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# Aggregated Imports and Economic Growth Nexus of South Africa: A Causal Regression Analysis

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***Abstract:*** **This study examined the causal relationship between Aggregated Imports and Economic Growth of South Africa for the period 1979 to 2014. In this study we use the Granger Causality to estimate the regression equation. The first step is to make the data stationary to avoid spurious regression. Based on the stationarity test results, cointegration tests were conducted to test for the existence of long-run relationship between Aggregated Imports and Economic Growth. The Error Correction Model (ECM) was employed to establish the short-run dynamics and speed of adjustment to the long-run. The estimation results for both the short-run and long-run models revealed that Aggregated Imports have a significant influence on Economic Growth. This was revealed through a uni-directional causality, with Economic Growth granger causing Aggregated Imports for both in the short-run and long-run periods. In the joint period analysis, there was evidence of a bi-directional causality with the two variables influencing each other.**

***Keywords:*** **Economic growth, Aggregated Imports, Error Correction, Granger Causality, Cointegration.**

## 1. INTRODUCTION

The debate on the causal relationship between Aggregated Imports and Economic Growth world over remain a moot point. Some studies which were carried out gave results which differed according to country specific. Some studies found that there is no causal relationship between the variables, with others finding causality running from uni-directional to bi-directional. Frankel and Romer (2001) asserts that imports benefit growth in three ways, through importation of consumer goods, intermediate goods and capital goods. On the other hand, Chen (2009) argues that imports impact negatively on growth, hence need to be bottled up.

### BACKGROUND OF THE STUDY:

South Africa is experiencing increases in imports, as a result of the growing of informal sector, with the bulk of players being cross-border traders. Domestic firms which have been smothered by the imports responded by closing down operations due to supressed demand. The situation contagiously spread to other sectors of the economy through the interdependence cobweb system, thereby magnifying the unemployment rate.

### PROBLEM STATEMENT:

The growing of the informal sector in South Africa, with the bulk of players in the market being cross-border traders, has resulted in increased imports. The implication of this from development economics is that, the demand for goods and services from domestic firms would have shifted to foreign products, resulting in domestic firms shutting down operations due to suppressed demand. The government of South Africa is inundated with requests from owners of the affected firms for protection, through introduction of restrictive policies on the importation of goods and services which can be ideally be produced from within. Chen (2009) argues that, imports impact negatively on growth hence needs to be bottled up. On the other hand, Frankel and Romer (2001) asserts that, in fact imports benefit growth in three ways, that is, through the

importation of consumer goods, importation of intermediate goods and the importation of capital goods, hence should be encouraged. Given that imports-growth relationship varies with countries, and that there is little evidence to suggest that a study of this nature was done for South Africa, it is in the interest of this study, to find out how imports are related to economic growth, in the short-run, long-run and joint periods for South Africa, so that informed policies are determined.

**RESEARCH OBJECTIVES AND HYPOTHESIS:**

The objective of this study is to determine the causal relationship between Aggregated Imports and Economic Growth, in the short-run, long-run and joint period for South Africa. It also seeks to make recommendations that would assist policy makers to come up with informed trade policies that improves economic growth. The hypothesis that pinned this study is that, by rejecting the null hypothesis in the short-run, long-run and joint periods, suggests the alternative hypothesis would have been accepted, meaning a causality is running either from uni-directional to bi-directional. On the other hand, rejecting the alternative hypothesis suggests that there is no causality between Aggregated Imports and Economic Growth.

## 2. LITERATURE REVIEW

An extensive empirical literature exists on the relationship between exports and growth, largely because of its bi-directionality nature. In fact, much of the empirical literature on trade and productivity defines trade as exports rather than imports. Therefore, relative to the empirical literature on exports and economic growth, the number of empirical studies on the relationship between imports and economic growth is quite limited. A large body of trade and development literature generally considers exports as a vehicle to accelerate economic growth. However, very little attention is paid on the role of imports in promoting growth (Lawrence and Weinstein, 1999, Kim, 2007).

