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Debt - Growth Nexus

The Case For Solomon Islands.

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Debt-Growth Nexus: The Case of Solomon Islands.

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ABSTRACT

This study investigates the impact of debt on growth by employing a cointegration technique. The results show that there is a cointegrating relationship between real gross domestic product (RGDP), and its explanatory variables namely; the Government's external debt stock, the US$/SI$ exchange rate and the debt-to-GDP ratio. In the long run both the debt stock and the debt ratio are significant while the exchange rate is found to be insignificant. The speed of adjustment to equilibrium in the short run is 31% per year. External debt contributed positively to growth when the debt-to-GDP ratio is 40% or less, beyond that real growth declines. In other words, the sustainable debt level is less than 40%.

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Acronyms

ADB:	Asian Development Bank
CBSI:	Central Bank of Solomon Islands
CDC:	Common Wealth Development Corporations
Debt:	external borrowing
Dumdev:	Dummy variable for Devaluation
Dumcrises:	Dummy variable for Periods of ethic crises
Dumdr	Dummy variable for the ratio of external debt to NGDP
DR:	Debt-to-GDP
EFIC:	Export Finance and Insurance Corporation
EIB:	European Investment Bank
ER:	Exchange Rate
EU:	European Union
EXIM:	Export and Import
GDP:	Gross Domestic Production
HCA:	Honiara Club Agreement
ICDF:	International Corporations and Development Fund
IDA:	International Development Association
IFAD:	International Funding for Agriculture
KFAED:	Kuwait Fund for Arab Economic Development
KWD:	Kuwaiti Dinar
MARU:	Marubeni Hong Kong Limited
MBA:	Mark Barnes & Associates
MNZ:	Multichem New Zealand Limited
NGDP:	Nominal Gross Domestic Production
ODA:	Overseas Development Administration
OPEC:	Organisational Petroleum Exporting Countries.
RGDP:	Real Gross Domestic Production

RAMSI:	Regional Assistance Mission to Solomon Islands
ROC:	Republic of China
SIG:	Solomon Islands Government
SINSO:	Solomon Islands National Statistics Office
SD:	Standard Deviation

1. Introduction

External borrowing occurs everywhere in the globe for various reasons. Countries borrow to meet development goals and to cushion revenue shortfalls. External debt is sourced from foreign commercial banks, multilateral institutions like the International Monetary Fund, World Bank and Asian Development Bank, and bilaterally from other Governments. External debt plays a crucial role in boosting economic growth, notwithstanding the associated negative impact it can cause when debt is unsustainable. Despite the vast literature on external debt-growth nexus, there is minimal discussions in the Pacific island countries especially in the Solomon Islands. Solomon Islands first borrowed externally before it gained Independence in 1978 and this dependency continued to prevail to the present. The objective of this paper is twofold. First, the paper investigates whether external debt contributes positively to economic growth in both the short run and long run or whether it merely becomes an unproductive perpetual obligation for future generations. The second objective is to examine the sustainable debt level judging from the debt-to-GDP ratio for Solomon Islands.

In this paper, we specifically investigate the relationship between external debt and real GDP (RGDP) growth in Solomon Islands by applying the cointegration technique. The study uses the time-series annual data for the periods 1981-2015. We use three independent variables, namely the Government's external debt stock, the US$/SI$ exchange rate and the debt-to-GDP ratio in line with existing literature. Two dummy variables were modelled to represent periods of social unrest from 1999 to 2002 and devaluation of the local currency particularly in 1997 and 1999.

The paper found that RGDP shares a long run relationship with the external debt stock, exchange rate, and debt-to-GDP ratio. All independent variables showed relationships consistent with theory. The external debt stock showed a positive and statistically significant relationship with growth in the long run. Meanwhile, the impact of the debt ratio on real economic growth is negative and significant. The exchange rate showed a negative but insignificant relationship with RGDP in the long run. The two dummy variables are found to be statistically significant. In the short-run only the debt-to-GDP ratio and the two dummy variables are significant, while all other dependant variables are not significant. Nevertheless, the error correction term is found to be statistically significant with a speed of adjustment of 31% a year. Estimates suggested that a sustainable debt-to-GDP ratio is less than 40%.

The rest of this paper is outlined as follows. Section 2 provides background … Section 3 undertakes a brief overview of the relevant literatures on debt-growth nexus. Section 4 lays out the empirical data analysis and results of the paper. Section 5 discusses the results from parameter stability tests, while concluding remarks and policy implications are covered in the final section.

2. Brief background of Solomon Islands Debt

The Solomon Islands Government (SIG) started borrowing externally in the 1970s, prior to gaining independence. Initially Government borrowing was low in the first decade, followed by an average borrowing of SI$84 million recorded in the second decade (1981-1989). This led to a 33% debt-to-

GDP ratio while a growth rate of 4% was recorded by the end of the decade (refer to Table 1 and Annex 1).

In the third decade from 1991 to 2000, Government borrowing increased further. Borrowings were geared towards the post conflict emergency rehabilitation projects and health sector development projects. During the latter part of these years, economic activities deteriorated and public systems were threatened as a result of the ethnic unrest which ignited in 1998. This strained the government revenue collection amidst the uncontrolled expenditure of the Government. This situation coupled with the 30% devaluation in the national currency further worsened the situation triggering a debt crisis.

