

The Effect of Budget Deficits on the Current Account in Eswatini: Investigating the Twin Deficit Hypothesis.

By Simiso Fabian Mkhonta⁴

Abstract

The study aims to analyze the effect of the fiscal deficit on the current account in Eswatini for the period 1982-2020. The Vector Error Correction (VEC) model is employed to capture the long-run and the short-run effects of the fiscal deficit. The budget deficit was found to be significant and positively related to the current account both in the long-run attesting to the validity of the twin deficit hypothesis in Eswatini. The long-run cumulative effect on the current account is -5.76 per cent due to increases in the fiscal deficit.

Key words: *Fiscal and Current account deficits, Ricardian equivalence, Twin and Divergence deficit*

1. Introduction

Researchers have identified the co-movements in the budget and current account deficits. In theory, the impact of the fiscal deficit on the current account can be divided into two basic branches that are either neutral or negative. In other words, an increase in the fiscal deficit results in a worsening/improvement of the current account or no effect at all. Earlier research was occupied with providing evidence for the existence of the Ricardian equivalence or the twin deficit hypothesis, which is founded by John Maynard Keynes.

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Under the Mundell Fleming model, based on the Keynesian theory, fiscal deficits worsen current account deficits contrary to the Ricardian equivalence where it is neutral. This is where on the one hand the Keynesian scenario an unchanged savings investment gap results in the budget deficit being reflected in the current account and on the other hand the private sector responds by increasing saving in an anticipation of an increase in taxes in light of the increasing fiscal deficits.

Policy makers were earlier influenced by the works of Ricardo (1817) that believed in the neutrality of the fiscal budget deficits but later researchers discovered its non-neutrality in the works of Fleming (1962) and Mundell (1963).

Eswatini's fiscal budget and current account have moved in a positive synchronized manner save for the decade ending 2020. With the advent of the Eswatini Revenue Service (ERS) in 2011, the country was able to put in place efficient trade data collection systems that saw the improvement in the collection of trade flows (both exports and imports). This led to Eswatini realising an increase in exports relative to imports, which led to surpluses in the merchandise trade balance from 2013 to 2022.

The fiscal budget deficits in period 1982-1990 averaged -0.46 per cent of GDP and the current account deficits averaged -4.67 per cent of GDP. In the decade ending 2000 the fiscal deficit improved to -0.31 per cent of GDP and, the current account deficit similarly, improved to -1.18 per cent of GDP. In the decade ending 2010 the fiscal deficit worsened to an averaged -2.27 per cent and accordingly the current account deficit as a per cent of GDP worsened to -3.34 per cent. Finally, in the decade ending 2020 divergence in the fiscal and current account deficit is observed where the average fiscal deficit settled at -4.18 per cent and the current account recorded a surplus of 3.87 per cent. The divergence cannot be expected to be sustained as the current account was influenced by restructuring of the Eswatini Revenue Authority

(ERS). Such strong positive trends in the fiscal budget and current account deficits raises concerns of what will happen to the current account balance, which inherently impacts on international reserves, when the fiscal authorities embark on expansionary paths in "*post COVI-19*" recovery.

Consequently, the aim of the paper is to establish the nature of the fiscal and current account deficits nexus in the period 1982-2020 so as to implement relevant policy measures. The nature of the relationship can be of the Keynesian twin deficits or Ricardian equivalence hypothesis form. Section 2 gives an overview of the fiscal budget deficit and current account in Eswatini in the period under review. Section 3 reviews both theoretical and empirical literature. Section 4 is the methodology presentation and model estimation. Section 5 presents and interprets the results. Finally, Section 6 concludes the paper with observations and policy recommendations.