Although most of the empirical works support the export-led-economic growth hypothesis, there is no overall consensus on this issue. Some economists (Krueger, 1980; Balassa, 1987; 1987; Chow, 1987, Salvatore and Hatcher, 1991) seem to generally agree that exports benefit economic growth, with (Kwan and Cotsomitis, 1990; Dodaro, 1993; Oxley, 1993; Yaghmaian, 1994) as cited by Ahmad (2002), finding no support to the export-led-economic growth hypothesis. Reizman (1996), gave emphasis on the significance of imports in the export-economic growth relationship. Utilizing a multivariate framework to incorporate the role of imports, he found evidence of uni-directional causality from exports to economic growth-conditional on imports growth in only 30 countries out of 126 countries analyzed. This outcome contrasts sharply with some studies that ignore the role of imports in influencing economic growth.

Islam (2012), using the autoregressive distributed Lag (ARDL) model with the Granger Causality test, examined the imports-growth nexus in 62 countries and found that the direction of causality depends on the level of income. Their study revealed evidence in high-income countries like South Africa thereby supporting the imports-led growth hypothesis, while low income countries showed bi-directionality.

Evans (2013), using a multivariate VAR framework for the 1973 -2005 period in four Sub Saharan African countries, he found practical evidence for imports-led growth in South Africa, Kenya and Nigeria while there was no evidence of association between the two variables in Ghana. On the other hand, Coe and Helpman (1993) as cited in (Evans, 2013) studied the contribution of imported intermediate goods to economic growth. They conducted a study on productivity of foreign research and development on a pooled data set of 22 countries during the period 1970-1990. In their model, the measure of foreign research and development capital stock was imports share-weighted average of trade partners' domestic research and development. This suggests that technology is gained by buying intermediate goods. The result indicated that foreign Research and Design, as measured by imports flow, for developing countries has influential effect on domestic productivity and it is much stronger if the economy is more open to foreign trade. However, unlike developing countries, for a developed country, the domestic research and development is stronger than foreign research and development, their study confirmed.

Coe (1997) studied the effect of foreign research and development on productivity based on data for 77 developing countries over the period 1971-90. The results revealed that imports of machinery and equipment from industrialised first world countries positively and significantly affect total factor productivity in developing countries and a 1 % increase in the research and development embodied in capital stock in the industrial countries leads to an average of 0.1 % increase in output in the developing countries. According to their research findings, United States is the most important industrial country which is a trade partner for many developing countries and therefore the largest spill over to the third world.

Also, Keller (2004) carried out a study that revealed results similar to that of Coe (1997). He conducted a study on productivity of imports of intermediate goods that embody new technology using industry level data for eight OECD countries during the period 1970-1991. The results showed that productivity of foreign research and development as measured by imports of intermediate goods is less for developed countries. Lopez and Thomas (1990) as cited in (Sewasew Pawlos 2002), estimated imports model for the seven Sub-Saharan African countries with slight modification from that of using Ordinary least squares estimation procedure for the period 1966-86. The major difference of their model from one that was done by Moran (1989), is that they used export-debt ratio as an indicator for imports capacity, absorption as a percentage of GDP as another very influential demand variable, in addition to the real GDP and real effective exchange rate, instead of the relative price. In this study, it was shown that real income elasticity of imports has the expected sign and is statistically significant except for two countries.

However, Habibullah (2007), had a different approach where he tested for financial-led, export-led and imports-led growth hypotheses on four Asian emerging economies, Singapore, South Korea, Taiwan and Thailand. They employed a vector error correction model (VECM) to distinguish between short-run and long-run causal effects in examining the three led growth determinants. The empirical results suggest that financial deepening leads to economic growth in South Korea, Singapore and Thailand. In terms of exports, their findings demonstrate that export-led growth hypothesis is supported for all four Asian economies namely, Singapore, South Korea, Taiwan and Thailand.

Saungweme (2013) on the other hand gave a brief account of Zimbabwe's trade dynamics for the 1980-2012 periods. He revealed that the economy moved from being close to self-sufficiency in the 1990s to a totally imports dependent by 2008. This showed that there was a total economic transition from being export-oriented to imports-oriented economy according to the report. This gives a suggestion that imports have been expanding over the years given the economic growth that has been achieved so far. Amiri and Gerdtham (2008) studied the relationship among imports, exports and economic growth of France from 1961 to 2006.

The variables used are real GDP, imports and exports. The existence of cointegration between variables has been tested by using autoregressive distributed lag (ARDL) technique. Empirical, results imply that cointegration exists between variables. Linear Granger's causality test and causality test with geo-statistical methods have been employed to find the causality direction between variables. Both tests showed uni-directional causality from imports to economic growth and from exports to economic growth.

