

THE IMPACT OF INFLATION ON STOCK PRICES IN SOUTH AFRICA.



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**A Mini Dissertation Submitted in Partial Fulfilment of the
Requirements for the Degree of Master of Business
Administration at the North West University – Mafikeng
Campus.**

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DECLARATION

I, JOHN KHUMALO, hereby declare that this research report is my own work. It is submitted in partial fulfillment of the requirements of the degree of Master of Business Administration at the Graduate School of Business & Government Leadership, North-West University, Mafikeng Campus. This document has not been previously submitted to any institution or any other University and all reference sources have been accurately reported and acknowledged.



JOHN KHUMALO

26/02/2012
DATE

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Thanks to the Almighty GOD for giving me life and preserving it throughout hard times of my studies. Through His grace and mercy He made my way seem bright even when days were dark.

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LIST OF ACRONYMS

ACF: Autocorrelation Functions.

ADF: Augmented Dickey – Fuller.

AEG: Augmented Engle – Granger.

AIC: Akaike Information Criterion.

ARDL: Autoregressive Distributed Lag.

BG: Breusch – Godfrey.

CPI: Consumer Price Index.

CRDW: Cointegration Regression Durbin – Watson.

DF: Dickey – Fuller.

DW: Durbin – Watson.

EC: Error Correction.

ECM: Error Correction Model.

EG: Engle – Granger.

EK: Measure of kurtosis.

EXCR: Exchange rate.

GARCH: Generalised Autoregressive Conditional Heteroskedasticity.

GDP: Gross Domestic Product.

IR: Interest rate.

JB: Jarque – Bera.

JSE: Johannesburg Stock Exchange.

LM: Lagrange Multiplier.

MS: Growth of money supply.

P- Value: probability Value.

PP: Phillips – Perron.

RESET: Regression Specification Test.

SIC: Schwatz Information Criterion.

SK: Measure of Skewedness.

SP: Stock Prices.

VAR: Vector Auto Regression.

VECM: Vector Error Correction Model.

ABSTRACT

The study is based on the time series analysis of stock prices in South Africa. It uses the data covering the period 1980Q1 to 2010Q4 to test the effect of inflation on stock prices. The analysis is done using Auto-Regressive Distributed Lag Model (ARDL). First, we investigate time series properties of data. The unit root test results reveal stock prices (SP), interest rate (IR), economic growth (GDP) and real effective exchange rate (EXCR) are integrated of order zero $\sim I(0)$, while the growth of money supply (MS) and inflation were found to contain unit root. The Augmented Dickey-Fuller (ADF) test and the Philips-Perron (PP) tests were used to test for unit root. Causality test suggests that causation runs from inflation to stock prices. Cointegration test shows that there is cointegration and as such, Error Correction Model (EC) is done to establish short-run and long-run dynamics. The study shows that inflation does contribute negatively to stock prices.

KEYWORDS: Stock prices, inflation, causality, unit root, cointegration, error correction.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Many financial economists and financial managers assert that the impact of macroeconomic variables on stock prices is not to be ignored when one is investing through a stock market. Investment involves high risks that need to be analysed carefully before company executives decide to invest. The Johannesburg Stock Exchange provides attractive investment opportunities to investors and has become the investment icon in the global financial market.

The relationship between macroeconomic variables and stock prices has been expansively studied in developed capital markets. However, many different models have been developed in order to find the relationship between stock prices and their explanatory factors, but most of those studies focused more on developed markets. In emerging markets, the relationship between stock prices and macroeconomic variables has been examined since the 1980s, after which interest in investing in emerging markets has shown noticeable growth over the past two decades. A study by Harvey (1995: 773) confirms that risks and stock returns in emerging markets have been found to be higher, relative to developed markets.

The stock exchange market in an economy serves as a channel through which surplus funds are moved from Lender-Savers to Borrower-Spenders who have shortages of funds (Mishkin, 2001). Not only Mishkin (2010) realized that stock market was that important, Subair and Salihu (2010) in support of Mishkin's (2010) idea advocate that variation in stock prices can appreciably affect the performance of the financial sector as well as the entire economy. For that reason, policy makers as well as finance managers and or company executives should be interested in the focal determinants of volatility and its spillover effects on real activities. Financial analysts and portfolio managers on other hand are interested in the direct effects that the time-varying volatility wields on the pricing and hedging of more financial derivatives. In these cases, forecasting stock price volatility constitutes an alarming challenge but also a fundamental instrument to manage the risks faced by these institutions (Corradi *et al* 2009).

1.2 Background

Chinzara (2011: 27) recently attempted to analyse how systematic risk emanating from the macroeconomy is transmitted into stock market volatility using augmented autoregressive Generalised Autoregressive Conditional Heteroscedastic (AR-GARCH) and vector autoregression (VAR) models. The study also incorporated the impact of the two financial crises (1997-1998 Asian flu and the 2007-2009 sub-prime financial crises) by use of dummies. The

findings show that macroeconomic uncertainty significantly influences stock market volatility, but inflation was found to be less important in determining stock market volatility. The stock prices graph (figure 1-2(a) below shows the stock market volatility by means of downward and upward trends.

Figure 1-2(a): Stock Prices in South Africa

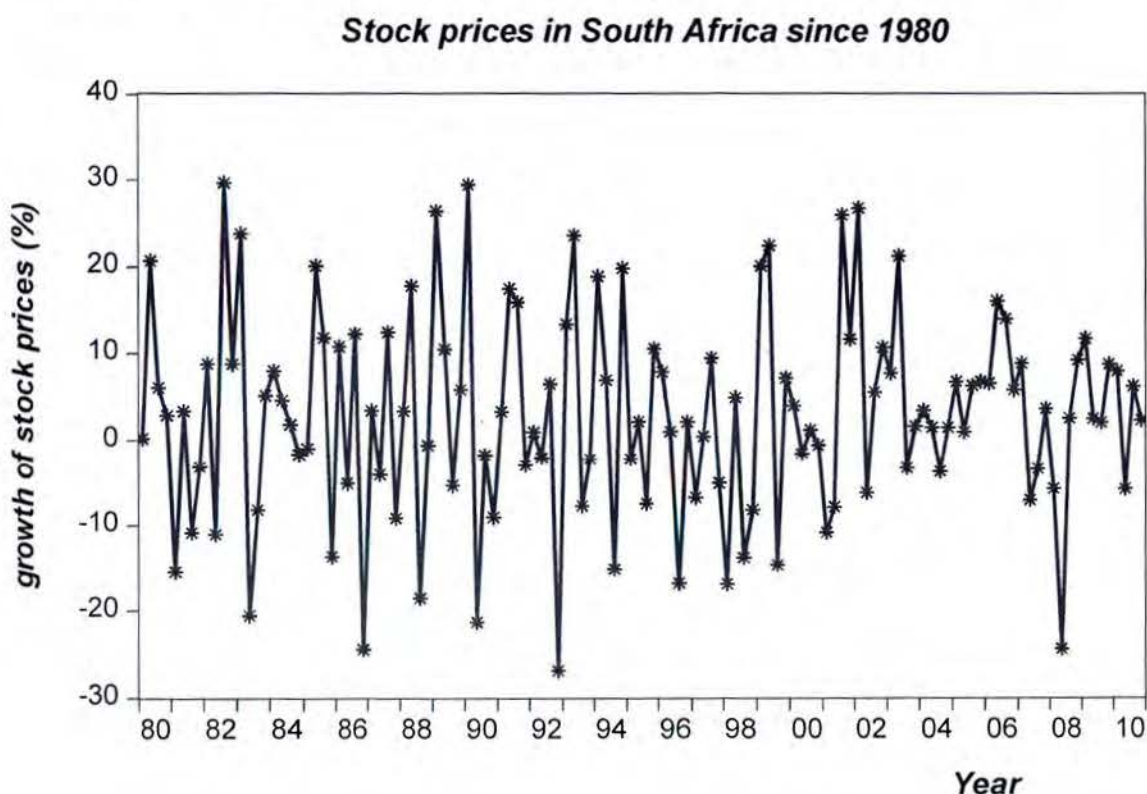


Table 1.2 below shows inflation in South Africa and its trading partners. Inflation is expressed as the annual percentage change in the consumer price index (CPI). Inflation was relatively low until the early 1970s, averaging 2.5% during the 1960s. It subsequently accelerated and entered the double-digit range in 1973. During the 1970s, the average inflation rate was 10.3%. After a period of

relative stability around a level of 11% in the late 1970s, inflation rose again in the early 1980s.

Table 1-2: Inflation in South Africa and its major trading partners

Country	Average annual rate (%)		
	1980–1990	1991–2000	2001–2010
RSA	14.57	8.99	6.13
<i>Trading partners</i>			
UK	7.62	3.05	2.60
USA	5.54	4.69	4.03
Germany	2.50	2.40	5.08
China	11.84	10.18	9.54

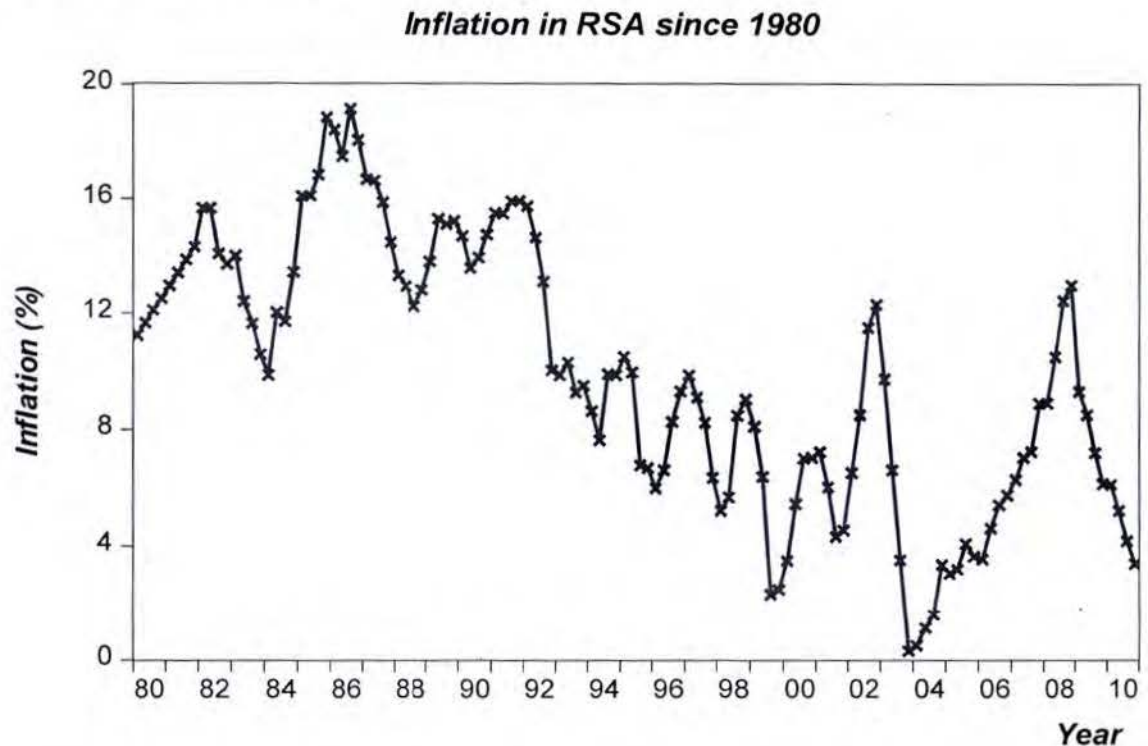
Source: World Bank Worlddata bank

The 1980s were characterised by high, but relatively stable rates of inflation ranging from 11.5 to 18.6%¹. The average inflation rate for the decade was 14.7%. Inflation subsided significantly in the early part of the 1990s. After peaking in 1986, the rate of inflation began decreasing and in 1993 it dropped to beneath 10%. It subsequently decreased further to 5.2% in 1999. On average, consumer prices rose by 9.3% during the 1990s. Stock prices also depicted an opposite trend in those years. This is clearly shown on the inflation and stock prices graphs. The pattern suggests that there is a negative relationship between inflation and the growth of stock prices. From the finance perspective,

Discussion of data sourced from the world Bank

we would arguably say “when inflation is on the rise, stay out of stocks and when inflation is on the decline, buy stocks”. Figure 1.2.2 below shows the picture of the discussion outline above.

Figure 1-2(b): Inflation in South Africa



Created by: Author

De Lange (2001) states that between September 2000 and August 2001, the price of Dimension Data shares on the Johannesburg Stock Exchange (JSE) plummeted by more than 80 per cent. According to de Lange, this has definitely astonished portfolio managers and individual investors to the core. Dimension Data's management was criticised for not issuing a timeous profitability warning. However, De Lange views this criticism as unfair, as he feels the warning signs had shown themselves prior to the fall in the share price.

According to the insightful financial theory, various macroeconomic variables affect stock market behaviour (Gjerde and Saettem, 1999: 61; Maysami and Koh, 2000: 79). The stock valuation model is normally concerned with the factors that affect the stock price of all firms. The monetary portfolio model by Rozeff (1974: 245) emphasises that a small increase in the cost of borrowing (interest rates) raises the opportunity cost of holding cash and this might lead to a substitution effect between stocks and other interest bearing securities. According to simple discounted present value (PV) model, stock prices are determined by the future cash flows to the firm and discount rates (Ibrahim and Jusoh, 2001; Ibrahim, 2002: 483).

The relationship between stock market and macroeconomic variables has also been extensively studied for other countries other than South Africa [e.g. Rousseau and Wachtel (2000: 657); Khan *et al.* (2007); Shahbaz *et al.* (2008: 182)]. Chen *et al.* (1986: 383) and Wongbangpo and Sharma (2002: 27) suggest a positive relationship between stock prices and industrial production index (IPI), which is used as a proxy for the levels of economic activity. Industrial production will influence stock prices through its impact on corporate profitability (Sharma and Wongbangpo (2002). Accordingly, stock returns-macro variables analysis investigates the interrelationship among the three markets, i.e. the goods market, the money market, and the security market.

