

An empirical analysis of the
relationship between the Purchasing
Managers' Index (PMI) and share
prices in the manufacturing sector of
South Africa

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ABSTRACT

This research report investigates the relationship between the Purchasing Managers' Index (PMI) and share prices in the manufacturing sector of the Johannesburg Stock Exchange of South Africa (JSE). Sub-sector and company performance effects are also considered in evaluating the relationship. The study contributes to existing literature by assessing the relevance of the PMI as a forward looking indicator in South Africa. The Granger Causality test is used with monthly data for the South African PMI and index prices in the manufacturing industry from 2000 to 2013. The results indicate that the PMI does not have the ability to forecast future trends in the manufacturing sector or in any of the sub-sectors. The PMI also had no predictive relationship with the top twenty-five industrial companies. Interestingly, the results revealed a causal relationship where the manufacturing sector prices aided in predicting future PMI figures. Sub sectors such as transportation and engineering provided the same result. Results for the metals and mining sector and the top twenty-five industrial companies revealed no causal relationship between prices and PMI. The findings confirms those of Collins (2001).

DECLARATION

I declare that this research report is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Commerce in Accounting at the school of Accountancy, University of Witwatersrand. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorization and consent to carry out this research.

Nitish Mudgal

Date

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1. INTRODUCTION

1.1 PURPOSE OF THE STUDY

The purpose of this research report is to investigate whether there is a causal relationship between the Purchasing Managers Index (PMI) and share value. The report investigates whether the release of the PMI has a causal effect on share prices of companies in the manufacturing sector of the JSE.

A broad stream of research has been focused on the PMI and its influence on Gross Domestic Product (GDP) and industrial production (Harris, 1991; Koenig, 2002; Smirnov, 2010; Tsuchiya, 2011; de Bondt, 2012). These studies conclude that the PMI is likely to be successful in predicting GDP and industrial production. Furthermore, Collins (2001), using United States data identified a positive relationship, finding that share performance had a causal effect on PMI indices, while PMI indices were found not to have a statistically significant influence on share performance. This appears contradictory to Johnson and Watson (2011) who found favorable results for PMI having a causal effect on share prices. No research could be found in a South African context testing PMI and any of the above mentioned variables.

This research report thus provides new knowledge on the South African PMI. Using secondary data collected from Quantec Easydata and McGregor BFA databases, this research assesses the relationship between the PMI and share prices of listed manufacturing companies during a thirteen year period, from 2000 to 2013, and draws conclusions about the causal effect of the PMI on share prices.

After analyzing the effect of PMI on share prices in the manufacturing sector overall, further analysis was performed by disaggregating the index, and examining the sub-sectors in the manufacturing sector as well as the effect on the top twenty-five manufacturing companies providing a small vs large comparison.

1.2 CONTEXT OF THE STUDY

1.2.1 HISTORY OF THE PMI

The National Association of Purchasing Managers (NAPM) in the U.S in co-operation with the U.S Department of Commerce launched the purchasing managers' business survey in manufacturing during the 1930's. The sole purpose of the survey was to gather better business information surrounding the manufacturing activity in the economy. The PMI was only formally established in 1982 by Theodore S. Torda in conjunction with the ISM (Institute of Supply Management) previously known as the NAPM. The PMI was based on a survey of 400 ISM members from the manufacturing industry of the U.S for over 70 years (Smit and Pellissier, 2002).

The success of the PMI in the U.S has resulted in many developed and emerging countries adopting similar practices such as the United Kingdom, Sweden and other European and Eastern countries like Russia where their respective national purchasing institutes have

formed alliances with economic research institutions to producing similar surveys and indices (Smit and Pellissier, 2002).

In October 1998, the Bureau for Economic Research (BER) and Institute for Purchasing and Supply South Africa (IPSA), now known as Chartered Institute of Purchasing and Supply Southern Africa (CIPS), agreed to embark on a joint venture to launch a PMI for South Africa. The official announcement to launch the PMI was made at the national IPSA conference in March 1999. In September 1999, the first survey of the PMI (currently known as the Kagiso PMI as Kagiso Group sponsors the PMI since 2009) for South Africa took place. The PMI however, was publically released from 30 August 2000 (Smit and Pellissier, 2002).

The PMI survey based index, due to its popularity, has been extended to the services sector. The reason for this extension could be due to the shrinking manufacturing sector over the years' and growing services sector in countries worldwide. These results are however produced separately from the PMI results. In South Africa, HSBC launched a rival to the PMI. The HSBC PMI survey focuses on manufacturing, services, construction, mining and retail industries (Bengamin, 2013, 05 November). Broader sector coverage does not by itself necessarily improve the cyclical indicator. The index is relatively new in the South African economy but may prove to be a strong contender against the PMI for evaluating economic performance.

1.2.2 CONSTRUCTION OF THE PMI

The PMI is a survey of approximately 250 purchasing managers in the manufacturing sector (Smit and Pellissier, 2002). The PMI follows the characteristics of business tendency surveys which use opinion survey techniques to determine the factors which determine their business conditions. The obvious difference with the PMI is that the survey relies on factual information. This refers to answering questions on actual results that occurred in the month.

The survey is conducted by means of mailed questionnaires to the panel of purchasing managers in the manufacturing sector. The questionnaire consists of nine questions on the monthly changes in business conditions within the manufacturing sector. The survey questions focus on qualitative impacts, i.e. whether a particular activity has increased, decreased or remained the same (Smit and Pellissier, 2002).

The questions focus on: Business activity, New sales orders, Employment, Backlog of sales orders, Purchasing inventories, Purchasing commitments, Purchasing supplier deliveries, Purchasing prices and Purchasing conditions. The questionnaires are completed during the second and third week of the month and are processed during the final week of the month (Smit and Pellissier, 2002).

The results of the responses on each of the questions are processed in the form of an index. The index is constructed by adding the percentage of respondents that indicated an increase plus one-half of the percentage that indicated that the activity has remained the same. In the case of supplier deliveries, the percentage that indicated a decrease is used. The remaining questions that were answered as decreased in that particular activity by managers are given a score of zero and are therefore excluded in calculating the index figure

going forward. This provides an index that ranges between 0 and 100; with 0 indicating that all the respondents experienced a decline in activity during the current month compared to last month. A score of 100 will indicate that all the respondents experienced an increase in activity during the current month compared to last month. A score of 50 indicates that the activity has remained the same compared to the prior month. Therefore, an index value of above 50 indicates that activity has increased and an index value below 50 indicates that activity has decreased (Smit and Pellissier, 2002).

The PMI is then calculated as a weighted average of five of the individual indices. The choice of indices included and the weightings used for the SA PMI are identical to that of the ISM in the U.S (Smit and Pellissier, 2002). The SA PMI currently uses the following indices and weightings:

- 0.25 Business activity
- 0.30 New sales orders
- 0.20 Employment
- 0.15 Supplier deliveries
- 0.10 Inventories

It can therefore be seen that the PMI is made up five key diffusion indices. This allows the PMI to incorporate various key areas that can successfully present current business conditions and possibly predict future business conditions in the short term.

In line with international norm, the SA PMI figure is adjusted to account for seasonal variation in the data by using the X12 statistical program. To obtain the seasonally adjusted figure, the five individual indices are each seasonally adjusted and summated using the

same weightings as described above. Furthermore, given changes in seasonal patterns over time, these seasonal factors are recalculated once a year, which also necessitates the historical revision of the seasonally adjusted series (Smit and Pellissier, 2002).

1.2.3 FEATURES AND SHORTFALLS OF THE PMI

One of the unique features of the PMI supporting forecasting ability is its timeliness. The PMI is released on the first day of every month, and is the first indicator of business conditions in the manufacturing sector, and is therefore of interest to analysts, executives and professionals. The PMI is also not subject to revised changes after publication, which is important as it may improve the possibility of the PMI being a successful forecasting tool (Harris, 1991).

One of the shortfalls of the PMI is that the index only picks up activity of the first half of the month due to collection and processing occurring in the second half (Harris, 1991). Therefore, a drastic change in business activity occurring in the second half of the month is likely to be reflected in the following month's PMI. In contrast, the PMI thus has a tendency to pick up activity in the weeks preceding the month it is supposed to measure (Harris, 1991). This however is hardly unique to just the PMI.

Another issue was raised by Harris (1991), who asserted that the index is not a reliable leading indicator as it sends too many false signals, and its lead time is too erratic to be used in anticipating cyclical swings. Harris (1991) further concluded that the PMI was not constructed with the scientific sampling and statistical methods that underlie most

macroeconomic series. Harris (1991) also raised that the PMI is only a qualitative measure of activity and makes no assessment of the strength of the change.

A further consideration is that the PMI is a diffusion index which has positive effects but can also be a shortfall; as a high or low PMI figure simply indicates that purchasing managers are reporting improving or deteriorating business conditions. There is no attempt to capture differences across firms or over time in the intensity with which conditions are changing. The sample is selected from a hand-picked of individual firms rather than from a probability sample. No attempt is made to account for industry growth as new fast-growing firms are only added in the sample once established while declining firms remain in the sample until they divest (Harris, 1991).