Lim and Park (2007), using quarterly data from 1980 to 2003, investigate the relationship between exports, imports, and economic Growth in Republic of Korea. Results indicate that imports have a significant positive effect on productivity growth but exports do not. Furthermore, the evidence reveals that the productivity-enhancing impact of imports is due to competitive pressures arising from consumer goods imports and technological transfers embodied in capital goods imports from developed countries. Most of the study's results still hold using gross domestic product growth rather than productivity growth as the measure of economic growth. The evidence implies that in certain conditions, imports liberalisation can make a positive and significant contribution to economic growth and development.

To reach almost similar conclusions although a bit different to the above findings, Tong (1995) as cited in (Chen, 2009) explored the relationship between economic growth and imports, and he recognized that imports at different times contributed to economy differently, but as a whole, there was a positive correlation between imports and economic growth. Humpage (2000) on the other hand, stressed that imports do not lower economic growth. He believed that imports and economic growth are positively correlated, with causality running in both directions. He went on to say that, faster economic growth does lead to higher imports and countries that are opened to trade tend to grow faster than those with a closed economy or less accessible.

The finding of these studies, clearly exhibits a mixed and inconclusive facts as to how imports are related to economic growth. Also, the findings failed to capture the heterogeneity as well as spatial effects between the countries which could result in potential bias in the estimates. It can be understood from the given background that economic policy makers face the difficult question of how best to promote rapid, sustainable economic growth in the face of depleted stocks of irreproducible natural resources.

Rather, improvements in technology are the best chance we have to overcome the apparent limits to growth. If greater output requires greater tangible inputs, then it seems more than likely that the fixity in the supplies of several of the earth's resources eventually will mean an end to rising per capita incomes. But if mankind continues to discover ways to produce more output or better output, while conserving on those inputs that cannot be accumulated or regenerated, then there seems no reason why living standards cannot continue to rise for many centuries to come.

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## 3. MATERIALS AND METHOD

This section explores the econometric methodology applied in the study to establish the causal relationship between aggregated imports and economic growth for South Africa. The study employs secondary annual time series data to determine the existence of relationship between Aggregated Imports and Economic Growth for South Africa from 1979 to 2014. In this study, we use the Granger Causality Test to estimate the equation. The estimation procedure was such that, unit root test is first undertaken to determine the order of integration of the variables and was done using the ADF and PP tests. The results show that there is no unit root across the South Africa's data.

Given the significant confirmation for unit root, this research proceeded to test Economic Growth (GDP) and Aggregated Imports (IMP) for cointegration, in order to determine if there is a long-run relationship between the two macro-economic variables. The cointegration test significantly rejected the null hypothesis of no cointegration. The results lead to the conclusion that Aggregated Imports and Economic Growth move together in the long-run, indicating that there is a long-run steady state relationship between the variables for South Africa. Lastly for the determination of short-run dynamics and speed of adjustment to the long-run, the Error Correction Model, applied to Granger Causality Test was considered. Normality Test using the Jacque Bera normality Test and Correlation Test using Correlation Matrix were carried out.

The theoretical basis of the model is a linear relationship between Economic Growth as the dependent variable and Aggregated Imports and the lagged term of Economic Growth as the explanatory variables. Also, Aggregated Imports as the dependent variable and Economic Growth and the lagged term of the Aggregated Imports as the explanatory variable. The relationship between Economic Growth and Aggregated Imports for South Africa can be specified as,

$$\Delta IMP_t = \alpha_{10} + \sum_{i=1}^{q_{11}} \alpha_{11i}\, \Delta IMP_{t-i} + \sum_{j=1}^{q_{12}} \alpha_{12j}\, \Delta GDP_{t-j} + \alpha_{13}\varepsilon_{t-1} + u_{1t}$$

$$\Delta GDP_t = \alpha_{20} + \sum_{i=1}^{q_{21}} \alpha_{21i}\, \Delta GDP_{t-i} + \sum_{j=1}^{q_{22}} \alpha_{22j}\, \Delta IMP_{t-j} + \alpha_{23}\varepsilon_{t-1} + u_{2t} \quad \text{.....01}$$

The *IMP* and *GDP* refer to the Aggregated Imports and real Gross Domestic Product in natural logarithmic form, respectively. The $\Delta$ is the difference operator, $q$ is the number of lags which have been optimally determined by the AIC, $\alpha$ is the parameter estimated, $u$ is the serially uncorrected error terms and $\varepsilon_{t-1}$ is the error correction term which is derived from the cointegration relationship, meaning to say, it captures the long-run dynamics. Where $\Delta$ is the first difference operator, $\varepsilon_{t-1}$ is the error correction term, $\alpha$ is the short-run co-efficient of the error correction term ($-1 < \alpha < 0$) and $u$ is the white noise.