In 2001, the Government defaulted on all its external loan obligations for the second time after a prior default in the years leading up to 1997. The second default resulted in accumulated debt amounting to SI$1.1 billion by the end of the fourth decade of 2001-2010. In 2003, the intervention of an external force in the form of a Regional Assistance Mission to Solomon Islands (RAMSI) helped control law and order and stabilised growth. The country barely managed to stay afloat up to the periods leading to the signing of the Honiara Club Agreement (HCA)[1] in 2005. The direct outcome of the HCA involved freezing of debt payments to external creditors for at least two years and debt forgiveness. To help mitigate debt-servicing difficulties, the Government went on to undertake debt restructuring. It then created a debt servicing account at the Central Bank of Solomon Islands (CBSI) and committed 15% of its consolidated revenue to the debt servicing account. This was later reduced to 10% in 2009. In the most recent years, the external debt stock fell to SI$655 million in 2015. This is equivalent to less than 10% of GDP, which is considered a manageable level under the HCA. With the current level of economic growth and opening up of HCA to allow for external borrowing to resume, it is worth investigating the fiscal space for borrowing that would create growth.

Table 1: Solomon Islands: External Debt and Growth (1981-2015)

Periods	External Debt (SI$M)	NGDP (SI$M)	RGDP (SI$M)	External Debt (% of NGDP)	External Debt (% of RGDP)	RGDP Growth Rate (%)
1981-1990 Ave	84	258	209	33	40	4
1991-2000 Ave	378	1,121	309	34	122	4
2001-2010- Ave	1,108	2,834	333	39	333	4
2011	973	5,528	465	18	209	11
2012	929	6,112	480	15	193	3
2013	888	6,722	494	13	180	3
2014	685	7,202	504	10	136	2
2015	655	7,802	520	8	126	3

[1] This was an agreement the Solomon Island Government (SIG) signed with IMF and World Bank that stopped the Government from further borrowing until it achieved a debt-to-GDP ratio of less than 10%.

3. Literature Review

The Solow-Swan (1956) neoclassical growth theory proposes that the key drivers of economic growth are capital accumulation, labour and technological change. The theory suggests that in a closed economy higher levels of savings and an increase in the labour force are necessary for short run economic growth. Once the steady state is reached and the economy is at full capacity, further growth is only possible through innovation and technological change. Several studies have extended the Solow-Swan model, based on a closed economy, to incorporate international capital transfers for an open economy see Otani and Villanueva (1989), Agenor (2000), Villanueva (2003), and Villanueva and Mariano (2007). Notwithstanding its simplicity, the neoclassical model acknowledges the role of capital accumulation in the growth process.

Low levels of domestic savings and foreign exchange reserves are binding constraints to domestic investment and growth in finance-constrained countries, limiting the role of capital accumulation to growth under the neoclassical model. This is explained by the dual gap theory where the savings gap and foreign exchange gap are inadequate to support the expected level of growth in the economy, revealing the role of external borrowing (Daud et al. 2013). According to Adegbite et al. (2008), developing countries prefer to borrow externally than domestically to finance development because of the dual gap effect. Developing countries with low levels of saving seek external debt to boost their economic performance (Abubakar, 2011). This is on the premise that reasonable levels of borrowing are likely to enhance economic growth, both through capital accumulation and productivity growth (Pattillo et al. 2004).

However, empirical studies investigating the debt-growth relationship on a country basis for developing countries yield mixed results. Hassan and Mamman (2006) found evidence supporting a positive relationship between external debt and economic growth for Nigeria, after employing time series data from 1970 to 2010. For Fiji, Jayaraman and Choong (2006) concluded that a positive relationship existed between debt and economic growth in both the short and long run. In contrast, Were (2001) found evidence that external debt accumulation has a negative impact on economic growth and private investment in Kenya. The latter confirming the existence of a debt overhang problem in Kenya. Munzara (2008) showed that external debt and trade openness impact negatively on economic growth in Zimbabwe while capital investment and labour force growth support economic growth. Using ordinary least squares (OLS) methodology, Malik Hayat and Hayat (2010) found that higher levels of debt stock and debt servicing costs have a significant negative impact on economic growth for Pakistan.

Moreover, the literature also identified two channels through which debt can negatively impact on growth; the debt overhang effect and the crowding out effect. The debt-overhang theory argues that if there is likelihood that in the future debt will be larger than a country's repayment ability, expected debt-servicing costs will discourage further domestic and foreign investments (Krugman, 1988; Sachs, 1989). The fear that increased taxes may be needed to service the external debt, will discourage investors from incurring investment costs today for increased output in the future (Corden, 1989). Moreover, high levels of debt stock may discourage governments to undertake policy reforms with initially high political and economic costs, resulting in a poorer policy environment that contributes to lower productivity growth (Pattillo et al. 2004). In addition, as the level of debt stock increases, uncertainties about likely distortionary policy actions the Government

may pursue to meet its debt servicing obligations may depress investment and growth (Clements, Bhattacharya & Nguyen, 2003).

Higher debt stock levels and increasing external debt servicing costs limit the ability of developing countries to meet their debt service obligations. This negatively impacts the creditworthiness of a country to borrow externally putting further pressure on domestic borrowing. Higher domestic borrowing by the Government drains capital that would otherwise be available for private sector investment leading to the crowding out effect. In a study undertaken by Iyoha (1999) found evidence of the crowding-out effect in sub-Saharan African countries, implying that heavy external debt stock and debt service payment could depress investment in the country. Clements, Bhattacharya and Nguyen (2003) further support the findings of crowding-out effects for 55 low-income countries. Essentially, increased borrowing to finance domestic fiscal expansionary policies leaves fewer avenues for private sector investment.

Nonetheless, a growing body of recent cross-country empirical studies found evidences suggesting a bell-shaped relationship between debt and growth. Debt is expected to contribute to growth up to a certain threshold, beyond which the impact of additional stock of external debt on growth becomes negative. However, the threshold level varies across studies. Pattillo, Poirson and Ricci (2002), for example, found that the average impact of external debt on growth in developing countries becomes negative for values of debt ranging between 35% and 40% of GDP. Using a cross country dataset on central Government debt across 44 countries, both advanced and emerging markets, Reinhart and Rogoff (2010b) found that debt-to-GDP ratios of 90% and above are associated with notably lower growth outcomes in advanced countries. For emerging markets, the external debt to GDP threshold was 60% and above. Clements, Bhattacharya and Nguyen (2003) also found evidence of non-linearity in the effect of debt and growth on similar growth models estimated exclusively on low-income countries.

