MACROECONOMIC DETERMINANTS OF STOCK MARKET BEHAVIOUR IN SOUTH AFRICA

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Thesis submitted in partial fulfilment of the requirements for the degree of

MASTER OF COMMERCE (FINANCIAL MARKETS)

DEPARTMENT OF ECONOMICS AND ECONOMIC HISTORY
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DECLARATION

I Kyle Chan Junkin do declare that except for references specifically indicated in the text and such help as has been provided to me by my supervisors, that this thesis is wholly my own work and has not been submitted at any other University or Technikon for any degree purposes.

Signed by____________________________on this 15th day of December 2011

ABSTRACT

This study investigates whether stock prices in South Africa are influenced by macroeconomic variables, and furthermore, the effects of financial crises on stock prices. The relationship between stock prices and the macroeconomy is a particularly important issue for investors, since a thorough understanding of such a relationship is likely to yield profitable or risk mitigating opportunities. Using monthly data for the period 1995 to 2010 the study focused at a macro level using the FTSE/JSE All Share Index, and at a micro level using sector indices. These included the construction and materials, financial, food producers', general retailers, industrial, mining and pharmaceuticals indices. The Johansen and Juselius (1990) multivariate cointegration approach was employed, along with impulse response and variance decomposition tests to address the issue.

The results showed that macroeconomic variables do have a significant influence on stock prices in South Africa. Also, the influences of these variables were found to have an inconsistent effect across the sectors under investigation. For example, inflation was found to negatively influence the All Share Index, but impacted the industrial index positively. These inconsistent influences on the various sectors were seen to have important diversification implications for investors. The impact of past financial crises proved to be significant on certain indices, however, indices such as that of the pharmaceuticals sector was found to be largely unaffected by such crises.

The findings of the study were discussed through an investor's perspective, and recommendations on investment decisions were given. The limitations of the study were such that certain results may have been influenced by a mis-specification of variables, particularly the Treasury bill rate.

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LIST OF ACRONYMS

ADF	Augmented Dickey Fuller
AGC	Ashanti Goldfields Company
APT	Arbitrage Pricing Theory
BSE	Bombay Stock Exchange
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Inflation
ECM	Error Correction Model
EG	Engle-Granger
EM	Emerging Markets
EMH	Efficient Market Hypothesis
ETF	Exchange Traded Fund
FDI	Foreign Direct Investment
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GGM	Gordon Growth Model
GNP	Gross National Product
JSE	Johannesburg Stock Exchange
KPSS	Kwiatkowski Phillips Schmidt Shin
LM	Lagrange Multiplier
LR	Likelihood Ratio
MICEX	Moscow Interbank Currency Exchange
NSE	National Stock Exchange
OLS	Ordinary Least Squares
PCA	Principal Components Analysis
PVM	Present Value Model
RTS	Russian Trading System
SA	South Africa
SARB	South African Reserve Bank
T-Y	Toda and Yamamoto
TBRATE	Treasury bill rate
UK	United Kingdom
US	United States

VAR	Vector Autoregressive
VECM	Vector Error Correction Model
ZAR	South African Rand

CHAPTER 1:
INTRODUCTION

1.1 CONTEXT OF THE RESEARCH

The link between the macroeconomy and stock prices is well documented in financial and economic literature. Early empirical studies such as that by Fama (1981) have shown that there is indeed a relationship between macroeconomic variables and stock returns. The theoretical underpinning of this relationship is explained by models such as the Present Value Model (and its later derivation the Gordon Growth Model), Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) (Moolman and du Toit, 2005; Fama and French, 2004; Ross, 1976). These models provide the theoretical framework which provides an explanation of how changes in the macroeconomy are transmitted into stock prices. To elucidate, such models explain how any anticipated or unanticipated arrival of new information about macroeconomic variables (e.g. GDP, industrial production, inflation, interest rate, exchange rate, etc) will indirectly affect stock prices through its impact on its expected future dividend stream, its discount rate, or both.

These three models suggest that an understanding of the macroeconomic determinants is invaluable for investors and policy makers. This is because both individual and institutional investors would be able to proactively act to either profit or mitigate risk in the face of macroeconomic or policy changes. Investors would adjust their equity holdings within their portfolios, to benefit or mitigate risks as a result of the possible implications the macroeconomy may have on equity in different sectors. For policy makers an understanding of the link between the macroeconomy and the stock market is a useful input in formulating policies in order to promote economic growth. This is because empirical research has shown stock markets and stock market development as being increasingly important for promoting economic growth in emerging marking markets (cf. Levine and Zervos, 1996; Kose *et al.*, 2006; Deb and Mukherjee, 2008). With this in mind, policy makers require an accurate understanding of the link between the macroeconomy and the stock market, if they hope to formulate policies that foster stock market development and therefore economic growth (Yartey, 2008).

Theoretical literature suggests a number of macroeconomic factors that could influence the stock market (cf. Fama, 1981; Chen *et al.*, 1986; Flannery and Protopapadakis, 2002). These factors include GDP, inflation, the exchange rate, interest rates, the money supply and foreign GDP. A wealth of empirical literature exists which have documented these relationships, for example, studies done by Maysami *et al.* (2004) and Adam and Tweneboah (2008), found evidence that linked inflation to stock returns in Singapore and Ghana respectively. Vuyyuri (2005) investigated the long run relationship and causality between the financial and real sectors of the Indian economy. Inflation, interest rates and exchange rates were found to be influential macroeconomic factors on stock returns.

For South Africa (SA), four studies of this nature exist, including Coetzee (2002), Moolman and Du Toit (2005), Olalere (2007), and Hancocks (2010). A study by Coetzee (2002) found statistically significant evidence of a negative relationship between quarterly monetary variables such as inflation, short-term interest rate, rand-dollar exchange rate and stock prices. Moolman and Du Toit (2005), however, showed that discounted future dividends determine the long-run behaviour of stock market behaviour while factors such as the short-term interest rate, the rand-dollar exchange rate and the S&P 500 index determine the short-run behaviour. Furthermore Olalere (2007) established that not only domestic macroeconomic factors but also foreign GDP influence the long-run behaviour of both the SA stock market index and stock market capitalisation. Following on from Olalere (2007), Hancocks (2010) investigated the extent to which macroeconomic factors influence stock market behaviour at both an aggregate and sector level. It was found that macroeconomic variables have differing effects on different areas of the South African stock market.

In the same spirit as most of the previous studies, this study paper analyses the long-run and short-run influences of macroeconomic variables and the SA stock market. Furthermore, emphasis will be placed on the implications of any such relationship on investment decisions with regard to portfolio diversification. The contribution of the current study is threefold. Firstly, more recent and higher frequency data is used. The use of monthly data in this study better captures the dynamics in the stock market, given that stock markets react promptly to new information, in contrast to relevant studies on SA that have used quarterly data (cf. Coetzee, 2002; Moolman and Du Toit, 2005; Olalere, 2006). Secondly, as in Hancocks (2010), both aggregate and sector level data will be used. However, a broader range of sector indices will be examined to identify possible sectors that may be viewed as possible opportunities for portfolio diversification. Thirdly, the current study departs from the existing studies as past financial crises and the possible effects of such crises on the South African stock market will be examined. It is the researcher's considered view that such events may have structural implications for developing stock markets. Thus the proposed study will provide insight into the investment decisions of South African investors during times of global financial distress.

1.2 OBJECTIVES OF THE STUDY

i. To investigate the extent to which macroeconomic variables influence stock prices in South Africa, especially in times of financial crises.

ii. To draw conclusions of the implications these have for investing in the South African equity market.

1.3 METHODS OF THE STUDY

In order to investigate this scientific paradigm, data for the following macroeconomic variables will be collected: industrial production (a proxy for domestic GDP), money supply, United States GDP (a proxy for foreign GDP) and consumer price inflation, Treasury bill rate, nominal exchange rate, and oil prices. For the stock market, the JSE-FTSE Top 40 Index and seven sector indices are used, selected based on their relative size as well as their importance to the South African economy. These sectors are: mining, industrial, financial, general retail, food producers, construction and materials, and pharmaceuticals. All data collected on these variables are monthly data, except for US GDP which was interpolated from quarterly to monthly data. Three dummy variables will be used to capture the influences of financial crises on stock prices in South Africa. These include the 1997 East Asian crisis, the exchange rate crisis of the rand in 2001, and the financial crisis of 2008. Johansen's cointegration approach will be used to provide insight into the long-run, and short-run nature of the effects of the macroeconomic variables, as well as the significance of each crisis on each stock index.

1.4 ORGANIZATION OF THE STUDY

The study is organized as follows: the next chapter reviews the theoretical literature pertaining to stock valuation models. Chapter 3 reviews the empirical literature documenting the links between various macroeconomic factors and stock prices, in both developed and emerging markets. Chapter 4 describes the econometric methodology used in the study, and discusses the *a priori* expectations. Chapter 5 presents the results of the study and the implications for investors in South Africa. Lastly, Chapter 6 provides the summary and conclusions of the study, ending with possible areas for further research.

CHAPTER 2:
THEORETICAL LITERATURE REVIEW

2.0 INTRODUCTION

This chapter reviews the theoretical underpinnings of the relationship between stock prices and the macroeconomy. Section 2.1 begins with a review of the Efficient Market Hypothesis to highlight the important implications it holds for the nature of stock prices, and also for investors seeking higher risk adjusted returns. Following this, the Capital Asset Pricing Model and the Arbitrage Pricing Theory are discussed and compared. As will be explained, both models represent early asset pricing models which assert that a linear relation exists between an asset's expected return and its covariance with other variables. The weakness of these two theories, originating from the restrictive nature of their simplifying assumptions, leads the review to an alternative set of asset pricing models. Present Value Models and their evolution are discussed, beginning with the earliest discount models to the later advances of the Gordon Growth Model. Lastly, Section 2.2 concludes the chapter.

2.1 THE THEORETICAL LINK BETWEEN STOCK MARKET BEHAVIOUR AND MACROECONOMIC VARIABLES

The link between the macroeconomy and stock prices is well documented in financial and economic literature. Literature, such as that by Sharpe (1964), Lintner (1965), Ross (1976) and Gordon (1959), has provided a theoretical basis by which stocks may be valued. However, the simplifying assumptions, upon which many of these models are derived and based, present key weaknesses. These weaknesses become increasingly evident in the implementation and practical application of the model in reality. Nonetheless, from a theoretical point of view, these models present a sound theoretical foundation on which stock market movement may be attributed to the influences of the macroeconomy.

2.1.1 EFFICIENT MARKET HYPOTHESIS

The Efficient Market Hypothesis (EMH), developed and introduced by Eugene Fama, is based on the premise that stock prices at any given time reflect all available information. In this sense Fama (1970) regards stock markets to be fully efficient, and encapsulated by the idea of a "random walk". The random walk lends support to the view that the flow of information is, without delay, immediately reflected in stock prices. Thus, stock prices of today reflect news released today and, furthermore, stock prices of tomorrow fully reflect information or news released at that point in time in the future. News by definition is unpredictable; the implications of this are that stock prices today cannot be used to predict stock prices tomorrow (Malkiel, 2003). In other words, investors are not able to earn risk adjusted returns that are higher than the market return since arbitrage opportunities are impossible.

The EMH thus has damning implications for technical analysts, since implicit to the hypothesis is that any individual who is able to invest in the market will earn a return that theoretically should be similar, if not the same, as professional traders or investors. However, in recent times, the EMH has become a topic of discussion due to instances where market prices have failed to reflect information, as well as investors being able to earn higher returns than those of the market. Malkiel (2005) cites instances, particularly relating to financial market irregularities such as the internet bubble of the late 1990s, where the EMH did not hold true. Furthermore, Moolman and du Toit (2005) suggests that only in the shortrun are investors able to earn higher risk adjusted returns. This is because the intrinsic value of stocks in different industries or sectors may, in fundamental analysis, be non-uniformly affected by macroeconomic changes. In such cases the EMH in its strictest form may not hold.

2.1.2 CAPITAL ASSET PRICING MODEL (CAPM)

The Capital Asset Pricing Model was developed by Sharpe (1964), Lintner (1965, 1969) and Mossin (1966), to investigate the effects risk had on the expected return of an investment relative to the market portfolio. The market portfolio in question is derived by applying the simplifying assumptions of the CAPM, with the foundations laid by portfolio theory. The first assumption of the CAPM is that investors are risk averse and seek to minimize their portfolio risk with a given level of expected return. Second, capital markets are perfect with no transaction costs or taxes, information is available to all investors, also allowing investors to borrow and lend at the risk-free rate. Third, the investment choices are homogenous for all investors. Lastly, all investors have the same estimates of the expected returns, standard deviations of return and correlations between returns of all assets (Perold, 2004).

In portfolio theory investors choose portfolios that are said to be mean-variance-efficient, and found along the efficient frontier for portfolios (Fama and French, 2004). The CAPM assumes that any portfolio that is mean-variance-efficient and lies on the efficient frontier is also equal to the market portfolio. The implications of this, according to Fama and French (2004), are that the relation between risk and expected return for any efficient portfolio must also hold for the market portfolio, if equilibrium is to be maintained in the asset market. Thus the CAPM may be stated as follows:

$$E(R_i) = R_f + \left[E(R_m) - R_f\right]\beta_{im} i = 1, \dots \dots N \qquad [2.1]$$

where,

$E(R_i)$ = Expected return on asset i

R_f = Risk-free rate of return

$E(R_m)$ = Expected return of the market portfolio

β_{im} = Beta of the asset market

Equation 2.1 illustrates how in the CAPM, an asset's expected return is determined by the risk-free rate plus a risk premium and, furthermore, is linearly related to the market beta. The risk premium consists of the market beta (β_{im}) times the premium per unit of beta risk [$E(R_m) – R_f$].

The CAPM has, however, come under criticism due to its unrealistic assumptions of investor behaviour as well as the condition of perfect capital markets. Roll (1977) suggests that the market portfolio itself presents a key weakness in the CAPM, since it does not state the assets to be included or excluded in the market portfolio. Due to these drawbacks, empirical evidence of the practical applicability of the CAPM has yielded inconsistent results, as noted by both Fama and French (2004) and Perold (2004).

2.1.3 ARBITRAGE PRICING THEORY (APT)

The Arbitrage Pricing Theory was formulated by Ross (1976) as an alternative to the CAPM. The APT addresses the shortcomings of the CAPM since no assumptions are made regarding the distribution of assets' returns and assumptions on utility theory. Furthermore, the APT in contrast to CAPM acknowledges several sources of risk that may affect an asset's expected return. The model attributes the expected return of a capital asset to multiple risk factors, and in the process measures the risk premiums associated with each of these risk factors. The risk of holding a particular asset comes in two forms; the first, according to Paavola (2006), is that which is inherent to the overall market which cannot be diversified away. The second is the idiosyncratic risk that is unique to each asset, is non-systemic, and can thus be diversified away through portfolio diversification. In essence the APT seeks to capture some of the non-market influences that cause capital assets to move together (Paavola, 2006: 6).

With the use of the APT framework, Chen *et al.* (1986) concluded that economic forces affect future cash flows as well as dividend payouts, and thus incorporate risk that may be either systemic or unique to capital assets. The APT model with multiple risk factors may be shown as follows:

$$E(R_{it}) = \lambda_0 + \lambda_1 b_{i1} \dots \lambda_J b_{iJ} + \varepsilon_{it} \qquad [2.2]$$

where

$E(R_{it})$ = Expected return of asset i

λ_0 = Risk-free rate of return

λ_J = Assets return sensitivity (price of risk)to factor j.

The APT, as with the CAPM, is subject to certain assumptions; the first of these being that investors may borrow and lend at the risk-free rate, there are no taxes and short selling of securities is unrestricted. The second assumption assumes that a wide variety of securities exist, thus risk unique to those securities may be diversified away, and lastly, investors are risk averse who aim to maximize their wealth.

Criticisms of the APT have centred on the generality of the model itself. The APT sets no theoretical foundations for the factors that should be included in ascertaining the risk-adjusted return of the capital asset, and furthermore does not state the number of risk factors that should be included. The APT also presents certain methodological issues relating to the estimation of the model. Cheng (1996) points out that the model may be sensitive to the number of independent variables included in the linear regression. Evidence of this was found by Paavola (2006) and Gunsel and Cukur (2007). However, in both cases it was found that the applicability of the APT in establishing asset returns may still be valid.

2.1.4 PRESENT VALUE MODELS

2.1.4.1 PRESENT VALUE/DISCOUNTED CASH FLOW MODEL

An alternative theory to capital asset pricing is the Present Value Model (PVM) or Discounted Cash Flow Model. This model asserts that the current value of a capital asset[1] is subject to its expected future cash flows (dividends), as well as the future discount rate of these cash flows. Thus factors influencing expected profit, and therefore future cash flows or dividend streams of the capital asset, would theoretically alter its present value. Intuitively, the PVM provides a firm theoretical grounding linking the macroeconomy and stock prices (Ahmed, 2008). The PVM as presented by Smith (1925) adopts the form:

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{E(D_{i,t+n})}{(1+k_i)^n} \qquad [2.3]$$

where P_i is the current price of the asset at time t, $D_{i,t+n}$ is the future discounted cash flows, and $(1+k_i)$ the discount factor with k_i being the applicable discount rate. Equation 2.3 may be solved to obtain the current price of the asset when $t=0$:

$$P_{i0} = \sum_{n=1}^{\infty} \frac{E(D_{i+n})}{(1+k_i)^n} \qquad [2.4]$$

The equation states that the current price of a capital asset is equal to the sum of the future cash flows of that asset, discounted to time t=0. Moolman and du Toit (2005) state that the capital gains realized upon the sale of the asset are subsumed since they are also dependent on the present value of the future cash flows or dividend streams. If an infinite number of future cash flows of the asset exist, Gordon and Shapiro (1956) estimate an expected growth rate:

[1]From this point onwards stock is referred to as the capital asset.

$$P_{i0} = \sum_{n=1}^{\infty} \frac{D_{i,0}(1+g_i)^n}{(1+k_i)^n} \quad [2.5]$$

where $D_{i,0}$ is the dividend paid at $t=0$, and g_i is the expected growth rate of asset *i*. Furthermore, it is assumed that the cash flows or dividend streams from the asset are fixed, as well as the rate at which the cash flows are discounted (Modigliani and Miller, 1958). Incorporating these assumptions reduces equation 2.5 to the following:

$$P_{i0} = \sum_{t=1}^{n} \frac{D}{(1+k)^t} + \frac{E(P_{in})}{(1+k)^n} \quad [2.6]$$

Equation 2.6 shows that the present value of a capital asset at t=0 is equal to the sum of the expected future dividends discounted to t=0, as well as the terminal price of the asset during the holding period *n*.

The relationship between the macroeconomic factors and stock prices thus becomes clearer, since any factor affecting either the future dividend stream or the discount rate or both, would affect the current price of the stock. The drawbacks of the model rest with the assumptions of the dividend streams and discount rates being fixed into the future. If dividends are largely dependent on profit, and profits strongly influenced by prevailing economic conditions, it is unlikely in reality for this assumption to hold. Also, the discount rate is likely to vary since, according to Moolman and du Toit (2005), it depends on three factors that are likely to vary, namely: the real risk-free rate, the expected rate of inflation, and the risk premium.

2.1.4.2 THE GORDON GROWTH MODEL

The Gordon Growth Model (GGM) proposed by Gordon (1962) is based upon the PVM but sought to remedy the drawbacks previously stated. The assumption of a fixed dividend was dealt with by the addition of a growth factor for dividends. In this case dividends are allowed to grow at a constant or steady rate into the future. The GGM is stated as follows:

$$P_0 = \frac{DPS_1}{k_e - g} \quad [2.7]$$

whereP_0 represents the current price of a share, D_1 is the expected future dividend yield, r is the required rate of return (discount rate), and g is the constant growth rate of the asset. Thus with the GGM, the current price of an asset is dependent upon the expected dividend of the asset, divided by the difference between the required rate of return and the growth rate of the asset. The GGM, although intuitively simpler, suffered from the deficiency of the constant growth of dividends. As in Equation 2.6, the weakness of this assumption is synonymous with that of the constant future dividend. In the longrun a firm is unlikely to experience constant dividend growth due to the cyclicality of expected profits.

2.1.4.3 THE TWO-STAGE GORDON GROWTH MODEL

To address this shortcoming the GGM was expanded to a two-stage model that accounted for fluctuating dividends over two periods. The first stage of the model takes into account a period of high dividend growth, whilst the second stage includes a period of lower, but stable growth (Damodaran, 2011). The GGM was amended as follows:

$$P_0 = \sum_{t=1}^{t=n} \frac{DPS_t}{(1 + k_{e,hg})^t} + \frac{P_n}{(1 + k_{e,hg})^n} \qquad [2.8]$$

where

$$P_n = \frac{DPS_{n+1}}{(k_{e,st} - g_n)}$$

and

P_0 = Price of asset at t=0

DPS_t = Expected dividends per asset in year t

$k_{e,hg}$= Required rate of return during period of high growth

$k_{e,st}$= Required rate of return during period of stable growth

P_n = Terminal price of the asset at the end of year n

g_n = constant growth rate after year n

As Equation 2.8 suggests, the present value of the capital asset is equal to the discounted value of dividends during the initial stage of high growth, plus the discounted value of the terminal price of the asset during the stable growth stage.

Two limitations specific to the two-stage GGM exist. The first practical problem involves determining the length of time for which there is high growth. A longer period of high growth would increase the present value of the capital asset, since after this period it is assumed a period of lower stable growth will ensue. Secondly, the model assumes that after the initial period of high growth, the period of stable growth follows instantaneously. Realistically, these changes are likely to occur over a period of time (Damodaran, 2011).

2.1.4.4 THE H MODEL

Fuller and Hsia (1984) addressed these problems of the two-stage GGM by assuming that dividends decrease linearly during the initial stage of high growth (which is assumed to last 2H periods), until reaching its stable state. Furthermore, the model assumes that the dividend payout ratio, as well as the required rate of return, are constant over time and are not affected by the change in growth rates. The H Model may be written as follows:

$$P_0 = \frac{DPS_0 * H * (g_a - g_n)}{(k_e - g_n)} + \frac{DPS_0 * (1 + g_n)}{(k_e - g_n)} \qquad [2.9]$$

where

P_0 = Price of asset at t=0

DPS_t = Expected dividends per asset in year t

k_e,= Required rate of return

g_n = Growth rate at the end of 2H years

g_a= Initial growth rate

From Equation 2.9 it can be clearly seen that the present value of the asset is dependent on two components, the first of which includes the period of higher growth that decreases gradually over 2H years, with the second component consisting of the stable rate of growth.

The H Model does, however, have certain difficulties in its practical application. The first of these is that the model is said to possess a structure that is too rigid in its application. Since the decline in initial growth rate is linearly incremental and restricted to a specific time limit, this renders the model less flexible. Secondly, as the growth rate declines the dividend payout ratio is likely to increase during this period of time.

2.1.4.5 THE THREE-STAGE GORDON GROWTH MODEL

The three-stage GGM allows for three periods of growth: a stable high growth period, a declining growth period and a lower stable period. In this way it provides a combination of both the two-stage GGM and the H model. In addition the three-stage GGM does not place any restrictions through assumptions on the dividend payout ratio and the required rate of return.

$$P_0 = \sum_{t=1}^{t=n1} \frac{EPS_0 * (1+g_a)^t * PO_a}{(1+k_{e,hg})^t} + \sum_{t=n1+1}^{t=2n} \frac{DPS_t}{(1+k_{e,t})^t} + \frac{EPS_{n2} * (1+g_n) * PO_n}{(k_{e,st} - g_n)(1+r)^n} \quad [2.10]$$

where

P_0 = Price of asset at t=0

EPS_t=Expected earnings per asset in year t

DPS_t = Expected dividends per asset in year t

g_a= Growth rate in high growth stage (lasting n1 periods)

g_n = Growth rate in stable stage

PO_a= Dividend payout ratio in high growth stage

PO_n= Dividend payout ratio in stable growth stage

$k_{e,,hg}$= Required rate of return in high growth stage

$k_{e,t,}$= Required rate of return in transition stage

$k_{e,,st}$= Required rate of return in stable growth stage

Equation 2.10 displays the three stages involved in ascertaining the asset's price at time t=0. Evidently, each component contains the respective required rate of return (k_e) associated with the growth rate expected in each stage (g). As alluded to earlier, the three-stage GGM eliminates many of the problems associated with earlier versions of the GGM. It provides increased flexibility in accommodating periods of inconsistent growth, whilst not imposing simplifying assumptions at the cost of its practical applicability. However, the three-stage GGM is empirically more advanced than previous versions since a larger number of variables are required. Importantly, the model elucidates on the various factors that may influence a stock's price, but also the channels in which macroeconomic forces may influence stock prices.

2.2 CONCLUSION

This chapter explored the various theoretical models that have been developed to ascertain capital asset prices, or in this study, stock prices. The derivation of each model, as well as their strengths and weaknesses, were highlighted. To begin, the Efficient Market Hypothesis was identified as being a crucial part of stock pricing theory, due to the implications it had with not only how investors and policy makers alike viewed the behaviour of stock prices, but also the implications it may have with regard to asset returns.

Following this, the Capital Asset Pricing Model, as an early asset pricing model, was discussed and explained. The assumptions of CAPM, and its application to portfolio theory, lead to the derivation of a quantifiable measure of market risk. In so doing, the CAPM formulated a means by which the risk associated with holding single assets may be calculated, relative to the market risk, and thus its expected return could be determined. However, due to the reliance on its assumptions, the practicality of the model was questioned, which led the discussion to the development of Arbitrage Pricing Theory.

Arbitrage Pricing Theory, although not subject to the same stringent assumptions as in CAPM, provided a key advantage over the CAPM: the ability of the APT to identify more than one source of risk for capital assets. Thus the APT was viewed as a multi-risk asset pricing model. The shortcomings of the APT model were, however, identified as the methodological issues that surrounded the estimation of such a model.

The key shortcomings of both the CAPM and APT provided the introduction of an alternative set of asset pricing models, specifically Present Value Models or Discounted Cash Flow Models. At the heart of these models lies the fundamental notion that the present value of a capital asset is equal to its future cash flows, or (in the case of stocks) dividends, discounted to the present. The earliest present value models provided the foundations on which the Gordon Growth Model, and its extended versions, evolved to remedy the shortcomings in each previous version. A recurring weakness that became evident in each of the discussed present value models was the rate at which cash flows were allowed to grow over time. The discussion ended with the latest derivation, the Three-Stage Gordon Growth Model, which provided the most flexibility with regard to dividend growth over time.

The next chapter reviews the empirical literature regarding macroeconomic factors and the links they may have with stock prices.

CHAPTER 3:
EMPIRICAL LITERATURE REVIEW

3.0 INTRODUCTION

This chapter considers the empirical literature on the various links that exist between the macroeconomy and stock prices. The chapter consists of three sections: the first section reviews empirical evidence, which is further divided into three subsections focusing on global and developed markets, emerging markets and South Africa. The second section outlines recent financial crises, and explores the role these may have on the relationships between macroeconomic factors and stock prices. Lastly, the chapter is concluded by providing an overview of the preceding sections.