Irrespective of the shortfalls and limitations identified above, evidence of the PMI being an indicator of economic conditions was supported (Smit and Pellissier, 2002). This research report therefore evaluates whether PMI has a causal effect on share prices from a South African perspective.

1.3 PROBLEM STATEMENT

To date, little research has been performed on analyzing the influences of survey based indices, such as the PMI, on share prices. Therefore, the problem identified in this research report is to investigate whether the PMI in South Africa has a causal effect on share prices of the listed companies in the manufacturing industry.

1.4 SIGNIFICANCE OF THE STUDY

The efficient market hypothesis suggests that share price movements are subject to the random walk hypothesis and are inherently unpredictable (Malkiel and Fama, 1970). This has not deterred researchers from evaluating the role that macroeconomic variables have to play in stock market performances. In this research report one macroeconomic variable, the PMI, is tested for causality in the South African market. This study is important as the literature has conflicting conclusions. For instance Collins (2001), found that the PMI in the US did not have a significant predictive ability on share prices, whereas more recent literature; Johnson and Watson (2011), found a positive statistically significant relationship between the PMI in the US and future share prices. No research has been found on the predictive power of the PMI in South Africa with respect to share prices. This study will contribute to the body of research in evaluating the role that macroeconomic variables, the PMI in particular, play in predicting stock market performance.

The study is important to investors, analysts and businessmen interested in the manufacturing sector in South Africa. The successful prediction of a share's future price could yield significant profit, therefore the determination of whether the PMI influences future share prices will be important to any individual or company in search of making profitable investments.

1.5 RESEARCH QUESTION/ HYPOTHESIS

The research problem expressed above will be addressed in this research report by investigating the following hypothesis:

H_1 = The PMI has a causal effect on share prices.

H_0 = The PMI does not have a causal effect on share prices.

1.6 DELIMITATIONS OF THE STUDY

This research report specifically tests the relationship between the share prices of listed companies in the manufacturing sector rather than investigating the relationship between the PMI and the whole stock market. The reason for the isolation is due to the PMI being an index focusing on the business conditions in the manufacturing sector. The survey is also isolated to the purchasing managers in the manufacturing sector only. It could be assumed that the maximum impact of the index will be related to companies in the manufacturing sector.

It is important to draw this distinction in order to determine an accurate analysis of the effect of the PMI. This coincides with the purpose of the research report, which is to empirically investigate the relationship between the PMI and share prices in the manufacturing sector.

Collins (2001) research analyses whether unexpected announcements influence market performance. This research report will not be addressing the effects of unexpected announcements due to the unavailability of consensus expectations data.

This research report will not analyze the reasons for the empirical results as the intention of this research study is to analyze factual findings and not add normative value.

Cho and Ogwang (2006) concluded that a simpler PMI based solely on the employment diffusion index should be equally reliable. This research report will not investigate the relationships of the individual variables and share prices; it will only focus on the effect that the overall PMI has on share prices.

Companies not listed on the JSE are excluded from the research report due to data constraints.

1.7 DEFINITION OF TERMS

Purchasing Managers' Index (PMI) – A composite index based on the seasonally adjusted diffusion indices. The index measures factors such as; new orders, production, supplier delivery times, backlogs, inventories, prices, employment, import orders and exports (Afshar, Arabian and Zomorrodian, 2011).

Granger Causality Test – A statistical test developed by Granger which tests the causal ordering based on the notion that absence of correlation between past values of one variable X and that part of another variable Y which cannot be predicted from Y's own past implies absence of causal influence from X to Y (Sims, 1972).

Augmented Dickey Fuller Test (ADF test) – This test can be used to determine whether the time series contains a unit root after adjusting for possible autocorrelation in the error term (Gujarati, 2003).

Share/Stock – These words are used interchangeably in the research report and refer to a unit of ownership interest in a company (Borrius, 2012).

Manufacturing/Industrial sector – These terms are used interchangeably in this research report and refer the collective group of companies that manufacture a wide variety of products ranging from raw materials such as steel, to those that produce highly finished products such as clothing, computers, and aircraft (Adenot, Beckner, Broennimann, Camerer, Cool, DiGeronimo et al., 2007).

Causal relationship – Causality implies that if y causes x , then x_{t+1} is better forecast if the information in y_{t-j} is used than if it is not used, where ‘better’ means a smaller variance of forecast error, or the matrix equivalence of variance (Granger, 1988).

Diffusion index – It is an index that is an average of many variables; a diffusion index summarizes the information in a large number of economic time series. It requires expert judgment by analysts to identify the series and the weights placed on each series in the index (Stock and Watson, 1998).

First difference – Differences of the successive values of the variables that may make a non-stationary time series stationary (Gujarati, 2003).

Unit root- A time series that contains a unit root refers to a series that is non-stationary (Gujarati, 2003).

1.8 ASSUMPTIONS

Due to the nature of the research report, the assumptions relate to the statistical models used. The following assumptions have been made:

- Assumptions of Augmented Dickey Fuller test – This test assumes a single unit root exists if present (Gujarati, 2003).
- The Granger causality test assumes the following:
 - That the information relevant to the prediction of the respective variables is contained solely in the time series data on these variables;
 - The two variables used in the test are stationary;
 - The error terms entering the causality test are uncorrelated (Gujarati, 2003).
- The PMI data received from Quantec Easydata database is accurate and complete.
- The monthly index data of the industrial sector, transportation sub-sector, metals and mining sub-sector, engineering sub-sector and the top twenty-five industrials received from BFA McGregor is accurate and complete.

2. LITERATURE REVIEW

2.1 EFFICIENT MARKET HYPOTHESIS (EMH)

Fama (1970) defined an efficient market as a market where prices fully reflect available information. Fama (1970) further elaborates the operational definition into kinds of efficiency; weak form efficiency, semi-strong efficiency and strong form efficiency.

The semi-strong efficiency, which looks at whether current prices fully reflect all available public information, will be off interest in this research report. PMI can be classified as publicly available information and the earliest available information in the manufacturing sector. If the current share prices reflect this information then it is unlikely that the PMI indices have any significant influencing power on future share prices. This could also indicate that the manufacturing sector of the market is semi-strong efficient.

Grossman and Stiglitz (1980) concluded that prices cannot perfectly reflect all available information. This is because information is costly and compensation should be received for those who spend resources trying to obtain such information. An empirical study by Jefferis and Smith (2005) on the efficiency of African stock markets shows that the JSE is efficient in the weak form. Bhana (1990) shows evidence that there is an overreaction by the share markets for earnings announcements. This would be a good indication that the market is not efficient in its semi-strong form.

The theoretical basis of the EMH and the empirical work on South African markets should suggest that it is unlikely that all available information is fully reflected in share prices. Therefore, it is plausible to test the relationship between PMI and share prices due to the

possibility the reaction of the PMI has not been impounded into the stock market in reasonable time.

2.2 VARIABLES INFLUENCING SHARE PRICES

Share prices in general are commonly believed to respond to information about economic fundamentals (Malkiel, 2003). The theory that may be of relevance in the relationship of PMI possibly predicting future share prices and the consequent interest in undertaking this research report could be based on the arbitrage pricing theory (APT). The APT is a general theory of asset pricing which purports to establish a line of causality between share returns and the prevailing and pervasive macroeconomic influences or factors, as well as partly on random disturbances (Brealey, Myers and Allen, 2006). Research by van Rensburg (2000) found that macroeconomic variables on the JSE are most parsimoniously expressed in the two factor APT model.

Share prices are also believed to be influenced by a wide variety of unanticipated events and variables, some of which have a more pervasive effect on share prices than others (Isenmila and Erah, 2012). Research by Brooks, Patel and Su (2003) examine the effect unanticipated events have on equity markets. Results show that information is not impounded into equity prices as quickly as suggested by previous research. Further evidence revealed that closed markets responded quicker than open markets.

Fisher (1961) examines the effect four variables have on share prices. The last dividend declared explained a considerable portion of share price movements. The addition of the last declared undistributed profits contributes to the explanation of share prices. The past rate of growth of dividend per share was found to have an uncertain effect on share prices.

Lastly, it was found that size also had a significant part to play in the explanation of share prices.

Campbell and Ohuocha (2011) suggested that dividend announcements may possibly have an impact on share price movements. However, Benartzi, Michaely and Thaler (1997) found limited evidence of increased dividends having positive excess returns for the next three years despite a lack of future growth in earnings. This coincides with Chen, Da and Zhao (2013) conclusion that revisions of expected cash flows have an effect on share prices and that the magnitude of this effect increases based on the revision period.

Investigating more broadly, Roll (1988) found that most of the variation in returns for individual shares cannot be explained by available information. These findings are consistent with research conducted by Cutler, Poterba and Summers (1998). These results indicated that tests of causality between share prices and readily available variables would likely be a meaningless exercise.