In this paper we follow closely the work of Jayaraman and Choong (2006) to model the effect of external debt on real gross domestic product for the following reasons. First, the study examines the case of Fiji, a Pacific island country with similar economic dynamics to that of the Solomon Islands. Second, the use of dummy variables to account for structural breaks in Fiji's case is relevant for our study as our time series data suffers structural breaks relating to the ethnic unrest as well as devaluation of the local currency. The use of RGDP as dependant variable is consistent with (Jayaraman et al 2006)).

4. Empirical framework & Data Analysis

4.1 Data

This section presents the empirical framework used to investigate the possible relationship between external debt and economic growth of Solomon Islands. This analysis uses annual time series data spanning 1981 to 2015 for Solomon Islands. The choice of using annual data instead of higher frequency data was dictated by frequency of the data we have available. For example, GDP for Solomon Islands is only available in annual terms. Data on the external debt stock is sourced from

the Ministry of Finance; GDP and exchange rate data are obtained from the Solomon Islands National Statistics (SINSO) and Central Bank of Solomon Islands respectively. Meanwhile, the debt-to-GDP ratio and dummy variables are computed by the authors.

Having reviewed the literature, we have chosen to look at external borrowing (debt), real gross domestic product (RGDP), the exchange rate (ER), and the ratio of debt-to-GDP (DR). The dummy variables (dumcrises, dumdev and dumdr) were included to represent the structural breaks from 2000 to 2005 which represent the crisis periods and the devaluation in 1997 and 1999. The third dummy variable 'Dumdr' was used in model 2 against real growth to estimate the sustainable debt-to-GDP ratio. The dummy variable 'Dumcrises' reflects the periods of ethnic unrest when the debt level increased sharply. It is constructed by inserting the value 'one (1)' in 2000 to 2005 and zero '0' in other normal periods. Similarly, the devaluation of the Solomon Island dollar in several episodes in 1997 and 20% devaluation in 1999 is modelled in the second dummy variable as 'Dumdev'.

We use a simple model to see the net impact of external debt on real growth of the country. The functional form shown in model 1 (equation 1) underpins the basis of this paper.

Model 1

$$RGDP = f(debt, er, dr, dumcrises, dumdev) \quad (1)$$

Model 2

$$rgdp\ growth = f(dumdr) \quad (2)$$

The second model comprises the real growth rate as the dependant variable while the dummy variable for debt-to-GDP ratio is an explanatory variable. The construction of the dummy variable were such that debt ratio were model and regress with real growth and the significant levels determine the sustainable level of debt in the model. Model 2 is aimed to measure the sustainable debt-to-GDP ratio.

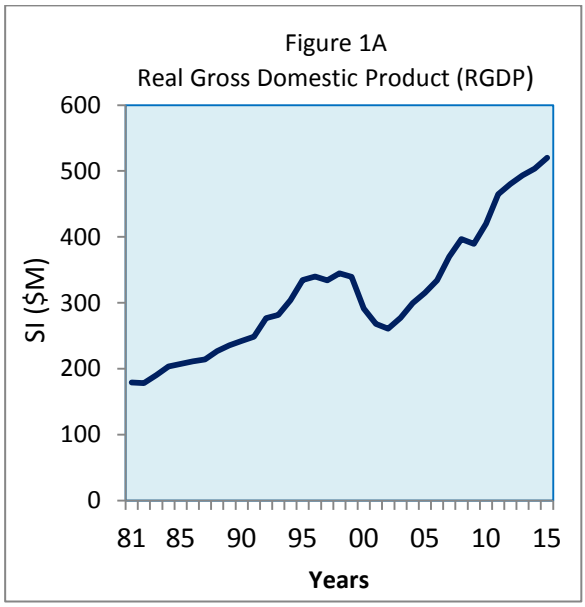
We expected external debt to have a positive relationship with growth in the long run. From theory, borrowing for development and infrastructure eventually improves economic growth. As found by Jayaraman and Choong (2006), in Pacific island countries, debt is positively related to economic growth. The debt–to-GDP ratio on the other hand is expected to have a negative relationship to growth. An increase in the debt-to-GDP ratio means that debt is rising at a faster rate than GDP growth. Similarly, a decline in the debt-to-GDP ratio indicates that debt increases at a slower pace compared to increases in GDP.

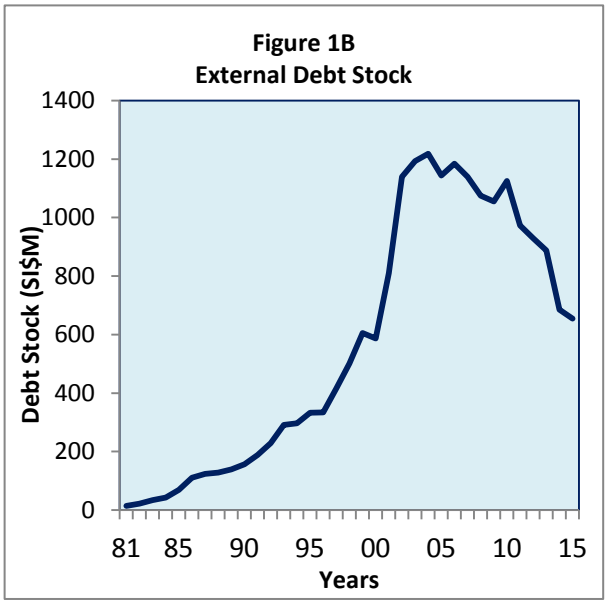
Likewise, the exchange rate is expected to have a negative relationship with growth. An increase in the exchange rate reflected a depreciation in the domestic currency which may lead to higher debt repayment. This is expected to have a negative impact on real growth.

