# AN ANALYSIS OF THE RELATIONSHIPS BETWEEN THE PURCHASING MANAGERS' INDEX (PMI), ECONOMIC GROWTH AND EMPLOYMENT IN THE MANUFACTURING SECTOR IN SOUTH AFRICA

**Habanabakize, Thomas,**
North-West University, South Africa
tomhaban12@gmail.com.

**Meyer, Daniel Francois,**
North-West University, South Africa
Daniel.meyer@nwu.ac.za.

**-Abstract-**
Employment growth in the South African economy has been dismal, and unemployment has been gradually increasing since the 2000s. The high rate of unemployment at more than 27 percent, is mainly due to weak gross domestic product (GDP). The purpose of the study was to analyse the relationships between the purchasing managers' index (PMI), economic growth and employment in manufacturing sector in South Africa. The study employed time series data from the first quarter of 2000 to the fourth quarter of 2016. The results of the Correlation analysis indicate significant positive relationships between the variables. Using Bounds test for co-integration, the results indicated that a long-run relationship exists between the variables. A 1 percent increase in GDP could lead to a 0.30 percent increase in employment in manufacturing, and a one percent increase in the PMI could result in a 0.37 percent increase in manufacturing employment. In the short-run, only GDP and not PMI is a significant predictor of employment in manufacturing. Based on the results from the Granger causality test, a bi-directional causality was found between manufacturing employment and PMI. From the results it can also be concluded that the PMI is still a reliable leading indicator of macro-economic conditions. A key strategy that can improve employment in the South African economy would be to enhancement economic growth and the promotion of the manufacturing sector by means of incentives.

**Key Words***:* economic growth, employment, manufacturing, purchasing managers' index, South Africa.

**JEL classification***: E6, O4*

## 1. INTRODUCTION

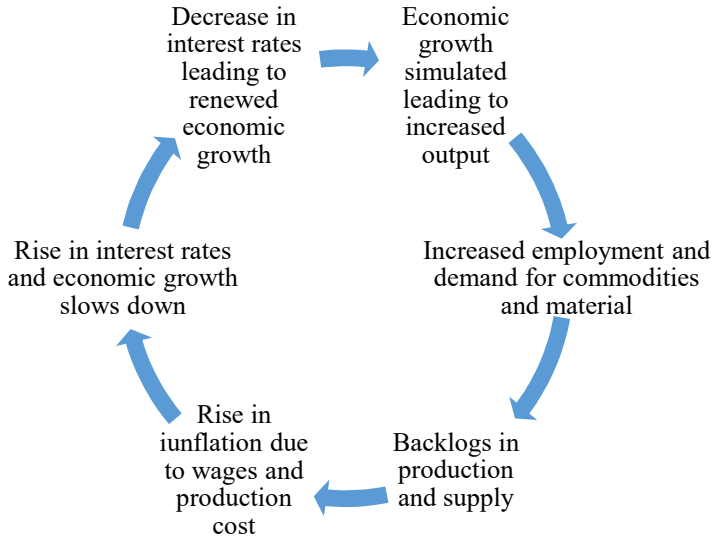
The manufacturing sector plays a major role in both economic growth and employment (Zalk, 2014). A healthy manufacturing sector is a significant predictor of growth in the economy and the manufacturing sector can turn the economy around (Rodseth, 2016). A growing manufacturing sector is of critical importance as a driver of economic growth and development (Leke *et al*., 2010). In South Africa, the contribution of the manufacturing sector has been declining over the last two decades to its current level of only 15 percent of GDP, with a labour force of approximately 1.6 million people (StatsSA, 2017). Globally economic conditions are changing rapidly and for this reason, economists find it important to use indicators that can also predict changes in the economy and specifically in the manufacturing sector. The development of the Purchasing Managers' Index (PMI) is one of the indexes that is used to predict manufacturing trends and activities. The index is one of the most closely monitored indexes in the world by economic agencies including central banks and local businesses in analysing production control, inventory management and effective marketing (Khundrakpam & George, 2012; Ursel, 2008). The PMI can be defined as a monthly composite index of business conditions and economic activity in the manufacturing sector (Chien & Morris, 2016; Kuepper, 2016; Buro of Economic Research, 2015; Soni, 2014). The results of monthly PMI surveys have a scale between 0 and 100. An overall index of above 50 indicates possible expansion of the sector, while a value of below 50 indicates contraction in activities. A sustained value below 50 and close to 42 indicates a possible recession in the economy (Barnes, 2015). The PMI consists of 5 sub-indexes namely business activity, new sales orders, employment, supplier deliveries and inventories (Buro of Economic Research, 2015).

