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Article

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Is the current economic performance compatible with the projected NDP unemployment target?

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ABSTRACT

This study investigated the relationship between unemployment rates and economic growth, known as Okun's Law. The non-linear autoregressive distributed lags (NARDL) model was employed using quarterly time series data sampled from 2000Q1 to 2021Q4. In this model, unemployment was used as the dependent variable, whereas output, exchange rate, and consumer prices index (CPI), were used as explanatory variables, and were decomposed into positive and negative partial sums to capture asymmetry in their effects on unemployment. The findings of this study provided evidence of asymmetry in the effect of all the explanatory variables in the long-run, and a negative relationship is found between output and unemployment. However, unemployment was found more elastic to negative shocks in output than positive shocks. This implies that in the South African labour market, employers are quicker to retrench when the economy is in recession and slower to absorb when the economy is in expansion. Therefore the 6% unemployment target by 2030 appears hypothetical for South Africa, considering its current position. In this regard, this study recommends South African policymakers adjust their labour laws to be more flexible, so that employers do not substitute more labour with capital in the production process.

IMPACT STATEMENT

This year 2024 marks twelve years since the National Development Plan (NDP) goals were formulated in South Africa. It is with deep sadness that the society is still characterised by deep poverty, elevated levels of crime and poor living standards. The stimulus packages employed by the South African government and policy uncertainty seem to be not working towards the direction of achieving the projected national development targets. It was necessary to conduct such an investigation to determine if the current economic experience could potentially steer South Africa towards the trajectory of achieving the NDP goals.

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1. Introduction

The beginning of the year 2022 marked a decade since the formulation of the National Development Plan (NDP) to achieve macro-economic objectives, amongst which are low unemployment and economic growth. The two central objectives of the NDP have not been drifting towards the projected targets. Unemployment has been stubbornly high causing a chaotic society characterised by poverty, crime, and corruption. According to Mosikari (2013), unemployment produces unwanted situations to become like permanent citizens of the country. These conditions include a low level of living standards, psychological stress, and loss of human freedom and dignity.

On the other hand, vibrant policies with a common goal to stimulate economic performance and reduce unemployment have been implemented in South Africa. These policies include the Accelerated and Shared Growth Initiatives for South Africa (ASGISA) and Gear Employment and Redistribution (GEAR). Economic growth has remained around 3.48% on average for SA between 2000 and 2010 higher than 1.15% on average between 2011 and 2020. Concurrently, the unemployment rate was 28.20% on

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average in the years between 2000 and 2010 and decreased in the later decade as it drifted to 26.93% on average. The status quo of existing literature proposes that economic growth ought to increase to a certain level to reduce the unemployment rate. This notation is known as Okun's Law, most studies such as Madito and Khumalo (2014), Mihajlovic and Fedajev (2021), Stungwa and Tozamile (2021), Pasara and Garidzirai (2020), to count few, have validated Okun's Law in SA. In this regard, most economies of the world strive to stimulate high output growth and absorb the available labour force in the production process, to reduce unemployment. On the other hand, there is undeniable evidence from existing literature that economic growth on some occasions may be positively related to unemployment rates in SA (Abraham & Nosa, 2018; Bakhshi & Ebrahimi, 2016; Tenzin, 2019).

The above disagreement in the literature remains the backbone of this study. The main aim of the study is to add value to the current debate and literature by deliberately investigating the nexus between unemployment and economic growth in SA employing the Nonlinear Autoregressive Distributed Lagged model (NARDL). This model will allow us to capture potential asymmetry in this nexus. Through this, we will be able to establish if the current economic performance is steering unemployment towards its projected targets, by evaluating the magnitude of unemployment response in negative and positive shocks on economic growth, respectively. The study also considers the effect of prices and exchange rate fluctuations, since currency arrangements and price changes form a huge part of economic performance. Inflation harms unemployment, and it creates an unstable environment for growth, while exchange rates remain a shock absorber and it reflects that since SA is an open emerging economy that is vulnerable to external shocks. These variables have been included in several studies when investigating the relationship between unemployment and economic growth, including Bakhshi and Ebrahimi (2016), Kocaarslan et al. (2020) and Nyahokwe & Ncwadi (2013). However, the highlighted studies above do not provide the same emphasis with regards to NDP and targeted level of unemployment; rather they are interested in the nexus between the two main variables under investigation. The rest of this paper proceeds as follows: Section 2 is the review of previous studies. Section 3 provides the econometric techniques applied for estimation and Section 4 offers a discussion of the results. Ultimately, the conclusion and policy recommendation of the study are highlighted in Section 5.

2. Literature review

The reviewed previous studies in this field were informed by few economic theories, one of them having been indicated earlier is the Okun's Law. The notion of this theory advocates that growth should grow above its potential level by 3% to be able to reduce unemployment rate by 1%, Bankole and Fatai (2013) and Elshamy (2013). Prachowny (1993), indicated that both highlighted percentages are consistent if growth takes place through labour-intensive industries. Growth can occur through capital-intensive industries where technological shocks are dominating. Therefore, concerning this current study Silvapulle et al. (2004), is relevant to address Okun's Law in asymmetric lenses. The author highlights the importance of assuming an asymmetric connection of output on unemployment. The relationship discussed here will be outlined in the first part of the theoretical model using relevant Equations (1, 1a and 1b). First, the theory of asymmetric Okun Law asserts that if there exists a non-linear relationship between output and unemployment, the unemployment will have a heterogeneous reaction to output during divergent phases of the business cycle namely expansion and contraction. Equally important is that it may relate to the Philips curve concerning the aggregate supply curve.

