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Relationship between financial ratios and share price performance of the top five sectors on the Johannesburg Stock Exchange

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ABSTRACT

Financial ratios have been commonly used to evaluate firm financial performance and assist investors with the evaluation of shares. Yan and Zheng (2017) argued that the most important financial ratios are sector specific. The purpose of this research was to determine if statistically significant relationships exist between financial ratios and the share price performance of the top five sectors on the Johannesburg Stock Exchange based on market capitalisation. The five sectors were the mining, banking, life insurance, real estate investment trusts and mobile telecommunication sectors. Multiple linear regression as statistical method was applied over a 20-year period from 1997 to 2018.

Statistically significant relationships were found between financial ratios and the share price performance for each of the five sectors. The mining sector displayed relationships with return on equity, price-to-book value, debt to equity, dividend yield, debt to assets and the total asset turnover ratios. Banking displayed relationships with the price-earnings and return on equity ratios. The life insurance sector and the operating profit margin displayed a relationship. Lastly, the mobile telecommunication sector delivered relationships with return on assets, dividend yield and debt to assets. This research delivered a practical contribution to the theory of quality fundamental analysis from a JSE sector perspective.

KEYWORDS

Financial ratios; Fundamental analysis; Sectors; Share Price; Johannesburg Stock Exchange (JSE)

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Peter Desmond Steyn

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13 March 2019

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CHAPTER 1 INTRODUCTION TO RESEARCH PROBLEM

1.1 Research Title

Relationship between financial ratios and share price performance of the top five sectors on the Johannesburg Stock Exchange.

1.2 Introduction

Delen, Kuzey and Uyar (2013) stated that using financial ratios to evaluate firm performance and financial health, even though a traditional method, has been a powerful and important tool for various decision makers. Financial ratio analysis is the most commonly used and effective financial performance evaluation method (Hsu, 2014; Musallam, 2018). Financial ratio analysis is also the most informative method of analysing firm performance due to its ability in delivering insights into every aspect of a company's financial performance (Skae et al., 2012).

According to Delen, Kuzey and Uyar (2013), financial ratios have various benefits, including the measurement of the performance of business managers, measuring the performance of departments within an organisation and making projections of the future based on the past. Financial ratios can further be used to perform comparisons with competitors or other companies across industries (Delen, Kuzey & Uyar, 2013; Musallam, 2018). Another benefit is that the financial performance of companies of different sizes can be compared to each other as they are judged on the same scale (Delen, Kuzey & Uyar, 2013; Yan & Zheng, 2017).

Financial ratios are most commonly used to evaluate financial performance of organisations in order to determine possible future stock returns (Delen, Kuzey & Uyar, 2013; Musallam, 2018). This is corroborated by Safdar (2016) which states that the interest in using financial statements in predicting future stock returns has been evident since the early 1900's, mainly due to the expectation that financial statement analysis could be valuable in discovering important information to make superior investment decisions.

1.3 Research Problem and Motivation

The first problem which however arises from financial ratios, financial ratio-based evaluation models and financial variables are their abundance and the lack of consensus regarding which financial ratios are of most importance. Some of the first noticeable authors identified, which mentioned this, was Ou and Penman (1989) who argued that even though previous academic literature agreed that financial statements were to be used to perform fundamental and ratio analysis, that little guidance was provided on which ratios were of most importance and therefore the authors used 68 different financial ratios in their research performed.

With regard to evaluating financial performance of an organisation, Delen, Kuzey and Uyar (2013) stated that when searching for literature regarding the use of financial ratios to evaluate firm performance, that thousands of publications were available, where each study tried to differentiate themselves by way of developing a different set of financial ratios. Delen, Kuzey and Uyar (2013) argued that “there is no universally agreed-upon list regarding the type, calculation methods and number of financial ratios used in earlier studies” (p. 3971). It was further mentioned that various earlier research used between 15 to nearly 60 different financial ratios.

With regard to stock returns, Yan and Zheng (2017) commented that finance researchers have sought to determine what the causes of stock return patterns are, which has led to hundreds of cross-sectional return anomalies being identified and documented. This abundance is further made clear by Hou, Xue, Zhang (2015), which investigated a broad range of 80 financial return anomaly variables, of which the majority were financial ratios. They further mentioned various other researchers which used a varying number of financial variables of up to 300 in their testing performed. Light, Maslov and Rytchkov (2017), document other research findings delivering significant financial variables between 50 and 330 variables.

An extreme example was where Yan and Zheng (2017) applied more than 18 000 financial statement derived fundamental variables, using data mining techniques, to predict stock returns. Further to this, in addition to financial accounting ratios, investors use price-to-fundamental ratios for share evaluation purposes. These include the dividend-yield, price-earnings, price-to-book and price-to-cash flow ratios to name a few (Chua, Delisle, Feng & Lee, 2014; Fama & French, 2008, 2012; Gupta & Modise, 2012; Lewellen, 2004; Morar, 2014; Muller & Ward, 2013; Jiang & Lee, 2007). The problem of abundance, continuous differences in the financial variables used and the results obtained from these variables therefore still appears to exist.

Consequently, amateur investors and managers with less technical financial knowledge in some instances, resort to applying and analysing an excess of financial ratios and financial models in a hopeful attempt to cover the most important. Investors further often suffer from a lack of expertise and end up making the incorrect investment decisions (Hsu, 2014). Business and finance students are also normally supplied with a list of financial ratios and financial models from a theoretical perspective, but in some instances, the specific ones to use which are of most importance in their specific fields of business or practice, is rather left for self-exploration and interpretation. The researcher has personally noticed this problem as various business students, studying towards an MBA, after the completion of their finance and accounting modules, are still seeking guidance as to which are the main financial ratios which drive their industries. With so many financial ratios and financial models available, it is sometimes unclear to less experienced users which are the most important ratios to focus on for a specific industry or sector in respect of share price performance.

The second problem which arises is the lack of South African financial ratio studies performed. According to Bunting and Barnard (2015), very few fundamental analysis studies have been performed outside the United States (U.S.) equity markets. Bunting and Barnard (2015) further noted that various differences exist between the United States accounting standards, security regulations and market microstructure when compared to other countries. The United States uses U.S. Generally Accepted Accounting Principles (GAAP) as accounting standard, where South Africa, uses International Financial Reporting Standards (IFRS) (Barth, Landsman, Lang & Williams, 2012; IFRS, 2016). Barth, Landsman, Lang and Williams (2012) argued that significant differences exist between the two accounting standards. Cinca, Molinero, and Larraz (2005) further determined that the countries where companies are located impact the structures of their financial ratios. These differences provide sufficient evidence to question if financial ratio models developed based on U.S. data would be transportable and replicable in the South African context with similar findings achieved (Bunting and Barnard, 2015).

Further to this, more recent literature by Konku, Rayhorn, and Yao (2018) argued that most of the research on stock price behaviour has focussed on developed markets, as data was more easily obtainable. They stated that emerging market economies have gained significant growth in the last two decades and therefore the importance for investors have started to increase. According to Financial Times (n.d.) “Emerging market is a term that investors use to describe a developing country, in which investment would be expected to achieve higher returns but be accompanied by greater risk” (para. 1). According to Konku, Rayhorn, and Yao (2018) the emerging market focus has been mainly based on larger emerging markets including Brazil, Russia, India and China, but the focus was turning to smaller emerging economies like South Africa due to the desire of diversification by developed country investors and the potential for higher returns. The authors further argued that studies on African markets were not as abundant as those of other emerging markets.

Deloitte (2017) argued that when South Africa was included as part of the BRICS (Brazil, Russia, India, China and South Africa) acronym in 2010, and was regarded as a first-tier emerging market, that all the BRICS nations were regarded as performing well in terms of rising and future demand. The BRICS landscape has however changed. While the Chinese and Indian emerging economies are growing and could deliver the higher returns as expected by emerging markets, South Africa is starting to display the bad economic trends of Brazil. With various credit rating downgrades (BB+ in 2017), various quarters of negative GDP growth realised in the most recent years, an unstable political environment, public sector underperformance and reduced investor confidence, South Africa might not deliver the higher returns which are expected from emerging markets. The results achieved from other emerging market finance research performed, might therefore not be replicable on the South African equity markets when attempted. It therefore appears that the South African economic and equity market landscape is unique to those of developed markets and some of those classified as emerging markets.

The third problem noted is that even though some South African specific financial ratio and share return related studies have been performed, that those identified by the researcher have been performed under a different lens. None of these focussed on the different sectors present on the Johannesburg Stock Exchange (JSE) in isolation. Yan and Zheng (2017) argued that the most important financial ratios are industry specific. Safdar (2016) further placed emphasis on the importance of industry context when performing financial ratio analysis and argued that financial ratio based fundamental analysis is more effective when used in industries which have less competition.

Delen, Kuzey and Uyar (2013) stated that the financial ratio structures of manufacturing and retail firms are different. Mohanram, Saiy, and Vyas (2018) further argued that most financial statement-based research performed excludes bank stocks, as banks have vastly different financial drivers when compared to other industries. This literature provides substantial evidence that most sectors are unique as they have different financial drivers, financial structures and different market dynamics. More specific and focussed results could therefore be derived and would be beneficial, if a sector specific study is performed.

The first South African study reviewed was that of Gupta and Modise (2012), where only two pricing ratios, namely the price-earnings and price-dividend ratios were evaluated for their share return predictability capabilities in the South African context over a period of nearly 20 years. This was followed by Hoffman (2012), which through the inclusion of all the companies listed on the JSE (376 companies) in aggregate, determined the effect that a few explanatory variables, including some financial ratios and other factors, have on stock returns. Next was the research by Muller and Ward (2013) which sought to determine the best financial ratio and other factor investing styles to use on the JSE. The top 160 companies of the Johannesburg Stock Exchange based on market capitalisation were researched over a 27-year period.

Ramkillawan (2014) further sought to determine what the relationships of only two financial accounting ratios were with the average stock returns of the Top 40 index of the Johannesburg Stock Exchange and the Top 50 index of the Nigerian Stock Exchange. This was followed by Morar (2014), which focussed on BRICS stock exchanges, but only applied four price-to-fundamental financial ratios in an attempted model for stock selection which only ranged over a period three years. The last study was that of Bunting and Barnard (2015), where a South African JSE based Piotroski F-Score study was performed to determine the relationship between financial accounting ratios and equity returns.

None of the above South African based or inclusive studies mentioned, focussed on the different South African JSE sectors in isolation, but grouped all companies from different sectors together during these evaluations. The only study which took some cognisance of the industries was that of Muller and Ward (2013), but an analysis was only performed between the high level industrial and resource classifications on the JSE to determine which of these two industries delivered the highest returns. By referring to the lowest level of the Industry Classification Benchmark (ICB) which is used by the JSE, 114 subsectors exist which provides an indication of how many classification categories are available in which companies on the JSE can be classified (FTSE Russell, n.d.).

Some researchers in other areas of the world, which have performed sector-based studies, have found stronger relationships between financial ratios and share price performance in certain sectors when compared to others. Vedd and Yassinski (2015), through analysing the Latin American industrial sector, determined that the asset turnover ratio and share prices in Brazil, Chile and Mexico were strongly correlated. Ma and Truong (2015), through an analysis of the banking, energy, investment, real estate and retail sectors of the Swedish OMX stock exchange, determined that the financial ratios which affect share price movement the most for each sector, was industry specific. From the results obtained by international sector-based studies, a clear argument can be made that more value could be derived by evaluating financial ratios and share price performance on a sector basis in the South African context instead of merely grouping all the companies together. The question which emerges from the combination of the three problems identified, is if financial ratios have statistical relationships with the share price performance of the different sectors of the South African JSE.

1.4 Research Objective and Scope

The objective of this research was to determine if statistically significant relationships exist between financial ratios and share price performance of different sectors on the JSE, with the possible result that the main financial ratio drivers of each sectors share price could be determined. To the best of the researcher's knowledge, a sector-based study regarding the relationship between financial ratios and share price performance has not been performed in the South African JSE market space. The scope of this research includes the top five sectors of the JSE based on the combined market capitalisation of each sector.

The sectors were classified according to the third level classification of the Industry Classification Benchmark (ICB) of which 41 sectors were available (FTSE Russell, n.d.). A broad range of fourteen specific financial ratios were used in the multiple linear regression analysis performed, including both those from a financial accounting and price-to-fundamental ratio perspective in order to form a holistic representation of the most important financial ratios for each sector. The scope of the research further ranged over a comparative period of 20 years from 1997 to 2018 with 1997 being set as the base year. This research aimed to deliver a practical contribution to the theory of quality fundamental analysis from a South African Johannesburg Stock Exchange sector perspective.

1.5 Academic and Business rationale

This research aimed to provide investors targeting certain sectors of the JSE greater insight regarding the specific financial ratios to focus on when evaluating equity shares for purchase in the different sectors included in the scope. This research further aimed to provide managers or executives operating in the selected sectors guidance as to which financial ratios are of most importance to their organisations when attempting to drive share price performance. Further, the aim was to assist these parties during decision making, as the possible effect on share price might be more predictable when for example making decisions regarding the organisations debt to equity structures or dividend policies. Lastly, this study aimed to aid finance, investment and accounting academic literature in South Africa, to improve the student's understanding regarding financial ratios and their relationship with share price performance in the various sectors included in the scope.

1.6 Overview of the research report

Chapter 2 follows and delves into the body of literature surrounding financial ratio-based company performance analysis, investment techniques commonly used and the detail around the different types of financial ratios. Further, Chapter 2 discusses what other researchers have found regarding the effect of financial ratios on share price performance and justifies the validity of performing this research on a sector basis on the South African JSE. Chapter 3 provides the hypotheses as determined from the research question and literature reviewed. Chapter 4 provides the methodology and design of the research project and the initial limitations identified before the data processing was performed. Chapter 5 provides the results of the data analysis as performed in accordance with the methodology and design documented in Chapter 4. Chapter 6 then discusses the results of Chapter 5 in the context of the literature reviewed in Chapter 2 and further provides the integrated findings derived from the individual hypothesis results and related literature. Lastly, Chapter 7 provides a conclusion of the research project performed, summarising the principal findings derived from Chapter 6, stating the implications for management, indicating the limitations encountered during the research and providing suggestions for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The purpose of this research was to determine if financial ratios have statistical relationships with the share price performance of the top five sectors of the JSE, based on market capitalisation. The literature review aimed to uncover the academic theory, debates and findings which assisted in framing the research hypotheses. Firstly, some of the most common theories and methods which investors use to evaluate shares were reviewed. From this literature the most important financial ratio classification groups were identified. These classification groups were individually investigated. The effects of the above financial ratios, identified from the classification groups, on share prices were reviewed. South Africa's positioning in the global economy and the Johannesburg Stock Exchange's positioning among the global equity markets were then reviewed. A review of the industry and sector classification standards, as used by the JSE, was lastly performed. The literature review was then concluded with the main findings which lead to the research hypotheses in Chapter 3.

2.2 Fundamental Analysis

It is generally accepted that two types of investing techniques exist, namely technical analysis and fundamental analysis (Avramov, Kaplanski & Levy, 2018; Chen, Lee & Shih, 2016). Technical analysis is normally used by technical security analysts and share portfolio managers where their main focus is on short-term price gains and volumes traded, identified with the use of charts (Avramov, Kaplanski & Levy, 2018; Chen, Lee & Shih, 2016). Hoffmann and Shefrin (2014) found that investors which operate on an individual basis and make use of technical analysis perform poorly when compared to other individual investors. Fundamental analysis on the other end considers firm-specific financial statements, the industry, the market, and firm-level economic factors to name a few (Avramov, Kaplanski & Levy, 2018; Chen, Lee & Shih, 2016). This research follows a fundamental analysis approach as this approach relies on financial ratios, which have a wide application for various users including business managers, investors and business students. This approach was best suited for the research performed.

According to Li and Mohanram (2018) and Bartram and Grinblatt (2018), the main concept of fundamental analysis is that a stock might currently be mispriced, but it is expected to correct itself in the future to reflect the fundamental value of the stock. Investors thereby make profits by purchasing these mispriced stocks at the low prices and selling them when the market corrects itself. Li and Mohanram (2018) stated that there are two approaches to fundamental analysis. The value approach is the first, where the stock's inherent value is determined based on the application of valuation techniques. Stock will only then be purchased if this inherent value is more than the market price that the stock is currently being traded for (Li & Mohanram, 2018). Various valuation methods to calculate the inherent value of a stock exists, but to obtain the value, highly stylized fair value models are needed, such as the discounted cash flow model, where future earnings, cash flow forecasts, discount rates and growth rates are required (Bartram & Grinblatt, 2018; Li & Mohanram, 2018). The issue with this method is that forecasts are merely subjective estimations, based on opinions and speculation (Lee, 2014; Li & Mohanram, 2018). These valuation methods further rely on summary metrics such as book value, earnings, cash flow and dividends and therefore only partially utilise the rich information available in the financial statements (Li & Mohanram, 2018).

According to Li and Mohanram (2018), the second approach is the quality approach, where financial statements are used to identify organisations with strong fundamentals, that are expected to deliver good performance in the future and generate high returns. The quality approach uses the rich information which is contained in the financial statements and therefore can be applied to more companies (Li & Mohanram, 2018). The study performed by the researcher used financial ratio analysis as derived from financial statements and market information and therefore was classified as part of the quality fundamental analysis approach.

The effectiveness of the quality approach was substantiated in various earlier research performed. Some of the first notable research into the quality approach was performed by Ou and Penman (1989) where the authors stated that an organisation's value is determined by the information contained in the financial statements. The authors believed that values that are not reflected in the share prices could be detected by analysing the financial statements. With the use of 68 financial ratios, Ou and Penman (1989) were able to determine that financial statement analysis can predict future stock returns.

Piotroski (2000) developed a fundamental analysis strategy, where nine simple accounting fundamental signals were used to form a combined F-Score. If a share complied with a fundamental signal requirement, it would be awarded a score (F-Score) for each of the nine requirements. Shares would then be classified in groups based on their F-Scores and would be analysed against their stock returns. Four of the nine signals related to profitability, three of the nine signals related to solvency and liquidity and two of the nine signals related to operating efficiency. All these ratios were calculated from the companies' financial statements. These classifications were corroborated by Muller and Ward (2013) which stated that the classification of the F-score variables took the form of the DuPont ratio analysis, as discussed in section 2.5.1. It was determined that when the F-Score method was applied to portfolios of high book-to-market firms (value stocks) that stocks could be selected which delivered significant stock returns. This fact was further substantiated by Bunting and Barnard (2015), Chen, Lee and Shih (2016), Li and Mohanram, (2018), Safdar (2016) and Turtle and Wang (2017) to name a few.

Mohanram (2005) took a similar approach to that of Piotroski (2000) and developed a G-Score model, consisting of eight fundamental signals, which could be applied to low book-to-market stocks, classified as growth stocks. The first three of the eight signals related to the profitability of an organisation. The next two signals related to the stability of growth ratios. The final three of the eight ratios related to ratios that would affect current profitability negatively, but boost future growth ratios of a company, thereby investing current profits for future growth. Mohanram (2005) determined that when the G-Score approach was applied to portfolios of growth stocks, in the long and short term, that significant excess stock returns could be realised. Piotroski and So (2012) later determined that the F-Score strategy, as developed in Piotroski (2000), was not only applicable to high book-to-market stocks but also was useful when applied to a broad variety of stocks.

Due to the nature of pure quality driven financial statement based fundamental analysis, none of the above studies performed incorporated price or market ratios, but only included ratios developed purely from financial statements. One important aspect however determined from these quality fundamental analysis studies, was that the ratios included generally fell under the categories of liquidity, solvency, profitability, operating efficiency and asset utilization (Delen, Kuzey & Uyar, 2013; Musallam, 2018). These financial accounting ratio classifications groups and their meanings were therefore further explored in section 2.5.

Even though some of these studies and underlying theories are a bit dated, they are widely used as a basis for research, further exploration or form part of the academic literature in new developing theories (Bartram & Grinblatt, 2018; Bin, Chen, Puclik, & Su, 2017; Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Goodman, Neamtiu & Zhang, 2018; Hou, Xue & Zhang, 2015; Kim & Lee, 2014; Li & Mohanram, 2018; Mohanram, Saiy & Vyas, 2018; Morar, 2014; Muller & Ward, 2013; Richardson, Tuna & Wysocki, 2010; Safdar, 2016; Turtle & Wang, 2017).

Some of the latest research have used the quality F-Score and G-Score methods in combination with other approaches including the value approach in Li and Mohanram (2018) and the technical analysis approach in Chen, Lee and Shih (2016) in order to determine if combinations of these methods, with others, could lead to improved returns. Chen, Lee and Shih (2016) found that when the F-Score and the G-Score methods are applied in combination, that an investment strategy was obtained that delivered significant stock returns. These theories are therefore still very relevant and are being researched more widely in various configurations on a developed market basis.

2.3 Value Investing

Value investing is not a new concept and was grounded in 1934 with the book by Benjamin Graham and David Dodd, titled “Security Analysis”, opening the field of buying under-priced shares based on fundamental analysis (Asness, Frazzini, Israel & Moskowitz, 2015; Lee, 2014; Li & Mohanram, 2018; Muller & Ward, 2013). The concept of value investing has been used by some of the greatest investors in the world, including Warren Buffet to the point where he posted a foreword in the latest publication of the series in 2008 (Graham & Dodd, 2008; Lee, 2014).

According to Athanassakos (2012), value investing involves a three-step process. Firstly, the market is scanned for potentially under-priced stocks. Various price-to-fundamental ratio screens are used for the screening process including the price-earnings (P/E), price-to-book (P/B), cash flow-to-price, earnings yield (Inverse of P/E) and dividend yield (DY) (Asness, Frazzini, Israel & Moskowitz, 2015; Athanassakos, 2012; Bartram & Grinblatt, 2018; Chen, 2017; Lee, 2014; Li & Mohanram, 2018; Penman & Reggiani, 2018; Piotroski & So, 2012; Richardson, Tuna & Wysocki, 2010). Secondly, after the stocks have been screened, the stocks identified which seems to be under-priced, are evaluated more in-depth based on the fundamental analysis approaches discussed earlier to determine the value (Athanassakos, 2012). Lastly when a stock appears to have a higher value than its current market price, a decision is made whether the stock is to be purchased or not. Athanassakos (2012) argued that some investors only use the first step of value investing where they apply screens to stocks to invest in without much further consideration. Value stocks tend to pay more dividends, when compared to those of growth stocks (discussed in 2.4) and therefore reliable dividend track records are of importance to many value investors (Chen, 2018; Conover, Jensen & Simpson, 2016).

Lee (2014) and Li and Mohanram (2018) used versions of Graham's value investing screens in their research. Graham's value investing screens included a total of 10 screens of which the first five measured the relative cheapness of the stock and included various price and price-to-fundamental ratios (Lee, 2014). The second grouping of five ratios did not include any pricing ratios and were purely based on information derived from financial statements in order to form an opinion on the quality of the company (Lee, 2014). The 10 screens in totality therefore included both price-to-fundamental and financial accounting ratios.

In Lee (2014), a slightly adapted version of these 10 screens, referred to as the "Levin-Graham strategy", was applied to U.S. companies for a period of 14 years ranging from 1999 to 2013. Dividend yield was replaced by cash-flow yield and the 10 years of earnings was replaced with five years. If a company met a condition, then a "+1" was allocated to it. If a company met all 10 screening conditions, then a "+10" was given and so forth. All these companies with their scores from 1 to 10 were then grouped into portfolios ranging from 0-100. The "0-10" portfolio included the companies which had a "+1" score, the "10-20" portfolio included those with a "+2" score and so forth. The average returns generated by these 10 portfolios of stocks, which were determined on a quarterly rebalanced, equal weighted basis, were then compared to the average return on the Standard & Poor's (S&P) Dow Jones Midcap 400 index indicated in the first column of Figure 1. The Standard & Poor's (S&P) Dow Jones Midcap 400 index is the top 400 mid-sized market capitalisation ranked companies on the NYSE or NASDAQ. It was determined that these value investing screens, even though based on historical principles, still carried immense value as shown in Figure 1 (Lee, 2014).

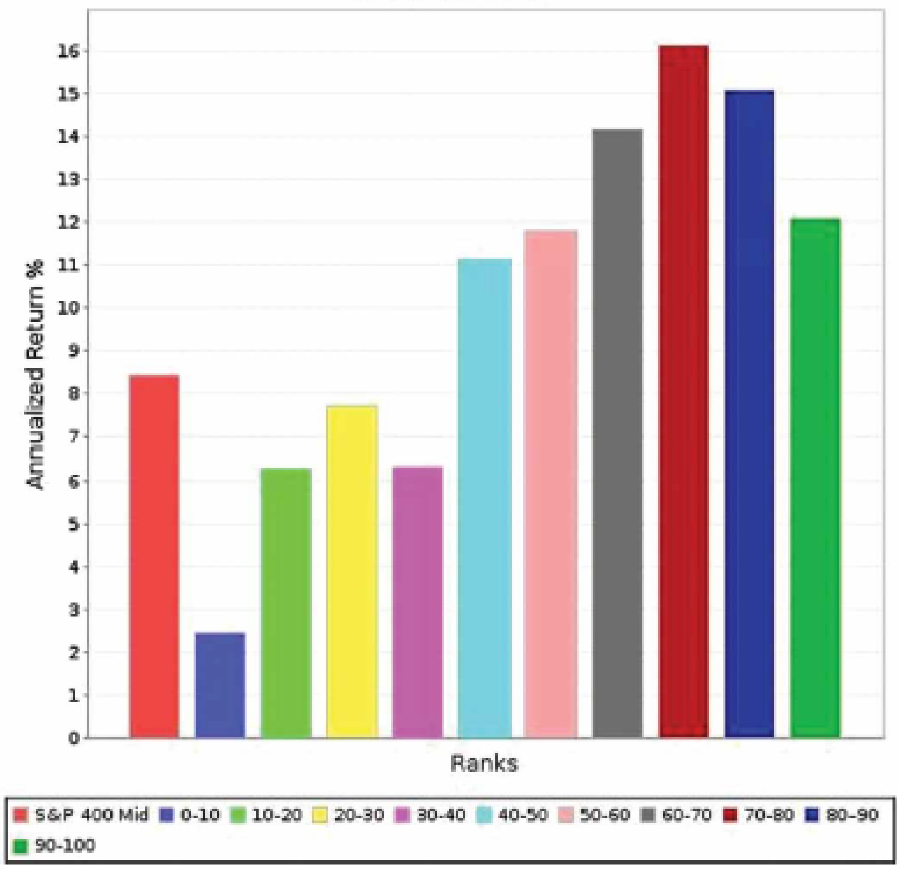

Figure 1. Portfolio returns for the Levin-Graham stock screen test period 1999 to 2013 (Lee, 2014).

Figure 1 clearly shows that by combining financial accounting ratios and price-to-fundamental ratios, that more value could be derived for analysis and research purposes as investors are expected to make use of both. This is further corroborated by Bartram and Grinblatt (2018) which stated that various finance research uses information and ratios from the financial statements, and price-to-fundamental ratios to predict stock returns. Seeing the importance of both categories, financial accounting ratios (2.5) and price-to-fundamental ratios (2.6) were further reviewed in the sections indicated.

2.4 Growth Investing

As discussed in the section 2.3, value investors normally tend to choose stocks with low price-to-fundamental ratios (or the inverse, high fundamental-to-price ratios) as they are cautious to overpay for stock (Athanassakos, 2012; Chen, 2017; Hou, Xue & Zhang, 2015; Muller & Ward, 2013; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010; Zhang, 2013). Growth stocks, on the other side, normally have high price-to-fundamental ratios, of which the most common identifiers are high price-to-book ratios (or the inverse, low book-to-market ratios) and high price-earnings (P/E) ratios

(Athanassakos, 2012; Bunting & Barnard, 2015; Chen, 2017; Hou, Xue & Zhang, 2015; Li & Mohanram, 2018; Mohanram, 2005; Muller & Ward, 2013; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010; Zhang, 2013).

Growth investors anticipate that the growth of growth stocks will be significantly higher than the average market growth and thereby focus on earning profits through capital gains when the stocks are sold (Chen, 2018). Dividends are therefore not normally paid by growth stocks as cash flows generated are mostly reinvested by the companies in order to increase growth in the short term (Chen, 2018; Conover, Jensen & Simpson, 2016). Growth investors therefore do not place much value on dividends (Conover, Jensen & Simpson, 2016). Value stocks normally have high dividend yields, where growth stocks tend to have low dividend yields (Conover, Jensen & Simpson, 2016).

Growth stocks normally tend to be overvalued as the prices seem to be driven by excitement in recent market performance and optimistic expectations rather than by the fundamentals of the company (Chen, 2018; Mohanram, 2005; Piotroski & So, 2012). This method of investing is therefore very risky, because if the optimistic growth as expected by investors is not realised, losses could be incurred when the stocks are sold which is further combined with the receival of no dividends (Chen, 2018). Conover, Jensen and Simpson (2016) and Cordis (2014) found that value stocks which normally have low price-to-book ratios and high dividend yields, have higher returns when compared to growth stocks.

In summary, it is therefore important to note that even though low price-to-fundamental ratios, especially a P/E and P/B ratio combined with a strong track record of dividend payments might be preferred by some investors, which classify themselves as value investors, growth investors might not focus on these ratios, and would be willing to purchase shares with high price-to-fundamental ratios and no dividends (Chen, 2018; Conover, Jensen & Simpson, 2016). Various investors however include both types of stocks in their portfolios for risk diversification purposes (Chen, 2018).

2.5 Financial accounting ratios

2.5.1 Introduction

According to Yan and Zheng (2017), more meaning can be derived from financial statements, if one variable in the financial statements is compared to another, where this comparison forms financial ratios. Financial ratios are valuable tools for various reasons of which one is that the financial health of an organisation can be analysed (Delen, Kuzey & Uyar, 2013; Musallam, 2018). Financial ratio analysis is the most informative financial statement analysis method due to its capability of analysing every aspect of an organisation's financial position (Skae et al., 2012).

Managers and users of financial ratios should however be aware that financial ratios on a standalone basis do not always provide as much value, but become much more valuable if tracked over time and in addition are compared to industry standards (Financial ratios, n.d.; Musallam, 2018). Financial accounting ratios can be classified into various groupings namely liquidity, solvency, profitability (operating efficiency), asset utilization or turnover ratios of which a discussion of each follows in the sections below (Delen, Kuzey & Uyar, 2013; Musallam, 2018).

A useful and widely used tool which has assisted various financial statement users with the assessment of an organisation's holistic financial health is the DuPont analysis (Jin, 2017; Skae et al., 2012). The DuPont analysis normally uses the Return on Equity (ROE) as its key determinant which is then broken up into the components of profit margin, asset turnover and financial leverage (Jin, 2017; Skae et al., 2012). Jin (2017) further found that by analysing the three broken-up components of the DuPont analysis, that ROE could be predicted one year in advance. Each component of this breakdown is further discussed in sections 2.5.3 (Financial Leverage), 2.5.4 (Profit Margin) and 2.5.5 (Asset Turnover). The expanded DuPont formula is presented in Equation 1.

Equation 1. DuPont analysis

$$ROE = \underbrace{\left(\frac{Net\ Income}{Ave.Equity}\right)}_{ROE} = \underbrace{\left(\frac{Net\ Income}{Revenue}\right)}_{Profit\ Margin} \times \underbrace{\left(\frac{Revenue}{Ave.Assets}\right)}_{Asset\ Turnover} \times \underbrace{\left(\frac{Ave.Assets}{Ave.Equity}\right)}_{Financial\ Leverage}$$

Source: Kenton, W. (2019).

Various researchers have also used the DuPont Analysis in the form of a Return on Asset (ROA) analysis, where only profit margin and asset turnover is included into the equation, while financial leverage is excluded (Chang, Chichernea, & HassabElnaby, 2014; Goodman, Neamtiu, & Zhang, 2018; Mohanram, 2005).

2.5.2 Liquidity ratios

These ratios are used to measure an organisation's ability to cover its current liabilities or payment obligations, using its cash and other current assets, such as inventory and receivables, which are quickly convertible into cash (BDO, 2017; Khidmat & Rehman, 2014; Ehiedu, 2014). Liquidity of an organisation is important as a company normally converts its current assets, as it is more liquid than long term-assets, to obtain cash, which is then used to cover the current liabilities (Skae et al., 2012). Ehiedu (2014) argued that liquidity is crucial to the existence and operation of a company. Liquidity is affected by the operating cash flows generated by a company's assets (Khidmat & Rehman, 2014). A few variations of these liquidity ratios exist of which the main ratios are provided in Table 1.

Table 1

Liquidity Ratios

Ratio	Calculation	Citation
Current Ratio or Liquidity Ratio	Current Assets ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)
Quick Ratio or Acid Test Ratio	(Current Assets – Inventory) ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)
Cash Ratio	Cash and Cash Equivalents ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)

Note. Researcher produced.

Zarb (2018) argued that the most basic and commonly used measure of liquidity is the current ratio. The change in the current ratio is also one of the nine factors used in the F-Score model to measure the change in liquidity (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). Lee (2014) and Li and Mohanram (2018) all used versions of Graham's value investing screen in their research, where the current ratio was further used as one of the 10 screens. Seeing the importance and popularity of the current ratio, it was used as the sole liquidity ratio in the research performed.

2.5.3 Solvency Ratios

These ratios are used to measure an organisation's ability to cover its long-term liabilities and financial commitments (BDO, 2017). Ratios in this category also explain how companies are leveraged, indicating the proportion of their debt funding compared to their equity funding and the extent of debt compared to assets held (Delen, Kuzey & Uyar, 2013).

Skae et al. (2012) argued that leveraging a company with more debt compared to equity could be cheaper for the company if the organisation is performing well. This is due to the tax deductions obtained on interest incurred and the lower expected returns required when compared to the returns expected by equity investors. Debt additionally provides financing for the company without the investors losing additional control. This could further be beneficial if the company is able to deliver higher returns on the debt than it needs to pay in interest and capital (Skae et al., 2012). Equity Investors however carry more risk in these circumstances as their returns are not guaranteed to the same extent as the banks supplying the debt. This is due to the interest and capital repayments being guaranteed through contracts between the bank and the company, where equity investors do not have the same guarantees. Further, if the company is not able to deliver on their future projected results, the company might not be able to make its interest repayments which could lead to losses for the organisation and subsequent losses for investors in the form of decreases in share prices and non-payment of dividends (Skae et al., 2012).

Even though debt appears to be cheaper for companies when compared to equity, Lewis and Tan (2016) found that more equity is issued by companies compared to debt when optimistic long-term growth is projected. It was further found that when this equity was issued, that lower returns were obtained by equity investors at the following earning announcements when compared to debt issuers (Lewis & Tan, 2016). In summary, it therefore appears that investors would be more prone to debt issuing when compared to equity as they could earn improved returns, but with increased financial risk. According to Skae et al. (2012), the debt ratio is used to determine if a company has high financial leverage, which leads to increased financial risk. Based on this ratio, investors determine if the company is capable of taking on any additional debt finance. The optimal debt to equity ratio (gearing) is however industry and company specific (Muller & Ward, 2013; Skae et al., 2012).

In addition to the debt ratio, investors use the interest cover ratio to determine if companies will be able to repay their debts before investing, as investor returns normally come last during financial difficulty (Skae et al., 2012). Muller and Ward (2013), which also used the interest cover as a financial ratio, determined that low interest cover ratios provide evidence of companies using too much debt compared to equity which ultimately could lead to financial distress. It was further found that companies with low interest cover continuously underperformed in the market with respect to share returns and therefore should be avoided by investors.

The change in an organisation's debt to asset ratio is one of the nine factors used in the F-Score model (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). Piotroski (2000) and Chen, Lee and Shih (2016) argued that an increase in the debt-to-asset is a negative signal for investors as it indicates the inability of an organisation to generate internal funds through the assets held. It was also found that higher debt to assets ratios significantly and negatively affected the profitability of organisations (Yazdanfar & Öhman, 2015). This ratio further provides an indication of the percentage of company assets financed through debt (Skae et al., 2012). A lower ratio is beneficial as potential losses would be reduced if a company would be liquidated (Skae et al., 2012).

The most important solvency ratios were presented in Table 2 of which all were used in the research performed. The financial leverage aspect of the DuPont ROE model, as provided in the introduction section, measuring the amount of assets compared to equity was not used as sufficient coverage was obtained from the other solvency ratios and it was further not available on the database where the information was obtained.

Table 2

Solvency Ratios

Ratio	Calculation	Citation
Debt to Equity (D/E)	Debt ÷ Owners Equity	(Delen, Kuzey & Uyar, 2013)
Debt to Assets (D/A)	Debt ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Interest cover (or times interest earned ratio)	Earnings Before Interest and Tax ÷ Interest	(Delen, Kuzey & Uyar, 2013)

Note. Researcher produced.

2.5.4 Profitability & Operating Efficiency Ratios

Profitability and operating efficiency ratios are mainly utilized to determine how profitable companies are and how effectively a company is operated. Akbas, Jiang and Koch (2017) found that a trend in a company's profitability, can predict its stock returns and its future profitability. Asness, Frazzini and Pedersen (2017) also argued that the more profitable a company is, keeping all else equal, the higher the stock price should be. Investors would therefore focus on a company's profitability in order to evaluate future stock price expectations. Five of the nine factors used in the F-Score model measure profitability and operating efficiency which demonstrates the importance of this category when performing financial ratio or fundamental analysis (Piotroski, 2000). Profitability and operating efficiency can be measured using various financial ratio formats including the return on assets (ROA), equity (ROE) and various profit stages in the income statement which is compared to sales to forms the respective profit margin (Asness, Frazzini & Pedersen, 2017; Delen, Kuzey & Uyar, 2013; Light, Maslov & Rytchkov, 2017).

From the DuPont analysis discussed in the financial ratio introduction, the importance of the ROE and ROA as financial health evaluation metrics is clear and therefore these ratios were further discussed below. When referring to the ROE ratio and its importance on an individual basis, Hou, Xue, and Zhang (2015) used ROE as part of their four-factor model to measure profitability and determined that their model is comparable and, in some cases, delivers improved results when compared to the Cahart and Fama and French models in identifying significant anomalies in stock returns. Ramkillawan (2014) further found a significant positive correlation between the ROE and the average stock returns of the Top 40 index of the Johannesburg Stock Exchange.

When referring to the ROA ratio and its importance on an individual basis, two of the five profitability and operating efficiency ratios used in the Piotroski (2000) model were return on assets and change in return on assets. These were selected as it provided information about a company's ability to generate funds internally. It has been determined by numerous research that when applying the F-Score model to evaluate portfolios of stocks, that significant excess returns could be realised (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). The G-Score model developed in Mohanram (2005) and further used in Li and Mohanram (2018) also used the ROA in two of the eight G-Score factors. This inclusion stems from its importance in the use of the DuPont ROA analysis (Mohanram, 2005). It has been determined that when this model is applied to low book-to-market stocks, that significant excess returns could be realised (Mohanram, 2005).

On a combined ROE and ROA basis, Light, Maslov and Rytchkov (2017) used ROE and ROA as their two sole measures of profitability. They however only found ROA to deliver significant excess stock returns. Mohanram, Saiy and Vyas (2018) also indicated that

ROE and ROA were used extensively in the banking industry to evaluate the profitability of banks and therefore both these ratios were included as their sole profitability measures in their B-Score model. Mohanram, Saiy and Vyas (2018) however stated that the ROE is the main key performance ratio in the banking industry as it was widely used by investors and bank managers.

Lee (2014) further established the importance of the Return on Capital Employed (ROCE), as derived from Greenblatt's investment book, which only used a two-factor formula, comprising of the ROCE and the earnings yield (inverse of P/E ratio) to evaluate companies. This formula was applied to over 50 years of U.S. data and the companies who met the criteria showed significant excess returns above their peers (Lee, 2014). Muller and Ward (2013) also found the ROCE to deliver significant excess returns when this ratio was used to construct investment portfolios on the JSE.

From further analysis of the Piotroski (2000) model, where five of the nine factors measured the profitability and operating efficiency ratios, one was the change in gross profit margin. Asness, Frazzini and Pedersen (2017), also used gross profit margin combined with ROE and ROA as part of their profitability measures and found that higher quality firms, which have higher profitability, deliver increased share prices. In the Bunting and Barnard (2015) research performed, the gross profit margin ratios, as used in the Piotroski (2000) F-Score model, was not reported on the database used and therefore the researchers used the change in the operating profit margin. This approach appears to have been appropriate as Ball, Gerakos, Linnainmaa and Nikolaev (2015) argued that the most appropriate measure of organisational profitability is the operating profit. In this research, the researcher experienced the same issue with the gross profit margin not being available, with only the operating profit margin and the net profit margin being reported on the Iress Expert database used.

When referring to the components of the DuPont analysis, as discussed in the financial ratio introduction, the net profit margin is used as the profitability measure (Chang, Chichernea, & HassabElnaby, 2014; Goodman, Neamtiu, & Zhang, 2018; Mohanram, 2005; Skae et al., 2012). Various financial ratio users will therefore use the net profit margin in analysing the financial profitability of an organisation. The researcher therefore included both the operating profit margin and the net profit margin analysis in the research performed. The use of both ratios for profitability analysis is further consistent with Hsu (2014). A summary of the most important profitability and operating efficiency ratios were illustrated in Table 3 of which all were used in the research performed:

Table 3

Profitability & Operating Efficiency Ratios

Ratio	Calculation	Citation
Return on Equity (ROE)	Net income ÷ Owners Equity	(Delen, Kuzey & Uyar, 2013)
Return on Assets (ROA)	Net income ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Return on Capital Employed (ROCE)	Earnings before interest and taxes (EBIT) ÷ Capital employed	(Skae et al., 2012)
Net Profit Margin	Net income ÷ Net Sales	(Delen, Kuzey & Uyar, 2013)
Operating Profit Margin	Operating Profit ÷ Net Sales	(Skae et al., 2012)

Note. Researcher produced.

2.5.5 Asset Utilization or Turnover Ratios

According to Delen, Kuzey and Uyar (2013) “asset utilization or turnover ratios measure how successfully a company generates revenues through utilizing assets" (p. 3970). The change in the asset turnover is one of the nine factors used in the F-Score model to measure the change in the productivity of assets (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). The asset turnover ratio is also one of the three components of the DuPont analysis which is a widely used to analyse the ROE or ROA of an organisation (Chang, Chichernea, & HassabElnaby, 2014; Goodman, Neamtiu, & Zhang, 2018; Skae et al., 2012). The Asset turnover ratio is presented in Table 4 and has been included as part of research performed.

Table 4

Asset Utilization or Turnover Ratio

Ratio	Calculation	Citation
Asset Turnover	Sales ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)

Note. Researcher produced.

2.6 Price-to-fundamental ratios

As stated in the value investing section (2.3), various price-to-fundamental ratio screens are used for the screening process to determine if a stock is potentially under-priced. These include the price-earnings (P/E), price-to-book (P/B), cash flow-to-price (or price-to-cash-flow), earnings yield (Inverse of P/E) and dividend yield (DY) (Asness, Frazzini, Israel & Moskowitz, 2015; Athanassakos, 2012; Bartram & Grinblatt, 2018; Lee, 2014; Li

& Mohanram, 2018; Muller & Ward, 2013). The calculations of these ratios are provided in Table 5:

Table 5

Price-to-fundamental ratios

Ratio	Calculation	Citation
Price-earnings (P/E)	Market price p.s. ÷ Earnings p.s.	(Skae et al., 2012)
Price-to-book (P/B)	Market price p.s. ÷ Book value p.s.	(Skae et al., 2012)
Price-to-cash-flow (P/CF)	Market price p.s. ÷ Cash flow p.s.	(Price-to-cash-flow ratio, n.d.)
Dividend yield (DY)	Dividend p.s. ÷ Market price p.s.	(Skae et al., 2012)

Note. Researcher produced. p.s. = per share.

Price-to-fundamental ratios provide an indication of investor sentiment towards a company and its prospects (Penman & Reggiani, 2018; Skae et al., 2012). When referring to the individual ratios, Chua, Delisle, Feng and Lee (2014) stated that the P/E ratio might be the most important price-to-fundamental ratio when valuing a company. The P/E ratio provides an indication of the market's expectation of future earnings growth (Penman & Reggiani, 2018). Conover, Jensen & Simpson (2016) stated that the DY is a widely used investment metric and formed part of various investment strategies. Damodaran (2012) argued that while applying the P/E and the P/B ratios as value screens are useful for most investors, the DY is seen to be the most secure measure of returns. This is as a stable dividend payment provides a reliable return for investors and decreases the risk of overpaying for a stock (Conover, Jensen & Simpson, 2016).

The importance of the P/B or B/M ratio, has been establish by various research, including the Piotroski (2000) F-Score and the Mohanram (2005) G-Score models which were based on sorted P/B or B/M ratio stocks, as it is seen as a value measure (Bali, Cakici & Fabozzi, 2013; Bartram & Grinblatt, 2018; Bunting & Barnard, 2015; Cordis, 2014; Fama & French, 2008, 2012; Hoffman, 2012; Hou, Xue, & Zhang, 2015; Jiang & Lee, 2007; Kim & Lee, 2014; Lee, 2014; Li & Mohanram, 2018; Maio & Santa-Clara, 2015).

The cash flow-to-price ratio (inverse of price-to-cash-flow ratio which measures the same characteristics) is also seen as an important value measure (Asness, Frazzini, Israel and Moskowitz, 2015; Lee, 2014; Muller & Ward, 2013). Van Heerden and Van Rensburg (2015) found the cash flow-to-price ratio to be the most significant value driver on the JSE when compared to the other value factors used namely, the dividend yield, the earnings yield (inverse of P/E), the sales-to-price ratio and the B/M ratio. They further found that the value factors deliver significant explanatory power for stock returns on the JSE. The cash flow from operations was also one of the nine factors used in the F-Score model (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017).

Peavler (2018) cautions against using price-to-fundamental ratios without taking other factors and context into account. A stock with a low P/E ratio in a stable industry might indicate that it is currently undervalued, but could also indicate that a company's future prospects are uncertain and that the stock presents increased risk (Peavler, 2018). Low price-to-book ratios also act as a measure of risk, as companies with low P/B ratios, especially those with a lower price than its book value, could be in trouble and therefore could soon go out of business (Damodaran, 2012). This was corroborated by Penman and Reggiani (2018) which stated that value stocks with low P/B and P/E ratios could achieve high growth, but the growth could be risky.