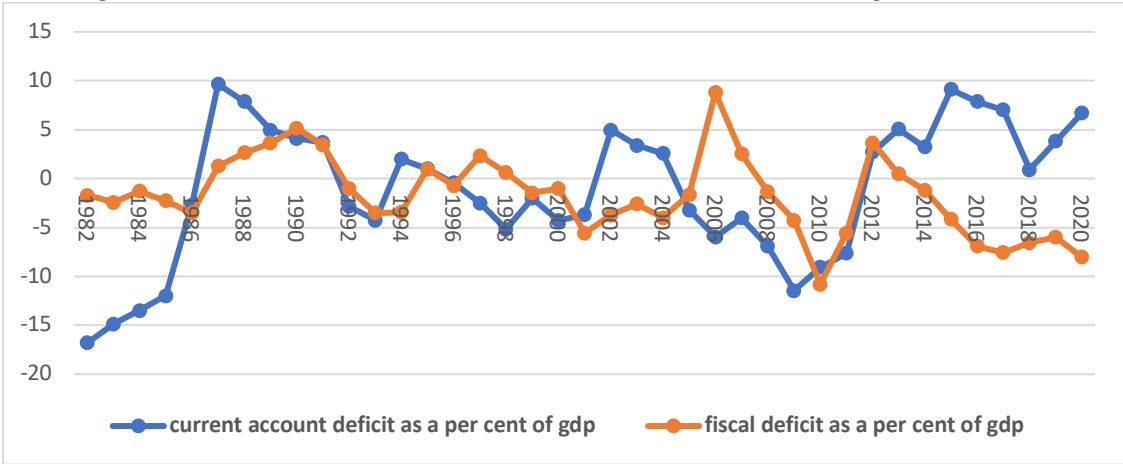
2. Fiscal Budget Deficit and Current Account in Eswatini

The fiscal budget, current account is significantly affected by disproportionate large financial risk shocks emanating from the volatile SACU receipts. The wide openness of the economy makes it vulnerable to external shocks, which have widely driven the external account in the form of shocks on exports.

In the 80s the country experienced lesser fiscal pressures than today. The fiscal deficit in the 80s was mild averaging 0.46 per cent of GDP and has worsened to average -4.18 per cent of GDP in the past decade. The current account deficits though rose from an average of -4.67 to a surplus of 3.87 per cent of GDP in the same period. The prima facie positive relationship between the two variables since the 1980s, however, seems to have weakened in the past decade (graphs 1 and 3). Earlier decades though show a positive relationship. The early 80s saw a deficit position in

the current account which turned into a surplus in the mid to late 80s. The deficits recorded by both the fiscal and current accounts in the early 80s was a the making of Cyclone domonia that hammered Eswatini, the northeast corner of South Africa and Southern Mozambique in January 1984 (ToS) coupled with a relatively strong local unit. In second half of the decade both accounts posted surpluses. The surplus positions resulted from the depreciation⁵ of the value of the domestic unit, which rendered Eswatini’s exports competitive and imports dearer. Government public debt interest payments in total recurrent expenditure declined from 8.6 per cent in 1987/88 to 4 per cent in 1991/92. Eswatini survived the depreciation of the Swazi Lilangeni)/US dollar in the early to late eighties because low debt levels (Development Plan Eswatini, 1992/93-94/95; Ayiko, 2011).

Graph 1. The Fiscal Deficit and Current Account as a per cent of GDP



Source: Central bank of Eswatini Quarterly Review.

In the early 1990s Eswatini plunged back into a current account deficit due to an appreciation of the local unit dampening exports volume sales and prices. Increases in government personnel cost resulting from the introduction of a fully-funded pension scheme and increases in the establishment register (staff compliment)

⁵ Eswatini withdrew from the peg with the South African Rand in 1986 as the slide amid worldwide political and economic sanctions imposed on South Africa.

returned the fiscal balance to a deficit. The fiscal recorded a huge surplus of 8.78 percent of GDP in 2006 as a result of SACU windfall.

Contagion effects from the 1998 Asian financial crisis resulted in a slump of exports pushing the current account and fiscal balance to deficit positions. In the period 2001-2004 the current account recovered posting a surplus due to the introduction of the African Growth Opportunities Act (AGOA) that resulted in an increase of exports mainly to the United States. In 2006 the current account was in a deficit as textiles fell and sugar exports weakened due the drop in the European Union preferential prices (Ayiko, 2011). Though on the other hand the fiscal balance recorded a surplus of 2006 due to SACU receipts almost doubling from 2005 levels of SZL 3.9 billion to SZL 6.1 billion due to strong economic growth recorded in South Africa and Eswatini. The fiscal budget surplus returned to a deficit shortly and did not reflect in an improvement of the current account, which deteriorated due to textile exports decline and sugar exports struggled with the fall in the European Union (EU) preferential prices.