3.1 EMPIRICAL EVIDENCE

A wealth of literature exists on the empirical link between the macroeconomy and stock prices, for both developed and developing economies. Key empirical studies done by Lintner (1975), Fama and Schwert (1977) and Fama (1981) have provided the foundation from which present studies of this nature largely draw reference. As noted earlier, these studies have provided important insights for the decision-making of investors and policy makers in terms of diversification, as well as fostering economic growth through the financial markets. The following subsections provide a review of empirical research done pertaining to the dynamic linkages between macroeconomic variables and stock markets in both developed and emerging markets.

3.1.1 GLOBAL AND DEVELOPED MARKETS

Ratanapakorn and Sharma (2007) sought to investigate the short-run and long-run, as well as causal, dynamics between US stock returns and six macroeconomic variables. These variables included the long-term as well as short-term interest rates, money supply (M1), industrial production, inflation and the Yen/USD exchange rate. Using monthly data from 1975:1 to 1994:4, Johansen's cointegration analysis showed that the S&P 500 index shared a long-term relationship with each of the macroeconomic variables. Each of the macroeconomic variables except for inflation and short-term interest rate yielded results that were consistent with theory. Both inflation and the short-term interest rate were, however, seen to positively affect the stock index. It was noted that the positive relationship between inflation and the S&P 500 suggested that the stock market may provide a hedge against inflation in the US. Also, the long-term interest rate was found to be superior to the short-term interest rate in explaining the variations in the stock index over time.

The causal relationships were examined using Granger causality tests, and the results showed that none of the independent variables Granger-cause changes in the US stock prices in the short-term. However, reverse Granger-causality was found to be evident in the shortrun, where US stocks cause changes in industrial production, interest rates, money supply and the exchange rate. In the longrun the macroeconomic variables do Granger-cause changes in US stock prices. It was concluded that the Granger causality and cointegration tests between the macroeconomic variables and US stocks suggested that the US stock market was not efficient and that this inefficiency presented arbitrage opportunities for investors.

Humpe and Macmillan (2007) empirically analysed whether macroeconomic variables are able to explain long-term aggregate stock market movements in both the US and Japan. A comparison of the two stock markets was conducted to examine whether the Japanese stock market followed the same equity model that was found to hold in the US. Humpe and Macmillan (2007) note that in order to provide a thorough examination of the trending nature of the data series, higher frequency data should be used in order to capture extreme movements of each price index. Thus, monthly data from January 1960 to June 2004 was used to conduct the analysis. The aggregate stock variables under consideration were the S&P 500 price index for the US and the Nikkei 225 price index for Japan. The macroeconomic variables used for both countries were industrial production, CPI, M1 money supply, the 10-year Treasury-Bond yield for the US and the official discount rate for Japan.

Using the Johansen's cointegrating procedure, the results for the US were found to be broadly in line with *a priori* expectations and evidence. Industrial production, CPI and the long-term interest rates were found to have a significant direct effect on the US stock market, whilst money supply was insignificant in influencing US stock prices. In contrast, the results for Japan showed that of the four macroeconomic variables only the discount rate was insignificant. The results also showed that the Japanese stock market was more sensitive to changes in industrial production than the US. Humpe and Macmillan (2007) concluded that changes in certain macroeconomic variables have varying effects on stock prices in different countries.

Using a multi-variate cointegrating framework, Nasseh and Strauss (2000) investigated the effects of both domestic and international macroeconomic activity on the stock markets of six European countries. Using quarterly data from 1962:1 to 1995:4, the stock markets of the six European countries that were included were the United Kingdom's FT 500, France's Industrial share price index (INSEE), the All Share Indices for Germany, the Netherlands and Switzerland,

and the MSE share price index for Italy. The countries were chosen according to their trading patterns with each other, but also for the effects a large open economy, such as the German economy, may have on each of them. The domestic macroeconomic variables used for each stock index were industrial production, business surveys of manufacturing orders, short- and long-term interest rates given by money market call rates and government bond rates respectively, and CPI. International macroeconomic activity was proxied by the short-term interest rates, the industrial production and the stock prices of Germany.

Using Johansen's cointegration approach the results indicated that in Germany, the UK and the Netherlands there is a strong long-run relationship between their respective stock indices and each of their corresponding domestic macroeconomic variables. The remaining markets, however, were not consistent in providing evidence of any long-run relation with all the macroeconomic variables. For example an observation of the results showed that neither long-term nor short-term interest rates had any influence on the Swiss All Share Index.

To analyse the influence of international macroeconomic activity, the German All Share Index and industrial production was used as a proxy for international activity. The results suggested that the industrial production of Germany has a significant effect on all the indices except for that of the Netherlands. Furthermore, as expected German stock prices had a significant effect on the other European stock indices, with the exception of France. It was thus concluded that the major European stock markets under investigation are highly influenced by both domestic as well as international macroeconomic activity, but are also highly integrated with the German stock market.

Nieh and Lee (2001), from a global perspective, analysed the possible dynamic relationships between the stock markets of the G7 economies, and their respective exchange rates to the US Dollar. Two cointegration tests were employed, namely the Engle-Granger (EG) two step test and the Johansen cointegration test. The stock market index used for each G7 country, except for the US was the Dow Jones World Index. For the US the Dow Jones Industrial Index was used in the empirical analysis. Spot rates for the domestic currency and the US Dollar were used for the exchange rate series, and in the case of the US the US Dollar Index was used.

Using daily data from October 1 1993 to February 15 1996 the Engle-Granger test results revealed that of the seven stock markets, only Germany showed slight evidence of a cointegrating relationship between its stock prices and its exchange rate to the USD. This result was, however, significant at the 10% level. Unexpectedly, the results suggested no significant long-run relationship between the stock indices of the G7 countries and their respective exchange rates. The results from the Johansen's test reaffirmed the non-existence of any long-run cointegrating relationship between the stock indices and exchange rates, with the exception being the US. The implications of these findings as concluded by Nieh and Lee (2001) were that stock indices and exchange rates largely have no predictive capabilities for each other.

In the case of Australia, Chaudhuri and Smiles (2004) investigated the effects that domestic macroeconomic variables, as well as international stock markets, may have on Australian stock prices. The study comprised the estimation of two separate models using Johansen's cointegration. The first model included the Australian stock index, the ASX All Ordinaries and the domestic variables, and the second introduced the effects of the foreign stock markets. Using quarterly data from 1960:1 to 1998:4, the domestic variables included M3 money supply, gross domestic product, private personal consumption expenditure, the price of crude oil and the term spread. The US, Japan and New Zealand stock markets were used to investigate the role foreign markets have on stock prices in Australia.

The results from the first model showed that money supply and the oil price both played an important role in explaining the movement of Australian stock prices, both in the medium and long run. However, in the shortrun, GDP and private consumption expenditure were seen to play a more prominent role in determining stock prices. In examining the role of the foreign markets, the US market was found to have a dominating long-run influence on the ASX All Share. Furthermore, the New Zealand stock market was found to have a minor influence on the Australian markets, with Japan having no influence at all.

The effects of fluctuating crude oil prices on stock returns was examined by Kilian and Park (2009), who traced out the response of the US stock market to both demand and supply shocks. The study was aimed to address the limitations of previous studies of the link between oil prices and stock prices. The first of these limitations was related to the price of oil being treated as exogeneous to the US economy. However, Kilian and Park (2009: 1267) note that reverse causality may be present, since oil prices have in the past responded to changes in the economic forces that consequently effect stock prices. Secondly, the underlying causes of oil price changes, either demand or supply shocks, was viewed as possibly having differing effects on the US economy.

Using a structural Vector Autoregressive (VAR) model to capture the effects of the demand and supply shocks, the analysis included both aggregate as well as an industry-specific investigation on US stock returns. The industries or sectors that were included in the analysis were Petroleum and Natural Gas, Automobiles and Trucks, Retail and Precious Metals. The variables used to capture the effects of oil price changes were the percent change in world crude oil production, the real price of crude oil imported by the US, and an indicator of global real activity. The results from the VAR model provided evidence that suggested the response of US stock returns differs significantly, depending on the underlying causes of the oil price change.

Kilian and Park (2009:1286) note that supply shocks are less prevalent in determining US stock price changes, whereas demand oil price shocks have a more significant effect on US stock returns. For example, impulse response analysis showed that an unanticipated increase in global demand for crude oil, due to increased global real economic activity, resulted in a sustained increase in US stock returns. It was concluded by Kilian and Park (2009) that oil price changes, particularly demand shocks, are fundamental for the US stock market.

In the same spirit as Ratanapakorn and Sharma (2007) Maysami and Koh (2000), in a two-part analysis, analysed the linkages between macroeconomic variables and stock returns in the Singapore context. Their analysis investigated the interrelationship of the Singapore stock market and foreign stock exchanges, namely that of the US and Japan. Employing Johansen's cointegration approach, monthly returns data for the Singapore All-Share Price Index during the period of January 1988 to December 1995 was used in the analysis. The macroeconomic variables that were included were the natural logarithms of the Singapore exchange rate in special drawing rights, M2 money supply, the consumer price index, the industrial production index, the 3-month interbank offer rate, the yield on 5-year government bonds, and the total domestic export from Singapore. Cointegration between the stock return variable and the identified macroeconomic variables was subsequently tested for.

The cointegration results showed that amongst the macroeconomic variables, only the coefficients for both short- and long-term interest rates as well as the exchange rate were significant. In addition, the relationship of the Singapore stock index with short-term interest rates was found to be positive, while its relation with long-term interest rates was negative. The positive relationship was not consistent with expectations but was confirmed by results of prior studies. Thus Maysami and Koh (2000:89) suggest that long-term interest rates may serve as a better proxy for the nominal risk free component of the discount rate in stock valuation models, a view shared by Mukherjee and Naka (1995). The relationship of the Singapore stock market and its exchange rate was found to be positive, contrary to expectations. Since Singapore's economy is characterized by high imports and exports, intermediate goods according to Maysami and Koh (2000:90) form a significant portion of its total expenditure. This result was found to support the view that local producers require a stronger Singapore dollar to reduce the cost of imported inputs, in order to be globally competitive in the export markets.

To determine the strength of the relationship between the stock market of Singapore and those of the US and Japan, a tri-variate model was estimated using Johansen's approach. The results showed that the Singapore stock market has a significant, as well as positive long-term relationship, with both the stock markets of the US and Japan. These two stock markets were also found to be exogenous, lending support to the view that the Singapore stock market tends to follow the directions taken by the US and Japan stock markets. Maysami and Koh (2000) conclude that theoretically there is no explanation for these dynamic relations between stock markets, although global financial integration may provide the most pronounced explanation for these interrelationships between stock markets.

Following on from Maysami and Koh (2000), Maysami *et al.* (2004) investigated the influence of the macroeconomy on the Singapore stock market at an aggregate level, but also at a sector level. As cited by Maysami *et al.* (2004), prior empirical studies failed to capture the effects the macroeconomy may have at a sector-specific level. The rationale behind such an approach would be to identify the nature and degree to which each sector is individually affected by different macroeconomic factors, yielding important information for policy makers, but also with regard to portfolio diversification. The returns of equity indices that were included in the analysis were the Finance Index, the Property Index, the Hotel Index, and the Singapore All Share Equities Index. The macroeconomic variables that were used in each model specification were the CPI, industrial production, the yield on 1-year inter-bank rates, the 3-month inter-bank offer rate, M2 money supply, and the exchange rate of the Singapore Dollar (in Special Drawing Rights).

Analysis of Johansen's cointegration results revealed certain interesting results. Firstly the CPI was found to be negatively related to the hotel index, but, and contrary to theoretical expectations, positively related to the remaining indices. According to Maysami *et al.* (2004:68), a possible explanation for these positive relationships may be due to the active role the Singapore government played in preventing price escalation during the recovery after the East Asian Crisis in 1997. Furthermore this positive relationship may provide certain hedging opportunities within the stock market for investors. Secondly, industrial production, as a proxy for real activity, was found to be insignificant in the finance index model. This result presented evidence that suggested that real assets may be viewed as an alternative to investments in the finance sector of Singapore (Maysami *et al.*, 2004:69). Thirdly, both short-term and long-term interest rates were found to have no significant effect on the hotel sector in Singapore. Lastly, the significant relation between exchange rates and the hotel index was found to be negative, whilst the remaining indices were consistent with the positive relationship found by Maysami and Koh (2000). This result as noted by Maysami *et al.* (2004:70) suggests that a depreciation of the currency would be beneficial to the hotel sector in Singapore, due to hotel rates becoming relatively cheaper for foreign currencies. It was concluded that since cointegration exists between macroeconomic variables and stock indices, the conclusions drawn by the EMH may be placed in doubt since stock market behaviour may be predicted.

Through the application of Arbitrage Pricing Theory (APT), Gunsel and Cukur (2007) sought to investigate the empirical applicability of APT in pricing UK stocks. Their aim was to determine the impact of macroeconomic factors on UK stock returns using the APT. Similar to Maysami *et al.* (2004), the study examines the relationships between macroeconomic factors and stock returns at an aggregate and sector level. However, the approach by Gunsel and Cukur (2007) differs in that, in addition to the macroeconomic factors, the study employs industry specific variables.

Using monthly data from January 1980 to December 1993, the stock returns of 87 UK firms were employed to construct 10 equally-weighted industry portfolios. These industry portfolios included food, beverage and tobacco, construction, building materials and merchants, electronic and electrical equipment, engineering, household goods and textiles, paper, packaging and printing, chemicals, diversified industrials, and lastly oil exploration and production. The FTSE-350 Index was used to capture the aggregate returns of UK stocks. The factors specified for the analysis were the term structure of interest rate, the risk premium, the exchange rate, the money supply (M0) and unanticipated inflation. The industry specific variables were the respective sector dividend yields and sector unexpected production.

Ordinary Least Squares (OLS) was employed in estimating eleven linear regression models, using the portfolio returns as the dependent variables in each case. The regression results showed that of the seven factors considered, only the dividend yield of the specific sectors was negative and significant in all cases. The negative relationship was, however, found to be inconsistent with expectations. According to Gunsel and Cukur (2007:146) this may be explained by the efficiency theory, which postulates that investors forecast dividends prior to their announcement. In this case the negative relationship suggests that the investor's forecasts were found to differ greatly from those announced. Gunsel and Cukur (2007) acknowledge that this result may also be due to the inaccuracy of the derivation of the dividend yields of the respective sectors.

Unexpectedly, unanticipated inflation had no significant effect on UK stock returns except for that of the food, beverage and tobacco industry, however, only at the 10% level of confidence. This result suggested that investors' expectations of future inflation are accurate, and that this is incorporated into stock prices prior to its announcement. Money supply was found to have varying effects amongst the sectors, although no conclusive explanation could be found by Gunsel and Cukur (2007). The regression results for the term structure of interest rate differed across the sectors. For example a positive relationship was found with the construction, food, beverage and tobacco, oil exploration and production, and electronic and electrical equipment sectors, whilst a negative relationship was evident with the remaining sectors. Gunsel and Cukur (2007:149) explain this by noting that it is unclear whether the term structure represents long- or short-term expectations on interest rates, since it incorporates both. The results for the remaining variables were found to be consistent with the expected results. The study found that the empirical applicability of the APT may still be valid, however, the estimation methodology may not provide accurate results in all cases. The conclusion drawn by Gunsel and Cukur (2007) was that macroeconomic factors have differing effects on the stock returns across sectors in the UK.

An alternative methodological approach compared to that of prior studies under review was presented by Flannery and Protopapadakis (2002). In order to investigate the effects of macroeconomic news announcements on aggregate stock returns in the United States, Flannery and Protopapadakis (2002) adopted a GARCH model approach. This approach was chosen over that of multi-factor models since the use of time series data, according to Flannery and Protopapadakis (2002: 755-756) may yield certain estimation errors when estimating multi-factor model coefficients. Furthermore, GARCH models that use high frequency data may provide a more thorough understanding of the underlying information that may influence stock returns on a daily basis.

Using daily data from 1980 to 1996, the analysis was carried out by identifying 17 macro series' announcements to which the conditional volatility of stock returns may be attributed. The stock returns were computed using the daily (close-to-close) returns to the value-weighted NYSE-AMEX-NASDAQ market index. The identified macro series announcements were: the balance of trade, consumer credit, construction spending, consumer price index, employment, unemployment, new home sales, housing starts, industrial production, leading indicators, M1 and M2 money supply, personal consumption, personal income, producer price index, real GDP and real GNP, and retail sales. Flannery and Protopapadakis (2002: 763) note that the order in which the announcements are made in any given month may modulate their respective impacts on the equity market. Thus, in order to analyse the impact of each macro announcement on stock return volatility, an announcement sequence was established. This sequence noted the day of the month that each announcement was made and established an average across the observed months. To account for non-trading days such as weekends and holidays within the sample, dummy variables were used to identify preholiday and postholiday trading days.

The results of the analysis provide evidence to suggest that six of the macro announcements have significant impacts on the volatility of equity returns of US stocks. These factors include the balance of trade and housing starts (both real factors), CPI, M1 and the producer price index (nominal factors), and lastly employment announcements. Surprisingly, no broad output measure (real GDP, real GNP and industrial production) was found to have any impact on stock returns, a finding that was noted by Flannery and Protopapadakis (2002: 767) to contradict earlier studies. Furthermore, days for which announcements were made regarding the CPI, housing sales, industrial production, leading indicators, the producer price index and real GNP, were associated with lower return volatility compared to no-announcement days.

Nikkinen *et al.* (2006) employed a similar approach to that of Flannery and Protopapadakis (2002) to investigate the impact of US macroeconomic news announcements on stock price volatility. The study extended previous research by investigating the impact of US macroeconomic news announcements not only on the US markets, but on 35 global stock markets. Nikkinen *et al.* (2006) note that because investors on US and non-US stock markets are interested in these news releases, the impact of these announcements may vary across economic regions. Thus the study sought to investigate the extent to which global stock markets are integrated with respect to scheduled US macroeconomic news announcements.

To carry out the analysis, the GARCH volatilities of 10 scheduled macroeconomic news announcements on the stock markets were analysed[2]. Also, to analyse whether the impact of macroeconomic news announcements varies across economic regions, the 35 stock markets were divided into six groups. These groups included the G7 countries, the European countries other than G7 countries, developed Asian countries, emerging Asian countries, Latin American countries, and countries from transition economies.

Using monthly data from July 1995 to March 2002, the methodology of Nikkinen *et al.* (2006) followed that of Flannery and Protopapadakis (2002) in order to calculate the GARCH volatility estimates. The results suggested that the impact of the news announcements and their importance, varied across different economic regions as expected. For example in the case of the G7 countries, the European countries other than G7 and the developed Asian countries, the news announcements significantly increased the volatility on the days on which these announcements were made. This finding was in contrast to the impact the macroeconomic news announcements had on the emerging Asian economies, the Latin American economies and the Transitional economies. Nikkinen *et al.* (2006) concluded that US macroeconomic news announcements cannot explain the variation in the uncertainty in all of these regions. This result was indicative of the low level of integration these stock markets were found to have with those of the developed economies (Nikkinen *et al.*, 2006).

3.1.2 EMERGING MARKETS

For the case of India, Ahmed (2008) sought to explore the causal relationship between stock prices and selected macroeconomic variables representing both the real and financial sectors of the Indian economy. In addition to determining the causal relationships, the study explored the

[2]Refer to Table A1 in the Appendix for a full list of the announcements.

notion of whether stock market movements are associated with the real sector of the Indian economy, the financial sector or both. The importance of such a study, as highlighted by Ahmed (2008:142), was due to the lack of related empirical literature after the economic liberalization of the Indian economy towards the end of the 20th century, as well as a study of this nature becoming increasingly important for policy makers, traders and investors.

The study employed Johansen's cointegration approach and Toda and Yamamoto (T-Y) Granger causality tests to examine the long-run causal relationships, whilst variance decompositions and impulse response functions were used to examine the short-run relationships. Using quarterly data for the period of March 1995 to March 2007, the stock variables that were used were the National Stock Exchange (NSE) Nifty and the Bombay Stock Exchange (BSE) Sensex. The macroeconomic variables identified were the index of industrial production, money supply, the interest rate, foreign direct investment (FDI) inflows, and export earnings.

The results for the long-run analysis showed that certain long-run relations existed between the stock indices and the macroeconomic variables. However, these relationships differed between the two stock indices. The validity of these results was confirmed from both the variance decomposition analysis as well as the impulse response analysis. As Ahmed (2008:161) pointed out, contrasting results of the Sensex and Nifty were concluded to be a result of the differing size and composition of each stock index. Also, the results for the BSE Sensex revealed that stock market activity in India leads to real economic activity. There are two explanations for this, according to Ahmed (2008:161), the first being that the growth rate of the real sector is factored into the movement of stock prices, and the second that positive growth expectations lead to a higher demand for stocks. Finally, the results provided evidence to suggest a positive relationship between FDI and stock prices in India, a finding they maintained may possess important information for policy makers.

In the same light as Gunsel and Cukur (2007), Paavola (2007) applied the APT to the Russian case using multiple regression techniques. The study aimed to identify macroeconomic factors that had an effect on stock returns, and additionally to determine how well the APT explained stock returns in Russia. The motivation for the study was that limited research of this nature was found by Paavola (2007) on Russia. The application of the APT to individual stocks on the stock markets of Russia was thus seen to be the first of its kind.

The individual stocks that were used in the analysis included 20 of the largest stocks that could be found on the Moscow Interbank Currency Exchange (MICEX) and on the Russian

Trading System (RTS) in 2005[3]. The identification and selection of suitable macroeconomic variables was seen to be particularly important in this study. This was because in the past stock returns of emerging economies were mainly found to be dependent on local factors rather than global factors, due to partial segmentation from global markets (Paavola, 2007:22). The macroeconomic variables were thus selected according to the unique features of the Russian economy. The independent variables selected were: money supply, inflation, the oil price, the exchange rate (RUB/EURO), industrial production, and the MSCI Emerging Markets (EM) index for Russia. The time period under consideration was from January 1999 to March 2006.

As noted by Paavola (2007) multiple regression estimations using Ordinary Least Squares (OLS) may present certain problems. The main problem is associated with the assumptions about the residual or error term of a linear regression. If the assumptions are violated, estimation problems may arise. In such a case the estimated coefficients may be subject to estimation bias, and thus not represent a true reflection of the data. A second problem that arises is the use of time series data in linear regressions, which may result in spurious regression. This potential shortcoming was addressed by Paavola (2007) by converting the data into logarithmic returns.

The results from the regression analysis showed that the macroeconomic variables poorly explained stock returns, a finding that was found to be very common amongst other studies employing the APT (Paavola, 2007: 31). These results thus lent no support to the applicability of the APT in Russia. However, the potential shortcomings of the specified model were highlighted by Paavola (2007:33). The first of these was the possibility of poor proxy identification, secondly the presence of information lags in the sample, and lastly a mis-specification of the model.

Verma and Ozuna (2005) employ a vector autoregressive (VAR) model to analyse the influence that macroeconomic variables have on the stock markets of four Latin American countries. Furthermore, the study analysed whether macroeconomic disturbances in one country had any spillover effects into any of the other Latin American stock markets. The increasing vulnerability of Latin American countries to both domestic macroeconomic movements, and to macroeconomic disturbances within other Latin American economies, underlined the importance of the study (Verma and Ozuna, 2005). As in Paavola (2007) limited empirical research of this nature could be found by Verma and Ozuna (2005) for Latin America.

Using monthly data from August 1993 to April 2003, the aggregate stock market indices for Brazil, Mexico, Argentina and Chile were obtained to calculate their respective stock returns. The four economies were selected according to the relative size of their domestic stock markets, as well as their economic growth. The macroeconomic variables selected for each country were

[3]For the full list of the 20 stocks see Paavola (2007).

the money supply (M1), the CPI, interest rates and the exchange rate (local currency/USD). A preliminary analysis of the data revealed that the stock returns for Brazil, Mexico and Argentina showed high levels of volatility, indicative of their high standard deviations and mean returns. This was in contrast to Chile, which exhibited low levels of volatility. This is as expected since emerging markets are associated with higher risks than that of developed markets, enforcing the positive relationship between the risk and return of an investment.

Impulse response functions were employed to test the domestic as well as cross-country macroeconomic influences. The results provided little evidence to suggest strong links between Latin American stock markets and the selected cross-country macroeconomic variables. The interest rate of Mexico was found to be the single cross-country macroeconomic variable to affect the stock returns of Argentina. Furthermore, only the domestic exchange rate for each country was seen to have any significant effect on its respective stock returns. This finding did, however, suggest that currency risk is a particularly important source of risk within Latin American countries. Interestingly, the stock market of Mexico was found to have a significant one-directional influence on the other Latin American markets. Verma and Ozuna (2005) conclude by suggesting that investors should pay particular attention to the stock market movements in Mexico, rather than to cross-country macroeconomic spillover effects.

In a similar study, Abugri (2008) investigated the effects that global variables and domestic macroeconomic variables have on the Latin American countries of Brazil, Mexico, Argentina and Chile. In addition to this, the study sought to determine whether the relative effects of the global and domestic variables differ in explaining returns across these four markets. As in Verma and Ozuna (2005), Abugri (2008) applies VAR methodology in the empirical analysis. Abrugri (2008:400) highlights the advantages VAR models have over multiple regression models, since VAR models are able to incorporate the time delay of new information being reflected in stock prices, with the use of lagged dependent variables. Monthly returns of the stock indices for the four countries are used from January 1986 to August 2001. The domestic macroeconomic variables were selected according to their theoretical soundness, as well as evidence from prior research.

The results showed that the coefficients for both global variables are significant in all four models. This finding highlights the susceptibility and importance of the Latin American economies to external shocks. Also, the results offer support for the view that not only are each of the countries affected by global shocks, but that domestic macroeconomic shocks have differing effects within each of the Latin American markets. As concluded by Abrugri (2008:409) the findings may have important implications for the decision making of investors and policy makers alike. Firstly, the implication of the macroeconomic variables having differing impacts across markets may prove useful for portfolio diversification strategies. Secondly, the link between the macroeconomy and the stock market places an emphasis upon the policy formulations and implementation of such policies that affect the macroeconomy. The implications are that policies that have been well planned and implemented may help to promote stock market stability in these markets.

A study by Bilson *et al.* (2001) incorporated the stock returns of 20 emerging markets across the globe, to investigate their linkages with macroeconomy variables from each of the respective countries. The goals of the study were twofold: firstly to determine the extent to which macroeconomic variables explain stock returns, and secondly to determine the degree of commonality between emerging market returns. To achieve the first goal, a multifactor model was specified to examine the linkages between the identified macroeconomic variables and stock returns of each of the emerging markets. In addition, Principal Components Analysis (PCA) was also employed to establish the degree of commonality between the emerging markets under investigation.