Over the past few decades, the interaction of the capital market and the macroeconomics variables has been a subject of interest among financial economists and practitioners. It is often argued that stock market performance is determined by some fundamental macroeconomic variables such as the interest rate, Gross Domestic Product (GDP), exchange rate, inflation, industrial production and money supply. Anecdotal evidence from the financial press indicates that investors generally believe that monetary policy and macroeconomic events have a large influence on the volatility of the stock market. This implies that macroeconomic variables could exert shocks on share returns and influence investors' investment decision. This motivates many researchers to investigate the relationships between share returns hence stock market performance and macroeconomic variable.

Finance literature contains considerable number of studies that examine stock price behaviour. Perhaps, one very important subject that has received increasing attention from economists, financial investors and policy makers is on dynamic linkages between macroeconomic variables and stock returns. Based on the stock valuation model, macroeconomic forces may have systematic influences on stock market performance via their influences on expected discounted future cash flows. Alternatively, the relations between them may be motivated using the arbitrage pricing theory (APT) model sometimes called the asset pricing theory. It is an asset pricing model based on the idea that an asset's returns can be predicted using the relationship between that same asset and many common risk factors (Ross, 1976: 341). This theory predicts a relationship between the returns of a portfolio and the returns of a

single asset through a linear combination of many independent macro-economic variables.

Moreover, the standard aggregate demand and aggregate supply (AD/AS) framework also allows for the roles of equity markets especially in the specification of money demand and in monetary transmission mechanisms. These models provide a basis for the long-run relationship and short-run dynamic interactions among macroeconomic variables and stock prices, hence performance. The main emphases have generally been on asset pricing, return predictability, stock market efficiency and equity price channel of monetary transmission mechanisms.

1.3 Problem Statement

In both the domestic and international markets, investors face the problem of diversification, security analysis, security selection and asset allocation. On a broader scope, international investments pose extra problems such as exchange rate risk, restrictions on capital flows across national boundaries, an additional dimension of political risk, inflation risk and country specific regulations and differing accounting practices in different countries. Inflation risk exposure reflects a stock's sensitivity to unexpected changes in the inflation rate. Unexpected increases in the inflation rate put a downward pressure on

stock prices, leading to stocks to have a negative exposure to inflation risk (Grant, 2004).

A handful of the studies on the impact of macroeconomic indicators on the stock market behaviour concentrated more on the developed nations and less is known about the relationship between stocks and macroeconomic variables in emerging markets. The recent paper by Kyereboah-Coleman and Agyire-Tetty (2008: 365) was one of the papers that tried to investigate the effect of macroeconomic variables on one of the African stock markets². There might be some studies on the subject matter in South Africa but they are few.

Other extensive studies include Malliaris and Urruita (1991), which revealed that changes in money supply lead to changes in stock markets. Studies by Kraft and Kraft (1997: 417) as well as Rozeff (1974) rejected any causal link between money supply and the stock prices. These studies have supported the stock market efficiency hypothesis that stock prices reflect all available information. Gupta and Modise (2011) in their study on the macroeconomic variables and stock market predictability considered the macroeconomic variables as key in intertemporal assets pricing models that represents priced factors in ATP. To the best of our knowledge, the study of this nature is/ might be the first that intends to uncover any link between macroeconomic variables and stock prices in South Africa. This study will therefore attempt to address the gap in literature.

²Their study was based on the Ghana Stock Exchange

It is the contention of this paper to try and investigate the impact of inflation on the stock market performance using JSE as the case study. In establishing the relationship among these variables, this research paper tries to answer the question of whether the South African macroeconomic indicators have any significant influence on stock market volatility (behaviour) by focusing on the effects of interest rates, industrial production and the inflation rate. It is the intention of this study to try and find the link between macroeconomic variables and the stock market using the JSE as the case study.

1.4 Research Purpose

The purpose of this paper is to establish the relationship that exists (if any) between inflation and stock prices in South Africa. The study will therefore inform financial economists and managers as to which variable causes the other. This will be guided by the causality test, proposed by Granger (1980: 424)

1.5 Aims and Objectives

1.5.1 Aims

This study broadly aims at investigating the impact of macroeconomic variables, particularly the inflation on the stock prices in South Africa and hence provide some policy objectives based on the findings. These macroeconomic variables are interest rate, Gross Domestic Product (GDP), exchange rate, inflation, interest rate and money supply covering the period 1980-2010.

1.5.2 Research Objectives

The objectives of this study are:

1. To investigate the causal link between the exchange rate and the stock prices, GDP and stock prices, and stock prices in South Africa.
2. To determine whether exchange rate volatility has any effect on stock prices in South Africa,
3. To determine if other macroeconomic variables affect stock prices volatility in South Africa.

1.6 Research Hypothesis

The hypotheses to be tested are stated as follows:

There exists a functional relationship between stock prices on one hand and a set of variables on the other: inflation, exchange rate, interest rate, GDP and the growth of money supply in South Africa. These, simply put or stated as the *null* and *alternative* hypotheses can be written as follows:

H_0 : Inflation has no effect on stock prices.

H_1 : Inflation has an effect on stock prices.

H_0 : Macroeconomic variables have no effect on stock market³.

H_1 : Macroeconomic variables have an effect on stock market.

³ Note that a separate hypothesis is done for each variable and.

1.7 Significance of the study

In addition to shedding a much-needed analysis of the impact of macroeconomic variables on stock prices in South Africa, this study will add to the small number of empirical studies that examine economic data by means of cointegration and casualty methodologies. Moreover, the answer to the question of whether macroeconomic variables lead to stock price volatility can only be determined through empirical research.

1.8 Possible limitation of the study

Since the study uses secondary data, the limitations of the study relate to the reliability of data and estimation and correctness of the methodology employed by the owners of the data sources. South Africa, like most developing countries, lacks sufficient data and sometimes the available data may be inadequate, inaccurate and inconsistent, and may vary from one source to another. Therefore, the interpretation that will be made based on this study will carefully be done bearing in mind this limitation. This study is limited by the availability of continuous data.

1.9 Methodology⁴

The study employs the Autoregressive Distributed Lag (ARDL) model and the Error Correction Mechanism. The application of the ARDL model is adopted from Henry and Richard (1983) as this method considers the behaviour of the variable over time and assumes that the effect of independent variables is spread over time. Other tests (e.g. the causality test) are also conducted to find the direction of causation between the variables and such causality test, this involves the use of the bivariate causal test.

1.10 Study Layout

This study is organized into five chapters. Chapter one provides an introduction and background to the study. This chapter is also devoted to the specification of the aims and justification, as well as the relevance of the study to the South African economy. It also provides some macroeconomic developments and stock market trends. The background part of this chapter assists in capturing some salient features of the economy and in understanding some relevant policy variables to be included in the specification of the empirical model to use in the study.

Chapter two, split into theoretical and empirical literature review, presents fundamental theoretical underpinnings on stock market. Thus, conventional

⁴ This section is discussed in detail in chapter 3

theories of asset pricing, and variants of such theories are elaborated in this chapter. The essence of this chapter is to assess theoretically and empirically various determinants of stock prices in both developed and developing countries, and to capture the influence of policy variables on stock prices on the basis of various studies carried out by other researchers on this field. Thus, the literature review in its entirety assists in blending various variables that are suitable for inclusion in the specification of the variant of the empirical model used in this study. Finally, this chapter presents as well the synthesis of the literature reviewed as well.

The empirical model is specified and presented in chapter three and it follows directly and draws heavily from the literature discussed in chapter three as well as consideration of the background of the economy presented in chapter one. This chapter also discusses in detail the estimation technique adapted in this study, not leaving out some *a priori* expectations and expected signs of parameters of the model and the method of data collection and analysis. The actual data analysis; estimation, presentation and economic interpretation of the results is provided in chapter four. Finally, the summary of the findings, conclusion and policy recommendations are offered in chapter five.

1.11 Chapter Summary

This chapter has hinted some features of the economy ranging from its historical stance to policy stance. It has precisely delineated that there has been volatility in the stock prices traded at the Johannesburg Stock Exchange. This

volatility is attributed to macroeconomic indicators, particularly the inflation rate and other macroeconomic variables. Several studies that have been explored have found conflicting results as opposed to the theoretical underpinnings, hence a need to undertake a study of this nature.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter presents some fundamental theoretical underpinnings on stock prices. The first section of the chapter presents some conventional theories of asset pricing, which had dominated literature in analyzing determinants of stock prices in developed countries, and then moves on to present variants of such models for developing countries like South Africa. Under the theoretical literature we explore how the respective variables enter the model, and how it (exploration) helps to determine the main determinants of stock prices. The relationship between macroeconomic variables and stock prices is touched upon in the second section while at the same time presenting some synthesis of the reviewed literature.

2.1 Theoretical Literature

Khalid (2008) advocates that most of the empirical studies regarding the determinants of stock market movements have been centered around two theories, the quantity theory of money and the efficient market hypothesis. The quantity theory of money has played a huge role in establishing the relationship between the money supply and various economic variables, while on the other

hand, in the efficient market hypothesis, new information is rapidly incorporated into the stock prices. So stock prices reflect all currently available information.

2.1.1 The quantity theory of money

The modern quantity theory of money also known as monetary portfolio model, developed by Brunner (1961: 47), Friedman (1961: 447), Friedman and Schwartz (1963: 32), assumed investors reach an equilibrium position in which they hold a number of assets including money in their portfolio. A monetary disturbance, such as an unexpected increase in the growth rate of money supply, causes disequilibrium in portfolios of assets. As a result, asset holders adjust the portion of their portfolio represented by money balances. This adjustment modifies the demand for other assets that compete with money balances, including stocks. An increase in the money supply is expected to create an excess supply of money balances and an excess demand for stocks, and, as a result, stock prices are expected to rise. This conduit of reaction between changes in money supply and stock prices has been described by advocates of the quantity theory of money as direct channel.

An alternative explanation for the response of stock market prices to unexpected changes in the money supply is based on investors' expectations about the reaction of monetary authority to the surprise. This scenario is known as the policy anticipation effect. In particular, an unexpected increase in money stock will lead market participants to believe that the authorities will have to

tighten credit to offset the rise, the measurement taken by the authorities will involve higher interest rates. This will lead to lower stock prices for two reasons. First, the discount rate will rise to reflect expectations of higher rates. Secondly, expected corporate cash flow will decline if market participants believe that an increase in rates depresses economic activity.

In support of the quantity theory of money, Sellin (2001: 491) developed another theory that postulates that the money supply will affect stock prices only if the change in money supply alters expectations about future monetary policy. He argues that positive money supply shock will lead people to anticipate tightening monetary policy in the future and the subsequent increase demand for bonds will drive up the interest rates. As interest rates go up, the discount rates go up as well and the present value of future earnings will decline. Due to this increase in interest rates, economic activities fall, hence stock prices.

2.1.2 Efficient markets theory

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

$$E\left[\frac{P_t - P_t^*}{I_{t-1}}\right] = 0$$

where: P_t : is the actual price at time t .

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

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

The forecast error $P_t - P_t^*$ is uncorrelated with variables in the information set I_{t-1} .

In that way, price changes are uncorrelated with variables.

2.1.3 Random Walk Theory

The random walk theory states that market prices follow a random path up and down, without any influence by past price movements, making it impossible to predict with any accuracy which direction the market will move at any point. In other words, the theory claims that a path that a stock's price follows is a random walk that cannot be determined from historical price information, especially in the short term. Investors who believe in the random walk theory feel that it is impossible to outperform the market without taking on additional risk, and believe that neither fundamental analysis nor technical analysis have any validity. However, some proponents of this theory do acknowledge that markets move gradually upward in the long run.

2.1.4 Inflation and stock prices

When the general prices are higher, then the absolute value of cash flows is higher, which raises the equity value of the company. Thus, stock prices rise. Of course, there are lots of reasons why inflation may hurt the economy and thus business performance, but this does tend to have a direct, positive impact on stock price. Also, inflation tends to rise when the economy is good, which is also a time when the stock market may perform very well. Of course, 2008 has been an exception where economic performance has been terrible while inflation has been high.

2.1.5 Asset pricing theory and capital asset pricing theory.

Modern asset pricing theories rest on the notion that the expected return of a particular asset depends only on that component of the total risk embodied in it that cannot be diversified away (Ross *et al.*, 1996 and Radcliffe, 1994). Market equilibrium precludes a price system under which diversification earns a reward, and thus, in a world of costless arbitrage, the fundamental question for asset pricing reduces to the identification and measurement of the relevant component of risk that exercises influence on an asset's expected return. There are mainly two modern theories which postulate the relationship between macroeconomic variables and asset returns. These two models or theories are the CAPM and the APT. In the capital-asset-pricing model (as in Sharpe, 1964 and Lintner 1965: 365), a particular mean-variance efficient portfolio is singled out and used as a formalization of essential risk in the market as a whole, and

the expected return of an asset is related to its normalized covariance with this market portfolio. The residual component in the total risk of a particular asset, inessential risk, does not earn any reward because it can be eliminated by another portfolio with an identical cost and return but with lower level of risk (Sharpe, 1994 and Samuelson, 1970: 537). On the other hand, in the arbitrage pricing theory, a given finite number of factors is used as a formalization of systematic risks in the market as a whole, and the expected return of an asset is related to its exposure to each of these factors, and now summarized by a vector of factor loadings. The reward to the residual component in the return to a particular asset, unsystematic or idiosyncratic risk, can be made arbitrarily small simply by considering portfolios with an arbitrarily large number of assets.

The basic point, however, is that the two theories capture two different sets of risks and address different aspects of the premium-awarding scheme for taking such risks. The CAPM, by its emphasis on efficient diversification in the context of a finite number of assets, neglects unsystematic risks in the sense of the APT, whereas the APT, with its explicit focus on markets with a "large" number of assets, and by its emphasis on naive diversification and on the law of large numbers, neglects essential risks. The two theories seem to be inherently disjoint. It is surprising, however, that a model which unifies their basic ingredients can nevertheless be found; and moreover, that it is one in which the absence of arbitrage opportunities is not only sufficient, but in contrast to the literature, also necessary for the validity of the APT pricing formula.

2.2 Empirical Literature

Several studies have been conducted to examine the effects of macroeconomic variables on stock market of industrialized economies. The focus is now being extended towards the analysis of stock markets of developing economies, due to their enormous profit potentials. These studies identify such factors as industrial production, risk premiums, slope of the yield curve, inflation, interest rate, money supply, exchange rate and so forth as being important in explaining stock prices.

