

AN EMPIRICAL REVIEW OF THE COMPLIMENTARY NATURE OF
FUNDAMENTAL AND TECHNICAL ANALYSIS TECHNIQUES BASED ON
JSE-LISTED STOCKS

BY

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ABSTRACT

This study contributes to the debate on whether fundamental analysis and technical analysis techniques can be used jointly in making investment decisions. Extant literature on fundamental and technical analysis techniques has frequently focused on analysing each of the valuation techniques independently of one another. In this study we construct a model that integrates both fundamental and technical analysis variables (hybrid model) to determine whether the hybrid model can have a superior explanatory power to models based on each of the valuation techniques in isolation. This study is based on all ordinary shares that have been listed on the JSE main board between the 2002 and 2012 fiscal years. Testing rejects the complimentary nature of fundamental and technical analysis techniques by showing that the technical analysis model has a superior explanatory power to both the hybrid model and the fundamental analysis model. We also demonstrate that JSE-listed stocks do not exhibit momentum or contrarian effects with respect to return performances and that the fundamental analysis variables that play a significant role in explaining stock price movements of JSE-listed stocks are the book value per share, cash flow per share, earnings per share and dividends per share.

Key words: Fundamental analysis, technical analysis, integration of fundamental and technical analysis

DECLARATION

I, Vuyolwethu Mashika declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in Finance and Investment at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Vuyolwethu Mashika

Signed at

On the day of 2014

DEDICATION

This thesis is dedicated to my late mother, Nobuntu Mashiqua, who taught me invaluable lessons in life. One of them being that I could achieve whatever goals I sought to pursue, no matter what the challenge, if I believed in myself.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Numerous equity valuation techniques have been developed since the late 1800s¹. Equity investors often have a preference for certain types of these equity valuation techniques when selecting stocks to include or remove from their investment portfolios. While an extensive amount of theoretical work has been conducted on each of the valuation techniques, practitioners and academics remain divided on which valuation technique best captures stock price movements. There is currently very limited amount of studies that aim to address this problem, especially in developing markets such as South Africa.

A further problem that remains unanswered is whether using a combination of equity valuation techniques can generate higher returns than using only one in isolation.

Answers to the above problems would not only settle the debate amongst academics and amongst practitioners, but would also allow investors to be more efficient in executing investment decisions and gain more insight into the drivers of asset prices. This study seeks to address these challenges in the South African context.

The subsequent sections in this chapter are organised as follows: we first provide background to the study to bring the reader up to speed with developments in equity valuation techniques. We then describe the gaps that have been identified in the existing body of knowledge. Furthermore we discuss how this study will address those gaps and the significance this study is expected to have.

1.2 Background to the study

There are mainly two distinct types of equity valuation techniques used by equity analysts, namely, Fundamental Analysis and Technical Analysis. Both techniques seek to identify profitable investment opportunities but they approach this problem from entirely different perspectives. The goal of a fundamental analyst is to determine whether a security is undervalued or overvalued relative to its “true” value. A technical analyst uses historical prices and volumes data to forecast future price trends of the security (see Levy, 1966).

¹ Rutterford (2004) provides a history of developments in equity valuation techniques since the 1800s.

Jackson (2006) pointed out that technical analysis is in essence an umbrella term for a myriad of technical indicators. Technical chart patterns and technical theories such as the Dow Theory, Elliot Wave Theory, Kondratieff Wave Theory, provided the early building blocks of technical indicators. Other technical indicators that have been introduced in recent times include Trend Following, Breath, Momentum, Sentiment Indicators² etc. These indicators have been developed with the purpose of giving a technical analyst a wide variety of tools to analyse the market and also as pointed out by Pring (1991, p. 9), *“No single indicator can ever be expected to signal all trend reversals, and so it is essential to use a number of them together to build up a consensus”*.

Fundamental analysis on the other hand maintains that share prices may deviate from their true fundamental prices due to short term market imbalances. The fundamental stock price is determined by the fundamental analyst based on an evaluation of the external and internal factors that can influence the future economic prospects of the firm. The external factors include economy-wide dynamics that will affect all companies in the economy as well as industry-specific factors that will affect all companies operating within a particular industry. The internal factors relate to company-specific concerns. On the basis of the temporary mispricing, a fundamental analyst would trade the mispriced stock and then profit when the stock price eventually converges towards the fundamental stock price (see Al-Abduljader and Al-Maraikhi, 2011).

An immense amount of academic literature has been written about the fundamental and technical analysis valuation techniques, with particular reference to their ability to earn risk-adjusted returns³. However, the level of market efficiency dictates whether the valuation techniques can be consistently profitable. In a market where stock prices reflect all available historical price and volumes data, technical analysis should not be able to provide profitable price forecasts. A market whose prices reflect all publicly available information should deem both fundamental and technical analysis unprofitable. The existing literature has produced mixed results on whether stock markets are efficient or not. However, the increasing popularity of technical analysis especially among asset management firms as noted by

² Alexander (1961), Kaufman (2005) and Davis (2003) provide an in-depth discussion of these indicators.

³ See e.g. Brock et al (1992), Ready (2002), Lento and Gradojevic (2007) etc.

Menkhoff (2010) points towards possible market inefficiencies in fully reflecting information in prices.

The existing literature often analyses the two valuation techniques in isolation and neglects to consider whether the two techniques can be integrated into a single valuation model that can have superior explanatory power of stock prices compared to when the techniques are considered without reference to one another.

The possibility that fundamental analysis and technical analysis may be complementary had been noted by Lui and Mole (1998) in a survey conducted based on Hong Kong foreign exchange dealers. The survey shows that more than 85% of foreign exchange dealers in Hong Kong use both fundamental and technical analysis to forecast future exchange rate movements. However, technical analysis was used for making short term forecasts and fundamental analysis was used for longer term forecasts. None of the dealers used a combination of fundamental and technical analysis for forecasting the same time horizon. Taylor & Allen (1992) and Oberlechner (2001) reached similar conclusions in surveys conducted in London and European trading centres respectively.

The Johannesburg Stock Exchange (“JSE”) has long attracted interest of both local and global investors. With over 800 listed securities on the JSE Equity Market, the JSE is currently the largest stock exchange on the African continent based on market capitalization and also ranks as the 20th largest stock exchange among the members of the World Federation of Exchanges on a market capitalization basis⁴. The absolute size and the increased importance of the JSE equities market therefore warrants a more thorough research interest into the drivers of the equities market.

1.3 Problem Statement

Three gaps in the existing body of knowledge have been identified for this study. First, we are not aware of a study that proves which of the two valuation techniques consistently outperforms the other. This lack of conclusive literature implies that equity investors have no indication as to which equity valuation technique can achieve superior investment returns.

⁴ Sources: www.jse.co.za and <http://www.stockmarkets.com/exchanges/africa/johannesburg-stock-exchange/>

Secondly, as highlighted by Bettman et al (2009), within each type of analysis there is an ongoing debate regarding which value-relevant explanatory variables to use in conducting an equity analysis. An in-depth study is therefore required to examine the primary drivers of the JSE equities market.

Thirdly, the relationship between fundamental and technical analysis and whether these two techniques can be used simultaneously by investors is an area that is not sufficiently covered by existing research and only a limited number of studies have considered this relationship to be plausible. To the author's knowledge, it is only the studies conducted by Bettman (2009) and Waworuntu & Suryanto (2010) on the US and Indonesian stock markets , respectively that have considered building models that integrates both technical and fundamental analysis factors. There may be some justification for this paucity of literature that reviews the complimentary nature of technical and fundamental analysis. The primary reason is that there are disagreements amongst investors about the primary drivers of the market. Some market participants believe in the ability of conventional fundamentals to explain stock price movements, whereas others perceive psychological influences to play a more significant role (see Menkhoff, 2010). Reconciling these differences has proven to be a challenge.

This lack of insight into the complimentary nature of technical and fundamental analysis implies that there is little indication on what the performance of an investment strategy that integrates both techniques would be. However, should the hybrid model that integrates both techniques have a superior explanatory power of stock prices relative to models based on each technique independently; that would suggest that the investor who uses a hybrid strategy would be more profitable than those who use each technique independently.

1.4 Purpose of the study

The primary purpose of this study is to determine whether fundamental and technical analysis can be used in a complimentary manner in making investment decisions. This analysis will identify the fundamental and technical analysis factors that influence the JSE stock market. Furthermore, this study will also determine which valuation technique has a superior explanatory power of stock prices between fundamental and technical analysis.

1.5 Objectives of the study

In summary, the objectives of this study can be itemized as follows:

- (1) To identify the fundamental analysis factors that drive stock prices and measure their ability to explain prices.
- (2) To identify the technical analysis factors that drive stock prices and measure their ability to explain prices.
- (3) To determine which equity valuation technique has a superior explanatory power of stock prices between fundamental and technical analysis.
- (4) To determine whether a model that integrates both fundamental and technical analysis factors can explain prices better than models that use one of the techniques in isolation.

1.6 Significance of study

This study aims to contribute towards a better understanding of the valuation techniques in the context of the investment decision making process. The results are expected to be beneficial to financial market participants, especially those in the investment management area.