The error correction co-efficient $\alpha$ is very important in this error correction estimation as greater co-efficient indicates higher speed of adjustment of the model from the short-run to the long-run. The error correction term represents the long-run relationship. A negative and significant co-efficient of the error correction term indicates the presence of long-run causal relationship (Granger, 1988). If both the co-efficient of error correction terms in the two equations are significant, this suggests the bi-directional causality.

In interpreting the causal relationship results, if only $\alpha 13$ is negative and significant, this suggest a uni-directional causality from aggregated imports to economic growth, implying that aggregated imports drives economic growth towards long-run equilibrium but not the other way round. Similarly, if $\alpha 23$ is negative and significant, this suggests uni-directional causality from economic growth to aggregated imports, implying that economic growth drives aggregated imports towards long-run equilibrium but not the other way around. The lagged terms of $\Delta$ *GDPt* and $\Delta$ *IMPt* appeared as explanatory variables indicating short-run cause and effect relationship between the two macro-economic variables.

Thus, if the lagged co-efficient of $\Delta GDPt$ appear to be significant in the regression of $\Delta IMPt$, it would mean that Economic Growth causes Aggregated Imports. Similarly, if the lagged co-efficient of $\Delta IMPt$ appear to be significant in the regression of $\Delta GDPt$, this mean that Aggregated Imports cause Economic Growth. Ultimately, the joint test, represented by this model ($\lambda 1/\Delta IMP^*$ *or* $\lambda 2/\Delta GDP^*$) are implemented to check for a strong causality test, where the variables bear the burden of a short-run adjustment to re-establish in a long-run equilibrium, following a shock to the system. Since the period of analysis has been divided into three, that is, the short-run, long-run and joint periods, the interpretation of results is based on the periods of analysis. In interpreting causality test results of the short-run and joint periods, F-statistic and its P-values are used, with the long-run period using the t-statistic value and its probability values. For the variable to be significant in influencing the other variable, its probability value should fall within the 5%

significance level, meaning that the null hypothesis of no causation is rejected at 5% significance level. The joint period analysis used the F-statistic against its Prob (F-statistic) to determine if there is causation and the interpretation of results are the same as that of short-run and joint period.

We the take the logarithmic of the variables. This is because most economic time series are non-stationary. By the same token the model given above is in logarithmic form. The natural logarithms smoothen the data as they allow for the management of high magnitude of figures and give the direct estimation of economic growth sensitivity to explanatory variables.

## 4. DATA ANALYSIS AND INTERPRETATION OF RESULTS

This section focuses on the empirical estimation, presentation and economic interpretation of the regression results carried out using the methodology highlighted in the previous section.

**PRELIMINARY TESTS:**

**Table 1: Descriptive Statistics**

| | SAGDP | SAIMP |
|---|---|---|
| **Mean** | 216.2750 | 48.10472 |
| **Median** | 196.6500 | 31.61000 |
| **Maximum** | 328.7000 | 123.2400 |
| **Minimum** | 144.0000 | 14.41000 |
| **Std. Dev.** | 57.32900 | 36.50815 |
| **Skewness** | 0.689872 | 1.064624 |
| **Kurtosis** | 2.036996 | 2.541578 |
| **Jarque-Bera** | 4.246605 | 7.115768 |
| **Probability** | 0.119636 | 0.058499 |
| **Sum** | 7785.900 | 1731.770 |
| **Sum Sq. Dev** | 115031.5 | 46649.56 |
| **Obs** | 36 | 36 |

Table 1 shows descriptive statistics of the dependent and explanatory variables used in the study for the period 1979 to 2014. Maximum and minimum statistics rule out the possibility of outliers in the data used. Classical linear regressions require that the residuals be normally distributed and judging by the probability value of the Jarque Bera, both the variables residuals follows a normal distribution therefore, the test for correlation between the variables can be conducted.