The 20 countries under investigation included six Latin American countries, eight Asian countries, three European countries, one Middle Eastern country, and two African countries[4]. The aggregate stock indices were used to calculate the stock returns for each market for the period January 1985 to December 1997. The macroeconomic variables identified for each country were: money supply (M1), the CPI, industrial production index, and the trade-weighted exchange rate (domestic currency/USD). Amongst these variables the MSCI World Index was used as a proxy to represent global influences on each of the emerging market returns.

The estimated results showed that the emerging market returns demonstrate little sensitivity to the MSCI World Index, which was found to be consistent with previous findings (Bilson *et al.*, 2001:410). The exchange rate was found to have the most significant influence on the emerging market stock returns, compared to the other macroeconomic variables. A strong negative relationship was found between the exchange rate of the respective countries and their stock returns. The remaining variables were found to have limited explanatory power in explaining the variation in returns. The weak results as noted by Bilson *et al.* (2001:411) may be attributed to the common problems associated with multifactor modelling. In this case the reasons may be that poor proxies for the variables were used, adjustments for the information lags may have been imprecise, and lastly the models may have been mis-specified. An alternative approach was thus taken which involved the inclusion of additional macroeconomic and microeconomic variables within each model. The addition of further explanatory variables was shown to improve the newly estimated models. However, the estimated models, although yielding more promising

[4]For the full list of the 20 emerging markets used see Table A2 in the Appendix.

results, may further suffer from problems of multicollinearity due to the large number of explanatory variables used (Bilson *et al.*, 2001:416).

To establish which of the macroeconomic factors were common to all markets PCA was conducted. The factor components that were found to be common in all the markets were, firstly, the industrial production and the trade sector (a real economic activity component); secondly, the trade sector and money supply (a consumption component); thirdly, country risk (a political risk component); and lastly, a component consisting of the global and regional indices with the microeconomic variables. However, Bilson *et al.* (2001) highlight that the commonalities do not necessarily suggest that each market shares identical sensitivities to each of the macro and microeconomic variables. It was concluded that since emerging market returns are driven by underlying fundamentals, the benefits of diversification across emerging markets may be limited due to the commonalities that were found to exist.

Ibrahim and Aziz (2003) analysed the dynamic linkages between stock prices and four macroeconomic variables in Malaysia. The analysis involved the application of Johansen's cointegration approach to investigate both short-run and long-run dynamics between stock prices and the macroeconomy. Rolling regression techniques were used to evaluate whether the interactions of stock prices and the macroeconomic variables change over time.

The data used in the study extended from January 1977 to August 1998, and included observations during the 1997/1998 Asian crisis. End-of-the-month values were used for the Kuala Lumpur Composite Index representing the aggregate stock price movement of Malaysia. The four logarithmically transformed macroeconomic variables included in the analysis were the industrial production index, the consumer price index, money supply (M2), and the exchange rate (MYR/USD).

The results of the cointegration analysis reveal that all four macroeconomic variables are significant in determining stock prices in Malaysia. Specifically, industrial production as a proxy for real economic movement, as expected, positively influenced stock prices. The CPI was found to have a positive relationship with stock prices, a finding that was not consistent with expectations. Interestingly, money supply was found to have a negative influence on stock prices in Malaysia. This finding provided an interesting insight into the relationship between money supply, inflation and stock prices in Malaysia. Implicit to these two findings was that money supply influences stock prices through a channel other than an inflationary channel. Lastly, the exchange rate was found to have a negative and highly significant association with stock prices. This result was expected by Ibrahim and Aziz (2003) since emerging Asian economies are commonly dependent on international trade, particularly in the export market.

The nature and significance of the relationships were confirmed with the use of impulse response and variance decomposition analysis. Similarly, the rolling regression results found that the interactions between the macroeconomic variables and stock prices were consistent throughout the sample period. Ibrahim and Aziz (2003) concluded that these findings provide evidence to suggest that the Asian crisis would only cause temporary irregularities between the dynamic linkages between the macroeconomic variables and stock prices.

Pyeman and Ahmad (2009) conducted a more in-depth analysis of the long-run and short-run linkages between the Malaysian stock market and its macroeconomic fundamentals. In contrast to Ibrahim and Aziz (2003), this study investigated the effects macroeconomic variables had on specific sectors within the Malaysian stock market. Furthermore, the short-term interest rate of Malaysia was added to the four macroeconomic variables used in Ibrahim and Aziz (2003). Nine sector indices were selected for the study: construction, plantation, consumer product, finance, industrial product, mining, hotels, property, and trading and services.

Using monthly data from January 1993 to December 2006, the Johansen's cointegration results showed that in the longrun, a total of 6 sectors returned to long-run equilibrium, given a short-run disequilibrium. The three sectors that did not provide error correction coefficients that were significant were the hotels, plantation and mining sectors. The property sector was found to adjust back to long-run equilibrium the fastest, specifically adjusting at a rate of 21.5% per month. The slowest sector to adjust was the construction sector which required a period of 15.38 months to adjust back to equilibrium, at a rate of 6.5% per month.

The short-run analysis results showed that GDP did not have a significant impact on the sector indices, except for the financial and property sectors. This finding was surprising since it implies that a higher level of industrial production or real growth does not result in higher stock prices in Malaysia (Pyeman and Ahmad, 2009:91). The money supply was found to have the most significant impact of all the macroeconomic variables. Except for the consumer product, property and mining sectors, which were not statistically influenced by the money supply, the relationship was found to be positive for the remaining sectors. According to Pyeman and Ahmad (2009:91) this positive relationship can be viewed in terms of the investment preferences amongst investors. Specifically, increases in money supply may lead to changes in preferences towards investing in stocks, thus resulting in higher stock prices.

The majority of the sector indices reacted negatively to changes in the short-term interest rate, which was consistent with *a priori* expectations. In contrast to this relationship, both the consumer price index and exchange rate positively influenced the majority of the sector indices. The finding for the consumer price index was in line with the findings of Ibrahim and Aziz (2003). The negative relationship between the exchange rate and the sector indices was, however, in contrast to these findings. This result may suggest that Malaysia has in recent years become more dependent on imports, as opposed to export trade as found by Ibrahim and Aziz (2003). The study concluded that the results suggest that macroeconomic fundamentals have an inconsistent effect on different sectors on the stock market of Malaysia.

A simpler analysis was conducted by Hussainey and Ngoc (2009), who investigated the influence that industrial production, inflation and interest rates had on aggregate stock prices in Vietnam. In addition, the effects of external factors were considered, specifically the effect the US macroeconomy and stock prices may have on stock prices in Vietnam. Employing Johansen's cointegration approach, it was found that stock prices in Vietnam were positively influenced by industrial production, which was as expected since 60% of the listed Vietnamese companies are industrial (Hussainey and Ngoc, 2009:327). Short-term and long-term interest rates had contrasting influences on stock prices: short-term interest rates were found to positively influence stock prices which did not conform to theory, while long-term rates were found to be negatively related to stock prices, which may indicate that stocks provide an alternative to long-term bonds for investors in Vietnam (Hussainey and Ngoc, 2009:328).

In the second part of the analysis, the S&P 500 Index was added to the domestic macroeconomic variables to act as a proxy for US stock price movements. The results show that stock price movement in the US has a significant positive effect on Vietnamese stock prices. Specifically, the results suggest that a 1% increase in US stock prices would lead to a 2% increase in stock prices in Vietnam. The US macroeconomy was, not surprisingly, also found to positively influence stock prices in Vietnam. However, US industrial production, a proxy for real industrial activity, was found to have a greater influence than that of its money market, approximated by its short-term interest rate. The findings of the study, as concluded by Hussainey and Ngoc (2009), provided Vietnamese investors and policy makers with a more in-depth knowledge of the impact that both domestic and external macroeconomic factors may have on future stock market movements in Vietnam.

Adam and Tweneboah (2008), however, provide empirical evidence of the linkages between stock prices and macroeconomic variables for Ghana. Using quarterly data from 1991.1 to 2006.4 the study investigated the effect that foreign direct investment, the Treasury bill rate, the CPI and the exchange rate (GHS/USD) had on the aggregate stock index of Ghana. To account for possible structural breaks in the data, a dummy variable that represented the period before and after the listing of Ashanti Goldfields Company (AGC) on the stock exchange of Ghana was included. The motivation for this was that AGC (now AngloGold Ashanti) accounted for 90% of the total market capitalization when it was first listed on the stock exchange of Ghana in 1994.

Using Johansen's cointegration approach the results suggested that cointegration did exist between stock prices in Ghana and the macroeconomic variables. The signs of the coefficients conformed to theory in the case of the Treasury-Bill rate, the exchange rate and foreign direct investment. These were found to be negative for both the Treasury-Bill rate and the exchange rate, but positive for foreign direct investment. In line with the findings of Ibrahim and Aziz (2003) and Pyeman and Ahmad (2009), the CPI was found to be positively related to the stock index. The dummy variable was found to be significant and to negatively affect stock prices in Ghana. Adam and Tweneboah (2008:13) note that this provides strong evidence to support the idea that the high concentration of AGC has decreased the liquidity of the exchange since its listing. It was concluded that investors in the shortrun should pay more attention to inflation, but in the longrun, short-term interest rates become increasingly important in influencing stock prices in Ghana.

Udegbunam and Eriki (2001) found empirical evidence that suggested aggregate stock prices in Nigeria are linked to certain macroeconomic variables. Employing the Cochrane-Orcutt procedure to account for lagged variables in the multiple regression model, seven dependent variables were considered. These included the rate of inflation, real GDP, money supply (M1), the long-term rate of interest, the price of crude oil, a measure for the trade balance deficit, and a dummy variable accounting for the financial deregulation of the Nigerian markets.

The estimation results found that changes in the price of oil and money supply are not significant determinants of stock prices in Nigeria. The remaining variables were significant, although the manner in which each exerted influence over stock prices differed. Inflation and the interest rate were found to be negatively related to stock prices. Specifically, it was found that a 1% increase in both the inflation rate and interest rate would depress stock prices in Nigeria by 0.9% and 4.7% respectively. As expected, GDP had a positive effect on stock prices as with financial deregulation. It was concluded by Udegbunam and Eriki (2001) that stock prices in Nigeria since deregulation in 1987 has become increasingly sensitive to changes in the macroeconomy.

3.1.3 SOUTH AFRICA

Jefferis and Okeahalam (2000) investigated the impact that both domestic and foreign economic factors had on real stock market returns in South Africa, Zimbabwe and Botswana from 1985 to 1995[5]. The domestic variables in question included real GDP, the real interest rate, the real exchange rate (ZAR/USD), whilst the real GDP and real interest rate of the US were used as the

[5]Since this section aims at reviewing empirical evidence for South Africa, only the results for South Africa will be discussed.

foreign variables. The FTSE/JSE All Share Index was used as a measure of the stock market behaviour for South Africa. Using quarterly data, the results of the Johansen's approach revealed that in the longrun, only the real GDP for the US was not significant. The remaining variables were seen to have significant impact on stock returns in South Africa in the longrun.

To investigate the short-run influences of the macroeconomic variables, the model was re-estimated without the US GDP variable. A close inspection of the results showed that in the shortrun, the real GDP and the real exchange rate had a positive impact on stock returns. Furthermore, both domestic and US real interest rates were found to have a negative impact. Of the four variables included, only changes in real GDP had an impact on stock returns that lasted for longer than a quarter. Jefferis and Okeahalam (2000:39) suggest that the impact of both domestic and foreign real interest rates, as well as the real exchange rate on stock returns, may only be indirect. Lastly, the error correction term which represents the speed of adjustment back to long-run equilibrium given short-run disequilibrium is 70% per quarter.

Moolman and du Toit (2005) developed a structural model for the stock market of South Africa to investigate its long- and short-run behaviours. A wide range of both domestic and foreign economic factors were identified and employed in the empirical analysis[6]. In addition, the business cycle fluctuations of the South African economy were included in the model, represented by a dummy variable. To test the long-run behaviour of the FTSE/JSE All Share Index, Moolman and du Toit (2005) tested for cointegration between the stock index, GDP and the constructed discount rate using Johansen's cointegration procedure. The results showed that the South African stock market is determined according to the present value model, that is, stock returns are functions of economic growth and the discount rate.

The short-run analysis included the business cycle dummy variables, constructed from a Markov-switching regime model, and the remaining macroeconomic variables. The results showed that the short-run behaviour was largely determined by the short-term interest rate of South Africa, the exchange rate, the S&P 500 index, the gold price, the forward-looking expectations of investors, and the risk premium. The significance of these variables was seen to cause short-run fluctuations in stock market behaviour in South Africa. It was concluded that although stock market behaviour in both the long- and short-run are determined by economic fundamentals, information asymmetry as well as the business cycle impact stock market behaviour.

Olalere (2007) sought to extend the studies of Jefferis and Okeahalam (2000:39) and Moolman and du Toit (2005) by introducing a second proxy to incorporate stock market behaviour in South Africa. The proxy variables used to depict stock market behaviour were the

[6]For a list of the factors considered see Table A3 in the Appendix.

FTSE/JSE All Share Index and market capitalization. The justification for the inclusion of market capitalization was that the FTSE/JSE All Share Index is computed from prominent stocks from each sector, but small capitalization stocks are left out. Thus, market capitalization may represent a more accurate proxy to encapsulate the overall behaviour of the JSE. Similarly to Jefferis and Okeahalam (2000:39) the influences of both domestic and foreign macroeconomic factors were considered which included the GDP and real long-term interest rate of South Africa and the US as well as the real exchange rate (ZAR/USD). In addition to these factors, the consumer price index of South Africa was also included.

Quarterly data from 1990:1 to 2004:4 was used to specify two models, with the market behaviour variable as the dependent variable in each case. A preliminary analysis of the data revealed that the GDP for the US was highly correlated to the GDP of South Africa, the real exchange rate and the consumer price index. US GDP was therefore excluded in the estimation of both the models, with the consumer price index also excluded from the market capitalization model. Using Johansen's cointegration approach, the long-run estimates of the two models yielded contrasting results. In the All Share model the real interest rate of South Africa and the real exchange rate were found to be insignificant, whereas for market capitalization it was found to be negative and significant in both cases. GDP for South Africa was found to be highly significant and positive for the All Share Index, but surprisingly insignificant for market capitalization. The real interest rate of the US was found to be significant in both models, having a negative impact on the All Share Index with the opposite for market capitalization. It was concluded by Olalere (2007) that changes in underlying economic fundamentals have a significant impact on stock market behaviour in South Africa.

Hancocks (2010) applied a similar approach to that of Maysami *et al.* (2004) and Pyman and Ahmad (2009) by investigating the impact that macroeconomic factors have on sector indices in South Africa. The sectors in question included the general retailers, mining and financial indices, with the FTSE/JSE All Share Index used as an aggregate measure. The macroeconomic variables identified included only domestic factors. These domestic variables were the money supply (M2), the nominal exchange rate (ZAR/USD), the 3-month Treasury bill rate, the yield on 10-year government bonds, and the consumer price index.

The results of the Johansen's cointegration test revealed that both money supply and the nominal exchange rate had significant and positive impacts on the stock indices in the longrun, except for the general retail index which was negatively related to the exchange rate. This finding was, however, found to be in line with expectations by Hancocks (2010). A surprising finding was the strong positive relationship the consumer price index shared with the general retail index, in contrast to the negative relationships with the remaining indices. However, the short-run behaviour of the retail index to the consumer price index was negative, suggesting that a positive relationship exists only in the long-run. The results confirmed those found by Maysami *et al.* (2004) and Pyman and Ahmad (2009) since evidence suggests that macroeconomic factors do influence stock returns, and these influences differ across sectors.

3.2 FINANCIAL CRISES, MACROECONOMIC FACTORS AND STOCK PRICES

Towards the end of the 20th century and into the 21st century, the global economy has suffered from financial turmoil that has occurred regularly and with destructive consequences for the financial world. Wee and Lee (1999) cite five financial crises that have occurred since the 1987 stock market crash and prior to the 2007 sub-prime crisis. The following sections discuss key financial crises, namely: the Mexican Peso crisis of 1994, the East Asian crisis of 1997 and the sub-prime mortgage crisis of 2007. The similarities and differences between the three crises are discussed, with specific focus on the effects crises have on the link between macroeconomic factors and stock prices.

3.2.1 FINANCIAL CRISES OVERVIEW: RECENT EVIDENCE

The Mexican Peso crisis of 1994 highlighted the dangers associated with the rapid integration of an emerging economy with that of the world economy. During the lead-up to the crisis, Mexico was viewed as an emerging economy that had been successful in implementing economic reforms geared towards attaining higher growth, stability and prosperity (Edwards, 1997). As a result, Mexico had experienced increased levels of capital inflows, due to the perceived expected growth, but more importantly as a result of the sharp decrease of the US interest rates preceding 1997. A currency appreciation ensued, and culminated in the devaluation of the Mexican Peso in December 1994. The market reaction to the devaluation had unexpected consequences not only for Mexico but also for other Latin American economies. The exchange rate devaluation resulted in a US $5 billion capital flight, and investor losses of more than US $30 billion (Lustig, 1995). Furthermore, historical volatility exceeded 150% and the Mexican Bolsa Index dropped 49% in December 1994. The contagion effects on the surrounding Latin American stock markets were more pronounced, with the Bovespa Index of Brazil and the Merval Index of Argentina declining by 61% and 58% respectively.

The East Asian crisis of 1997 once again illustrated the pitfalls of accelerated financial liberalization, in this case with Thailand, Indonesia, Malaysia and the Philippines. After decades of higher economic growth, these East Asian countries attracted large capital inflows, precipitated by domestic property booms and increased credit lending (Goldstein, 1998). However, weaknesses in financial market regulation, as well as low policy transparency, exacerbated the crisis and its reach across the Asian countries. The origins of the crisis began in Thailand, which during the years preceding the crisis assumed a pegged currency to the US dollar. According to Fischer (1998: 168), this encouraged increased external borrowing, resulting in a large current account deficit, whilst also increasing the exposure of both corporate and financial sectors to foreign exchange risk. The abolishment of the fixed exchange rate regime by Thailand in mid 1997, in order to curb the economic pressure, triggered one of the worst financial crises of the century (Furman *et al.*, 1998).

As noted by Fischer (1998: 169), the contagion and spillover effects to the surrounding Asian economies were relentless. During December 1997, the composite indices of Indonesia and Malaysia fell by 41% and 45% respectively (Wee and Lee, 1999). The stock indices of Hong Kong, Taiwan and Korea over the 12 month period lost 138%, 83% and 167% of their values between peak and trough respectively (Leong and Felmingham, 2003). What began as a currency crisis in Thailand manifested in a far-reaching global economic crisis, particularly across the emerging markets.

The more recent sub-prime crisis originating in the US bears testimony to the financial fragility of the world economy and its main occupants. The bursting of the US housing bubble in early 2006 triggered mass defaults on a subset of the mortgage market, namely the sub-prime market. The collapse of the sub-prime market resulted in systemic panic, the height of which saw Lehman Brothers, an iconic US financial services firm, fail in 2008 (Acharya *et al.*, 2009). Unlike the currency crises of Mexico and the East Asian countries, the sub-prime crisis of 2007 was a banking crisis that was not restricted to the country in which it began, but, to a greater extent, had systemic effects globally. Goodhart (2008) attributed the cause of the sub-prime crisis to the prolonged actions of the US Federal Reserve in maintaining low nominal and real interest rates. This was in order to negate any price deflation due to the bursting of the Tech bubble in 2001. As a result of an expansionary monetary policy, low interest rates began fuelling the housing bubble which resulted in the under pricing of risk by investors and mortgage lenders alike. These actions ultimately led to a financial crisis that continued into 2009 (Acharya *et al.*, 2009).

The period following the crisis saw stock markets around the world crumble and economies plunge into recession. From October 2007 to July 2008, the Dow Jones Industrial Average declined more than 21%, outpacing the 19.4% decline in the S&P500 (Stanton, 2008). As illustrated by Short (2011), the S&P500 would continue to fall into 2009, a total decline of more than 35%, and over the same period the tech-heavy NASDAQ Index dropped by 24% (Twin, 2008). Furthermore, according to Stanton (2008), the MSCI World Index, a measure of 23 developed countries stocks, fell by 18.2%. This illustrated the gravity and seriousness of the crisis in the financial markets around the world.

3.2.2 SIMILARITIES, DIFFERENCES, AND THE EFFECTS OF FINANCIAL CRISES ON THE LINK BETWEEN MACROECONOMIC FACTORS AND STOCK PRICES

The three financial crises reviewed display both similar and differing characteristics in the manner in which each occurred, but also in the role that macroeconomic factors played in each. Common in all cases was that each crisis brought about a period of economic turbulence that resulted in sharp declines of stock prices, and also the spill-over effects each crisis had. The sub-prime crisis, although having similar effects to that of the Mexican and East Asian crises was, as mentioned in the previous section, a banking crisis. Parallels may be identified with that of Mexico since low interest rates in the US were a key determinant that sparked a series of events that eventually led to the crisis. The housing and credit bubble in the US is synonymous with the East Asian crisis, however, the scale and depth of each in the US far exceeded that of Asia.

The period after 2009 has seen US interest rates at near zero levels, but also a lowering of interest rates in economies around the world (Stewart and Hopkins, 2009). This action is as expected since lower domestic interest rates, according to theory, should stimulate the economy in a way which promotes economic growth (Mishkin, 1995). During 2009, for example, the US Federal Reserve lowered interest rates to 0.25% which translated to a 5.6% increase in GDP in the fourth quarter of 2009 (Mataloni, 2010). However, as evidence has shown, low interest rates have not had the expected effect of promoting growth in the longrun. In the US, although initially benefiting from the low interest rates, GDP declined to 1.3% in the second quarter of 2011 (Mataloni, 2010). It is evident that the long-run effects of changes in the macroeconomy are thus subdued due to the systemic nature of the crisis.

In Mexico and East Asia, both crises illustrated the pitfalls of financial liberalization, without adequate regulation and policies. In both cases a currency crisis ensued, as a result of the pressure large capital inflows had placed on their respective currencies. However, striking differences are evident, particularly from a macroeconomic perspective. As noted by Edwards (1997), preceding the Peso crisis, Mexico showed modest real economic growth at 2.8%, whereas the East Asian countries experienced average real growth levels of close to 8% (Fischer, 1998). The implications of this may contradict the predictions of stock pricing models because, even if an economy experiences higher real economic growth in the shortrun, in times of financial distress this may not necessarily translate into higher stock prices in the longrun. The role US interest rates played in the Mexican crisis also sheds light on the effects that foreign macroeconomic disturbances may have on a domestic economy. The relatively lower interest rates in the US preceding 1994 and the resultant capital inflows into Mexico in turn allowed Mexico's exchange rate to appreciate to unsustainable levels. This is in contrast to East Asia where, as a result of credit over-extension, a property bubble was at the forefront of the crisis.

3.3 CONCLUSION

This chapter reviewed a small proportion of the empirical literature pertaining to the empirical link between the macroeconomy and stock prices. Further, the chapter discussed the implications of past financial crises, and their impact on stock prices was considered. The empirical evidence was grouped into three subsections, relating to global and developed markets, emerging markets, and lastly a subsection specific to South Africa.

The empirical evidence presented suggested that there is indeed a link between changes in certain macroeconomic factors, and stock price movement. Studies in the developed markets by Ratanapakorn and Sharma (2007) and Humpe and Macmillan (2007) investigated the impact domestic macroeconomic factors have on aggregate stock prices in the US, as well as in Japan, using cointegration techniques. Both studies concluded that in the longrun macroeconomic factors had a significant impact on stock prices in the US and Japan. Nasseh and Strauss (2000), Nieh and Lee (2001), Chaudhuri and Smiles (2004) and Maysami and Koh (2000) extended these studies by examining the impact that both domestic and international factors have on stock prices in their respective countries under investigation. In particular it was found that not only international macroeconomic factors but also foreign stock movements, affect domestic stock prices due to financial integration. Nieh and Lee (2001), however, found that no long-run relationships existed between the stock prices of the G7 economies and their exchange rates to the US Dollar.

The impact on stock prices was carried out in greater depth by Killian and Park (2009), Maysami *et al.* (2004) and Gunsel and Cukur (2007), who examined the impact of macroeconomic factors on both aggregate indices and on sector indices. The rationale of a sector approach, as noted by Maysami *et al.* (2004), was to provide greater insight into portfolio diversification implications for investors, and also into policy implications for policy makers. The results of the studies illustrated that macroeconomic factors have inconsistent effects across sectors. Flannery and Protopapadakis (2002) and Nikkinen *et al.*(2006) offered an alternative methodological approach in examining the underlying linkages between macroeconomic news announcements and stock prices. In both studies it was found that news announcements have a significant impact on the volatilities of stock prices of developed countries.

The empirical studies reviewed for emerging markets were carried out in much the same manner as those for the developed markets. A common motivation for studies of this nature was found to be due to the lack of empirical evidence available for emerging markets. This was particularly true for African markets. Broadly speaking, the stock price movements of emerging markets displayed similar reactions to changes in macroeconomic factors. Notably, in a number of the studies reviewed, the exchange rate variable showed consistent significance in affecting stock prices in emerging markets. As stated by Ibrahim and Aziz (2003), the exchange rate of emerging markets is crucial to the export trade, and thus economic growth. An exception was found in Pyeman and Ahmad’s (2009) study, which found evidence that suggested GDP does not have a significant impact on certain sectors in Malaysia.

The empirical evidence for South Africa illustrated that there is a strong relationship between stock prices and macroeconomic factors. Both Jefferis and Okeahalam (2000) and Moolman and du Toit (2005) investigated the long-run and the short-run impacts on South African stock prices. Olalere (2007) furthered these studies by investigating stock market behaviour by including market capitalization and also foreign factors into the analysis. It was found that the GDP of South Africa was central to stock market movement and growth. Hancocks (2010), Kilian and Park (2009), Maysami *et al.* (2004) and Gunsel and Cukur (2007) investigated the impact of macroeconomic factors at a sector level. However, only domestic factors were considered in the analysis. Again, the conclusions drawn were that sector indices show inconsistent reactions to changes in the macroeconomy in South Africa. As evident from the review, the empirical studies for South Africa have focused solely on domestic factors influencing stock prices or, if international factors were considered, did not consider a sector approach. This study attempts to combine these two aspects.

Lastly, the effects of financial crises were discussed, beginning with a review of recent crises. Three crises were considered; the exchange rate crises for both Mexico and the East Asian countries, and the more recent sub-prime crisis. Similarities and differences between the crises were outlined, with a specific focus on the effects financial crises may have on the relationship between macroeconomic factors and stock prices. As was discussed, interest rates played important roles in each of the crises, particularly in the Mexico sub-prime crisies. What was made evident from the discussion was that changes in macroeconomic factors may not have the same effects on stock prices after or during a financial crisis, thus the decisions of both policy makers and investors require careful consideration during such times.

The next chapter sets out the analytical framework that is used to provide answers to the objectives of the study, as set out in Chapter 1.