Global research indicates that the PMI is a relevant leading indicator for economic conditions. The reason for this is that the sector has both forward and backward linkages with the primary and tertiary sectors. Purchasing managers in the manufacturing sector could therefore provide information on changes in demand and supply in the economy (Laubscher, 2003). Kuepper (2016) agrees and states that manufacturing purchasing trends react to demand by consumers indicating early signs of growth or slowdown. In addition Laubscher (2003) states that the correlation between PMI and manufacturing data has been significant. The three variables included in this study have been selected to test the relationships and also to focus on the manufacturing sector which is an important sector for future economic growth in South Africa. The study also tests the role of the PMI as a leading indicator of the other two variables in the study.

## 2. LITERATURE REVIEW

Accoring to IHS Markit (2017), the relationship between economic growth, employment and the PMI is best explained via the economic pattern of "boom-bust" business cycles. Figure 1 provides an explanation of the process. Economic expansion usually leads to employment growth and a rise in demand for commodities and raw material. This situation leads to new orders for firms to manufacture and output increase. This growth in demand could also lead to supply backlogs at manufacturing firms with high levels of demand. Suppliers are under pressure to deliver due to backlogs in production. Prices of goods and services will rise due to excess demand with accompanied rise in wages which leads to an increase in inflation over time. Rise in wages leads to increased cost of production. At this point the central bank needs to respond the rising inflation by increasing interest rates, which usually results in a decrease in consumer spending and the low growth in the economy. When the slow-down in demand has reached a certain level, interest rates could again be lowered, leading to increased economic growth.

**Figure 1: Boom-bust business cycles**




*Source:* IHS Markit, 2017.

The complicated relationship between economic growth and employment was originally developed by Okun, known as Okun's Law (Okun, 1962). This law or theory, attempts to conceptualise a positive relationship between economic growth and employment. The theory explains the relationship between economic growth

and employment growth, where the output is dependent on the quantity of labour used in the production process. This law states in its simplest form that a one percent increase in GDP will result in a 0.3-0.5 percent increase in employment (Meyer & Tasci, 2012). The relationship could however be affected by many factors including improvements in production capacity by means of capital investment, leading to lower labour absorption rates. Traditionally, rapid and sustained economic growth has been seen as the solution to job creation through inclusive growth (World Bank, 2013). In terms of macro-economic theory, Keynes (1936) states that changes in employment should result from changes in economic growth due to aggregate demand and low growth that leads to rising unemployment. Economic growth therefore determines the level of employment in terms of the Keynesian theory. Therefore, this theory indicates a positive relationship between the two variables and the direction of the causality flows from economic growth to employment (Dumitrescu *et al*., 2009; Eita & Ashipala, 2010).

A number of studies found PMI as a significant indicator for forecasting economic growth and manufacturing activities (Kuepper, 2016; Tsuchiya, 2012; Banerjee & Marcellino, 2006; Lindsey & Pavur, 2005). PMI has emerged as a key indicator of manufacturing activity because it is a broad indicator consisting of various sub-indexes relating to economic activity in the sector (Harris, 1991). Harris (1991) analysed PMI as a reliable tool to forecast economic activity and found evidence of usefulness for using the index for the prediction of economic activities. He has also found that the PMI has leading indicator qualities with a general time lead of approximately 12 months (Cox & Torda, 1980).

Laubscher (2003) states that PMI and the manufacturing data produced by StatsSA has an historical positive correlation of 0.83. A study by Chien and Morris (2016) found a positive correlation between PMI and economic growth in the US with a coefficient of 0.75, which confirmed findings by Koenig (2002) in an earlier study. Chien and Morris (2016) also analysed this relationship in China and also found a strong positive correlation with a coefficient of 0.73. The importance of the PMI is its timeliness as a leading economic indicator, as the index is released on a monthly basis and available 2 to 5 months ahead of manufacturing data. The majority of economic indicators have a historical outlook, but economic surveys such as the PMI has forward looking quality. Soni (2014) states that the PMI has a positive relationship with economic growth and an increase in the PMI could predict employment growth in the economy. According to Rodseth (2016), over the last four decades, the PMI has served as a leading indicator for both the manufacturing sector and economic growth. South Africa can re-industrialise its economy through

improved productivity, achieve cheaper energy in cost reduction processes, and access to the rapidly growing urbanized African markets (Rodseth, 2016). In a study in Spain, Harker (2017) found PMI to be a significant predictor of GDP and manufacturing activities from 2006 to 2017. In addition, in a study in India from 2005 to 2012, Khundrakpam and George (2012) analysed whether the PMI is a useful indicator of manufacturing activities by means of OLS and ARDL approaches. Their results indicate that PMI is a significant predictive index for manufacturing activities in that country.

