International Journal of Scientific Research and Management (IJSRM)
||Volume||5||Issue||10||Pages||7220-7237||2017||
Website: www.ijsrm.in ISSN (e): 2321-3418
Index Copernicus value (2015): 57.47 DOI: 10.18535/ijsrm/v5i10.07

Mauritius and Risk of Debt Crises: Evidence from Dynamic Stochastic Model and Arima Forecast

Adebayo ADEDOKUN

Department of Economics
Obafemi Awolowo University, Nigeria

Abstract
The paper employs dynamic stochastic approach and autoregressive integrated moving average (ARIMA) model to investigate the external debt status of Mauritius, following recent weak export performances and insinuation of debt crises. The study establishes that, Mauritius was free of debt crisis over the years till mid-2000s when the debt crises began to set in and escalated since 2009 till date. The paper also found that debt increase will persist till 2022, before it will stabilize and remain steady above the optimal size require for economic probity. The study therefore suggests economic overhauling of management strategies as against the current palliative measures introduced by the government.

1. Introduction

Debt crises are more pronounced in developing countries over the past four decades, Easterly (2002), and much more pronounced in sub-Saharan Africa where thirty three of the thirty nine global Heavily Indebted Poor Countries (HIPCs) were identified, Gunter, Rahman and Wodon (2008). The crises in the countries were traced to over bearing financial recklessness and unbridled appetite for foreign products, which culminated into historical trend of balance of payment deficit. This was aggravated by crash in the global prices of the primary products which formed a major source of income to most of the countries. Meanwhile, the crisis is more rooted in some sub-regions than others, for instance, thirteen of fifteen countries in Economic Community of West African States (ECOWAS) are HIPCs, eight of ten in Economic Community of Central African States (ECCAS), four of five in East African Community (EAC) and four of fifteen in Southern Africa Development Communities (SADC) are HIPCs.

Specifically, Southern Africa has the lowest proportion of countries named as HIPCs. Knowing that, HIPC is a tag for the countries with extreme poverty incidence and also heavily indebted, while many other countries also had long history of debt crises, for instance, Nigeria and Kenya, Muhanji and Ojah (2011). However, the few countries with clean record of debt history are in southern Africa including Mauritius. The country, Mauritius has a rich history of financial probity and unprecedented economic growth and development.

It is a small economy with low natural resources endowment unlike many other countries in sub-Saharan Africa. It is located in remote area that is far from world markets, but succeeded in transforming itself

from a poor sugar economy into one of the most successful economies in Africa. It achieved this through trade-led approach to development. The Real GDP growth of the economy averaged more than 5 percent between 1970 and 2009, while GDP per capita has increased more than tenfold over the same period, Zafar (2011). It was difficult to trace any article relating to debt problem to Mauritius until the later part of 2000s when some write-ups were arguing that the countries appeared to be on a verge of debt crisis. Mauritius government foresaw the fiscal problem as an aftermath of the global financial crisis of 2007-2009, thus it is documented in Zafar (2011) that in response to the global financial crisis, Mauritius passed a fiscal stimulus and monetary easing package of about 5 percent of GDP over 2009–10. The plan focused on infrastructure spending, providing financial relief to the firms that were hit hardest by the global crisis, and social and job protection measures. At the same time, the government introduced offsetting measures that were expected to bring the primary budget into surplus by the end of 2011, Zafar (2011).

Unfortunately, foreign debt indicators show that the measures were not responding positively to forestall the debt problems. For instance, the external debt stock as percentage of gross national income (GNI) which was 7 percent in 2008 rose to 28 percent in 2011 and 42 percent in 2012. So also, external debt as percentage of export which was 12 percent in 2008 rose to 45 percent in 2011 and 58 percent in 2012, International Debt Statistics (2014). The debt trend in the Mauritius has not been accorded a rigorous empirical investigation despite the overbearing trend of the crisis and the palliative measured the government proposed to forestall the effect of the crisis over the few years. This article therefore employed a dynamic stochastic approach to model optimal debt for Mauritius as a way to investigate its current debt status and used Autoregressive Integrated Moving Average (ARIMA) model to forecast the future trend.

2.0 Review of Literature On Debt Crisis In Developing Countries

The crisis of debt burden in developing countries have been attributed to many factors and traced to various sources (see Alvarez-Plata and Bruck 2008, Porcile et al 2011, Reinhart and Rogoff 2009; Elgin and Uras 2013). Kaminsky and Pereira (1996) identified that, creditors blamed the crisis on the policy mistakes of the debtor governments, and debtors blamed the crisis on the macroeconomic and trade policies of the major industrial countries. Dooley (2000) identified two reasons that may lead to payment default, which include; Bad luck which he argued may erode the government's tax base so that payment is impossible or deliberate default in which the government may choose not to pay and suffer whatever penalties creditors can impose. The position of debtor is credit advancement agreement, which is believed to indicate the position for possible default. Countries with little or no risk of bad luck, and associated unavoidable default, will favor debt structures that insure maximum punishment to follow a default that could be avoided. This he tagged as a strategic default. But in the submission of Kaminsky and Pereira (1996), it is believed that, there is no

doubt that, during the 1980s, developing countries were brutally and repeatedly shocked from the outside. As such; 'extremely tight monetary conditions in the center economies provoked a protracted slowdown in the industrial world, which quickly translated into a steep decline of export prices and terms of trade in the periphery' (ibid).

In explaining the reasons for crisis, (Evrensel 2004, Kharas 1984, Dornbush 1989, Eaton 1990), identified that, recipient countries usually engaged in unrealistic macroeconomic policies and exhibited domestic mismanagement, such as exchange rate misalignments, fiscal deficits, and import protection. As such debt crisis is premised on the increase in world interest rates and the decline in developing countries' terms of trade which led to debt service difficulties in recipient countries. In this regards, the structural interpretations of the debt crisis were provided in the literature as the consequence of an incomplete international capital market with moral hazard and risk of repudiation. Under these, the optimal contract implies capital outflow and a decline in consumption, investment, and output in recipient countries, which is believed to be key observation during the debt crisis period (Atkeson, 1991). It is also argued that both debt service payments and outstanding debt may affect GDP growth rate negatively even if it does not affect investment levels. As such, debt has an adverse effect directly on growth by reducing productivity as a large stock of public external debt reduces the production efficiency when it leads to a tight fiscal policy which reduces the size of formal sector(Drine and Nabi 2010, Furceri and Zdzienicka 2012)

In support of that, Madavhi in his study of 'composition of government spending as it responds to the debt burden' asserts that since interest payments on the public debt is relatively substantial and inflexible component of total public spending, it presents challenging problem such that, if spending reduction mainly falls on expenditure categories that affect current income and consumption levels of large segments of population, they will have adverse welfare implication which promote poverty level. It may thus, lead to a rise in the levels of public discontent and political instability. This argument is further entrenched in Fosu (2007), where it is noted that although Mahdavi (2004) estimates the effect of the external debt burden on the composition of government spending, it does not isolate various components of spending in the study. It is on this foundation Fosu built his study through a focus on how the debt burden impacts education expenditure. The study maintains a negative effect of debt. In general, various studies suggest that the external debt burden serves as limiting factor on economic growth in sub- Sahara Africa (Fosu, 1996, 1999). The basis of the relationship, as argued by few researchers might have resulted from reduction in government spending which may connect to illiquidity constraints in many of the countries. The extant literatures therefore show that, any country could slide into debt crisis if one or more of various fiscal management loopholes are allowed to creep into the economy.