CHAPTER 4:
ECONOMETRIC ANALYSIS: METHODOLOGY AND DATA

4.0 INTRODUCTION

This chapter sets out the econometric framework that is used to achieve the objectives set out in Chapter 1. The chapter also includes the identification of macroeconomic variables and stock indices, as well as the data implications. Lastly, the models to be estimated are specified and the expected relationships between the stock indices and macroeconomic variables are discussed. As noted in Chapter 1, the Johansen cointegration approach (Johansen and Jusulius, 1990) will be used as the econometric framework in which to investigate the long-run relations between the selected variables.

The chapter is organized as follows: Section 4.1 discusses the methodology of determining the long-run relationships between the selected variables. Section 4.2 discusses the selection of the identified macroeconomic variables and stock indices, and the data implications. Section 4.3 provides the model specifications, and includes a discussion on the hypothesized relationships between the macroeconomic variables and the stock indices. Section 4.4 concludes the chapter with a summary.

4.1 TESTING FOR STATIONARITY AND THE COINTEGRATION FRAMEWORK

The standard Ordinary Least Squares (OLS) method requires that each series is integrated of order zero, [i.e. I(0)]. If this is not the case, then the possibility of spurious regression arises (Chinzara and Aziakpono, 2009). However, it is possible for a combination of individual I(1) series to be I(0). In such a case the series are said to possess a long-run relationship and the possibility of spurious regressions from such series is invalidated. One necessary condition for cointegration is that the series must be integrated of an order greater than zero (normally order 1) or at least have a deterministic trend. In this regard, it is logical that studies testing for the existence of a long-run relationship among series first perform stationarity tests (Moolman and du Toit, 2005). The stationarity of a series is important for two reasons, according to Chinzara (2008). Firstly, forecasts are only possible whilst using a stationary series, and secondly, the possibility of spurious regression is reduced. In this study, the stationarity of the series, both stock market indices and macroeconomic variables, is tested using the Augmented Dickey Fuller

(ADF) and the Kwiatkowski *et al.* (1992) (KPSS) tests[7]. The ADF tests the null hypothesis of there being a unit root in the series (i.e. the series is not stationary), with the alternative of there being no unit root. This is in contrast to the KPSS test, which tests the null hypothesis of the series being stationary, against the alternative hypothesis of the series being non-stationary.

Two most commonly used methods for testing for cointegration are the Engle and Granger (Engle and Granger, 1987) and the Johansen cointegration approach (Johansen and Jesulius, 1990). The former has lost popularity in recent years because, among other weaknesses, it fails to identify multiple cointegrating vectors and suffers from an inability to accommodate the possibility of simultaneity in the causal relationship among variables. Such problems are solved by the Johansen approach, which initially assumes that all variables are endogenous in the system. It is then possible to run a weak exogeneity test to distinguish between truly endogenous variables on which the identified cointegrating vectors will be normalised. Given its relative superiority, the current study uses the multivariate Johansen approach as followed by Olalere (2007) and Hancocks (2010).

The Johansen approach involves applying the maximum likelihood techniques to a VAR model assuming that the errors are white noise (Maddala and Kim, 1998). Following the practice in standard econometric literature, a typical $VAR(k)$ model can be represented as:

$$\Delta X_t = \Pi X_{t-1} + \sum_{t=i}^{k} \Gamma_i \Delta X_{t-i} + \varepsilon_{kt} \qquad [4.1]$$

where $X_t = (X_{1t}, X_{2t} ...)$ denotes an *nx1* vector of $I(1)$ stock market indices and the identified macroeconomic variables[8], ΔX_t are all $I(0)$, Γ_i are *n x n* coefficient matrices; ε_{kt} are normally and independently distributed error terms; and Π is a long-run coefficient matrix, the rank of which gives the number of cointegrating vectors. Given that $\Delta X_t ... \Delta X_{t-k+1}$ are all $I(0)$, but X_t is $I(1)$, it is logical that, for equation (1) to be consistent, Π_i should not be of full rank. Otherwise, a full rank be would imply that all X_t are $I(0)$, thus invalidating the necessity of testing for cointegration[9]. A rank of Π_i = 0 is possible, but would imply that there are no long-run

[7]Since the two techniques are very common and have been employed by several empirical studies, the theoretical underpinning behind them will not bediscussed here. For a discussion of the method see Gujarati (2003) and Brooks (2003).
[8]Note that all variables for the stock market indices were found to be endogenous.
[9] This will mean that all the variables are stationary at level terms, thus OLS can be used provided the other

relationships among the variables (Harris, 1995). Usually Π_i has a reduced rank, that is $r \leq (n-1)$, in which case it can be decomposed as:

$$\Pi_i = \alpha\beta^1 \qquad [4.2]$$

where α is a $n \times r$ matrix and β' is a $r \times n$ matrix. Then $\beta' X_{t-1}$ are the r cointegrated variables, β' is the matrix of the long-run coefficients, and α has the interpretation of the matrix of error correction terms[10].

The rank of the matrix Π_i and the number of cointegrating relation(s) are determined using the two likelihood ratio (LR) test statistics proposed by Johansen (1988). These are the trace statistic (λ_{trace}) and the maximum eigenvalue test ($\lambda_{\max}$) with their test statistics given respectively as follows:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \log\left(1 - \hat{\lambda}_i\right) \qquad [4.3]$$

$$\lambda_{max} = -Tlog\left(1 - \hat{\lambda}_{r+1}\right) \qquad [4.4]$$

where λ_i is the i^{th} largest eigen value of the Π_i matrix in equation (2). The trace statistic consecutively tests the null hypothesis that the number of cointegrating relations is *r* against the alternative of *k* cointegrating relations, where *k* is the number of endogenous variables. The maximum eigenvalue tests the null hypothesis that there are *r* cointegrating vectors against an alternative of *r+1* (Brooks, 2003).

Once the cointegrating vectors are identified, it is possible to estimate the Vector Error Correction Models (VECMs). This is done by first identifying the variables that are truly endogenous and exogenous using the weak-exogeneity test. The VECMs are then obtained by specifying the number of cointegrating vectors, trend assumptions used in identifying the vectors and normalising on the truly endogenous variables. The VECM framework restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships, while accommodating short-run adjustment dynamics. Finally, it is necessary to perform diagnostic

Classical Linear Regression assumptions are satisfied.

[10] This is Granger's representation theorem.

checks on the residuals from the estimated VECM to ensure that they are white noise. Normally, serial correlation, heteroscedasticity and normality are tested. However, since the study is dealing with financial data, there is no guarantee that the last two latter problems will be dealt with[11]. For this reason our concern in this study will be serial correlation.

If cointegration is found in this study, then it would imply that although the stock market indices and macroeconomic variables are individually non-stationary, they move together in the long run. Moreover, since cointegration implies that a valid VECM model exists, it would also imply that, in contrast to weak form efficiency, lagged macroeconomic variables can be used to predict the behaviour of the stock market.

In this study, the short-run relationships between the stock market and macroeconomic variables are further analysed using impulse response functions. Impulse response functions trace out the responsiveness of stock market returns to one standard deviation shocks in each of the macroeconomic variables in the VAR framework. Of importance here is the sign, magnitude and persistence of responses of stock market returns.

Given a VAR model such as that in equation 4.1 and assuming that the error terms follow a white noise process, impulse responses are the coefficients of a moving average process that is obtained from the VAR equation (Lutkepohl and Saikkonen, 1997). The moving average takes the following form:

$$X_t = C + \sum_{s=1}^{k} \beta_s \varepsilon_{t-s} \qquad [4.5]$$

where X_t denotes a linear combination of current and past one-step-ahead forecast error or innovations. The coefficients β_s can be interpreted as the response of stock market returns to a one standard error shock of any of the macroeconomic variables. As in equation 4.1, ε_{kt} are also serially uncorrelated although they may be contemporaneously correlated (Chinzara and Aziakpono, 2009).

4.1.1 IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSIS

Impulse response functions trace out the responsiveness of the dependent variable to shocks to each of the explanatory variables within the VAR framework. In the context of this study, the response of each stock index to a standard error shock to each of the macroeconomic variables

[11]For problems with financial data which cannot be captured by time series model, see Brooks (2003:380-382)

was examined. The impulse responses are commonly estimated using the generalised impulse response proposed by Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998), and the Cholesky decomposition proposed by Sims (1980). The former has the advantage over the latter in that it does not require orthogonolization of innovations as it does not vary with the ordering of variables in the VAR[12] (Pesaran and Shin, 1998:17). For this reason, this study uses the generalized estimation criterion. Again, stationarity of the series is important since the impulse response functions are only reliable when series are stationary. Thus the data on macroeconomic variables and stock market indices were differenced once to make them stationary.

An alternative to investigating VAR system dynamics is variance decomposition analysis. This approach involves analysing the proportion of movements of the dependent variable that are due to its own innovations, and the innovations of the explanatory variables. This is in contrast to impulse response analysis, which traces out the response of a shock to one variable on other variables in the VAR framework. Within the context of the study, the variance decomposition apportions the variance of the stock indices to shocks to itself and the macroeconomic variables. Furthermore the variation in one macroeconomic variable is also likely to have an impact on the others, as well as the stock index.

4.2 SELECTION OF VARIABLES AND DATA

The study focuses on one aggregate stock index, namely the JSE-FTSE Top 40 Index, and seven sector indices. The sector indices were chosen not only according to their relative size and importance to the South African economy, but also according to what investors may find defensive sectors to invest in during times of financial crisis. Seven macroeconomic variables were chosen, namely: South African (SA) industrial production[13], SA money supply, United States GDP (a proxy for foreign GDP), SA consumer price inflation, SA 3-month treasury bill rate, USD/ZAR nominal exchange rate, and USD oil prices. These variables have been viewed as important determinants of stock market behaviour, since each features prominently in the South African economy. Moreover, these variables have featured in numerous past studies (Jefferis and Okeahalam, 2000; Moolman and du Toit, 2005; Pyman and Ahmad, 2009; Hussainey and Ngoc, 2009) that are of a similar nature.

Three dummy variables were incorporated in the analysis in order to capture periods of financial market instability. These periods include the East Asian crisis of 1997, the rand crises of 1998 and 2001 and the financial crisis of 2007. The beginning and ending of these periods

[12] However, results from the two methods coincide if the shocks are uncorrelated.
[13]Note that industrial production is used as a proxy for GDP because GDP figures are only available on a quarterly basis, and industrial production is a measure of real economic activity.

differ across the numerous studies done on each crisis. Therefore, a number of studies were considered, and the dates that had sound economic reasoning were used. The period for the East Asian crisis starts in July 1997 and ends in August 1998. These dates begin with the devaluation of the Thai Baht on 2 July 1997, and the end was signalled by the beginning of an upward trend of the East Asian stock indices (Mitton, 2001: 223). The rand crises of 1998 and 2001, according to Bhundia and Ricci (2009) run from April 1998 to August 1998, and September 2001 to December 2001, respectively. These two periods were characterised by a sharp depreciation of the ZAR against the USD. In the period for 1998, the ZAR depreciated by 28% (in nominal terms), which resulted in a contraction of national output and a fall in stock prices by 40%. In 2001, the ZAR depreciated by 26% which, in contrast to 1998, led to increased real GDP and an appreciation of stock prices by 28%. The 2007 financial crisis signalled the beginning of the downward phase of not only the South African economy, but also the global economy. The South African Reserve Bank notes December 2007 as the official start to the downturn, with the South African economy yet to enter the next upward phase (SARB, 2011).

The data used for this study is for the period August 1995 to December 2010, obtained from Thompson DataStream 2007[14]. All data was available in monthly frequency except for United States GDP, which was interpolated from quarterly to monthly. Except for interest rate, all the variables are logarithmically transformed. Table 4.1 summarises the variables and their measurement. Also provided in the table are the expected sign(s) based on literature of each of the macroeconomic variables.

Table 4.1: Variable and model description summary

Variable	Description	Unit
LALSI	LOG of FTSE/ALL SHARE INDEX	PRICE INDEX
LCMPI	LOG of FTSE/CONSTRUCTION AND MATERIALS PRICE INDEX	PRICE INDEX
LFPI	LOG of FTSE/FINANCIAL PRICE INDEX	PRICE INDEX
LFPRPI	LOG of FTSE/FOOD PRODUCERS PRICE INDEX	PRICE INDEX
LGRPI	LOG of GENERAL RETAIL PRICE INDEX	PRICE INDEX
LIPI	LOG of FTSE/INDUSTRIAL PRICE INDEX	PRICE INDEX
LMPI	LOG of FTSE/MINING PRICE INDEX	PRICE INDEX
LPHARPI	LOG of FTSE/PHARMACEUTICALS PRICE INDEX	PRICE INDEX
LCPI	LOG of CONSUMER PRICE INFLATION	INDEX (2005=100)
LMS	LOG of M3 MONEY SUPPLY	R MILLIONS
LPCO	LOG of PRICE OF BRENT CRUDE OIL	R PER BARREL
LIPSA	LOG of INDUSTRIAL PRODUCTION OF SOUTH AFRICA	INDEX (2005=100)
LUSGDP	LOG of GDP OF UNITED STATES OF AMERICA	$ BILLIONS
LNER	LOG OF NOMINAL EXCHANGE RATES	RANDS/DOLLAR
TBRATE	3-MONTH TREASURY BILL RATE	PERCENTAGE
DUM1	DUMMY VARIABLE FOR EAST ASIAN CRISIS OF 1997	

[14]The time period under investigation was chosen according to the availability of data for all variables.

DUM2	DUMMY VARIABLE FOR THE RAND CRISIS OF 1998 and 2001
DUM3	DUMMY VARIABLE FOR THE FINANCIAL CRISIS OF 2007

4.3 MODEL SPECIFICATION AND *APRIORI* EXPECTATIONS

As noted in section 4.1, the Johansen cointegration approach allows the true endogenous variable to be identified, and thus can be normalized on. Furthermore, multiple cointegration relations between the variables may be possible. However it is the author's considered view that changes in macroeconomic variables cause changes in stock prices, as found to be the case in Killian and Park (2009); Pyeman and Ahmad (2009) and Hancocks (2010). To this effect the eight models were estimated using each of the stock indices as the presumed endogenous dependent variable, with the same macroeconomic variables being used in each case:

$$\begin{matrix} LALSI \\ LCMPI \\ LFPI \\ LFPRPI \\ LGRPI \\ LIPI \\ LMPI \\ LPHARPI \end{matrix} = f(\mathrm{LCPI}^{-}, \mathrm{LMS}^{-}, \mathrm{LPCO}^{-}, \mathrm{LIPSA}^{+}, \mathrm{LUSGDP}^{+}, \mathrm{LNER}^{+}, \mathrm{TBRATE}^{-}, \mathrm{DUM1}, \mathrm{DUM2}, \mathrm{DUM3})$$

Note: + and - represent the expected relationships between the dependent and explanatory variables

As noted in Chapter 1, the theoretical literature provides evidence of possible relationships between macroeconomic variables and stock prices. These macroeconomic variables may include domestic GDP, inflation, interest rates, the money supply, the exchange rate, foreign GDP and oil prices. The domestic aggregate level of production (GDP) is hypothesized to have a positive impact on stock prices, because as an economy experiences increased current or predicted growth, aggregate consumption would increase and this would increase corporate profitability (Chen *et al.*, 1986; Chaudhuri and Smiles, 2004; Gunsel and Cukur, 2007). With reference to the present value model, this would increase anticipated dividends and investors would be induced to purchase more shares. This increase in demand for shares will put upward pressure on stock prices. Furthermore, an expanding economy allows economic agents to increase their spending on consumption and investment, according to Keynes's motive for holding money (Olalere, 2007). According to Olalere (2007) this will allow firms to expand their production capacity by raising capital through the stock market, to meet the increased demand of economic agents.

The tax-effect and the proxy-effect hypotheses outline the channels through which inflation can negatively affect the stock market. Coined by Feldstein (1980), the tax-effect hypothesis posits that inflation imposes higher effective tax rates on corporate income and by doing so reduces the real net yield that investors receive per unit of capital. This effect emanates from the accounting treatment of historical-cost depreciation and capital gains. The latter hypothesis emphasises the effects of inflation on the stock market through its impact on the real economy (Fama, 1981). Because real economic activity is positively related to stock market performance and negatively related to inflation, it is logical that inflation is negatively related to stock market prices.

Interest rates have the potential to impact on the stock market through two main channels. Firstly, the interest rate imposes a cost of borrowing to both corporate and stock market investors (Mishkin, 1995). Thus both the profitability of investments and demand for shares are likely to be negatively affected, and consequently stock prices. Secondly, an increase in interest rates increases the opportunity costs of investing in the stock market, because other financial assets such as bonds become cheaper according to the Liquidity Preference Theory (Froyen, 2005). Thus, investors would reallocate funds from the stock market to the bond market resulting in a reduction in stock prices.

According to Coetzee (2002), changes in the money supply may have a double-sided effect on stock prices, due to the theoretical linkage between money supply, inflation and interest rates. On the one side, an increase in money supply would affect stock prices through its effects on current interest rates. Lower interest rates would reduce financing costs and thus increase the profitability of companies. The effect on stock prices in this case would depend on the interest rate sensitivity of different sectors or companies as well as their source of finance. Furthermore, a decrease in interest rates would inveigle investors to sell interest-earning assets like bonds (as their prices would have increased) and invest the resultant earnings in the stock market, thus putting upward pressure on stock prices. On the other side, an increase in the money supply would increase the likelihood of increased inflation and thus a decrease in future demand for goods (Mishkin, 2004:11). Since investors are forward-looking, they would interpret this anticipated decrease in aggregate demand as a decrease in the future profitability of companies. According to the Present Value Model, lower profitability of a firm lowers expected dividends and thus stock prices.

In an open economy like that of South Africa, exchange rate movements affect the stock markets through their impact on imports and exports as well as on capital flows. Bodurtha *et al.* (1989: 24-25) illustrate the demand-side and supply-side effects that exchange rates may have on stock prices. For example, depreciation of a currency promotes exports and discourages imports.

In the shortrun, this would increase the earnings of exporting companies and hence their stock prices (Maysami *et al.*, 2004: 54). However, in the longrun depreciation of a currency could also promote economic growth and thus overall stock market development. Depreciation may also increase the flow of portfolio equity capital as foreign investors try to take advantage of cheaper domestic shares. This increase in demand for domestic shares will increase share prices in the short-run (Mukherjee and Naka, 1995). Mukherjee and Naka (1995) conclude, however, that in the long run, both increased exports and capital inflows could result in positive pressure being put on domestic interest rates, thereby dampening the initial increase in stock prices. Similar effects can also result if depreciation is too much so that it fuels imported inflation. This of course would be the case if a country relies heavily on imported goods such as oil and physical capital.

The influence of foreign GDP on domestic stock prices is uncertain. In the first instance, according to Jefferis and Okeahalam (2000), foreign GDP may be positively related to domestic stock prices. A possible reason for this is that if the domestic country were a strong export trading partner of the foreign country, an economic upswing of the foreign country's economy would increase the relative attractiveness of the domestic country's exported goods to that country. As a result, an increase in profitability of the domestic country's exporting firms would result in higher dividend yields of these firms and increase the price of their stocks. On the other hand, foreign GDP may have a negative impact on domestic stock prices. According to Jefferis and Okeahalam (2000) this is because an economic upswing of a foreign economy may result in the increased profitability and stock prices of foreign firms, which in turn may trigger a capital outflow from the domestic country into the more profitable foreign firms. A net capital outflow would theoretically lead to a decrease in domestic stock prices and an increase in foreign stock prices.

The price movement of Brent crude oil may have implications that have certain effects on stock prices. Since the price of Brent crude oil is directly linked to the price of petroleum, and thus transport costs in South Africa, this has a knock-on effect on inflation. A rise in the price of Brent crude oil would lead to increased inflationary pressures and, as discussed previously, results in lower profitability and thus lower stock prices. As noted by Sadorsky (1999:468), the price movement of oil is important because "increases in oil prices are often indicative of inflationary pressure in the economy, which in turn could indicate the future of interest rates and investments of all types" (Sadorsky, 1999:468). Sadorsky (1999) concluded that oil prices and oil price volatility both play important roles in affecting economic activity and explaining movements in stock returns.

4.4 CONCLUSION

In this chapter, the analytical framework to be utilized in determining the long-run relationships between stock indices and macroeconomic variables was discussed. The Johansen cointegration approach was identified as being a superior method for estimating long-run behaviour. The selection of variables was then discussed and the data implications. Lastly, the models to be estimated were presented, and the expected relationships between the stock indices and macroeconomic variables were discussed. Having set out the analytical framework, the following chapter moves on to estimating the specified models.

CHAPTER 5:
EMPIRICAL RESULTS

5.0 INTRODUCTION

In Chapter 1, the following objectives were set: (i) investigate the extent to which macroeconomic variables influence stock prices in South Africa, especially in times of financial crises; and (ii) draw conclusions of the implications these have for investing in the South African equity market. In order to achieve these objectives the following chapter estimates the models specified in Chapter 4, using the analytical framework discussed.

The chapter is laid out as follows: Section 5.1 provides a preliminary analysis of the data used in the study. Section 5.2 tests the stationarity of the data using both the ADF and KPSS tests. Section 5.3 carries out the Johansen cointegration analysis to establish the presence and nature of the relationship between the macroeconomic variables and stock indices. Section 5.4 discusses the VECM results for each estimated model. Section 5.5 presents the impulse response analysis and variance decomposition analysis for each of the estimated models. Lastly, Section 5.6 discusses the implications that the results obtained in Section 5.4 may have for investors in South Africa.

5.1 PRELIMINARY ANALYSIS

5.1.1 GRAPHICAL ANALYSIS

An analysis of Figures 1 and 2 in the appendix reveal that the sector indices, as well as the macroeconomic variables, is time-varying. This may imply that each series is not stationary in level terms. Furthermore, all series except for the 3-month Treasury bill rate (TBRATE) seem to display a positive upwards trend with an intercept. Such knowledge of each series is particularly important with regard to testing for a unit root, because the correct assumption selected in the unit root tests may prove to be crucial in determining whether a series is stationary or not.

A more thorough analysis of Figure 1 reveals certain common trends in each of the sector indices. Within the period from 1996 to approximately 2001, each of the sector indices displays periods of volatility. This is particularly obvious in the construction and materials (LCMPI), financial (LFPI), food producers (LFPRPI), general retail (LGRPI), industrial (LIPI) and pharmaceutical (LPHAPI) pricing indices. Furthermore, during the period from approximately 2008 to the end of 2010 high volatility is also evident in all of the sector indices, except for that of the pharmaceuticals sector. The presence of these periods of volatility adds to the justification for the use of dummy variables in the empirical analysis.

5.1.2 PAIR-WISE CORRELATION

As mentioned in the previous section, all the macroeconomic variables, except for the Treasury bill rate, display a positive upward trend. Moreover, given the theoretical links amongst some of these variables, the possibility of multicollinearity cannot be ruled out. Multicollinearity or near-perfect multicollinearity is said to exist between the explanatory variables of a model, when there is a perfect relationship amongst these variables (Gujarati, 2003). This may result in inflated standard errors of the regression coefficients, and may thus lead to inefficient estimates[15]. To this end, pairwise correlation matrices for the variables were estimated.

The results are presented in Table 5.1. The results suggest possible multicollinearity between money supply (LMS) and oil prices (LPCO), and most of the remaining macroeconomic variables. Specifically, money supply is highly correlated with inflation (LCPI), oil prices and US GDP, while oil prices are also highly correlated with inflation, US GDP and the South African industrial production index. With the wisdom that multicollinearity negatively affects the efficiency of estimates, both money supply and oil prices were dropped from the empirical analysis in order to maintain efficiency in further estimation.

Table 5.1: Pair-wise correlation of the macroeconomic variables

	LCPI	LIPSA	LMS	LNER	LPCO	LUSGDP	TBRATE
LCPI	1.00						
LIPSA	0.78	1.00					
LMS	0.99	0.83	1.00				
LNER	0.66	0.43	0.60	1.00			
LPCO	0.87	0.88	0.90	0.40	1.00		
LUSGDP	0.96	0.83	0.96	0.69	0.88	1.00	
TBRATE	-0.74	-0.59	-0.73	-0.47	-0.74	-0.80	1.00

5.2 STATIONARITY TESTS

As set out in the previous chapter, the two unit root tests employed are the ADF and the KPSS. The graphical analysis in Section 5.1.1 found that all the series contained an intercept and were trending, therefore the tests were carried out using the "intercept and trend" assumption. The appropriate lag length used in the ADF test using the Schwarz information criterion was 12. This was due to the use of monthly data in this study. The KPSS test was estimated using the Bartlett

[15] A discussion on the nature and consequences of multicollinearity can be found in Gujarati (2003).

Kernal estimation method, where a lag length is not required. The results of both tests are presented in Table 5.2 below.

Table 5.2: ADF and KPSS unit root results (trend and intercept)

Variable	ADF Level	ADF 1ST Difference	KPSS Level	KPSS 1st Difference	Order of Integration
LALSI	-2.23(0.472)	-12.00(0.000)[a]	0.04(0.779)	0.18(0.000)[a]	I(1)
LCMPI	-2.02(0.585)	-13.41(0.000)[a]	0.17(0.365)	0.29(0.000)[a]	I(1)
LFPI	-2.58(0.289)	-13.18(0.000)[a]	0.07(0.822)	0.19(0.000)[a]	I(1)
LFPRPI	-1.75(0.725)	-12.88(0.000)[a]	0.07(0.403)	0.33(0.000)[a]	I(1)
LGRPI	-1.87(0.664)	-11.21(0.000)[a]	0.05(0.128)	0.32(0.000)[a]	I(1)
LIPI	-2.16(0.509)	-12.51(0.000)[a]	0.06(0.745)	0.13(0.000)[a]	I(1)
LMPI	-2.18(0.497)	-13.64(0.000)[a]	0.05(0.776)	0.11(0.000)[a]	I(1)
LPHARPI	-2.49(0.334)	-14.26(0.000)[a]	0.05(0.908)	0.10(0.000)[a]	I(1)
LCPI	-2.61(0.278)	-10.06(0.000)[a]	0.08(0.440)	0.14(0.000)[a]	I(1)
LIPSA	-3.16(0.097)	-8.13(0.000)[a]	0.05(0.827)	0.13(0.000)[a]	I(1)
LMS	-1.09(0.927)	-14.82(0.000)[a]	0.19(0.526)	0.22(0.000)[a]	I(1)
LNER	-1.63(0.778)	-11.59(0.000)[a]	0.06(0.193)	0.26(0.000)[a]	I(1)
LPCO	-2.86(0.179)	-14.35(0.000)[a]	0.03(0.835)	0.12(0.000)[a]	I(1)
LUSGDP	-2.77(0.210)	-4.34(0.003)[a]	0.05(0.107)	0.34(0.000)[a]	I(1)
TBRATE	-2.67(0.249)	-10.50(0.000)[a]	0.04(0.743)	0.16(0.000)[a]	I(1)

Notes: The MacKinnon (1996) ADF 1% critical value = -4.01 and the KPSS (1992) 1% critical value = 0.216. [a] denotes the rejection of the null hypothesis of a unit root for the ADF test, and the rejection of non-stationarity in the KPSS test. p-values are in parentheses.
Source: Thompsom Datastream (2009) and the author's own estimates using Eviews 7.