Wide range of studies that have delved to an investigation to validate the existence of Okun's theory for different economies, including SA. For example, Mazorodze and Siddiq (2018) investigated the nexus between these two variables where they used the nonlinear Autoregressive distributed lags (NARDL) model. The study found a negative relationship between unemployment and output; furthermore, during the recession the unemployment rate increased by 10.3% compared with decreasing unemployment during the recovery. The study has considered the data sample that ranged from 1994Q1 to 2017Q4. These results were also validated by a great deal of the studies such as those of Phiri (2018); Mihajlovic and Fedajev (2021); Khalid et al. (2021); Lubbok et al. (2022); Yasmin et al. (2020) and Sere and Tchereni (2020). The above findings indicate that during the downswing of the business cycle, the economy is at

substantial risk to incur high unemployment rates which may hardly be recovered during the expansion phase, especially if it lasts shorter than the recession.

Tenzin (2019) on the other hand, has found a positive relationship between output and unemployment rates in both the short-run and long-run for SA. The study used the ARDL model with the data observed between 1998 and 2016. For the same economy, similar sentiments were shared by Abraham and Nosa (2018). The same findings were verified by Bakhshi and Ebrahimi (2016), in Iran. Katumo (2019) derived similar findings in Kenya where economic growth was linked to youth unemployment. The study relied on simple Ordinary Least Square (OLS) and Granger causality tests to validate the positive relationship between the variables. Other studies such as Hlongwane and Daw (2021) have diverged in terms of the results of the current debates. The study used the ARDL model and the Granger causality test with data observed between 1980 and 2020 and found no relationship between the variables in SA. Similar sentiments were shared by Conteh (2021) in Liberia.

At the beginning of the study, it was highlighted that the SARB pursued targeting inflation. This variable should have a negative relationship with unemployment based on the economic theory alluded to by the Philips curve. Vermeulen (2017) has validated the negative relationship between unemployment rates and inflation rates in SA. Based on the results, the recommendation was that South Africa ought to adopt a dual targeting for both inflation and unemployment rates. Similar sentiments were also raised by Maduku and Kaseeram (2018); this implies the validity of low unemployment, especially in SA. Similarly important, the interest rates channel influences growth by influencing high investment by firms, if it is at a low average level. Nyahokwe and Ncwadi (2013) indicated that interest rates have a positive effect on unemployment in the short-run. These findings were derived from vector autoregressive VAR and general autoregressive conditional heteroscedasticity (GARCH) models that were used in the study. Therefore, with regard to inflation and interest rates, the results indicate monetary policy conduct has an important influence on the South African economy.

Similarly important the exchange rates system may be fixed or flexible and it also signifies that the economy is open to interacting with other economies. At the same time, economic activities such as growth and unemployment may be affected by the exogenous factors transmitted by the exchange rates channel. For example, Nyahokwe and Ncwadi (2013) has indicated that high exchanges rates volatility leads to an increase in unemployment rates by 8%, while depreciation of the currency did not induce high unemployment rates between 2000 and 2010. The study relied on results interpreted from VAR and GARCH models. Usman and Elsalih (2018) have come to a similar conclusion, but the study used the NARDL model. Similarly important, Bakhshi and Ebrahimi (2016) indicated that there is a negative relationship between the appreciation of the currency and unemployment rates in Iran. Similar findings were also corroborated by (Kocaarslan et al., 2020; Nyahokwe and Ncwadi, 2013).

3. Methodology

The use of nonlinear models is becoming prevalent in economic modelling. The application of the NARDL to study economic growth and unemployment can be traced from the work of Mazorodze and Siddiq (2018), Mikajlovic and Fedajev (2021) and Phiri (2018). The rationale behind the application of the NARDL is that the response of a dependent variable is distinguished into two parts: firstly, the response to the direction of a shock (positive or negative) and lastly on the magnitude of a shock (big or small). Therefore, such a model is more applicable in this study, as it examines the response of unemployment on the contractionary and expansionary episodes in output. This will allow us to capture asymmetry in the effect of GDP on unemployment.

3.1. Data

This study adopts a quantitative research approach based on quarterly time series data sampled from the year 2000Q1 to 2021Q4. This sampling period was carefully selected in the bid to reflect the success of the contemporary monetary policy (inflation targeting) since it was adopted, at realizing the goal of the NDP of reducing unemployment to 6% by 2030. Table 1 depicts the variables included in the model. The selection of these variables, particularly the control variables, is underpinned by the theory between them

Table 1. Description of variables.

Variables and Presentation	Unit of measure	Source	Expected sign
Dependent variables			
Unemployment Rate (<i>Un</i>)	%	FRED	
Independent variables			
Output (<i>Y</i>)	Rands	Easy Data	Negative (Okun's Law)
Exchange rate (<i>Ex</i>)	Rand vs. USD	Easy Data	Negative
Consumer price index (<i>CPI</i>)	Rands	IMF	Negative (Philips curve)

Source: Authors Compilation.

and the dependent variable (unemployment rate). The data was collected from various sources that appear in the table, and the expected signs are negative for all the variables as proposed by the theory.