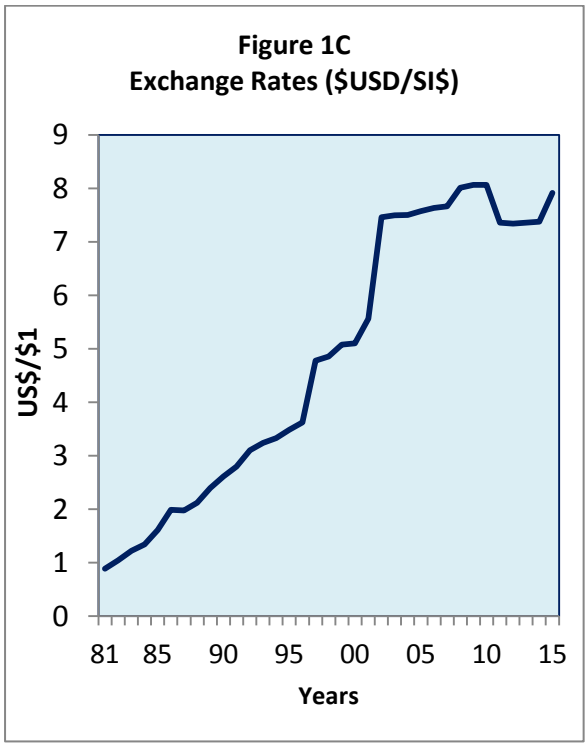
Looking at the data, RGDP exhibited an overall upward trend on average, albeit the period 1996 to 2002. Nevertheless, economic growth started to improve following the intervention of RAMSI. The debt stock spiked in 1995 to 2000 and was partly due to adverse exchange rate shocks. The spike in accumulated debt stock combined with weak Government finances resulted in SIG defaulting on its obligations in 2000. Debt arrears peaked at more than SI$1.2 billion by the end of 2005. This debt

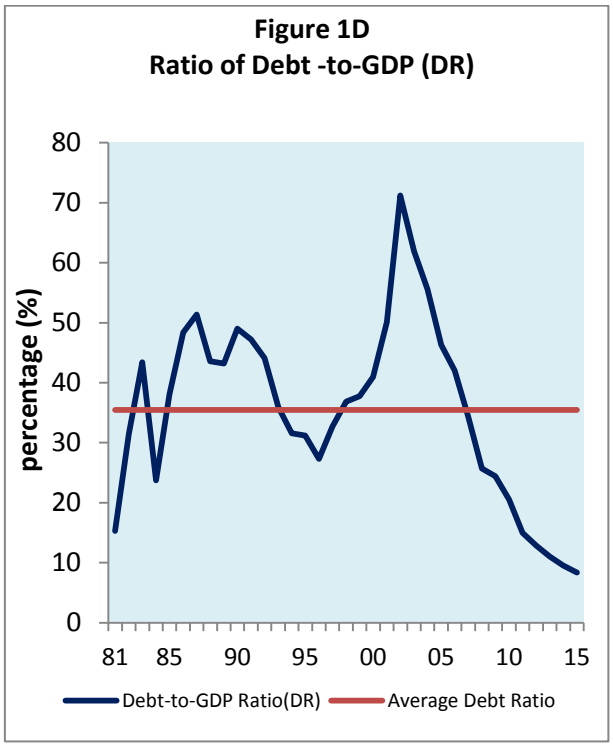
level marked the turning point of the Government's high debt trajectory which triggers an external intervention known as the Honiara Club Agreement (HCA). Through the implementation of HCA, public debt contracted to just above SI$600 million by 2015. The current debt level is below 10% of GDP which is considered sustainable . The plots of the data used in this study are shown in Figure 1.

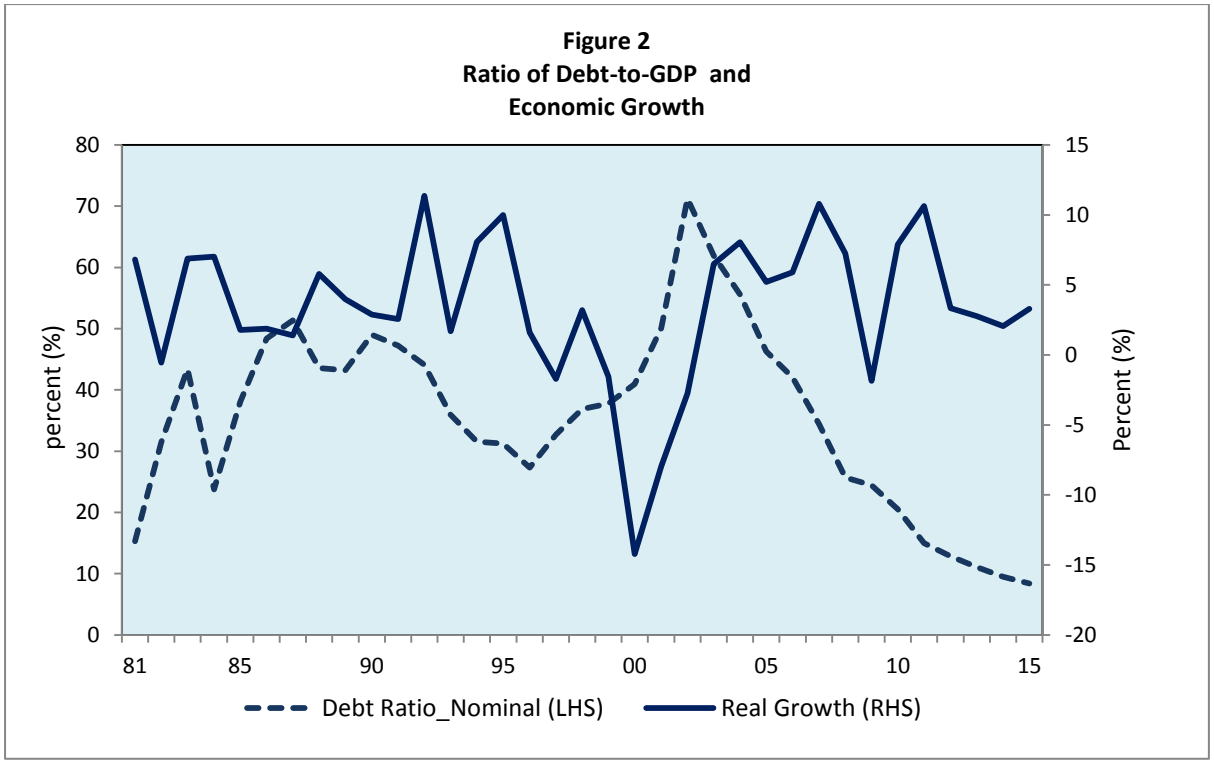
Figure 1 plot of the data series, 1981- 2015.