The relationship between PMI and employment is also interesting. According to IHS Markit (2017), employment is directly correlated with changes in output of the manufacturing sector. Any divergences in this relationship need to be understood and investigated. Such information provides insights into labour intensity, capital investment and productivity changes. For example, output could increase at a faster pace than employment if the production process is more capital intensive and productivity will decrease if employment grows faster than output.

Chien and Morris (2016), Barnes (2015) and Lahiri and Monokroussos (2012) list strengths and weaknesses of the PMI. Strengths include the timeliness of the index and it is a good indicator to forecast future economic growth and employment growth in the manufacturing sector while weaknesses include the fact that this index only focus on the manufacturing sector and surveys are subjective. According to Basunana (2011), in recent years with the diminishing contribution of manufacturing to GDP, the strong correlation between PMI and economic growth has weakened somewhat over time. Barnes (2015) agrees that the manufacturing sector has a diminishing contribution to economic growth, but this sector is in most cases where recessions could start and end. Barnes is of the opinion that PMI is still a reliable indicator of GDP.

## 3. METHODOLOGY

### 3.1. Variables description

This study analysed the relationship between gross domestic product (GDP), purchasing managers index (PMI) and employment in the manufacturing sector (EMP). The dataset was acquired from two different sources: the GDP and employment index were acquired from South African Reserve Bank (SARB), while the PMI was provided by the Bureau of Economic Research (BER). The time period ranges between the first quarter of 2000 and the fourth quarter of 2016. Therefore, the study employed 64 quarterly observations. The Bounds test for cointegration, alternatively the Wald test, was used to determine the presence or absence of a long-

run relationship among variables. The short-run relationship and the speed for the model adjustment towards long run equilibrium were determined by using the error correction model (ECM). The Granger causality test was used to determine the causal relationship between the variables. Variables employed by the study and their symbols are:

**Employment (EMP)**: The dependent variable of the study was employment in the South African manufacturing sector.

**Gross domestic product (GDP)**: The gross domestic product refers to the market value of all final goods and services produced in a nation during a specific period of time, usually a year (Tucker, 2011).

**Purchasing managers' index (PMI)**: PMI is an economic indicator used to measure the well-being of the manufacturing sector. The PMI level is subjected to inventory levels, new orders, production, supplier deliveries and employment status of businesses in the manufacturing sector. The PMI is also used to acquire information when evaluating the current business status of manufacturing firms (IHS Markit, 2017).

### 3.2. Model specification

In analysing the relationship between the variables, all variables were transformed into natural logarithm and various econometric approaches were used. The first step was a correlation analysis. Secondly, a unit root test was conducted using the Augmented Dickey-Fuller (ADF) method to determine the stationarity of variables (Ouattara, 2004). The choice of the ARDL model was driven by its ability to provide accurate results even when small sample is employed and that it can be used for a mixture of variables [I(0) & I(1)] as it is the case in this study. Additionally, while testing the presence of co-integration among variables, this model can distinguish between explained and explanatory variables (Dritsakis, 2011:12). Using EViews 9, the ARDL model has the power to select the optimum number of lag to be included into the model. The Granger causality test was undertaken to determine the causal relationship between the variables. Using the ARDL model, the following model was estimated to determine the long-run relationship:

$$LEMP_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \ LEMP_{t-i} + \sum_{i=1}^{k} \delta_i \ \mathrm{LGDP}_{t-i} + \sum_{i=1}^{k} \theta_i \ \mathrm{LPMI}_{t-i} + \varphi_1 LEMP_{t-i} + \varphi_2 \mathrm{LGDP}_{t-i} + \varphi_3 \mathrm{LPMI}_{t-i} + e_t \quad \ldots\ldots\ldots(1).$$

The $lEMP_t$ symbolises changes in manufacturing employment at time t, LGDP and LPMI symbolise changes in GDP and PMI at time t. The $\alpha_0$ denotes the intercept, k represents the optimum number of lag, whilst $e_t$ stands for error term. $\beta_i$ , $\delta_i$ and

$\theta_i$ indicates the short-term model dynamism. In Equation 1 the long-run coefficients are represented by $\varphi_1$ , $\varphi_2$ , $\varphi_3$. Based on Equation 1and applying the Pesaran *et al.* (2001) approach for bound testing, the following hypotheses were estimated for the test of long run relationship among variables:

- Null hypothesis (H0) for no co-integration: $\varphi_1 = \varphi_2 = \varphi_3 = 0$
- Alternative hypothesis (H1) for co-integration: $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq 0$

