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Is there a Nexus between Inflation, Exchange Rate and Unemployment in South Africa: An Econometric Analysis?

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ABSTRACT

The nexus between exchange rate, unemployment and inflation is one of the most hotly debated issues because disagreements persist between economists on the relationship between these variables. This is because of different perspectives from different schools of thoughts. The monetarists view inflation as a monetary phenomenon, while the conflict approach view inflation as a symptom of fundamental disharmony in a society. Nonetheless, South Africa is still an emerging economy that is developing and grasping with high level of joblessness and small size of gross domestic product (GDP). This article examines the association amongst exchange rate, unemployment and inflation in South Africa. Cointegration techniques were used capture the association amongst the variables. The Engle-Granger test (causality) in- addition to the response function (impulse) were used correspondingly to estimate the causality result as well as the reaction of exogenous shocks amongst the variables. The results indicate that unemployment is negatively related to inflation, while there is a affirmative association amongst exchange rate plus inflation. This infers that the country is grasping with the difficulties of the trade-off between inflation and unemployment, which is problematic to deal with concurrently. A need for a policy mix to even out the curves for a smooth economy has become imperative.

INTRODUCTION

The connection amid inflation and unemployment was originally signposted in the Phillips curve. A New Zealand economist, A.W Phillips, after he studied about the connection concerning redundancy (unemployment) and the changes in incomes in the United Kingdom from 1861 to 1957 developed the Philips-Curve concept (Hyman 1992). The results from his scholarship showed a negative association between unemployment and changes in wages. Despite the fact there was a little theoretic context on the Phillips-Curve, it was viewed as a clear signal of the trade-off between unemployment and inflation (Mohr 2012). Data from the 1960s mirrored the trade-off between unemployment and inflation objectively well, and the theory seemed stable and probable. The Phillips curve presented plausible economic policy outcomes, nevertheless, when governments tried to use the Phillips curve to control unemploy-

ment and inflation, the connection did not pull through. Data from the 1970s and onwards did not follow the trend as predicted by the Phillips curve. For several years, the rate of inflation and joblessness were more than the Phillips curve would have anticipated, a phenomenon known as stagflation. In the end, the Phillips curve was attested to be unstable, and therefore, not practical for policy purposes.

The AS-AD model is one of the models that provide more clarifications on the analyses of unemployment and inflation because it incorporates the views of different schools of thoughts about macroeconomics. Many factors can cause inflation in the short run but it depends on how real GDP and the price level interact. The AS-AD model differentiate between two forms of inflation, precisely; demand-pull and cost-push inflation. Demand-Pull ensues when the summative (aggregate) demand (AD) for goods and services in the economy increases whereas summative supply (AS) remains unchanged. This can be as a result of the following factors; increase in the money supply, increase in government spending, increase in consumption spending by households, increase in export earnings and increase in investment spending (Mohr, 2012). Cost-push inflation occurs because of an increase the prices of factors of production. The main sources of cost-push inflation are; increases in wages and salaries, an increase in the price of imported capital and intermediate goods, natural disasters, decreased productivity in the economy and increases in profit margins by firms (Mohr, 2012). The AS - AD model can best analyse the inflation rate in South Africa because Stats SA measures the rate of inflation using both CPI and PPI.

The problem of inflation has been experienced in every country in the world but the rate of inflation differs from country to country. The most common thing about this phenomenon is that it brings unpredictable gains and losses to borrowers and lenders, workers and employers, and it also diverts resources from producing goods and services to predicting inflation (Parkin et al, 1997). Thus, inflation reduces the purchasing power of money. With the world economies growing rapidly, the exchange rate plays an important role for transactions between two or more different countries. South African producers or consumers who are willing to trade with foreign countries need to convert their Rands into the foreign currencies that they are willing to trade with. The most common question asked by trading parties is how much does it cost for one to buy another country's currency. This brings to the reason why the political leadership or monetary authorities of every country strive to protect the value of its currency. A stabilised exchange rate is very much good for a country for the reason that the vital role it performs on economic development and balance in the economy.

South Africa, being the leading nation-state in Africa as per economic development, as reflected in her infrastructure, financially advanced sector and somewhat sound fiscal stance, remarkably agonizes from one of the utmost joblessness rates worldwide. South Africa is presently experiencing both high level of unemployment and a sluggish economic growth rate. Statistics South Africa (Stats SA) indicates that the unemployment rate for 2019 first quarter was sitting at a rate of 27.6% (strict definition) and 38% (expanded definition). The youth unemployment rate was also reported at 34.2% for the youth between the age of 25 - 34 and 55.2% for youth between the ages of 15 - 24. The total number of discouraged job seekers also increased by 156 000 during the first quarter of 2019. The gross domestic product (GDP), which hovered below 1% in the previous years, was reported at a rate of -3.2% during the first quarter of 2019 (Stats SA, 2019). This lodged serious concerns from different stakeholders in the country. The rate of inflation in the country seems to be satisfactory even though the Rand (South African currency) is not doing well in the foreign exchange market. According to the South African Reserve Bank (SARB), inflation rate was reported at 4.4% (which is below the target of 6%) and 6.5% (which is above the target of 6%) for the Price Index of Consumer (CPI) and Price Index of Producer (PPI) respectively (SARB, 2019). On the other hand, the exchange rate between the US dollar and Rand and was trading at roughly around R13.00 per US dollar for the past five (5) years. These provide clear indication that the Given the strength of the U.S. dollar against other currencies, even in the industrialized countries, coupled with a significant differential in inflation rates, this suggests that the strength of the Rand with respect to these other currencies is a product of government intervention. It may be noteworthy that where the European and Japanese Central Banks have intervened, it has been to weaken the Euro and the Yen. In a world of slowing growth, a weaker currency has the advantage of making exports more competitive and improving economic growth, reducing unemployment. A strong currency would have the opposite effect. However, exports have not been optimum from South Africa thereby losing the advantage of making exports competitive