The results from both tests show that at level terms all series are non-stationary i.e. have a unit root, but the series becomes stationary when differenced once. For the ADF test at level terms with a 1% critical value of -4.01, the null hypothesis cannot be rejected in all cases until the series is differenced. In the KPSS test at level, the null hypothesis is rejected at a 1% critical value of 0.216. The results therefore imply that all series are I(1). As mentioned in the preceding chapter, two or more series are said to be cointegrated when a linear combination of individual I(1) series is I(0).Thus a long-run relationship between these variables may be present in such a case.

5.3 JOHANSEN COINTEGRATION ANALYSIS

5.3.1 IDENTIFICATION OF THE VAR LAG ORDER

As noted in the previous chapter, this analysis follows Olalere (2007) and Hancocks (2010) by using Johansen's multivariate approach, which involves specifying a VAR for each of the indices and the macroeconomic variables. Eight VARs were thus specified and cointegration was tested for. The Johansen cointegration approach requires that an appropriate lag length and deterministic assumption be specified. While an extremely low lag length may lead to serial correlation, a lag length that is too high negatively impacts on the asymptotic properties of estimates, especially if the sample size is small (Hall, 1991). Empirical studies have also shown that Johansen's test statistics are sensitive to the chosen lag. Furthermore, different information criteria may also display conflicting results. To solve this potential problem various information criteria will be employed to determine the optimal lag order. Unfortunately, different information criteria tend to select conflicting VAR orders, thus basing the analysis on a single information criterion could be misleading. To this end the analysis will initially employ information criteria and identify the range of lags that have been selected by the information criteria (Allen and McDonald, 1995; Chinzara and Aziakpono, 2009). Cointegration is then sequentially tested beginning from the smallest lag length until meaningful cointegration results are obtained[16]. Should no meaningful cointegration be found until the highest lag selected, this will be interpreted as an indication that there is no long-run relation among the variables. Since monthly data is being used, twelve months were used as the maximum lag order as it is expected that due to arbitrage, the stock market would adjust back to equilibrium should there be short-run disequilibrium. The lag length results for the eight models are presented in Table 5.3 and it is evident that different information criteria select different lags. In all the models except for Model 8, the FPE, AIC, SC and HQ selected a lag length of 2, whilst the LR statistic identified lag lengths that differed from these. In Model 8 the information criterion provided less consistency with regard to lag lengths. LR and AIC both identified a lag lengths of 7, with SC and HQ identifying an appropriate lag length at 2, and lastly FPE with 5 lags.

Table 5.3: Lag length selection

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Lag Criteria	All Share Index	Construction and Materials Index	Financial Index	Food Producers Index	General Retail Index	Industrial Index	Mining Index	Pharmaceuticals Index
LR	8	8	11	8	8	8	8	7
FPE	2	2	2	2	2	2	2	5
AIC	2	2	2	2	2	2	2	7
SC	2	2	2	2	2	2	2	2
HQ	2	2	2	2	2	2	2	2

Notes
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
Source: Thompsom Datastream (2009) and the author's own estimates using Eviews 7.

[16] By meaningful results here we mean cointegration and meaningful VECM should exist in that lag order and the residual obtained should be *unserially correlated*.

5.3.2 COINTEGRATION TESTS

In order to test for cointegration, Johansen (1988) provides two likelihood ratio (LR) test statistics, namely the trace statistic and the maximum eigenvalues statistic. Cointegration was tested in all eight models and the results were subsequently tested for serial correlation. All the results of the cointegration tests were found to be robust for the serial correlation diagnostic test. Table 5.4 reports the cointegration test results.

In models 1, 4 and 6 the lag order that yielded the most meaningful results was found to be at 4 lags. A lag order of 2 was found to be appropriate in models 2, 5 and 8, with models 3 and 7 providing meaningful results at lags of 8 and 5 respectively. In all eight models deterministic assumption 4 was used. In models 1, 3, 5, 6 and 8, the trace statistic identified one cointegrating vector, whilst in models 2, 4 and 7, two cointegrating vectors were identified. In contrast the maximum eigenvalue identified no cointegrating vectors in models 1, 2, 5, 6 and 8, and only a single cointegrating relation in models 3, 4 and 7. The models were estimated according to the results of the trace statistic.

Table 5.4: Cointegration test results

					Trace		Max	
Model	Obs	k	A	r<0	r<1	r<2	r<0	r<1
1 (LALSI)	182	4	4	124.03 [0.02]	90.34 [0.08]	-	33.70 [0.45]	-
2 (LCMPI)	184	2	4	138.98 [0.00]	99.38 [0.00]	63.77 [0.05]	39.60 [0.15]	-
3 (LFPI)	178	8	4	106.92 [0.00]	74.73 [0.06]	-	55.83 [0.00]	32.19 [0.21]
4 (LFPRPI)	182	4	4	156.19 [0.00]	101.97 [0.01]	68.80 [0.08]	54.22 [0.00]	33.17 [0.17]
5 (LGRPI)	184	2	4	119.88 [0.04]	85.08 [0.09]	-	34.79 [0.38]	-
6 (LIPI)	182	4	4	128.76 [0.01]	92.89 [0.08]	-	35.88 [0.32]	-
7 (LMPI)	181	5	4	145.84 [0.00]	97.56 [0.01]	65.21 [0.05]	48.29 [0.02]	32.35 [0.21]
8 (LPHARPI)	184	2	4	124.89 [0.02]	82.98 [0.12]	-	41.90 [0.09]	-

Notes: Obs is the number of observations in the model, k represents the chosen lag length, and A is the cointegration assumption used. P-values are in parentheses. Source: Thompson DataStream (2009) and author's own estimates using Eviews 7.

5.3.3 WEAK EXOGENEITY TESTS

Having identified cointegrating vectors, the VECM is estimated. Since estimating VECMs requires that we normalize on truly endogenous variables, weak exogeneity tests were performed for each of the models and the results are reported in Table 5.5. Given that the objective is to determine whether macroeconomic variables explain the stock market in the longrun, the main concern was whether the stock market indices were endogenous.

In model 1, the FTSE/FTSE All Share Index was found to be endogenous at the 5% level of significance. In contrast, all the macroeconomic variables were weakly exogenous, with p-values exceeding 0.27. According to theory this is as expected, since the All Share Index, which represents the aggregate share price movement on the JSE, is likely to be affected by changes in the macroeconomy. Conversely, changes in the macroeconomy are not a result of a change in the All Share index.

The results for model 2 reveal that the construction and materials index and the industrial production of South Africa are weakly exogenous at the 5% level. Furthermore, Table 5.5 shows that US GDP is endogenous at the 1% level. This is not theoretically plausible since it is unlikely that the macroeconomic variables of a small emerging economy like South Africa would affect the economic activity of the world's largest economy. This result was thus considered economically meaningless.

In model 3, the financial index and SA industrial production were both found to be weakly exogenous at the 1% and 5% levels respectively. The food producers index was found to be the true endogenous variable in model 4, with inflation and US GDP found to be weakly exogenous at the 5% level of confidence. The results for model 5 report that the general retailers index and the US GDP were both weakly exogenous at the 10% level. As previously explained, the result for US GDP carries no theoretical underpinning. In model 6 the industrial index was the only endogenous variable within the model at the 5% level, the remaining variables being weakly exogenous. Similarly, in model 7 the mining index was found to be endogenous at the 1% level, with the remaining macroeconomic variables all being weakly exogenous.

The weak exogeneity tests for model 8 provide unexpected results. Although SA industrial production, nominal exchange rates, and the Treasury bill rate are weakly exogenous, this is only at the 5% level, with US GDP being weakly exogenous at the 10% level of confidence. The pharmaceutical price index is evidently the only variable endogenous at the 1% level.

Table 5.5: Weak exogeneity test results

Model	Price Index	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1 (LALSI)	2.80 [0.09]	0.16 [0.69]	0.03 [0.86]	0.59 [0.44]	0.13 [0.72]	1.22 [0.27]
2 (LCMPI)	6.39 [0.01]	2.03 [0.15]	5.00 [0.03]	0.17 [0.68]	11.89 [0.00]	0.20 [0.66]
3 (LFPI)	5.05 [0.02]	0.45 [0.50]	9.86 [0.05]	1.56 [0.21]	2.60 [0.11]	0.30 [0.58]

4 (LFPRPI)	9.57 [0.00]	0.13 [0.04]	0.08 [0.78]	0.31 [0.58]	5.03 [0.02]	1.15 [0.28]
5 (LGRPI)	2.77 [0.09]	0.00 [0.95]	0.02 [0.90]	0.17 [0.68]	3.44 [0.06]	0.01 [0.93]
6 (LIPI)	3.39 [0.07]	0.82 [0.37]	1.09 [0.30]	0.85 [0.36]	0.03 [0.86]	4.77 [0.13]
7 (LMPI)	4.76 [0.01]	0.01 [0.93]	1.75 [0.19]	2.78 [0.10]	0.36 [0.55]	2.56 [0.09]
8 (LPHARPI)	11.12 [0.00]	0.93 [0.34]	7.51 [0.05]	7.61 [0.05]	2.96 [0.09]	10.68 [0.05]

P-values are in parenthesis.
Source: Thompson DataStream (2009) and Authors' own estimates Eviews 7.

5.4 VECM RESULTS

The weak exogeneity tests performed in Section 5.3.3 provide evidence of all the stock indices being endogenous within their respective models. However, in cases such as that of model 2, where more than two cointegrating vectors exist, only the vector normalised on the stock index will be analysed. The following section examines the VECM results for each stock index. The results are presented in Table 5.6.

5.4.1 FTSE/JSE ALL SHARE INDEX

In model 1, the All Share Index was normalized upon in the single cointegrating vector identified in the weak exogeneity tests. The macroeconomic variables for SA industrial production and US GDP were found to be not significant at the 10% level of confidence. Inflation, nominal exchange rates and the Treasury bill rate were found to be highly significant at the 1% level of confidence. The insignificance of industrial production is particularly surprising since, as a proxy for SA GDP, economic theory predicts a highly correlated positive relationship between GDP growth and the aggregate stock index (Fama, 1981; Chen *et al.*, 1986). The study, however, does not incorporate SA GDP, but instead uses a proxy in the form of SA industrial production[17]. A possible explanation for this result may thus be that industrial production is not an accurate measure of real economic activity in South Africa, because SA industrial production includes the mining, manufacturing and utilities sectors, which account for only a small portion of total GDP. Similarly, the insignificance of the US GDP may also be a result of the interpolation of the US GDP data. The interpolation of data may not always accurately capture the trend in a data series, thus the use of interpolated time series data with a trend may yield misleading results.

As expected, the All Share Index reacts negatively to inflationary pressures. This is in alignment with studies done by Feldstein (1980), Fama (1981), Naka *et al.* (1998), and Hancocks (2010). The industrial production of South Africa, although not significant, is as expected positively related to

[17] For the justification of the use of proxy variables see Section 4.2 in Chapter 4.

the All Share Index Index. The nominal exchange rate is positively related to stock prices on the All Share Index, in line with the findings by Jefferis and Okeahalam (2000). This reaffirms the demand-side effect that exchange rates may have on domestic stock prices (Bodurtha *et al.*, 1989: 24-25). The relationship between the All Share Index and US GDP differs from *a priori* expectations, but as stated previously is not significant within the model.

Interest rates, given by the Treasury bill rate, are positively related to the All Share Index. This positive relationship is however against *a priori* expectations. Maysami *et al.* (2004) note that long-term interest rates may capture the effects of interest rate changes more adequately than short-term rates, because in stock valuation models long-term interest rates serve as a better proxy for the nominal risk-free component, and furthermore may serve as a proxy for inflation in the discount rate. This view is reaffirmed by the results from Ratanapakorn and Sharma (2007) who find that a positive relationship exists with short-term interest rates, whilst long-term interest rates conform to *a priori* expectations. Humpe and Macmillan (2007) explain that the short-term interest rate is driven by the business cycle and monetary policy, and Ratanapakorn and Sharma (2007) conclude that in the sense that if there is an improvement in the profit outlook, and consequently aggregate demand and investment, this would lead to a rise in short-term interest rate.

The three dummy variables listed as DUM1, DUM2 and DUM3 in Table 5.6 display the possible influences of shocks to the respective indices, due to financial distress in the global financial markets. The 2007 financial crisis (DUM3) coefficient is significant at the 1% level and thus had a significant influence on the All Share Index. The coefficients for the East Asian crisis of 1997 and the rand crisis of 2001 both impacted on the All Share Index and are significant at the 5% level of confidence.

In order to attain a valid VECM, the error correction model (ECM) coefficients are required to be negative and significant, as well as there being no autocorrelation amongst the residuals. The ECM coefficient implies that the respective stock index adjusts back to its long-run equilibrium relationship with the macroeconomic variables, if there is short-run disequilibrium. In the case of model 1, the All Share Index has an ECM coefficient of -0.17 and is significant at the 1% level. This coefficient can be interpreted as the All Share Index adjusting back to long-run equilibrium at a rate of 17% per month, given a short-run disequilibrium. In other words, the All Share Index will achieve its long-run equilibrium state in less than 6 months. Furthermore no autocorrelation is present in the model, since we fail to reject the null hypothesis of there being no autocorrelation at the 10% level of confidence[18].

[18]Using the LM autocorrelation test on Eviews 7.

5.4.2 FTSE/JSE CONSTRUCTION AND MATERIALS INDEX

In model 2, two cointegrating vectors were identified in the cointegration test. In order to identify the long-run relationship between the index and the macroeconomic variables, restrictions are imposed on the cointegrating space. As stated earlier, the main concern is whether the stock index is endogenous. Since the weak exogeneity tests reported in Table 5.5 confirm that SA industrial production is weakly exogenous, we normalize on the construction and materials index and set the SA industrial production to zero.

The results for model 2 in Table 5.6 show that inflation, the nominal exchange rate, and US GDP are significant at the 1% level of confidence. The Treasury bill rate is, however, only significant at the 5% level, but has a negative coefficient, and is in line with *a priori* expectations. Inflation is reported to be negatively related to the construction and materials index, which is consistent with *a priori* expectations. In contrast, the result for the nominal exchange rate is not in line with *a priori* expectations, as a negative relationship exists. This result suggests that the South African construction and materials sector is a net importer of materials, equipment and machinery (Ebohon and Rwelamila, 2002). Similarly, the coefficient for US GDP is negative and is not consistent with economic theory. This result suggests that foreign economic growth depresses domestic construction activity in South Africa.

Table 5.6 suggests that only the coefficients for DUM1 and DUM3 have had a significant impact on the construction and material index. The coefficients for both dummy variables are significant at the 5% level of confidence, with the DUM2 coefficient having no significant impact at any level of confidence.

To reaffirm the VECM, the ECM coefficient of -0.09 is evidently negative and significant at the 1% level. The ECM suggests that the construction and materials index, when in short-run disequilibrium, would adjust back to its long-run state at a rate of 9% per month, thus the period of time required to reach long-run equilibrium is approximately 11 months. Lastly, the model does not show any signs of autocorrelation with the LM statistic having a p-value of 0.42.

5.4.3 FTSE/JSE FINANCIAL INDEX

The financial index variable in model 3 was normalized upon with no restrictions placed upon the model, due to only one cointegrating vector being present. The results in Table 5.6 show that the nominal exchange rate and the Treasury bill rate are not significant determinants within the model. In contrast, inflation is significant at the 1% level, with SA industrial production and US GDP being significant at the 5% level of confidence.

The results confirm the expected negative relationship between inflation and the financial index. However, SA industrial production and US GDP do not conform to *a priori* theory. As noted, both are significant but are negatively related to the stock index. In both cases this does not make economic sense. Higher economic growth is largely dependent on the efficiency of the financial sector, with these financial intermediaries playing a crucial role in the flow of funds within an economy (Yartey, 2008). A strong positive influence is thus expected between the financial index and SA industrial production. In the same light, foreign GDP growth is not likely to have a negative effect on the financial index, because the risk appetite of foreign investors is also likely to increase during periods of economic growth (Fung *et al.*, 2008). Thus the riskier stocks of developing economies such as South Africa become more appealing due to the higher returns that could be earned (Salomans and Grootveld, 2002). The financial sector of South Africa may be one such sector that appeals to foreign investors during periods of higher economic growth in their respective economies.

As expected, the three dummy variables significantly affect the financial index. The coefficients for DUM1 and DUM3 are significant at the 1% level of confidence, whilst the DUM2 coefficient is significant at the 5% level. This provides evidence that three possible structural breaks may be present within the data for the financial index. As expected, disturbances to the financial markets around the world have an impact on the financial index. This may be attributed to the sensitivity of the South African financial markets to changes in capital flows.

The ECM coefficient for model 3 is -0.02 and significant at the 1% level. The ECM coefficient suggests that the financial index reverts back to long-run equilibrium in over 4 years (50 months) when in short-run disequilibrium. Lastly the LM test for autocorrelation indicates that there is no autocorrelation between the residuals of the model, with the LM statistic having a p-value of 0.20.

5.4.4 FTSE/JSE FOOD PRODUCERS INDEX

In model 4 the food producers' index was normalized upon with restrictions to obtain the long-run equation. Inflation was set to zero since the exogeneity tests confirmed its weakly exogenous nature. All the macroeconomic variables were found to be significant at the 1% level of confidence, except for the Treasury bill rate which was found to be not significant. The coefficient for SA industrial production was positive and consistent with *a priori* expectations, therefore higher levels of real economic activity are associated with higher levels of food production in South Africa. The nominal exchange rate does not conform to economic theory since a negative relationship exists with the index. This is however a theoretically sound result since South Africa is a net importer of food goods, and thus a depreciation of the ZAR would impose a higher exchange rate cost for importing food producers, resulting in decreased profitability and thus lower stock prices.

Similarly, the US GDP coefficient does not conform to *a priori* expectations since it too is negatively related to the food producers' index. A possible explanation for this may be that because the food producing industry in South Africa is seen as a net importer, and given the positive correlation between economic growth and exchange rates, an increase in foreign GDP would appreciate that country's exchange rate and thus reduce imports to South Africa. Alternatively, the higher cost of the imported goods may also be passed on to price-sensitive consumers through higher domestic prices, resulting in lower demand for the product (Hancocks, 2010). Lower consumer demand coupled with higher import costs, according to Hancocks (2010), would suppress production by food producers, as well as profitability, thus reducing their stock prices.

The effects of financial distress captured by the three dummy variables show that only the coefficient for the exchange rate crisis of 2001 (DUM2) is significant at the 5% level of confidence. This is as expected, since as discussed food production in South Africa is sensitive to exchange rate movements with its trading partners.

The ECM coefficient of -0.19 is significant at the 1% level. The food producers index thus reverts to long-run equilibrium at a rate of 19% per month, obtaining long-run equilibrium in over 5 months. Lastly there appears to be no autocorrelation between the residuals of the model with the LM statistic having a p-value of 0.61.

5.4.5 FTSE/JSE GENERAL RETAIL INDEX

In model 5, the general retail index was normalized on with no restrictions, given the presence of only one cointegrating vector. Amongst the six macroeconomic variables, only the Treasury bill rate is not significant at the 10% level of confidence. Inflation, SA industrial production, nominal exchange rates, and US GDP are significant at the 1% level of confidence, with inflation being significant only at the 5% level. The results for SA industrial production conform to *a priori* expectations, however the remaining variables – inflation, nominal exchange rates and US GDP – do not conform. Inflation is positively related to the general retail index, which is against *a priori* expectations since increasing inflation should theoretically result in a decrease in real income, thereby reducing consumer spending in the retail sector. This result is consistent with those of Maysami *et al.* (2004), Spyrou (2004) and Hancocks (2010). According to Hancocks (2010), a possible explanation for the positive relationship may be that an increase in inflationary pressure results in firms in the retail index adjusting the prices of their goods and services to include higher expected inflation in the future. Current goods and services thus bear the costs of future anticipated inflation, which in turn increases the profit margins on such goods and services (DeFina, 1991). The stock prices for these firms included in the retail index may thus yield returns that are above the sector average, during periods of high inflation.

The results illustrate that nominal exchange rates have a negative effect on the general retail index. A speculative explanation for this result could be that a depreciation of the ZAR against the currencies of other trading countries would increase the cost of foreign substitute goods and services. Since retail sales in South Africa are governed by consumer demand, a reduction in the demand for foreign goods and services may increase the consumption of domestic goods and services. Firms in the retail index would thus acquire higher profits through increased sales, which in turn would lead to an increase in demand, and thus in the price of retail stocks.

US GDP is similarly noted to also have a negative impact on the general retail index. Two possible explanations may shed light on this relationship. Firstly, Jefferis and Okeahalam (2000) suggest that higher economic growth in a foreign economy may increase the attractiveness of foreign stocks, due to the higher profitability of foreign firms, and thus reduce the demand for domestic stocks. Secondly, the low cost production of goods and services of foreign countries, particularly the export-led Asian economies, may increase the demand for foreign substitute goods and services. Coupled with the appreciation of the ZAR, this would increase the attractiveness of the cheaper Asian goods and services, resulting in decreased profitability of domestic retail firms.

The coefficients for the three dummy variables show that only the financial crisis of 2007 and the exchange rate crisis of 2001 are significant at 1% and 5% levels respectively. These results indicate that the South African retail sector is sensitive to sharp economic movements both domestically and abroad. The significance of the DUM2 coefficient suggests that exchange rate shocks would negatively affect the general retail index. Financial distress in the global financial markets would, as the DUM3 coefficient suggests, also significantly impact the retail index. The significance of the DUM3 coefficient suggests that the 2007 financial crisis had a more significant effect, specifically on the retail index, than that of an exchange rate shock.

The ECM coefficient for model 5 is -0.17 and is significant at the 1% level. This result suggests that the general retail index when in short-run disequilibrium would attain its long-run equilibrium at a rate of 17% per month. Thus long-run equilibrium will be achieved in less than six months given the parameters of the model. The LM autocorrelation test reaffirms the robustness of the model with a p-value of 0.29, suggesting that no autocorrelation is present within the model.

5.4.6 FTSE/JSE INDUSTRIAL INDEX

The industrial index of model 6 was normalized upon with no restrictions imposed and the results are reported in Table 5.6. The nominal exchange rate and US GDP were both found to be not significant at any level. The coefficients for inflation and SA industrial production were significant at the 1% level of confidence. Unexpectedly, inflation seems to have a positive influence on the industrial index which is not consistent with theory. Fama (1981) posits that the effects of inflation on stock returns may be spurious, since inflation is a proxy for underlying fundamentals, namely anticipated real activity. Thus, the relationship between inflation and stock returns is dependent upon the covariance between inflation and expected economic outputs (Boudoukh *et al.*, 1994). It is therefore possible that if a positive relationship exists between economic growth and inflation, higher inflation would be associated with higher economic growth, which in turn results in an appreciation of stock prices. Spyrou (2004) found evidence that the stock return-inflation relationship may be positive, particularly in emerging economies. It was found that a positive relationship between inflation and real output exists in the examined emerging economies, because money was seen to play a more pronounced role as a determinant of inflation, compared to real output. This result is also consistent with that of Ratanapakorn and Sharma (2007), who conclude that stocks may present a possible hedge against inflationary pressures.

Lu (2008) suggests an alternative explanation to that of Fama (1981), Boudoukh *et al.* (1994) and Spyrou (2004). Lu (2008) suggests that a positive relationship between inflation and stock prices may exist in the longrun, since longer term inflation information is more relevant for equity investment decisions. Furthermore, it was found that over a 10 year period or longer, the effects of inflation on stock returns diminish or become positive during this 10 year period. Hodge (2005) provides evidence that a positive relationship between inflation and economic growth may also exist in South Africa. This finding by Hodge (2005) may however be specific to the industrial sector due to the linkages between economic growth, industrial production and thus the industrial index that encompasses these firms. SA industrial production is positively related to the industrial index, which is expected since higher levels of industrial production should increase the profitability of firms included in the industrial index.

However, the Treasury bill rate does not conform with *a priori* expectations since it is positively related to the industrial index. This does not make theoretical sense since a decrease in the domestic interest rates should lead to an increase in consumption, investment and production. As noted in Section 5.4.1, this result may be due to an incorrect use of short-term interest rates instead of longer term rates.

The coefficient of the dummy variable DUM3 provides evidence that the financial crisis of 2007 has had a significant impact on industrial production in South Africa. The coefficients for DUM1 and DUM2 were found to have no significant effect on the industrial index during their respective periods of financial distress. The ECM coefficient of -0.22 is significant at the 1% level of significance, and implies that the industrial index would adjust back to long-run equilibrium in approximately 4.5 months after short-run disequilibrium. This rapid adjustment may be due to firms in the industrial sector being able to efficiently alter their output to accommodate both domestic as well as international demand. The LM statistic with p-value of 0.18 confirms the robustness of the results of the VECM for model 6.

5.4.7 FTSE/JSE MINING INDEX

The mining index of model 7 is normalized upon with the restriction of inflation being set to zero. The reason for this restriction is that mining commodity stocks have been found to provide a hedge against inflation. Thus the mining index is expected to be positively correlated with inflation. Except for the nominal exchange rate, which was found to be significant at the 1% level, the remaining macroeconomic variables were significant at the 5% level of significance.

The coefficient for SA industrial production and the Treasury bill rate was found to be positive and in line with *a priori* expectations. Likewise, the nominal exchange rate coefficient was also positive. This is as expected since the mining sector is heavily dependent on export earnings. A depreciation of the ZAR would therefore benefit them. The result for US GDP, however, was not consistent with theory as a negative coefficient is evident from Table 5.6. Since US GDP is used as a proxy for foreign GDP, this result may suggest that the South African mining sector is experiencing decreasing global competitiveness. Seccombe (2010), for example, notes that during the 2001 to 2008 commodity boom the South African mining sector had shrunk, and had been surpassed by its foreign competitors. A decrease in global competitiveness of the mining sector, coupled with an appreciating currency (ZAR), may deter international importers of South African mining products during periods of increased global economic growth. This would reduce the revenue of mining firms in South Africa from exports, thus their profitability, and lastly their respective stock prices.

The dummy variables provide evidence to suggest that the mining index was affected by only the East Asian crisis. The coefficients of both DUM2 and DUM3 are statistically insignificant, with the DUM1 coefficient being significant at the 5% level of confidence. These results reinforce the notion of a decline in the global competitiveness of the South African mining sector. The reason for this is that during times of financial uncertainty, commodity stocks such as gold are viewed as a "safe haven" for investors to invest in (Saefong, 2011). One would thus expect South Africa, as one of the world's leading gold producers, to benefit from periods of financial uncertainty, most notably from the 2007 financial crisis.