3.2. Theoretical model

Okun's Law forms a fundamental empirical formulation of the relationship between GDP and unemployment (Mazorodze & Siddiq, 2018). The notation of this theory is that there exists an indirect correlation between unemployment and output. The rationale for this relationship stems from the fact that when GDP drops due to downturns in economic activities, more people lose their jobs, and as a result unemployment increases. The opposite becomes the case when there is an expansion in economic activities. Okun (1962) proposed two specifications of Okun's Law, which are: differenced approach and the gap approach. In this study the gap approach is specified as it relates unemployment to the cyclical component of output (output gap), as shown in Equation (1):

$$U_t = \gamma_0 + \gamma_1(Y_t^A - Y_t^*) + \varepsilon_t \quad (1)$$

$t = 2000Q1 \dots \dots \dots 2021Q4$

In the above equation, t denotes time in quarters, γ_0 is the intercept and is the coefficient of the output gap or slope. The output gap ($Y_t^A - Y_t^*$) is made from actual output Y_t^A and expected output Y_t^* , since the cyclical component of output is not directly observable, therefore the filter proposed by Hodrick and Prescott (1997) will be applied to generate the output gap component. Consider the Equation (1a) that depicts the ingenious model:

$$U_t = \sum_j^p \delta_j U_t + \sum_i^q \theta_i Y_t + \varepsilon_t \quad (1a)$$

Where δ_j denotes the coefficient for dependent variable. The first step Silvapulle et al. (2004), was to form a distributed lags model out of the first equation, so that unemployment is explained by it lags and output. The second step was to decompose the output into positive and negative shock, as indicated in Equation (1b).

$$U_t = \sum_j^p \delta_j U_t + \sum_i^q (\alpha_i Y_t^+ + \beta_i \quad (1b)$$

The Equation (1b) is the reason that this study undertook the NARDL model because it is underpinned by the theoretical background. Therefore, the study adopts Silvapulle's et al. (2004) work concerning the assumption of non-linearity of the variables.

3.3. Empirical model

Okun's Law is specified in the NARDL setting following the specification by Shin et al. (2014) in Equation (3). Equation (2) presents the long-run equation of the conventional ARDL which assumes linearity among parameters. This study considers two additional explanatory variables, exchange rate and CPI, to incorporate other variables influencing unemployment in South Africa. CPI is backed by the Philips curve theory which posits an indirect propositional correlation between inflation and unemployment. Silvapulle et al. (2004) equally added that Okun's Law in an asymmetric form provides extension of the Philips curve; on the other hand, exchange rate volatility may have a profound influence on

unemployment in the case of South Africa, being an emerging economy that is subjected to external vulnerabilities.

$$Un_t = \alpha_0 + Y_t + EX_t + CPI_t + \varepsilon_t \quad (2)$$

Equation (2) represents the long-run equation of the conventional ARDL, and it was further developed to the NARDL of Shin et al. (2014) to consider nonlinearity in parameters as shown by Equation (3).

$$Un_t = \alpha_0 + \alpha_1 Y_t^+ + \alpha_2 Y_t^- + \alpha_3 EX_t^+ + \alpha_4 EX_t^- + \alpha_5 CPI_t^+ + \alpha_6 CPI_t^- + \varepsilon_t \quad (3)$$

Where (Un_t) is the unemployment rate as a dependent variable, Y_t , EX_t , CPI_t are output gaps generated by the Hodrick Prescott Filter, exchange rate and CPI respectively, as regressors. Unlike the conventional ARDL in Equation (1), where linearity is assumed in the parameters, in this model the variable of interest (Output) and other regressors are decomposed into their positive and negative partial sums, as shown by Equation (4). For this study, Okun's Law model will be estimated under the auspices of the NARDL. However, the conventional ARDL will be applied for robustness check, particularly in the long-term findings.

$$X_t^+ = \sum_{i=1}^t \Delta X_t^+ = \sum_{i=1}^t \text{MAX} (\Delta Y_t, \Delta EX_t, \Delta CPI_t), X_t^- = \sum_{i=1}^t \Delta X_t^- = \sum_{i=1}^t \text{MIN} (\Delta Y_t, \Delta EX_t, \Delta CPI_t) \quad (4)$$

Negative variations for each regressor are represented by (X_t^-) whereas the positive deviations for each respective regressor are captured by (X_t^+) . The cointegrating vector for the long-run parameters to be estimated, is represented by $(\alpha = \alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6)$ in Equation (3), and (ε_t) is the white noise error term. Equation (4) represents the short-run error correction model (ECM).

$$\begin{aligned} \Delta Un_t = & \alpha + \beta_0 Un_{t-1} + \beta_1 Y_{t-1}^+ + \beta_2 Y_{t-1}^- + \beta_3 EX_{t-1}^+ + \beta_4 EX_{t-1}^- + \beta_5 CPI_{t-1}^+ + \beta_6 CPI_{t-1}^- \\ & + \sum_{i=1}^p \gamma_i \Delta Un_{t-1} + \sum_{i=1}^q (\theta_i^+ \Delta Y_{t-1}^+ + \theta_i^- \Delta Y_{t-1}^- + \theta_i^+ \Delta EX_{t-1}^+ + \theta_i^- \Delta EX_{t-1}^- \\ & + \theta_i^+ \Delta CPI_{t-1}^+ + \theta_i^- \Delta CPI_{t-1}^-) + \varphi ECT_{t-1} + \mu_t \end{aligned} \quad (6)$$