3.0 Optimal Debt In Mauritius: A Dynamic Stochastic Approach

3.1 The Model

The dynamic stochastic model by Flemming and Stein (2004) and modified for emerging economies by Abutaleb & Hamad (2012) was adapted in this article for the empirical investigation of optimal debt model for Mauritius. The model is designed for the economies that accumulate deficit or debt for capital project with inbuilt mechanism for repayment, which are the characteristics that suit debt history of Mauritius.

The debt equation is specified as;

$$dB_t = [C_t + I_t - Y_t + r_t B_t]dt \quad (1)$$

This implies that, the deficit dB_t is a function of trade deficit $[C_t + I_t - Y_t]$ and the interest on accumulated debt $r_t B_t$; where Y_t is GDP, B_t is debt, I_t is investment and r_t is interest rate.

Y_t is assumed to grow as a function of capital stock K_t such that:

$$Y_t = i_t K_t \quad (2)$$

where i_t is return on investment.

The interest rate r_t and return on investment i_t is described as a constant value plus noisy component to capture uncertainty,

The networth in the economy is specified as the difference between the capital stock in the economy and the total accumulated debt. Such that

$$dX_t = dK_t - dB_t \quad (3)$$

Where, X is networth in the economy, K and B are capital stock and debt stock respectively. As such after all required substitutions, eq. 3 it transformed to

$$dX_t = \left[i + (i - r)\frac{B_t}{X_t} - \frac{C_t}{X_t}\right] X_t dt - \sigma_1 \frac{B_t}{X_t} X_t dw_{1t} + \sigma_2 [1 + \frac{B_t}{X_t}] X_t dw_{2t} \quad (4)$$

Eq. (4) is a constraint function for optimization.

The objective function is specified as follows:

$$V = E[\int_0^T U(C_t) e^{-\delta t} dt] \quad (5)$$

Where δ is a discount factor, T is time of the analysis, $U(C_t)$ is the utility of consumption function with hyperbolic absolute risk aversion (HARA) function. That is;

$$U(C_t) = \frac{1}{\gamma} C_t^{\gamma}; 0 < \gamma < 1 \quad (6)$$

and as such:

$$U(C_t) = lnC_t;\ \gamma = 0 \quad (7)$$

Where γ is a measure of risk aversion, the bigger the γ, the larger the risk of investment.

Specifying (6) as a ratio of net worth X_t gives;

$$U(C_t) = \frac{1}{\gamma} (\frac{C_t}{X_t})^{\gamma} X_t^{\gamma};\ \gamma < 1 \quad (8)$$

Also, by specifying control variable in the same way, then;

$$U_{1t} = f_{1t} = \frac{B_t}{X_t} \quad (9)$$

As such the eq. 4 could be specified as

$$dX_t = [i + (i - r)f_t - c_t]X_t dt - \sigma_1 f_t X_t dw_{1t} + \sigma_2[1 + f_t]X_t dw_{2t} \quad (10)$$

In a control term, it could also be specified as;

$$dX_t = [i + (i - r)u_{1t} - u_{2t}]X_t dt - \sigma_1 u_{1t_t} X_t dw_{1t} + \sigma_2[1 + u_{1t}]X_t dw_{2t} \quad (1)$$

However, the only relevant control variable for this study as adapted from Abutaleb and Hamad (2012) is u_{1t} given that the focal point of this article is optimal debt.

Optimizing (10) for the utility function (8) for derivation of u_{1t} gives;

$$u_{1t} = \frac{[i_t - r_t + \sigma_2^2(\gamma - 1)]}{(\sigma_1^2 + \sigma_2^2)(1 - \gamma)} \quad (12)$$

Eq. (12) has a significant importance in borrowing decision, if $u_{1t} > 0$, borrowing could be embarked upon. In other words, this depends on the value of $(i_t - r_t)$; if $i_t - r_t > \sigma_2^2(1 - \gamma)$; then $u_{1t} > 0$ since $\gamma < 1$, as such borrowing is encouraged.

But since $X_t = K_t - B_t$, and $U_{1t} = \frac{B_t}{X_t}$ from eq. (9), by substitution, the optimal value of debt allowed is;

$$B_t = K_t \frac{\frac{[i_t - r_t + \sigma_2^2(\gamma - 1)]}{(\sigma_1^2 + \sigma_2^2)(1 - \gamma)}}{1 + \frac{[i_t - r_t + \sigma_2^2(\gamma - 1)]}{(\sigma_1^2 + \sigma_2^2)(1 - \gamma)}} \quad (13)$$

The eq. 13 states that, debt level is a function of capital stock, return on investment and interest rate to be paid on the borrowed loan, given the prevailing risk and level of uncertainty. The model, eq 13 is simulated through programming to generate optimal debt trend for Mauritius.

3.2 Definition of Variables and Sources of Data

The foreign debt is measured as the external debt stock and sourced from the world bank's International Debt Statistics (IDS), Stock of capital is measured as the addition of the foreign direct investment and gross capital formation. They are sourced from the World Development Indicator (WDI). The return on investment (ROI) is proxy by return on equity which is sourced from the Stock Exchange of Mauritius. Interest Rate is measured as the average interest on new external debt commitment and sourced from IDS.

3.3 The Empirical Results

Stochastic model is appreciated for its versatility to model an economy under various scenarios of risk, given the prevailing interest rate and investment volatility in the economy. Abutaleb and Hamad (2012) suggests various scenarios of risk and measure of volatility under which the optimal debt in an economy could be modeled.

3.3.1 Scenario 1: Low Risk and Low Volatility Measure (Interest Rate and Investment)

The measure of low risk is varied within $0 < \gamma < 0.5$; while the measure of low volatility is varied within $0 < \sigma^2 \leq 1$ it is observed that the optimal debt steadily maintain the same pattern within the specified range as presented.