Chowdhury and Rahman (2004: 209) have studied the relationship between the predicted volatility of DSE⁵ returns and that of selected macroeconomic variables of Bangladesh economy. They have followed the methodology of Schwert (1989: 1115; 1990: 1237) to calculate the predicted volatility of the variables used in the study. They have calculated volatility from errors after using an autoregressive and seasonality adjusted forecasting model. The volatility series derived from such process has some limitations, which have been corrected in Generalized Conditional Autoregressive Heteroskedasticity (GARCH) models developed by Bollerslev (1986: 177). For example, empirical research has found that evidence of large changes in stock prices is followed by small changes of either signs. Therefore GARCH models, which take into account the volatility-clustering phenomenon of security prices, is more suitable

⁵ Dhaka Stock Exchange in Bangladesh

in modelling volatility of financial assets and macroeconomics variables like exchange rates, industrial production, inflation among others.

Two portfolio models explain the interaction between exchange rate and stock market volatility. First, the "Flow-Oriented" model (Dornbusch and Fischer, 1980 and Gavin, 1989: 181) – in which exchange rate movement affects output levels of firms as well as the trade balance of an economy. Share price movements on the stock market also affect aggregate demand through wealth, liquidity effects and indirectly the exchange rate. Specifically, a reduction in stock prices reduces wealth of local investors and further reduces liquidity in the economy. The reduction in liquidity also reduces interest rates which in turn induce capital outflows and in turn causes currency depreciation.

The second is the Stock-Oriented model (Frankel, 1983). In the case of the *Stock-Oriented* model the stock market exchange rate link is explained through a country's capital accounts. In this model, the exchange rate equates demand and supply for assets (bonds and stocks). Therefore, expectations of relative currency movements have a significant impact on price movements of financially held assets. Thus stock price movements may influence or be influenced by exchange rate movements. That is, if the cedi⁶, for a example, depreciates against a foreign currency (the British pound), it will increase returns on the foreign currency (the pound). Such events will motivate investors to move funds from domestic assets (stocks) towards pound assets, thus

⁶ Ghana currency

depressing stock prices. Thus a depreciating currency has a negative impact on stock market returns (Adjasi and Biekpe, 2006).

Officer (1973) showed that aggregate stock volatility, volatility of money growth and industrial production increased during the period of depression. But stock volatility was at similar levels before and after the depression. However, Black (1976: 716) and Christie (1982: 15) discovered that stock market volatility can partially be explained by financial leverage. This is a divergent finding to that of Officer (1973). Also, French *et al.* (1987) and Schwert (1989) measured market volatility as the variance of monthly returns of market index. They discovered that the market volatility changes over time. They were also of the view that the value of corporate equity depends of the health of the economy, so a change in the level of uncertainty about future macroeconomic conditions would cause a proportional change in stock return volatility.

But as French *et al.* (1987) fail to find a direct positive relation between expected return and volatility, Schwert (1989) also failed to explain much of the change in market volatility over time using macroeconomic variables. In a related study, Schwert (1990) analyzed the behaviour of stock return volatility around stock market crashes and discovered that stock market volatility jumps dramatically during the crash and returns to low pre-crash levels quickly.

In related studies, Officer (1973) explained the drop in stock market volatility in the 1960s with a reduced variability in industrial production. Schwert (1989) and Hamilton and Lin (1996) discovered that stock market volatility increases in

times of recession. In Mao and Kao (1990: 441) exporting firms' stock values were seen to be more sensitive to changes in foreign exchange rates. Their findings also revealed another topical issue of the relationship between stock prices at the macro and micro levels. Although theories suggest a causal relationship between exchange rate and stock prices, existing evidence indicates a weak link between them at a micro level. On the macro level, Mao & Kao (1990: 441) found that a currency appreciation negatively affects the domestic stock market for an export-dominant country and positively affects the domestic stock market for an import-dominant country, which seems to be consistent with goods market theory.

On the other hand, Khoo (1994: 342) estimated mining companies' economic exposure by using exchange rates, interest rates and price of oil and discovered that, the sensitivity of stock returns to exchange rate movement and proportion of stock returns explained by exchange rate movement are small. Domely and Sheehy (1996) also found a contemporaneous relation between the foreign exchange rate and the market value of large exporters in their study.

Adjasi and Biekpe (2006) scrutinized the relationship between stock market returns and exchange rate movements in seven African countries. Cointegration tests showed that in the long-run exchange rate depreciation leads to increases in stock market prices in some of the countries, and in the short-run, exchange rate depreciations reduce stock market returns. In Mishra (2004: 209), it was identified that there was no Granger's causality between the exchange rate and stock return. The study of Mishra (2004) indicated that stock return, exchange

rate return, the demand for money and interest rate are related to each other though no consistent relationship exists between them.

Furthermore, forecast error variance decomposition evidenced that exchange rate return affects the demand for money; interest rate causes exchange rate to change; exchange rate affects the stock return; demand for money affects stock return; interest rate affects the stock return, and demand for money affects the interest rate. Engle and Rangel (2005) also examine the link between the unconditional volatility and a number of macroeconomic variables. Bercker and Clement (2005) extended the SPLINE GARCH model proposed by Engle and Rangel (2005) when they modelled stock market volatility conditional on macroeconomic conditions. They incorporate macroeconomic information directly into the estimation of such GARCH models. It was demonstrated that forecasts of macroeconomic variables can be easily incorporated into volatility forecasts for share index returns. Thus their model can lead to significantly different forecasts than traditional GARCH type volatility models. It is also evident that the standard Granger causality method has been the most predominant model used in most studies.

One strand of studies have investigated the link between exchange rate and stock prices and includes Kim (2003: 301). Kim's (2003: 301) study reveals that that S&P's⁷ common stock price is negatively related to the exchange rate. Contrary to Kim's (2003) paper, Ozair (2006) found no causal linkage and no cointegration between these two financial variables, while Hatemi-J and

⁷ Standard and Poors in the USA

Irlandoust (2002: 197) found unidirectional causation from stock prices to exchange rate for Sweden. Tsoukalas (2003: 87) in the study of the relationship between stock prices and macroeconomic factors in Cyprus finds a strong relationship between stock prices and exchange rates.

Pan *et al.* (2007) take the data of seven East Asian countries over the period 1988 to 1998 to examine dynamic linkages between exchange rates and stock prices. The results of that study reveal that there is a bidirectional causal relation for Hong Kong before the 1997 Asian crises. Also, there is a unidirectional causal relation from exchange rates and stock prices for Japan, Malaysia, and Thailand and from stock prices to exchange rate for Korea and Singapore. During the Asian crises, there was only a causal relation from exchange rates to stock prices for all countries except Malaysia. Ibrahim and Aziz (2003: 6) analyze dynamic linkages between stock prices and four macroeconomic variables for Malaysia and use monthly data over the period 1977-1998. The empirical results show that the exchange rate is negatively associated with the stock prices.

Kurihara (2006: 375) chooses the period March 2001-September 2005 to investigate the relationship between macroeconomic variables and daily stock prices in Japan. He takes Japanese stock prices, U.S. stock prices, exchange rate (yen/U.S. dollar), and the Japanese interest rate among others. The empirical results show that domestic interest rate does not influence Japanese

stock prices. However, the exchange rate and U.S. stock prices affect Japanese stock prices. Consequently, the quantitative easing policy implemented in 2001 influenced Japanese stock prices. Doong *et al.* (2005: 118) investigate the dynamic relationship between stocks and exchange rates for six Asian countries (Indonesia, Malaysia, Philippines, South Korea, Thailand, and Taiwan) over the period 1989-2003. According to the study, these financial variables are not cointegrated. The result of Granger causality test shows that bidirectional causality can be detected in Indonesia, Korea, Malaysia, and Thailand.

Abdalla and Murinde (1997: 25) investigate stock prices-exchange rate relationships in the emerging financial markets of India, Korea, Pakistan and the Philippines and find a unidirectional causality from exchange rates to stock prices in India, Korea and Pakistan, while the results for the Philippines showed that causation runs from stock prices to exchange rate. Muhammad and Rasheed (2002: 535) examine the exchange rates and stock price relationships for Pakistan, India, Bangladesh and Sri Lanka using monthly data from 1994 to 2000. The empirical results show that there is a bi-directional long-run causality between these variables for only Bangladesh and Sri Lanka. No associations between exchange rates and stock prices are found for Pakistan and India. Smyth and Nandha (2003: 699) investigate the relationship between exchange rates and stock prices for the same countries over the period 1995-2001 and find that there is no long run relationship between variables

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

In order to analyze short-run dynamics and long-run relationships among macroeconomic variables⁸, we make use of the Autoregressive Distributed Lag (ARDL) model and the Error Correction Mechanism specifications in this study. The application of the ARDL is adopted from Henry and Richard (1983) because this method helps us to consider the behaviour of the variable over time and that the effect of the exogenous variables on stock market is spread over a period of time. The causality test is also conducted to find the direction of causation between the variables. This involves the bivariate causal test.

3.1 Model specification

The basis of our hypothesized model is the interrelationship among four markets, i.e. the goods market, the money market, the securities market and the labour market. However, Walras' law allows any one of these markets to be dropped from the analysis. We have therefore dropped the labour market from the explicit consideration. The goods market variables considered are the gross domestic product (GDP) and the consumer price index (CPI). The money

⁸ interest rate, Gross Domestic Product (GDP), exchange rate, inflation, and money supply

market variables under consideration are money supply and the interest rate and the security market variable(s) is the stock price indices. Finally, we also included in our study the exchange rate in order to account for the foreign exchange market and the trade balance since South Africa is a trade oriented. Thus, we establish the long run and short relationship between stock prices and the above mentioned macroeconomic variables, hence the model below.

$$X_t = \beta_1 + \beta_2 CPI_t + \beta_3 Ex_t + \beta_4 GDP_t + \beta_5 Ms_t + \beta_6 IR_t + \beta_7 IP_t + \beta_8 X_{t-1} + \mu_t \dots\dots (3.0)$$

Where X is the dependant variable (JSE price index), Ex is the exchange rate, GDP is the gross domestic product, Ms is the broad money, IR is the interest rate, IP is the industrial production index , β_1 and μ are intercept parameter and white noise error term.

3.2 Data description

The study uses time series quarterly data for the period 1980 to 2008. The data is obtained mainly from secondary sources including the South African Reserve Bank (SARB), Statistics South Africa (Stats SA), JSE publications, as well as the International Monetary Fund (IMF) International Financial statistics (Direction of trade). Table 3.1(a) shows the variables considered in this study and their definitions.

Table 1-2(a): Description of variables

Variable	Definition
JSE All price index	Official published index of the market weighted value of closing price for shares listed on Johannesburg Stock Exchange
Inflation	Proxied by consumer price index (CPI)
Gross domestic product (GDP)	Real production based on gross domestic product at constant prices
Interest rate	Base lending rate
Money supply (M3)	currency in circulation plus demand deposits plus savings, and time deposits
Exchange rate volatility (ExcR)	Exchange rate (Rand against a US Dollar)

3.2.1 Apriori expectation

The theoretical underpinnings of Fama (1990: 1089), Naka and Mukherjee (1995: 223) among others have suggested a positive relationship between stock prices and GDP. The higher level of GDP will increase stock prices through its impact on corporate profitability, hence stock prices and the opposite is the

case. This, therefore suggests that the value of β_4 is expected to be greater than zero ($\beta_4 > 0$).

The relationship between the general price level and stock prices has been theorised as negative (Fama and Schwart, 1977: 115; Cheng, 1995: 61). In a competitive country like South Africa, inflation raises a firm's production costs, decreases its future cash flow and lowers revenue. DeFina (1991: 2) in his study attributes this negative relationship to nominal contracts that disallow the immediate adjustments of the firm's costs and revenue. On this note, one would argue that stock prices could react in a positive manner to changes in the price level due to hedging. Equities serve as a hedge against inflation as they represent claims on real assets.

We expect that the money supply may have a positive effect on stock prices. Fluctuations in money supply may affect stock prices through changes in portfolio substitution or inflationary expectations. The volatility of interest rates is also crucial for asset pricing. The economic argument revolves around the discount rate used in computing the present value of asset prices. An increase in interest rates raises the required rate of return, which in turn affects the value of an asset negatively.

3.3 Analytical Techniques

3.3.1 Stationarity

For establishing a meaningful (as opposed to spurious) relationship between stock prices and various macroeconomic variables, the variables must satisfy stationarity condition. A series is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed (Gujarati and Porter, 2010). Differencing variables when they are stationary is likely to cause a loss of valuable information about the long-run relationship between the variables. The most commonly used methods are those adopted from Dickey and Fuller (1979) and the Augmented Dickey-Fuller (ADF). The Dickey-Fuller (DF) test involves running three regressions, one without drift, the second one with drift and the third with drift and trend. The equations are:

Without drift

$$X_t = \rho X_{t-1} + \varepsilon_t \dots\dots\dots (3.3.1.1)$$

The null hypothesis is that $H_0 : \rho = 1$ as opposed to $H_1 : \rho < 1$. An alternative way of writing the above equation is

$$\begin{aligned} \Delta X_t &= (\rho - 1)X_{t-1} + \varepsilon_t \\ &= \delta X_{t-1} + \varepsilon_t \dots\dots\dots (3.3.1.2) \end{aligned}$$

In this particular case the null hypothesis is that $\delta = 0$, suggesting that there is unit root or the process is non-stationary.

The equation with drift is

$$\Delta X_t = \alpha + \delta X_{t-1} + \varepsilon_t \dots\dots\dots (3.3.1.3)$$

With drift and trend

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \varepsilon_t \dots\dots\dots (3.3.1.4)$$

An improvement to the above method is the Augmented Dickey-Fuller test. Such test is presented below.

