Suffice to indicate, however, that nowadays this is not such a problem. As Bjonness (2012:13) points out, there are several tests that can be employed to check for the robustness and the stability of a model.

Furthermore, some commentators have highlighted that VARs fall short because they do not offer information about the underlying structure of the economy but focus instead on the interrelationships of the economic variables (Hakkio & Morris, 1984:1). However, scholars like Amarasekara (2008:5) have played down this criticism, arguing that VARs are not designed to explain the structure of the economy but, rather, analyse the relationships between variables. Hakkio & Morris (1984:1) point out that "although VARs cannot make inferences about the structure of the economy, they can be used to estimate parameters of interest to policy makers".

3.2.4 The identification problem

The most important concern about SVARs, perhaps, is that they require "identification assumptions" in order for correlations to be interpreted in a causal manner. See Stock & Watson (2001:101) and Kilian (2011:1). Identification assumptions refer to how one arranges the variables in a system of equations in order to solve the causation and correlation problems (Stock & Watson, 2001:102). In other words, as Stock & Watson (2001:103) put it, identification requires that all causal links in the system are spelled out, such that only a specific causal link is identified. Beetsma & Giuliodori (2011:9) and Kilian (2011:1) have argued that identification requires knowledge of institutions, economic theory and other extraneous constraints on the model responses. This is not an easy exercise, since SVAR results are sensitive to identification assumptions. Ravnik & Zulic (2011:37) argue that small changes in the identification process can create large changes in the impulse responses and, thus, change the results of the SVAR model.

However, SVARs are important in this particular study because they allow us to impose identification about the error terms, so that we can look at individual shocks which are not correlated with other variable shocks. This is important because only if shocks are uncorrelated can we suspend some specific shocks and observe the impact of a particular shock of interest on another variable. In our case, it allows us, for instance, to suspend all other shocks, apart from the fiscal deficit variable shock, and observe how this shock affects real GDP.

In this paper, we use the recursive identification approach, suggested by Sims (1980:2). The recursive identification approach involves the use of the Cholesky decomposition method to separate structural shocks from reduced form shocks by making the error terms in the reduced form VAR uncorrelated, which is commonly referred to as *Orthogonalization.* This is done in order to facilitate make the interpretation of the resulting impulse response functions. It is Orthogonalization that enables us to implement the idea of isolating fiscal deficit shocks, suspend other specific shocks and see how real GDP reacts.

Suffice to mention that there are several other methods that are used to identify equations in an SVAR model. Ravnik & Zulic (2011:28) cite the Structural Vector Error Correction model (SVEC) as one of them. Some scholars like Fatas & Mihov (2001:10) use the basic identification method of putting fiscal variables first, while the contemporaneous relationship of other variables is not specified. Kamps & Caldara (2008:28) compare various identification approaches and conclude that the Cholesky decomposition approach, with proper order of the variables in the model is one of the most appropriate methods of identifying variables.

3.3 DATA

The study uses quarterly macroeconomic time series data sets which span from 1991Q2 to 2012Q4. The first quarter in this study refers to the first three months of the Gregorian calendar, that is, January to March, and so on.

Quarterly data, as opposed to annual data are employed in this study. Quarterly data have several advantages in comparison to annual data. Firstly, it is necessary to note, as De Castro & Garrote (2012:10) point out, decisions on fiscal policy are taken throughout the year and are often based on information gathered on a monthly or quarterly basis. As a result, quarterly data are better placed to capture this rich dynamic pattern of the decision-making process than the aggregate yearly data, which often contain large contemporaneous effects that complicate the analysis and the interpretation of results. See also Martins (2010:13) and Splimbergo et al (2009:5). Ilzetzki et al (2010:8) confirm that annual data are not good at producing precise estimates.

Next, the use of quarterly data helps to minimise the likelihood of structural breaks and also increases the number of observations, or degrees of freedom. In South Africa, many structural breaks are eminent, due to several economic regime changes that have taken place. However, the use of quarterly data, as opposed to annual data helps to minimise the number of these structural breaks (Martins, 2010:14). On the other hand, many degrees of freedom realised from quarterly data are essential in enhancing the credibility of the estimates of a model. According to Martins (2010:14) the use of the VAR model normally results in the vanishing of degrees of freedom. The use of quarterly rather than annual data, therefore, helps to minimise that loss of degrees of freedom by substantially increasing the sample size.

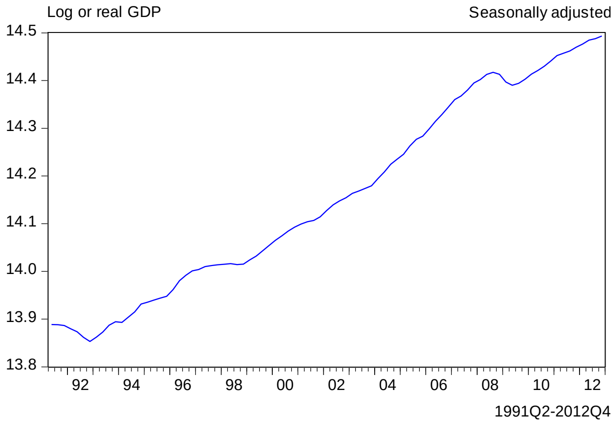
Finally, some studies have argued that since fiscal policy is susceptible to the problem of lags, annual data should be used to account for this challenge. It, however, should be pointed out that even if lags are present, it is unrealistic to assume that an entire year is required for the authorities to respond to output shocks. Ilzetzki et al (2010:8) argue that many countries, including developing countries responded with discretionary measures as early as the first quarter of 2009 to the economic fallout in the fourth quarter of 2008. As such, the approach to using quarterly data is substantiated.

Source and type of data

In terms of the sources of the data, we use a local source. All the data is obtained from the South African Reserve Bank (SARB, 2013). The SARB was chosen because it has a relatively long span of macroeconomic time series on South Africa and the data are consistent in terms of the units of measurement used. The data which we collected include:

a) The two key variables of the study. The first, also serving as our dependent variable, is the log of real GDP (*O*) measured at 2005 market prices. GDP refers to expenditure on domestically produced goods and services, or economic activity. This variable is obtained from the SARB, while already seasonally adjusted. Figure 3.1 below shows the evolution of the log of real GDP over the forecast horizon. The graph gives the idea that GDP is non-stationary, since it maintains an upward trend throughout the period, suggesting that the mean of GDP was perhaps changing. Discussion of the meaning of non-stationarity and how to address it is analysed in the next section.

Figure 3.1

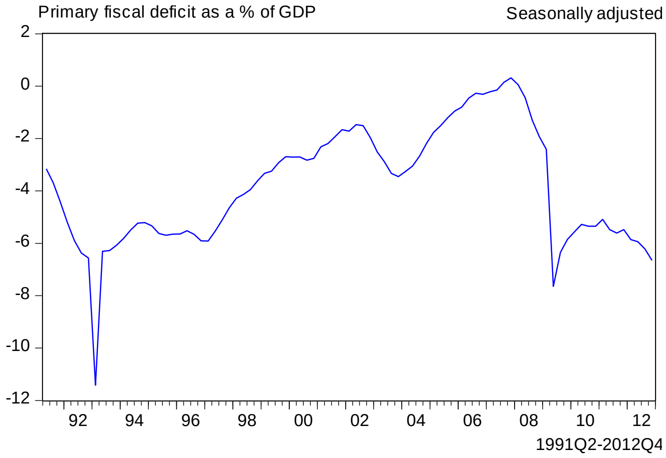


The second key variable, also serving as one of the explanatory variables, is the real primary fiscal deficit as a percentage of GDP (*F*), which is expressed in rates. As we defined it in chapter 1, a fiscal deficit refers to the surplus of government (public) expenditure over revenue (Dalyop, 2010:155). We use the primary deficit[13] as opposed to the conventional deficit because, as Tshiswaka-Kashalala (2006:3) points out, the conventional fiscal deficit may not properly represent discretionary fiscal policy because it contains interest rate payments, which are not a fiscal discretionary component of the fiscal deficit. On the other hand, the primary fiscal deficit does not include interest payments, thus, making it suitable to capture government's discretionary fiscal policy. We adjusted this variable for seasonality, using the TRAMO/SEAT ARIMA model[14] with programme package Eviews 7.0. Figure 3.2 below shows the pattern of the real primary fiscal deficit as a percentage of GDP for the time frame of consideration. The graph shows that this variable is also not stationary.

[13] We subtracted interest payments from the conventional fiscal deficit in order to arrive at the primary fiscal deficit.

[14] These seasonal adjustment technics were developed by Victor Gomez and Augustin Maravall, and are officially used by the Bank of Spain (Maravall, 2006). Their main advantage over other popular technics like the X-12 ARIMA used by the FED of the US is that they can handle missing as well as non-positive figures.

Figure 3.2

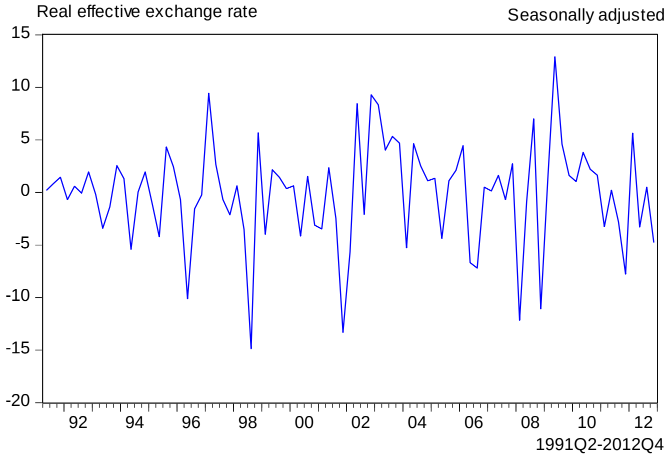


b) Apart from the above variables, there are other factors that are very important in determining the effectiveness of fiscal deficits. The mechanism through which they influence the effectiveness of fiscal deficits was discussed in the previous chapter. We, therefore, have to use these factors for controlling purposes in our analysis of the results in chapter 4. The first of these control factors is the real exchange rate, for which we use the real effective exchange- rate[15] (*X*) because it captures the relative strength of the domestic currency against other currencies better than the ordinary exchange-rate. This is a critical variable. As argued in the literature review, there is a link between fiscal deficits and the monetary aspect of exchange rates. Fiscal deficits may theoretically lead to an appreciation of the real exchange-rate (Dalyop 2010:161). This could have a negative impact on the external competitiveness of the economy, thereby offsetting the positive economic effect of fiscal deficits.

This variable is in rates and we seasonally adjusted it using the TRAMO-SEATS ARIMA model with programme package Eviews 7.0. Figure 3.3 below shows the evolution of the real effective exchange rate in South Africa from 1991 to 2012. The plot of this graph looks quite stationary. However, a more objective way of ascertaining whether this series is stationary is used in chapter 4.

[15] The real effective exchange-rate measures the strength of the Rand against a weighted average strength of 15 of South Africa's major international trading economies.

Figure 3.3



c) Moreover, it was also discussed in chapter 2 that the effect of fiscal deficits differs, depending on the exchange rate regime used in a given economy. As Spilimbergo et al (2009:3), Ilzetzki et al (2010:11) among others argue fiscal policy is more effective in fixed exchange rate regimes compared to floating exchange rate regimes. The paper creates a dummy called *dumreg* to compare the impact of exchange rate regimes on the effectiveness of fiscal policy. In this dummy, *dumreg* = 0 represents periods (quarters) of fixed exchange rate regime, while *dumreg* = 1 represents periods (quarters) of floating exchange-rate regime. Table 2.1 in the previous chapter showed a compilation of episodes of exchange-rate regimes that South Africa has passed through. It shows that from the time horizon of our consideration, it was only from 1991Q2 to 1994Q4 that South Africa was considered to be in a fixed exchange rate regime. This means that from 1995Q1 to 2012Q4, the floating exchange rate was used in the economy. We verify in chapter 4 whether or not the dominance of the floating exchange-rate in South Africa over our forecast horizon does significantly hamper the effectiveness of fiscal deficits, as many scholars suggest.

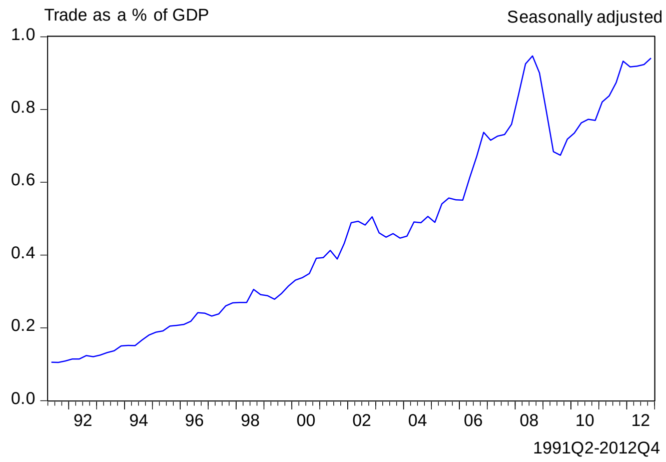
d) The next variable we include is trade as a percentage of GDP (*T*) in real terms. This measures the degree of openness of the economy. Openness of an economy, as discussed in chapter 2, has a critical influence on how fiscal deficits perform. Spilimbergo et al (2009:3) point out that the more open an economy is, the more likely fiscal deficits will be impotent. Theoretically, an open economy will result in the channelling of the income received from fiscal expenditure towards imports, thereby offsetting the current account and GDP. With South Africa being a small open economy, we wait to verify in Chapter 4 if her openness to trade has an impact on the effectiveness of fiscal deficits.

Trade as a percentage of GDP is measured as exports plus imports as a proportion of GDP[16] (Dalyop, 2010:155). In other words, it measures the trade share of an economy. The higher the percentage of trade as a share of GDP, the more open the economy is. This type of approach to measuring the degree of openness of an economy, according to David (2007:9) is quite popular because it relies on the use of data for determination purposes, which data are normally readily available. In addition this approach makes it easy to make comparisons across studies of how economies are open (David, 2007:9).

We have expressed the variable, trade as a percentage of GDP, in rates. The series, which we used to calculate for this variable, were obtained from the SARB, already seasonally adjusted. Figure 3.4 below shows the plot of this variable over our time period of consideration. The graph exhibits non-stationarity tendencies for this variable, as the mean seems not to be constant.

[16] This can be calculated using either current or constant prices (David 2007:9). In our case, we used real values.