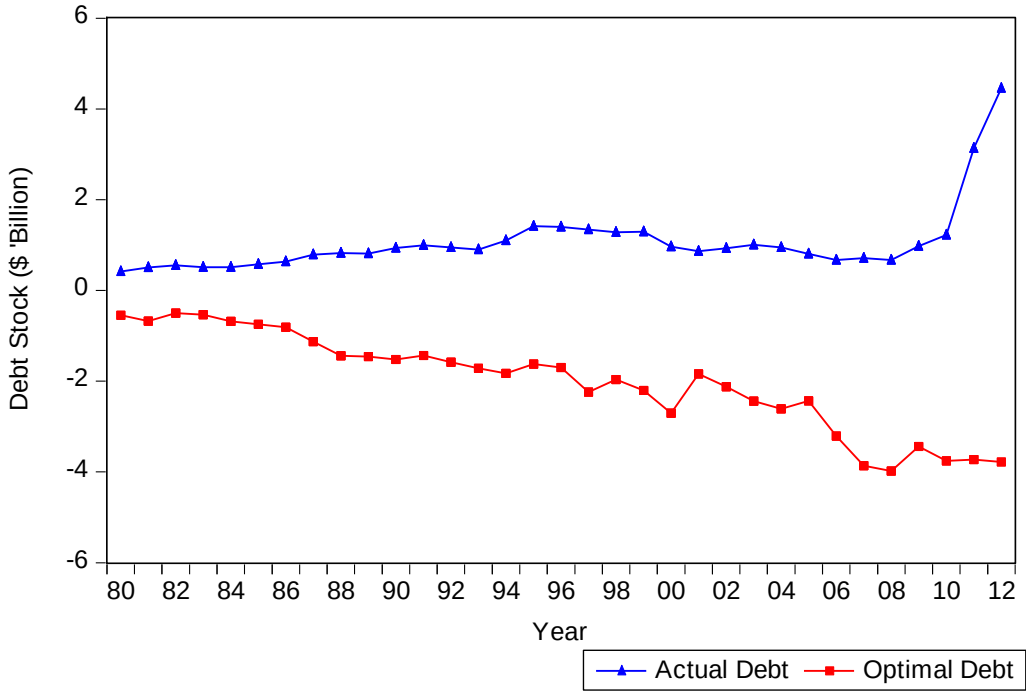


Figure 1: Actual and Modeled Optimal Debt (Scenario 1)

The modeled optimal debt presented in figure 1 within the historical reality of Mauritius is unrealistic. As presented, the trend suggests that Mauritius manages debt far above the optimal level over the years before 1980. In other words, it suggests that the country has been consistently and deeply suffering from debt crisis over the years.

3.3.2 Scenario 2: Low Risk and High Volatility Measure (Interest Rate and Investment)

The measure of low risk is varied within $0 < \gamma < 0.5$; while the measure of high volatility is varied within $1 < \sigma^2 \leq 2$ as observed under scenario 1, the optimal debt steadily maintain the same pattern within the specified range as presented in figure 2

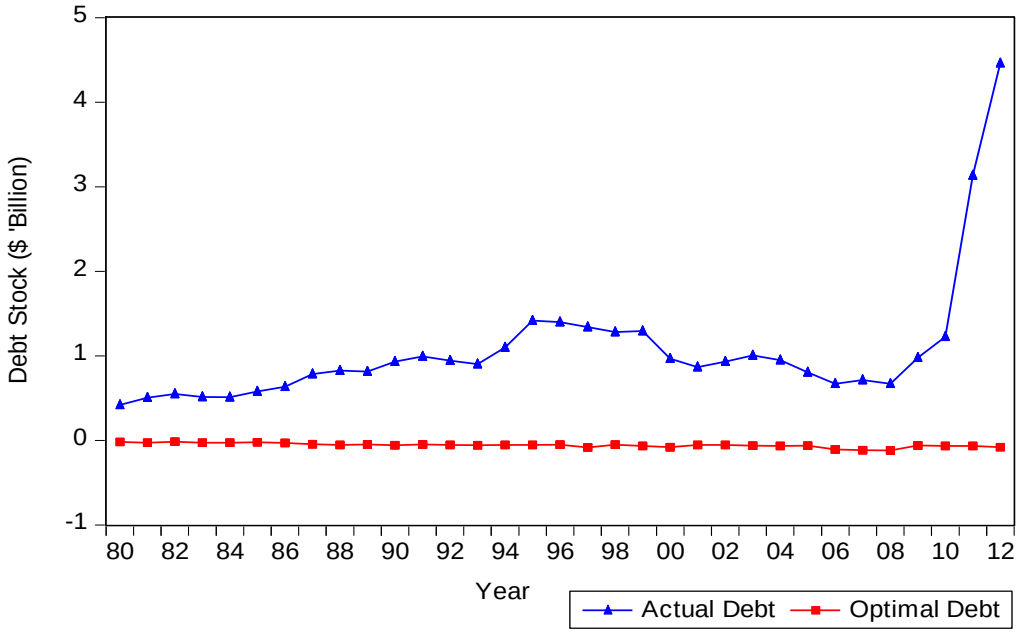


Figure 2: Actual and Modeled Optimal Debt (Scenario 2)

Figure 2 is similar to figure 1. It also suggest that debt crisis in Mauritius is grievance over the past decades which is contrary to the historical reality of the country. It thus has the implication that the optimal debt model in Mauritius is irresponsive to the variation in the volatility of interest rate and investment.

3.3.3 Scenario 3: High Risk and Low/High Volatility Measure (Interest Rate and Investment)

The measure of high risk is varied within $0.5 \leq \gamma < 1$; while the measure of volatility is varied within $0 < \sigma^2 < 2$ the modeled optimal debt alongside the actual debt is presented in figure 3. The model does not respond to the high or low volatility variations. In other words, the pattern of the modeled trend of the optimal debt retains the same pattern regardless of high or low volatility variation.

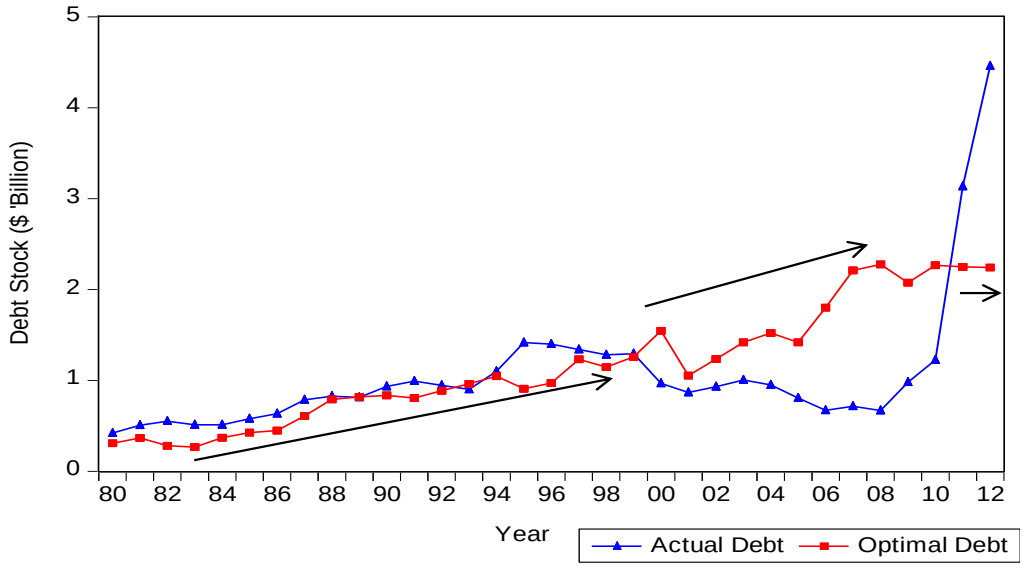


Figure 3: Actual and Optimal Debt (Scenario 3)

Figure 3 is an appropriate model of optimal debt in Mauritius. The trend could be aligned with the historical debt and fiscal history of the country.

Mauritius has not been linked with any serious debt problem since its independence in 1968. The most recent shake-up experienced in the economy is in connection with various short term shocks over the past few years in the latter part of 2000s. The shocks never impacted seriously on the debt level, thus making the debt trend to remain on manageable path over the years. However, the model shows that, the country did not experience debt problem over the years up to 2010, though a sharp upward trend in the actual debt began in 2007. The upsurge in the debt pattern up to 2011, which is far above the optimal debt is a serious concern on the future of Mauritius.