Furthermore, South African economy is currently not doing well when coming to the issue of achieving macroeconomic objectives. South Africa as a developing country has the pursuit to achieve sustained economic growth, reduction of the level of unemployment, equal distribution of income, stability on prices and stable balance of payments. Unemployment is a global problem that almost every country's government has to fight against (Mafiri, 2002). Statistics in South Africa show that joblessness amplified to 27.1% at end 2018 from about 26.5% at the end of 2016, while youth joblessness rate increased to 54.7% at the end of 2018 from 51% in 2016. This scenario continues to exacerbate South Africa's inequality, which is amongst the world's utmost. The GDP in South Africa further deteriorated 0.5% year-on-year in the fourth quarter of 2019, after expanding 0.1% in the previous period. This was the steepest economic debility since the fourth quarter of 2009. The effect of unparalleled power blackouts was reflected through segments of the economy, namely utilities (-3.6% vs -2.4% in Q3); manufacturing (-2.6% vs -1.5%); mining (-1% vs -0.7%); communication, transport and storage (-3.7% vs -1%) and construction (-4.6% vs -3.7%). In the meantime, agrarian activity rebounded (2.1% vs -7.4%). On a three-monthly basis, the economy shrank by an annualized 1.4% in the three months to December of 2019, ensuing an upwardly revised 0.8% shrinkage in the previous period and much shoddier than market expectations of a 0.1% decrease. The economy progressed by 0.2% in 2019, the smallest since the global financial watershed in 2009 and far less than 0.8% a year ago. South Africa's twelve-monthly core inflation, which omits prices of food, non-alcoholic beverages, petrol and energy, rose to 3.8% year-on-year in February of 2020, marginally down from 3.7% in January. Markets had expected the rate to remain stable at 3.7%. On a once-a-month basis, core inflation picked up to 1.2%, from 0.1% in the previous month. The twelve-monthly inflation rate in South Africa increased to 4.6% in February 2020 from 4.5% in January and above market anticipations of 4.5%. It was the uppermost inflation rate since November 2018, as cost of non-alcoholic beverages and food rose the most in over 2 years (4.2% vs 3.7% in January), of which fruit (6.6%) and fish (6.3%). Likewise, prices progressed further for miscellaneous goods and services (6.3% vs 5.7%); footwear and clothing (2.3% vs 2.2%) and health (5.5% vs 5%). Meantime, inflation was steady for housing & utilities (at 4.7%). In contrast, cost slowed for transport (6.2% vs 6.4%); tobacco and alcoholic beverages (4.9% vs 5.2%); household substances and services (2.4% vs 2.7%) and restaurants and hotels (1.8% vs 2.4%). On a periodic basis (monthly), consumer prices went up 1%, the utmost since February 2017, after rising 0.3% in January.

Using an evaluation of substitute inflation models, Fedderke and Liu (2018) investigated inflation in South Africa. Their fundamental assumptions was that the most vigorous covariate of inflation is unit labour cost. This point out a sturdy positive relationship between price increases (inflation) and nominal earnings. Their results also stated that improvements in real labour efficiency had only a somewhat weak negative association with inflation. Additionally, they also pointed out that supply-side shocks also had a steady relationship with inflation. This provide extra proof that the cost of production in South Africa is contributing more on the PPI, which was above the target during the first quarter of 2019. Nonetheless, Herman (2010) investigated inflation and unemployment in the Romanian economy. Using Phillips curve relation analogy, the results on the evolution of inflation and unemployment in Romania between 1990 and 2009 could not be noticed. However, the results of the statistical analysis showed that between unemployment and inflation, it could not detect a stable statistically substantial relationship. This is for the reason that the economic policies in use did not target directly, the reduction of inflation rate centred on the increase in joblessness. He further argued that it does not mean that there is no compromise between inflation and unemployment in the short-run. Throughout this period, Romania experienced a reduction in joblessness as well as in inflation. Herman posited that in order to maintain inflation as well as unemployment at a low level, the fundamental economic association between salaries and output must be respected. This implies that wage increases should be based on the growth on the productivity of labour.

Berentsen, Menzio and Wright (2011) developed a principle in which both goods-market and labour-market were modelled with the search and bargaining approach. Their study targeted defining the long-run relation between redundancy and monetary policy. Their results submits that joblessness is interconnected to both inflation and interest rates in the low-frequency data in an affirmative mode. Ezirim, Amuzie and Emenyonu (2012) nevertheless, used the VAR model to examine the long-run equilibrium association between exchange rates and inflation in Nigeria, with similar results. Kamin (1997) benchmarked the reaction of inflation to variations in exchange rate competitiveness in various regions of the