Asness, Frazzini, Israel and Moskowitz (2015) further demonstrated the importance of not only using individual pricing measures like the B/M to construct portfolios of stocks, as various researchers have done, but to use all the value measures. The value measures used were the book-to-market (Inverse of P/B), earnings-to-price (Inverse of P/E), cash flow-to price (inverse of P/CF) and dividend yield ratios. They found that by using all these value measures in conjunction to construct portfolios, that a 20% decrease in volatility was achieved while still delivering similar returns when compared to only using the B/M ratio individually. When the dividend yield was individually used as n value measure, it delivered positive returns but performed the worst of all the value measures discussed above as some companies did not pay dividends and rather reinvested their earnings (Asness, Frazzini, Israel & Moskowitz, 2015). All four price ratios discussed above were included as part of the research performed, as investors would use these ratios in conjunction to evaluate shares for purchase.

2.7 Effect of financial ratios on share price performance

Some studies reviewed included multiple ratios from multiple categories and therefore would have led to the duplication of these studies in multiple sections above. In order to avoid duplication these studies were grouped in this section. The first set of studies reviewed found that financial ratios showed no or minimal relationships, correlations or predictability with share price performance. Gupta and Modise (2012), in applying the price-dividend (inverse of DY) and price-earnings ratios to South African companies, over a period of nearly 20 years, found no evidence of short-term or long-term predictability in share price performance. Morar (2014) applied four financial ratios to the emerging BRICS country stock exchanges over a period of 3 years in an attempt to develop a simple model for stock selection. These ratios were the price-earnings, price-sales, price-to-book and dividend yield ratios. Morar found that only the price-earnings and dividend yield ratios showed some, but very weak correlations to share price performance. Ma and Truong (2015) used multiple regression analysis and a much broader dataset of 17 combined financial accounting and price-to-fundamental ratios, over a period of 7 years (2006 – 2014), to determine which financial ratios influence the share price performance of different sectors of the Swedish OMX stock exchange most.

The sectors analysed were banking, energy, investment, real estate and retail. The ratios used in the study were the price-earnings ratio, price-earnings-growth ratio, price-to-book ratio, price-sales ratio, dividend per share, earnings per share, revenue per share, equity per share, dividend yield, net profit margin, EBITDA margin (Earnings before interest, tax, depreciation and amortization), return on equity, return on assets, current ratio, debt-to-equity ratio, equity ratio and lastly capital expenditure. Firstly, it was found that the most significant financial ratios in the different sectors varied. According to Ma and Truong (2015), the most significant ratios for the different sectors were as illustrated in Table 6:

Table 6

Most significant financial ratios per sector

Sector	Ratio
Banking	Price-earnings, Dividend per share
Energy	None
Investment	Price-earnings, Return on equity, Equity ratio
Real Estate	Price-to-sales, Return on equity, Net profit margin
Retail	Price-earnings-growth, Price-to-sales, Dividend Yield, Earnings per share

Note. Produced from information in Ma and Truong (2015).

It was however discovered, that even though financial ratios influenced share price growth, that this effect was marginal when compared to long-term macroeconomic trends and only accounted for a small part of share price growth. Ma and Truong (2015) further found that combined for all the sectors, high price ratios affected share price negatively, and good liquidity ratios affected share price positively.

The second set of studies reviewed found that certain financial ratios showed some or strong relationships, correlations or predictability with share price performance. More dated studies, including, Ang and Bekaert (2006), through using datasets from developed countries namely, the United states, Germany and the United Kingdom, determined that the dividend yield predicts excess share returns, but only in the short term. Lewellen (2004), found that market returns on the New York Stock Exchange (NYSE) could be predicted by the dividend yield ratio, during the period 1946-2000 tested. It was further found that higher earnings-to-price (inverse of P/E) and higher book-to-market ratios predicted positive market returns during the 1963-2000 period tested (Lewellen, 2004).

More recent research by Cordis (2014), found that the return on stocks can be determined as a function of the combination of the ROE ratio, the B/M ratio (inverse of P/B ratio) and the lagged B/M ratio for non-dividend paying stocks. Cordis (2014) further found that for dividend paying stocks, the return on these stocks can be determined as a function of the combination of the same ratios above, excluding the lagged B/M ratio, but including the DY ratio. Vedd and Yassinski (2015) performed a regression analysis on the Latin American industrial sector and used data from more than 700 companies, over a 10-year period, to determine the relationship between financial ratios and share prices. A strong correlation between the asset turnover ratio and the share prices of companies in Brazil, Chile and Mexico was determined. An important but less significant positive correlation was further determined between the debt to equity ratio and share prices of Columbian companies. The ratios used in the study, which did not deliver significant correlations to the industrial sector, were the return on equity, cash flow from operations divided by sales, net profit margin, current ratio and lastly the total assets.

Arkan (2016) applied 12 financial ratios to 15 companies in the Kuwait financial market from 2005 to 2014 to determine if financial ratios affect share prices. These companies formed part of the industrial, services and investment sectors. Arkan (2016) determined that certain financial ratios had a significant relationship with share price performance in each of the sectors tested. The 12 ratios used in the research were grouped within the five groups displayed in table 7.

Table 7

Financial ratios and groupings used

No	Group	Financial Ratio
1	Liquidity and Solvency	Current
2	Leverage	Debt to Equity Short Term Debt to Equity
3	Operating /Asset efficiency	Fixed Asset Turnover Total Asset Turnover
4	Profitability	Return on Total Assets (ROA) Return on Equity (ROE) Net Profit Margin
5	Valuation	Earnings per share (EPS) Market to Book Book Value per share Price Earnings (PE)

Note. Adapted from Arkan (2016).

For the industrial sector, Arkan (2016) found that a significant positive relationship exists between ROE, ROA, fixed asset turnover, net profit margin, debt to equity, book value per share and the market-to-book ratio when compared to the share prices. For the service sector, Arkan (2016) found a significant positive relationship between ROE, ROA, EPS, net profit margin, book value per share and the market-to-book ratios when compared to share prices. Lastly, for the investment sector, Arkan (2016) found that a significant positive relationship exists between ROE, ROA, EPS, current ratio, book value per share and the market-to-book ratios when compared to share prices.

Asness, Frazzini, Israel and Moskowitz (2015) found that when the price-to-fundamental ratio are used to sort stocks, that portfolios could be constructed which produce positive returns. The price-to-fundamental ratios used to construct portfolios were the book-to-market (Inverse of P/B), earnings-to-price (Inverse of P/E), cash flow-to-price (inverse of P/CF) and dividend yield ratios. Yan and Zheng (2017) performed fundamental analysis using data mining techniques from 1963-2013, where they applied more than 18 000 financial statements derived fundamental variables. They concluded that fundamental variables can predict significant stock returns and were able to rank the top 100 signals. This analysis was however only performed on companies from 19 developed countries and no price-to-fundamental ratios were included as part of the research. Li and

Mohanram (2018) found that when the F-Score, G-Score and two other value driven approaches are used in combination, when applied to portfolios of stocks listed between 1973 and 2012 on US stock exchanges, that this combined approach produced exceptional positive returns. Li and Mohanram (2018) further found that even though the Graham and Dodd 1934 stock screen approach, as mentioned in section 2.3, produced excess returns when tested using the same data, that the combined approach used by Li and Mohanram (2018) produced even greater excess returns.

Four South African JSE specific studies were noted, which found that certain financial ratios showed strong relationships with share price performance. The first was Hoffman (2012), which sought to determine if stock return anomalies existed on the JSE. A cross-sectional regression analysis was performed on all the shares listed on the JSE in 2010 (376 companies), over a 25-year period. Hoffman (2012) found that the book-to-market ratio (inverse of P/B), market capitalisation, momentum and to a lesser extent, yield-to-book and net shares issued, when used as sorting mechanisms to produce portfolios of stocks, lead to portfolios which generate abnormal stock returns.

Muller and Ward (2013) followed by seeking to determine which the best investment styles were on the JSE. The 160 companies listed on the JSE based on market capitalisation were analysed over a period of 27 years (1985-2011). Muller and Ward (2013) found that certain investment styles, when used to develop portfolios of stocks outperformed the JSE All Share Index. These portfolios were constructed using the earning yield (an inverse of the P/E ratio), dividend yield, liquidity, return on capital, return on equity, price to book, cash flow-to-price (inverse of price-to-cash flow), interest cover and momentum. The shares in this study were however only broadly classified in two industries namely industrial and resources.

The study attempted by the researcher did however not focus on providing an investment style for share selection on the JSE as a whole, but attempted to provide a clarification regarding which financial ratios affect share price to the greatest extent in different sectors. These two mentioned studies further did not solely focus on financial ratios where other aspect such as momentum were considered. Ramkillawan (2014) further found a significant positive correlation between the return on equity and the average stock return on the Top 40 index of the JSE. Out of the two financial ratios used namely, ROE and dividend pay-out, the dividend pay-out ratio effect on the JSE was however inconclusive.

Lastly was the research by Bunting and Barnard (2015), where fundamental analysis was performed on the South African JSE, based on the Piotroski (2000) F-Score model, ranging over an 11-year period ending June 2014. The F-Score study involved nine accounting based financial ratios to classify companies into their relevant F-Scores, where the companies with a score of zero displayed the poorest financial health and the companies with a score of nine the best financial health. It was determined that statistically significant correlations exist between the accounting based financial ratios used and the share returns received. None of the above studies however focussed on the different sectors on the JSE in isolation but grouped all the companies together. The only study that took some cognisance of the industries was Muller and Ward (2013), but only differentiated between the high level industrial and resource classifications to determine which of these two industries delivered higher returns.

From the international studies investigated above, it was clear that the majority, especially those from the U.S., found that financial ratios showed some or strong relationships, correlations or predictability with share price performance. Only three of these studies however focussed on the different sectors, where these were based on less developed markets including Latin America and Kuwait. From the South African studies investigated a clear consensus was however not reached as some found no or minimal relationships, correlations or predictability of financial ratios and share price performance, where others found the opposite. In summary, from a total JSE market perspective, a greater majority seems to find that relationships exist between financial ratios and share price performance. The results of a sector-based JSE analysis are however still undetermined, but based on international research, could deliver value. The hypotheses were therefore developed from the contrasts between these markets and findings.

2.8 South Africa, a unique market place

According to Bunting and Barnard (2015), very few fundamental analysis studies have been performed outside the United States (U.S.) equity markets. Bunting and Barnard (2015) further noted that various differences exist between the United States accounting standards, security regulations and market microstructure when compared to other countries. The United States uses U.S. Generally Accepted Accounting Principles (GAAP) as an accounting standard, where South Africa uses International Financial Reporting Standards (IFRS) (Barth, Landsman, Lang & Williams, 2012; IFRS, 2016). Barth, Landsman, Lang and Williams (2012) argued that significant differences exist between the two different accounting standards.

Cinca, Molinero, and Larraz (2005) further determined that the countries where companies are located impact the structures of their financial ratios. According to the screener function on Iress (2018), available through the University of Pretoria's library database, in October 2018, 372 companies were listed on the JSE. When comparing this with the New York stock exchange, where shares of around 2800 companies are traded, the JSE is small in comparison (NYSE, n.d.). This further substantiates the difference in structures of the equity markets as noted by Bunting and Barnard (2015).

Further to this, more recent literature by Konku, Rayhorn, and Yao (2018) argued that most of the research on stock price behaviour has focussed on developed markets, as data was more easily obtainable. Two of the three most recent fundamental analysis studies reviewed by the researcher, were both performed only using companies listed on U.S. Stock exchanges (Bartram & Grinblat, 2018; Li & Mohanram, 2018). The third was that by Yan and Zheng (2017) where this research was performed on 19 developed countries, where the authors noted that two other recent research groups used the same 19 developed countries. Konku, Rayhorn, and Yao (2018) argued that emerging market economies have gained significant growth in the last two decades and therefore the importance for investors have started to increase.

According to Financial Times (n.d.) "Emerging market is a term that investors use to describe a developing country, in which investment would be expected to achieve higher returns but be accompanied by greater risk" (para. 1). Konku, Rayhorn, and Yao (2018) stated that the emerging market focus had been mainly based on larger emerging economies including Brazil, Russia, India and China, but the focus was turning to smaller emerging economies including South Africa due to the desire of diversification by developed country investors and the potential for higher returns. Konku, Rayhorn, and Yao (2018) further argued that studies on African markets were not as abundant as those of other emerging markets.

An example of an emerging market study follows to demonstrate the differences between emerging markets and developed markets, specifically China and the United States. Bin, Chen, Puclik, and Su (2017), sought to use models which were developed based on U.S. data, to determine if similar return results could be realised in the Chinese stock market, which is classified as an emerging market. Some results were consistent with those of the U.S. markets, where other results were specific to the Chinese stock markets. The main reason for this appeared to be the difference in preferences by Chinese and U.S.

investors. Shares with smaller firm sizes, higher share trading turnovers and lower initial share price levels tended to be the most extreme performers in U.S. markets, where the same categories of stocks in the Chinese stock markets tended to not perform as well. Bin, Chen, Puclik, and Su (2017) further found that, “US extreme performers are significantly associated with factors of firm age, stock return volatility, sales trend and earnings surprise, while Chinese extreme performers are significantly related to book-to-price, sales-to-price and debt-to-price ratios” (p. 22).

Li, Zhang and Zheng (2018) further found that the seasonality of stock returns differed between developed and emerging markets, where 21 of both developed and emerging markets were tested, including South Africa as emerging market. The seasonality of stock returns was found to be significant in developed markets with the opposite being found in emerging markets. The two studies above provided valuable and important examples of how developed markets differ in some instances when compared to emerging markets.

Deloitte (2017) stated that when South Africa was included as part of the BRICS (Brazil, Russia, India, China and South Africa) acronym in 2010, and was regarded as a first-tier emerging market, that all the BRICS nations were regarded as performing well in terms of rising and future demand. The BRICS landscape has however changed. While the Chinese and Indian emerging economies were growing and could deliver the higher returns as expected by emerging markets, South Africa was starting to display the bad economic trends of Brazil. With various credit rating downgrades (BB+ in 2017), various quarters of negative GDP growth realised in the most recent years, an unstable political environment, public sector underperformance and reduced investor confidence, South Africa might not deliver the high returns which are expected from emerging markets. It therefore appears that the South African economic and equity market landscape is unique, different and more volatile than those of developed markets and most of those classified as emerging markets.

2.9 Industries/Sectors of the JSE

It is clear from financial literature that the most important financial ratios to consider is industry specific (Yan and Zheng, 2017). Financial literature reviewed provided specific evidence that financial ratio structures like those of manufacturing, retail and banking are different due to the unique financial drivers of each sector (Delen, Kuzey & Uyar, 2013; Mohanram, Saiy & Vyas, 2018). It was therefore important to understand which industry and sector classifications are used by the JSE in order to accurately select the correct industries for the research performed.

The JSE uses the Industry Classification Benchmark (ICB) to classify its industries and sectors (FTSE Russell, n.d.). The ICB is managed by FTSE Russell and is an internationally recognised standard which is vastly adopted around the world with approximately 100 000 securities classified on this standard (FTSE Russell, n.d.). 65 percent of the world's stock exchanges, based on market capitalisation, use the ICB classification standard (Kenton, 2018). According to FTSE Russell (n.d.) the exchanges which use this classification include the "Euronext, NASDAQ OMX, London Stock Exchange, Taiwan Stock Exchange, Johannesburg Stock Exchange, Borsa Italiana, Singapore Stock Exchange, Athens Stock Exchange, SIX Swiss Exchange, Cyprus Stock Exchange and Boursa Kuwait" (Features and contents section, para. 4). The aim of these classifications is to categorise organisations into the various sectors based on their major revenue streams (Kenton, 2018). According to FTSE Russell (n.d.) the ICB classification consists out of four levels. The first level consists out of 10 broad industry classifications. The second level consists out of 19 supersectors. The third level consists out of 41 sectors. The fouth level consists out of 114 subsectors. A graphical representation of the 4 ICB levels is presented in Figure 2.

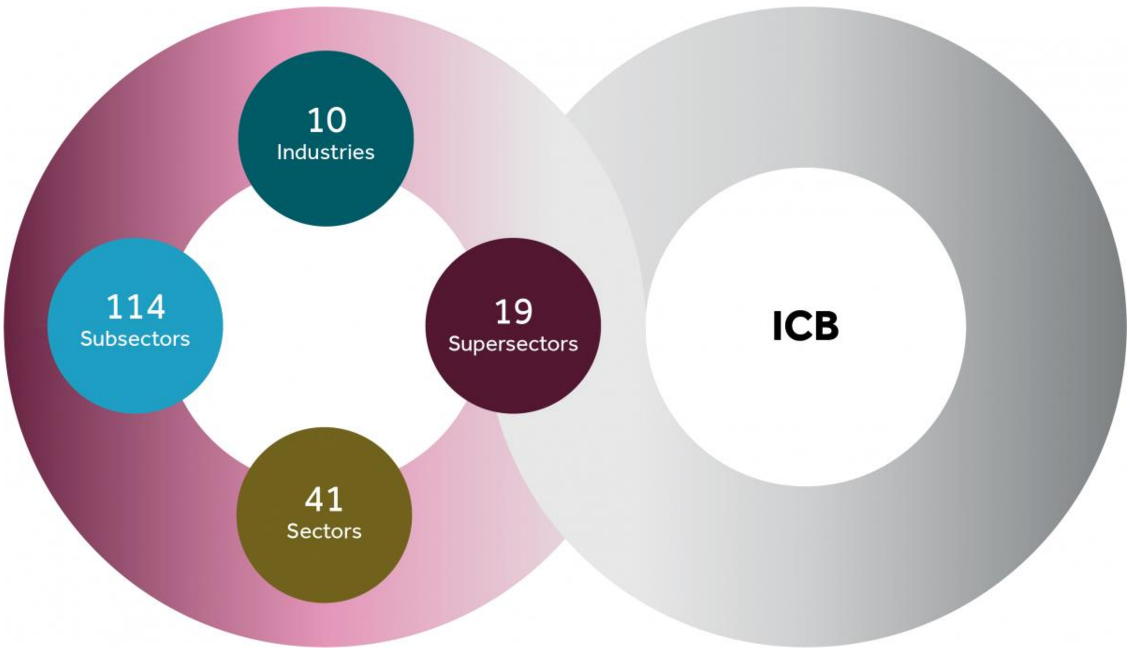

Figure 2. Industry Classification Benchmark (FTSE Russell, n.d.).

2.10 Conclusion

Firstly, the most applicable investing theories and methods relating to the research problem were discovered and reviewed, namely fundamental analysis, value investing and growth investing. From this literature the two most important financial ratio classification groups, namely financial accounting and price-to-fundamental ratios were discovered and reviewed. It was found that the financial accounting ratio category consisted mainly of liquidity, solvency, profitability, operating efficiency and asset utilization or turnover ratios. The price-to-fundamental ratio group consisted of ratios where the price formed one aspect of the ratio and the other aspect was related to a financial statement fundamental.

The financial ratio theory and literature reviewed lead the researcher to select 14 financial ratios, of which 10 consisted of financial accounting ratios and 4 consisted of price-to-fundamental ratios. Literature regarding the relationship between financial ratios and the share price performance of companies were further reviewed and mixed results were obtained. Most of the literature however found relationships, correlations or predictability between some financial ratios and the share prices of companies. A clear lack of research from a South African JSE sector perspective was however noted. These insights assisted the researcher in forming the hypotheses.

Further, the positioning of South Africa and the Johannesburg Stock Exchange (JSE), as an equity market among other international markets, was reviewed. It was found that differences exist between South Africa and developed markets as South Africa was classified as an emerging market. It was further found that most finance-based research focussed on the larger emerging markets and that the attention was turning to smaller emerging markets including South Africa, where research on the African continent was not as abundant as those from other emerging markets. Various factors were starting to affect the South African economy and markets. The higher returns as expected by well performing emerging markets, such as China and India, might therefore not be achievable by South Africa as it displayed unique characteristics when compared to some other emerging markets. Lastly a review of the International Classification Benchmark (ICB) standards, as used by the JSE for industry and sector classifications followed, which provided an indication of the vast amount of industries and sectors available for classification. Overall it was found that the need for this research on a JSE sector basis was valid and that value could be achieved from both a business and academic perspective.

CHAPTER 3 RESEARCH HYPOTHESES

Following the literature review performed in the previous Chapter, the most important ratios identified were as indicated in Table 8:

Table 8

Financial Ratios

Classification	Ratio	Calculation	Citation
Liquidity Ratio	Current or Liquidity	Current Assets ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Interest cover	Earnings before interest and tax (EBIT) ÷ Interest	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Equity (D/E)	Total Liabilities ÷ Owners Equity	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Assets (D/A)	Total liabilities ÷ Total assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Equity (ROE)	Net income ÷ Owners' Equity	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Assets (ROA)	Net Income ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Capital Employed (ROCE)	Earnings before interest and taxes (EBIT) ÷ Capital employed	(Skae et al., 2012)
Profitability Ratio	Net profit margin	Net profit ÷ Sales	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Operating profit margin	Operating Profit ÷ Net Sales	(Skae et al., 2012)
Asset Utilization or Turnover ratio	Total asset turnover	Sales ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Price-to-fundamental ratios	Price-earnings ratio (P/E)	Price p.s. ÷ Earnings p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-book ratio (P/B)	Price p.s. ÷ Book value p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-cash-flow (P/CF)	Price p.s. ÷ Cash flow p.s.	(Price-to-cash-flow ratio, n.d.)
Price-to-fundamental ratios	Dividend yield (DY)	Dividend p.s. ÷ Price p.s.	(Skae et al., 2012)

Note. Researcher produced. p.s. = per share.

The focus of the research was therefore to determine if any statistical relationships exist between any of the pre-mentioned 14 ratios and the top five sectors of the JSE based on market capitalisation. The same research hypothesis was therefore repeated five times for each of the five sectors which were identified and discussed in Chapter 4.3. The five hypotheses were tested using multiple linear regression statistical methods where the methods were fully discussed in Chapter 4.8.

3.1 Hypothesis 1: Mining

Research question one (RQ1): Do statistical relationships exist between financial ratios and share price performance of the mining sector on the JSE?

- Null hypothesis one ($H_0 1$): No significant statistical relationships exist between any financial ratios and the share price performance of the mining sector on the JSE.
- Alternate hypothesis one ($H_1 1$): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mining sector on the JSE.

3.2 Hypothesis 2: Banking

Research question two (RQ2): Do statistical relationships exist between financial ratios and share price performance of the banking sector on the JSE?

- Null hypothesis two ($H_0 2$): No significant statistical relationships exist between any financial ratios and the share price performance of the banking sector on the JSE.
- Alternate hypothesis two ($H_1 2$): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the banking sector on the JSE.

3.3 Hypothesis 3: Life Insurance

Research question three (RQ3): Do statistical relationships exist between financial ratios and share price performance of the life insurance sector on the JSE?

- Null hypothesis three ($H_0 3$): No significant statistical relationships exist between any financial ratios and the share price performance of the life insurance sector on the JSE.
- Alternate hypothesis three ($H_1 3$): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the life insurance sector on the JSE.

3.4 Hypothesis 4: Real Estate Investment Trusts

Research question four (RQ4): Do statistical relationships exist between financial ratios and share price performance of the real estate investment trust on the JSE?

- Null hypothesis four ($H_0 4$): No significant statistical relationships exist between any financial ratios and the share price performance of the real estate investment trust sector on the JSE.

- Alternate hypothesis four ($H_1$4): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the real estate investment trust on the JSE.

3.5 Hypothesis 5: Mobile Telecommunications

Research question five (RQ5): Do statistical relationships exist between financial ratios and share price performance of the mobile telecommunications sector on the JSE?

- Null hypothesis five ($H_0$5): No significant statistical relationships exist between any financial ratios and the share price performance of the mobile telecommunications sector on the JSE.
- Alternate hypothesis five ($H_1$5): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mobile telecommunications sector on the JSE.

CHAPTER 4 RESEARCH METHODOLOGY AND DESIGN

4.1 Introduction

This chapter outlines the methodology and design used to perform the testing of the hypotheses presented in Chapter 3. Firstly, section 4.2 provides the overarching research methodology and design used in the research. This is followed by the details of the five populations used in the research and how they were determined on a step by step basis in section 4.3. The unit of analysis is then defined in section 4.4, where after section 4.5 explains that no sampling methods were used and why this was appropriate. Section 4.6 provides information regarding the measurements used in the research and explains why a pure measurement instrument as defined was not applicable for this research. Further, even though validity does not fully apply to quantitative research in the form of the reanalysis of secondary data, the validity criteria was applied and evaluated for completeness.

Section 4.7 explained which data was obtained, from where it was obtained, how it was prepared and cleaned for data analysis. Further the credibility and trustworthiness of the data provider was discussed, which provided evidence regarding the reliability of the information extracted. The details of the statistical tests performed were provided in section 4.8, after which the research ethics considerations were discussed in section 4.9. Lastly, the research limitations as determined before the performance of the data analysis process was discussed in section 4.10.

4.2 Research Methodology and design

This research aimed to determine if statistically significant relationships exist between financial ratios and the share price performance of the top five sectors on the JSE. Positivism philosophy was adopted as highly structured methods, namely statistical multiple linear regression analysis, was performed using accurate, uninfluenced, secondary data, namely share prices and financial ratios in an attempt to discover law-like generalisations (Saunders & Lewis, 2018; Saunders, Lewis & Thornhill, 2009). These law-like generalisations were the relationships between financial ratios and share price performance of the top five sectors of the JSE. A deductive approach, in line with that of Bunting and Barnard (2015) and Ma and Truong (2015), was followed as the financial ratios used in the research for testing purposes was obtained from existing financial ratio theory and literature (Saunders & Lewis, 2018).

A mono method, structured, quantitative study was the most suitable method for this type of research as a single data collection technique, namely retrieval of secondary company data from the Iress Expert database, and corresponding analysis, namely multiple linear regression analysis, was used (Saunders, Lewis & Thornhill, 2009). A descripto-explanatory approach was followed. Firstly, this study could be classified as descriptive as it sought to determine if statistically significant relationships exist between various financial ratios and share price growth in various sectors of the JSE, through the reanalysis of secondary data. Secondly, this study sought to determine which of those ratios have the most significant statistical relationships with share price growth and could potentially be seen as the key share price drivers (Saunders, Lewis & Thornhill, 2009). A longitudinal study was performed as the relationships between financial ratios and share prices were studied on an annual basis over an extended period of 20 years (Saunders & Lewis, 2018). Bunting and Barnard (2015), Gupta and Modise (2012), Hoffman (2012), Muller and Ward (2013), Ramkillawan (2014) and Vedd and Yassinski (2015) all used longitudinal studies as this method delivers more reliable and powerful results.

4.3 Population

A graphical representation of how the populations were determined is illustrated in Figure 3.

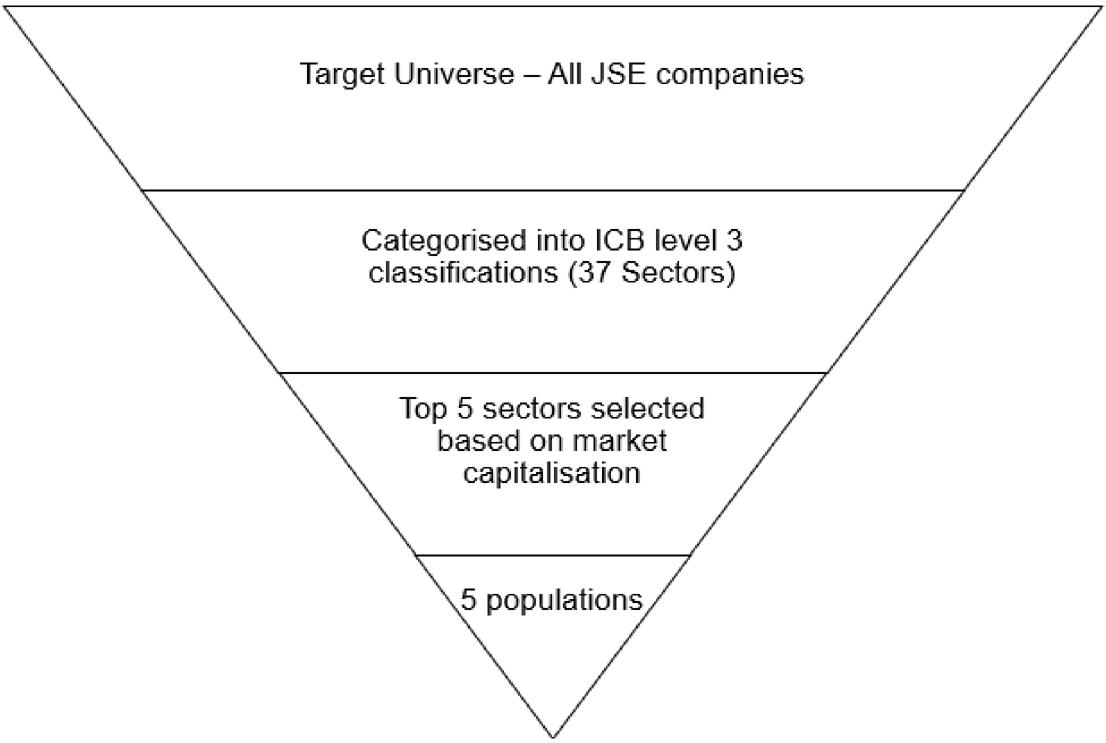

Figure 3. Population funnel (Researcher produced).

The target universe was all companies as listed and delisted on the JSE. The research performed used the third level ICB classification which includes 41 sectors to classify all JSE companies within (FTSE Russell, n.d.). Of the 41 ICB sector classifications available, only 37 were currently used by the JSE as companies on the JSE did not operate in the Electricity, Gas, Water and Utilities, Oil Equipment and Services and lastly, Aerospace and Defence sectors (Iress, 2018).

The reason for the selection of the third ICB level, was as this level of classification lead to the most consistent industry financial drivers for the companies within to determine the statistical relationships with financial ratios, without going in too deep when compared to the fourth level ICB classification, or too broad when compared to the second level ICB classification. The fourth level classifications in some subsectors contained none, one, or very minimal companies (Iress, 2018). With 372 listed companies on the JSE in October 2018 and 114 subsectors available on the fourth classification level, this can easily be seen (Iress, 2018; FTSE Russell, n.d.).

The following examples are given to provide more context and substantiation on the ICB classification levels which were used. When referring to the media sector on the third ICB classification level, it contained five different stock codes. When that same sector was broken up into the fourth level of the ICB classification of which publishing is one, only one company, namely Caxton remained (Business day, 2018). Further, in another field, when going up the classification ranks to the second level of healthcare, medical providers such as Netcare and Life Healthcare were grouped with companies such as Aspen and Adcock Ingram, the first being healthcare providers and the second being medicine manufacturers (Business day, 2018). The second level ICB classification companies mentioned operate in very different contexts with one being a health service provider and the other a health product manufacturer. The third level was thus the most appropriate level of classification to use.

The market capitalisation of each of the 37 ICB level three classification sectors were selected as the benchmark due to the aspect of liquidity. According to Holden, Jacobsen and Subrahmanyam (2014) market liquidity can be defined as “the ability to trade a significant quantity of a security at a low cost in a short time” (p. 4). The cost and time taken to trade securities on the JSE, are perceived to be rather consistent, but the quantity or volume traded will depend on a few factors, of which the market capitalisation of the organisation is highly ranked. Small market capitalisation companies will not have as many shares available to trade on any given period when compared to large market capitalisation firms. Further, the demand for lower market capitalisation companies are also not always as high as for high market capitalisation companies and therefore sellers might struggle to sell their small market capitalisation shares. High market capitalisation firms therefore usually have higher liquidity. Muller and Ward (2013) further argued that companies which have small market capitalisation could be too illiquid and therefore would not be invested in by large institutional investors. Their research of the top 160 companies, out of the 350 listed on the JSE in that period, based on market capitalisation, represented 99% of the total market capitalisation of the JSE.

The date of 28 September 2018 for the determination of market capitalisation was selected as this was the last trading day for the month of September 2018 and the share prices would have reflected the effects of the published financial statements for companies with a 30 June 2018 year end. This is as time lagging was allowed for in line with the three-month after year end JSE financial statement publication rules (JSE, n.d.). For the market capitalisation exercise, only listed companies were selected as delisted companies would not have any market capitalisation on 28 September 2018. To obtain the market capitalisation of each of the ICB level three sectors, the screener function of the Iress Expert database which is available through the University of Pretoria library database was used with the filters as indicated in Table 9 being applied (Iress, 2018). The reliability and credibility of the Iress Expert database was later discussed in the data gathering process section (4.7).

Table 9

Market capitalisation filters

Filter	Selection	Explanation
Type	Equities and Companies	Only company traded equities included
Exchange	JSE Securities Exchange	Only those included on the JSE
Listing Status	Listed	Only currently listed companies included
Location	South Africa	The JSE is a South African stock exchange
Sectors	ICB Sectors – South Africa Only	To obtain market cap categorised in ICB format

Note. Researcher produced from Iress (2018).

After applying these filters on 1 October 2018 for the date of 28 September 2018, 372 listed companies were noted which was in line with the researcher’s expectations (Iress, 2018; No of listed companies JSE, n.d.). Once the filters were applied the tools and then compare function was selected where all the companies as filtered in Table 9 were selected to be compared. The edit fields option was selected where the market capitalisation field was solely selected. The results of the applied fields were exported into excel. The market capitalisation of each of the 37 ICB level three companies were aggregated by way of a Pivot Table to determine the combined market capitalisation for each sector. The top 10 Sectors based on market capitalisation as on 28 September 2018 were provided in Table 10 (Iress, 2018).

Table 10

Top 10 Market Capitalisation per ICB level 3 Sector

Ranking	ICB level 3 sector	Market Capitalisation (ZAR)
1	Mining	2 638 693 752 933
2	Beverages	2 125 028 877 529
3	Tobacco	1 640 237 579 841
4	Media	1 344 713 106 638
5	Banks	1 158 616 490 881
6	Personal Goods	605 913 080 784
7	Life Insurance	501 438 435 004
8	Real Estate Investment Trusts	476 702 628 079
9	Mobile Telecommunications	402 860 547 256
10	General Financial	399 496 702 772

Note. Researcher produced from information extracted and processed from Iress (2018).

The mining sector contained 43 companies, was deemed fit for analysis and was therefore included as the first sector in the research performed (Iress, 2018). The beverages and tobacco sectors only included two companies and one company respectively. Due to the limited amount of companies included in these sectors, multiple linear regression analysis was not fit for performing as datasets derived from single or minimal sources could have led to distorted results. An example would be where a company has a strong or weak leadership team or brand and even though the financial ratios change significantly, share prices might not vary in relationship, due to the belief and perception of the company by the investors. By having more companies in a sector dataset with different perceptions linked to each, distortion of relationships would be reduced. These two sectors were therefore not included in the research. The following category was media which consisted of 5 different companies. NASPERS was however the largest company with 99.5% of the total sector market capitalisation. The only reason this sector therefore qualified within the top sectors was due to the large market capitalisation of NASPERS. Without NASPERS this sector would have been ranked 33rd out of the 37 ICB level three sectors and therefore this sector was not selected for testing.

The next sector was the banking sector which included seven different banks of which most were of comparable size and therefore were included as part of the research. The income statements of banks were however different from most sectors as they do not produce revenue/turnover/sales but have different income streams mainly resulting from interest income and therefore limited profitability financial ratios were available. From inspection of the Iress Expert database, the net profit margin, operating profit margin and the asset turnover ratio were not available as no revenue/turnover/sales figures exist (Iress, 2018). The other profitability ratios were still available for use and therefore this sector was selected as the second sector to be included in the research, where the three ratios discussed could not be tested.

The personal goods sector which followed only contained two companies, namely Compagnie Financière Richemont and Imbalie Beauty Limited. The first made up nearly 100 % of the market capitalisation where the second was experiencing various issues and uncertainty with multiple cautionary trading announcements being made by the JSE during 2018 (Sharenet SENS, 2018). This sector was therefore not fit for analysis due to mainly one company making up the whole sector and was therefore excluded from the research. The next sector was the life insurance sector. Six companies were present in this sector, was deemed fit for analysis and was therefore included as the third sector to be included in the research. The last sectors were real estate investments trusts which included 44 companies and mobile telecommunications which included four companies. These sectors were deemed fit for analysis and therefore were included as the fourth and fifth sectors in the research respectively.

In closing, the five ICB level three sectors namely mining, banking, life insurance, real estate investment trusts and mobile telecommunications and all the accompanying companies classified within these sectors were selected as the five populations to be used in the research performed.

4.4 Unit of analysis

The units of analysis were the share prices and related defined financial ratios for the individual listed and delisted companies in each of the five sectors, namely mining, banks, life insurance, real estate investment trusts and mobile telecommunications of the JSE for the 21-year period from 1 January 1997 to 30 September 2018.

4.5 Sampling method and size

No sampling methods were used during the research performed. All companies both listed and delisted, which formed part of the five sectors indicated above, were included for testing purposes. This information was obtained on an annual basis where financial ratios and share price data were available from the Iress Expert database for the 21-year period from 1 January 1997 – 30 September 2018. Seeing that this study was longitudinal time series-based research it was appropriate to use the full data-set and not apply any sampling methods or sampling sizes.

4.6 Measurement instrument

The study made use of quantitative secondary data, retrieved from a database named Iress Expert, in the form of share prices and financial ratios. There therefore were no measurement instruments as traditionally defined in research literature such as surveys, questionnaires, interviews etc. (Saunders & Lewis, 2018). The credibility and reliability of the information obtained from the Iress Expert database was discussed in section 4.7.

Financial ratios were reliable measurements to use in the research they are tools to evaluate firm performance and financial health and can be applied over various sizes of companies in the same industries, leading to a universal comparison tool (Delen, Kuzey & Uyar, 2013; Financial ratios, n.d.; Yan & Zheng, 2017). Financial ratios are most effective when used to track company performance over time (Financial ratios, n.d.). In the research performed, the percentage change in share price and the accompanying financial ratios were therefore compared from year to year and were tracked over time. The year of 1997 was set as the base period for comparison and if no data was available for 1997, or the company was listed in a later period, then the first subsequent period was used as base period.

Multiple linear regression was used as the statistical testing method to determine if financial ratios have significant statistical relationships with the share price movement of the different industries selected. Various studies including Arkan (2016), Ma and Truong (2015) and Morar (2014) have all used multiple linear regression analysis to determine if statistical relationships exist between financial ratios and share prices. The reason for not applying correlation analysis as a statistical method on an individual basis, is as correlation analysis does not address the issue of multicollinearity, which is caused when independent variables, namely the financial ratios used in this study, are highly correlated with each other (Hair, Black, Babin & Anderson, 2010; Wegner, 2016). Multicollinearity causes the independent variables to overlap when determining the relationship with the dependent variable, namely the share price, which could lead to unreliable results (Hair et al., 2010; Wegner, 2016). Correlation analysis further does not consider the effects of the other variables as a combined group on the independent variable. Therefore, more rigorous multiple linear regression hypothesis tests were used to determine the statistical significance of the relationships between the percentage change in share price from the previous period and financial ratios (Wegner, 2016).

Even though the validity aspects of quantitative research based on secondary data is not always discussed as the credibility and reliability of the sources of secondary data is normally of most importance a quick review and reasoning of the five validity factors were performed in Table 11. Seeing that the most appropriate and reliable statistical methods, data and data formats were used, the reliability and the validity of the results were assured.

Table 11

Validity factors and reasoning for each

Factor	Reasoning
Subject selection	No bias in subject selection as the selected ratios, sectors and related companies were determined by direct literature and mathematical calculation, where the full population was included for each sector.
History	Longitudinal research performed over an extended period of 20 years is deemed sufficient.
Testing	Data collection was fully unbiased as the data was based on audited and published financial statements. Further, all available datapoints were included for each sector with the exceptions where data errors were incurred from the secondary data or where significant outliers were detected which would distort the results of the multiple linier regression per group significantly due to error or unusual circumstances.
Mortality	All "subjects" were included including those listed after 1997 or which were delisted afterwards up until 2018. The inclusion or loss of certain companies due to delisting or liquidation strengthens the quality of the research as survivorship bias is removed (Hoffman, 2012; Muller & Ward, 2013; Bunting & Barnard, 2015).
Ambiguity about causal direction	Relationship variables were clearly determined by theoretical and academic literature. Stock prices were determinants of financial ratios, financial ratios were not determinants of stock prices except for price-to fundamental-ratios where one of the two components of the ratios were the share price. This concern was however resolved as part of the process of lagging the share prices by three months when compared to the share prices used in the four price-to-fundamental ratios affected.

Note. Adapted from Saunders and Lewis (2018).

4.7 Data gathering process

Secondary quantitative data, namely financial ratios and share prices, for all listed and delisted companies in the five selected sectors, were extracted from the Iress Expert database which is available through the University of Pretoria library database. Firstly, the fact that this database is made available by the University of Pretoria for student use provides some initial credibility. Iress is a global and reputable supplier of financial markets information, which has been in operation since 1993 (Iress, n.d.). Iress is also used by the Business Day newspaper, a widely used South African newspaper, for their daily market information (Business day, 2018). Iress further purchased INET BFA, a consolidated company of McGregor BFA and INET Bridge, which was owned by Media24 in September 2016 ("IRESS to buy" 2016). INET BFA was used during the research of Bunting and Barnard (2015), Muller and Ward (2013), Herbst (2017) and was considered as a reliable alternative source by Morar (2014). Hoffman (2012) further used McGregor BFA before the merging with INET Bridge, of which the consolidated company is owned by Iress.

Further, when discussing the objective of the research performed with a Gordon Institute of Business Science library representative, it was indicated that the Iress Expert database would be best suited platform to use for the detailed, longitudinal research to be performed. This was as this database was the most complete, contained the longest time period of complete data and was able to extract the data in an excel format. Overall, the data received from the database was therefore deemed to be reliable as it was obtained from a credible and trustworthy source.

The process explained below was performed five times for each of the five sectors selected namely mining, banking, life insurance, real estate investment trusts and mobile telecommunications. The Iress Expert database was accessed, and the screener function was selected. The filters as illustrated in Table 12 were applied:

Table 12

Applied Iress Expert filters

Filter	Selection	Explanation
Type	Equities and Companies	Only company traded equities included
Exchange	JSE Securities Exchange	Only those included on the JSE
Listing Status	Listed & Delisted	Listed and delisted companies included
Location	South Africa	The JSE is a South African stock exchange
Sectors	ICB Sectors – South Africa Only - "Individual sector"	The 5 ICB sectors were selected individually

Note. Researcher produced from Iress (2018).

Delisted shares were also selected for testing to eliminate survivorship bias. This is an occurrence where research only considers companies which are still listed, operating and have survived through different cycles, while ignoring the companies which did not survive and were delisted due to bad performance, as an example, which leads to unreliable results. Bunting and Barnard (2015), Hoffman (2012), Muller and Ward (2013) also incorporated delisted companies in their research in order to eliminate survivorship bias. The Iress Expert database keeps all the data for the delisted companies. Another risk documented by Bunting and Barnard (2015) was the backfill bias risk, where company data is included before they are listed on a stock exchange, in this instance the JSE. The Iress Expert database did not include company data before listing and only reported ratios based on publicly announced JSE results. The backfill bias risk was therefore mitigated.

Based on the literature review performed, the various classifications of financial ratios available, and the results achieved by previous studies evaluated in section 2.5 and 2.6, the financial ratios as illustrated in Table 13 were selected in the edit fields section and were included in the research.

Table 13

Financial ratios selected

Classification	Ratio	Calculation	Citation
Liquidity Ratio	Current or Liquidity	Current Assets ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Interest cover	Earnings before interest and tax (EBIT) ÷ Interest	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Equity (D/E)	Total Liabilities ÷ Owners Equity	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Assets (D/A)	Total liabilities ÷ Total assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Equity (ROE)	Net income ÷ Owners' Equity	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Assets (ROA)	Net Income ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Capital Employed (ROCE)	Earnings before interest and taxes (EBIT) ÷ Capital employed	(Skae et al., 2012)
Profitability Ratio	Net profit margin	Net profit ÷ Sales	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Operating profit margin	Operating Profit ÷ Net Sales	(Skae et al., 2012)
Asset Utilization or Turnover ratio	Total asset turnover	Sales ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Price-to-fundamental ratios	Price-earnings ratio (P/E)	Price p.s. ÷ Earnings p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-book ratio (P/B)	Price p.s. ÷ Book value p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-cash-flow (P/CF)	Price p.s. ÷ Cash flow p.s.	(Price-to-cash-flow ratio, n.d.)
Price-to-fundamental ratios	Dividend yield (DY)	Dividend p.s. ÷ Price p.s.	(Skae et al., 2012)

Note. Researcher produced. p.s. = per share.

Further to the above ratios selected, the closing share price was also selected as part of the edit field option. According to the study performed by Morar (2014), the limitations discussed therein, and the review of other studies performed, a minimum of 10 years was evident for such a study to be performed (Bartram & Grinblat, 2018; Bunting & Barnard, 2015; Gupta & Modise, 2012; Hoffman, 2012; Li & Mohanram, 2018; Muller & Ward, 2013; Vedd & Yassinki, 2015). A 20-year period was selected from 1 January 1997 to 30 September 2018 on the database, with the year 1997 being set as the base year. A longer period might have caused issues, as through inspection, it was noticed that older datasets tended to be rather incomplete. The period until 30 September 2018 was selected as various organisations have 28 February as well as 30 June year ends, and therefore their 20-year comparison period would only be fulfilled on 28 February 2018 or 30 June 2018 respectively.

According to the JSE, all JSE listed companies have three months after their financial year ends to publish their results on SENS (JSE, n.d.). Share prices of listed companies would therefore not immediately be affected by financial information on the date of a reporting period. The share data as obtained from Iress Expert was therefore time lagged for a period of three months after the financial reporting period and therefore the date of 30 September 2018 was selected so that the companies with a financial year end of 30 June 2018 were still included as part of the research. This approach was line with those taken by Muller and Ward (2013) and Bunting and Barnard (2015) in their research performed. The periods as stipulated above were selected on the Iress Expert database by inputting the dates on the custom period selector and requesting these ratios to be reported monthly to ensure that any companies with unusual year ends were reflected. After the selection of the dates the data was exported to excel.

In the research performed by Muller and Ward (2013), name changes were tracked to ensure that companies that went through name changes were not seen as different entities. From inspection of the excel data extracted from the Iress Expert Database, it was confirmed that companies who underwent name changes were retrospectively updated with the new names. This was in line with the findings of Bunting and Barnard (2015) while using the INET database. An example for illustration purposes, in the Mining sector, was Sentula Mining Limited which undertook a name change to Unicorn Capital Partners Limited on the 2nd of August 2017 (Sentula Mining Limited, 2017). The researcher previously audited this company and therefore was fully aware of the name change and therefore investigated. From inspection of the data extracted the name Unicorn Capital Partners reflected since 1997/01/31, the first day data this company was extracted for the mining sector.

