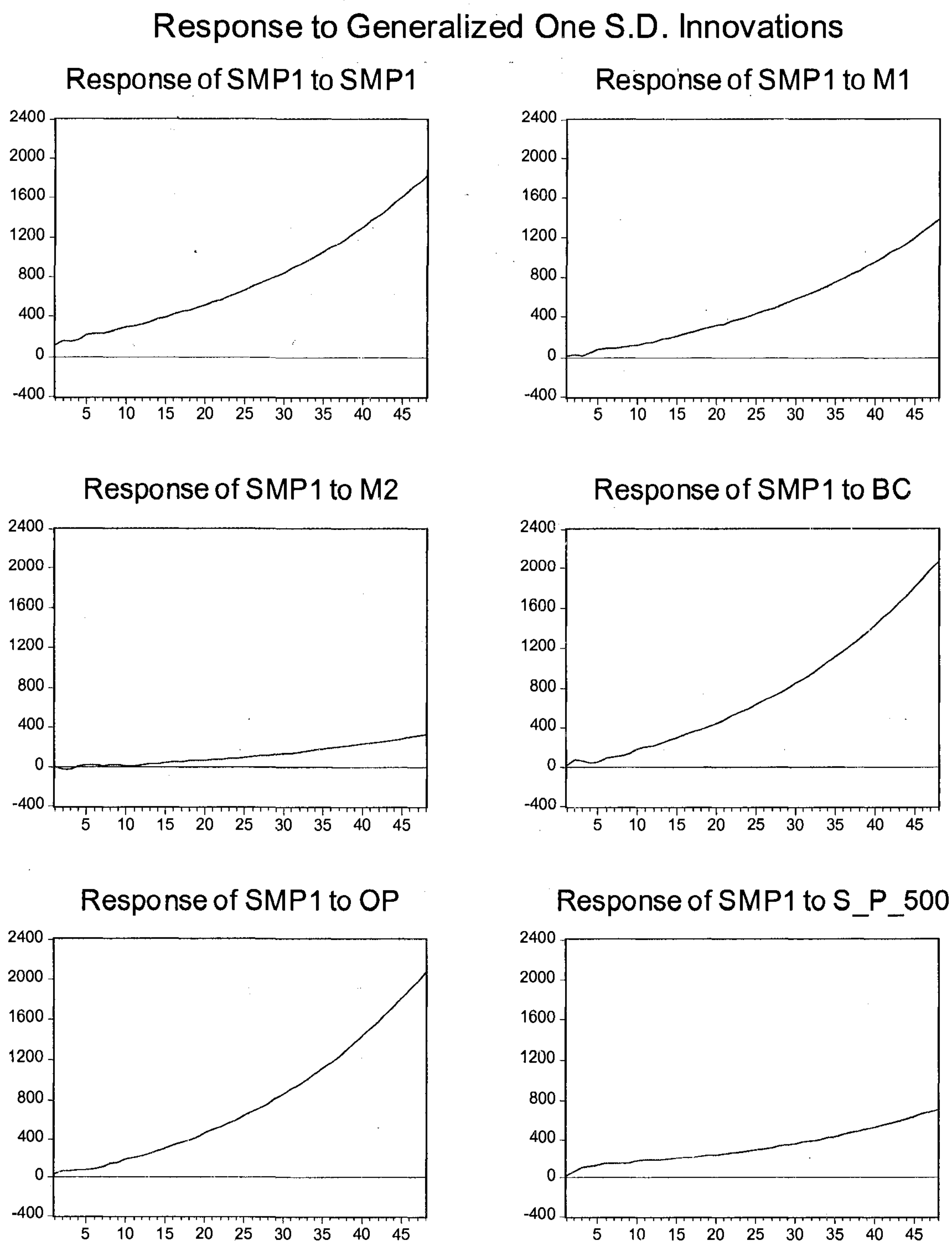


Table (6.3) Forecast Error Variance Decomposition for (TBSI)

Variance Decomposition of SMPBANK						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	81.1900	3.7342	1.9956	1.8298	0.0302	11.2202
12	63.4806	9.7741	4.6047	9.2796	1.2755	11.5855
24	43.0635	17.8500	6.1888	21.7351	4.3387	6.8239
36	34.3234	20.9086	6.6257	27.5083	5.9159	4.7180
Variance Decomposition of M1						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	15.0337	69.4738	4.5874	4.8425	5.6984	0.3642
12	16.9209	59.7831	2.9335	14.7957	5.3477	0.2190
24	21.5627	42.2404	2.3831	25.5612	7.4721	0.7806
36	22.8791	34.2634	3.7474	29.8622	7.9008	1.3471
Variance Decomposition of M2						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	3.5384	61.3888	14.3193	10.7270	9.7448	0.2818
12	4.8150	50.0622	4.6237	27.6430	12.6794	0.1767
24	13.3331	37.4712	2.7220	34.0526	11.5857	0.8354
36	17.7660	31.7065	3.9459	34.9754	10.1923	1.4138
Variance Decomposition of BC						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	6.7216	1.3673	5.2084	83.8315	1.7039	1.1672
12	19.6200	7.5618	6.0680	64.8271	0.6454	1.2776
24	24.5048	15.8088	6.8722	47.8620	2.8420	2.1103
36	24.5794	19.5212	6.9799	41.8375	4.7914	2.2905
Variance Decomposition of OP						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	2.6952	2.2632	4.0413	1.7729	79.7044	9.5230
12	1.3917	1.1724	4.4643	2.1394	82.2446	8.5876
24	1.6032	0.6163	4.3733	2.7553	83.6454	7.0066
36	2.3180	0.4790	4.0399	2.3050	84.4840	6.3741
Variance Decomposition of S_P_500						
Period	SMPBANK	M1	M2	BC	OP	S_P_500
6	2.5664	1.8265	0.4394	0.4650	4.6243	90.0784
12	1.4761	2.2491	0.3484	0.4253	10.1603	85.3408
24	2.0532	6.5031	0.8054	2.9292	17.6688	70.0403
36	6.3981	13.5311	2.3527	10.7441	20.5875	46.3865

Figure 6.2 Impulse Response Function for (TBSI)