The fiscal budget surplus quickly deteriorated in 2007 and 2008 due to increases in Government expenditure, particularly the implementation of the Dupius salary review report. Both the current account and fiscal balance were plunged further into one of the deepest negative territory due to the 2008 Global Financial crisis recording -11.5 in 2009 and -10.8 in 2010 as per cent of GDP respectively. In 2012 both the fiscal and current account balance improved to record surpluses but the fiscal balance quickly returned to negative territory due to high levels expenditure further compounded by high interest payment due to high debt levels as the exchange rate depreciated. The total government debt has doubled in 10 years from 12.1 per cent in 2012 to 25.4 per cent of GDP in 2020 along with external debt which rose from 6.9 to 10.4 per cent of GDP in the same period. The current account surplus was

sustained by favorable movements in the exchange rate which fell by 72.13 per cent from 2012 to 2020 and the real exchange rate with South Africa strengthened by 39.60 per cent.

The persistent intermittent deficits have resulted in the government debt approaching 40 per cent of GDP. Consequently, government's accumulation of stock of bonds and treasury bills holding have mounted. Government has further converted central bank advance into a government bond deferring its settlement and opening up space for more for money creation. This has resulted in the monetization elevated but within the limits of the Central bank/Government of Eswatini advance agreement. It is in particular after the global financial crisis that government took to habitual money creation to finance the deficit.

The fiscal deficit and current account deficit generally moved in the same direction with shocks seemingly arising from the fiscal to the current account or the other way around. Eswatini is highly dependent on external markets, developments in South Africa, reliance on revenue from less diversified products dominated by sugar and falling SACU receipts.

3. Theoretical and Empirical Literature Review

A deeper analysis of the Keynesian framework by Fleming (1962) and Mundell (1963) show that there is a possibility of the deficits to diverge.

On the one hand, Ricardian equivalence posits that the effect of the fiscal deficits on the current account is neutral because people increase their savings to pay anticipated tax increases. Taxation and public borrowing constitute equivalent forms of financing public expenditure (Ricardo, 1817).

Koji (2011) found the existence of the Ricardian equivalence in some European countries using a consumption function to analyze aloofness of economic agents to

policy changes. The study estimated a regression equation that was based on the Stanley (1998) consumption function. The insignificance of government tax revenue, the amount of government debt and government transfer payment to household in the estimation of the Stanley consumption function proved that the Ricardian equivalence holds. People will change their consumption pattern to accommodate future tax obligations. Mosikari and Hinaunye (2017) using the ARDL (Autoregressive Distributed Lags) model with data for the periods 1980-2014 and 1988-2014 in Lesotho found that the Ricardian equivalence holds in the two periods. The existence of the Ricardian equivalence was determined by running the effects of government debt and expenditure on household consumption per capita, which were found to be negative. The variables that were used by the authors are household consumption, government debt, government expenditure, GDP per capita, population, growth and inflation.

On the other hand, Keynesians argue that fiscal deficits will increase domestic absorption via import expansion causing a current account deficit. Njoroge et al (2014) with data from 1971q1-2012q1 applying unit roots, cointegration analysis, a dynamic vector error correction model and a multivariate Toda-Yamamoto long-run granger-causality found no evidence of a direct relationship between the fiscal budget deficit and the current account. The interest rate channel in line with Fleming (1962) and Mundell (1963) proved to be the credible transmission channel. Mugo et al (2021) found the presence of the Keynesian twin deficit hypothesis in Kenya with data from 1980-2016 using the same statistical techniques in their analysis. Handoyo et al (2020) applied the ADRL on data from 1981-2017 in Indonesia and found that the twin deficit holds in the long-run and in the short-run the divergence hypothesis holds. They concluded that the divergence hypothesis is associated with countries with a high savings rate.

The Keynes school of thought further argues in Fleming (1962) and Mundell (1963) that an increase in the fiscal deficits exert an upward pressure on domestic interest rate, which strengthens the domestic currency leading to deterioration of the current account. In real life though some studies have found that the exchange rate weakens in response to interest rate increases leading to an improvement in the current account. This outcome is known as the Twin divergence. It would occur in situation where government's financing of the fiscal deficit crowd's out the private investment exerting upwards pressure on interest rates that then reduce access to investment fund. Savings, on the other hand, increase leading to an improvement in the current account.