The optimal debt model support the fiscal and debt problem alarm raised in Zafar (2011), though the article also argued that Mauritius government foresaw the fiscal problem as an aftermath of the global financial crisis of 2007-2009, thus the government passed a fiscal stimulus and monetary easing package of about 5 percent of GDP over 2009–10. In a related study, the beginning of the crisis is traced to 2005, Imam and Köhler (2010). As a response mechanism to the shock that threatened the competitiveness of the economy, the government in 2005 launched wide-range reform strategies. Trade was liberalized, various price controls were lifted, and business regulations were simplified. The aftermath of the strategies earned Mauritius the title "best place to do business in Africa" from the World Bank in 2008 and 2009, Imam and Köhler (2010). The structural measures were complemented by fiscal policy reforms. The government initiated far-reaching tax reform featuring a 15 percent flat tax and established a central revenue authority. However, despite the reform, Imam and Köhler (2010) argued there was external alarm from observers that the debt level of the country is rising fast which might culminate into crisis if not properly managed. As a further response, the country adopted fiscal consolidation strategy that were anchored in a new public debt law that stipulates public debt to be reduced to 50 percent of GDP by 2013, from a higher level of 80 percent that is was (ibid).

However, it is obvious from figure 3 that Mauritius has demonstrated rare economic management in the past decades. As presented, the actual and optimal trends are closely knitted together over the years from 1980 till 2000. Thereafter the optimal spending rises above the actual debt which is a further sign of prudency management. The improvement was consistent till 2008, before it waned from the definite pattern. It was during the period that the alarm was raised on the debt trend of the country which was being argued to have deviated from the moderate path, though the ministry of finance of Mauritius dismissed the fear. Regardless of the position of the ministry, the trends support the fact that, the economy is bleeding in the recent years.

The modeled optimal debt trend is not supporting the effectiveness of the policies and strategies which were introduced as a measure to forestall the trend of the debt crises in the country. However, in order to ascertain the extent of the crises if the present trend is not reverted, the future debt profile of the country is thus investigated through Autoregressive Integrated Moving Average (ARIMA) forecast model.

4. The Debt Forecast: Autoregressive Integrated Moving Average (Arima) Method

ARIMA is a single variable forecast model, but is highly sophisticated. It incorporates the historical feature of the data over a long period to predict the future values for the variable. This forecasting tool came to existence through the publication of Box and Jenkins (1978). It suggests the analysis of the probabilistic or stochastic features of time series data independent of constructing single or simultaneous equation model. Through the use of ARIMA's model, each variable is able to be explained through its past or lagged values and resulting stochastic error term.

The model is an improvement on the Autoregressive Moving Average Model (ARMA) by incorporating data difference to allow stationary of data before the application of the ARMA technique. The ARMA (p, q) could be specified as

$$Y_t = \theta + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \cdots + \alpha_p Y_{t-p} + \beta_0 u_t + \beta_1 u_{t-1} + \cdots + \beta_q u_{t-q} \qquad (3.45)$$

In its procedure, if we have to difference a time series data d times to make it stationary and then apply the ARMA (p, q) model to it, the data is then a series of ARIMA (p, d, q). Specific with the use of ARIMA model is that the time series must be stationary or stationary at one or more difference.

Four steps are involved in the use of ARIMA model; identification, estimation, diagnostic checking and forecasting. The identification involves the determination of the model specification parameters which are p, d and q. Autocorrelation Function (ACF) and the Partial Autocorrelation Function (PACF) are the principal tools in the identification process. The result of ACF and PACF are plotted against its lag length on correlogram for the identification. ACF is defined as ratio of covariance at lag (say lag k) and the variance which could be denoted as $\rho_k = \frac{\tau_k}{\tau_0}$, ρ_k's value lies between -1 and +1 and has no unit attached because the covariance and variance, that is, the numerator and denominator are in the same units. The PACF on the other hand is defined as a measure of correlation between observations that are k time periods apart, when the correlation at the intermediate lags are controlled for. In other words, the influence of intervening variables is removed. The PAC is the correlation between Y_t and Y_{t-k}, after removing the effect of intermediate Y's.

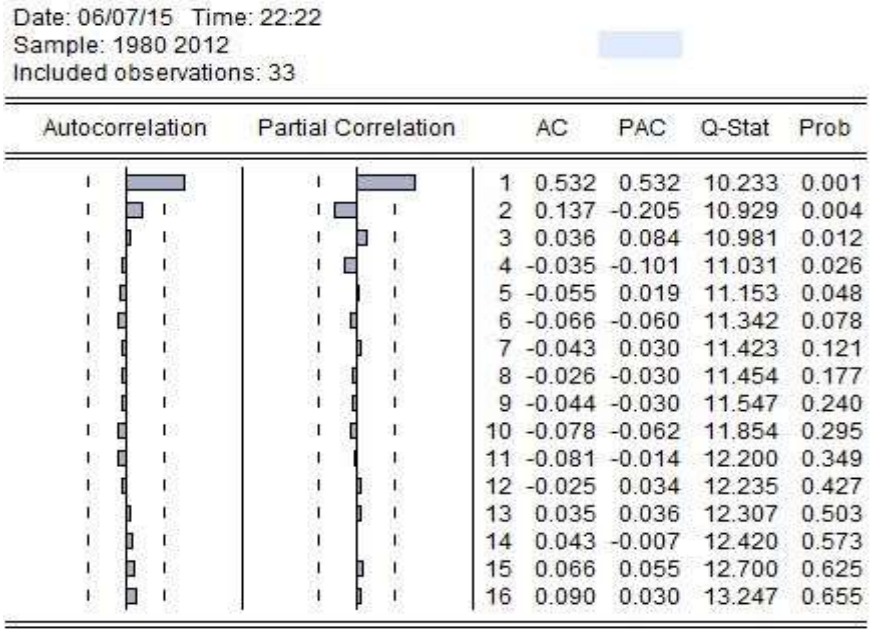
Formal unit root test or visual observation of correlogram assist to detect if the data is stationary or not, if it is not stationary, the data is difference till the non-stationary disappears. Depending on the number of difference to achieve stationary, the value of p, d, q are then determined for the ARIMA model estimation. The estimated value is subjected to diagnostic check. The data fitness is achieved by collecting the residual of the estimation to verify whether the AC or PAC of residuals is statistically significant. If they are not significant, it can then be concluded that the residuals are purely random, supporting the fact that the

ARIMA estimated is a correct fit for the data. Otherwise, a more appropriate ARIMA specification is sought. Forecasting is conducted based on the fitted model.