Lastly, the ECM coefficient of -0.07 is significant at the 1% level of significance and suggests that the mining index would adjust back to long-run equilibrium in over 14 months at a rate of 7% per month. For the LM test, the p-value of 0.13 confirms the absence of autocorrelation in the estimated VECM for the mining index.

5.4.8 FTSE/JSE PHARMACEUTICALS INDEX

In model 8, the pharmaceutical index was identified as the true endogenous variable and normalized upon. Except for the nominal exchange rate, the remaining macroeconomic variables were found to be significant at the 1% level. The negative inflation coefficient was in line with theory regarding its expected relationship with the pharmaceuticals index. Similarly, the sign of the coefficient for US GDP is consistent with *a priori* expectations and is positively related to the pharmaceutical index. In contrast, the coefficient for SA industrial production did not conform to theory as previously expected. The negative relationship is indicative of the defensive nature of pharmaceutical stocks. As an economy experiences higher levels of economic growth and investor confidence, cyclical stocks in other sectors may outperform non-cyclical defensive stocks (Little, 2010). Investors, who seek higher returns given a certain level of risk, would adjust their portfolios to include higher earning stocks and less defensive stocks that offer lower returns. Thus demand for defensive stocks such as those in the pharmaceutical index would decrease during periods of high economic growth. The Treasury bill rate did not conform to *a priori* expectations and is positively related to the pharmaceuticals index. Barsky (1989) explains this positive relationship in terms of a change in risk premium. For example increased risk and/or precautionary saving may lead to a decrease in interest rates, because investors would substitute away from riskier assets such as stocks into less risky assets such as bonds. As already mentioned, pharmaceutical stocks are non-cyclical or defensive in nature, thus investors who seek to maintain their stock portfolio may invest in defensive stocks as an alternative to bonds, resulting in upward pressure of defensive stocks such as pharmaceutical stocks.

The coefficients for the dummy variables DUM1 and DUM3 were found to be statistically insignificant within model 8, whilst the DUM2 coefficient was significant at the 5% level of confidence. The coefficients for DUM1 and DUM3 provide reassuring evidence of the non-cyclicality of pharmaceutical stocks. The statistically significant ECM coefficient suggests that when in short-run disequilibrium the pharmaceuticals index would adjust back to long-run equilibrium at a rate of 8% per month and thus long-run equilibrium would be reached in 12.5 months. No autocorrelation was found in VECM for model 8, which was confirmed by the p-value (0.17) of the LM statistic.

Table 5.6: VECM results

Model	Intercept	LCPI	LIPSA	LNER	LUSGDP	TBRATE	DUM1	DUM2	DUM3	R^2	ECM	S.Cor
1	-76.14	-19.53	1.81	1.90	-0.16	0.11	-0.05	-0.01	-0.57	0.30	-0.17	39.16
(LALSI)		[7.12][a]	[-1.78][c]	[-5.74][a]	[0.03][c]	[-4.36][a]	[-1.98][b]	[-2.27][b]	[-2.70][a]		[-4.12][a]	[0.33]
2	-41.45	-19.74	0.00	-1.13	-17.53	-0.04	-0.06	0.00	-0.06	0.14	-0.09	37.05
(LCMPI)		[-3.66][a]		[5.97][a]	[4.79][a]	[2.03][b]	[-2.38][b]	[0.14][c]	[2.02][b]		[-2.90][a]	[0.42]
3	-1395.45	-180.15	-28.94	4.15	-132.56	-0.03	-0.02	-0.06	-0.01	0.43	-0.02	42.91
(LFPI)		[4.52][a]	[2.24][b]	[-0.89][c]	[2.43][b]	[0.09][c]	[2.83][a]	[-2.12][b]	[3.53][a]		[-3.48][a]	[0.20]
4	-86.58	0.00	16.95	-0.85	-15.28	0.02	-0.01	-0.05	0.01	0.32	-0.19	42.98
(LFPRPI)			[-3.31][a]	[4.71][a]	[4.21][a]	[-0.89][c]	[-0.46][c]	[-2.08][b]	[0.26][c]		[-4.59][a]	[0.61]
5	-90.80	12.95	12.66	-1.94	-20.93	-0.02	-0.02	-0.07	-0.43	0.20	-0.17	40.31
(LGRPI)		[-1.98][b]	[6.03][a]	[8.22][a]	[4.39][a]	[0.95][c]	[-0.90][c]	[-1.98][b]	[-3.05][a]		[-4.33][a]	[0.29]
6	19.48	98.61	3.55	-0.05	6.55	0.13	-0.01	0.01	-0.01	0.29	-0.22	43.47
(LIPI)		[-7.05][a]	[-4.36][a]	[0.18][c]	[-1.15][c]	[-1.32][c]	[-1.55][c]	[0.35][c]	[3.29][a]		[-3.58][a]	[0.18]
7	-40.16	0.00	3.56	1.37	-13.11	0.08	-0.06	0.01	0.02	0.21	-0.07	48.81
(LMPI)			[-2.57][b]	[-4.47][a]	[2.26][b]	[-2.57][b]	[-1.95][b]	[0.38][c]	[0.35][c]		[-3.18][a]	[0.13]
8	-34.45	-13.90	-17.39	-0.06	25.36	2.23	-0.05	0.14	-0.04	0.22	-0.08	43.87
(LPHARPI)		[2.94][a]	[9.32][a]	[0.10][c]	[-3.16][a]	[-4.21][a]	[-1.00][c]	[2.21][b]	[-1.03][c]		[-3.40][a]	[0.17]

Notes:
t-values in parentheses.
[a] and [b] denote significance of the coefficient at the 1% and 5% respectively, while [c] denotes a statistically insignificant coefficient.
The ECM is the short run adjustment coefficient of the VECM, and S.Cor is the serial correlation of the model.
The signs of each of the macroeconomic variables have been adjusted accordingly for interpretation.
Source: Thompson DataStream (2009) and author's own estimates using E-views 7.

5.5 IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSIS

5.5.1 IMPULSE RESPONSE ANALYSIS

To examine the signs and persistence of the short-run response of the stock market to one standard error shocks in each of the macroeconomic variables, twelve month ahead impulse response functions were estimated using the generalised response approach. The results are presented in Figure 5.1.

In all cases, the stock indices were non-persistent in their response to short-run shocks to each of the macroeconomic variables. Furthermore the stock indices reverted to equilibrium within 12 months given a standard error shock to each of the variables. Generally, the responses of the indices to the shocks to each macroeconomic variable were as expected, and their signs consistent with the VECM results in Table 5.6. Except for LMPI, the remaining indices respond negatively to changes in inflation, with the LCMPI seemingly non-responsive. The LALSI and the LFPI display sharper responses to short-run shocks to inflation, but these effects die off after approximately 7 months. Initially the LMPI responds positively to changes in inflation, however after a month responds negatively and dies off after 6 months. This result confirms the possibility of the mining index as a hedge against inflationary pressures in the shortrun. The negative responses of LGRPI and LIPI are not consistent with the signs of their respective coefficients in the VECM, however, this lends support to the findings of Lu (2008), where inflation is more likely to have a negative effect on stock returns in the shortrun.

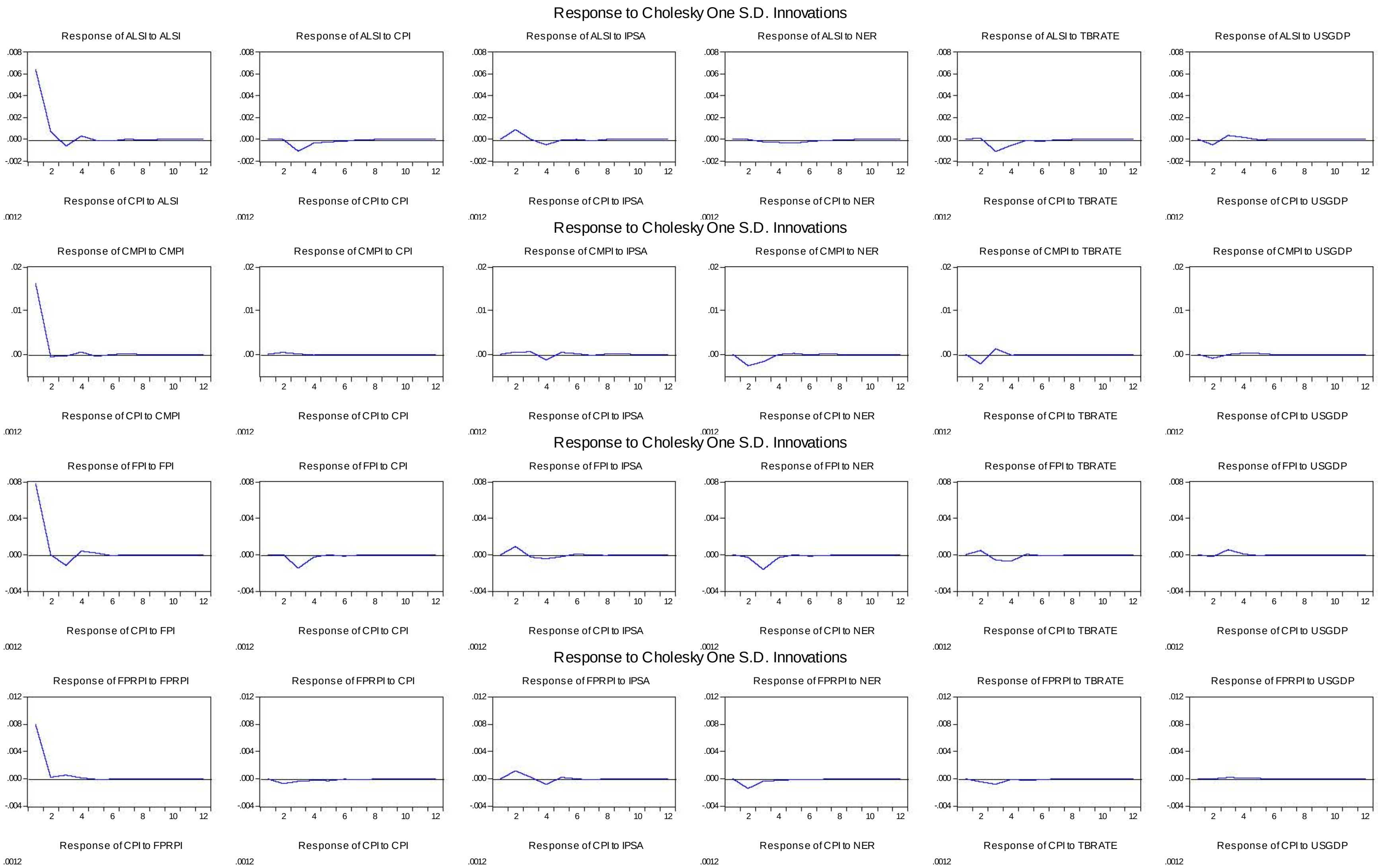
As expected, each of the indices responds positively to short-run shocks in SA industrial production. The LGRPI, LMPI and LPHARPI are however non-responsive to these changes. The indices for the LALSI, LFPI, LFPRPI and LIPI display similar responses to a change in SA industrial production. Initially a positive response is evident. However, after approximately 1.5 months, the response is negative and eventually dies off after 7 months. The positive response of LFPI to the SA industrial production is not consistent with that of the negative sign of its coefficient in the VECM results. It was stated, however, that this result had no theoretical underpinning. The result from the impulse response is therefore in line with *a priori* expectations.

Short-run innovations from the nominal exchange rate tend to have a negative effect on the stock indices, except for LMPI and LPHARPI. Furthermore the responses of the indices are consistent with the signs of the VECM coefficients, except for LFPI and LPHARPI. However, the VECM coefficients for the nominal exchange rate in both cases, as with LIPI, are insignificant. The LGRPI displays the sharpest response to a change in the nominal exchange rate. The effects of this taper off after 4 months. The response of the LALSI to a short-run shock to the nominal exchange rate, in contrast to the other indices, is particularly small although the effects persist for a longer period of time. In this case the effects die off after 8 months.

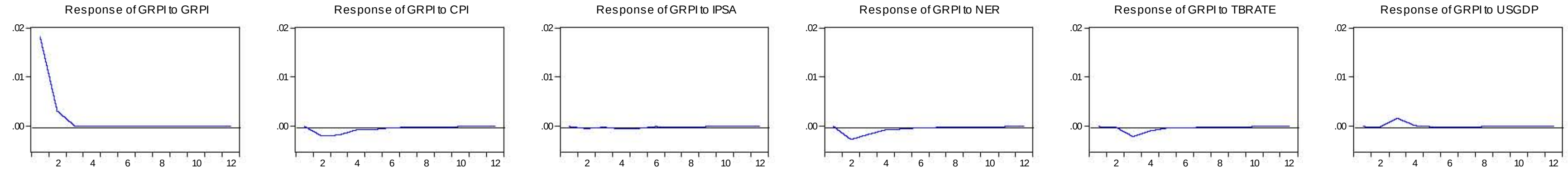
Each of the stock indices in Figure 5.1 shows responsiveness to a short-run shock in the Treasury bill rate. Mixed results are evident since the indices respond both negatively as well as positively. The LPHARPI has the sharpest response to a standard error shock to the Treasury bill rate. This positive response is however against expectations. Nonetheless, the effects require less than 3 months to dissipate. LIPI and LFPI both respond positively to a change in Treasury bill rate against *a priori* expectations. For LFPI, the Treasury bill coefficient is, however, insignificant in the VECM. These positive responses provide additional justification for the use of long-term interest rates. Once more the effects on LALSI persist for the longest period of time, over 6 months, and gradually dissipate.

The last column of Figure 5.1 shows that US GDP has a diminutive effect on the stock indices, in comparison to the other macroeconomic variables. Both LFPRPI and LPHARPI are seemingly non-responsive to short-run shocks to US GDP. Similarly, none of the remaining indices show any sharp responsiveness to a change in US GDP.

Figure 5.1: Impulse response functions

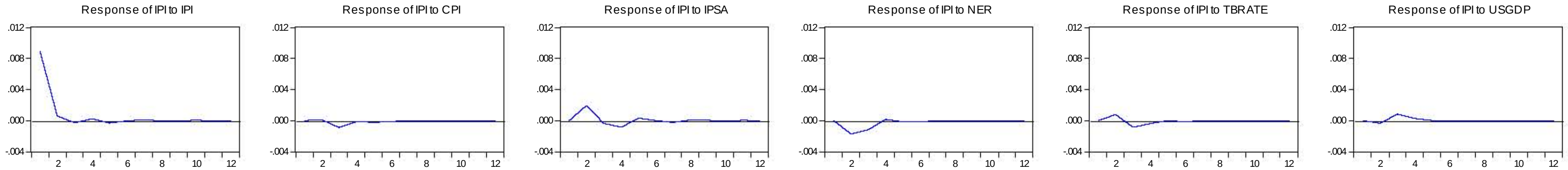


Response to Cholesky One S.D. Innovations



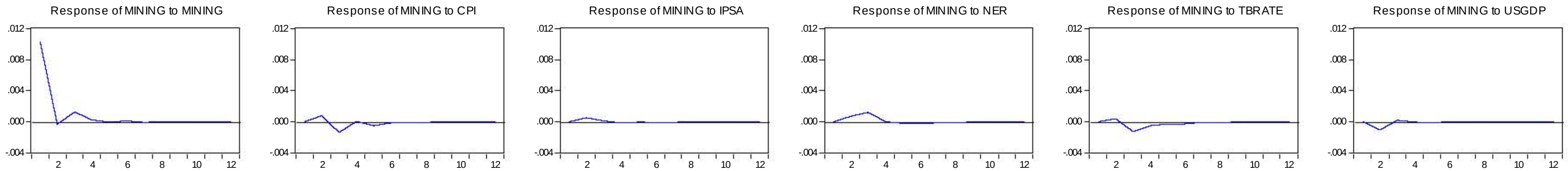
Response of CPI to GRPI .0012 | Response of CPI to CPI .0012 | Response of CPI to IPSA .0012 | Response of CPI to NER .0012 | Response of CPI to TBRATE .0012 | Response of CPI to USGDP .0012

Response to Cholesky One S.D. Innovations



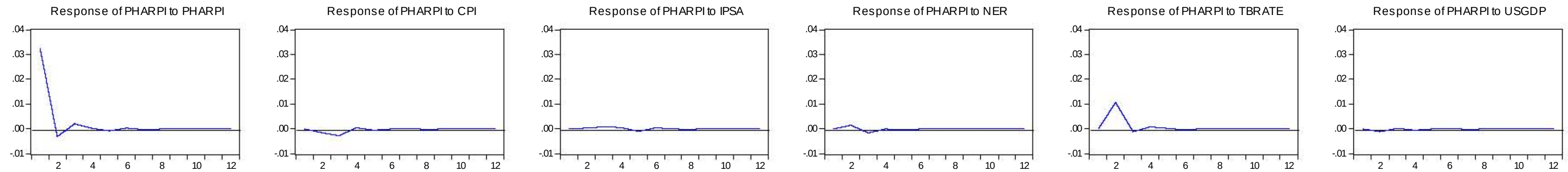
Response of CPI to IPI .0012 | Response of CPI to CPI .0012 | Response of CPI to IPSA .0012 | Response of CPI to NER .0012 | Response of CPI to TBRATE .0012 | Response of CPI to USGDP .0012

Response to Cholesky One S.D. Innovations



Response of CPI to MINING .0012 | Response of CPI to CPI .0012 | Response of CPI to IPSA .0012 | Response of CPI to NER .0012 | Response of CPI to TBRATE .0012 | Response of CPI to USGDP .0012

Response to Cholesky One S.D. Innovations



Response of CPI to PHARPI .0012 | Response of CPI to CPI .0012 | Response of CPI to IPSA .0012 | Response of CPI to NER .0012 | Response of CPI to TBRATE .0012 | Response of CPI to USGDP .0012

5.5.2 VARIANCE DECOMPOSITION ANALYSIS

To investigate the proportions by which variations in the stock indices are explained by variations in itself and the macroeconomic variables, variance decomposition functions were estimated. Figure 5.2 displays the graphical estimates of the variance decompositions for each stock index, with Table A4 (in the appendix) displaying the estimated values for 24 months ahead.

As observed, the JSE/FTSE All Share Index explains 100% of its own variation in period 1, after which the effects of the macroeconomic variables become evident. After 4 months, inflation becomes increasingly important in explaining the variation in LALSI, peaking at approximately 32% in month 17, and gradually decreases through to month 24. This result for inflation lends support to the VECM results that inflation is an important determinant of stock market behaviour in South Africa. The remaining macroeconomic variables display minimal influence on LALSI, with only the Treasury bill rate explaining 8.2% of the variation.

The variance decomposition for the construction and materials index suggests that individually none of the macroeconomic variables play any notable role in explaining the construction and materials index. In month 24, LCMPI explains 82.3% of the variation in itself, with only the nominal exchange rate and US GDP showing signs of slight increasing proportion. Specifically the variation in LCMPI due to the nominal exchange rate and US GDP peaks at 5.4% and 6.6% respectively in month 24. This result suggests that both nominal exchange rate and US GDP have a lagged effect on the construction and materials sector at time periods longer than 24 months.

The financial index displays a unique trend in its variance decomposition in comparison with the other stock indices, because after month 1 changes in LFPI explained by itself gradually decrease until month 12, after which LFPI begins to increase, albeit at a low rate. Towards month 12, however, the effect of inflation on LFPI becomes proportionally large, explaining 22.4% of the variation in LFPI. None of the remaining macroeconomic variables individually explain more than 7% of the variation in LFPI, with each variable, including inflation, displaying decreasing influence towards month 12. Inflation is thus a more prominent determinant of the financial sector at shorter time periods, less than one year.

Initially, from after month 3 until month 10, the food producers' index experiences a gradual decrease in explaining its own variation. LFPRPI, in explaining its own variation, decreases from 97% to 60% over this 7 month period. Evidently during this period the proportion of variance attributed to the macroeconomic variables increases. Inflation, SA industrial production, US GDP as well as the Treasury bill rate become increasingly more influential in explaining the variation in LFPRPI after month 3. Inflation by month 17 accounts for 25% of the variance in LFPRPI and thereafter flattens out and begins to decrease. Similarly, US GDP gradually increases from 1.8% in month 3 to 21.7% in month 24, however, it does not show any sign of flattening out or decreasing.

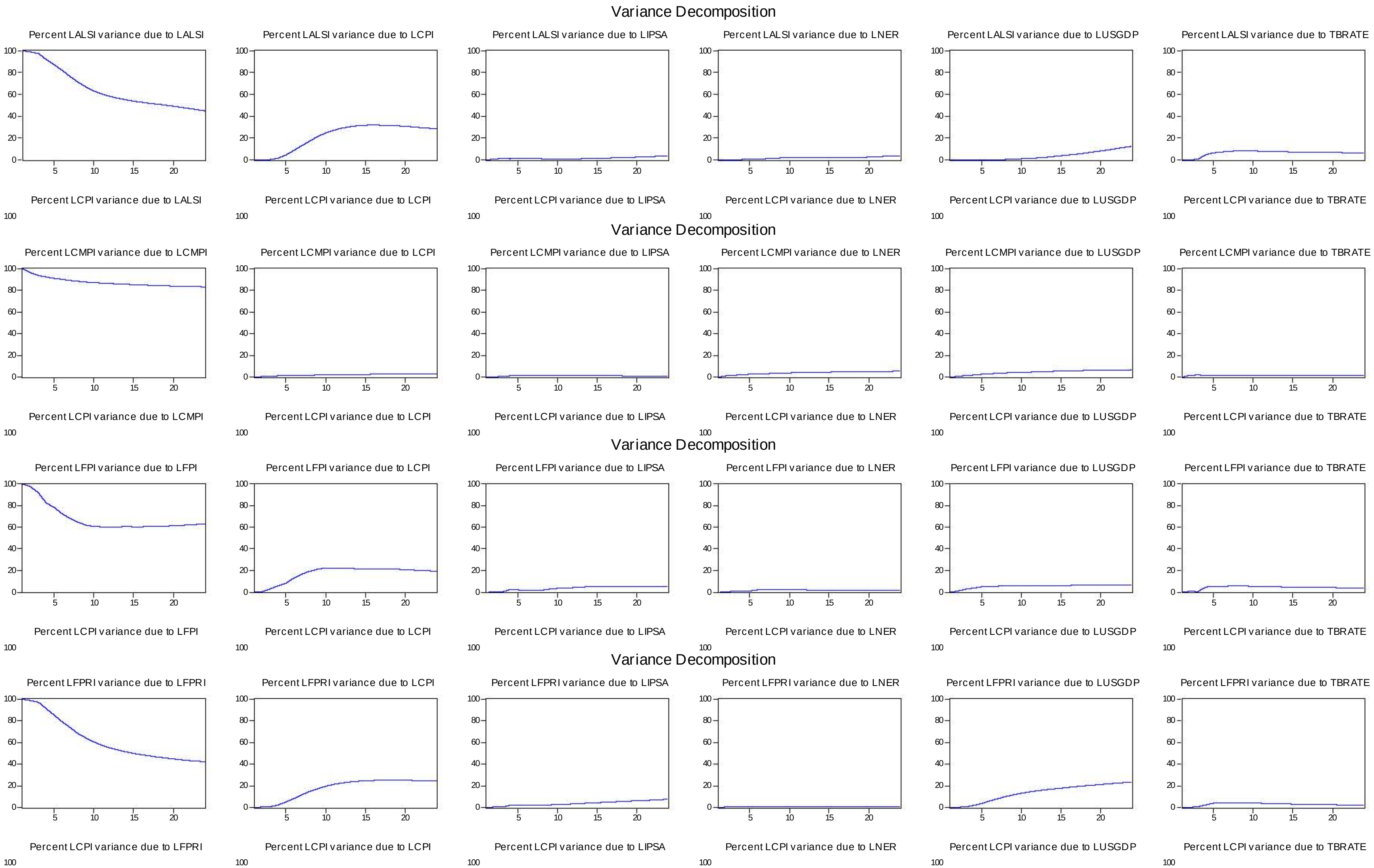
The variance decomposition for the general retail price index displays a similar trend to that of LFRPI in explaining its own variation. A more gradual decrease is evident from 96.5% in month 3 down to 39.5% in month 24. However, nominal exchange rates, US GDP and to a lesser extent SA industrial production play a more prominent role in explaining the variation in LGRPI, particularly after month 5. The variation in LGRPI attributed to the nominal exchange rate steadily rises to 16.5% in month 21 and thereafter maintains its influence. US GDP however maintains a gradually increasing influence on LGRPI, accounting for 27.2% of the variation in month 24. Neither inflation nor the Treasury bill rate display a rise in influence on LGRPI during the entire period.

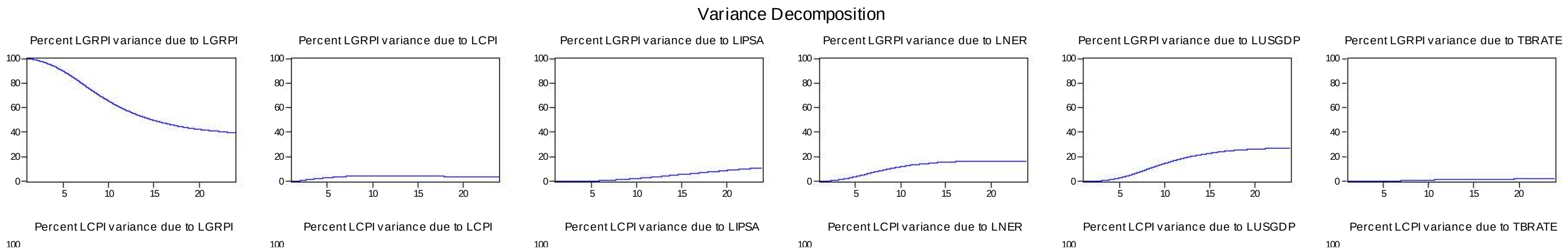
The industrial price index shows a constant decrease in explaining its own variance, from 100% in month 1 to 55% in month 24. The SA industrial production and the nominal exchange rate are the only two macroeconomic variables that have a visible influence on the variation of LIPI during the first 24 months. The SA industrial production at month 19 accounts for 15.9% of the variation in LIPI and thereafter its influence on LIPI remains constant and flattens out towards month 24. In contrast, the nominal exchange rate after month 5 shows a constantly rising influence, explaining proportionally 26.6% of the variation in LIPI by month 24.