Sakyi and Opoku (2016) using cointegrating techniques with structural breaks found the presence of the twin divergence deficit in Ghana for the period 1960-2012. Control variables used in the study were the real GDP and the discount rate. The results suggest that interest rate increases in Ghana strengthened the current account with inflows and dampens investment and increases savings. Calderon (2000) also found the same with 44 developing countries. Roubini and Kim (2008) based on VAR models for the period 1973q1-2004q1 carried out research on the budget deficit and current account in the USA. They found the presence of a twin divergence in the USA. They concluded that when an increase in the fiscal deficit causes a depreciation in the exchange rate the current account position would improve. The USA external expenditure on the military weakened the current account leading to the depreciation in the real exchange rate. Increases in interest rates that followed attracted private saving which led to an improvement in current account.

The Keynesian framework so far implies that the subject is in a flexible exchange regime. The model is also applicable to a pegged exchange rate regime. Under a

pegged exchange rate system, interest rates cannot be determined independently. Government increased deficit financing it through bonds and treasury bills and through imports results in the current account deficit (Jayaraman, 2010; Mundell 1963; and Fleming, 1962). Nafimaketwe (2018) analyzed relationship between budget deficit and current account deficit in Namibia in the period 1990q1-2014q4. He found that the budget deficit does influence current account deficits however interest rate and exchange rates were found to be insignificant.

3.1 The Keynesian theoretical framework

From the national income accounts identity:

$$Y = C + I + G + (X - M) \quad (1)$$

Where Y is national income, C is consumption, I is investment, G is government expenditure, X exports and M imports. The national income can also be written as being consumed, saved and taxes paid is expressed as follows;

$$Y = C + S + T \quad (2)$$

Then;

$$C + S + T = C + I + G + (X - M) \quad (3)$$

Rearranging equation (3);

$$(S - I) + (T - G) = (X - M) \quad (4)$$

In equation 4 one has established that the current account ($X - M$) is equals to the fiscal budget deficit, ($T - G$), and the savings-investment gap, ($S - I$). The budget deficit affects the current account if and only if the savings-investment gap remains unchanged and the current account in turn affects the budget deficit as demonstrated in equation 5 below.

$$\overline{(S - I)} + (T - G) = (X - M) \Rightarrow (T - G) = (X - M) \quad (5)$$

This is a far-fetched assumption in world of open economies and increased globalization, hence the saving-investment gap will change as private economic agents transact with the rest of the world.

4. Methodology

4.1 Model Specification

The theoretical review has covered many variables that are deemed to influence the current account. Variables are selected largely, based on their theoretical connection to the variable of interest. Control variables selected from the literature review are the real GDP growth and the real exchange rate for Eswatini and South Africa due to availability of data and of course the variables of interest; the current account and the fiscal deficit. The variables and the model are selected from the studies in the literature review. The real exchange rate under a fixed exchange rate regime though has limited effect, instead the annual South African Customs Union (SACU) receipts has a great effect on current account. The statistical techniques used in the analysis of the impact of the fiscal deficit on the current account by researchers vary but they predominately use the Vector Autoregressive (VAR) and Vector Error Correction (VECM) model. Granger (1997) points out that eventually a computationally simpler technique with an acceptable degree of precision will be widely used. Caution should be taken though, in as much as the authors have used the VAR and VECM, they have supplemented their analysis with other models. The VECM's ability to capture both the long and short run is often cited by authors as the main advantage.

Table 1. Data Definition and Sources.

Variable	Definition	Source
<i>CA</i>	The current account shows flows of goods and services, primary income and secondary income between	Central Bank of Eswatini Quarterly Review.

	residents and nonresidents as a per cent of GDP (BPM 6).	
<i>FD</i>	The fiscal deficit is the difference between the total revenue and total expenditure of the government in a fiscal year.	Central Bank of Eswatini Quarterly Review
<i>SACU</i>	Annual SACU receipts on quarterly disbursement	Central bank of Eswatini Quarterly Review.
<i>rgdp</i>	real gross domestic product.	Central Statistics Office National Accounts Quarterly Gross Domestic Product Bulletin.

Source: Author.

The data are obtained from The Central Bank of Eswatini quarterly review in the period of 1982-2020 and Government of Eswatini Development Plans. Variables have to be tested for a unit root to establish their degree of stationarity.