Globalization has resulted in the expansion of companies beyond domestic borders. This exposes companies to various local and international risks. Masih and Masih (1999) investigated the effect of regional variables and international variables, finding that in Asian markets, share prices was explained mostly by regional factors rather than international factors. More recently, Choudhry, Lu and Peng (2007) found a significant relationship in the Far East markets and found periods where the U.S influence was greater than regional influences. Supporting this, King and Wadhvani (1990) found evidence that contagion, where rational agents infer information price changes in other markets, occurred between markets. Similar evidence was found by Eun and Shim (1989), emphasizing that the U.S

markets having a significant impact on foreign markets. While Lam and Ang (2006) concluded that global factors offer four times more explanatory power than domestic factors for developed markets; they also concluded that domestic factors are as important as global factors for emerging markets. This was confirmed by Fifield, Power and Sinclair (2002), who found that global factors may be significant in explaining emerging markets returns; local factors however play a crucial role as well.

Jefferis, Okeahalam and Matome (1999) examined linkages of Southern African markets amongst each other and stock markets elsewhere. Their findings indicated that the South African market is closely related to international markets, particularly the UK (United Kingdom) and Asian markets in the short term. Whereas, a long term relationship existed between South Africa and Botswana. Further results indicated that Southern African markets are in its early stages of integrating into the international financial system.

Recently there has been a growing importance in Corporate Social Responsibility (CSR); the question remains whether this emphasis on CSR has a significant impact on company performance. Earlier results show a low and insignificant relationship between risk adjusted performance and the degree of CSR. However, recent research, by Pava and Krausz (1996) found that more investors allocate funds based on CSR criterion rather than mere profits. Supporting the importance of CSR, Tsoutsoura (2004) concluded that the relationship between CSR and returns was statistically significant.

When considering variables that may impact share prices, media influence should be considered, as public information could impact share performance, unless it already encompasses the movement in the share price before the information is released. Research

by Deephouse (2000) indicated that media reputation was a resource that increased performance. Tetlock (2007) found that high media pessimism predicted downward pressure on market prices, While Fang and Peress (2009) concluded that companies in the media spotlight tended to perform worse than companies with no media coverage. Dyck and Zingales (2003) found that stock prices were most reactive to the type of earnings emphasized by the press.

Social media has also been a recent new trend in the current economy. Bollen, Mao and Zeng (2011) tested the impact of mood states on the stock market and found that collective mood states on twitter significantly predicted daily up and down changes on the stock market. Research by Kocenda and Hanousek (2010) on the Czech Republic, Hungary and Poland markets revealed that news announcements on the respective PMI's in these markets impacted the stock returns if they were unexpected index figures.

The above variables are not intended to represent an exhaustive list of variables that may influence share prices. The lesson drawn forward by examining the literature is that there are clearly internal and external factors that influence share prices, where no one factor can by itself successfully influence the share price of companies consistently through time.

2.3 MICROECONOMIC AND MACROECONOMIC VARIABLES

A study by Lyn and Zychowicz (2004) on the developing markets of Eastern Europe showed that book-to-market ratios were positively and significantly related to future returns while some evidence existed that earnings-to-price ratios were negatively related to returns. It was also found, with a lower degree of statistical significance, that dividend yields were positively related to stock returns. Similar results regarding 12 emerging markets were obtained by Aras and Yilmaz (2008) for the period 1997-2003.

In South Africa, earlier research by Gupta and Modise (2010) found that valuation ratios failed to significantly predict stock returns in the short and long term horizons. Research by Bonga-Bonga and Makakabule (2010) concluded that the magnitude of macroeconomic variables explaining stock returns depended on the size of the dividend yield. Recent research (Muller and Ward, 2012) found significant and persistent excess returns in momentum, earnings yield, dividend yield, price to book, cash flow to price, liquidity, return on capital, return on equity and interest cover on the JSE during the period 1985 to 2011.

Extensive research has been undertaken to determine the relationship between macroeconomic variables and stock market performance. A significant negative correlation between inflation and stock returns was observed using U.S data (Fama and Schwert, 1977); (Fama, 1981); (Geske and Roll, 1983) & (Kaul, 1987). Similar results were obtained using the APT framework (James, Koreisha and Partch, 1985; Chen, Roll and Ross, 1986).

This expanded the debate to other macroeconomic variables; further analysis examining the relationship between real interest rates and stock returns has proved to be contradictory. Chen et al. (1986) concluded that stocks have a negative relationship with respect to

changes in real interest rates. Similar results were found by Alam and Uddin (2009), while Lee (1992) found that stock returns are not significantly explained by real interest rates. All the studies apply the Vector Auto Regression model; however use varied number of variables in the model. This may be the reason for the contradictory results achieved.

In South Africa, testing data for the political transition period from 1965- 1995 found that equity returns lead real activity indicators, and the relationship between market returns and changes in interest rates was consistently negative (Van Rensburg, 1999). Results by Gupta and Modise (2013) showed that different interest rate variables, world oil production growth and money supply had some predictive power at certain short horizons in South Africa for the period 1990-1996. Gupta and Modise (2013) also provided evidence that inflation had very strong predictive power from data between 1997 and 2010. Recent research has shown that macroeconomic variables had a significant influence on stock prices in South Africa; however the results were inconsistent across the sectors under investigation (Junkin, 2012).

In Southern African stock markets, it was found that markets are influenced by domestic economic growth; however the influence of other economic variables depended on the size, openness and market-orientation of the individual economies, as well as the size and liquidity of the various stock markets (Jefferis and Okeahalam, 2000).

In a study on the Spanish market, no significant pricing relationship was found between stock returns and macroeconomic factors (Martinez and Rubio, 1989). Similar results were found in the United Kingdom (Poon and Taylor, 1991). In Norway, using the same methodology, results concluded that real interest rate changes affected both stock returns

and inflation (Gjerde and Sættem, 1999). In Australia, it was found that macroeconomic variables are important determinants of industry returns (Wang and Lim, 2010).

The relationship between money supply and stock returns was investigated for the six largest emerging markets at that time. Using Granger causality tests and co-integration tests it was found that for two markets a causal relationship did not exist, concluding that in those markets there was information inefficiency (Cornelius, 1991). Chen, Kim and Kim (2005) found that money supply and unemployment rates significantly explained the movements in hotel stock returns on the Taiwan Stock Exchange.

Chinzara (2011) found that volatility in both the South African stock market and most macroeconomic variables significantly increases during a financial crisis and that volatility transmission between stock markets and most macroeconomic variables is bidirectional.

As evidenced from the above, extensive research exists around the relationship between micro and macro-economic variables. There was evidence of certain micro and macro-economic variables influencing share returns, therefore, it is viable to extend investigations to the PMI (a macroeconomic variable).

2.4 PMI

The evidence above reflects that certain macroeconomic variables and their influence on share prices have been extensively tested. However, little research has been undertaken on the relationship between PMI and stock market returns. This research report contributes to the existing literature by examining the influence of the PMI in South Africa on share prices.

Öller (1990) suggested that surveys of business professionals provided clues pertaining to changes in business cycles from expansion to contraction or vice versa. Kauffman (1999) confirmed that the PMI provided insight into changes in the U.S economic activity and should therefore be considered in making strategic purchasing decisions. Koenig (2002) provided evidence that the PMI is useful as an indicator of growth in the manufacturing sector, and the economy as a whole. In Russia, it was concluded that the PMI showed signs of an approaching crisis (Smirnov, 2010). Whereas Harris (1991) concluded that the index is better used to confirm recent turning points than to anticipate them.

In a more recent study using the standard Granger causality test, evidence was found in support of the PMI as a predictor of GDP, and was quantitatively more important than the Consumer Confidence Index (Afshar et al., 2011). Supportin this, Tsuchiya (2011) found PMI to be a predictor of the direction of change in the industrial production and GDP. Similar conclusions were made by (Harris, Owens and Sarte, 2004); (Vermeulen, 2012); (Schröder and Hufner, 2002); (Drechsel, Giesen and Lindner, 2013) & (de Bondt, 2012) . Rossiter (2010) further concluded that PMI's are useful for forecasting developments in the global economy.

2.4.1 SHARE PRICES AND THE PMI

Limited research was found investigating whether the PMI is a predictor of share prices. A study analyzing the relationship between the Shanghai composite index and the PMI resulted in evidence of a long- term and co- integrated relationship, concluding that the PMI can be applied to analyze and predict the trend of the stock market (Wang, 2012). Collins (2001), using Granger causality tests, concluded that the PMI is not a predictor of stock market performance, based on U.S data. However, a more recent study in the U.S, using

time-series regression analysis, concluded that the PMI does predict subsequent stock returns (Johnson and Watson, 2011). There is therefore an on-going debate in the literature on whether the PMI influences share prices. No research could be found testing this relationship on the South African PMI.