Figure 3.4

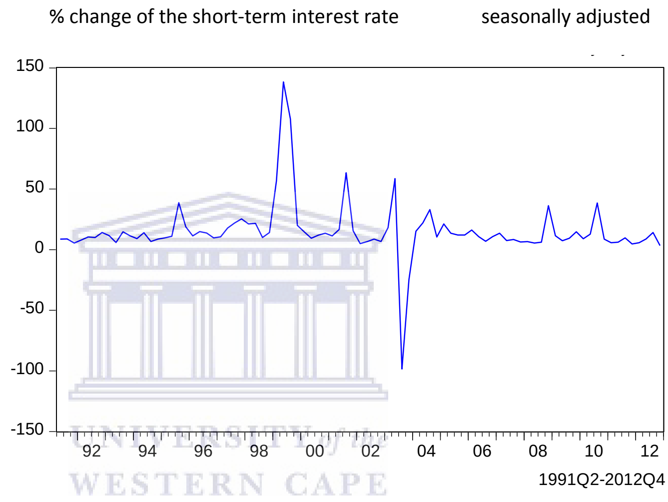


e) The base rate *(B)*, or the interest rate policy of the central bank, is another important monetary policy variable that could have an influence on the effectiveness of fiscal deficits. We argued in chapter 2 that both the neoclassical economists and New Keynesians admit that fiscal deficits may raise interest rates. From the rise in interest rates, the neoclassical economists contend that this would automatically have a dampening effect on private investment and may have an adverse effect on fiscal deficits. On the other hand, the new Keynesians argue that interest rates may rise, but fiscal deficits would still spur investment given any level of interest rate.

Moreover, we discussed in chapter 2 that the SARB follows a Taylor-type interest rate rule to implement its inflation-targeting monetary policy. The need to maintain inflation within the target range, using the short-term interest rate, may have offsetting effects on the effectiveness of fiscal deficits. For instance, if the rise in GDP arising from the increase in fiscal deficits mounts upward pressure on prices in the economy, the SARB may raise interest rates to cushion the rising prices and maintain them within the target range. This rise in interest rates may dampen investments and offset the stimulative effect of fiscal deficits. The inclusion of the interest rate variable in our model, therefore, helps us to evaluate the conclusion by Spilimbergo et al (2009:3) and Christiano et al (2009:17) that fiscal policy under inflation-targeting monetary policy is a failure.

We use the central bank repurchase rate (repo rate) to proxy the short-term interest rate policy of the central bank. The repurchase rate was introduced by the SARB in 1999, but prior to that, the bank rate was used to proxy the central bank interest policy rate (Dube & Zhou, 2003:197). We seasonally adjusted this variable using the TRAMO-SEATS ARIMA model with program package Eviews 7.0. Figure 3.5 below shows the trend of the repo rate since 1991. The variable seems to be stationary.

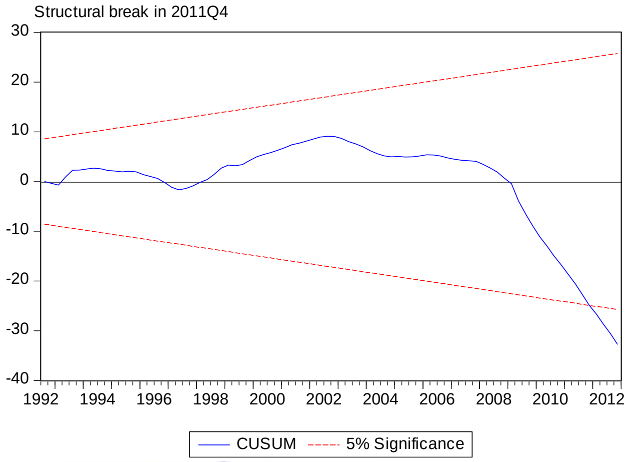
Figure 3.5



f) Finally, the paper creates a dummy variable *(dum11)*[17] to represent a structural break which took place in 2011Q4. We discovered this structural break after undertaking a stability diagnostic test of the residuals in the equation using program package Eviews 7.0. In this diagnosis, we rejected at 5% level the Chow Breakpoint test null hypothesis stating that there was no structural break in the fourth quarter of 2011. Adding structural break dummies in a VAR model when structural breaks are observed in the data improves the specification and stability of the model. Figure 3.6 shows a graph depicting the structural break that took place in 2011Q4 when the test statistic broke out of the 5% interval.

[17] Dum11 takes values of 0 from 1991Q2 to 2011Q4, and values of 1 from 2012Q1 to 2012Q4.

Figure 3.6



3.4 ECONOMETRIC TOOLS

As mentioned earlier, this study uses time series data. A time series is defined by Gourieroux & Monfort (1997:1) as "the sequence of observations on one variable". The data in these series may be available, for example, once a year or once a quarter. They come from repeated observations, corresponding to different dates.

3.4.1 Challenges to time series data and solutions

Time series data are a problem to use in research activities. The problem is that they often tend to have unit roots. Unit root is a term that implies that the data is non-stationary. A non-stationary series has a mean or variance, or both, that vary over time (Gujarati, 2003: 797). Gujarati (2003:797) contends that using such data would require that each set of time series data should be for a particular episode and, as such, it is not possible to generalise it to other periods. Using such time series in regressions produces results that appear to be true, when actually they are false. It so happens that a regression involving two non-stationary variables would produce a high adjusted R-Squared[18] when actually no relationship exists (Gujarati, 2003:797). Not taking action to make the data stationary can lead, therefore, to false results. Moreover, the VAR model that we use in this

[18] The adjusted R-squared is used to determine the fitness of a model. The higher it is, the better fitted a model is.

study requires, in the first place, that all the data used are stationary, or else the results would be invalid.

The graphical analysis made in section 3.4 already highlights that most of the time series used in this study are suspected to be non-stationary because they have sustained trends and random walk movements with drifts. However, a more objective way of assessing whether unit roots are present, and how to address them, is required. A number of methods are used to detect unit roots. One of them is the Augmented Dickey-Fuller test (ADF), named after its discoverers (Cheung & Lai 1995: 177). The ADF is based on random walk movements in time series and the fact that random walks have unit roots. It assumes that the explained variable (Y) follows an auto-regressive (AR) process of order p, that is, $\mathrm{AR(p)}$ and adds p lagged differenced terms of the Y time series to the right hand side of the regression. The null hypothesis of the ADF test states that unit roots are present in the time series. The alternative hypothesis, on the other hand, states that there are no unit roots in the time series. The ADF, according to Cheung & Lai (1995:177) is effective and is easy to apply and, for that reason, we find it appropriate to use in this study. Another technique available for detecting unit roots is the Phillips-Perron test (1988). However, for reasons we have already indicated, we use the ADF in this study.

3.4.1.1 Differencing

There are a number of methods used to address unit roots in time series data in order to make them stationary. Differencing is one of the easiest ways. Differencing[19] refers to the series of changes of a time series from one period to the next. The number of differencing operations that it takes to make the series stationary is known as the order of integration (Gujarati, 1995: 719). It is denoted as I(*d*). If it takes one differencing operation to make a series stationary, that operation would be expressed as I(*1*). By convention if *d*=0, the resulting I(*0*) expression entails that the time series is stationary. Differencing operation can be done using the ADF.

Though it is an easy way of addressing unit roots, differencing has disadvantages. A number of researchers have condemned it, arguing that it may result in the loss of important data. In addition, a model that only includes (lagged) differenced variables assumes that the impact of the independent variables on the dependent variable never last longer than one time period

[19] If Y_t denotes the value of the time series *Y* at period *t*, then the first difference of *Y* at period t is equal to Y_t-Y_{t-1}

(Mukherjee, White and Wuyts, 1998:407). This may not be correct. Moreover, Mukherjee et al. (1998:407) point out that using a regression with differenced variables yields no information on the long-run equilibrium relationship between the variables of consideration. As such, differenced variables are often thought of as representing only the short-run relationship.

3.4.1.2 Cointegration

Because of the inadequacy of the differencing method, this study employs the cointegration technique. The concept of cointegration was popularised by Robert Engle and Clive Granger in 1987. Their analysis was based on the argument that if two or more time series of the same order of integration, say I(*1*), are linearly combined and produce I(*0*) residuals, it means that those variables are cointegrating in the long run. Such variables can also be said to form an equilibrium relationship in the long-run. In other words, variables are cointegrated with one another if the residuals from the levels regression are stationary (Mukherjee et al, 1998: 399).

Testing if our model cointegrates is critical for our SVAR, as it determines whether or not our regressions are spurious. If our model cointegrates, it confirms that we are estimating a stationary model, and our regressions are not spurious.

Previously, cointegration analysis was predominantly undertaken for purposes of estimating "Restricted VAR models" or Vector Error Correction Models (VECM). This implies that unrestricted VARs, such as the one we use in this study, would not have to go through the process of cointegration tests. However, cointegration analysis, perhaps, is currently considered to be more important in unrestricted VAR analyses. As Baharumshah (2005:30) points out, "estimating the unrestricted VAR model for the cointegrated variables is a normal route taken by much of the literature". Furthermore, Ramaswamy & Slok (1998:380) argue that when variables are cointegrated it is better to apply an unrestrictive SVAR than a restricted one. This, Ramaswamy & Slok (1998:380) argue, "is because restricted VARs imply that the effect of a given shock is permanent, while that of an unrestricted VAR allows history to decide on whether the impact of a shock is permanent or not, which is desirable".

In line, therefore, with this literature, if we discover that our variables cointegrate, we will proceed with the estimation of an unrestricted SVAR model. There is need to mention however, that we will also run a VECM for the sole purpose of using it as a recommended method for determining causality in multivariable models. We discuss the use of VECM in determining causality in section 3.5.5.1 below.

In this study, we use the Johansen approach to test for cointegration. This approach involves the application of standard multivariate calculations in the context of a Vector Auto-Regression (VAR) system. The Johansen approach allows for more than one cointegrating relation. In other words, it allows for the testing of cointegration in multivariate models (Mukherjee et al, 1998:399). This technique is, therefore, a suitable one for the multivariable model that we have in this study. The number of cointegrating vectors in our model can be up to 4, since we have 5 endogenous variables in the model. Moreover, we choose the Johansen approach, because of its ability to incorporate structural breaks and dummies in the tests for cointegration, as done by Thornton & Lusinyan (2009:864). This is important in our case because we have a structural break dummy and a dummy for the exchange rate regimes in our model.

Typically, the Johansen cointegration approach was designed to handle variables that are I(*1*) integrated. In our case, there is a possibility that we might also have variables which are I(*0*). However, Johansen (1991:1560) argues that there is still no problem with combining I*(0*) and I(*1*) variables when testing for cointegration. See also Harris (1995:80). This, he argues, is because, if some variables are I(*0*) instead of I(*1*), they will reveal themselves through cointegrating vectors whose space is spanned by the stationary variables in the model (Johansen, 1991: 1560).

The Johansen approach has two types of tests. These are the trace statistic and the maximum Eigenvalue statistic. Either one of the two tests or both can be used as a benchmark for deciding the number of cointegrating relationships in the model, as argued by Lutkepohl, Saikkonen, Trenkler (2001:305). However, they caution that the trace test has more power when handling more than one cointegrating relationship, while the Eigenvalue test is suitable for one cointegrating relationship (Lutkepohl et al, 2001:305).

The trace test is a joint test with a null hypothesis which states that the number of cointegrating relations is less or equal to *r*. The *r* is also called the 'rank' and it determines the number of cointegrating vectors. If *r* = 0, it means there is zero cointegration relations in the model. Its alternative hypothesis, on the other hand, is a general one which states that there are more than *r* cointegrating vectors (Johansen 1991: 1554).

In the maximum Eigenvalue test, separate tests on each Eigenvalue are conducted. Its null hypothesis states that there are *r* cointegrating relations. The alternative hypothesis, on the other hand, states that there are *r* + 1 cointegrating vectors (Johansen 1991: 1554).

3.4.1.3 Deterministic trend assumptions and lag length

The output of the Johansen approach cointegration tests is sensitive to the deterministic trend assumptions used for the time series and the lag order choice. A slight change in information on any of these, results in a change in the number of cointegrating vectors outputted. The Johansen cointegration system in E-views 7.0 asks for this information, and it is therefore important to input it correctly. From the preliminary investigation of our time series, based on graphical appearance, we observe that they have intercepts/constant, and a trend. Graphical appearance, as we discuss in chapter 4, is however, not an objective way of deciding the deterministic trend assumptions of the data. A more robust way of doing this is shown in the next chapter where, in the process of testing for unit roots, we also discover the correct and significant deterministic trend assumptions for our series. As for the lag order choice, we use the VAR lag order selection criteria in E-views 7.0. More discussion on lag choice selection follows in the next section.

3.4.2 The SVAR model for analysing deficits

There are different classes of SVAR models (E-views 7.0: 472). The one we use may broadly be written as:

- $\alpha u_t = \beta \varepsilon_t$ ………1

In the above equation, u_t and ε_t are vectors of length *K*. u_t are the observed (or reduced form) residuals, while ε_t are the unobserved structural disturbances. The structural disturbances (ε_t) in the equation are orthonormal or uncorrelated with each other by assumption, that is, their variance-covariance matrix $\sum \varepsilon_t$ is diagonal. α *and* β are endogenous *K* x *K* matrices to be estimated. Following this broad analysis, the objective of this paper is to estimate this specific SVAR system:

- $\alpha Y_t = \sum_{k=1}^{K} C_k Y_{t-k} + \mathrm{m}_k X_{t-k} \beta u_t$……………………………………………………………………………………2

In this system, Y_t is a cointegrated *K* variable vector, where *K* includes the following endogenous variables: the real primary fiscal deficit as a percentage of GDP *(F)*, real trade as a percentage of GDP *(T)*, real effective exchange rate *(X)*, log of real GDP *(O)*, and the short-term real interest rate or base rate *(B)*. *K* also includes X_t matrix of exogenous variables, which are: exchange rate regimes dummy *(dumreg)* and the 2011 structural break *(dum11)*. A deterministic component may also be added as an exogenous variable. The process of testing for unit roots, which is done in the next chapter, aids to reveal the deterministic nature of our series.

In the same SVAR system above, *t* represents a quarter or three consecutive months in the Gregorian calendar. C_k, is a matrix of the own and cross-effect of the k^{th} lag of the variables on their current observations. The α matrix allows for the possibility of the contemporaneous relation contained in the vector Y_t of the variables. β is another component which we need to estimate in our structural VAR. Actually, the representation of this structural form is referred to in the literature as the $\alpha\beta$ model (Luetkepohl 2006: 364). The structural model can be said to be identified only if restrictions are imposed to α and β.

The recursive identification approach which we use restricts β to a *K* dimensional diagonal matrix. In other words, β is a diagonal matrix, implying that the vector $u_t[u_t^F, u_t^T, u_t^X, u_t^O, u_t^B]$ is an orthogonal vector corresponding to reduced-form residuals. Some literatures use an β identity matrix with a unit diagonal. However, the E-views 7.0 guideline: 472, argues that most of the literatures use a diagonal matrix where values that need to be estimated are assigned the label NA[20]. We thus, follow this argument by allowing our SVAR to estimate values for the diagonal matrix, as we show below on the matrix to the right:

$$\begin{Bmatrix} 1 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ NA & NA & NA & 1 & 0 \\ NA & NA & NA & NA & 1 \end{Bmatrix} \begin{bmatrix} u_t^F \\ u_t^T \\ u_t^X \\ u_t^O \\ u_t^B \end{bmatrix} = \begin{Bmatrix} NA & 0 & 0 & 0 & 0 \\ 0 & NA & 0 & 0 & 0 \\ 0 & 0 & NA & 0 & 0 \\ 0 & 0 & 0 & NA & 0 \\ 0 & 0 & 0 & 0 & NA \end{Bmatrix} \begin{bmatrix} \varepsilon_t^F \\ \varepsilon_t^T \\ \varepsilon_t^X \\ \varepsilon_t^O \\ \varepsilon_t^B \end{bmatrix}$$

On the other hand, we restrict α (the matrix to the left, above) to a lower triangular matrix with a unit diagonal. This implies that the variance-covariance matrix captured in $\sum u_t$ must be decomposed. The decomposition is derived from the Cholesky decomposition $\sum u_t$ = *FF'* by defining a diagonal matrix *P* which has the same main diagonal as *F*, and by specifying α^{-1} = FP^{-1} and $\sum \varepsilon_t$ = *PP'*. This implies that the elements on the main diagonal of *P* and *F* are equal to the standard deviation of the respective structural innovation (Kamps & Caldara, 2008:13). What this essentially means is that, the βu_t in our SVAR system describes the relation between the structural disturbances (ε_t) and the reduced form disturbance (u_t).