world. The results also provided that an empirical association exist between the rate of inflation and the level of real exchange rate. Furouka (2008) used VECM to study the connection between unemployment and inflation in the Philippines. The findings of the study pointed out that there is an existence of cointegration relationship but no causal association was observed between redundancy and inflation in the Philippines. Several economies have become more dependent on exports owing to sluggish domestic growth and a relatively, weaker exchange rate that would allow export goods to become more competitive (Kaiser and Wroughton, 2010). Owen (2005) equally concurs that currency weakness is viewed as a pursuant of a policy of export-led growth to many developing countries. Mussa and Rosen, (1978), Auer and Chaney, (2009) further posit that this tails the argument that a weaker home currency would lower the price of exports making them inexpensive when compared to competitors within the same market. According to Owen (2005), the economy that grows as a result of greater demand of exports encourages higher domestic production and this boost employment level in the domestic country. In-addition to earlier studies, Todaro and Smith (2009) contended that a weak rand may have negative significances on the economy. Their argument was premised on the datum that aggregate demand for domestically produced goods may well cause price inflation as a result of lower exports prices.

Although the South African economy has grown at a yearly average of about 2.5% per year since 1990, the unemployment rate has in fact considerably worsened. From 1990, the actual number of people employed has increased by more than 1.5% per year, just over half the growth of real GDP. These figures give the idea that low and stable inflation does play a part in supporting growth for the economy. At the same time, conversely, it does not suggest that this economic growth is transformed into satisfactory employment growth, raising yet more questions about the multifarious relationships between inflation, output and employment. Even though there is a massive literature that scrutinizes the causes of high unemployment rates from a microeconomic perception (see e.g., Bhorat, 2007; Banerjee, Galiani, Levinsohn, McLaren and Woolard, 2008), there are few studies on the subject from a macroeconomic observation. Exchange rate vacillations influence employment via the profitability of the sectors in export-oriented activities. This is so for the reason that exchange rate volatility modifies the production costs of firms, and consequently, causes improbability of future earnings. This is the reason why exchange rate irregularity is hypothetically expected to influence employment following the notion of “the option value of waiting” (Dixit, 1989). The connection between exchange rate, unemployment and inflation is one of the most hotly contested issues, because differences persist amongst economists on the relationship between these variables. This is because of diverse opinions from different schools of thoughts on these macroeconomic variables. For instance, the monetarists see inflation as a monetary sensation, while the conflict approach view inflation as a indication of a fundamental disagreement in society which results in a non-stop imbalance between the rate of growth in the real national income and the rate of growth of the effective claims on income (Mohr et al, 2008). It is apparent from literature that there are mixed results on the association between exchange rate, unemployment and inflation. Even though the majority of the studies were done from diverse economies, using different econometric techniques, it has become imperative to focus on the South African economy because of its contemporary dwindling and challenging economic outlook. Thus, this paper, poses a pertinent question; is there a nexus between inflation, exchange rate and unemployment? This paper investigates the relationship between exchange rate, unemployment and inflation in South Africa.

1. DATA AND METHODS

This article used three-monthly data series for the period 1994 to 2018. Unemployment date was obtained from Stats SA and the data for Rand/US dollar exchange rate as well as inflation (consumer prices) was gotten from online statistical query from the Reserve Bank in South Africa (SARB). In defining the association amongst the variables, we used the Vector Error Correction Model (VECM) and Johansen Cointegration techniques. To ensure robustness and parsimony, we paid utmost attention to the time series data set (1994 – 2018) because of the possibility of a white noise (where variables are not stationary). We applied the Augmented Dickey-Fuller (ADF) test, which is the most used unit root tests. In-addition, a concurrent test to determine the long-run association among variables under examination was done by using the Johansen co-integration test. This test is imperative as variables that fail to con-

gregate in the long run may be precarious to policy making. The purpose of this test is to decide if to use the Vector Error Correction (VEC) or Vector Autoregressive (VAR). The VAR would only be applicable if there are no Cointegrating relationships. To determine the exact relationship between the variables used in the analysis Pair-wise correlation Matrix was used. Stability tests were further performed to determine whether the model were correctly specified, in-addition to the impulse response function.

Table 1. Variable Descriptors

| S/N | Variable | Description |
|-----|----------|-----------------------|
| 1. | LIF | Log of Inflation Rate |
| 2. | LEX | Log of Exchange Rate |
| 3. | LUN | Log of Unemployment |

1.1 Model Specifications

The model analyzed involves three (3) variables with three-monthly time series data. The variables are inflation rate, exchange rate and unemployment rate. In the model, the outcome variable is Inflation, with unemployment and exchange rate been regarded as the predictor variables. The model equation is expressed as:

$$IF = f(EX, UN) \dots\dots\dots 1$$

$$IF_t = \beta_0 + \sigma_1 EX_t + \sigma_2 UN_t + \varepsilon_t \dots\dots\dots 2$$

Where:

- β_0 = Constant
- IF = Inflation rate
- EX = Exchange rate
- UN = Unemployment rate
- σ = Parameters of the model with all real numbers
- ε = Error term

