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Research article

Employment dynamics in South Africa: an econometric analysis of the role of macro-economic impacts

Daniel Francois Meyer*

College of Business and Economics, University of Johannesburg, South Africa

* **Correspondence:** Email: dfmeyer@uj.ac.za.

Abstract: South Africa has long faced the dual challenges of slow economic growth and persistently high unemployment. This study examined the key macroeconomic drivers of employment from 1995Q1 to 2024Q3 using time-series econometric methods. Through the ARDL bounds testing framework, a long-run relationship was identified between employment, real GDP, investment, and inflation. Of these, GDP was the only statistically significant long-run determinant of employment, with a statistically significant and positive elasticity of 1.18, highlighting the central role of sustained economic growth in job creation. In the short term, investment was found to have a meaningful impact on employment, though its effect diminishes over time. Granger causality and VAR block exogeneity tests indicated that GDP and investment jointly influence employment, while inflation contributes marginally. The variance decomposition results confirm GDP and investment as the dominant factors explaining changes in employment over time, with inflation's role remaining minimal. These findings suggest that employment growth in South Africa is primarily driven by economic output, supported by capital investment. The study recommends pro-growth reforms and targeted investment strategies as essential tools for addressing unemployment and promoting inclusive labor market development.

Keywords: employment; monetary policy; macro-economy; South Africa

JEL Codes: E24, J21

1. Introduction

Jobs are the cornerstone of a successful modern society (Clifton, 2013). Employment remains one of the most pressing socio-economic challenges in South Africa, with persistently high unemployment rates undermining inclusive growth and social stability (Stats SA, 2023; World Bank, 2024). This research paper is focused on how key macroeconomic variables, including economic growth, domestic capital formation, and inflation, interact to influence employment outcomes over a 30-year period. By using econometric techniques, the study aimed to clarify the extent to which these factors drive or constrain job creation in South Africa (Raissi, 2015; Meyer & Sanusi, 2019).

The core problem statement guiding this research is that despite significant policy focus on job creation, South Africa's employment outcomes remain weak (Faulkner et al., 2013), and it is unclear whether macroeconomic levers such as GDP growth and investment are effectively translating into employment gains and, if so, to what extent (Lewis, 2001; Altman, 2012; Meyer, 2014). Various national policies were put in place to try and resolve the employment issues in South Africa, such as the New Growth Path (2010), the National Development Plan (2012), and Broad-Based Black Economic Empowerment (B-BBEE) and Employment Equity Frameworks. Furthermore, the potential disruptive or neutralizing role of inflation remains insufficiently explored in this context (Mutwanamba, 2024). The absence of clear empirical evidence makes it difficult to align fiscal, monetary, and labor policies for maximum impact on employment. This paper seeks to contribute to the existing body of knowledge by offering empirical evidence on the relative influence of GDP, investment, and inflation on employment. By doing so, it provides policymakers with actionable insights into the macroeconomic conditions that facilitate or hinder employment creation.

This research is significant as South Africa's unemployment rate remains among the highest globally, with youth unemployment exceeding 60% in recent years (Stats SA, 2024). Policymakers often debate the relative roles of growth-oriented strategies versus structural interventions, yet empirical evidence on the precise economic drivers of employment remains fragmented (Bateman, 2016). Understanding these dynamics is critical for designing effective economic and labor market policies that can stimulate job creation, especially in a post-COVID and fiscally constrained environment (World Bank, 2021).

The primary objective of this study is therefore to empirically assess the long-run and short-run relationships between employment and three key macroeconomic indicators: real GDP, investment (gross fixed capital formation), and inflation (CPI). Using an autoregressive distributed lag (ARDL) model, the study investigates both the equilibrium relationships and the causal directions among these variables.

2. Literature review

2.1. Theoretical foundation

This study is grounded in key macroeconomic and labor market theories that explain the relationship between employment and aggregate economic variables (Blanchard & Brancaccio, 2019). The Keynesian theory of employment posits that aggregate demand, especially investment and government spending, is a driver of employment (Keynes, 1936). According to Keynes, insufficient demand results in underutilized labor, and only increased output (GDP) can restore full employment.

This theoretical position aligns with the hypothesis that GDP growth is positively associated with employment levels (Burggraeve et al., 2015).

Complementing this, the neoclassical growth theory emphasizes capital accumulation as a critical engine of economic expansion and employment generation (Solow, 1956). In the Solow–Swan model, investment boosts the capital stock, which enhances productivity and leads to greater output and labor absorption (Chukwuemeka, 2024). However, this view also contends that long-run employment is largely determined by labor market flexibility and technological progress, implying that investment alone may not guarantee sustained job creation unless accompanied by complementary factors (Cesaratto et al., 2003).

The role of inflation is more complex and is addressed by the Phillips Curve theory, which suggests a short-run trade-off between unemployment and inflation (Abu, 2019). In periods of rising demand, inflation may increase as unemployment declines. Modern macroeconomic models, such as the expectations-augmented Phillips Curve, propose that this trade-off is not stable over time, particularly in the presence of supply-side shocks or inflation expectations, raising questions about the actual long-run effect of inflation on employment (Hagemann, 2020).

Taken together, the Keynesian employment framework, the neoclassical growth model, and the Phillips Curve perspective provide a comprehensive theoretical basis for understanding the macroeconomic drivers of employment, directly aligning with the focus of this study on employment dynamics in South Africa. Keynesian theory highlights the demand-side role of output expansion in stimulating labor absorption, suggesting that higher GDP should translate into higher employment. Neoclassical growth theory complements this by emphasizing the importance of capital accumulation and investment in raising productive capacity, though it cautions that long-term employment gains depend on how efficiently capital interacts with labor and technology. Meanwhile, the Phillips Curve framework introduces the potential influence of inflation on labor market outcomes, particularly in the short run, through wage and demand adjustments. Together, these perspectives suggest that employment outcomes are shaped by a combination of output growth, capital formation, and macroeconomic stability. This theoretical synthesis directly underpins the study's central objective: to empirically examine how GDP, investment, and inflation interact over time to influence employment levels in South Africa, thereby testing whether established macroeconomic theories hold within a developing, structurally constrained labor market context.