[20] In e-views NA represents a value that is unrestricted or rather, needs to be estimated in the SVAR model. In the diagonal matrix system that we use, it means that we identify β by putting NA in a diagonal form.

3.4.2.1 The recursive causal chain for the SVAR model

The recursive identification approach which we use requires the imposition of a particular causal relationship, based on economic theory from the data (Kilian 2011:5). This implies that VARs are not completely atheoretic, since they require economic theory to be followed. In most cases, though, it is rare to find a fully developed theoretical model on which to base the causal chain. Kilian (2011:8) argues that in such cases “identification may be achieved by using extraneous information or by using selective insights from economic theory”. Using this approach helps to make the causal chain relationship general and uncontentious.

We follow the Kilian (2011:8) suggestion, just mentioned above, and combine it with the basic identification procedure of Fatas & Mihov (2001b:10) and Blanchard & Perotti (2002) who order fiscal variables before output. We, thus, order our variables as follows: *fiscal deficit (F) — trade as a percentage of GDP (T) — real effective exchange-rates (X) — log of real GDP (O) — base rate (B).*

The implication of this causal order is that the fiscal deficit affects all the variables in the system at the same time in the first period. In the next period, any shock affects all the variables, all the variables have lags included in each other’s equations. In other words, any shock can affect all the variables with a delay lag.

The equations below can be used to explain the recursive causal relationship identified above. It can be seen that the contemporaneous fiscal deficit is included as an explanatory variable in equations 4 to 7. Similarly, trade as a percentage of GDP is a contemporaneous explanatory variable in equations 5 to 7. The same pattern is applicable to the rest of the variables. Of course, the lag of one which we use below is just for demonstration purposes. The lag length could go beyond the length we have used. The Greek symbol ε represents the structural shocks to the models. By custom, the size of a shock is set equal to its standard deviation.

- $F_t = \alpha_0 + \alpha_1 F_{t-1} + \alpha_2 T_{t-1} + \alpha_3 X_{t-1} + \alpha_4 O_{t-1} + \alpha_5 B_{t-1} + \varepsilon_t^F$ ……………………………………………3

- $T_t = \beta_0 + \beta_1 F_t + \beta_2 F_{t-1} + \beta_3 T_{t-1} + \beta_4 X_{t-1} + \beta_5 O_{t-1} + \beta_6 B_{t-1} + \varepsilon_t^T$ ……………………………….4

- $X_t = \delta_0 + \delta_1 F_t + \delta_2 T_t + \delta_3 F_{t-1} + \delta_4 T_{t-1} + \delta_5 X_{t-1} + \delta_6 O_{t-1} + \delta_7 B_{t-1} + \varepsilon_t^X$ ……………………………………….5

- $O_t = \psi_0 + \psi_1 F_t + \psi_2 T_t + \psi_3 X_t + \psi_4 F_{t-1} + \psi_5 T_{t-1} + \psi_6 X_{t-1} + \psi_7 O_{t-1} + \psi_8 B_{t-1} + \varepsilon_t^O$ 6

- $B_t = \phi_0 + \phi_1 F_t + \delta_2 T_t + \phi_3 X_t + \phi_4 O + \phi_5 F_{t-1} + \phi_6 T_{t-1} + \phi_7 X_{t-1} + \phi_8 O_{t-1} + \phi_9 B_{t-1} + \varepsilon_t^B$ 7

The ordering of these variables was guided by the following economic assumptions. The primary fiscal deficit as a percentage of GDP affects all the variables in the system in the same period because it appears as a contemporaneous explanatory variable for all of them, as shown above. This, as we argued in chapter 2, helps us to analyse whether fiscal deficits (1) are leaked out of the economy through increased imports, as captured by the increase in trade as a percentage of GDP; (2) lead to the appreciation of the real exchange rate, which may have negative consequences on net exports and GDP; (3) have a discretionary effect on GDP- this particular ordering rules out potentially important contemporaneous effects of automatic stabilizers on fiscal deficit, which can affect the impact of fiscal deficits on economic growth and; (4) lead to the increase in interest rates. An increase in interest rates, according to neoclassical economists crowds-out private investment and appreciates the real exchange-rate. Both of these may negatively affect the impact of fiscal deficits, as we discussed in chapter 2.

Trade as a percentage of GDP and real effective exchange-rate are ordered before real GDP so that we can analyse the net exports position of the economy after a fiscal shock has been subjected to them. As we discussed in the previous chapter, the appreciation of the real exchange-rate and the increase in imports for open economies may cause a negative trade balance, thereby minimising the fiscal multiplier.

Finally, we order the short-term real interest rate (base rate) last. We give two justifications for ordering this variable last. Firstly, based on the argument made in the previous chapter, the SARB pursues an inflation-targeting monetary policy, where interest rate changes are bound by the need to maintain inflation at the targeted level as GDP changes. This means that the obligation to fix inflation at a certain level may compel the SARB to change the interest rate in the direction that offsets the stimulative effect of the fiscal deficit. Secondly, the fiscal deficit, as we define it, represents the primary deficit, which excludes interest payments. We want to verify whether the fiscal deficit variable does not react to changes in the interest rate.

3.4.2.2 Estimation of the SVAR model

The matrix $\alpha^{-1}C_k$ and the coefficients α and β are what we aim to estimate. Estimation of VAR regressions is normally done using the Ordinary least squares (OLS). However, Luetkepohl (2011:8) points out that the OLS may be inefficient in cases where restrictions must be imposed on the parameters, such as what we do in this study. In view of that, we estimate our regression using the Generalised Least Squares (GLS). Luetkepohl (2011:8) argues that the GLS is beneficial when restrictions to parameters are imposed, and this estimator is consistent and asymptotically normal under general conditions. The GLS, thus, will provide us with the above estimates.

3.4.3 Lag length selection

Before estimation can be done, determination of the optimal lag length is always a prerequisite when dealing with VAR models. In our case, we combine statistical criteria and economic theory to determine the lag length. For the statistical criteria, we use the VAR lag choice selection criterion which is incorporated in the E-views 7.0 statistical package. We apply this criterion while cautious of the warning by Gujarati (2004: 733) that the more the lags that one adds to the model, the more the degrees of freedom get consumed. On the other hand, not including a lag at all in the model may be rejected on economic grounds, since it takes a quarter or more for fiscal policy to react (Bjonness 2012:15). We perform the lag selection procedure in the next chapter.

3.4.4 Residual diagnostic tests

Residual tests describe the distribution and characteristics of the residuals in the model. These tests are very important, for they determine the credibility of the conclusions drawn from a model. We follow the standard practice of testing the residuals for serial correlation, normality distribution and heteroskedasticity. In addition, we test for the stability of our SVAR, using the inverse roots of the AR characteristic polynomial.

3.4.4.1 Serial correlation

Serial correlation, also known as autocorrelation, is a serious problem in time series data. Serially correlated error terms underestimate the standard errors, thereby making the t-values overestimated. This renders the estimates biased. We use the Breusch-Godfrey serial correlation LM test to test for serial correlation. The null hypothesis for this test states that there is no serial correlation in the model.

3.4.4.2 Normality test

A normality test investigates whether the residuals in a model are normally distributed. Estimates derived from a model whose residuals are not normally distributed are invalid. We, therefore, have to undertake this test. We use the Jarque-Bera normality test to ascertain the distribution of the residuals in our model. The null hypothesis for this test states that the residuals are not normally distributed.

3.4.4.3 Heteroskedasticity

Heteroskedasticity means that residuals do not have a constant variance. This results in a model which has different probability distributions. Such a model cannot yield reliable estimates. We use the Breusch-Pagan-Godfrey test for heteroskedasticity to analyse heteroskedasticity in our model. The null hypothesis for this test states that the residuals have no heteroskedasticity.

3.4.4.4 Inverse Roots of AR Characteristic Polynomial

Finally, since we are running an SVAR model, it is also important that we test for the stability of our model. We use the technique called the "Inverse roots of AR characteristic polynomial" to ascertain the stability of our SVAR. In this test, if the Inverse roots of the AR polynomial have roots with modulus which are less than one and they lie within the unit circle, it means that the model is stable and the impulse response standard errors would be valid and the conclusions of the model would also be reliable.

3.4.5 SVAR Results

In analysing the results from our SVAR model, we follow the standard practice of reporting results from the Granger-causality tests, impulse responses and the forecast error variance decompositions. The E-views 7.0 package we use in this study, and many other econometrics packages, such as, TSP and RATS, can compute these statistics automatically. Stock & Watson (2001:104) argue that because VARs have complicated dynamics, reporting these statistics is more informative than using the regression coefficients or R^2 statistics.

3.4.5.1 Causality test

The concept of causality is attributed to Engle Granger (1969) who explained that if *X* Granger causes *Y*, then past values of *X* should contain information which helps to predict *Y*. This culminated in what is commonly known as the Granger causality test. However, the normal Granger –causality test is more suitable for bivariate equations. Lutkepohl (2006:76) points out that the normal Granger causality test is not reliable in a VAR with more than two variables. A Granger causality test which is appropriate for handling more than two variables requires the use of the VECM. Maddala & Kim, (1998:297) argue that Granger causality for multivariate equations can be subdivided into long-run and short-run causality using the VECM. This can be done only after establishing that a cointegration relationship exists among the variables. Maddala & Kim (1998:297) argue that the long-run causality is determined by the error correction term. If the error term coefficient is statistically significant and has a negative sign, it indicates that long-run causality runs from the independent variables, jointly, to the dependent variable. The short-run causality, on the other hand, as argued by Maddala & Kim, (1998:298), is determined by a test of the joint significance of the lagged independent variables. The F-test or the Wald tests can be used in this case. We do these tests in the next chapter.

3.4.5.2 Impulse Response Functions (IRFs)

SVARs, like recursive VARs, are typically interpreted using Impulse Response Functions (IRFs). IRFs are used to trace out the time path of various innovations (shocks) that are in the SVAR system. Stock & Watson (2001:106) point out that "impulse responses trace out the response of current and future values of each of the variables to a one unit increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero". IRFs can be achieved through expressing variables in the model in terms of shocks. We use IRFs to interpret results because using individual coefficients from an estimated SVAR is difficult (Bjonness, 2012:14).

3.4.5.3 Forecast Error Variance Decomposition (FEVD)

According to Stock & Watson (2001:106) "the Forecast Error Variance Decomposition (FEVD) is the percentage of the variance of the error made in forecasting a variable (say, GDP) due to a specific innovation (say, the error term in the fiscal deficit equation) at a given horizon (like two years)". Whereas the IRF trace the effect of an innovation to an endogenous variable on the variables in the VAR system, the FEVD gives information about the relative importance of each random shock or innovation to the variables in the VAR system. The IRF together with the FEVD constitute what is known as "Innovation accounting"

3.5 CONCLUSION

This chapter addressed the methodology that would be used to investigate the effectiveness of fiscal deficits in stimulating economic growth in South Africa. We argued that macroeconomic time series data would be applied in an SVAR model in order for us to determine whether or not fiscal deficits have a stimulative effect on the South African economy. We analysed the source and type of time series data that are appropriate for our study. We examined problems associated with the use of time series data, and how to resolve them. The SVAR technique was discussed and we discovered that, despite the challenge of how to make “identification assumptions”, it is a better technique to use in investigating the economic effectiveness of fiscal policy. We also examined the diagnostic tests that would be used to assess the efficiency and validity of our estimates.

CHAPTER 4: EMPIRICAL RESULTS

4.1 INTRODUCTION

This chapter empirically investigates the impact of fiscal deficits on economic growth in South Africa. Specifically, it answers the questions raised in chapter 1: What is the effect of fiscal deficits on South Africa's economic growth and what factors are expected to explain it? The decision on whether fiscal deficits are an effective stimulatory policy in South Africa depends on the conclusions we draw from the following hypotheses: Fiscal deficits lead to a positive effect on economic growth, our null hypothesis (H_0). The alternative hypothesis (H_1), states that fiscal deficits have an effect on economic growth which is equal to or less than zero. If our results show an effect, which is statistically significantly positive, we should conclude that fiscal deficits are effective in stimulating economic growth in South Africa. Otherwise, the alternative hypothesis is accepted and we conclude that fiscal deficits are not effective in stimulating economic growth in South Africa.

As part of answering our research question, we also analyse factors that may explain the effectiveness of fiscal deficits on economic growth. For this reason, our model includes important variables for the analysis of the mechanism through which the economic impact of fiscal deficits may have been affected.

To determine the effectiveness of fiscal deficits, an SVAR model, which we re-write below from chapter three, is used. As stated, this model includes the real primary fiscal deficit as a percentage of GDP *(F)*, the real trade as a percentage of GDP *(T)*, the real effective exchange rate *(X)*, the log of real GDP *(O)* and the short-term real interest rate of the central bank *(B)*, as endogenous variables. It also includes exogenous variables: the exchange-rate regimes dummy *(dumreg)* and the 2011 structural break *(dum11)*.

- $\alpha Y_t = \sum_{k=1}^{K} C_k Y_{t-k} + \text{m}_k X_{t-k}\ \beta u_t$

To answer our research question, we organise this chapter as follows: in order to address the problem of unit roots, which in chapter 3 were discussed as being a serious problem in time series data, we use section 4.2 to detect the presence of unit roots and address them. The ADF method is used to detect unit roots, while the Johansen cointegration technique is used to address them. Section 4.3 discusses the diagnostic tests of the residuals and the stability of the SVAR model which we use in this study. This is important because the validity and reliability of our estimates and conclusions strongly depend on these tests. After satisfying that prerequisite, we estimate the SVAR in section 4.4. We use the standard procedure in VAR models of reporting the Granger causality test, the impulse response functions and the variance decomposition analysis. In all these reports, the short-run and long-run relationship outcomes are considered. Section 4.5 concludes chapter.