In addition, this study will also shed some light on the elements that drive the valuation of JSE-listed stocks, both fundamental and technical analysis factors. The equity valuation framework developed by Ohlson (1995), which states that stock prices are dependent on book values per share and earnings per share, lays the foundation for the valuation models constructed in this study. The current study however, goes beyond Ohlson (1995)'s framework by incorporating the following additional variables; dividends per share, book-to-market ratio, cash flow per share and dummy variables that represent extreme historical return performances.

Although this study focuses exclusively on the equities market, the findings can also be applied to other asset classes.

1.7 Outline of study

The remainder of this paper is organised as follows. Chapter 2 reviews the relevant literature on the Efficient Market Hypothesis and how it relates to the JSE equities market,

the fundamental analysis valuation technique, the technical analysis valuation technique and how the two valuation techniques can be integrated into a single model.

Chapter 3 presents the methodology adopted in this study including a framework in which the explanatory power of a model that integrates both fundamental and technical analysis factors can be measured relative to models based on only one of the valuation technique without reference to the other.

Chapter 4 presents the empirical results and the analysis of those results. Chapter 5 concludes the report.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter begins by examining the existing literature on the Efficient Market Hypothesis. A brief background of the Efficient Market Hypothesis is provided as well as a review of literature that focuses on efficiency of the JSE. The level of efficiency of the JSE is considered to be relevant in this study because the success or failure of the models formulated in this study depends on whether the JSE is efficient or not.

The subsequent sections in this chapter review the existing literature on fundamental analysis, technical analysis and the potential integration of these techniques.

2.2 Efficient Market Hypothesis

Fama (1970) defined an efficient market as a market where market prices fully reflect all available information. However this definition is very broad and cannot be empirically tested. Jensen (1978, p. 96) provided a more practical and testable definition as follows:

“A market is efficient with respect to an information set ϑ_t if it is impossible to make economic profits by trading on the basis of information set ϑ_t .”

Jensen defined three forms of market efficiency; “Weak-form”, “Semi-strong-form” and “Strong-form”. The differences revolved around the definition of the information contained by the information set θ_t .

A market will be weak-form efficient if market prices reflect all the information contained in the historical market prices as of time t . This implies that in a weak-form efficient market, market participants cannot earn risk-adjusted profits by examining the past price history of the market.

A semi-strong form efficient market is one where prices reflect all publicly available information at time t . This implies that market participants cannot make risk-adjusted profits by trading on publicly available information such as company financial statements. Since past price history forms part of publicly available information, this implies that a semi-strong form efficient market is also weak-form efficient.

In a strong-form efficient market, market prices incorporate all available information, both public and private. This implies that any trading strategies based on privileged information would not yield any risk-adjusted profits.

A number of academic researchers have found equity markets in developed economies to be efficient, semi-strong form efficient in particular. Malkiel (2003) studied the efficiency of the US stock market based on the index constituents of the Standard and Poor's 500 stock index and found it to be semi-strong form efficient. Malkiel (2003, p. 60) concedes that "*an anomalous behaviour in stock prices may exist, but its existence does not create a trading opportunity that enables investors to earn extraordinary risk-adjusted returns*". This is consistent with conclusions on earlier studies that found that trading costs make such trading opportunities unprofitable (see e.g. Odean, 1999).

Malkiel (2005) analysed the performance of professional investment managers, both in the US and abroad and found that the investment managers do not outperform their index benchmarks. This result makes it difficult for active fund managers to justify the sometimes excessive investment management fee involved in active fund management relative to passive fund management. Malkiel (2005) also provided evidence that market prices do appear to reflect all available information.

Given the lack of outperformance by professional investment managers in Malkiel (2005)'s study, French (2008) examined the fees, expenses and trading costs that society pays to invest in the US stock market relative to the costs that would be paid if everyone invested passively. He found that investors spent 0.67% of the aggregate value of the market each year in search of superior returns through active fund management. This finding implies that the investing community does not fully subscribe to the notion that markets are efficient even in a developed market such as the US.

2.2.1 Market efficiency outside the US

Jammie and Hawkins (1974) conducted the first study that reviewed the efficiency of the JSE. The study tested whether stock prices followed a random walk process using weekly changes in price indices over the period from 1966 to 1973. Jammie and Hawkins (1974) concluded that the JSE stock prices did not follow a random walk process and therefore the JSE was not weak-form efficient.

Hadassin (1976) used the serial correlations and runs tests to test the efficiency of the large stocks trading on the JSE. He established that there was a definite correlation between past and future share prices but that the exact relationship between them remained unknown. This result also suggests that the JSE was not weak-form efficient.

Gilbertson and Roux (1977) found evidence of deviations from strict independence of stock prices. However, they noted that such deviations are consistent with an efficient market. They also found that South African fund managers under-performed the market index over the period from 1973 to 1976, thus questioning the value added by active fund management over passive fund management. However, Strebel (1977) challenged the findings from Gilbertson and Roux (1977) on the basis that more than half of the JSE traded stocks had volumes so low that any analysis of their performance becomes meaningless. Strebel (1977) also stated that many of the previous studies that had analysed the efficiency of the JSE were of marginal use as they did not separate out the low volume effect.

Instead of using the serial correlations test and the runs test which had been predominantly used to test the efficiency of the JSE, Klerck (1986) conducted a multivariate time series analysis to determine whether there was any systematic relationship between economic activity and share prices. He concludes that share prices on the JSE can be forecasted with reasonable accuracy. However the forecasting accuracy of Klerck (1986)'s model can be challenged as only a limited data set was used and the inputs into the model also have to be forecasted.

Philpott and Firer (1994) found that share price anomalies of a magnitude larger than the direct transaction costs of switching from one share to another existed on the JSE. These anomalies were found to be persistent over long periods of time. Philpott and Firer (1994) also addressed Strebel (1977)'s concerns about the low volume effect by splitting the shares into high and low volume shares. Share price anomalies were detected in both high and low volume stocks.

Oldfield and Page (1997) investigated the timing and stock selection skills of seventeen South African unit trust managers over the period from 1987 to 1994 using the Jensen performance measure. No evidence of superior performance was found. This result is

consistent with Gilbertson and Roux (1977)'s conclusion about the lack of out-performance by fund managers. These results are consistent with an efficient market.

Some months have been proven to generate higher returns than other months, especially January (Rozeff and Kinney, 1976). Robins et al (1999) examined the calendar-effect on the JSE and found evidence of the January effect over the period from 1986 to 1995. This result was inconsistent with an earlier finding by Bradfield (1990). In a recent study conducted by Auret and Cline (2011), no evidence of the January effect was found on the JSE.

The efficiency of the JSE compared to other African countries has also been examined. Smith et al. (2002) tested the hypothesis that the stock market index follows a random walk for South Africa, Egypt, Kenya, Morocco, Nigeria, Zimbabwe, Botswana and Mauritius. The hypothesis is rejected for all the markets except for South Africa. The findings of this study are also consistent with a weak-form efficient market.

In a recent study, Mbululu and Chipeta (2012) tested the day-of-the week effect on 9 JSE sectors over the period from 1995 to 2011. No day-of-the week effect is detected for eight of the nine sectors considered, only the basic materials sector was found to have the Monday effect. The conclusion from this study is that the JSE is weak-form efficient with respect to the other eight sectors considered and the basic materials sector is weak-form inefficient.

The debate on the whether the JSE as a whole is efficient or not is still on-going. The existing literature has produced mixed results so far. The primary difference in conclusions appears to be as a result of different methodologies and the periods of investigation. Earlier studies appear to consistently conclude that the JSE was inefficient, while more and more of the recent studies are finding the JSE to be efficient. These results point to an increase in the market efficiency of the JSE in recent times which can be attributed to an increase in the speed of information dissemination to investors and reductions in trade execution times. However, the fact that some of the recent studies have found market inefficiencies implies that trading strategies that aim to exploit such market inefficiencies such as Fundamental and Technical Analysis techniques can be profitable when applied to JSE stocks.

2.3 Fundamental Analysis

Lev and Thiagarajan (1993, p. 190) defined the aim of fundamental analysis as *“determining the value of corporate securities by a careful examination of key value-drivers, such as earnings, risk, growth and competitive position”*. The primary sources of information examined by a fundamental analyst are the annual company financial statements, company announcements, interviews with management of the company and so forth.

The goal of fundamental analysis is to produce an intrinsic value (or a fair value) of a security that can be compared to the market price of the security in order to determine whether the security is under or overvalued. The fundamental analyst believes that the intrinsic value of the security is the “correct” price and that any deviations between the intrinsic value and the market value represent profitable trading opportunities. A buy (sell) opportunity arises when the intrinsic value of the security is above (below) the market value of the security.

However, if the stock markets are semi-strong form efficient, fundamental analysis will not yield any risk-adjusted profits. This is because all the information analysed by the fundamental analyst is publicly available and should thus be already incorporated in stock prices.

Graham and Dodd’s 1934 seminal work on US stocks laid the foundation for the development of fundamental analysis (see Chan et al, 1993). Since then a myriad of studies have been conducted to determine which fundamental variables have an influence on stock prices. Chan et al (1993) studied the effect of earnings yield, company size, book-to-market ratio and cash flow yield on Japanese stock prices over the period from 1971 to 1988. Chan et al (1993) found a significant relationship between the returns in the Japanese market and the four fundamental variables. The book-to-market ratio is found to be most significant variable, statistically and economically. Firms with high book-to-market ratios significantly outperformed firms with low book-to-market ratios. Fama and French (1992) found the same book-to-market effect when studying US stocks.