From Figure 2, the trend of the debt-to-GDP ratio shows that in the period from 1985 to 1995, the average debt-to-GDP ratio was equal to or above 30% and was partly due to adverse movements in the exchange rate and new borrowings for various sector reforms. This was followed by a fall in the debt-to-GDP ratio to 26% by the end of 1996. The subsequent years from there on, the debt ratio was on a rising path again to reach its highest peak of 75% in 2002. This reflected loan accumulation and non-repayment by the Government as a result of weak revenue collections during the ethnic crises. During this time, general economic activities were disrupted and so the Government defaulted on its loan obligations. From 2003 onwards, the debt-to GDP ratio fell considerably to 8% of GDP by the end of 2015. Economic growth which also benefited from the arrival of RAMSI remained positive, despite large swings, and the debt-to GDP ratio fell persistently.

Selected descriptive statistics are presented in Table 2. Over the sample period the mean value of RGDP was $314 million while the debt stock showed a mean value of $567 million. The average value of the debt-to-GDP ratio was 35%.

Table 2 Descriptive Statistics

	RGDP	DEBT	ER	DR
Mean	313.5714	566.8943	4.8271	35.4914
Median	300.0000	501.2000	4.8600	36.9000
Maximum	520.0000	1218.7000	8.0600	71.2000
Minimum	178.0000	15.0000	0.8900	8.4000
Std. Dev	97.1470	432.9707	2.5810	15.1952
Observation	35	35	35	35

Table 3 Correlation Matrix

	lnRGDP	*lnDebt*	*lnER*	*lnDR*
lnRGDP	1			
lnDebt	0.7998	1		
lnER	0.8523	0.9875	1	
lnDR	-0.6168	-0.0754	-0.1943	1

Table 3 shows the correlation matrix between the variables. Firstly, debt and the exchange rate are highly correlated with RGDP and positively associated. However the debt ratio is negatively correlated with RGDP.

4.2 Data Analysis and Results

This section covers the data analysis and the accompanying results conducted in the study commencing with unit root analysis.

4.2.1 Unit Root Test

The aim of this section is to assess the nature of the data in terms of the integration properties of debt and real growth. We used the Augmented Dicky Fuller (ADF) (1979, 1981) test based on the following regression model:

$$\Delta y_t = \kappa + \alpha y_{t-1} + \beta_t + \sum_{j=1}^{m} d_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

Eq. (3) tests for a unit root in y_t, where y_t consists of each of the three variables in our model, t=1,…,T is an index of time, Δy_{t-j} is the lagged first differences to accommodate for serial correlation in the errors, ε_t. Eq. (3) tests the null hypothesis of a unit root against a trend stationary alternative. In conducting the unit root test, all variables were checked with constant and trend as the series have trended overtime. The exception is the debt ratio which is tested only against the constant as it does not depict a trending path. The null and the alternative hypotheses for a unit root in y_t are: H_0 : α=0 and H_1 : α<0. To select the lag length (k), we use the 't-sig' approach proposed by Hall (1994). The results of the unit root test are presented in Table 4.

Table 4 Unit Root Test Results

ADF unit root test results

	Level		**First Difference**	
	t-stat	**p-value**	**t-stat**	**p-value**
ln RGDP	-2.3931	0.3761	-3.5374***	0.0131
ln DEBT	-0.824	0.9532	-4.5631***	0.0048
ln ER	-1.218	0.8906	-5.7996***	0.0002
ln DR	-0.8465	0.9504	-6.2156***	0.0001

*Notes: significant coefficients are indicated by ***, for significance at the 1%. The MacKinon critical values for ADF are -3.2096 (10%), -3.5530 (5%), and -4.2627 (1%)*

From the results tabulated in Table 4, all tests confirmed at the 1% significance level that real growth and the debt stock are non-stationary series and are stationary in first differences indicating that both variables are integrated order 1, I(1) variables. The result also suggested that the two variables can potentially share a cointegration relationship in the long run. The next section discusses the cointegration analysis and results.

4.2.2 Cointegration

After having found that the variables were integrated of order one or are stationary in first differences, the next test was to conduct a cointegration test to see whether or not these variables share a long run relationship. In this section, the goal was to investigate whether GDP and the level of Government debt and the debt-to-GDP ratio shared a long run relationship. Based on two statistics, (the trace and the maximum eigenvalue test), we used Johansen (1998) cointegration test. The testing sequence under the null hypothesis is r=0, 1,…,*k*-1, where *k* is the number of series. The value of *r* increases until we can no longer reject the null hypothesis. If the test statistics is greater than the critical values, we reject the null hypothesis that there are *r* cointegrating vectors in favour of the alternative that there are more than r cointegrating vectors. The results are presented in Table 4.