The short-run lag orders are symbolized by p, q . The long-run coefficients $(\alpha_1 = -\beta_1 \div \beta_0, \alpha_2 = -\beta_2 \div \beta_0, \alpha_3 = -\beta_3 \div \beta_0, \alpha_4 = -\beta_4 \div \beta_0, \alpha_5 = -\beta_5 \div \beta_0, \alpha_6 = -\beta_6 \div \beta_0)$ will represent the long-run influences of both negative and positive shocks in the independent variables. On the other hand, the effect of both negative and positive shocks in the independent variables on unemployment, in the short-run will be captured by $\sum_{i=1}^q \theta_i^+$ (increase) and $\sum_{i=1}^q \theta_i^-$ (Decrease). Equation (6) is specified in such a way that it shows the asymmetric effect of independent variables shocks on unemployment for both the short-run as well as the long-run. The coefficient of the error correction is denoted by φ , it is expected to be negative and statistically significant. The null hypothesis for the long-run asymmetry using a Wald test is $\beta^+ = \beta^-$ to assess long-run asymmetry; the null hypothesis must be rejected in favour of the alternative stating $\beta^+ \neq \beta^-$. Likewise for the short-run asymmetry the alternative hypothesis of $\sum_{i=1}^q \theta_i^+ \neq \sum_{i=1}^q \theta_i^-$ must be accepted. Intuitively, the presence of asymmetry both in the long-run and the short-run implies that the effects of the negative and positive shocks are not identical on unemployment.

One of the benefits of applying the NARDL is that, alongside the above tests, we can also model the dynamic multipliers, to assess how the dependent variable (unemployment) adjusts to its long-run equilibrium, given the negative and positive deviations on each independent variable as shown by Equation (5).

$$X_k^+ = \sum_{j=0}^k \frac{\partial Un_{t+j}}{\partial X_{t-1}^+}, X_k^- = \sum_{j=0}^k \frac{\partial Un_{t+j}}{\partial X_{t-1}^-}, k = 0, 1, 2, 3, \dots, \infty \quad (7)$$

Note, as $k \rightarrow \infty$, $M_k^+ \rightarrow \alpha_1$ and $M_k^- \rightarrow \alpha_2$.

The procedure for the application of the NARDL requires that all the series be either integrated of order I (0) or I (1). There should be no order I (2). Therefore, the unit root test will be the first step in determining the order through which the underlying series are integrated. If stationarity is established

among the series, then the Augmented Dickey-Fuller cointegration test will be applied to establish if there is long-run cointegration. Basically, Cointegration will mean that there is a causal effect among the variables in the long-run. The long-run cointegration is tested using the Pesaran et al. (1999) bound test that may use F-stat to test for a joint hypothesis or a t-stat that is used to test a sing hypothesis. The F-stat hypothesis is as follows:

$$H_0^F : (\alpha = 0) \cap \left(\sum_{j=0}^q \beta_j = 0 \right) \quad (8)$$

$$H_a^F : (\alpha \neq 0) \cup \left(\sum_{j=0}^q \beta_j \neq 0 \right) \quad (9)$$

For t-stat, the null hypothesis and alternative hypothesis are denoted by $\alpha = 0$ and $\alpha \neq 0$ respectively. The critical values depend on the number of factors such as the number of independent variables, their integration order, the number of short-run coefficients and the inclusion of the intercept and trend. Reject the null hypothesis (H_0^F or H_0^t) if F-stat or t-stat is more extreme than the upper bound of critical values at 1%, 5%, and 10%.

4. Results and discussion

4.1. GDP and unemployment trends

Figure 1 shows the trends between the variables of interest (unemployment and economic growth) over the years.

Economic growth has been upward trending since the year 2001 to 2006, at the same time the unemployment rate was diminishing up until the year 2008. This means that unemployment was acting as a lagging indicator and had a negative relationship with economic growth. Since 2008, economic activities decreased drastically towards 2009 and 2020. This attributes the effect of the global financial crisis and lockdown respectively. In 2020, the trough is too deep since almost all firms were closed while spending was autonomous and most people were highly dependent on government provisions, such as grand reliefs. However, since the beginning of 2010 to 2019, the South African economy declined and in contrast, unemployment has been increasing. This is contrary to the expected reaction of unemployment to output growth explained by Okun's theory.

Table 2 indicates the result of the descriptive statistics. The table particularly contains the mean, standard deviation, kurtosis, and skewness.