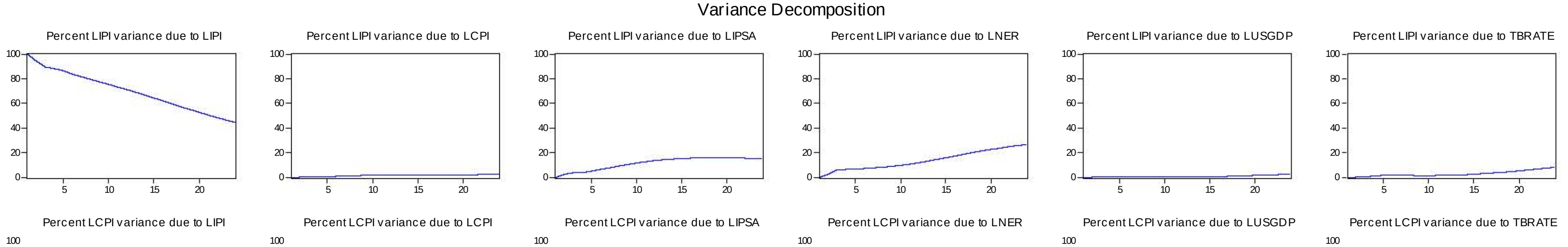
The proportion of variance of the mining index due to its own variation initially decreases at a slight rate, however after month 4 this rate increases until month 10. From month 10 onwards the proportion of variation attributed to LMPI itself flattens out at a level of approximately 70%. By month 24 LMPI explains 69.5% of its own variation. Notably US GDP and the Treasury bill rate account for a minute proportion of the variance of LMPI. In both cases this is less than 1%. The SA industrial production is only slightly greater than this, increasing to 6.7% in month 24. The nominal exchange rate and inflation show relatively greater influences on LMPI. The nominal exchange rate displays the greatest influence on LMPI but only explains 13.2% of the variation at month 24. Inflation initially displays an increasing effect on LMPI, peaking at 10.7% in month 12, and subsequently decreases through to month 24.

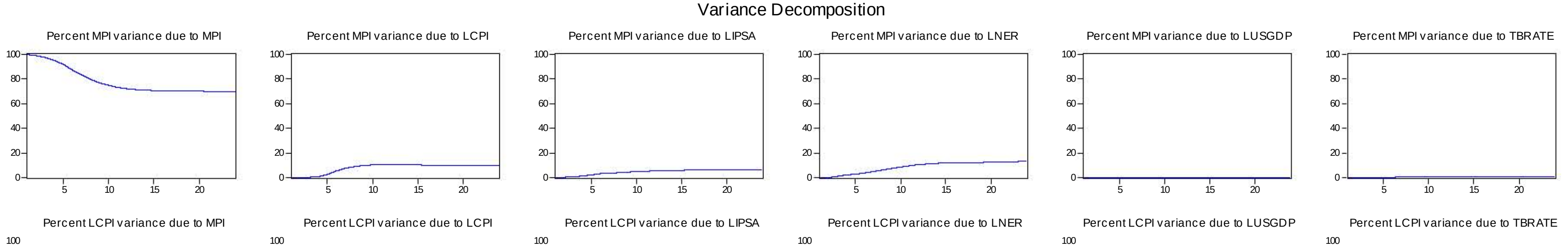
The pharmaceuticals index shows a similar plot for explaining its own variance to that of LIPI. LPHAR decreases at a constant rate from 100% in month 1 to 61.6% in month 24. The variance decomposition suggests that SA industrial production plays an increasing role in influencing LPHAR. In month 5, SA industrial production accounts for only 2.6% of the variation in LPHAR, however by month 24 the proportion increases to 24.6%. As discussed previously, this is indicative of the non-cyclicality of pharmaceutical stocks. To a lesser extent the Treasury bill rate slowly increases its influence on LPHAR to 9.5% by month 10, becomes relatively constant between months 11 to 19, and thereafter begins to decrease to 8.7% in month 24.

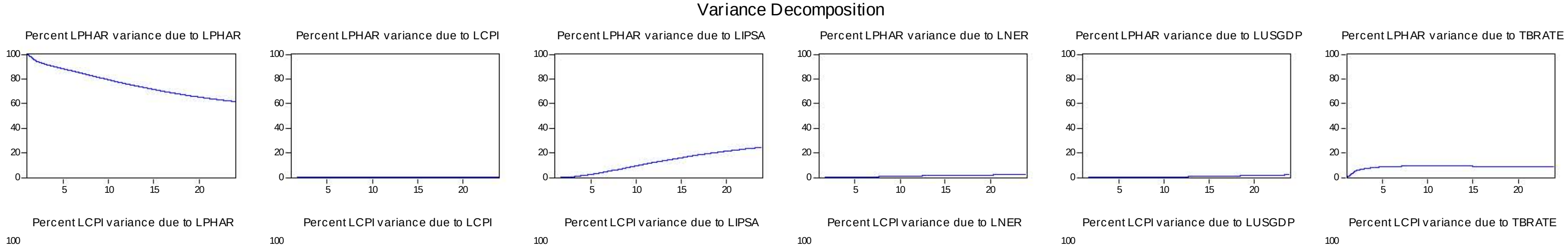
Figure 5.2: Variance decompositions




Variance Decomposition
Percent LGRPI variance due to LGRPI
Percent LGRPI variance due to LCPI
Percent LGRPI variance due to LIPSA
Percent LGRPI variance due to LNER
Percent LGRPI variance due to LUSGDP
Percent LGRPI variance due to TBRATE
Percent LCPI variance due to LGRPI
Percent LCPI variance due to LCPI
Percent LCPI variance due to LIPSA
Percent LCPI variance due to LNER
Percent LCPI variance due to LUSGDP
Percent LCPI variance due to TBRATE


Variance Decomposition
Percent LIPI variance due to LIPI
Percent LIPI variance due to LCPI
Percent LIPI variance due to LIPSA
Percent LIPI variance due to LNER
Percent LIPI variance due to LUSGDP
Percent LIPI variance due to TBRATE
Percent LCPI variance due to LIPI
Percent LCPI variance due to LCPI
Percent LCPI variance due to LIPSA
Percent LCPI variance due to LNER
Percent LCPI variance due to LUSGDP
Percent LCPI variance due to TBRATE


Variance Decomposition
Percent MPI variance due to MPI
Percent MPI variance due to LCPI
Percent MPI variance due to LIPSA
Percent MPI variance due to LNER
Percent MPI variance due to LUSGDP
Percent MPI variance due to TBRATE
Percent LCPI variance due to MPI
Percent LCPI variance due to LCPI
Percent LCPI variance due to LIPSA
Percent LCPI variance due to LNER
Percent LCPI variance due to LUSGDP
Percent LCPI variance due to TBRATE


Variance Decomposition
Percent LPHAR variance due to LPHAR
Percent LPHAR variance due to LCPI
Percent LPHAR variance due to LIPSA
Percent LPHAR variance due to LNER
Percent LPHAR variance due to LUSGDP
Percent LPHAR variance due to TBRATE
Percent LCPI variance due to LPHAR
Percent LCPI variance due to LCPI
Percent LCPI variance due to LIPSA
Percent LCPI variance due to LNER
Percent LCPI variance due to LUSGDP
Percent LCPI variance due to TBRATE

5.6 INVESTOR IMPLICATIONS

As highlighted in Chapter 1, an understanding of the link between the macroeconomy and stock prices is invaluable for investors to proactively act either to profit or to mitigate risk. The following section discusses the results presented previously, and their implications for investors in South Africa.

5.6.1 INFLATION

The consumer price index, although excluded from models 4 and 5, is the most significant determinant of stock prices in comparison to the other macroeconomic variables. As Table 5.6 reveals, both the general retail as well as the industrial indices may provide investors with a possible hedge against inflationary pressures in South Africa. This is a result of the positive relationship that they were found to share with CPI. This relationship is in contrast to that with the All Share, construction, financial and pharmaceutical indices. The industrial index was found to be more susceptible to higher inflation than the general retail index, therefore providing stronger credentials as an inflationary risk-mitigating index. The implications for portfolio diversification may, however, be dependent on the length of time high inflation is perceived to persist. In a short period, investors may switch to a more defensive strategy in order to protect returns from higher inflation, by increasing the weighting of their holdings in the industrial sector. However, if an extended period of high inflation is expected, profit opportunities exist by further increasing the portfolio weighting into industrial as well as retail stocks.

Lu (2008) proposes an inflation timing strategy to maximize returns. This is done by ranking industries according to their sensitivity to inflationary pressure, thus allowing the construction of two portfolios, one consisting of industries of high sensitivity and the other of industries of low sensitivity. From the identified industries the four stocks with the highest market capitalization, for both high and low sensitivity, are selected to form the two portfolios. An investor may thus switch between the two portfolios depending on the expected level of inflation, and therefore maximize returns in both high and low inflationary periods.

Consider the results from Table 5.6. If a simplistic view is adopted due to the size constraints of the study, the inflation timing strategy for both positive and negative links may be considered. In the case of a negative relationship existing between stock prices and inflation, the four largest stocks from the financial as well as the pharmaceutical index would form the high sensitive and low sensitive portfolios respectively. If a period of high inflation is expected an investor would switch to the portfolio with the lower sensitivity, that being the pharmaceutical portfolio. If periods of low inflation prevail, the financial portfolio with the higher sensitivity would be adopted to maximize returns.

5.6.2 SA INDUSTRIAL PRODUCTION

Industrial production for South Africa gave some surprising results, as noted and discussed in Section 4.4.1 for the All Share index. Except for the financial and pharmaceutical indices, the remaining indices were consistent with *a priori* expectations. The stock valuation models presented in Chapter 2 suggest that higher economic growth would result in higher expected dividends, thus increasing the present value of a stock. According to the results in Table 5.6, investors should pay attention to the opportunities for higher returns in the food producer and general retail sectors. This is as expected, since higher economic growth and a healthier economic outlook should theoretically induce higher consumer spending on goods and services. The food producer index does in this case carry a higher sensitivity to increased economic growth than the general retail index.

As suggested in Section 4.4.8, the results for the pharmaceutical index, show that it is a defensive stock by nature. The pharmaceuticals sector may thus provide a hedging option for investors during an economic downturn. Further evidence in this regard can be seen from Figure AI in the appendix. Since the beginning of the 21st century, the pharmaceuticals index has maintained a gradual upward trend, particularly during the sub-prime crisis in 2007. Therefore, as a defensive stock, pharmaceutical stocks should be considered as an important hedging and diversification option for investors, particularly during times of financial crises.

5.6.3 NOMINAL EXCHANGE RATE

The nominal exchange rate proved to be significant in all cases except for the financial, industrial and pharmaceuticals indices. The respective relationships with the remaining stock indices differed, such that only the All Share and mining indices were positively related to the nominal exchange rate. Specifically, stocks in the mining sector are likely to benefit through increased exports and thus revenue gains, in addition to the repatriation of such revenue to ZAR. In the event of a long-term depreciation of the ZAR, net exporting firms, such as those in the mining sector, are likely to experience an upward trend in their stock prices. The All Share index, given its VECM results, is however more sensitive to an exchange rate movement than the mining index. Investors seeking to profit from a depreciating ZAR are likely to do so by holding upper end market capitalization stocks listed on the JSE. Also, given the All Share's relative sensitivity, investment into an All Share Index exchange traded fund (ETF) may also be profitable in the long-term. Furthermore, an All Share Index ETF may present a less risky option since an investor is exposed to the overall market, but without the risk associated with investing in a single stock (McWhinney, 2011). Alternatively, a long-run appreciation of the ZAR presents profitable opportunities for investors in the construction and materials, food producer, and general retail sectors.

5.6.4 FOREIGN GDP

The influence of foreign macroeconomic forces, in this case proxied by US GDP, was found to have no significant impact on either the All Share index or the industrial index. The implication this result may have for investors is that in the event of a downturn in the world's largest economy, this may not necessarily depress South African stocks on the All Share and industrial indices. A possible explanation for this may be that the US, as a trading partner of South Africa, is falling behind that of the Euro zone and China (Riskowitz, 2011). Investors should thus pay increasing attention to developments in these regions and not focus solely on that of the US. It must be emphasized, however, that the results obtained for the US GDP may be misleading due to data implications noted in Section 4.4.1.

5.6.5 INTEREST RATE

The Treasury bill rate was found to be an insignificant determinant of stock prices for the financial, food producers, general retail and industrial indices. The VECM results in Table 5.6 show that the All Share index, the mining index, and the pharmaceuticals index are positively influenced by a change in the Treasury bill rate. A closer inspection reveals that All Share index and the mining index are largely inelastic to changes in the short-term interest rate. The implication this has for investors is that these three indices may hedge against rising interest rates in South Africa. Furthermore, they may also provide an alternative to money market instruments such as bonds, whose values fall as a result of an increase in interest rates. Specifically, to maximize returns in an equity portfolio, given the results, an investor requires a relatively higher allocation to these stocks during periods of increasing interest rates.

The South African Reserve Bank has actively managed inflation through the use of the repo rate, which in turn affects all other interest rates in the market. Increasing interest rates to curb inflationary pressures would provide an investor who has invested in the All Share Index and in pharmaceuticals with a boost in returns. However, both indices are also, as previously discussed, negatively related to inflation. Thus returns from an increase in interest rate to curb inflation, coupled with the resultant drop in inflation, would render these stocks highly profitable for investors.

5.6.6 FINANCIAL CRISES

As the results in Table 5.6 illustrate, the three periods of crisis each had varying impacts on stock prices across sectors. The most notable was the impact the sub-prime crisis had on the All Share index and also on the financial, general retail, industrial, and construction and materials indices. The East Asian crisis was found to have a significant impact on the financial index, however, to a lesser extent with the All Share, construction and materials and mining indices. The rand crisis, although having an insignificant impact on the construction and materials, industrial and mining indices, significantly impacted the remaining indices.

Kaminsky *et al.* (2004) cite two possible strategies investors may adopt, particularly in times of financial crises. The first of these strategies is momentum trading, which involves investors selling stocks that have performed badly and purchasing those that have performed well, particularly stocks that have performed well in the past. This strategy was found to be prominent amongst investors during the Mexico and East Asian crises, as noted by Kaminsky *et al.* (2004:17). The second strategy, contagion trading, involves investors selling (buying) stocks from one country when stock prices are falling (rising) in another. Kaminsky *et al.* (2004) found that contagion trading was particularly evident in the US during the Mexico crisis, where investors sold US stocks amidst falling Mexican stock prices.

Given the results in Table 5.6, a momentum trading strategy during each of the financial crises may have yielded higher returns for investors. In the sub-prime crisis investors would likely sell leading stocks listed on the All Share index, and in the food producer, general retail and industrial sectors. Stocks that performed well at the time include pharmaceutical stocks, inducing a higher weighting of these stocks in investor portfolios. This is indicative of the defensive nature, as previously discussed, of pharmaceutical stocks. During the rand crisis, a sharp depreciation of the ZAR (according to the VECM results) is likely to have adverse consequences for the construction and materials, food producer, and general retail indices. The selling of the stocks in these sectors, in momentum trading, may be coupled with a purchase of stocks in the mining sector. This is due to the boost that a sharp depreciation of the ZAR would have on short-term exports in the mining sector, and also the insignificant impact the rand crisis was found to have on the mining index.

The East Asian crisis was found to have significant spillover effects, or contagion, with not only other Asian economies but also other emerging markets around the world (Baig and Goldfajn, 1999). A contagion trading strategy may provide a more appropriate strategy for

South African investors during a crisis of such nature. Specifically, the results suggest that financial stocks are likely to be sold if there are fears of contagion from other emerging markets. Also, by employing a momentum strategy, investors may purchase pharmaceutical stocks for example, to shift their portfolios to a more defensive strategy. Figure A1 in the appendix may provide some evidence of the resultant effects of the East Asian crisis on pharmaceutical stocks, where a sharp rise in the index can be seen during this period.

5.7 CONCLUSION

This chapter presented and discussed the empirical link that was found to exist between macroeconomic variables and stock indices. The first part of the chapter involved the preliminary analysis of the data, which showed that each of the time series data under investigation was non-stationary. Furthermore, high degrees of correlation were found to exist between certain macroeconomic variables, thus these variables, money supply and oil prices, were excluded from the investigation. After determining the stationarity of each series, the multi-variate Johansen's cointegration approach was conducted in estimating eight models. The cointegration results provided evidence to suggest that certain relationships may exist between some of the macroeconomic variables and the stock indices. Thereafter, weak exogeneity tests were conducted in order for the true endogenous variable to be identified and normalized upon. The VECM results presented in Table 5.6 confirmed *apriori* expectations that macroeconomic factors do influence stock prices in South Africa. The impulse response analysis and variance decomposition analysis re-affirmed these results, attributing movements in the stock indices to shocks in each of the independent variables in the respective models. Furthermore, it was found that financial crises also have an impact on stock prices.

The last section of the chapter focused on the implications the results may have for investors in South Africa. Specifically, this section highlighted the implications each macroeconomic variable had on each of the stock indices, and the possible opportunities that may exist for investors. Trading strategies, such as the inflation switching, momentum and contagion strategies were also discussed, to show how investors may hedge/profit from the dynamic linkages between the macroeconomy and stock prices. However, it must be noted that these opportunities for investors were discussed within the context of the results estimated, and are thus a small portion of the investment opportunities for investors in South Africa.

Having produced and discussed the results required to achieve the objectives of the study, the next chapter provides a summary and conclusions of the study.

CHAPTER 6:
CONCLUSION

6.0 SUMMARY OF THE STUDY AND CONCLUSIONS

The study analysed the link between the macroeconomy and stock prices in South Africa, and also the effect past financial crises may have had on stock prices. This was done to assess the nature of the relationship between macroeconomic variables and stock indices across various sectors of the South African stock market, with a view to giving investment recommendations for investors in South Africa. The purpose of the study was outlined in Chapter 1, namely, to investigate the extent to which macroeconomic variables influence stock prices in South Africa particularly in times of financial crises, and also the implications these may have for investing in the South African equity market.

The first step of the study was to review existing theoretical and empirical literature pertaining to the topic of the study. Chapter 2 reviewed the theoretical underpinnings of the relationship between stock prices and the macroeconomy. Here, the Efficient Market Hypothesis or EMH was discussed, to provide an understanding of efficient markets and the implications these have for arbitrage opportunities for investors. Furthermore, early asset pricing models such as the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) were discussed. A crucial distinction between the two models was the ability of the APT to attribute risk to various sources, thereby being able to calculate the risk premiums of stock. Present Value Models (PVM) or discounted cash flow models, as presented by Smith (1925), provided the foundations on which modern asset pricing models are based. The Gordon Growth Model (GGM) and its derivations provided a theoretical framework on which stocks may be valued, without the limitations of unrealistic assumptions adopted by earlier models.

The empirical literature review of Chapter 3 was in two parts. The first part reviewed recent empirical evidence of the linkages between macroeconomic factors and stock prices, in both developed and emerging markets. A common trend in the literature reviewed was the inconsistent effects that macroeconomic factors were seen to have in various markets. Specifically, literature for emerging markets, including South Africa, illustrated that the effects macroeconomic factors have on stock prices in developed markets differ to that in emerging markets. The second part of the literature review discussed key financial crises, and the effects these crises may have on the link between macroeconomic factors and stock prices. It was noted that changes in macroeconomic factors may not have the same effects on stock prices during times of financial crisis, thus careful consideration is required by both investors and policy makers.

To address the objectives set out in Chapter 1, Johansen's cointegration procedure was identified as the analytical framework required to investigate the short-run and long-run behaviour of the stock indices and the identified macroeconomic variables. As discussed in Chapter 4, the methodology required each variable to be stationary at first difference (integrated to the order I(1)) using both the ADF and KPSS stationarity tests. From here the appropriate lag order for each model was ascertained by considering a range of information criteria. Once the lag order was established the Johansen cointegration test was conducted to identify the number of cointegrating vectors present in each model. To identify the true endogenous variable on which to normalize, weak exogeneity tests were conducted in order for the true VECM to be estimated. Finally, diagnostic checks using serial correlation tests were conducted to maintain model efficiency and robustness.

The results of the estimated VECM models showed that each stock index corrects back to long-run equilibrium, given a short-run disequilibrium. It was also found that a number of the macroeconomic variables shared long-run co-movements with the stock indices under investigation. However, the nature of these relationships was inconsistent across the sectors. Inflation was found to be largely in line with expectations, except in the general retail and industrial sectors where a positive relationship was found to exist. This result provided evidence to suggest that certain stocks in these sectors may provide a hedge against inflation in South Africa, thus having important implications for investors.

As expected, the exchange rate had varying effects on stock prices in South Africa. As discussed in Chapter 4, the effect the exchange rate may have on stock prices depends on the import or export activities that dominate the sector. A sector that is positively related to the exchange rate would thus benefit from a depreciation of the ZAR, and can therefore be seen as a net exporter. This was found to be the case for the FTSE/JSE All Share Index and the mining index. This finding may have particular importance for future policies regarding exchange rates, since the mining sector, as a major contributor to the South African economy, may further contribute if policies resulting in the weakening the ZAR were to be adopted by the South African government. However, this action may be detrimental to the construction and materials, food producers' and general retail sectors, given their negative relationship with exchange rates.

The results for the US GDP were found to be somewhat confusing. Although it is expected that a positive relationship would exist with the stock indices, only the pharmaceuticals index was found to have such a relationship. These findings may, however, be the result of interpolation techniques used to obtain monthly data for the US GDP variable. Another possible explanation could be that the influence of the US economy on South Africa is diminishing, with the Euro countries as well as China becoming increasingly influential.

The results for the SA industrial production and Treasury bill rate were somewhat surprising. In the first instance industrial production was found to be an insignificant determinant of the FTSE/JSE All Share Index. This result, although unexpected, may be the result of a poor proxy variable being used to represent real economic growth in South Africa. The results for the Treasury bill rate showed that it is insignificant in four of the estimated models, including the financial index. This is highly unlikely since the financial sector in particular is dependent on the level of the interest rate set by the Reserve Bank. It was noted that long-term interest rates may capture interest changes better than short-term rates, as evidence provided by Maysami *et al.* (2004), Ratanapakorn and Sharma (2007) and Humpe and Macmillan (2007) suggest.

The inclusion of the three dummy variables representing the East Asian crisis, the rand crisis and the recent sub-prime crisis, showed that each had an impact on the different sectors. The sub-prime crisis was found to have the greatest impact on South African stock prices, with the other two crises impacting only on certain sectors. The pharmaceuticals sector, and to a lesser extent the mining sector, were both found to be relatively immune to all of the crises. These findings provided certain portfolio diversification options for investors during times of financial distress.

The last section of Chapter 5 focused on the implications the results had for investors in South Africa. Firstly, hedging, diversification and profit opportunities exist for investors due to the inconsistent effects each of the macroeconomic variables have across sectors. Secondly, the varying degrees of influence each of the macroeconomic factors have on stock indices may allow investors to profit through the use of appropriate trading strategies. Lastly, specific trading strategies during times of financial crisis may be adopted to maximize returns or minimise losses using an aggressive approach or a more defensive approach given the results of the study.

Overall the results of the study show that macroeconomic factors are important determinants of stock market behaviour in South Africa. Furthermore these macroeconomic factors have a significant impact on stock prices in South Africa, both in the shortrun and the longrun. However, the presence of financial crises may also impact on the linkages between the macroeconomy and stock prices, presenting opportunities for investors in the South African markets.

6.1 AREAS OF FURTHER RESEARCH

A possible area in which the study may be extended is to investigate the influence that other foreign variables have on stock prices between sectors in South Africa, in particular to examine the importance that other economies such as the Euro countries and China may have on South

African markets. Secondly, a wider range of sectors or sub-sectors may be chosen to increase the possible investment opportunities available for investors. Lastly, better proxy variables as well as the use of the long-term interest rate may be used to possibly increase the robustness of the results.