Gordon and Shapiro (1956) had recognised the importance of dividends in valuing a firm’s market value when they formulated the Dividend Discount Model. Recent studies have also confirmed the relation between dividends and market prices (see e.g. Gurgul et al, 2006 and Gunasekarange and Power, 2006). Ohlson (1995) extended Gordon and Shapiro (1956)’s

Dividend Discount Model by expressing the market price as a weighted average of current earnings minus current dividends, and current book value. The dividends are subtracted because a dollar of dividends displaces a dollar of market value. Ohlson (1995)'s model is derived based on the clean surplus relation, which requires the change in book value to equal earnings minus dividends. Ohlson (1995) also states that book values are unbiased estimators of market values in that the expected goodwill equals zero. Collins et al (1997) applied the framework developed by Ohlson (1995) on US stock over the period from 1953 to 1993. Collins et al (1997) confirmed Ohlson (1995)'s results in that stock prices are dependent on book values and earnings.

Based on the literature above, a fundamental analysis model is formulated in this study by extending the valuation framework developed by Ohlson (1995). The explanatory variables that are included in our fundamental analysis model are the book value per share, earnings per share, dividend per share, book-to-market ratio and cash flow per share.

2.4 Technical Analysis

Levy (1966) defines technical analysis as the recording of the actual history of trading (including both price movement and the volume of transactions) for one stock or a group of equities, and deducing the future price trend from this historical analysis. Technical analysis was popularized by Charles Dow, the editor of the Wall Street Journal in the late 1890s, who developed the Dow Theory. The Dow Theory laid the foundation for much of the technical analysis techniques currently used by practitioners. Neely and Weller (2011) summarised the three principles that guide the behaviour of technical analysts. The first principle is that market action (that is, prices and volume) discounts everything. This implies that market prices incorporate all the relevant information. The second principle is that asset prices move in trends. The third principle is that history repeats itself with respect to market movements.

Brock et al. (1992) highlighted that technical analysis is the original form of investment analysis as it came into widespread use long before the period of extensive and fully disclosed financial statements which enabled fundamental analysis to develop.

However technical analysis has not been widely accepted as a valid form of analysing securities as much as fundamental analysis, especially by academics. The views of most academics against technical analysis are well articulated by Malkiel (1985, p. 132):

“Obviously I am biased against the chartist. This is not only a personal predilection, but a professional one as well. Technical Analysis is anathema to the academic world. We love to pick on it. Our bullying tactics are prompted by two considerations: the method is patently false; and it’s easy to pick on. And while it may seem a bit unfair to pick on such a sorry target, just remember it is your money we are trying to save.”

Several studies have been conducted that analyse whether technical analysis can add any significant value to an investor’s portfolio. These studies have however, produced mixed results thus far. Jensen and Bennigton (1970) and Fama and Blume (1966) analysed the profitability of various technical trading rules relative to a buy and hold strategy. They both found that the technical rules could not outperform a buy and hold strategy.

Brock et al. (1992) tested the profitability of the Moving Average and Trading Range Breakout rules using data from the period from 1897 to 1986 based on stocks in the Dow Jones Industrial Average. Brock et al. (1992) concluded that the trading rules have the ability to forecast future stock prices. However, Ready (2002) found that the trading rules used by Brock et al (1992) performed poorly after 1986. The results from the study conducted by Lento and Grandojevic (2007) also contradict Brock et al (1992) when utilising data over the period from 1995 to 2004. A plausible explanation of these contradictory findings is that the trading opportunities could have been arbitrated away by the informed traders after 1986.

The extensive amount of studies that have been conducted on technical analysis reveal an emergence of two investment strategies that are both based purely on historical past prices; contrarian and momentum investment strategies. The difference between these two strategies is influenced by whether the market under reacts or over reacts to information. Jegadeesh and Titman (1993) stated that if stock prices overreact or under react to information, then profitable trading strategies that select stocks based on their past returns will exist.

2.4.1 Momentum investment strategies

Jegadeesh and Titman (1993) investigated the profitability of trading strategies that select stocks based on their past returns based on US stocks. They concluded that trading strategies that buy past winners and sell past losers from the previous three to twelve month period realize significant abnormal returns over a holding period of three to twelve months. Rouwenhorst (1998) also found evidence in support of the momentum effect when investigating 12 European countries between 1980 and 1995. Liu et al (1999) found the momentum effect to be present in UK stocks. These findings imply that momentum trading strategies are profitable.

To provide further insight on the existence of the momentum effect, Moskowitz et al (1999) found that once the industry momentum is controlled, the momentum effect in individual stocks become less significant. Hong et al (2000) finds that the profitability of momentum strategies will be highest among low market capitalization stocks and also among stocks that have low analyst coverage.

2.4.2 Contrarian investment strategies

In contrast to the studies that support the momentum effect, De Bondt and Thaler (1985) found that a portfolio of past losers over the previous three to five year period outperformed prior winners over a three to five year holding period. This study was conducted using data from 1926 to 1982 on US stocks.

Page and Way (1992) tested the profitability of contrarian strategies on the JSE using the same methodologies employed by De Bondt and Thaler (1985). Page and Way (1992)'s results show that a portfolio of prior losers significantly outperformed prior winners over a three year holding period over the period from 1974 to 1989.

This study formulates a technical analysis based model that incorporates historical/lagged prices and dummy variables based on the past return performance of the stocks in the study. The presence dummy variables in the model will help determine whether a momentum or contrarian effect is present on the JSE.

2.5 Integration of Fundamental and Technical Analysis

Bettman et al (2009) were the first explorers of the complementary nature of fundamental and technical analysis techniques. They constructed a model that integrates both

techniques. The model developed by Bettman et al (2009) is based on the framework that was established by Ohlson (1995).

Bettman et al (2009) constructed 3 models in their study; one with only fundamental analysis factors, one with only technical analysis factors and one that integrates both the fundamental and technical analysis factors. The fundamental analysis factors included in Bettman et al (2009)'s fundamental analysis model were: book value per share and earnings per share. The technical analysis factors in their technical analysis model were: the lagged price and two momentum dummy variables, one reflecting extremely positive returns and the other reflected extremely negative returns.

Bettman et al (2009) concluded that the model that incorporated both fundamental and technical factors had a superior explanatory power of stock prices as shown by the markedly higher adjusted R^2 values and lower Akaike Information Criteria values as compared to the models that examine the fundamental and technical analysis factors in isolation.

The testing done by Bettman et al (2009) was based on US listed stocks over the period from 1983 to 2002. A similar study conducted by Waworuntu and Suryanto (2010) on the Indonesian market confirmed the complementary nature of fundamental and technical analysis techniques.

This study seeks to apply the models developed by Bettman et al (2009) to JSE-listed stocks and also extend the models to include the book-to-market ratio, dividend per share and cash flow per share.

2.6 Chapter Summary

This chapter has presented the relevant literature and evidence on the efficiency of the JSE equities market, how the fundamental and technical analysis valuation techniques have performed in practice. Empirical studies on how the existing studies have integrated the two valuation techniques are also considered.

The literature reveals that although the efficiency of the JSE has often been questioned by market practitioners, recent studies indicate that there has been an increase in market efficiency.

Ohlson (1995)'s valuation model provided a rigorous framework which has been extended in this study to include other value-relevant variables beyond the earnings and book value variables considered by Ohlson (1995). Empirical studies have found that beyond the earnings and book value variables, there exists a significant relationship between dividends, cash flows, book-to-market ratio, historical share price performance and current market prices. The models developed in this paper takes these additional variables into account.

The following chapter presents the research methodology, data sources and the data selection process used to select the data sample that underpins this study.

Chapter 3: METHODOLOGY

3.1 Introduction

Numerous valuation models have been developed in recent literature that focused on determining the market values of firms in developed markets (see Ohlson, 1995 and Bettman et al, 2009). However, only a few studies have been extended to include emerging markets such as South Africa. This study seeks to extend the models developed by Ohlson (1995) and Bettman et al (2009) to determine whether fundamental and technical explanatory variables are relevant in explaining market prices on the JSE Exchange.

In this chapter we develop three valuation models which are in a linear regression format with several explanatory variables and error terms. The first model investigates the impact of fundamental analysis explanatory variables, namely, earnings per share, book value per share, dividend per share, book to market ratio and cash flow per share on market price movements as in Ohlson (1995).

The second model seeks to examine how well technical explanatory variables can explain market prices. The technical variables under consideration include the historical price variable and momentum/contrarian dummy variables that depict the stock's historical return performance.

The third model integrates both the fundamental and technical explanatory variables into a single model with the sole purpose of determining whether the hybrid model can have a superior explanatory power of stock prices.

3.2 Data and Data Sources

3.2.1 Data sources

The data required for this study consists of firm share prices (three month before and after the fiscal year end), earnings per share, book value per share, cash flow figures, cash dividends, historical return performances for individual stocks and the number of shares outstanding for all the firms under consideration.