The average value is 25% which is very high. It indicates that South African policies aimed at amplifying growth have never reduced unemployment; rather it has been more capital intensive. Furthermore, the Kurtosis of unemployment is above 3, which indicates that it has the highest peak among the variables, and hence shows the overall picture of high unemployment rates in SA. All selected variables show 88 observations which is enough for the time series model. Having explored the nature of the data, the

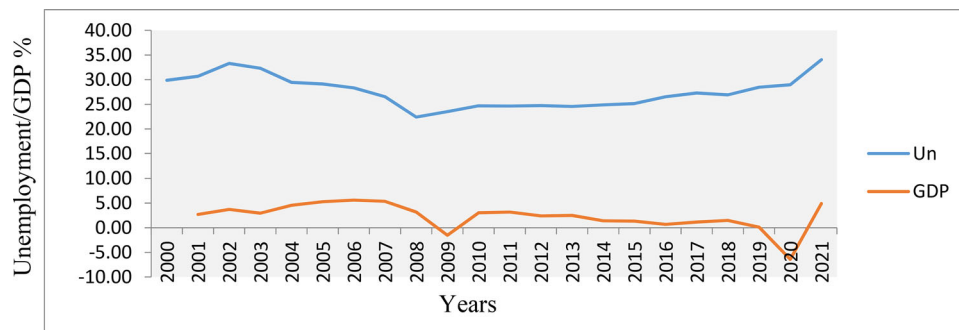


Figure 1. Unemployment and economic growth in SA.

Source: Compiled by the Authors using the data extracted from World Bank.

Table 2. Descriptive statistics.

	UN	GDP	EX	CPI
Mean	25.71338	750581.2	9.998402	108.0481
Std. Dev.	2.861302	358485.6	3.274841	35.06366
Skewness	1.319765	0.138095	0.582362	0.336010
Kurtosis	5.065655	1.653686	1.948039	1.789746
Jarque-Bera	41.19151	6.925760	9.031746	7.026528
Probability	0.000000	0.031339	0.010934	0.029799
Observations	88	88	88	88

Source: Estimation.

Table 3. Unit Root.

Series	Augmented Dickey-Fuller (ADF)			Philips Perron (PP)		
	I (0)	I (1)	Order	I (0)	I (1)	order
Un	0.567	−9.865***	I (1)	−2.097	13.015***	I (1)
Y	13.33***	—	I (0)	−14.459***	—	I (0)
Ex	−0.855	−7.074***	I (1)	−1.977	−6.992***	I (1)
CPI	2.458	−5.852***	I (1)	−1.129	−6.632***	I (1)

Note. *** imply 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors.

Source: Estimation.

Table 4. Cointegration-bound test.

Function: ($Un = f(Y^+, Y^-, EX^+, EX^-, CPI^+, CPI^-)$)	F Stat	Lower Bound	Upper Bound
	6.06	2.12*	3.23*
		2.45**	3.61**
		3.15***	4.43***

Note. *** implies 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors.

Source: Estimation.

study applied the unit root test to assess for stationarity among the series and the results are presented in [Table 3](#).

All variables were found to be non-stationary at levels except GDP growth, but they were rendered stationary after taking their first differences. This is indicative of the variability of the variables from 2000 to 2021 given the quarterly data used in the study. There is no variable which was stationary after the second difference I (2), in this regard; the long-run cointegration test can be performed followed by the appropriate model. This study relies on the bound test for cointegration, which accommodates the cases where variables have a mixed order of integration, or if they are integrated of order one. In this regard, the study will use the non-linear autoregressive distributed lags (NARDL) model. This model is flexible and has an advantage compared to the traditional ARDL model since it allows the researcher to analyse the effect of both negative and positive shocks of the explanatory variables on the dependent variables.

Since stationarity has been established, and order through which the series are integrated it meets the procedures of the cointegration test. The study carries on with the cointegration test, and the results are contained in [Table 4](#). The NARDL model allows for the variables to be a combination of I (1) and I (0). In the literature, many integration tests can be used to evaluate long-run relationships, and these include the fully modified OLS procedure of Phillips and Hansen (1990), Engle and Granger (1987) test, and maximum likelihood test by (Johansen and Juselius 1990). These methods however assume that all-time series variables are integrated of order one i.e. I (1) and are also not reliable in cases of small sample sizes. The bounds testing procedure proposed by Pesaran et al. (1999) is relevant because it accommodates the situation where variables are integrated into different orders. The results in [Table 4](#) reveal a long-run relationship among the variables when asymmetry is taken into consideration.

Since the F statistics (6.06) exceeds all the critical values of the lower and upper bounds (See [Table 4](#)), the null hypothesis of no long-run cointegration is rejected. When estimating the long-run, and short-run models we opted for an automatic lag selection which by default detects the maximum number of lags compatible with the employed data sets. Lag selection is one of the preconditions under the

Table 5. ARDL Long-run relation.

Variable [AIC: 4.3.4.2.0.0.4]	Coefficient	Std. Error	t-Statistic	Prob
GDP_POS	−1.541965	0.740517	−2.082282	0.0417
GDP_NEG	−1.829093	0.756940	−2.416430	0.0188
CPI_POS	−0.214835	0.098042	−2.191263	0.0324
CPI_NEG	5.052215	0.930601	5.428979	0.0000
EX_POS	0.989952	0.370604	2.671184	0.0098
EX_NEG	−0.400621	0.359100	−1.115626	0.2691
C	27.62614	1.019172	27.106467	0.0000
Long-run Asymmetry $\beta^+ = \beta^-$	F. Stat	Prob	Conclusion	
GDP	5.624987	0.0202	Long-run asymmetry	
EX	53.25471	0.0000	Long-run asymmetry	
CPI	39.67162	0.0000	Long-run asymmetry	

Source: Estimation.