2.2. Conceptual framework

Based on the above theories, this study proposes a conceptual model where employment (dependent variable) is influenced by three key macroeconomic indicators:

Real GDP (economic growth): Serves as a proxy for aggregate demand and output expansion. Economic theory and empirical evidence suggest a positive relationship between GDP and employment, as higher output typically requires more labor.

Investment (gross fixed capital formation): Acts as a supply-side driver of job creation, particularly in capital-intensive sectors. In the short run, investment is expected to stimulate employment through infrastructure projects and private sector expansion. However, its long-run impact may depend on the efficiency and productivity of the investment.

Inflation (Consumer Price Index): Captures the price level effect on labor markets. While moderate inflation may indicate economic dynamism, high or volatile inflation can erode real wages, reduce consumption, and increase uncertainty, potentially harming employment.

The model hypothesizes both short-run and long-run relationships between these macroeconomic variables and employment. This conceptual framework informs the econometric strategy employed in the study, which integrates the ARDL bounds testing approach for long-run relationships, Granger causality for directionality, and variance decomposition to evaluate the relative explanatory power of each variable over time.

2.3. Empirical results

2.3.1. Evidence from developed economies

Numerous studies in developed economies have examined the relationship between macroeconomic variables and employment. For instance, Blanchard and Katz (1999) analyzed U.S. regional labor markets and found a strong and consistent positive relationship between output growth and employment. Using VAR models, they demonstrated that GDP shocks had long-lasting effects on job creation, while inflation played a negligible role. Similarly, Haschka (2024) revisited the Phillips Curve in the context of advanced economies and concluded that inflation has lost much of its predictive power for employment in the long run due to globalization and the anchoring of inflation expectations.

In Europe, Nickell et al. (2005) employed panel data techniques and found that real GDP growth significantly improves labor market outcomes, but the impact of investment depends on the type of investment and sectoral focus. They also highlighted that labor market regulations and institutional factors can moderate the strength of the GDP-employment relationship. Bassanini and Duval (2006) reinforced these findings by showing that labor market institutions and policy settings significantly influence the employment elasticity of output. Bernanke and Gertler (1995) emphasized the role of investment and monetary policy shocks in employment dynamics, arguing that real-sector linkages are central to understanding job creation. Ball et al. (2017) further supported this by demonstrating that economic growth is the single most robust predictor of employment improvements across OECD countries.

These findings from high-income contexts suggest that economic expansion is central to employment growth, but the responsiveness of labor markets varies based on structural and institutional conditions. Therefore, understanding how macroeconomic variables such as GDP, investment, and inflation interact with labor policies is critical for developing effective employment strategies.

2.3.2. Evidence from developing economies

In developing countries, the link between GDP and employment is often weaker or more volatile due to structural rigidities and labor market dualism (Ocampo, 2003). Felipe and Hasan (2006), in a cross-country study in Asia, found that although GDP growth leads to employment expansion, the elasticity of employment to growth is often low, particularly in capital-intensive sectors. Using ARDL and ECM models, they showed that investment has a short-run effect on job creation, but its long-run impact is inconsistent due to inefficiencies in capital deployment. Agénor (2004) emphasized that in

developing economies, output shocks often translate into limited employment gains due to weak labor absorption and informality. This model showed that macroeconomic volatility, especially in inflation, can erode employment gains unless supported by strong institutional frameworks.

Additionally, Kapsos (2006), in a global ILO study, estimated employment elasticity of growth in various regions and found that sub-Saharan Africa displayed particularly low responsiveness, requiring more targeted and inclusive growth strategies to ensure labor market outcomes improve alongside economic expansion. A study by Qayyum and Zaman (2019) analyzed the impact of trade openness on Pakistan's economic growth and employment from 1980 to 2017. The total labor force and gross fixed capital formation were included as control variables in this study. The results confirm the growth-led trade hypothesis. The findings also reveal a one-way causality flowing from trade openness to gross fixed capital formation and from total labor to economic growth. The study suggested several policy measures to promote trade openness within a country to support long-term, sustainable economic growth.

These studies suggest that while economic growth and investment play vital roles in job creation, their effectiveness in developing countries is contingent upon structural reforms, macroeconomic stability, and institutional capacity to absorb labor productively.

2.3.3. Evidence from African countries

In the African context, studies on the macroeconomic drivers of employment have grown, but findings remain inconclusive. Omitogun and Longe (2017), analyzing data from Nigeria, found that GDP positively affects employment in both the short and long term. However, investment influenced employment only in the short run. Their application of the ARDL model highlighted differences in the effects of public versus private investment, while inflation was shown to reduce employment during certain periods by eroding real wages and dampening consumer demand.

Mathenge and Muturi (2021) examined the relationship between employment and its key macroeconomic determinants across five East African Community countries. The study considered variables such as inflation, GDP growth, population growth, and investment. Using a panel ARDL model, they investigated the existence of a long-run relationship among these variables. The findings revealed that both GDP and investment significantly influence employment in the long run, while inflation had no statistically significant impact. Baah-Boateng (2016), in a study of Ghana, showed that while economic growth has been robust, its employment intensity is relatively low, largely due to the capital-intensive nature of growth and a mismatch between labor supply and demand. While GDP growth and investment are necessary for job creation, their effects are frequently moderated by inflation, institutional quality, and structural labor market challenges.

2.3.4. Evidence from South Africa

In the South African context, several empirical studies have analyzed the employment-growth-investment nexus, often with policy relevance. Banerjee et al. (2008) examined the role of GDP and labor market flexibility and found that output growth has a strong positive relationship with formal employment, but its impact on overall employment is diluted by the prevalence of informal and discouraged workers. According to Banerjee et al. (2008), unemployment in South Africa is largely driven by structural issues rather than short-term economic fluctuations.