Data cleaning was thereafter performed in excel, by removing the datapoints where all the financial data for a specific period, for a company, was not present. These removed datapoints were kept on a separate spreadsheet so that they can be accessed at a later stage. This method was in line with that performed by Muller and Ward (2013). This was performed throughout the datasets except where the dividend yield ratio was the only ratio where a zero value was displayed. This was as companies might not pay dividends every single year and therefore the ratio would be expected to be zero and not an error or missing variable. Instances were also noted where the dividend yield was blank with no value where all the other 13 ratios displayed values. If all the preceding and following years displayed a zero-dividend yield ratio this blank ratio was also changed to zero.

Where the dividend yield ratio consistently displayed a value for the preceding and following years, but was blank on one line of the dataset, the individual data line was removed and was deemed as incomplete. The reason for this action is due to the fact that companies have dividend policies in place. If the company never pays dividends as in the first instance, then it would be safe to determine that no sudden dividends would be paid where the blanks were displayed. If a company displays a usual trend of paying dividends, then it normally happens that consistent dividends are paid based on a predetermined calculation for example 5% of profit etc.

Where companies which were previously listed were unlisted in subsequent years, the data of those companies were only included up until the latest published financial ratios and the three-month lagged share price before the company was delisted. The three month lagged share prices were then copied and inserted next to the financial ratios applicable. For example, if a company had a financial year end of 30 June, the three month later lagged 30 September share price was copied and inserted next to the 30 June financial ratios. The percentage change in the share price from the previous year was then calculated to produce a new variable which would replace the actual share price for the applicable year. This was achieved by applying Equation 2 to each of the three months lagged share prices for the relevant years.

Equation 2. Percentage change equation

$$\%\ Change = ((P_t) - (P_{t-1}))/(P_{t-1}) \times 100$$

Where

P_t = Value of current year

P_{t-1} = Value of previous year

Source: Adapted from Percentage change (n.d.).

The initial base period (P_{t-1}) was set as 1997 and the next period (P_t) as 1998. Every year these periods would move in line with the accompanying financial ratio periods. When companies were only listed in a later period, the listing year was set as (P_{t-1}) and the next as (P_t). It is important to understand that the financial year end dates for some companies in the various industries differed, as the financial year end date of a company can be chosen and also in some instances, companies undertook financial year end changes during the course of their operations which is normal and expected. Seeing that all the share price data in the different periods were able to be standardised into a consistent universal measure, namely percentage change from previous period, companies with different market capitalisation and especially higher and lower share prices were able to be compared to each other and be included in the same dataset. Lastly with this one consistent measure of percentage change in share price, weight was equally distributed between each datapoint, even if the share price was minimal or substantial, causing no company to carry more weight than another. Please note all data cleaning processes described above were performed in Microsoft Excel 2017 before performing the data analysis in IBM SPSS v25.

4.8 Data analysis approach

The data analysis approach used for testing hypothesis 1-5 was a stepwise multiple linear regression analysis approach. This approach is a widely used tool in business and specifically finance when working with returns (Wegner, 2016). This method aims to determine the relationship between multiple independent variables and a dependent variable and was therefore best fit for the research that was performed (Hair et al., 2010; Wegner, 2016). The percentage change in share prices from period to period was classified as the dependent variable (*y*). Each of the 14 financial ratios were classified as the independent variable (*x*).

The stepwise regression was performed using the automated stepwise regression function in IBM SPSS v25 (George & Mallery, 2019). The stepwise regression is the most popular and commonly used regression model, specifically in IBM SPSS v25, as it combines both forward and backward regression procedures and takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Firstly, the independent variable which delivers the greatest contribution is added, after which the remaining variables are then included based on their contribution in addition to the variables already included (Hair et al., 2010). Arkan (2016) and Ma and Truong (2015) also used a stepwise regression model to determine which financial ratios had the most significant relationship with share price performance for the selected sectors.

All the variables and accompanying data used in the population first needed to fulfil the multiple linear regression assumptions before the automated stepwise regression could be performed as defined below (Bezuidenhout, 2017; Laerd Statistics, n.d.-a; Parke, 2013). Only after the all assumptions were met using a normal regression model for the testing of assumptions was the automatic stepwise regression performed. The reason for performing the assumption testing using normal regression testing in IBM SPSS v25 was to provide all variables initially entered an equal chance, after being corrected for outliers, highly influential points, highly leveraged points, multicollinearity etc., to possibly form part of the stepwise regression results. The approach of first ensuring the assumptions were met before applying stepwise regression was similar to that used by Ma and Truong (2015). For all testing performed the level of significance was set at 0.05 which leads to a 95% confidence interval.

Multiple Linear Regression Assumptions

The first assumption is that one continuously measurable dependent variable is used. Secondly, two or more independent variables are used. The observations (residuals) are then independent, which is followed by ensuring that the dependent variable (percentage change in share price) has a linear relationship with the independent variables (financial ratios). The data then needs to be homoscedastic. It should then be ensured that there is no multicollinearity and that no significant outliers, highly influential of highly leveraged points exist. Lastly, the residuals should be approximately normally distributed (Bezuidenhout, 2017; Laerd Statistics, n.d.-a; Parke, 2013).

4.8.1 Assumption 1

One dependent variable is used which is measured on a continuous scale.

The annual percentage change in the share price is the dependent variable and it is measured on a continuous scale.

4.8.2 Assumption 2

Two or more independent variables are used.

There are 14 independent variables, namely the financial ratios, which were measured on a continuous level as indicated in Table 14. The only sector where all 14 independent variables could not be applied but only 11 was the banking sector as the banking sector could not produce the net profit margin, operating profit margin or total asset turnover due to the format of its operations and financial statements. The banking sector does not contain revenue/turnover/sales as it mainly obtains funds through the income obtained from loan income. All the 11 other ratios were however consistently applied during the testing of the banking sector.

Table 14

Financial ratios selected

Classification	Ratio	Calculation	Citation
Liquidity Ratio	Current or Liquidity	Current Assets ÷ Current Liabilities	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Interest cover	Earnings before interest and tax (EBIT) ÷ Interest	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Equity (D/E)	Total Liabilities ÷ Owners Equity	(Delen, Kuzey & Uyar, 2013)
Solvency Ratio	Debt to Assets (D/A)	Total liabilities ÷ Total assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Equity (ROE)	Net income ÷ Owners' Equity	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Assets (ROA)	Net Income ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Return on Capital Employed (ROCE)	Earnings before interest and taxes (EBIT) ÷ Capital employed	(Skae et al., 2012)
Profitability Ratio	Net profit margin	Net profit ÷ Sales	(Delen, Kuzey & Uyar, 2013)
Profitability Ratio	Operating profit margin	Operating Profit ÷ Net Sales	(Skae et al., 2012)
Asset Utilization or Turnover ratio	Total asset turnover	Sales ÷ Total Assets	(Delen, Kuzey & Uyar, 2013)
Price-to-fundamental ratios	Price-earnings ratio (P/E)	Price p.s. ÷ Earnings p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-book ratio (P/B)	Price p.s. ÷ Book value p.s.	(Skae et al., 2012)
Price-to-fundamental ratios	Price-to-cash-flow (P/CF)	Price p.s. ÷ Cash flow p.s.	(Price-to-cash-flow ratio, n.d.)
Price-to-fundamental ratios	Dividend yield (DY)	Dividend p.s. ÷ Price p.s.	(Skae et al., 2012)

Note. Researcher produced. p.s. = per share.

4.8.3 Assumption 3

The observations (residuals) are independent.

According to Weiers, Gray & Peters (2011), time series-based regression models, such as which was performed by the researcher are especially susceptible to autocorrelation, which is the phenomenon which occurs when independence of observations does not exist. The most suitable way to test for the independence of observations is by using the Durbin-Watson test (Durbin & Watson, 1950, 1951; Laerd Statistics, n.d.-a; Parke, 2013; Weiers et al., 2011). Independence of observations was tested by calculating the Durbin Watson Statistic using IBM SPSS v25. Any scores close to 2 were accepted as this indicated that there was independence of observations (Bezuidenhout, 2017; Nightingale, 2018; The Open University, n.d.; Weiers et al., 2011).

4.8.4 Assumption 4

The dependent variable (percentage change in share price) has a linear relationship with the independent variables (financial ratios).

The first step to substantiate this assumption was to produce scatter plots to determine the degree of linearity between the dependent variable (*y*) and each independent variable (*x*) (Hair et al., 2010; Wegner, 2016; Laerd Statistics, n.d.-a; Parke, 2013; The Open University, n.d.). Scatterplots were produced in IBM SPSS v25 between the percentage change in share price (dependent variable) and each financial ratio (independent variable). The percentage change in the share price was placed on the y-axis and the relevant financial ratio on the x-axis. These were inspected to determine if linear relationships existed between the variables, the direction, namely positive or negative and the strength of the relationships between the variables were inspected and the need for removal of any additional outliers were considered. Professional judgement as a financial expert was applied when removing any outliers which would significantly distort the results and lead to decreased linear fit. Outliers were classified as those datapoints which significantly would affect the linear function of the multiple linear regression analysis for the specific sector and was not representative of the majority of the sectors results or occurred due to special circumstances. Any outliers were kept in a separate sheet which was in line with Muller and Ward (2013).

After the production of scatterplots, partial regression plots were produced and inspected for linearity in SPSS with the percentage change in share price being placed on the y-axis and the respective financial ratio being placed on the x-axis (Bezuidenhout, 2017; Hair et al., 2010; Laerd Statistics, n.d.-a). Further, the scatterplot of standardized residual values versus the standardized predicted values was inspected and a Loess curve was added to this graph to ensure that the residuals were roughly scattered around zero to ensure the relationships were linear (UCLA Institute for Digital Research and Education, n.d.). Some of the ratios selected did not present strong linear relationships, where others displayed a stronger relationship with the data presented. Seeing that an automated stepwise regression model was used the stepwise model would have removed the independent variables which did not have a strong linear relationship with the percentage change in share price and only keep the significant independent variables which displayed a strong linear relationship for each sector.

4.8.5 Assumption 5

The data is homoscedastic.

Homoscedasticity was ensured by inspecting the scatterplot of the regression standardised residual versus the regression standardized predicted value (Parke, 2013; The Open University, n.d.). Even though the inspection of this scatterplot provides some comfort, it does not provide statistical significance tests where the homoscedasticity is determined by a way of a hypothesis test. The researcher therefore opted to perform more rigorous homoscedasticity hypothesis tests.

The Breusch-Pagan and the Koenker tests were available (Breusch & Pagan, 1979; Koenker, 1981). The Koenker was an improved and more reliable test as it corrected an estimation error which was present in the Breusch-Pagan test (Koenker, 1981). Another test namely White's test (White, 1980) for homoscedasticity was also available, but it was deemed that the Koenker test had more power than that of White's test (Lyon & Tsai, 1996). The Koenker test was therefore selected for use in the research as it was deemed to be the most effective homoscedasticity tests out of the three mentioned.

A macro, which was developed by Daryanto (2018), was obtained which could be ran on SPSS to perform this test automatically. Even though this macro produced both the Breusch-Pagan and Koenker Results, only the Koenker results were focussed on and used in this research as it was more reliable as explained above. If data is not homoscedastic then it is classified as being heteroscedastic. The null hypothesis per the test was that heteroskedasticity was not present (homoscedastic). If a significance value of less than 0.05 was obtained, then the null hypothesis would be rejected indicating that the data was heteroscedastic and is in violation of the assumption of homoscedasticity. According to Hair et al. (2010) if heteroscedasticity was detected, the data could be transformed using similar techniques to those used in transformations to achieve normality, for example by applying a square root or inverse transformation, depending on the nature on the heteroscedasticity.

4.8.6 Assumption 6

Multicollinearity is not present.

Multicollinearity is the phenomenon which occurs when an independent variable's effect can be largely predicted by another independent variable (Hair et al., 2010; Laerd Statistics, n.d.-a). The inspection of a correlation analysis is a simple way of determining if multicollinearity exists (Hair et al., 2010; Wegner, 2016; Weiers et al., 2011). This is however not the best method as it does not consider the effect of the other financial variables when calculated (Hair et al., 2010).

The Variance Inflation Factor (VIF) and tolerance values are much more reliable methods of testing for multicollinearity and therefore the values of these tests were inspected in IBM SPSS v25 (Bezuidenhout, 2017; Hair et al., 2010; Herbst, 2017; Laerd Statistics, n.d.-a; Ma & Truong, 2015; Nightingale, 2018; Parke, 2013; The Open University, n.d.). Any VIF score below 10, or tolerance factor of more than 0.1 was accepted (Bezuidenhout, 2017; Herbst, 2017; Ma & Truong, 2015; Nightingale, 2018; Parke, 2013; The Open University, n.d.). If higher scores were obtained, then the variables with the highest scores were removed and the tests were rerun until all VIF scores were below 10 and all tolerance levels were above 0.1. These tests were performed firstly with all the variables in place and only after all variables displayed acceptable VIF and tolerance values was the stepwise regression run.

4.8.7 Assumption 7

No significant outliers, highly influential or highly leveraged points exist.

Significant outliers were first removed as stated earlier in Assumption 4 by way of the inspection of scatterplots and residual plots. After this process, casewise diagnostics were performed using IBM SPSS v25 by setting the value to detect outliers with values more than positive or negative three standard deviations (Bezuidenhout, 2017; Laerd Statistics, n.d.-a; La Trobe University, n.d.; Parke, 2013). Any outliers which were detected by the casewise diagnostics were removed from the dataset which after the regression was reperformed until no further outliers existed.

Highly influential points were firstly evaluated by inspecting the Cook’s distance values (Parke, 2013; Laerd Statistics, n.d.-a) Any datapoints with Cook’s distance values of more than one was seen as highly influential and were removed (Bezuidenhout, 2017; The Open University, n.d.). Further to this, a scatterplot plotting Cook’s distance value (y-axis) by centred leverage value (x-axis) was produced and inspected to further detect any highly influential or leveraged points (IBM Corporation, n.d.). Some datapoints might possess larger Cook’s distance values when compared to other datapoints, which will add increased variability to the regression estimates, but if these values do not possess a high leverage value then it is not likely to affect the regression equation (IBM Corporation, n.d.). Similarly, some datapoints might possess a higher leverage value when compared to other datapoints, but if it does not possess a large Cook’s distance then it is not likely to exert undue influence on the regression model (IBM Corporation, n.d.). The values of each of the scores on the scatterplot in combination were therefore analysed to determine if any highly leveraged and influential points existed, and if so, these were removed (IBM Corporation, n.d.).

4.8.8 Assumption 8

The residuals are approximately normally distributed.

Firstly, the histogram of regression standardized residuals was inspected in IBM SPSS v25, as this is the simplest visual inspection method (Hair et al., 2010; Laerd Statistics, n.d.-a; Parke, 2013). Secondly, the normal P-P plot of regression standardized residuals was inspected (Bezuidenhout, 2017; Hair et al., 2010; Laerd Statistics, n.d.-a; The Open University, n.d., UCLA Institute for Digital Research and Education, n.d.). Hair et al. (2010) argued that this method is beneficial as the inspection of the histogram of residuals, in instances where small samples exist, could lead to a badly-formed distribution which is difficult to interpret. Residual plots which followed close to the diagonal line provided evidence that the residuals were approximately normally distributed (Hair et al., 2010).

According to Hair et al. (2010) the inspection of graphical presentations is not to replace other tools available, but these methods should be used in conjunction with other methods including the evaluation of skewness and kurtosis values. To obtain additional comfort regarding the normality of residuals using skewness and kurtosis, general rules of thumbs are available which were evaluated against the skewness and kurtosis values delivered by the standardized residuals. A skewness value of above ± 1 indicates that a distribution is heavily skewed (George & Mallery, 2019; GoodData Corporation, n.d.; Hair et al., 2010). A skewness value between ±1 and ± 0.5 in the same direction indicates a moderately skewed distribution (GoodData Corporation, n.d.). A skewness value of between ± 0.5 and 0 indicates that the distribution is approximately normally distributed and symmetric (GoodData Corporation, n.d.). When referring to the kurtosis rule of thumb, the same values are applicable to substantiate the normality aspect relating to skewness (George & Mallery, 2019). Both the skewness and kurtosis values of the residuals were inspected to ensure that these values were between ± 0.5 each to obtain comfort that the residuals were approximately normally distributed.

Further, to obtain additional comfort regarding the normality of residuals, more rigorous testing was performed. SPSS can produce two types of normality tests for residuals namely the Shapiro-Wilk and the Kolmogorov-Smirnov test and these were also the most commonly used tests (Hair et al., 2010; Laerd Statistics, n.d.-b). According to Ghasemi and Zahediasl (2012), the Kolmogorov-Smirnov test has lower power when compared to the Shapiro-Wilk test and therefore the second test should rather be used in combination with the inspection of visual graphs in SPSS to obtain the best results. The Shapiro-Wilk test, similar to that used by Nightingale (2018), was therefore used in the research performed.

Hair et al. (2010) however warns that the statistical normality tests discussed above, namely the Shapiro-Wilk and the Kolmogorov-Smirnov tests, are less useful in small samples (<30) and could be oversensitive in large samples (>1000) and therefore should be combined with the inspection of visual plots to ensure approximate normal distribution. Kim (2013) seems to take a more conservative approach with regard to large samples and indicates that both these tests are more useful for samples smaller than 300 and may be unreliable for larger samples. The results of the Shapiro-Wilk test on a standalone basis might therefore not deliver an actual representation of normality for all the sectors tested due to the large variation in sample sizes between the sectors tested.

To perform the Shapiro-Wilk test, the standardized and unstandardized residuals were inserted in the explore function of the descriptive statistics selection in SPSS. Normality plots with tests were then selected. The significance of the Shapiro-Wilk test was first inspected, and it was ensured that for both standardized and unstandardized residuals the significance was consistent. The value of significance was then inspected and if these values were larger than 0.05 it could provide evidence that the errors were normally distributed (Laerd Statistics, n.d.-b). Lastly, after this test was executed the box plot and normal Q-Q plot of standardized residuals was inspected (Laerd Statistics, n.d.-a; Laerd Statistics, n.d.-b; Parke, 2013; UCLA Institute for Digital Research and Education, n.d.). The box plot inspection was combined with that of the extreme values (outlier) output to identify any datapoints which were both extreme outliers and presented extreme outlying residuals which affected the normality of residuals.

According to Parke (2013), if certain variables appear to lead to non-normality, an option is to remove these individual variables. The most significant of the overlapping datapoints which were both extreme outliers and non-normally distributed were therefore removed. The researcher used careful consideration when analysing the results of the Shapiro-Wilk test in combination with the graphical representations and the skewness and kurtosis values to make an informed decision regarding the approximate normal distribution of residuals of each of the five sectors.

Finalization

It is of importance to note that the aim of this study was not to develop a model for prediction purposes where every single possible financial ratio was included, but only to determine which financial ratios from those selected based on the literature reviews performed have the strongest statistical relationship to share price performance. After all of the eight assumptions above were satisfied, the automatic stepwise regression was performed in IBM SPSS v25 and the most significant financial ratios for each sector was identified based on the most commonly used 0.05 level of significance, which leads to a 95% confidence interval (Wegner, 2016). Seeing that an automatic stepwise regression was used, the combination of the statistically significant financial ratios together delivered the highest R^2 value possible with all the variables available.

4.9 Research Ethics

This research used secondary data, in the form of financial ratio and share price information, which were publicly available data, seeing that this information pertained to publicly listed companies on the JSE. The database used, namely Iress Expert, was made available for all students via the University of Pretoria library database and therefore no specific approval had to be obtained to use this data from Iress, the supplier. No human data was gathered during this research and therefore no further ethical concerns arose from this aspect.

4.10 Research Limitations

The preliminary limitations as determined before the statistical testing of the data obtained follows. The study firstly was performed on the top five JSE sectors based on market capitalisation even though 37 of the total 41 ICB level three sectors were available on the JSE for analysis (FTSE Russell, n.d.; Iress, 2018). Due to time constraints, more sectors were not able to be investigated, but in addition to the time constraints, some of the sectors would have not been fit for multiple linear regression analysis as some would only contain one or very minimal companies within the sectors. This was clearly noted from section 4.3 where the initial population was determined, where some of the high market capitalisation ICB level three sectors like tobacco only included one company, which would have led to insufficient datapoints for effectively performing multiple linear regression analysis. This was therefore a limitation to the study.

Secondly, the database used to obtain the secondary data, namely share prices and financial ratios, could only provide these on an annual basis. Even though financial ratios in South Africa are mostly generally calculated on an annual basis, as JSE listed companies are only required to be audited on an annual basis, based on their year-end financial results, the JSE requires listed companies to release results two times a year, namely at an interim period and at a final year end period (JSE, n.d.). Seeing that interim ratios were not available, which would have led to more datapoints for testing purposes, this was seen as a limitation.

Thirdly, share prices were lagged for three months to ensure that financial statement information would have been released to investors in line with JSE regulations (JSE, n.d.). Companies might however release their results on earlier periods than exactly three months from financial yearend or investors might not all respond to financial information on precisely the day the financial information is released. This is therefore a limitation but was the most appropriate method to perform the research as a similar method was used by Bunting and Barnard (2015) and Muller and Ward (2013).

Lastly, some of the research performed by others, especially those of Muller and Ward (2013) add dividends received together with the change in the share price, in order to calculate the annual returns percentage in the period. In this research the focus is however not on returns but only the pure change in the share price. Some might label this as a limitation even though our research includes the dividend yield ratio which would be compared to the change in share price. Nonetheless this was classified as a limitation.

CHAPTER 5 RESULTS

5.1 Introduction

This chapter presents the results of the tests performed in order to either accept or reject the null hypothesis of each of the five-hypotheses documented in Chapter 3. Firstly, the relevant hypothesis was restated under each section. This was followed by a description of the sample obtained and the cleaning of the data for multiple linear regression assumption purposes. The main findings of the eight multiple linear regression analysis findings were then stated. Further the descriptive statistics of the multiple linear regression were displayed. Lastly, the final stepwise regression results were presented after which the section was completed by presenting the results of the rejection, or acceptance of the null hypothesis.

The IBM SPSS v25 and other outputs of the eight multiple linear regression assumptions, which first needed to be fulfilled as described in Chapter 4.8, were included under Appendix B, under the first section of the relevant Hypothesis. The IBM SPSS v25 outputs of the stepwise multiple linear regression were included in Appendix B, under the second section of the relevant hypothesis.

5.2 Hypothesis 1: Mining

Research question two (RQ1): Do statistical relationships exist between financial ratios and share price performance of the mining sector on the JSE?

- Null hypothesis two ($H_0$1): No significant statistical relationships exist between any financial ratios and the share price performance of the mining sector on the JSE.
- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mining sector on the JSE.

5.2.1 Description of data obtained and cleaned

The full dataset from 1 January 1997 to 30 September 2018 for the ICB level 3 mining sector was obtained and cleaned for multiple linear regression purposes as displayed in Table 15.

Table 15

Data obtained for mining sector

Description	No. of datapoints	
Total number of companies	134	
Listed	43	
Delisted	91	
Initial datapoints	1052	
Incomplete datapoints missing data	368	
Removal of single company datapoints	5	*
Removal of base period year as no comperative for % change	68	
Final datapoints inserted into SPSS	611	
Significant outliers detected via scatterplots removed	54	
Casewise diagnostic outliers removed	29	
Outliers and non-normally distributed residuals removed	21	
Highly leveraged and influential points removed	5	
Final datapoints included in results	502	

Note. Researcher produced. *Companies with only one period of results cannot be used for comparative purposes to determine percentage change in share price.

5.2.2 Multiple linear regression assumption results

All tests which followed were performed using a 95% confidence interval. The percentage change in share price, titled “Close”, which was the dependent variable was consistent and therefore the first assumption of multiple linear regression analysis which is from now on referred to as MLR was met. All 14 financial ratios as previously discussed were initially set as the dependent variable. Independence of observations were present, as a Durbin-Watson score of 2.175 was obtained. A linear relationship existed between the dependent variable (percentage change in share price) and the independent variables (financial ratios). This was confirmed through the inspection of scatterplots, partial regression plots and lastly the scatterplot of standardized residual values versus the standardized predicted values fitted with the Loess curve.

The data was homoscedastic. This was confirmed through the inspection of the regression standardised residual versus the regression standardized predicted value scatterplot. Homoscedasticity was lastly confirmed through the inspection of the Koenker test where a significance value above 0.05 was obtained, p = .200. Initial multicollinearity did not exist, but after the removal of outliers, highly influential and leverage points discussed below, multicollinearity arose between net profit margin and operating profit margin. Operating profit margin possessed the highest VIF score (12.793) and lowest tolerance factor (0.078) and was therefore removed. No multicollinearity was further detected for the variables as all VIF scores were below 10, indicating insignificant multicollinearity.

See Table 15 where a summary was made of the number of outliers, highly influential and highly leveraged points which were discussed below. 54 significant outliers were firstly removed by the inspection of scatterplots and by applying professional judgement to these scatterplots. Secondly, 29 outliers were removed by way of running and rerunning case wise diagnostics in the normal regression mode until no outliers were detected which were more than three standard deviations. Further, 21 extreme outliers and residuals were removed by detecting these via the inspection of a combination of the extreme values (outlier) function and the normality box-plot in SPSS. Five highly leveraged and influential points were identified and removed. Even though some additional points remained which were situated above other points on the Cook's Distance vs Centred Leveraged Value graph, the combination of their Cook's and leverage rating would not have led to significant influence or leverage (See Appendix B) (IBM Corporation, n.d.).

Lastly, the normal distribution of the residuals was ensured. This was confirmed by inspecting the histogram of regression standardized residuals and by inspecting the normal P-P plot of regression standardized residuals. Further, the skewness and kurtosis value of the normal regression standardized, and unstandardized residuals both amounted to 0.268 and -0.306 respectively, which were less than ± 0.5, indicating approximate normal distribution. The Shapiro-Wilk test on both the standardized and unstandardized residuals however did not deliver a significance value above 0.05.

As indicated by Hair et al. (2010) and Kim (2013), the Shapiro-Wilk test could be oversensitive to large populations and could lead to unreliable results. Kim (2013) indicated that these large samples are classified as any population with more than 300 datapoints. In this instance the mining sector contained the largest population of 502 datapoints, followed by the real estate investment trusts sector, which was the second largest sector, with 284 datapoints. Seeing that the inspection of the histogram of regression standardized residuals and normal P-P plot of regression standardized residuals strongly indicated that the residuals were approximately normally distributed, the opposite finding delivered by the Shapiro-Wilk test appears to have been due to the large population of more than 300 as indicated by Kim (2013). To further confirm the approximate normality of the residuals, the normal Q-Q plot and Box plot was inspected, where all indicated that the residuals were approximately normally distributed.

After performance of the tests discussed above, a final total of 502 datapoints out of the initial 1052 datapoints were fit for testing purposes, as these met all eight of the multiple linear regression assumptions. The final stepwise multiple linear regression test followed in which all 502 datapoints were included. Please refer to the first section of Appendix B under Hypothesis 1 for all the IBM SPSS v25 outputs and other detail to support the results which were discussed above for each of the eight assumptions of multiple linear regression analysis.

5.2.3 Descriptive statistics

Table 16 provides a summary of the most important descriptive statistics derived from the final 502 datapoints which were produced from the normal multiple linear regression model after meeting the eight multiple linear regression assumptions. As part of the descriptive statistics, the Pearson correlation and its significance were included. 11 of the 13 financial ratios displayed statistically significant correlations with share price performance. A Pearson correlation however does not take into account the combined effect of the other financial ratios on the dependent variable when determining a correlation and therefore provides less concrete evidence when compared to performing a multiple regression model. The return on equity ratio produced the most statistically significant Pearson correlation with the percentage change in share price.

Table 16

Descriptive statistics: Mining

Variable	*M*	*SD*	*N*	*r*	*p*
Close	-2.1573%	46.15487%	502	1.000	
Current Ratio	1.765544	1.4321616	502	0.045	0.155
Debt / Assets	0.322488	0.2150847	502	-0.081	0.035
Debt / Equity	0.663384	1.1683318	502	0.060	0.090
Dividend Yield %	2.532773	9.8714664	502	-0.099	0.013
Interest Cover	9.061497	61.5321707	502	0.161	0.000
Net Profit Margin %	-35.068461	244.2410093	502	0.115	0.005
Price / Book Value	2.305909	3.7793298	502	0.262	0.000
Price / Cash Flow	6.962279	36.9700231	502	0.147	0.000
Price / Earnings	17.934518	68.4907108	502	0.105	0.009
Return On Assets %	1.149405	28.4152499	502	0.282	0.000
Return On Capital Employed %	-0.242366	34.1167740	502	0.280	0.000
Return On Equity %	-3.791491	68.6482921	502	0.293	0.000
Total Assets Turnover	0.640971	0.4419568	502	0.085	0.029

Note. Researcher produced. *M* = Mean, *SD* = Standard deviation, *N* = Population size, *r* = Pearson correlation, *p* = significance.

5.2.4 Stepwise multiple linear regression results

Table 17 provides a summary of the results of the automatic stepwise multiple linear regression performed in IBM SPSS v25. A stepwise multiple linear regression takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Some variables might therefore have statistically significant relationships with the dependent variable on an individual basis, but when added to the equation do not increase the adjusted coefficient of determination (adjusted R^2). These variables would therefore not be included as part of the multiple linear regression equation.

The ratios provided in Table 17 were therefore the ratios which in combination delivered the highest adjusted R^2 for the sector. The stepwise multiple linear regression was performed at the 95% confidence interval where these findings were displayed in order of the most significant financial ratios to the least significant. Return on equity delivered the most significant effect on the percentage change in the share price, where total asset turnover delivered the least significant.

Table 17

Automatic stepwise regression results: Mining

No.	Variable	β	*CSE*	*Beta*	*t*	*p*
	(Constant)	-9.445	3.973		-2.377	0.018
1	Return On Equity %	0.282	0.030	0.419	9.361	0.000
2	Price / Book Value	3.017	0.497	0.247	6.072	0.000
3	Debt / Equity	7.870	1.871	0.199	4.206	0.000
4	Dividend Yield %	-0.760	0.187	-0.163	-4.057	0.000
5	Debt / Assets	-26.544	9.187	-0.124	-2.889	0.004
6	Total Assets Turnover	10.398	4.427	0.100	2.349	0.019

Note. Researcher produced. β = Unstandardized coefficients beta, *CSE* = Unstandardized coefficient standard error, *Beta* = standardised coefficient beta, *t* = t - statistic, *p* = significance.

The combined model achieved a coefficient of determination (R^2) value of 0.234 and an adjusted coefficient of determination (adjusted R^2) value of 0.225. 22.5% of the variation in share prices could therefore possibly be explained by the six financial ratios as indicated in Table 17. The analysis of variance (ANOVA) showed that the effect of the change in financial ratios was statistically significant on the share price performance at the 95% confidence level, $F(6,495) = 25.221$, $p = .000$.

Please refer to the second section of Appendix B under Hypothesis 1 for the relevant IBM SPSS v25 outputs and other detail to support the automatic stepwise multiple linear regression results discussed above.

5.2.5 Result

Based on the results discussed above, rejection of the null hypothesis and acceptance of the alternative hypothesis was appropriate.

- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mining sector on the JSE.

5.3 Hypothesis 2: Banking

Research question two (RQ2): Do statistical relationships exist between financial ratios and share price performance of the banking sector on the JSE?

- Null hypothesis two ($H_0$2): No significant statistical relationships exist between any financial ratios and the share price performance of the banking sector on the JSE.
- Alternate hypothesis two ($H_1$2): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the banking sector on the JSE.

5.3.1 Description of data obtained and cleaned

The full dataset from 1 January 1997 to 30 September 2018 for the ICB level 3 Banking sector was obtained and cleaned as displayed in Table 18. This table includes the details around items that were removed from the dataset which is further

Table 18

Data obtained for banking sector

Description	No. of datapoints
Number of Companies	134
Listed	43
Delisted	91
Initial datapoints	158
Incomplete datapoints missing data	7
Removal of base period year as no comperative for % change	9
Initial share price % change outliers detected	2
Final datapoints inserted into SPSS	140
Significant outliers detected via scatterplots removed	13
Casewise diagnostic outliers removed	5
Outliers and non-normally distributed residuals removed	5
Highly leveraged and influential points removed	8
Final datapoints included in results	109

Note. Researcher produced.

5.3.2 Multiple linear regression assumption results

All tests which followed were performed using a 95% confidence interval. The percentage change in share price, titled "Close", which was the dependent variable was consistent and therefore the first assumption of multiple linear regression analysis which is from now on referred to as MLR was met. All 14 financial ratios as previously discussed were initially attempted to be extracted, but only 11 of the 14 chosen financial ratios were available as dependent variables with figures from the Iress Expert Database. The banking industry does not generate turnover or revenue as generally defined as most income is derived from interest income and other sources and therefore these ratios are not common within the selected industry. No operating margins, net profit margins or total asset turnover ratios were therefore available on the database and were therefore not included.

Independence of observations were present, as a Durbin-Watson score of 2.157 was obtained. A linear relationship existed between the dependent variable (percentage change in share price) and the independent variables (financial ratios). This was confirmed through the inspection of scatterplots, partial regression plots and lastly the scatterplot of standardized residual values versus the standardized predicted values fitted with the Loess curve. The data was homoscedastic. This was confirmed through the inspection of the regression standardised residual versus the regression standardized predicted value scatterplot. Homoscedasticity was lastly confirmed through the inspection of the Koenker test where a significance value above 0.05 was obtained, $p = .071$. No significant multicollinearity existed as constant VIF scores of far below 10 existed.

See Table 18 where a summary was made of the number of outliers, highly influential and highly leveraged points which were discussed below. 13 significant outliers were firstly removed by the inspection of scatterplots and by applying professional judgement to these scatterplots. Secondly, five outliers were removed by way of running and rerunning case wise diagnostics in the normal regression mode until no outliers were detected which were more than three standard deviations. Further, five extreme outliers and residuals were removed by detecting these via the inspection of a combination of the extreme values (outlier) function and the normality box-plot in SPSS. Eight highly leveraged and influential points were identified and removed. Even though some additional points remained which were situated above other points on the Cook's Distance vs Centred Leveraged Value graph, the combination of their Cook's and leverage rating would not have led to significant influence or leverage (See Appendix B) (IBM Corporation, n.d.).

Lastly, the normal distribution of the residuals was ensured. This was confirmed by inspecting the histogram of regression standardized residuals and by inspecting the normal P-P plot of regression standardized residuals. The skewness and kurtosis value of the normal regression standardized, and unstandardized residuals both amounted to 0.457 and -0.173 respectively, which were less than ± 0.5, indicating approximate normal distribution. The Shapiro-Wilk test on both the standardized and unstandardized residuals delivered a significance value above 0.05 which further substantiated the normality of the regression model, $p = .058$. To further confirm the approximate normality of the residuals, the normal Q-Q plot and Box plot was inspected, where all indicated that the residuals were approximately normally distributed. In the final Box plot some residuals occurred above the main grouping of box plot residuals but seeing these were not significant, the Shapiro-Wilk score was above significance, and various other residuals had already been removed before these, no significant outlier of residuals were identified. No further action was deemed necessary.

After performance of the tests discussed above, a final total of 109 datapoints out of the initial 158 datapoints were fit for testing purposes, as these met all eight of the multiple linear regression assumptions. The final stepwise multiple linear regression test followed in which all 109 datapoints were included. Please refer to the first section of Appendix B under Hypothesis 2 for all the IBM SPSS v25 outputs and other detail to support the results which were discussed above for each of the eight assumptions of multiple linear regression analysis.

5.3.3 Descriptive statistics

Table 19 provides a summary of the most important descriptive statistics derived from the final 109 datapoints which were produced from the normal multiple linear regression model after meeting the eight multiple linear regression assumptions. As part of the descriptive statistics, the Pearson correlation and its significance were included. 3 of the 11 financial ratios displayed statistically significant correlations with share price performance. A Pearson correlation however does not take into account the combined effect of the other financial ratios on the dependent variable when determining a correlation and therefore provides less concrete evidence when compared to performing a multiple regression model. The price-earnings ratio produced the most significant Pearson correlation with the percentage change in the share price.

Table 19

Descriptive statistics: Banking

Variable	*M*	*SD*	*N*	*r*	*p*
Close	7.8488%	22.35236%	109	1.000	
Current Ratio	1.005911	1.2710939	109	-0.068	0.240
Debt / Assets	0.713537	0.2744575	109	-0.099	0.153
Debt / Equity	9.432221	5.5368326	109	0.005	0.479
Dividend Yield %	3.246362	1.8397924	109	0.037	0.351
Interest Cover	-0.268046	1.7503462	109	-0.144	0.067
Price / Book Value	2.017306	0.8601335	109	0.392	0.000
Price / Cash Flow	7.434219	3.7080963	109	0.130	0.089
Price / Earnings	10.883295	4.2682355	109	0.394	0.000
Return On Assets %	-1.584957	2.5563923	109	0.060	0.269
Return On Capital Employed %	7.241282	19.3528223	109	0.115	0.116
Return On Equity %	17.912200	7.1393932	109	0.245	0.005

Note. Researcher produced. *M* = Mean, *SD* = Standard deviation, *N* = Population size, *r* = Pearson correlation, *p* = significance.

5.3.4 Stepwise multiple linear regression results

Table 20 provides a summary of the results of the automatic stepwise multiple linear regression performed in IBM SPSS v25. A stepwise multiple linear regression takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Some variables might therefore have statistically significant relationships with the dependent variable on an individual basis, but when added to the equation do not increase the adjusted coefficient of determination (adjusted R^2). These variables would therefore not be included as part of the multiple linear regression equation. The ratios provided in Table 20 were therefore the ratios which in combination delivered the highest adjusted R^2 for the sector. The stepwise multiple linear regression was performed at the 95% confidence interval where these findings were displayed in order of the most significant financial ratios to the least significant. Price-earnings delivered the most significant effect on the percentage change in the share price, where return on equity delivered the least significant.

Table 20

Automatic stepwise regression results: Banking

No.	Variable	β	*CSE*	*Beta*	*t*	*p*
	(Constant)	-24.752	6.886		-3.594	0.000
1	Price / Earnings	1.046	0.459	0.372	4.241	0.000
2	Return on Equity %	0.638	0.274	0.204	2.325	0.022

Note. Researcher produced. β = Unstandardized coefficients beta, *CSE* = Unstandardized coefficient standard error, *Beta* = standardised coefficient beta, *t* = t - statistic, *p* = significance

The combined model achieved a coefficient of determination (R^2) of 0.196 and an adjusted coefficient of determination (adjusted R^2) value of 0.181. 18.1% of the variation in share prices could therefore possibly be explained by the two financial ratios as indicated in Table 20. The analysis of variance (ANOVA) showed that the effect of the change in financial ratios was significant on the share price performance at the 95% confidence level, $F(2,108) = 12.940$, $p = .000$.

Please refer to the second section of Appendix B under Hypothesis 2 for the relevant IBM SPSS v25 outputs and other detail to support the automatic stepwise multiple linear regression results discussed above.

5.3.5 Result

Based on the results discussed above, rejection of the null hypothesis and acceptance of the alternative hypothesis was appropriate.

- Alternate hypothesis two ($H_1 2$): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the banking sector on the JSE.

5.4 Hypothesis 3: Life Insurance

Research question two (RQ1): Do statistical relationships exist between financial ratios and share price performance of the life insurance sector on the JSE?

- Null hypothesis two ($H_0$1): No significant statistical relationships exist between any financial ratios and the share price performance of the life insurance sector on the JSE.
- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the life insurance sector on the JSE.

5.4.1 Description of data obtained and cleaned

The full dataset from 1 January 1997 to 30 September 2018 for the ICB level 3 life insurance sector was obtained and cleaned for multiple linear regression purposes as displayed in Table 21.

Table 21

Data obtained for life insurance sector

Description	No. of datapoints
Number of Companies	11
Listed	6
Delisted	5
Initial datapoints	143
Incomplete datapoints missing data	37
Removal of base period year as no comperative for % change	8
Final datapoints inserted into SPSS	98
Significant outliers detected via scatterplots removed	11
Casewise diagnostic outliers removed	0
Outliers and non-normally distributed residuals removed	0
Highly leveraged and influential points removed	2
Final datapoints included in results	85

Note. Researcher Produced.

5.4.2 Multiple linear regression assumption results

All tests which followed were performed using a 95% confidence interval. The percentage change in share price, titled “Close”, which was the dependent variable was consistent and therefore the first assumption of multiple linear regression analysis which is from now on referred to as MLR was met. All 14 financial ratios as previously discussed were initially set as the dependent variable. Independence of observations were present, as a Durbin-Watson score of 1.769 was obtained. A linear relationship existed between the dependent variable (percentage change in share price) and the independent variables (financial ratios). This was confirmed through the inspection of scatterplots, partial regression plots and lastly the scatterplot of standardized residual values versus the standardized predicted values fitted with the Loess curve.

The data was homoscedastic. This was confirmed through the inspection of the regression standardised residual versus the regression standardized predicted value scatterplot. Homoscedasticity was lastly confirmed through the inspection of the Koenker value where a significance value above 0.05 was obtained, p = .262. Initial multicollinearity was detected. Return on Assets % presented a VIF score of 23.374 and a tolerance of 0.043. This variable was removed, and multicollinearity was again inspected. Another variable namely Return on Capital Employed %, subsequently developed a VIF score of 10.525 and a tolerance of 0.095. This variable was also removed. The tests were rerun and further, no significant multicollinearity was detected as all the variables presented a VIF score of less than 10, and a tolerance value of more than 0.1, indicating insignificant multicollinearity. 12 independent variables remained.

See Table 21 where a summary was made of the number of outliers, highly influential and highly leveraged points which were discussed below. 11 significant outliers were removed by the inspection of scatterplots and by applying professional judgement to these scatterplots. No significant outliers were detected by using the case wise diagnostics function in SPSS. No extreme outliers and residuals were removed as none were detected via the inspection of a combination of the extreme values (outlier) function and the normality box-plot in SPSS. Two highly leveraged and influential points were identified and removed. Even though some additional points remained which were situated above other points on the Cook's Distance vs Centred Leveraged Value graph, the combination of their Cook's and leverage rating would not have led to significant influence or leverage (See Appendix B) (IBM Corporation, n.d.).

The normal distribution of the residuals was ensured. This was confirmed by inspecting the histogram of the regression standardized residuals and by inspecting the normal P-P plot of regression standardized residuals. Further, the skewness and kurtosis value of the normal regression standardized, and unstandardized residuals both amounted to 0.055 and -0.220 respectively, which were less than ± 0.5, indicating approximate normal distribution. The Shapiro-Wilk test on both the standardized and unstandardized residuals further delivered a significance value above 0.05, indicating to the normality of residuals, p = .732. To further confirm the approximate normality of the residuals, the normal Q-Q plot and Box plot was inspected, where all indicated that the residuals were approximately normally distributed.

After performance of the tests discussed above, a final total of 85 datapoints out of the initial 143 datapoints were fit for testing purposes, as these met all eight of the multiple linear regression assumptions. The final stepwise multiple linear regression test followed in which all 85 datapoints were included. Please refer to the first section of Appendix B under Hypothesis 3 for all the IBM SPSS v25 outputs and other detail to support the results which were discussed above for each of the eight assumptions of multiple linear regression analysis.

5.4.3 Descriptive statistics

Table 22 provides a summary of the most important descriptive statistics derived from the final 85 datapoints which were produced from the normal multiple linear regression model after meeting the eight multiple linear regression assumptions. As part of the descriptive statistics, the Pearson correlation and its significance were included. 3 of the 12 financial ratios displayed statistically significant correlations with share price performance. A Pearson correlation however does not take into account the combined effect of the other financial ratios on the dependent variable when determining a correlation and therefore provides less concrete evidence when compared to performing a multiple regression model. Operating profit margin produced the most significant Pearson correlation with the percentage change in the share price.

Table 22

Descriptive statistics: Life Insurance

Variable	*M*	*SD*	*N*	*r*	*p*
Close	10.8234%	21.84553%	85	1.000	
Current Ratio	1.214342	0.8344178	85	-0.034	0.378
Debt / Assets	0.255254	0.2106740	85	-0.043	0.346
Debt / Equity	3.131715	3.7654204	85	-0.202	0.032
Dividend Yield %	3.906562	2.6981041	85	-0.177	0.053
Interest Cover	4.831219	26.5324308	85	0.065	0.278
Net Profit Margin %	11.520494	7.2078115	85	0.166	0.064
Operating Profit Margin %	-4.486348	20.7351526	85	0.269	0.006
Price / Book Value	2.290821	1.7345587	85	0.151	0.084
Price / Cash Flow	6.807238	3.5820210	85	0.190	0.041
Price / Earnings	12.135044	4.0472783	85	0.138	0.103
Return On Equity %	19.468082	12.2635786	85	0.148	0.088
Total Assets Turnover	0.270884	0.2296268	85	0.115	0.148

Note. Researcher produced. *M* = Mean, *SD* = Standard deviation, *N* = Population size, *r* = Pearson correlation, *p* = significance.

5.4.4 Stepwise multiple linear regression results

Table 23 provides a summary of the results of the automatic stepwise multiple linear regression performed in IBM SPSS v25. A stepwise multiple linear regression takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Some variables might therefore have statistically significant relationships with the dependent variable on an individual basis, but when added to the equation do not increase the adjusted coefficient of determination (adjusted R^2). These variables would therefore not be included as part of the multiple linear regression equation. The operating margin ratio provided in Table 23 was therefore the only ratio which after considering the effect of the other available ratios delivered the highest adjusted R^2 for the sector. The stepwise multiple linear regression was performed at the 95% confidence interval.

Table 23

Automatic stepwise regression results: Life Insurance

No.	Variable	β	*CSE*	*Beta*	*t*	*p*
	(Constant)	12.097	2.349		5.149	0.000
1	Operating Profit Margin %	0.284	0.111	0.269	2.548	0.013

Note. Researcher produced. β = Unstandardized coefficients beta, *CSE* = Unstandardized coefficient standard error, *Beta* = standardised coefficient beta, *t* = t - statistic, *p* = significance

The combined model achieved a coefficient of determination (R^2) value of 0.073 and an adjusted coefficient of determination (adjusted R^2) value of 0.061. 6.1% of the variation in share prices could therefore possibly be explained by the operating profit margin %. The analysis of variance (ANOVA) showed that the effect of the change in financial ratios was statistically significant on the share price performance at the 95% confidence level, $F(1,83) = 6.494$, $p = .013$.