1.2 Unit root tests

According to Khumalo and Mongale (2015), various tests can be utilized to examine if a particular series exhibits the incidence of unit root. In accordance with the model containing economic variables of a time series characteristics, we started the empirical examination by penetrating the statistical properties of the variables. The principle of examining these properties is to determine if the variables in the model are stationary, in order to avoid spurious regression which might lead to a high R² value and thus, misleading conclusions (Asteriou and Hall, 2011). The Augmented Dickey-Fuller (ADF) test was used for stationarity. The ideal rule says the data become stationary if the likelihood value is lower than 5% level of significance. When running the ADF test, the focus will be on the likelihood values, critical values and the t-statistics values. If the critical values are lesser than the values of the t-statistics at various levels of significance, the null hypothesis is not rejected. Meaning there is a unit root or the time series data is not stationary. However, if the critical values are greater than the t-statistics at different levels of significance, the null hypothesis is rejected. Meaning there is no unit root. If variables are stationary in a model, they will incline to have a steady variance and some elements of autocorrelation over time (Noula, 2012). This article tested each series for stationarity and used the unit root tests on the first differences to ensure I (1). The equation for ADF is given by:

$$\Delta Y_t = \alpha_0 + \beta_t + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \dots + \delta_{p-1} \Delta Y_{t-p+1} \dots\dots\dots 3$$

Where α is the constant, β is the coefficient on a time trend and P is the lag order of the autoregressive process. In order to select the optimal lag length for the model, the log-likelihood function must be maximised (Maggiara and Skerman, 2009).

1.3 Johansen cointegration test

We used the Johansen Cointegration technique in determining the long-run association among the variables. According to Gujaratti (2004), Johansen’s method takes a starting point from the VAR representation of the variables:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \dots\dots\dots 4$$

Where Y_t is an $n \times 1$ vector of variables that are integrated of order of one commonly denoted by $I(1)$ and ε_t is an $n \times 1$ vector of innovations. If the coefficient matrix Π has a reduced rank $r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'Y_t$ is stationary, whilst r is the number of cointegrating relationships. The Johansen cointegration approach depends on two different likelihood ratio tests of the reduced rank of the matrix; namely, the trace test and the maximum eigenvalue test. The Johansen cointegration approach depends on two different likelihood ratio tests of the reduced rank of the matrix; namely, the trace test and the maximum eigenvalue test. The Trace test is given by:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_{r+1}) \dots\dots\dots 5$$

The maximum eigenvalue test is given by:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad 6$$

Where:

T is the sample size, and $\hat{\lambda}_i$ is the i th largest canonical correlation.

β' , represent the matrix of cointegrating vectors

α , represent the speed of adjustment coefficients

r , represent the number of cointegrating relationships

Π , determines the extent to which the system is cointegrated and is called the impact.

1.4 The vector error correction model (VECM)

We chose the VECM in this study is to define the short-run relationship between the variables. This technique is only used if the variables from the Johansen cointegration test indicates cointegration. Model equations:

$$\Delta X_t = \beta_{x0} + \beta_{xx1} \Delta_{t-1} + \beta_{x11} \Delta P^1_{t-1} + \beta_{x21} \Delta P^2_{t-1} + v^x_t \dots\dots\dots 7$$

$$\Delta P^1_t = \beta_{10} + \beta_{1x1} \Delta_{t-1} + \beta_{111} \Delta P^1_{t-1} + \beta_{121} \Delta P^2_{t-1} + v^1_t \dots\dots\dots 8$$

$$\Delta P^2_t = \beta_{20} + \beta_{2x1} \Delta_{t-1} + \beta_{211} \Delta P^1_{t-1} + \beta_{221} \Delta P^2_{t-1} + v^2_t \dots\dots\dots 9$$

Where: ΔX_t represent the unemployment variable, ΔP^1_t represent the exchange rate variable and ΔP^2_t represent the inflation variable. β Represent the coefficients of the variables, $t-1$ represent the tests for unit root, while (v^x_t, v^1_t, v^2_t) represents the VECM error terms.

1.5 The Engle-Granger causality test

Granger causality is based on the principle that the yet to come cannot affect the past. If event A occurs after event B, then A cannot cause B. Granger (1969), used this context with economic time series to establish if one time series “causes” in the sense of precedes another. Nevertheless, simply because event A occurs before B does not mean that A causes B. Therefore, we used the Granger causality test to determine if there is causality between the variables, as well as which one actually causes or predicts the other. The framework states, that if the probability value is significant at 5%, then the null propositions will be rejected.

1.6 Diagnostic Test

Diagnostic tests are imperative for the robustness of results because it validates the estimates of the parameters in any estimated VECM. In this analysis, we used the Jarque-Bera test to determine whether residuals were normally distributed; and Breauch-Godfrey tests to determine the existence of serial correlation and heteroscedasticity. Brooks (2008) confirms the latter test as adequate for heteroscedasticity testing in a model. The test is valuable for the reason that it assumes that the regression model estimated is of the standard linear. The null hypothesis for the test is homoscedasticity, and if we fail to reject the null hypothesis, then we have homoscedasticity and if we reject the null hypothesis, then we have heteroscedasticity.

1.7 Stability Test

The paper employed Ramsey RESET and Cusum test for stability test. The purpose of these tests is to determine whether the equation were correctly specified.

1.8 The Impulse Response Function (IRF)

The IRF test traces out the responses of the current and future values of each of the variables to a one unit increase in the current value of one of the VAR errors. The IRF demonstrates the impact of an exogenous shock on the entire procedure over time.

2. RESULTS AND DISCUSSIONS

2.1 Unit root test

Results from this test (ADF) point out that the null proposition of a unit root process for the series exchange rate, unemployment and inflation cannot be disallowed for the reason that they display the existence of a unit root at the level form. Nevertheless, all the time series data seems to be stationary after been differenced once. Table 2 displays the results summary from the ADF test.