ARDL Framework. The Square parentheses provide the Akaike information criteria (AIC) which by default provide the orders of appropriate lags. Now that the variables move in the same direction in the long-run, both long-run and short-run error correction models can be estimated. Table 5 presents the results of the long-run along with the long-run Wald test of asymmetry.

The constant term is +27.63 and it is statistically significant, which means if all other variables are held constant then the unemployment rate remain at 27%. This is close to the mean of 25 indicated in the descriptive statistic table (See Table 2). The variable of interest (GDP) takes the expected negative sign, which validates Okun's Law notation of an association between these variables. The results further indicate that more people lose their jobs in South Africa when an economy is in contraction, and fewer people are being hired when an economy is in expansion in the long-run. Intuitively, unemployment is more elastic to negative shocks in GDP than positive shocks, as 1.54 is greater than 1.82. The results of the Wald test provide genuine insights into the presence of asymmetry in the effect of output on unemployment, as the F stat is significant at 10%. These findings concur with that of Madito and Khumalo (2014), Pasara and Garidzirai (2020) and Stungwa and Tozamile (2021) in the same region. Previous studies like Mazorodze and Siddiq (2018) have argued that in the South African labour market, employers are faster to retrench when an economy is in recession and slower to absorb when an economy expands. Silvapulle et al. (2004) add that bad news is easier to spread than good news. Another example is the case where it takes a few hours to ruin a good reputation of a company, while it can take years to restore it. Therefore, during expansion, employers are reluctant to hire because they may assume that expansion will last only for a short-run. The recent example that supports the notations made by Mazorodze and Siddiq is that after the COVID-19 pandemic outbreaks in 2020 output decreased dismally and more people lost their jobs; as a result, unemployment increased. However, at the beginning of the year 2022, when more COVID-19 restrictions were done away with, economic activities were boosted; therefore, GDP increased by 4.9%, but unemployment continued to rise to 34% in the second quarter of the year 2022. Employers are reluctant to hire even when economic activities are conducive. On the other hand, Black et al. (2017) argue that in the production process, capital is preferred labour, because of strict labour laws, and this is the case in the South African mining industry.

Moving along to the negative and positive shocks in CPI, the results suggest that, in the long-run, positive shocks in CPI reduced unemployment by 0.214 for the period under investigation and is significant at 5%. These results accord with the notations of the Philips curve theory. Likewise, the negative shocks also reduce unemployment drastically by 5.052 in the long-run, and the effect of CPI on unemployment is also found to be asymmetric. This implies that it does not matter whether consumer prices increase or decrease; unemployment will continue to decrease. However, it decreases at a faster rate when there is deflation than inflation. The results were supported by most studies including Bakhshi and Ebrahimi (2016) and Vermeulen (2017) in SA. These results imply that the inflation targeting adopted by SA in 2000, is a mastering remedy to create an environment conducive to growth to reduce unemployment rates. This means that the monetary authorities are doing their best to reduce unemployment rates through monetary policy transmission mechanisms toward the NDP target. Table 6 presents the results of the robustness check. The conventional version of an ARDL was employed to assess the reliability of the long-run results.

Table 6. Robustness check results.

Variable [AIC: 6.4.0.6]	Coefficient	Standard error	t-stat	P-values
GDP-GAP	−1.105614	0.155023	−7.131923	0.0000
CPI	−0.178801	0.062865	−2.844229	0.0061
EX	1.507344	0.538087	2.801302	0.0068
C	11.779891	1.254511	9.390026	0.0000
@TREND	0.009665	0.004675	2.067134	0.0430
R-squared	0.9217			
Adjusted R-squared	0.8961			
F-stat	35.9333			
P-value	0.0000			
Durbin-Watson stat	2.14			

Source: Estimation Results.

Table 7. Short-run error correction model.

Variable	Coefficients
D(GDP_POS(-1))	1.1460
D(GDP_NEG(-1))	1.0920
D(CPI_POS(-1))	−0.0949 [0.1260] **
D(CPI_NEG(-1))	2.2308 [0.4372] ***
D(EX_POS(-1))	0.4903 [0.2695] *
CointEq (-1) *	−0.44 [0.0823] ***

Note. *** implies 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors.

Source: Estimation.

The robustness check results conformed with the long-run findings, which validated the existence of Okun's Law and Philips in the sampled period. The long-run bound test and diagnostic tests of the robustness check model are provided in [Appendix C](#).

Now turning to the negative and positive shocks in the exchange rate, the results show that the depreciation of the Rand increases unemployment by 0.98 and is significant at 1%; such findings are in line with Nyahokwe and Ncwadi (2013). This means in SA, the depreciation of the currency in the long-run, is accompanied by high unemployment rates. On the other hand, the appreciation of the Rand reduces unemployment by 0.40, however, the effect of the rand appreciation is insignificant. These results are directly in accordance with those of Usman and Elsalih (2018), who in their findings indicated that the unemployment rate reacts to depreciation rather than appreciation of the currency. This means that in SA as an open economy, the exchange rates play a significant role in accelerating the unemployment away from the target of 6% by 2030. The effect of the exchange rate is also found to be asymmetric.

The results in [Table 7](#) present the short-run error correction model, coefficients particularly for the variable of interest GDP, were written in such a way that lags coefficients were summed up for positive and negative shocks, respectively.