Please refer to the second section of Appendix B under Hypothesis 3 for the relevant IBM SPSS v25 outputs and other detail to support the automatic stepwise multiple linear regression results discussed above.

5.4.5 Result

Based on the results discussed above, rejection of the null hypothesis and acceptance of the alternative hypothesis was appropriate.

- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the life insurance sector on the JSE.

5.5 Hypothesis 4: Real Estate Investment Trusts

Research question two (RQ1): Do statistical relationships exist between financial ratios and share price performance of the real estate investment trusts sector on the JSE?

- Null hypothesis two ($H_0$1): No significant statistical relationships exist between any financial ratios and the share price performance of the real estate investment trusts sector on the JSE.
- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the real estate investment trusts sector on the JSE.

5.5.1 Description of data obtained and cleaned

The full dataset from 1 January 1997 to 30 September 2018 for the ICB level 3 real estate investment trusts sector was obtained and cleaned for multiple linear regression purposes as displayed in Table 24.

Table 24

Data obtained for real estate investment trusts sector

Description	No. of datapoints
Number of Companies	57
Listed	44
Delisted	13
Initial datapoints	427
Incomplete datapoints missing data	66
Removal of single company datapoints	3
Removal of base period year as no comperative for % change	40
Final datapoints inserted into SPSS	318
Significant outliers detected via scatterplots removed	28
Casewise diagnostic outliers removed	2
Outliers and non-normally distributed residuals removed	4
Highly leveraged and influential points removed	0
Final datapoints included in results	284

Note. Researcher Produced. *Companies with only one period of results cannot be used for comparative purposes to determine percentage change in share price.

5.5.2 Multiple linear regression assumption results

All tests which followed were performed using a 95% confidence interval. The percentage change in share price, titled “Close”, which was the dependent variable was consistent and therefore the first assumption of multiple linear regression analysis which is from now on referred to as MLR was met. All 14 financial ratios as previously discussed were initially set as the dependent variable. Independence of observations were present, as a Durbin-Watson score of 2.124 was obtained. A linear relationship existed between the dependent variable (percentage change in share price) and the independent variables (financial ratios). This was confirmed through the inspection of scatterplots, partial regression plots and lastly the scatterplot of standardized residual values versus the standardized predicted values fitted with the Loess curve.

Initial multicollinearity was detected. Return on Assets % presented a VIF score of 30.892 and a tolerance score of 0.032 and was removed. Various other variables also presented substantial VIF and tolerance scores, but on each test only one variable was removed per test, after which the normal regression was rerun and inspected to determine the effect of the variable removal on multicollinearity. Debt to Equity presented a VIF score of 226.334 and tolerance score of 0.045 and was removed. After rerunning the multiple linear regression, Net Profit Margin % presented a VIF score of 11.188 and tolerance score of 0.080 and was removed. After this no VIF or tolerance scores above 10 or below 0.1 respectively were detected indicating that no multicollinearity remained. In total three variables were removed due to multicollinearity issues.

See Table 24 where a summary was made of the number of outliers, highly influential and highly leveraged points which were discussed below. 28 significant outliers were firstly removed by the inspection of scatterplots and by applying professional judgement to these scatterplots. Secondly, two outliers were removed by way of running and rerunning case wise diagnostics in the normal regression mode until no outliers were detected which were more than three standard deviations. Further, four extreme outliers and residuals were removed by detecting these with a combination of the extreme values (outlier) function and the normality box-plot in SPSS. No highly leveraged and influential points were identified or removed. Even though some additional points were noted which were situated above other points on the Cook's Distance vs Centred Leveraged Value graph, the combination of their Cook's and leverage rating would not have led to significant influence or leverage (See Appendix B) (IBM Corporation, n.d.).

The normal distribution of the residuals was ensured. This was confirmed by inspecting the histogram of the regression standardized residuals and by inspecting the normal P-P plot of regression standardized residuals. Further, the skewness and kurtosis value of the normal regression standardized, and unstandardized residuals both amounted to 0.268 and -0.181 respectively, which were less than ± 0.5, indicating approximate normal distribution. The Shapiro-Wilk test on both the standardized and unstandardized residuals delivered a significance value above 0.05 which further substantiated the normality of the regression model, $p = .083$. To further confirm the approximate normality of the residuals, the normal Q-Q plot and Box plot was inspected, where all indicated that the residuals were approximately normally distributed.

Homoscedasticity procedures

In terms of the fifth assumption of multiple linear regression testing, the data is required to be homoscedastic. If the data is not homoscedastic, then it is classified as heteroscedastic. Some of the data variables initially displayed heteroscedastic characteristics. When performing the Koenker test on all the input data, a significance score of below 0.05 was obtained, $p = .004$. To determine precisely which variable contained data which was heteroscedastic, the Koenker test was performed for each independent variable. Out of the remaining 11 variables, after the removal of variables with multicollinearity as discussed above, two of the variables namely dividend yield and debt to assets presented significance values of less than 0.05, indicating that heteroscedasticity was present, $p = .005$, $p = .029$.

According to Hair et al. (2010), heteroscedasticity could possibly be solved by transforming the affected data. When determining how to solve heteroscedastic data, the scatterplot should be inspected to determine if a cone shaped distribution exists. If the cone opens to the right side of the distribution, then the data should be transformed using the inverse. If the cone opens to the left side of the distribution, then a square root transformation is most appropriate (Hair et al., 2010). Debt to assets opened to the right side and therefore an inverse transformation was performed which improved the homoscedasticity of the data by delivering a significance value of more than 0.05, $p = .211$. The new inverse transformation variable created from the debt to assets ratio variable was titled INV_DA_3.

Dividend yield opened to the left side seeing that a great number of dividend yield ratios were situated on the 0% points, as no dividends were paid by most of the companies. A square root transformation was performed, but the heteroscedasticity of this transformed variable decreased as a lower significance value than previously calculated before transformation was obtained, $p = .003$. Power transformations were also attempted but even though this improved the significance value, it still did not deliver a significance value of more than 0.05 and therefore, a transformation was not performed, $p = .040$. Other possible transformations were investigated, as indicated by Hair et al. (2010), but these could not be executed due to the presence of zero values in the variable data.

Inverse transformations could not be performed as no values could be divided by zero without data errors. Logarithm transformation could also not be performed as the presence of zero values also provided data errors. Lastly, Hair et al. (2010) discussed the use of arcsin transformations which are best suited for the transformation of proportions. Even though this was not the best method to use for the data, it was attempted, but also delivered data errors as data with a value of greater than one, could not be transformed using the arcsin transformation. Seeing that transformations attempted did not improve the homoscedasticity of the data and the variable did not present a strong linear function in comparison with the dependent variable, it was seen best fit to remove the dividend yield variable. After the removal of the dividend yield variable and the transformation of the debt to assets variable, the Koenker test delivered a significance value of more than 0.05 and the data was deemed as homoscedastic, p = .166. Homoscedasticity was further confirmed through the inspection of the regression standardised residuals versus the regression standardized predicted value scatterplot which indicated that the data was homoscedastic.

After performance of the tests discussed above, a final total of 284 datapoints out of the initial 427 were fit for testing purposes, as these met all eight of the multiple linear regression assumptions. The final stepwise multiple linear regression test followed in which all 284 datapoints were included. Please refer to the first section of Appendix B under Hypothesis 4 for all the IBM SPSS v25 outputs and other detail to support the results which were discussed above for each of the eight assumptions of multiple linear regression analysis.

5.5.3 Descriptive statistics

Table 25 provides a summary of the most important descriptive statistics derived from the final 284 datapoints which were produced from the normal multiple linear regression model after meeting the eight multiple linear regression assumptions. As part of the descriptive statistics, the Pearson correlation and its significance were included. 6 of the 10 financial ratios displayed statistically significant correlations with share price performance. A Pearson correlation however does not take into account the combined effect of the other financial ratios when determining a correlation and therefore provides less concrete evidence when compared to performing a normal or stepwise multiple regression. Operating profit margin produced the most significant Pearson correlation with the percentage change in the share price.

Table 25

Descriptive statistics: Real Estate Investment Trusts

Variable	*M*	*SD*	*N*	*r*	*p*
Close %	7.2156%	22.18092%	284	1.000	
Current Ratio	0.805857	1.1464304	284	-0.105	0.038
Interest Cover	5.965767	12.2148352	284	0.142	0.008
Operating Profit Margin %	120.171258	75.2562836	284	0.442	0.000
Price / Book Value	2.369648	4.1070726	284	0.013	0.410
Price / Cash Flow	20.310443	101.5112897	284	0.077	0.099
Price / Earnings	13.328641	291.0270744	284	-0.019	0.378
Return On Capital	7.724882	6.8075295	284	0.373	0.000
Return On Equity %	15.596004	18.0946576	284	0.435	0.000
Total Assets Turnover	0.098065	0.0316571	284	0.114	0.027
INV_DA_3	3.0285	3.08662	284	0.015	0.403

Note. Researcher produced. *M* = Mean, *SD* = Standard deviation, *N* = Population size, *r* = Pearson correlation, *p* = significance. Operating Profit Margin produced the most significant Pearson correlation with the percentage change in share price. INV_DA_3 is the inverse transformation variable of the debt to asset ratio as discussed in section 5.5.2.

5.5.4 Stepwise multiple linear regression results

Table 26 provides a summary of the results of the automatic stepwise multiple linear regression performed in IBM SPSS v25. A stepwise multiple linear regression takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Some variables might therefore have statistically significant relationships with the dependent variable on an individual basis, but when added to the equation do not increase the adjusted coefficient of determination (adjusted R^2). These variables would therefore not be included as part of the multiple linear regression equation. The ratios provided in

Table 26 were therefore the ratios which in combination delivered the highest adjusted R^2 for the sector. The stepwise multiple linear regression was performed at the 95% confidence interval where these findings were displayed in order of the most significant financial ratios to the least significant. Operating profit margin delivered the most significant effect on the percentage change in the share price, where return on equity delivered the least significant.

Table 26

Automatic stepwise regression results: Real Estate Investment Trusts

No.	Variable	β	*CSE*	*Beta*	*t*	*p*
	(Constant)	-24.342	4.989		-4.879	0.000
1	Operating Profit Margin	0.115	0.021	0.391	5.396	0.000
2	Total Assets Turnover	147.025	39.521	0.210	3.720	0.000
3	Return On Equity %	0.210	0.086	0.171	2.450	0.015

Note. Researcher produced. β = Unstandardized coefficients beta, *CSE* = Unstandardized coefficient standard error, *Beta* = standardised coefficient beta, *t* = t - statistic, *p* = significance

The combined model achieved a coefficient of determination (R^2) value of 0.271 and an adjusted coefficient of determination (adjusted R^2) value of 0.263. 26.3% of the variation in share prices could therefore possibly be explained by the three financial ratios as indicated in Table 26. The analysis of variance (ANOVA) showed that the effect of the change in financial ratios was statistically significant on the share price performance at the 95% confidence level, $F(3,280) = 34.748$, $p = .000$.

Please refer to the second section of Appendix B under Hypothesis 4 for the relevant IBM SPSS v25 outputs and other detail to support the automatic stepwise multiple linear regression results discussed above.

5.5.5 Result

Based on the results discussed above, rejection of the null hypothesis and acceptance of the alternative hypothesis was appropriate.

- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the real estate investment trust sector on the JSE.

5.6 Hypothesis 5: Mobile Telecommunications

Research question two (RQ1): Do statistical relationships exist between financial ratios and share price performance of the mobile telecommunications sector on the JSE?

- Null hypothesis two ($H_0$1): No significant statistical relationships exist between any financial ratios and the share price performance of the mobile telecommunications sector on the JSE.
- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mobile telecommunications sector on the JSE.

5.6.1 Description of data obtained and cleaned

The full dataset from 1 January 1997 to 30 September 2018 for the ICB level 3 mobile telecommunications sector was obtained and cleaned for multiple linear regression purposes as displayed in Table 27.

Table 27

Data obtained for mobile telecommunications sector

Description	No. of datapoints
Number of Companies	6
Listed	4
Delisted	2
Initial datapoints	73
Incomplete datapoints missing data	4
Removal of base period year as no comperative for % change	5
Final datapoints inserted into SPSS	63
Significant outliers detected via scatterplots removed	9
Casewise diagnostic outliers removed	0
Outliers and non-normally distributed residuals removed	0
Highly leveraged and influential points removed	5
Final datapoints included in results	49

Note. Researcher Produced.

5.6.2 Multiple linear regression assumption results

All tests which followed were performed using a 95% confidence interval. The percentage change in share price, titled “Close”, which was the dependent variable was consistent and therefore the first assumption of multiple linear regression analysis which is from now on referred to as MLR was met. All 14 financial ratios as previously discussed were initially set as the dependent variable. Independence of observations were present, as a Durbin-Watson score of 1.665 was obtained. A linear relationship existed between the dependent variable (percentage change in share price) and the independent variables (financial ratios). This was confirmed through the inspection of scatterplots, partial regression plots and lastly the scatterplot of standardized residual values versus the standardized predicted values fitted with the Loess curve. The data was homoscedastic. This was confirmed through the inspection of the regression standardised residual versus the regression standardized predicted values scatterplot. Homoscedasticity was lastly confirmed through the inspection of the Koenker test where a significance value above 0.05 was obtained, $p = .259$.

Initial multicollinearity was detected. Return on Equity % presented a VIF score of 92.621 and a tolerance score of 0.011 and was removed. Various other variables also presented substantial VIF and tolerance scores, but on each test only one variable was removed per test, after which the normal regression was rerun and inspected to determine the effect of the variable removal on multicollinearity. Operating Profit Margin % presented a VIF score of 26.811 and tolerance score of 0.037 and was removed. After rerunning the multiple linear regression, price-to-book value presented a VIF score of 13.764 and tolerance score of 0.073 and was removed. After this no VIF or tolerance scores above 10 or below 0.1 respectively were detected until the removal of highly leveraged and influential points occurred, after which Net Profit Margin % presented a VIF score of 12.370 and a VIF score of 0.081. This variable was lastly removed after which no more significant multicollinearity remained. In total four variables were removed, and 10 variables remained.

See Table 27 where a summary was made of the number of outliers, highly influential and highly leveraged points which were discussed below. Nine significant outliers were firstly removed by the inspection of scatterplots and by applying professional judgement to these scatterplots. No outliers were detected via performing case wise diagnostics. Five highly leveraged and influential points were identified and removed. Even though some additional points remained which were situated above other points on the Cook's Distance vs Centred Leveraged Value graph, the combination of their Cook's and leverage rating would not have led to significant influence or leverage (See Appendix B) (IBM Corporation, n.d.).

Lastly, the normal distribution of the residuals was ensured. This was confirmed by inspecting the histogram of the regression standardized residuals and by inspecting the normal P-P plot of regression standardized residuals. Further, the skewness and kurtosis value of the normal regression standardized, and unstandardized residuals both amounted to 0.163 and -0.519 respectively. Even though the kurtosis values were just above the ± 0.5 rule of thumb, the Shapiro-Wilk test on both the standardized and unstandardized residuals delivered a substantial significance value above 0.05, which indicates that the residuals were normally distributed, $p = .529$. To further confirm the approximate normality of the residuals, the normal Q-Q plot and Box plot was inspected, where all indicated that the residuals were approximately normally distributed.

After performance of the tests discussed above, a final total of 49 datapoints out of the initial 73 were fit for testing purposes, as these met all eight of the multiple linear regression assumptions. The final stepwise multiple linear regression test followed in which all 49 datapoints were included. Please refer to the first section of Appendix B under Hypothesis 5 for all the IBM SPSS v25 outputs and other detail to support the results which were discussed above for each of the eight assumptions of multiple linear regression analysis.

5.6.3 Descriptive statistics

Table 28 provides a summary of the most important descriptive statistics derived from the final 49 datapoints which were produced from the normal multiple linear regression model after meeting the eight multiple linear regression assumptions. As part of the descriptive statistics, the Pearson correlation and its significance were included. 3 of the 10 financial ratio displayed statistically significant correlations with share price performance. A Pearson correlation however does not take into account the combined effect of the other financial ratios when determining a correlation and therefore provides less concrete evidence when compared to performing a normal or stepwise multiple regression. The return on assets ratio produced the most significant Pearson correlation with the percentage change in the share price.

Table 28

Descriptive statistics: Mobile Telecommunications

Variable	*M*	*SD*	*N*	*r*	*p*
Close	12.8246%	37.26224%	49	1.000	
Current Ratio	1.344133	0.4920879	49	0.053	0.358
Debt / Assets	0.562771	0.1298834	49	-0.278	0.027
Debt / Equity	0.901139	0.4561634	49	-0.100	0.248
Dividend Yield %	3.250351	2.5699368	49	-0.320	0.013
Interest Cover	15.922035	28.7304561	49	0.098	0.252
Price / Cash Flow	10.020029	5.2700417	49	0.232	0.055
Price / Earnings	15.546969	8.4435524	49	0.157	0.140
Return On Assets %	21.740449	9.3118580	49	0.450	0.001
Return On Capital Employed %	16.704065	9.9419542	49	0.230	0.056
Total Assets Turnover	1.967129	1.1673438	49	-0.006	0.484

Note. Researcher produced. *M* = Mean, *SD* = Standard deviation, *N* = Population size, *r* = Pearson correlation, *p* = significance.

5.6.4 Stepwise multiple linear regression results

Table 29 provides a summary of the results of the automatic stepwise multiple linear regression performed in IBM SPSS v25. A stepwise multiple linear regression takes the effect of all variables entered into account to find the model, from multiple combinations, with the most explanatory power (George & Mallery, 2019; Hair et al., 2010). Some variables might therefore have statistically significant relationships with the dependent variable on an individual basis, but when added to the equation do not increase the adjusted coefficient of determination (adjusted R^2). These variables would therefore not be included as part of the multiple linear regression equation. The ratios provided in Table 29 were therefore the ratios which in combination delivered the highest adjusted R^2 for the sector. The stepwise multiple linear regression was performed at the 95% confidence interval where these findings were displayed in order of the most significant financial ratios to the least significant. Return on assets delivered the most significant effect on the percentage change in the share price, where the debt to assets ratio delivered the least significant.

Table 29

Automatic stepwise regression results: Mobile Telecommunications

No.	Variable	β	*CSE*	*Beta*	*t*	*p*
	(Constant)	29.325	20.664		1.419	0.163
1	Return On Assets %	2.090	0.456	0.522	4.583	0.000
2	Dividend Yield %	-5.341	1.657	-0.368	-3.224	0.002
3	Debt / Assets	-79.215	32.508	-0.276	-2.437	0.019

Note. Researcher produced. β = Unstandardized coefficients beta, *CSE* = Unstandardized coefficient standard error, *Beta* = standardised coefficient beta, *t* = t - statistic, *p* = significance.

The combined model achieved a coefficient of determination (R^2) value of 0.43 and an adjusted coefficient of determination (adjusted R^2) value of 0.392. 39.2% of the variation in share prices could therefore possibly be explained by the three financial ratios as indicated in Table 29. The analysis of variance (ANOVA) showed that the effect of the change in financial ratios was statistically significant on the share price performance at the 95% confidence level, $F(3,45) = 11.295$, $p = .000$.

Please refer to the second section of Appendix B under Hypothesis 5 for the relevant IBM SPSS v25 outputs and other detail to support the automatic stepwise multiple linear regression results discussed above.

5.6.5 Result

Based on the results discussed above, rejection of the null hypothesis and acceptance of the alternative hypothesis was appropriate.

- Alternate hypothesis two ($H_1$1): Significant statistical relationships exist between at least one or more financial ratios and the share price performance of the mobile telecommunications sector on the JSE.

5.7 Summary of results

Table 30 provides a summary of the stepwise multiple regression results for each of the five hypotheses tested. First the overall outcome of either the acceptance or rejection of the nul hypothesis was presented. The coefficient of determination (R^2) and adjusted coefficient of determination (adjusted R^2) was then provided. The most significant financial ratios which had a statistically significant relationship with the percentage change in the share price was then provided in order of beta weight and significance value. Mobile telecommunications had the highest adjusted coefficient of determination out of all five sectors tested which indicates that the highest variation in percentage change in share prices could be explained by financial ratios in this sector.

Table 30

Summary of stepwise multiple linear regression results

Hypothesis	Sector	Outcome	R^2	*Adjusted* R^2	Ratios	*Beta*	*p*
1	Mining	Reject H_{01}	0.234	0.225	Return on Equity %	0.419	0.000
					Price / Book Value	0.247	0.000
					Debt / Equity	0.199	0.000
					Dividend Yield %	-0.163	0.000
					Debt / Assets	-0.124	0.004
					Total Asset Turnover	0.100	0.019
2	Banking	Reject H_{02}	0.196	0.181	Price / Earnings	0.372	0.000
					Return on Equity %	0.204	0.022
3	Life Insurance	Reject H_{03}	0.073	0.061	Operating Profit Margin %	0.269	0.013
4	Real Estate Investment Trusts	Reject H_{04}	0.271	0.263	Operating Profit Margin %	0.391	0.000
					Total Assets Turnover	0.210	0.000
					Return On Equity %	0.171	0.015
5	Mobile Telecommunications	Reject H_{05}	0.430	0.392	Return On Assets %	0.522	0.000
					Dividend Yield %	-0.368	0.002
					Debt / Assets	-0.276	0.019

Note. Researcher produced. R^2 = coefficient of determination, *Adjusted* R^2 = adjusted coefficient of determination, *Beta* = standardised coefficient beta, *p* = significance.

CHAPTER 6 DISCUSSION OF RESULTS

6.1 Introduction

This chapter provides a discussion of the results as presented in Chapter 5 per hypothesis as documented in Chapter 3. The discussion links the results with the literature, theories and results obtained by other researchers as documented in Chapters 1 and 2. The aim of this research was to determine if statistically significant relationships exist between financial ratios and share price performance of the top five sectors on the Johannesburg Stock Exchange (JSE), based on market capitalisation. These were the mining, banking, life insurance, real estate investment trust and mobile telecommunication sectors.

The aim of the research was met as each of the five sectors contained the appropriate data to perform multiple linear regression analysis. The research was performed using 14 of the most commonly and documented financial ratios, as determined by academic literature, of which 10 were financial accounting ratios and four price-to-fundamental ratios. Further, this research was performed on both listed and delisted companies on an annual basis, over a period of 20 years (1997 – 2018).

6.2 Hypothesis 1: Mining

The research objective as set out for the mining sector was met as linear stepwise multiple regression analysis was performed on 502 datapoints, after ensuring all eight-multiple regression assumptions were satisfied. It was determined that the return on equity (ROE), price-to-book (P/B), debt to equity (D/E), dividend yield (DY), debt to assets (D/A) and total asset turnover had statistically significant relationships with the percentage change in share prices of the mining sector. The six ratios are discussed in order of significance (lowest to highest) and beta weight (highest to lowest absolute beta weight). The adjusted coefficient of determination of 0.225 indicates that 22.5% of the variation in share prices could possibly be explained by the change in the six financial ratios.

The return on equity ratio (ROE) obtained the highest positive standardised coefficient beta of 0.419. A positive relationship is in line with literature reviewed, as higher returns on invested equity indicate that higher profitability and operating efficiency was achieved (Akbas, Jiang & Koch, 2017; Hou, Xue, & Zhang, 2015; Mohanram, Saiy and Vyas, 2018; Muller & Ward, 2013). Further, when referring to the DuPont analysis, based on the ROE equation, various investors would rely on this metric individually, and further in its broken-up components namely, profit margin, asset turnover and financial leverage to obtain a view of an organisations financial performance and health before investing (Jin, 2017; Skae et al., 2012). A higher ratio would therefore indicate greater financial performance and health.

As indicated by Asness, Frazzini and Pedersen (2017), who used ROE as a profit measure, more profitable companies are expected to achieve higher stock prices. Cordis (2014) found that the return on shares (movement in share price) was directly linked to three factors, of which one factor was the ROE. Ramkillawan (2014) found a significant positive correlation between the return on equity and the average stock returns of the Top 40 index of the JSE. A positive relationship between ROE and share price performance is further in-line with the results obtained by Ma and Truong (2015) where the most significant financial ratios of two of the five sectors tested was ROE. The research finding was lastly also in line with Arkan (2016), which found a significant positive relationship between ROE and the share prices of each of the three sectors tested.

The price-to-book ratio (P/B) was second in line with a positive standardized coefficient beta of 0.247. As discussed in section 2.3, when applying value investing principles, investors would be more inclined to purchase shares with low price-to-fundamental ratios, especially those with low P/B ratios, as they want to obtain these shares for a relatively inexpensive price compared to the book value (Athanassakos, 2012; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010; Zhang, 2013). On the other end, if growth investors are investing, companies with high P/B ratios will normally be purchased as substantial recent share price growth was achieved or future growth expectations exist for these companies (Athanassakos, 2012; Bunting & Barnard, 2015; Chen, 2018; Hou, Xue & Zhang, 2015; Li & Mohanram, 2018; Mohanram, 2005; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010; Zhang, 2013). Based on the above, a stronger growth investing trend appears to have been present in the mining sector, where shares with higher P/B ratios achieved higher share prices. A similar finding was made by Arkan (2016), where a significant positive relationship was found between the market-to-book ratio (similar to P/B) and share prices in each of the three sectors tested, namely the industrial, services and investments sectors.

Debt to equity (D/E) had the third highest positive standardized beta weight of 0.199. Investors in the mining sector therefore appears to prefer companies with relatively higher debt compared to equity. This could be as some argue that leveraging a company with more debt compared to equity is cheaper for some organisations due to the tax deductions obtained from interest incurred (Skae et al., 2012). Investors and organisations might also prefer a company taking on more debt compared to equity as additional equity financing would lead to a reduction in control (Skae et al., 2012). This is further corroborated by Lewis and Tan (2016), which found that when equity is issued by companies with optimistic long-term growth projections, in comparison with debt, that lower returns were obtained by these equity investors at the following earning announcements when compared to debt issuers. This indicates that some investors would be more inclined for a company to take on debt if possible and does not lead to significant increased risk, compared to equity. Similar findings were made by Arkan (2016) which found that a positive significant relationship exists between the debt to equity ratio and the share price performance of companies in the industrial sector of the Kuwait financial markets.

Dividend yield was the fourth financial ratio with a negative standardized beta weight of -0.163. As discussed in section 2.4, growth stocks normally tend to have low dividend yields, compared to value stocks which normally have higher dividend yields (Conover, Jensen & Simpson, 2016). This is as growth investors prefer the reinvestment of funds and cash flows made by the organisation in order to obtain higher capital gains when the shares are sold, instead of taking a dividend (Chen, 2018; Conover, Jensen & Simpson, 2016). A growth investing trend therefore appears to be present in the mining sector, which is further substantiated by the positive standardized coefficient beta obtained by the price-to-book ratio discussed above.

Debt to asset (D/A) was the fifth financial ratio and obtained a negative standardized coefficient beta of -0.124. This indicates that investors in the mining sector prefer to invest in companies with more assets compared to debt. This finding is substantiated by Piotroski (2000), Chen, Lee and Shih (2016) and related F-score studies which stated that an increase in the debt to asset ratio indicates the inability of a company to generate internal funds through the assets held, which would indicate that a lower debt to asset ratio is beneficial for investors (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). This is further in line with Yazdanfar and Öhman (2015) who found that a company's profitability was negatively affected by a higher debt to asset ratio. Lastly, lower debt to assets would decrease potential losses if a company was to be liquidated as funds would be able to be generated from the sale of the assets, decreasing the risk of potential losses for investors (Skae et al., 2012).

The final ratio with a positive standardized coefficient beta of 0.100 was total asset turnover. The positive relationship between total asset turnover and share price performance is in line with literature reviewed, as a higher total asset turnover indicates that assets are used more productively to generate turnover (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Delen, Kuzey and Uyar, 2013; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Skae et al., 2012; Turtle & Wang, 2017). This finding was also in line with that of Vedd and Yassinski (2015) which found a strong relationship between the asset turnover ratio and the share prices of companies in Brazil, Chile and Mexico in the industrial sector. A significant positive relationship was lastly found by Arkan (2016) between the fixed asset turnover ratio of companies in the industrial sector of the Kuwait financial markets and their share price performance, which further supports the research findings.

6.3 Hypothesis 2: Banking

The research objective as set out for the banking sector was met as linear stepwise multiple regression analysis was performed on 109 datapoints, after ensuring all eight-multiple regression assumptions were satisfied. It was determined that the price-earnings (P/E) and return on equity (ROE) ratio had statistically significant relationships with the percentage change in share prices of the banking sector. The two ratios are discussed in order of significance (lowest to highest) and beta weight (highest to lowest absolute beta weight). The adjusted coefficient of determination of 0.181 indicates that 18.1% of the variation in share prices could possibly be explained by the change in the two financial ratios.

The price-earnings ratio (P/E) obtained the highest positive standardised coefficient beta of 0.372. As discussed in section 2.3, when applying value investing principles, investors would be more inclined to purchase shares with low P/E ratios, as they want to obtain these shares for a relatively inexpensive price compared to the earnings (Athanassakos, 2012; Muller & Ward, 2013; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010). On the other end, if growth investors are investing, companies with high P/E ratios will normally be purchased as substantial recent share price growth was achieved or future growth expectations exist for these companies (Athanassakos, 2012; Muller & Ward, 2013; Penman & Reggiani, 2018; Richardson, Tuna & Wysocki, 2010). Based on the above, a stronger growth investing trend appears to have been present in the banking sector, where shares with higher P/E ratios achieved higher share prices compared to those with lower P/E ratios.

The second and final ratio was the return on equity (ROE), which obtained a positive standardised coefficient beta of 0.204. A positive relationship is in line with literature reviewed, as higher returns on invested equity indicate that higher profitability and operating efficiency was achieved (Akbas, Jiang & Koch, 2017; Hou, Xue, & Zhang, 2015; Muller & Ward, 2013). Further, when referring to the DuPont analysis, based on the ROE equation, various investors would rely on this metric individually, and further in its broken-up components namely, profit margin, asset turnover and financial leverage to obtain a view of an organisations financial performance and health before investing (Jin, 2017; Skae et al., 2012). A higher ratio would therefore indicate greater financial performance and health.

As indicated by Asness, Frazzini and Pedersen (2017), who used ROE as a profit measure, more profitable companies are expected to achieve higher stock prices. Cordis (2014) found that the return on shares (movement in share price) was directly linked to three factors, of which one factor was the ROE. Ramkillawan (2014) found a significant positive correlation between the return on equity and the average stock returns of the Top 40 index of the JSE. A positive relationship between ROE and share price performance is further in-line with the results obtained by Ma and Truong (2015) where the most significant financial ratios of two of the five sectors tested was ROE. The research finding was also in line with Arkan (2016), which found a significant positive relationship between ROE and the share prices of each of the three sectors tested. When referring to the banking sector specifically, Mohanram, Saiy and Vyas (2018) indicated that the ROE has been the main performance ratio used in the banking industry as it has been widely used by investors, bank managers and other market participants. The findings therefore support this statement in the South African context where the ROE also delivered valuable relationships with share price performance in the banking sector.

6.4 Hypothesis 3: Life Insurance

The research objective as set out for the life insurance sector was met as linear stepwise multiple regression analysis was performed on 85 datapoints, after ensuring all eight-multiple regression assumptions were satisfied. It was determined that the operating profit margin had a statistically significant relationship with the percentage change in share prices of the life insurance sector. The adjusted coefficient of determination of 0.061 indicates that 6.1% of the variation in share prices could possibly be explained by the change in the operating profit margin, indicating that other factors could also have been present affecting share price performance.

The operating profit margin obtained a positive standardised coefficient beta of 0.269. Ball, Gerakos, Linnainmaa, and Nikolaev (2015) argued that the most appropriate measure of organisational profitability is the operating profit. Akbas, Jiang and Koch (2017) found that a company's profitability predicts stock returns and also future profitability. Bunting and Barnard (2015) which used the operating profit margin in their F-Score study, instead of the gross profit margin as used in the Piotroski (2000) F-score study, found that statistically significant positive relationships existed between financial ratios and equity returns. A positive relationship between the operating profit margin and share price performance is therefore supported.

6.5 Hypothesis 4: Real Estate Investment Trusts

The research objective as set out for the real estate investment trusts sector was met as linear stepwise multiple regression analysis was performed on 284 datapoints, after ensuring all eight-multiple regression assumptions were satisfied. It was determined that the operating profit margin, total asset turnover and return on equity (ROE) ratio had statistically significant relationships with the percentage change in share prices of the real estate investment trusts sector. The three ratios are discussed in order of significance (lowest to highest) and beta weight (highest to lowest absolute beta weight). The adjusted coefficient of determination of 0.263 indicates that 26.3% of the variation in share prices could possibly be explained by the change in the two financial ratios.

Firstly, operating profit margin obtained a positive standardised coefficient beta of 0.391. Ball, Gerakos, Linnainmaa, and Nikolaev (2015) argued that the most appropriate measure of organisational profitability is the operating profit. Akbas, Jiang and Koch (2017) found that a company's profitability predicts stock returns and also future profitability. Bunting and Barnard (2015) which used the operating profit margin in their F-Score study, instead of the gross profit margin as used in the Piotroski (2000) F-score study, found that statistically significant positive relationships existed between financial ratios and equity returns. A positive relationship between the operating profit margin and share price performance is therefore supported.

The second ratio with a positive standardized coefficient beta of 0.210 is total asset turnover. The positive relationship between total asset turnover and share price performance is in line with literature reviewed, as a higher total asset turnover indicates that assets are used more productively to generate turnover (Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Delen, Kuzey and Uyar, 2013; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Skae et al., 2012; Turtle & Wang, 2017). This finding was also in line with that of Vedd and Yassinski (2015) which found a strong relationship between the asset turnover ratio and the share prices of companies in Brazil, Chile and Mexico in the industrial sector. Lastly, Arkan (2016) found a significant positive relationship between the fixed asset turnover ratio and share price performance in the industrial sector of the Kuwait financial markets which supports the research finding.

Lastly, the return on equity ratio (ROE) obtained a positive standardised coefficient beta of 0.171. A positive relationship is in line with literature reviewed, as higher returns on invested equity indicate that higher profitability and operating efficiency was achieved (Akbas, Jiang & Koch, 2017; Hou, Xue, & Zhang, 2015; Mohanram, Saiy and Vyas, 2018; Muller & Ward, 2013). Further, when referring to the DuPont analysis, based on the ROE equation, various investors would rely on this metric individually, and further in its broken-up components namely, profit margin, asset turnover and financial leverage to obtain a view of an organisations financial performance and health before investing (Jin, 2017; Skae et al., 2012). A higher ratio would therefore indicate greater financial performance and health.

As indicated by Asness, Frazzini and Pedersen (2017), who used ROE as a profit measure, more profitable companies are expected to achieve higher stock prices. Cordis (2014) found that the return on shares (movement in share price) was directly linked to three factors, of which one factor was the ROE. Ramkillawan (2014) found a significant positive correlation between the return on equity and the average stock returns of the Top 40 index of the JSE. A positive relationship between ROE and share price performance is further in-line with the results obtained by Ma and Truong (2015) where the most significant financial ratios of two of the five sectors tested was ROE. A significant positive relationship was lastly found by Arkan (2016) between the fixed asset turnover ratio of companies in the industrial sector of the Kuwait financial markets and their share price performance, which further supports the research findings.

6.6 Hypothesis 5: Mobile Telecommunications

The research objective as set out for the mobile telecommunications sector was met as linear stepwise multiple regression analysis was performed on 49 datapoints, after ensuring all eight-multiple regression assumptions were satisfied. It was determined that the return on assets (ROA), dividend yield (DY) and the debt to asset (DA) ratio had statistically significant relationships with the percentage change in share prices of the real estate investment sector. The three ratios are discussed in order of significance (lowest to highest) and beta weight (highest to lowest absolute beta weight). This sector had an adjusted coefficient of determination of 0.392, which is the highest when compared to the other four sectors. This indicates that 39.2% of the variation in share prices could possibly be explained by the change in the three financial ratios.

The return on assets (ROA) obtained the highest positive standardised coefficient beta of 0.522. A positive relationship is in line with literature reviewed, as higher returns on assets indicate higher profitability was achieved (Akbas, Jiang & Koch, 2017; Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Mohanram, 2005; Mohanram, Saiy and Vyas, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). Further, when referring to the DuPont analysis, based on the ROA equation, various investors would rely on this metric individually, and further in its broken-up components namely, profit margin, asset turnover to obtain a view of an organisations financial performance and health before investing (Skae et al., 2012). A higher ratio would therefore indicate greater financial performance and health. The results further deliver similar insights, as those obtained from Light, Maslov & Rytchkov (2017), who found the ROA, as a profitably measure, to deliver significant stock returns. As indicated by Asness, Frazzini and Pedersen (2017), who used ROA as a profit measure, more profitable companies are expected to achieve higher stock prices. The research finding was lastly also in line with Arkan (2016), which found a significant positive relationship between ROA and the share prices of each of the three sectors tested.

The second ratio with a negative standardized coefficient beta of 0.368 was dividend yield (DY). As discussed in section 2.4, growth stocks normally tend to have low dividend yields, compared to value stocks which normally have higher dividend yields (Conover, Jensen & Simpson, 2016). This is as growth investors prefer the reinvestment of funds and cash flows made by the organisation in order to obtain higher capital gains when the shares are sold, instead of taking a dividend (Chen, 2018; Conover, Jensen & Simpson, 2016). A growth investing trend therefore appears to be present in the mobile telecommunications sector as shares with lower DY ratios obtain higher share prices.

Lastly, the debt to asset ratio obtained a negative standardised coefficient beta of 0.276. This indicates that investors in the mining sector prefer to invest in companies with more assets compared to debt. This finding is substantiated by Piotroski (2000), Chen, Lee and Shih (2016) and related F-score studies which stated that an increase in the debt to asset ratio indicates the inability of a company to generate internal funds through the assets held, which would indicate that a lower debt to asset ratio is beneficial for investors

(Bunting & Barnard, 2015; Chen, Lee & Shih, 2016; Li & Mohanram, 2018; Piotroski, 2000; Piotroski & So, 2012; Safdar, 2016; Turtle & Wang, 2017). This is further in line with Yazdanfar and Öhman (2015) who found that a company's profitability was negatively affected by a higher debt to asset ratio. Lastly, lower debt to assets would decrease potential losses if a company was to be liquidated as funds would be able to be generated from the sale of the assets, decreasing the risk of potential losses for investors (Skae et al., 2012).

6.7 Summary of findings

When analysing the above hypotheses and their results in combination, three summarised findings were drawn of which each linked back to the initial three problems as stated in chapter one, which in combination formed the research aim.

6.7.1 Financial ratio specific

The first finding relates to the first of the three research problems, incorporated into the research aim. The first problem was that an abundance of financial ratios, financial ratio-based evaluation models, and financial variables existed in the academic literature where a lack of general consensus was found regarding the most important financial ratios. From the results, no more than six financial ratios presented statistically significant relationships with share price performance in any of the sectors researched, where most of the sectors presented three or less significant financial ratios. This therefore firstly indicates that a multitude of general financial ratios, as some researchers have done, do not have to be analysed in order to deliver some value, but that sufficient value lies in analysing and understanding a smaller number of appropriate financial ratios.

Further, even though the coefficients of determination (R^2) varied between the different sectors, in general, no sector achieved an exceptionally high coefficient of determination (R^2). Financial ratios therefore appear to only make up a portion of the factors which affect share price performance, where various other factors could potentially play a role. For example, in the sector-based research performed by Ma and Truong (2015) on the Swedish OMX stock exchange, it was found that even though financial ratios influenced share price performance, that this effect was marginal when compared to long-term macroeconomic trends. Therefore, even though analysing a smaller number of appropriate and specific financial ratios provides value, financial ratios should not be analysed in isolation without considering other relevant factors and context in the market.

6.7.2 Country specific

The second finding relates to the second of the three research problems, incorporated into the research aim. It was determined that the South African JSE stock market displays unique characteristics in some instances when compared to the findings obtained from developed and other emerging markets. An example was where the mining and mobile communications sectors reported a negative relationship between dividend yield and the percentage change in the share price, where other researchers found that a positive dividend yield predicts excess stock returns (Ang & Bekaert, 2006; Lewellen, 2004) and that a positive relationship existed between the dividend yield and share price performance in developed markets (Ma & Truong, 2015).

Similarly, in three of the five sectors tested, the return on equity delivered a positive relationship with share price performance. Vedd and Yassinski (2015) in contrast found that the ROE did not have a significant relationship with share price performance when analysing the companies in the industrial sector of Brazil, Chile and Mexico. This finding therefore delivers evidence that some of the findings and subsequent models developed from other markets might not be applicable in the South African market context and therefore should be used with caution.

6.7.3 Sector specific

The third principal finding relates to the last of the three research problems incorporated into the research aim. It was found that the most important financial ratios for the five sectors differed as they all displayed a unique combination and varying number of statistically significant financial ratios with differing adjusted coefficients of determination and also different beta weights for each ratio. This is in line with Yan and Zheng (2017) who argued that the most important ratios for different industries/sectors are industry specific.

The life insurance sector obtained the lowest adjusted coefficient of determination (R^2) of 6.1%, with the operating profit margin having the only significant relationship with share price performance. The mobile telecommunications sector obtained the highest adjusted coefficient of determination (R^2) of 39.2 %, with three financial ratios showing statistically significant relationships with share price performance. This indicates that the relationship between financial ratios and share price performance are not as significant in some sectors as in others. It is therefore very important to understand the related sectors which are operated or invested in to truly gain the most from financial ratio analysis in addition to understanding the South African market in totality.

Some good contrasts, found in the South African context, which demonstrates the importance of analysing a market on a sector basis follow. Gupta and Modise (2012) found no evidence of short-term or long-term predictability in share price performance existed when applying the DY and the P/E ratio to South African companies as a whole. Further, Morar (2014) found the P/B ratio to show no correlation and DY to show some, but very weak correlations to share price performance, when applied to BRICS country companies, with the majority being South African. Lastly, Muller and Ward (2013) found that of the Top 160 companies based on market capitalisation in totality, that those with a higher dividend yield delivered increased returns when compared to those with a lower dividend yield.

The results of the research performed for the individual mining and mobile telecommunications sectors however differed from the above JSE studies as statistically significant relationships were found between the P/E, P/B and DY ratio in the two sectors mentioned. Further, the negative relationship of the DY and share price performance found in the mining and mobile telecommunication sectors were opposite to that of Muller and Ward (2013), which found that a higher dividend yield delivered increased returns on the JSE in totality. It can therefore be concluded that a blanket rule of the most important financial ratios with regards to share price performance in the South African context cannot be applied to the stock market as a whole but should rather be applied on a sector basis to derive more value and insight.

CHAPTER 7 CONCLUSION

The results of the research in terms of the research questions, related literature and theory was discussed in the previous chapter. In this chapter, the principal findings of the research and the related implications for management is discussed. This is followed by the limitations incurred during the data analysis approach, subsequent to the initial limitations discussed in section 4.10. Lastly suggestions for future research was provided.

7.1 Introduction

The aim of this research was to determine if statistical relationships exist between financial ratios and share price performance of the top five sectors on the JSE, based on market capitalisation. This aim was formulated in response to a combination of three problems which were noted from academic literature.

The first was that an abundance of financial ratios, financial ratio-based evaluation models and financial variables existed in the academic literature where a lack of general consensus was found regarding the most important financial ratios. Delen, Kuzey and Uyar (2013) stated that when searching for literature regarding the use of financial ratios to evaluate firm performance, that thousands of publications were available, where each study tried to differentiate themselves by way of developing a different set of financial ratios. Delen, Kuzey and Uyar (2013) further commented that “there is no universally agreed-upon list regarding the type, calculation methods and number of financial ratios used in earlier studies” (p. 3971). Consequently, this led to amateur investors and business managers with less technical financial knowledge in some instances, resorting to applying and analysing a multitude of financial ratios and models in a hopeful attempt to cover the most important. Business and finance students, after receiving lists of available financial ratios and financial ratio-based evaluation models, had to figure out which specific ones were of most importance in their specific current or future fields of practice.

The second problem which arose, was the lack of South African specific financial ratio studies performed. This was seen as a problem, as the majority of the financial related research had been performed on the United States and other developed markets (Bunting & Barnard, 2015; Konku, Rayhorn & Yao, 2018). Bunting and Barnard (2015) argued that various differences exist between the U.S. equity markets when compared to South Africa and that these differences provided evidence to question the transportability of internationally developed models to the South African market. Further, Konku, Rayhorn, and Yao (2018) argued that even though emerging market research had been gaining significant growth, that the emerging market research mainly focussed on Brazil, Russia, India and China. The attention was however turning to smaller emerging economics like South Africa, due to the desire of diversification by developed country investors and the potential for higher returns (Konku, Rayhorn & Yao, 2018). The authors lastly argued that the research on African markets were not as abundant as those of other emerging markets.

The third problem noted was that even though some South African specific financial ratio and share return related studies have been performed, that those identified by the researcher have been performed under a different lens. None of these focussed on the different sectors present on the Johannesburg Stock Exchange in isolation. This lack of South African sector-based research was determined to be a problem, as the most important financial ratios are industry specific (Yan & Zheng, 2017).

In order to achieve this aim, the ICB level three sectors on the JSE and their respective contents were analysed, after which 37 ICB level three sectors contained companies within. A detailed analysis process of the top sectors based on market capitalisation was followed as documented in section 4.3, after which the mining, banking, life insurance, real estate investment trust and mobile telecommunications sectors were selected. 14 financial ratios were used in the multiple linear regression analysis which were derived from a combination of the most prominent academic literature. These selections included 10 financial accounting ratios from the liquidity, solvency, profitability, operating efficiency and asset utilization or turnover ratio classifications. Further, four price-to-fundamental ratios were also included. To ensure the comprehensiveness of the research, a 20-year analysis period from 1997 to 2018 was applied.

7.2 Principal findings

The below findings were drawn from the summary of findings documented in chapter 6, where each of the three principal findings addressed each of the three research problems, which in combination formed the research aim. These findings in their respective classifications further provided evidence for the management recommendations in section 7.3.

7.2.1 Financial ratio specific

Analysing a multitude of general financial ratios, as some researchers have done, is not needed in order to deliver some value, as sufficient value could be obtained from analysing and understanding a smaller number of appropriate and focussed financial ratios. Further, even though the relationships between financial ratios and share price performance vary in the five sectors tested, financial ratios appear to only make up a portion of the factors which affect share price performance, which indicates that various other factors could potentially play a role.