The demand for unskilled labor has declined, particularly in key economic base sectors such as mining and agriculture, while the supply of such labor has increased. This statement describes a classic labor market imbalance driven by structural economic change. On the demand side, sectors like mining and agriculture have historically absorbed large numbers of low-skilled workers in South Africa. Over time, however, these sectors have become more capital-intensive and technology-driven. As a result, the number of jobs available for unskilled labor has fallen, not necessarily because production stopped, but because production methods changed. On the supply side, the number of people entering the labor market with low or outdated skill levels has grown. Population growth, rural-urban migration, and weaknesses in the education and training system have all contributed to a larger pool of workers who do not have the skills demanded by a modernizing economy. When demand falls and supply rises at the same time, unemployment increases, especially among the unskilled (Acemoglu, 1999).

This shift has disproportionately affected unskilled workers, pushing them into unemployment while skilled labor becomes more in demand, a global trend tied to skill-biased technological change (Handel, 2025). Real wages have stagnated or declined since the late 1990s, but unemployment remains high, indicating that moderate inflation has not helped clear the labor market (Klein, 2012). Key structural constraints include the difficulty school-leavers face in obtaining first jobs and the skill mismatch in the labor market. The authors stress that unemployment will not be resolved without intervention and advocate for experimental, small-scale policy trials with careful evaluation to identify effective solutions tailored to South Africa's structural unemployment challenges.

Kingdon and Knight (2004) highlighted the dualistic nature of the South African labor market, showing that while GDP growth improves employment prospects in the formal skilled sector, it has little effect on informal and low-skilled sector absorption. Mbanda and Chitiga-Mabugu (2017), using a computable general equilibrium (CGE) model, demonstrated that public sector investment could yield substantial employment benefits if aligned with labor-intensive sectors and pro-poor policies. Bhorat et al. (2014) found that policy uncertainty and rigid labor regulations significantly undermine the employment-creating potential of economic growth in South Africa, especially for low-skilled workers. Bhorat and Mayet (2013), focusing on South Africa, found that while GDP growth supports formal skilled employment, its impact on informal low-skills employment is minimal, suggesting that structural factors like education, skills mismatch, and labor regulations are key constraints.

Pasara and Garidzirai (2020) examined the causal relationships among unemployment, economic growth, and gross fixed capital formation (GFCF) over the period 1980–2018 using a vector autoregressive (VAR) model. Their findings indicate a positive long-term association between GFCF and economic growth. In the short term, unemployment was found to have no significant effect on economic growth. However, a significant and positive link was observed between unemployment and GFCF, while an inverse relationship existed between economic growth and unemployment. Meyer (2017) emphasized that for unemployment to decline and economic development to advance, employment must grow at a faster pace than economic output. Focusing on South Africa's context of persistently high unemployment, subdued economic growth, and elevated inflation and interest rates, the study examined the relationship between employment and economic growth using quarterly data from 2002 to 2016. The results revealed a long-run cointegrating relationship among the variables, with an employment elasticity of 0.96. Furthermore, Granger causality analysis showed that both economic growth and the repo rate significantly influence employment.

These studies confirm that while GDP and investment are critical for employment growth, their effectiveness in the South African labor market is shaped by structural factors such as informality,

education, spatial inequality, and institutional rigidity. The reviewed literature broadly confirms that GDP is a consistent long-run driver of employment across different economic contexts, while investment tends to have stronger short-run impacts. Inflation's role is generally weak or negative, especially in developing and African economies. However, few studies have comprehensively combined ARDL, Granger causality, and variance decomposition within a unified framework to analyze South Africa's employment dynamics over an extended time horizon. This study addresses that gap by offering a holistic and time series–based examination of employment determinants in South Africa from 1995 to 2024. By applying advanced econometric methods, the research provides robust empirical evidence on the macroeconomic drivers of employment and offers nuanced insights for policymakers seeking to align growth and labor market strategies more effectively.

In summary, studies in developed economies consistently show that GDP growth strongly drives employment, while inflation has little effect. Institutional factors and labor market regulations moderate these outcomes. In developing countries, the employment impact of growth is weaker and often inconsistent due to structural rigidities, informality, and inefficient investment, as highlighted by Ocampo (2003) and Felipe and Hasan (2006). African evidence similarly indicates that GDP and investment can support employment, but their effectiveness is constrained by labor market challenges and low absorptive capacity. In South Africa, research finds that GDP positively affects formal skilled employment but has a limited impact on informal sectors. Structural issues—skill mismatches, rigid regulations, and spatial inequalities—are key barriers. Investment contributes more in the short term, while inflation's role is generally weak or negative.

3. Methodology

3.1. Research design

This study adopts a quantitative time-series econometric approach to examine the dynamic relationship between employment and selected macroeconomic indicators in South Africa, namely, real GDP, gross fixed capital formation (domestic investment), and consumer price index (CPI as a proxy for inflation), from 1995Q1 to 2024Q3. The analytical framework is structured to assess both short-run dynamics and long-run equilibrium relationships using the autoregressive distributed lag (ARDL) bounds testing approach, complemented by Granger causality tests, and forecast error variance decomposition.

3.2. Data and variables

The analysis utilizes quarterly time series data for each variable (the variable abbreviation is indicated in brackets):

- Employment (EMPL): Total employment data obtained from Statistics South Africa.
- Real GDP (GDP): GDP data at constant prices sourced from the South African Reserve Bank (SARB).
- Investment (INV): Gross fixed capital formation data from SARB.
- Inflation (CPI): Consumer Price Index sourced from Statistics South Africa.

All variables are transformed into natural logarithms to ensure linearity, reduce heteroscedasticity, and allow for elasticity interpretation of the coefficients. Data consistency and comparability were ensured by aligning base years and applying standard time-series transformation procedures.

3.3. Preliminary analysis

Descriptive statistics were first computed to evaluate the distributional characteristics of each variable as well as the development of an employment-to-investment ratio and a productivity analysis. This was followed by unit root testing using the augmented Dickey-Fuller (ADF) test to assess the stationarity of the series. The presence of structural breaks was noted, and first differencing was applied where necessary.