4.2 UNIT ROOT TESTS AND HOW TO ADDRESS THEM

4.2.1 Initial investigation of the data

Before undertaking a formal test for unit roots, Gujarati & Porter (2009:749) advise that a graphical analysis by visually plotting the time series should be done. They justify this by arguing that a graphical representation of the series provides a primary clue of the expected nature of the series with regard to the inclusion or not of a trend, constant/intercept term or both in the model. Our series are plotted in section 3.4 of chapter 3. Based on figures 3.1 to 3.5, the visual analysis of our series is as follows: The log of real GDP (Fig 3.1) has a constant term and maintains an upward time trend starting from the early 1990s. However, following the economic recession, it slightly declined in 2008 and then continued with the upward trend. On the other hand, the primary fiscal deficit as a percentage of GDP (Fig 3.2) has mainly been in the negative region, meaning that for most of the period, government expenditure (excluding expenditure on interest payments) was more than the revenue collected. The sharpest increases in the fiscal deficit were witnessed in the years 1993 and 2008. This time series has a constant term and shows random walk movement with time trend drifts in some periods, meaning that it is not stationary. The next time series, which is the real effective exchange-rate (Fig 3.3), is fairly stationary in the main, as its mean and variance seem to be constant throughout the period. Trade as a percentage of GDP, according to Fig 3.4, has a constant term and a time trend. This graph also shows that from the beginning of the sample period, the share of trade to GDP was increasing until 2008 when the economy was hit by a recession, making it decline and then rise again. Finally, the short-term real interest rate appears to have no constant term and is, fairly, stationary. However, a formal way of assessing if it is stationary is done below.

4.2.2 The ADF test for unit roots

The above analysis is not objective enough, as we cannot be sure about the stationarity or non-stationarity of the variables. A formal hypothesis testing approach for unit roots is required. The approach we use to test for unit roots as discussed in chapter 3 is the ADF, which has a null hypothesis, stating that unit roots are present in the series. This approach requires the use of trend deterministic assumptions. Based on the visual graphical analysis made above, we apply the following trend deterministic assumptions, as specified in E views package 7.0, which we use, ‘intercept term’, ‘intercept term and trend’, and ‘none’. Table 4.1 below shows results from the unit roots tests we have done for each of the five endogenous variables.

Table 4.1 Augmented Dickey-Fuller unit root test

	ADF Test		
Variables	**Level**	**1st Difference**	**Robust deterministic trends**
Fiscal deficit as % of GDP (F)	**-0.65**	**-11.69***	**None**
Trade as % of GDP (T)	**1.41**	**-5.56***	**None**
Effective Exchange rate (X)	**-8.96***	**-**	**None**
Real GDP (O)	**0.12**	**-4.06***	**Intercept**
Base rate (B)	**-6.20***	**-**	**Intercept**

Source: Author’s compilation;

** Denotes that we reject the null-hypothesis at 5% level of significance. The Schwarz Information Criterion is used to determine the lag order.*

Table 4.1 shows that, except for the real effective exchange-rate and the base rate, all the other variables are non-stationary at level. The non-stationary variables all become stationary after the first difference. Contrary to the trend deterministic assumptions based on our visual graphical analysis, the ADF test reveals that our series predominantly exhibit the no constant/no trend, and constant deterministic assumptions. Because of this pattern, in all our VAR estimations we assume that there is no deterministic trend in our model and choose the option in E-views which states that there is ‘no intercept or trend’.

4.2.3 Test for cointegration

We cannot run a model based on variables that are non-stationary. Doing so would produce spurious regressions. However, as we argued in chapter 3, if the series in the model, even if some are non-stationary, are able to form stationary residuals I(*0*) when they are regressed together, their regressions will not be spurious. This is because those series form a long-run equilibrium relationship, and they cointegrate, which is desirable. We use the Johansen cointegration test to ascertain if our model forms a long-run equilibrium relationship. Before we can apply the Johansen cointegration test, however, it is imperative that we determine the optimal lag length for our model, as the Johansen cointegration test is sensitive to the number of lags chosen.

Lag order choice

We use the lag length selection criteria to determine the optimal lag length for our model. As mentioned earlier, we use the option 'no intercept or trend' as our trend deterministic assumption in this test. Table 4.2 below shows our lag order choice outcome.

Table 4.2 VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-588.2858	NA	2.956052	15.27306	15.72295	15.45330
1	-181.1271	731.8548	0.000186	5.598155	6.797875*	6.078800
2	-134.4354	78.01663	0.000109	5.048996	6.998542	5.830044*
3	-106.6264	42.94548*	0.000104*	4.977883	7.677254	6.059334
4	-81.44483	35.70045	0.000108	4.973287*	8.422483	6.355140
5	-59.75784	28.00093	0.000127	5.057160	9.256182	6.739417
6	-41.11828	21.70683	0.000167	5.218184	10.16703	7.200844
7	-24.08847	17.67651	0.000240	5.419961	11.11863	7.703024
8	3.932467	25.53806	0.000278	5.343482	11.79198	7.926947

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

We choose the lag length of 4 based on the result suggested by the Akaike Information Criterion (AIC). We do this because this lag length is the generally accepted lag order choice in empirical fiscal policy studies. This can be verified in studies by Blanchard & Perotti (2002), Ilzetzk et al (2010) and Kamps & Caldara (2008). A smaller lag length, as suggested by other criteria, can be rejected on economic grounds. This is because, theoretically, it takes more than one quarter for the effects of fiscal policy to be registered in the economy.

4.2.4 Johansen cointegration approach

Having made a decision on the lag order choice and the trend deterministic assumptions, we can now investigate if our model forms a long-run equilibrium relationship using the Johansen cointegration approach. Suffice to mention that the unit root tests in table 4.1 reveal that our series exhibit I(*0*) and I(*1*) variables. Typically, the Johansen cointegration approach was designed to handle variables that are integrated I(*1*). However, Johansen (1991: 1560) argues that there is still no problem with combining I*(0*) and I(*1*) variables when testing for cointegration. This, he argues, is because, if some variables are I(*0*) instead of I(*1*), they will reveal themselves through cointegrating vectors whose space is spanned by the stationary variables in the model (Johansen, 1991: 1560).

As we mentioned in chapter 3, the Johansen cointegration approach has two tests for cointegration. These are the Trace test and the Maximum Eigenvalue tests.

4.2.4.1 Trace test

Table 4.3 below shows the results from the trace test for cointegration.

Table 4.3 Trace test: Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.307877	74.70842	60.06141	0.0018
At most 1 *	0.266434	44.53317	40.17493	0.0171
At most 2	0.151509	19.12646	24.27596	0.1946
At most 3	0.059812	5.654240	12.32090	0.4794
At most 4	0.007252	0.596833	4.129906	0.5012

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

In this test, we reject the null hypothesis that there is no cointegrating vector in our model. This is because at this rank (number of cointegrating vectors) the trace statistic value of approximately 74.71 is greater than the 5% critical value of about 60.06. Next, the null-hypothesis that there is at most 1 cointegration relationship, is also rejected, because at this rank the trace statistic value of approximately 44.53 is greater than the 5% critical value of about 40.17. We, however, do not reject the null hypothesis which states that there are at most 2 cointegrating relations. This is because at this rank the trace statistic value of approximately 19.13 is less than the 5% critical value of about 24.28.

4.2.4.2 Maximum Eigenvalue test

Table 4.4 below shows the results from the maximum Eigenvalue cointegration test.

Table 4.4 Maximum Eigenvalue test: Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.307877	30.17525	30.43961	0.0539
At most 1 *	0.266434	25.40671	24.15921	0.0338
At most 2	0.151509	13.47222	17.79730	0.1990
At most 3	0.059812	5.057407	11.22480	0.4692
At most 4	0.007252	0.596833	4.129906	0.5012

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

In this test, we do not reject the null hypothesis, that there are no cointegrating relations. This is because at this rank the maximum Eigen statistic of approximately 30.18 is less than the 5% critical value of about 30.44.

Based on the two Johansen cointegration tests, we have two conflicting numbers of cointegrating relations. The trace test gives us 2, while the maximum Eigenvalue test gives us 0. Literature advises that either of the two tests can be used as a benchmark to determine the number of cointegrating vectors in the model (Lutkepohl et al, 2001: 305). These researchers conclude, however, that the Trace test produces more robust findings than the Eigenvalue test. This is because the trace test has more power when analysing more than one cointegrating relations, while the eigenvalue test is suitable in analysing one cointegrating relationship (Lutkepohl et al, 2001:305).

Based on the above analysis, we conclude that 2 is the total number of cointegrating relations we have in our model. This is desirable as we now know that our model forms an equilibrium relationship in the long run, and that we can run a VECM to use for determining causality in our model without getting spurious regressions. The other interesting finding in this test is that we have discovered that I(*0*) and I(*1*) variables are able to give us cointegrating relations. This conforms to the argument by Johansen (1991:1560) that variables with different levels of integration may be cointegrated. See also Harris (1995:80).

4.3 RESIDUAL DIAGNOSTIC CHECKS

Before we show our estimated results, it is necessary to begin by analysing the residuals from our estimated SVAR model. This analysis determines whether the results which we show in the next section, are efficient and reliable. We undertake the following residual diagnostic tests: serial correlation based on the Breusch-Godfrey serial correlation test, normality based on the Jarque-Bera test, and heteroskedasticity based on the White heteroskedasticity test. The null hypotheses for these diagnostic tests are that there is no serial correlation, no normality and no heteroskedasticity, respectively. In addition, we undertake inverse roots of AR characteristic polynomial in order to analyse the stability of our VAR.

4.3.1 Test for serial correlation or Autocorrelation

Correlation of a variable with itself over successive time periods (serial correlation) is a normal problem faced in time series analysis. Serial correlation can lead to the underestimation of standard errors, thereby making t-values to be overestimated. Our VAR estimates are suspect if our model exhibits serial correlation. We also highlighted in chapter 3 that the presence of serial correlation in the residuals is one indication that there could be an omitted important variable. Table 4.5 below is the Breusch-Godfrey serial correlation test with the null hypothesis stating that there is no serial correlation in our model. The test shows a value of about 1.015 for the observed R-squared, which is statistically insignificant at 5% level. Based on this finding, we cannot reject the null hypothesis of no serial correlation in our model. In other words, there is no serial correlation between the residuals and we do not have an important omitted variable in our model.

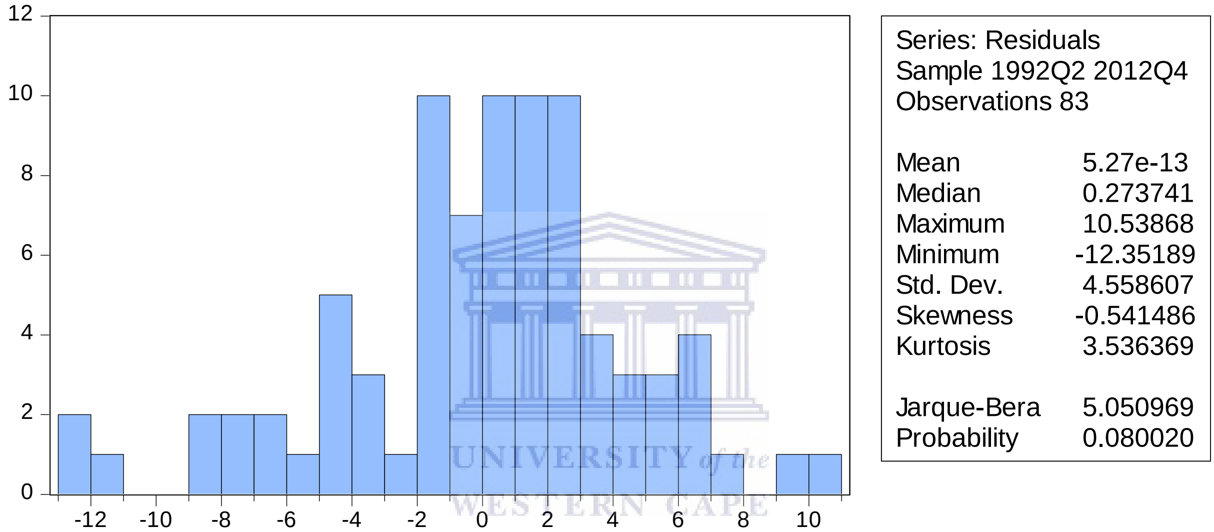
Table 4.5 Breusch-Godfrey Serial Correlation LM Test for our model

F-statistic	0.173335	Prob. F(4,56)	0.9512
Obs*R-squared	1.015060	Prob. Chi-Square(4)	0.9075

4.3.2 Normality test

We do the normality test to make sure that the estimated residuals are normal. A model with residuals that are not normally distributed cannot produce efficient estimates. Figure 4.1 below shows the Jarque-Bera test for normality, with a value of about 5.05, which is statistically insignificant at 5% level. Based on this test we do not reject the null hypothesis which states that the model is normal. In other words, the residuals in our model are normally distributed, and this is desirable in making our estimates efficient and unbiased.

Figure 4.1 Normality test



4.3.3 Heteroskedasticity test

Heteroskedasticity means that residuals do not have a constant variance. This results in a model having different probability distributions. We use the Breusch-Pagan-Godfrey test to test for heteroskedasticity. Based on the test in table 4.6, with an observed R-squared of about 17.95, which follows a Chi-square probability, we cannot reject at 5% level of significance the null hypothesis that our model has no heteroskedasticity. In other words, the residuals in our model are constant, and this is desirable in rendering our estimates efficient.

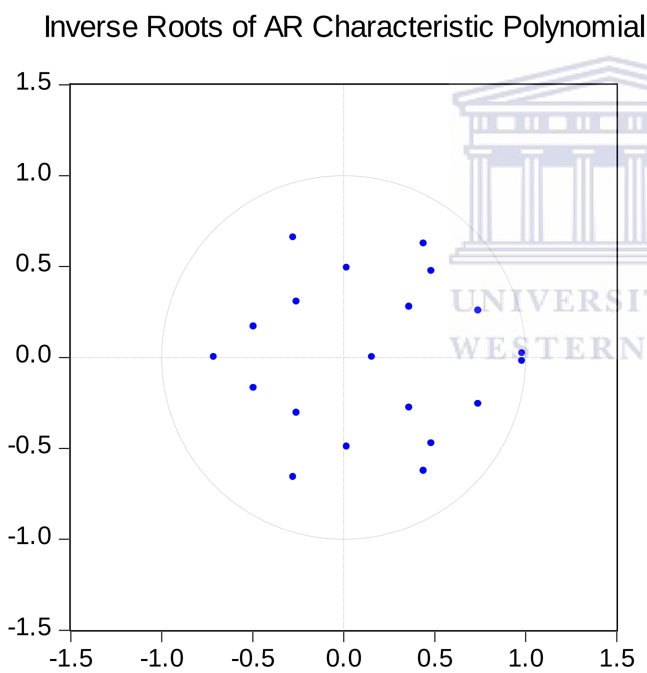
Table 4.6 Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.752450	Prob. F(22,60)	0.7669
Obs*R-squared	17.94779	Prob. Chi-Square(22)	0.7091
Scaled explained SS	11.89433	Prob. Chi-Square(22)	0.9595

4.3.4 Inverse Roots of AR Characteristic Polynomial

As we discussed in chapter 3, VAR models need to be tested for stability in order for their estimates to be credible. Figure 4.2 below shows that all the reported inverse roots of the AR polynomial have roots with modulus which are less than one and they lie within the unit circle. This indicates that our estimated VAR is stable and stationary. This is a very desirable result due to the fact that, if our VAR were not stable, results, such as the impulse response standard errors, would be invalid, thereby making the results and conclusions of our model unreliable.