7.2.2 Country specific

The South African JSE stock market displays unique characteristics in some instances when compared to developed and other emerging markets. Models and findings based on other country's data might therefore not be applicable or replicable in the South African market context and therefore should be used with caution.

7.2.3 Sector specific

The most important financial ratios for each the five sectors differed as they all displayed a unique combination and varying number of statistically significant financial ratios, with differing adjusted coefficients of determinations and beta weights for each ratio. This provides evidence that the relationships between financial ratios and share price performance varies in each sector, and that the most important ratios for different sectors are sector specific.

The results of some of these sectors individually further delivered unique relationships in contrast with those found by other research performed on the JSE in totality. This further emphasises the importance of not relying on generalised findings obtained from analysing the JSE on a holistic basis, but by understanding each sector on a deeper, individual basis.

7.3 Implications for management

7.3.1 Financial ratio specific

Based on the first principal finding made, management is recommended to focus on uncovering and subsequently analysing a few extremely important financial ratios and other related factors, which are applicable to the share price of their organisations, instead of analysing a multitude of general financial ratios in isolation without considering other related factors. Skae et al. (2012) advises any financial statement users who are analysing a company to understand local and international occurrences in the political and economic space in addition to financial ratio analysis, as this could affect the company being evaluated. Seeing that South Africa is part of the global economy, South African companies might be affected by any macroeconomic changes which occur, both globally and in South Africa (Skae et al., 2012).

This is substantiated by Herbst (2017) which found that from a South African macroeconomic perspective, that factors such as exchange rate volatility, debt rates, GDP growth rates and inflation rates affected the JSE market performance. This focussed and comprehensive approach will ensure that company resources are used more effectively to obtain the greatest and most valuable insights. This is applicable to management when seeking to drive share price performance, as well as investors when analysing organisations for investment purposes.

7.3.2 Country specific

Seeing that the South African equity markets deliver unique results in certain instances, when compared to those obtained by developed and other emerging markets, it is important for managers who are seeking to drive share price performance and also for investors, not to place an over reliance on internationally developed models and findings, but to rather invest time and resources analysing the South African markets, to develop more meaningful insights. Further, dual listed organisations which are listed on multiple stock exchanges are in some instances provided with target financial ratios and performance metrics by international head offices. These target financial ratios should be analysed in depth and based on market research, if not appropriate for the South African markets, should be debated with the supplying office.

7.3.3 Sector specific

Seeing that the JSE sectors, specifically those researched, differ from each other in relation to the most important financial ratios, with respect to share price, management should ensure they understand the unique characteristics of the sectors they operate in. Safdar (2016) found that using financial ratio analysis for analysing potential stock performance is more effective in industries with less competition. Applying and pursuing a set of multiple generic financial ratios when seeking to drive share price performance, is not the most appropriate method. An intricate understanding of the related sector operated in could further assist decision making and provide an indication of potential market reaction.

A good example in the South African context which demonstrated the importance of understanding the sector operated in, was where the MTN group had taken out loans for a consecutive five-year period up until 2017 in order to pay dividends (Reuters, 2018). In 2018, MTN however decided to decrease the dividend payment in order to repay these incurred debts. This notion was taken positively by investors where a 13 % increase in share price was achieved in one day, leading to the largest daily gain in a two-year period (Reuters, 2018). By understanding their investors better and by taking this decision earlier, similar fruitful market results could have been obtained. This action further supported the research findings where the DY had a negative relationship with share price performance for the mobile telecommunications sector, as a lower DY would have been incurred by MTN due to a lower dividend payment and a higher share price.

Management should further understand that optimal financial ratios, especially debt to equity structures are industry specific and the determined funding structure should be a product of analysed industry risk and company specific circumstances (Skae et al., 2012). From an investors perspective, similar recommendations are provided, where a generic set of evaluation techniques should not be used over all targeted sectors, but sector specific considerations should be employed.

7.4 Limitations of the research

In Section 4.10 the limitations were discussed which were incurred before performing the data analysis section. In this section the subsequent limitations detected while performing the data analysis is discussed.

While performing the data cleaning and analysis process, it was noted that not all the data obtained from the Iress Expert database was complete for every ratio in each datapoint. These were mostly related to older datapoints and for companies which form part of the delisted set of companies included. This was therefore seen as a limitation, especially for the mining and life insurance sectors which yielded the highest percentage of incomplete data compared to the total datapoints initially extracted. A summary of incomplete datapoints for each sector which was removed is provided in Table 31:

Table 31

Incomplete datapoints

	Total Datapoints	Incomplete Datapoints	% Incomplete
Mining	1052	368	35%
Banking	158	7	4%
Life Insurance	143	37	26%
Real Estate Investment Trusts	427	66	15%
Mobile Telecommunications	73	4	5%

Note. Researcher produced. Of the total initial datapoints extracted the mining sector had the most significant incomplete dataset with 35% of the total initial datapoints. This was mainly caused by various delisted companies which were mostly only operational in the early years of the 20-year testing period (1997 – 2018).

7.5 Suggestions for future research

As mentioned in section 4.10, the top five sectors were selected for testing based on market capitalisation. 37 ICB level three JSE sectors however contained companies. Different sector selection methods could be used or more sectors could be tested based on the market capitalisation method. Further, the database used only reported financial ratios based on the annual financial statements and not on interim periods. It would be beneficial if a dataset could be obtained and used where the interim ratios are also provided, as this would lead to increased datapoints for testing purposes and more comprehensive results obtained.

14 determined financial ratios were used in the research. A different set of financial ratios could be used in future research or additional financial ratios could be added if these additional financial ratios are expected to deliver improved coefficients of determination (R^2). Lastly, with regards to the limitations discussed in 4.10, this research used the change in the share price as the dependent variable and did not include the dividend received to form the total return percentage. Future research could consider this method and include both the change in share price and the dividend to form the total equity return percentage as the dependent variable.

With regards to the limitation discussed in 7.4, it would be beneficial to obtain data which is more complete for testing purposes as this would lead to increased datapoints available for analysis, from which more value could possibly be derived. This research was further only based on the South African Johannesburg Stock Exchange. A similar research method could be applied to other markets to obtain more value on a sector basis.

Finally, this research determined which financial ratios have relationships with share price performance in the top five sectors of the JSE based on market capitalisation. This research however did not go a step further and based on literature seek to understand why these ratios in some sectors displayed stronger relationships with share price performance when compared to other, for example seeking to understand why the return on assets only displayed a significant relationship with mobile telecommunications and not the other sectors. Future research could therefore build on this research to determine why these ratios are significant to the related sectors.

7.6 Conclusion

This research delivered a practical contribution to the theory of quality fundamental analysis (section 2.2) from a South African Johannesburg stock exchange (JSE) sector perspective, including both financial accounting (section 2.5) and fundamental-to-price ratios (section 2.6). In the researcher's knowledge a sector-based study regarding the relationship between financial ratios and share price performance has not been performed in the South African JSE context. In some instances, it confirmed academic theory and findings produced from data in developed and emerging markets where in other instances it demonstrated the uniqueness of the South African market, especially on a sector basis.

In conclusion, the following three summarised principles are provided as key takeaways:

1. The analysis of financial ratios provides value in respect of share price performance but should not be relied upon in isolation without the consideration of other market, sector and company specific factors.
2. The South African JSE is a unique marketplace and therefore theories developed based on developed and other emerging market data should not be applied blindly to the South African market without further consideration.
3. Each South African JSE sector investigated is unique and shares different relationships with share price performance. Therefore, each sector operated or invested in should be treated as unique and should be analysed individually to derive maximum value and insights.

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APPENDIX A: CONSISTENCY MATRIX

Title: Relationship between financial ratios and share price performance of the top five sectors on the Johannesburg Stock Exchange

Research Questions	Literature review	Data collection tool	Analysis
Research question 1 - 5 Do relationships exist between financial ratios and share price performance of the top five sectors of the Johannesburg stock exchange based on market capitalisation?	Seeing that same research questions and theory was applied to all five hypotheses, all mentioned literature is relevant to each of the five hypotheses.	Secondary data retrieval from Iress Expert database	Multiple linear regression

APPENDIX B: STATISTICAL OUTPUTS PER HYPOTHESIS

Hypothesis 1: Mining

Please note all outputs are the final outputs after tests were rerun accept if otherwise indicated.

1. Regression Assumptions

1.1 One independent variable is used which is measured on a continues scale.

Variable	Description
Close	Percentage change in closing share price from previous period

1.2 Two or more independent variables are used

No.	Variable
1	Current Ratio
2	Interest Cover
3	Debt to Equity
4	Debt to Assets
5	Return on Equity
6	Return on Assets
7	Return on Capital Employed
8	Net profit margin
9	Operating profit margin
10	Total asset turnover
11	Price-earnings ratio
12	Price-to-book ratio
13	Price-to-cash-flow
14	Dividend yield

1.3 Independence of observations exists.

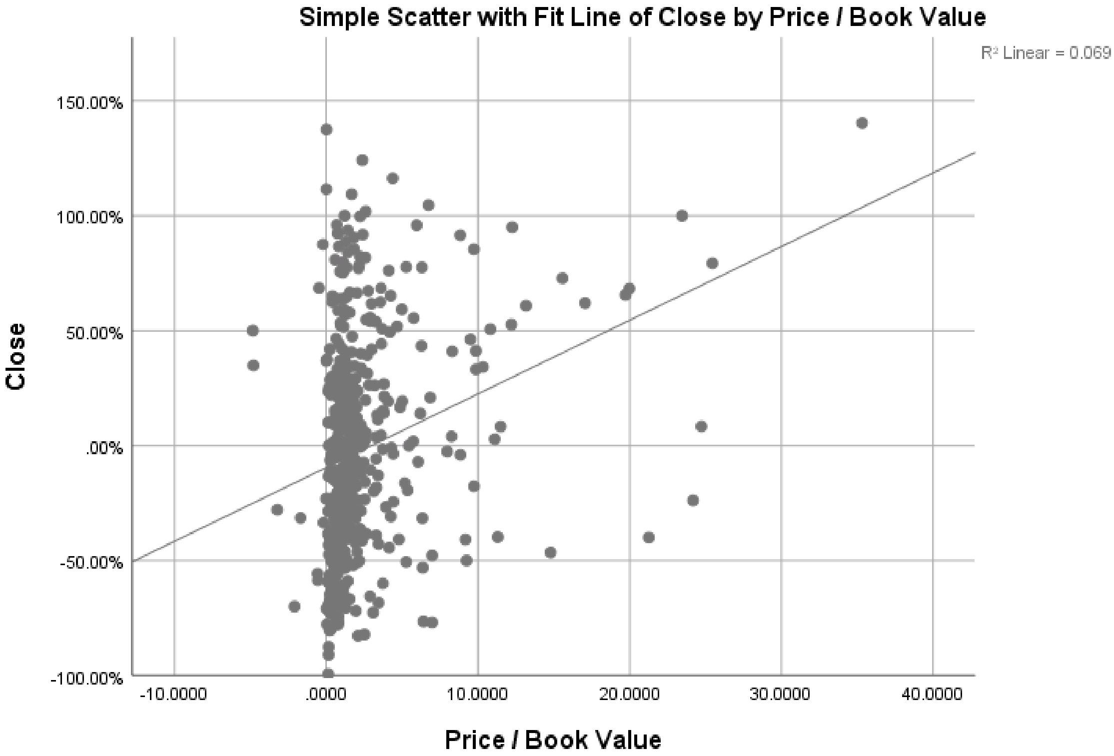
Durbin Watson

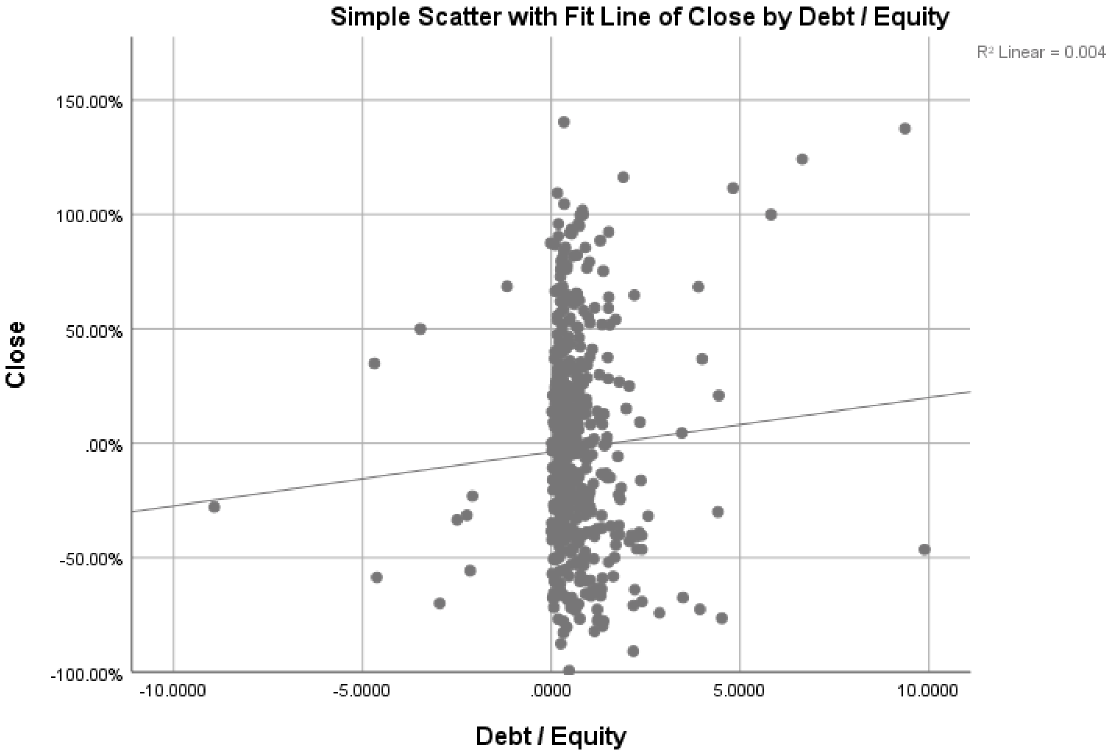
Model Summary[b]

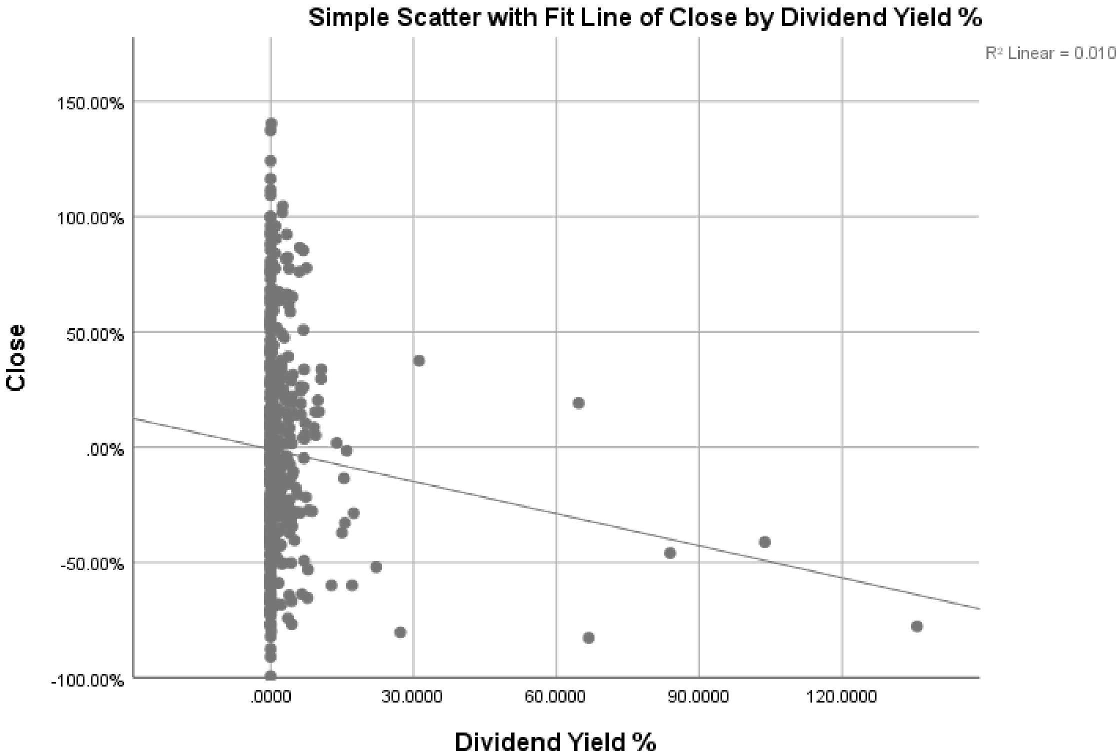
Model	Durbin-Watson
1	2.175[a]

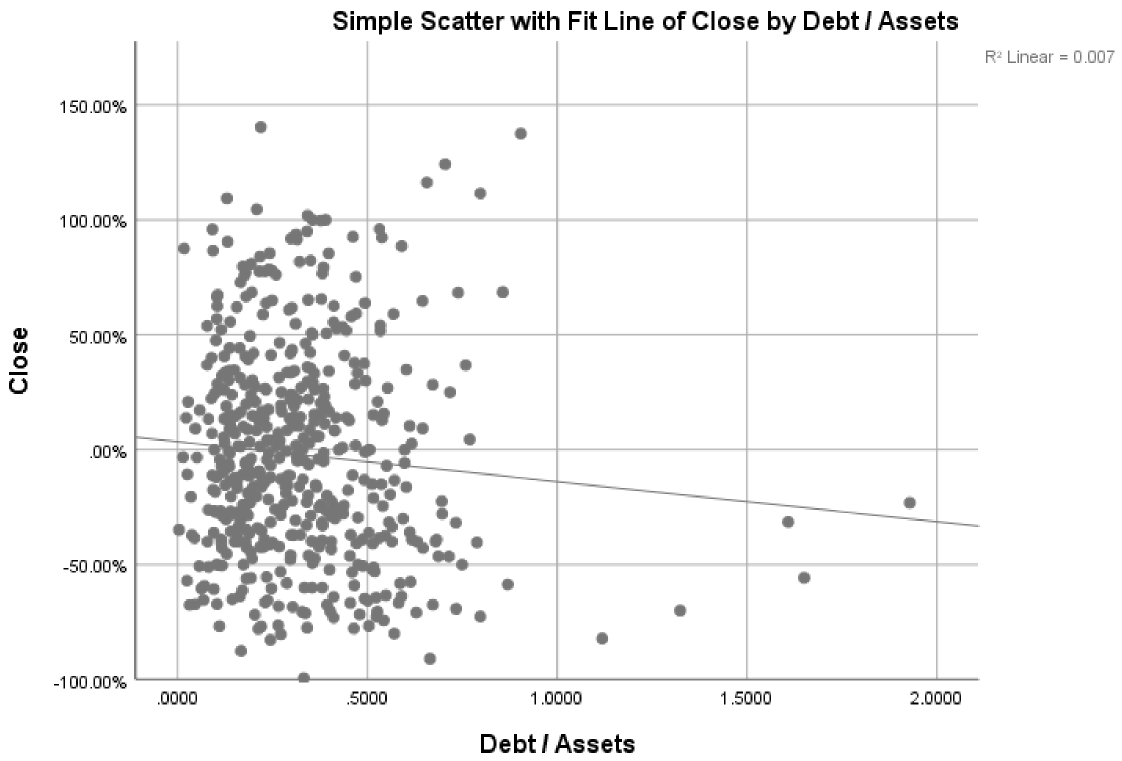
1.4 The dependent variable has a linear relationship with each of the independent variables.

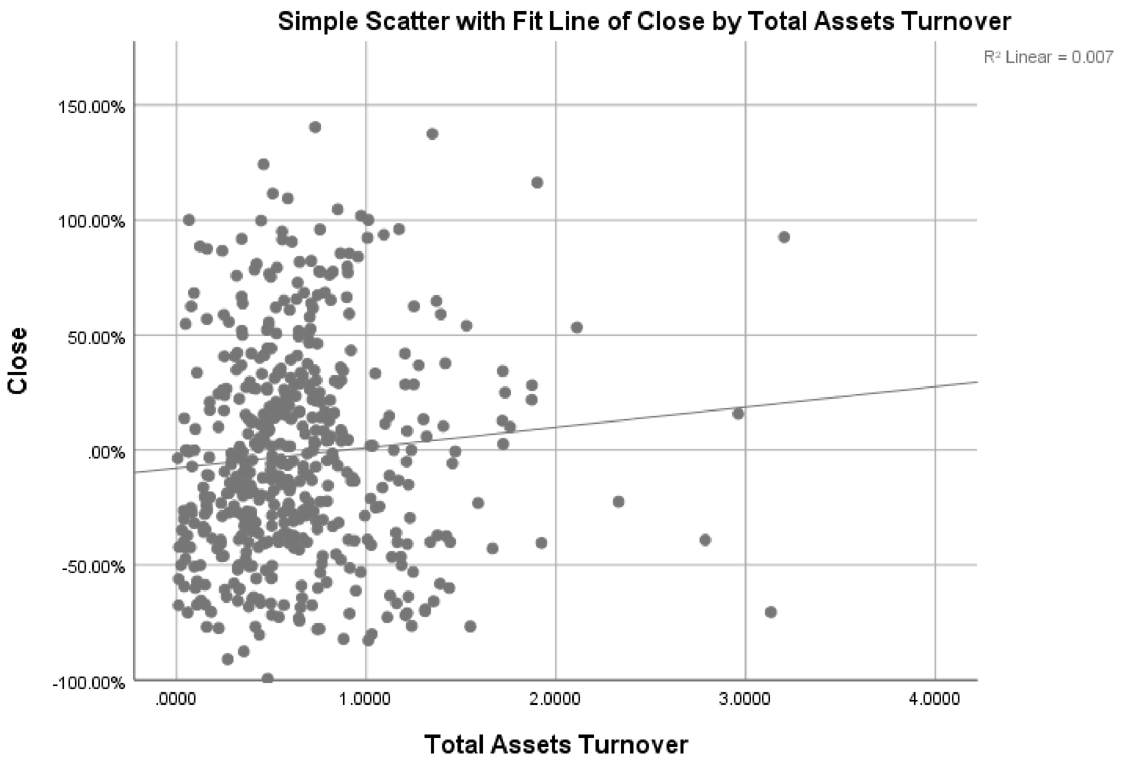
Final scatterplots based on stepwise regression variables identified



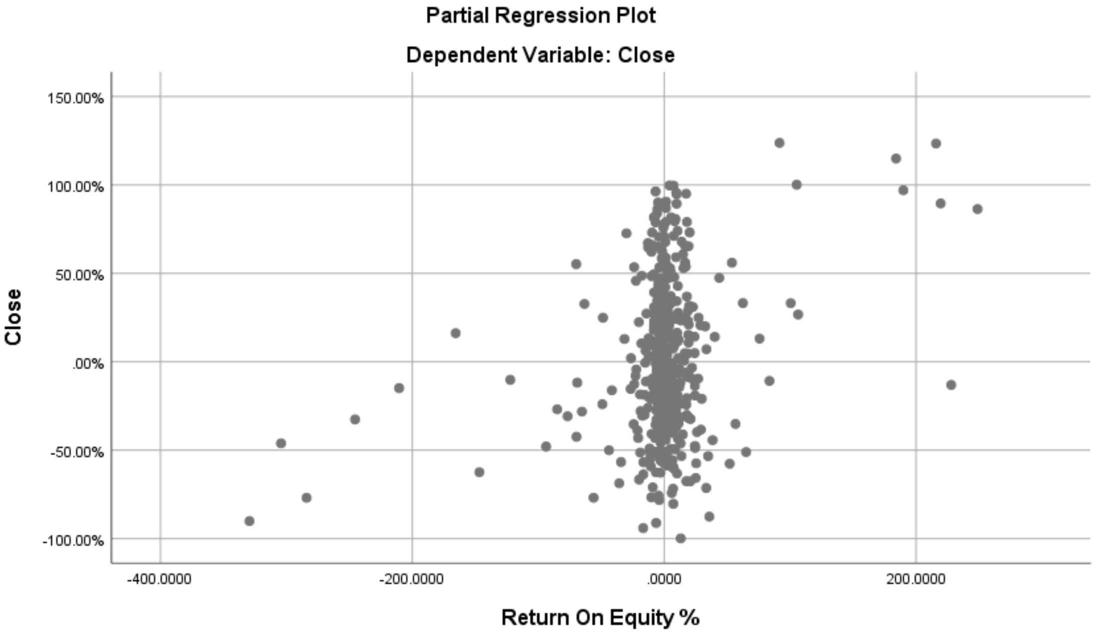

Simple Scatter with Fit Line of Close by Debt / Equity
R² Linear = 0.004
150.00%
100.00%
50.00%
.00%
-50.00%
-100.00%
Close
-10.0000
-5.0000
.0000
5.0000
10.0000
Debt / Equity

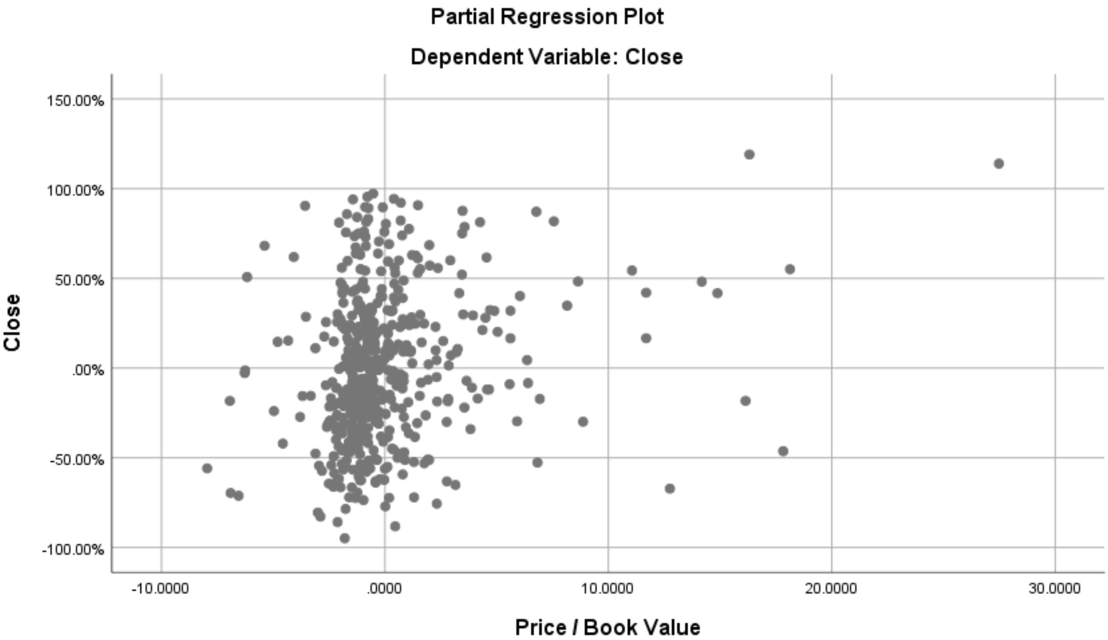

Simple Scatter with Fit Line of Close by Dividend Yield %
R² Linear = 0.010
150.00%
100.00%
50.00%
.00%
-50.00%
-100.00%
Close
.0000
30.0000
60.0000
90.0000
120.0000
Dividend Yield %

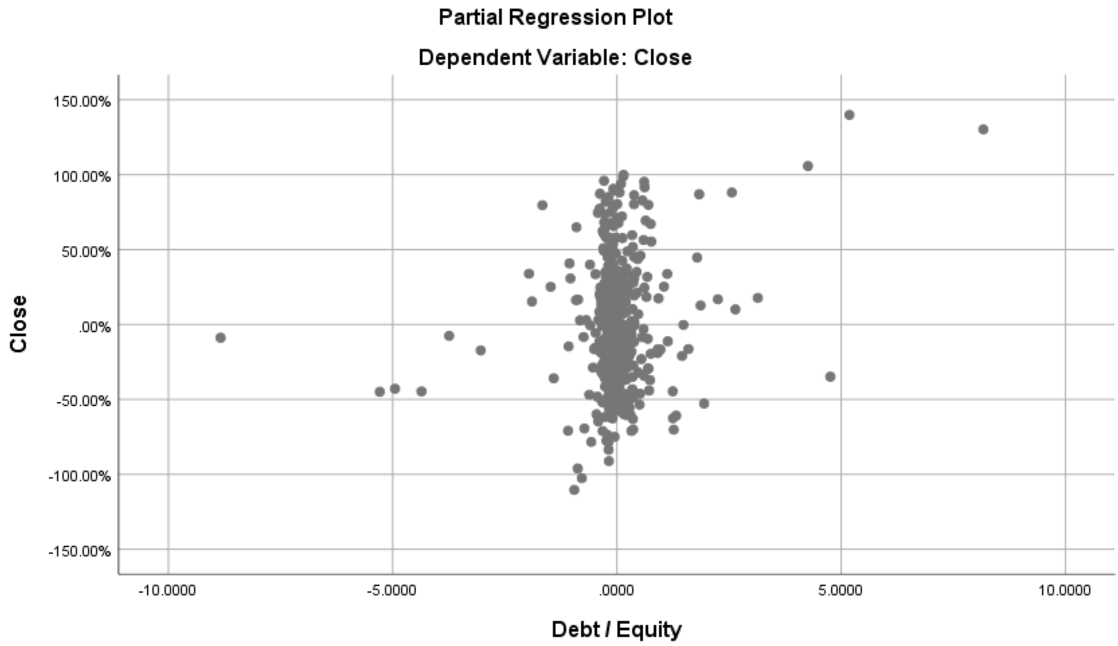

Simple Scatter with Fit Line of Close by Debt / Assets
R² Linear = 0.007
150.00%
100.00%
50.00%
.00%
-50.00%
-100.00%
Close
.0000
.5000
1.0000
1.5000
2.0000
Debt / Assets

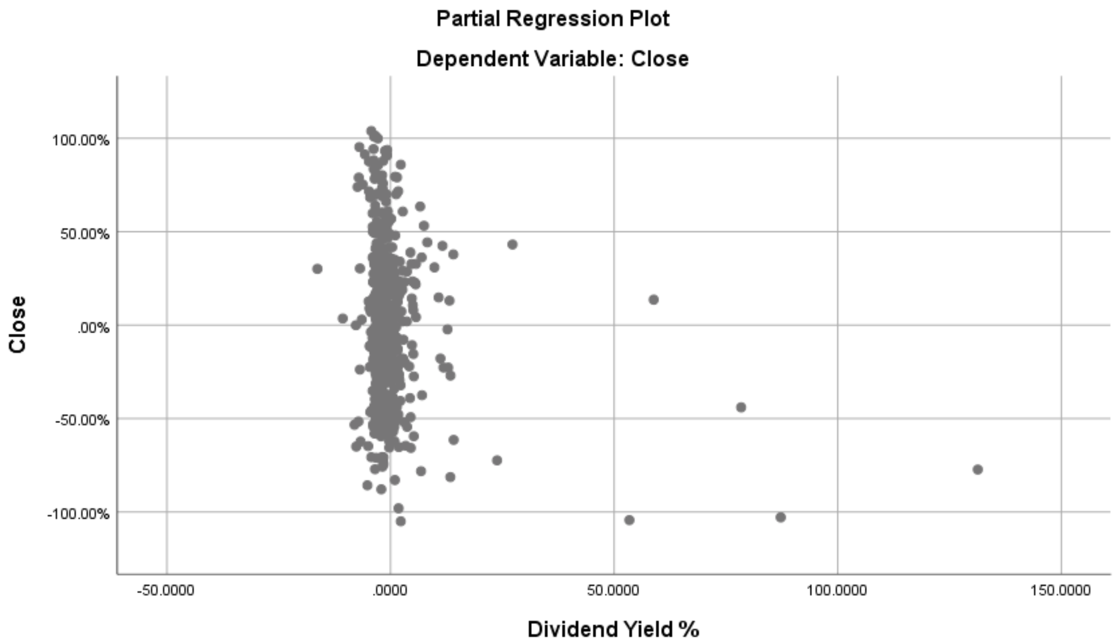

Simple Scatter with Fit Line of Close by Total Assets Turnover
R² Linear = 0.007
150.00%
100.00%
50.00%
.00%
-50.00%
-100.00%
Close
.0000
1.0000
2.0000
3.0000
4.0000
Total Assets Turnover

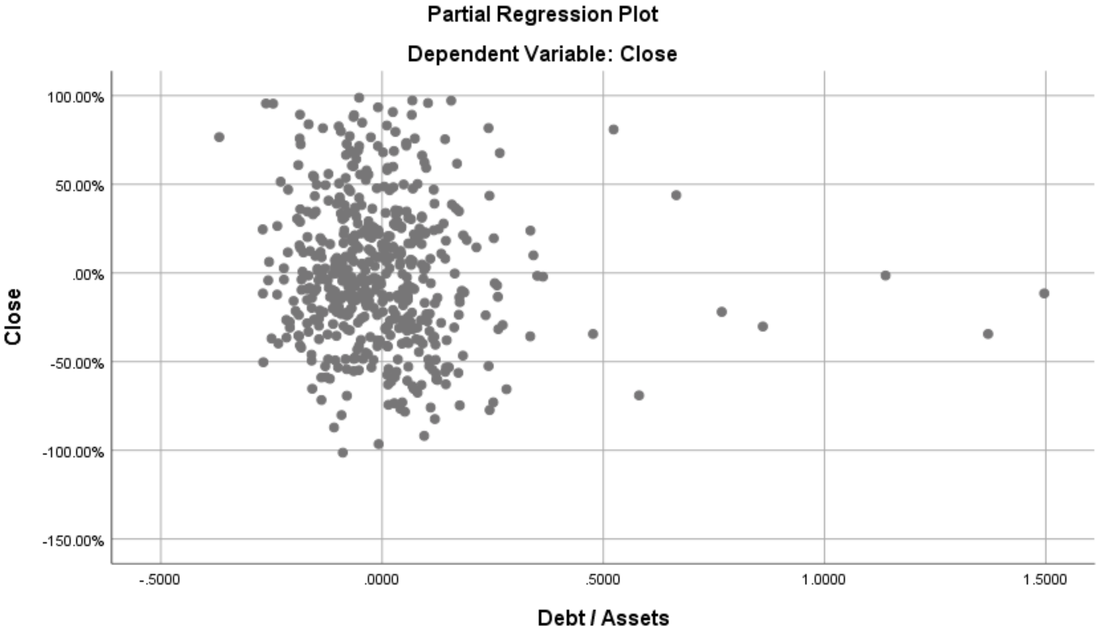
Partial regression plots on stepwise regression variables identified

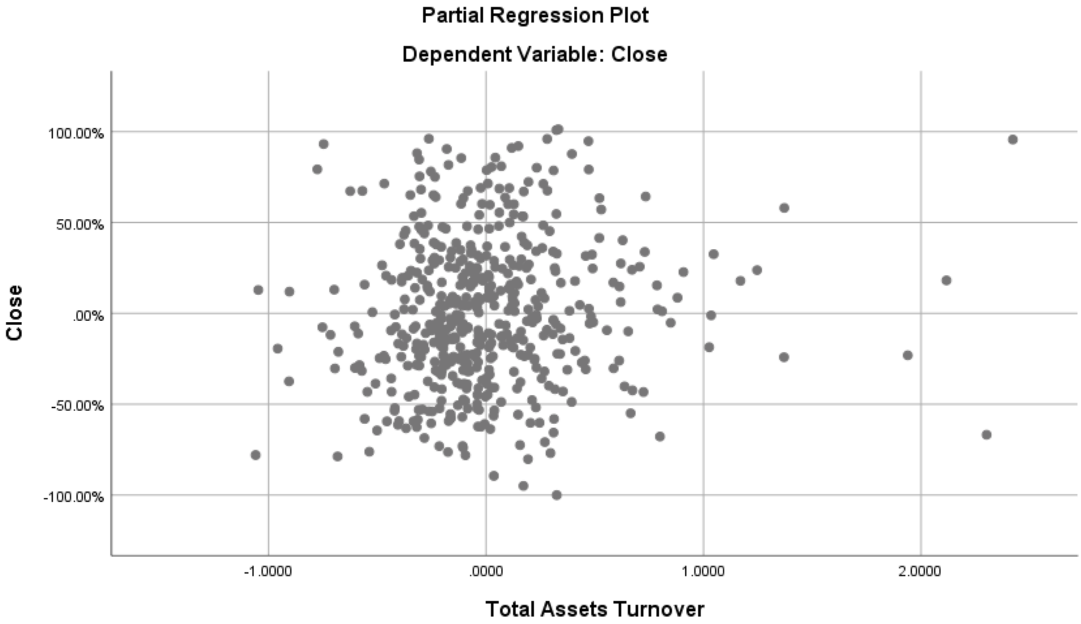




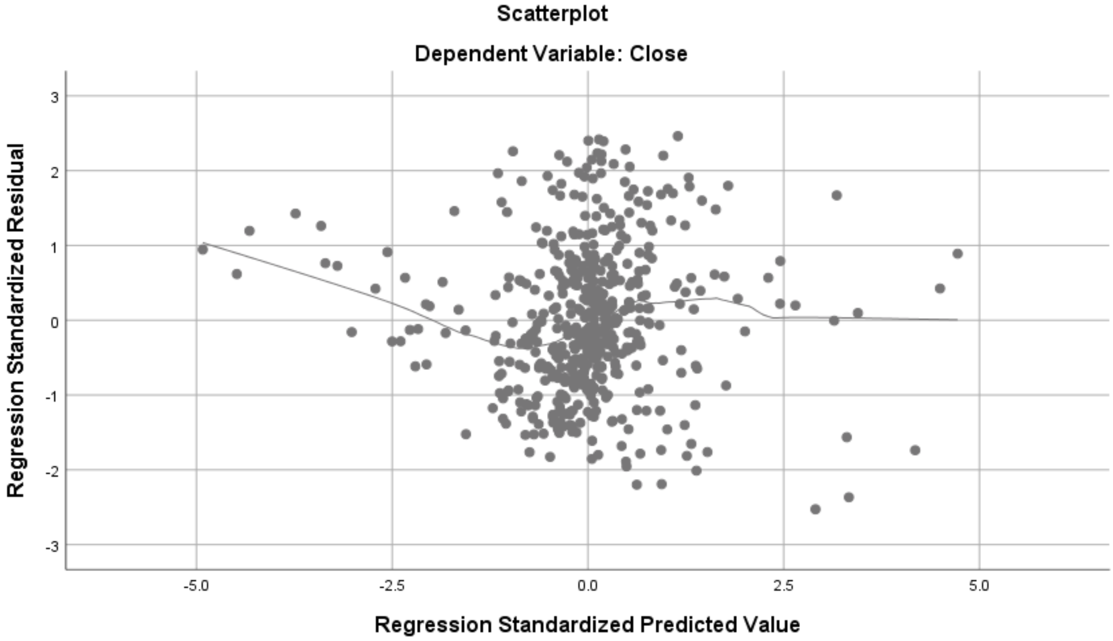

Partial Regression Plot
Dependent Variable: Close
Close
150.00%
100.00%
50.00%
.00%
-50.00%
-100.00%
-150.00%
-10.0000
-5.0000
.0000
5.0000
10.0000
Debt / Equity


Partial Regression Plot
Dependent Variable: Close
Close
100.00%
50.00%
.00%
-50.00%
-100.00%
-50.0000
.0000
50.0000
100.0000
150.0000
Dividend Yield %


Partial Regression Plot
Dependent Variable: Close
Close
100.00%
50.00%
.00%
-50.00%
-100.00%
-150.00%
-.5000
.0000
.5000
1.0000
1.5000
Debt / Assets

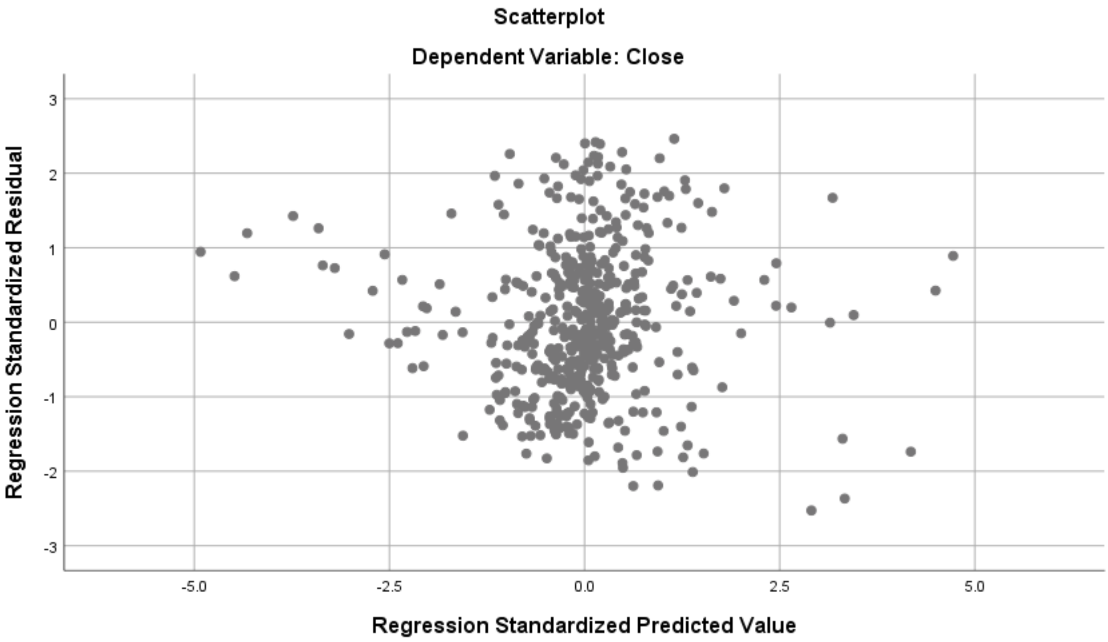

Partial Regression Plot
Dependent Variable: Close
Close
100.00%
50.00%
.00%
-50.00%
-100.00%
-1.0000
.0000
1.0000
2.0000
Total Assets Turnover

Standardized residual values versus standardized predicted values scatterplot (With Loess curve)



1.5 The data is homoscedastic.

Standardised residual values versus the standardized predicted values scatterplot



Koenker Test

```
------- ANOVA TABLE  --------
                 SS          df          MS           F         Sig
Model        28,632      13,000       2,202       1,315        ,000
Residual    817,281     488,000       1,675    -999,000    -999,000

------- Breusch-Pagan and Koenker test statistics and sig-values --------
                LM          Sig
BP          14,316         ,352
Koenker     16,992         ,200

Null hypothesis: heteroskedasticity not present (homoskedasticity).

If sig-value less than 0.05, reject the null hypothesis.
```

1.6 There is no multicollinearity.

VIF and Tolerance factor

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	Current Ratio	.741	1.350
	Debt / Assets	.648	1.544
	Debt / Equity	.621	1.610
	Dividend Yield %	.917	1.091
	Interest Cover	.788	1.269
	Net Profit Margin %	.687	1.456
	Price / Book Value	.738	1.355
	Price / Cash Flow	.823	1.214
	Price / Earnings	.868	1.152
	Return On Assets %	.260	3.844
	Return On Capital Employed %	.320	3.123
	Return On Equity %	.389	2.574
	Total Assets Turnover	.803	1.245

a. Dependent Variable: Close

1.7 The data is free from significant outliers, highly influential points or highly leveraged points.

Casewise Diagnostics

Round 1

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
133	3.264	233.33%	3.2732%	230.06010%
194	3.091	227.62%	9.7489%	217.87015%
208	3.665	318.27%	59.9547%	258.31803%
268	6.432	461.99%	8.5879%	453.40518%
281	3.087	240.82%	23.1921%	217.62419%
405	4.706	419.23%	87.5456%	331.68512%
410	3.473	253.33%	8.5391%	244.79428%
431	5.137	386.67%	24.5857%	362.08096%
474	4.656	364.00%	35.7819%	328.21811%
492	4.211	310.00%	13.1899%	296.81012%
554	3.107	262.86%	43.8405%	219.01662%

a. Dependent Variable: Close

Round 2

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
144	3.195	200.00%	19.4934%	180.50660%
205	-3.006	-54.99%	114.8640%	-169.85209%
245	3.702	234.13%	24.9711%	209.15671%
280	3.060	166.67%	-6.2417%	172.90839%
331	3.353	188.46%	-0.9565%	189.41806%
423	3.062	190.00%	16.9732%	173.02679%
453	3.156	179.41%	1.0850%	178.32677%
465	3.024	201.72%	30.8827%	170.84144%

a. Dependent Variable: Close

Round 3

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
125	3.260	178.61%	8.4920%	170.11501%
255	3.073	150.00%	-10.3790%	160.37897%
278	3.219	178.57%	10.6082%	167.96322%
308	3.226	185.52%	17.1832%	168.33405%
459	3.276	100.00%	-70.9515%	170.95153%
508	3.033	178.34%	20.0546%	158.28936%

a. Dependent Variable: Close

Round 4

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
279	3.174	163.64%	7.4503%	156.18606%
375	3.044	158.49%	8.7141%	149.77646%
504	3.164	172.00%	16.3122%	155.68778%

a. Dependent Variable: Close

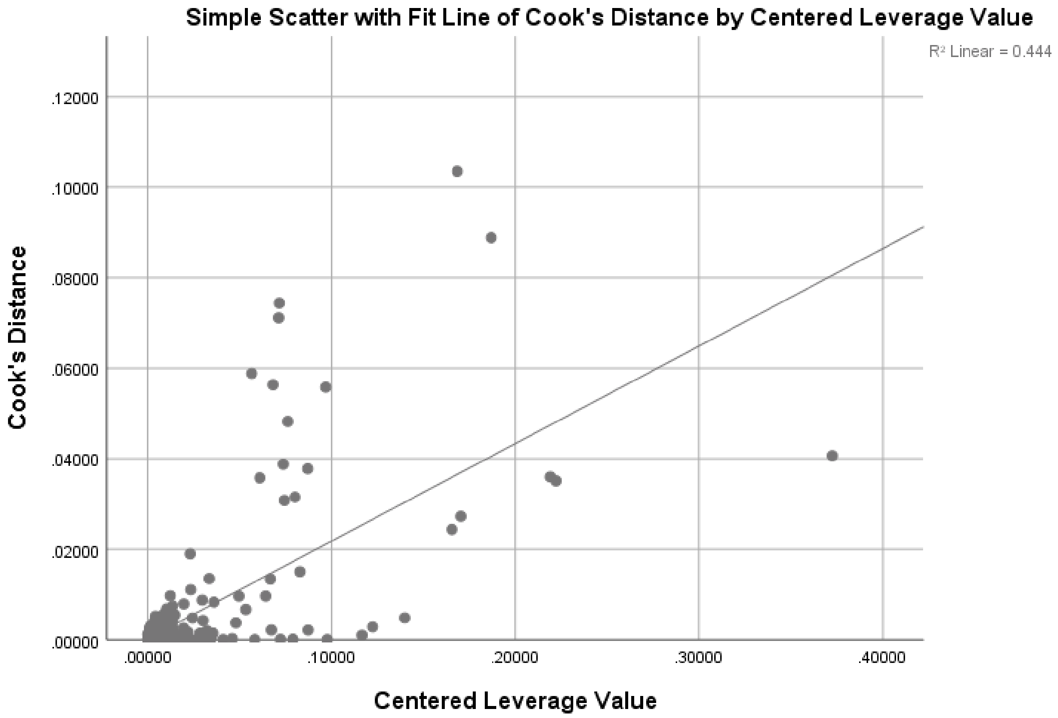
Round 5

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
186	3.032	150.00%	4.7561%	145.24393%