4.1 The Model Specification

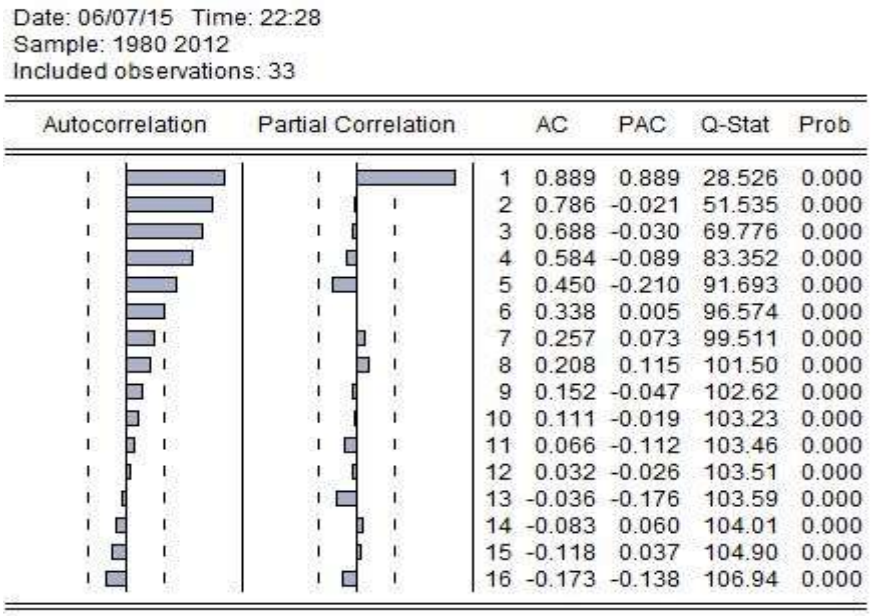
The correlogram of actual and optimal debt up to 16 lags presented in figure 4a and 4b show that Autocorrelation Function (ACF) start from very high value from lag 1(0.565) and 1(0.855) and decline gradually till lag 3 and 8 respectively. It is statistically significantly different from zero having fallen outside of 95% confidence interval up to lag 6, especially in the case of optimal debt. The observation of Partial Correlation Function (PACF) shows the insignificance of other values after the first observation. The pattern supports a non-stationary of the data.

Figure 4a : Correlogram of Actual Debt



	AC	PAC	Q-Stat	Prob
1	0.532	0.532	10.233	0.001
2	0.137	-0.205	10.929	0.004
3	0.036	0.084	10.981	0.012
4	-0.035	-0.101	11.031	0.026
5	-0.055	0.019	11.153	0.048
6	-0.066	-0.060	11.342	0.078
7	-0.043	0.030	11.423	0.121
8	-0.026	-0.030	11.454	0.177
9	-0.044	-0.030	11.547	0.240
10	-0.078	-0.062	11.854	0.295
11	-0.081	-0.014	12.200	0.349
12	-0.025	0.034	12.235	0.427
13	0.035	0.036	12.307	0.503
14	0.043	-0.007	12.420	0.573
15	0.066	0.055	12.700	0.625
16	0.090	0.030	13.247	0.655

Figure 4b: Correlogram of Optimal Debt

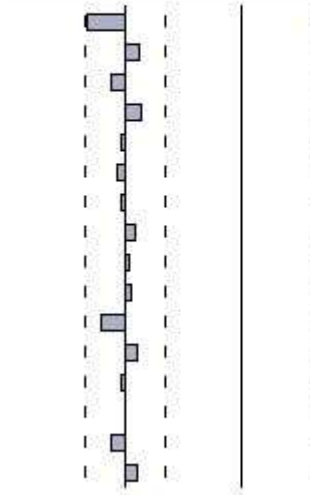


	AC	PAC	Q-Stat	Prob
1	0.889	0.889	28.526	0.000
2	0.786	-0.021	51.535	0.000
3	0.688	-0.030	69.776	0.000
4	0.584	-0.089	83.352	0.000
5	0.450	-0.210	91.693	0.000
6	0.338	0.005	96.574	0.000
7	0.257	0.073	99.511	0.000
8	0.208	0.115	101.50	0.000
9	0.152	-0.047	102.62	0.000
10	0.111	-0.019	103.23	0.000
11	0.066	-0.112	103.46	0.000
12	0.032	-0.026	103.51	0.000
13	-0.036	-0.176	103.59	0.000
14	-0.083	0.060	104.01	0.000
15	-0.118	0.037	104.90	0.000
16	-0.173	-0.138	106.94	0.000

The Actual and Optimal debt data are stationary at second and first difference correlogram as presented in figure 5a and 5b respectively. The definite pattern observed at the level plot disappeared which suggests that data are stationary. A formal Philip Perror (PP) unit root test validates this. From the figure, it is observed that ACF at lag 1 and 11 for actual debt and lag 1, 2 and 5 for optimal debt are significant, while they are not significant at any other lag value. Through PACF and ACF, it could be said that the process that generate the second difference actual debt is at most 11 while that of optimal debt is 5, that is Autoregressive AR(11) and AR(5) respectively, thus the AR term at lag 1 and 11 for actual debt and 1, 2 and 5 for optimal debt shall be included in the model for being the only lags that are significantly different from zero through ACF. To conclude step one of ARIMA modeling process, it could be said that the Actual Debt (AD) and Optimal Debt (OD) series are ARIMA (11, 1, 0) and ARIMA (5, 1, 0) respectively, implying that the second difference stationary data of AD and OD can be modeled as ARMA (11, 0) and ARMA (5, 0) process respectively.

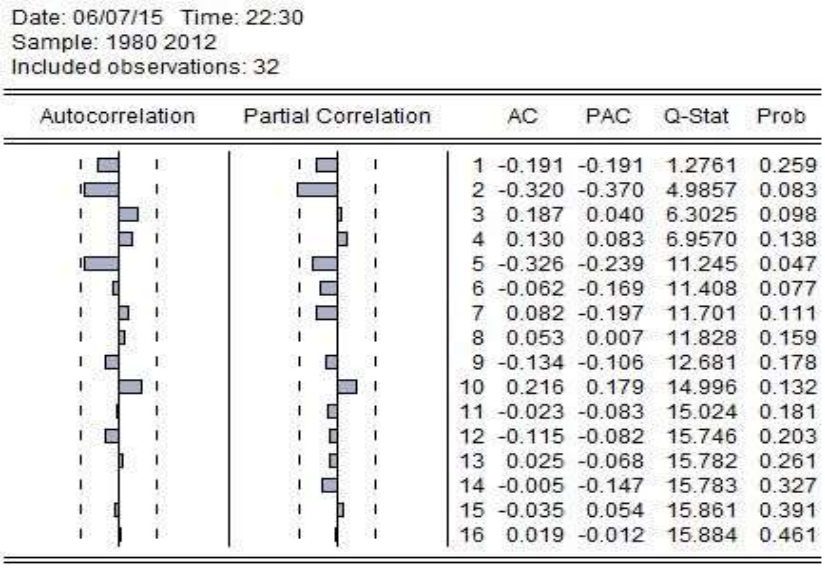
Figure 5a: Correlogram of Second Difference Actual Debt

Date: 06/07/15 Time: 22:25
Sample: 1980 2012
Included observations: 31



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.345	-0.345	4.0564	0.044
		2	0.124	0.006	4.5973	0.100
		3	-0.124	-0.090	5.1553	0.161
		4	0.139	0.078	5.8844	0.208
		5	-0.043	0.041	5.9567	0.310
		6	-0.081	-0.112	6.2224	0.399
		7	-0.031	-0.089	6.2629	0.509
		8	0.095	0.067	6.6659	0.573
		9	0.037	0.095	6.7304	0.665
		10	0.054	0.122	6.8738	0.737
		11	-0.217	-0.183	9.2774	0.596
		12	0.102	-0.074	9.8391	0.630
		13	-0.044	-0.024	9.9510	0.698
		14	-0.006	-0.043	9.9529	0.766
		15	-0.136	-0.099	11.143	0.742
		16	0.099	0.027	11.805	0.757