The sample period covers the period from the 2002 fiscal year to the 2012 fiscal year (11 year data set). This study includes all the stocks that have been listed on the JSE main board

in the periods between the 2002 and 2012 fiscal years, both currently listed shares and delisted shares.

The list of firms that have been listed on the JSE's main board on each of the fiscal years between 2002 and 2012 was generously provided by the JSE's customer services department. The other data for each firm was obtained from the Bloomberg Professional Service (henceforth, Bloomberg) database and from publicly available financial statements of the firms.

3.2.2 Data selection

In maintaining consistency with existing literature such as Bettman et al (2009), Waworuntu and Suryanto (2010), the data selection criteria is as follows: companies with book values per share equal to or less than 0 are excluded. Furthermore, companies that took in excess of 90 days from the fiscal year-end to disclose annual financial information to the market are also excluded.

However, in contrast to Bettman et al (2009) and Waworuntu and Suryanto (2010), firms with missing observations and firms that have been delisted during the sample period were not removed from the study. Instead, where there were missing observations, a value of zero was assigned to the data point. The inclusion of firms with missing observations ensures that the sample size for the study is as large as possible. The inclusion of the firms also ensures that there is no selection bias in the study towards the recently listed stocks on the JSE and that the data sample is comprehensive.

3.3 Research Design

The following linear regression model is used to evaluate the joint value-relevance of the fundamental accounting variables.

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 CFPS_{it} + \beta_4 DPS_{it} + \beta_5 B/M_{it} + \varepsilon_{it} \quad (1)$$

Where:

$P_{it+0.25}$ = stock price of firm i three months after the fiscal year-end t

$BVPS_{it}$ = book value per share of firm i at the end of fiscal year-end t

EPS_{it} = earnings per share of firm i during year t

$CFPS_{it}$ = cash flow per share of firm i at time t

DPS_{it} = dividend per share of firm i at time t

B/M_{it} = book to market ratio of firm i at time t

ε_{it} = error term

α = intercept term

The next model fitted is the technical analysis model. This model examines how well technical analysis variables used by technical analysts can explain stock prices. The model is similar to that of Bettman et al (2009) and Waworuntu & Suryanto (2010), where price is modelled as a function of lagged prices and historical return performance. The technical analysis model is designed as follows:

$$P_{it+0.25} = \theta + \gamma_1 P_{it-0.25} + \gamma_2 D_{it\ up} + \gamma_3 D_{it\ down} + \varepsilon_{it} \quad (2)$$

Where:

$P_{it-0.25}$ = lagged price of firm i three months prior to time t

$D_{it\ up}$ = dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely positive and placed in the highest performance decile, equal to 0 otherwise

$D_{it\ down}$ = dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely negative and placed in the lowest performance decile, equal to 0 otherwise

ε_{it} = error term

θ = intercept term

The third model fitted is the hybrid model that incorporates both the fundamental analysis and technical analysis variables. This model essentially integrates model (1) and model (2). The model is presented as follows:

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 CFPS_{it} + \beta_4 DPS_{it} + \beta_5 B/M_{it} + \beta_6 P_{it-0.25} + \beta_7 D_{it\ up} + \beta_8 D_{it\ down} + \varepsilon_{it} \quad (3)$$

The coefficient of determination (adjusted R^2) is the goodness-of-fit statistic employed in this study to measure the ability of the above-mentioned models in explaining share price movements. The student t-test is used to determine the value-relevance of each of the explanatory variables in the models.

3.4 Specification of the explanatory variables

The International Accounting Standard (“IAS”) Framework states that *“the objective of financial statements is to provide information about the financial position, performance and changes in financial position of an enterprise that is useful to a wide range of users in making economic decisions”*. Within the financial statements there are countless components that a financial analyst could explore in order to arrive at a conclusion about the financial prospects of a particular firm. The challenge facing a financial analyst is thus to determine which accounting variables are more relevant in valuing the firm’s equity. In this study, five fundamental accounting variables are identified that are most value-relevant in explaining market prices based on empirical studies, namely, dividend per share, cash flow per share, book value per share, earnings per share and book-to-market ratio. The following section states how each of these accounting variables is specified in the models in this study and also highlights how these variables have been related to market prices in the existing literature.

3.4.1 Dividends per share variable

The importance of dividends as one of the explanatory variables is supported by the “information content of dividends hypothesis”, which was initially introduced by Miller & Modigliani (1961) and Lintner (1956). The hypothesis states that company managers use dividend announcements to signal their belief about the prospects of the firm, as they often possess privileged information. The hypothesis is further supported by Graham and Dodd (1934) who stated that investors scrutinize companies’ dividend policies as a window into management’s thinking about the durability of free cash flow, and hence equity value.

The results of a study conducted by Bhana (1991) on JSE listed companies provided strong support for the information content of dividends hypothesis. The study was conducted using data from the period from 1970-1988.

Given the strong support for the information content of dividends hypothesis, we therefore expect that:

H₁: The firm's dividend per share positively and significantly influences the firm's share price.

The dividend per share is calculated as the sum of the interim and final dividends divided by the outstanding number of shares in a given year. Any other forms of dividends other than cash dividends are not considered in this study.

3.4.2 Cash flow per share variable

The inclusion of the cash flow per share variable is supported by previous studies that have found that cash flows are significantly correlated with stock prices (see Cheng et al 1997, Kwon 2009 and Chan et al 1993). We thus posit that:

H₂: The firm's cash flow per share positively and significantly influences the firm's share price.

The cash flow per share is calculated as the annual operating cash flows divided by the outstanding number of shares in a given year. For companies that do not state the cash flows from operations explicitly in the financial statements, the operating cash flows are estimated as the sum of core earnings, depreciation and amortization.

3.4.3 Earnings per share variable

In maintaining consistency with previous studies such as Collins et al (1997), core earnings are used in this study. Core earnings represent earnings that are generated by the firm's principal business activities, and excludes gains or losses from nonrecurring activities.

The primary reason for using core earnings instead of headline earnings which take the nonrecurring items into account stems from the existing studies which suggests that nonrecurring activities can adversely affect the value relevance of earnings (see Basu 1997, Elliot & Hanna 1996 and Hayn 1995). Elliott and Hanna (1996) examined the information content of earnings in the presence of large nonrecurring charges against earnings. They demonstrate that the investment community places less weight on nonrecurring item and that earnings response coefficients generally decrease in the presence of nonrecurring items. Elliott and Hanna (1996) also noted an increasing frequency at which nonrecurring

items are being reported across time. Taking into account all the evidence, nonrecurring items should be excluded from the analysis in order to maintain the integrity of the information content derived from the earnings variable.

As this study pools together both profitable and loss making firms in the JSE All Share index in order to estimate the information content of earnings, this leads to a downward bias in the estimated earnings response coefficient. A study conducted by Hayn (1995) showed that firms reporting negative earnings have lower earnings response coefficient than profitable firms. Hayn (1995) also states that the reporting of negative earnings by firms has become very frequent.

With regards to the earnings per share variable, we are interested in examining the following hypothesis:

H₃: The firm's earnings per share positively and significantly influences the firm's share price.

The earnings per share variable is calculated as the core earnings over the fiscal year t as per the income statement divided by the total number of shares outstanding in year t .

3.4.4 Book value per share variable

A vast amount of literature has focused on determining the relative value relevance between book values and earnings in explaining market prices (see Berger et al 1996 and Collins et al 1997). The studies appear to unanimously conclude that book values are more important in explaining market prices than earnings when earnings are negative or contain nonrecurring items. In sum, we expect that:

H₄: The firm's book value per share positively and significantly influences the firm's share price.

The book value per share variable is defined as the value of the firm's equity (total assets minus liabilities) as the financial year end balance sheet figures divided by the number of shares outstanding in year t .

3.4.5 Book-to-market ratio variable

The question of whether the book-to-market ratio can be a value relevant variable in explaining market prices is one that has attracted a lot of attention from academic

researchers (see Rosenberg et al 1985, Chan et al 1992, Fama & French 1992 and Stattman 1980). A study conducted by Fama and French (1992) based on US listed stocks found that firms with higher book-to-market ratios have higher returns than firms with lower book-to-market ratios. Based on the framework developed by Fama and French (1992), Auret and Sinclair (2006) applied the framework on the South African listed stocks and the results were consistent with Fama and French (1992). We therefore, expect that:

H₅: The firm's book-to-market ratio positively and significantly influences the firm's share price.

The book-to-market ratio is defined as the ratio of book value of equity as per the balance sheet figures at the financial year end divided by the market value of the firm's equity (market capitalisation of the firm).

3.4.6 Momentum/contrarian dummy variables

Following Bettman et al (2009) methodology, the shares are ranked according to past return performance in the six month period commencing exactly one year before the measurement of $P_{it+0.25}$ and then assigned to performance deciles. The top (worst) performing shares in the top (bottom) decile are allocated a D_{up} (D_{down}) dummy equal to 1. Shares in the remaining deciles are assigned a value equal to 0.

When the momentum effect is present, D_{up} (D_{down}) can be expected to be significantly positive (negative) when performance is measured over the subsequent 6 month period. If the contrarian effect is present, then D_{up} (D_{down}) can be expected to be significantly negative (positive) in the technical analysis model. The 6 month period is also used by Jegadeesh and Titman (1993), Bettman et al (2009) and by Waworuntu & Suryanto (2010).