**CORRELATION TEST**

The Correlation Matrix is used to test the linear relation among the explanatory variables. It is also important in determining the strength of explanatory variable in the explaining the dependent variable. Further, it helps in identifying which variable to include and those to drop from the model, especially if more than two variables are being used. The correlation matrix in Table 2 below presents the outcome of the correlation tests.

**Table 2: Correlation Matrix**

| | SA_GDP | SA_IMP |
|---|---|---|
| **SA_GDP** | 1.0000 | 0.9677 |
| **SA_IMP** | 0.9677 | 1.0000 |

In this study there is a strong correlation in South Africa between the two variables as indicated by the coefficient above 0.90. Since there was no evidence of multicollinearity the study proceeds to test for stationarity

**STATIONARITY TESTS:**

**Table 3: Stationarity Test Results**

The stationarity or unit root tests of the data used in this study were conducted using ADF and PP Tests and the results are shown below.

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**Table 3: Stationarity Test Results**

| Country | Variable | Lag | ADF | | | | PP | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | No time effects | | Time fixed effects | | No time effects | | Time fixed effects | |
| | | | *Level* | *Δ* | *Level* | *Δ* | *Level* | *Δ* | *Level* | *Δ* |
| **SA** | **GDP** | 1 | 1.44 | -3.54** | -1.42 | -4.28* | 2.23 | -3.57** | -0.73 | -4.20** |
| | **IMP** | 0 | 0.29 | -5.09* | -1.44 | -5.30* | 0.36 | -5.06 | -1.38 | -5.35* |

Notes: *Δ* denotes the first differences. Both variables are in natural logarithms. *, **, *** Means that the null hypothesis of the unit root in the ADF and PP tests are rejected at the 1%, 5% and 10% levels respectively. The lag lengths are selected using Akaike's information criterion.

Macroeconomic time series data are generally characterized by a stochastic trend which can be removed by differencing. Some variables are stationary on levels, others become stationary after one differentiation, and some may become stationary by more than one differentiation. However, the study considers the level and first differencing for both Augmented Dickey-Fuller and Phillips and Perron (PP) test in determining the stationarity of the series for each country data set. The tests rely on rejecting a null hypothesis of unit root in favour of the alternative hypotheses of stationarity. The tests are conducted without a deterministic trend for each of the series on no time effects.

The results indicate that both variables are not stationary on their levels under the no time effects on both the ADF and PP tests. In other words, they have a unit root which calls for repeated unit root test for the first difference for both variables under the no time effects. After first differencing, the results for ADF tests under no time effects shows that Aggregated Imports series became stationary at 1% significance, with the GDP series rejecting the null hypothesis for unit root at 5% level. When the model was set for fixed time effects under both ADF and PP test, the results points out that imports data series for South Africa could not reject the null hypothesis of unit root on their levels-integration of order zero [I (0)].

Henceforth, first differencing became a necessity with the results reject the null hypothesis of non-stationarity at 1% significance level on both variables. On the contrary, the test results of PP for time fixed effects the decision rule of rejecting the null hypothesis was maintained, with the level of significance deteriorated to 5% on GDP data series. Basing on the outcome of the PP test first differencing, the study reasonably concludes that both GDP and Imports appear to be integration of order one [I (I)] series in South Africa.

**COINTEGRATION TEST:**

Prior to the test for cointegration, we first determine the lag length of the estimation which must be small enough to allow estimation and high enough to ensure that errors are approximately white noise. The lag length selection procedure is based on five different information criteria: AIC, SIC, HQ, FPE and LR. However, the study implemented the AIC criteria to determine the lag length. The table 4 below shows the cointegration tests results.

**Table 4: Cointegration Tests Results.**

| Country | Null hypothesis | Test statistic | |
|---|---|---|---|
| | | Max Eigen | Trace |
| SA | r = 0 | 10.751 | 10.987 |
| | r ≤ 1 | 0.236 | 0.236 |

*Notes: * Denotes that the null hypothesis of no Cointegration relationship is rejected at 5% significance level.*

Cointegration test was performed using Johansen's maximum likelihood approach to examine whether there is a long-run relationship between real GDP and imports for South Africa. Using optimal lag lengths, we found that the null of no cointegration could not be rejected. There is a linear deterministic trend in the cointegrating equation between gross domestic product and imports. This implies that, there is significant long-run relationship at (5%) and that a common trend exists between gross domestic product and imports.

