The Sectoral Employment Intensity of Growth in South Africa: 2000:01-2012:04

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Abstract

Concerns have been expressed recently about the inability of the South African economy to provide adequate employment for the increasing number of job seekers. The rate of unemployment remains stubbornly high in spite of vastly improved macroeconomic fundamentals since the 1990s. South Africa registered positive average growth rates of 4.9 per cent in 2005-2008 and 1.7 per cent in 2009-2011. However despite these growth rates employment has not increased significantly. This paper investigates how the sectoral employment intensity of output growth in the eight non-agricultural sectors of the South African economy has evolved in the period 2000:01-2012:04, with a view to identify key growth sectors that are employment intensive. To achieve this, the study evaluates the employment elasticities in the major SIC divisions of the economy to establish whether growth is employment intensive in these sectors. Empirical findings of the study suggest that employment and economic growth do not move together in the long run, implying that jobless growth did occur in South Africa during the period under review. This supports the view that South Africa has become less labour intensive and more capital intensive, and in turn facilitated a structural adjustment that has led to the weakening employment-growth relationship. Results of a sectoral division confirm a long run relationship between employment and growth in finance and business services, manufacturing, transport and the utilities sectors. In particular, the results suggest that sectors within the tertiary sector are best performing sectors, in terms of employment intensity of output growth, reflecting the changing structure of the economy and the nature of employment shifting away from primary towards the tertiary sector. Investment in the tertiary sector is necessary to foster new employment opportunities and can assist in improving the overall employment intensity in South Africa.

Key words: sectoral output growth, employment, employment intensity

JEL Classification: E24, J21, J23, O17, O55

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1. Introduction

The general perception of employment performance in South Africa has been rather negative. The key issue in the long lasting debate about this problem is the inability of South Africa's economic growth, generally regarded as the creator of employment, to create sufficient employment opportunities for the growing labour force. The rate of unemployment remains stubbornly high in spite of vastly improved macroeconomic fundamentals compared with the situation in the 1990s (Hodge, 2009). According to the South African Reserve Bank (SARB) data reflected in Table 1 below, South Africa registered positive average growth rates of 4.9 per cent in 2005-2008 and 1.7 per cent in 2009-2011. However despite these growth rates employment has not increased significantly. During these two periods total non-agricultural employment was on a declining trend from 2.4 per cent in 2005-08 to -0.6 per cent in 2009-11.

Table 1: Summary of main economic and labour outcomes in South Africa: 2006-2011.

							Av.annual growth (%)	
Main variables		2005	2008	2009	2010	2011	2005-08	2009-11
Macroeconomic outcomes	GDP growth	5.3	3.6	-1.5	3.1	3.6	4.9	1.7
	Labour productivity growth rate	-1.3	1.7	1.7	4.0	1.3	-0.9	2.3
Labour market outcomes	Unemployment rate	23.8	22.7	23.7	24.7	24.7	22.5	24.4
	Total non-agricultural employment	8 960 881	9 690 312	9 436 473	9 383 523	9 520 110	2.4	-0.6
	Construction	434 291	472 672	433 690	409 065	422 786	6.3	-3.5
	Finance	1 646 872	1 907 495	1 816 214	1 776 492	1 819 960	3.1	-1.5
	Manufacturing	1 321 676	1 298 570	1 212 206	1 170 701	1 154 662	-0.2	-3.8
	Mining	449 305	535 109	511 136	573 034	594 682	4.2	3.8
	Social and personal services	3 063 641	3 327 970	3 387 844	3 387 873	3 436 898	2.4	1.1
	Trade	1 636 644	1 728 618	1 661 904	1 650 695	1 668 827	2.5	-1.1
	Transport	359 993	364 083	357 481	358 419	362 724	0.9	-0.1
	Utilities	48 459	55 794	55 997	57 245	59 572	5.3	2.2
Sector's share of total employment	Construction	4.8	4.9	4.6	4.4	4.4		
	Finance	18.4	19.7	19.2	18.9	19.1		
	Manufacturing	14.7	13.4	12.8	12.5	12.1		
	Mining	5.0	5.5	5.4	6.1	6.2		
	Social and personal services	34.2	34.3	35.9	36.1	36.1		
	Trade	18.3	17.8	17.6	17.6	17.5		
	Transport	4.0	3.8	3.8	3.8	3.8		
	Utilities	0.5	0.6	0.6	0.6	0.6		

Source: SARB (2014); World Bank's World Development Indicators (2014)

In fact, in the recent years between 2009 and 2011 a modest average annual GDP growth rate of 1.7 per cent was met with a greater relative decline in employment growth and an increase in productivity growth. During this period total non-agricultural employment fell by 0.6 per cent while labour productivity rate grew by 2.3 per cent. Accordingly, it is clear that productivity growth has benefited at the expense of employment growth throughout much of this period. Furthermore, in the same period unemployment rates have risen sharply from 23.7 per cent in 2009 to 24.7 per cent in 2011.

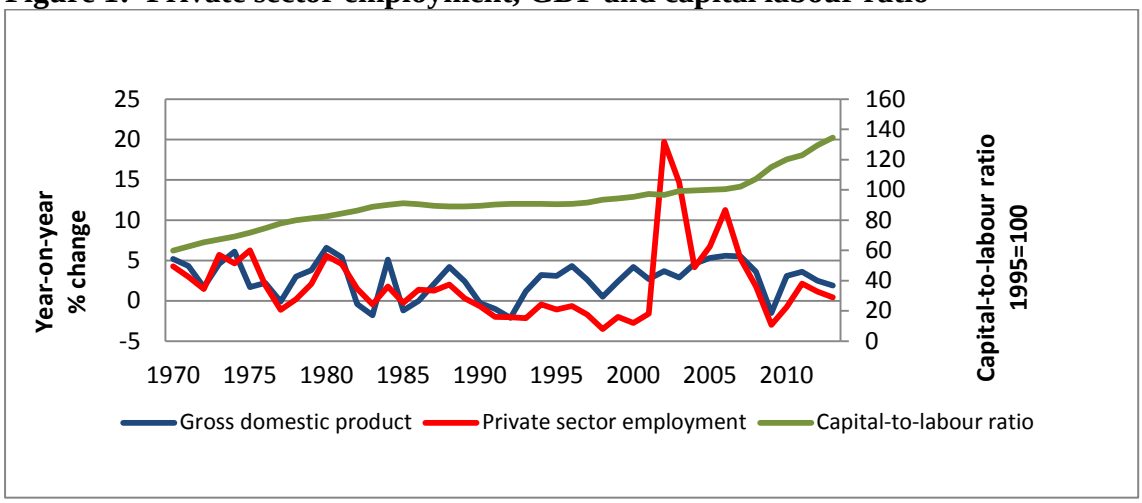
According to the National Treasury (2011), currently there are only two out of five persons of working age (41 per cent) that have a job, compared with 65 per cent in Brazil, 71 per cent in China and 55 per cent in India. It is further asserted that in order to match the emerging markets average of 56 per cent, South Africa would need to employ approximately 18 million people, which would be 5 million more than are employed.

Figure 1 below shows the relationship between Gross Domestic product (GDP) and employment. As can be seen, between the 1970s and 1980s GDP growth and private sector employment were highly correlated. However structural shifts together with increasing capital intensity in the early 1990s have led to the deterioration of this relationship. According to SARB's 2001 report, this relationship broke down in the 1990s. During this period, unemployment rate began to increase in each successive year, with the most rapid increase having occurred in the mid- and late 1990s. The average labour force absorption capacity declined from 79.6 per cent during the 1973-1977 period to zero during the 1990-1995 period (Loots, 1998). The rates of job creation started to rise more slowly than economic growth during economic expansion periods and more rapidly during recessions (Samson et al., 2001).

Furthermore, the average productivity of labour increased in the early 2000s, largely due to increases in the capital-labour ratio. The relatively flat trend of the capital-to-labour ratio in the early 1990s can be associated with a weak correlation between employment and growth, whereas its upward trend seen in 2000s depicts the substitution of capital for labour (Samson et al., 2001). During this period, employment growth had become less responsive to economic growth. In an effort to stem the contraction of the labour market, government launched an Expanded Public Works Programme in the mid-2000s which was aimed at creating jobs and provide training opportunities through investment in physical infrastructure. The impact of this initiative is indicated in the figure below by the once-off sharp increases over this period.

The SARB (2001) reaffirmed that the deteriorating relationship between employment and growth was in part attributed to rising capital intensity. An International Labour Organisation (ILO) study by Hyter et al. (1999) indicated that some of the causes for increasing capital intensity in developing countries included trade liberalisation that shifts production in favour of capital intensive sectors and to the detriment of the labour intensive ones. This reaffirms the view by Nattrass (1998) that since South Africa embarked on trade liberalisation in 1990s, exports have become relatively less labour intensive and more capital intensive. This suggests that South Africa have specialised in capital intensive products, and in turn facilitated a structural adjustment that has led to a weakening employment-growth relationship.

Figure 1: Private sector employment, GDP and capital labour ratio



Source: SARB, 2014; QUANTEC, 2014.