Both of the independent variables (GDP and PMI) are expected to have a positive relationship with employment in manufacturing sector. In other words the value of coefficients $\delta_i$ *and* $\theta_i$ are likely positive; thus $\delta_i > 0$ and $\theta_i > 0$. The presence of co-integration among variables requires the error correction model (ECM) to determine the speed of adjustment to the equilibrium. The following error correction model (ECM) equation was estimated:

$$\Delta LEMP_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \, \Delta LEMP_{t-i} + \sum_{i=1}^{k} \delta_i \, \Delta \mathrm{LGDP}_{t-i} + \sum_{i=1}^{k} \theta_i \, \Delta \mathrm{LPMI}_{t-i} + ECM_{t-i} + e_t \quad \ldots\ldots(2)$$

## 4. RESULTS AND DISCUSSION

### 4.1. Descriptive analysis

Table 1 provides data from 2000 to 2016 for the three variables used in the study namely PMI, GDP and employment in the manufacturing sector. PMI indicates the perceptions of purchasing managers in the manufacturing sector. PMI reached its lowest level of 41.4 in 2008 during the financial crises and recession. In 2015 and 2016, the index has remained below the critical level of 50 and is currently even decreasing to low levels of 46 and even lower. GDP has grown by an average annual rate of 2.5 percent per annum since 2000. Low growth rates have been experienced during 2015 to 2016 of below 0.5 percent. Employment in manufacturing is indicated as an index in the table. The overall annual growth in employment in this sector has been negative from 2000 to 2016 indicating a declining sector.

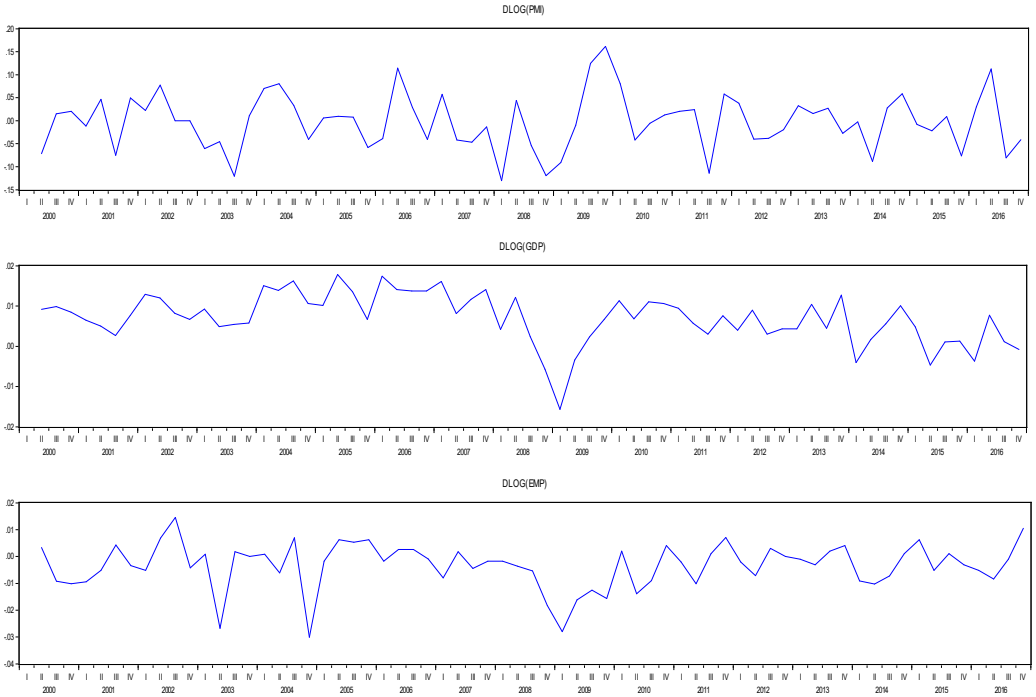
**Table 1: Summary of descriptive statistics**