Figure5b: Correlogram of First Difference Optimal Debt



	AC	PAC	Q-Stat	Prob
1	-0.191	-0.191	1.2761	0.259
2	-0.320	-0.370	4.9857	0.083
3	0.187	0.040	6.3025	0.098
4	0.130	0.083	6.9570	0.138
5	-0.326	-0.239	11.245	0.047
6	-0.062	-0.169	11.408	0.077
7	0.082	-0.197	11.701	0.111
8	0.053	0.007	11.828	0.159
9	-0.134	-0.106	12.681	0.178
10	0.216	0.179	14.996	0.132
11	-0.023	-0.083	15.024	0.181
12	-0.115	-0.082	15.746	0.203
13	0.025	-0.068	15.782	0.261
14	-0.005	-0.147	15.783	0.327
15	-0.035	0.054	15.861	0.391
16	0.019	-0.012	15.884	0.461

4.2 The Estimation

The second step in ARIMA process is estimation. If ADD represent the second difference of actual debt data and ODD represent the first difference of optimal debt data for Mauritius, following the conclusion from the first step, the model is specified as follows;

$$ADD_t = \delta + \beta_1 ADD_{t-1} + \beta_3 ADD_{t-11} + u_t \quad (14a)$$

$$ODD_t = \delta + \beta_1 ODD_{t-1} + \beta_2 ODD_{t-2} + \beta_3 ODD_{t-5} + u_t \quad (14b)$$

The ordinary least squared estimated parameter of the model transformed eq. 14 a and b as follows;

$$ADD_t = 0.0762 - 0.2442 ADD_{t-1} - 1.6333 EADD_{t-11} \quad (15a)$$

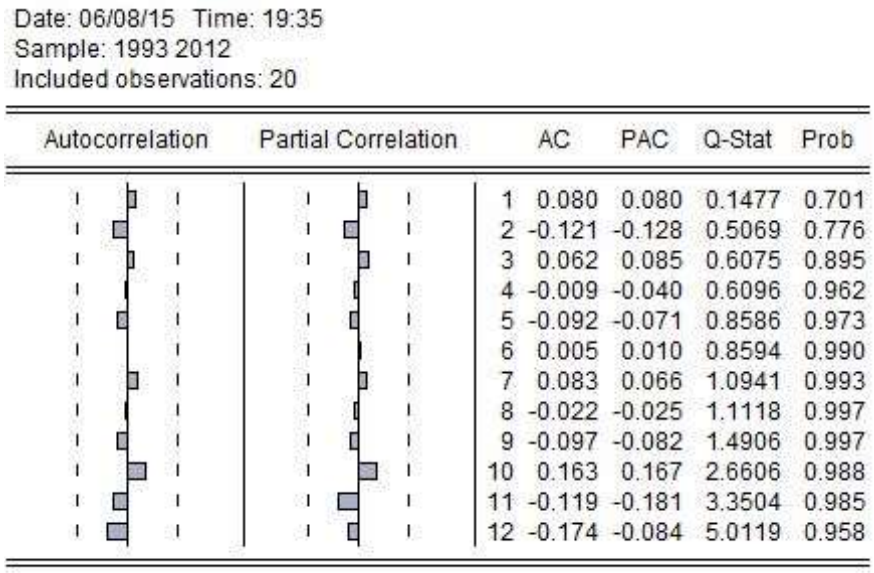
$$ODD_t = 0.1298 - 0.2458 ODD_{t-1} - 0.3384 ODD_{t-2} - 0.2713 ODD_{t-5} \quad (15b)$$

Equations 15a and b are the models that could forecast the second difference data and first difference data of actual and optimal debt respectively for Mauritius.

4.3 The Diagnostic Checking

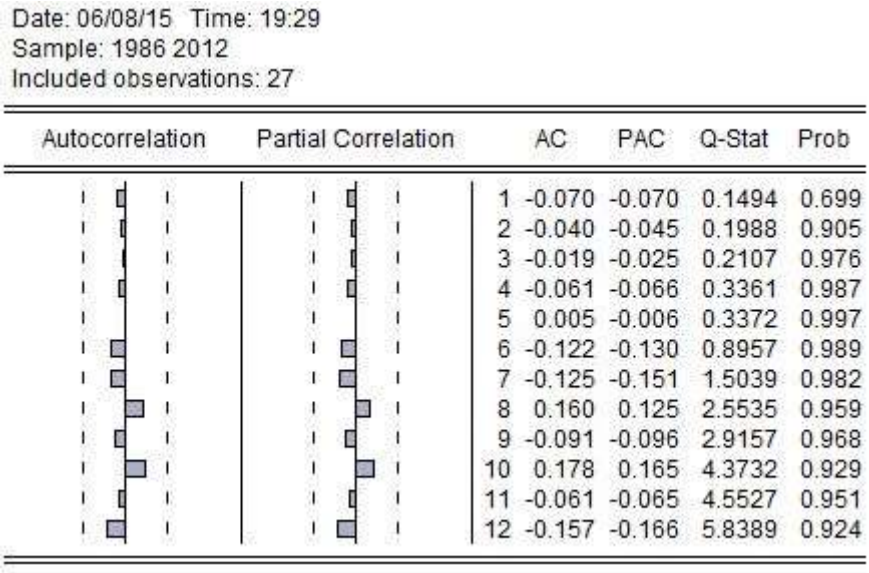
To perform diagnostic test, residuals are obtained from eq. 15a and b and determine the fitness of the data through correlogram, the ACF and PACF is presented in figure 6a and b

Figure 6a: Correlogram of Residual of Actual Debt forecast Model



	AC	PAC	Q-Stat	Prob
1	0.080	0.080	0.1477	0.701
2	-0.121	-0.128	0.5069	0.776
3	0.062	0.085	0.6075	0.895
4	-0.009	-0.040	0.6096	0.962
5	-0.092	-0.071	0.8586	0.973
6	0.005	0.010	0.8594	0.990
7	0.083	0.066	1.0941	0.993
8	-0.022	-0.025	1.1118	0.997
9	-0.097	-0.082	1.4906	0.997
10	0.163	0.167	2.6606	0.988
11	-0.119	-0.181	3.3504	0.985
12	-0.174	-0.084	5.0119	0.958

Figure 6b: Correlogram of Residual of Actual Debt forecast Model



	AC	PAC	Q-Stat	Prob
1	-0.070	-0.070	0.1494	0.699
2	-0.040	-0.045	0.1988	0.905
3	-0.019	-0.025	0.2107	0.976
4	-0.061	-0.066	0.3361	0.987
5	0.005	-0.006	0.3372	0.997
6	-0.122	-0.130	0.8957	0.989
7	-0.125	-0.151	1.5039	0.982
8	0.160	0.125	2.5535	0.959
9	-0.091	-0.096	2.9157	0.968
10	0.178	0.165	4.3732	0.929
11	-0.061	-0.065	4.5527	0.951
12	-0.157	-0.166	5.8389	0.924

The results show that the AC and PAC are not individually statistically significant which means that, the correlogram of both AC and PAC affirm that the residuals estimated from regression eq.15a and b are pure random noise, thus, the ARIMA models are adequate.