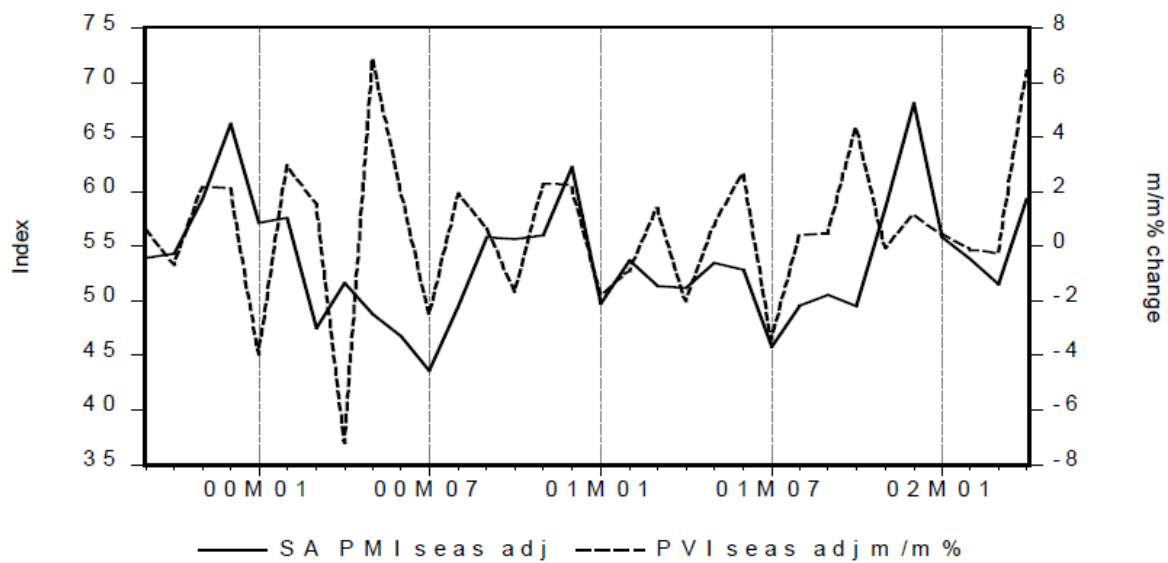
In researching the PMI it would be beneficial to understand the principal variables that make up the PMI. This consists of five diffusion indices.

The PMI is an addition of the diffusion indices, and applying the appropriate mix and weightings of variables would enhance the significance of the PMI. The weightings and variables used by the South African PMI are based on the US PMI. Dasgupta and Lahiri (1993) concluded that diffusion measures have additional explanatory power in the prediction of business cycle turning points. These specified weightings were chosen to maximize the correlation of the PMI with real GDP growth (Torda, 1985), (Kauffman, 1999) and (Lindsey and Pavur, 2005).

Cho and Ogwang (2006) used the principal components variable selection strategy considered by (Jolliffe, 1972, 1973) to investigate the choice of principal variables for the PMI. The results question the current assigning of the highest weight to 'New orders' and the lowest to 'Inventories'. They further concluded that a simpler PMI based solely on the employment diffusion index could be compared without too much loss of information. Dasgupta and Lahiri (1993) concluded that inventory dispersion on its own could be successful in signaling turning points. The debate over the components is important as improvements in forecast horizons occur when estimating the factors using fewer but informative predictors (Bai and Ng, 2008).

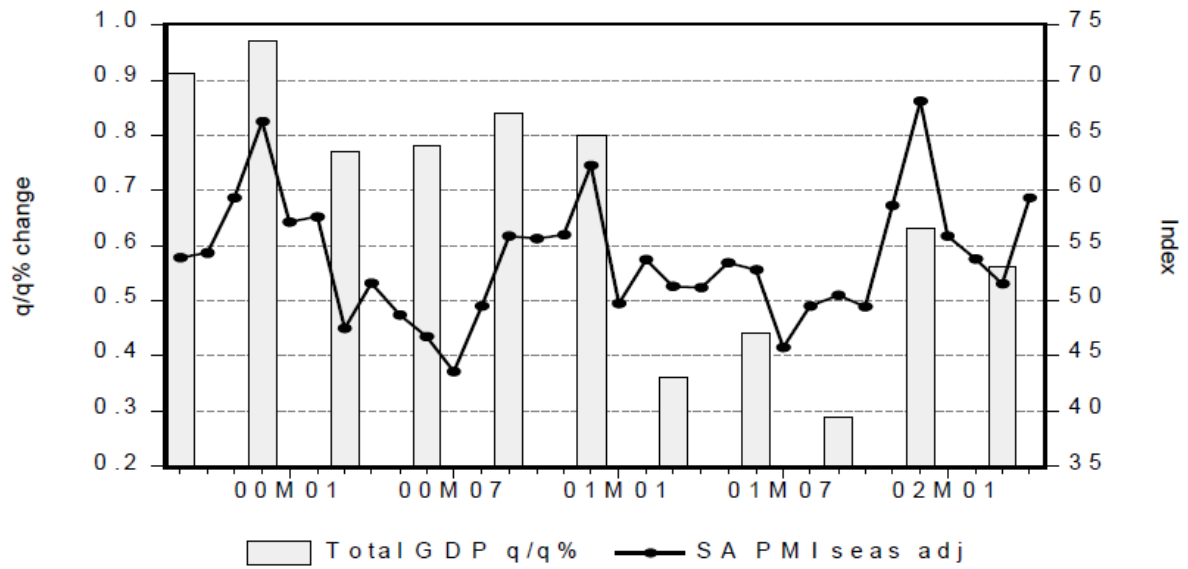
In order to confirm the cyclical and leading indicator properties of the SA PMI, the following graphical analysis in its beginning stages is provided below. The graphs reveal a good trend with the recent South African business cycle behavior and a tendency to lead the business cycle measures. The graphical information was obtained from Smit and Pellissier (2002).

SA PMI and the SA manufacturing production volume:



Source: Smit and Pellissier (2002)

SA PMI and Real GDP Growth:



Source: Smit and Pellissier (2002)

2.5 CONCLUSION

There is no shortage of research around testing various variables that can successfully predict share prices or stock market performance. The EMH proposes that if the market is semi-strong efficient, all publically available information is impounded in the share price instantaneously. The empirical work done on the JSE would suggest that the market is not semi-strong efficient (Jefferis and Smith, 2005).

The review of literature has brought to light that there are many variables that can influence share prices and it is unlikely that one known variable would successfully move share prices consistently. This is where the PMI is special, as the PMI is made up of five sub-indices and therefore; the PMI in itself incorporates more than one variable. This gives the PMI a greater likelihood of having a causal effect on share prices.

Prior research focused on the common macroeconomic variables impact on share prices, which has resulted in a body of research that at times have conflicting views. The PMI (a macroeconomic variable), however shows strong associations of predicting GDP and industrial production.

In conclusion, the literature has shown that the PMI has forecasting ability and it is therefore worthwhile investigating the relationship it has with share prices.

3. RESEARCH METHODOLOGY

The purpose of this research report is to examine whether the Purchasing Managers Index (PMI) has a causal effect on share prices. This involves the determination of whether information in the release of the PMI actually has some causal effect on the future share prices of companies in the manufacturing sector of the JSE. Further analysis is performed by taking into account the sub-sector effect of the listed companies in the manufacturing sector as well as the effect PMI has on the top twenty-five manufacturing companies.

3.1 OVERVIEW OF THE RESEARCH METHOD

The nature of the study requires the research to be conducted using a purely quantitative methodology. In testing whether the PMI has a causal effect on share prices, the Granger causality test will be used to determine if the PMI has any predictive power. The qualitative research approach produces factual findings by using statistical measures thereafter analyzing and reporting on the results obtained. The research report is structured to answer a research hypothesis; this in itself leads on to applying a quantitative approach.

The study will follow the approach of Collins (2001), where the Granger causality test was used to establish whether business confidence surveys anticipated market returns. Eviews 8 is the statistical program that is used to perform the quantitative method. The Augmented Dickey-Fuller and Granger causality tests are performed to examine the influential power of the PMI on share prices. The Augmented Dickey-Fuller test is preferred over the Dickey-Fuller test as it takes autocorrelation into account therefore, tests stationarity at the most restrictive level (Gujarati, 2003). Causality implies that if y causes x , then x_{t+1} is better

forecast if the information in y_{t-j} is used than if it is not used (Granger, 1988). According to Geweke, Meese and Dent (1983), the behavior of the Granger test is preferred among other causality tests. Other measures, such as regression analysis, would not be a viable option as it does not address the concept of causality.

The methodology determines the relationship between the PMI and share prices. This is done by investigating the effect lagged PMI figures have on monthly index prices of the manufacturing sector. Further analysis of the effect lagged monthly index prices of the manufacturing sector has on monthly PMI figures is also investigated.

Sufficient and accurate secondary data, from McGregor BFA, in the form of index closing prices, was used in the mathematical and statistical calculations to ensure the relationship tested produces accurate results of the causal effect PMI has on share prices.

The primary purpose of the methodology in this research report was to examine the influence PMI figures had on future share prices, during the thirteen-year period from 2000 until 2013.

3.2 DATA

3.2.1 POPULATION AND SAMPLE

Monthly PMI seasonally adjusted indices are used from August 2000 to August 2013 covering a period of 13 years. The PMI data will not be included from September 1999; the date of which the PMI surveys first began. This is due to the PMI data officially being released publically from August 2000. This approach insures consistency is achieved when

examining the relationship between the PMI and index closing prices. This also allows any reaction by the publically announced PMI on the stock market to be taken into account.