Table 2. Summary of unit root tests (ADF test)

| Variables | T Statistics | Critical Value (10%) | Critical Value (5%) | Critical Value (1%) | Probability Value |
|---------------------|--------------|----------------------|---------------------|---------------------|-------------------|
| EX: Constant | -1.329431 | -2.585861 | -2.897223 | -3.512290 | 0.6125 |
| Trend and intercept | -2.180759 | -3.159372 | -3.465548 | -4.073859 | 0.4935 |
| None | 1.230828 | -1.614204 | -1.944762 | -2.593121 | 0.9433 |
| DEX: Constant | -7.063483 | -2.585861* | -2.897223** | -3.512290*** | 0.0000 |
| Trend and intercept | -7.022774 | -3.159372* | -3.465548** | -4.073859*** | 0.0000 |
| None | -6.940371 | -1.614175* | -1.944811** | -2.593468*** | 0.0000 |
| IF: Constant | -2.169524 | -3.586866 | -3.899115 | -3.516676 | 0.3751 |
| Trend and intercept | -2.246702 | -3.761067 | -3.488459 | -4.080021 | 0.3436 |
| None | -1.184793 | -1.614050 | -1.945024 | -2.594946 | 0.2141 |
| DIF:Constant | -4.045333 | -2.586866* | -2.899115** | -3.516676*** | 0.0020 |
| Trend and intercept | -4.011243 | -3.161067* | -3.468459** | -4.080021** | 0.0122 |
| None | -4.057020 | -1.614050* | -1.945024** | -2.594946*** | 0.0001 |
| UN:Constant | -2.331394 | -2.585626 | -2.896779 | -3.511262 | 0.1647 |
| Trend and intercept | -2.375260 | -3.158974 | -3.464865 | -4.072415 | 0.3896 |
| None | 0.111922 | -1.614204 | -1.944762 | -2.593121 | 0.7154 |
| DUN:Constant | -9.422212 | -2.585861* | -2.897223** | -3.512290*** | 0.0000 |
| Trend and intercept | -9.387023 | -3.159372* | -3.465548** | -4.073859*** | 0.0000 |
| None | -9.457709 | -1.614175* | -1.944811** | -2.593468*** | 0.0000 |

* denotes the rejection of the null hypotheses at 10% level of significance

** denotes the rejection of the null hypotheses at 5% level of significance

*** denotes the rejection of the null hypotheses at 1% level of significance

Source: Own table with data from Eviews9.5 econometric Software



Figure 1: Corresponding Trends Graphs

Unemployment has persisted for a long while in the system whereas the GDP growth rate is fluctuating leading to weak productive capacity. On the other hand, Inflation and Exchange rate are also fluctuating putting the economy in a precarious state. The graph above indicates that Exchange rate and Unemployment are on the same negative trajectory as GDP plummets with huge variations in inflation.

2.2 Pair-wise Correlation

All our variables are positively correlated to the dependent variable DLIF as per the pair-wise correlation results. The observed correlation between the independent variables and dependent variable is in line with theoretical underpinnings in literature. The results in table 3 show that among the variables there is no multicollinearity problem. All variables are correlating with DLIF, and there is no specific variable, which is corresponding to all variables; this implies that there is less likelihood of the multicollinearity problem. In this regard, DLIF agrees with the proposed explanatory variables.

Table 3. Pair-wise Correlation Results

| Variables | LIF | LEX | LUN |
|-----------|--------|--------|--------|
| LIF | 1.0000 | 0.2536 | 0.1813 |
| LEX | 0.2536 | 1.0000 | 0.3854 |
| LUN | 0.1813 | 0.3854 | 1.0000 |

Source: Own table with data from Eviews9.5 econometric Software

2.3 Johansen cointegration test

In testing for cointegration amongst the variables, we used Trace test and the Maximum Eigenvalue test. Table 4 and 5 below shows the results from the Trace test and Maximum Eigenvalue correspondingly. These results imply that at 5% level of significance, there is one cointegrating equation. This suggests that the null hypothesis of no cointegration between the variables can be disallowed. This additionally

proves that there is a long-run equilibrium association between exchange rate, unemployment and in South Africa.

Table 4. Summary of the Trace test

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | Critical Value @5% | Prob. ** |
|---------------------------|-----------------|-----------------|--------------------|---------------|
| None * | 0.337946 | 47.16160 | 29.79707 | 0.0002 |
| At most 1 | 0.135584 | 13.75656 | 15.49471 | 0.0899 |
| At most 2 | 0.023844 | 1.954746 | 3.841466 | 0.1621 |

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations

Table 5. Summary of Maximum eigenvalue tests

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | Critical Value @5% | Prob. ** |
|---------------------------|-----------------|---------------------|--------------------|---------------|
| None * | 0.337946 | 33.40504 | 21.13162 | 0.0006 |
| At most 1 | 0.135584 | 11.80181 | 14.26460 | 0.1183 |
| At most 2 | 0.023844 | 1.954746 | 3.841466 | 0.1621 |

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations

Table 6. Normalised cointegrating equation

| Normalised cointegrating coefficient (Standard error in parentheses) | | |
|--|-----------|-----------|
| IF | EX | UN |
| 1.000000 | -0.199756 | 0.433688 |
| | (0.26370) | (0.19387) |