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{i=1}^n \lambda_i \Delta X_{t-i} + \varepsilon_t \dots\dots\dots (3.3.1.5)$$

Its advantage over the DF test is that it allows for the presence of the deterministic trend and drifts to be tested. This means that with the addition of the lagged difference terms, serial correlation is corrected in the residuals. Just like in the case of the DF test, the ADF test also involves three test specifications, one without drift, second with drift and the last with both the drift and the trend. One experiments with different specifications because the correct one may not be known. Specifications are as follows:

$$\begin{aligned} \Delta X_t &= \alpha + \beta t + \delta X_{t-1} + \sum_{i=1}^n \lambda_i \Delta X_{t-i} + \varepsilon_t \\ \Delta X_t &= \alpha + \delta X_{t-1} + \sum_{i=1}^n \lambda_i \Delta X_{t-i} + \varepsilon_t \dots\dots\dots (3.3.1.6) \\ \Delta X_t &= \delta X_{t-1} + \sum_{i=1}^n \lambda_i \Delta X_{t-i} + \varepsilon_t \end{aligned}$$

where X is the variable under consideration, Δ is the first difference operator, t is a time trend, n is the number of lags and ε_t is a white noise random error term. The number of difference terms to include is determined through the use of the Akaike (1974) and Schwartz (1978: 464) information criteria. An appropriate lag length would be the one that minimizes either AIC or SIC. These are not the only procedures recommended. Several authors have presented sequential procedures with the "general to specific" framework for testing unit root if the data generating process is not known.

If the null hypothesis, that $\delta = 0$, is not rejected the variable series contains a unit root and is non-stationary. An appropriate lag length is the one that reduces or eliminates autocorrelation, that is, we choose k such that serial correlation is eliminated. Few series are likely to be stationary at level form, and if not stationary, we proceed to the first and second differences to ensure that a series is stationary. This process of differencing a series X_t a certain number of times before it becomes stationary is referred to as the order of integration. If found to be stationary at level form, then it is said to be integrated of order zero denoted as $X_t \sim I(0)$ and if differenced d times before becoming stationary, then it is integrated of order d denoted $X_t \sim I(d)$. Thus any time we have an integrated time series of order one or greater, we have a non-stationary series. Though DF and ADF tests are very common, they are found to have some drawbacks in that their power as stated below and are likely to be low for series where

moving average terms are present or where the disturbances are heterogeneously distributed.

In this case the simple DF test is no longer valid, and the lagged differences of the dependent variable should be added or augmented to the test model in order to mitigate autocorrelation problem in the disturbance term. This, gives rise to the Augmented Dickey Fuller test, thus ADF takes into account the possibility of autocorrelation in the error term. Nevertheless, there are still other central problems associated with the ADF test. These include:

- The problem of the number of lags to include in the test equation, because incorporating many lags, although helps solve the problem of autocorrelation, reduces the power of the test, leading to acceptance of null hypothesis of nonstationarity when it ought to have been rejected. Similarly introducing too few lags may leave some autocorrelation unaccounted for and thereby resulting in rejection of null hypothesis, when is true (Harris, 1995; Pesaran, 1997: 289).
- The dilemma on whether to include the constant and trend in the test equation, because over parameterising the test equation may reduce the efficiency of the parameters and may lead to less accurate estimation, resulting in low size properties of ADF test by rejecting the null hypothesis when it ought to have been accepted. On the other hand, under parameterising the equation by leaving out the constant and trend when the actual data generating process includes an intercept and/or trend would have an impact on the test.

- Biasness towards non-rejection of the unit root hypothesis if the series is subject to exogenous break. Perron (1989, 1990) shows that the ADF tests for unit root hypothesis against trend stationary alternatives cannot reject unit root hypothesis if the true data generating process was stationary around a trend function that is subject to exogenous shock. In other words, structural breaks in the series may reduce the power of the test by increasing the probability of accepting the null hypothesis of unit root. Consequently the test may wrongly conclude that the series is non-stationary when it is stationary but subject to a break.

However, several improvements and solutions to the above problems have been proposed in literature, and the section that follows briefly outlines some. An alternative unit root test, Phillips-Perron (PP) test (Phillips 1987: 277; Phillips and Perron 1988: 335) will also be conducted to ensure the stationarity of the data series as this test uses non-parametric correction to deal with any correlation in the error terms.

3.3.2 Causality test

The Granger causality test is a technique for determining whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown, usually through a series of F-tests on lagged values of X (and with lagged values of Y also known), that those X values provide

statistically significant information about future values of Y . In performing the Granger causality tests, the hypothesized dependent variable is regressed on its lagged values. The lag length in the regression equation must be selected in such a way that the resulting residuals are white noise, eliminating any first order serial correlations. Next the lagged values of the hypothesized independent variable are added to the right side of the regression equation and the new regression is executed. Using an F test, the resulting sums of squared residuals from the two regression equations are compared. A relatively large difference between the two sums of squared residuals (a large F) would provide evidence that the hypothesized independent variable Granger causes the dependent variable (Granger, 1969: 424; 1980: 329 and 2001).

Since one of our objectives is to test the causal link between stock prices and inflation and other explanatory variables contained in table 1, we do such a test using a special test called Granger causality test. In the bivariate case, the standard Granger causality test amounts to testing whether past values of a variable Y_t , together with past values of another variable X_t , explain the current change in X_t better than the past values of X_t alone do. A failure to reject this null hypothesis leads to the researcher to conclude that Y_t Granger causes X_t . This process is repeated interchanging the two variables. The Vector Autoregressive bivariate regressions of the form below will be estimated:

$$SP_t = \sum_{i=1}^n \alpha_{1i} SP_{t-i} + \sum_{j=1}^n \alpha_{2j} CPI_{t-j} + \mu_t \dots\dots\dots (3.3.2.1)$$

$$CPI_t = \sum_{i=1}^k \lambda_{1i} CPI_{t-i} + \sum_{j=1}^k \lambda_{2j} SP_{t-j} + \delta_t \quad \dots\dots\dots (3.3.2.2)$$

Where SP_t represents the stock prices and CPI_t the inflation rate. μ_t and δ_t are the white noise terms. Using general-to-specific approach, the lag length is chosen such that serial correlation is eliminated between the error terms. The following presents all possible causal relationships:

- a) Unidirectional causality from SP_t to CPI_t exists if $\sum_{j=1}^k \alpha_{2j} \neq 0$ and $\sum_{j=1}^k \lambda_{2j} = 0$
- b) Unidirectional causality exists from CPI_t to SP_t if $\sum_{i=1}^k \lambda_{2i} \neq 0$ and $\sum_{j=1}^k \alpha_{2j} = 0$
- c) Bidirectional causality between SP_t and CPI_t if $\sum_{j=1}^k \lambda_{2j} \neq 0$ and $\sum_{j=1}^k \alpha_{2j} \neq 0$
- d) No causality is established between SP_t and CPI_t if $\sum_{j=1}^k \alpha_{2j} = 0$ and $\sum_{j=1}^k \lambda_{2j} = 0$

The results of the Granger causality test are sensitive to the lag lengths. Employing arbitrarily chosen lag lengths, although a common practice, gives rise to economic problems in that choosing a less than optimal lag order may lead to a bias, whereas, applying a more than optimal lag order may lead to a loss of efficiency (Ansari, 1994). To avoid these problems we use the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC) to determine the optimal lag length for each series by estimating an equation of an autoregressive form choosing a lag order as the optimal lag which minimizes the AIC and SIC. The optimal lag is the lag that minimizes the AIC. Knowing the

direction of causation will help the policy makers as to which variable to target first.

3.3.3 Cointegration Analysis and Error Correction Model

The idea of cointegration analysis derives from the notion that, although economic time series exhibit non-stationary behaviour, a linear combination among these non-stationary variables may be stationary. In this case, the series are said to be cointegrated. Therefore, the essence of conducting the cointegrating analysis is basically to test the presence of long-run relationships among variables, and in multivariate models, to estimate long-run parameters, to estimate long-run coefficients of adjustments, and to employ long-run information to estimate VECMs, which describe short-run dynamics.

After establishing the stationarity condition of the series, we then make use of the Johansen (1988: 231) and Johansen and Juselius (1990: 169) approaches to examine the test of a long-run equilibrium relationship among the variables. This involves testing for cointegration among the variables. One alternative of testing for cointegration is by use of the error terms obtained from the regression. The error terms thus obtained can be tested for stationarity, if stationary then there is long a run relation between the variables. In this study we employ the Johansen approach because the Engle-Granger method is somehow criticized on special grounds. Engle-Granger (1987) assumes one

cointegrating vector, but there is a possibility that more than one cointegrating vectors may be obtained.

After establishing the long run relationship between stock prices and the explanatory variables, we will then turn to examine the short-run dynamics of the relationship. For this purpose, following Engle and Granger (1987), an error correction model is developed. The error correction mechanism allows long term components of variables to obey equilibrium constraints, while short-run components have a flexible dynamic specification. The idea is simply that a proportion of the disequilibrium from one period is corrected in the next period. It involves estimating the model in the first difference form and adding an error correction term as an explanatory variable.

Several tests and procedures have been proposed in literature to test for cointegration between variables. The most celebrated of these tests are the Engle-Granger (EG) test, the Augmented Engle-Granger (AEG) test, the Cointegration Regression Durbin-Watson (CRDW) test, the Autoregressive Distributed Lag (ADL) model approach, and lastly the Johansen maximum likelihood test of cointegration within VAR framework. While the ADL and VAR approaches to cointegration are appropriate for cases where more than two variables are cointegrated in the regression (that is where there are more than one cointegrating vector), the former three are only appropriate for two variable cases (only when the assumption is made of one cointegrating vector).

Due to limitations inherent in the first three tests, the study employed Johansen maximum likelihood test of cointegration proposed and developed by Johansen (1988) and applied in Johansen and Juselius (1990), within the VAR approach. The whole mark of this test relies heavily on the relationship between the rank of a matrix and its characteristic roots. Therefore, the statistical hypothesis under cointegration is $H(p): \text{rank}(\Pi) \leq r$, where r is the rank of the long-run matrix Π (the number of linear dependent equations in the matrix, also known as cointegrating vectors). Johanson *et al.* (1990) suggest two tests statistics to use in order to decide on the number of characteristic roots that are insignificantly different from unity: the trace test and the maximum eigen-value test. Formally stated these statistics are:

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \dots\dots\dots (3.3.2.3)$$

$$\lambda_{\text{max}}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \dots\dots\dots (3.3.2.4)$$

where $\hat{\lambda}_i$ = the estimated values of the characteristic roots (also known as eigen-values) obtained from the estimated Π matrix.

T = the number of usable observations.

The first statistic in equation tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r , against a general alternative that it is not equal to r . Whereas the second statistics in equation tests the null hypothesis that the number of cointegrating vectors is r , against the alternative

of $(r + 1)$. Generally, the $\lambda_{\max}$ statistics is usually more preferred for trying to pin down the number of cointegrating vectors, since it has a shaper alternative.

In our case the error correction model to be estimated is as follows:

$$\Delta SP_t = \beta_1 + \sum_{i=0}^n \beta_2 \Delta CPI_{t-i} + \sum_{i=0}^n \beta_3 \Delta GDP_{t-i} + \sum_{i=0}^n \beta_4 \Delta MS_{t-i} + \sum_{i=0}^n \beta_5 \Delta IR_{t-i} + \sum_{i=1}^n \beta_7 \Delta SP_{t-i} + \beta_8 EC_{t-1} + v_t$$

(3.3.2.5)

Where the respective variables are of the same order of integration but those with order zero will cointegrate with high power, while those integrated with order one will cointegrate with low power. The value of n is chosen using the AIC and the SIC. EC is the error correction component and V is the random error term (white noise). The error correction term (EC) is the lagged values of the error term that has been derived from the regression model. If the coefficient of EC is negative and statistically significant, it tells us what proportion of the disequilibrium in stock prices is corrected in the next period.

CHAPTER 4

EMPIRICAL ANALYSIS

4.1 Introduction

This chapter discusses the estimation results of the study. The reliability of the results is done on both a priori criterion as well as on statistical test criterion. The reliability of a priori criterion is determined by the principles of economic theory and refers to the sign of the coefficient of economic theory, that is the marginal values. If the estimate turns up with the wrong signs or magnitudes, they are rejected, meaning that the observations are not the true representatives of the data. On statistical criterion, the statistical theory aims at evaluating statistical reliability of estimates of parameters. The tests normally used include the t-ratios, coefficient of determination (R^2) and many more. The reliability of data is based on the probability value. If the probability value is above 10 percent, the estimate in question is considered insignificant.

4.2 The Nature of Data and Variables used in the study

The nature of data for respective variables used in the study is summarized in Table 4.1 below. The residuals from some of the variables in level form do not satisfy the normality test. From the descriptive statistics, it is observed that the null-hypothesis that residuals from Money growth (MS) and exchange rate (ExcR)

variables are normally distributed is rejected at 5 percent level of significance (indicated by low p-value of Jarque-Bera statistic⁹), while for inflation (CPI), Economic growth (GDP), Real interest rate (IR) and stock prices (SP) such hypothesis cannot be rejected at 5 percent level of significance, hence residuals from these variables are normally distributed. The non-normality of residuals from the former variables might be due to the observed structural breaks and the presence of outliers present in the data of such variables, which therefore indicated that, in testing for stationarity of such variables, structural breaks and outliers had to be accounted for, lest false conclusions are drawn using conversational unit root tests.

Table 4-1: Descriptive Statistics for variables used in the study

<i>Variable</i>						
<i>Name</i>	<i>CPI</i>	<i>EXCR</i>	<i>GDP</i>	<i>IR</i>	<i>MS</i>	<i>SP</i>
Mean	9.944032	0.112903	3.787304	15.90524	1.804355	2.684590
Median	9.870000	0.550000	3.684381	15.50000	1.875000	2.667385
Maximum	19.13000	24.10000	11.90063	25.00000	2.190000	29.60749
Minimum	0.300000	-15.80000	-2.445693	9.000000	1.220000	-26.88132
Std. Dev.	4.568331	5.621763	2.617067	3.893865	0.254352	11.76430
Skewness	-0.054563	0.117367	0.240264	0.205275	-0.931413	-0.047107
Kurtosis	2.078676	6.216459	3.513579	2.207483	2.954003	2.993581
Jarque-Bera	4.447192	53.73700	2.555800	4.115940	17.93988	0.046073
Probability	0.108219	0.000000	0.278622	0.127713	0.000127	0.977227
Sum	1233.060	14.00000	469.6257	1972.250	223.7400	332.8891
Sum Sq. Dev.	2566.966	3887.319	842.4320	1864.949	7.957448	17023.05
Observations	124	124	124	124	124	124

Source: Author

⁹ This statistic proposed by Jarque-Bera (1982) is used to test for normality of residuals and is computed as $JB = [n/6SK^2 + n/24(EK - 3)^2]$, where n=number of observations, SK= a measure of skewedness of the distribution, and EK= measure of kurtosis of the distribution.