3.4. ARDL bounds testing and error correction model

The ARDL bounds testing procedure, as proposed by Pesaran et al. (2001), was employed to test for the existence of a long-run cointegration relationship among the variables. The model was specified with employment (LEMPL) as the dependent variable and GDP, investment, and CPI as regressors. Optimal lag length was selected based on the Akaike Information Criterion (AIC). The computed F-statistic was compared against critical bound values at different significance levels to test the null hypothesis of no level relationship. The following null and alternative hypotheses are formulated:

- Null hypothesis (H_0): No long-run relationship.
- Alternative hypothesis (H_1): Long-run relationship exists.

The long-run relationship extracted from the ARDL model is as follows:

$$LEMPLt = \gamma_1 LGDPt + \gamma_2 LINVt + \gamma_3 LCPIt + ut \quad (1)$$

where $\gamma_1, \gamma_2, \gamma_3$ are long-run elasticity coefficients, and ut is the error term in the long-run equation. Once a long-run relationship is established using the bounds test, the ECM representation of the ARDL model is estimated to capture short-run dynamics and the speed of adjustment to long-run equilibrium.

Upon confirming cointegration, the long-run coefficients were estimated, followed by the construction of a short-run error correction model (ECM) to capture the speed of adjustment back to long-run equilibrium. The coefficient of the error correction term [CointEq(−1)] indicates the proportion of disequilibrium corrected in each quarter.

3.5. Granger causality

To explore the directionality of relationships, pairwise Granger causality tests were performed to assess whether one variable statistically precedes another. These were complemented by VAR Granger causality/block exogeneity Wald tests to provide multivariate validation within a system of equations. The optimal lag order was again chosen using AIC, and system stability was ensured through characteristic root analysis. The VAR model was further used to conduct forecast error variance decomposition, which quantifies the proportion of forecast error variance in each endogenous variable that can be attributed to shocks in other variables. This approach provides insights into the relative importance and influence of GDP, investment, and CPI in explaining employment fluctuations over a 15-quarter forecast horizon.

3.6. Diagnostic and robustness checks

Although not fully detailed in the output, standard diagnostic tests were conducted to ensure model robustness, including:

- Serial correlation tests (Breusch–Godfrey LM test),
- Heteroscedasticity tests (ARCH LM),
- Normality tests on residuals (Jarque–Bera), and
- Stability tests using CUSUM and CUSUMSQ.

These tests confirmed the appropriateness of the model specification and the reliability of the estimated coefficients for both policy analysis and forecasting purposes.

4. Results and discussion

4.1. Descriptive analysis

The descriptive statistics, as listed in Table 1, provide an overview of the trends and distributional properties of the variables analyzed quarterly from 1995 to 2024.

Employment, based on Statistics South Africa data, averaged 9.14 million over the period. The highest figure was 10.9 million in 2023Q3, and the lowest was 7.5 million in 2003Q2, reflecting economic shocks and the COVID-19 pandemic. Skewness (0.088) shows near symmetry, while kurtosis (1.71) indicates a flatter distribution. The Jarque-Bera test p-value (0.0438) suggests mild non-normality, though not severe enough to compromise time-series analysis validity.

Gross domestic product (GDP) at constant prices, from the South African Reserve Bank, averages R4.09 trillion with a median of R4.35 trillion. The lower mean suggests slight negative skewness (−0.875), indicating more high-end GDP values and fewer extreme lows, likely from earlier contractions. GDP ranged from R2.72 trillion in 1995 to R4.81 trillion in 2023, showing long-term growth. Kurtosis of 2.61 reflects a near-normal but flatter distribution. The Jarque-Bera test ($p = 0.0026$) confirms significant non-normality, likely due to structural changes and economic shocks over time.

Domestic investment, measured as gross fixed capital formation (GFCF) from SARB, averages R681 billion with a median of R707 billion. The lower mean and skewness (−1.067) indicate pronounced negative skew, reflecting higher investment values and some low periods, likely tied to recessions or political uncertainty. Values range from R392 billion in 2002 to R815 billion in 2013, showing substantial variation. Kurtosis (3.28) suggests heavier tails and the presence of outliers. The Jarque-Bera test ($p < 0.001$) confirms significant non-normality, linked to irregular capital formation across business cycles.

The Consumer Price Index (CPI), proxying inflation, has a mean of 70.19 and a median of 67.70, ranging from 37.8 in 1995 to 116.1 in 2024, reflecting steady long-term inflation. A standard deviation of 23.52 shows substantial variation, influenced by exchange rates, commodity shocks, and policy. Mild right skewness (0.29) indicates slightly more low-end values, while kurtosis (1.91) suggests a flatter distribution with lighter tails. The Jarque-Bera p-value (0.0589) is just above 0.05, indicating near-normality, making CPI appropriate for regression without transformation.

Table 1. Descriptive analysis.

Concept	Total employment	GDP at constant prices (R millions)	Domestic investment (R millions)	CPI
Mean	9,139,765	4,086,568	681,253	70.185
Maximum	10,898,284	4,814,177	815,427	116.100
Minimum	7,510,435	2,721,260	392,372	37.800
Skewness	0.0883	−0.8746	−1.0666	0.2901
Kurtosis	1.7130	2.6098	3.2783	1.9088
Jarque–Bera	6.2573	11.9129	17.1649	5.6635
Probability	0.0437	0.0026	0.0002	0.0589

Sources: SARB (2025), Stats SA (2025).

4.2. Ratios and indexes

Figure 1 presents the employment-investment ratio, an index constructed to measure the number of jobs supported per unit of domestic investment over time. The ratio is calculated by dividing total employment by gross fixed capital formation (GFCF), with both variables expressed in consistent real terms to remove price distortions. This formulation provides a proxy for the labor intensity of economic growth, indicating how effectively investment spending translates into employment creation. A rising ratio suggests that each unit of capital investment is associated with greater labor absorption, typically reflecting labor-intensive production structures or strong employment multipliers. Conversely, a declining ratio implies that investment is becoming more capital-intensive, where technological upgrading, automation, or shifts toward high-productivity sectors generate output growth without proportional job creation. The importance of this index lies in its ability to reveal structural changes in the economy that are not visible through GDP or employment levels alone. While GDP growth may appear stable, a falling employment-investment ratio signals weakening job creation efficiency, highlighting potential mismatches between capital allocation and labor market needs. In 2002, the index was at its highest point of 19.9, but declined to 10.5 in 2008. The index had a slight recovery since 2008 to 16.1 in 2024, still well below the values of 2002. A falling ratio means fewer jobs are created per unit of investment, often due to increased automation or capital-intensive production. A higher ratio suggests more labor-intensive growth. For example, from 2002Q3 to 2008Q3, the ratio dropped from 19.9 to 10.7, meaning fewer jobs were being supported per unit of investment over time. The employment-investment ratio is generally decreasing, which suggests that over time, investment in the economy is becoming more capital-intensive and less employment-generating. This type of trend is common in industrializing or technologically advancing economies.