In his study, Mahadea (2012) reaffirmed that, with the exception of the year 2008, the ratio of GDP growth to employment growth has been far less than one, reflecting that South Africa's job creation performance against GDP has been rather weak for most years between 2002 and 2010. In fact, according to Mahadea and Simson (2010), although the economy registered positive economic growth over the past 15 years since the demise of apartheid in 1994, the formal sector in South Africa has been unable to provide adequate employment for labour. It is against this backdrop that it is widely held that the South African economy has experienced 'jobless growth' during its past expansion phase.

Although several studies have explored the relationship between economic growth and employment for specific countries and across countries or both, no previous work has analysed this in the single-digit code in eight major Standard Industrial Classification (SIC) divisions of the South African economy.

The objective of the study is to investigate how the sectoral employment intensity of output growth in the eight non-agricultural sectors of the South African economy has evolved, with a view to identify key growth sectors that are employment intensive. To achieve this, the study will evaluate the employment elasticities in the major SIC divisions to establish whether growth is employment intensive in these sectors. This paper is organised into five sections. Following the introductory section is section 2 which provides a theoretical background and empirical evidence of the relationship between growth and employment. Section 3 derives an empirical model of employment demand in South Africa using a production function approach. Some methodological issues related to the econometric estimation of the demand model are also discussed in section 3, while section 4 presents and analyses the empirical results. Section 5 concludes the paper.

2. Theoretical Background

The theoretical background on the relationship between growth and employment is provided by the production function theoretical framework, the business cycle theory and the Okun's Law. In his study, Schmid (2008) used the production theoretical framework to examine the employment intensity of growth in European countries. The production function theory was used to answer the question on how decisions on employment are linked to decisions on production.

The study used isoquants to demonstrate the attainment of alternative combinations of inputs (labour and capital) that are used to produce a given level of aggregate output (GDP or Gross Value Added) in order to explain different expansion paths in the economy and the possibility of jobless growth. This helps to explain how decisions on employment are linked to decisions on production processes as economic sectors employ different resource combinations ranging from capital intensive combinations (much capital and little labour) to labour intensive combinations (much labour and little capital) in order to meet new demand increases. Hence the use of isoquants attempts to illustrate how different technologically efficient combinations of labour and capital can be employed to produce a given level of output.

The classical version of the business cycle theory developed by Kydland and Prescott (1982) assumes that there are random fluctuations in the rate of technological change and that individuals change their amounts of labour supply and spending in response to these. It is based on this reasoning that sudden changes in aggregate supply or demand induces short-term fluctuations in growth around its long-term trend. These fluctuations are called business cycles and are responsible for fluctuations in employment. It has been generally understood that when economies have been in the recovery phase of the business cycle, employment has grown at the same time or soon thereafter. According to Andolfatto and MacDonald (2005) jobless recovery following a recession is what the neoclassical theory predicted, as new technology affects various sectors of the economy differently and as adjustments in the labour market gets delayed.

The relationship between growth and unemployment has been widely studied based on what is known as the Okun's law. In his work, Okun (1962) formalised the inverse relationship between the unemployment rate and growth in real output into a statistic one. He estimated a coefficient (commonly known as Okun coefficient) that postulates a specific empirical relationship between economic growth and the change in the rate of unemployment (output-unemployment elasticity), using US data. More specifically, his study concluded that there was a ratio of 1:3 relationship between unemployment rate and output, which simply states that a one percentage point increase in unemployment will induce real growth of output to fall by approximately three per cent. Reversing the causality, a one percentage point increase in growth (above potential output) would lead only to 0.3 per cent reduction in unemployment (Khemraj et al., 2006).

A study by Padalino and Vivarelli (1997) discussed the Okun coefficient for the G-7 countries. It concluded that the Okun relation was still valid for these countries. Similarly, Lee (2000) estimated Okun equations for all OECD countries and concluded that the impact of growth on employment was valid. Schalk and Untiedt (2000) discussed the link between employment and growth with a special focus on the German. They estimated Okun equations and concluded that Okun's law is a valid approximation. In a study by Ravenga and Bentolila (1995), the authors discussed the reasons for different employment intensity of growth across countries by evaluating the Okun coefficients in a group of OECD countries. The estimate of employment elasticity to be used in this paper is a widely used indicator for examining how employment intensity of output growth has evolved over time.

2.1. Empirical Literature

A number of quantitative and statistical based studies including work by Fofana (2001); Kapsos (2005); Hodge (2009); Ajilore and Yinusa (2011); Bhorat and Oosthuizen (2008); Sawtelle (2007); Upender (2006); and Mahadea and Simson (2010) have investigated the empirical relationship between economic growth, employment and other policy and institutional variables suggested by theory for a range of different countries including South Africa. Fofana (2001) investigated the empirical relationship between employment and GDP in Cote d'Ivoire and concluded that it was negative. In his study he used simple regression analysis to assess the linkage between employment and other selected variables such as GDP, public expenditure, investment and development aid. After undertaking a series of tests on the data including unit root test for stationarity in the variables and cointegration test his study found that the employment elasticities of growth, aid, public expenditure, and investment were -0.11, -0.09, 0.02 and 0.26 respectively. Since employment and growth were

found to be negatively correlated, the study concluded that the possibility of jobless growth exists in the country and that relying solely on macroeconomic equilibrium was not enough to tackle the challenge of unemployment. The study recommended that efforts should be made towards employment generating strategies through increased and reorientation of investments targeted towards employment intensive activities.

A study by Kapsos (2005) utilised cross-country panel data analysis for 160 economies to examine employment elasticities for the general employed population as well as for demographic groupings (such as women and youth) and for the three broad economic sectors including agriculture, industry and services, between 1991 and 2003. His study utilised a multivariate log-linear regression model with country dummy variables to generate point elasticities. His paper established that while the share of employment growth to total output was approximately 0.3 in the early 1990s, it has however declined to 0.24 in the period 1999 to 2003. This was attributed to the global slowdown that occurred in 2001. Other regional trends presented in the paper reflected a wide variation in employment intensity among regions. For instance, Africa and Middle East registered the most employment intensive growth between 1991 and 2003, which is a reflection of the regions' large labour surplus. In addition, the study found that the rapid economic growth in the Asian and Pacific regions, has led to larger productivity gains. The evidence presented on North America and Western Europe suggests a structural divide between the two regions. During the period under review, employment intensity in the North American region was found to be decreasing whereas in Western Europe it was found to be increasing. This is in line with the findings of Mourre (2004) who discovered that employment elasticity in the Euro area increased from 0.4 to 0.6 while it fell from 0.6 to 0.4 in the United States between the period 1986 to 1990 and 1997 to 2000. His study further examined employment intensity of growth in different economic sectors and concluded that in the Euro area the services sector reflected high employment elasticities, between 1997 and 2001, which contributed to the region's higher average employment elasticity.

A similar methodology is applied in the study by Ajilore and Yinusa (2011). Their study used an econometric technique to calculate employment elasticity in Botswana over the period 1990 to 2008. It sought to estimate a labour demand model of a double-log linear specification of the linkage between sectoral employment and other variables included in the demand for labour model, comprising the real wage rate, user cost of capital, sectoral gross value added and a measure for international exposure. The model was also tested for cointegration in order to determine the existence of a long run relationship between the model variables. The results of the study indicated a low total employment intensity of growth in Botswana of around 0.01. At a sectoral level, the study found that the employment elasticity of sectoral output growth in banking, commerce, construction, manufacturing and mining were positive but weak indicating that growth in these sectors was more productivity driven rather than labour employment driven.

Other sectors including agriculture, government, transport, electricity, gas and water exhibited negative employment elasticities, signified negative employment growth and positive productivity growth. The study attribute the negative employment elasticity in the agricultural sector, for instance, to labour replacing technologies and processes in the sector, implying that this sector was no longer able to absorb the growing rural labour force. It thus recommended a successful mineral-led economy that diversifies into sectors that are more labour intensive.

Mahadea and Simson (2010) examined the problem of low employment economic growth performance in South Africa, for the period 1994 to 2008. Their study used the least squares regression method to examine the long term linkage between growth and employment as well as Harrod-Domar model as a heuristic guide to analyse the real economic growth of South Africa. The results of the regression analysis found that during the 1994-2008 study period, the output elasticity of employment in South Africa was low at 0.1541. Moreover, it found that the long run growth-employment effect was also weak.

Domar (1946) stipulated that the country's savings and the incremental capital output ratio (ICOR) provide the key to investment-led growth. In light of the optimistic view that South Africa needs a growth rate of 6 per cent in order to create 400 000 jobs annually, the study by Mahadea and Simson (2010) asserted that insufficient investment was the main growth constraint in South Africa. The study concluded that, given the global economic climate, there was no simple solution for the cycle of sluggish growth and high levels of joblessness in South Africa. The authors recommended the creation of a sound environment conducive to labour absorption development and business entrepreneurship.