The monthly index closing prices for the industrial sector were extracted for the same periods, as well as the monthly index closing prices of the transportation, metals and mining, engineering and the top twenty-five industrial companies for the additional testing on the PMI. Index closing prices were chosen over individual closing share prices of manufacturing companies to avoid survivorship bias.

3.2.2 SOURCES AND COLLECTION OF DATA

The collection of accurate and reliable data is important due to the quantitative approach of the research report. The PMI monthly data was obtained and analyzed from Quantec Easydata database. The historic monthly closing index prices for the industrial sector as well as the transportation, metals and mining, engineering and the top twenty-five industrial companies were extracted from the McGregor BFA Research Domain database.

3.3 RESEARCH DESIGN

3.3.1 INTRODUCTION

The linear regression model is a theoretical construct because it is based on set of assumptions that may be unrealistic, even though regression analysis measures linear association of one variable on other variables that does not necessarily imply a cause-and-effect relationship (Gujarati, 2003). The Granger causality test was used in this research report as this model is used to analyze statistically whether one time series is useful in forecasting another. The model was developed by Granger (1969) and, according to Geweke et al. (1983) the behavior of the Granger test is preferred among other causality tests. The model was used by Collins (2001) to determine whether the PMI forecasts stock market performance. The Granger causality test is therefore deemed to be appropriate in addressing the research problem in this research report.

This methodology determines whether the X variable is causing the Y variable, if we are better able to predict the Y variable using all available information than if the information apart from X had been used (Granger, 1969). The X variable in this research is the overall PMI index of the manufacturing sector; the Y variable is the closing index figures of the manufacturing sector. Collins (2001) and Afshar et al. (2011), have tested this methodology for similar research purposes. The basic idea of the statistical method is to find out whether the sector's closing price can be attributable to prior PMI figures that are announced.

The granger causality test requires both variables to be stationary in order to avoid spurious results. In this research report, the Augmented Dickey-Fuller test (ADF test) is used to

determine whether the variables are stationary (Dickey and Fuller, 1979). According to Mushtaq (2011), the test is considered most important and widely used in research where time series is involved. The Dickey Fuller test is extended by including extra lag in terms of the dependent variable to the existing model in order to eliminate the problem of autocorrelation. This chapter will explain the methodology that was followed.

3.3.2 MODEL CONSTRUCTION

3.3.2.1 AUGMENTED DICKEY- FULLER TEST (ADF TEST)

For data to be classified as stationary requires that both the joint probability distribution and the conditional probability distribution are invariant with respect to time (Pindyck and Rubinfeld, 1998). Estimating series that are not stationary would lead to spurious results in the Granger causality test; therefore the data will initially be tested using the ADF test. An ADF test is used to allow for serial correlation in the error term (ε_t). This allows for the most restrictive form for stationarity to be tested:

$$X_t = \alpha + \beta t + \rho X_{t-1} + \sum_{j=1}^p \gamma_j X_{t-j} + \varepsilon_t$$

Where $\Delta X_t = X_t - X_{t-1}$. The series is tested with up to 6 lags (p) and the Akaike Information Criterion (AIC) is used to determine which lags to eliminate. The ADF statistics of the final specification are then compared to critical values to accept or reject the null hypothesis of a unit root i.e. the null hypothesis is that the series is non-stationary (Collins, 2001).

If any variable is non-stationary, the first difference of the variable will be used in the Granger causality test. This will ensure the data is transformed into stationary variables which can be used in the Granger causality test (Gujarati, 2003).

3.3.2.2 GRANGER CAUSALITY TEST

Once the variables are stationary, the Granger causality test can be used in assessing whether the PMI (the dependent variable (X)) Granger causes the manufacturing index closing prices (the independent variable (Y)). The approach is based on the idea that if X causes Y then changes in X should precede changes in Y. To claim that X causes Y, two conditions must be met. First, X should help predict Y and second, Y should not help to predict X. Two equations help establish whether these conditions hold. To test the null hypothesis that X does not cause Y, values of Y are regressed against lagged values of Y and lagged values of X (Collins, 2001; Gujarati, 2003):

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots + \alpha_m Y_{t-m} + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \dots + \beta_n X_{t-n} + \varepsilon_t$$

Then Y is regressed against only lagged values of Y (Collins, 2001):

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots + \alpha_m Y_{t-m} + \varepsilon_t$$

Where:

Y= Independent variable

Y_{t-i} = Lagged independent variables

X_{t-i} = Lagged dependent variables

m = maximum number of lagged terms included in the model

α_i = Coefficient of the model

= Coefficient of the model

ε_t = residuals for each time series

The interest is in testing causality, therefore one need not present the estimated coefficients of models explicitly, the results of the F test will suffice (Gujarati, 2003). An F test determines whether the lagged values of X contributed significantly to the explanatory power of the first equation. If they do, the null hypothesis is rejected and the conclusion is that X does cause Y. AIC criterion is used to help determine the most appropriate number of lags (Collins, 2001).

3.4 PORTFOLIO CONSTRUCTION

To further analyze and understand the influencing power of the PMI on share prices, the Granger causality test is re-run to test whether sub-sectors causes any significant differences from the results found between the PMI and the entire manufacturing sector.

To test the sub-sector effect, portfolios are constructed based on the sub-sector indices that make up the manufacturing sector. This research report uses the sub-sectors from McGregor BFA that splits the manufacturing sector into three distinct sub-sectors: Transportation, Engineering and Metals and Mining.

To test whether performance has an impact on the causality between PMI and the manufacturing sector prices, the Granger causality test is run to test whether the PMI Granger causes the top twenty-five manufacturing companies price index. The results are analysed against the entire sector to determine whether the top twenty-five companies'

results are vastly different to the entire sector and if so, could this be attributable to the performance of the companies.

3.5 LIMITATIONS

- The length of the period is limited to 13 years due to availability of data, which may not reflect the true situation with regards to the PMI effect on share prices.
- The input variables are very important- if incorrect data is inserted into the test, this will result in misstated results.
- Only the PMI figures are assessed for the manufacturing sector. Other variables that affect share prices are omitted from the research study.
- Share price may be influenced by variables other than the market's response to PMI announcements.
- The Granger causality test provides estimates of the short-term impact on share prices only. A different methodology will have to be considered in evaluating the long term effects.
- The Granger causality test is sensitive to lag selection period. Changes in lag periods will result in different conclusions.

Although there are limitations, they do not invalidate the research or the results.

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

This chapter presents the results based on the research methodology used as well as an interpretation of these results. Eviews 8 software was used to run the ADF and Granger causality test. The data analyzed is from August 2000, the date when the PMI was available to the public in South Africa (Smit and Pellissier, 2002), up to August 2013. The results included in this research report are extracted directly from the Eviews 8 software.

The findings are split into two main sections. The first section presents the results of the PMI and the manufacturing sector as a whole. The second section presents the results of the additional testing performed to examine whether there is a causal relationship when the sub-sectors of the manufacturing sector and the top twenty-five companies are considered.

The results follow a chronological order for both sections. It is first determined whether both variables that are used in the Granger causality test are stationary using the ADF test. If the variable is determined to be stationary, the level variable is used in the Granger causality test. If the variable is non-stationary, the first difference of the variable is tested for stationarity. The first difference of the variable is used in the Granger causality test if it is stationary. Thereafter, the results of the Granger causality test are presented.

The ADF test is based on a null hypothesis of a unit root (non-stationary) and an alternative hypothesis of a zero root (stationary). Lag selection as discussed in the research methodology section is a key input in the ADF and Granger causality test that can result in varied results. The maximum lag length selected was 6 and the optimal lag length in ADF tests are chosen based on the Akaike Information Criterion (AIC). This is consistent with

prior research examining the relationship between the PMI and the stock market (Collins, 2001; Afshar et al., 2011). The series was tested for trend and intercept to ensure the strictest form of stationarity is tested. It is reasonable and credible to test the prediction of share price using the PMI, given that the ADF statistic is less than the critical value on the 5% confidence level (Wang, 2012). Therefore, the critical value at the 5% confidence level will be compared to the ADF statistic in determining whether the variable is stationary.

The Granger causality test is run in both directions. Therefore, the test determines whether the x variable causes the y variable and whether the y variable causes the x variable. The lag selection as with the ADF test is important. The lag period of 6 is used for the monthly data which is consistent with Collins (2001). The null hypothesis where no Granger causality exists is rejected when the p-values are lower than the 5% percent significant level which is consistent with Afshar et al. (2011) and Collins (2001).

The chapter includes the interpretation of the statistical results so as to present a comprehensive view of what the information is communicating. The information in this chapter is the basis for the conclusions presented in the research report.

4.2 EMPIRICAL RESULTS OF PMI AND THE MANUFACTURING SECTOR IN SOUTH AFRICA

4.2.1 RESULTS: STATIONARITY

The result of the ADF test for the PMI is provided in Figure 1 below.