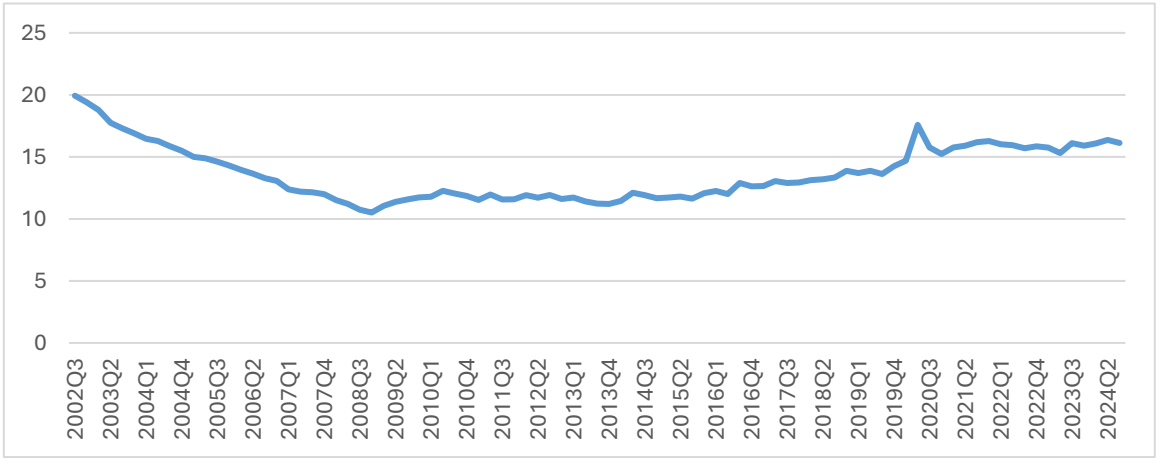

Figure 1. Employment to investment ratio. Sources: SARB (2025), Stats SA (2025).

While Figure 1 illustrates how effectively investment translates into employment over time, Figure 2 shifts the focus from job creation efficiency to the productivity of labor and capital, offering deeper insight into the structural drivers behind the changing employment–investment relationship.

Figure 2 presents the Labor and Capital Productivity Indexes, constructed to measure the efficiency with which labor and capital inputs generate economic output over time. Labor productivity is calculated as real GDP divided by total employment, while capital productivity is measured as real GDP divided by gross fixed capital formation (GFCF). Both series are converted into index form (base year = 100) to allow for clear comparison of trends and relative changes across time. Labor productivity, therefore, reflects the output per worker, capturing improvements in skills, technology, and organizational efficiency, while capital productivity indicates the output generated per unit of investment, reflecting the effectiveness of capital allocation and utilization. The importance of these indexes lies in their ability to reveal whether economic growth is driven by efficiency gains or by input expansion alone. Rising labor productivity suggests that workers are becoming more efficient, often due to technological progress, better training, or improved management practices. In contrast, stagnating or declining capital productivity may indicate diminishing returns to investment, misallocation of capital, or insufficient complementary factors such as infrastructure, governance, or skills. In the South African context, the divergence between labor and capital productivity trends is particularly significant, as it helps explain why rising investment does not always translate into proportional employment gains. Together, these productivity measures provide critical evidence on the structural transformation of the economy and help policymakers assess whether growth is becoming more knowledge- and capital-intensive, potentially reducing the employment intensity of future expansion. Labor productivity was stable with an index of approximately 80 in the mid-1990s, but showed a gradual but consistent upward trend, especially from the early 2000s onward up to 2010. This suggests that the economy has become increasingly efficient in generating output per worker over time. Regarding capital productivity, the index started slightly higher than labor productivity and also increased, but showed less stability. From the early 2000s to around the mid-2010s, it increased notably but flattened or fluctuated more in recent years. This indicates that while investment in capital (e.g., machinery, infrastructure) has grown, its marginal productivity may be declining or stagnating. Important implications are that positive labor productivity growth signals improved worker efficiency, due to better technology, education, or management practices. Slowing or stagnant capital productivity

could reflect the misallocation of investment (e.g., infrastructure not yielding returns) and weak complementary factors like governance or skills.

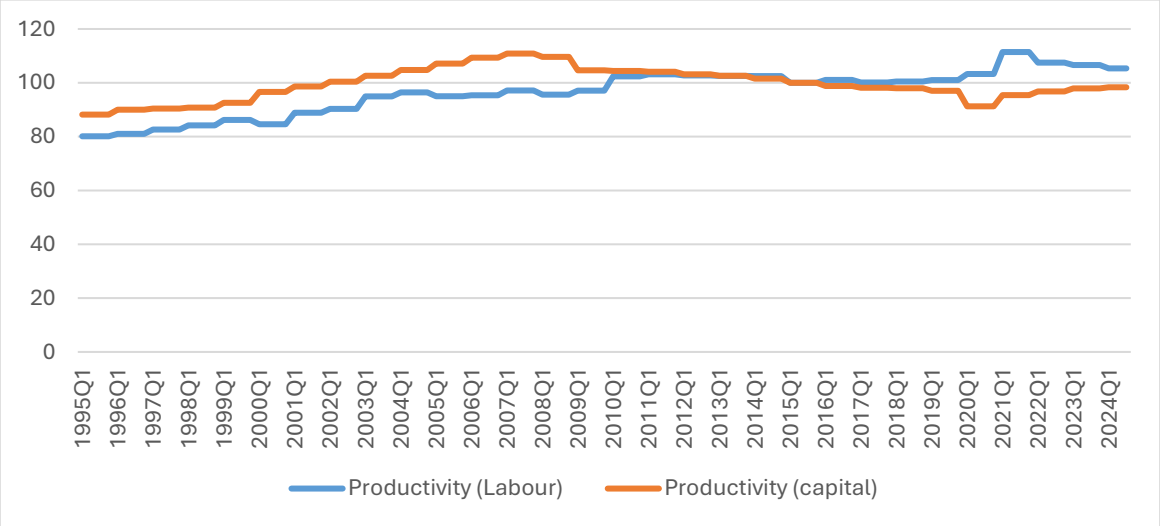

Figure 2. Productivity index. Sources: SARB (2025), Stats SA (2025).