Given the vast amount of literature that supports the existence of momentum and contrarian effects on various markets⁵ including the JSE, we expect that:

H₆: Either firms that outperformed (underperformed) in the past continue to outperform (underperform) in future in the presence of the momentum effect **or** firms that outperformed (underperformed) in the past now underperform (outperform) in future in the presence of the contrarian effect.

⁵ See Jegadeesh and Titman (1993), Rouwenhorst (1998), Liu et al (1999), De Bondt and Thaler (1985), Page and Way (1992) etc.

3.4.7 Lagged/Historical price variable

The dependent variable ($P_{it+0.25}$) is defined as the price three months after the financial year end. This ensures that the market has had sufficient time to dissect any new information and that the new information has been fully incorporated into the market prices. The look ahead bias is therefore circumvented, a scenario where the data used in the study is available but not yet known by investors. This approach is consistent with the approach used by Collins (1997).

With regards to the lagged price variable, we are interested in examining the following hypothesis:

H₇: The firm's lagged price positively and significantly influences the firm's future price movements.

The lagged price variable is defined as the firm's end of month share price 6 months prior to $P_{it+0.25}$. This approach is consistent with previous studies such as Bettman et al (2009) and Waworuntu & Suryanto (2010).

3.5 Panel Data Approach

In order to determine the most appropriate form of each model, we first determine whether we should use a model with pooled data or a model with cross-sectional and/or period effects. Whilst employing a pooled data approach is the simplest way to proceed relative to the panel data approach, this approach does not take account of the cross-sectional relationships amongst the firms in the data sample and also ignores the influence of time when estimating the models (Baltagi, 2005).

Furthermore, employing a panel data approach instead of a pooled data approach brings further advantages to the estimation process as listed by Brooks (2008). Firstly, a broader range of issues can be addressed and tackled with panel data than would be possible with pure time series or pure cross-sectional data approach. Secondly, by combining the cross-sectional and time series data, one can increase the number of degrees of freedom, and thus the power of the test. One can therefore test the dynamic behaviour of a large number of variables at the same time. Employing the panel data approach can also help mitigate problems associated with multicollinearity, which may arise if time series are modelled individually.

For each model, we conduct the redundant fixed effects test and Hausman's test to ascertain the most appropriate form of each model. We use the redundant fixed effects test to determine whether cross-sectional and/or period effects are supported by the data sample instead of simply using a pooled data sample.

The redundant fixed effects test is conducted by imposing restrictions on the data to determine whether these restrictions are supported by the data. Three sets of restrictions are imposed. Cross-section effects are restricted to zero; Period fixed effects are restricted to zero and finally, both cross-section fixed effects and period fixed effects are restricted to zero. For each restriction that is imposed, F-test and Chi-square test statistics and p-values are calculated.

Provided that cross-sectional and/or period effects are supported by the data, we then use Hausman's test to determine whether fixed effects or random effects should be employed.

Brooks (2008) sheds some light on the difference between models with fixed effects and random effects. For simplicity, consider a model with only cross-sectional fixed effects (with no period effects) versus a model with only cross-sectional random effects. Brooks (2008) clarifies the difference as follows: both models will allow the intercept term to vary for each firm, however, the difference with the random effects model is that the intercept for each cross-sectional firm is assumed to arise from a common intercept (which is the same for all cross-sectional firms and over time) plus a random term which measures the random deviation of each firm's intercept from the common intercept. The random deviations from the common intercept are assumed to have a zero mean, are independent of individual observation error terms, have constant variance and are independent of the explanatory variables. A fixed effects model on the other hand, captures the differing intercept terms by introducing dummy variables for each firm's intercept.

3.6 Data Characteristics

In order to dispel any concerns about the possibility of the dependent price variable containing a unit root, we employ the testing procedure developed by Im, Pesaran, and Shin (2003) (henceforth, IPS), which extends the renowned Dickey-Fuller stationarity test to accommodate panel data. The choice to use the IPS testing procedure was influenced by

empirical studies that have found the procedure to be superior to most other available techniques in modelling long-run panel relationships (see Hoang and McNown, 2006).

The IPS procedure accommodates panel data by averaging the augmented Dickey-Fuller statistics across all cross-sectional units.

The IPS begins by first testing the null hypothesis of unit roots for each of the N individual cross-sectional units based on the following data generating process:

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \varepsilon_{it}, t = 1, 2, \dots, T \quad (4)$$

The null hypothesis of unit roots is then defined as:

$$H_0: \beta_i = 0 \text{ for all } i$$

The alternative hypothesis is defined as:

$$H_A: \beta_i < 0 \text{ for } i = 1, \dots, N_1 \quad \beta_i = 0 \text{ for } i = N_1 + 1, \dots, N$$

The alternative hypothesis assumes that the fraction of individual series that are stationary is non-zero, $\lim_{N \rightarrow \infty} (N_1/N) = \vartheta$, $0 < \vartheta \leq 1$. In other words, the alternative hypothesis allows some cross-sectional units to have unit roots, but not all.

After estimating model (4) for each of the N cross-sectional units, an average of the t-statistics from each of the equations is computed as follows:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^N t_{i,T} \quad (5)$$

Im, Pesaran, and Shin (2003) showed that when the average t-statistic is standardised, it follows a standard normal distribution as T and N approach infinity, based on the Central Limit Theorem.

3.7 Chapter Summary

The purpose of this chapter is to present the framework with which the joint value relevance of both fundamental and technical variables can be assessed relative to models that consider the two types of variables in isolation.

The chapter began with a brief introduction of the chapter. In section two, the research design for the study is discussed. This section presented the econometric formulation of the regression models for the fundamental analysis, technical analysis and the hybrid models.

In the third section, a definition of each explanatory variable was provided as well as a brief summary of the existing literature to justify the inclusion of the variable in this study. Section four discusses the data sources used to gather the data sample and the criteria used to select the data. The panel data approach used to analyse the data is also discussed in section four.

Chapter 4: PRESENTATION AND ANALYSIS OF RESULTS

4.1 Introduction

Initially we first present the descriptive statistics and the correlation coefficients calculated from the data sample. We then show that the independent price variable is stationary using the methodology developed by Im, Pesaran, Shin (2003) and is suitable for use in a linear regression model.

We then present the estimation results for the fundamental analysis model, technical analysis model and the hybrid model which combines fundamental analysis and technical analysis explanatory variables. We conclude the chapter by comparing the goodness-of-fit statistics of the fitted models to determine which model has the greatest explanatory power of stock prices for the JSE-listed stocks.

4.2 Descriptive Statistics and Correlation Coefficients

The final cross-sectional sample comprises of 25, 207 observations. Table 4.1 below shows that the data sample used in this study is comprehensive and broad as the stock prices of the stocks included in the study range from roughly R0.01 up to R2, 480 over the period from 2002 to 2012.

Table 4.1 also shows that stocks used in this study all had a positive book values, this is consistent with the defined data selection criteria for the study.

Table 4.1 Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
$P_{t+0.25}$	34.48526	8.950000	2480.000	0.005700	92.56535	11.98753	237.5090
$P_{t-0.25}$	32.84386	8.500000	2299.000	0.004800	87.47347	11.70037	227.4801
$BVPS_t$	14.27699	5.243500	940.9600	0.000200	35.46311	14.05895	294.6448
$CFPS_t$	3.324203	0.861400	381.2635	-30.56790	10.65479	18.69264	604.6506
EPS_t	2.403026	0.727300	270.3000	-22.45000	7.749898	19.09213	576.9050
DPS_t	0.974574	0.210000	57.20000	0.000000	2.768923	10.81084	166.6404
B/M_t	0.901472	0.626037	34.60208	0.000395	1.496866	13.36506	251.0232

The notation used in the above table is as follows: $P_{t+0.25}$ refers to the stock price three months after the fiscal year-end t . $P_{t-0.25}$ refers to the stock price three months before the fiscal year-end t . $BVPS_t$ refers to the book value per share at fiscal year-end t . $CFPS_t$ refers to cash flow per share at fiscal year-end t . EPS_t refers to the earnings per share at fiscal year-end t . DPS_t refers to the sum of the

interim and final dividends declared during fiscal year t . B/M_t refers to the book value divided by the market price at fiscal year-end t .

A relatively high correlation coefficient exists between EPS_t and $CFPS_t$ (0.829466) on Table 4.2 below, which could indicate near multicollinearity. However, given the strong evidence from the literature review for the inclusion of both these variables and to avoid the omitted variable bias, none of the variables were dropped from the modelling process. Furthermore, given that the presence of near multicollinearity does not affect the desired properties of the ordinary least squares (“OLS”) estimators (i.e. unbiased, consistent, efficient etc.), any presence of multicollinearity should not significantly affect the model as long as the model is adequate.