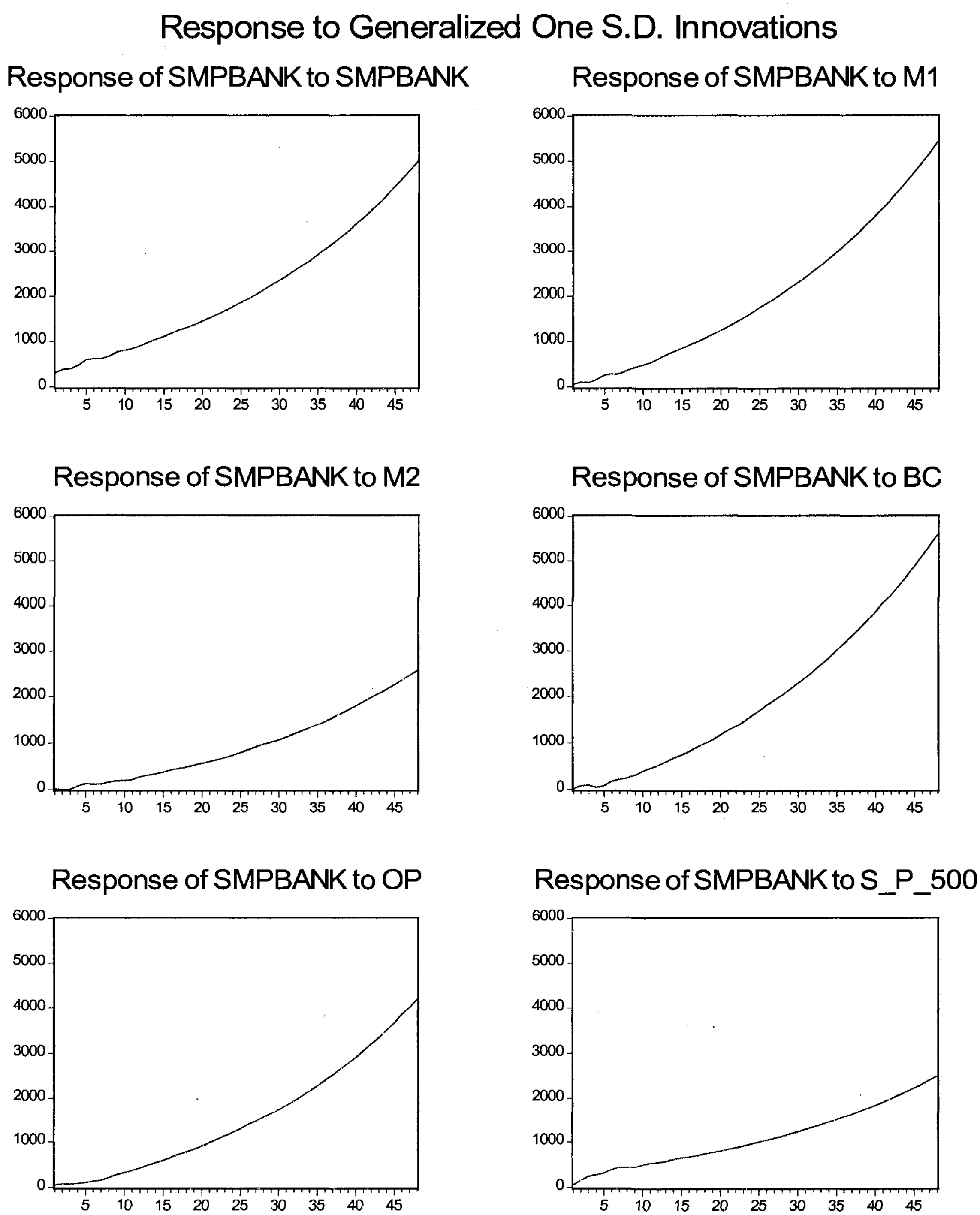


Table (6.4) Forecast Error Variance Decomposition for (TISI)

Variance Decomposition of SMPINDUSTRY						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	78.6545	0.7218	1.6474	1.9745	2.4179	14.5839
12	66.8351	1.5184	3.2214	6.9847	7.3738	14.0666
24	54.2989	3.4217	4.5296	15.1464	12.8129	9.7906
36	48.3503	4.3320	4.9688	19.0856	15.3416	7.9217
Variance Decomposition of M1						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	15.4773	73.6242	3.3323	0.9641	6.2838	0.3183
12	26.0984	51.2170	2.1716	7.8976	11.3053	1.3101
24	38.2193	20.9582	2.3968	17.2680	17.5472	3.6106
36	41.1892	11.4900	3.6703	20.5791	18.1447	4.9268
Variance Decomposition of M2						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	7.8549	55.4110	16.4033	4.6918	14.8106	0.8284
12	17.4315	26.7170	4.5278	21.8856	27.3506	2.0875
24	32.8110	11.6521	2.7346	24.4419	24.0216	4.3387
36	38.1144	7.8748	3.8270	23.9695	20.8912	5.3231
Variance Decomposition of BC						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	18.1748	1.6126	3.1398	74.7349	0.3458	1.9921
24	40.6606	3.0034	5.2538	37.4464	9.3170	4.3189
36	42.1067	4.0718	5.3525	29.7874	13.3794	5.3022
Variance Decomposition of OP						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	1.7816	3.5923	0.1541	1.0382	83.5555	9.8783
12	2.2124	2.1648	0.1142	0.7448	82.2412	12.5226
24	9.0722	0.8134	0.8857	4.1815	71.4432	13.6041
36	20.4335	1.1188	2.3028	10.3044	53.7890	12.0515
Variance Decomposition of S_P_500						
Period	SMPINDUS	M1	M2	BC	OP	S_P_500
6	122.3387	4.8315	1.8117	3.4712	1.2264	6.1933
12	186.5518	5.9726	2.1693	1.9177	0.9857	12.0097
24	279.3981	9.4289	1.4444	1.2875	0.8976	13.8465
36	352.9236	12.4056	1.0540	0.9215	0.6233	12.7939

Figure 6.3 Impulse Response Function for (TISI)