In another study by Marinkov and Geldenhuys (2007) the authors estimated Okun's coefficient for the South African economy, using data from 1970 to 2005. Their study found no cointegrating relationship between the unemployment and output series. Their study recommended that the extent to which total unemployment (not only cyclical unemployment) responds to output be investigated as well as the factors associated with other types unemployment before any definite policy recommendations can be made.

3. The Model

In investigating a macro production function of an economy, the use of labour input (demand for labour) and other complementary factors of production produce a national output. The demand function for labour in this study is derived from the Constant Elasticity of Substitution (CES) production function by solving the marginal product of labour equation for the labour input variable (Upender, 2006). Hence, the following CES production function is considered in this paper to derive the empirical demand function for labour. The CES production function can be specified as:

$$GVA_t = A \{\alpha K_t^{-\rho} + (1-\alpha) E_t^{-\rho}\}^{-\eta/\rho} \quad (1)$$

where,

GVA_t = Gross Value Added (sectoral output)

K_t = Capital (input)

E_t = Employment/labour (input)

A = Efficiency parameter; $A > 0$

η = Returns to scale parameter; $\eta > 0$

α = Distribution parameter; $0 < \alpha < 1$

ρ = Extent of substitution (between K and E) parameter, ρ > -1, and related to elasticity of substitution; σ = 1 / 1+ ρ

The derivative of labour (i.e. marginal product of labour (MP_L)) from Equation (1) can be written as:

$$dGVA_t / dE_t = \eta (1-\alpha) / A^{\rho/\eta} . GVA_t^{(1+\rho)/\eta} / E_t^{\rho+1} \quad (2)$$

The above MP_L expression is solved for the E_t input variable in order to derive the empirical labour (employment) demand function:

$$\eta (1-\alpha) / A^{\rho/\eta} . GVA_t^{(1+\rho)/\eta} = E_t^{\rho+1}$$

$$[\eta (1-\alpha) / A^{\rho/\eta} . GVA_t^{(1+\rho)/\eta}]^{1/\rho+1} = E_t$$

$$E_t = [\eta (1-\alpha) / A^{\rho/\eta} . GVA_t^{(1+\rho)/\eta}]^{1/\rho+1}$$

$$E_t = [\eta (1-\alpha) / A^{\rho/\eta}]^{1/\rho+1} . GVA_t^{(1+\rho/\eta)(1/\rho+1)}$$

$$E_t = \beta_0 GVA_t^{\beta 1} \quad (3)$$

where,

$$\beta_0 = [\eta (1-\alpha) / A^{\rho/\eta}]^{1/\rho+1}$$

$$\beta_1 = (1+\rho/\eta)(1/\rho+1)$$

$$\beta_1 = 1+\rho/\eta . \sigma$$

σ (elasticity of substitution) = $1/\rho+1$

However, if we log-transform Equation (3) above we obtain the following employment function:

$$ln\ E_t = ln\ \beta_0 + \beta_1\ ln\ GVA_t$$

$$= \beta_0 + \beta_1\ ln\ GVA_t + \ \ldots\ \beta_n\ lnX_{nt} + \varepsilon_t \quad (4)$$

Thus written, the model is linear in parameters β_0 and β_1 and it is therefore a linear regression model. Although from Equation (1) it is clear that the relationship between output and the two inputs (capital and labour) is nonlinear but it is linear in the logs of these variables. Hence, Equation (4) is a double-log linear regression model.

3.1. Estimation Methodology

Engle and Grange (1987) proposed a 'four step' testing procedure which seeks to determine whether the residuals of the equilibrium relationship are stationary. To explain this, if two variables, Y_t and X_t , are said to be integrated of order 1, the Angle-Granger four-step procedure is used to determine if the two I(1) variables are cointegrated of order CI(1, 1). That is, whether there exists an equilibrium relationship between the two variables.

Step 1: Unit Root Test

When dealing with time series data, it is important to assess whether the series are stationary or not. Several tests are available to examine whether the series are stationary or non-stationary. If the series under investigation are stationary, this means that the series do not exhibit unit roots, hence the series are said to be I(0). However if the series under investigation are non-stationary in their level form, but stationary in the first difference form, then they are said to be integrated of order 1 or I(1). Most time series are able to be classified as being integrated of order *d*, I(*d*), which means that the series must be differenced *d* times to produce a stationary time series. The most commonly approach to investigate the stationarity of a time series is the Augmented Dickey-Fuller (ADF) test proposed by Engle and Granger (1987). In this study the ADF test will be used, which is written as follows:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\beta_1} + \boldsymbol{\beta_{2t}} + \boldsymbol{\delta Y}_{t-1} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{m}} \boldsymbol{\alpha}_i \, \Delta \mathbf{Y}_{t-i} + \boldsymbol{\varepsilon}_t$$

where Y_t is the relevant time series, t is time trend, ε_t a white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$. The hypothesis of the ADF test can be specified as follows:

Null hypothesis: Ho: $\beta = 0$

Alternative hypothesis: H_1: $\beta < 0$

If the null hypothesis is not rejected, this implies that the time series is non-stationary. Similarly, a rejection of the null hypothesis implies that the time series stationary or I(0). A time series is said to be stationary when the process by which the data is being generated is the same over time. That is, the series' mean, variance and covariance with lagged values of itself should not change with time (Hansen and King, 1996). The study by Song and Witt (2000) discusses the importance of selecting the appropriate lag length for time series data since ADF tends to over-reject the null hypothesis when using too few lags and to reduce the degrees of freedom when there are too many lags. This study utilises the Schwarz Information Criterion (SIC) to select the appropriate lag length of the ADF test.

Step 2: Cointegration Test

Cointegration tests are used to explore whether there is a long-run relationship between variables in the model. If two time series *Yt* and *Xt* are both I(*d*), then in general any linear combination of the two time series will also be I(*d*). That is, the residuals obtained from regressing Y_t on X_t are I(*d*). Suppose, $Y_t = \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_t$ where $Y_t \sim$ I(0), $X_{1t} \sim$ I(1) and $X_{2t} \sim$ I(1), then $\varepsilon_t \sim$ I(1). However there could exist a cointegrating vector ($\beta_1 \beta_2$) such that ($\beta_1 X_{1t} + \beta_2 X_{2t}$) ~ I(0). In such a case, ε_t will be stationary since $Y_t \sim$ I(0) and also ($\beta_1 X_{1t} + \beta_2 X_{2t}$) ~ I(0). In essence, this implies that if two series are non-stationary but their linear combination is, the two series are said to be cointegrated. That is, the two series move together in the long-run at the same rate.

The theory on cointegration was first developed and introduced by Engle and Granger (1987). Since then, a number of methods for testing cointegration have been proposed in the general

literature such the Johansen cointegration analysis and the Durbin-Watson (CRDW). This study will employ ADF unit root test on the residuals commonly known as the Engle-Granger cointegration test.

The residual-based ADF test for cointegration will examine whether these variables are cointegrated. Cointegration in these variables would suggest that there is a long-run or equilibrium relationship between them.

If the variables are cointegrated, an Ordinary Least Squares (OLS) regression would yield a consistent estimator of the cointegrating parameters β_1, β_2 and β_3. OLS method will be used to determine the parameters of the equation. It is one of several methods of obtaining the sample regression function (SRF) as an estimator of the true population regression function (PRF). It is based on the principle that the estimators of the parameters of PRF are chosen in such a way that the residual sum of squares (RSS) $\sum e_i^2$ are as small as possible. That is,

$$\sum e_i^2 = \sum (Y_i - \hat{Y}_i)^2$$

$$= \sum (Y_i - \hat{\beta}_1 - \hat{\beta}_2 X_i)^2$$

The OLS method is popular due to its many desirable properties. Given the assumptions of the classical linear regression model, OLS estimators (in the class of unbiased linear estimators), have minimum variance. That is, they are BLUE (best linear unbiased estimators). Hence, this study employs the OLS method in order to estimate the β_s more accurately and to satisfy the BLUE property. In the OLS results, R^2 reflects the regression equation's ability to determine the dependant's variables behaviour. That is, it measures the proportion or percentage of the total variation in the dependant variable explained by the regression model (i.e. goodness of fit). However since the conventional R^2 does not take into account the degree of freedom, this study makes use of the adjusted R^2 as a measure of goodness of fit that is adjusted for the degrees of freedom. The study uses a logarithm model because the parameters of the model have an explanation as elasticities.