4.3. Unit root testing

The augmented Dickey-Fuller (ADF) unit root test assessed the stationarity of variables in first-differenced logarithmic form. Results (Table 2) show that all variables—employment (LEMPL), GDP (LGDP), investment (LINV), and inflation (LCPI)—are integrated of order one, I(1). For employment, the ADF statistic is −8.497 (p = 0.0000), strongly rejecting the null of a unit root. The GDP series also rejects the null at the 1% level with a statistic of −4.446 (p = 0.0004), indicating that both exhibit stochastic trends in levels but are stationary after differencing. Investment and CPI display strong evidence of first-difference stationarity, with ADF statistics of −10.571 and −10.105 and p-values of 0.0000. These results validate the use of ARDL and VAR models that accommodate mixed integration orders.

Table 2. Unit root stationarity tests.

Variables	Augmented Dickey-Fuller test statistic		Final result	Breakpoint unit root test result
	I(0) p-value	I(1) p-value		
Total employment	0.8956	0.0001*	I(1)	Significant in 2020Q2
GDP	0.1866	0.0004*	I(1)	Significant in 2004Q1 and 2013Q4
Domestic investment	0.2154	0.0001*	I(1)	Significant in 2020Q2
CPI (inflation)	0.5339	0.0002*	I(1)	Significant in 1998Q3

Note: * indicates significance level at 5% (0.005).

4.4. Bound test and long-run results

Table 3 reports the results of the ARDL bounds test for cointegration and reveals that a long-run equilibrium relationship exists between employment and its explanatory variables, GDP, investment, and CPI. The calculated F-statistic is 6.182, which exceeds the upper bound critical values at the 5% significance level. This rejects the null hypothesis of no cointegration, indicating that employment, GDP, investment, and inflation are tied together in a stable long-term relationship. This justifies further analysis of the long-run coefficients.

Table 3. ARDL bounds test.

F-bounds test		Null hypothesis: No-levels relationship		
Test statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.182	10%	2.10	3.21
		5%	2.38	3.74
		2.5%	2.55	4.25
		1%	3.53	4.91

Table 4 lists the long-run results. In the long-run equation, GDP emerges as the only statistically significant determinant of employment, with a coefficient of 1.178 and a significant p-value (0.0001). This implies that a 1% increase in real GDP (LGDP) is associated with a 1.18% increase in employment, underscoring the critical role of sustained economic growth in job creation in South Africa. In contrast, investment (LINV) and inflation (LCPI) are statistically insignificant. This suggests that in the long run, neither domestic investment nor inflation has a direct and stable impact on employment levels. These findings could reflect structural inefficiencies in how investment translates into job creation and the neutralizing effects of inflation on labor markets. Overall, the results highlight that long-term employment strategies should prioritize GDP expansion as the primary engine for absorbing labor into the economy.

This also confirms that sustained economic growth is the primary structural driver of job creation in South Africa. It suggests that, despite labor market rigidities and structural constraints, employment ultimately expands when the economy grows consistently. These findings confirm that growth-led employment strategies are essential. Macroeconomic policy should prioritize pro-growth fiscal reforms, infrastructure expansion that raises productive capacity, and trade and industrial policies that stimulate output in labor-absorbing sectors.

Since GDP is the dominant long-run driver, employment policy cannot succeed without sustained output expansion. Structural reforms that raise long-term growth (energy reliability, logistics efficiency, regulatory certainty) therefore become indirect but powerful labor-market policies.

Table 4. Long-run results (dependent variable: LEMPL).

Variable	Coefficient	Std. Error	t-statistic	p-value
LGDP	1.1777	0.2017	5.8378	0.0001*
LINV	0.1383	0.2087	0.6626	0.5094
LCPI	0.0028	0.0941	0.0297	0.9763

Notes: * indicates significance at 5%. Model selected: ARDL (1, 0, 2, 1).

4.5. ECM and short-run results

Table 5 contains the ECM and short-run results. The error correction term [CointEq(−1)] is negative and statistically significant at the 1% level (coefficient = −0.055; $p < 0.0001$), confirming the existence of a stable long-run relationship and the system's tendency to revert to equilibrium after a shock. The magnitude of −0.055 implies that approximately 5.5% of the deviation from the long-run employment equilibrium is corrected each quarter, suggesting a relatively slow but steady adjustment process. The model explains about 40.3% of the short-run variation in employment ($R^2 = 0.403$), and the Durbin-Watson statistic of 2.09 suggests no serious autocorrelation in the residuals.

In terms of short-run dynamics, investment (LINV) has a highly significant and positive immediate effect on employment in the current period (coefficient = 0.187; $p < 0.0001$), but no significant impact in the first lag period. This implies that investment activity yields short-run employment benefits, potentially through labor-intensive capital projects. This indicates that new investment projects, especially construction, infrastructure, and expansion phases, generate temporary employment boosts, even if those jobs are not sustained in the long term. The coefficient of LGDP is 0.075, statistically significant at the 5% level ($p = 0.0498$). This means a 1% increase in GDP is associated with a 0.075% increase in employment. The implication is that GDP positively contributes to short-run variations in the dependent variable, reflecting that economic growth plays a role in job creation even in the short run. The short-run effect of CPI is negative (coefficient = −0.150) but statistically insignificant ($p = 0.169$), suggesting that inflation does not have a meaningful short-term impact on employment in this sample. The coefficient of the lagged dependent variable, LEMPL(−1), is 0.064 and statistically significant ($p = 0.0076$), implying a relatively persistent structure in employment behavior over time. Overall, these findings confirm the earlier results: GDP is the dominant long-run driver, while investment plays a key role in short-run employment fluctuations supported by GDP, underscoring the need for both macroeconomic growth and capital formation strategies to address employment challenges in South Africa.