Table 4.2 Correlation Matrix

	P_{t+3}	P_{t-3}	$BVPS_t$	$CFPS_t$	EPS_t	DPS_t	B/M_t
P_{t+3}	1.000000						
P_{t-3}	0.984141 (0.0000)*	1.000000					
$BVPS_t$	0.818032 (0.0000)	0.836417 (0.0000)	1.000000				
$CFPS_t$	0.748467 (0.0000)	0.751198 (0.0000)	0.739431 (0.0000)	1.000000			
EPS_t	0.749219 (0.0000)	0.746615 (0.0000)	0.769718 (0.0000)	0.829466 (0.0000)	1.000000		
DPS_t	0.547794 (0.0000)	0.539755 (0.0000)	0.457160 (0.0000)	0.534392 (0.0000)	0.545128 (0.0000)	1.000000	
B/M_t	-0.108960 (0.0000)	-0.108011 (0.0000)	-0.035163** (0.0686)	-0.081994 (0.0000)	-0.086047 (0.0000)	-0.098615 (0.0000)	1.000000

* Values in brackets below the correlation coefficients represent p -values

** = insignificant coefficient at the 5% significance level

Table 4.2 above presents the correlation coefficients calculated from the data set used for the analysis. The notation used is as follows: $P_{t+0.25}$ refers to the stock price three months after the fiscal year-end t . $P_{t-0.25}$ refers to the stock price three months before the fiscal year-end t . $BVPS_t$ refers to

the book value per share at fiscal year-end t . $CFPS_t$ refers to cash flow per share at fiscal year-end t . EPS_t refers to the earnings per share at fiscal year-end t . DPS_t refers to the sum of the interim and final dividends declared during fiscal year t . B/M_t refers to the book value divided by the market price at fiscal year-end t .

4.3 Diagnostic Test

Table 4.3 presents the results of the unit root test for the dependent price variable using the IPS methodology. The null hypothesis of the IPS test is that the price variable is not stationary and therefore contains a unit root, and the alternative hypothesis is that the price series is stationary. Given that the p-value of the test (0.0247) is less than 0.05, we therefore reject the null hypothesis of a unit root at the 5% significance level in favour of the alternative hypothesis. We therefore conclude that the price variable is stationary.

Table 4.3 Panel Unit Root Test Results - Im, Pesaran, Shin (IPS)

Method	Statistic	Prob.
Im, Pesaran and Shin W-stat	-1.96449	0.0247

4.4 Fundamental Analysis Model

The primary focus of this paper is to determine whether a model that combines fundamental and technical analysis factors can have a higher explanatory power of stock prices compared to models that consider each of the factors in isolation. Prior to conducting this analysis, we examine how well each model can explain stock prices in isolation.

In order to determine whether cross-sectional or time/period fixed effects are supported by the data instead of simply employing a pooled sample, a redundant fixed effects test is conducted.

4.4.1 Redundant Fixed Effects Test

Table 4.4 below presents the results of the redundant fixed effects test for the fundamental analysis model.

Table 4.4 Redundant fixed effects test for the fundamental analysis model

Effects Test	Statistic	d.f.	Prob.
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Cross-section F	7.841824	(465,2228)	0.0000
Cross-section Chi-square	2626.396697	465	0.0000
Period F	9.353741	(10,2228)	0.0000
Period Chi-square	111.408491	10	0.0000
Cross-Section/Period F	7.762004	(475,2228)	0.0000
Cross-Section/Period Chi-square	2645.010770	475	0.0000

The p-values for all three restrictions for both F and Chi-square test are equal to zero to four decimal places. This implies that restricting the cross-section and period effects to zero is not supported by the data. This then implies that a model incorporating both cross-section effects and period fixed is more appropriate than a pooled sample.

Given that the appropriate model needs to incorporate an intercept that varies over time and also varying for each firm in the data sample, we also determine whether this phenomenon can best be captured by a model with random effects or fixed effects.

4.4.2 Hausman's Test

One of the requirements of a valid random effects framework is that the random effects component of the model should be independent of the explanatory variables in the model (Brooks, 2008). This independence assumption is tested using Hausman's test.

The null hypothesis of the test is that the random effects terms are uncorrelated with the explanatory variables and thus the random effects model is preferred. The test statistic for the fundamental analysis model has a Chi-square distribution with 5 degrees of freedom. The results of the Hausman test are presented below.

Table 4.5 Hausman's test for the fundamental analysis model

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	95.781306	5	0.0000

The p-value of Hausman's test is equal to zero to four decimal places. This implies that a model with random effects is rejected and that fixed effects are preferred.

The redundant fixed effects test and Hausman's test conducted for the fundamental analysis model have shown that the appropriate fundamental analysis model is one where the intercept varies for each firm in the data sample and also varies over time instead of utilising a pooled data framework. Finally, a model with fixed effects rather than random effects should be preferred.

4.4.3 Estimation results for the fundamental analysis model

A model that satisfies the above-mentioned criterion is estimated below in Table 4.6. The model is estimated with both cross-sectional fixed effects and period fixed effects.

Table 4.6 Estimation results for the fundamental analysis model

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 DPS_{it} + \beta_4 CFPS_{it} + \beta_6 B/M_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	13.99673	1.312273	10.66601	0.0000
BVPS _t	0.818468	0.075271	10.87355	0.0000
CFPS _t	1.460429	0.137543	10.61802	0.0000
EPS _t	1.376841	0.182309	7.552228	0.0000
DPS _t	1.539106	0.365862	4.206796	0.0000
B/M _t	-0.878452	0.817134	-1.075040	0.2825
Adjusted R-squared	0.876674	Mean dependent var		34.48277
S.E. of regression	32.48381	S.D. dependent var		92.49966
Sum squared resid	2350982.	Akaike info criterion		9.958998
Log likelihood	-13008.46	Schwarz criterion		11.00735
F-statistic	41.10438	Hannan-Quinn criter.		10.33805
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.622397

The notation used in this table is as follows: $P_{it+0.25}$ refers to the stock price of firm i three months after the fiscal year-end t . $BVPS_t$ refers to the book value per share at fiscal year-end t . $CFPS_t$ refers to cash flow per share at fiscal year-end t . EPS_t refers to the earnings per share at fiscal year-end t . DPS_t refers to the sum of the interim and final dividends declared during fiscal year t . B/M_t refers to the book value divided by the market price at fiscal year-end t . μ_i is a variable that captures cross-sectional effects but does not vary over time. λ_t is a time-varying intercept that is constant cross-sectionally. ε_{it} is a remainder disturbance term.

The estimation results show that price is indeed highly dependent on the book value per share and earnings per share. This finding is consistent with Ohlson (1995)'s clean surplus relation. Explanations that have been put forward for the positive relationship between stock prices and book value per share and earnings per share is that the book value per share represents the liquidation value of the company, whereas earnings per share serve as a proxy for the company's current value (see e.g. Bettman et al, 2009). These results are also consistent with Collins et al (1997) who found the value-relevance of book values and earnings per share to be increasing over time. The estimated results are supportive of hypothesis H₃ and hypothesis H₄, as the earnings per share and the book value per share variables are both significant and positively related to market prices.

The results in Table 4.6 are also consistent with Gordon and Shapiro (1956) who were one of the early pioneers of equity valuation techniques. In line with the findings of this paper, they had also found a significant relationship between dividends and market prices. This is the relationship that laid the foundation to the revolutionary Dividend Discount Model. This finding therefore, supports hypothesis H₁ with regards to the importance of dividends per share in explaining stock price movements.

However, the results in Table 4.6 are at odds with Chan et al (1993) regarding the importance of book-to-market ratios in equity valuations. This study finds the book-to-market ratio to be an insignificant explanator of market prices, implying that we reject hypothesis H₅. This result is at odds with Auret and Sinclair (2006) who found the book-to-market ratio effect to be significant in the JSE over the period from 1990 to 2000. Chan et al (1993) had also found book-to-market ratios to be the most significant variable, statistically and economically, in the Japanese market. The results in this paper are also in contrast with Fama and French (1992)'s findings. Fama and French (1992) found a positive relationship between book-to-market ratios and US stocks.

The results in Table 4.6 are also consistent with hypothesis H₂, which stated that the cash flow per share positively and significantly influences future stock price movements. This result is consistent with findings by Cheng et al (1997) and Kwon (2009) based on US and Korean stock markets, respectively.

Table 4.6 also presents the goodness-of-fit statistics on the fundamental analysis model. The model is highly statistically significant. The p-value of the F-test for the joint null hypothesis that all the coefficients of the explanatory variables are zero (i.e. $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$) is equal to zero to six decimal places. The adjusted R-squared of the model is 87.67 percent.

4.5 Technical Analysis Model

In a similar approach to the above section on the fundamental analysis model, we first perform the redundant fixed effects test to determine whether the intercept of the model should be completely static or should vary with time and/or with the cross-sectional firms in the data sample. Lastly, we will perform Hausman's test to ascertain whether fixed or random effects would be suitable.

4.5.1 Redundant Fixed Effects Test

Table 4.7 below shows that the restriction of the cross-section effects to zero is well supported by the data. The null hypothesis which states that the cross-section effects are equal to zero is not rejected by both the Chi-square test and by the F-test. This implies that the intercept of the technical analysis model will not be allowed to vary with the firms in the data sample.

Since the cross-section effects are insignificant, that also suggests that a combination of cross-section and period effects will also be insignificant.