Source: Author's calculations

Inflation rate (IF) normalised to unity as endogenous variable of the regression. With the estimated cointegrated vector, the associated coefficients represent the long-run equilibrium relationship. The cointegrated vector is expressed as follows:

$$IF + EX + UN + = 0 \dots\dots\dots 10$$

$$\text{Thus: } IF - 0.199756EX + 0.433688UN = 0 \dots\dots\dots 11$$

$$IF = 0.199756EX - 0.433688UN \dots\dots\dots 12$$

Equation 12 indicates the existence of a long-run positive relationship between inflation and exchange rate. This implies that a 1% Rand depreciation against the US dollar will lead to 0.199% increase in the rate of inflation. In the same logic, a 1% decrease in inflation will appreciate the value of the Rand per US dollar by 0.199%. In line with economic theory, the positive relationship between inflation and exchange rate is associated with price inflation in the economy. These support the idea that a weak Rand will affect the economy in a negative way. Equation 10 further indicates a negative relationship between inflation and unemployment. This implies that a 1% increase in the unemployment rate decreases inflation rate by 0.43%. Inversely, an increase in inflation rate by 1% decreases the unemployment rate by 0.43%. This can be achieved by applying contractionary or expansionary monetary policy and fiscal policy.

2.4 VECM

Using the Vector Error Correction approach, the analysis of variables that were presumed endogenous were done, and these variables were stationary at the first differencing. With the presumption that our variables are endogenous, we further used the criterions (Akaike Information and Schwartz) to determine ideal lag options in our model. The VECM was conducted to examine both the long run and short-run dynamics of the series. The term error correction recounts to the fact that the last period deviation from the long run equilibrium influences the short run dynamics of the dependent variable. VECM estimates both short term and long run effects of explanatory time series. It rectifies long run imbalance through short run modifications, pushing the system to short run equilibrium. The paper establish VECM considering one cointegrating vector derived from the Johansen cointegration test, with lags interval of 1 to 2. Table 7 present summary of the VECM estimates.

Table 7. Summary of VECM estimates

| <i>Variables</i> | <i>Coefficients</i> | <i>Standard error</i> | <i>t-statistics</i> |
|---------------------------|---------------------|-----------------------|---------------------|
| D (IF) | 0.6298 | 0.0873 | 7.2104 |
| D(EX) | 0.1426 | 0.2045 | 0.6974 |
| D(UN) | 0.1263 | 0.0889 | 1.4202 |
| CointEq1 | -0.2931 | 0.0520 | -5.6300 |
| Constant | -0.0974 | 0.1088 | -0.8953 |
| ECM | 0.3523 | 0.0643 | -5.3875* |
| R-squared = 0.58 | | | |
| Adjusted R-squared = 0.54 | | | |

Source: Author's calculations

Our error term of the cointegrating equation one is negative (-0.2931) and significant. The implication is that the estimated coefficient of -0.29 indicates that about 29% of this disequilibrium is corrected between one quarter. The coefficient of correlation (R^2 of about 58%) of the series suggest that the VECM considerably translate the short-term adjustments in all the three variables and explains changes in all series as per short run changes. The error correction term, point to a significant modification to long-run shocks, which influences natural equilibrium by price increases rate, unemployment and exchange rate. The speediness of adjustment (ECT) that test the long-run equilibrium was positive and statistically significant in the VECM model. ECT evaluates the proportion of coming together to the long-run equilibrium state. We constructed the ECT index by using the residuals as variables in the VECM estimation. Negative value supposes that the models returns to a long run equilibrium state, whereas positive means a sustained deviation from it in the case of a shift. The coefficient of ECT in our model is 0.352. The noteworthy co-efficient affirmative sign specifies that the economic variables have a momentous relationship, as the departure in one path would not be good for Inflation in South Africa. The contemporary economic outlook in S. Africa indicates that the inflation rate is a consequence of the disparities in exchange rate and unemployment.

2.5 The Engle-Granger causality test

The results for Engle-Granger causality test are presented in table 4-6. They indicate that exchange rate does Granger cause inflation but inflation does not Granger cause exchange rate. They further indicate that unemployment and inflation has a causal effect on each other. The results further indicate that there is no causality effect between unemployment and exchange rate.

Table 8. Summary of the Engle-Granger causality test

| Pairwise Granger Causality Tests | | | |
|----------------------------------|-----|-------------|--------|
| Sample: 1994Q1 2018Q4 | | | |
| Lags: 2 | | | |
| Null Hypothesis: | Obs | F-Statistic | Prob. |
| EX does not Granger Cause IF | 80 | 2.54324 | 0.0470 |
| IF does not Granger Cause EX | | 0.36006 | 0.8362 |
| UN does not Granger Cause IF | 80 | 3.66954 | 0.0090 |
| IF does not Granger Cause UN | | 3.35607 | 0.0142 |
| UN does not Granger Cause EX | 80 | 0.43094 | 0.7858 |
| EX does not Granger Cause UN | | 1.57242 | 0.1911 |

Source: Author's calculations

Table 9. Summary of Diagnostic tests

| TEST | Ho | P-VALUE | CONCLUSION |
|-----------------------|------------------------------------|----------|-----------------------------------|
| Jarque-Bera | Residuals are normally distributed | 0.027320 | Accept Ho since PV is < 5% |
| Breusch-Godfrey | No serial Correlation | 0.032527 | Do not reject Ho since PV is < 5% |
| Breusch-Pegan-Godfrey | No Heteroscedasticity | 0.047483 | Do not reject Ho since PV is < 5% |
| Ramsey RESET | The model is correctly specified | 0.144364 | Do not reject Ho since PV is > 5% |

NB: PV = Probability Value; Source: *Author's calculations*

The probing (Diagnostics) test in table 9 shows that residuals are routinely distributed. This is shown by the likelihood value of 0.0273, which is less than 5% level of significance. Gujarati (2004), posits that the ordinary least square is still Best Linear Unbiased Estimator (BLUE) and efficient even if the residuals are not typically distributed. This postulation is based on the concept that as long as the model is in accordance with other assumptions, it is BLUE and efficient to be used in the article. In-addition, the results from Breusch-Godfrey and Breusch Pegan-Godfrey tests show that there is no serial correlation and heteroscedasticity in the model respectively, while the Ramsey RESET test for stability also supports that the model is parsimonious and correctly specified.