Investment policy should be designed with employment multipliers in mind, not just capital deepening. This means prioritizing labor-intensive infrastructure (maintenance, housing, local services), supporting SMEs and local supply chains that create more jobs per rand invested, and incentivizing sectors such as renewable energy installation, tourism, agroprocessing, and services.

Table 5. Error correction model and short-run results.

Variable	Coefficient	Std. Error	t-statistics	p-value
Cointegration equation (−1)	−0.0545	0.0122	−4.4547	0.0001*
LEMPL (−1)	0.0635	0.0232	2.7360	0.0076*
LGDP	0.0748	0.0376	1.9914	0.0498*
LINV (−1)	0.0087	0.0156	0.5624	0.5753
LCPI (−1)	0.0002	0.0059	0.0300	0.9761
D(LINV)	0.1865	0.0293	6.3509	0.0001*
D(LCPI)	−0.1504	0.1083	−1.3891	0.1686

Notes: * and ** indicate significance at 5% and 10%, respectively.

4.6. Causality analysis

This analysis includes two types of causality analysis, namely, pairwise and VAR Granger causality. First, the pairwise Granger causality analysis (Table 6) reveals several key directional relationships among employment, GDP, investment, and CPI over the sample period (1995Q1–2024Q3). Most notably, the test rejects the null hypothesis that GDP does not Granger-cause employment, with a statistically significant F-statistic of 3.715 ($p = 0.0285$). This indicates that past values of GDP contain predictive power for changes in employment, confirming that economic growth precedes and potentially drives job creation in South Africa. However, the reverse is not true; employment does not Granger-cause GDP ($p = 0.1840$), suggesting that labor market outcomes are more a result of growth than a driver of it. This unidirectional causality reinforces the finding from the ARDL model that GDP is a primary long-run determinant of employment.

Another important finding is the bidirectional causality between CPI and employment. Both directions are statistically significant at the 5% level ($p = 0.0423$ and $p = 0.0391$), indicating a feedback loop between inflation and employment. Rising inflation may influence wage dynamics and job creation, while labor market developments could, in turn, affect demand-side pressures in the economy. Interestingly, no statistically significant Granger causality is found between investment and employment in either direction ($p > 0.23$). Interestingly, there is marginal evidence at the 10% level that GDP Granger-causes investment, implying that growth may precede investment decisions due to improved business confidence or higher demand. Lastly, the absence of causality between CPI and either GDP or investment suggests that inflation during the sample period was more likely driven by external shocks or price rigidities rather than changes in real economic activity. Overall, the results highlight GDP as a causal driver of employment, CPI as an interactive variable, and investment as a less direct influence in the short run.

Table 6. Pairwise Granger causality analysis.

Null hypothesis	Obs	F-statistic	Prob.
LGDP does not Granger-cause LEMPL	87	3.7154	0.0285*
LEMPL does not Granger-cause LGDP		1.7280	0.1840
LINV does not Granger-cause LEMPL	87	0.6456	0.5269
LEMPL does not Granger-cause LINV		1.4874	0.2320
LCPI does not Granger-cause LEMPL	87	3.2875	0.0423*
LEMPL does not Granger-cause LCPI		3.3720	0.0391*
LINV does not Granger-cause LGDP	117	1.0696	0.3466
LGDP does not Granger-cause LINV		2.8845	0.0600**
LCPI does not Granger-cause LGDP	117	1.2503	0.2904
LGDP does not Granger-cause LCPI		1.0032	0.3700
LCPI does not Granger-cause LINV	117	0.4513	0.6379
LINV does not Granger-cause LCPI		0.4749	0.6231

Notes: * and ** indicate significance at 5% and 10%, respectively.

4.6.1. VAR causality (control estimation)

The VAR Granger causality/block exogeneity Wald test (Table 7) results offer insights into the causal relationships among employment, GDP, investment, and inflation. When employment (LEMPL) is the dependent variable, GDP and investment show significant predictive power. GDP records a Chi-square of 9.889 (p = 0.0071), and investment 6.807 (p = 0.0333), indicating that their past values help explain employment changes. Inflation (CPI) shows no significant short-term impact (p = 0.9747). The joint significance test yields a p-value of 0.0047, confirming the robustness of the model in explaining employment dynamics.

When GDP is the dependent variable, none of the predictors, including employment, are statistically significant (all p-values > 0.23), suggesting that GDP is exogenous—consistent with its role as a primary driver rather than an outcome. For investment (LINV), GDP emerges as a significant predictor (Chi-square = 13.892, p = 0.0010), supporting the view that output influences capital formation. Employment and CPI do not significantly predict investment. Regarding inflation, the joint Chi-square test is significant (p = 0.0074), but no individual variable reaches the 5% threshold, indicating weak evidence of joint causality, possibly reflecting multicollinearity or delayed effects.

Overall, the VAR causality results reinforce prior findings: GDP acts as a key exogenous driver, significantly affecting employment and investment, while CPI mainly reacts to other variables and exerts little short-term influence within the system.

Table 7. Granger causality/block exogeneity Wald test.

Model	Model 1	Model 2	Model 3	Model 4
Dependent variable	LEMPL	LGDP	LINV	LCPI
Indep variable 1	LGDP	LEMPL	LEMPL	LEMPL
	(0.0071)*	(0.325)	(0.675)	(0.0737)**
Indep variable 2	LINV	LINV	LGDP	LGDP
	(0.033)*	(0.239)	(0.0010)*	(0.1911)
Indep variable 3	LCPI	LCPI	LCPI	LINV
	(0.975)	(0.635)	(0.0767)**	(0.7938)
Combined causality	(0.0047)*	(0.3434)	(0.0067)*	(0.0074)*

Notes: * and ** indicate significance at 5% and 10%, respectively.