Step 3: Error Correction Model

Having obtained the estimates of the long-run relationship, the next step of the EG procedure is to estimate the short-run Error Correction Model (ECM) using the estimates of disequilibrium (ε_{t-1}) to obtain information about the speed of adjustment to equilibrium. Given the long-run equation $Y_t = \beta X_t + \varepsilon_t$, the ECM formation of the dynamic autoregressive distributive lag (ARDL) model $Y_t = \alpha_0 + \gamma_0 X_t + \gamma_1 X_{t-1} + \alpha_1 Y_{t-1} + \upsilon_t$ is derived as follows:

$$Y_t - Y_{t-1} = \alpha_0 + \gamma_0 X_t + \gamma_1 X_{t-1} + \alpha_1 Y_{t-1} - Y_{t-1} + \upsilon_t$$

$$\Delta Y_t = \alpha_0 + \gamma_0 X_t + \gamma_1 X_{t-1} - (1 - \alpha_1) Y_{t-1} + \upsilon_t$$

$$\Delta Y_t - \gamma_0 X_{t-1} = \alpha_0 + \gamma_0 X_t - \gamma_0 X_{t-1} + \gamma_1 X_{t-1} - (1 - \alpha_1) Y_{t-1} + \upsilon_t$$

$$\Delta Y_t = \alpha_0 + \gamma_0 \Delta X_t + \gamma_0 X_{t-1} + \gamma_1 X_{t-1} - (1 - \alpha_1) Y_{t-1} + \upsilon_t$$

$$\Delta Y_t = \alpha_0 + \gamma_0 \Delta X_t + (\gamma_0 - \gamma_1) X_{t-1} - (1 - \alpha_1) Y_{t-1} + \upsilon_t$$

$$\Delta Y_t = \gamma_0 \Delta X_t - (1 - \alpha_1)[Y_{t-1} - \alpha_0/(1 - \alpha_1) - (\gamma_0 - \gamma_1)/(1 - \alpha_1)X_{t-1}] + \upsilon_t$$

ECM: $$\Delta Y_t = \gamma_0 \Delta X_t - (1 - \alpha_1)[Y_{t-1} - \beta_0 - \beta_1 X_{t-1}] + \upsilon_t$$

where $\alpha_1 < 1$. The long-run equilibrium is represented by the lagged residual $\varepsilon_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1}$. When the equilibrium condition holds $\varepsilon_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1} = 0$. However during periods of disequilibrium it measures the distance away from equilibrium and $\varepsilon_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1}$ is called the error-correction term. The size of the coefficient $-(1 - \alpha_1)$ indicates the speed of adjustment towards equilibrium, such that small values of $-(1 - \alpha_1)$ tending to -1 indicate that economic agents remove a large percentage of disequilibrium each period (i.e. adjustment is fast). Larger values tending towards 0, indicate a slow adjustment while extremely small values less that -2 indicate an overshooting of equilibrium. A zero value is indicative of no adjustment (i.e. equilibrium condition) whereas positive values would imply that Y_{t-1} diverges from the long-run equilibrium path and this would be inconsistent with the notion of economic equilibrium and short-run adjustment.

Step 4: Diagnostic Testing

After the error correction model is estimated in the study, it is important to assess the adequacy (or appropriateness) of the model. In order to assess model adequacy, the diagnostic tests will be conducted on the error correction model in order to determine whether any of the assumptions of the classical normal linear regression model have been violated. These tests will cover the Jarque-Bera test for normality that the residuals are normally distributed with a zero mean and variance; the Ljung-Box Q test of no autocorrelation in residuals; a Breusch-Godfrey LM test for serial autocorrelation; an ARCH-LM test for no autoregressive conditional heteroscedasticity, White's test for heteroscedasticity and Ramsey's RESET general test of misspecification.

The Engle-Granger 'four step' testing procedure had gained comparative popularity due to its simplicity to estimate a static model using OLS, and then performing unit root test on residuals. Also, by estimating the short-run Error Correction Model itself, using the estimates of disequilibrium makes it possible to obtain information on the speed of adjustment to equilibrium. This method have been widely used in the context of employment intensity of output growth by [Fofana (2001); Kapsos (2005); Ajilore and Yinus (2011); Sawtelle (2007); Upender (2006)].

In order to capture the employment elasticities of the main SIC divisions of the economy and the differential partial elasticities of employment with respect real wage rate, inflation and user cost of capital, the double-log linear regression Equation (4) is extended and estimated. Equation (4) is rewritten as:

$$lnE_t = \beta_0 - \beta_1 \ln W_t + \beta_2 \ln r_t + \beta_3 \ln GVA_t + \beta_4 \ln \pi_t + T_t + \varepsilon_t \qquad (5)$$

where, t = 1, …, 52 indicate quarters. The dependent variable, E_t , represents total non-agricultural employment comprising of formal and informal sectors, in thousands of persons in the specific economic sectors, in quarter *t*.

The eight economic sectors for employment are:

EMP_MIN = mining

EMP_MAN = manufacturing

EMP_UTIL = utilities

EMP_CON = construction

EMP_TRAD = trade

EMP_TRANS = transport

EMP_FIN = finance and business services

EMP_SOC = social and community services

The explanatory variables are:

W_t = quarterly sector specific nominal wages, seasonally adjusted, measured in thousand Rands.

r_t = is the user cost of capital, proxied by long term bond interest rates.

π_t = inflation rate measured in terms of the Consumer Price Index (CPI).

GVA_t = sector specific gross value added (GVA) in constant 2005 prices.

The eight economic sectors for gross value added are:

GVA_MIN = mining

GVA_MAN = manufacturing

GVA_UTIL = utilities

GVA_CON = construction

GVA_TRAD = trade

GVA_TRANS = transport

GVA_FIN = finance and business services

GVA_SOC = social and community services

TIME (T_t) = quarterly time trend variable where t = 1 is April 2000 and t = 52 is December 2012

ε_t = error term.

Thus, the sector specific functional relationship to be analysed in this study is as follows:

$$\begin{matrix} & (-) & (+/-) & (+/-) & (+) & (+) & (+) & (+) \\ E_t = f\ (W_t\ , & r_t & , & \pi_t, & GVA\_MIN_t\ , & GVA\_MAN_t\ , & GVA\_UTIL_t\ , & \\ GVA\_CON_t & & & & & & & \\ & (+) & (+) & (+) & (+) & & & \\ GVA\_TRAD_t\ , & GVA\_TRANS_t\ , & GVA\_FIN_t\ , & GVA\_SOC_t), & & & & \end{matrix}$$

The model hypothesise that employment in persons (not hours) responds to macroeconomic variables, and that employment decisions by firms depend upon the most recent data (previous quarter) known prior to the employment activity. The signs hypothesised for the model coefficients are as follows:

W_t : *negative*. An increased percentage change in nominal wages creates upward pressures on the cost per unit of production causing employers to reduce their demands for labour.

r_t : *positive or negative*. An increase (decrease) in long term bond interest rates will decrease (increase) the demand by employers for capital and will decrease (increase) the demand for consumer goods and services. The decreased (increased) demand for capital will decrease (increase) labour productivity and the decreased (increased) demand for consumer goods and services will decrease (increased) the derived demand for labour. In these circumstances employment would be inversely related to long term interest rates. However, in some industries capital may be a substitute for labour. Therefore an increase in long term bond interest rates may decrease the demand for capital and consequently increase the demand for labour. In this case long term interest rates would be positively related to employment.

π_t : *positive or negative*. An increase in the rate of inflation as measured by CPI implies higher marginal revenue products of labour and hence a subsequent increase in demand for labour by employers. Alternatively, an increase in the rate of inflation may decrease consumer demand for goods and services and thus decrease the derived demand for labour.

GVA_t : *positive*. The expansion of sector real gross value added will generate increased derived demand for workers (not only worker hours) as employers view increased real sector output as a signal of future increased demand for consumer final goods and services.

The logarithmic specification of Equation (5) ensures that β_i can be interpreted as elasticities (Koop, 2005). For instance, β_2 is the (partial) elasticity of employment with respect to user cost of capital, holding all other things constant. Likewise, β_3 is the (partial) elasticity of employment with respect of output. It measures the percentage change in employment for a 1 percentage change in sectoral output, holding other things constant. The parameter of primary interest in this study will be β_3, the sectoral output elasticity of employment, which will enable the identification of those sectors in the economy that are employment intensive. Hence a positive elasticity value of 0.5, for instance, implies that a percentage increase in gross value added is associated with half a percentage increase in employment. The estimates of employment elasticity that will be generated from Equation (5) above are based on the assumption that employment is a primary function of output (Ajilore and Yinusa, 2011). Hence, the elasticity coefficients that will be generated for individual economic

sectors are indicative of the responsiveness of the quantity of employment persons to sectoral output.

3.2. Data Sources and Description

The study utilises secondary, quarterly data covering the period from 2000:01 to 2012:04. The variables used in this empirical study include total employment, GDP, sectoral GVA, nominal wages as price for labour, long term bond interest rates as price of capital and the inflation rate. The data on employment in the non-agricultural sector was sourced from the Quarterly Labour Force Survey of Statistics South Africa (STATSSA). Data on GDP and GVA was also obtained from STATSSA. Data on wages, long term bond rates and inflation rate was sourced from the South African Reserve Bank database. Employment is measured as the total number of employees in the South African non-agricultural sector. Sectoral output is proxied by gross value added in constant 2005 prices. The nominal wage variable is measured as average employee earnings by sector in thousand Rands. The inflation rate is measured in terms of CPI published in the South African Reserve Bank's Quarterly Bulletin statistics.