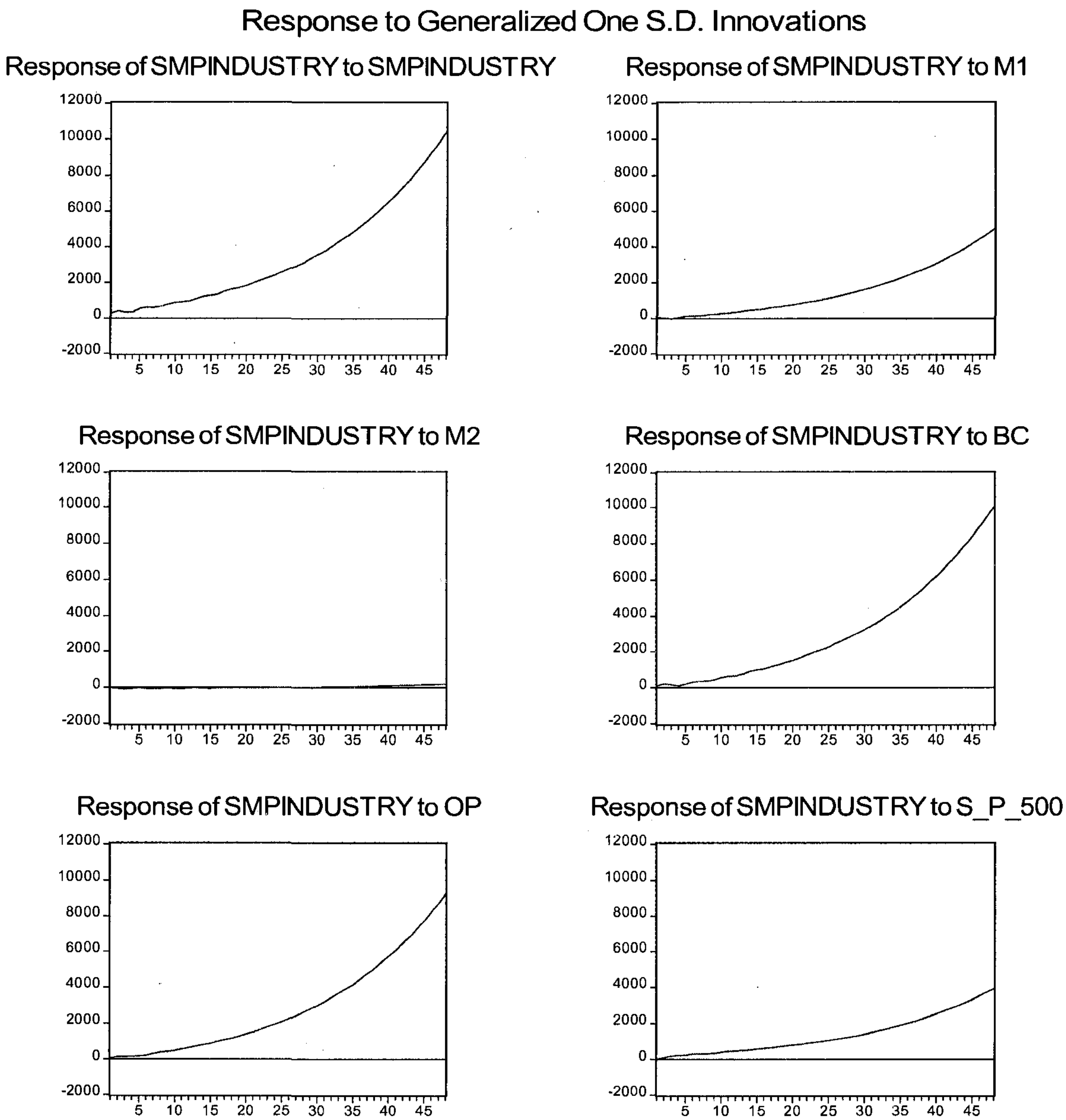


Table (6.5) Forecast Error Variance Decomposition for (TCSI)

Variance Decomposition of SMPCEMENT						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	80.2623	4.5525	3.3961	8.5992	2.0331	1.1569
12	64.5520	13.2139	5.5542	9.1339	6.5229	1.0230
24	27.6803	30.0952	8.9554	16.0836	14.7268	2.4587
36	10.9312	37.3948	10.4138	20.6081	17.2847	3.3673
Variance Decomposition of M1						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	2.5714	79.3987	2.5015	7.7182	7.3098	0.5004
12	2.8804	72.8251	2.2904	12.4380	8.6732	0.8928
24	0.8452	59.3819	4.1244	19.0439	14.3266	2.2780
36	0.3129	52.2225	6.5052	21.7705	16.1042	3.0847
Variance Decomposition of M2						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	0.8485	61.7795	19.4108	5.8772	10.4198	1.6642
12	0.4582	60.9264	6.6544	13.9459	15.3777	2.6373
24	0.0578	52.1446	4.6962	21.1251	18.1431	3.8332
36	0.0132	47.8140	6.8117	23.0602	18.2169	4.0840
Variance Decomposition of BC						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	10.4630	2.1315	13.2221	70.5107	0.5257	3.1469
12	6.2956	12.8102	14.6083	60.9102	1.8469	3.5288
24	1.9644	26.1651	14.2013	46.4668	7.1572	4.0452
36	0.6879	33.1608	13.1647	37.5548	11.1966	4.2352
Variance Decomposition of OP						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	0.6719	1.6307	1.2598	2.6383	85.0066	8.7927
12	0.8010	1.1218	0.9799	1.2536	83.3558	12.4879
24	0.8923	4.4284	2.5169	2.1023	75.6731	14.3869
36	0.6331	11.3503	4.6142	5.6953	64.4412	13.2659
Variance Decomposition of S_P_500						
Period	SMPCEME	M1	M2	BC	OP	S_P_500
6	1.2873	2.2321	2.7811	1.1045	2.7338	89.8612
12	3.3709	4.1345	2.0454	1.2728	10.2207	78.9557
24	3.0171	15.3065	5.0015	1.9067	21.5367	53.2314
36	1.8127	30.0614	8.7829	7.7521	26.8765	24.7145

Figure 6.4 Impulse Response Function for (TCSI)