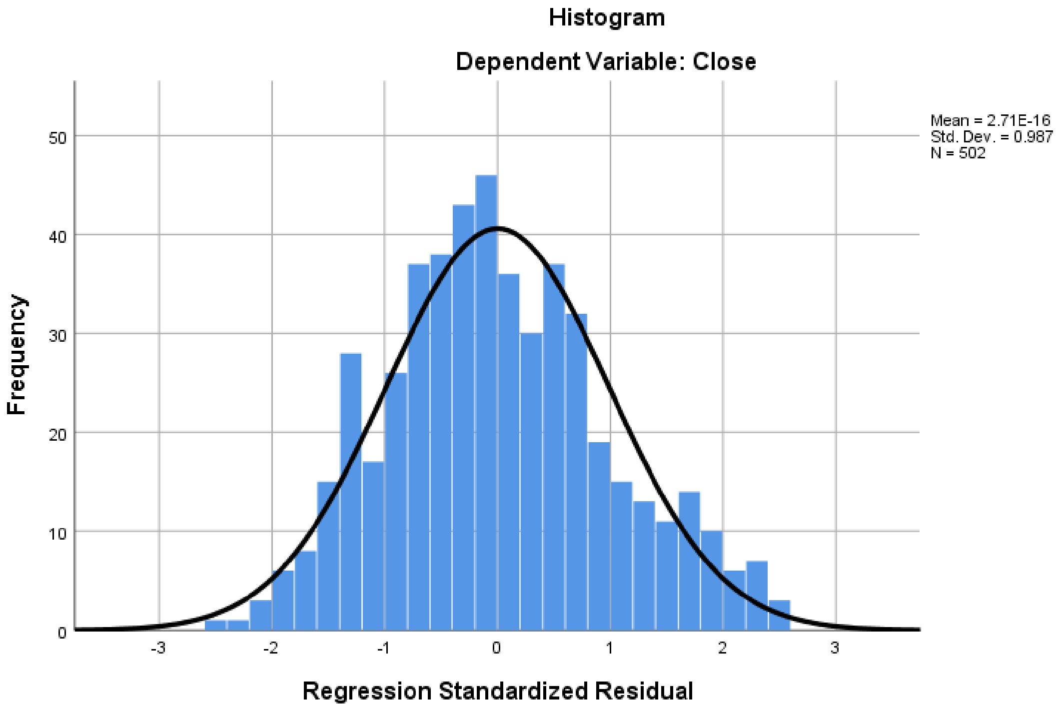
a. Dependent Variable: Close

Cook's distance vs Centred leverage value (Final after removal of outliers, highly influential and leveraged points)

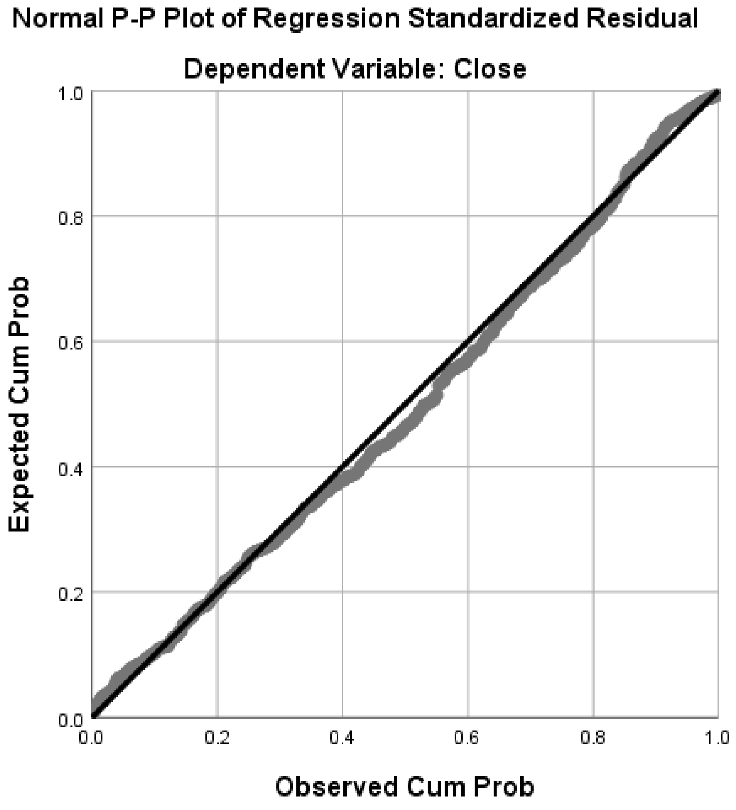


1.8 The residuals (errors) are approximately normally distributed.

Histogram of regression standardized residuals



Normal P-P plot of regression standardized residual



Skewness & Kurtosis

Skewness	.268
Kurtosis	-.306

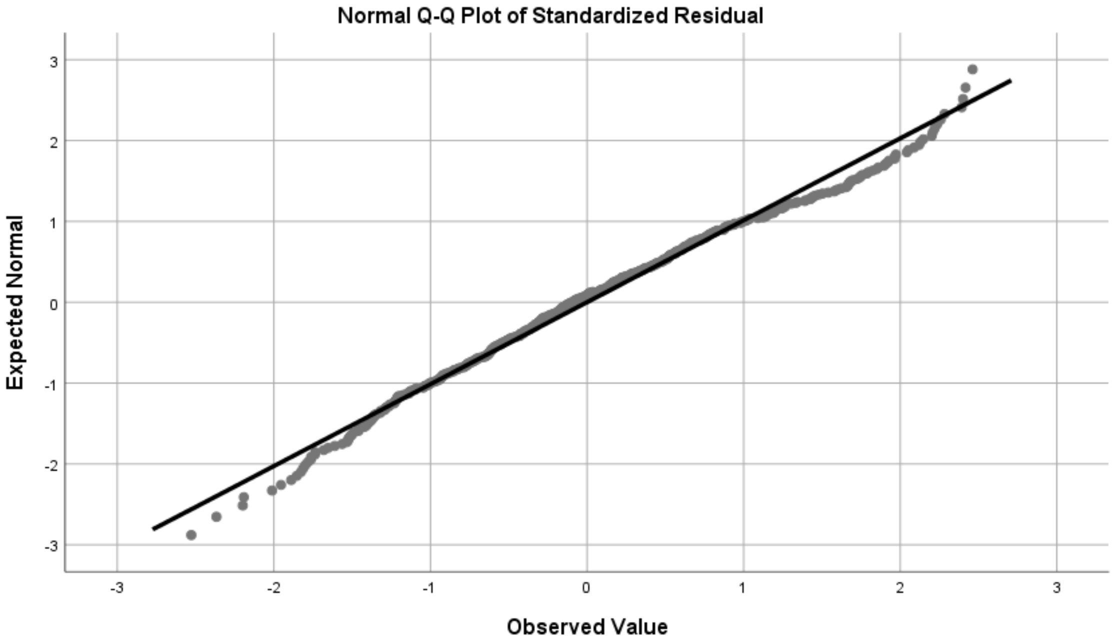
Shapiro-Wilk

Tests of Normality

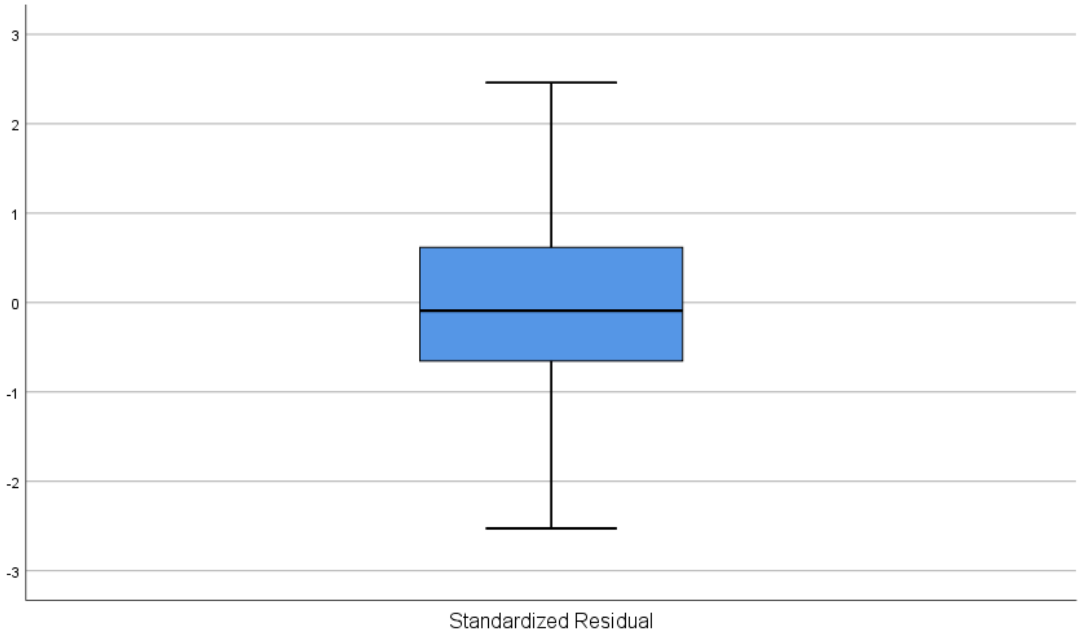
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.041	502	.041	.989	502	.001
Standardized Residual	.041	502	.041	.989	502	.001

a. Lilliefors Significance Correction

Normal Q-Q plot of Standardized Residuals



Box Plot



2. Automatic Stepwise Regression Outputs

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Return On Equity %	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
2	Price / Book Value	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
3	Debt / Equity	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
4	Dividend Yield %	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
5	Debt / Assets	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
6	Total Assets Turnover	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).

a. Dependent Variable: Close

Model 6 below is the final stepwise multiple linear regression model

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.293[a]	.086	.084	44.17874%	.086	46.822	1	500	.000	
2	.412[b]	.169	.166	42.14732%	.084	50.360	1	499	.000	
3	.439[c]	.193	.188	41.59810%	.023	14.263	1	498	.000	
4	.466[d]	.217	.211	40.99520%	.025	15.756	1	497	.000	
5	.475[e]	.226	.218	40.82061%	.008	5.260	1	496	.022	
6	.484[f]	.234	.225	40.63600%	.009	5.517	1	495	.019	2.163

a. Predictors: (Constant), Return On Equity %

b. Predictors: (Constant), Return On Equity %, Price / Book Value

c. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity

d. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %

e. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %, Debt / Assets

f. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %, Debt / Assets, Total Assets Turnover

g. Dependent Variable: Close

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	91385.871	1	91385.871	46.822	.000[b]
	Residual	975880.611	500	1951.761		
	Total	1067266.482	501			
2	Regression	180844.651	2	90422.325	50.902	.000[c]
	Residual	886421.831	499	1776.396		
	Total	1067266.482	501			
3	Regression	205526.190	3	68508.730	39.591	.000[d]
	Residual	861740.292	498	1730.402		
	Total	1067266.482	501			
4	Regression	232005.143	4	58001.286	34.512	.000[e]
	Residual	835261.339	497	1680.606		
	Total	1067266.482	501			
5	Regression	240770.637	5	48154.127	28.898	.000[f]
	Residual	826495.844	496	1666.322		
	Total	1067266.482	501			
6	Regression	249880.481	6	41646.747	25.221	.000[g]
	Residual	817386.000	495	1651.285		
	Total	1067266.482	501			

a. Dependent Variable: Close

b. Predictors: (Constant), Return On Equity %

c. Predictors: (Constant), Return On Equity %, Price / Book Value

d. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity

e. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %

f. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %, Debt / Assets

g. Predictors: (Constant), Return On Equity %, Price / Book Value, Debt / Equity, Dividend Yield %, Debt / Assets, Total Assets Turnover

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1.411	1.975		-.715	.475		
	Return On Equity %	.197	.029	.293	6.843	.000	1.000	1.000
2	(Constant)	-9.531	2.204		-4.324	.000		
	Return On Equity %	.214	.028	.318	7.773	.000	.992	1.008
	Price / Book Value	3.550	.500	.291	7.096	.000	.992	1.008
3	(Constant)	-12.943	2.356		-5.494	.000		
	Return On Equity %	.264	.030	.392	8.734	.000	.804	1.243
	Price / Book Value	3.137	.506	.257	6.205	.000	.946	1.057
	Debt / Equity	6.860	1.816	.174	3.777	.000	.767	1.304
4	(Constant)	-11.185	2.363		-4.733	.000		
	Return On Equity %	.286	.030	.426	9.448	.000	.776	1.289
	Price / Book Value	3.048	.499	.250	6.112	.000	.944	1.059
	Debt / Equity	7.513	1.798	.190	4.179	.000	.760	1.315
	Dividend Yield %	-.750	.189	-.160	-3.969	.000	.963	1.038
5	(Constant)	-5.126	3.538		-1.449	.148		
	Return On Equity %	.288	.030	.428	9.539	.000	.776	1.289
	Price / Book Value	2.953	.498	.242	5.925	.000	.937	1.067
	Debt / Equity	8.609	1.853	.218	4.647	.000	.710	1.409
	Dividend Yield %	-.763	.188	-.163	-4.053	.000	.963	1.039
	Debt / Assets	-20.243	8.826	-.094	-2.294	.022	.923	1.083
6	(Constant)	-9.445	3.973		-2.377	.018		
	Return On Equity %	.282	.030	.419	9.361	.000	.771	1.298
	Price / Book Value	3.017	.497	.247	6.072	.000	.935	1.070
	Debt / Equity	7.870	1.871	.199	4.206	.000	.690	1.450
	Dividend Yield %	-.760	.187	-.163	-4.057	.000	.963	1.039
	Debt / Assets	-26.544	9.187	-.124	-2.889	.004	.844	1.185
	Total Assets Turnover	10.398	4.427	.100	2.349	.019	.861	1.161

a. Dependent Variable: Close

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-115.6287%	106.2277%	-2.1573%	22.33301%	502
Std. Predicted Value	-5.081	4.853	.000	1.000	502
Standard Error of Predicted Value	1.850	24.868	3.860	2.853	502
Adjusted Predicted Value	-119.4705%	105.3588%	-2.2707%	22.77364%	502
Residual	-101.49650%	100.15030%	0.00000%	40.39194%	502
Std. Residual	-2.498	2.465	.000	.994	502
Stud. Residual	-2.574	2.561	.001	1.003	502
Deleted Residual	-107.80582%	108.10423%	0.11338%	41.15995%	502
Stud. Deleted Residual	-2.589	2.575	.002	1.005	502
Mahal. Distance	.040	186.626	5.988	15.715	502
Cook's Distance	.000	.104	.003	.010	502
Centered Leverage Value	.000	.373	.012	.031	502

a. Dependent Variable: Close

Hypothesis 2: Banking

Please note all outputs are the final outputs after tests were rerun accept if otherwise indicated.

1. Regression Assumptions

1.1 One independent variable is used which is measured on a continues scale.

Variable	Description
Close	Percentage change in closing share price from previous period

1.2 Two of more independent variables are used.

No.	Variable
1	Current Ratio
2	Interest Cover
3	Debt to Equity
4	Debt to Assets
5	Return on Equity
6	Return on Assets
7	Return on Capital Employed
8	Price-earnings ratio
9	Price-to-book ratio
10	Price-to-cash-flow
11	Dividend yield

1.3 Independence of observations exists.

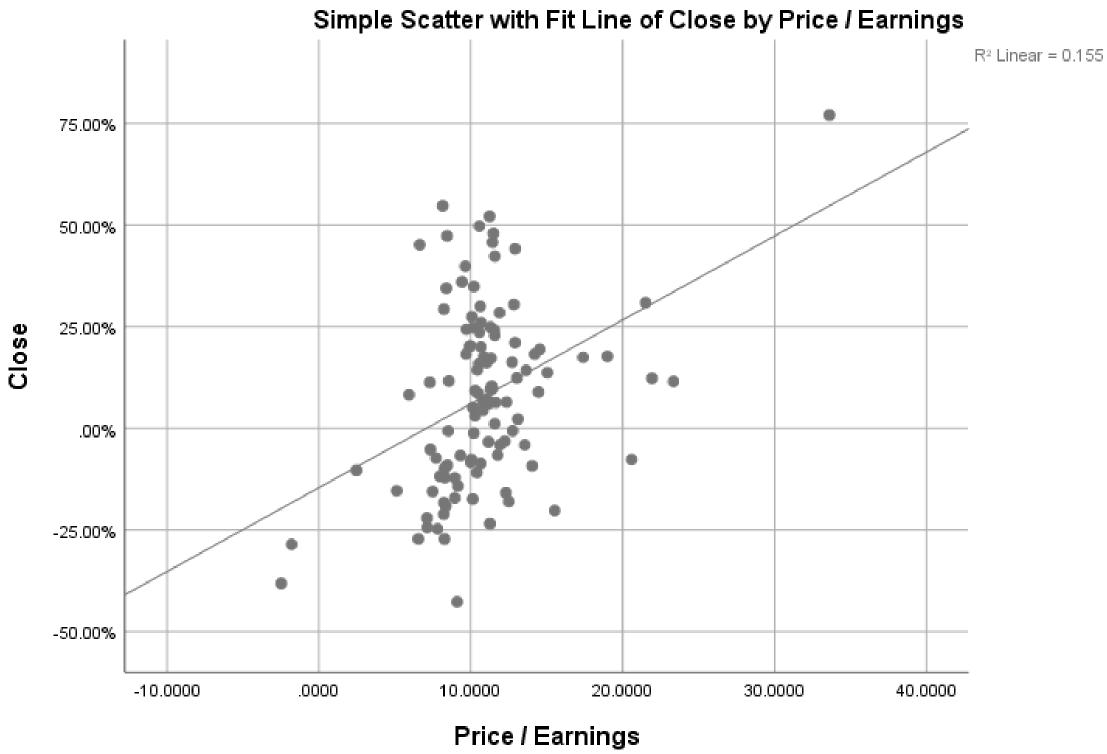
Durbin Watson

Model Summary[b]

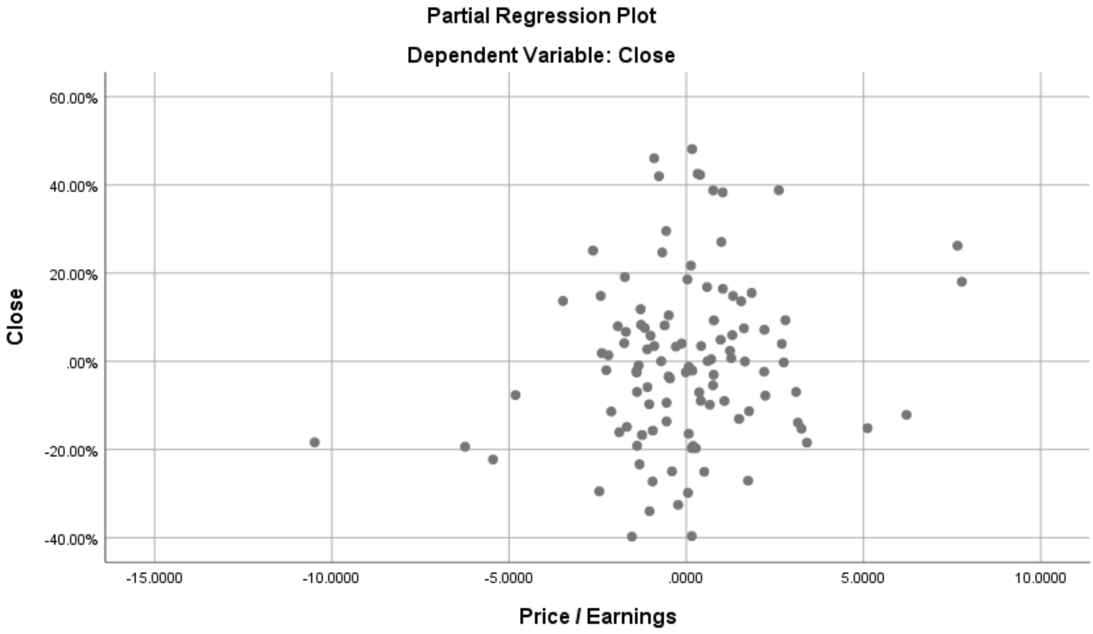
Model	Durbin-Watson
1	2.157[a]

1.4 The dependent variable has a linear relationship with each of the independent variables.

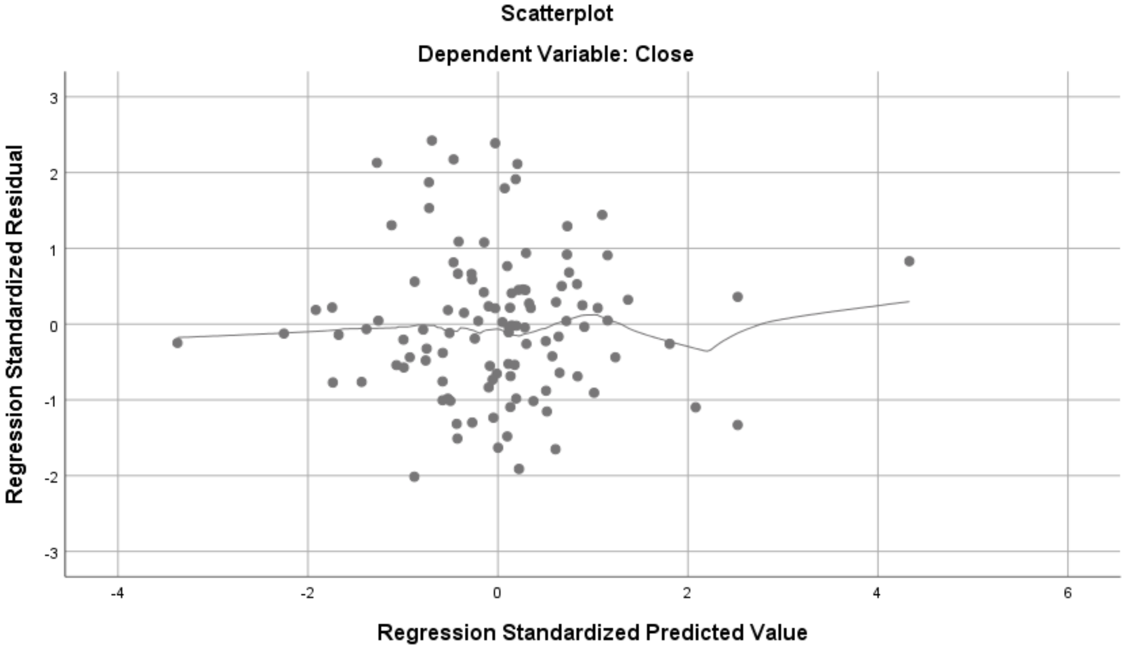
Final scatterplots based on stepwise regression variables identified



Partial regression plots on stepwise regression variables identified

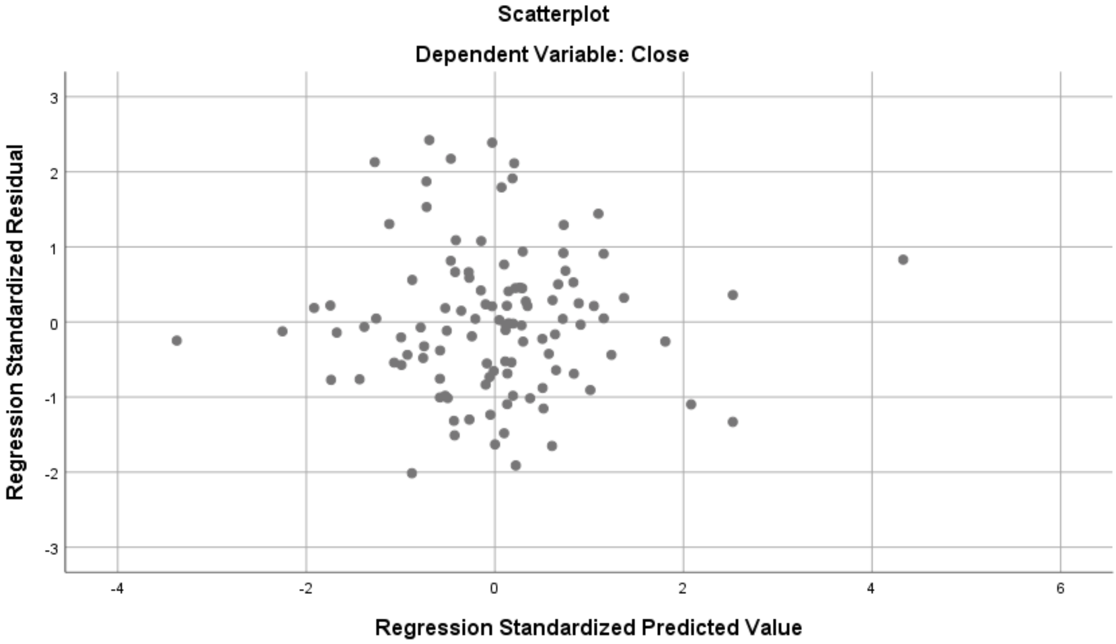


Standardized residual values versus standardized predicted values scatterplot (With Loess curve)



1.5 The data is homoscedastic.

Standardised residual values versus the standardized predicted values scatterplot



Koenker Test

```
------- ANOVA TABLE  --------
                  SS          df          MS           F         Sig
Model         39,013      11,000       3,547       1,800        ,000
Residual     191,082      97,000       1,970    -999,000    -999,000

------- Breusch-Pagan and Koenker test statistics and sig-values --------
                 LM         Sig
BP           19,506        ,053
Koenker      18,481        ,071

Null hypothesis: heteroskedasticity not present (homoskedasticity).

If sig-value less than 0.05, reject the null hypothesis.
```

1.6 There is no multicollinearity.

VIF and Tolerance factor

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	Current Ratio	.305	3.281
	Debt / Assets	.194	5.143
	Debt / Equity	.303	3.295
	Dividend Yield %	.803	1.246
	Interest Cover	.579	1.728
	Price / Book Value	.178	5.620
	Price / Cash Flow	.542	1.844
	Price / Earnings	.310	3.223
	Return On Assets %	.429	2.333
	Return On Capital Employed %	.868	1.153
	Return On Equity %	.487	2.055

a. Dependent Variable: Close

1.7 The data is free from significant outliers, highly influential points or highly leveraged points.

Casewise Diagnostics

Round 1

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
28	3.034	140.49%	37.4708%	103.01698%
58	4.306	150.00%	3.7847%	146.21527%

a. Dependent Variable: Close

Round 2

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
12	3.549	127.45%	23.0867%	104.36430%
23	3.034	128.23%	39.0019%	89.22329%

a. Dependent Variable: Close

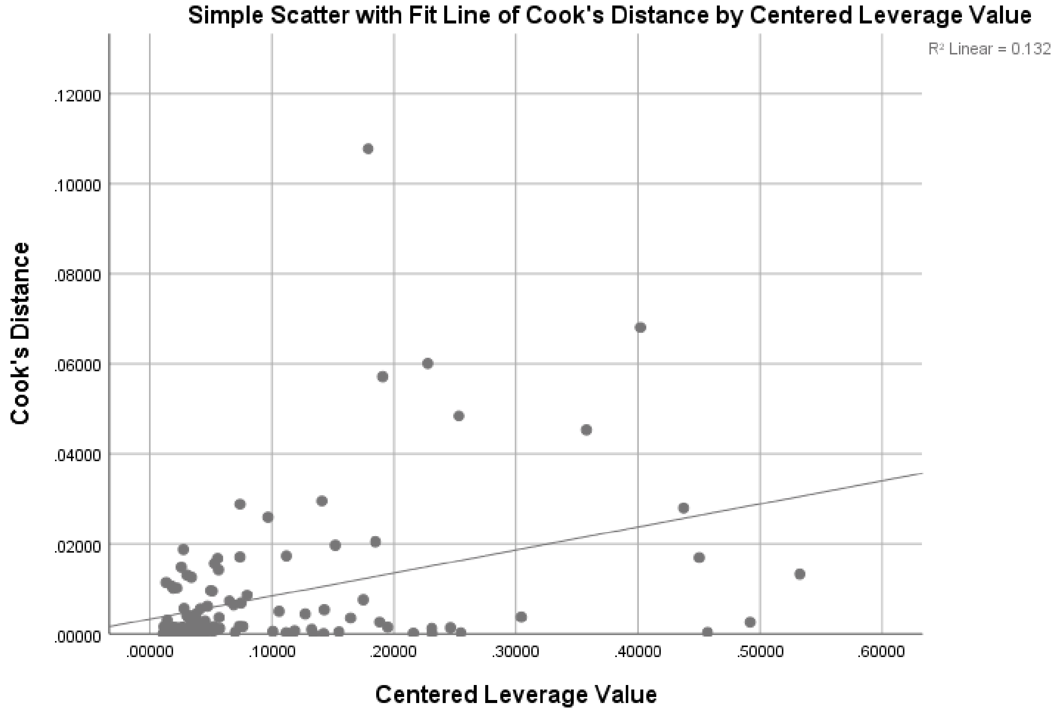
Round 3

Casewise Diagnostics[a]

Case Number	Std. Residual	Close	Predicted Value	Residual
29	-3.178	-33.89%	49.5807%	-83.47191%

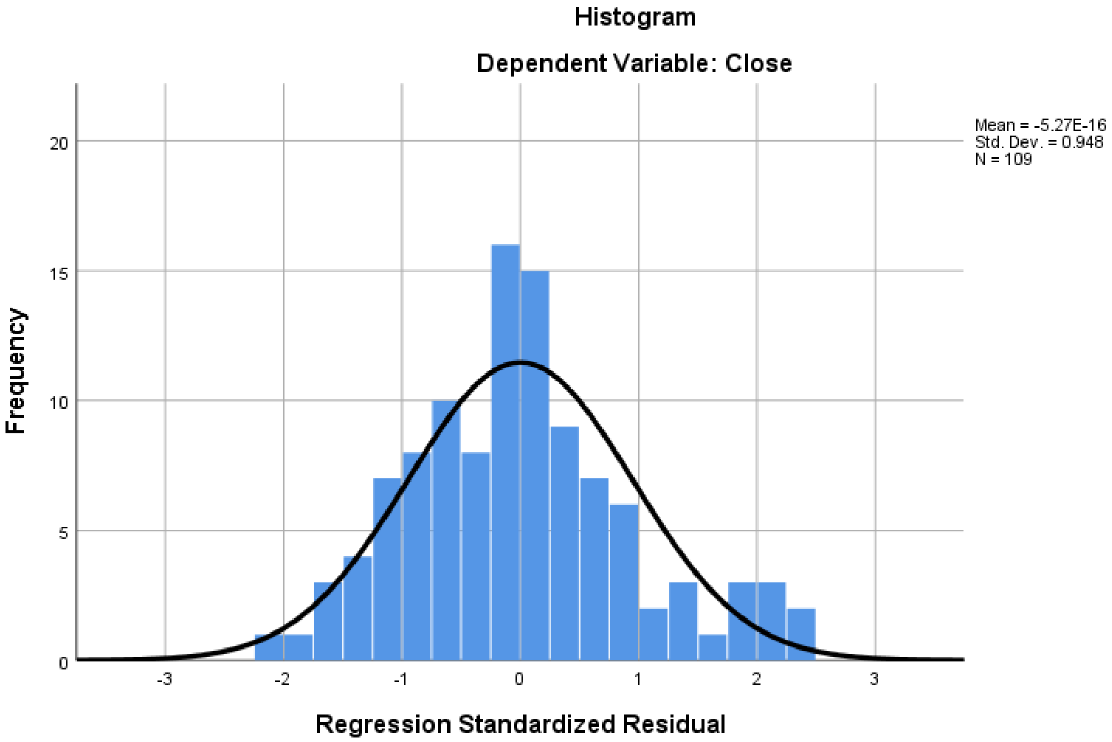
a. Dependent Variable: Close

Cook's distance vs Centred leverage value (Final after removal of outliers, highly influential and leveraged points)

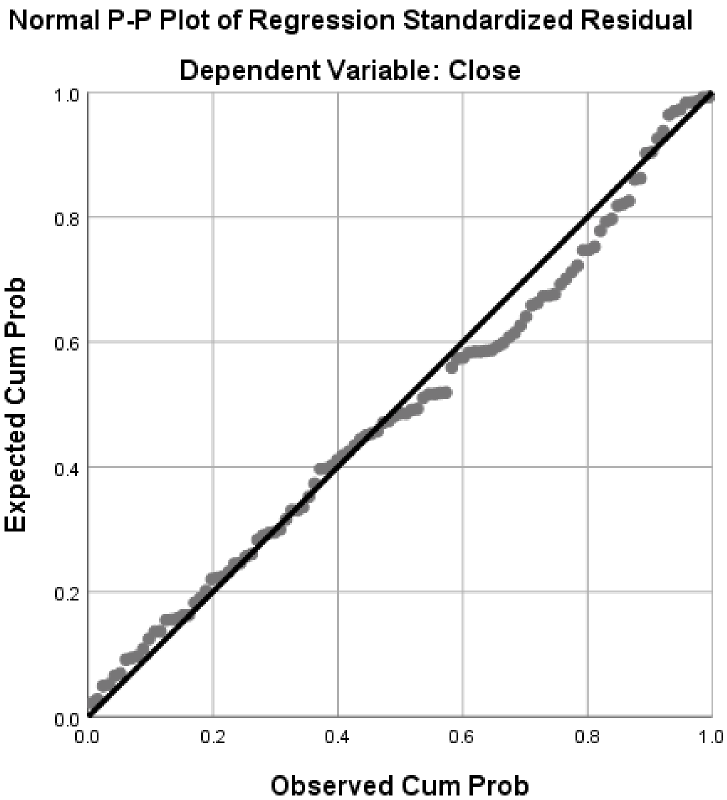


1.8 The residuals (errors) are approximately normally distributed.

Histogram of regression standardized residuals



Normal P-P plot of regression standardized residual



Skewness & Kurtosis

Skewness	.457
Kurtosis	.173

Shapiro-Wilk

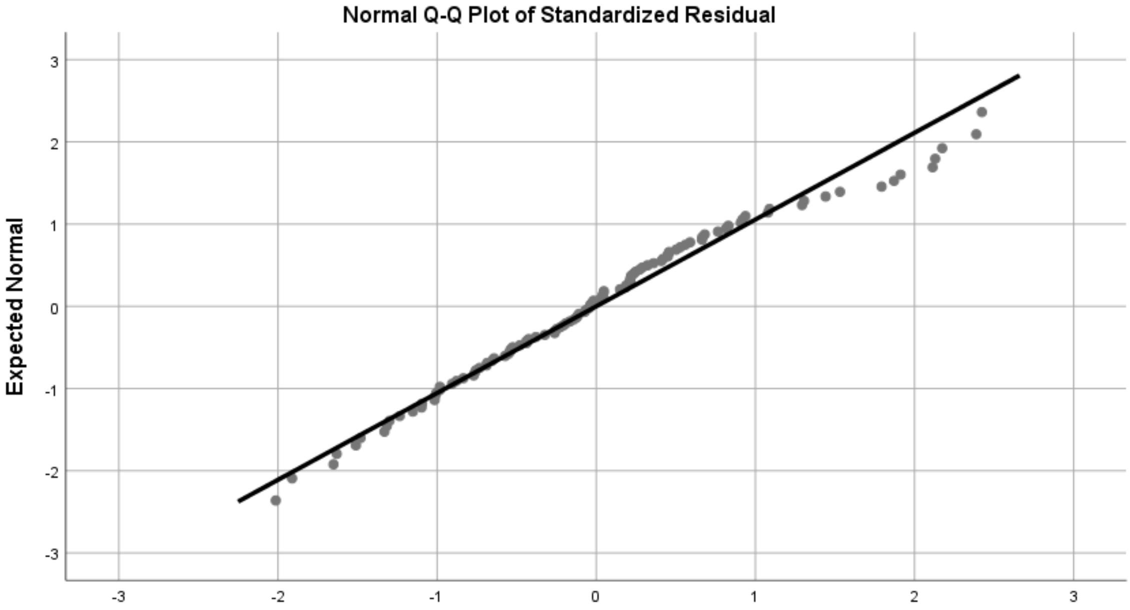
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.068	109	.200*	.977	109	.058
Unstandardized Residual	.068	109	.200*	.977	109	.058

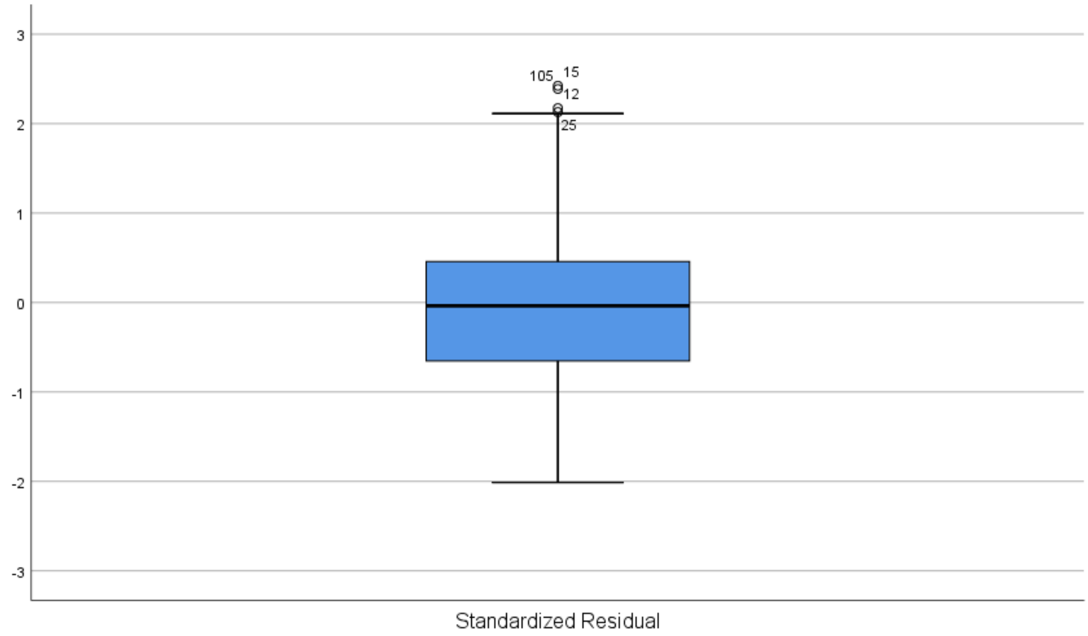
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Normal Q-Q plot of Standardized Residuals



Box Plot



2. Automatic Stepwise Regression Outputs

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Price / Earnings	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Return On Equity %	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Close

Model 2 below is the final stepwise multiple linear regression model

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.394[a]	.155	.147	20.64002%	.155	19.663	1	107	.000	
2	.443[b]	.196	.181	20.22769%	.041	5.407	1	106	.022	2.063

a. Predictors: (Constant), Price / Earnings

b. Predictors: (Constant), Price / Earnings, Return On Equity %

c. Dependent Variable: Close

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8376.682	1	8376.682	19.663	.000[b]
	Residual	45583.130	107	426.011		
	Total	53959.812	108			
2	Regression	10588.895	2	5294.447	12.940	.000[c]
	Residual	43370.917	106	409.160		
	Total	53959.812	108			

a. Dependent Variable: Close

b. Predictors: (Constant), Price / Earnings

c. Predictors: (Constant), Price / Earnings, Return On Equity %

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-14.607	5.436		-2.687	.008		
	Price / Earnings	2.063	.465	.394	4.434	.000	1.000	1.000
2	(Constant)	-24.752	6.886		-3.594	.000		
	Price / Earnings	1.946	.459	.372	4.241	.000	.988	1.012
	Return On Equity %	.638	.274	.204	2.325	.022	.988	1.012

a. Dependent Variable: Close

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-40.1569%	49.9923%	7.8488%	9.90178%	109
Std. Predicted Value	-4.848	4.256	.000	1.000	109
Standard Error of Predicted Value	1.946	10.869	3.011	1.489	109
Adjusted Predicted Value	-40.9585%	40.1403%	7.8711%	9.72338%	109
Residual	-44.61141%	49.46991%	0.00000%	20.03953%	109
Std. Residual	-2.205	2.446	.000	.991	109
Stud. Residual	-2.220	2.467	-.001	1.005	109
Deleted Residual	-45.20293%	50.33047%	-0.02230%	20.66008%	109
Stud. Deleted Residual	-2.263	2.529	.001	1.014	109
Mahal. Distance	.009	30.189	1.982	4.395	109
Cook's Distance	.000	.325	.011	.033	109
Centered Leverage Value	.000	.280	.018	.041	109

a. Dependent Variable: Close

Hypothesis 3: Life Insurance

Please note all outputs are the final outputs after tests were rerun accept if otherwise indicated.