| Variables | PMI | PMI quarter to quarter growth as % | GDP | GDP quarter to quarter growth as % | Employment index in manufacturing | Employment quarter to quarter growth as % |
|---|---|---|---|---|---|---|
| 2000 | 52.7 | -3.54 | 1981313 | 2.79 | 117.5 | -1.59 |
| 2001 | 53.2 | 0.89 | 2024922 | 2.20 | 115.9 | -1.36 |
| 2002 | 58.7 | 10.47 | 2107049 | 4.06 | 117.3 | 1.21 |
| 2003 | 47.3 | -19.47 | 2160922 | 2.56 | 114.5 | -2.39 |
| 2004 | 54.6 | 15.36 | 2284801 | 5.73 | 111.3 | -2.79 |
| 2005 | 52.7 | -3.42 | 2397432 | 4.93 | 113.1 | 1.62 |
| 2006 | 56.2 | 6.58 | 2543057 | 6.07 | 113.4 | 0.27 |
| 2007 | 53.7 | -4.33 | 2673414 | 5.13 | 112.0 | -1.23 |
| 2008 | 41.4 | -22.89 | 2708410 | 1.31 | 108.8 | -2.86 |
| 2009 | 49.9 | 20.35 | 2681051 | -1.01 | 101.2 | -6.99 |
| 2010 | 52.2 | 4.61 | 2789950 | 4.06 | 99.5 | -1.68 |
| 2011 | 51.6 | -1.15 | 2862777 | 2.61 | 99.1 | -0.40 |
| 2012 | 48.6 | -5.82 | 2921353 | 2.05 | 98.5 | -0.61 |
| 2013 | 50.9 | 4.95 | 3016106 | 3.24 | 98.7 | 0.20 |
| 2014 | 50.7 | -0.46 | 3056440 | 1.34 | 96.2 | -2.53 |
| 2015 | 46.0 | -9.33 | 3064154 | 0.25 | 96.1 | -0.10 |
| 2016 | 46.9 | 2.10 | 3077532 | 0.44 | 95.7 | -0.42 |
| Average Growth per annum | | -0.88 | | 2.53 | | -1.24 |

Note: Data for quarter 4 of each year were used
*Source:* Data from SARB and BER were used.

Figure 2 is a visual presentation of the three variables as percentage change per quarter from 2000 to 2016. Overall the graphs of the variables follow similar patterns indication a positive relationship between the variables. GDP and employment in the manufacturing sector especially follow similar patterns with the employment graph indicating more severe changes in the first period up to 2008. The graphs show the significant impact of the financial crisis in 2008. The PMI graph shows how the variable is a leading indicator for the other two variables as its changes precede changes in the other two variables. Good examples of this occurrence are visible in 2003 and 2008.

**Figure 2: Percentage change in variables per quarter from 2000 to 2016**




*Source:* Data from SARB and BER were used.

## 4.2. Correlation and unit root testing

Table 2 is a summary of the correlation analysis. The results indicate significant positive relationships between the variables. This result is in line with theory as indicated in the literature review section and supported by Laubscher (2003) and Kuepper (2016).

**Table 2: Correlation analysis**

| Variables | EMP | GDP | PMI |
|---|---|---|---|
| **EMP** | 1.0000 | | |
| **GDP** | 0.9168 [0.0002*] | 1.0000 | |
| **PMI** | 0.3764 [0.0016*] | 0.3618 [0.0024*] | 1.0000 |

Notes: [ ] indicates the p-value and * denotes the rejection of the null hypothesis at 5% level of significance.

The next step in the analysis was to perform unit root tests to determine the level at which the variables are stationary. Table 3, displays the unit root test results, and as it can be seen, PMI is integrated at level [I (0)] whilst GDP, and employment are integrated at first difference [I (1)].

**Table 3: Unit root test results**

| Variables | Level | | | | First difference | |
|---|---|---|---|---|---|---|
| | **Without trend** | | **With trend** | | **Without trend** | |
| | **t-stat** | **p-value** | **t-stat** | **p-value** | **t-stat** | **p-value** |
| LEMP | -2.9055 | 0.8337 | -3.4783 | 0.8254 | -2.9069 | 0.0000* |
| LPMI | -2.9062 | 0.0122* | -3.4793 | 0.0122* | -2.9076 | 0.0000* |
| LGPD | -2.9062 | 0.9832 | -3.4793 | 0.9773 | -2.9069 | 0.0014* |

Note: * denotes the rejection of the null hypothesis at 5% level of significance

### 4.3. Lag section and model specification

Lag selection is one of important steps in time series analysis. According to Bahmani-Oskooee and Brooks (1999), the level or the value of F-test depends more on the number of lags selected for the model. In this study, using automatic lag selection in EViews 9, under Akaike Information Criteria (AIC) top 20 model selections were suggested, with the most desirable model in ARDL is (1, 1, 1).

### 4.4. Bounds testing for cointegration

Table 4 represents the cointegration results and critical values. Pesaran *et al.* (2001) suggest that if the computed F-value fall below the lower bound of the critical value, the null hypothesis stipulating that there is no cointegration among analyzed variables is not rejected. Thus, there is no long run relationship among variables. However, if the computed F-value is greater than the upper bound of the critical value, the null hypothesis is rejected, suggesting that in the long-run, variables cointegrate. In the context of this study, the computed F-value is 8.5567 which is greater than 3.87, the upper bound of the critical value at 5 percent level of significance. Therefore, the null hypothesis of no cointegration is rejected in favour of the alternative suggesting the existence of long run relationship among variables.