Figure 1: ADF results for PMI

Null Hypothesis: PMI_INDEX has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.648484	0.0290
Test critical values:		
1% level	-4.017956	
5% level	-3.438886	
10% level	-3.143776	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(PMI_INDEX)
 Method: Least Squares
 Date: 03/20/14 Time: 08:27
 Sample (adjusted): 2000M09 2013M08
 Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PMI_INDEX(-1)	-0.165475	0.045354	-3.648484	0.0004
C	8.980071	2.517785	3.566656	0.0005
@TREND("2000M08")	-0.004397	0.005211	-0.843854	0.4001
R-squared	0.080306	Mean dependent var		0.028902
Adjusted R-squared	0.068284	S.D. dependent var		2.906707
S.E. of regression	2.805711	Akaike info criterion		4.920235
Sum squared resid	1204.418	Schwarz criterion		4.978886
Log likelihood	-380.7783	Hannan-Quinn criter.		4.944056
F-statistic	6.679870	Durbin-Watson stat		2.001117
Prob(F-statistic)	0.001655			

As per figure 1, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -3, 65 is lower than the critical value of -3, 44. Therefore, the PMI is considered stationary at a 5% significance level. The level PMI variable can thus be used in the Granger causality test.

The result of the ADF test for the industrial sector price for South Africa is provided in figure 2 below.

Figure 2: ADF results for industrial sector price

Null Hypothesis: ALL_INDUSTRIALS_PRICE has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.738494	0.7294
Test critical values:		
	1% level	-4.017956
	5% level	-3.438886
	10% level	-3.143776

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(ALL_INDUSTRIALS_PRICE)
 Method: Least Squares
 Date: 03/20/14 Time: 08:28
 Sample (adjusted): 2000M09 2013M08
 Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ALL_INDUSTRIALS_PRICE(-1)	-0.040493	0.023292	-1.738494	0.0841
C	205.5723	185.2219	1.109870	0.2688
@TREND("2000M08")	10.49537	5.290302	1.983888	0.0491
R-squared	0.025784	Mean dependent var		219.7447
Adjusted R-squared	0.013049	S.D. dependent var		1053.808
S.E. of regression	1046.910	Akaike info criterion		16.76412
Sum squared resid	1.68E+08	Schwarz criterion		16.82277
Log likelihood	-1304.601	Hannan-Quinn criter.		16.78794
F-statistic	2.024670	Durbin-Watson stat		1.949273
Prob(F-statistic)	0.135560			

As per figure 2, at a 5% significance level, the null hypothesis is accepted as the t-statistic of -1,74 is higher than the critical value of -3,44. Therefore, the industrial sector price is considered non-stationary at a 5% significance level. The first difference of the all industrials price is therefore computed in order to determine stationarity that can be used in the Granger causality test.

The result of the ADF test for the first difference of the industrial sector price for South Africa is provided in figure 3 below.

Figure 3: ADF results for first difference industrial sector price

Null Hypothesis: DALL_INDUSTRIALS_PRICE has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-12.29302	0.0000
Test critical values:		
1% level	-4.018349	
5% level	-3.439075	
10% level	-3.143887	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(DALL_INDUSTRIALS_PRICE)
 Method: Least Squares
 Date: 03/20/14 Time: 08:29
 Sample (adjusted): 2000M10 2013M08
 Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DALL_INDUSTRIALS_PRICE(-1)	-0.996195	0.081037	-12.29302	0.0000
C	85.93410	172.8029	0.497296	0.6197
@TREND("2000M08")	1.740260	1.908574	0.911812	0.3633
R-squared	0.498557	Mean dependent var		4.947613
Adjusted R-squared	0.491959	S.D. dependent var		1486.727
S.E. of regression	1059.694	Akaike info criterion		16.78851
Sum squared resid	1.71E+08	Schwarz criterion		16.84742
Log likelihood	-1298.110	Hannan-Quinn criter.		16.81244
F-statistic	75.56269	Durbin-Watson stat		2.002548
Prob(F-statistic)	0.000000			

As per figure 3, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -12, 29 is lower than the critical value of -3, 44. Therefore, the first difference is considered stationary at a 5% significance level. The first difference of the industrial sector price variable can thus be used in the Granger causality test.

4.2.2 RESULTS: GRANGER CAUSALITY

The result of the Granger causality test for the PMI and the first difference of the industrial sector price for South Africa are provided in figure 4 below.

Figure 4: Granger causality test of PMI and all industrials

Pairwise Granger Causality Tests

Date: 03/20/14 Time: 08:21

Sample: 2000M08 2013M08

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
DALL_INDUSTRIALS_PRICE does not Granger Cause PMI_INDEX	150	3.68898	0.0020
PMI_INDEX does not Granger Cause DALL_INDUSTRIALS_PRICE		0.51221	0.7983

The result in figure 4 show that as the PMI index does not Granger cause industrial price due to the p-value (0.7983) exceeding the 5% significance level. Therefore, the null hypothesis of PMI not Granger causing industrial price is accepted. The result as well found industrial price does Granger cause the PMI index due to the p-value (0.0020) being lower than the 5% significance level. Therefore, the null hypothesis of industrial price not Granger causing PMI is rejected.

4.3 ADDITIONAL EMPIRICAL RESULTS ON PMI

Other useful analysis that further explores the forecasting effects of the PMI are presented in this section. The analysis of the sub-sectors: Transportation, metals and mining and engineering are presented below. These sub-sector indices are extracted from the McGregor BFA database for the period of August 2000 up to August 2013.

The top twenty five industrials index was also extracted from the McGregor BFA database and tested to determine whether the PMI's effect on the better performing companies is materially different to the whole industry.

The ADF test results for the PMI is not reiterated in each calculation as the results in figure 1 are applicable to all the tests below and therefore the PMI is consistent in all the Granger causality tests relating to the top 25 industrials and the sub-sectors.

4.3.1 TRANSPORTATION

4.3.1.1 RESULTS: STATIONARITY

The result of the ADF test for the transport sub-sector price for South Africa is provided in figure 5 below.

Figure 5: ADF results for transport sub-sector price

Null Hypothesis: INDUSTRIALS_TRANSPORT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.206151	0.9052
Test critical values:		
1% level	-4.018748	
5% level	-3.439267	
10% level	-3.143999	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INDUSTRIALS_TRANSPORT)
 Method: Least Squares
 Date: 03/20/14 Time: 08:36
 Sample (adjusted): 2000M11 2013M08
 Included observations: 154 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDUSTRIALS_TRANSPORT(-1)	-0.021881	0.018141	-1.206151	0.2297
D(INDUSTRIALS_TRANSPORT(-1))	-0.028412	0.080543	-0.352756	0.7248
D(INDUSTRIALS_TRANSPORT(-2))	0.246177	0.080439	3.060430	0.0026
C	0.875352	1.115097	0.785001	0.4337
@TREND("2000M08")	0.024002	0.016410	1.462682	0.1457
R-squared	0.072409	Mean dependent var		1.036883
Adjusted R-squared	0.047507	S.D. dependent var		5.847129
S.E. of regression	5.706549	Akaike info criterion		6.353035
Sum squared resid	4852.141	Schwarz criterion		6.451637
Log likelihood	-484.1837	Hannan-Quinn criter.		6.393087
F-statistic	2.907778	Durbin-Watson stat		1.975379
Prob(F-statistic)	0.023652			

As per figure 5, at a 5% significance level, the null hypothesis is accepted as the t-statistic of -1,21 is higher than the critical value of -3,44. Therefore, the transport sub-sector price is considered non-stationary at a 5% significance level. The first difference of the transport

sub-sector price is therefore computed in order to determine stationarity that can be used in the Granger causality test.

The result of the ADF test for the first difference of the transport sub-sector price for South Africa is provided in figure 6 below.

Figure 6: ADF results for first difference transport sub-sector price

Null Hypothesis: DINDUSTRIALS_TRANSPORT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.056262	0.0000
Test critical values:	1% level	-4.018748	
	5% level	-3.439267	
	10% level	-3.143999	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DINDUSTRIALS_TRANSPORT)
Method: Least Squares
Date: 03/20/14 Time: 08:34
Sample (adjusted): 2000M11 2013M08
Included observations: 154 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINDUSTRIALS_TRANSPORT(-1)	-0.815405	0.115558	-7.056262	0.0000
D(DINDUSTRIALS_TRANSPORT(-1))	-0.229945	0.079425	-2.895124	0.0044
C	0.156067	0.943664	0.165384	0.8689
@TREND("2000M08")	0.008751	0.010475	0.835419	0.4048
R-squared	0.554477	Mean dependent var		0.016623
Adjusted R-squared	0.545566	S.D. dependent var		8.478046
S.E. of regression	5.715194	Akaike info criterion		6.349764
Sum squared resid	4899.516	Schwarz criterion		6.428646
Log likelihood	-484.9318	Hannan-Quinn criter.		6.381806
F-statistic	62.22764	Durbin-Watson stat		1.968149
Prob(F-statistic)	0.000000			

As per figure 6, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -7, 06 is lower than the critical value of -3, 44. Therefore, the first difference is considered stationary at a 5% significance level. The first difference of the transport sub-sector price variable can thus be used in the Granger causality test.