APPENDIX

FIGURE A1: SECTOR INDICES

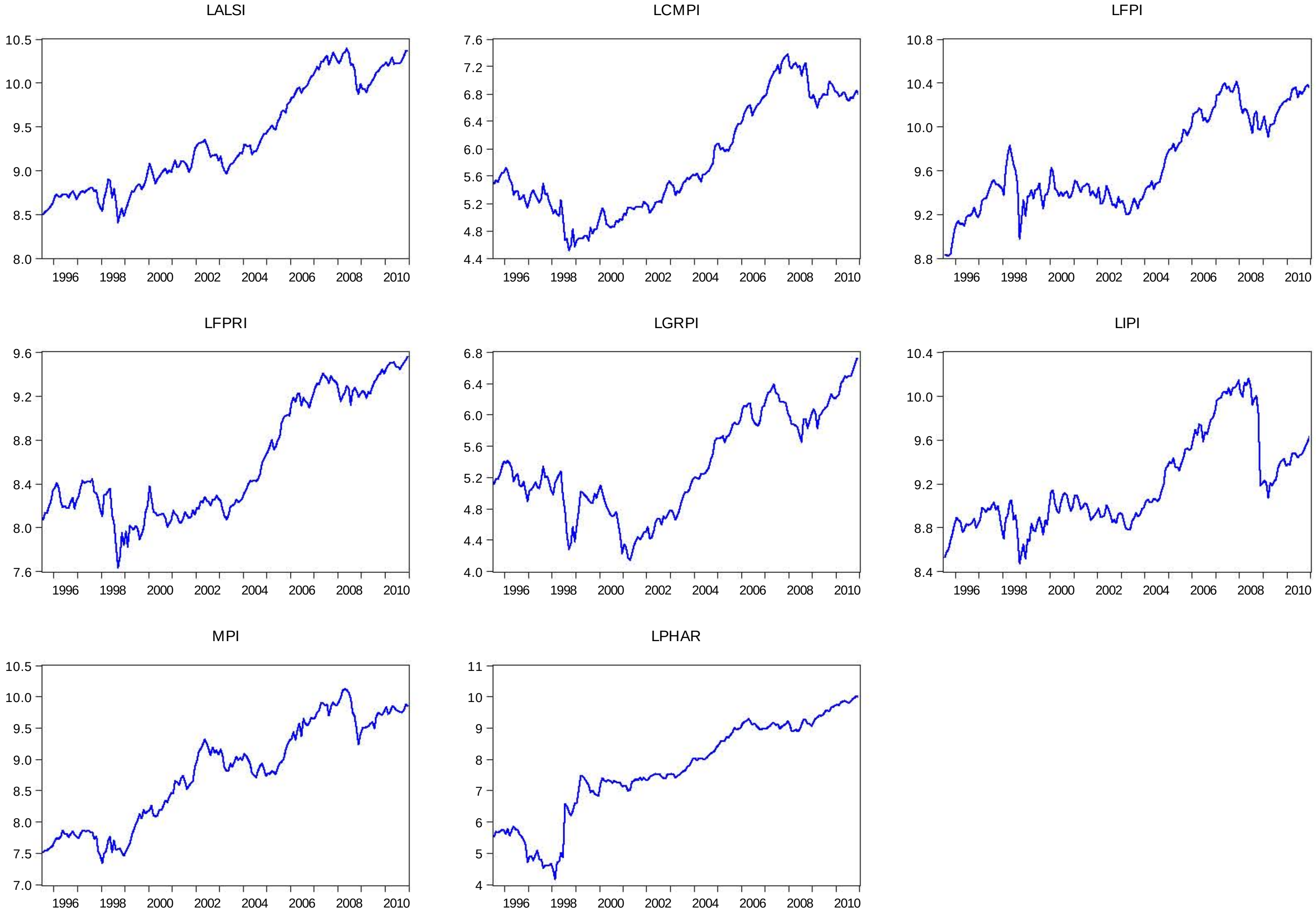


FIGURE A2: MACROECONOMIC VARIABLES

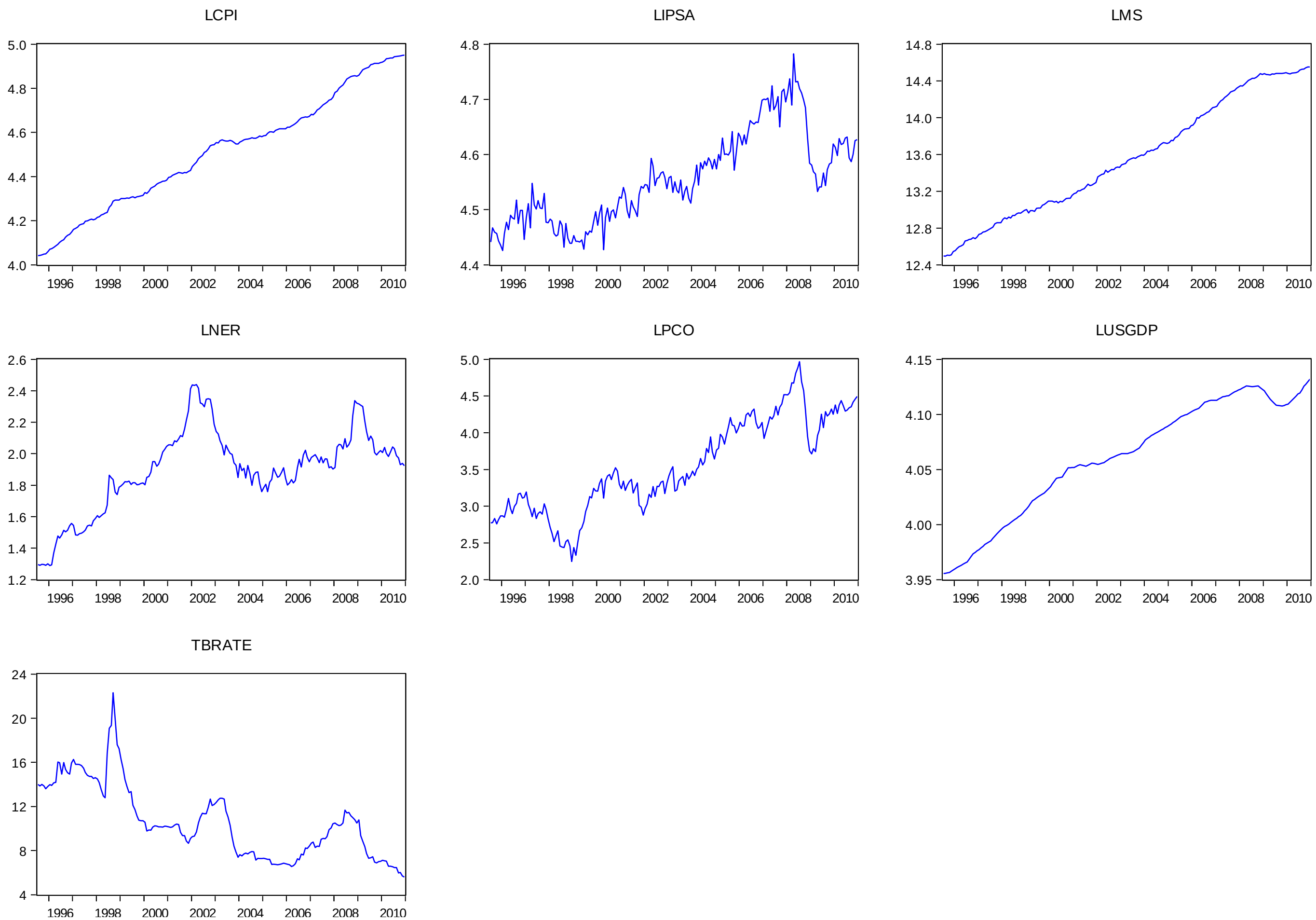


TABLE A1: GLOBAL AND DEVELOPED MARKETS SUMMARY

Author(s)	**Country**	**Stock variable**	**Macroeconomic variables**	**Methodology**
Chaudhuri and Smiles (2004)	Australia	Aggregate index	Real oil price Real GNP Money supply Private consumption GDP US, Japan and New Zealand Stock indices	Johansen's
Flannery and Protopapadakis (2002)	US	Aggregate index	Macroeconomic announcements: Balance of trade Consumer credit Construction CPI Employment Home sales Home starts Industrial production Leading indicators Money supply (M1) Money supply (M2) Personal consumption Producer price index Real GNP Sales	GARCH

Gunsel and Cukur (2007)	UK	Aggregate index Sector indices: Food, Beverage and Tobacco, Construction, Building materials, Electronic and electronic equipment, Engineering, Household Goods and Textiles, Paper, Packaging and Printing, Chemicals, Diversified industrial, Oil exploration and production	Term structure of interest rates Inflation Industrial production Risk premium Real exchange rates Money supply Dividend yield	Multifactor regression
Humpe and Macmillan (2007)	US and Japan	Aggregate Indices	Industrial production CPI Money supply (M1) 3-month Treasury rate 10-year Government bond yield	Johansen's
Killian and Park(2009)	US	Aggregate Index Manufacturing index	World crude oil production Real price crude oil	Structural VAR
Maysami and Koh (2000)	Singapore		Money supply (M2) CPI Industrial production 3-month interbank rate 5-year Government security rate Total exports Stock indices for US and Japan	Johansen's

Maysami *et al*. (2004)	Singapore	Aggregate Index Sector indices : Finance Property Hotel	Industrial production 3-month interbank rate 5-year Government security rate CPI Exchange rate Money supply (M2)	Johansen's
Nasseh and Strauss (2000)	France, Germany, Italy, Netherlands, Switzerland, UK	Aggregate Indices	Real industrial production Business surveys of manufacturing orders Short-term call rates Long-term government bond rates CPI	Johansen's
Nieh and Lee (2001)	G7	Aggregate Indices	Exchange rates	Engle and Granger, and Johansen's

Nikkinen *et al*. (2006)	G7 Europe: Austria, Belgium, Denmark, Holland, Switzerland, Sweden, Finland Asia: Australia, Hong, Kong, Singapore, Taiwan, Transition: Czech Republic, Hungary, Poland, Slovakia, Russia, Latin America: Argentina, Brazil, Chile, Columbia, Mexico, Peru, Venezuela	Aggregate Indices	U.S. news announcements: Consumer confidence CPI Employment cost index Employment situation GDP Import and export price indices Manufacturing and non-manufacturing Producers price index Retail sales	GARCH
Ratanapakorn and Sharma (2007)	US	Aggregate index	3-month Treasury rate 10-year Government bond yield Money supply Industrial production Consumer price index Exchange rate	Johansen's

TABLE A2: EMERGING MARKETS SUMMARY

Author(s)	Country	Stock variable	Macroeconomic variables	Methodology
Adam and Tweneboah (2008)	Ghana	Aggregate	Inward foreign direct investment Treasury bill rate CPI Exchange rate	Johansen's
Ahmed (2008)	India	Aggregate	Industrial production Exports Foreign direct investment Money supply Exchange rate Interest rate	Johansen's
Bilson *et al*. (2001)	Latin America: Argentina Brazil Chile Colombia Mexico Venezuela Asia: India Indonesia Malaysia Pakistan Philipines South Korea Taiwan Thailand Europe: Greece Portugal Turkey Middle east: Jordan Africa: Nigeria Zimbabwe	World index	Money supply CPI Industrial production Exchange rates Country risk Trade sector index Regional index	Multifactor regression OLS, Principal Components Analysis

Hussainey and Ngoc (2009)	Vietnam	Aggregate index	Industrial production Short-term Interest rates Long-term interest rates US stock prices US Short-term interest rates US Long-term interest rates	Johansen’s
Ibrahim and Aziz (2003)	Malaysia	Aggregate index	Industrial production Money Supply (M2) CPI Exchange rate	Johansen’s
Paavola(2006)	Russia	Aggregate index of 20 largest stocks	Money supply (M2) CPI Oil price Exchange rate Industrial production	Multifactor regression OLS
Pyman and Ahmad (2009)	Malaysia	Sectors: Construction Plantation Consumer products Finance Industrial products Mining Hotel Property Trading and services	GDP CPI Treasury bill rate Money supply (M1) Exchanges rates	Johansen’s
Verma (2005)	Argentina Brazil Chile Mexico	Aggregate indices	Federal funds rates Exchange rates Money supply CPI	VAR

Abugri (2008)	Argentina Brazil Chile Mexico	Aggregate indices	Treasury bill rate Exchange rates Industrial production Money supply US Treasury bill rate World equity index	VAR

TABLE A3: SOUTH AFRICA SUMMARY

Author(s)	Country	Stock variable	Macroeconomic variables	Methodology
Jefferis and Okeahalam (2000)	South Africa Botswana Zimbabwe	Aggregate indices	GDP Real interest rate Real exchange rate US GDP US Interest rate	Johansen's
Moolman and du Toit (2005)	South Africa	Aggregate index	GDP Long-term interest rates Short-term interest rates Gold price Risk premium Business cycle indicator Discount rate US interest rate US stock prices	Johansen's
Olalere (2007)	South Africa	Aggregate index Market capitalization	GDP Long term interest rate Exchange rate CPI U.S. GDP US Long-term interest rates	Johansen's
Hancocks (2010)	South Africa	Aggregate index Sector indices: General retailers Mining Financial	Money supply (M2) Exchange rate 3-month Treasury bill rate 10-year Government bond rate CPI	Johansen's

TABLE A4: VARIANCE DECOMPOSITIONS FOR STOCK INDICES

Variance Decomposition of LALSI: Period	S.E.	LALSI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.054863	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.075164	98.97845	0.003642	0.853792	0.004548	0.032933	0.126639
3	0.084569	97.53167	0.341343	1.366210	0.012331	0.032754	0.715696
4	0.093359	91.85656	1.687050	1.166924	0.473416	0.043476	4.772577
5	0.099330	87.07828	4.434026	1.252461	0.816241	0.038437	6.380560
6	0.104141	81.88266	8.634946	1.349079	0.913037	0.067587	7.152691
7	0.108650	76.35918	13.05113	1.265196	1.198305	0.153450	7.972745
8	0.112634	71.30617	17.37934	1.192990	1.583440	0.331249	8.206810
9	0.116361	66.83658	21.35442	1.119496	1.881815	0.624120	8.183571
10	0.119699	63.16055	24.58749	1.067047	2.095395	0.983742	8.105770
11	0.122505	60.31047	27.11988	1.044547	2.185839	1.400628	7.938634
12	0.124835	58.09407	29.01863	1.062117	2.185800	1.880644	7.758742
13	0.126733	56.37373	30.33784	1.127289	2.144950	2.421158	7.595040
14	0.128290	55.01500	31.19486	1.228094	2.093569	3.029925	7.438549
15	0.129631	53.88240	31.68241	1.368443	2.062138	3.710870	7.293741
16	0.130850	52.88561	31.87317	1.547439	2.070829	4.463580	7.159375
17	0.132027	51.95320	31.83310	1.756911	2.132556	5.290645	7.033587
18	0.133223	51.03350	31.61177	1.996037	2.250905	6.190836	6.916959
19	0.134473	50.09775	31.24860	2.261262	2.422169	7.158618	6.811609
20	0.135805	49.12854	30.77564	2.546931	2.641156	8.186450	6.721282
21	0.137230	48.11938	30.21857	2.849916	2.900263	9.263347	6.648530
22	0.138755	47.07189	29.59901	3.165759	3.191582	10.37600	6.595759
23	0.140381	45.99124	28.93520	3.489551	3.508571	11.51044	6.564993
24	0.142103	44.88548	28.24304	3.817381	3.845020	12.65259	6.556488

Variance Decomposition of LCMPI: Period	S.E.	LCMPI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.086283	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.120660	96.31466	0.407123	0.071603	1.077405	0.533355	1.595855
3	0.145568	93.84796	0.724000	0.699412	1.673802	1.284512	1.770316
4	0.167088	92.31936	0.989788	0.983558	2.092486	1.924573	1.690240
5	0.186224	91.00916	1.200785	1.221449	2.458660	2.495970	1.613972
6	0.203710	89.95720	1.383665	1.363080	2.773135	2.982976	1.539945
7	0.219915	89.08475	1.544403	1.440404	3.054028	3.401579	1.474834
8	0.235108	88.35385	1.688175	1.469406	3.306953	3.764236	1.417384
9	0.249468	87.73047	1.817955	1.465115	3.536993	4.082676	1.366788
10	0.263131	87.19046	1.935835	1.438471	3.747296	4.365986	1.321951
11	0.276198	86.71600	2.043315	1.397416	3.940218	4.621092	1.281963
12	0.288745	86.29403	2.141536	1.347613	4.117547	4.853194	1.246076
13	0.300837	85.91495	2.231409	1.293042	4.280719	5.066185	1.213695
14	0.312521	85.57155	2.313693	1.236477	4.430934	5.263004	1.184340
15	0.323840	85.25840	2.389041	1.179819	4.569233	5.445887	1.157622
16	0.334826	84.97129	2.458029	1.124345	4.696544	5.616563	1.133225
17	0.345508	84.70696	2.521179	1.070881	4.813705	5.776391	1.110883
18	0.355910	84.46278	2.578964	1.019937	4.921489	5.926456	1.090376
19	0.366053	84.23662	2.631820	0.971791	5.020612	6.067645	1.071514
20	0.375955	84.02672	2.680152	0.926561	5.111741	6.200694	1.054135
21	0.385631	83.83159	2.724334	0.884256	5.195497	6.326227	1.038096

22	0.395094	83.64996	2.764711	0.844808	5.272463	6.444784	1.023273
23	0.404359	83.48072	2.801606	0.808097	5.343180	6.556838	1.009557
24	0.413434	83.32289	2.835316	0.773977	5.408153	6.662810	0.996850

Variance Decomposition of LFPI: Period	S.E.	LFPI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.067994	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.093503	97.33998	0.628590	0.020003	0.043052	1.019625	0.948749
3	0.110867	91.85103	2.997220	0.368365	1.157144	2.897163	0.729077
4	0.127802	82.20062	5.984423	2.335573	1.002559	3.681396	4.795434
5	0.139224	78.29653	8.088992	2.059677	1.153242	4.915060	5.486501
6	0.151114	72.51164	13.05237	1.751311	2.168790	5.454784	5.061102
7	0.160596	68.10548	16.69392	1.574759	2.393869	5.569185	5.662784
8	0.168735	64.67549	19.12548	1.830369	2.428791	5.965334	5.974532
9	0.178454	61.79546	21.15836	2.916422	2.255195	6.162456	5.712106
10	0.188456	60.57256	22.36921	3.474109	2.160409	6.083038	5.340676
11	0.197632	60.50690	22.38332	3.585449	2.155068	6.175744	5.193521
12	0.207676	60.04856	22.28984	4.352562	2.043135	6.245688	5.020214
13	0.217731	60.28898	21.99958	4.797363	1.942166	6.062180	4.909731
14	0.227216	60.60516	21.69616	4.995189	1.894371	6.046106	4.763015
15	0.235209	60.46567	21.61632	5.221968	1.825531	6.235182	4.635323
16	0.241933	60.52728	21.55750	5.222035	1.766561	6.358411	4.568214
17	0.248009	60.71826	21.36972	5.276361	1.733995	6.428060	4.473604
18	0.253463	60.72835	21.28878	5.370992	1.711968	6.525061	4.374851
19	0.258429	60.99716	21.12580	5.326179	1.700459	6.532486	4.317917
20	0.263141	61.35227	20.78919	5.325108	1.689072	6.611486	4.232875
21	0.267777	61.74111	20.42005	5.314087	1.687110	6.704239	4.133408
22	0.272394	62.22408	20.05061	5.244554	1.701256	6.723269	4.056237
23	0.276907	62.64037	19.67361	5.220922	1.710467	6.766807	3.987826
24	0.281232	62.96322	19.37398	5.195042	1.714632	6.831108	3.922022

Variance Decomposition of LFPRI: Period	S.E.	LFPRI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.059462	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.080010	98.73011	0.374398	0.313062	0.415020	0.088748	0.078660
3	0.094896	97.14309	0.680609	0.266394	0.808085	0.595663	0.506159
4	0.104984	90.96591	2.209860	1.920605	0.663304	1.800089	2.440230
5	0.112330	85.28945	4.986033	1.786881	0.599526	3.571274	3.766832
6	0.119632	79.00598	8.326331	1.854269	0.545158	5.983414	4.284850
7	0.126833	73.53476	11.56885	2.065920	0.487858	7.934945	4.407660
8	0.133188	68.37929	14.72568	2.148386	0.448442	9.936543	4.361655
9	0.139240	64.08747	17.29848	2.379551	0.410379	11.61319	4.210936
10	0.144905	60.39378	19.43582	2.731461	0.381359	13.03949	4.018089
11	0.150037	57.45375	21.16680	2.940294	0.357399	14.27481	3.806951
12	0.154930	55.02131	22.43380	3.275035	0.337223	15.33321	3.599422
13	0.159504	53.03594	23.38181	3.612682	0.324349	16.23713	3.408085
14	0.163815	51.34936	24.08370	3.935905	0.311957	17.08372	3.235366
15	0.168000	49.92195	24.54760	4.303467	0.304380	17.84541	3.077197
16	0.172037	48.66752	24.86146	4.670302	0.299491	18.56674	2.934494
17	0.175964	47.56335	25.05058	5.026062	0.295824	19.25880	2.805380
18	0.179840	46.56438	25.13168	5.404229	0.294550	19.91806	2.687098

19	0.183642	45.65577	25.14295	5.771475	0.295195	20.55501	2.579600
20	0.187399	44.81967	25.09457	6.135662	0.296590	21.17245	2.481057
21	0.191124	44.04922	24.99690	6.500804	0.299805	21.76306	2.390210
22	0.194806	43.33438	24.86683	6.855741	0.303849	22.33260	2.306603
23	0.198458	42.67227	24.70879	7.203315	0.308664	22.87782	2.229138
24	0.202080	42.05670	24.52987	7.544518	0.314391	23.39742	2.157105

Variance Decomposition of LGRPI: Period	S.E.	LGRPI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.086824	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.127444	98.56054	0.725783	0.127613	0.475170	0.106039	0.004856
3	0.153624	96.52540	1.522407	0.158057	1.224853	0.545555	0.023726
4	0.172169	93.49312	2.307086	0.276892	2.387195	1.442143	0.093559
5	0.186791	89.52888	3.046763	0.439277	3.887004	2.876175	0.221906
6	0.199760	84.86294	3.666164	0.680909	5.594250	4.804695	0.391040
7	0.212197	79.82397	4.139595	0.997571	7.359253	7.099444	0.580166
8	0.224641	74.73022	4.463652	1.394914	9.054244	9.586370	0.770599
9	0.237290	69.83584	4.657065	1.866325	10.59187	12.09839	0.950506
10	0.250179	65.30739	4.746151	2.403988	11.92631	14.50236	1.113800
11	0.263266	61.23285	4.758259	2.996177	13.04449	16.70951	1.258711
12	0.276482	57.64032	4.717120	3.630448	13.95478	18.67141	1.385925
13	0.289753	54.51853	4.641615	4.294018	14.67741	20.37109	1.497330
14	0.303014	51.83337	4.545809	4.974872	15.23763	21.81313	1.595191
15	0.316206	49.53963	4.439727	5.662161	15.66142	23.01534	1.681716
16	0.329285	47.58871	4.330241	6.346536	15.97316	24.00249	1.758862
17	0.342214	45.93314	4.221882	7.020242	16.19451	24.80196	1.828270
18	0.354963	44.52902	4.117509	7.677101	16.34403	25.44107	1.891273
19	0.367514	43.33722	4.018804	8.312405	16.43727	25.94536	1.948932
20	0.379849	42.32362	3.926647	8.922759	16.48702	26.33788	2.002079
21	0.391960	41.45899	3.841378	9.505899	16.50361	26.63876	2.051365
22	0.403840	40.71860	3.762982	10.06050	16.49534	26.86528	2.097298
23	0.415488	40.08168	3.691225	10.58602	16.46878	27.03202	2.140276
24	0.426903	39.53094	3.625737	11.08250	16.42910	27.15111	2.180613

Variance Decomposition of LIPI: Period	S.E.	LIPI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.077961	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.109334	94.31824	0.158832	2.655816	2.680476	0.004747	0.181889
3	0.130443	89.42656	0.350867	3.721795	6.289848	0.063154	0.147780
4	0.140851	88.10006	0.306135	3.815115	6.492775	0.056996	1.228921
5	0.148663	86.31447	0.428669	5.081791	6.573394	0.092905	1.508773
6	0.155510	83.79426	0.805361	6.570597	7.169802	0.129804	1.530177
7	0.160571	81.61482	1.143550	7.782426	7.736646	0.174765	1.547796
8	0.164788	79.43118	1.413271	9.186112	8.299627	0.194059	1.475753
9	0.168575	77.32335	1.605585	10.52440	8.937823	0.190410	1.418438
10	0.172095	75.30454	1.677151	11.69573	9.734031	0.182771	1.405776
11	0.175627	73.20836	1.667025	12.74416	10.72316	0.183540	1.473754
12	0.179180	71.08652	1.615121	13.60659	11.86844	0.206419	1.616907
13	0.182831	68.92181	1.551277	14.30558	13.12684	0.259264	1.835238
14	0.186670	66.66974	1.499907	14.86240	14.48170	0.347922	2.138328
15	0.190675	64.36465	1.477346	15.27627	15.89563	0.473517	2.512583

16	0.194843	62.02679	1.492361	15.56962	17.32484	0.633252	2.953132
17	0.199178	59.67250	1.546825	15.76020	18.73685	0.824074	3.459551
18	0.203664	57.32895	1.640155	15.86064	20.10493	1.041369	4.023950
19	0.208294	55.01553	1.770041	15.88604	21.40845	1.279978	4.639965
20	0.213056	52.75058	1.932388	15.84847	22.63314	1.535066	5.300349
21	0.217932	50.55116	2.122754	15.75885	23.76997	1.801688	5.995586
22	0.222909	48.42901	2.336375	15.62767	24.81504	2.075237	6.716664
23	0.227970	46.39373	2.568289	15.46388	25.76814	2.351629	7.454341
24	0.233095	44.45234	2.813742	15.27560	26.63150	2.627223	8.199592

Variance Decomposition of MPI: Period	S.E.	MPI	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.091588	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.123006	98.96207	0.039635	0.385008	0.213645	0.063732	0.335906
3	0.150294	97.35347	0.381944	0.810172	1.043351	0.185749	0.225317
4	0.176236	94.92192	0.953107	1.405217	2.350452	0.184009	0.185292
5	0.196585	91.86412	2.605459	2.390348	2.813005	0.156069	0.170998
6	0.216509	87.09316	5.605313	3.192698	3.706692	0.130529	0.271609
7	0.233493	83.12141	7.605109	3.624450	4.967765	0.130900	0.550370
8	0.248684	79.78565	9.051705	4.125583	6.201547	0.122423	0.713088
9	0.262783	76.95391	10.03211	4.529133	7.513673	0.117837	0.853342
10	0.275735	74.77476	10.44508	4.951506	8.746033	0.113084	0.969547
11	0.287680	73.20282	10.63306	5.271474	9.786331	0.105802	1.000515
12	0.298630	72.09671	10.69916	5.547320	10.54891	0.099559	1.008343
13	0.308901	71.36361	10.64898	5.783591	11.10380	0.093624	1.006397
14	0.318649	70.91440	10.54821	5.934356	11.53036	0.088157	0.984522
15	0.328072	70.64299	10.43083	6.060240	11.82398	0.083170	0.958781
16	0.337274	70.48907	10.29339	6.163307	12.04169	0.078773	0.933767
17	0.346229	70.38958	10.16741	6.241881	12.21891	0.074977	0.907236
18	0.355009	70.30094	10.06719	6.316320	12.36032	0.071704	0.883530
19	0.363590	70.21147	9.982769	6.384331	12.48890	0.068839	0.863692
20	0.371952	70.10227	9.921381	6.446852	12.61736	0.066308	0.845826
21	0.380129	69.97023	9.879383	6.508989	12.74644	0.064073	0.830891
22	0.388115	69.82613	9.844729	6.568359	12.88030	0.062083	0.818392
23	0.395913	69.67189	9.817483	6.624404	13.01906	0.060305	0.806856
24	0.403544	69.51309	9.794155	6.678620	13.15891	0.058694	0.796533

Variance Decomposition of LPHAR: Period	S.E.	LPHAR	LCPI	LIPSA	LNER	LUSGDP	TBRATE
1	0.162883	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.216671	94.23432	0.014613	0.235149	0.035363	0.000418	5.480140
3	0.260254	91.88681	0.055051	0.726728	0.125885	0.001726	7.203799
4	0.296902	89.94804	0.089317	1.554489	0.246290	0.009949	8.151918
5	0.329350	88.15851	0.122101	2.601915	0.383205	0.030386	8.703879
6	0.358944	86.37825	0.153150	3.826980	0.530396	0.066265	9.044957
7	0.386490	84.59450	0.182862	5.165464	0.681952	0.119391	9.255828
8	0.412501	82.80983	0.211041	6.574733	0.833829	0.189925	9.380645
9	0.437313	81.04026	0.237644	8.016058	0.982908	0.276933	9.446192
10	0.461155	79.30104	0.262604	9.460741	1.127079	0.378662	9.469870
11	0.484189	77.60620	0.285919	10.88634	1.264939	0.492916	9.463685
12	0.506529	75.96661	0.307614	12.27664	1.395659	0.617299	9.436187

13	0.528259	74.39026	0.327745	13.62012	1.518829	0.749425	9.393624
14	0.549440	72.88240	0.346386	14.90921	1.634343	0.887042	9.340624
15	0.570120	71.44600	0.363625	16.13930	1.742310	1.028113	9.280647
16	0.590335	70.08221	0.379556	17.30812	1.842980	1.170855	9.216283
17	0.610114	68.79070	0.394273	18.41510	1.936698	1.313752	9.149475
18	0.629481	67.57011	0.407871	19.46094	2.023858	1.455545	9.081670
19	0.648457	66.41830	0.420440	20.44722	2.104883	1.595216	9.013942
20	0.667060	65.33256	0.432066	21.37614	2.180200	1.731961	8.947074
21	0.685305	64.30987	0.442829	22.25027	2.250230	1.865168	8.881632
22	0.703206	63.34701	0.452804	23.07242	2.315376	1.994382	8.818008
23	0.720777	62.44067	0.462059	23.84549	2.376022	2.119288	8.756471
24	0.738031	61.58753	0.470656	24.57242	2.432528	2.239683	8.697186

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