4.4 The Forecasting Model

The second and first difference equations of actual and optimal debts in eq. 15a and b are integrated to obtain the substantive equation of Actual and Optimal Debt. This is used to achieve the final stage in the process which is forecasting. The result of integration is presented in eq. 16a and b. $AD_t = 0.076 + 1.756AD_{t-1} - 0.512AD_{t-2} - 0.244AD_{t-3} - 1.633AD_{t-11} + 3.267AD_{t-12} - 1.633AD_{t-13}$ $(16a)$

$$OD_t = 0.1298 + 0.7542OD_{t-1} - 0.0926OD_{t-2} + 0.3384OD_{t-3} - 0.2712OD_{t-5} + 0.2712OD_{t-6} \quad (16b)$$

Eq. (16a and b) is used to generate forecast values for the variables till 2030.

4.5 The Model Validation and Forecast

The accuracy of forecasting model (16a and b) is validated for accuracy using the observed data over six years from 2007 to 2012. As presented in table 1, the forecast and actual value deviate with an average deviation of 11.42% and 4.41% respectively which are moderate to carry out a forecast.

Table 1: Validation of ARIMA Modeling

	Actual Debt					
	Forecast		Actual Values		Deviation (Absolute)	
Year	*Export*	*Annual % Change*	*Export*	*Annual % Change*	*Value of Deviation*	*Deviation (% of Actual)*
2007	0.60		0.71		0.11	15.97
2008	0.75	25.00	0.67	-6.30	0.08	12.11
2009	0.72	-4.00	0.98	46.19	0.26	26.38
2010	1.22	69.44	1.23	25.26	0.01	0.41
2011	3.56	191.80	3.13	155.76	0.43	13.63
2012	4.46	25.28	4.46	42.32	0.00	0.02
			Optimal Debt			
2007	1.85		2.24		0.39	
2008	2.08	12.43	2.31	3.03	0.23	9.82
2009	2.25	8.17	2.10	-9.14	0.15	7.36
2010	2.28	1.33	2.29	9.24	0.01	0.41
2011	2.34	2.63	2.27	-0.78	0.07	3.01
2012	2.23	-4.70	2.27	-0.19	0.04	1.64

Source: Author's Computation

The final step in the process is to generate the forecast value for the variables. This is presented graphically in figure 7.

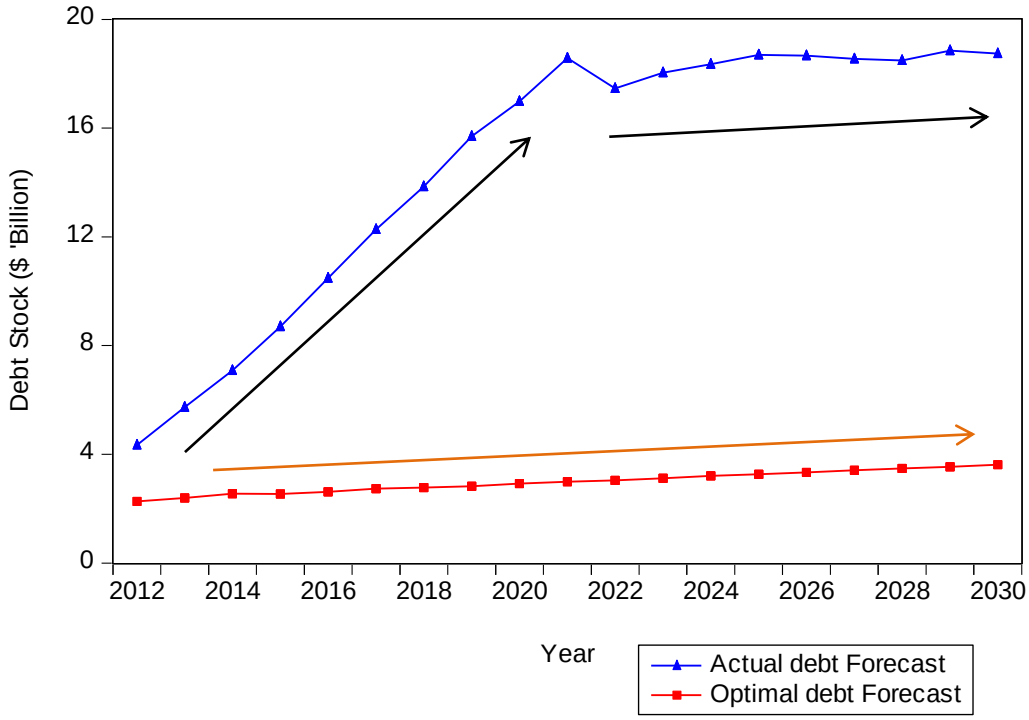


Figure 7: Mauritius Debt Forecast (2013-2030)

As presented, external debt in Mauritius is not and may not be sustainable in the future given the projected margin between the actual debt trend and the projected optimal debt. The sharp increase observed over the years from 2007 till 2012 is projected to remain steady till 2022 before the rising trend stagered downward and then remain relatively stabilised. However, the forecast optimal debt lies below the actual debt, though it increases marginally and steadily over the periods.

The debt trend which is an image of internal economic crisis of the country is inline with the economic outlook 2014, where it is reported that the economy has maintained annual growth rates of around 3%. According to the report, in 2013, real GDP growth rate slowed down to 3.3% from 3.4% in 2012, driven by weak sugar and textile exports and a fall in construction. As such in June 2013 the Bank of Mauritius (BoM) reduced the Key Repo Rate (KRR) by 25 basis points to 4.65% per annum to boost the slowing domestic economy as first quarter exports and tourist arrivals showed signs of slowing down. The performance of the economy is a serious problem following several strategic and palliative steps to redress the economy since the mid-2000s when the crisis began. Given the projection of the ministry of finance of Mauritius, the economic mayhem was expected to have been corrected by 2010. However, all the projections failed and the crisis persisted till 2013. For instance, it was stated that the government introduced offsetting measures that were expected to bring the primary budget into surplus by the end of 2011, Zafar (2011). It was not suprising that, the projection of normality reported in 2014 economic outlook in which it was expected that the economy would show a rebound to 3.5% in 2014 and 4.1% in 2015 was unrealistic, as the 2015 report shows that, 'real GDP growth in 2014 was lower than expected at 3.2%, well under the 4% projected in the

2014 National Budget. The government's fiscal stance in 2014 remained expansionary, with the budget deficit increasing to 3.6% of GDP, compared with 3.5% recorded at the end of 2013, AEO (2015).

The debt crises of Mauritius are pronounced and raised serious concern in various development articles. In an OECD/AfDB (2006), it is stated that since 2000, Mauritius had faced new challenges and its economic performance had suffered, resulting from its loss of preferential access to the European Union sugar and textile markets. The problem traced to the textile sector, where Mauritius is facing increased competition from cheaper Chinese and other East Asian country exports. The constraints mean there is urgent need for the economy to diversify the economy.