4.2.1 Unit Root Tests Results

In testing variables for unit root, the "Eye Ball" analysis was carried out first, thus the graphs and Autocorrelation Functions (ACF) of variables were plotted (See Appendix A). The results from this preliminary analysis showed that CPI and MS were non-stationary as indicated by the slowly falling Autocorrelation functions (ACF) towards zero as the number of lags of the ACF. However, ACFs of CPI and MS, respectively gave a notion of stationarity for these two.

The results pertaining to the most parameterized model are presented in Table 4.2 (b), where ADF-statistic, appropriate lag length based on AIC and SIC are reported. The results indicate that the series SP, GDP, IR and EXCR are stationary as the null hypothesis of unit root is rejected at, at most 10 percent level of significance, and therefore they are integrated of order zero, $I(0)$. On the other hand, series CPI and MS are non-stationary since the null hypothesis of unit root cannot be rejected for each of the series at any conversional level of significance. For the non-stationary series, the trend appears to be insignificant. Moreover, for the stationary series both the individual t-statistic for the trend and the F-test reinforce each other that the trend is significant at, at most 10 percent level of significance.

Table 4-2.(a): Unit Root Test Results using model with intercept only

<i>Name of variable</i>	<i>ADF Lag Length (K)</i>	<i>t-statistics ADF</i>	<i>PP Lag Length (K)</i>	<i>t-statistics PP</i>	<i>Inference</i>
<i>SP</i>	1	12.264(0.0000)	1	12.264(0.0000)	Stationary
<i>CPI</i>	4	1.113(0.7089)	4	1.07(0.7249)	Non-stationary
<i>MS</i>	1	0.217(0.9321)	5	0.553(0.8755)	Non-stationary
<i>GDP</i>	1	11.289(0.0000)	6	11.292(0.0000)	Stationary

<i>IR</i>	2	3.510(0.0093)	5	2.571(0.1017)	Stationary
<i>EXCR</i>	2	10.787(0.0000)	4	5.397(0.0000)	Stationary

Source: Author

Notes:

- Critical Values for Augmented Dickey Fuller (ADF)-Statistics are -3.21, -3.46, and -4.06 at 10%, 5% and 1% levels of significance respectively (values produced by E-views 7 and found in Dickey and Fuller (1979)).
- P-values in parentheses are the conventional probability values for the t-statistics.

Table 4-2(b): Unit Root Test Results using a model with intercept and trend

Name of variable	ADF Lag Length (K)	t-statistics ADF	PP Lag Length (K)	t-statistics PP	Inference
<i>SP</i>	1	12.220(0.0000)	1	12.166(0.0000)	Stationary
<i>CPI</i>	4	2.513(0.3212)	4	2.672(0.2501)	Non-stationary
<i>MS</i>	1	1.092(0.9254)	5	1.375(0.8635)	Non-stationary
<i>GDP</i>	1	11.867(0.0000)	6	12.278(0.0000)	Stationary
<i>IR</i>	2	4.292(0.0045)	5	9.932(0.0000)	Stationary
<i>EXCR</i>	2	5.401(0.0001)	4	10.749(0.0000)	Stationary

Source: Author

Since the variables CPI and MS were found to be non-stationary at level form, this prompts first difference to be done, with intercept and with intercept and trend. The results of unit root test done at first difference are reported in table 4-2(c) below. At first difference, the unit root is eliminated and hence the series CPI and MS are said to be integrated of order one, unlike the other series that are integrated of order zero, i.e. $\sim I(0)$. It is now appropriate that regression can be done since we know the order of integration of our variables. Having variables integrated of different orders does not imply that we cannot run a regression. This is according to Pesaran *et al* (2001: 289).

Table 4-2(c): Unit Root test Results at first difference

Name of variable	ADF Lag Length (K)	t-statistics		PP Lag		Inference
		ADF		Length (K)	PP	
CPI	3	8.289(0.0000)		4	25.595(0.0000)	Stationary
MS	0	9.179(0.0000)		5	9.213(0.0000)	Stationary
CPI	3	8.274(0.0000)		4	25.265(0.0000)	Stationary
MS	0	9.195(0.0000)		1	6.662(0.0000)	Stationary

Source: Author

4.3 Granger Causality Analysis

Under this section, we report the test results for the causation. We adopted Granger's representation. This follows from the fact that theory suggests that SP is explained by CPI, GDP, MS, IR and EXCR. It is therefore necessary to determine whether CPI plays a role if any, in the stock price volatility in South Africa. There seems to be causality between inflation and stock prices and runs from CPI to SP. This is justified by the F-value that is significant as depicted by its p- value. What this means is that CPI does cause SP. This is in support of the theory that postulates that CPI causes increases in stock prices.

The causality between GDP and SP was tested. The hypothesis that GDP does not granger cause SP was accepted, while the null hypothesis that says that SP does not granger cause GDP was found to be significant and thus led to acceptance of the alternative. The probability value for the F-statistic is 0.0056, which implies that the F-value is highly significant, therefore we conclude that

SP causes GDP. The opposite is the case with the null hypothesis that IR does not granger cause SP. We tend to accept and conclude that there is unidirectional causality with causality running from CPI to SP. See Table 4-2.4 below.

Table 4-3: Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
CPI does not Granger Cause SP	123	4.32636	0.0397
SP does not Granger Cause CPI		0.39691	0.5299
GDP does not Granger Cause SP	123	0.59445	0.4422
SP does not Granger Cause GDP		7.95440	0.0056
IR does not Granger Cause SP	123	2.67696	0.1044
SP does not Granger Cause IR		3.83425	0.0525
EXCR does not Granger Cause SP	123	0.08122	0.7761
SP does not Granger Cause EXCR		0.14216	0.7068
MS does not Granger Cause SP	123	3.19678	0.0763
SP does not Granger Cause MS		2.99075	0.0863

Based on the information reported on the table above, we conclude that only CPI and MS cause SP.

4.4 Model Estimation

The main aim of this paper is to find the macroeconomic impact of CPI on SP in South Africa. This is determined by the estimation coefficients. The results of the estimation based on level form series are reported in equation 4.4. and the variables in question are in their natural form. From the ADF and PP test

results, we saw that CPI and MS were $\sim I(1)$ while GDP, MS, IR, EXCR as well as SP were $\sim I(0)$. Therefore the estimation results obtained when using data in their level form is reported on table 4-4. Economic theory leads to believe that the long-run relationships could be found between SP, CPI, GDP, MS, IR and EXCR. As such, the relationship is found among the variables in the model.

Table 4-4: Model Estimation at levels

	$SP = 85 - 0.31948CPI - 0.09926GDP - 34.60453MS - 0.306525IR + 0.034044EXCR$					
<i>t-value</i>	(24.596)	(-2.658)	(-0.538)	(-16.400)	(-2.206)	(0.403)
<i>p-value</i>	[0.000]	[0.008]	[0.591]	[0.000]	[0.029]	[0.687]

Variables CPI, GDP, MS and IR have a negative effect on SP, while at the same time exchange rate has a positive effect in South Africa. This contradicts the theoretical underpinnings of, among others; Ito and Yuko (2005), Kawai and Khalid (2003: 131). This implies that in South Africa, when a rand appreciates, the value of the stock increases, which is not the case. The standard *t* – value for the intercept is highly significant with the *p* – value of 0.000. The model suggests that SP will fall by about 31 percent if CPI was to increase by one percent. This coefficient is highly significant. The coefficient of GDP is insignificant, which means that there is no clear relationship between SP and GDP. It should also be noted that these results were only preliminary as most test, e.g. RESET test were not taken into account at this stage.

MS and IR also show a negative relationship with significant. The R^2 of 0.803 suggests that SP is explained by about 80 percent of the explanatory variables

included in the model. The only problem with these results is that, there is serial correlation as shown by the Durbin – Watson statistics of 0.221636.

4.5 Other diagnostic tests

The Ramsey test was done and it revealed that the model was misspecified. This was shown by the coefficient of the fitted variable that was found to be significant at 1 percent. Though the models appeared wrongly specified, the RESET test does not provide the correct specification, therefore we proceeded with the estimation. The Breusch-Godfrey LM test was also done based on the series in level form and the result showed that there was serial correlation in the residuals if regression is done using that linear functional form that does not include the lagged values of the variables (including the dependent variable). The null hypothesis of the presence of serial correlation could not be rejected. This prompted us to use another approach that will take into account the problem of serial correlation. With the new approach, the results of the LM test are reported in table 4-5(a) below.

Table 4-5(a): BG LM Test

F-statistic	1.399842	Prob. F(2,109)	0.2510
Obs*R-squared	3.080161	Prob. Chi-Square(2)	0.2144

The results of the Chow Breakpoint Test reported in the table below support the rejection of the null hypothesis of no structural change in the period 1994Q4.

This is shown by the highly significant statistics (F) based on the p-value. (0.0000). See the table below.

Table 4-5(b): Chow Breakpoint Test

Null Hypothesis: No breaks at specified breakpoints

F-statistic	14.10788	Prob. F(6,112)	0.0000
Log likelihood ratio	69.80120	Prob. Chi-Square(6)	0.0000
Wald Statistic	84.64730	Prob. Chi-Square(6)	0.0000

4.6 Cointegration Analysis

From Table 4-6(a), the trace test rejects null hypothesis of zero cointegrating vector at 5 percent level of significance and that of at least two cointegrating vectors at 5 percent level of significance, in favour of at most three cointegrating vectors. The critical trace statistics at 5 percent level of significance are 95.753, 69.818 and 47.856 for both zero one and at most two cointegrating vector respectively, while that of at most three cointegrating vectors is 25.259, the values not reported herein. Therefore, the computed trace statistics that are greater than the critical trace values at 5 percent level of significance ($133.330 > 95.753$, $82.396 > 69.818$, $50.230 > 47.856$) explains the rejection of the null hypothesis of either zero, one or at most two cointegrating vectors.

Table 4-6 (a): Cointegration analysis, and testing for Cointegration Rank (r)

<i>Results for Trace Test</i>					
<i>Null Hypothesis</i>	<i>Alternative Hypothesis</i>	<i>Eigenvalue</i>	<i>LL</i>	<i>Trace Statistic</i>	<i>P-value</i>
$H_0: r = 0$	$H_1: r \geq 1$	0.348197	884.37	133.3304	(0.000)*
$r \leq 1$	$r \geq 2$	0.236856	868.29	82.39694	(0.0036)*
$r \leq 2$	$r \geq 3$	0.189287	855.80	50.23016	0.0294)*
$r \leq 3$	$r \geq 4$	0.109057	848.93	25.25906	(0.1524)
$r \leq 4$	$r = 5$	0.072027	844.49	11.51760	(0.1816)

Source: Author

Notes: (i) Asterisks *and ** indicates significant at 5% and 1% level of significance respectively.

(ii) Although, the trace statistics is tabulated above, it is not used in deciding the number of cointegrating vectors because of its lack of exactness, therefore decisions are based on the Maximum Eigenvalue Statistics, which is preferred over the former because of its exactness on the alternative hypothesis.

(iii) "LL" denotes log likelihood.

However, in an attempt to pin down the exact number of cointegrating vectors, the Maximum Eigenvalue Test was conducted and results are reported in Table 4-6(a). The results of the maximum eigenvalue test reject the hypothesis of one cointegrating vector at 1 percent level of significance and pins down that there are two cointegrating vectors. The rejection of the null hypothesis is explicated by the fact that the computed maximum eigenvalue statistic at 5 percent level of significance for null hypothesis of one cointegrating vector is 50.933, the value greater than the critical maximum Eigen value at the same level for one cointegrating vector ($50.933 > 40.077$), therefore indicating the rejection of the null hypothesis in favour of an alternative hypothesis of two cointegrating vectors or rank 2 of the Π matrix. See the respective Table below.

Table 4-6(b): Cointegration Analysis – Results from Maximum Eigenvalue Test**Results for Maximum Eigenvalue Test**

<i>Null Hypothesis</i>	<i>Alternative Hypothesis</i>	<i>Eigenvalue</i>	<i>LL</i>	<i>λ_{max} Statistic</i>	<i>95%CV</i>
$H_0: r = 0$	$H_1: r = 1$	0.348197	884.37	50.933	40.077*
$r = 1$	$r = 2$	0.236856	868.29	32.166	33.876
$r = 2$	$r = 3$	0.189287	855.80	24.971	27.584
$r = 3$	$r = 4$	0.109057	848.93	13.741	21.131
$r = 4$	$r = 5$	0.072027	844.49	8.895	14.264

Source: Author

Notes: (i) Asterisks * indicates significant at 5% level of significance respectively.

(ii) Although, the trace statistics is tabulated above, it is not used in deciding the number of Cointegrating vectors because of its lack of exactness, therefore decisions are based on the Maximum Eigenvalue Statistics, which is preferred over the former because of its exactness on the alternative hypothesis.

(iii) "LL" denotes log likelihood.

(iv) "CV" denotes critical value.

Therefore, from the above-determined rank of the Π matrix, the respective unrestricted normalized estimates for the two cointegrating vectors β' , also known as the long-run elasticities and their respective unrestricted long-run adjustment co-efficients are reported in Table 4-6(c) and 4-6(d) respectively. According to Charemza and Deadman (1993), the adjustment coefficients in the α matrix are supposed to be negative in order to be in alignment with the hypothesis of an error correction mechanism given by deviations from the long-run equilibrium or variable path, and that both β' and α co-efficients attain some economic meaning after standardizing. The elements of the β' matrix are economically interpreted as the long-run parameters and those of the α matrix are referred to as the measure of the speed of adjustment of particular variables with respect to a disturbance in the equilibrium relation.