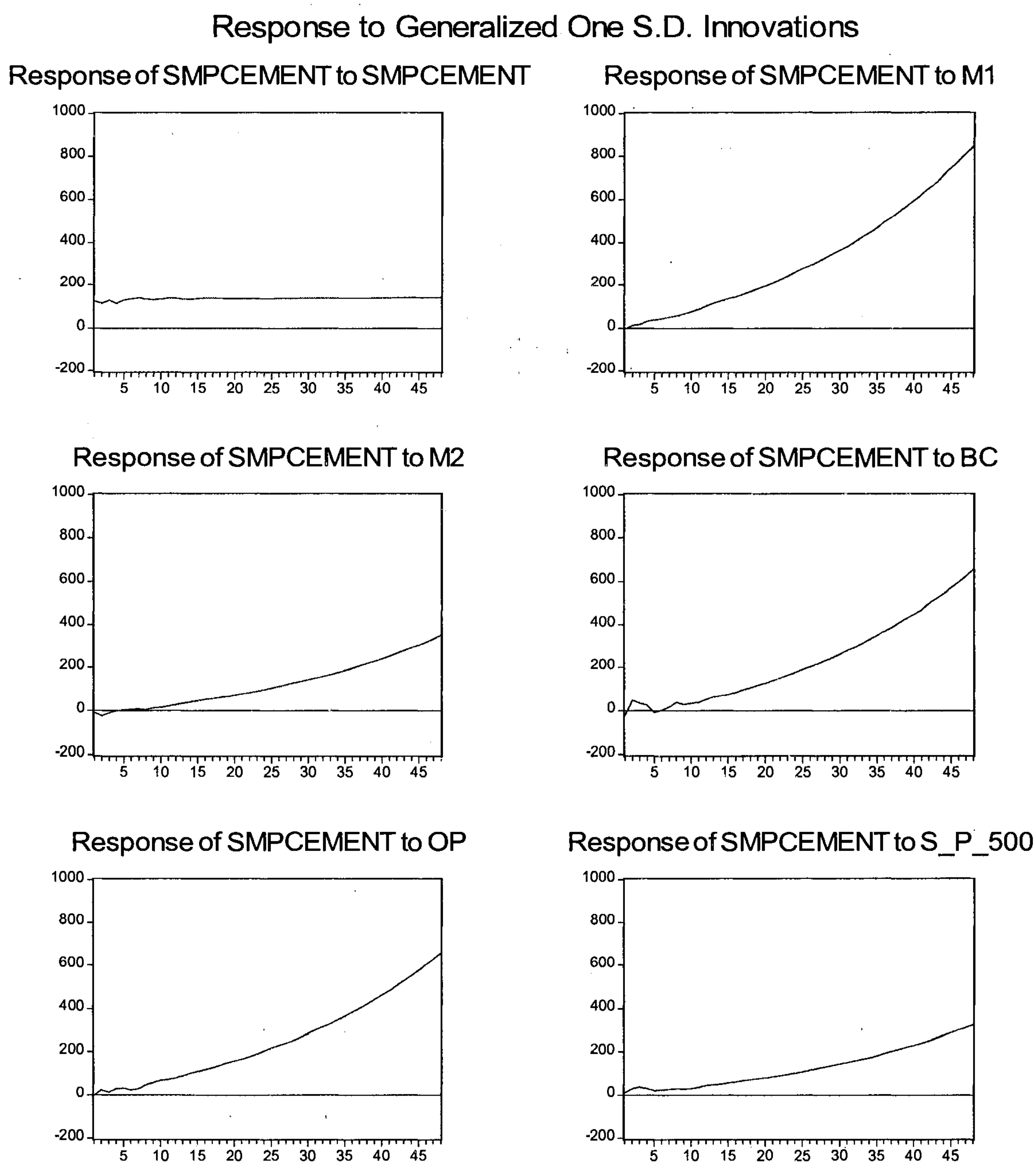


Table (6.6) Forecast Error Variance Decomposition For (TSSI)

Variance Decomposition of SMPSERVICE						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	77.3459	11.6790	3.4198	0.7767	3.1823	3.5963
12	73.4465	13.6155	3.7220	1.2331	3.8675	4.1154
24	65.2520	16.8610	5.7970	2.9532	5.3581	3.7787
36	59.9212	18.7611	6.9664	4.1722	6.5873	3.5918
Variance Decomposition of M1						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	8.3941	77.6332	2.9623	1.7170	9.0705	0.2229
12	13.4175	70.3547	2.3090	3.7746	9.6306	0.5137
24	22.5759	54.5295	3.1025	6.3680	12.4059	1.0181
36	26.6477	46.5988	4.6816	7.6592	13.0242	1.3886
Variance Decomposition of M2						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	2.7401	62.1712	17.0375	2.6861	13.9991	1.3659
12	10.2014	52.2597	6.6278	9.9794	18.5165	2.4152
24	22.5979	40.3440	5.2287	10.9560	18.1237	2.7497
36	26.8672	35.7739	6.6613	11.1069	16.8259	2.7649
Variance Decomposition of BC						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	19.6092	1.8621	11.1289	64.1961	0.6668	2.5368
12	30.9717	6.2923	13.4356	46.3916	1.0725	1.8362
24	36.6074	12.1363	13.8407	31.8638	3.4596	2.0923
36	37.5549	15.4442	13.6725	25.7503	5.3231	2.2550
Variance Decomposition of OP						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	0.6967	3.1077	1.6266	1.8992	81.1648	11.5049
12	0.7795	1.3401	1.6620	0.8208	80.7020	14.6958
24	4.1642	2.1584	3.9055	1.1709	73.7770	14.8239
36	8.5413	4.6022	5.7393	2.2446	65.3796	13.4930
Variance Decomposition of S_P_500						
Period	SMPSERV	M1	M2	BC	OP	S_P_500
6	0.4636	2.1348	3.3071	1.3456	3.4434	89.3055
12	0.2665	3.4900	2.7243	1.7965	12.1336	79.5891
24	1.8307	7.7517	5.2960	0.9703	20.9428	63.2085
36	6.3669	13.3605	8.1108	1.2101	25.3960	45.5557

Figure 6.5 Impulse Response Function for (TSSI)