Table 5: Results for Johansen Cointegration Test

Johansen's test for cointegration

H0 (r)	H1 (r)	Trace statistics	5% CV
0	1	144.3561***	95.7537
≤1	2	93.6130***	69.8189
≤2	3	53.2483***	47.8561
≤3	4	29.4901	29.7971
H0 (r)	H1 (r)	Max eigenvalue statistics	5% CV
0	1	50.7430***	40.0776
≤1	2	40.3646***	33.8769
≤2	3	23.7582	27.5843

Source: Authors' own calculations

Notes: *** , *denotes statistical significance at the 1% level and 10% respectively.

According to the trace test, we are able to reject the null hypothesis of no cointegration vector up to $H_0 \leq 2$ in favour of $H_1 = 3$ at the 1% significance level whilst we cannot reject the null hypothesis of $H_0 \leq 3$ which means there are more than one cointegrating vector. Similarly, the maximum eigenvalue test showed at most 2 cointegrating relationship amongst RGDP, the debt stock, the exchange rate and the debt ratio. Likewise, since there is a long run cointegrating relationship between the variables, the next procedure is to assess the long run elasticity between the variables and economic growth which is covered in the next section.

4.2.3 Long Run elasticities

The long-run elasticity was constructed according to available variables. In this model, external debt, the exchange rate, and the debt ratio are modelled together to find out the impact on real growth.

The long run specification is shown in equation 4. From the model, we expect debt to be positively correlated with growth on the assumption that the Government borrowed to finance development projects in the country. The debt-to-GDP ratio on the other hand is expected to have a negative relationship with growth as a high debt ratio signifies a high rate of increase in debt relative to GDP growth. A negative relationship may arise if debt accumulation is not invested in capital projects but spent on consumables. Similarly the exchange rate is expected to have a negative relationship with growth, due to the fact that a weaker currency meant that foreign denominated debt is more expensive to repay thus increasing the principle and interest payments of loans. However, there could be ambiguity when a weaker exchange rate encourages export activities.

$$lnrgdp_t = \propto_0 + \propto_1 lndebt_t + \propto_2 lner_t + \propto_3 lndr_t + \propto_4 lndumcrises_t + \propto_5 lndumdev_t + \varepsilon_t \quad (4)$$

Table 6 Long Run

Long run elasticities

Independent Variable	***ln*RGDP**	
Regressor	**Coefficient**	**t-statistic**
ln Debt	0.2737***	3.2725
ln ER	-0.1563	-1.0015
ln DR	-0.3238***	-10.0755
Dumcrisis	-0.1123**	-2.714
Dumdev	0.1653**	2.2443
Constant	5.4500***	26.0766

Source: Authors' own calculations
*Notes: ***,** denotes statistical significance at the 1% and 5% level respectively.*

From the long run elasticity, we found that the debt stock and RGDP have a positive relationship. A 1% change in debt stock leads to a 0.3% change in RGDP. Secondly, the exchange rate has a negative but insignificant relationship with RGDP. The negative coefficient of 0.15 implies that a 1% increase in the exchange rate leads to 0.2% fall in real GDP. Likewise the debt-to-GDP ratio showed a negative relationship with RGDP. The results showed that a 1% change in the debt-to-GDP ratio leads to a 0.3% fall in real GDP. Meanwhile the two dummy variables representing the ethnic crises and devaluation showed a negative and positive relationship with RGDP respectively. The former implies that during the time of crises, growth was negatively impacted. Meanwhile, the latter depicted that the devaluation of the local currency positively impacted RGDP, through the export channel as exports are more competitive during devaluation.

From model 2, the result is presented in equation 5, with figures in parentheses representing 't-values'.

$$rgdp\ growth = 4.3585 \quad -3.8981 dumdr_t - 1.9997\ \varepsilon_t \qquad (5)$$
$$\qquad\qquad (4.2375) \quad (-1.9598)$$

From equation 5, using a dummy variable that takes a value of one when the debt-to-GDP ratio exceeded 40%, the results showed that during those periods growth fell on average by 3.9%.

4.2.4 Short Run Elasticities

To estimate the short run model, each of the series in natural logarithm was differenced denoted by delta (Δ). The error term from the long run elasticity was modelled to capture the speed of adjustment in the short run. Dummy variables are used in the short run model to capture the structural breaks during the periods of ethnic crises and devaluation.

Equation 6 shows the model specification in the short run and output for the short run model is tabulated in Table 7.

$$\Delta lnrgdp_t = \propto_0 + \propto_1 \Delta lndebt_t + \propto_2 \Delta lner_t + \propto_3 \Delta lndr_t + \propto_4 dumcrises_t + \propto_5 dumdev_t + \propto_6 \varepsilon_{t-1} + \varepsilon_t \qquad (6)$$

Table 7: Short-Run Elasticities

Independent Variable	**Δ*ln* RGDP**	
Regressor	**Coefficient**	**t-statistic**
Δ*ln* Debt	0.0908	1.5916
Δ*ln* ER	0.0291	0.2642
Δ*ln* DR	-0.1332***	-3.3867
*Dum*crisis	-0.1085***	-5.0231
*Dum*dev	0.0816**	1.9870
Constant	0.0270***	2.8201
ECT_{t-1}	-0.3065***	-2.4803

Source: Author's own calculations

*Notes: ***, ** denotes statistical significance at the 1%, 5% level respectively.*

We found that debt has a positive relationship with real growth in the short run, however this is insignificant . Meanwhile, the exchange rate has a positive but insignificant relationship with RGDP. All other variables are consistent with long run elasticities in their relationships. The debt-to-GDP

ratio has a negative relationship with real growth. In terms of the dummy variables, dumcrises has a negative effect on growth while dumdev contributes positively to growth.