2.6 Stability Test

The CUSUM test on figure 2 illustrates that our model is stable to a reasonable extent, as the cumulative sum moves inside the critical lines. This effort between the lines of significance at 5% is hence a sign of stability.

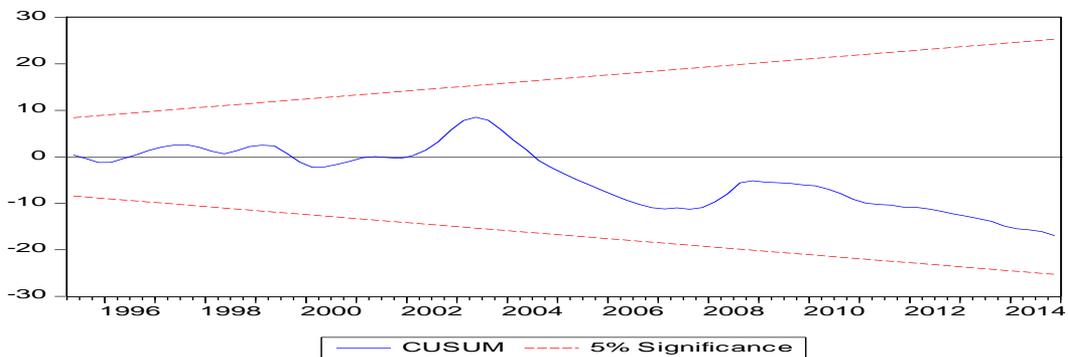
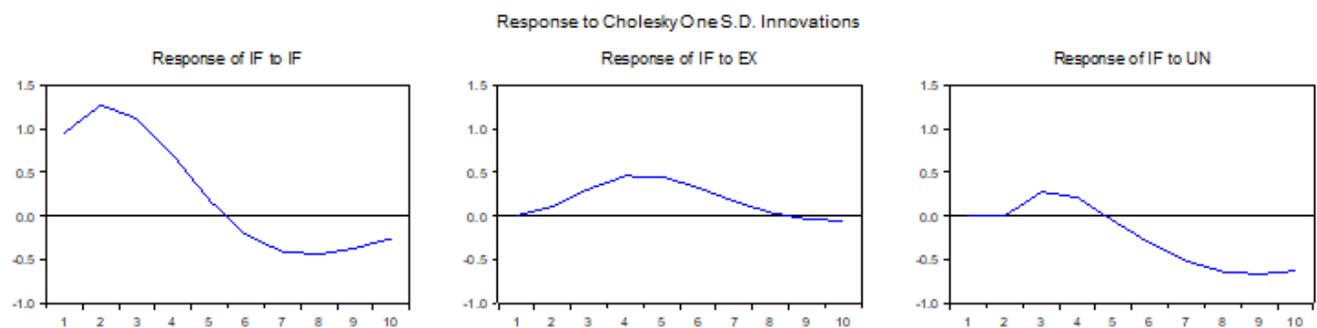


Figure 2. The CUSUM test

Source: *Author's calculations*

3.7 The impulse response function

Impulse response function shows how one variable responds over time to a single innovation in itself or another variable. Figure 3 present the results for the impulse response function.