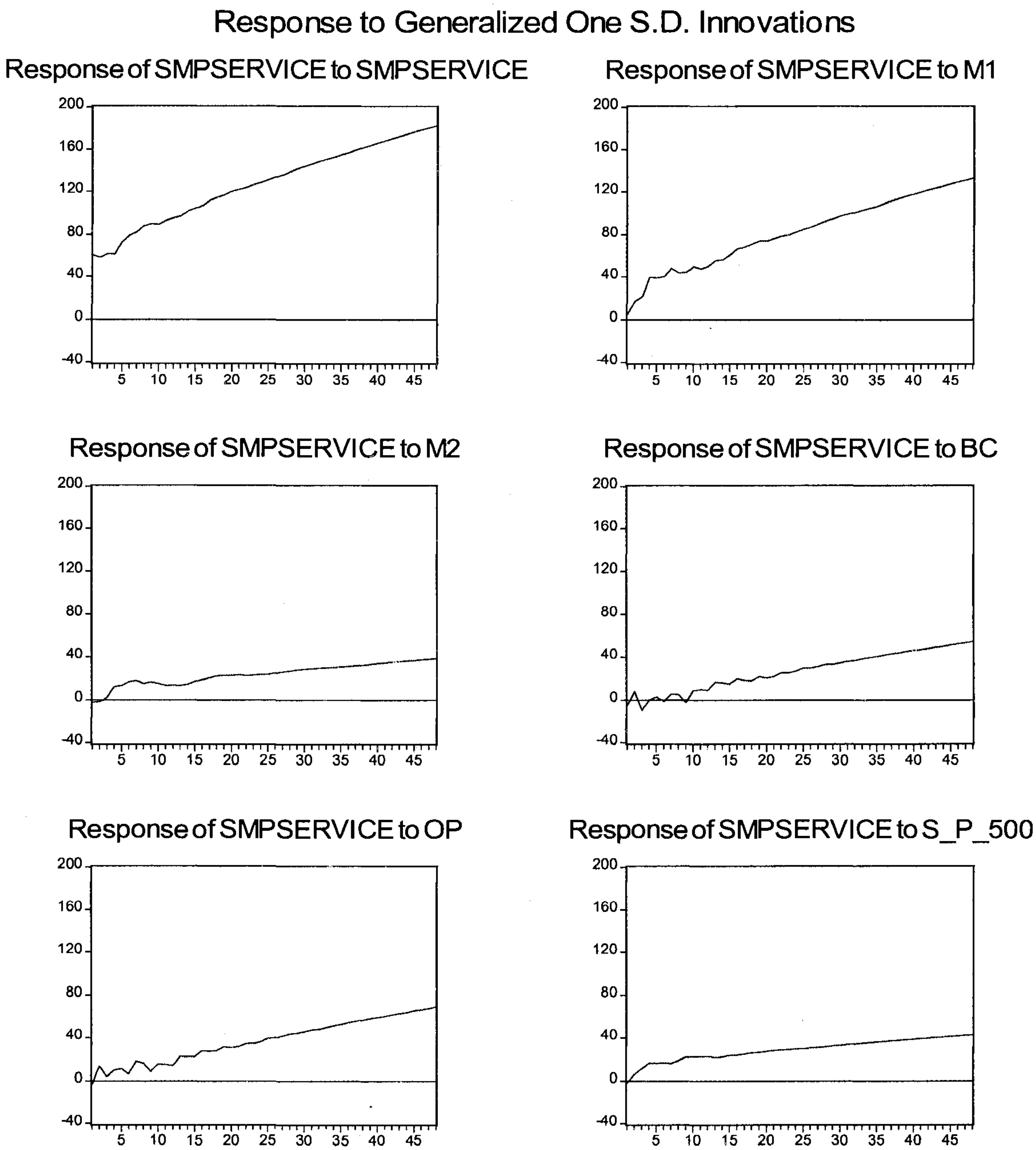


Table (6.7) Forecast Error Variance Decomposition For (TESI)

Variance Decomposition of SMPELECTRIC						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	87.0015	6.9979	1.9098	0.3507	0.8772	2.8629
12	87.1494	9.2675	1.0614	0.3987	0.4999	1.6230
24	82.5594	13.0000	1.8151	1.2708	0.4512	0.9036
36	76.3478	16.5432	2.8403	2.5448	1.0233	0.7005
Variance Decomposition of M1						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	3.1190	80.7093	1.9909	3.1753	10.6065	0.3991
24	6.3180	62.2140	4.1710	12.2785	14.9347	0.0839
36	7.3838	54.5524	6.6762	15.0032	16.2618	0.1227
Variance Decomposition of M2						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	1.8170	65.6231	14.6841	3.5570	13.5840	0.7347
12	3.4017	58.0215	6.2708	12.8360	18.3339	1.1360
24	6.6361	48.8483	6.5738	17.2214	19.8963	0.8241
36	7.6907	44.9135	8.7703	18.5228	19.4399	0.6628
Variance Decomposition of BC						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	12.2376	2.6724	19.2544	64.3242	0.2151	1.2962
12	12.3916	12.9848	21.0958	50.9388	2.1418	0.4472
24	11.8382	22.9916	19.5981	38.5043	6.7846	0.2833
36	11.2422	27.7712	18.3067	32.5273	9.8550	0.2975
Variance Decomposition of OP						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	1.0517	2.4867	0.6652	1.5412	82.5342	11.7209
12	1.4503	1.1172	0.7519	0.9400	80.2323	15.5084
24	3.2205	3.9491	3.1651	3.3138	72.4656	13.8857
36	4.8452	9.1175	5.6618	6.4739	63.1592	10.7426
Variance Decomposition of S_P_500						
Period	SMPELEC	M1	M2	BC	OP	S_P_500
6	5.0510	2.1060	2.6920	0.6786	4.2099	85.2625
12	4.8708	2.9466	2.2380	0.5194	14.6005	74.8246
24	2.7678	8.9740	5.4343	1.5731	25.4488	55.8021
36	1.5669	17.5173	9.0433	4.8804	30.0359	36.9562

Figure 6.6 Impulse Response Function for (TESI)