Table 4.7 Redundant fixed effects test for the technical analysis model

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.459607	(466,2359)	1.0000
Cross-section Chi-square	246.718737	466	1.0000
Period F	11.016336	(10,2359)	0.0000
Period Chi-square	129.576420	10	0.0000
Cross-Section/Period F	0.684909	(476,2359)	1.0000
Cross-Section/Period Chi-square	367.506202	476	0.9999

However, the period effects are highly significant to four decimal places under both the F-test and the Chi-square test. This means that the intercept of the technical analysis model will only be allowed to vary over time and will remain fixed with respect to the firms in the data sample.

4.5.2 Hausman's Test

The results of Hausman's test are presented below in Table 4.8. The null hypothesis that the appropriate model is one with random effects is not rejected, given that the p-value of the test (0.8177) exceeds the 5% significance level by far.

Table 4.8 Hausman's test for the technical analysis model

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	0.931922	3	0.8177

The results of Hausman's test suggest that an appropriate technical analysis model to use should contain random effects rather than fixed effects.

The redundant fixed effects test suggested that an appropriate technical analysis model is one with only period effects (i.e. intercept will vary over time, but remain constant for the cross-sectional firms). Taking into consideration the results of the redundant fixed effects test and Hausman's test, the appropriate technical analysis model is one with only period random effects. The estimation results of this model are presented in the following section.

4.5.3 Estimation results for the technical analysis model

Table 4.9 presents the estimation results for the technical analysis model.

Table 4.9 Estimation results of the technical analysis model

$$P_{it+0.25} = \alpha + \beta_1 P_{it-0.25} + \beta_2 D_{i\ up} + \beta_3 D_{i\ down} + \varepsilon_t + v_{it} \quad (2)$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.528445	1.189146	0.444391	0.6568
$P_{it-0.25}^{intercept}$	1.038498	0.003205	324.0139	0.0000
D _{UP}	-1.172772	0.985321	-1.190244	0.2341
D _{DOWN}	-0.334109	0.990253	-0.337398	0.7358

Adjusted R-squared	0.973874	Mean dependent var	8.84618
S.E. of regression	15.74416	S.D. dependent var	97.4113
F-statistic	35264.60	Sum squared resid	702735.
Prob(F-statistic)	0.000000	Durbin-Watson stat	2.10580

The notation used in the above table is as follows: $P_{it+0.25}$ refers to the stock price of firm i three months after the fiscal year-end t . $P_{it-0.25}$ refers to the stock price of firm i three months before the fiscal year-end t . D_{up} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely positive and placed in the highest performance decile, equal to 0 otherwise. D_{down} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely negative and placed in the lowest performance decile, equal to 0 otherwise. ε_t is a term that varies over time but is constant cross-sectionally and measures the random deviation of each cross-sectional firm's intercept from the global intercept term α . v_{it} is the individual observation error term.

Testing results in Table 4.9 show that lagged price is the most significant explanator of prices in the model. This result supports hypothesis H_7 with regards to the importance of the lagged price in explaining future price movements. The significance of the lagged price variable is in accordance with studies conducted by Lo and MacKinlay (1988), Bettman et al (2009) and Waworuntu and Suryanto (2010). The implication of this result is that one can be able to produce reasonably accurate forecasts of future stock prices from using historical prices. This result, thus, contradicts the random walk hypothesis which states that stock price changes are independent of each other (Dupernex, 2007).

Notably, both dummy variables representing extreme return performances are not significant. This result suggests that shares that had an extreme total return performance in the prior 6 month holding period did not continue to show a persistence in return performance into the next 6 months. We therefore reject hypothesis H_6 . This is a significant result for investors on the JSE equities market. This is because investors who buy stocks that were winners in previous periods or sell losers from previous periods cannot expect to outperform the market with those strategies. The insignificance of the dummy variables also means that there is also no evidence of a contrarian effect on the JSE. It is however, important to note that this result alone does not mean that the JSE is weak-form efficient.

The lack of the momentum/contrarian effect found in this study is in contrast with a number of studies that have been conducted on momentum and contrarian effects on various markets including the JSE.

Jegadeesh and Titman (1993), Rouwenhorst (1998) and Liu et al. (1999) found the momentum effect to be present in the US, European and UK stock markets, respectively.

Some the previous studies on the contrarian effects that this study contrasts include De Bondt and Thaler (1985) who found that a portfolio of past losers over the preceding three year period outperformed the prior winners over the ensuing three year period, based on US stocks. A subsequent study by Page and Way (1992) using the same methodology concluded that the contrarian effect existed on the JSE equities market over the period from 1974 to 1984.

One possible explanation for the lack of momentum/contrarian effects on the JSE as opposed to earlier studies can be partly attributed to findings from a study conducted by Mabhunu (2004). Mabhunu (2004) found the efficiency of the JSE to have increased over the period from 1999 to 2003, particularly with regards to weak form efficiency. The contributing factors to the improved efficiency are the introductions of the SENS (Stock Exchange News Service) and STRATE (Share Transactions Totally Electronic) services in the JSE.

The technical analysis model has an adjusted R-squared of 97.39 percent, which signifies that the model fits the data fairly well.

4.6 Integration of the fundamental and technical analysis models (Hybrid model)

In this section we present estimation results for the model that integrates both technical and fundamental analysis factors. In order to establish the appropriate form of the model to employ, we use the redundant fixed effects test and Hausman's test in a similar manner as the preceding sections.

4.6.1 Redundant Fixed Effects Test

The results of the hybrid model are shown in Table 4.10 below.

Table 4.70 Redundant fixed effects test for the Hybrid model

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.315491	(446,2162)	1.0000
Cross-section Chi-square	165.639083	446	1.0000
Period F	11.188880	(10,2162)	0.0000
Period Chi-square	132.552568	10	0.0000
Cross-Section/Period F	0.559160	(456,2162)	1.0000
Cross-Section/Period Chi-square	292.868321	456	1.0000

The cross-sectional effects are highly insignificant under both the F-test and the Chi-square test. The combination of cross-sectional and period effects is also not significant. The results suggest that the appropriate form of the hybrid model is one with only period effects.

4.6.2 Hausman's Test

Hausman's test helps us determine whether we should use random effects or fixed effects in the model. The results of Hausman's test for the hybrid model are shown in the table below.

Table 4.81 Hausman's test for the hybrid model

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	16.317575	8	0.0381

The results of Hausman's test in Table 4.11 show that the period random effects are not significant at the 5% significance level. This implies that the appropriate form of the hybrid model is one with only period fixed effects. This model is estimated in the following section.

4.6.3 Estimation results for the hybrid model

The estimation results for the hybrid model are shown in Table 4.12 below.

Table 4.92 Estimation results for the hybrid model

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 DPS_{it} + \beta_4 CPS_{it} + \beta_5 B/M_{it} + \beta_6 P_{it-0.25} + \beta_7 D_{i\ up} + \beta_8 D_{i\ down} + \varepsilon_t + v_{it} \quad (3)$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.331260	0.419674	0.789328	0.4300
BVPS _t	-0.102050	0.017583	-5.803957	0.0000
CFPS _t	-0.011726	0.056012	-0.209348	0.8342
EPS _t	0.491855	0.080049	6.144416	0.0000
DPS _t	0.581583	0.138604	4.195999	0.0000
B/M _t	0.050921	0.215184	0.236641	0.8130
P _{it-0.25}	1.035580	0.007152	144.7920	0.0000
D _{UP}	-1.305792	1.036009	-1.260406	0.2076
D _{DOWN}	0.103616	1.087076	0.095316	0.9241
Adjusted R-squared	0.971035	Mean dependent var		34.91297
S.E. of regression	15.90527	S.D. dependent var		93.45534
Sum squared resid	659765.4	Akaike info criterion		8.378384
Log likelihood	-10986.01	Schwarz criterion		8.420865
F-statistic	4891.839	Hannan-Quinn criter.		8.393768
Prob(F-statistic)	0.000000	Durbin-Watson stat		2.309511

The notation used in this table is as follows: $P_{it+0.25}$ refers to the stock price of firm i three months after the fiscal year-end t . $BVPS_t$ refers to the book value per share at fiscal year-end t . $CFPS_t$ refers to cash flow per share at fiscal year-end t . EPS_t refers to the earnings per share at fiscal year-end t . DPS_t refers to the sum of the interim and final dividends declared during fiscal year t . B/M_t refers to the book value divided by the market price at fiscal year-end t . $P_{it-0.25}$ refers to the stock price of firm i three months before the fiscal year-end t . D_{up} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely positive and placed in the highest performance decile, equal to 0 otherwise. D_{down} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely negative and placed in the lowest performance decile, equal to 0 otherwise. ε_t is a term that varies over time but is constant cross-sectionally and measures the random deviation of each cross-sectional firm's intercept from the global intercept term α . v_{it} is the individual observation error term.

In the presence of technical analysis factors, cash flow per share has now become an insignificant explainer of prices. This result is at odds with findings from Model (1), where technical analysis factors were not included. The presence of technical analysis factors therefore diminishes the importance of cash flow per share as an explainer of stock prices.

In accordance with findings from Model (1), the book-to-market ratio still remains insignificant.

The presence of fundamental analysis variables does not appear to have an influence on the level of significance of the technical analysis variables. The lagged price is still highly significant whilst the momentum/contrarian effects dummy variables remain insignificant.