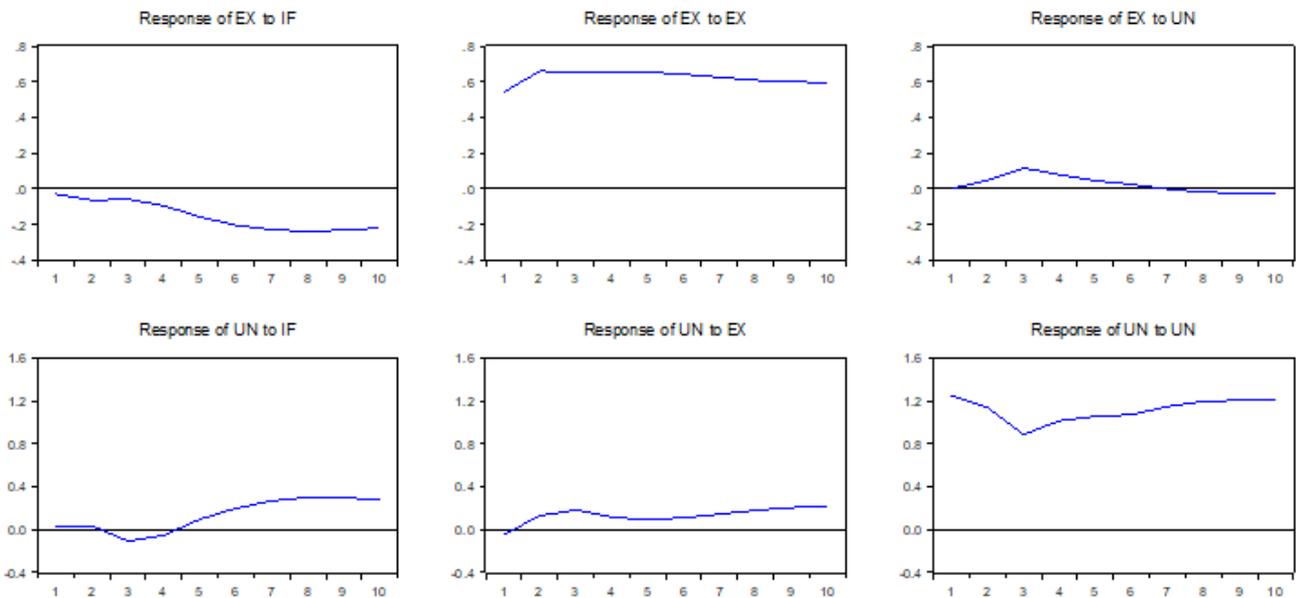


Figure 3. The Impulse Response Estimates

Source: Author's calculations

The response of inflation-to-inflation start positively from period one to period five. After period five, the response becomes negative until the end period. Inflation respond positively to a shock on the exchange rate from period two until period eight, then hovers a bit negatively around zero until the end period. The response of inflation to unemployment is positive from period two to period five, and then becomes negative up until the end period. The reaction of exchange rate to inflation is undesirable from period one until the end period. This indicates that a rise in inflation will depreciate the worth of the Rand in the foreign exchange market. On the other hand, the reaction of exchange rate-to-exchange rate is positive from period one to the end period. However, the response of exchange rate to a shock on unemployment start a bit positively from period two to period six, then sit a bit negatively below zero until the end period. The reaction of unemployment to inflation start negatively between period two and three until period four, and then becomes positive from period five until the end period. Unemployment reacts positively to exchange rate from period one until the end period. The outcomes also signpost a positive response on unemployment to unemployment from period one up until the end period.

SUMMARY

When policies (monetary or fiscal) are included to decrease joblessness level below the natural rate, the resultant upsurge in demand will boost producers to increase prices even faster. As inflation accelerates, workers may provide services in the short term for the reason of increased earnings, ensuing a lowering in the redundancy rate. However, over the long-term, once workers are aware of the decline in their purchasing power because of an inflationary situation, their predisposition to supply labour is decreased and the unemployment (joblessness) rate upsurges to the natural rate. Nonetheless, the normal rate of unemployment is not a stationary value but fluctuates over time because of the effect of a number of factors, which comprises impact of technology, variations in minimum wages, and the status of unionization amongst others. Likewise, income inflation and price inflation will continue to grow. Therefore, over the long-term, higher inflation would not benefit the economy through a reduced rate of redundancy. For the same reason, a reduced rate of inflation must not impose a burden on the economy through an increased proportion of joblessness. As inflation has no influence on the joblessness level in the long term, the long-run Phillips curve shifts into a straight up line at the normal rate of joblessness.

The definitive intention of this article is to define the connection between exchange rate, unemployment and inflation in the South African context. Our analysis was bordered by the long-running argument about the effectiveness of inflation pursuance within the framework of economic growth and reduction of joblessness in an economy. The main results of this article is that inflation is negatively linked to joblessness, whereas positively connected to exchange rate. This infers that policy makers in South Africa are facing challenges of a quid pro quo between inflation and joblessness. The findings of the association between inflation and unemployment (joblessness) are in tandem with the framework of the Phillips curve. The affirmative connection between inflation and exchange rate

indicates that a not too strong rand in the foreign exchange market intensifies the speed of inflation in the home country. Thus, South Africa is dependent on imported capital and intermediates goods, and a weak rand will have a negative effect on the domestic industries because of the imported products they depend on, subsequently increasing the producer price index. This scenario portends a main challenge economic growth rate with the resultant increase in joblessness. From an economic point of view, a nation that faces low level of output and high level of unemployment should apply expansionary monetary/fiscal policy. However, the macro fundamentals indicate that the most common type of unemployment experienced in South Africa is structural (where, there is a mismatch of qualifications or unskilled labour). This feature is not reactive to either monetary conditions or domestic absorption, which complicates policy framework further. While the unemployment problem is a weighty issue in South Africa, it will be inappropriate to tackle it by continuously allowing inflation to increase. Wide-ranging macroeconomic policies, including an institutional commitment to price stability, in addition to targeted interventions in the labour market is needed to address the unemployment problem. Following from above, we recommend that the government:

- Provide qualitative education and training which is receptive to the current economic conditions to support the reduction of structural unemployment. In-addition job projections, which should if possible, match the expertise available in the labour market, needs to be created faster than the rate at which the labour force grows.
- Encourage free enterprise and innovation as way of creating new products and market request, which will generate new work prospects. Further, to reduce the high tax burden that small businesses encounter as they try to contribute to employment creation.
- Provide a counter-factual mechanism for monitoring government-training programs to structurally unemployed citizens. This will qualitatively progress skills/human capital to provide flexibility in the workplace
- Avoid policy contradictions between monetary and fiscal policies. The South African Central Bank could deliberately at opportune times weaken the Rand to boost competitive exports that could grow the economy in the medium term.

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