In line with Tenzin (2019), the results suggest that in the short-run, unemployment moves together with GDP, unemployment increases when GDP increases and decreases when it decreases. This disregards Okun's Law in the short-run. On the other hand, positive shocks in CPI result in a reduction in unemployment by 0.094 and is significant at 5%; this proves the evidence of the Philips curve in the short-run. The negative shocks in CPI reduce unemployment by 2.28 in the short-run, and the effect is statistically significant at 1%. This implies that in the short-run, it does not matter whether the price increases or decreases unemployment will still decrease. However, it decreases at a faster rate in response to negative shocks than positive shocks. Exchange rate depreciation in the short-run also increases unemployment by 0.49 and is significant at 10%. In the short-run, no evidence of asymmetry was detected. Ultimately, the ECM takes a negative sign as expected, and is significant at 1%; this implies that there exists a long-run relationship among the variables. The adjustment process is too slow as it takes more than two quarters for the disequilibrium of the previous quarter to be corrected ($\frac{1}{0.44} = 2.27$).

The results of the dynamic multiplier graphs presented in [Appendix A](#) are the same as the results of both the long-run and short-run. The graphs show that the response of a dependent variable

Table 8. Diagnostic tests.

Diagnostic Tests	F-statistic	P-value
Heteroskedasticity Test	2.479966	0.0511
Breusch-Godfrey Serial Correlation LM Test:	1.461127	0.2266
Ramsey RESET Test	1.645520	0.1760
Jarque-Bera	3.4998	0.1738

Source: Estimation.

(unemployment) in both negative and positive shocks in the dependent variables, is smaller in the short-run. However, as time goes by, the dependent variable becomes more elastic to both negative and positive shocks and becomes more asymmetric. Table 8 presents results from the post-estimation diagnostic checks which are necessary to ensure the reliability of the estimated results. The evidence indicates that the residuals from the estimated models are free from autocorrelation, heteroscedasticity, model misspecification and residual non-normality since the p-values are above the 5% significant level. Equally important is the CUSUM test for stability which is presented graphically in Appendix B. The CUSUM test is used to evaluate the systematic movement of the model's parameters within a 5% significance level. Both the CUSUM and CUSUM square line fluctuate within the 5% significance band (See Appendix B). This means that the estimated models do not suffer from instability in parameters.

5. Conclusion

Achieving low rates of unemployment has been a matter of concern in emerging economies like South Africa. High rates of unemployment are both socially and economically detrimental. Therefore, South Africa embarked on a plan to reduce unemployment to 6% by 2030. From a theoretical standpoint, it is noted that sustained economic growth will play a role in reducing unemployment. However, the result shows that the conditions of the South African labour market are not appealing for the reduction of unemployment. The results in the long-run postulate that employers are quicker to retrench when the economy is in recession, and they are slower to hire when the economy is in expansion. According to Black and Hassan (2016), this can be attributed to the fact that in the production process capital is preferred to labour, because of the strict labour laws which make employers reluctant to hire. The policy implication of this is that in developing countries like South Africa there are great uncertainties in the labour market. Artificial intelligence coming with the Fourth Industrial Revolution (4IR) will have a perfect destination in South Africa to replace more labour. Furthermore, the depreciation of the rand plays a vital role in accelerating the high rate of unemployment in South Africa. This implies that creating conditions that will ensure the competitiveness of the Rand in the foreign exchange markets, is highly recommendable at this point. Ultimately inflation targeting as a monetary policy plays a vital role in achieving the unemployment targets, as the results show that unemployment is reduced at a faster rate when prices are stable. Considering the above-mentioned results, economic growth is not sufficient to achieve the unemployment target of 6% by 2030. By contrast, creating a flexible labour market may go a long way towards achieving the NDP by 2030. The South African policymakers are advised to revise and reduce strict labour laws that make firms look at the labourers as the highest expense among factors of production and thereby replace them with capital in the long-run. Future research studies may investigate the effect of corruption on unemployment rates in South Africa.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Limitations and future research

Although there are various objectives prioritised by the NDP to be achieved by 2030, due to the scope of this project, this study was confined to economic growth and unemployment. In this regard, future research may explore if the current economic climate is drifting other NDP objectives such as inequality, poverty, and crime for example, towards their projected targets.