Table 4-6 (c): The Normalized Unrestricted Cointegration Vectors (The β' matrix)

	<i>SP</i>	<i>CPI</i>	<i>GDP</i>	<i>MS</i>	<i>IR</i>	<i>EXCR</i>
β_1'	1.00000	-1.946259 (0.62435)	11.01327 (2.78111)	35.04790 (10.3266)	-0.972765 (0.78839)	4.172698 (1.08280)
β_2'	0.00000	1.00000	25.93471 (10.2712)	-53.12826 (42.4035)	-2.81711 (3.20087)	-23.73528 (4.38345)

Table 4-6(d): The Normalised Unrestricted Vectors

	<i>SP</i>	<i>CPI</i>	<i>GDP</i>	<i>MS</i>	<i>IR</i>	<i>EXCR</i>
β_1'	1.00000	-1.946259 (0.62435)	11.01327 (2.78111)	35.04790 (10.3266)	-0.972765 (0.78839)	4.172698 (1.08280)

Table 4-6(e): the Unrestricted Long – run Adjustment Coefficients Matrix (The α matrix)

Variable	α_1
<i>SP</i>	-0.012630 (0.01297)
<i>CPI</i>	-0.020676 (0.00731)
<i>GDP</i>	-0.044155 (0.01666)
<i>MS</i>	-0.000709 (0.00025)
<i>IR</i>	0.022669 (0.00844)
<i>EXCR</i>	-0.082878 (0.03582)

Note:

- Values in parenthesis are the conversional t-values given by $t = \beta/\text{se}(\beta)$ and $t = \alpha/\text{se}(\alpha)$ respectively.
- In order to identify the unique Eigenvector, the trend in the standardized β^1 Eigenvector was restricted to zero and the first variable in the first restricted to one.

Interestingly, the adjustment coefficients of the α matrix appear with negative signs for the first variables; SP, CPI, GDP, MS and EXCR suggesting that they align with the theory. The variable IR, on the other hand has a positive sign and therefore contradicts with economic theory.

4.7 Vector Error Correction model (VECM)

Since the variables guaranteed existence of cointegration with each other as depicted in section 4.5, there was a need to perform the error correction mechanism. The intuition behind this is to capture the long-run responses in series. This is achieved by running equation 3.3.2.5. The results of the short-run dynamics are presented in Table 4-7 below.

Table 4-7: The VECM Results

Error Correction:	$\Delta(\text{SP})$	$\Delta(\text{CPI})$	$\Delta(\text{GDP})$	$\Delta(\text{MS})$	$\Delta(\text{IR})$	$\Delta(\text{EXCR})$
CointEq1	-0.012630 (0.01297) [-0.97417]	-0.020676 (0.00731) [-2.82901]	-0.044155 (0.01666) [-2.65030]	-0.000709 (0.00025) [-2.87464]	0.022669 (0.00844) [2.68718]	-0.082878 (0.03582) [-2.31402]

Note: Numbers in parenthesis () are the standard deviations and those in brackets [] are the t-values

The VECM results reveal that about 1 percent of the disequilibrium is corrected each quarter by changes in stock prices in South Africa. This is justified by the coefficient -0.012630. This coefficient bears the expected sign (negative) as per theory. The error correction suggests the validity of the equilibrium relationship indicating the existence of market forces that operate to restore long – run

equilibrium after a short – run short. Most variables coefficients bear negative signs as was expected, except the interest rate (0.022669).

4.8 Interpretation of results

The findings of this study provide reliable evidence explaining the relationship between stock prices and our independent variables (CPI, GDP, MS, IR and EXCR). The results reveal negative and significant coefficients of inflation, economic growth, growth of money supply as well as real interest rates. Appendix D(a) shows the R^2 of .803443 suggests that the model explains 83 percent of the variation in stock prices and the F-statistic is highly significant, meaning that the respective explanatory variables indeed explain stock prices.

The coefficient of interest rate variable is negatively correlated with stock prices in South Africa. When interest rate increases, the investors tend to switch out of stocks causing a fall in stock prices. This implies that a certain level of predictability is present in stock prices that can be explained through the behaviour of the interest rate in South Africa. The growth of money supply on the other hand was also found to be negatively related to stock prices, which contradicts theoretical bearing. Only the lagged money supply mainly appeared to have a negative impact on equity price movements implying that investors could earn profits by using a trading strategy based on the past behaviour of the money stock.

One most influential macroeconomic variable is the exchange rate, which displays mainly a negative relation to stock prices. The implication of this finding is that, for an export dominant economy, (exports companies listed on the JSE), the currency appreciation has a negative effect on the stock market of which the currency appreciation enhances the stock market for an import dominant country. The results obtained seem to indicate that, contrary to a commonly held belief among economists and investment analysts, the stock prices are mainly negatively related to inflation. This finding implies that the stock prices decline during the inflationary phase.

CHAPTER 5

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.0 Introduction

This section discusses the summary, conclusions and the policy recommendations based on the results obtained. In the policy recommendations, policy implications of the findings are discussed and some suggestions about the stock market behaviour in South Africa.

5.1 Summary and Conclusions

Using quarterly data covering the period 1980-2010, the existence of a stable long-run relationship between stock prices and inflation has been tested in this study and the results are affirmative. Causality and cointegration tests have been done. Using the cointegration vectors found in the study, a significant impact of inflation on stock prices cannot be refuted. The inertia in the stock prices could be due to the volatility expectations. It can also be explained by the general equilibrium nature of price system where the increase in one price will drive up the other ones and the continuity of the process will be guaranteed whenever overshooting of some prices occur.

5.2 Recommendations

The regression results in this study revealed a strong relation between the stock prices and inflation and other explanatory variables. The key finding is that the null hypotheses, which suggest the coefficients of variables do not make any impact on stock prices in South Africa are rejected. This was shown by the Wald test that restricts the coefficients or equates all coefficients to zero. The p-values on the Wald test seemed highly significant, thus suggesting that none of the coefficients are zeros. The negative and positive effects of the explanatory variables on stock prices found in this study have several practical implications. The evidence provides that stock prices appear to react mainly negatively to inflation rates and interest rate. The findings on the impact of inflation on stock prices in this study appear to be consistent with those of Fama (1981), Gupta and Modise (2010) and Gallagher and Taylor (2005: 147). One reason for this relationship between stock prices and interest rate could be that the expected returns on stocks on which the higher interest rate has a direct bearing. This therefore, reveals that higher interest rates would directly affect the returns on stocks causing prices to fall. When interest rate increases, the investors tend to switch out of stocks causing a fall in stock prices. This implies that a certain level of predictability is present in stock prices that can be explained through the behaviour of the interest rate in South Africa.

The growth of money supply was found to be negatively related to stock prices, which contradicts theoretical bearing. Only the lagged money supply appeared to have a negative impact on equity price movements implying that investors could earn profits by using a trading strategy based on the past behaviour of the money stock. One most influential macroeconomic variable is the exchange rate, which displays mainly a negative relation to stock prices. The implication of this finding is that, for an export dominant economy, (exports companies listed on the JSE), the currency appreciation has a negative effect on the stock market of which the currency appreciation enhances the stock market for an import dominant country.

The results obtained seem to indicate that, contrary to a commonly held belief among economists and investment analysts, the stock prices are mainly negatively related to inflation. This finding implies that the stock prices decline during the inflationary phase. The results have implications on both local and foreign investors, stock market regulators such as Securities and Exchange Commission, policy makers and stock market analysts. Investors and security analysts could predict stock prices and earn profits. Stock market regulators could take steps to monitor the activities of companies to prevent manipulation of stock prices and get the general public educated on the stock market and encourage them to invest in stocks. Policy makers should be aware of these macroeconomic effects, more specially the inflation, on stock market and take informed decisions in a more effective and accurate way. It is also important that, investors hedge against inflation and exchange rate.

5.3 Limitations of the Study

The study used quarterly time series data for the period 1980-2010, the period chosen subject to data availability. Therefore, the major limitation of this study is the quality and reliability of data used in the analyses. This limitation is grounded on the fact that in South Africa like in any developing country, data sets available are either, inaccurate or/and sometimes inconsistent, thus varying between sources. However, the interpretation, credibility and degree of reliability as well as policy recommendations drawn on the results of this study are done carefully with this limitation taken into consideration.

5.4 Areas of further research

Although, the study has demonstrated the impact of policy variables on stock prices in South Africa, several extensions of the presented work seem worth pursuing in the course of any further research. In particular, more theoretical and empirical analysis is required and country – comparative (panel) studies are necessary in order to achieve adequate and informed policy recommendations.

Having identified the critical role that inflation and other macroeconomic variables play in regard to stock market, a need arises therefore to further empirically test the relationship using non-linear functional forms as opposed to the linear model assumed in this study. Moreover, it was mentioned under the synthesis of literature, that the reviewed literature shows that stock market are

very much multidimensional, and that only the most important factors that affect stock prices were identified, and it by no means provided an exhaustive list of stock price determinants and very few have herein been empirically tested. It therefore becomes relatively important to further attempt modelling stock prices using other variables and different methodologies. With regard to applying a different methodology to modelling stock prices as an area for further research, we suggest the use of Generalised Autoregressive Conditional Heteroskedasticity (GARCH). We hope this will make us understand better the behaviour of stock markets.

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APPENDICES

APPENDIX A

SP

Date: 9/19/11 Time: 21:12

Sample: 1980Q1 2010Q4

Included observations: 124

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
*****	*****	1	0.959	0.959	116.76	0.000
*****	*	2	0.908	-0.134	222.44	0.000
*****	*	3	0.865	0.076	319.08	0.000
*****	..	4	0.826	0.010	407.95	0.000
*****	..	5	0.785	-0.050	488.89	0.000
*****	..	6	0.750	0.063	563.31	0.000
*****	*	7	0.725	0.091	633.47	0.000
*****	*	8	0.709	0.086	701.20	0.000
*****	..	9	0.695	0.009	766.78	0.000
*****	**	10	0.661	-0.236	826.70	0.000
*****	..	11	0.623	-0.020	880.36	0.000
*****	..	12	0.585	-0.043	928.05	0.000
*****	*	13	0.540	-0.106	969.08	0.000
*****	*	14	0.486	-0.089	1002.7	0.000
****	..	15	0.435	-0.020	1029.8	0.000
****	*	16	0.387	-0.070	1051.4	0.000
**	..	17	0.346	0.025	1069.0	0.000
**	..	18	0.314	0.029	1083.5	0.000
**	..	19	0.284	0.028	1095.5	0.000
**	..	20	0.258	0.019	1105.5	0.000
**	..	21	0.232	-0.023	1113.6	0.000
*	..	22	0.207	0.025	1120.2	0.000
*	*	23	0.186	0.117	1125.5	0.000
*	..	24	0.165	0.003	1129.8	0.000
*	..	25	0.143	0.007	1133.0	0.000
*	..	26	0.120	-0.010	1135.3	0.000
*	..	27	0.101	-0.000	1136.9	0.000
*	..	28	0.082	-0.033	1138.0	0.000
..	..	29	0.068	0.058	1138.8	0.000
..	..	30	0.056	-0.029	1139.3	0.000
..	..	31	0.043	-0.041	1139.6	0.000
..	*	32	0.028	-0.110	1139.8	0.000
..	..	33	0.014	0.001	1139.8	0.000
..	..	34	0.001	-0.014	1139.8	0.000
..	..	35	-0.013	-0.032	1139.8	0.000
..	..	36	-0.021	0.070	1139.9	0.000

CPI

Date: 09/19/11 Time: 21:14

Sample: 1980Q1 2010Q4

Included observations: 124

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
*****	*****	1	0.948	0.948	114.13	0.000
*****	***	2	0.862	-0.357	209.34	0.000
*****		3	0.772	0.018	286.37	0.000
*****		4	0.692	0.048	348.70	0.000
*****		5	0.648	0.295	403.82	0.000
*****		6	0.630	0.032	456.35	0.000
*****		7	0.614	-0.104	506.71	0.000
*****		8	0.594	-0.021	554.19	0.000
*****		9	0.570	0.100	598.39	0.000
*****		10	0.537	-0.053	637.86	0.000
*****		11	0.510	0.098	673.79	0.000
*****		12	0.498	0.071	708.37	0.000
*****		13	0.511	0.245	745.16	0.000
*****		14	0.537	-0.027	786.15	0.000
*****		15	0.560	-0.044	831.03	0.000
*****		16	0.564	-0.076	877.09	0.000
*****		17	0.548	0.041	920.93	0.000
*****		18	0.522	0.049	961.15	0.000
*****		19	0.501	0.056	998.55	0.000
*****		20	0.493	0.012	1035.1	0.000
*****		21	0.497	0.039	1072.7	0.000
*****		22	0.496	-0.165	1110.3	0.000
*****		23	0.475	-0.106	1145.2	0.000
*****		24	0.432	-0.115	1174.3	0.000
*****		25	0.371	-0.008	1196.0	0.000
*****		26	0.304	-0.088	1210.8	0.000
*****		27	0.243	-0.119	1220.3	0.000
*****		28	0.190	-0.162	1226.1	0.000
*****		29	0.152	0.007	1229.9	0.000
*****		30	0.125	-0.057	1232.5	0.000
*****		31	0.100	-0.033	1234.2	0.000
*****		32	0.079	-0.002	1235.3	0.000
*****		33	0.061	0.042	1235.9	0.000
*****		34	0.045	-0.064	1236.2	0.000
*****		35	0.035	-0.089	1236.5	0.000
*****		36	0.027	-0.118	1236.6	0.000

GDP

Date: 09/19/11 Time: 21:17

Sample: 1980Q1 2010Q4

Included observations: 124

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
. .	. .	1 -0.013	-0.013	0.0200	0.888
* .	* .	2 -0.203	-0.203	5.2873	0.071
. *	. *	3 0.106	0.104	6.7277	0.081
. *	. *	4 0.186	0.154	11.222	0.024
. *	. *	5 0.092	0.146	12.340	0.030
. .	. .	6 -0.032	0.027	12.479	0.052
. *	. *	7 0.119	0.139	14.385	0.045
. *	. *	8 0.131	0.094	16.713	0.033
. .	. .	9 -0.056	-0.044	17.142	0.047
. .	. .	10 0.012	0.010	17.163	0.071
. .	. .	11 0.027	-0.062	17.262	0.100
. *	. .	12 0.082	0.033	18.190	0.110
. .	. .	13 0.002	-0.021	18.191	0.150
. .	. .	14 -0.020	-0.004	18.247	0.196
. .	. .	15 0.018	-0.024	18.291	0.248
. *	. *	16 0.142	0.143	21.221	0.170
. *	. *	17 0.083	0.104	22.226	0.176
* .	* .	18 -0.142	-0.092	25.195	0.120
. .	. .	19 0.050	0.051	25.562	0.143
. *	. *	20 0.192	0.095	31.086	0.054
. .	. .	21 -0.015	-0.018	31.120	0.072
. .	. .	22 -0.037	0.009	31.327	0.090
. .	. .	23 0.050	0.002	31.717	0.106
. *	. *	24 0.176	0.095	36.556	0.048
* .	* .	25 -0.134	-0.147	39.384	0.034
* .	. .	26 -0.103	-0.063	41.073	0.031
. *	. .	27 0.156	0.023	44.999	0.016
. *	. .	28 0.105	0.056	46.790	0.014
. .	. .	29 -0.008	0.069	46.802	0.019
. .	. .	30 -0.054	0.009	47.280	0.023
. .	. .	31 0.015	-0.018	47.320	0.031
. *	. *	32 0.180	0.144	52.800	0.012
. .	. .	33 0.025	0.061	52.904	0.015
* .	. .	34 -0.087	-0.065	54.208	0.015
. .	. .	35 0.069	0.039	55.035	0.017
. .	* .	36 0.019	-0.134	55.098	0.022