4. Empirical Evidence: Results and Interpretation

This section presents the results and the interpretation of the regression analysis based on the empirical tests and estimation undertaken. As a preliminary step to empirical analysis, the study commences by investigating the integration properties of the series. This is done in order to establish the presence of unit roots in the data and to apply appropriate modelling procedures to avoid a spurious regression (Harris, 1995). By differencing data to remove the non-stationary (stochastic) trend, spurious regression problem can be avoided. While there are several ways for testing the presence of unit roots in the data, this study utilises the Augmented Dickey-Fuller approach to test the null hypothesis that a series contain a unit root against the alternative of stationarity. The results of the Augmented Dickey-Fuller test, reflected in Table 1 below, suggest that none of the variables are stationary in levels (except for interest rates, inflation and the utilities' employment series). This implies that the non-stationary variables must be differenced. Further tests indicate that the non-stationary variables are stationary after the first and second differencing, suggesting generally differenced stationary series of order one, I(1), and two, I(2), respectively.

Table 2: Augmented Dickey-Fuller (ADF) unit root test on series

Series	Levels	First differences	Second differences
EMP_AGGR	-2.466	-3.636***	
EMP_CON	-1.636	-7.687***	
EMP_FIN	-1.395	-7.643***	
EMP_MAN	-2.938	-7.640***	
EMP_MIN	-1.581	-4.754***	
EMP_SOC	-2.299	-9.701***	
EMP_TRAD	-1.890	-6.741***	
EMP_TRANS	0.222	-7.630***	
EMP_UTIL	-3.956***		
GDP	-0.910	-4.380***	
GVA_CON	-4.774***		
GVA_FIN	-1.677	-2.377	-12.002***
GVA_MAN	-0.865	-3.718***	
GVA_MIN	-1.888	-11.919***	
GVA_SOC	-1.306	-1.739*	
GVA_TRAD	-0.653	-1.678	-124.969***
GVA_TRANS	-2.604	-3.933**	
GVA_UTIL	-1.950	-1.994**	
N_WAGE_AGGR	0.213	-7.603***	
N_WAGE_CON	-0.185	-7.696***	
N_WAGE_FIN	-0.962	-8.375***	
N_WAGE_MAN	0.227	-8.396***	
N_WAGE_MIN	-0.128	-8.103***	
N_WAGE_SOC	0.243	-3.337**	
N_WAGE_TRAD	-0.671	-7.577***	
N_WAGE_TRANS	-2.654	-9.148***	
N_WAGE_UTIL	0.699	-11.144***	
R_RATE	-3.316**		
INFL_RATE	-3.570***		

* statistically significant at 10% level.

** statistically significant at 5% level.

*** statistically significant at 1% level.

A long-run relationship between sectoral employment and other selected variables was also examined using cointegration regression methodology, whereby the residuals obtained from the Ordinary Least Squares (OLS) estimation were subjected to unit root analysis. Empirical studies indicate that series that are cointegrated move together in the long run at the same rate, meaning that they obey an equilibrium relationship in the long run (Davidson and MacKinnon, 1993). The implication of which being that if economic growth and employment are cointegrated then they should move together in the long run at the same rate. That is, economic growth should be employment intensive (Fofana, 2001). However, if the two series were not cointegrated, it is an indication of the possibility of jobless economic growth.

Based on the Engle-Granger (1987) cointegration test, the results suggest that the residuals from certain regressions were stationary, hence cointegrated. These results are presented in Table 2 below which indicates four cointegrating regressions, namely, in finance and business services; manufacturing; transport and the utilities industry sectors, suggesting a long-run relationship between employment and the other variables.

Table 3: Cointegration test on residuals sectoral employment and other selected variables

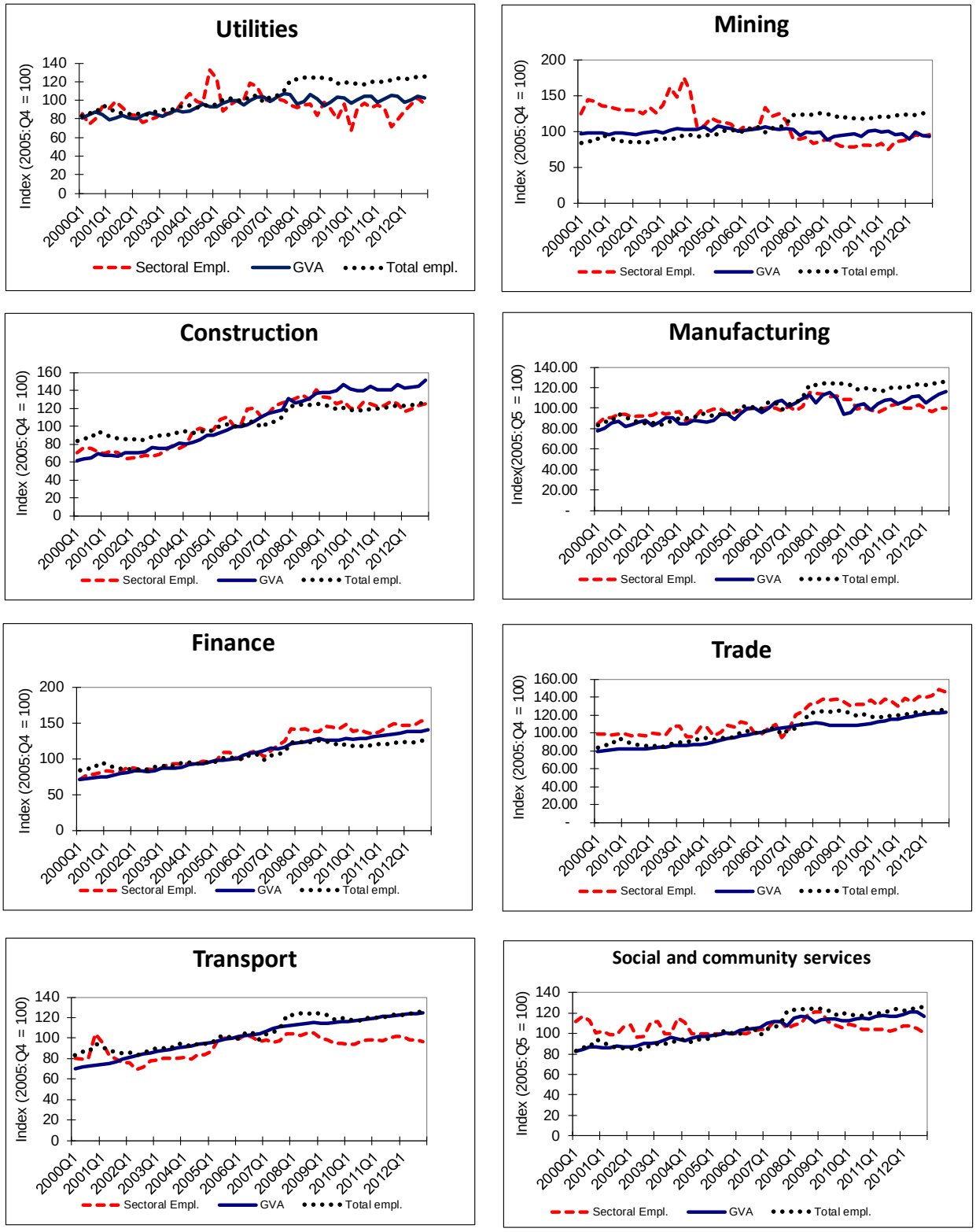
Industry Sector	t-Statistic (ADF test on residuals)	Decision
Aggregate economy	-3.00	Not cointegrated
Construction	-2.65	Not cointegrated
Finance and business services	-5.48***	Cointegrated
Manufacturing	-4.15*	Cointegrated
Mining	-3.11	Not cointegrated
Social and community services	-3.48	Not cointegrated
Trade	-2.82	Not cointegrated
Transport	-4.9**	Cointegrated
Utilities	-5.54***	Cointegrated

Notes: The critical values for the Engle-Granger cointegration test on regression residuals at 1%, 5% and 10% are -5.00173, -4.31461 and -3.97286, respectively. (*) indicate parameters are significant at 10% level; (**) significant at 5% level; and (***) significant at 1% level.

These results also show the other variables that are not cointegrated. In these cases the absolute value of the computed test statistic is lower than the critical value at 10 per cent confidence level, suggesting that employment and growth do not move together in the long-run, at the same rate. Most importantly, the residual-based cointegration test showed that total non-agricultural employment and the GDP variables are not cointegrated. Consequently this implies that jobless growth did occur in the economy during the 2000:01-2012:04 period. This is indicative of the inability of the economic growth to create adequate employment for the increasing number of job seekers. Similarly, a sectoral division of the employment-output relationship revealed no cointegration detected in the construction, mining, social and community services and trade sectors. Therefore, this also implies that jobless growth did occur in these sectors during the period under review. This is further evident in Figure 2 below which indicates that in the construction sector, for instance, an upward sloping trend of GVA growth continued after 2009Q1, whereas in the same period the employment growth trend was declining. A similar pattern can be seen with respect to the other non-cointegrating sectors.