The VAR model in general form;

$$\begin{aligned}
 LCA_t &= \beta_{10} + \beta_{11}LCA_{t-i} + \beta_{12}LFD_{t-i} + \beta_{13}LSACU_{t-i} + \beta_{14}LNGDP_{t-i} + v_t^{CA} \\
 LFD_t &= \beta_{20} + \beta_{21}LCA_{t-i} + \beta_{22}LFD_{t-i} + \beta_{23}LSACU_{t-i} + \beta_{24}LNGDP_{t-i} + v_t^{FD} \\
 LSACU_t &= \beta_{30} + \beta_{31}LCA_{t-i} + \beta_{32}LFD_{t-i} + \beta_{33}LSACU_{t-i} + \beta_{34}LNGDP_{t-i} + v_t^{SACU} \\
 LNGDP_t &= \beta_{40} + \beta_{41}LCA_{t-i} + \beta_{42}LFD_{t-i} + \beta_{43}LSACU_{t-i} + \beta_{44}LNGDP_{t-i} + v_t^{NGDP}
 \end{aligned}$$

If the variables are cointegrated then one can proceed to estimate the vector error correction model. We perform the Johannes cointegration procedure to determine the cointegration of the variables.

The VECM model;

$$\begin{aligned}
 \Delta LCA_t &= \beta_{10} + \beta_{11}\Delta LCA_{t-i} + \beta_{12}\Delta LFD_{t-i} + \beta_{13}\Delta LSACU_{t-i} + \beta_{14}\Delta LGDP_{t-i} + v_{1t} \\
 \Delta LFD_t &= \beta_{20} + \beta_{21}\Delta LCA_{t-i} + \beta_{22}\Delta LFD_{t-i} + \beta_{23}\Delta LSACU_{t-i} + \beta_{24}\Delta LGDP_{t-i} + v_{2t} \\
 \Delta LREER_t &= \beta_{30} + \beta_{31}\Delta LCA_{t-i} + \beta_{32}\Delta LFD_{t-i} + \beta_{33}\Delta LSACU_{t-i} + \beta_{34}\Delta LGDP_{t-i} + v_{3t} \\
 \Delta LNGDP_{gr_t} &= \beta_{40} + \beta_{41}\Delta LCA_{t-i} + \beta_{42}\Delta LFD_{t-i} + \beta_{43}\Delta LSACU_{t-i} + \beta_{44}\Delta LNGDP_{t-i} + v_{4t}
 \end{aligned}$$

5. Model Estimation

5.1 Data Description

Both the current account and fiscal deficit have a negative mean of -1.10 and -1.71 and also negative minimum of -10.79 and 16.80 as a per cent of GDP. The negative means of the current account and fiscal deficits suggests that the deficits are persistence. The large standard deviations for the current account, fiscal budget deficits and nominal GDP may suggest presence of heteroskedasticity.

Table 2. Descriptive Statistics (1982-2020)

Variables	Number of observations	Mean	Standard Deviation	Minimum	Maximum
<i>LCA</i>	39	-1.0979	6.9247	-16.8000	9.6513
<i>LFD</i>	39	-1.7121	4.0124	-10.7938	8.7842
<i>LSACU</i>	39	1.1449	0.3953	0.4100	2.4505
<i>LNGDP</i>	39	4.2479	4.2778	-1.8500	21.0200

Source: Author's Computation.

Times series data has to be tested for stationarity to obtain plausible parameters. The standard Augmented Dicky Fuller (ADF) is used to perform the stationarity tests. All t-statistics of the individual variables are less than the critical values. We fail to reject the null hypothesis of unit root absence.

5.2 Unit Root and Cointegration Test Results

Table 3. Augmented Dicky-Fuller Stationarity test results.

Variable	Test type	At level		
		t-statistics	1% Critical Value	Prob
<i>CA_t</i>	constant	-1.486964	-3.615588	0.5293
	constant + trend	-1.864764	-4.219126	0.6549
	non	-1.414783	-2.627238	0.1439
<i>FD_t</i>	constant	4.652892	-3.679322	1.0000
	constant + trend	3.748570	-4.309824	1.0000
	non	4.944165	-2.647120	1.0000