1. Regression Assumptions

1.1 One independent variable is used which is measured on a continues scale.

Variable	**Description**
Close	Percentage change in closing share price from previous period

1.2 Two or more independent variables are used.

No.	**Variable**
1	Current Ratio
2	Interest Cover
3	Debt to Equity
4	Debt to Assets
5	Return on Equity
6	Return on Assets
7	Return on Capital Employed
8	Net profit margin
9	Operating profit margin
10	Total asset turnover
11	Price-earnings ratio
12	Price-to-book ratio
13	Price-to-cash-flow
14	Dividend yield

1.3 Independence of observations exists.

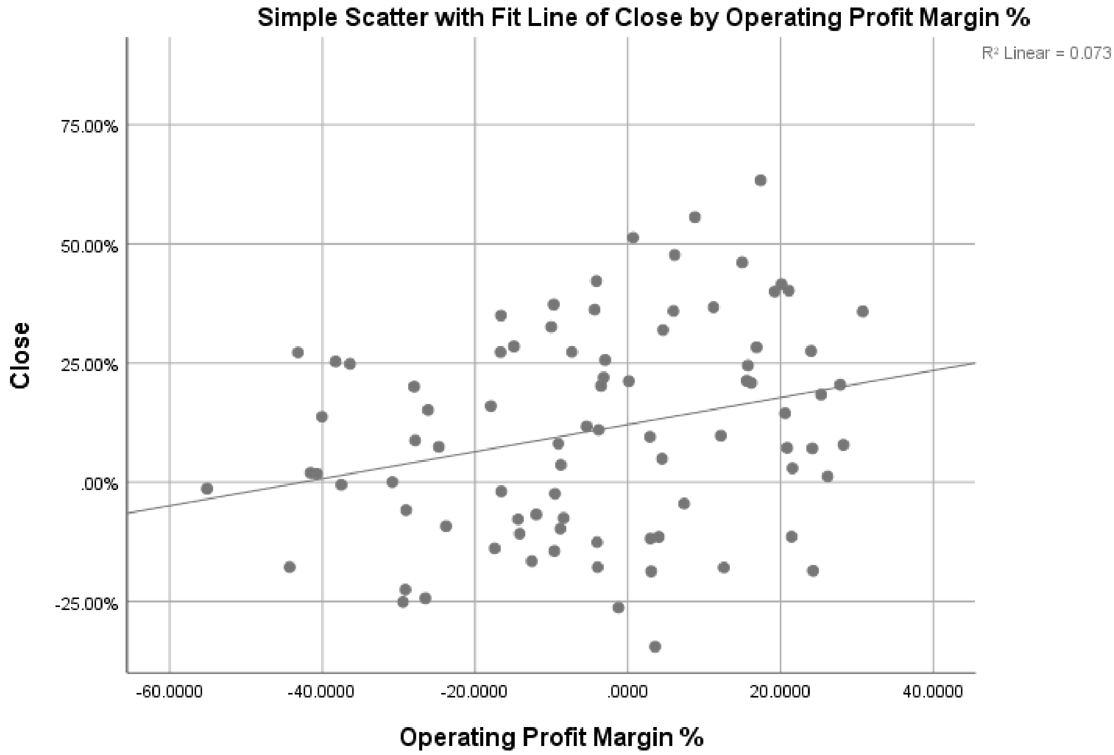
Durbin Watson

Model Summary[b]

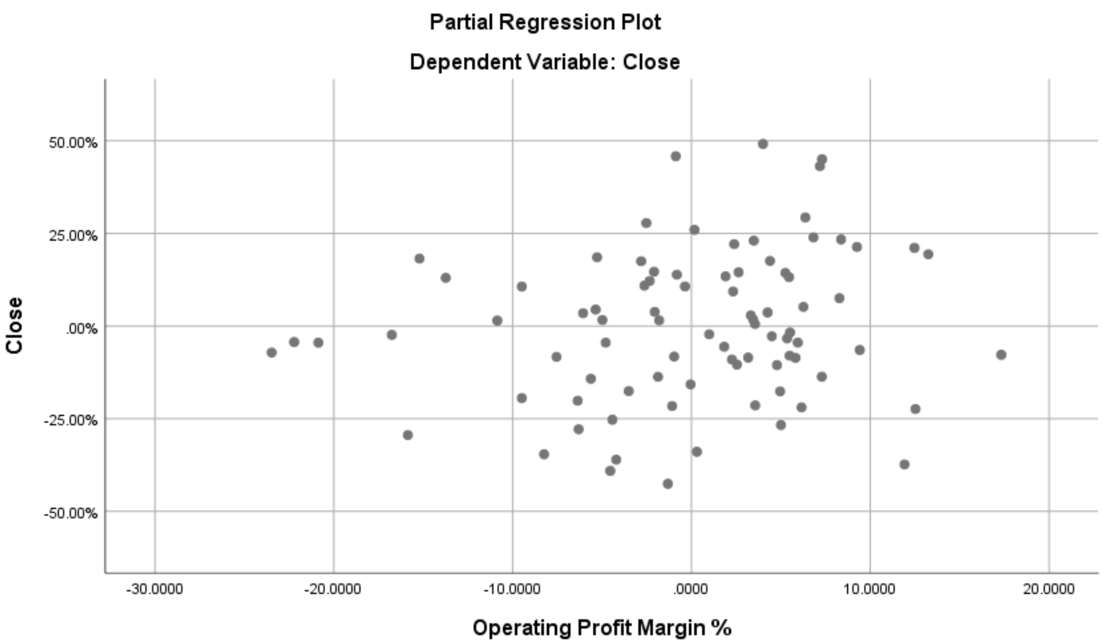
Model	Durbin-Watson
1	1.769[a]

1.4 The dependent variable has a linear relationship with each of the independent variables.

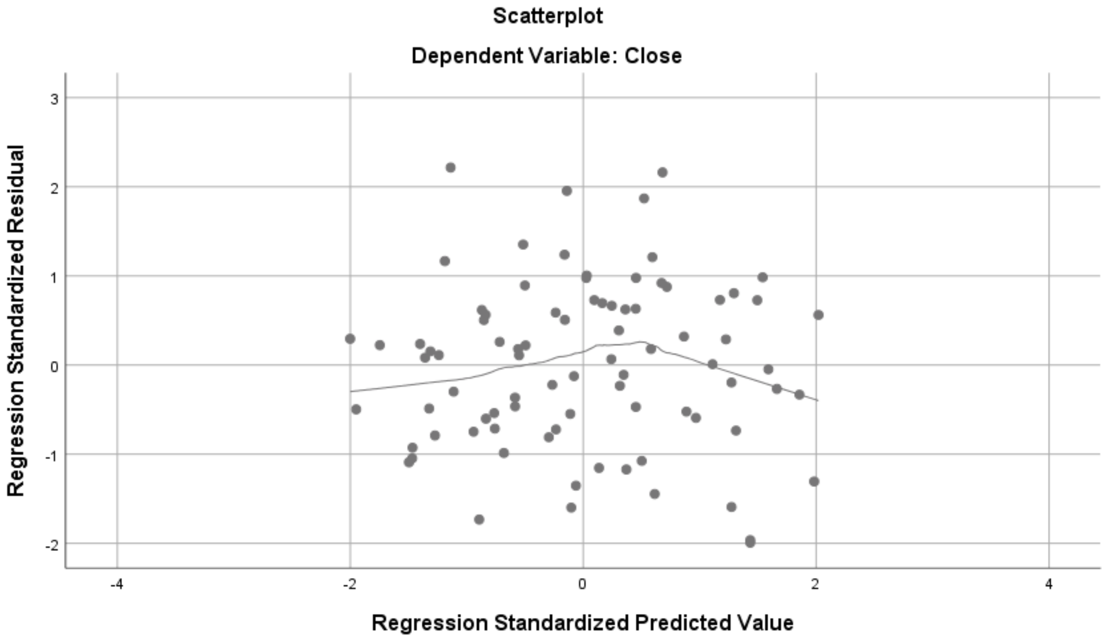
Final scatterplots based on stepwise regression variables identified



Partial regression plots on stepwise regression variables identified

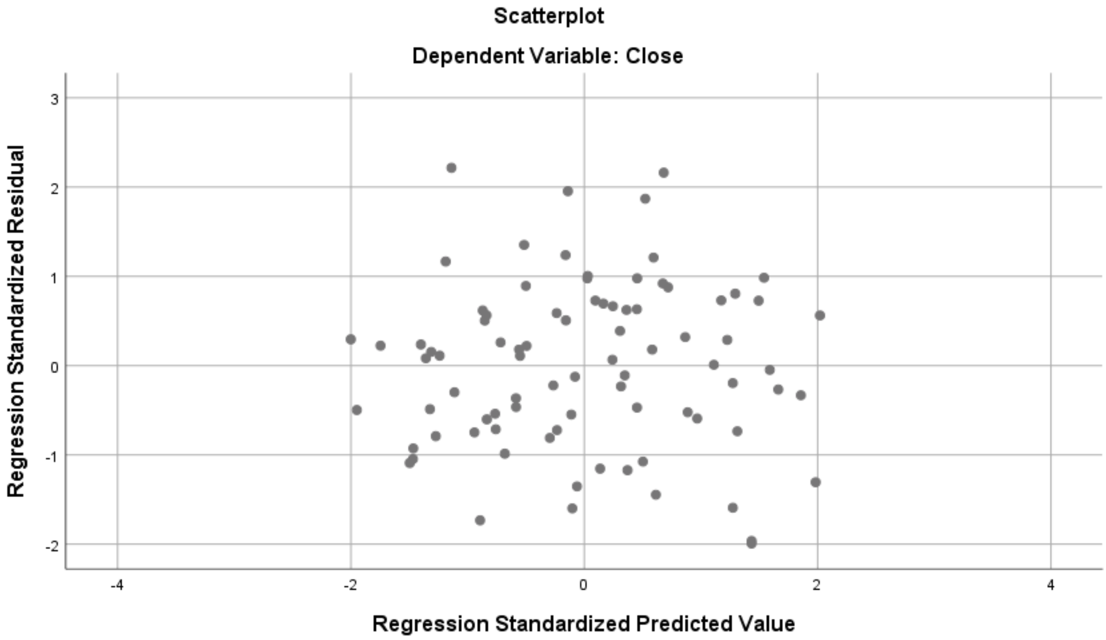


Standardized residual values versus standardized predicted values scatterplot (With Loess curve)



1.5 The data is homoscedastic.

Standardised residual values versus the standardized predicted values scatterplot



Koenker Test

```
------- ANOVA TABLE  --------
                 SS          df          MS           F         Sig
Model        25,213      12,000       2,101       1,247        ,235
Residual    121,273      72,000       1,684    -999,000    -999,000

------- Breusch-Pagan and Koenker test statistics and sig-values --------
                LM          Sig
BP          12,607         ,398
Koenker     14,630         ,262

Null hypothesis: heteroskedasticity not present (homoskedasticity).

If sig-value less than 0.05, reject the null hypothesis.
```

1.6 There is no multicollinearity.

VIF and Tolerance factor

Coefficients[a]

Model		Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	Current Ratio	.730	1.370
	Debt / Assets	.179	5.592
	Debt / Equity	.114	8.779
	Dividend Yield %	.658	1.520
	Interest Cover	.325	3.078
	Net Profit Margin %	.405	2.470
	Operating Profit Margin %	.146	6.865
	Price / Book Value	.148	6.762
	Price / Cash Flow	.661	1.514
	Price / Earnings	.360	2.777
	Return On Equity %	.127	7.891
	Total Assets Turnover	.359	2.785

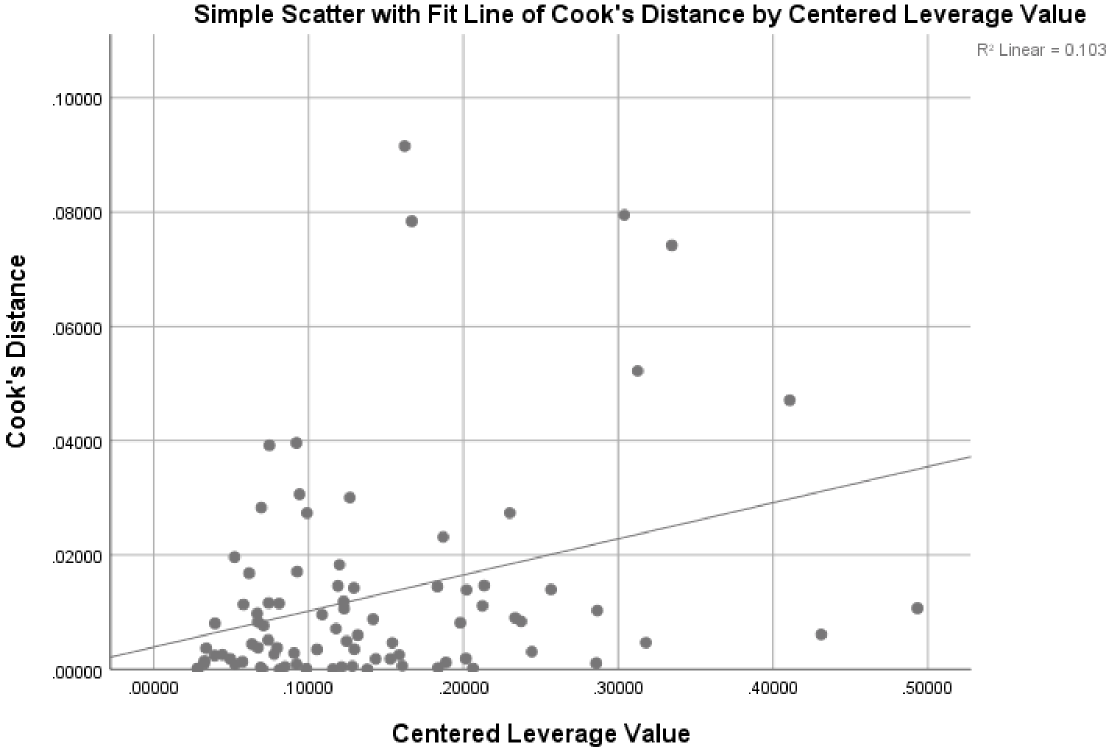
a. Dependent Variable: Close

1.7 The data is free from significant outliers, highly influential points or highly leveraged points.

Casewise Diagnostics

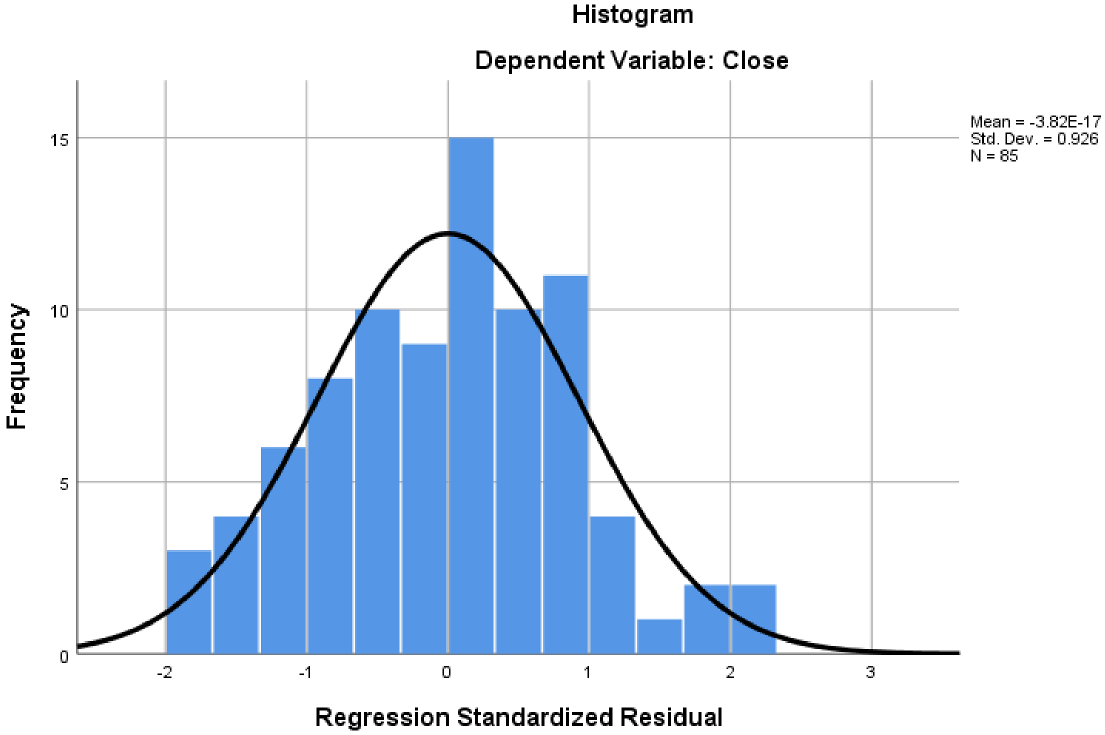
N/A

Cook's distance vs Centred leverage value (Final after removal of outliers, highly influential and leveraged points)

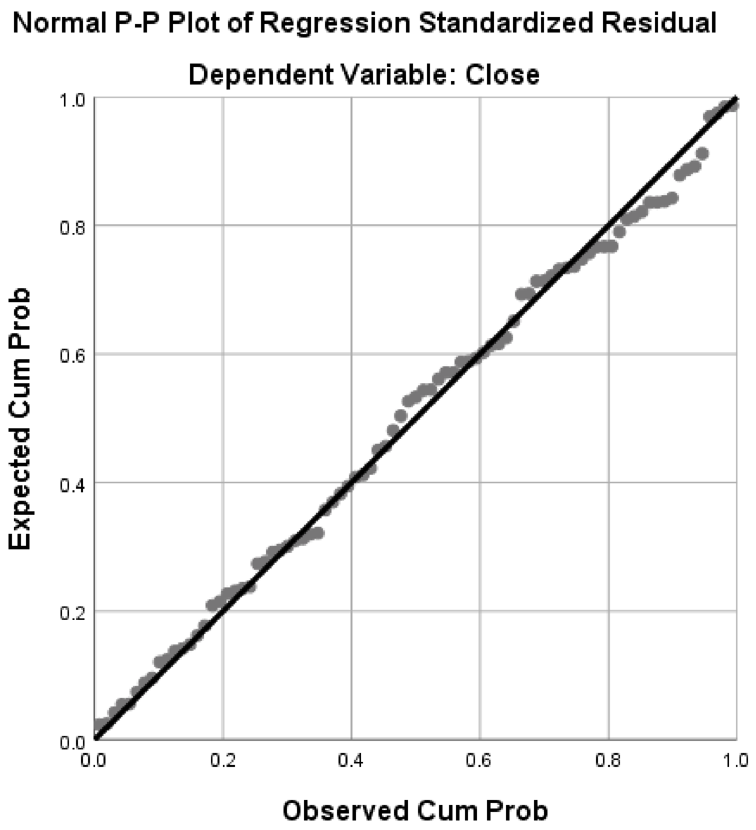


1.8 The residuals (errors) are approximately normally distributed.

Histogram of regression standardized residuals



Normal P-P plot of regression standardized residual



Skewness & Kurtosis

Skewness	.055
Kurtosis	-.220

Shapiro-Wilk

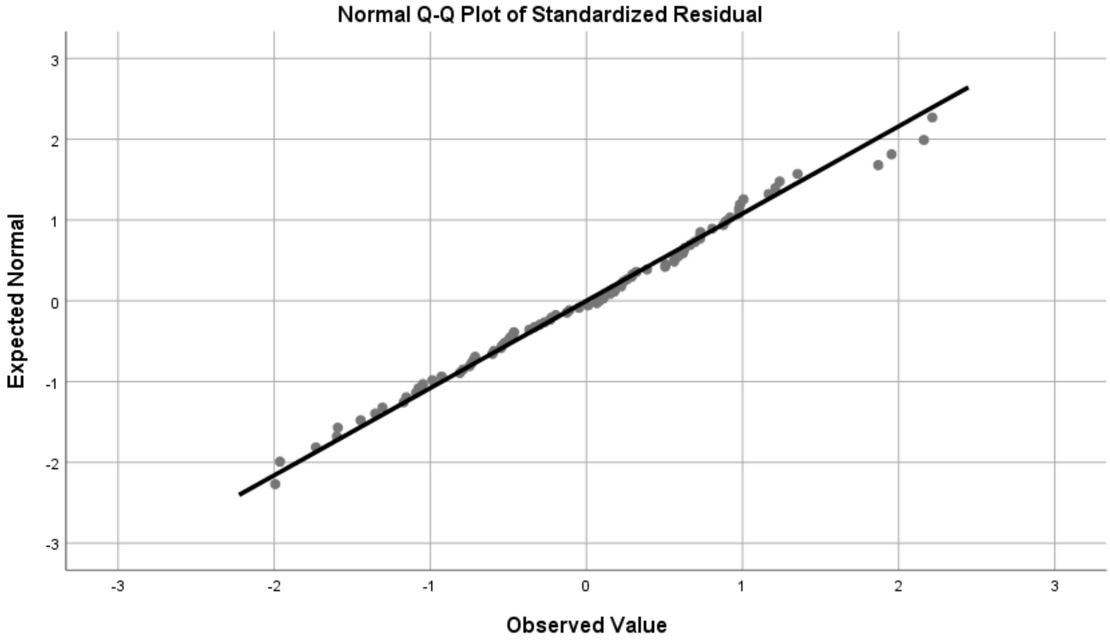
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.048	85	.200*	.990	85	.732
Standardized Residual	.048	85	.200*	.990	85	.732

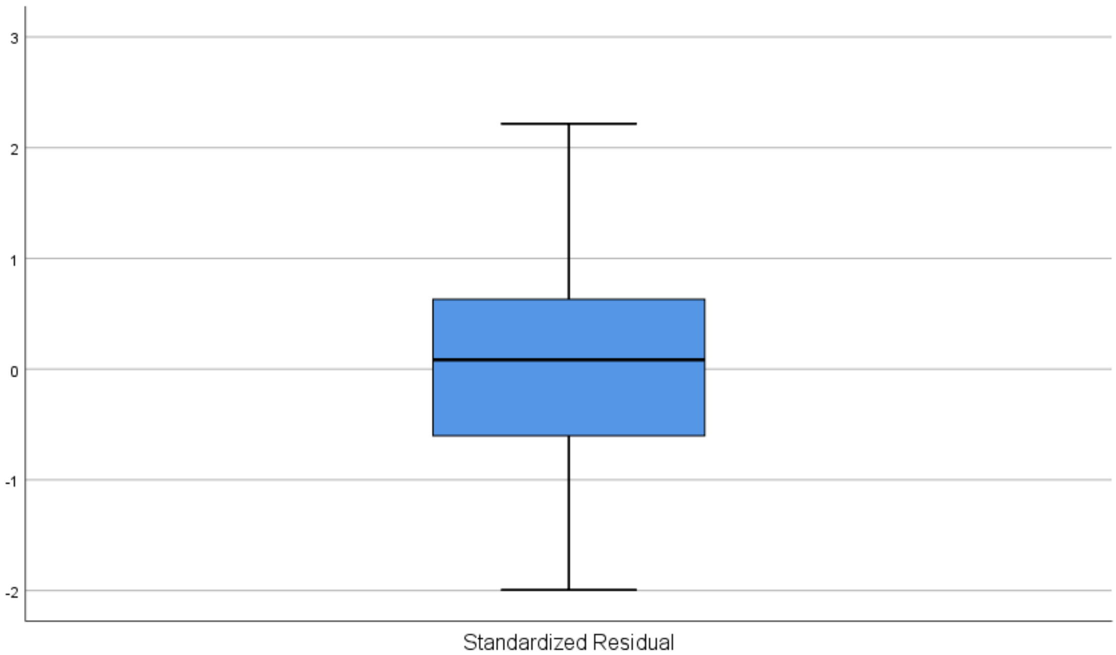
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Normal Q-Q plot of Standardized Residuals



Box Plot



2. Automatic Stepwise Regression Outputs

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Operating Profit Margin %	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).

a. Dependent Variable: Close

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.269[a]	.073	.061	21.16437%	.073	6.494	1	83	.013	1.654

a. Predictors: (Constant), Operating Profit Margin %

b. Dependent Variable: Close

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2908.851	1	2908.851	6.494	.013[b]
	Residual	37178.229	83	447.930		
	Total	40087.081	84			

a. Dependent Variable: Close

b. Predictors: (Constant), Operating Profit Margin %

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	12.097	2.349		5.149	.000		
	Operating Profit Margin %	.284	.111	.269	2.548	.013	1.000	1.000

a. Dependent Variable: Close

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-3.5360%	20.8252%	10.8234%	5.88466%	85
Std. Predicted Value	-2.440	1.700	.000	1.000	85
Standard Error of Predicted Value	2.296	6.085	3.139	.835	85
Adjusted Predicted Value	-3.7319%	20.6305%	10.8081%	5.94667%	85
Residual	-47.58915%	46.30201%	0.00000%	21.03801%	85
Std. Residual	-2.249	2.188	.000	.994	85
Stud. Residual	-2.264	2.216	.000	1.005	85
Deleted Residual	-48.24315%	47.48989%	0.01530%	21.48496%	85
Stud. Deleted Residual	-2.323	2.270	.000	1.012	85
Mahal. Distance	.000	5.954	.988	1.121	85
Cook's Distance	.000	.063	.011	.013	85
Centered Leverage Value	.000	.071	.012	.013	85

a. Dependent Variable: Close

Hypothesis 4: Real Estate Investment Trusts

Please note all outputs are the final outputs after tests were rerun accept if otherwise indicated.

1. Regression Assumptions

1.1 One independent variable is used which is measured on a continues scale.

Variable	**Description**
Close	Percentage change in closing share price from previous period

1.2 Two or more independent variables are used.

No.	**Variable**
1	Current Ratio
2	Interest Cover
3	Debt to Equity
4	Debt to Assets
5	Return on Equity
6	Return on Assets
7	Return on Capital Employed
8	Net profit margin
9	Operating profit margin
10	Total asset turnover
11	Price-earnings ratio
12	Price-to-book ratio
13	Price-to-cash-flow
14	Dividend yield

1.3 Independence of observations exists.

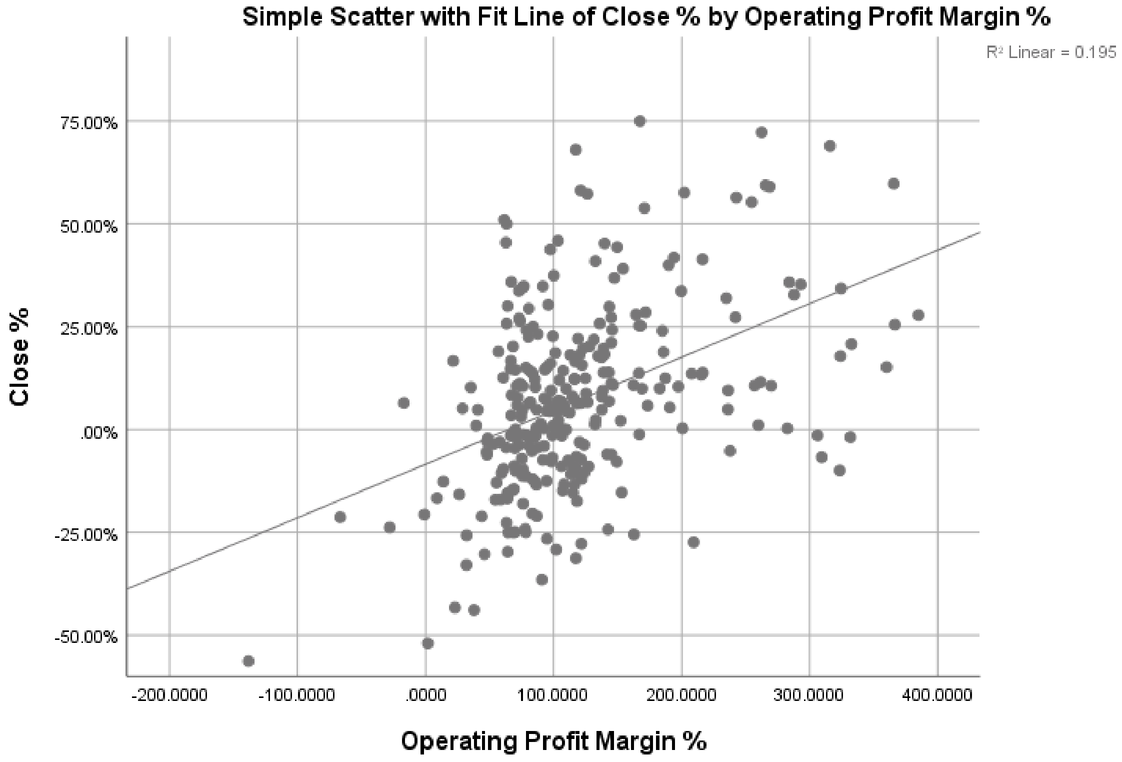
Durbin Watson

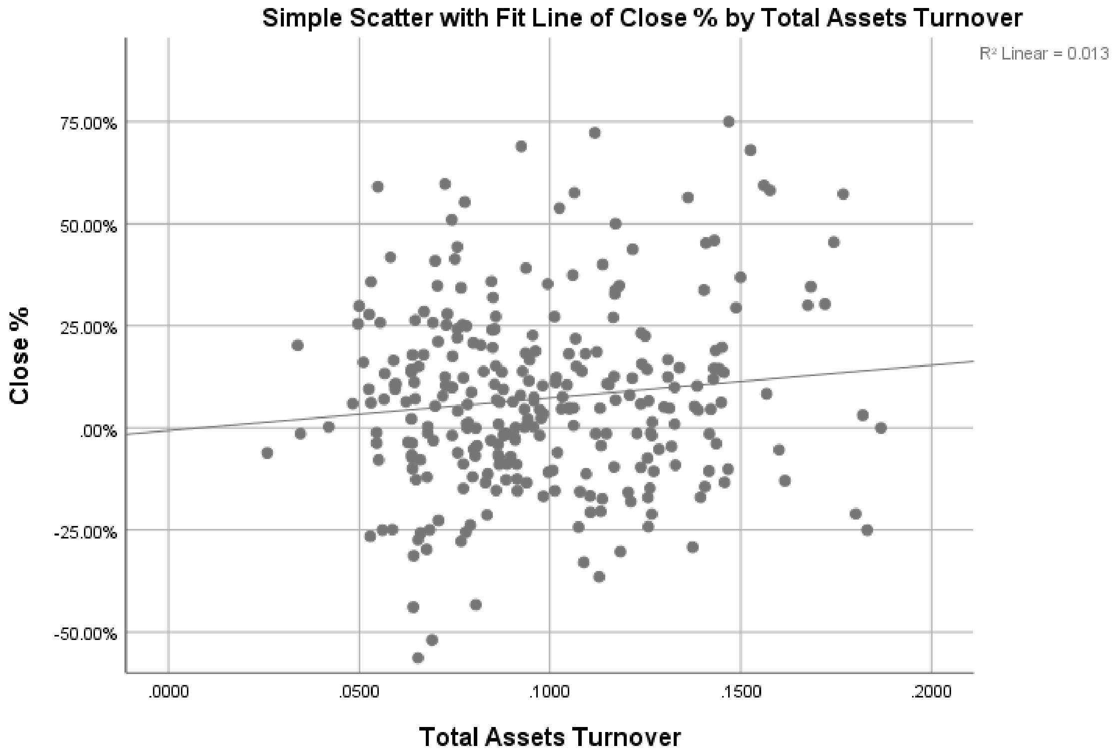
Model Summary[b]

Model	Durbin-Watson
1	2.124[a]

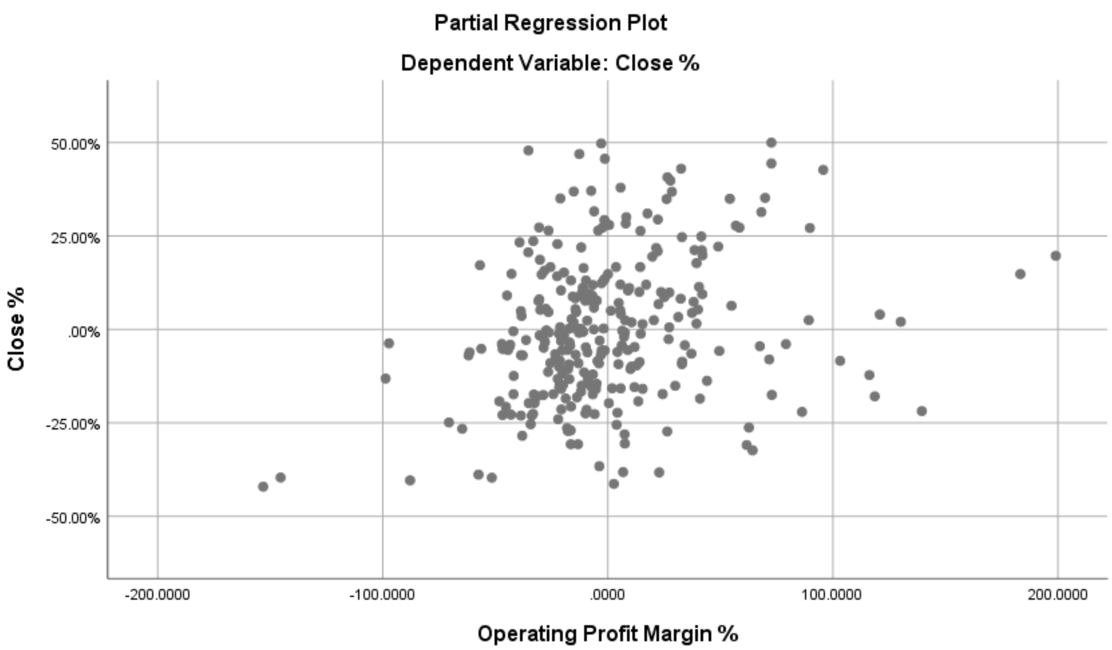
1.4 The dependent variable has a linear relationship with each of the independent variables.

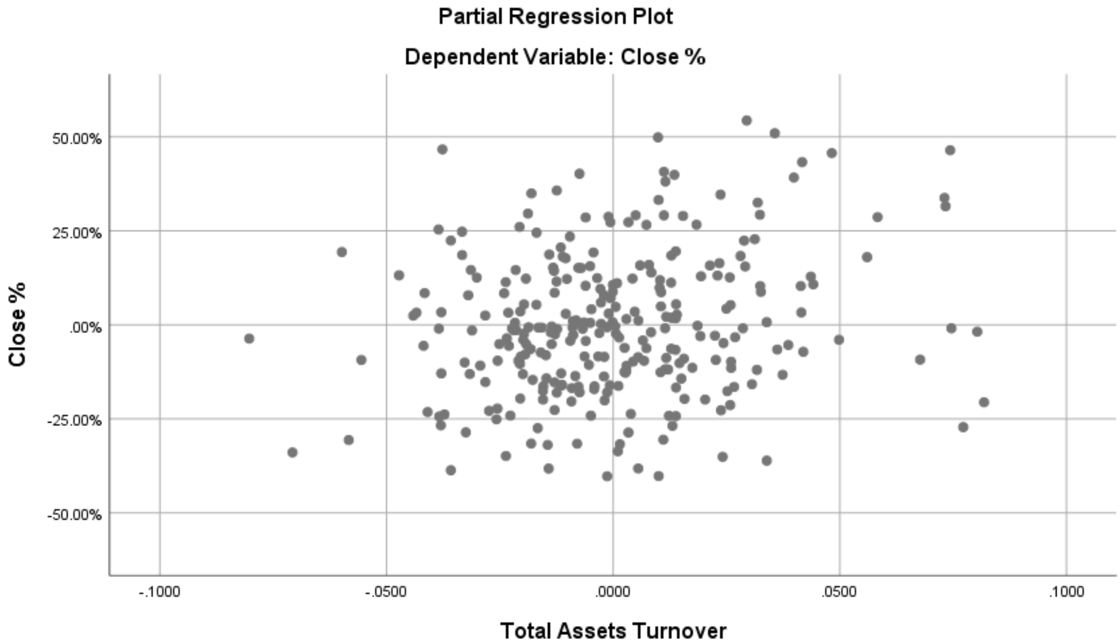
Final scatterplots based on stepwise regression variables identified

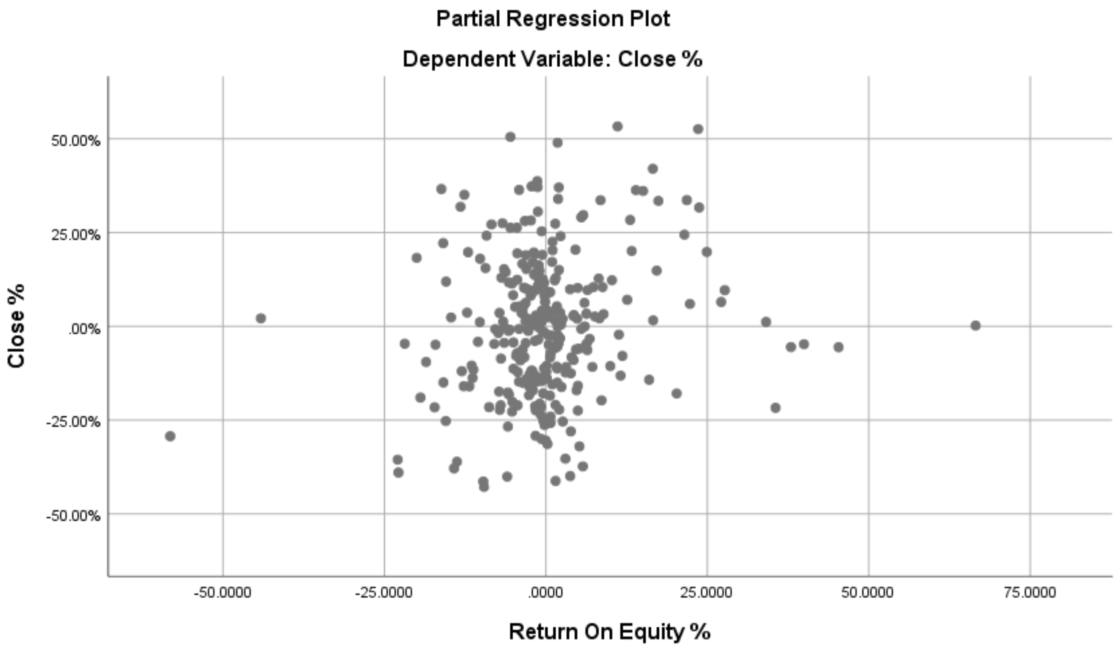




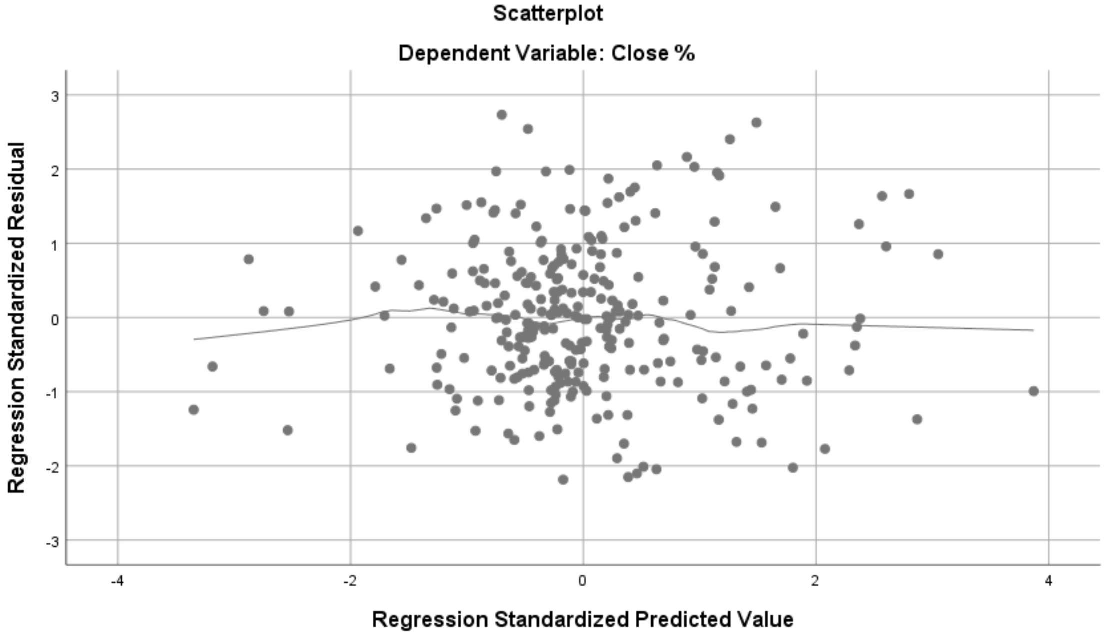
Partial regression plots on stepwise regression variables identified




Partial Regression Plot
Dependent Variable: Close %
50.00%
25.00%
.00%
-25.00%
-50.00%
Close %
-.1000
-.0500
.0000
.0500
.1000
Total Assets Turnover

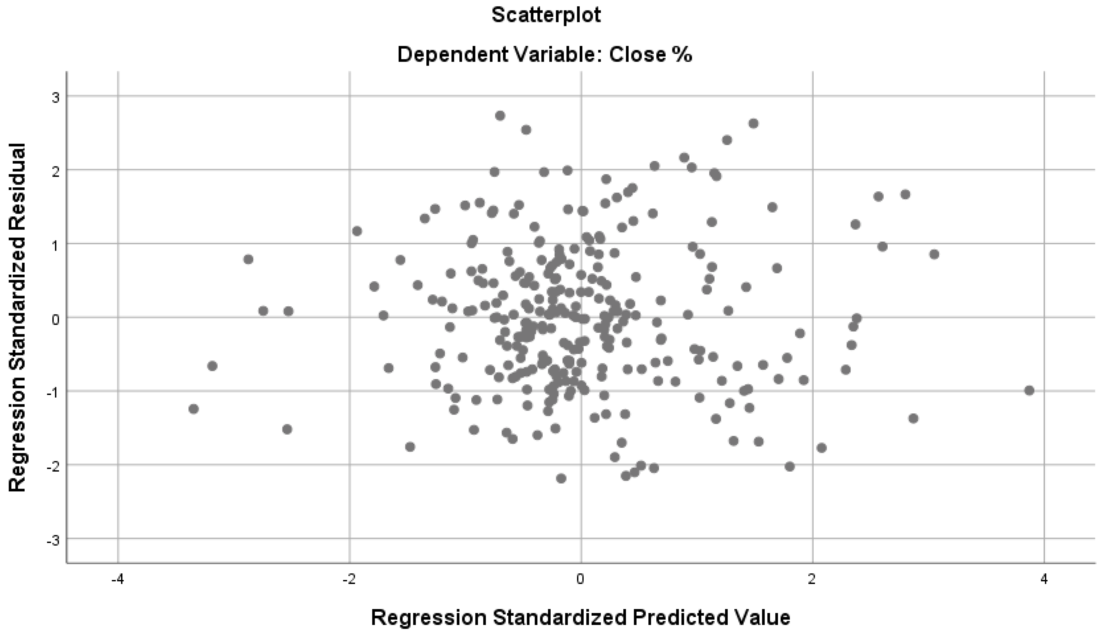

Partial Regression Plot
Dependent Variable: Close %
50.00%
25.00%
.00%
-25.00%
-50.00%
Close %
-50.0000
-25.0000
.0000
25.0000
50.0000
75.0000
Return On Equity %

Standardized residual values versus standardized predicted values scatterplot (With Loess curve)



1.5 The data is homoscedastic.

Standardised residual values versus the standardized predicted values scatterplot



Koenker Test

```
------- ANOVA TABLE  --------
                   SS          df          MS           F         Sig
Model          25,477      10,000       2,548       1,431        ,000
Residual      486,004     273,000       1,780    -999,000    -999,000

------- Breusch-Pagan and Koenker test statistics and sig-values --------
                 LM         Sig
BP           12,738        ,239
Koenker      14,146        ,166

Null hypothesis: heteroskedasticity not present (homoskedasticity).

If sig-value less than 0.05, reject the null hypothesis.
```

1.6 There is no multicollinearity.

VIF and Tolerance factor

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	Current Ratio	.816	1.225
	Interest Cover	.199	5.034
	Operating Profit Margin %	.312	3.203
	Price / Book Value	.733	1.364
	Price / Cash Flow	.923	1.083
	Price / Earnings	.948	1.055
	Return On Capital Employed %	.261	3.830
	Return On Equity %	.390	2.566
	Total Assets Turnover	.674	1.483
	INV_DA_3	.222	4.500

a. Dependent Variable: Close %

1.7 The data is free from significant outliers, highly influential points or highly leveraged points.

Casewise Diagnostics

Round 1

Casewise Diagnostics[a]

Case Number	Std. Residual	Close %	Predicted Value	Residual
181	3.280	77.78%	9.2984%	68.47935%

a. Dependent Variable: Close %

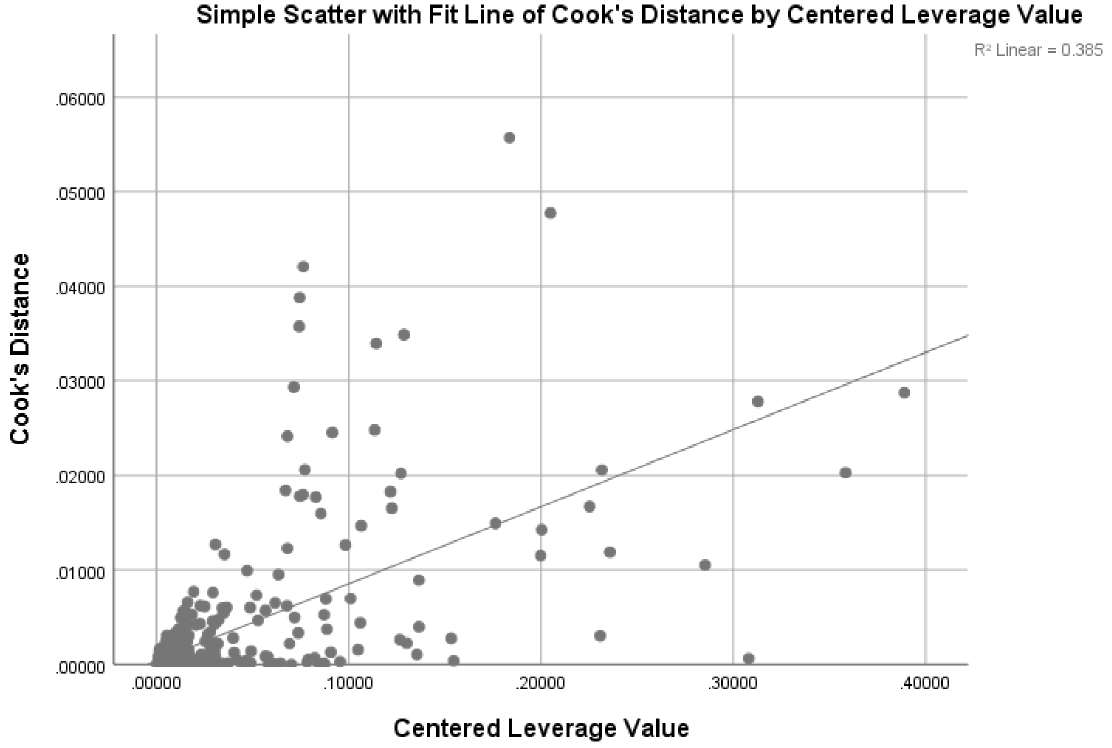
Round 2

Casewise Diagnostics[a]

Case Number	Std. Residual	Close %	Predicted Value	Residual
204	3.173	83.33%	18.2989%	65.03447%

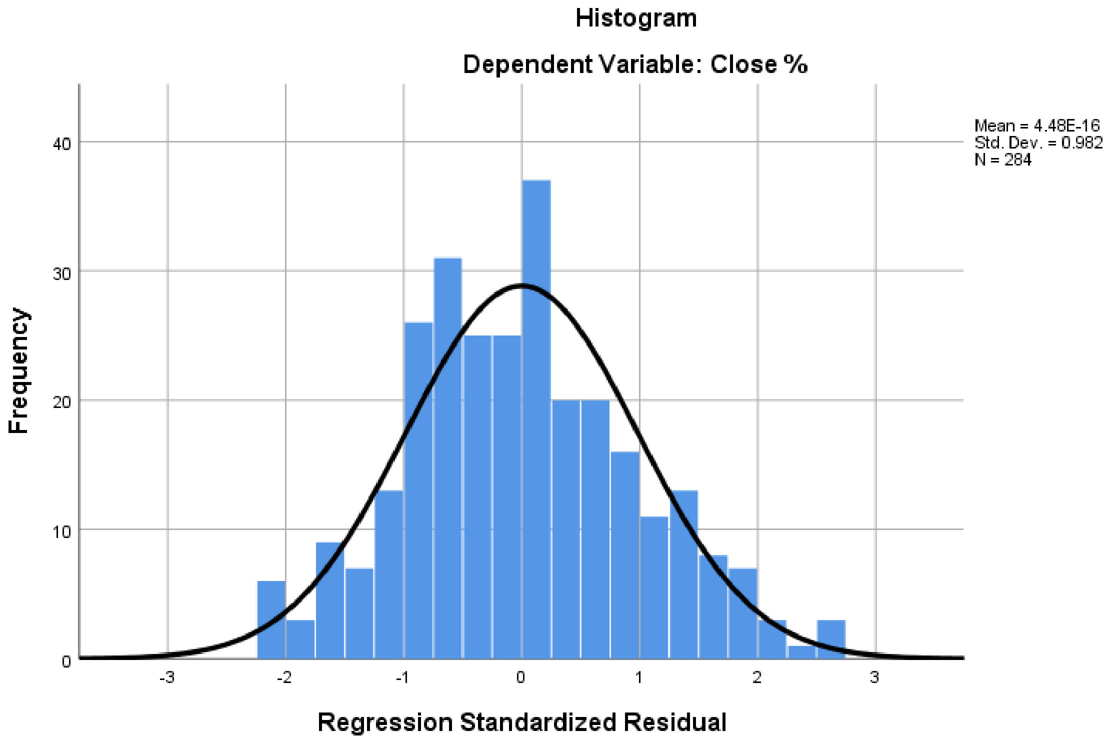
a. Dependent Variable: Close %

Cook's distance vs Centred leverage value (Final after removal of outliers, highly influential and leveraged points)