4.3.1.2 RESULTS: GRANGER CAUSALITY

The result of the Granger causality test for the PMI and the first difference of the transportation sub-sector price for South Africa are provided in figure 7 below.

Figure 7: Granger causality test of PMI and the transportation sub-sector

Pairwise Granger Causality Tests
 Date: 03/20/14 Time: 08:38
 Sample: 2000M08 2013M08
 Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
DINDUSTRIALS_TRANSPORT does not Granger Cause PMI_INDEX	150	2.80867	0.0131
PMI_INDEX does not Granger Cause DINDUSTRIALS_TRANSPORT		0.38674	0.8865

The results in figure 7 shows that as the PMI index does not Granger cause transportation sub-sector price due to the p-value (0.8865) exceeding the 5% significance level. Therefore, the null hypothesis of PMI not Granger causing transportation sub-sector price is accepted. The result as well found the transportation sub-sector price does Granger cause the PMI index due to the p-value (0.0131) being lower than the 5% significance level. Therefore, the null hypothesis of transportation sub-sector price not Granger causing PMI is rejected.

4.3.2 METALS AND MINING

4.3.2.1 RESULTS: STATIONARITY

The result of the ADF test for the metals and mining sub-sector price for South Africa is provided in figure 8 below.

Figure 8: ADF results for metals and mining sub-sector price

Null Hypothesis: INDUSTRIALS_MINING has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 3 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.987538	0.1392
Test critical values:		
1% level	-4.019151	
5% level	-3.439461	
10% level	-3.144113	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(INDUSTRIALS_MINING)

Method: Least Squares

Date: 03/20/14 Time: 08:46

Sample (adjusted): 2000M12 2013M08

Included observations: 153 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDUSTRIALS_MINING(-1)	-0.075340	0.025218	-2.987538	0.0033
D(INDUSTRIALS_MINING(-1))	0.253449	0.080082	3.164876	0.0019
D(INDUSTRIALS_MINING(-2))	0.093649	0.082763	1.131532	0.2597
D(INDUSTRIALS_MINING(-3))	0.170587	0.082097	2.077866	0.0395
C	279.4292	377.6131	0.739988	0.4605
@TREND("2000M08")	15.10415	7.096295	2.128456	0.0350
R-squared	0.138982	Mean dependent var		144.7624
Adjusted R-squared	0.109696	S.D. dependent var		2377.204
S.E. of regression	2243.033	Akaike info criterion		18.30747
Sum squared resid	7.40E+08	Schwarz criterion		18.42631
Log likelihood	-1394.522	Hannan-Quinn criter.		18.35575
F-statistic	4.745639	Durbin-Watson stat		2.011889
Prob(F-statistic)	0.000476			

As per figure 8, at a 5% significance level, the null hypothesis is accepted as the t-statistic of -2, 99 is higher than the critical value of -3, 44. Therefore, the metals and mining sub-sector price is considered non-stationary at a 5% significance level. The first difference of the

metals and mining sub-sector price is therefore computed in order to determine stationarity that can be used in the Granger causality test.

The result of the ADF test for the first difference of the metals and mining sub-sector price for South Africa is provided in figure 9 below.

Figure 9: ADF results for first difference metals and mining sub-sector price

Null Hypothesis: DINDUSTRIALS_MINING has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 5 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.768385	0.0000
Test critical values:		
1% level	-4.020396	
5% level	-3.440059	
10% level	-3.144465	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(DINDUSTRIALS_MINING)

Method: Least Squares

Date: 03/20/14 Time: 08:50

Sample (adjusted): 2001M03 2013M08

Included observations: 150 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINDUSTRIALS_MINING(-1)	-0.854117	0.148069	-5.768385	0.0000
D(DINDUSTRIALS_MINING(-1))	0.052926	0.135219	0.391410	0.6961
D(DINDUSTRIALS_MINING(-2))	0.132324	0.127186	1.040397	0.2999
D(DINDUSTRIALS_MINING(-3))	0.277772	0.118001	2.353989	0.0199
D(DINDUSTRIALS_MINING(-4))	0.306352	0.104912	2.920076	0.0041
D(DINDUSTRIALS_MINING(-5))	0.121396	0.084657	1.433974	0.1538
C	366.4579	400.9883	0.913887	0.3623
@TREND("2000M08")	-2.912158	4.321143	-0.673932	0.5014
R-squared	0.420157	Mean dependent var		3.840733
Adjusted R-squared	0.391573	S.D. dependent var		2922.388
S.E. of regression	2279.512	Akaike info criterion		18.35317
Sum squared resid	7.38E+08	Schwarz criterion		18.51374
Log likelihood	-1368.488	Hannan-Quinn criter.		18.41840
F-statistic	14.69913	Durbin-Watson stat		2.008995
Prob(F-statistic)	0.000000			

As per figure 9, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -5, 77 is lower than the critical value of -3, 44. Therefore, the first difference is considered

stationary at a 5% significance level. The first difference of the transport sub-sector price variable can thus be used in the Granger causality test.

4.3.2.2 RESULTS: GRANGER CAUSALITY

The result of the Granger causality test for the PMI and the first difference of the metals and mining sub-sector price for South Africa are provided in figure 10 below.

Figure 10: Granger causality test of PMI and the metals and mining sub-sector

Pairwise Granger Causality Tests

Date: 03/20/14 Time: 08:51

Sample: 2000M08 2013M08

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
DINDUSTRIALS_MINING does not Granger Cause PMI_INDEX	150	1.75931	0.1120
PMI_INDEX does not Granger Cause DINDUSTRIALS_MINING		0.81689	0.5586

The results in figure 10 show that as the PMI index does not Granger cause metals and mining sub-sector price due to the p-value (0.5586) exceeding the 5% significance level. Therefore, the null hypothesis of PMI not Granger causing metals and mining sub-sector price is accepted. The result as well found the metals and mining sub-sector price does not Granger cause the PMI index due to the p-value (0.1120) exceeding the 5% significance level. Therefore, the null hypothesis of the metals and mining sub-sector price not Granger causing PMI is accepted.

4.3.3 ENGINEERING

4.3.2.1 RESULTS: STATIONARITY

The result of the ADF test for the engineering sub-sector price for South Africa is provided in figure 11 below.

Figure 11: ADF results for engineering sub-sector price

Null Hypothesis: INDUSTRIALS_ENGINEERING_ has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 5 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.610388	0.2764
Test critical values:		
1% level	-4.019975	
5% level	-3.439857	
10% level	-3.144346	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INDUSTRIALS_ENGINEERING_)
 Method: Least Squares
 Date: 03/20/14 Time: 08:55
 Sample (adjusted): 2001M02 2013M08
 Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDUSTRIALS_ENGINEERING_(-1)	-0.052628	0.020161	-2.610388	0.0100
D(INDUSTRIALS_ENGINEERING_(-1))	0.128104	0.080831	1.584847	0.1152
D(INDUSTRIALS_ENGINEERING_(-2))	0.119643	0.080426	1.487609	0.1391
D(INDUSTRIALS_ENGINEERING_(-3))	-0.103673	0.079891	-1.297684	0.1965
D(INDUSTRIALS_ENGINEERING_(-4))	0.213364	0.080224	2.659601	0.0087
D(INDUSTRIALS_ENGINEERING_(-5))	0.211125	0.082432	2.561199	0.0115
C	16.87320	45.83000	0.368169	0.7133
@TREND("2000M08")	2.436382	1.006813	2.419896	0.0168
R-squared	0.145972	Mean dependent var		47.83470
Adjusted R-squared	0.104166	S.D. dependent var		281.1237
S.E. of regression	266.0793	Akaike info criterion		14.05699
Sum squared resid	10124144	Schwarz criterion		14.21685
Log likelihood	-1053.303	Hannan-Quinn criter.		14.12193
F-statistic	3.491679	Durbin-Watson stat		1.978476
Prob(F-statistic)	0.001738			

As per figure 11, at a 5% significance level, the null hypothesis is accepted as the t-statistic of -2, 61 is higher than the critical value of -3, 44. Therefore, the engineering sub-sector price is considered non-stationary at a 5% significance level. The first difference of the

engineering sub-sector price is therefore computed in order to determine stationarity that can be used in the Granger causality test.

The result of the ADF test for the first difference of the engineering sub-sector price for South Africa is provided in figure 12 below.