Figure 4.2 Inverse roots of AR characteristic polynomial



4.4 EMPIRICAL RESULTS

We follow the standard practice in VAR analysis which requires us to report results on causality in the model, impulse responses and forecast error variance decomposition.

4.4.1 Causality

In this section, we are interested in finding out whether the independent variables are useful in predicting the values of our dependent variable, which is real GDP. These variables include: the real primary fiscal deficit as a percentage of GDP, real trade as a percentage of GDP, real effective exchange rate, real short-term interest rate, exchange-rate regimes dummy and the 2011 structural break. Of particular interest, is to find out whether this relationship exists in both the short-run and the long-run.

In chapter 3 we ascertained that the normal Granger causality test is not effective in multivariate models. As a result, we use the procedure suggested by Maddala & Kim (1998:297) of using the Vector Error Correction Model (VECM) to determine causality for the short-run and the long-run. To determine short-run causality, a Wald-coefficient restriction test is undertaken using the joint lagged coefficient values of the independent the variables derived from the VECM model (excluding the coefficient of the error correction term).

On the other hand, to determine long-run causality, the Error Correction Term (ECT) of the VECM model is used. If the ECT is statistically significant and its coefficient value is negative, it means that, in the long run, the independent variables can jointly predict the values of the dependent variable.

4.4.1.1 Short-run causality test

Table 4.7 below shows the results of the Wald-coefficient restriction test derived after running a VECM. The null hypothesis in this test states that the dependent variable (real GDP) is in the short-run not jointly caused by all the independent variables, c(77) to c(100). Based on the statistical significance at 5% of the Chi-square value of 271.9875, we reject the null hypothesis that the independent variables [c (77) to c (100)] jointly cannot cause a short-run change in the dependent variable. In other words, our independent variables, jointly, can cause a short-run change in real GDP. This is a desirable result.

Table 4.7 Wald-coefficient restriction test results

Wald Test:

Equation: Real GDP as caused by other variables

Test Statistic	Value	Df	Probability

F-statistic	11.33281	(24, 57)	0.0000
Chi-square	271.9875	24	0.0000

Null Hypothesis: C(77)=C(78)=C(79)=C(80)=C(81)=C(82)=
C(83)=C(84)=C(85)=C(86)=C(87)=C(88)=C(89)=C(90)=
C(91)=C(92)=C(93)=C(94)=C(95)=C(96)=C(97)=C(98)=
C(99)=C(100)=0

4.4.1.2 Long-run causality test

Table 4.8 below shows the regression involving real GDP as explained by the lagged coefficients of the other variables in our model. We obtained this regression from the VECM, which we ran. We are interested in coefficient 73, which corresponds to the Error Correction Term (ECT). As we stated earlier, this test is based on the statistical significance of the ECT. The null hypothesis for this test is that the independent variables jointly cause the dependent variable in the long run. In order for the ECT to be accepted as a determinant of long-run causality in the VECM model, its coefficient must have a negative sign. From table 4.5, the ECT coefficient of about -2.54 has a correct sign, which is desirable. However, this coefficient is not statistically significant at 5% level. Our conclusion therefore, is that in the long-run, there is no causality from the independent variables to the dependent variable.

Table 4.8 Vector Error Correction Model results for the ECT

Dependent Variable: D(real GDP)
Method: Least Squares
Date: 03/24/13 Time: 19:01
Sample (adjusted): 1992Q3 2012Q4
Included observations: 82 after adjustments
D(real GDP) = C(73)*(F(-1) - 4.75019623249*X(-1) - 1.04059138528*O(-1) +
0.780286327946*B(-1)) + C(74)*(T(-1) - 4.7261647684*X(-1) -
0.268526560153*O(-1) - 0.097226364125*B(-1)) + C(75)*D(F(-1)) +
C(76)*D(F(-2)) + C(77)*D(F(-3)) + C(78)*D(F(-4)) + C(79)*D(T(-1)) +
C(80)*D(T(-2)) + C(81)*D(T(-3)) + C(82)*D(T(-4)) + C(83)*D(X(-1)) +
C(84)*D(X(-2)) + C(85)*D(X(-3)) + C(86)*D(X(-4)) + C(87)*D(O(-1)) +
C(88)*D(O(-2)) + C(89)*D(O(-3)) + C(90)*D(O(-4)) + C(91)*D(B(-1)) +
C(92)*D(B(-2)) + C(93)*D(B(-3)) + C(94)*D(B(-4)) + C(95)*DUMREG +
C(96)*DUM11

	Coefficient	Std. Error	t-Statistic	Prob.

C(73) or Error Correction Term	-2.54E-05	5.54E-05	-0.458245	0.6485
C(74)	-2.53E-05	9.89E-05	-0.255391	0.7993
C(75)	0.000344	0.000750	0.458914	0.6480
C(76)	-0.000137	0.000844	-0.161919	0.8719
C(77)	0.000674	0.000852	0.790882	0.4322
C(78)	0.001640	0.000720	2.278041	0.0264
C(79)	-0.008392	0.029767	-0.281904	0.7790
C(80)	-0.034423	0.027967	-1.230848	0.2233
C(81)	0.000381	0.028127	0.013548	0.9892
C(82)	-0.018567	0.030466	-0.609419	0.5446
C(83)	-9.03E-05	0.000288	-0.313504	0.7550
C(84)	-0.000229	0.000251	-0.910946	0.3661
C(85)	6.88E-06	0.000211	0.032654	0.9741
C(86)	5.62E-05	0.000142	0.395632	0.6938
C(87)	0.842154	0.134229	6.273988	0.0000
C(88)	-0.173720	0.176822	-0.982457	0.3300
C(89)	0.028957	0.182892	0.158327	0.8747
C(90)	-0.045461	0.156101	-0.291229	0.7719
C(91)	1.70E-05	4.22E-05	0.402234	0.6890
C(92)	-6.46E-06	3.60E-05	-0.179152	0.8584
C(93)	1.34E-05	3.09E-05	0.434186	0.6658
C(94)	-9.24E-06	2.68E-05	-0.344705	0.7316
C(95)	0.003021	0.001533	1.970776	0.0535
C(96)	0.000217	0.002946	0.073579	0.9416

R-squared	0.527462	Mean dependent var	0.007558
Adjusted R-squared	0.340076	S.D. dependent var	0.006368
S.E. of regression	0.005173	Akaike info criterion	-7.451489
Sum squared resid	0.001552	Schwarz criterion	-6.747084
Log likelihood	329.5111	Hannan-Quinn criter.	-7.168681
Durbin-Watson stat	1.944941		

4.4.2 Impulse Response Functions (IRFs) analysis

SVAR models are easily interpreted with Impulse Response Functions (IRFs). We are interested in investigating the short-run and long-run IRFs. In line with Boussard et al (2012:5), we take the short-run to represent a time gap of one year (four quarters) from the time the fiscal shock first occurred, and the long-run as a period of three years (12 quarters) from the time the fiscal shock first took place.

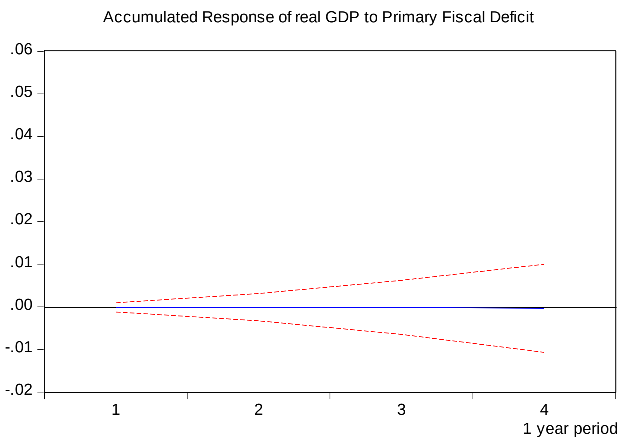
In our interpretation of the IRFs, we take the procedure of reporting responses, using the 'cumulative impulse response measure'. Hereafter, we refer to the cumulative impulse response measure as the 'cumulative response' or 'accumulated response'. The cumulative response analysis investigates the cumulative change in a variable, say real GDP over a given time horizon *N*, in response to cumulative changes in a variable like primary fiscal deficit over the same time horizon *N*.

Since the economic stimulative effect of fiscal deficits, depends not only on the increase in fiscal deficits but also on other variables, we restate that we included in our model other variables that are most important in influencing the effectiveness of fiscal deficits in stimulating economic growth. The mechanism through which those variables influence the potency of fiscal deficits is incorporated in our analysis of the IRF results.

4.4.2.1 Short and long- run cumulative response of real GDP to primary fiscal deficit

We begin our analysis by investigating the short-run IRF for the relationship between the key variables in our model. In this relationship, we analyse the response of real GDP to a one standard deviation positive shock in the primary fiscal deficit. Results based on the accumulated response measures in figure 4.3 below indicate that, in the short-run, the response of real GDP to a one standard deviation positive shock in the primary fiscal deficit is negligible or zero.

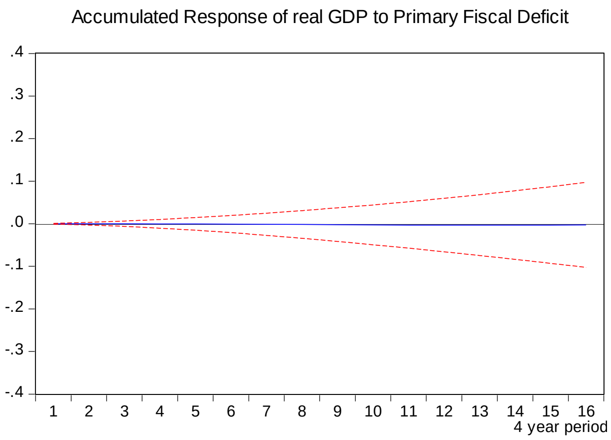
Figure 4.3 Short run response of real GDP to primary fiscal deficit



Since, in the above analysis, we find no significant change in real GDP to a change in the primary fiscal deficit, we can now state that there is a zero short-run response of real GDP to an increase in the primary fiscal deficit.

In the long-run, the IRF in figure 4.4 below shows that just as in the case of the short-run, the long-run response of real GDP to a one unit positive standard deviation shock in the primary fiscal deficit is almost zero.

Figure 4.4 Long-run response of real GDP to primary fiscal deficit



The results show that the response of real GDP to the primary fiscal deficit is negligible. We can now state that there is a zero long-run response of real GDP to an increase in the primary fiscal deficit.

Fiscal deficits lead to a positive effect on economic growth, our null hypothesis (H_0). The alternative hypothesis (H_1), states that a fiscal deficit has an effect on economic growth which is equal to or less than zero

These results provide an answer to our research hypotheses which, once again, state as follows: Fiscal deficits lead to a positive effect on economic growth in South Africa, as the null hypothesis; and fiscal deficits in South Africa have an effect on economic growth which is equal to or less than zero, as the alternative hypothesis.

Based on the above results, we reject the null hypothesis and conclude that fiscal deficits are not effective in stimulating both short-run and long-run economic growth in South Africa. This conclusion is quite similar to findings established by other related studies on South Africa. Jooste et al (2001:1), using the same methodology as ours, conclude that fiscal deficits in South Africa have a negative effect sometimes and positive one at other times. Our results fall between the Jooste et al (2001:1) findings. In terms of the long-run impact, our results are consistent with those of Jooste et al (2001:1) who also find a negligible effect. Ocran (2009:14) finds a negligible effect of fiscal deficits on economic growth. Clearly, these findings bring questions to the potency of discretionary fiscal policy in South Africa. We find the following factors to be credible in explaining the impotency of discretionary fiscal policy in South Africa:

4.4.2.2 Short and long-run cumulative response of primary fiscal deficit to real GDP

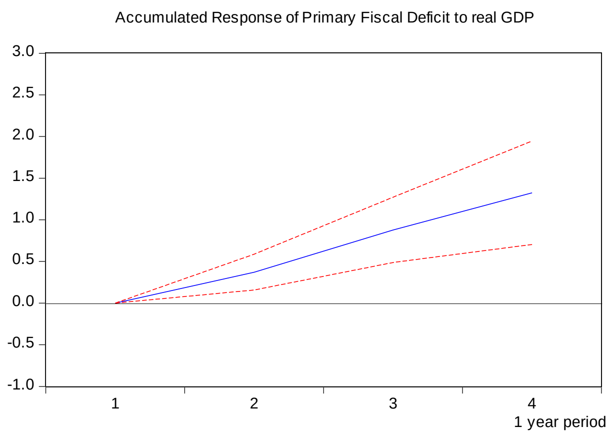
In this section, we analyse the state of automatic stabilisers in South Africa, and how it impacts the effectiveness of discretionary fiscal policy. The state of automatic stabilisers in our model is captured by the response of the primary fiscal deficit to a change in real GDP. Our interest is more in establishing whether automatic stabilisers in South Africa are strong.

Based on figure 4.5 below a one unit positive standard deviation shock in real GDP causes a rise in the primary fiscal deficit. This outcome portrays a scenario of small or weak automatic stabilisers in South Africa. If automatic stabilisers were strong, an increase in real GDP should have been associated with a fall in the primary fiscal deficit. Interestingly, our study is not the first one to make such a claim. Swanepoel & Schoeman (2003:566) find no significant evidence of automatic stabilisers in South Africa.

Suescun (2007:29) points out that, small fiscal automatic stabilisers tend not to be responsive to cyclical conditions and thus, have a weak anti-cyclical capacity to business fluctuations. Hoppner (2002:16) points out that, weak automatic stabilisers render discretionary fiscal policy ineffective in smoothening out business cycles. See also Swanepoel & Schoeman (2003:572). Discretionary fiscal policy works well when it is reinforced by automatic stabilisers. This is because, with strong automatic stabilisers, spending through transfer payments increases, while taxes automatically fall during economic downturns. This helps to stimulate the economy.

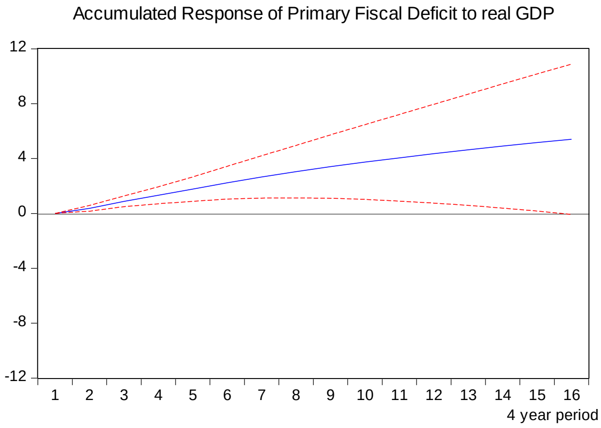
In view of the fact that our study finds weak short-run automatic stabilisers, we make the claim that this could explain why we obtained a zero response in economic growth to changes in fiscal deficits.