**Table 4: Cointegration results**

| **The estimate F-value: 8.5567** | | |
|---|---|---|
| **Critical Value** | **Pesaran *et al.* (2001) Table values** | |
| | Lower Bound Value | Upper Bound Value |
| 1% | 4.13 | 5.00 |
| 5% | 3.1 | 3.87 |
| 10% | 2.63 | 3.35 |

Note: The table of unrestricted intercept without trend table was used for critical values (Pesaran *et al.,* 2001).

### 4.5. Long-run relationship analysis

Equation (3) presents the long-run results. A long-run relationship was found between the variables. If GDP increased by 1 percent, employment in

manufacturing would increase by approximately 0.3 percent. This result corresponds to the expected outcome that a significant and positive relationship exists between manufacturing employment and GDP. This result is also consistent with findings by Meyer and Tasci (2012) and Dumitrescu *et al*. (2009). Thus GDP leads to job growth. In addition, a 1 percent increase in the PMI will result in a 0.37 percent increase in employment in the manufacturing. Similar results were also confirmed by Laubscher (2003) and IHS Markit (2017).

$LEMP_t$= 7.5969 + 0.3033*LGDP + 0.3691*LPMI…….(3)

### 4.6. Short-run relationship and Error correction model (ECM) results

Since a long-run relationship was found, it was imperative to test if any short-run relationships exist between the variables. Moreover, using the ECM, the short-run results determine the speed of adjustment. The results of the short-run relationship are shown in Table 5. As illustrated in Table 5, the PMI is not significant, thus it does not affect manufacturing employment in the short-run. Unlike PMI, GDP has a significant and positive effect on the manufacturing employment levels. A disturbance in the system (model) takes approximately 14 quarters to move back to equilibrium.

**Table 5: Short-run relationship and Error correction model (ECM) results**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LOG_GDPR) | 0.4598 | 0.1328 | 3.4623 | 0.0010* |
| D(LOG_PMI) | 0.0028 | 0.0154 | -0.1811 | 0.8568 |
| CointEq(-1) | -0.0700 | 0.0116 | -5.9925 | 0.0000* |

Note: * rejection of the null hypothesis at 5 percent level of significance

Table 6 displays results of the Granger causality test. The test outcome reveals a uni-directional causality from economic growth to employment in the manufacturing sector (Eita & Ashipala, 2010). Also a bi-directional causality was found between economic growth and PMI. That is to say, in short run, the level of employment in manufacturing sector can increase due to changes in economic growth and the PMI. Similar results were found by Harker (2017) and Soni (2014).

**Table 6: Granger causality results**

| Null Hypothesis | Chi-sq | Prob. | Direction of Causality |
|---|---|---|---|
| LGDP does not Granger Cause LEMP | 4.7796 | 0.0118* | LGDP → LEMP |
| LEMP does not Granger Cause LGDP | 0.1998 | 0.8194 | No causality |
| LPMI does not Granger Cause LEMP | 4.6652 | 0.0130* | LPMI → LEMP |
| LEMP does not Granger Cause LPMI | 2.6078 | 0.0819** | LEMP → LPMI |
| LPMI does not Granger Cause LGDP | 0.8802 | 0.4199 | No causality |
| LGDP does not Granger Cause LPMI | 6.0496 | 0.0040* | LGDP → LPMI |

Notes:* rejection of null hypothesis at 5% level of significance
**rejection of null hypothesis at 10 level of significance

### 4.7. Residual diagnostic results

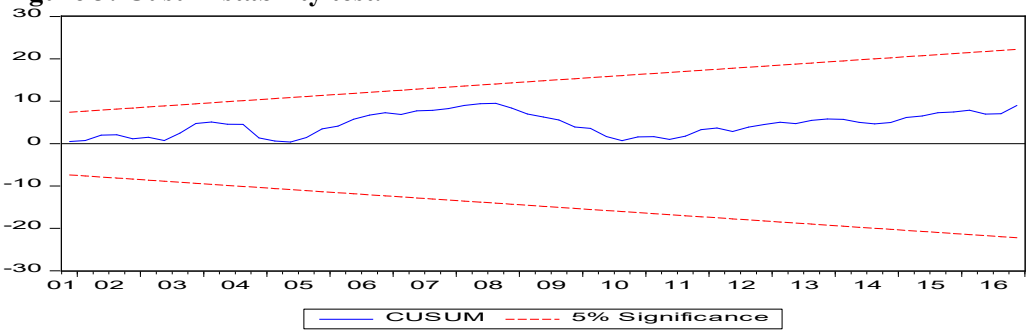
Different diagnostic tests were employed to ensure the reliability of the used model and the accuracy of the study findings. Table 7 shows results of tests of serial correlation, heteroscedasticity and normality. The null hypotheses for serial correlation and heteroscedasticity were not rejected as their probability values are greater than 5 percent level of significance. However, the null hypothesis of normality test was not rejected. Thus, employed series are not normally distributed. To ensure that these results from normality test did not affect the accuracy of the used model, the stability test was performed. The Cusum test, shown in Figure 3, confirms the model is dynamically stable.