5. Policy Implications

The implication of the escalating debt crisis implies that, Mauritius needs complete economic overhauling and redefinition of economic management strategies. This requires a cut off from the palliative approaches that were introduced since the inception of the crises in the mid-2000s. For instance, in the Mauritius' strategy of action for 2014-2018, it is stated that Mauritius' widening current account deficit over the past decade reflects a worsening trade balance and falling savings. For instance, at 10.0 % of GDP in 2012 the deficit has persisted in double digits since 2009. The total imports as a proportion of GDP increased from 42% to 47% driven by high prices of food and fuel which on average contributed about 18% and 20% respectively to the import bill. Meanwhile total exports were reported to have only increased from 22% of GDP to 23%. While investments have remained largely the same at 25% of GDP, Gross National Savings have declined from 22% of GDP in 2007 to about 15% in 2012 driven by a fall in private savings. The suggestion from the ongoing is that, austerity measure in the country is not an option but a decisive step that are necessary to rescue the economy from further complications.

More so, the World Bank overview of Mauritius indicates that, the external shocks demonstrated the heavy reliance of the economy on few sectors and markets. However, it is stated that, Mauritius is not yet ready to fully take advantage of the global re-balancing of export markets and it is not yet well integrated in the production chain and final markets of those countries which are bound to increase domestic absorption, World Bank (2014). It is easier for the country to rebound in this aspect given its rich history of policies that attract foreign investment, the process that earned it 'a best place to do businesses' in Africa over the years. If the export promotion and product diversification are given more priorities, it would cushion the effect of the imbalance foreign exchange which might escalate the external debt problem.

A sound domestic economic management and import substitution is a key insight to immediate financial prudency to retain more foreign exchange for the immediate debt management, while medium and long term policies to halt the unprecedented increasing trend of the foreign debt are appropriately designed. This is very important; given that, the external debt stock which was 7 percent of GNI in 2008 sharply increased to

42 percent of GNI in 2012 and the external debt to export which was 12 percent in 2008 increased to 58 percent in 2012, IFS (2014). Given this trend, import substitution is an immediate strategy that is necessary to free foreign exchange for debt service payment, having realized that, the size of export earnings has reduced due to fall in the demand for sugar which is the main export product of the country.

6. Conclusion

Mauritius is currently battling with debt management problem which is traced to mid-2000s when the export earnings dropped. The problem was also aggravated by the global financial crisis of 2007-2009. This study, irrespective of various palliative measures of the government over the years of the crises, has demonstrated that the country is growing deeper into debt crises. However, Mauritius as a mature economy considering its years of leadership in economic management of sub-Saharan Africa is expected to act decisively to reverse the ugly trend through structural repackaging of the economic policies instead of various palliative measures which appear inappropriate to return the economy back on its path to financial and economic probity. Specifically, this study has suggested stronger policies on import substitution, a better commitment to economic diversification and austerity measure as a way to totally overhaul the economic activities in the country. It is an expectation that renewed economic management strategies would restore the economy back to its historical path of fiscal prudency.

References

1. Abutaleb A. S and Hamad M. G (2012): "Optimal Foreign Debt for Egypt: A Stochastic Control Approach", *Economic Modelling 29*, pp. 544-556
2. AfDB/OECD (2006): "African Economic Outlook: Mauritius", OECD and Africa Development Bank Publication, Port-Louis
3. Alvarez-Plata P. and Brϋck T. (2008): "External Debt in Post-Conflict Countries", *World Development, 36(3)*, pp. 485-504
4. Atkeson, A., (1991): "International lending with moral hazard and risk of repudiation", *Econometrica 59*, pp. 1069–1089
5. Box G.P.F. and Jenkins G.M (1978): *"Time Series Analysis: Forecasting and Control"*. 3rd Edition., Holden Day, San Francisco, ISBN-10: 0130607746.
6. Dooley M.P (2000): "Debt management and crisis in developing countries" *Journal of Development Economics 63,* pp. 45–58
7. Dornbush, R., (1989): "*Debt problems and the world economy"*, In: Sachs, J.D. (Ed.), Developing Country Debt and Economic Performance. University of Chicago Press, Chicago; 331–358
8. Drine I. and Nabi M.S (2010): "Public external debt, informality and production efficiency in developing countries", *Economic Modelling 27*, pp. 487–495
9. Eaton J. (1990): "Debt Relief and the International Enforcement of Loan Contracts", *Journal of Economic Perspectives, 4(1);* pp. 43-56, Winter
10. Easterly, W. (2002): "How did Heavily Indebted Poor Countries become heavily indebted? Reviewing two decades of debt relief", *World Development, 30(10),* pp. 1677-1698
11. Elgin C. and Uras B.R (2013): "Public debt, sovereign default risk and shadow economy", *Journal of Financial Stability 9*, pp. 628– 640
12. Evrensel A.Y (2004): "Lending to developing countries revisited: changing nature of lenders and payment problems" *Economic Systems 28;* pp. 235–256
13. Fosu, A. K. (1996): "The impact of external debt on economic growth in sub-Saharan Africa", *Journal of Economic Development, 21(1),* pp. 93–117

14. Fosu, A. K. (1999): "The external debt burden and economic growth in the 1980s: evidence from sub-Saharan Africa", *Canadian Journal of Development Studies, 20(2);* pp. 307–318.
15. Fosu, A. K. (2007): "Fiscal allocation for education in sub-Saharan Africa: implications of the external debt service constraint", *World Development 35(4);* pp. 702-713
16. Furceri D. and Zdzienicka A. (2012): "How costly are debt crises?" *Journal of International Money and Finance 31;* pp. 726–742
17. Gunter B.G., Rahman J., and Wodon Q. (2008): "Robbing Peter to pay Paul Understanding Who Pays for Debt Relief", *World Development 36 (1);* pp. 1-16
18. Imam P and Köhler R. (2010): "Balance Sheet Vulnerabilities of Mauritius During a Decade of Shocks", *IMF Working Paper, No: WP/10/148*
19. IFS (2014): "Database", Publications of World Bank
20. Kalumiya N. & Kannan A. P. (2015): "African Economic Outlook: Mauritius", Africa Development Bank Publication,
21. Kaminsky, G. L., & Pereira, A. (1996): "the Debt Crisis: Lessons of the 1980s for the 1990s", *Journal of Development Economics, 50(1);* pp. 1-24
22. Kharas, H., (1984): "The long-run creditworthiness of developing countries: theory and practice". *Quarterly Journal of Economics 99;* pp. 415–439
23. Mahdavi, S. (2004): "Shifts in the composition of government spending in response to external debt burden", *World Development, 32(7);* pp. 1139-1157
24. Muhanji S. & Ojah K.(2011): "Management and sustainability of external debt: A focus on the emerging economies of Africa", *Review of Development Finance 1;* pp. 184-206
25. Porcile G, Souza A. G, Viana R. (2011): "External debt sustainability and policy rules in a small globalized economy", *Structural Change and Economic Dynamics 22;* pp. 269– 276
26. Reinhart, C., Rogoff, K., (2009): "*This Time is Different"*, Princeton University Press, Princeton, New Jersey
27. World Bank (2014): "Mauritius Overview", World Bank Database, http://www.worldbank.org/en/country/mauritius/overview, accessed June 6, 2015
28. Zafar A. (2011): "Mauritius: An Economic Success Story", *World Bank Working Paper*, A draft