Figure 4.5 Short-run response of primary fiscal deficit to real GDP



In the long-run, we still find that automatic stabilisers are weak. Figure 4.6 below portrays weak long-run automatic stabilisers in South Africa. For the same reasons we gave above, we believe this could explain why we obtained a zero long-run response of economic growth to changes in fiscal deficits.

Figure 4.6 Long-run response of primary fiscal deficit to real GDP



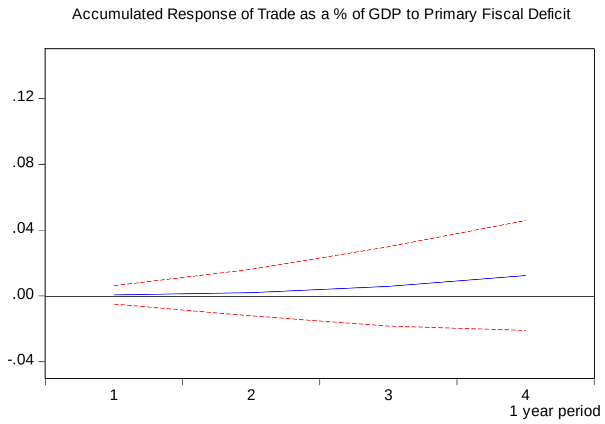
4.4.2.3 Short and long-run cumulative response of trade as a % of GDP to primary deficit

The next analysis refers to the extent to which the degree of openness to trade can offset the economic stimulative effect of fiscal deficits. We discussed in chapter 2 that more open economies render fiscal policy ineffective because fiscal stimuli may be leaked out of the economy through imports. See among others Spilimbergo et al (2009:2) and Ilzetzki et al (2010:6).

We use trade as a percentage of GDP to assess whether fiscal deficits are leaked out of the economy through increased imports. An increase in trade as a percentage of GDP due to a positive shock in the primary fiscal deficit indicates that the fiscal deficit is leaked out of the economy through imports. We are aware that trade as a percentage of GDP can increase due to an increase in exports, as well. However, we contend that, if trade as a percentage of GDP increases due to the rise in exports, this effect should lead to a positive impact on real GDP. Failure to do so makes us claim that the increase in trade as a percentage of GDP emanates from the rise in imports.

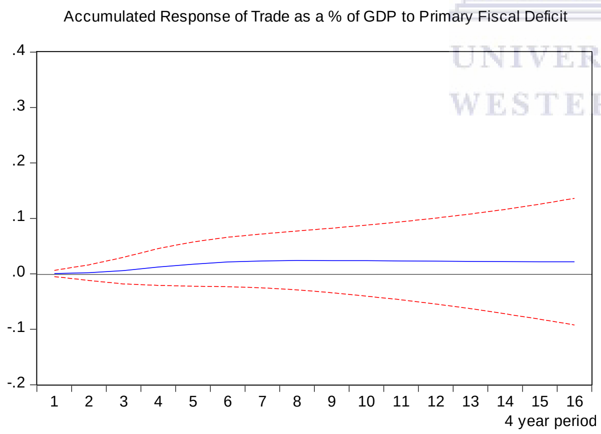
Figure 4.7 below shows the short-run response of trade as a percentage of GDP to a one unit positive standard deviation shock in the primary fiscal deficit. We find a positive IRF. We claim that this outcome is attributed to the leakage of the fiscal deficit through increased imports. Because of that, the economic stimulative effect of fiscal deficits was offset by leakages through increased imports. This possibly explains why we obtained a zero response of economic growth to changes in fiscal deficits.

Figure 4.7 Short-run response of trade as a % of GDP to primary fiscal deficit



In terms of the long-run relationship for these variables, figure 4.8 below reports a positive cumulative response. Based on this response result, we contend that the long-run economic stimulative effect of the primary fiscal deficit was offset by the leakages through increased imports. We believe that this could explain why we obtained a zero response of economic growth to changes in fiscal deficits.

Figure 4.8 Long-run response of trade as a % of GDP to primary fiscal deficit



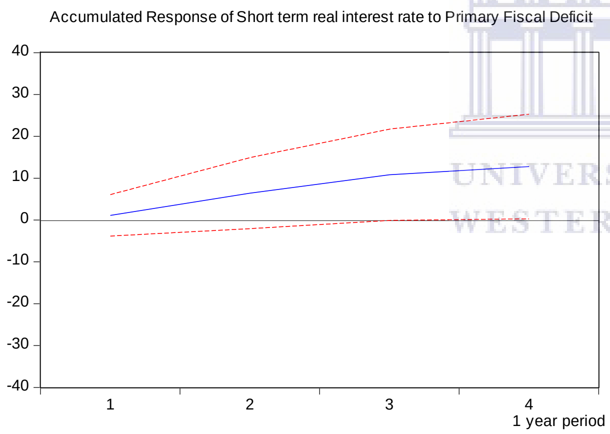
4.4.2.4 Short and long-run cumulative response of the real interest rate to the primary deficit

In this section, we assess whether fiscal deficits lead to the rise in interest rates. Perhaps, the most cogent argument against fiscal deficits, particularly by the neoclassical economists, is that they lead to an increase in interest rates which then dampen or crowd-out private investment. The crowding-out of private investment offsets the economic stimulative effect of fiscal deficits. Interestingly, the new Keynesians, like Eisner (1989:89), acknowledge that fiscal deficits do raise interest rates. However, to them, fiscal deficits are important for improving business confidence, such that, regardless of the level of interest rate, private investment would still occur, guaranteeing an increase in GDP.

From the two schools of thought, figure 4.9 below helps to ascertain the claim which conforms to our empirical findings. From figure 4.9, a one unit short run positive standard deviation shock in the primary fiscal deficit leads to a positive change in the short-term real interest rate. So far, both schools of thought are correct in their predictions. However, we argue that the neoclassical prediction is consistent with our findings, that is, there is a rise in interest rates which is associated with a fall in real GDP. On the other hand, the new Keynesian prediction fails on the basis that the rise in the interest rate is, in our case, not associated with an increase in real GDP.

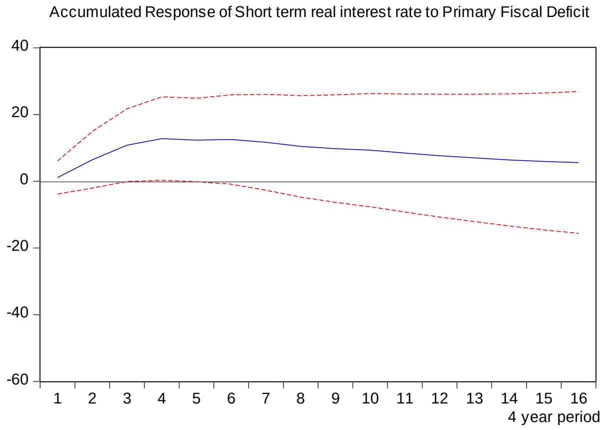
Our conclusion is that, the short-run economic stimulative effect of the primary fiscal deficit was offset by the dampening effect of the rise in interest rates on private investment. This could explain why we obtained a zero response of economic growth to changes in fiscal deficits.

Figure 4.9 Short-run response of the short-term real interest rate to primary fiscal deficit



In terms of the long-run relationship for these variables, figure 4.10 below shows an increase in the short-term real interest rate to a one unit positive standard deviation shock in the primary fiscal deficit. We conclude that the long-run economic stimulative effect of fiscal deficits was offset by the crowding-out of private investment. This could potentially explain why we found a long-run fiscal multiplier which is less than one.

Figure 4.10 Long-run response of short-term real interest rate to primary deficit

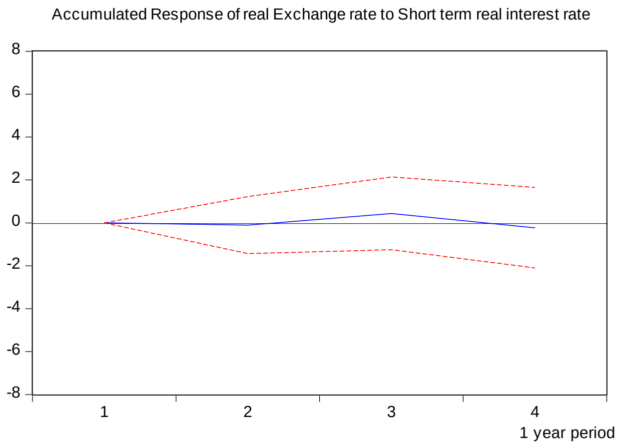


4.4.2.5 Short and long-run cumulative response of real effective exchange-rate to real interest rate

In this section, we make an analysis that fiscal deficits lead to the rise in interest rates. This rise in interest rates creates room for the appreciation of the real exchange-rate, which then causes a trade deficit, and hampers GDP. In chapter 2, we made reference to the Mundell-Fleming framework which posits that fiscal policy is ineffective in economies where capital is mobile. The justification for this argument was that fiscal deficits lead to the rise in interest rates, which we have already established in the section above. This rise in interest rates leads to increased capital inflows, which cause the real appreciation of the exchange rate. The appreciation of the real effective exchange-rate leads to a trade deficit, in addition to the fiscal deficit, ending in what is called the "twin deficit hypothesis" which we mentioned in chapter 2. These reactions offset the economic stimulative effect of fiscal deficits.

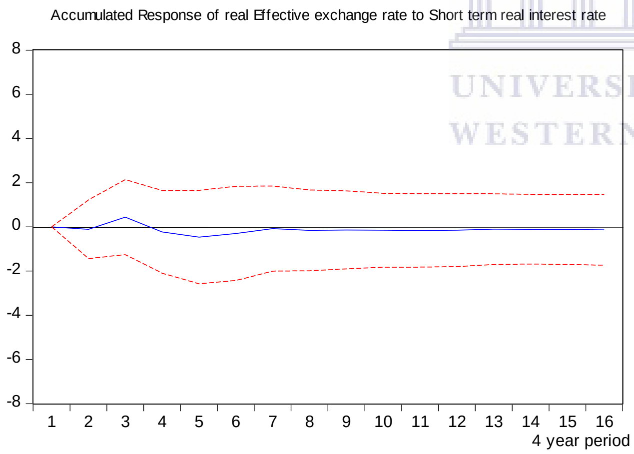
Focusing on the results from our SVAR, figure 4.11 below shows the response of the real effective exchange-rate to a one unit short run positive standard deviation shock to the short-term real interest rate. There is a noticeable amount of appreciation of the real effective exchange-rate, although not throughout the entire short-term period. This appreciation of the real effective exchange-rate could have led to a trade deficit, thereby offsetting the short-run economic stimulative effect of the fiscal deficit. Barro (1981:1109) reaches this same conclusion about the economic effect of fiscal policy. We, therefore, believe this could explain why we obtained a zero short-run fiscal impact of fiscal deficits on economic growth.

Figure 4.11 Short-run response of real effective exchange-rate to short-term real interest rate



As for the long-run relationship for these variables, figure 4.12 below shows that the change in the real effective exchange-rate, due to a one unit positive standard deviation shock, is almost negligible. We conclude that the relationship between these variables had a negligible effect on the long-run effect of fiscal deficits.

Figure 4.12 Long-run response of real effective exchange-rate to short-term real interest rate



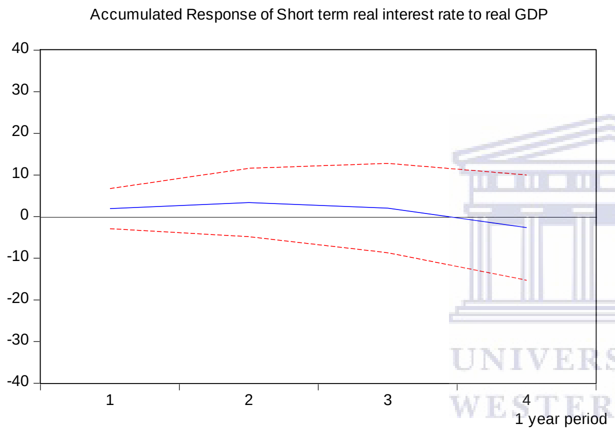
4.4.2.6 Short and long-run cumulative response of short-term real interest rate to real GDP

In this section, we are interested in assessing the impact of the monetary policy framework of inflation-targeting on the effectiveness of fiscal policy. Christiano et al (2009:80) and Spilimbergo et al (2009:3) argued that fiscal stimuli are a failure under inflation targeting monetary policy. This is because, under inflation-targeting, the monetary authorities adjust the short-term interest rate in response to deviations of GDP and inflation from their steady-state levels (Jooste et al, 2012:7). In this case, the active role of monetary policy to maintain a certain desired level of inflation or output through changes in the interest rate might offset the economic stimulative effect of fiscal deficits.

The SARB follows this approach. Because of that, we expect that an increase in real GDP should result in an increase in the short-term real interest rate in order for the SARB to maintain inflation and GDP in their steady state. In other words, we expect an offsetting effect of the economic stimulative effect of fiscal deficits through the raising of interest rates by the SARB.

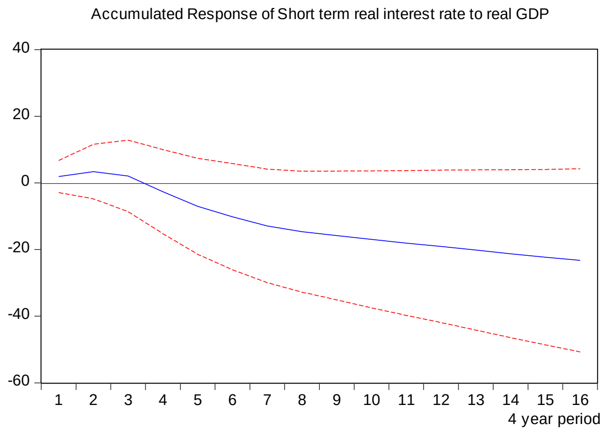
Figure 4.13 below, confirms the active role of the SARB. The short-term real interest rate rises due to a one unit positive standard deviation shock in real GDP. We argue that this active role of the SARB had an offsetting economic stimulative effect of the primary fiscal deficit. Thus, inflation-targeting monetary policy of the SARB could have contributed towards the ineffectiveness of fiscal deficits on economic growth.

Figure 4.13 Short-run response of the short-term real interest rate to real GDP



In the long-run, we find results which do not confirm our expectations, as can be seen in figure 4.14 below. We see a negative response of the short-term real interest rate to an increase in real GDP. This result reveals that the SARB was more interested in the continued stimulation of long-run economic growth. This could also explain why South Africa's inflation rate over the years has been bordering the upper limit of the targeted range.