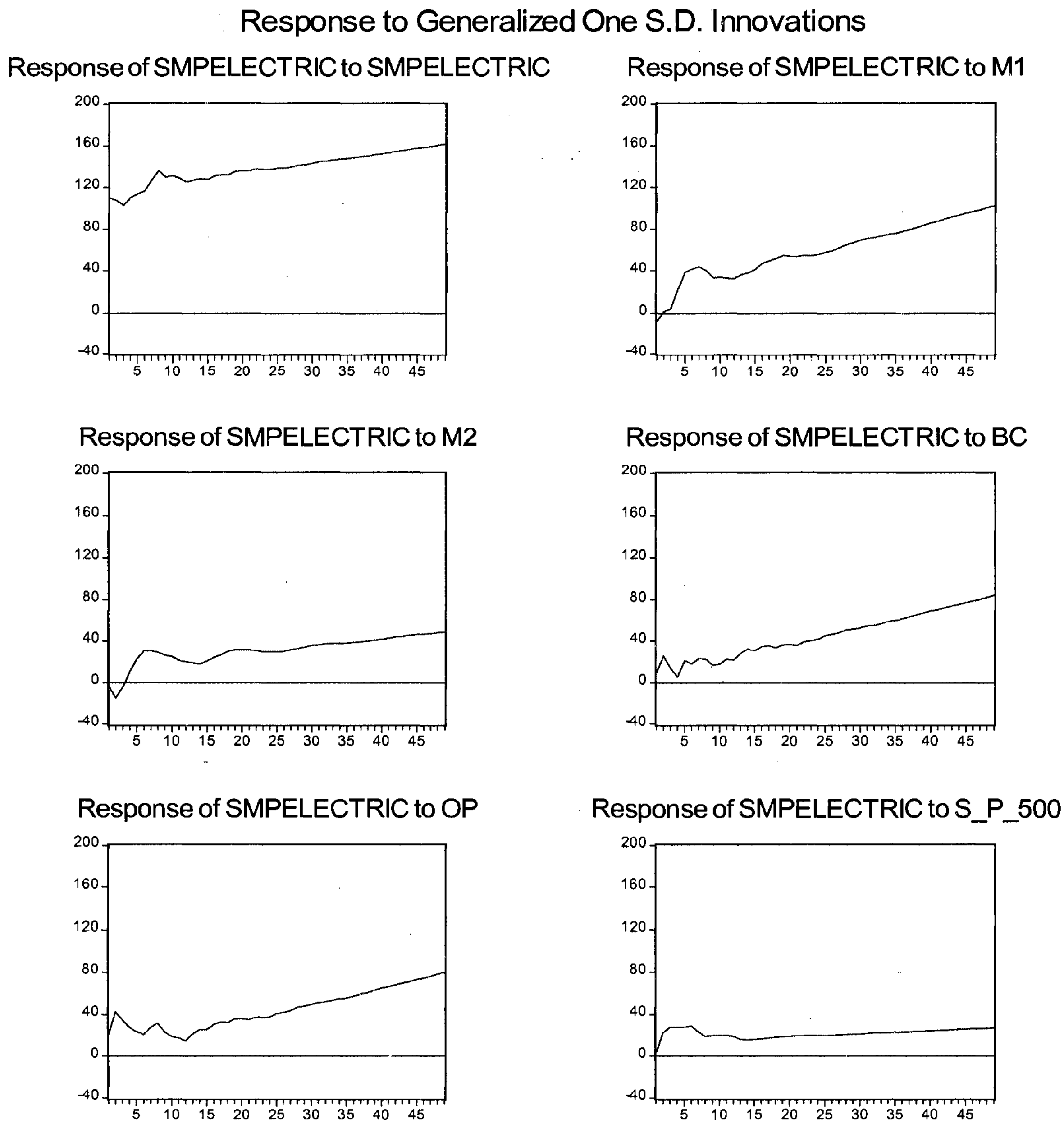
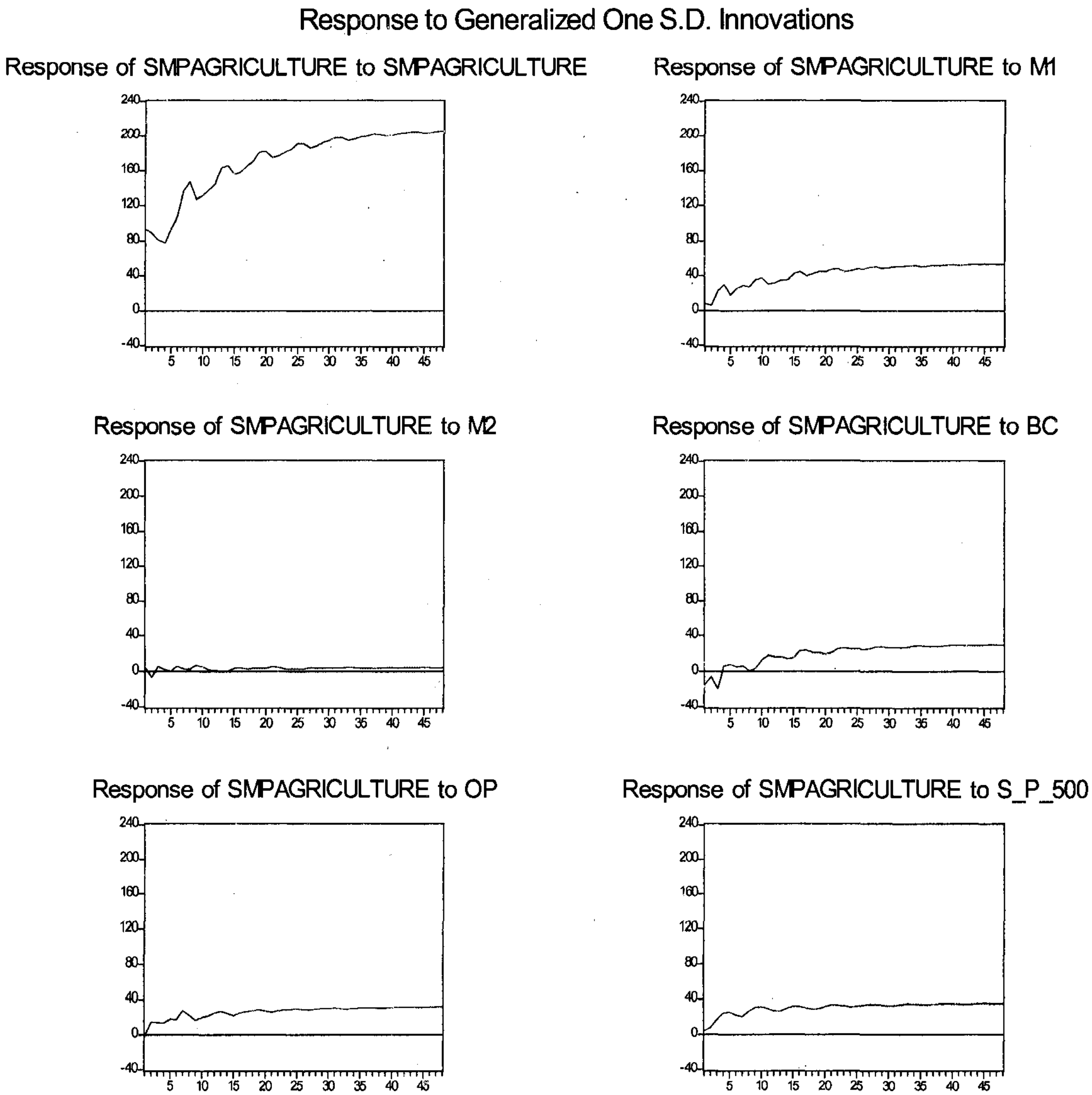


Table (6.8) Forecast Error Variance Decomposition For (TGSI)

Variance Decomposition of SMPAGRICULTURE						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	86.1494	1.9934	3.5293	2.8320	2.8711	2.6247
12	84.7059	1.9503	3.7046	4.4678	2.8402	2.3312
24	82.6969	2.1654	4.4378	6.3413	2.5977	1.7608
36	81.7849	2.3053	4.7117	7.0935	2.5592	1.5455
Variance Decomposition of M1						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	32.3554	57.8889	4.9096	0.4318	3.8042	0.6101
12	42.8281	47.3066	2.7958	2.2083	4.3998	0.4614
24	57.0297	32.0144	1.2533	4.4813	5.0064	0.2149
36	61.4994	26.3827	1.2916	5.7233	4.9256	0.1774
Variance Decomposition of M2						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	19.7399	49.9170	20.6562	0.8230	8.2209	0.6431
12	41.5249	31.5004	6.6969	7.1080	11.9925	1.1773
24	59.6185	17.9266	2.6070	9.4261	9.5335	0.8883
36	63.3463	14.5485	2.6566	10.3729	8.3004	0.7753
Variance Decomposition of BC						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	31.5779	2.9002	7.4360	57.3789	0.3726	0.3345
12	47.1067	1.1840	7.7191	43.6437	0.1877	0.1589
24	55.3672	0.9105	7.6947	35.6340	0.3176	0.0760
36	58.1133	1.0135	7.6823	32.6810	0.4450	0.0649
Variance Decomposition of OP						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	5.4111	3.6899	0.8589	2.2533	77.7481	10.0386
12	8.6723	1.9431	0.7914	1.4378	74.0066	13.1488
24	17.6850	0.8483	1.6703	0.6661	66.1770	12.9533
36	23.5538	0.5053	2.2410	0.6784	60.8596	12.1619
Variance Decomposition of S_P_500						
Period	SMPAGRI	M1	M2	BC	OP	S_P_500
6	1.9608	2.0419	4.4972	0.8795	3.6890	86.9315
12	1.2971	3.7339	3.3802	1.9478	10.2746	79.3664
24	5.5309	5.2913	5.1332	1.0300	16.5809	66.4336
36	11.7876	6.2667	6.4461	0.7609	18.4276	56.3111

Figure 6.7 Impulse Response Function for (TGSI)



6.3 Concluding Remarks for Empirical analysis

This chapter was devoted to illustrating and analyzing the empirical results of this study. The main focus of this study was to investigate both the long-run and short-run interactions between stock market prices and measures of aggregate real activity, including real money supply, bank credit, oil price, and the Standard and Poor 500 Index in Saudi Arabia. Seven stock price indexes (composite and sectoral) were taken for the period January 1995 to December 2004. To examine the interactions among these variables, several time series techniques such as unit root testing, multivariate cointegration, Granger causality, and innovation accounting analysis procedures were employed. The results can be summarized as follow:

1. In the first step, all the series were tested for the unit roots. In this context, the augmented ADF was applied to both the original series and the first differences. The results suggest the acceptance of the presence of unit roots in the original series, indicating that none of the original series is stationary. However, the presence of unit roots is conclusively rejected in the first differences of the series for all variables in the study. This suggested that all series are integrated of order one.