Furthermore, the error correction term, ECT_{t-1}, is statistically significant at the 1% level. The coefficient value of the error correction term suggests that the economy is able to adjust from a shock by 31% in a year. This means that it will take approximately 3.3 years for RGDP to adjust to normal equilibrium levels when faced with debt shocks.

4.2.5 Granger Causality

In this section, we examine the causality between the explanatory variables and the dependant variable. The Granger Causality statistic is the F-Statistic testing the null hypothesis that the coefficients of all logged values of a variable are zero. This null hypothesis implies that the explanatory variables have no predictive content. From the results (see Table 8), both debt and real GDP do not granger cause one another. Implying that changes in growth are not directly linked to changes in the debt stock as the F-Statistic is fairly insignificant.

Likewise, the exchange rate does not granger cause RGDP meaning that predictive content of the exchange rate to forecast real GDP is insignificant. Meanwhile the ratio of debt-to-GDP has a unidirectional granger causality running from real GDP to the debt ratio. Similarly, the debt stock and the debt ratio have a unidirectional granger causality running from the debt-to-GDP ratio. The exchange rate also granger causes the debt ratio in a similar unidirectional path running from the exchange rate to the debt ratio. Lagged values were not significant, and were therefore omitted from the results.

Table 8 Results of Granger Causality Tests

Results of pairwise Granger Causality test			
Model 1 Null Hypothesis	F-statistics [probability]		
Δ*ln* Debt does not granger cause Δ*ln R*GDP	0.0379		[0.9628]
Δ*ln* RGDP does not granger cause Δ*ln* Debt	1.5634		[0.2278]
Δ*ln* ER does not granger cause Δ*ln* RGDP	0.0562		[0.9454]
Δ*ln* RGDP does not granger cause Δ*ln* ER	1.0537		[0.3626]
Δ*ln* DR does not granger cause Δ*ln* RGDP	0.1760		[0.8396]
Δ*ln* RGDP does not granger cause Δ*ln* DR	5.2044	***	[0.0123]
Δ*ln* ER does not granger cause Δ*ln* Debt	0.1097		[0.8965]
Δ*ln* Debt does not granger cause Δ*ln* ER	0.8582		[0.4352]
Δ*ln* DR does not granger cause Δ*ln* Debt	0.6191		[0.5459]
Δ*ln* Debt does not granger cause Δ*ln* DR	2.6776	*	[0.0869]
Δ*ln* DR does not granger cause Δ*ln* ER	0.0514		[0.9500]
Δ*ln* ER does not granger cause Δ*ln* DR	2.53041	*	[0.0983]

Notes: The probability values are in square brackets.
**** ,* denote statistically significance at 1% and 10% significance levels respectively*

4.2.6 Impulse Responses

The aim of this section is to identify the responsiveness of the dependent variable when there is a one SD (standard deviation) shock to the economy through each of the explanatory variables. The time taken for RGDP to respond to these shocks is of particular importance for policy decisions. To

investigate the impulse response functions we used the Choleski decomposition, and the ordering of variables started with RGDP, the debt stock, the exchange rate and the debt-to-GDP ratio.

Shown in Figure 3 are the impulse responses. Starting from Figure 3A to 3D, RGDP responds positively to a one standard deviation in RGDP itself, up to the fourth year before the response dies out. In Figure 3B, RGDP responds positively to a one standard deviation change in debt stock but turns negative and remains so after the third year. Turning to the exchange rate in Figure 3C, real GDP positively responds to a one standard deviation shock to the exchange rate up to the fourth year after which RGDP responded negatively. Lastly as shown in Figure 3D, RGDP responds negatively to changes in the debt-to-GDP ratio after the second year, then was negligible after the third year onward.