MS

Date: 09/19/11 Time: 21:18
Sample: 1980Q1 2010Q4
Included observations: 124

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. *****	. *****	-1	0.971	0.971	119.73	0.000
. *****	* .	2	0.938	-0.080	232.40	0.000
. *****	* .	3	0.902	-0.069	337.44	0.000
. *****	. .	4	0.868	0.017	435.43	0.000
. *****	* .	5	0.829	-0.090	525.69	0.000
. *****	* .	6	0.786	-0.092	607.58	0.000
. *****	. .	7	0.742	-0.034	681.15	0.000
. *****	. .	8	0.696	-0.063	746.34	0.000
. *****	. .	9	0.650	-0.012	803.72	0.000
. *****	. .	10	0.604	-0.011	853.78	0.000
. *****	. .	11	0.558	-0.035	896.90	0.000
. *****	. *	12	0.518	0.080	934.36	0.000
. ***	. .	13	0.482	0.048	967.12	0.000
. ***	. .	14	0.448	-0.025	995.58	0.000
. ***	. .	15	0.415	0.010	1020.2	0.000
. ***	. *	16	0.389	0.101	1042.2	0.000
. ***	* .	17	0.363	-0.070	1061.4	0.000
. **	. .	18	0.340	0.006	1078.5	0.000
. **	. .	19	0.315	-0.047	1093.2	0.000
. **	. *	20	0.298	0.077	1106.6	0.000
. **	. .	21	0.284	0.036	1118.8	0.000
. **	. .	22	0.270	-0.052	1129.9	0.000
. **	. .	23	0.259	0.054	1140.4	0.000
. **	. .	24	0.247	-0.040	1149.9	0.000
. **	. .	25	0.236	-0.017	1158.6	0.000
. **	. .	26	0.222	-0.056	1166.5	0.000
. *	. .	27	0.206	-0.048	1173.4	0.000
. *	* .	28	0.186	-0.084	1179.0	0.000
. *	* .	29	0.162	-0.094	1183.3	0.000
. *	. .	30	0.136	-0.022	1186.4	0.000
. *	. .	31	0.107	-0.063	1188.3	0.000
. *	. .	32	0.081	0.073	1189.5	0.000
. .	. .	33	0.057	0.035	1190.0	0.000
. .	. .	34	0.033	-0.011	1190.2	0.000
. .	. .	35	0.010	0.058	1190.2	0.000
. .	. .	36	-0.011	0.011	1190.2	0.000

IR

Date: 09/19/11 Time: 21:20

Sample: 1980Q1 2010Q4

Included observations: 124

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
*****	*****	1	0.917	0.917	106.84	0.000
*****	*	2	0.819	-0.139	192.74	0.000
*****	**	3	0.677	-0.327	251.94	0.000
****	*	4	0.525	-0.125	287.85	0.000
***	.	5	0.384	0.051	307.26	0.000
**	.	6	0.270	0.107	316.93	0.000
*	.	7	0.175	-0.027	321.00	0.000
.	*	8	0.126	0.134	323.13	0.000
.	.	9	0.096	0.002	324.36	0.000
*	.	10	0.083	-0.054	325.30	0.000
*	.	11	0.079	-0.028	326.17	0.000
*	.	12	0.079	0.010	327.03	0.000
.	.	13	0.073	-0.019	327.78	0.000
.	.	14	0.068	0.011	328.42	0.000
.	.	15	0.055	0.001	328.86	0.000
.	.	16	0.048	0.050	329.20	0.000
.	*	17	0.055	0.103	329.63	0.000
.	.	18	0.070	0.046	330.36	0.000
*	.	19	0.088	-0.042	331.51	0.000
*	*	20	0.122	0.082	333.76	0.000
*	.	21	0.155	0.036	337.40	0.000
*	.	22	0.197	0.073	343.33	0.000
**	*	23	0.246	0.118	352.71	0.000
**	*	24	0.274	-0.089	364.41	0.000
**	.	25	0.290	-0.041	377.66	0.000
**	.	26	0.286	-0.031	390.74	0.000
**	*	27	0.253	-0.077	401.09	0.000
*	.	28	0.210	0.004	408.27	0.000
*	.	29	0.152	-0.020	412.07	0.000
*	.	30	0.094	0.037	413.54	0.000
.	*	31	0.033	-0.091	413.72	0.000
.	.	32	-0.020	-0.043	413.79	0.000
.	.	33	-0.065	0.002	414.53	0.000
*	.	34	-0.098	-0.027	416.19	0.000
*	*	35	-0.128	-0.081	419.06	0.000
*	.	36	-0.147	-0.017	422.90	0.000

EXCR

Date: 09/19/11 Time: 21:21

Sample: 1980Q1 2010Q4

Included observations: 124

Autocorrelation		Partial Correlation		AC	PAC	Q-Stat	Prob
. .	. .	1	0.019	0.019	0.0469	0.828	
* .	* .	2	-0.188	-0.189	4.5972	0.100	
. **	. **	3	0.244	0.261	12.267	0.007	
. .	. .	4	0.021	-0.043	12.323	0.015	
* .	* .	5	-0.159	-0.068	15.652	0.008	
* .	** .	6	-0.138	-0.211	18.174	0.006	
. .	. .	7	0.019	0.005	18.224	0.011	
* .	* .	8	-0.070	-0.088	18.876	0.016	
. .	. *	9	-0.010	0.103	18.888	0.026	
. .	* .	10	0.001	-0.066	18.889	0.042	
. .	. .	11	-0.062	-0.045	19.428	0.054	
. .	* .	12	-0.035	-0.113	19.598	0.075	
. *	. *	13	0.078	0.089	20.458	0.084	
. .	. .	14	-0.004	-0.035	20.460	0.116	
* .	. .	15	-0.083	-0.008	21.448	0.123	
. .	. .	16	0.070	-0.009	22.162	0.138	
* .	* .	17	-0.066	-0.126	22.795	0.156	
* .	* .	18	-0.127	-0.103	25.165	0.120	
. .	. .	19	-0.004	-0.036	25.167	0.155	
. **	* .	20	-0.064	-0.084	25.790	0.173	
* .	* .	21	-0.121	-0.097	28.014	0.140	
. .	. .	22	0.049	0.021	28.380	0.163	
. .	. .	23	0.030	-0.065	28.517	0.197	
. .	. .	24	0.007	0.052	28.525	0.239	
. *	. .	25	0.116	0.051	30.638	0.201	
. .	. .	26	0.015	-0.046	30.677	0.241	
. .	. .	27	0.019	-0.007	30.732	0.282	
. .	. .	28	0.066	0.017	31.430	0.298	
. .	. .	29	0.011	-0.015	31.451	0.344	
* .	* .	30	-0.107	-0.099	33.368	0.307	
. .	. .	31	0.032	0.058	33.544	0.345	
. .	. .	32	0.063	-0.024	34.220	0.362	
* .	. .	33	-0.070	0.015	35.072	0.370	
. .	. .	34	-0.027	-0.034	35.194	0.411	
. .	. .	35	0.024	-0.033	35.299	0.454	
. .	. .	36	0.002	-0.043	35.300	0.502	

APPENDIX B

Dependent Variable: D(SP)
Method: Least Squares
Date: 9/22/11 Time: 11:21
Sample (adjusted): 1981Q2 2010Q4
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.171079	0.183619	0.931705	0.3540
D(SP(-1))	0.135570	0.110532	1.226522	0.2232
D(SP(-2))	-0.051325	0.112755	-0.455185	0.6501
D(SP(-3))	0.122633	0.110118	1.113660	0.2684
D(SP(-4))	0.099328	0.108285	0.917287	0.3615
D(CPI)	0.020945	0.177284	0.118145	0.9062
D(CPI(-1))	-0.252238	0.176677	-1.427675	0.1569
D(CPI(-2))	-0.224837	0.170254	-1.320598	0.1900
D(CPI(-3))	0.031641	0.173623	0.182243	0.8558
D(CPI(-4))	-0.033446	0.172871	-0.193476	0.8470
D(GDP)	0.034595	0.079557	0.434842	0.6647
D(GDP(-1))	0.125561	0.104333	1.203459	0.2320
D(GDP(-2))	0.209843	0.118297	1.773866	0.0795
D(GDP(-3))	0.128686	0.102155	1.259715	0.2111
D(GDP(-4))	0.020749	0.075945	0.273211	0.7853
D(MS)	5.941617	5.366073	1.107256	0.2712
D(MS(-1))	-2.843758	5.613953	-0.506552	0.6137
D(MS(-2))	0.017541	5.427687	0.003232	0.9974
D(MS(-3))	-5.482063	5.442896	-1.007196	0.3166
D(MS(-4))	-3.936684	5.187486	-0.758881	0.4499
D(IR)	0.039194	0.156309	0.250747	0.8026
D(IR(-1))	0.005828	0.177325	0.032864	0.9739
D(IR(-2))	0.109121	0.184347	0.591934	0.5554
D(IR(-3))	0.058610	0.173225	0.338344	0.7359
D(IR(-4))	-0.108004	0.172287	-0.626888	0.5323
D(EXCR)	0.075410	0.037479	2.012078	0.0472
D(EXCR(-1))	0.080162	0.047154	1.699990	0.0926
D(EXCR(-2))	0.058861	0.055588	1.058891	0.2925
D(EXCR(-3))	-0.002498	0.045807	-0.054532	0.9566
D(EXCR(-4))	-0.008591	0.034348	-0.250133	0.8031
R-squared	0.222216	Mean dependent var	0.325034	
Adjusted R-squared	-0.031219	S.D. dependent var	1.749598	
S.E. of regression	1.776698	Akaike info criterion	4.201105	
Sum squared resid	280.9425	Schwarz criterion	4.901725	
Log likelihood	-219.9658	Hannan-Quinn criter.	4.485605	
F-statistic	0.876816	Durbin-Watson stat	1.926429	
Prob(F-statistic)	0.646669			

APPENDIX C

WALD TEST

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.363037	(5, 89)	0.2459
Chi-square	6.815185	5	0.2348

Null Hypothesis: $C(1)=C(2)=C(3)=C(4)=C(5)=0$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.171079	0.183619
C(2)	0.135570	0.110532
C(3)	-0.051325	0.112755
C(4)	0.122633	0.110118
C(5)	0.099328	0.108285

Restrictions are linear in coefficients.

APPENDIX D

Regression (a)

Dependent Variable: SP
Method: Least Squares
Date: 9/20/11 Time: 22:04
Sample: 1980Q1 2010Q4
Included observations: 124

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	85.50890	3.476409	24.59690	0.0000
CPI	-0.319480	0.120192	-2.658084	0.0089
GDP	-0.099264	0.184501	-0.538011	0.5916
MS	-34.60453	2.109964	-16.40054	0.0000
IR	-0.306525	0.138896	-2.206873	0.0293
EXCR	0.034044	0.084333	0.403693	0.6872
R-squared	0.803443	Mean dependent var		14.64567
Adjusted R-squared	0.795114	S.D. dependent var		11.32073
S.E. of regression	5.124246	Akaike info criterion		6.153021
Sum squared resid	3098.432	Schwarz criterion		6.289487
Log likelihood	-375.4873	Hannan-Quinn criter.		6.208457
F-statistic	96.46699	Durbin-Watson stat		0.221636
Prob(F-statistic)	0.000000			

Regression (b)

Dependent Variable: SP

Method: Least Squares

Date: 09/23/11 Time: 00:35

Sample (adjusted): 1980Q3 2010Q4

Included observations: 122 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.886859	2.979966	2.311053	0.0228
SP(-1)	1.064736	0.098427	10.81751	0.0000
SP(-2)	-0.124939	0.100661	-1.241194	0.2173
CPI	0.017632	0.142861	0.123424	0.9020
CPI(-1)	-0.287960	0.223187	-1.290217	0.1998
CPI(-2)	0.166343	0.136776	1.216168	0.2267
GDP	0.031824	0.070629	0.450582	0.6532
GDP(-1)	0.108988	0.066026	1.650689	0.1018
GDP(-2)	0.132894	0.068496	1.940178	0.0551
MS	6.404480	4.648804	1.377662	0.1713
MS(-1)	-7.732506	6.794488	-1.138056	0.2577
MS(-2)	-1.617383	4.428356	-0.365233	0.7157
IR	0.042752	0.129418	0.330336	0.7418
IR(-1)	-0.036687	0.183613	-0.199804	0.8420
IR(-2)	-0.030003	0.140561	-0.213454	0.8314
EXCR	0.060428	0.033126	1.824181	0.0710
EXCR(-1)	0.002944	0.031249	0.094220	0.9251
EXCR(-2)	-0.024183	0.031363	-0.771059	0.4424
R-squared	0.981525	Mean dependent var	14.81322	
Adjusted R-squared	0.978505	S.D. dependent var	11.33664	
S.E. of regression	1.662075	Akaike info criterion	3.989463	
Sum squared resid	287.2993	Schwarz criterion	4.403171	
Log likelihood	-225.3572	Hannan-Quinn criter.	4.157498	
F-statistic	325.0164	Durbin-Watson stat	1.954354	
Prob(F-statistic)	0.000000			