According to the South African Reserve Bank's 2001 Annual Report the country's jobless growth, which has affected a number of sectors, can be attributed to a number of factors, including rising capital intensity, pressures on domestic producers to remain competitive within the global economy and the slow pace of foreign direct investment inflows into South Africa. Similarly, an ILO report by Heyter et.al (1999) identified other causes that may have increased jobless growth including the shortage of skilled labour which hinders the development of labour-intensive sectors. Another motive cited is trade liberalisation that may have shifted production in favour of capital-intensive sectors to the detriment of labour-intensive ones. Unless the construction, mining, trade and the social and community services sectors are specifically orientated towards activities that are more labour-intensive, the employment creation potential in these sectors will remain significantly low.

Figure 2: Employment and GVA in the total non-agricultural sector: 2000:01-2012:04



Source: Author's calculations using STATSSA data (various years)

Table 4 presents the coefficient estimates of the model based on the ordinary least squares estimation of the relationship between employment and selected macroeconomic variables.

Table 4: OLS estimates of the relationship between employment and other macroeconomic variables

Dependant variable: Employment ($DIemp_t$)	Aggregate economy	Construction	Finance and business services	Manufacturing	Mining	Social and community services	Trade	Transport	Utilities
Constant	12.52***	-8.45***	5.61	25.17***	8.81	6.83	12.56	12.41***	12.45**
	(34.26)	(-2.90)	(1.59)	(3.33)	(0.94)	(1.38)	(1.42)	-3.93	(2.12)
Output (proxy by GDP and sectoral GVA)	0.44***	0.96***	1.65***	0.24*	0.38	0.80***	0.27*	0.46*	0.23
	(4.89)	(-4.23)	(6.47)	(1.69)	(0.73)	(2.22)	(1.80)	(1.81)	(0.65)
Labour costs (wages)	-0.12'***	-0.92***	-0.59***	-0.80*	0.06	-0.07	-0.03	-0.30*	-0.17
	(-2.60)	(-3.66)	(-2.65)	(-1.80)	(0.12)	(-0.52)	(-0.07)	(-1.72)	(-0.60)
User cost of capital (Interest rates)	0.004	-0.03***	0.02***	-0.01	(-0.02)	0.03***	-0.01	0.03***	-0.05***
	(1.27)	(-2.48)	(2.79)	(-1.30)	(-0.90)	(2.67)	(-1.08)	(2.71)	(-2.94)
Inflation rate	0.005**	-0.03**	0.02***	-0.003	-0.03	0.02***	-0.01	0.03***	-0.06***
	(2.11)	(-2.94)	(3.57)	(-0.57)	(-1.16)	(2.74)	(-0.94)	(3.44)	(-3.32)
Time trend		-0.04***	0.01*	0.01*	(-0.02)	-0.002	0.002	0.02***	-0.0007
		(-5.47)	(1.70)	(-1.79)	(-1.00)	(-0.32)	(0.21)	(3.23)	(-0.07)
Summary statistics									
Adjusted R^2	0.91	0.92	0.97	0.58	0.71	0.17	0.49	0.88	0.30
F-statistic	114.56	124.10	295.85	14.94	25.73	3.15	10.92	75.18	5.32
Prob (F-statistic)	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Number of observations	52	52	52	52	52	52	52	52	52
Estimation method	Least squares	Least squares	Least squares	Least squares	Least squares	Least squares	Least squares	Least squares	Least squares

* statistically significant at 10% level.

** statistically significant at 5% level.

*** statistically significant at 1% level.

t-statistics are shown in brackets

In the above table, the coefficients assigned to output corresponds to employment elasticity of output growth, whereby its interpretation relates to the interrelationship between employment and output growth. Hence in the above results employment and output growth are positively correlated in the aggregate economy and in all eight sectors during the period of 2000:01 to 2012:04. The absolute values of the elasticities across sectors differ substantially. For example, the employment elasticity for the construction sector is 0.96 but in the trade sector it is only 0.27. This signifies, the degree of variance of employment elasticities across industry sectors, from very inelastic (0.23 in the utilities sector) to quite elastic (1.65 in the finance sector) responses to changes sectoral output.

The overall employment elasticity of output growth in South Africa during this study period was quite inelastic at 0.44, though statistically significant at the 1 per cent level. This suggests that total non-agricultural employment was relatively unaffected or rather less responsive to changes in GDP growth, hence signalling an increase in capital input and total factor productivity. This is in line with the findings by other studies. For instance, according to Mahadea (2012), the average capital-labor ratio increased from R166 016 in 2000 to R186 631 in 2010, reflecting rising capital intensity in production. In addition, his study reported that except for the year 2008, the ratio of GDP growth to employment growth has been far less than one, reflecting that South Africa's job creation performance against GDP has been weak for most years during the period 2002–2010. Nattras (1998) reported that a number of jobs in South Africa have been lost as a result of investment being channelled increasingly into capital intensive sectors and technologies.

In addition a study by Marinkov and Geldenhuys (2007) also found that employment growth has become less responsive to economic growth since the mid-1980s. It found that, between 2001 and 2005, a 1per cent increase in real GDP was associated with a 0.45 per cent increase in employment (which is close to 0.44 per cent reported in our findings). Their study identified the sluggish growth as well as structural shifts in output as the main causes that led to structural shifts in the demand for certain categories of labour. A number of other studies seem to suggest that these structural shifts together with the increasing capital intensity of production, have led to a decrease in the elasticity of employment growth with respect to output growth (Terreblanche, 2002; UNDP, 2003; Bhorat, 2004).

Within the primary sector, the table above shows that employment intensity of output growth in the mining sector is insignificant, suggesting that structural shifts in this sector could not induce an increase in employment opportunities. According to Bhorat and Oosthuizen (2008), the nature of output shifts across the economy's main sectors provides clues about the changing structure of the economy, away from primary towards tertiary or service based output. A sectoral analysis by the South African Reserve Bank (2009) showed that during the prolonged 1999–2007 upward phase of the business cycle, growth in real gross domestic product was widely spread among the main sectors, with the exception of the mining sector where production, on balance, rose very little. The weakening of this sector, as a consequence, impacted on the nature of sectoral employment shifts with least growth occurring in this sector. This sector having being directly influenced by the substantial decline in international commodity prices in 2008/09, experienced a reversal of earlier employment gains. During that period the gold-mining sector contracted by around 7 500 in employment in the six-month period to the first quarter of 2009, while in the non-gold mining sector the contraction amounted to 20 500 jobs.

Also, noting the fact that the mining sector is obviously capital-intensive, these structural changes also account for the greater impact of technological and productivity improvements in the mining sector, to the detriment of labour absorption in this sector. A study by Samson et al., (2001) explained that the capital-to-labour ratio in the major sectors of the economy was suggestive of rising capital intensity in the mining sector. This study found that sectors that are not education-intensive, such as mining, are growing more slowly or contracting even as their capital intensity increases and they are shedding jobs. This serves to confirm the low labour absorptive capacity in the mining sector and the corresponding high levels of unemployment.

In the secondary sector, both construction and manufacturing are statistically significant and positively correlated with employment. The estimate of employment elasticity of sectoral growth in construction is significantly close to unity suggesting that a one percentage increase in output will increase employment by 0.96 per cent. The high elasticity coefficient in this regard points to the fact that the labour absorptive capacity in this sector is relatively high. Between 1995 and 2005 this sector created the largest number of jobs within the secondary sector, where more than 500 000 employment opportunities were created. Despite a brief job shedding experienced by the sector during the second and third quarters of 2008, partly due to electricity-related backlogs, the level of employment had recovered by the end of that year as non-residential building activity countered the depressed state in residential building activity. This was attributed to infrastructural development related to the hosting of the 2010 FIFA World Cup tournament and various other infrastructural developments, such as the Gautrain Rapid Rail link. Through these infrastructure development projects the sector made a meaningfully contribution to counter job shedding incurred by construction companies involved in the residential sector.

The employment elasticity of growth in the manufacturing sector is weak, although significant at 10 per cent level. This indicates that growth experiences in this sector have been driven largely by productivity rather than employment. The increase in productivity growth in the manufacturing sector can be linked to the growth in the capital/labour ratio in this sector. In their study, Samson et al., (2001) confirmed a rising capital intensity in the manufacturing sector in South Africa during the period, 1992 to 1999. This rising capital intensity (declining labour intensity) is in part responsible for the sector's experience with job losses. Employment levels in the manufacturing sector have declined from a high of 1,6 million in 1995 to an estimated 1,1 million in 2011, reflecting the strong competitive forces and productivity imperatives in the sector (SARB, 2012). This sector has shed jobs almost uninterruptedly since the middle of the 1990s to the second quarter of 2011, with an estimated 30 per cent of the manufacturing workforce being dismissed over this period. This prompted government to step up various growth initiatives in an effort to promote job creation, including but not limited to, the Industrial Policy Action Plan (IPAP) aimed at providing support to relatively labour-intensive and value-adding manufacturing firms that have been adversely affected by the global financial crisis. These and other initiatives are an affirmation that sectoral growth alone cannot guarantee substantial employment growth in this sector but simultaneous targeted industry labour market initiatives may be desirable to assist employment growth.