**Table 7: Diagnostic test results tests**

| Item | Applied test | P-value | Decision |
|---|---|---|---|
| Serial Correlation | LM Test | 0.6499 | No Serial correlation |
| Normality | Jarque-Bera | 0.0000* | Variables not normally distributed |
| Heteroscedasticity | Breusch-Pagan-Godfrey | 0.5122 | No Heteroscedasticity |

Note: *null hypothesis rejected at 5 percent significance level of significance

**Figure 3: Cusum stability test.**




## 5. CONCLUSIONS AND RECOMMENDATIONS

The manufacturing sector is still the main driver of economic growth in South Africa. Unfortunatly, this sector has been on the decline in recent decades, and has led to a negative impact on employment and GDP growth. The main objective of the study was to investigate the relationship between PMI, economic growth and employment in the South African manufacturing sector. The primary results from the study indicate significant positive correlation between the variables and that a long-run relationship exists between all variables when using the Wald test to investigate cointegration. When using the ARDL approach to determine short-run relationships, PMI was found not to be a significant predictor of employment growth in the manufacturing sector. While PMI has a non-significant impact, economic growth has a positive and significant short-run effect on employment in manufacturing. This study also employed the Granger causality test to determine the causal relationship among variables. Interesting causalities were found in the study. Two uni-directional causality were found. The first one is where economic growth causes manufacturing employment and the other is where PMI causes employment in manufacturing.

An increase in economic growth is an effective strategy to boost rapid and lasting employment growth in the manufacturing sector. Growth in the manufacturing sector will also have forward and backward linkages with other sectors of the economy, leading to further growth. Growth in the manufacturing sector should be promoted by means of incentives for production, employment and export. Other areas where South Africa can improve regarding the manufacturing sector are improved productivity, reduction in cost of production through the use of renewable energy, and expansion of the market through access to Africa. Future research should focus on PMI as a leading indicator for other macro-economic variables such as interest rates and inflation. The use of manufacturing output in place of

employment will also provide further insight in the relationship between PMI and the manufacturing sector. Research on the manufacturing sector remain important as most recessions tend to start and end in this sector of the economy.

## REFERENCES

Bahmani-Oskooee, M. & Brooks, T.J. (1999). Bilateral J-curve between US and her trading partners. *Weltwirtschaftliches Archiv*, 135(1), 156-165.

Banerjee, A. & Marcellino, M. (2006). Are There Any Reliable Leading Indicators for the US Inflation and GDP Growth? *International Journal of Forecasting*, 22, 137-151.

Barnes, R. (2015). Economic indicators: Purchasing managers' index (PMI). https://abcdofupsc.files.wordpress.com/2015/05/economic-indicators.pdf. Accessed: 2017/04/15.

Basunana, A. (2011). The evolution of economic relationships: The PMI and growth. https://www.fxstreet.com/analysis/special-commentary/2011/08/31. Accessed: 2017/04/15.

Buro of Economic Research (BER). (2015). Manufacturing Purchasing Managers' Index. Stellenbosch University. Stellenbosch.

Chien, Y. & Morris, P. (2016). PMI and GDP: Do They Correlate for the United States? For China? *Economic Synopses*, 6, 1-2. https://ssrn.com/abstract=2756951. Accessed: 2017/04/16.

Chin, H. & ZhongToa, C. (2017). PMI Quarterly on China manufacturing. Fung Business Intelligence, January 2017, Issue 27.

Cox, W.A. & Torda, T.S. (1980). Survey by purchasing managers can provide signal on end of recession. *Business America*, 14, 21-31.

Dritsakis, N. (2011). Demand for money in Hungary: an ARDL approach. *Review of Economics and Finance*, *5,* 1-28.

Dumitrescu, B.A., Dedu, V. & Enciu, A. (2009). The correlation between unemployment and real GDP growth: A study case on Romania. *Annals of Faculty of Economics*, 2(1), 317-322.