APPENDIX E

Date: 9/20/11 Time: 22:45
Sample (adjusted): 1981Q2 2010Q4
Included observations: 119 after adjustments
Trend assumption: Linear deterministic trend
Series: SP CPI GDP MS IR EXCR
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.348197	133.3304	95.75366	0.0000
At most 1 *	0.236856	82.39694	69.81889	0.0036
At most 2 *	0.189287	50.23016	47.85613	0.0294
At most 3	0.109057	25.25906	29.79707	0.1524
At most 4	0.072027	11.51760	15.49471	0.1816
At most 5	0.021793	2.621990	3.841466	0.1054

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.348197	50.93351	40.07757	0.0021
At most 1	0.236856	32.16678	33.87687	0.0788
At most 2	0.189287	24.97110	27.58434	0.1042
At most 3	0.109057	13.74146	21.13162	0.3866
At most 4	0.072027	8.895608	14.26460	0.2949
At most 5	0.021793	2.621990	3.841466	0.1054

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX F: ERROR CORRECTION MODEL RESULTS

Vector Error Correction Estimates

Date: 09/26/11 Time: 20:31

Sample (adjusted): 1981Q2 2010Q4

Included observations: 119 after adjustments

Standard errors in () & t-statistics in []

Cointegrating Eq:	CointEq1					
SP(-1)	1.000000					
CPI(-1)	-1.946259 (0.62435) [-3.11725]					
GDP(-1)	11.01327 (2.78111) [3.96003]					
MS(-1)	35.04790 (10.3266) [3.39396]					
IR(-1)	-0.972765 (0.78839) [-1.23386]					
EXCR(-1)	4.172698 (1.08280) [3.85362]					
C	-83.67972					

Error Correction:	D(SP)	D(CPI)	D(GDP)	D(MS)	D(IR)	D(EXCR)
CointEq1	-0.012630 (0.01297) [-0.97417]	-0.020676 (0.00731) [-2.82901]	-0.044155 (0.01666) [-2.65030]	-0.000709 (0.00025) [-2.87464]	0.022669 (0.00844) [2.68718]	-0.082878 (0.03582) [-2.31402]
D(SP(-1))	0.178665 (0.10809) [1.65294]	0.135608 (0.06093) [2.22553]	0.260041 (0.13890) [1.87218]	-0.000411 (0.00206) [-0.19996]	-0.086326 (0.07033) [-1.22745]	0.471241 (0.29859) [1.57820]
D(SP(-2))	-0.074483 (0.11581) [-0.64317]	0.055434 (0.06528) [0.84913]	0.018653 (0.14881) [0.12534]	0.000117 (0.00220) [0.05295]	-0.019699 (0.07535) [-0.26144]	-0.371146 (0.31991) [-1.16015]
D(SP(-3))	0.160912 (0.11314) [1.42224]	0.017096 (0.06378) [0.26805]	-0.042398 (0.14539) [-0.29162]	0.000536 (0.00215) [0.24876]	-0.049398 (0.07362) [-0.67103]	0.471679 (0.31255) [1.50915]
D(SP(-4))	0.111585 (0.11269) [0.99018]	0.108717 (0.06353) [1.71135]	0.054004 (0.14481) [0.37293]	0.003231 (0.00215) [1.50619]	-0.055716 (0.07332) [-0.75987]	-0.158062 (0.31131) [-0.50774]
D(CPI(-1))	-0.242388 (0.17431) [-1.39059]	0.284277 (0.09826) [2.89308]	-0.192976 (0.22399) [-0.86155]	-0.000709 (0.00332) [-0.21356]	-0.016016 (0.11341) [-0.14122]	0.289908 (0.48152) [0.60207]
D(CPI(-2))	-0.206135 (0.16872) [-1.22176]	-0.076169 (0.09511) [-0.80083]	0.228937 (0.21681) [1.05593]	-0.000881 (0.00321) [-0.27443]	0.170524 (0.10978) [1.55333]	0.171323 (0.46608) [0.36758]
D(CPI(-3))	0.034740	0.041516	0.008273	-0.005452	-0.146390	0.553554

	(0.16954) [0.20491]	(0.09557) [0.43439]	(0.21786) [0.03798]	(0.00323) [-1.68956]	(0.11031) [-1.32706]	(0.46834) [1.18194]
D(CPI(-4))	-0.079824 (0.15475) [-0.51581]	-0.352323 (0.08724) [-4.03858]	-0.597092 (0.19886) [-3.00252]	-0.002101 (0.00295) [-0.71312]	-0.076457 (0.10069) [-0.75931]	-0.031841 (0.42751) [-0.07448]
D(GDP(-1))	0.207080 (0.14574) [1.42090]	0.111329 (0.08216) [1.35508]	-0.474002 (0.18728) [-2.53101]	0.005038 (0.00277) [1.81596]	-0.164638 (0.09483) [-1.73620]	0.815144 (0.40260) [2.02470]
D(GDP(-2))	0.273930 (0.12869) [2.12856]	0.035814 (0.07255) [0.49366]	-0.591391 (0.16537) [-3.57610]	0.002065 (0.00245) [0.84315]	-0.059613 (0.08374) [-0.71192]	0.873638 (0.35551) [2.45742]
D(GDP(-3))	0.192009 (0.10067) [1.90738]	0.003287 (0.05675) [0.05792]	-0.376500 (0.12936) [-2.91051]	0.002380 (0.00192) [1.24210]	-0.012915 (0.06550) [-0.19717]	0.774677 (0.27809) [2.78572]
D(GDP(-4))	0.068694 (0.07222) [0.95123]	-0.033064 (0.04071) [-0.81218]	-0.126293 (0.09280) [-1.36093]	-0.000675 (0.00137) [-0.49118]	-0.009296 (0.04699) [-0.19784]	0.736469 (0.19949) [3.69167]
D(MS(-1))	-1.097527 (5.51869) [-0.19887]	-2.515985 (3.11103) [-0.80873]	-5.848087 (7.09165) [-0.82464]	0.146563 (0.10505) [1.39523]	-0.273288 (3.59079) [-0.07611]	16.40983 (15.2452) [1.07639]
D(MS(-2))	-0.352880 (5.30398) [-0.06653]	-5.925425 (2.98999) [-1.98175]	-1.003951 (6.81575) [-0.14730]	-0.006578 (0.10096) [-0.06516]	-5.106514 (3.45109) [-1.47968]	0.788687 (14.6521) [0.05383]
D(MS(-3))	-7.198783 (5.17838) [-1.39016]	3.083644 (2.91919) [1.05634]	-21.70348 (6.65434) [-3.26155]	-0.106375 (0.09857) [-1.07920]	-2.953420 (3.36936) [-0.87655]	-3.267929 (14.3051) [-0.22844]
D(MS(-4))	-2.523426 (4.96703) [-0.50803]	-7.168704 (2.80005) [-2.56021]	4.845970 (6.38276) [0.75923]	0.005681 (0.09455) [0.06009]	-2.548850 (3.23185) [-0.78867]	19.31634 (13.7213) [1.40776]
D(IR(-1))	-0.139698 (0.15128) [-0.92345]	0.336187 (0.08528) [3.94219]	0.043533 (0.19440) [0.22394]	-0.002961 (0.00288) [-1.02820]	-0.076772 (0.09843) [-0.77996]	-1.814702 (0.41790) [-4.34241]
D(IR(-2))	0.162572 (0.16718) [0.97246]	-0.004473 (0.09424) [-0.04746]	-0.116257 (0.21483) [-0.54117]	-0.000213 (0.00318) [-0.06700]	0.435724 (0.10877) [4.00575]	0.522425 (0.46182) [1.13123]
D(IR(-3))	0.072822 (0.16484) [0.44177]	-0.290521 (0.09293) [-3.12635]	-0.078483 (0.21183) [-0.37050]	-0.005944 (0.00314) [-1.89428]	0.077760 (0.10726) [0.72498]	0.764730 (0.45538) [1.67933]
D(IR(-4))	-0.144130 (0.17616) [-0.81820]	0.007208 (0.09930) [0.07259]	-0.524638 (0.22637) [-2.31766]	-0.003573 (0.00335) [-1.06550]	-0.145169 (0.11462) [-1.26654]	0.186086 (0.48663) [0.38240]
D(EXCR(-1))	0.068054 (0.05689) [1.19631]	0.046247 (0.03207) [1.44213]	0.222530 (0.07310) [3.04412]	0.003377 (0.00108) [3.11850]	-0.080423 (0.03701) [-2.17276]	-0.549907 (0.15715) [-3.49927]
D(EXCR(-2))	0.032003	0.034612	0.191987	0.002569	-0.094268	-0.645083

	(0.05550) [0.57665]	(0.03129) [1.10631]	(0.07132) [2.69205]	(0.00106) [2.43203]	(0.03611) [-2.61055]	(0.15331) [-4.20765]
D(EXCR(-3))	-0.007218 (0.04482) [-0.16105]	0.004685 (0.02527) [0.18542]	0.177915 (0.05760) [3.08904]	0.001555 (0.00085) [1.82216]	-0.081342 (0.02916) [-2.78921]	-0.244592 (0.12382) [-1.97545]
D(EXCR(-4))	-0.013302 (0.03332) [-0.39927]	0.003976 (0.01878) [0.21172]	0.109861 (0.04281) [2.56615]	0.000317 (0.00063) [0.50027]	-0.047397 (0.02168) [-2.18649]	-0.123284 (0.09203) [-1.33955]
C	0.128193 (0.18480) [0.69370]	-0.249918 (0.10417) [-2.39903]	-0.289365 (0.23747) [-1.21855]	-0.005730 (0.00352) [-1.62907]	-0.024416 (0.12024) [-0.20306]	0.148094 (0.51049) [0.29010]
R-squared	0.184209	0.576637	0.658994	0.333453	0.433570	0.702792
Adj. R-squared	-0.035089	0.462829	0.567326	0.154274	0.281303	0.622898
Sum sq. resids	294.6708	93.64262	486.5867	0.106764	124.7515	2248.712
S.E. equation	1.780029	1.003449	2.287382	0.033882	1.158194	4.917285
F-statistic	0.839994	5.066779	7.188901	1.861001	2.847444	8.796491
Log likelihood	-222.8044	-154.5952	-252.6470	248.6136	-171.6621	-343.7235
Akaike AIC	4.181587	3.035214	4.683144	-3.741406	3.322052	6.213841
Schwarz SC	4.788791	3.642417	5.290347	-3.134202	3.929256	6.821045
Mean dependent	0.325034	-0.080504	-0.022670	-0.004958	-0.008403	-0.011765
S.D. dependent	1.749598	1.369113	3.477428	0.036843	1.366182	8.007477
Determinant resid covariance (dof adj.)	0.504278					
Determinant resid covariance	0.114891					
Log likelihood	-884.3777					
Akaike information criterion	17.58618					
Schwarz criterion	21.36952					

APPENDIX G

Ramsey RESET Test

Equation: UNTITLED

Specification: SP C CPI GDP MS IR EXCR

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	13.08438	117	0.0000
F-statistic	171.2009	(1, 117)	0.0000
Likelihood ratio	111.7840	1	0.0000

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	1840.572	1	1840.572
Restricted SSR	3098.432	118	26.25790
Unrestricted SSR	1257.861	117	10.75095
Unrestricted SSR	1257.861	117	10.75095

LR test summary:

	Value	df
Restricted LogL	-375.4873	118
Unrestricted LogL	-319.5953	117

Unrestricted Test Equation:
 Dependent Variable: SP
 Method: Least Squares
 Date: 09/24/11 Time: 08:35
 Sample: 1980Q1 2010Q4
 Included observations: 124

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-66.61080	11.83695	-5.627361	0.0000
CPI	-0.103476	0.078659	-1.315491	0.1909
GDP	0.198540	0.120231	1.651315	0.1014
MS	31.91588	5.260172	6.067459	0.0000
IR	0.537016	0.109796	4.891034	0.0000
EXCR	-0.004513	0.054042	-0.083515	0.9336
FITTED^2	0.048653	0.003718	13.08438	0.0000
R-squared	0.920204	Mean dependent var		14.64567
Adjusted R-squared	0.916112	S.D. dependent var		11.32073
S.E. of regression	3.278863	Akaike info criterion		5.267666
Sum squared resid	1257.861	Schwarz criterion		5.426876
Log likelihood	-319.5953	Hannan-Quinn criter.		5.332341
F-statistic	224.8744	Durbin-Watson stat		0.444465
Prob(F-statistic)	0.000000			

APPENDIX H

LM TEST (a)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	461.7492	Prob. F(1,117)	0.0000
Obs*R-squared	98.93214	Prob. Chi-Square(1)	0.0000

LM Test (b)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.399842	Prob. F(2,109)	0.2510
Obs*R-squared	3.080161	Prob. Chi-Square(2)	0.2144

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 09/20/11 Time: 22:00

Sample: 1980Q2 2010Q4

Included observations: 123

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.583302	3.185689	0.183101	0.8551
SP(-1)	-0.007220	0.035315	-0.204454	0.8384
CPI	-0.026420	0.125673	-0.210225	0.8339
CPI(-1)	0.027513	0.128710	0.213763	0.8311
GDP	-0.005252	0.063717	-0.082429	0.9345
GDP(-1)	-0.001113	0.062726	-0.017746	0.9859
MS	-0.385169	4.245956	-0.090714	0.9279
MS(-1)	0.139498	4.299765	0.032443	0.9742
IR	0.015817	0.122146	0.129492	0.8972
IR(-1)	-0.017653	0.120088	-0.146999	0.8834
EXCR	-0.006467	0.029702	-0.217746	0.8280
EXCR(-1)	0.001588	0.029466	0.053885	0.9571
RESID(-1)	0.154666	0.105625	1.464285	0.1460
RESID(-2)	-0.090251	0.106863	-0.844551	0.4002
R-squared	0.025042	Mean dependent var	-3.14E-16	
Adjusted R-squared	-0.091237	S.D. dependent var	1.600557	
S.E. of regression	1.671978	Akaike info criterion	3.972698	
Sum squared resid	304.7108	Schwarz criterion	4.292784	
Log likelihood	-230.3209	Hannan-Quinn criter.	4.102716	
F-statistic	0.215360	Durbin-Watson stat	1.950970	
Prob(F-statistic)	0.998265			