4.7. Variance decomposition

Variance decomposition in VAR quantifies how much of a variable's forecast error variance is due to its own past values versus shocks from other variables. Table 8 summarizes employment variance decomposition over 15 periods. Initially, employment variation is entirely self-driven (100%). By period 5, GDP explains 9.7% and investment 4.9%. At period 15, GDP accounts for 24.2% and investment 19.5%, showing their growing importance in shaping employment, while CPI remains negligible (<0.3%). These results align with ARDL and causality findings, confirming GDP and investment as key drivers of employment dynamics over time. Variance decomposition for GDP shows it is mainly self-determined, explaining 89% of its own variation by period 15, though investment's influence rises to 8.2%. For investment, GDP becomes the dominant external driver, accounting for

44.6% by period 15, while employment contributes 19.2%, suggesting a bidirectional link between growth and capital formation. CPI variance is largely self-determined early on, but GDP's role increases significantly, explaining 36% by period 15, followed by employment and investment. Overall, GDP emerges as the most influential variable, investment acts as both a driver and responder, employment reacts mainly to macroeconomic shocks, and inflation plays a limited explanatory role, mostly reflecting broader economic trends over time.

Table 8. Variance decomposition (LEMPL as dependent variable).

Period	S.E.	LEMPL	LGDP	LINV	LCPI
1	0.0111	100.0000	0.0000	0.000	0.0000
2	0.0153	97.9271	1.9535	0.085	0.0333
3	0.0174	95.1398	4.0782	0.753	0.0282
4	0.0188	90.6005	6.9084	2.464	0.0262
5	0.0199	85.4015	9.7128	4.857	0.0284
6	0.0209	80.1884	12.3148	7.434	0.0291
7	0.0217	75.4195	14.6456	9.895	0.0276
8	0.0224	71.2670	16.6306	12.075	0.0262
9	0.0230	67.7556	18.2929	13.922	0.0288
10	0.0236	64.8272	19.6921	15.441	0.0392
11	0.0240	62.3957	20.8763	16.668	0.0598
12	0.0244	60.3718	21.8890	17.646	0.0922
13	0.0248	58.6751	22.7662	18.421	0.1367
14	0.0251	57.2379	23.5367	19.032	0.1927
15	0.0254	56.0055	24.2231	19.512	0.2590

4.8. Diagnostic tests and model stability

The diagnostic tests reported in Table 9 confirm the reliability and robustness of the estimated model. The normality test yields a probability value of 0.381, indicating that the residuals are normally distributed. The Breusch-Godfrey serial correlation LM test returns a probability value of 0.6808, suggesting that there is no evidence of serial correlation in the residuals. Additionally, the Breusch-Pagan-Godfrey test for heteroskedasticity shows a probability value of 0.1061, which confirms that the variance of the residuals is constant and there is no issue of heteroskedasticity. Overall, these diagnostic results validate the appropriateness of the model for inference and policy analysis.

Table 9. Diagnostic tests.

Diagnostic test	F-value of probability	Result description
Normality test	0.3810	Data is normally distributed
Breusch–Godfrey serial correlation LM test	0.6808	No serial correlation was detected.
Heteroskedasticity test: Breusch–Pagan–Godfrey	0.1061	No evidence of heteroskedasticity was detected.

5. Conclusions

This study set out to examine the macroeconomic determinants of employment in South Africa over the period 1995Q1 to 2024Q3, using robust econometric techniques including the ARDL bounds test, Granger causality, VAR analysis, and variance decomposition. The key findings indicate that real GDP is the only statistically significant long-run determinant of employment, affirming the critical role of sustained economic growth in driving job creation. In the short run, investment exerts a strong and significant positive effect on employment supported by GDP, while inflation (as measured by CPI) has no meaningful influence in either the long or short run. The VAR-based variance decomposition supports these findings, showing that GDP and investment account for increasing proportions of employment fluctuations over time, while CPI consistently contributes less than 1%.

The primary research objective—to empirically determine the dynamic relationship between employment, GDP, investment, and inflation—has been achieved. Through a combination of time-series methods, the study not only confirms the existence of a long-run cointegrating relationship but also clarifies the directionality and magnitude of these effects. Granger causality tests validate the unidirectional influence of GDP on employment and identify short-run feedback loops between employment and CPI. The study provides a comprehensive and statistically sound assessment of the employment-growth-investment nexus in the South African economy.

The study makes several important theoretical and practical contributions. Theoretically, it aligns with the Keynesian and neoclassical perspectives that output expansion and capital accumulation are fundamental to employment generation. It also adds empirical weight to the limited body of South African literature applying an integrated ARDL-VAR approach over an extended time frame. Practically, the findings highlight that investment policies can yield immediate employment benefits, while long-term employment stability depends on consistent economic growth. This duality is critical for policymakers seeking to balance short-term interventions with structural reform.

Despite the robustness of the methodology, the study is subject to certain limitations. First, it focuses solely on macroeconomic determinants, excluding important microeconomic and institutional variables such as labor regulations, education, and demographic trends. Second, the use of quarterly national aggregates may mask important sectoral or regional variations. Future research could explore employment dynamics across different sectors or provinces using panel data techniques. In addition, incorporating labor market frictions, informality, and productivity measures could yield deeper insights into the employment creation process in South Africa.

Based on the findings, several policy recommendations emerge. First, the government should prioritize GDP growth through pro-investment, pro-export, and infrastructure-led strategies, as output expansion has a direct and significant impact on employment. Second, short-run employment interventions should focus on stimulating private and public investment, especially in labor-absorbing sectors like construction, services, and renewable energy. Third, efforts to control inflation should continue, but should not dominate employment strategies, given its limited direct effect on labor markets. Lastly, structural reforms aimed at improving the efficiency of capital allocation, reducing policy uncertainty, and enhancing workforce skills will be essential to convert short-run investment into sustained employment gains.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The author declares no conflicts of interest in this paper.

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