2. Next, cointegration regressions were estimated. The results of cointegration show that the null hypothesis of no cointegration between stock prices and macroeconomic variables is rejected in all cases, indicating that, in general, there exists a long-run relationship between stock prices and macroeconomic variables in the seven indices.

3. Third, to explore the long-run relationship between stock prices and macroeconomic variables further as well as the short-run and cause-and-effect relationships, the Error Correction Model was employed and the results are reported in Table 6.9. This table

shows that, for the long-run causality, bidirectional causality was found between the stock price and money supply for the general index, the bank sector index, the industry sector index, and the service sector index. Moreover, for these indices there is unidirectional causality running from the Standard and Poor's 500 Index to stock prices. For the cement sector index, the electric sector index, and the agriculture sector index, movement of stock price was found to affect money supply and not vice-versa in these sectors.

On the other hand, the short-run causality showed different relationships among indices. While all variables M1, M2, BC, OP, S&P500 caused movement in stock prices in the general index, none of these variables caused the stock prices in the electric sector index, and the agriculture index. For the bank sector index and the service sector index, there is only unidirectional causality from M1 and M2 to SMP for the first one and M1 to SP for the second one. Furthermore, the results show that a short-run Granger causality runs from M1, OP, and S&P500 to SMP in the industry sector index, and only one-direction causality from BC to stock prices for the cement sector index. Finally, there is only unidirectional causality from stock prices to bank credit in five out of seven indices; namely, the general index, the bank sector index, the service sector index, the electric sector index, and the agriculture sector index. In the other two sectors, movement on stock prices does not cause any variable in these two sectors.

4- Finally, the variance decomposition analysis for a horizon of three years (36 monthly data) estimates the contribution of distinct shocks to variances. Not surprisingly, at short horizon, the variances in all seven indices are mainly attributed to SMP itself. However, the effect drops as the horizon lengthens. At the 3-year horizon (i.e., long term), the portion of FEV explained by SMP itself remain large in TSSI, TESI, TGSI, but becomes less than 50% for other indices. For TASI, TBSI, TCSI, about 50% or more of the variance of SMP can be attributed largely to innovations in BC, and slightly M1. Moreover about 20% of FEV of SMP in TSSI, TESI is attributed to M1,and M2. For TGSI only 20% or less of the variance of SP is attributed to all variables.

The impulse response analysis illustrates the response of the stock price to a one standard deviation shock to all macroeconomic variables. The seven indices seem to be sensitive to shocks from the stock prices themselves as well as from macroeconomic variables. The impulse response analysis seems to reinforce the results of the variance decomposition analysis. Initially, stock prices respond intensively to shock in itself. Over the 3-year period the effect continue to increase for TASI, TBSI, TISI, TSSI, TGSI, but remain constant for TCSI, and TESI. For innovations in macroeconomic variables, stock prices react primarily to BC,M1, while M2, OP, S&P 500 seem to produce less response.

Table (6.9) Summary of Short run and Long run Causality

Index	Macro Variable	Causality Direction	Index	Short Run Causality	Long Run Causality
Composite Sector Index	M1	—→ →	SMP	Unidirectional	Unidirectional
	M2	←→ →		Unidirectional	Bidirectional
	BC	—— ↔		Bidirectional	No causality
	OP	—— →		Unidirectional	No causality
	S&P 500	—→ →		Unidirectional	Unidirectional
Bank Sector Index	M1	←→ →	SMP Bank	Unidirectional	Bidirectional
	M2	←→ →		Unidirectional	Bidirectional
	BC	—— ←		Unidirectional	No causality
	OP	—— —		No causality	No causality
	S&P 500	—→ —		No causality	Unidirectional
Industry Sector Index	M1	—→ →	SMP Industry	Unidirectional	Unidirectional
	M2	←→ —		No causality	Bidirectional
	BC	—— —		No causality	No causality
	OP	—— →		Unidirectional	No causality
	S&P 500	—— →		Unidirectional	No causality
Cement Sector Index	M1	—— —	SMP Cement	No causality	No causality
	M2	←— —		No causality	Unidirectional
	BC	—— →		Unidirectional	No causality
	OP	—— —		No causality	No causality
	S&P 500	—— —		No causality	No causality

Service Sector Index	M1	——→ →	SMP Service	Unidirectional	Unidirectional
	M2	←——→ —		No causality	Bidirectional
	BC	—— ←		Unidirectional	No causality
	OP	—— —		No causality	No causality
	S&P 500	——→ —		No causality	Unidirectional
Electric Sector Index	M1	—— —	SMP Electric	No causality	No causality
	M2	←—— —		No causality	Unidirectional
	BC	—— ←		Unidirectional	No causality
	OP	—— —		No causality	No causality
	S&P 500	—— —		No causality	No causality
Agriculture Sector Index	M1	←—— —	SMP Agriculture	No causality	Unidirectional
	M2	←—— —		No causality	Unidirectional
	BC	—— ←		Unidirectional	No causality
	OP	—— —		No causality	No causality
	S&P 500	—— —		No causality	No causality

Long Arrow indicates Long run Causality.
Short Arrow indicate Short run Causality.
Long line indicates No causality in the Long run.
Short line indicates No causality in the Short run.

CHAPTER SEVEN

SUMMARY, CONCLUSION, IMPLICATIONS

7.1 Summary and Conclusion

The purpose of this study was to determine whether current economic activities, in particular money supply (M1, M2), bank credit, oil prices and the Standard and Poor's 500 Index can be used to predict stock prices in Saudi Arabia. In other words, the goal of this dissertation is to test for the informational efficient market hypothesis.

Determinants of stock market movements have been centered on two contradicting theories: the quantity theory of money and the efficient market hypothesis. Those in favor of the presence of links between money market variables and stock markets argue that any change in money supply creates a wealth effect that disturbs the existing equilibrium in the portfolio of investors, and when they readjust their asset portfolio, a new equilibrium is established in which the price level of various assets is changed.

On the other hand, if the stock market is efficient, it would have already incorporated all the current and anticipated changes in macroeconomic variables. Consequently, there is no causal relationship between changes in macroeconomic variables and stock prices. Moreover, if the change in macroeconomic variables coincides with a corresponding change in the velocity of the money, it will not have any effect on stock prices. A rise in money supply, for example, could be offset by a fall in velocity of money that leaves $M \times V$ (and therefore $P \times Y$) unchanged.