The hybrid model is highly significant and the explanatory variables explain the variability in stock well as shown by the relatively high adjusted R-squared value of 97.10 percent (Table 4.12).

4.7 Comparison of the models

The previous sections of this chapter have solely focused on the ability of the models in explaining stock prices in isolation. We now examine whether fundamental analysis is complementary with technical analysis. We achieve this by comparing the goodness-of-fit statistics of the individual models, in particular the adjusted R-squared statistic.

The technical analysis model has an adjusted R-squared figure of 97.39 percent whilst the fundamental analysis model has an adjusted R-squared of 89.85 percent (Table 4.13). This important result indicates that technical analysis is better suited in explaining stock prices than fundamental analysis when considering JSE-listed stocks. The higher adjusted R-squared value for technical analysis is in line with findings from similar studies conducted by Bettman et al (2009) and Waworuntu and Suryanto (2010) in the US and Indonesian stock markets, respectively.

Table 4.13 below further shows that the hybrid model has a higher explanatory power than the fundamental analysis model as shown by the markedly higher adjusted R-squared value (i.e. 97.10 percent vs. 89.85 percent). This result suggests that by integrating technical analysis factors into a fundamental analysis model, one can significantly increase the explanatory power of an equity valuation model.

However, the adjusted R-squared of the technical analysis model is higher than that of the hybrid model. This result implies that by integrating fundamental analysis variables into a technical analysis model does not necessarily produce a superior model. The technical analysis model is therefore superior to the fundamental analysis model, and the addition of fundamental analysis factors does not enhance the explanatory power of the model and only serve to reduce it. This finding is at odds with previous research by Bettman et al (2009) and Waworuntu and Suryanto (2010), who found the hybrid model to have a superior explanatory power than both the fundamental analysis and technical analysis models.

Table 4.103 Comparison of the models

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 DPS_{it} + \beta_4 CFPS_{it} + \beta_6 B/M_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

$$P_{it+0.25} = \alpha + \beta_1 P_{it-0.25} + \beta_2 D_{i\ up} + \beta_3 D_{i\ down} + \varepsilon_t + v_{it} \quad (2)$$

$$P_{it+0.25} = \alpha + \beta_1 BVPS_{it} + \beta_2 EPS_{it} + \beta_3 DPS_{it} + \beta_4 CPS_{it} + \beta_5 B/M_{it} + \beta_6 P_{it-0.25} + \beta_7 D_{i\ up} + \beta_8 D_{i\ down} + \varepsilon_t + v_{it} \quad (3)$$

	Fundamental Analysis Model	Technical Analysis Model	Hybrid Model
Variable	(1)	(2)	(3)
Intercept	13.99673	0.528445***	0.331260***
BVPS	0.818468		-0.102050
CFPS	1.460429		-0.011726***
EPS	1.376841		0.491855
DPS	1.539106		0.581583
B/M	-0.878452***		0.050921***
Pit-0.25		1.038498	1.035580
DUP		-1.172772***	-1.305792***
DDOWN		-0.334109***	0.103616***
Adjusted R-squared	0.876674	0.973874	0.971035
S.E. of regression	32.48381	15.74416	15.90527
F-statistic	41.10438	35264.60	4891.839
Prob(F-statistic)	0.000000	0.000000	0.000000

*** = Insignificant coefficient

The notation used in this table is as follows: $P_{it+0.25}$ refers to the stock price of firm i three months after the fiscal year-end t . $BVPS_t$ refers to the book value per share at fiscal year-end t . $CFPS_t$ refers to cash flow per share at fiscal year-end t . EPS_t refers to the earnings per share at fiscal year-end t . DPS_t refers to the sum of the interim and final dividends declared during fiscal year t . B/M_t refers to the book value divided by the market price at fiscal year-end t . $P_{it-0.25}$ refers to the stock price of firm i three months before the fiscal year-end t . D_{up} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely positive and placed in the highest performance decile, equal to 0 otherwise. D_{down} is a dummy variable equal to 1 if the holding period return of firm i in the 6 month period commencing 1 year before the measurement of $P_{it+0.25}$ is extremely negative and placed in the lowest performance decile, equal to 0 otherwise.

4.8 Chapter Summary

A number of notable results have been demonstrated in this chapter. A few of the main findings are summarised below.

One, we demonstrated that the fundamental analysis variables that play a significant role in explaining stock price movements of JSE-listed stocks are the following: book value per share, cash flow per share, earnings per share and dividends per share.

Two, we found no evidence of a momentum/contrarian effect on the JSE; implying that stocks that outperform (underperform) in one period do not continue to outperform (underperform) in subsequent periods.

Three, we found the technical analysis model to possess a higher explanatory power than its fundamental analysis counterpart. This result indicates that the technical analysis model is better suited than the fundamental analysis model in explaining the volatility in JSE-listed stocks.

Finally, we found the technical analysis model to be superior to the hybrid model in explaining stock prices. This dismisses the idea that technical analysis and fundamental analysis could be complementary in nature when considering JSE-listed stocks.

Chapter 5: CONCLUSION

5.1 Introduction

Extant literature on equity valuation techniques has not sufficiently covered several aspects of equity valuation techniques that are essential to a successful stock selection process. One of the most important questions in equity valuation that has been rarely explored is whether fundamental analysis and technical analysis are complimentary in nature. Put in a different way, this question asks whether an equity analyst that uses a combination of fundamental analysis and technical analysis can achieve superior investment returns than analysts that uses only one of the valuation techniques.

Furthermore, each of the valuation techniques has its own group of proponents based on theoretical foundations or otherwise. Each group of proponents advocates that their valuation technique is more superior to the other. However, very limited amount of work has been conducted to evaluate these assertions, more especially in a developing market context.

This paper makes a contribution by addressing these key questions based on JSE-listed stocks, for the benefit of market participants and academics. Over and above this, this study also consolidates work that has been done on drivers of stock prices and provides results on the value-relevance of several fundamental analysis and technical analysis explanatory variables.

This chapter is organised as follows: Section 5.2 discusses the findings of this study. Section 5.3 concludes the study.

5.2 Discussion

The results indicate that technical analysis and fundamental analysis techniques are not complimentary in nature when considering JSE-listed stocks. This finding is by virtue of the hybrid model having a lower explanatory power than the technical analysis model, as measured by the adjusted R^2 statistic. The technical analysis model also has a higher explanatory power than the fundamental analysis model. This significant result implies that technical analysis techniques are best suited in explaining price movements of JSE-listed stocks. The superiority of the technical analysis model relative to the fundamental analysis

model is consistent with Bettman et al (2009) and Waworuntu and Suryantu (2010). However the lack of evidence in support of the complementary nature of the two valuation techniques is in direct contrast to Bettman et al (2009) and Waworuntu and Suryantu (2010) who found the valuation techniques to be complimentary in US and Indonesian stock markets, respectively.

We also found no evidence of a momentum or contrarian effect on the JSE. This means that stocks that had extreme return performances in a previous periods did not continue to show a persistence in extreme returns in subsequent periods. A plausible explanation for this finding as suggested by Mabhunu (2004) is that the JSE has become more efficient in recent periods and that trading opportunities from market inefficiencies continue to be arbitrated away. This finding is at odds with Page and Way (1992)'s results who found that the contrarian effect existed on the JSE over the period from 1974 to 1984. Furthermore, our results also contrasts several studies conducted on international markets that have found either the momentum or contrarian effects (see Jegadeesh and Titman (1993), Rouwenhorst (1998), Liu et al. (1999) and De Bondt and Thaler (1985)).

With regards to drivers of stock prices, we find book value per share, earnings per share, dividends per share, cash flow per share and lagged prices to be significantly related to stock prices. The significance of book values per share and earnings per share is consistent with Ohlson (1995)'s clean surplus framework, as well as Collins (1997), Bettman et al (2009) and Waworuntu and Suryantu (2010). Significance of the dividend per share variable is consistent with the renowned Dividend Discount Model framework, while the significance of the cash flow per share is supported by Chan et al (1993)'s similar finding on the Japanese stock market. The significant ability of the lagged price variable to explain market prices is consistent with Lo and MacKinlay (1988).

However, we also demonstrate that the book-to-market ratio does not play a significant role in explaining price movements of JSE-listed stocks. The presence of integration of technical and fundamental analysis variables does not alter this finding. This finding is in contrast to a study conducted by Auret and Sinclair (2006) who found the book-to-market ratio to be significantly related to JSE stock prices.

5.3 Conclusion

The primary goal of this study was to examine whether fundamental and technical analysis techniques are complimentary or substitutes for one another. Whilst the two valuation techniques can explain share price movements fairly well in isolation, empirical results however, show that when considering JSE-listed stocks, the two techniques are not complimentary; and that technical analysis plays the biggest role in the JSE.

The empirical results show that technical analysis has a higher explanatory power than the fundamental analysis model in isolation and as well as the model that integrates both valuation techniques.

The prominence of the technical analysis model thus challenges the random walk hypothesis with regards to JSE-listed stocks. Notwithstanding the above conclusions, a technical analyst should not however, solely rely on momentum or contrarian effects in the search for risk-adjusted returns as no evidence of these effects was found on the JSE.

Furthermore, in South Africa, the best predictors of stock price movements are shown in this study to be the book value, earnings, dividends and the lagged prices.

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