Figure 12: ADF results for first difference engineering sub-sector price

Null Hypothesis: DINDUSTRIALS_ENGINEERING has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.733579	0.0230
Test critical values:	1% level	-4.019975	
	5% level	-3.439857	
	10% level	-3.144346	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DINDUSTRIALS_ENGINEERING)
Method: Least Squares
Date: 03/20/14 Time: 08:59
Sample (adjusted): 2001M02 2013M08
Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINDUSTRIALS_ENGINEERING(-1)	-0.567063	0.151882	-3.733579	0.0003
D(DINDUSTRIALS_ENGINEERING(-1))	-0.319233	0.143673	-2.221950	0.0278
D(DINDUSTRIALS_ENGINEERING(-2))	-0.228950	0.123848	-1.848641	0.0666
D(DINDUSTRIALS_ENGINEERING(-3))	-0.359728	0.106317	-3.383549	0.0009
D(DINDUSTRIALS_ENGINEERING(-4))	-0.170792	0.082590	-2.067962	0.0404
C	15.51649	46.74305	0.331953	0.7404
@TREND("2000M08")	0.153220	0.508634	0.301238	0.7637
R-squared	0.481821	Mean dependent var		0.818543
Adjusted R-squared	0.460230	S.D. dependent var		369.4044
S.E. of regression	271.3978	Akaike info criterion		14.09030
Sum squared resid	10606572	Schwarz criterion		14.23017
Log likelihood	-1056.817	Hannan-Quinn criter.		14.14712
F-statistic	22.31606	Durbin-Watson stat		1.967744
Prob(F-statistic)	0.000000			

As per figure 12, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -3, 73 is lower than the critical value of -3, 44. Therefore, the first difference is considered

stationary at a 5% significance level. The first difference of the engineering sub-sector price variable can thus be used in the Granger causality test.

4.3.2.2 RESULTS: GRANGER CAUSALITY

The result of the Granger causality test for the PMI and the first difference of the engineering sub-sector price for South Africa are provided in figure 13 below.

Figure 13: Granger causality test of PMI and the engineering sub-sector

Pairwise Granger Causality Tests

Date: 03/20/14 Time: 09:01

Sample: 2000M08 2013M08

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
DINDUSTRIALS_ENGINEERING does not Granger Cause PMI_INDEX	150	3.79636	0.0016
PMI_INDEX does not Granger Cause DINDUSTRIALS_ENGINEERING		0.36709	0.8987

The results in figure 13 shows that as the PMI index does not Granger cause engineering sub-sector price due to the p-value (0.8987) exceeding the 5% significance level. Therefore, the null hypothesis of PMI not Granger causing the engineering sub-sector price is accepted.

The result as well found the engineering sub-sector price does Granger cause the PMI index due to the p-value (0.0016) being lower than the 5% significance level. Therefore, the null hypothesis of the engineering sub-sector price not Granger causing PMI is rejected.

4.3.4 ANALYSIS OF THE TOP 25

4.3.4.1 RESULTS: STATIONARITY

The result of the ADF test for the top 25 industrials price for South Africa is provided in figure 14 below.

Figure 14: ADF results for top 25 industrials price

Null Hypothesis: INDUSTRIALS_TOP_25 has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.568924	0.9994
Test critical values:		
1% level	-4.018349	
5% level	-3.439075	
10% level	-3.143887	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INDUSTRIALS_TOP_25)
 Method: Least Squares
 Date: 03/20/14 Time: 09:08
 Sample (adjusted): 2000M10 2013M08
 Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDUSTRIALS_TOP_25(-1)	0.010248	0.018014	0.568924	0.5703
D(INDUSTRIALS_TOP_25(-1))	-0.185536	0.082204	-2.257012	0.0254
C	-212.9920	141.6118	-1.504056	0.1347
@TREND("2000M08")	4.283947	4.142619	1.034116	0.3027
R-squared	0.104604	Mean dependent var		255.8985
Adjusted R-squared	0.086815	S.D. dependent var		903.6864
S.E. of regression	863.5691	Akaike info criterion		16.38549
Sum squared resid	1.13E+08	Schwarz criterion		16.46403
Log likelihood	-1265.876	Hannan-Quinn criter.		16.41739
F-statistic	5.880183	Durbin-Watson stat		1.996224
Prob(F-statistic)	0.000800			

As per figure 14, at a 5% significance level, the null hypothesis is accepted as the t-statistic of 0, 57 is higher than the critical value of -3, 44. Therefore, the top twenty-five industrials price is considered non-stationary at a 5% significance level. The first difference of the top

twenty-five industrials price is therefore computed in order to determine stationarity that can be used in the Granger causality test.

The result of the ADF test for the first difference of the top 25 industrials price for South Africa is provided in figure 15 below.

Figure 15: ADF results for first difference top 25 industrials price

Null Hypothesis: DINDUSTRIALS_TOP_25 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-14.71060	0.0000
Test critical values:		
	1% level	-4.018349
	5% level	-3.439075
	10% level	-3.143887

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DINDUSTRIALS_TOP_25)
Method: Least Squares
Date: 03/20/14 Time: 09:11
Sample (adjusted): 2000M10 2013M08
Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINDUSTRIALS_TOP_25(-1)	-1.174887	0.079867	-14.71060	0.0000
C	-210.0704	141.2035	-1.487714	0.1389
@TREND("2000M08")	6.455055	1.608298	4.013594	0.0001
R-squared	0.587407	Mean dependent var		4.419484
Adjusted R-squared	0.581978	S.D. dependent var		1332.691
S.E. of regression	861.6458	Akaike info criterion		16.37473
Sum squared resid	1.13E+08	Schwarz criterion		16.43364
Log likelihood	-1266.042	Hannan-Quinn criter.		16.39866
F-statistic	108.2010	Durbin-Watson stat		1.993014
Prob(F-statistic)	0.000000			

As per figure 15, at a 5% significance level, the null hypothesis is rejected as the t-statistic of -14, 71 is lower than the critical value of -3, 44. Therefore, the first difference is considered stationary at a 5% significance level. The first difference of the top twenty-five industrials price variable can thus be used in the Granger causality test.

4.3.2.2 RESULTS: GRANGER CAUSALITY

The result of the Granger causality test for the PMI and the first difference of the top 25 industrials price for South Africa are provided in figure 16 below.

Figure 16: Granger causality test of PMI and the top 25 industrials

Pairwise Granger Causality Tests

Date: 03/20/14 Time: 09:12

Sample: 2000M08 2013M08

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
DINDUSTRIALS_TOP_25 does not Granger Cause PMI_INDEX	150	1.80430	0.1026
PMI_INDEX does not Granger Cause DINDUSTRIALS_TOP_25		0.68063	0.6655

The results in figure 16 shows that as the PMI index does not Granger cause the top 25 industrials price due to the p-value (0.6655) exceeding the 5% significance level. Therefore, the null hypothesis of PMI not Granger causing the top 25 industrials price is accepted. The result as well found the top 25 industrials price does not Granger cause the PMI index due to the p-value (0.1026) exceeding the 5% significance level. Therefore, the null hypothesis of the top 25 industrials price not Granger causing PMI is accepted.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS OF THE RESEARCH

The results in chapter 4 provide for an interesting conclusion as they don't support the phenomenon of the PMI being a leading indicator of Industrial sector share prices. The results from the stationarity test indicate that the PMI is stationary whereas the first difference of the industrial index prices was concluded to be stationary. Similar results were found for the sub-sectors and the top twenty-five industrial companies.

The stationary variables were used in the Granger causality test in order to ensure the results are reliable and credible. The results revealed that the PMI does not have the ability to forecast future trends in the industrial sector, nor was this prevalent in any of the sub-sectors. The PMI could also not aid in forecasting the trend of the top twenty-five industrial companies. Interestingly, the results revealed a causal relationship where the industrial sector prices aided in predicting future PMI figures. Sub sectors such as transportation and engineering provided the same result. Results for the metals and mining sector and the top twenty-five industrial companies revealed no causal relationship between prices and PMI.

The results in this research report support prior research by Collins (2001) where stock market performance aided in predicting the PMI figures and contradict the results from Johnson and Watson (2011) where it was concluded that a positive, statistically significant relationship between changes in PMI and subsequent market returns exists.

The SA PMI has a relatively shorter history compared to some of the PMI's in foreign markets such as the U.S PMI. A deeper history of data on the SA PMI may lead to further research and a greater understanding of the predictive power of the SA PMI.

The results could also be attributable to the PMI data only explaining business activities of the first half of the month due to the collection and processing occurring in the second-half. Inevitably this lapse in time and the actual period the PMI monthly index covers may result in PMI figures not fully encapsulating the economic conditions in the industrial sector.

Ultimately, the results observed are consistent with those found by Collins (2001). The SA PMI does not have predictive power over future industrial sector share prices, but rather industrial sector share prices is a predictor of future PMI index figures.

5.2 RECOMMENDATIONS

The information in this research should be useful to investors who seek to gain from making profitable investments. The PMI index is public information available to investors in aiding them to assess the historical performance of the industrial sector but fails to aid in predicting the future trends in the industrial sector.

As this represents the first research performed on the SA PMI, further research assessing the effect that the PMI has on the Gross Domestic Product as well as Industrial Production may be useful information in assessing whether the PMI has the ability to track economic cycles. As the PMI is a diffusion index, a deeper understanding of the inputs of the PMI may lead to invaluable information that may aid in improving the information the PMI purports.

South Africa has recently begun compiling the HSBC PMI which covers the manufacturing, services, construction, mining and retail sectors. The quality of the information of the HSBC PMI over the PMI that focuses on the manufacturing sector would be of great interest in future research.

Even though this study suggests that the PMI does not have power to predict prices in the industrial sector, the survey may add value in other ways. The continuous progression of longer running data sets for emerging markets such as South Africa will aid in improving the quality of research in emerging markets.

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