Eita, J.H. & Ashipala, J.M. (2010). Determinants of unemployment in Namibia. *International Journal of Business and Management,* 5(10), 92-104.

Giles, J. A. & Mizra, S. (1998). Some pretesting issues on testing for Granger non-causality, Econometric Working Papers. Department of Economics, University of Victoria, Canada.

Harker, A. (2017). Spain manufacturing jobs growth at 19 year high amid strong output expansion. https://www.ft.com/content/7d3936f4-a735-3f9b-8ab7-26e240c912c3. Accessed: 2017/04/12.

Harris, E.S. (1991). Tracking the economy with the purchasing manager's index. *FRBNY Quarterly Review*. Autumn, 61-69.

IHS Markit. (2017). Interpreting PMI data. https://www.markiteconomics.com/Survey/PDF. Accessed: 2017/07/17.

Investopedia. (2017). Purchasing Managers' Index - PMI. http://www.investopedia.com/terms/p/pmi.asp. Accessed: 2017/04/19.

Keynes, J.M. (1936). The general theory of employment, interest and money. London. Macmillan.

Khundrakpam, J.K. & George, A.T. (2012). An Empirical Analysis of the Relationship between WPI and PMI-Manufacturing Price Indices in India. Reserve Bank of India. Working Paper Series 06/2013. https://mpra.ub.uni-muenchen.de/50929/1/MPRA_paper_50929.pdf . Accessed: 2017/07/18.

Koenig, E. F. (2002). Using the Purchasing Managers' Index to Assess the Economy's Strength and the Likely Direction of Monetary Policy. Federal Reserve Bank of Dallas. *Economic and Financial Policy Review*, 2002, *1*(6), 1-10.

Kuepper, J. (2016). What is the PMI? www.thebalance.com/what-is-the-purchasing-managers-index-pmi-1978996. Accessed: 2017/07/08.

Lahiri, K. & Monokrousoussos, G. (2012). Nowcasting US GDP: The role of ISM Business Surveys. Department of Economics, University at Albany, State University of New York, Albany.

Laubscher, P. (2003). The value of two survey-based indicators in South Africa: The BER business confidence index and the BER PMI. Paper presented at the Joint European Commission-OECD workshop on International Development of Business and Consumer Tendency Surveys, 20-21 November 2003.

Leke, A., Lund, S., Roxburgh, C. & Van Wamelen, A. (2010). What is driving Africa's growth? http://www.mckinsey.com/global-themes/middle-east-and-africa/whats-driving-africas-growth. Accessed: 2017/07/22.

Lindsey, M.D. & Pavur, R. (2005). As The PMI Turns: A Tool for Supply Chain Managers. *The Journal of Supply Chain Management*, 41(3), 30-39.

Mavrotas, G. & Kelly, R. (2001). Old wine in new bottle: Testing causality between savings and growth. *The Manchester School Supplement*, 69(1), 97–105.

Meyer, B., & Tasci, M. (2012). An unstable Okun's Law, not the best rule of thumb. *Economic Commentary*, 8, 1-5.

Okun, A.M. (1962). Potential GNP, its measurement and significance. Cowles Foundation. Yale University.

Ouattara, B. (2004). Foreign Aid and Fiscal Policy in Senegal, mimeo. University of Manchester, UK, Manchester.

Rodseth, P. (2016). The importance of manufacturing for SA's economic growth. www.ee.co.za/article/the-importance-of-manufacturing-for-sas-economic-growth.html. Accessed: 2017/07/25.

Soni, P. (2014). Why do key purchasing manager's index readings move markets? http://marketrealist.com/2014/04/key-pmi-readings-move-markets. Accessed: 2017/07/12.

Statistics South Africa. (2017). Quarterly employment statistics. June 2017. Pretoria, Government printer.

Thompson, W. (2017). Are we heading for a recession? https://www.moneyweb.co.za/news/economy/are-we-heading-for-a-recession/. Accessed: 2017/07/15.

Tsuchiya, Y. (2012). Is the Purchasing Managers' Index Useful for Assessing the Economy's Strength? A Directional Analysis. *Economics Bulletin,* 32 (2), 1302-1311.

Tucker, I.B. (2011). Microeconomics for Today. 7th Ed. Mason, OH: Thomson South-Western.

Ursel, S. (2008). Best practice in Einkauf und Logistik. Wiesbaden, Gabler Publishers.

World Bank. (2013). World development report*, 2013*. Washington, DC.

Zalk, N. (2014). What is the role of manufacturing in boosting economic growth and employment in South Africa? http://www.econ3x3.org/article/what-role-manufacturing-boosting-economic-growth-and-employment-south-africa. Accessed: 2017/07/12.