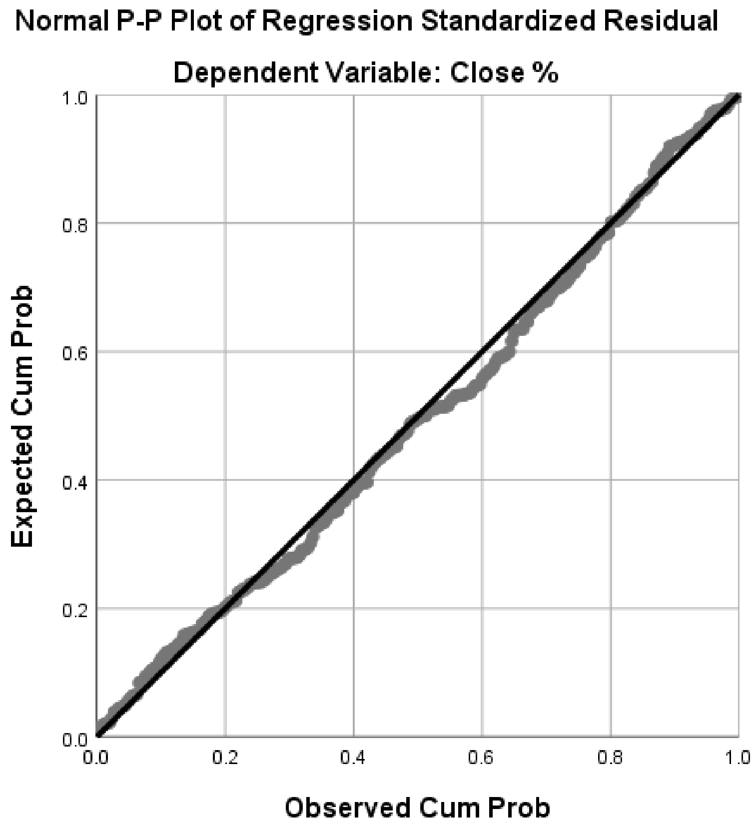


1.8 The residuals (errors) are approximately normally distributed.

Histogram of regression standardized residuals



Normal P-P plot of regression standardized residual



Skewness & Kurtosis

Skewness	.268
Kurtosis	-.181

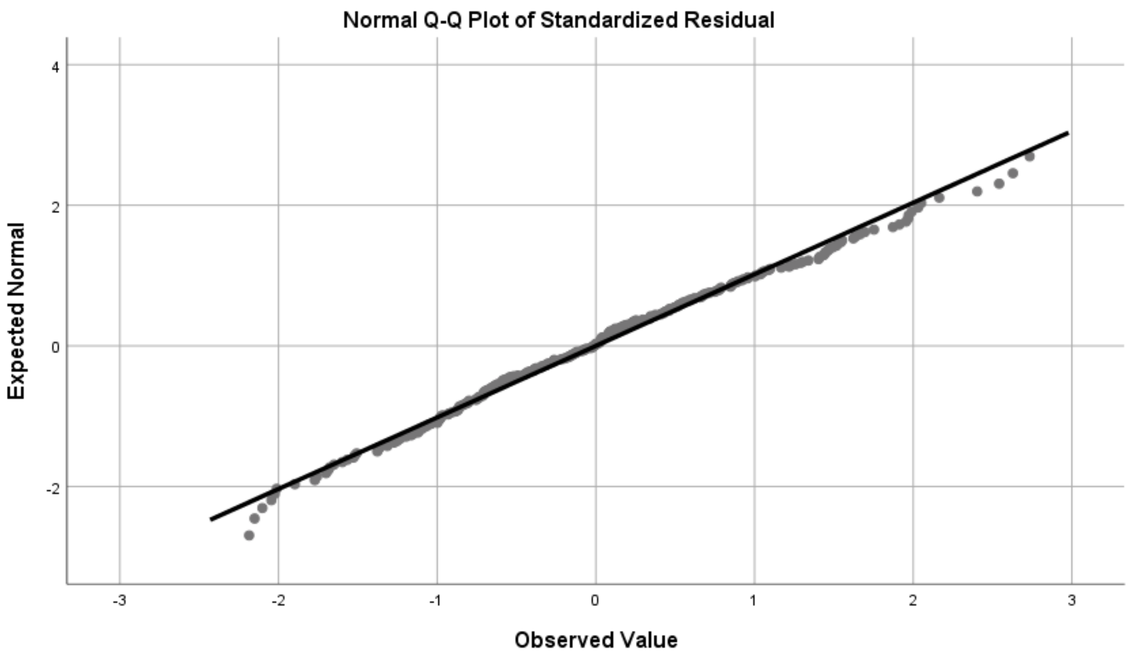
Shapiro-Wilk

Tests of Normality

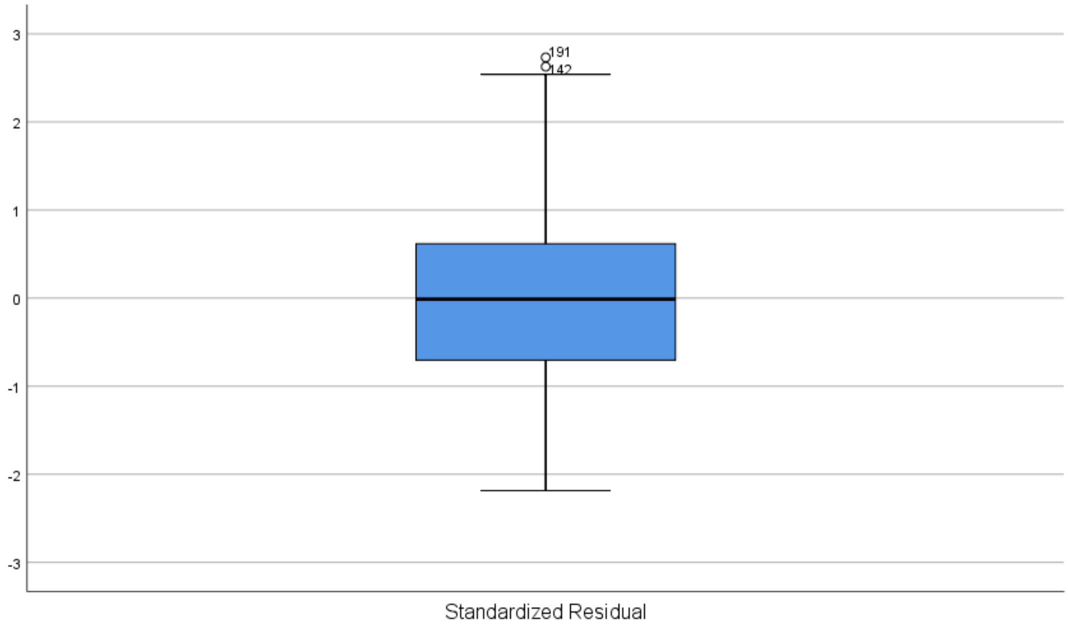
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.049	284	.098	.991	284	.083
Unstandardized Residual	.049	284	.098	.991	284	.083

a. Lilliefors Significance Correction

Normal Q-Q plot of Standardized Residuals



Box Plot



2. Automatic Stepwise Regression Outputs

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Operating Profit Margin %	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Total Assets Turnover	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Return On Equity %	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Close %

Model 3 below is the final stepwise multiple linear regression model

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.442[a]	.195	.192	19.93713%	.195	68.284	1	282	.000	
2	.506[b]	.256	.250	19.20441%	.061	22.929	1	281	.000	
3	.521[c]	.271	.263	19.03568%	.016	6.003	1	280	.015	2.117

a. Predictors: (Constant), Operating Profit Margin %

b. Predictors: (Constant), Operating Profit Margin %, Total Assets Turnover

c. Predictors: (Constant), Operating Profit Margin %, Total Assets Turnover, Return On Equity %

d. Dependent Variable: Close %

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27142.100	1	27142.100	68.284	.000[b]
	Residual	112091.922	282	397.489		
	Total	139234.022	283			
2	Regression	35598.601	2	17799.301	48.262	.000[c]
	Residual	103635.420	281	368.809		
	Total	139234.022	283			
3	Regression	37774.011	3	12591.337	34.748	.000[d]
	Residual	101460.010	280	362.357		
	Total	139234.022	283			

a. Dependent Variable: Close %

b. Predictors: (Constant), Operating Profit Margin %

c. Predictors: (Constant), Operating Profit Margin %, Total Assets Turnover

d. Predictors: (Constant), Operating Profit Margin %, Total Assets Turnover, Return On Equity %

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	-8.423	2.232		-3.774	.000		
	Operating Profit Margin %	.130	.016	.442	8.263	.000	1.000	1.000
2	(Constant)	-28.564	4.724		-6.047	.000		
	Operating Profit Margin %	.151	.016	.513	9.570	.000	.923	1.083
	Total Assets Turnover	179.714	37.531	.256	4.788	.000	.923	1.083
3	(Constant)	-24.342	4.989		-4.879	.000		
	Operating Profit Margin %	.115	.021	.391	5.396	.000	.494	2.022
	Total Assets Turnover	147.025	39.521	.210	3.720	.000	.818	1.222
	Return On Equity %	.210	.086	.171	2.450	.015	.532	1.878

a. Dependent Variable: Close %

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-33.7469%	49.0391%	7.2156%	11.55323%	284
Std. Predicted Value	-3.546	3.620	.000	1.000	284
Standard Error of Predicted Value	1.136	6.870	2.066	.917	284
Adjusted Predicted Value	-32.1114%	51.2419%	7.2495%	11.57703%	284
Residual	-41.54802%	56.65431%	0.00000%	18.93452%	284
Std. Residual	-2.183	2.976	.000	.995	284
Stud. Residual	-2.188	2.990	-.001	1.003	284
Deleted Residual	-41.74118%	57.18510%	-0.03384%	19.24927%	284
Stud. Deleted Residual	-2.203	3.034	.000	1.006	284
Mahal. Distance	.012	35.861	2.989	4.374	284
Cook's Distance	.000	.041	.004	.008	284
Centered Leverage Value	.000	.127	.011	.015	284

a. Dependent Variable: Close %

Hypothesis 5: Mobile Telecommunications

Please note all outputs are the final outputs after tests were rerun accept if otherwise indicated.

1. Regression Assumptions

1.1 One independent variable is used which is measured on a continues scale.

Variable	Description
Close	Percentage change in closing share price from previous period

1.2 Two or more independent variables are used.

No.	Variable
1	Current Ratio
2	Interest Cover
3	Debt to Equity
4	Debt to Assets
5	Return on Equity
6	Return on Assets
7	Return on Capital Employed
8	Net profit margin
9	Operating profit margin
10	Total asset turnover
11	Price-earnings ratio
12	Price-to-book ratio
13	Price-to-cash-flow
14	Dividend yield

1.3 Independence of observations exists.

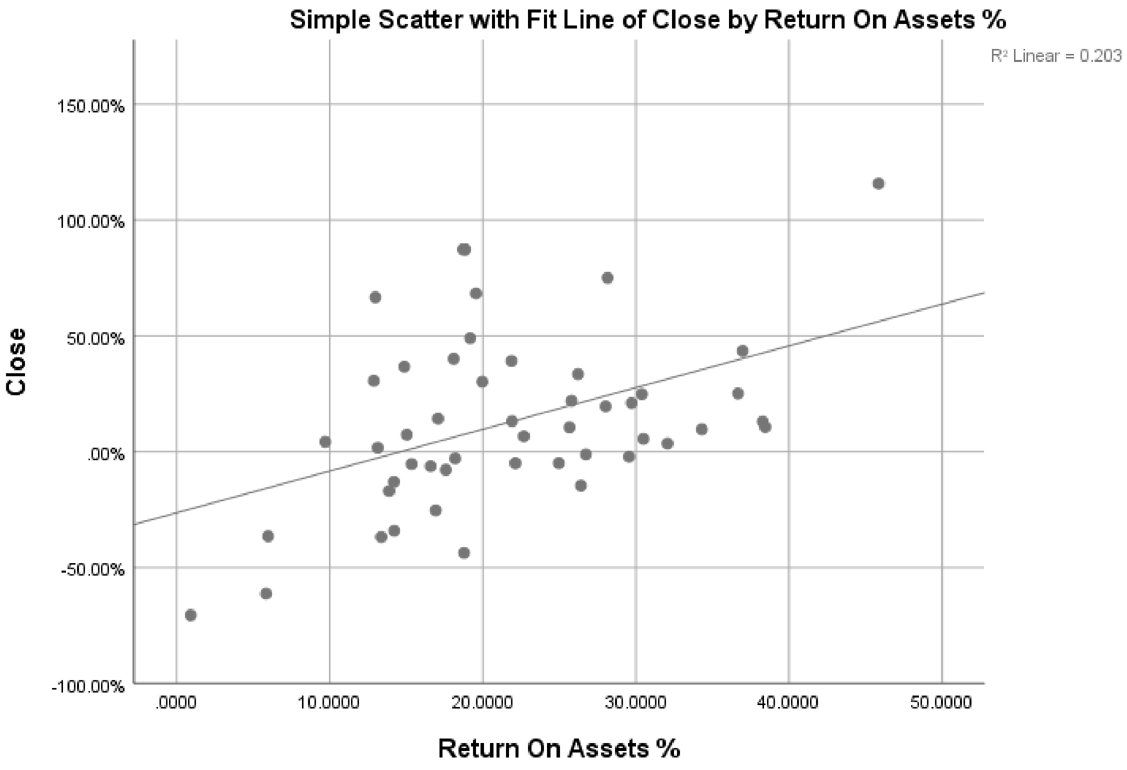
Durbin Watson

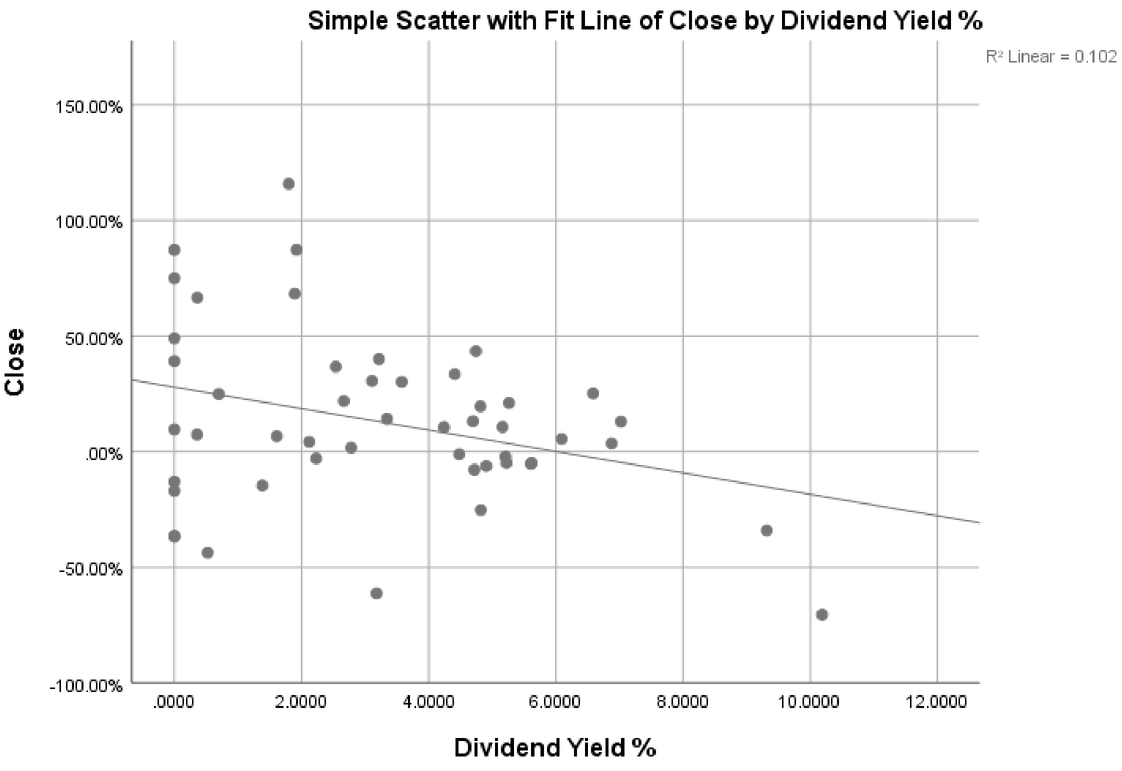
Model Summary[b]

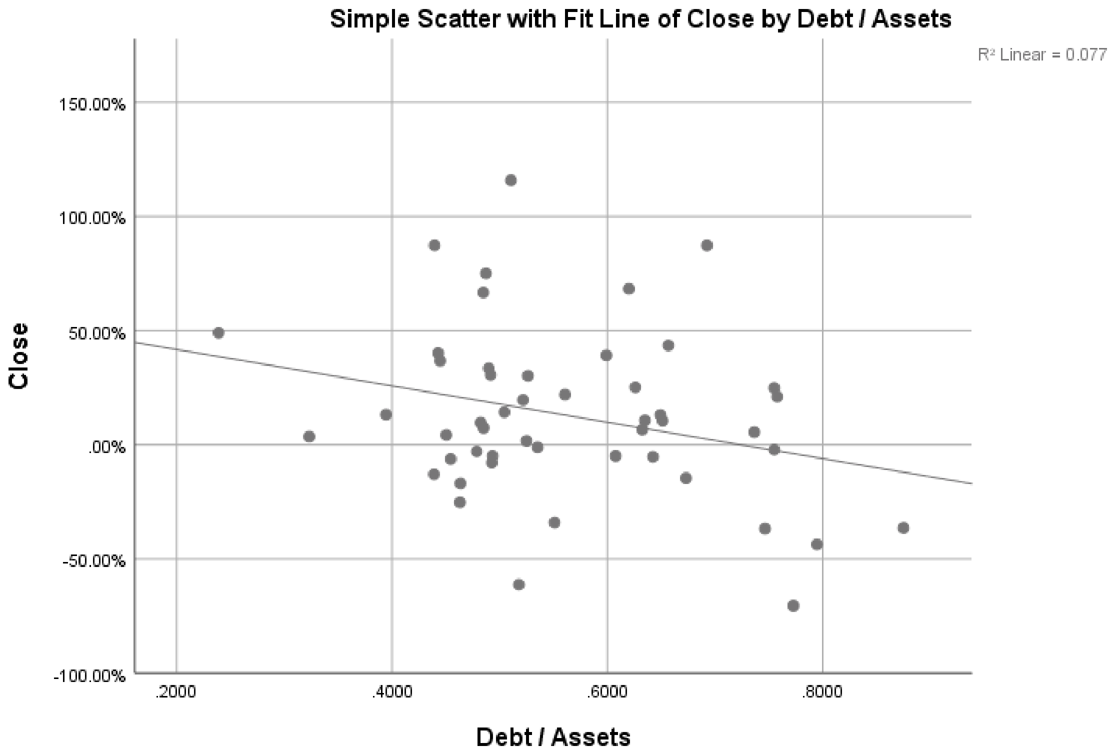
Model	Durbin-Watson
1	1.665[a]

1.4 The dependent variable has a linear relationship with each of the independent variables.

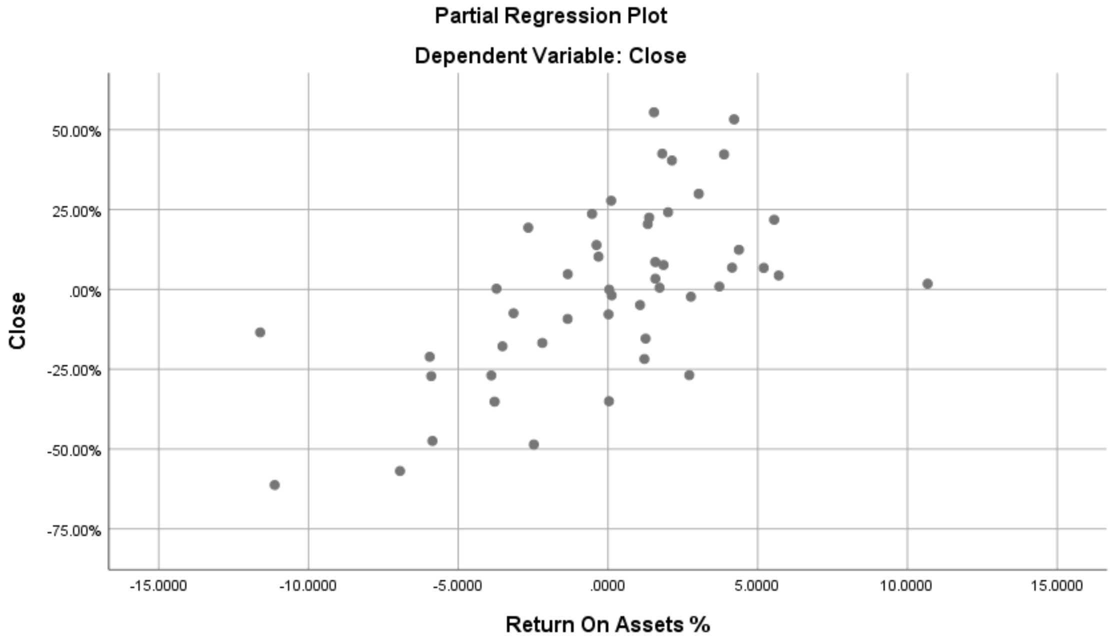
Final scatterplots based on stepwise regression variables identified

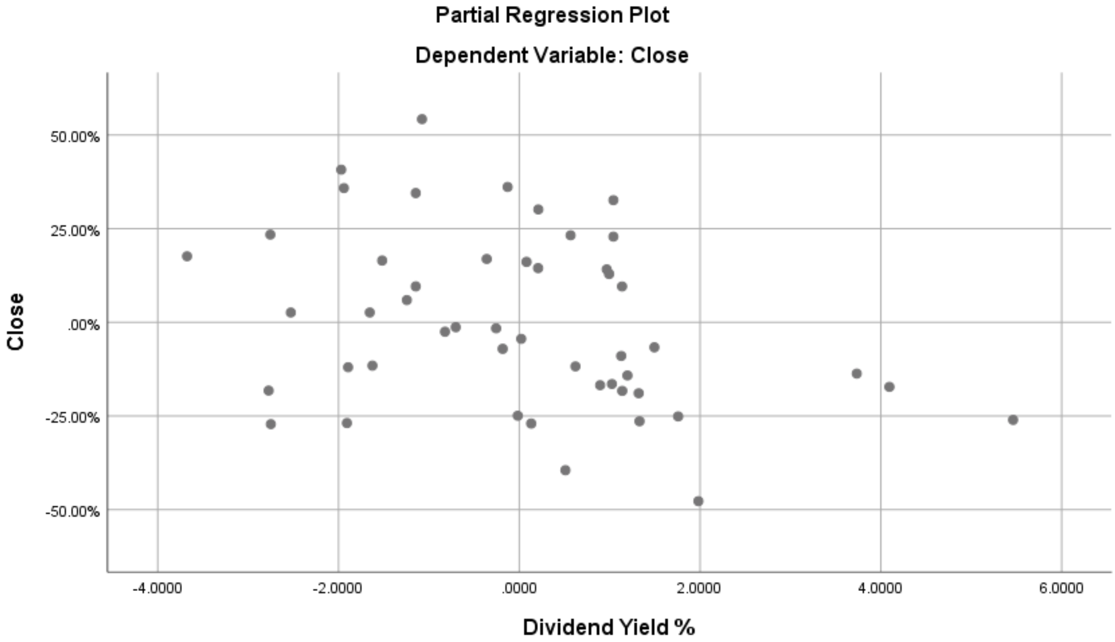


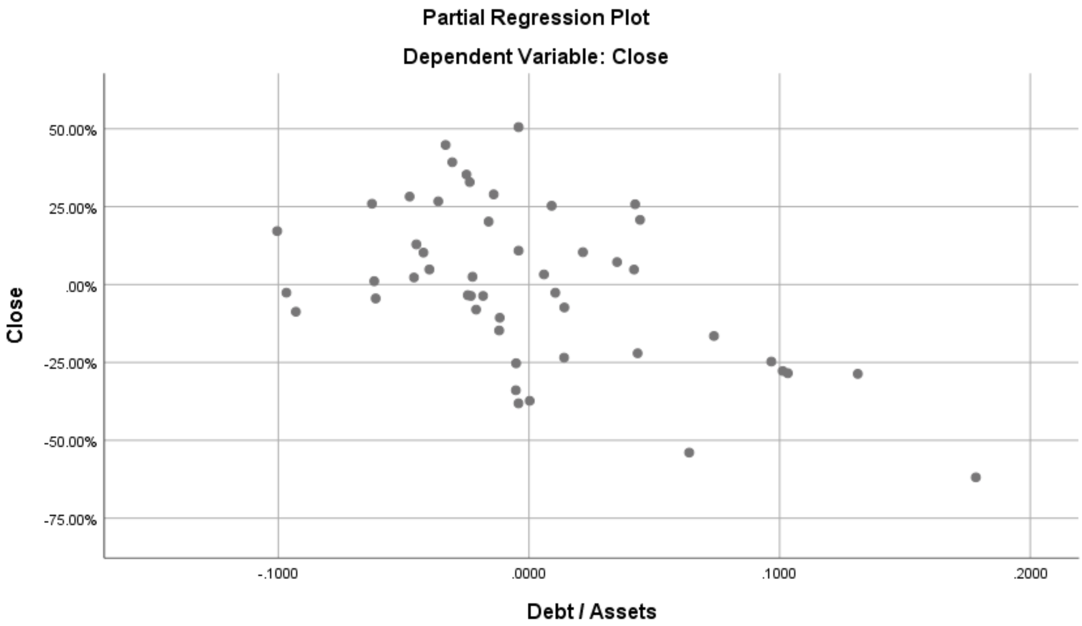




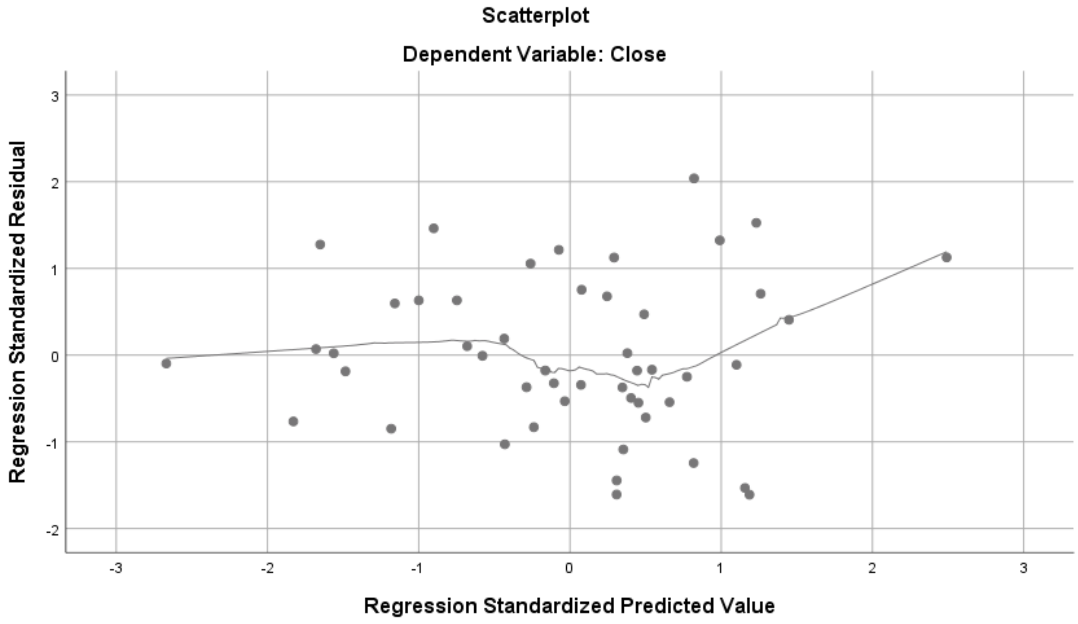
Partial regression plots on stepwise regression variables identified




Partial Regression Plot
Dependent Variable: Close
Close
50.00%
25.00%
.00%
-25.00%
-50.00%
-4.0000
-2.0000
.0000
2.0000
4.0000
6.0000
Dividend Yield %

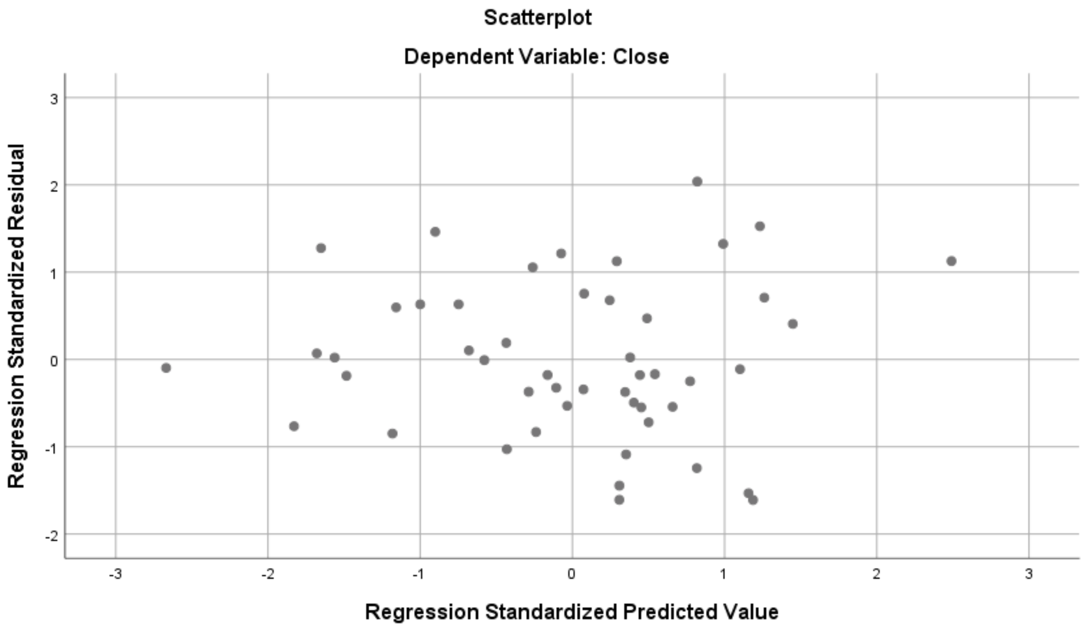

Partial Regression Plot
Dependent Variable: Close
Close
50.00%
25.00%
.00%
-25.00%
-50.00%
-75.00%
-.1000
.0000
.1000
.2000
Debt / Assets

Standardized residual values versus standardized predicted values scatterplot (With Loess curve)



1.5 The data is homoscedastic.

Standardised residual values versus the standardized predicted values scatterplot



Koenker Test

```
------- ANOVA TABLE  --------
                    SS          df          MS           F         Sig
Model           17,514      10,000       1,751       1,287        ,000
Residual        51,697      38,000       1,360    -999,000    -999,000

------- Breusch-Pagan and Koenker test statistics and sig-values --------
                   LM          Sig
BP              8,757         ,555
Koenker        12,399         ,259

Null hypothesis: heteroskedasticity not present (homoskedasticity).

If sig-value less than 0.05, reject the null hypothesis.
```

1.6 There is no multicollinearity.

VIF and Tolerance factor

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Current Ratio	.166	6.040
	Debt / Assets	.192	5.203
	Debt / Equity	.279	3.587
	Dividend Yield %	.497	2.011
	Interest Cover	.474	2.112
	Price / Cash Flow	.204	4.912
	Price / Earnings	.204	4.897
	Return On Assets %	.203	4.930
	Return On Capital Employed %	.134	7.478
	Total Assets Turnover	.329	3.037

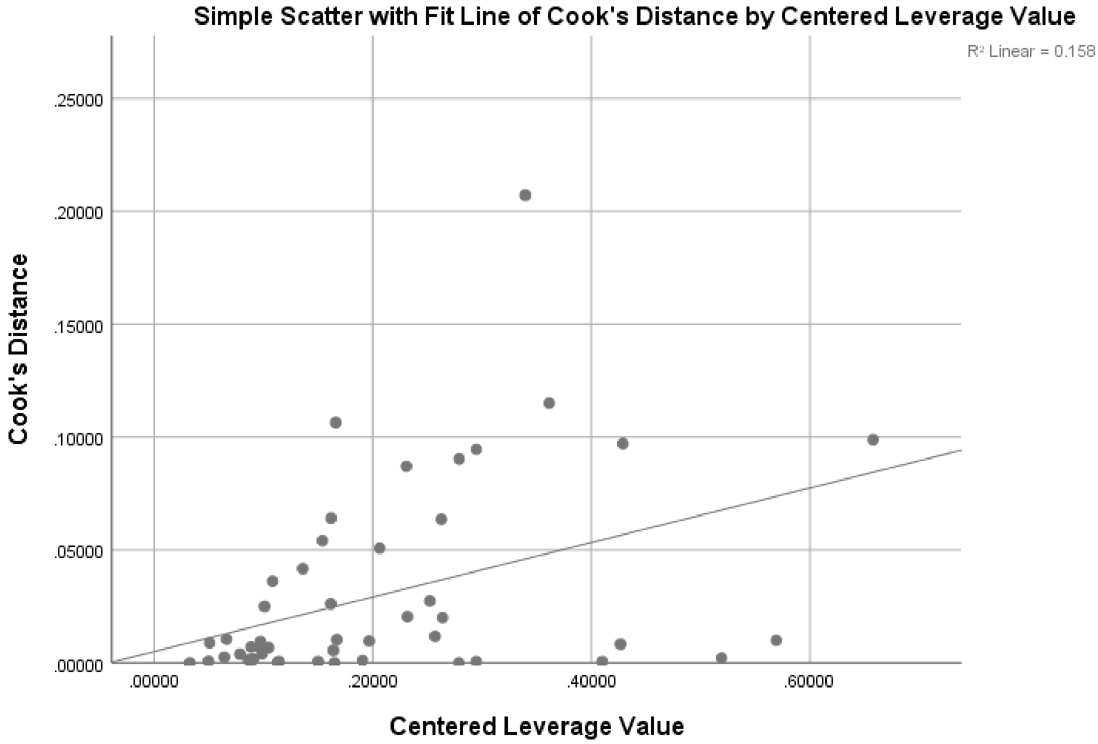
a. Dependent Variable: Close

1.7 The data is free from significant outliers, highly influential points or highly leveraged points.

Casewise Diagnostics

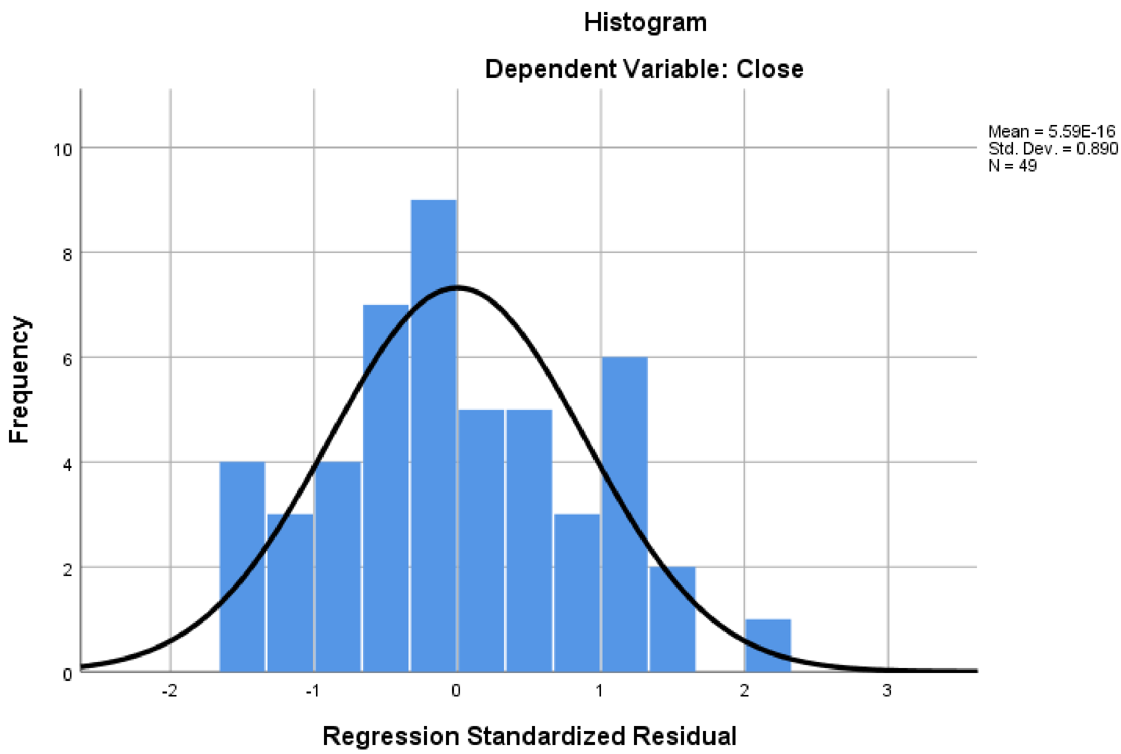
N/A

Cook's distance vs Centred leverage value (Final after removal of outliers, highly influential and leveraged points)

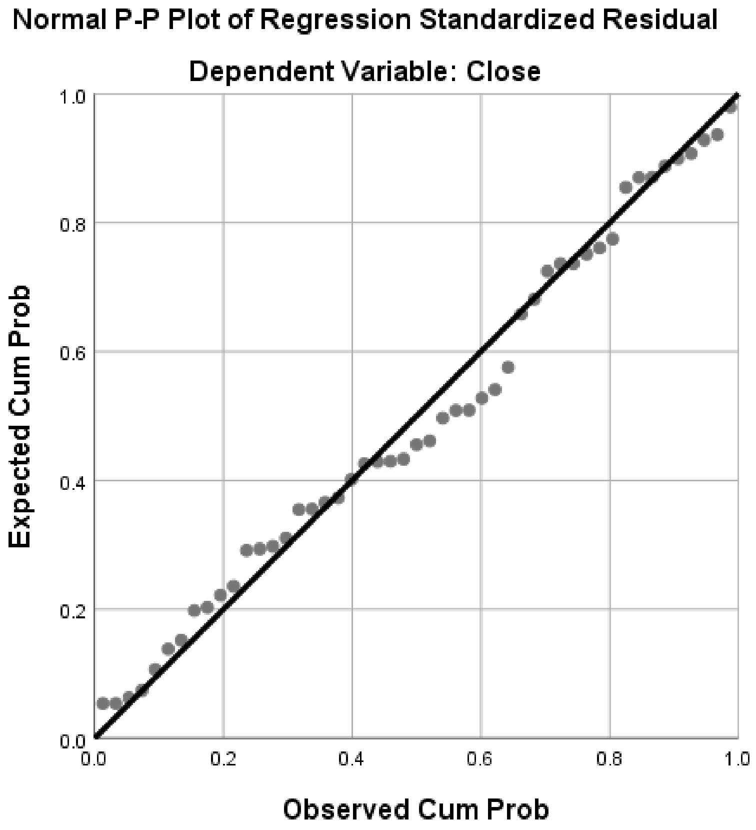


1.8 The residuals (errors) are approximately normally distributed.

Histogram of regression standardized residuals



Normal P-P plot of regression standardized residual



Skewness & Kurtosis

Skewness	.163
Kurtosis	-.519

Shapiro-Wilk

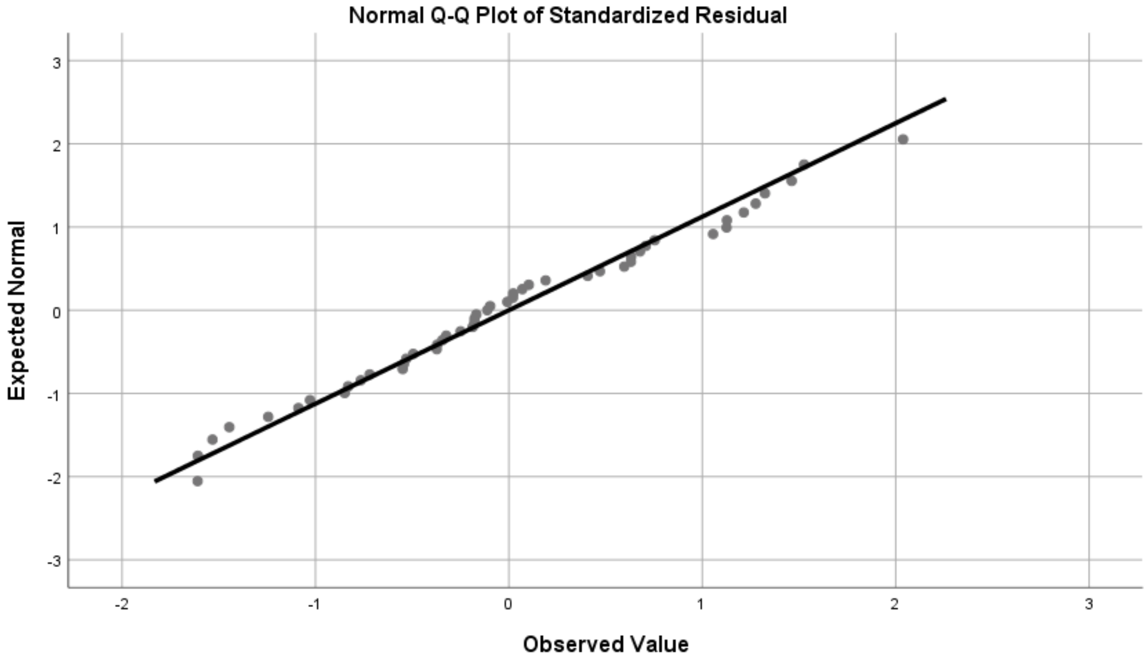
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.087	49	.200*	.979	49	.529
Unstandardized Residual	.087	49	.200*	.979	49	.529

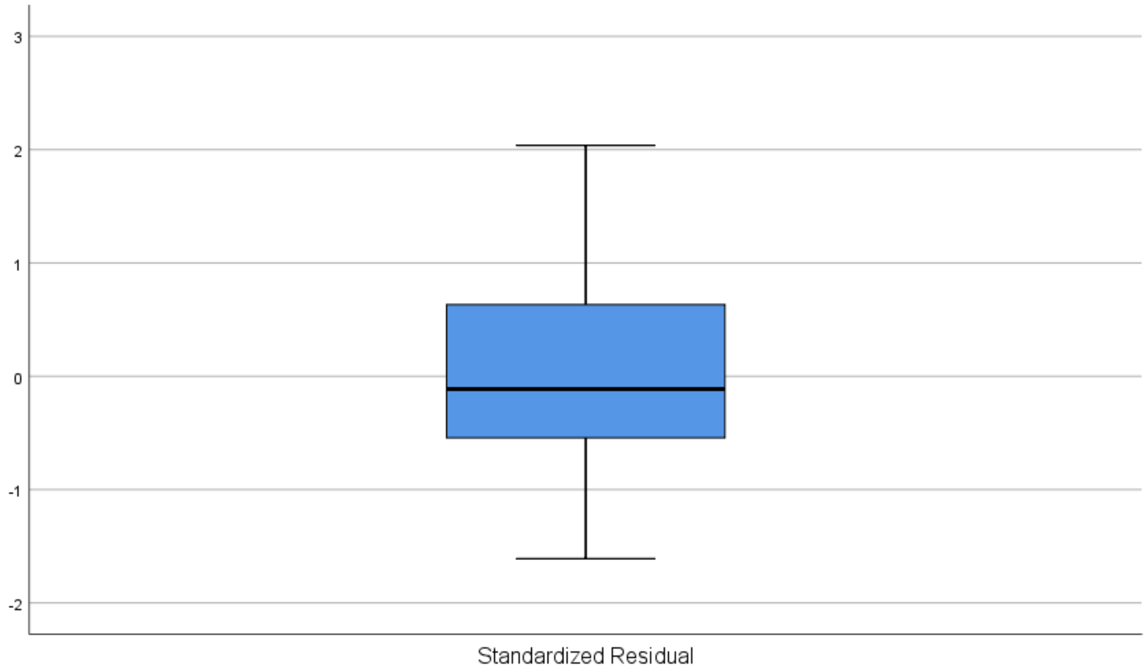
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Normal Q-Q plot of Standardized Residuals



Box Plot



2. Automatic Stepwise Regression Outputs

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Return On Assets %	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Dividend Yield %	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Debt / Assets	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Close

Model 3 below is the final stepwise multiple linear regression model

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.450[a]	.203	.186	33.62610%	.203	11.942	1	47	.001	
2	.595[b]	.354	.326	30.58700%	.152	10.804	1	46	.002	
3	.655[c]	.430	.392	29.06671%	.075	5.938	1	45	.019	1.487

a. Predictors: (Constant), Return On Assets %

b. Predictors: (Constant), Return On Assets %, Dividend Yield %

c. Predictors: (Constant), Return On Assets %, Dividend Yield %, Debt / Assets

d. Dependent Variable: Close

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13503.216	1	13503.216	11.942	.001[b]
	Residual	53143.576	47	1130.714		
	Total	66646.793	48			
2	Regression	23610.817	2	11805.408	12.618	.000[c]
	Residual	43035.976	46	935.565		
	Total	66646.793	48			
3	Regression	28627.486	3	9542.495	11.295	.000[d]
	Residual	38019.307	45	844.873		
	Total	66646.793	48			

a. Dependent Variable: Close

b. Predictors: (Constant), Return On Assets %

c. Predictors: (Constant), Return On Assets %, Dividend Yield %

d. Predictors: (Constant), Return On Assets %, Dividend Yield %, Debt / Assets

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-26.334	12.308		-2.140	.038		
	Return On Assets %	1.801	.521	.450	3.456	.001	1.000	1.000
2	(Constant)	-12.771	11.932		-1.070	.290		
	Return On Assets %	2.031	.479	.507	4.237	.000	.979	1.022
	Dividend Yield %	-5.707	1.736	-.394	-3.287	.002	.979	1.022
3	(Constant)	29.325	20.664		1.419	.163		
	Return On Assets %	2.090	.456	.522	4.583	.000	.976	1.025
	Dividend Yield %	-5.341	1.657	-.368	-3.224	.002	.971	1.030
	Debt / Assets	-79.215	32.508	-.276	-2.437	.019	.987	1.013

a. Dependent Variable: Close

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-84.3898%	75.1094%	12.8246%	24.42142%	49
Std. Predicted Value	-3.981	2.550	.000	1.000	49
Standard Error of Predicted Value	4.441	17.591	7.872	2.672	49
Adjusted Predicted Value	-92.4168%	69.4291%	12.9341%	24.90365%	49
Residual	-53.13043%	73.37498%	0.00000%	28.14372%	49
Std. Residual	-1.828	2.524	.000	.968	49
Stud. Residual	-1.938	2.633	-.002	1.010	49
Deleted Residual	-59.74910%	79.85052%	-0.10956%	30.67559%	49
Stud. Deleted Residual	-2.002	2.831	.004	1.037	49
Mahal. Distance	.141	16.600	2.939	3.020	49
Cook's Distance	.000	.153	.023	.037	49
Centered Leverage Value	.003	.346	.061	.063	49

a. Dependent Variable: Close