Figure 4.14 Long-run response of short-term real interest rate to real GDP

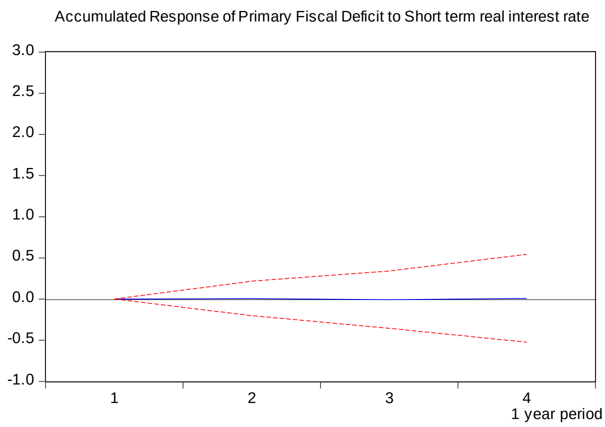


4.4.2.7 Short and long-run cumulative response of primary deficit to short-term real interest rate

In this section, we are interested in making one attempt of assessing the consistency of relationships in our model. We do so by analysing the response of the primary fiscal deficit to an increase in the short-term real interest. In chapter 3, we mentioned that one of the reasons we ordered the interest rate variable after the primary fiscal deficit variable was to assess whether the primary fiscal deficit can react to interest rate changes. Since the primary fiscal deficit excludes interest payments, if our estimates are consistent, it means that this variable should not react to changes in the short-term real interest rate.

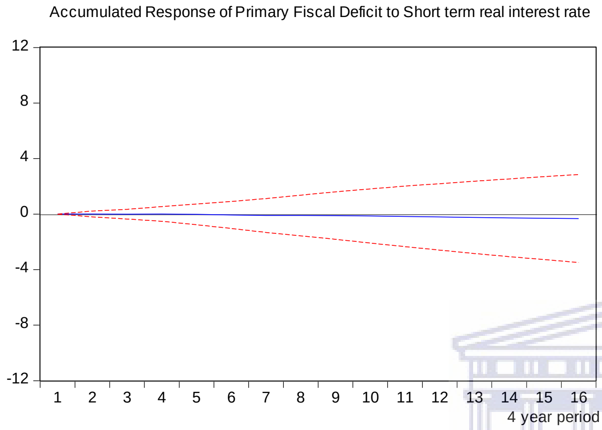
Figure 4.15 below demonstrates that the primary fiscal deficit has a negligible short-run response to a one unit positive standard deviation shock in the short-term real interest rate. This result is in accordance with what we expected. It is an indication of consistency in our model.

Figure 4.15 Short-run response of primary fiscal deficit to short-term real interest rate



In the long-run, figure 4.16 below shows a slight negative response of the primary fiscal deficit to a one unit positive standard deviation shock to the short-term real interest rate. This result is contrary to what we expected. However, undertaking an experiment of testing the consistency of the estimates from data series in the manner we do, comes at a risk. This is because national accounts data are never objective enough, and thus, will often fail the type of consistency test that we have just applied.

Figure 4.16 Long-run response of primary fiscal deficit to short-term real interest rate



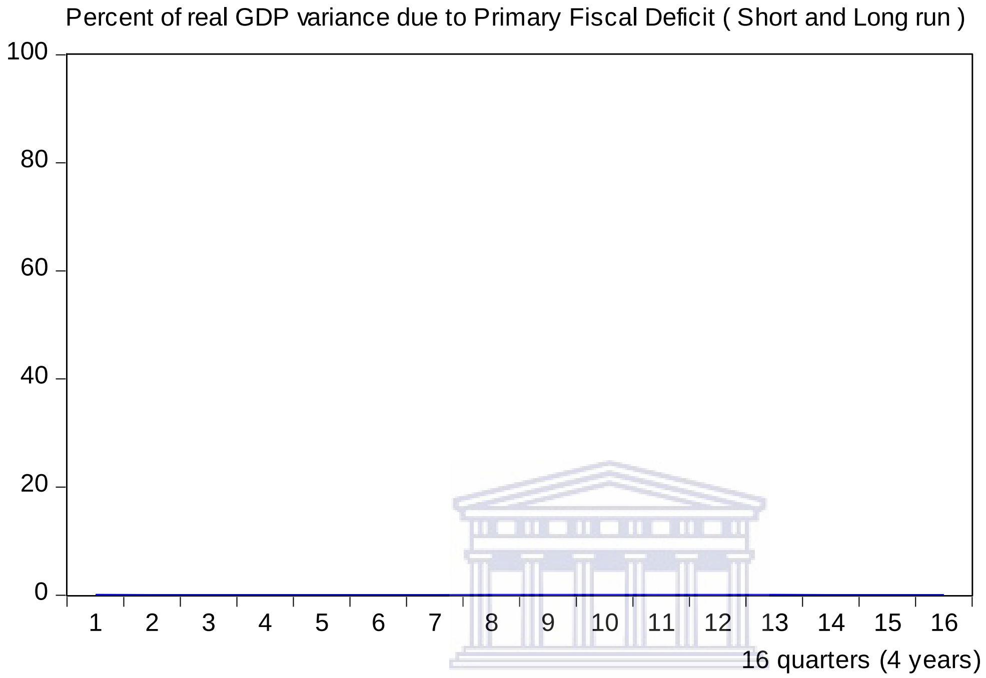
4.4.3 Forecast Error Variance Decomposition (FEVD)

In consonance with the standard practice when showing findings for VAR models, we also report results from the Forecast Error Variance Decomposition (FEVD). Once again, this reports the strength of a given shock in explaining the changes that occur in another variable. This is necessary as it helps us to gauge the relevance of a given variable in influencing another variable. It also helps us to assess the consistency of the analyses we made under the IRFs. We report the short-run and long-run FEVD for each relationship using the same graph. As before, the short-run is a period up to 4 quarters (1 year), while the long-run is a period of 12 quarters (3 years) and beyond. A tabular FEVD is provided at the end of this section particularly to analyse the variables that had the greatest influence in offsetting the economic stimulative effect of fiscal deficits.

4.4.3.1 Short and long-run real GDP variance due to primary fiscal deficit

In this section, we are interested in finding out the extent to which the primary fiscal deficit can influence changes in real GDP. As can be seen in figure 4.17, the primary fiscal deficit has almost a 0% influence on real GDP, both in the short-run and long-run. This tallies well with the results which we reported using the IRFs, where real GDP remained zero after an increase in the primary fiscal deficit. It is, therefore, correct for us to conclude that the primary fiscal deficit in South Africa has no stimulative effect on real GDP.

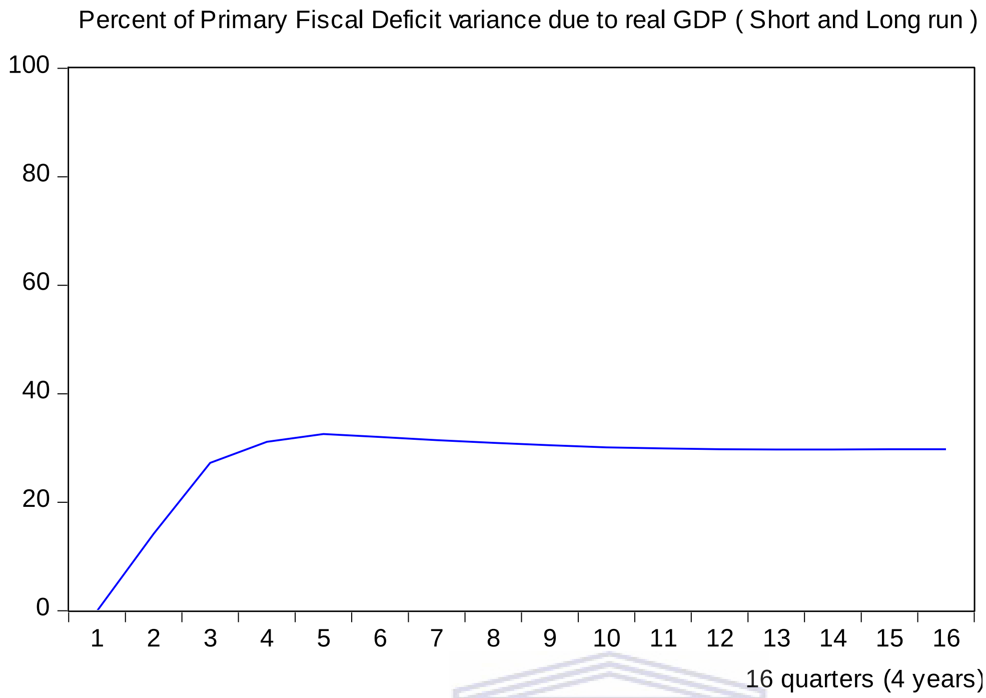
Figure 4.17 Real GDP variance due to primary fiscal deficit



4.4.3.2 Short and long-run primary fiscal deficit variance due to real GDP

According to figure 4.18 below, real GDP explains over 35% of variations taking place in the primary fiscal deficit. As we established when we analysed the IRFs, this variation relates to the increase in the primary fiscal deficit, which explains the case of very weak automatic stabilisers. As can be seen in the figure below, our results are almost in line with those of Swanepoel & Schoeman (2003:256) who find no evidence of the presence of automatic stabilisers in South Africa. Because of that, we once again, believe that weak automatic stabilisers could explain why we found a zero short-run and long-run response of economic growth to changes in fiscal deficits.

Figure 4.18 Primary fiscal deficit variance due to real GDP

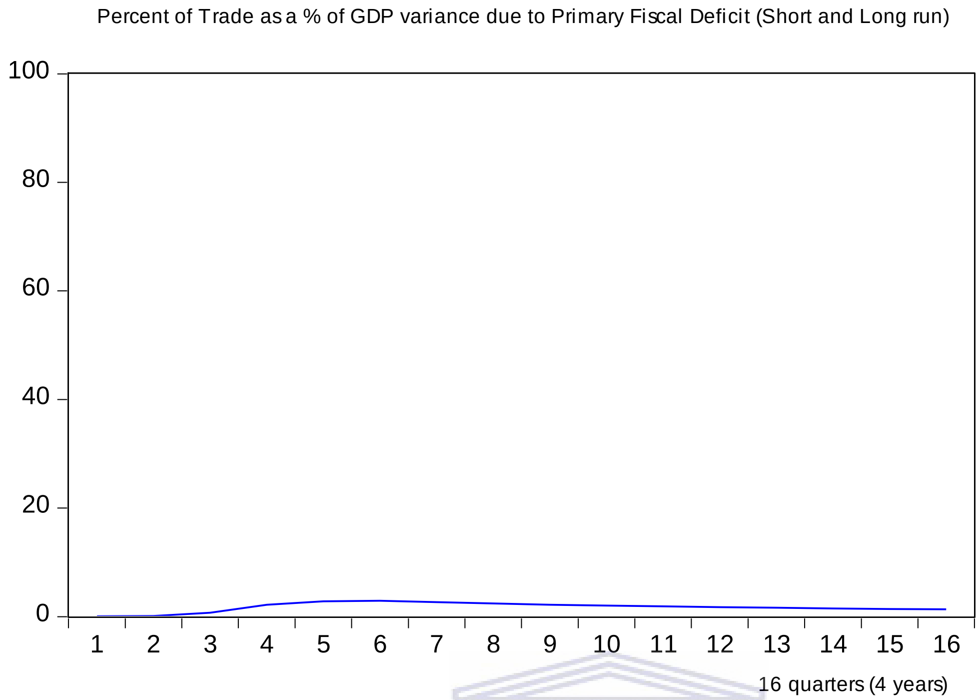


4.4.3.3 Short and long-run trade as a % of GDP variance due to primary fiscal deficit

In this section, we want to assess if the primary fiscal deficit has an influence in the increase in trade as a share of GDP. In our context, we have already established that the increase in trade as a percentage of GDP may have possibly been as a consequence of the primary fiscal deficit being leaked out through imports. In analysing the FEVD, we therefore look at the extent to which the primary fiscal deficit might have led to leakages through increased imports.

Figure 4.19 below shows a positive contribution of the primary fiscal deficit towards leakages through increased imports. This is in line with the analysis we made under the IRF analysis. Our conclusion is that, this outcome could explain why we found a zero short-run and long-run impact of fiscal deficits on economic growth.

Figure 4.19 Trade as a % of GDP variance due to primary fiscal deficit

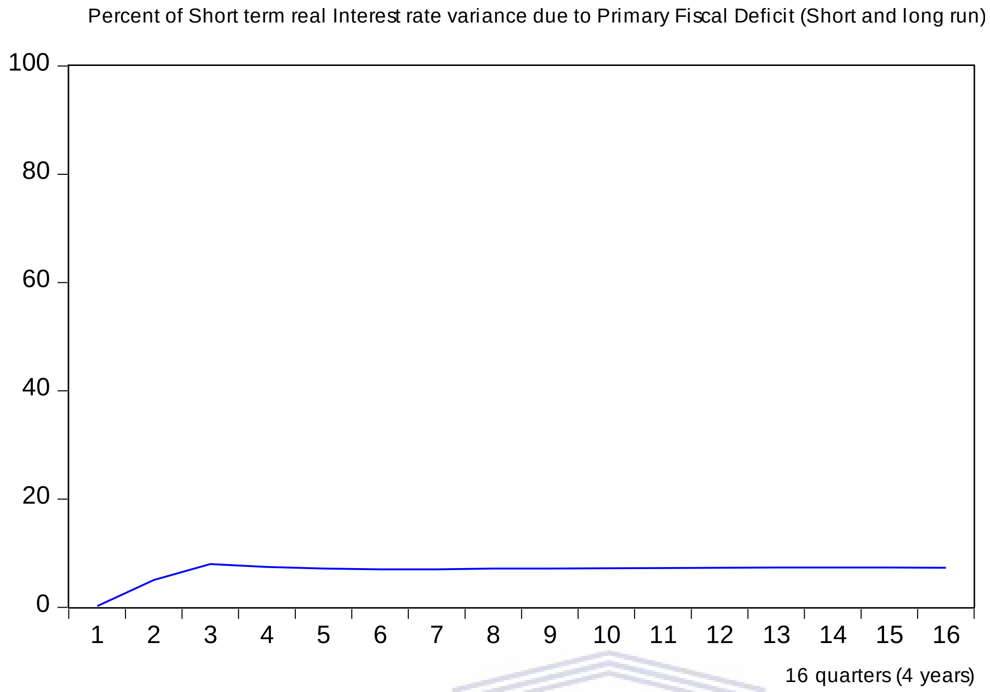


4.4.3.4 Short and long-run short term real interest rate variance due to primary fiscal deficit

In this section, we analyse the extent to which the primary fiscal deficit could explain the rise in interest rates, thereby, possibly causing what is commonly known as the crowding-out of private investment.

Figure 4.20 below shows that a shock in the primary fiscal deficit does contribute about 8% of the rise in the short-term real interest rate. Once again, this is consistent with our arguments under the IRF analysis that an increase in the primary fiscal deficit leads to a rise in the short-term real interest rate. Since our study finds a zero change in real GDP, we once again, claim that the economic stimulative effect of the primary fiscal deficit could have been offset by the dampening effect of the rise in the short-term real interest rate, both in the short-run and long-run.