**CAUSALITY TEST:**

Having observed the presence of the deterministic trend between gross domestic product and imports, the study went on to carry out the causality tests in order to find out the direction of influence between economic growth and aggregated imports. Table 5 below shows the findings after conducted the tests.

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**Table 5: Causality Test Results**

| Country | Null Hypothesis | Source of Causation | | | | |
|---|---|---|---|---|---|---|
| | | Short run | | Long run | Joint (Short/Long run) | |
| | | F-Statistic | | t-Statistic | F-Statistic | |
| | | $\Delta IMP$ | $\Delta GDP$ | $\varepsilon_{t-1}$ | $\Delta IMP, \varepsilon_{t-1}$ | $\Delta GDP, \varepsilon_{t-1}$ |
| | | | | | | |
| SA | IMP does not cause GDP | 0.693 (0.509) | | 1.523 | 3.105* | |
| | GDP does not cause IMP | | 0.675 (0.517) | 3.263* | | 5.083* |

*Notes: The number in parenthesis is p-values. *Means that the null hypothesis of no causation is rejected at the 5% significance level.*

- **Short-Run Granger Causality Test Results**

The Granger Causality Test results shows that there is no causation in the short-run between economic growth and aggregated imports. This entails that neither of the two variables has direct influence over the other in South Africa.

- **Long-Run Granger Causality Test Results**

In the long-run, the null hypothesis of no causation was rejected at 5% significance level. This shows that there is a long-run relationship between Economic Growth and Aggregated Imports. It has been noted that Economic Growth (GDP) granger cause Aggregated Imports. The results are in agreement with the findings on studies which were conducted for the Sub Sahara countries by Lopez and Thomas (1990). Alam (2009) carried out similar studies for Bangladesh and a uni-directional causality was determined, with Economic Growth influencing Aggregated Imports. In addition, Chang (2013) conducted studies for nine provinces in South Africa and growth led imports (GLI) was found. Similarly, studies carried in Trinidad and Tobago by Howard (2002) have results which support the GLI.

- **Joint Period Granger Causality Test Results**

The joint analysis for both short-run and long-run was also carried out and the results revealed that there is causation between Economic Growth and Aggregated Imports. This is shown by the rejection of the null hypothesis at 5% significance level. The results entails that there is a bi-directional causality between the two macro-economic variables.

The causal relationship has significant implications on imports expenditure and economic development. The direction of influence of the two variables helps policymakers to make the most appropriate decisions on imports consumption and macroeconomic planning. For uni-directional causality results, this entails that the increase in the independent variable will result in the increase in the dependent variable. The bi-directional causality shows that an increase in imports results in an increase in economic growth, while a permanent increase in economic growth results in a permanent increase in imports.

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

With reference to the findings in the joint period analysis, the bi-direction causality calls for both the Import Substitution Policy (ISP) and the Export Promotion Policy (EPP). Unlike import substitution strategy, the tariffs and quotas on imports should be reduced for exporters in order to encourage exportation. In addition to this, the banks should provide more easy and flexible financial terms to exporters. Also, the South African government should adopt subsidies on specific products to encourage the exporting of cheaper goods to foreign consumers and at the same time giving some exemptions and incentives for those who want to export. Again, the South Africa government needs to maximise its trade potential by addressing binding constraints, with their governments taking a lead in discharging a development-state-mandate and to reassert themselves in other regional markets in order to garner sufficient muscle to penetrate the global economy.

It would therefore be imperative for the South African Government to adopt a proactive and strategic trade policy aimed at stimulating both the formal and non-formal sector that should focus not only on importing oriented trade but also on reforming the domestic industrial structure. This would therefore call for the deepening of regional trade integration initiatives.

In this regard, the South Africa government should actively engage its regional partners and support both regional and international forces seeking to make a strong regional trading bloc a reality. The government intervention strategy should extend protection to strategic and labour intensive sectors, at the same time promoting export diversification, value addition and beneficiation. Adequate funding and subsidies should be made available for research and development activities.

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