Many studies have been conducted to explore the variation of financial markets to macroeconomic variables theoretically and empirically. Some of these studies have focused extensively on the relationship between stock market prices and money supply, and others have focused on the relationship between stock market prices and fundamental economic activities. The outcome of these studies varies greatly regarding the effect of changes of money supply and other macroeconomic variables on stock prices. Some of these studies found that changes in macroeconomic variables lead the changes in stock markets, and that stock prices can be predicted by means of publicly available information such as time series data on financial and macroeconomic variables. On the other hand, some other studies support the point of view of the proponent of the efficient market hypothesis, which is to reject the idea of any type of causal relation between macroeconomic variables and changes in stock prices, with stock prices responding only to unanticipated changes in macroeconomic variables. Controversies with regard to the effect of macroeconomic variables on stock prices suggest that many important issues concerning stock price fluctuations are still open to empirical investigation.

To be able to investigate the interrelated relation between stock prices and macroeconomic variables in Saudi Arabia, this study was subjected to an extensive empirical analysis utilizing the technique of cointegration, Granger causality based on the vector-error correction model (VECM), and the innovation analysis.

Beside the composite index of the Saudi Stock Market, six sectional indexes, namely, the bank sector index, the industry sector index, the cement sector index, the service sector index, the electric sector index, and the agriculture sector index were tested for informational efficiency against a set of macroeconomic variables comprised of money supply (M1, M2), bank credit (BC), oil price (OP), and the Standard and Poor's 500 Index (S&P500).

The data used are monthly stock prices for the period from January 1995 to December 2004 (120 monthly observations), and the macroeconomic variables used are monthly data for the same period as the stock market data. The results of empirical investigation can be summarized as follows:

First, the cointegration analysis indicates that there exists a positive long-run relationship between stock prices and money supply, bank credit, oil prices and the Standard and Poor 500 in all indexes.

Second, the direction of Granger causality was detected through the use of a vector error correction model (VECM). The Granger causality test results indicate that in the long run, there is a unidirectional causality from stock prices to money supply in the cement sector, electric sector, and agriculture sector, while a bidirectional causality is observed between stock prices and money supply in the composite index, the bank sector, industry sector, and the service sector.

The interaction between money supply and stock prices is supported by Abdullah and Hayworth (1993) and Mukherjee and Naka (1995), who found a positive relationship between money supply and stock prices for the United States and for Japan.

Third, in the short-run, the results are different. For the bank sector, there is an unidirectional causality run from money supply1, and money supply2 to stock prices, while it runs from stock prices to bank credit. For the cement sector index, only a unidirectional causality runs from bank credit to stock prices as well as only one direction causality from money supply1 to stock prices in the service sector index. For both the electric sector and the agriculture sector, there are none of the macroeconomic variables causing stock prices, and, instead, the stock prices causes movements in bank credit in these two indexes. Finally, it seems that causality in the composite index is accumulative, that is, all the variables cause movements in stock prices and stock prices only causes bank credit in this sector.

Fourth, the innovation analysis tends to suggest that stock prices dynamically interact with their own macroeconomic factors. Most of the variation in stock prices in all indexes can be captured by innovation in itself as well as in money supply, bank credit, oil prices, and Standard and Poor 500 Index, while the reverse also holds. The causal relationships that macroeconomic variables Granger-cause and are Granger-caused by stock prices are quantitatively supported by innovation accounting analysis. The analysis suggests that the stock market in Saudi Arabia is not efficient with respect to macroeconomic variables.

7.2 Policy Implication

A careful analysis of this study suggests that it is a fairly simple exercise where standard techniques are applied. Testing of stationarity, cointegration, and the application of an error correction model are now commonly treated in textbooks. For this study, it is not only the technique which needs to be emphasized, but the main focus should be on the message and policy implications that emerge from these results. The findings from this study have implications for policy-makers and investors in stock markets. Policy-makers and market participants should be aware of the relationship between macroeconomic variables and stock market performance in order to understand these implications.

Our results indicate that there is a long-run as well as a short-run relationship between macroeconomic variables and stock prices, which means that the Saudi stock market is informationally inefficient and these variables could be used to predict movements in this market.

One possible explanation for this inefficiency is the availability of information. The lack of sophistication in the information technology which ties markets to fundamental economic activities could be another reason. A third possible explanation relates to the capital restriction, including provision regarding foreigners' participation in the Saudi stock market.

In order for the Capital Market Authority of Saudi Arabia to fulfill one of its important functions in the Saudi economy, the observed inefficiencies must be eliminated, and a certain policy needs to be implemented, such as:

1. It can be recommended at this point that the Stock Market Authorities may develop mechanisms to distribute official information to market participants. This policy may make stock prices reflect the condition of the economy at the right time.
2. Free Capital Mobility. In this regard, policy-makers should remove restrictions and facilitate the access of foreign investors to the Saudi stock market.
3. Advanced technology and high-speed communication can help participants in the stock market to quickly respond to economic activities and conditions.

4. Besides the significant causal impact that monetary growth has on fluctuations in stock prices, stock markets are not independent of monetary policy in the long run. Policy-makers have not considered change in share prices as a factor in their design of monetary policy. There is a channel through which the monetary authority can affect the volatility of stock prices.

Analysis and findings of this study are also of significant for analysts, investment managers, and individual investors. Understanding the interrelationship between macroeconomic variables and stock price should allow these individuals to create a profile of trading rules that will help them earn above-normal returns, which will allow them to build accurate asset pricing models and forecast future stock market volatility.

Although qualitatively the results are similar for each of the seven indexes, there is a substantial variation in the magnitude of effects of variables through sectors on stock prices. For instance, if people are investing in the industry sector, they should pay attention to oil price and Standard and Poor's 500 Index fluctuations. If they are investing in the cement sector, they should pay attention to bank credit fluctuations.

7.3 Suggestions for Further Studies

This study provides much-needed analysis of the relationship between stock prices and the underlying economic activities in Saudi Arabia, utilizing cointegration and causality methodology. Based on our findings, it seems that there remains plenty of research to be done in this area.

Further study of these relations is certainly indicated, including other macroeconomic variables not included in this study. Furthermore, it would be interesting to know if the results hold true for other developing countries, especially those with oil-based economies in the Middle East, Such as; Kuwait, United Arab Emirates, Qatar, Oman, and Iran. A comparison study can be conducted to explore the differences between stock markets in oil-based economies and non oil-based economies in the Middle East, such as; Egypt, Syria, Morocco, and Jordan.

Since the money supply proved to be a significant variable in the short run and the long run, it would be of great interest to see more work done on the relation between stock prices and monetary policy, as opposed to the relation between stock prices and the money supply. Empirical results show that sectoral analysis proves different causal relations than composite analysis does; however, exploring the relationship between a firm's stock prices and macroeconomic variables may significantly improve study results.

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