Figure 4.20 Short-term real interest rate variance due to primary fiscal deficit

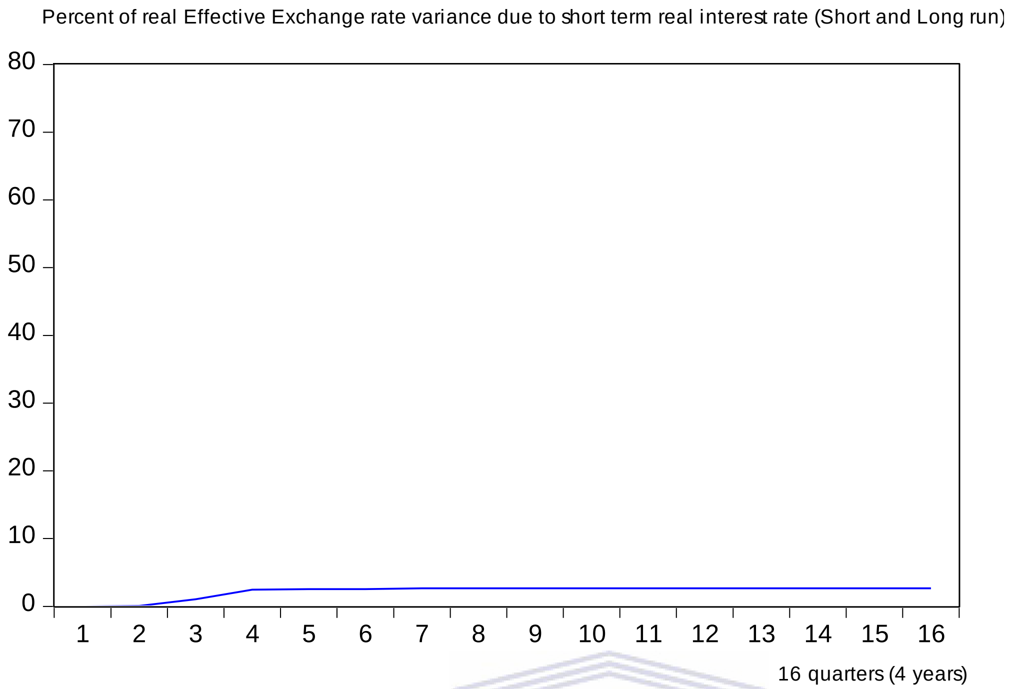


4.4.3.5 Short and long-run real effective exchange-rate variance due to real interest rate

In this section, we are interested in assessing the extent to which the short-term real interest rate could have influenced changes in the real effective exchange-rate. This assessment comes as a result of the Mundell-Fleming argument, made above, that fiscal deficits lead to a rise in interest rates. If capital is mobile in the economy, this could lead to an increase in capital inflows which then causes an appreciation of the real exchange-rate.

Figure 4.21 below, shows that a shock in the primary fiscal deficit has a positive contribution towards the appreciation of the real effective exchange-rate, both in the short-run and long-run. This is in line with our analysis under the IRFs where we established that an increase in the short-term real interest resulting from a fiscal stimulus would lead to the appreciation of the real effective exchange- rate. The appreciation of the real effective exchange-rate could have led to a trade deficit, thereby thwarting real GDP. As a result we are led to conclude that the economic stimulative effect of the fiscal deficit could have been offset by the increase in the trade deficit emanating from the appreciation of the real effective exchange-rate.

Figure 4.21 Real effective exchange rate variance due to short-term real interest rate

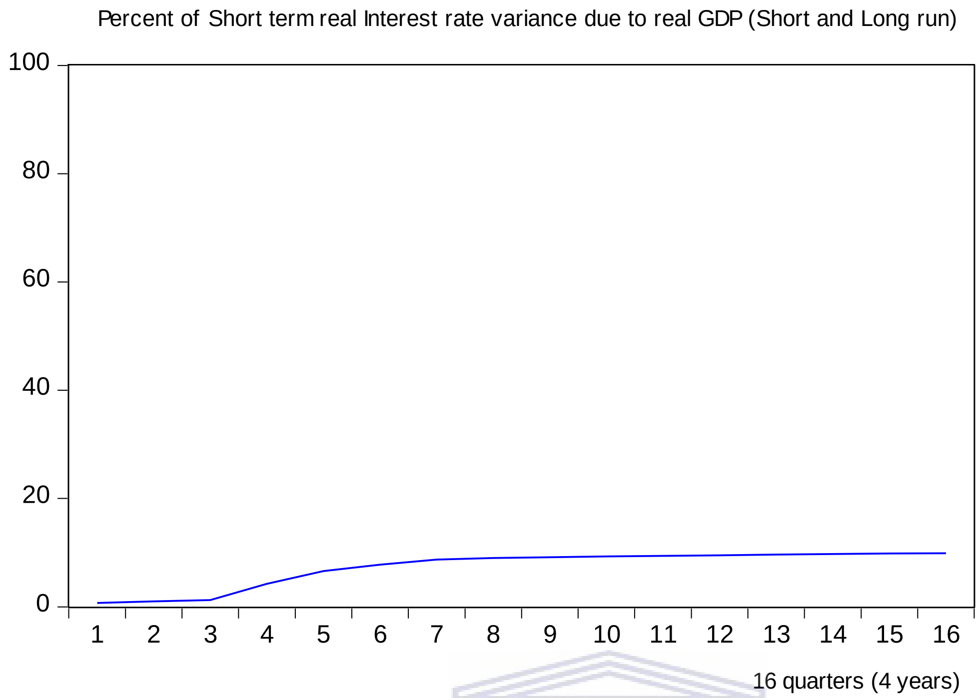


4.4.3.6 Short and long-run short-term real interest rate variance due to real GDP

Once again, South Africa pursues an inflation-targeting monetary policy. As we established earlier, the SARB adjusts the short-term real interest rate in response to deviations of real GDP and inflation from their steady state. In our case, we are interested in finding out the extent to which real GDP influences the SARB to change the short-term real interest rate.

From figure 4.22, we see that the percentage impact of real GDP on changes that take place in the short-term real interest rate is positive, both in the short-run and long-run. This implies that, real GDP contains information upon which the SARB bases its inflation-targeting monetary policy. As we mentioned earlier, the SARB reacts to this information by changing the short-term real interest rate, as can be seen in figure 4.22 below. We therefore conclude that the zero response of real GDP to changes in fiscal deficits we obtained could be attributed to the offsetting effects of the SARB's need to comply with the inflation-targeting monetary policy.

Figure 4.22 Short-term real interest rate variance due to real GDP

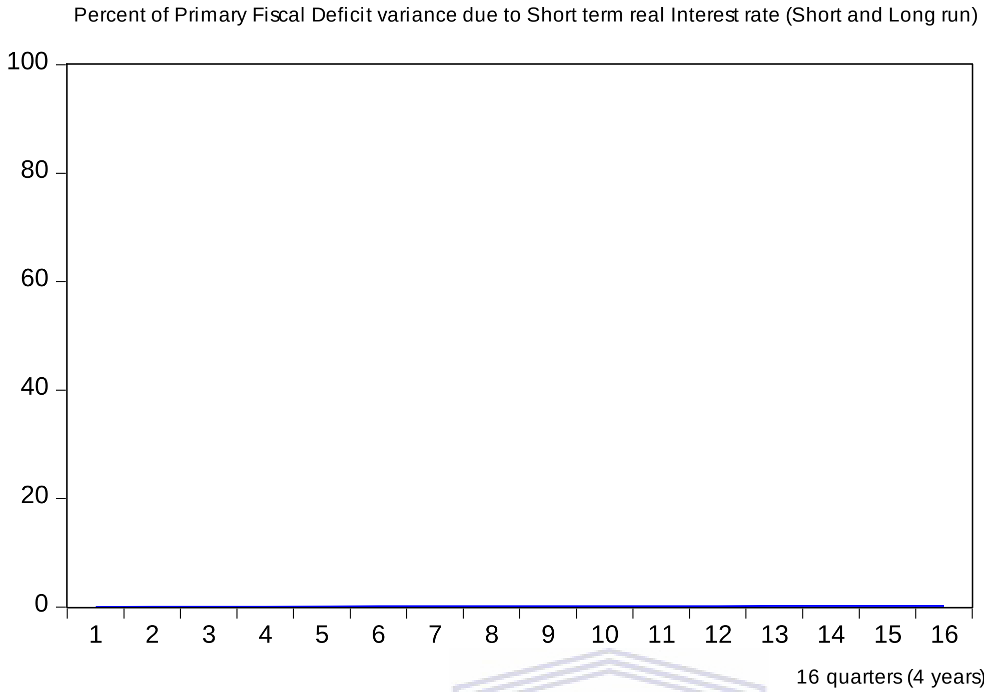


4.4.3.7 Short and long-run primary fiscal deficit variance due to short-term real interest rate

Finally, in this section, we attempt to assess the consistency of our estimates through gauging the extent to which the short-term real interest rate can influence the primary fiscal deficit. Since we calculate the primary fiscal deficit by subtracting interest payments, we expect that the short-term real interest rate should have a 0% influence on the primary fiscal deficit.

Figure 4.23 below shows exactly what we expected. This proves that our estimates between the primary fiscal deficit and the short-term real interest rate are consistent. In addition, our FEVD results help us to clarify the unclear findings we obtained under the IRF analysis where there was a slight response of the primary fiscal deficit to a change in the short-term real interest rate.

Figure 4.23 Primary fiscal deficit variance due to short-term real interest rate



4.4.3.8 Variance decomposition table for real GDP

In this segment, we are interested in finding out the variables which had the greatest influence in the variations of real GDP. The variables that had the greatest influence are taken to have had a dominant offsetting effect on the stimulative effort of the primary fiscal deficit. Table 4.6 below shows percentage contributions of each variable shock towards changes in real GDP at different forecast periods.

Table 4.9 Variance decomposition of real GDP:

Period	S.E.	Deficit	Trade as % GDP	Effective exchange rate	real GDP	Interest rate
1	0.004967	0.088613	5.225305	0.004531	94.68155	0.000000
2	0.009877	0.023607	2.631257	0.159388	97.16347	0.022281
3	0.014398	0.011601	1.238955	0.114694	98.62114	0.013608
4	0.018589	0.020282	2.451430	0.096163	97.41165	0.020473
5	0.022722	0.018786	5.839806	0.083378	94.03788	0.020152
6	0.026651	0.023880	9.252071	0.065732	90.63263	0.025688
7	0.030347	0.038119	11.95656	0.051668	87.92511	0.028544
8	0.033757	0.053688	13.88540	0.063217	85.96785	0.029839
9	0.036930	0.062067	15.29862	0.089850	84.52219	0.027279

10	0.039943	0.064886	16.41420	0.122034	83.37496	0.023916
11	0.042866	0.062052	17.35487	0.153523	82.40878	0.020767
12	0.045714	0.056842	18.13869	0.181079	81.60507	0.018320
13	0.048496	0.050990	18.78876	0.205007	80.93890	0.016345
14	0.051209	0.045743	19.33151	0.227530	80.38053	0.014683
15	0.053852	0.042291	19.80048	0.247265	79.89666	0.013299
16	0.056431	0.041540	20.22654	0.263539	79.45623	0.012147

In table 4.9 above, we notice that real GDP had the greatest short-run influence on itself, explaining about 97% of fluctuations in itself. It is followed by Trade as a percentage of GDP, with about 2% contribution. After that, the real effective exchange rate follows. The last ones are the short term real interest rate and the primary fiscal deficit.

In the long run, the influence of real GDP on itself declines, while the influence of trade as a percentage of GDP, real effective exchange-rate, primary fiscal deficit and short-term real interest rate increase, in that order.

We can claim, therefore, that the economic stimulative effect of fiscal deficits was offset by the influence of other variables. The influence of those variables can be ranked, starting with the strongest, as follows: trade as a percentage of GDP, which captures leakages through imports; real effective exchange-rate, which captures the trade dampening effect of the appreciation of the exchange-rate; fiscal deficit, and the short-term real interest rate, which captures the crowding out of private investment.

4.5 CONCLUSION

We undertook this chapter in order to test the research hypotheses: Fiscal deficits lead to a positive effect on economic growth, as our null hypothesis. The alternative hypothesis, on the other hand, stated that fiscal deficits have an effect on economic growth which is equal to or less than zero. We used macroeconomic time series data ranging from 1991 to 2012 to apply an SVAR model. We implemented all the necessary measures required to ensure that our series were made stationary and suitable for our SVAR model. Based on the IRF and FEVD analyses, we rejected the null hypothesis that fiscal deficits in South Africa lead to a positive effect on economic growth. We, therefore, establish that fiscal deficits in South Africa generate a zero short-run and long-run impact on economic growth, and conclude that they are not effective in stimulating economic growth. We analysed the different factors that could have led to this outcome. Basically, these factors explain how the economic stimulative effect of fiscal deficits was offset. They include: weak automatic stabilisers, openness to trade, real appreciation of the exchange-rate, crowding-out of private investment, and the fact that the SARB pursues an inflation-targeting monetary policy. These findings are efficient and reliable, based on the success in the diagnostic checks we undertook, which included the residual diagnostic tests and model stability test. Our findings are not very different from those of similar studies on South Africa. Jooste et al (2012:1) find that the short-run fiscal deficit impact can be positive sometimes and other times negative. Our long-run fiscal multiplier is exactly as found by Jooste et al (2012:1) where real GDP does not respond to an increase in the primary fiscal deficit. Ocran (2009:14) finds that fiscal deficits have an insignificant impact on economic growth.

CHAPTER 5: CONCLUSION

This study set out to investigate the short-run and long-run effectiveness of fiscal deficits in stimulating South Africa's economic growth. Determination of whether fiscal deficits are effective was based on the analysis of the impulse response functions and the forecast error variance decomposition estimated through an SVAR model.

Before the model was estimated, a literature review in chapter 2 was provided. In this chapter, we discovered that there is no consensus among different schools of thought regarding the effectiveness of fiscal deficits in stimulating economic growth. Whereas the new Keynesians argue that fiscal deficits stimulate economic growth, the neoclassical and Ricardian theorists disagree. The disagreements filtered into our literature on empirical findings about the effectiveness of fiscal deficits in stimulating growth. We discovered that empirical evidence on the effectiveness of fiscal deficits is mixed, regardless of which fiscal shock one uses. It can be positive, negative or zero.

We then discussed the methodology to use in estimating the effect of fiscal deficits in chapter 3. We substantiated the selection of the SVAR system for the analysis of the results in our study. Basically, the SVAR is easier to analyse and provides better estimates for economies susceptible to poor quality data such as developing countries, compared to the large scale simultaneous models. In this chapter, we presented the types of time series data that would be used for analysis and discussed how to resolve the problem of unit roots which is normally a source of concern in these types of data. Arising from the argument that one of the most critical challenges of using SVAR models is how to apply identification assumptions, we showed how the recursive identification method suggested by Sims (1980) could help in addressing this challenge in our study.

In chapter 4, we applied all the econometric tools necessary to ensure that our series were satisfactory for use in estimating the SVAR. This implies that we chose the optimal lag length, used robust deterministic assumptions and ensured that our series were stationary. Our model passed all the residual diagnostic and stability tests, making our conclusions efficient and reliable. We reported our results using Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD). Our results showed that fiscal deficits have a zero impact on economic growth. This led us to the conclusion that fiscal deficits are not effective in stimulating economic growth in South Africa. This arose due to the fact that the stimulative effect of fiscal deficits was offset by the crowding-out effect, small automatic stabilisers, leakages through increased imports, appreciation of the Rand and the inflation-targeting policy rule of the SARB.

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