Figure 3: Impulse Responses

Figure 3A

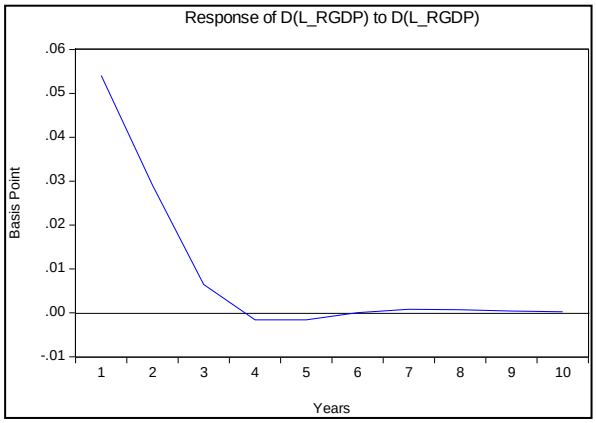


Figure 3B

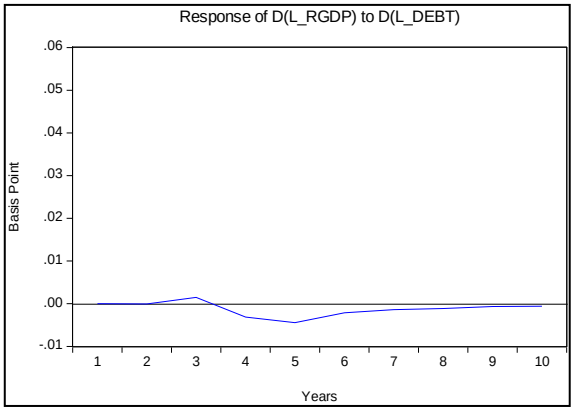


Figure 3C

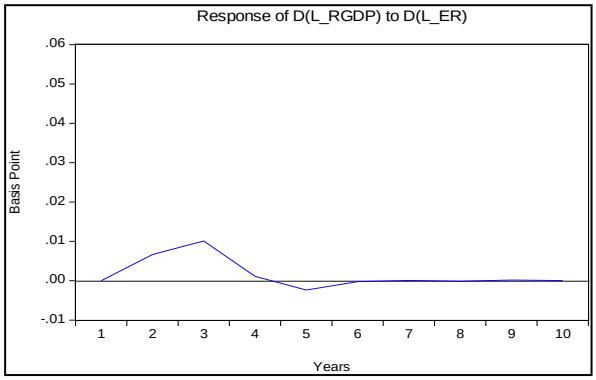
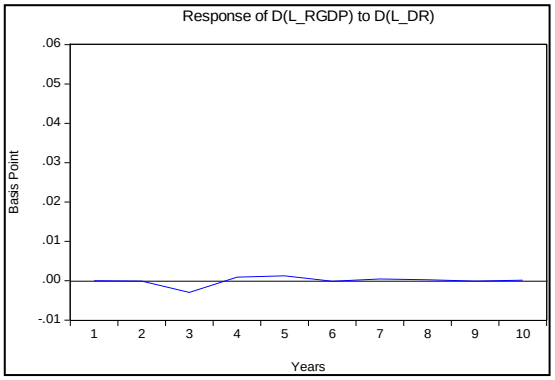


Figure 3**D**



5.0 Results from Diagnostic Tests

Having identified that all variables are cointegrated, this section examines the commonly used diagnostic tests to determine the stability of the model. This will also confirm whether or not the empirical model is consistent with the assumptions of the OLS estimator. The first residual test was the test for normality with a null hypothesis asserting that the model is normally distributed. We find that we fail to reject the null hypothesis of normality implying that the residuals are normally distributed at all conventional levels.

The second test conducted was the residual test for serial correlation. Using the Breusch-Godfrey serial correlation LM test, we tested the null hypothesis of 'no autocorrelation' among the residuals. It was found that the model does not suffer from auto-correlation as the test failed to reject the null hypothesis. There is robust evidence that the residuals are free from autocorrelation which is a condition for OLS.

In conducting the Breusch Pagan-Godfrey test for heteroscedasticity, the null hypotheses is that the residuals are homoscedastic that is they do not suffer heteroscedasticity. Again, the test failed to reject the null hypothesis suggesting that the residuals are independent of one another. The combined results of these tests indicated that the variables in this model met the OLS requirement and that their residuals are white noise or stable.

5.1 Parameter Stability

Testing the parameter stability of the model, we use the Cusum2 test where the null hypothesis states that there is no sudden shift in the model. We could not certainty confirmed the stability of model to be within the 5% critical bounds of the Cusum squared statistics. We found that the test rejected the null hypothesis of no sudden shift in the model indicating that the model is either unstable or miss-specified which requires further revisions.

6. Conclusions & Policy Implications

This study examines the nexus between debt and economic growth. The result reveals that debt contributed positively and significantly to economic growth in the long run but insignificant in the short run. In the main, we find that; (i) there is a long run relationship between debt and growth. The long run elasticity showed that a 1% change in debt stock changes RGDP by 0.3%; (ii) the speed of adjustment for RGDP to adjust back to equilibrium is 3.3 years; (iii) for the years that the debt-to-GDP ratio exceeds 40%, real growth was reduced and the estimates suggested that the sustainable debt-to-GDP ratio is between 30% to 40%; and (iv) there is lack of evidence on granger causality between debt and growth, implying the existence of other channels through which debt plays a significant role, one of which includes the capital expenditure of the country.

Lastly the impulse responses test showed that RGDP responds positively to a one standard deviation shock on the debt level up to the third year and negatively after the third year and beyond. Meanwhile, the effect dies out after the seventh period.

Policy implications emerging from our study are that 1) external debt translated to growth in the long run so the Government can borrow from external sources to finance productive investments to contribute to growth; 2) the Government should maintain debt at a sustainable level as excessive borrowing can be counterproductive to growth; 3) the level of debt can become unsustainable because of excessive borrowing or because of slower or declining GDP growth and hence reduced ability to meet debt obligations.

It is important to note that this working paper, like other empirical studies, is constrained by data limitation and findings should be taken with some caution. The structural breaks due to the social unrest and devaluation could still be revisited with structural VAR models accounting for nonlinear relationships. This may have different results that may or may not complement the current findings in this paper.

Further extension to this paper will be to test the non-linear coexistence between debt and growth; to treat the structural breaks with specific tests; to extend the model by including other variables such as investment, capital spending and inflation, and use ARDL[2] method of analysis.

[2] Defined as Autoregressive Distributive Lag

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ANNEX 1: Purpose of External Borrowing

Year	Creditors	Purpose of Loan	Sectors
1970-1979	ODA, OPEC, EU, ADB.	• Purchase of land from LPPL • Establishment of Honiara Housing • Beef Cattle • Honiara Port • DBSI	• Infrastructure • Agriculture • Financial
1980-1989	IDA, OPEC, CDC, IFAD, EIB, EFIC, Eu, ADB.	• Honiara Water Supply • DBSI • BOP Support • Agriculture Development Project • Henderson Airport • Road Improvements • Power Expansion • Purchase of Per seiners	• Infrastructure • Agriculture • Fisheries • Financial • Financial support for BOP
1990-1999	ADB, IFAD, EU, MARU, EIB, KWAD, OPEC, ICDF, EFIC	• Education Projects • Honiara Main Road Project • Public Sector Reform Program • DBSI RCDF • Post Conflict Rehabilitation Project. • Health Sector Development Project.	• Infrastructure • Education • Health • Public Service
2000-2009	IDA, MBA, EXIM, MNZ, IMF	• General Commercial Use • MDA/MNZ 1 & MDA/MNZ 2 amortizing bonds.	• Commercial
2010-2015	IMF	• IMF standby credit facility • IMF extended credit facility	• Financial