The utilities employment is indicated as having a positive but not significant relationship to sectoral output suggesting that structural changes in the sector and other macro factors, other than GVA, play a more critical role in determining utilities employment. Since the utilities sector is capital intensive, increasing employment in this sector depends mainly on the

expansion of installed capacity (Ajilore and Yinusa, 2011). Hence, sustained spending to meet the increased electricity demand in the country will support growth in employment creation in the sector.

Within the tertiary sector, the employment elasticity coefficients for finance and business services, social and community services, transport and trade indicate a positive and significant relationship between employment and sectoral output. The employment elasticity coefficients in finance and business services (1.65), social and community services (0.80), transport (0.46) and trade (0.27) are an indication of the important role of tertiary sector's output in employment generation. According to Pattanaik and Nayak (2011), much of the rise in economic performance in the tertiary sector is because of lack of employment opportunities in other sectors of the economy. According to O'Connell (1999) developed economies that have succeeded in dealing with the challenge of high unemployment have relied on the expansion of high-value services such as finance, business and professional services. Previously this sector had relied on the growth of other sectors, however given increasing segmentation and niching this sector has become a driver for growth (Altman, 2006). This is indicative of the sectoral shift that characterised the output structure of the South African economy from the 1970s until recently, from primary and secondary sector activities to tertiary sector activities (Bhorat and Oosthuizen, 2008).

The coefficients of the wage variable represent the elasticity of employment with respect to wages. The theoretical model suggested in this study assumes a negative relationship between wages and employment. That is, higher wages put upward pressure on labor costs and cause firms to substitute capital for labor, thereby reducing the demand for labour (employment) and increasing the marginal productivity of labor (Wakeford, 2004). This inverse relationship is confirmed by the negative coefficients of the wage variable found in all the sectors, with the exception of the mining sector. The negative and significant coefficients of the wages variable in the construction (-0.92), finance (-0.59), manufacturing (-0.80), and transport (-0.30) sectors suggests that growth in wages was achieved at the cost of employment. In fact, a study by Klein (2012) suggests that "excess" real wage growth accounted for at least 25 per cent of the employment loss in South Africa during 2008–2010. In his study he made a conclusion that the rapid growth of the real wage, which outpaced the labor productivity growth in most sectors, played an important role in suppressing employment creation during that period.

With regards to the coefficients attached to the user cost of capital variable, the degree of employment elasticity and the signs varies across individual sectors in line with the model assumptions. The user cost of capital coefficients for the construction and utilities sectors are negative and significant. These results suggest that employment in the construction and utilities sectors are negatively responsive to the rising user cost of capital. Thus we can conclude that, in these capital intensive sectors, the increase in long-term interest rates (a proxy for user cost of capital) has resulted in a decrease in the demand for consumer capital goods and services, which in turn decreased the derived demand for labour (Sawtelle, 2007). Similarly, the positive and significant elasticity coefficient in finance and business services, social and community services and transport suggests that an increase in the user cost of capital would generate an expansion in employment in these sectors.

Lastly, as hypothesised, the sign for the inflation coefficient is mixed. The inflation coefficients in finance and business services, social and community services and transport are positive and significant at 1 per cent level. This suggests that employment expansion levels

were achieved at the cost of high inflation in these sectors. To the contrary, signs of the coefficients of the inflation variable in the construction and utilities sectors are negative and significant. This means that inflation have a negative impact on employment in these sectors. We can deduce therefore that, in these sectors, an increase in the rate of inflation would decrease in the demand for consumer capital goods and services, and in turn decreased the derived demand for labour.

With regards to the error-correction terms, the cointegrating vectors for finance, manufacturing, transport and utilities are statistically significant at 1 per cent level (Table 4). The error-correction terms correct between 42 and 72 per cent of the errors in the models after the short-run disturbances. These error correction coefficients indicate that (with the exception of utilities) finance, manufacturing, and transport adjust relatively slower towards the underlying equilibrium since the parameter estimate of their respective lag residual shows that 0.52, 0.53 and 0.42 percentage of disequilibrium is removed in each period, respectively.

Table 5: Results of the error-correction model

Dependant variable: Employment ($Dlemp_{it}$)	Finance	Manufacturing	Transport	Utilities
EC $term_{t-1}$	-0.52***	-0.53***	-0.42***	-0.77***
	(-4.23)	(-4.30)	(-3.14)	(-5.42)
Dln_wage_fin(-1)	-0.47***			
	(-2.85)			
Dln_wage_man(-1)		-0.91***		
		(-2.45)		
Dlemp_man(-1)		0.22*		
		(1.64)		
Dlemp_trans(-1)			-0.35***	
			(-2.75)	
R_RATE			-0.004**	
			(-2.20)	
R_RATE(-2)				0.006*
				(1.50)
Diagnostic Tests				
Jarque-Bera (p-value)	0.02	0.00	0.05	0.10
Ljung-Box Q (p-value)	0.65	0.11	0.45	0.26
Breusch-Godfrey LM Test (p-value)	0.49	0.43	0.54	0.53
ARCH-LM (p-value)	0.64	0.42	0.35	0.95
White (p-value)	0.96	0.28	0.19	0.85
Ramsey RESET (p-value)	0.61	0.15	0.42	0.70

* statistically significant at 10% level.
** statistically significant at 5% level.
*** statistically significant at 1% level.
t-statistics are in brackets

Furthermore, the diagnostic tests (Table 5) reveal that the error-correction models are correctly specified and conform with the statistical assumptions of the classical linear model. The diagnostic checks performed include the Jarque-Bera test for normality in the residuals; the Ljung-Box Q test of no autocorrelation in residuals; a Breusch-Godfrey LM test for serial autocorrelation; an ARCH-LM test for no autoregressive conditional heteroscedasticity, White's test for heteroscedasticity and Ramsey's RESET test of misspecification. Based on the tests performed, the results show that the residuals of the models do not have problems of misspecification, serial correlation and heteroscedasticity. Also, the results of the normality test show that the residuals are normally distributed with a zero mean and variance. These

results suggest that the estimated regression model is well specified and generally conforms with economic theory and the assumptions underlying our modelling procedures.

So far we have proved that finance and business services; manufacturing; transport and the utilities sectors obey an equilibrium relationship in the long run and that their error-correction terms are statistically significant at 1 per cent. The next step however would be to test for the patterns of Granger causality across these variables. That is, we apply a Granger causality test in order to investigate the possibility that sectoral output and employment affect each other in the short run. Or put it differently, we want to investigate any causal directions detected by these two variables.

Table 6: Short run causality tests

	H_0: No Granger causality from GVA to employment.	H_0: No Granger causality from employment to GVA.
Finance	7.94338***	1.4926
	(0.0011)	(0.2357)
Manufacturing	4.78667***	1.1303
	(0.013)	(0.3319)
Transport	3.45631**	0.18723
	(0.0401)	(0.8299)
Utilities	0.52578	1.02867
	(0.5947)	(0.3657)

* statistically significant at 10% level.

** statistically significant at 5% level.

*** statistically significant at 1% level.

p-values are shown in brackets

Table 6 presents the results of the Granger causality test. The causality inference of the Granger test suggests a uni-directional and positive short run causal effects from GVA to employment, in all three sectors except for the utilities sector. That is, in the period reviewed, a short run causal link from output to employment was found to exist in the finance and business services; manufacturing; transport sectors. In interpreting the empirical results of short run links between sectoral GVA and employment, time series evidence of this relationship suggests that sectoral output growth in the finance and business services; manufacturing; transport sectors is employment enhancing. Therefore since employment adjust to output changes in these sectors, in dealing with the challenge of high unemployment in the short run, attention should be placed on the expansion of these sectors i.e. wherever output goes in these sectors, employment will follow.

Given the elasticity coefficients (in Table 4) derived from the OLS estimation of the relationship between employment and growth, it is possible to quantify the impact of output intensity of sectoral growth through sectoral simulation. Projecting economic growth rates against these elasticities and baseline employment levels enables the econometric model to predict employment trends over the medium term. Table 7 below shows aggregate and sectoral baseline employment levels as at 2012:04. As can be seen, sectors within the tertiary sector account for the largest share of total non-agricultural employment. Combined these sectors contribute more than 60 per cent of total non-agricultural employment followed by the construction (20.9 per cent) and primary sectors (15.8 per cent).

Table 7: Total non-agricultural employment, by sector as at 2012:04

Sectors	Total employment	as % of total employment
Aggregate economy	14 524	100.00
Construction	1 132	7.79
Finance and business services	1 950	13.42
Manufacturing	1 814	12.49
Mining	380	2.62
Social and community services	3 251	22.38
Trade	3 108	21.40
Transport	877	6.04
Utilities	102	0.70

Source: Statistics South Africa various years (2012:04)

Since the main elasticity of interest in this study is the elasticity of employment with respect to output, Table 8 below lists the respective employment elasticity values for each sector based on the results of Table 4.