$SACU_t$	constant	-1.264140	-3.615588	0.6361
	constant + trend	-3.730833***	-4.219126	0.0322
	non	-0.269446	-2.627238	0.5824
y_t	constant	-3.166618***	-3.632900	0.0307
	constant + trend	-3.575043***	-4.243644	0.0468
	non	-3.569293***	-2.632688	0.0008
First differences				
dCA_t	constant	-5.791182***	-3.621023	0.0000
	constant + trend	-5.820708***	-4.226815	0.0001
	non	5.817591***	-2.628961	0.0000
dFD_t	constant	1.025915	-3.689194	0.9957
	constant + trend	-6.44090***	-4.252879	0.0000
	non	1.729771	-2.650145	0.9768
$dSACU_t$	constant	-6.053185***	-3.639407	0.0000
	constant + trend	-6.027710***	-4.252879	0.0001
	non	-6.665273***	-2.628961	0.0000
dy_t	constant	-3.458265***	-3.670170	0.0166
	constant + trend	3.224568	-4.296729	0.0988
	non	-3.685705***	-2.644302	0.0006

Note *, ** and *** indicate the critical values at the 10%, 5% and 1% level, respectively.

Table 3.1. Cointegration Test: Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	0	1	0	1	1
Max-Eig	0	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

The variables are nonstationary at levels. The vector error correction model can now be estimated. The Cointegration tests however is performed and the Trace and Eigenvalue show that there is one cointegrating equation in Table 3.1 above. We proceed to select the appropriate lag length before estimation. The FPE, SC and HQ select 1 lag and the AIC selects 3 lags.

Table 4. Optimal Lag Order Selection Criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
1	23.91405	NA	7.60e-06*	-0.439670	0.264117*	-0.194029*
2	38.50839	22.70230	8.44e-06	-0.361577	1.045995	0.129703
3	56.41309	23.87293	8.19e-06	-0.467394*	1.643965	0.269527

* indicates lag order selected by the criterion Source: Authors Computation, 2022.

The model is run with lag 1 and lag 3. The lag 1 results are more plausible than the lag 3 results and the model is run with 1 lag.

5.3 Model Analysis (Model Run and Diagnostic Tests of VECM)

The plausibility of the model is enhanced by detecting and correcting multicollinearity, heteroskedasticity and serial correlation. The VAR Residual heteroskedasticity test shows no correlation in the product of the error term, the null hypothesis of the presence of heteroskedasticity is rejected. The variables are however smoothed by taking their logarithms which retains their properties and the chi-sq. joint test improves. The LM serial correlation test rejects the null hypothesis of serial correlation (appendix 1 table 7). The results of the tests suggest that the results of VECM are robust. It can now be ascertained with the performance of the tests that the estimated results are credible.

5.4 Results Presentation and Interpretation

Table 5. Vector Error Correction Model Long run and short run Results.

Cointegrating Equation: Long run

Dependent variable	1.000000
lca_t	
$ldef_t$	-5.767327
	(0.60032)
	[-9.60712]
$lrer_t$	3.956779

	(1.09202)
	[3.62337]
$rgdp_t$	-0.000178
	(2.27388)
	[5.03939]
$lsacu_{t-3}$	1.302590
	(-0.000035)
	[5.68025]
c	9.071872

A percentage increase in the budget deficit is found to lead to a 5.76 per cent worsening in the current account in the long run. Eswatini current account and fiscal deficit data for the period 1982-2020 shows the presence of the twin deficit hypothesis. The model shows an insignificant positive short run relationship between the current account and fiscal deficit. The error term adjusts by 5.8 per cent a year. The data shows that the Keynesian twin deficit hypothesis holds only in the long run for Eswatini. The findings are in line with the findings by Handoyo (2020), Mugo et al (2021). The real GDP has a positive relationship with the current account imply that in the long run; the current account deficit could improve by 0.000178 per cent (Sakayi and Opoku; 2016; Jayaraman, 2010). High levels of income tend to worsen the current account position because of high propensities to import more particularly in developing countries. The SACU receipts have a negative significant relationship with the current account in the long run. This implies that higher SACU receipts are usually followed lower trajectories. In the short run the current account improves with an improvement in SACU receipts.

6. Conclusions and Policy Recommendations

The GDP growth rates that positively impact on the current account suggest that if the country pursues GDP growth rate set to specific target. This would help improve the current account and stabilize reserves. The presence of the twin deficit in Eswatini suggest that the fiscal budget is important in determining the external position of the country. The implementation of fiscal reforms is pertinent in reining in Government expenditure to ensure that the external position of country is tenable and not detrimental to the level of international reserves. The implementation of the Fiscal adjustment Road map should be revived to reign in the fiscus and bring confidence to the economy.