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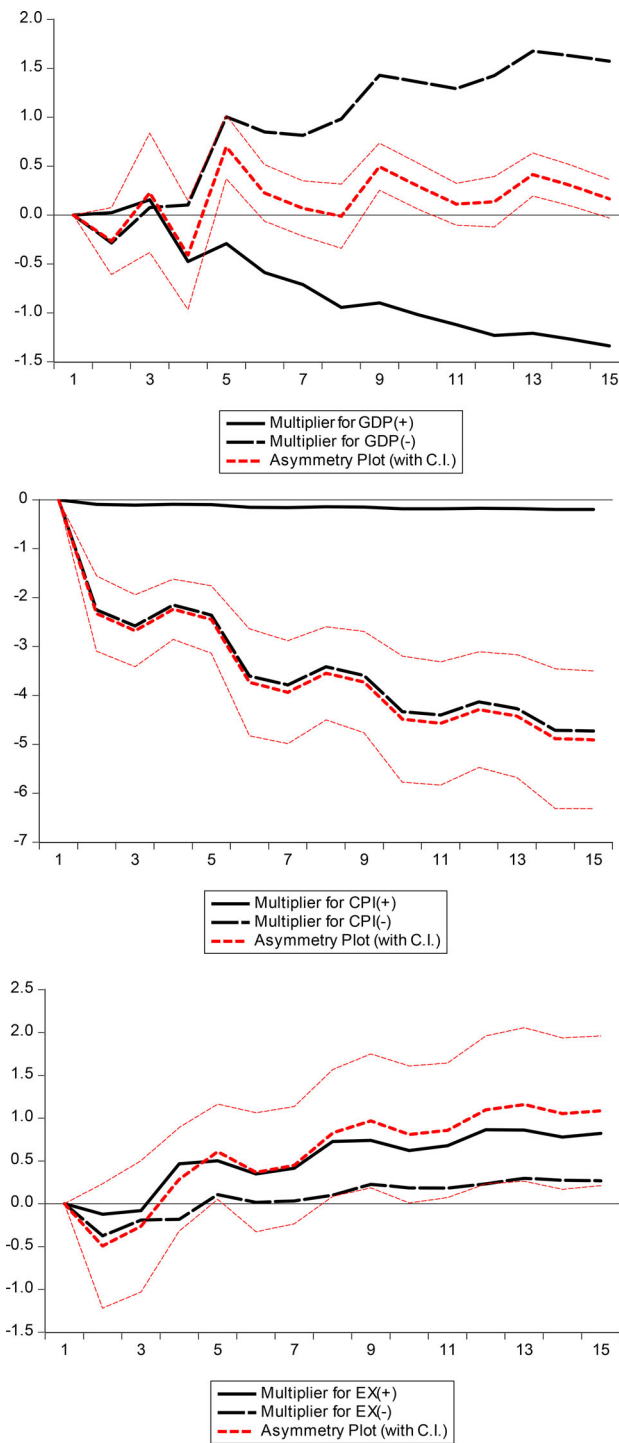
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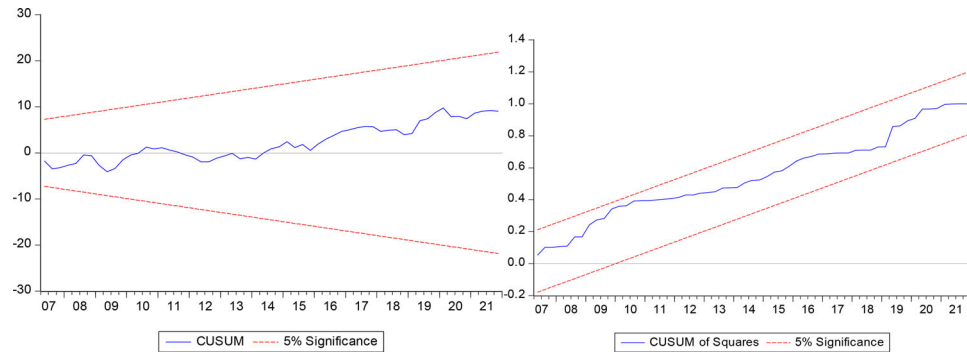
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Appendix A

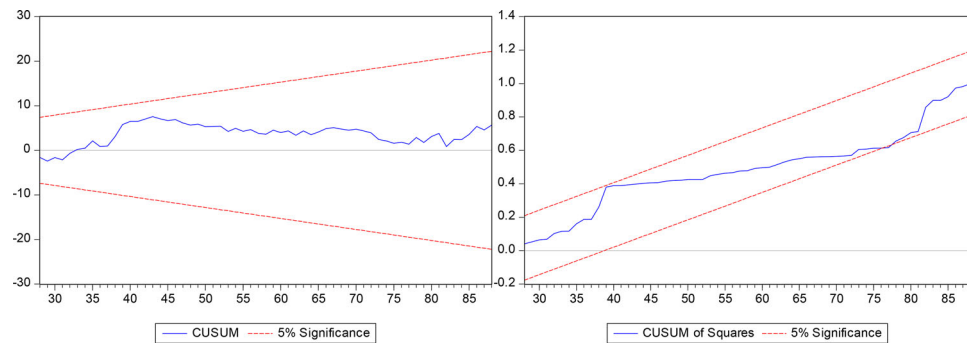


Appendix B



Appendix C

Function: ($Un = f(Un, CPI, EX, GDP_GAP)$)			
	F Stat	Lower Bound	Upper Bound
	4.5488	3.47*	4.45*
		4.01**	5.07**
		5.17***	6.36***
Diagnostic Tests	F-statistic		P-value
Heteroskedasticity Test	1.5638		0.0928
Breusch-Godfrey Serial Correlation LM Test:	0.9016		0.4114
Ramsey RESET Test	2.3441		0.1310
Jarque-Bera	0.012261		0.9938



$$Un_t = 0.30^{***} Un_{t-4} - 0.87^{***} GDP_{GAP_t} + 0.56^{***} GDP_{GAP_{t-3}} - 0.11^{***} CPI_t + 2.25^{**} EX - 3.05^{***} EX_{t-2} - 0.0062^* EX_t + 0.0059^{***} TREND - 0.615^{***} ECT_{t-1}$$