Table 8: Computed employment elasticity of output growth

Sectors	Employment elasticity
Aggregate economy	0.44
Construction	0.96
Finance and business services	1.65
Manufacturing	0.24
Mining	0.38
Social and community services	0.8
Trade	0.27
Transport	0.46
Utilities	0.23

Source: Statistics

Table 9 below relies on the elasticities reported in Table 8 above to illustrate the impact on the number of jobs created for a given percentage change in GDP. As can be seen, there are considerable differences in the projected number of jobs created by each sector depending on the values of the corresponding elasticities, for a given percentage change in GDP. For instance, in the case of manufacturing, using the corresponding elasticity coefficient derived from the OLS regression yields 11 755 jobs per quarter, for a 2.7 percentage change in GDP. Similarly, 13 932 additional jobs are created if GDP increased by 3.2 per cent.

Obviously, given its relatively high elasticity value, finance and business services yields the most additional number of jobs for a given percentage change in GDP than any other sector.

Table 9: Number of additional jobs created for a given percentage change in GDP.

	% change in GDP		
Sectors	2.7%	3.2%	3.5%
Aggregate economy	172 533	204 484	223 654
Construction	29 341	34 775	38 035
Finance and business services	86 828	102 907	112 555
Manufacturing	11 755	13 932	15 238
Mining	3 899	4 621	5 054
Social and community services	70 222	83 226	91 028
Trade	22 650	26 844	29 361
Transport	10 892	12 909	14 120
Utilities	633	751	821

Note: This table is based on elasticities reported in Table 4.
The projections are based on 2012:04 employment levels.
GDP growth projections are taken from National Treasury's 2014 Budget Review.

The finance and business services sector has become an important contributor to private sector employment. According to Statistics South Africa (2012) there were about 1.74 million individuals working in the finance and business services in 2011, with a further 3.06 million people in the wholesale and retail trade. The services sector has become an important location for future job creation in South Africa (Altman, 2006). Approximately 70 per cent of South African employment is found in this sector (Mayer, 2005). It has been reported that these sectors have been growing at rate of 3 to 5 per cent per annum (Altman, 2006). This reaffirms the argument by Bhorat and Oosthuizen (2008) that the structure of the South Africa's domestic production is now one more readily characterised by a large share of tertiary output removing concerns that the South African economy is resource-based.

A report by the OECD (2010) on the assessment of economic transformation documented that its general trend depict an expansion in the tertiary sector that is accompanied by a simultaneous contraction of other sectors. In South Africa, current trends shows that employment levels in the trade, catering and accommodation services sector increased by 1,1 per cent in 2011, while employment levels in the finance, insurance, real-estate and business services sector increased by 2,5 per cent. This was attributed to the robust growth in household consumption expenditure, alongside a gradual acceleration in private-sector credit extension (SARB, 2012). A well-functioning tertiary sector provides important opportunities to strengthen employment and productivity. Investment in the tertiary sector is necessary to foster new employment opportunities and will assist in improving the overall employment intensity in South Africa.

According to a study by Samson et al. (2001), since the 1990s, formal sector unskilled jobs have been shed while the demand for scarce skilled labour and capital has risen. Their study reported that in sectors that heavily employ less educated workers, capital intensity has increased and the effects economic growth has largely benefited sectors that rely more on relatively educated labour, and in these sectors capital intensity has not significantly increased. Table 10 below shows how the skills mix have changes overtime across the different sectors of the South African economy between 1995 and 2008.

Table 10: Skills share of total employment by sector, 1995-2008.

Main Sectors	Year	Skilled	Semi-skilled	Low skilled	Total
Aggregate economy	1995	0.09	0.59	0.32	1.00
	2002	0.11	0.61	0.28	1.00
	2007	0.14	0.48	0.38	1.00
	2008	0.13	0.51	0.36	1.00
Construction	1995	0.06	0.74	0.19	0.99
	2002	0.06	0.74	0.20	1.00
	2007	0.06	0.60	0.34	1.00
	2008	0.09	0.63	0.28	1.00
Finance	1995	0.17	0.77	0.06	1.00
	2002	0.25	0.67	0.08	1.00
	2007	0.25	0.61	0.14	1.00
	2008	0.25	0.59	0.16	1.00
Manufacturing	1995	0.06	0.74	0.19	0.99
	2002	0.10	0.75	0.15	1.00
	2007	0.11	0.45	0.44	1.00
	2008	0.11	0.48	0.41	1.00
Mining	1995	0.04	0.77	0.19	1.00
	2002	0.04	0.89	0.07	1.00
	2007	0.04	0.41	0.55	1.00
	2008	0.07	0.45	0.48	1.00
Social and personal services	1995	0.13	0.71	0.15	0.99
	2002	0.19	0.70	0.11	1.00
	2007	0.17	0.40	0.43	1.00
	2008	0.13	0.45	0.42	1.00
Trade	1995	0.14	0.66	0.20	1.00
	2002	0.10	0.60	0.30	1.00
	2007	0.11	0.54	0.35	1.00
	2008	0.11	0.57	0.32	1.00
Transport	1995	0.19	0.69	0.12	1.00
	2002	0.23	0.64	0.12	0.99
	2007	0.22	0.29	0.49	1.00
	2008	0.18	0.27	0.55	1.00
Utilities	1995	0.06	0.79	0.14	0.99
	2002	0.09	0.82	0.08	0.99
	2007	0.12	0.72	0.16	1.00
	2008	0.17	0.58	0.25	1.00

Source: For 1995 – 2002 figures, Bhorat (2003); for 2007 – 2008 ILO (2014).

From the table above, experience by most of these sectors indicate a gradual shift away from low skilled workers towards semi-skilled and skilled labour. The construction and manufacturing sectors, for instance, indicate a substitution process that shows low skilled occupations being replaced by semi-skilled workers. While the capital intensity has increased in these sectors, studies have also found that capital complemented skilled labour but substituted unskilled labour in the production process (Bergstrom and Panas, 1992). A significant number of losses of low skilled labour were incurred in the mining, manufacturing, social and personal services and the utilities sectors. In all sectors the share

of semi-skilled employment is relatively larger compared to other skills categories, with utilities, manufacturing, construction, mining and finance dominating in this category in terms of their respective sector skills composition of employment. This implies that employment growth in these sectors had been most evident amongst semi-skilled workers during this period. In addition, employment in finance, transport and to a lesser extent in the social and personal services, continued to be skills-biased. The pattern of employment in these sectors is the one that displaces semi-skilled jobs more in favour of skilled occupations. For instance, in the finance sector, between 1995 and 2002, the proportions of skilled workers increased by 0.08 percentage points while those of semi-skilled workers declined by 0.1 percentage points. On whole, economy-wide aggregate data on the demand for skills shows declining proportions of low skilled workers and higher shares of semi-skilled and skilled occupations, hence suggesting that growth during this period remained skills-biased.

5. Conclusion

Concerns have been expressed recently about the inability of the South African economy to provide sufficient employment for the increasing number of job seekers. The rate of unemployment remains stubbornly high despite South Africa registering positive and sustained growth rates since the demise of apartheid more than 15 years ago. The study explored these issues by examining how the employment intensity of growth in the eight non-agricultural sectors of the economy has evolved with a view to identify key growth sectors that are employment intensive.

Results of cointegration analysis showed that total non-agricultural employment and the GDP series are not cointegrated, and hence do not move together in the long run. Consequently this implies that jobless growth did occur in the economy during the period reviewed. This reaffirms the view that South Africa is more capital intensive (and less labour intensive) which in turn facilitated a structural adjustment that led to the weakening of the employment-growth relationship. Findings of the sectoral division of the employment-output relationship revealed a long run relationship between employment and growth in all sectors except in the mining, construction, social and community services and trade sectors. Specifically, this indicates that the observed growth performance in these sectors have been more labour productivity driven than labour employment driven. This confirms the rising capital intensity that has been experienced in these sectors. Hence, sectoral growth alone cannot guarantee substantial employment growth in these sectors but simultaneous targeted industry labour market initiatives may be desirable to assist employment growth.

The positive and significant coefficients of employment elasticities in finance and businesses services, social and community services, trade and transport indicate that growth experiences in these sectors are more labour employment driven. Moreover, the quite elastic employment elasticity values in the finance and business services sector, construction, social and community services and to a lesser extent in the transport sector are a strong indication of the role of the tertiary and secondary sectors in employment generation in South Africa. In particular, sectors within the tertiary sector are the best performing sectors, in terms employment intensity of output growth, reflecting the changing structure of the South African economy and the nature of employment shifting away from primary more towards the tertiary sector.

The three skills classifications shows that experience by most sectors indicate a gradual shift away from the demand for low skilled workers towards demand for semi-skilled and skilled labour. In particular, the pattern of employment in sectors within the tertiary sector is the one that shows declining proportions of low skilled workers and higher shares of semi-skilled and skilled occupations. On whole, aggregate data on the demand for skills during this period remained skills-biased in favour of the tertiary sector.

A well-functioning tertiary sector can provide important opportunities to strengthen employment and productivity. Investment in the tertiary sector is necessary to foster new employment opportunities and can assist in improving the overall employment intensity in South Africa.

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