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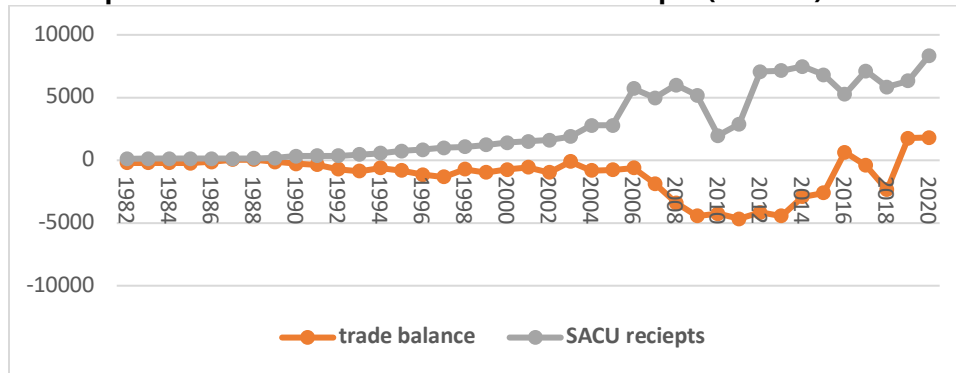
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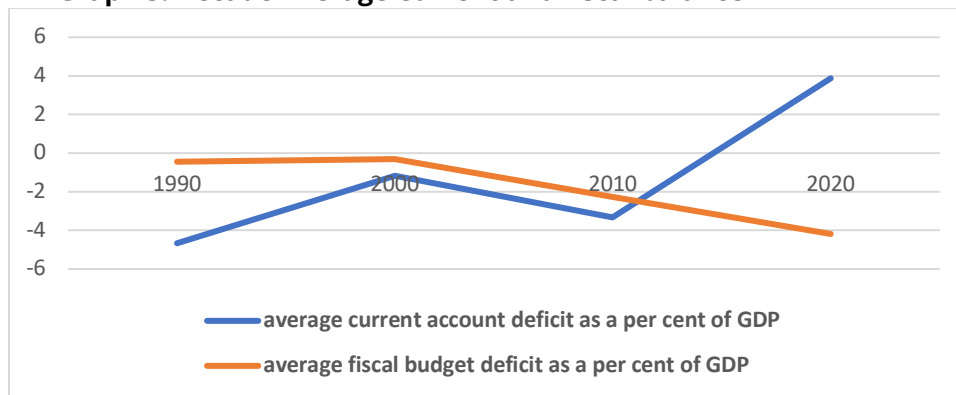
Appendix 1. Fiscal and Current Deficit, SACU Receipts and Diagnostic Tests.

Graph 2. The Fiscal Deficit and the SACU receipts (000 000)



Source: Central Bank of Eswatini Quarterly Reviews.

Graph 3. Decade Average Current and fiscal balance



Source: Central of Eswatini Quarterly Review.

Appendix 1.....cont.

Table 7. VAR Residual Serial LM Tests

Date: 07/16/22 Time: 05:13

Sample: 1982 2020

Included observations: 36

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	29.50660	16	0.0207	2.106180	(16, 52.6)	0.0221
2	10.73511	16	0.8255	0.648810	(16, 52.6)	0.8285
3	21.46931	16	0.1612	1.425659	(16, 52.6)	0.1662
4	14.30679	16	0.5759	0.891924	(16, 52.6)	0.5815

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	29.50660	16	0.0207	2.106180	(16, 52.6)	0.0221
2	45.13314	32	0.0618	1.567256	(32, 49.5)	0.0761
3	57.68470	48	0.1597	1.244792	(48, 36.7)	0.2470
4	63.01590	64	0.5113	0.783470	(64, 21.9)	0.7772

*Edgeworth expansion corrected likelihood ratio statistic.

Table 8. VEC Residual Heteroskedasticity Tests non-log variables. VEC Residual Heteroskedasticity Tests (Levels and Squares)

Date: 07/16/22 Time: 05:08

Sample: 1982 2020

Included observations: 35

Joint test:

Chi-sq	df	Prob.
279.4014	260	0.1950

Table 9. VAR Heteroskedasticity Tests log variables.
VAR Residual Heteroskedasticity Tests (Levels and Squares)

Date: 07/16/22 Time: 05:05

Sample: 1982 2020

Included observations: 36

Joint test:

Chi-sq	df	Prob.
255.3898	240	0.2363